THE SCHOOL OF MATHEMATICS AT ROME'S UNIVERSITY CAMPUS

GIO PONTI, 1935

Edited by Simona Salvo | Sapienza University of Rome

SAPIENZA UNIVERSITÀ EDITRICE

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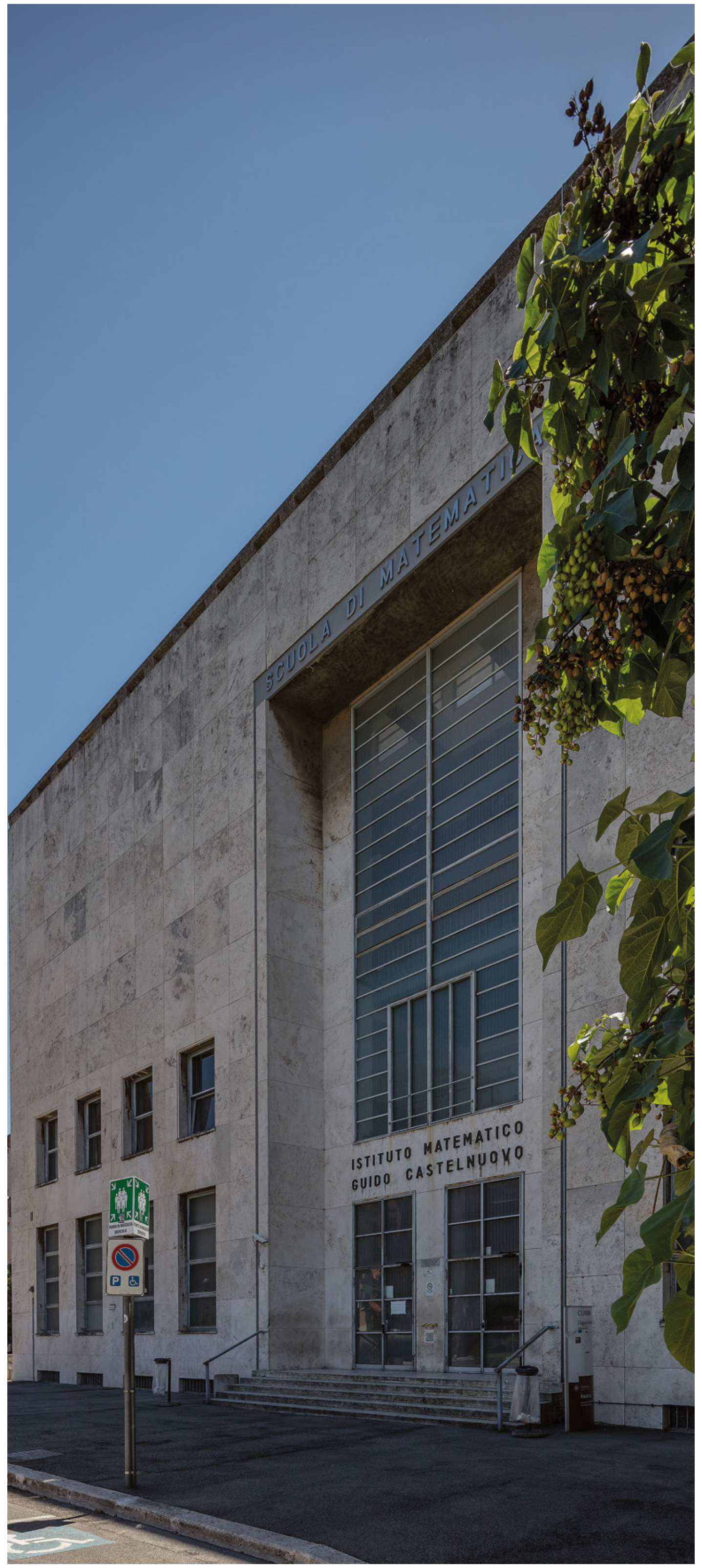

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FOREWORDS

Antonella Polimeni
Rector of Sapienza University of Rome

The three-year research project on the School of Mathematics building on Sapienza Main Campus is the result of a strong collaboration between scientific institutes and Sapienza departments. It is not the first time that this building has attracted the attention of scholars, architecture historians and specialists. It is, however, the first time that an interdisciplinary working group has dedicated energy, time, and scientific expertise to integrate the study of the building's history with a structural survey, analysis of materiality and evaluation of its current state.

A team of more than twenty-five researchers, scholars, students, consultants and experts has worked continuously – uninterrupted even by the pandemic – joining forces to afford a transdisciplinary glance at this impressive work of architecture.

The School of Mathematics is a masterpiece of the early 1930s by Gio Ponti, who is today regarded as a master of Italian Modernism. Although World War II bombings shattered the coloured stained-glass window that once adorned the balanced and harmonious white travertine façade, the building remains a striking and significant piece of architecture. Although it underwent a series of transformations over the years before its historical and artistic relevance was recognised, it can still be appreciated and admired for its magnificent expressivity. Its uniqueness derives from its complexity, such as is often found in Italian monuments of all ages: a rare synthesis of urban design, architecture, art, industrial design, historical archives and – perhaps the first of its kind – scientific production in the field of mathematics.

This illustrated report is a synopsis of the extensive technical research documents produced by the research team for each step of the work. It is also a premise for the conservation management plan proposed at the end of the full report. As in any area of science, knowledge is at the basis of future action: we need to understand today how to take care of the historical buildings of our campus tomorrow – buildings recognised worldwide as architectural and historical monuments.

We are very grateful to The Getty Foundation for its support for this initiative, which in turn depends on our researchers' expertise and commitment. We fully recognise the importance of drawing the interest of international specialists in architectural conservation to this specific building, one of Gio Ponti's most significant masterpieces of which Sapienza's community is proud.

This research project thus occupies a special place in the process of recognition of an Italian master builder, as well as in the context of the conservation of modern architecture. The care and preservation of our campus, and many other urban ensembles built in Rome during the first half of the 20th century, are part of this wider framework.

The management, upkeep, and conservation of a university campus and even more so of Sapienza's "Città Universitaria" must achieve a balance between a range of needs, from functionality to the expression of the academic community's cultural identity, while meeting safety requirements and satisfying the ever-growing demand for technological upgrading, in terms of energy efficiency and standards of communication. Today, we know that every step taken in transforming the campus buildings – particularly the School of Mathematics – deserves a cautious approach based on the awareness of their value and a thorough survey of their current condition. However, we are also confident that Sapienza can count on all the necessary expertise, skills, tools and staff needed to trigger an ethical approach, capable of responding to a variety of demands and offering advanced and solid solutions.

We herein bring together the conclusions of the work developed by the interdisciplinary working group that has collaborated on this report, with a commitment to further research this topic. The aim is to highlight that knowledge should precede and support every transformation, especially in advanced cultures that should rely on the lessons of the past to build the future.


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Isabeau Birindelli
Director of the School of Mathematics

Mathematical buildings, building mathematics- For many centuries Mathematics was a branch of Philosophy and at some point, it became an instrument to be used by physicists, engineers, and other scientists. Not until the XX century did it acquire an autonomy, a status of independent science. It is difficult to pin the precise moment when this happened. The fact that mathematics is a branch of science and not just a useful tool for science and engineer is by no means a foregone conclusion.

For example Luigi Cremona, a great mathematician with an essential role in the reform of the universities in the end of the XIX century, was called to the University of Rome in 1873, where he founded the "Royal School of Engineers" by unifying it with the "mathematical section" of the Faculty of Sciences, which would have been the primitive nucleus of the Istituto Matematico, later named after Guido Castelnuovo, hosted in the "Scuola di Matematica" by Gio Ponti. Until 1920, even in Göttingen, that had been the university of Gauss, and which appointed the greatest mathematicians of the world like David Hilbert and Felix Klein, there was no Department or Institute of Mathematic, as the mathematicians were members of the Philosophical Faculty. In 1926 Courant and Klein, not only created the Mathematisches Institut but, maybe for the first time in history, endeavoured to obtain a building dedicated to mathematics. However, for the construction of the Mathematisches Institut in Göttingen, Courant had to ask for funding from the Rockefeller Foundation.

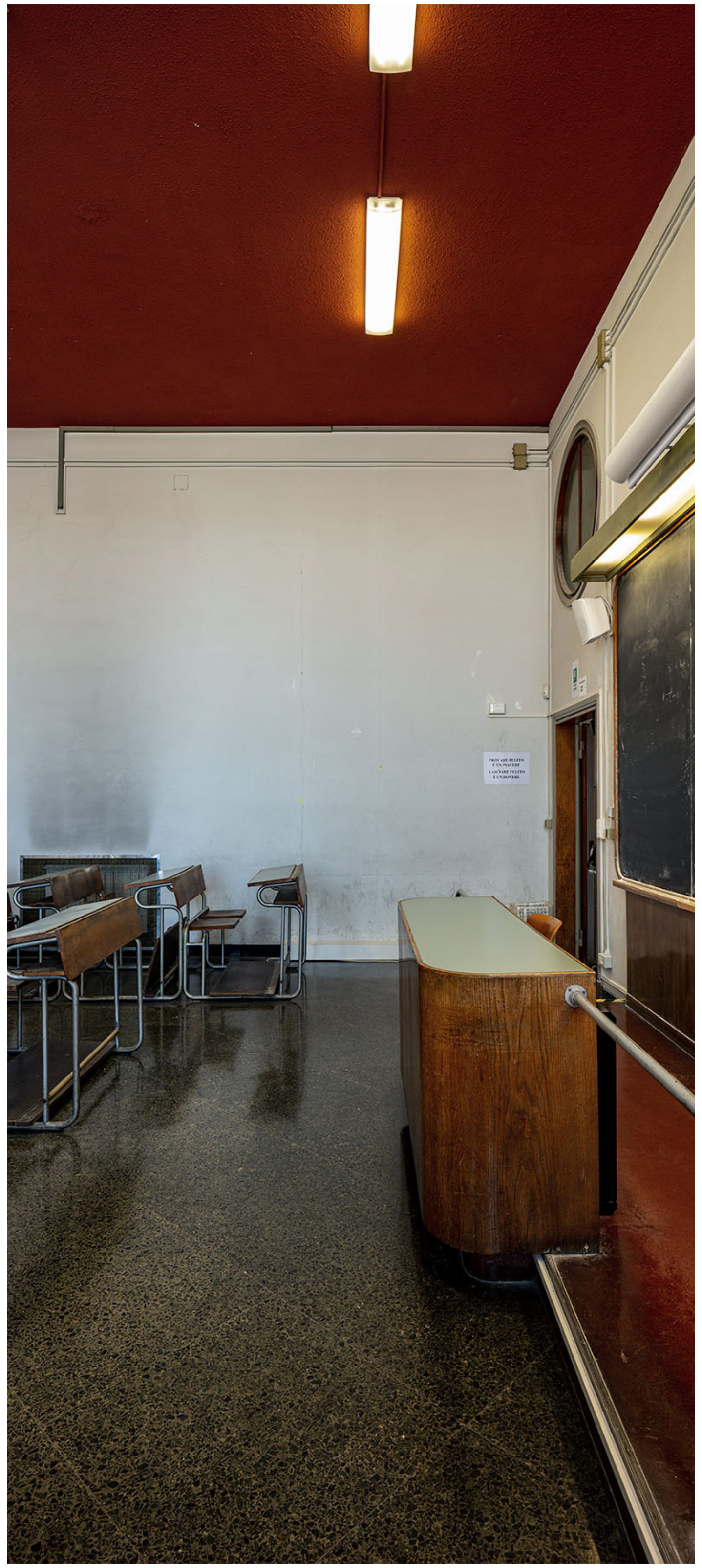
The endorsement allowed not only the construction of the building but the appointment of many mathematicians. This made Gottingen the dream come true. According to those who lived there in that period, nothing before or after could be compared to that golden period. As it is well known, within a few years this miracle was destroyed by the Nazis since most of the great mathematicians there were Jews. Nonetheless, in the meantime, this incredible success led to the foundation of other "Mathematics Institutes" in Europe, as in the case of the Institut Henri Poincaré (1928) in Paris also funded by the Rockefeller Foundation.
Of course, another important pole for mathematics in Europe was the School of Rome that included Guido Castelnuovo and Tullio Levi Civita, to mention two names among many. In the vision of the new campus, the idea of dedicating to mathematics a whole building, located in a key point of the città universitaria, was the proof of an incredible foresight, considering that Italy, at the time, was dominated by the philosophical views of Giovanni Gentile, who thought that natural sciences and mathematics were second order subjects since they had no universal value and had their importance only on a professional level.

Considering that when the Scuola di Matematica was planned, there only existed two buildings dedicated to Mathematical Institutes in Europe, in Göttingen and in Paris, it is important to consider how these had been shaped. The building in Gottingen was designed by Werner Seidel but under strict control of the mathematician Neugebauer. Neugebauer insisted on the importance of the presence of a great library where mathematicians could study and find the necessary references. This was also true for the Institut Poincaré that had a very rich library having inherited the part of the Sorbonne library dedicated to mathematics funded by Darboux and Appell.

The great novelty of the Scuola di Matematica by Gio Ponti consists in the fact that the architect prevails on the mathematicians. Nonetheless, also in Rome, Ponti dedicated a great part of the building to the library around which the entire building is conceived.

Another similarity is in the fact that the library has inherited a great part of the books of the library of the Royal School of Engineers, in particular its historical collection which included about 2500 works published between 1482 and 1830. The most valuable editions are those between the XV and XVIII centuries: nine incunabula, 140 XVI century, and precious editions of the XVII and XVIII centuries.
In conclusion, as Head of the Mathematics Department "Guido Castelnuovo", I wish to emphasise that, albeit the terrible laws against jews had destroyed most mathematical schools in Europe, and had wiped out the Scuola di Roma, Sapienza's Mathematical Institute has somehow recovered after the Second World War. The Department now includes more than 80 professors and researchers, many visiting scholars, it publishes the journal "Rendiconti di Matematica" and organises regularly international conferences and colloquia. The professors of the department teach in the whole of Sapienza and are invited in the most prestigious universities and research institutes. The department is usually the first or second mathematical department in Italy in the international ranking, such as QR ranking or Shanghai ranking.

I deeply believe that the beauty of the building where our research in mathematics takes place has contributed to its success. I therefore rejoice in the fact that the Getty foundation has financed this important research, which is hopefully the first step to maintain the beauty of Ponti's building without destroying its original aim: giving a beautiful home to mathematics and mathematicians.



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Carlo Bianchini

Director of the Department of History, Representation and Restoration of Architecture

The School of Mathematics in the Città Universitaria
There are moments in life in which what has always been impossible suddenly becomes possible. Generally referring to the lives of human beings, this remark can occasionally fit also the life of a building like the School of Mathematics by Giò Ponti in the Città Universitaria of Sapienza University of Rome.
It would not be appropriate (and far too long) describing here in detail the evolution of such a masterpiece of rational architecture also because these pieces of information would be found in other sections of this paper. Nevertheless, I would like to explain how and at what level the mentioned impossible is turning into possible.

After the end of World War 2, for many decades, the whole compound of the Città Universitaria has undergone a sort of cultural and political rebound. Any reference or symbol to the fascist era that had designed and implemented the campus' project must be either obliterated through overwriting or removed or consciously ignored. This unspoken directive, while on one side has determined "re-arrangements" (as in the case of Sironi's fresco in the Aula Magna), on the other has somehow demoted the value of many buildings inside the Città Universitaria. This cultural (and in some cases even ideological) program appears now clear and even reasonable at a certain extent: the buildings had to be regarded as buildings. In other words, they had to lose their symbolic and cultural reference to fascism and become physical containers of educational and research functions. The 60's, 70's and most of the 80's of last century represent the "golden age" of this way of re-thinking the Città Universitaria.

The result of this long and troubled period crossing the '68 and the so-called Years of Lead, has been a substantial loss of any reference to the original architectural value of the original buildings that paved the way to incoherent, uncontrolled and sometimes damaging interventions either for adaptation or extension reasons. These wounds can be easily appreciated just walking around the Città Universitaria and looking at the flourishing emergency stairways around the Aschieri's (Chemistry) and Pagano's (Physics) buildings or the unapparent destruction of Capponi's (Botany) masterpiece.

In the same period in which most of these "adaptations" were performed, the seed for a change was starting to sprout. The strong, sound and original Italian way to restoration of architecture was in fact growing fast and in a short while was able to provide a consistent theoretical and operational approach not only for ancient buildings but also for "modern" ones. The term "restoration of modern architecture" born around the end of the 90's intended to embrace in fact a special category of buildings being on one side the product of the modernist culture, on the other artefacts built using the "new" steel and concrete technology.

Even if an increasing number of researchers and scholars have chosen rationalist buildings for studies in the last three decades, this cultural/operational preparation was not enough though to determine effective changes on the buildings of the Città Universitaria. The actual situation was in fact very tangled: on one hand the responsibilities were too spread among different offices not so inclined to share information, on the other there was not enough coordination between the inputs of the University Governance and the technical implementation of activities.

This phenomenon was not necessarily a responsibility of the different actors involved in the process but more the result of the many (sometimes contradictory) changes that have affected the Italian university structure at least in the last 20 years and especially after the 2010 reform that has strictly separated the academic functions from the managing ones.

For these reasons, when supporting prof. Simona Salvo in the application of the project for the "Keeping It Modern" initiative, I was pretty sure that many of the foreseen results would certainly display "on paper" the consistency and value of the method applied to the School of Mathematics but have very little chance to come out of the drawer were they would have been stowed.
On the contrary, while writing this presentation at the end of the project, I must acknowledge that "impossible is turning into possible" if not even to "probable".

Once hardly to even conceive, the status of monument of the Città Universitaria compound and of its buildings is now to be considered commonplace both for Sapienza community and its Governance. Such so, that we do find in the Governance board a Deputy Rector for the Patrimonio Architettonico (Architectural Heritage). This new approach has also influenced the "intervention/managing workflow" actually establishing a strict coordination between the technical structure of Sapienza (Area Gestione Edilizia – AGE) and the Deputy Rector and his supporting group of experts. The sensation is like as everything was ready for rearrangement, accomplishing a process that has been growing for decades. The School of Mathematics project funded by the Getty Foundation has been for sure one significant driver for this movement to begin.

In this framework many projects are starting and others are about to start but the School of Mathematics' one is definitely the first of the list. The Getty Foundation funding has in fact worked in this case as a trigger: on one side it has demonstrated the feasibility of the knowledge/assessment workflow needed to deal with modern monuments; on the other, thanks to the Conservation Management Plan, it has outlined a clear and sound framework for appropriately considering the different issues coming from the living body of the building.

But, more than all the remarks presented so far, one "detail" must be considered as the more outstanding result of this complex project: Sapienza has decided to invest more than 1 Mln € for further investigations and first interventions: what a best result for the School of Mathematics, Gio Ponti, 1935 Project?

I.
RESEARCH AS A MEANS OF CONSERVATION

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MAKING SCIENTIFIC RESEARCH POSSIBLE. THE GETTY FOUNDATION FUNDING AWARD AND THE "KEEPING IT MODERN" PROGRAM

Simona Salvo

We only have our civilization to save our civilization.
Gio Ponti, 1940

As part of the 2018 "Keeping It Modern" program the Getty Foundation of Los Angeles funded a two-year research project on the School of Mathematics at Sapienza University in Rome. The grant was an unprecedented opportunity to perform interdisciplinary research on the building and identify the guidelines for its conservation over a period of time. The scientific and cultural support provided by the philanthropic North American institution, together with its generous economic incentive, made the cross-disciplinary and multiscalar investigation possible, quite apart from other contingent situations, placing this research and case study within the international scenario of the conservation of modern architecture.

The results of this research are probably neither groundbreaking in terms of historical discoveries – no unexpected document or historical drawing was discovered in the archives – nor did it identify dramatic vulnerabilities or damages to the building, peculiarly resilient given its almost 90 years of intense working life. Instead, the research has highlighted the little attention paid so far to this building (and to the entire University campus), treated pragmatically and considered only for the possibilities it offers for transformation, adaptation and development, rather than for its historical, artistic, and cultural importance. Conservation, preservation, and respect for this and other buildings on campus are undoubtedly a goal for the academic community, but remain wishful thinking without producing any substantial progress because they clash with the ever-growing requirements of intensive use and functional adaptation.

Figure 1 - The professor's lounge, now 'Aula Ponti', partially restored after interventions in 2011-2013 (© Sardo 2021)

As a result, apart from the scientific achievements and in-depth data collected during this research, the study was an opportunity to measure the discrepancy between the historical and artistic importance of the building and the interest rate incurred by public institutions on the sums borrowed for its conservation- including the University, the Municipality of Rome and the Ministry of Culture; the discrepancy also reflects the distance between the propensity to support the mere use of this building instead of its preservation and conservation, in view of its best and complete fruition.

Rome's University campus is not an isolated case. This kind of treatment is also reserved for other modernist urban ensembles in the Capital, namely the E42 district (now EUR) and the former 'Foro Mussolini' (now 'Foro Italico'), that play a crucial functional role within the city, but are also heritage sites in the full sense of the word. Yet, in the case of the University campus, it is a burning issue for us academics. The goal of researchers and scholars- especially those who perceive the historical value and architectural qualities of the university buildings and are willing to perform scientific research to preserve them- clashes with the mission of public and governmental institutions which has been based, at least till now, on a free, pragmatic, and uninformed approach. Hopefully the data gathered by this research will trigger a change, leading to a better future and optimal collaboration at all levels in order to conserve, preserve and enhance our common heritage.

Scholars in the field of architectural conservation, especially those based at Sapienza University, have always shown enormous interest in the School of Mathematics. This research continues, develops, and broadens a previous study triggered in 2010 by the Director of the Mathematics Department, Vincenzo Nesi, in support of limited interventions on the building based on historical data[1]. At the time, the objective was to gather scientific data with a view to reorganizing the building's interior and provide the best possible use of spaces whose architectural significance had become indecipherable due not only to continuous adjustments and transformations over a period of time, but also to the accumulation of files of documents and other furnishings everywhere in the lobbies and corridors. Archival research, surveys, and specific studies were performed between 2011 and 2013; the skylight above the library reading hall was waterproofed, the roof underwent general maintenance, and the layout of the corridors, offices and other spaces were rearranged, first and foremost the so-called "professors' lobby", which had been radically altered in the Fifties[2].

The link between research / knowledge / appreciation / intervention in that early experimental project heralded a conscious and respectful approach to the building, sensitive not only to a reinterpretation of its original condition, but also to a critical assessment of the alterations to Ponti's design. It is worth emphasizing that this early initiative, respectful of the building's architectural quality, was prompted by the academic faculty. Professors, scholars, and students who spent every day of their working life in the building, were able to perceive and understand its value perfectly. Surprisingly enough, decades earlier the Department of Mathematics had established a special commission for the décor of its headquarters, an initiative that no other Sapienza department has undertaken, until now. At that time, the authorial value of the project for the building to Gio Ponti certainly had less influence on the daring initiative to rationalize and reduce the office spaces in order to revive the monument.

The focus on the School of Mathematics undoubtedly increased thanks to that initiative; it highlighted new important cultural initiatives, e.g., the international conference held at Sapienza University marking the 80th anniversary of its foundation (Azzaro, 2017, 2018, 2019). During the conference, specifically on the evening of November 24, 2017, the lost stained glass window designed by Ponti and made by Fontana Arte in 1935 for the main façade of the building, was re-created by projecting its image on the current blank window[3]. This should be considered a pivotal event along the path to reappropriate and preserve the building: a performance that moved the audience, thus emphasizing the power of art and culture[4].

This is the viewpoint with which we look to the future, exploiting the long wave of fame lately regained by Ponti; we are fortified by the data collected in the past two years of research on the School of Mathematics, and hope that- in Ponti's words- *our civilization will save our civilization.*

Figure 2 - The re-creation of Ponti's stained glass window obtained by projecting the original image on the current window (© Lanzetta 2017)

RESEARCH ON THE SCHOOL OF MATHEMATICS AT THE TIME OF GIO PONTI'S REVIVAL

Simona Salvo

A first spotlight had been shined on Ponti's works two decades earlier when the Pirelli Tower was restored in Milan, sparking interest in the master's artistic and architectural production, especially during the post-war years. Its conservation between 2002 and 2004 was undoubtedly a turning point in the re-evaluation process, not only because it was aesthetically and technically innovative, but also because it triggered many historical findings. Above all, that experience reaffirmed the strong cultural link that critical assessment establishes between architectural history and the scientific analysis of the built fabric, in view of its appreciation and conservation. The unprecedented opportunity of working 'with an open heart' and dismantling a stretch of the building's curtain wall envelope piece by piece, was a crucial step in order to motivate and support the decision-making process, and consequently the material conservation of the curtain wall. This opportunity once again proved that direct, scientific and hands-on knowledge is vital to initiate a process of disclosure and appreciation of cultural properties, and establish a positive cycle.

In fact, the history and restoration of the Pirelli Tower is directly linked to our research on the School of Mathematics, not only because it involves two of Gio Ponti's most important works, but because that first experience led to the cultural recovery of his works in Italy and abroad. In April 2002, the Pirelli Tower- with its wounded and mutilated façades and structure due to a dramatic accident- captured international attention. It was then that the final decision was taken to preserve the original curtain wall. A meticulous study had revealed the extraordinary historical and technological importance of these façades, thus helping to critically understand the "object" and provide scientific data for the decision-making process. The urgent and politically relevant project was followed by a very broad national and international public: but the stakes were obvious, and the historical value of the façades was undeniable at that point.

Scientific knowledge, appreciation, urgency, and a certain pragmatism magically merged and evolved into a virtuous experience. The work performed thanks to the very courageous choice to preserve the original metal and glass curtain walls- a completely new and untested intervention- involved an exciting, pioneering experience that welded traditional Italian restoration theory to ultra-modern construction technology. Apart from the many intriguing aspects of that work- ranging from a strict analysis of the residual efficiency of a late Fifties curtain wall system to the very difficult and unprecedented regeneration process of the metal frame of the building envelope (Salvo, 2007, Salvo 2014)- the project highlighted Ponti's magnificent and ingenious architecture, encouraging both specialists and the public to focus on the figure and work of a master of Italian architecture, who had so far been underestimated as an industrial designer.

Notwithstanding this renewed attention towards Ponti's production, the works he did in the Thirties were still on the backburner and, of all the projects he designed during the years of the fascist Regime (1922-1943), the School of Mathematics was the least considered, despite the fact it was a high point in Ponti's production: it was his first non-residential building, his first important, publicly commissioned project, his first important commission in Rome, his first work for the Regime, his first construction in a newly-built urban context, and his first professional opportunity after the end of his partnership with Emilio Lancia, which took place in a certain cultural context; this development allowed Ponti to occupy a nationally and internation-

Figure 3 a,b - The Pirelli building in Milan in 1960, and after restoration work (© Paolo Monti, BEIC Milan; © Salvo 2006) ally acknowledged role. The project was undoubtedly a turning point in the career of the forty-four year old Ponti.

Despite the fact that historiography (and public opinion based on historiography) has not considered them in the same way, the Roman School of Mathematics and the Tower in Milan are equally representative of his architectural poetics, notwithstanding the fact they are considered in an antithetical position within the current critical interpretation of Ponti's work. The School of Mathematics has been protected by law since 1989, while the Pirelli Tower has never had monumental protection; the former belongs to an apparently specific historical period, while the latter is part of an architectural era that is still under-explored; the former is largely ignored by specialists and by the public and has been subject to multiple alterations, while the latter is considered an icon of the Sixties. And yet, the two buildings express just one idea of artistic creativity, namely Ponti's architectural concept developed in XX century Italian culture.

Rome's School of Mathematics has remained one of Ponti's least considered works and certainly the least studied, until this research5. This fact testifies to the complicated historical-critical positioning of Ponti's early works, probably due to his unclear cultural role during the years of the Regime and his ambiguous relationship with the fascist commission. Although this situation has constantly evolved, and his work is today superlatively appreciated and considered a cult, his projects in the Thirties and Forties, especially the public commissions he received from the fascist Regime, continue to be underestimated and sometimes ignored, leaving the critical issue unsolved. The decades during which the Duce held sway over the fate of the country- the so-called 'Ventennio'- have represented a "hard rock" for Italian architectural historiography, which has long been influenced by a political and ideological interpretation of the architectural production of that period.

Moreover, except for several studies based on the visual analysis of the building and a rather repetitive bibliography, this architectural work has been set aside due to a rather "Milan-centric" historiography of Ponti, as well as by Ponti himself, who rarely mentioned his Roman projects[6].

Ponti and his artistic production have certainly gained a key role within the powerful current, ongoing cultural process that has sparked broader interest in the man and his artistic and architectural works, as well as his cultural role in XX century Italian culture. Lately, attention for his work has grown exponentially, accompanied by a flourishing series of cultural initiatives celebrating his profile as a refined artist and multifaceted intellectual, and his extraordinary skills as an architect, urban planner, writer, artist, etc.

Appreciated for his intellectual versatility and his open, optimistic and dialogic nature, Ponti lived through the XX century and made himself an interpreter of his age by imbuing his works with an all-Italian creativity. Contemporary culture inevitably tends to mirror itself in his dialogic nature, the search undertaken by a generation that gave its best by investing in ingenuity and creativity in the years after World War II. Consideration of Ponti's work and its critique was pushed to a point that was ostensibly the exact opposite to previous architectural historiography. The harsh criticism of the late Seventies opposed to his nature and his works, especially those of the Thirties, seems to have been put aside7. In fact, previous critical positions have been truly revised only recently; this is due to the wider chronological gap that separates today's scholars from the years of the dictatorship, allowing for a more detached and objective judgment. Monographic research currently underway on some of Ponti's most important works- and naturally this research on the School of Mathematics- represents an indispensable scientific and philological reference to which critical judgment should be anchored, within the ongoing historiographical re-evaluation process.

Ponti's exuberant revival in the last decade is documented in many exhibitions8, books, studies, and initiatives of all kinds, including an initial conservative attitude towards his works9; they are therefore to be considered a cultural phenomenon of our times, a sort of 'revival' that has also triggered a broader and deeper understanding of Ponti's production and, perhaps, also of its 'survival'.

When we applied for funding to The Getty Foundation in Los Angeles in 2018, the 'Ponti revival' had already begun in earnest, indicating that it was time to focus on his other works, even the more uncomfortable ones. The Getty Foundation's interest in Ponti's building in Rome is, one way or another, probably related to the conservation work on the tower in Milan; it is also inspired by a cultural objective: to shed light on an architectural episode that can be considered a pivotal moment in Ponti's entire career.

Today, historians of architecture consider Gio Ponti and his works as a very important subject; they have focused on the many different considerations inspired by the Master's exuberant nature. Ponti and the arts, Ponti and design, Ponti and architecture, Ponti and the city10, Ponti the demiurge who, nevertheless, continues to elude a focused definition and a comprehensive and final historical-critical interpretation: Ponti artist, Ponti designer, Ponti architect, Ponti urban planner, but also poet, writer, publicist, theorist, and practitioner. We are therefore idealizing this figure, perhaps attributing responsibilities and merits that Ponti deserved only in part, shifting the axis of critical consideration to an extreme that is the opposite of what it was two decades ago.

The materiality of most of Ponti's buildings have not yet been analyzed, and may be therefore considered 'unexplored'. On the contrary, those built in the Thirties have fallen even further behind the others, especially the ones commissioned by the fascist Regime, such as the School of Mathematics.

This research has therefore made the most of the experience accrued with the Pirelli Tower, placing material data at the center of the scientific-analytical interpretation. Notwithstanding the very different conditions of the two projects- an urgent intervention due to a dramatic accident in Milan, and a study to draft a conservation plan in Rome- both share the same theoretical and methodological approach based on a cross-disciplinary value assessment directly applied to the materiality of the building. In both cases, the urge for a conservative approach stems from the scientific awareness of the complexity and beauty of these artifacts, considered not only to be two of Gio Ponti's most beautiful works, but also historical documents, precious architectural pieces of Italian modernism produced in the first half of the XX century and the expression par excellence of the culture of that age.

This is why the focus of our work is the School of Mathematics- not Gio Ponti.

The current condition of the building, compromised but also enriched by its 85 years of intense life, history and memory, offers us the measure of times gone by; it forces us to hold onto the truth of constructed reality, to avoid clichés and the inaccuracies of remote interpretation and, as far as possible, to stop projecting contemporary cultural on memories of the past. Of course, this research is nourished by the critique and interpretation of Ponti since his death, but it primarily deals with construction; it takes note of the original physical consistency of the artifact, and its current condition, with all the possible limitations, given the fact that our understanding is far from absolute.

All in all, the greatest assumption acquired through this research is how much has not yet been understood of this- albeit 'recent'- building, and how much knowledge and material substance we have lost and will never be able to recover. For instance, it is certainly impossible to retrieve the 'original color' and original urban environment around the building, once metaphysically isolated and dominant in the context of the University campus.

We believe that research and knowledge about our past are the greatest means we have to encourage appreciation and awareness of the values at stake, for us as scholars and for anyone interested in this subject.

Figure 4 - Entrance lobby to the front building (© Sardo 2021)

This new experience has opened avenues of scientific and cultural interest that are worthy of being investigated further.

The achievement of a cross-cultural research to scientifically assess the importance of the building, beyond its authorial recognition- i.e. not only as one of Ponti's creations- is one of the objectives of this study. In redefining Ponti's profile as an architect it is therefore of primary importance to consider specific aspects tackled during the study. Ponti's project for the School of Mathematics provides clear evidence of the architect's genius, but it also bears witness to the expertise of many engineers, architects, clients, entrepreneurs, craftsmen, workers, artists, and technicians, etc., who contributed to shaping a cultural mosaic that allowed the "Ponti phenomenon" to take place.

This cultural, historical, and human mosaic requires careful analysis and evaluation and should be considered part of the hermeneutic process that will hopefully lead to a correct historicisation and appreciation of the building and, indirectly, to its protection and conservation.

We have invested more than two years of collective work in this cross-disciplinary research, exchanging points of view and information, but the building- its material truthfulness- has always been our focus and we have never ignored the 'human factor'. Appreciation, or misappreciation, embodies what the building currently means to society and individuals; it measures their respect and understanding, or their disrespect for, and sometimes even their rejection of this architecture, today, yesterday, and possibly tomorrow. Therefore, we have always tried to frame the School of Mathematics within the imagery of the students, the academics, the administrative staff, and the public in general, as we consider them the true stakeholders of our work.

On the other hand, in the words of Cesare Brandi[11], we have always concentrated on the building's "physical subsistence" and this has led us to new interpretations. By adopting an interdisciplinary approach, comparing the construction with archival documentation- drawings and projects as well as technical and administrative records- we have begun to understand what the design drawings alone do not say, but also what mere observation of the artifact cannot reveal. Again, in Brandi's words, we have aimed at the philological interpretation of the form and the scientific analysis of matter, in order to operate a fully cognizant recognition of value.

The ultimate goal of our research has been to raise awareness of the values at stake, first of all in its 'inhabitants', academics, and students in Mathematics, and then Sapienza university as a whole, including the staff of the Technical Office responsible for the maintenance of the buildings, and of course Rome's residents and its national and international tourists. The focus has been to show that this admirable building may be enjoyed not only from a functional point of view, but also for its extraordinary architectural effects

Figure 5 - The School of Mathematics during the pandemic (© Sardo 2021)

GIO PONTI (MILAN 1891-1979)

Giovanni - called "Gio" - was born in Milan on November 18, 1891, son of Enrico Ponti and Giovanna Rigone. After completing his classical studies he enrolled in Milan's Royal Higher Technical Institute and graduated as a "Civil Architect" at Milan's Polytechnic in 1919, despite his much stronger passion for painting. The opportunity to visit the Palladian villas during World War I sparked his fascination for classical architecture, and prompted him to start a new architecture magazine called "Domus" in 1928, as well as entertain close contacts with the 'Novecento' artistic movement founded by Margherita Sarfatti and supported by Mario Sironi and Giovanni Muzio. After an intense apprenticeship in industrial design, to which he dedicated much of his life, Ponti began to collaborate with important firms that produce household objects; from 1923 to 1933 he was the artistic director of the Richard-Ginori company. This collaboration gave rise to a renewed production of very successful ceramic objects, proposed during international decorative arts exhibitions, the first of which was held in Monza in 1923. At the Paris Exhibition in 1925, Ponti was awarded the Grand Prix for porcelains.

At the end of Twenties he began to collaborate with the Venini glass factory in Murano, and in 1932 became creative director together with Pietro Chiesa of the Fontana Arte company, one of the main producers of artistic glass in Italy, a sector that was gaining momentum during that period. Starting in the Thirties glass windows played an important decorative role in Ponti's works, including in the School of Mathematics, and testifies to his tendency to merge all artistic expressions in a Gesamtkunstwerk. At this stage his interest in architecture was imbued with close connections to the manufacturing production.

In 1926, he began working with Emilio Lancia, obtaining commissions for many projects, mainly residential buildings mostly located in Milan. These domus or typical houses of the high-ranking Milanese bourgeoisie are the focus of Ponti's architectural research before the war, embodying the idea of dwelling as a means of aesthetic, social, and cultural expression through architecture. This early "Ponti idiom" developed between 1927 and 1933, merging painting with Milanese neoclassical architecture, thus defined a new architectural language strongly influenced by classical tradition linked to Vitruvius, Palladio and Serlio, and was renamed 'Novecento'. Villa Bouilhet, the "typical houses" and projects by the atelier "Il Labirinto", proposed a new idea of Italian design to Milanese clients. In the pages of "Domus", Ponti promoted a vision of architecture based on classical language, but ideated using advanced construction techniques and materials - such as concrete, steel, glass, and rubber - in search of an Italian way to modernity.

Ponti's popularity was at its peak at the end of the Thirties, when dictatorship became even stronger in Italy (1922 - 1943). He initially shared the Regime's initiatives by first joining the Fascist Union of Architects in 1933, and then in 1936 the Commission for the "Littoriali di Architettura", a national competition showcasing the best design achievements of young Italian architects. He participated and indirectly contributed to shaping fascist ideology, but kept his political distance from the Regime by adopting an independent architectural language marked by classical themes, defined as "Mediterranean" by Edoardo Persico (Persico 1934a); in fact he withdrew from the architectural controversy between traditionalists and rationalists.

In 1921 he married Giulia Vimercati, from a well-known Milanese family, who gave him four children: Lisa, Giovanna, Letizia, and later Giulio. In 1927 he completed his first house in Milan, in via Randaccio.

After breaking with Emilio Lancia in 1932, Ponti accepted public clients and began to design service buildings. The task to design the School of Mathematics arrived in 1932 from Marcello Piacentini - indirectly from Mussolini - and kept him busy for three years, together with a myriad of other commitments, probably due to Ponti's official enrolment in the National Fascist Party that same year. During that period, Ponti began to work with Eugenio Soncini and Antonio Fornaroli with whom he designed and built other typical houses and public buildings. Among these, Ponti alone designed the project for the "Liviano", the Faculty of Letters at the University of Padua, having been commissioned by the Rector who also entrusted him with the decoration of the main entrance to the Rector's Office. His artistic contributions are clearly visible not only in Padua, where he worked with Massimo Campigli on the huge fresco at the entrance of the "Liviano", but also in Rome where he constantly tried to sell the idea of merging art and architecture to clients, such as the government and the Vatican.

In 1930 Ponti joined the IV Biennale in Monza, becoming a member of its steering committee; he directed the Milanese edition in 1933 which became a "Triennale" from that year on. This prestigious role probably won him the "Mussolini Prize" (1934) for his contribution to Italy's production of manufacturing art as a result of the convergence between art and industry. But the most important commission Ponti received was in 1936, offered by a leading figure in Italian industry, Guido Donegani, who entrusted him, Fornaroli, and Soncini, with the prestigious project for the new Milanese headquarters of the Montecatini company, considered an example of functional efficiency and formal elegance.

During that period Ponti's activities branched out into various fields. Between 1941 and 1947 – when he distanced himself from "Domus" - which he was to direct almost uninterruptedly until his death in 1979 - he focused on "Stile," another magazine about architecture, industrial design, and artistic culture. He also designed costumes for the Teatro alla Scala in Milan and in 1936 became tenured professor of Interior Design at the Politecnico di Milano, maintaining this position until he retired in 1961.

Ponti trusted completely in progress and firmly believed that the future can only be better than the past. He was spontaneously open to any form of artistic collaboration, and was interactive by nature, promoting true cultural osmosis: the pages of "Domus" and "Stile" clearly serve as a venue where intellectuals could meet to exchange ideas. He stands out not only for his artistic and architectural production, but also for the extensive cultural activity he engaged in with extraordinary dedication and coherently with industrial development in Italy. Such qualities originate in his strong artistic sensibility, his outstanding intellectual skills, and a profound religious faith that marked his everyday life, together with proverbial optimism, freedom from partisanship and sectarianism, and absence of prejudices.

At the end of World War II he threw himself into the reconstruction of the country, with a theoretical, practical, and social commitment illustrated in Verso la casa esatta, written with Adalberto Libera and Giuseppe Vaccaro.

In 1952 he founded a new office with Antonio Fornaroli and Alberto Rosselli, his son-in-law. In 1954 Ponti invented the "Compasso d'oro" award for Italian Design and fine-tuned his theory of the "finite form", described in Amate l'Architettura (1957), a key element in all his projects. In 1957 he began to produce the "Superleggera" chair for Cassina, and in 1954-1960 he designed and built the Pirelli tower in Milan, considered his XX century masterpiece. His projects in the late Fifties are currently considered icons of Italian modernism.

Thanks to the powerful dissemination of his works in "Domus", this period brought new fame to the architect, also in the international arena. Between the Sixties and Seventies he designed buildings in Holland, China, Pakistan, Iran, Japan, and North and South America. In Caracas he built Villa Planchart and Villa Arreaza, considered iconic Italian villas, thanks to the collaboration of several artists, such as Fausto Melotti, Pietro Fornasetti, and Damiano Chiesa. Designing churches and cloisters was another chance to focus on the importance of holy spaces and further develop the trend towards the dematerialization of architecture, e.g., in the Milanese churches of San Francesco d'Assisi al Fopponino (1964), San Carlo Borromeo (1967) and the convent of Bonmoschetto (1959). The ability to imbue architecture with spirituality became evident in the Cathedral in Taranto (1970).

Ponti died on September 16, 1979 in his Milanese house in via Dezza which also hosted his offices and the editorial staff of "Domus" on the ground floor. He left behind a huge number of projects and achievements, bearing witness to his status as one of the most important architects of the XX century.

Figure 6 - Padua, Palazzo del Liviano, mural painting by Gio Ponti and Massimo Campigli. Gio Ponti explains the project to the Rector Carlo Anti (© Cortesi 2019)

CROSS-DISCIPLINARY RESEARCH METHODOLOGY: SIX INVESTIGATION TASKS

Simona Salvo

The best hours dedicated to this building are those that have seen us think about it, and the building is (and will be) what always brings us together.

Gio Ponti to Valtolina, Dell'Orto, Fornaroli, Rosselli, Nervi and Danusso, during the construction of the Pirelli Tower in 1958

The trans-disciplinary team that developed this research has been organized into six task groups, the same that structured the research proposal presented in 2018 to The Getty Foundation when applying for funding. The tasks are: historical-critical research; survey and representation of the current state; analysis of materials and construction techniques; study of the load-bearing structure, geotechnical features, and static and dynamic behavior; analysis of installations and evaluation of its energy performance; investigation of the building's functional organization and current use; final assessment regarding its cultural value and state of conservation. All six disciplinary areas have been coordinated by the same number of scholars and permanent staff working at Sapienza University, who are somehow related to the field of the conservation of modern architecture[12].

The scope was to investigate the building from an interdisciplinary perspective and obtain physical and figurative scientific data so as to take stock of its current condition. These six core activities structure the Italian architectural conservation methodology and apply to any artifact, not specifically to modern buildings.

Technical coordination and logistic support were carried out by the Project Manager Carlo Bianchini and by the former and current Directors of the Mathematics Department, namely Riccardo Salvati Manni (2017-2018) and Isabeau Birindelli (2018-today). Unfortunately, interaction with the Research Plan Consultant, originally an employee of Sapienza's Technical Office, was not successful, in terms of availability and helpful reactions. This is not only significant, but also a distinguishing feature of the perpetual approach by the management of campus buildings. Rather than surprising, it is disappointing, as the continuous request made by architecture scholars and researchers to investigate, survey, and study the campus buildings, has always been pared-down, notwithstanding the support and contribution they could offer.

Task Group 1 fulfilled the crucial assignment of inputting historical and archival data to the research performed by other task groups, and of course redefining a critical outline of the design and construction of the building. Scholars have systematically searched, documented, analyzed, and catalogued all available archival documentation- written, iconographic, photographic,

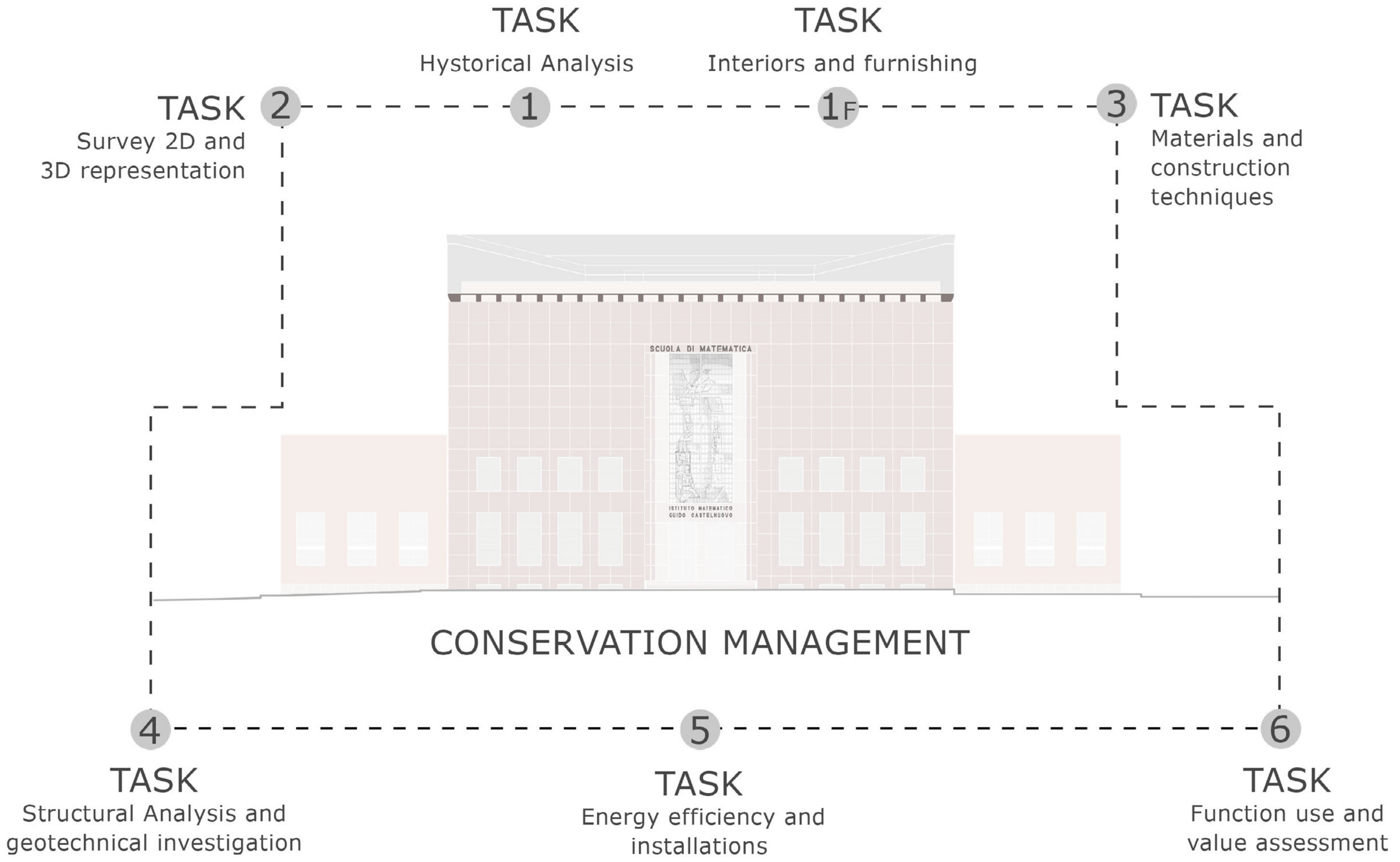


Figure 5 - Organization of interdisciplinary research methodology (© Salvo 2018)

Figure 6 - Group work during a preliminary on-site inspection of the building in preparation for the research proposal regarding the Keeping It Modern 2018 award (© Salvo 2018)

Figure 7 - Launch of the research on Gio Ponti's School of Mathematics at Rome's University campus awarded in 2018 by The Getty Foundation within the "Keeping It Modern" Program in the presence of Sapienza University Rector Eugenio Gaudio and scientific coordinator Simona Salvo; the ceremony took place in the library reading hall on April 11, 2019 (© Marandola 2019)

Figure 8 a/c - Snapshots of research activity and on-site inspections (© Salvo 2018)

Figure 9 a/e - Research activity and on-site inspections performed as a team (© Salvo 2018 and 2020)

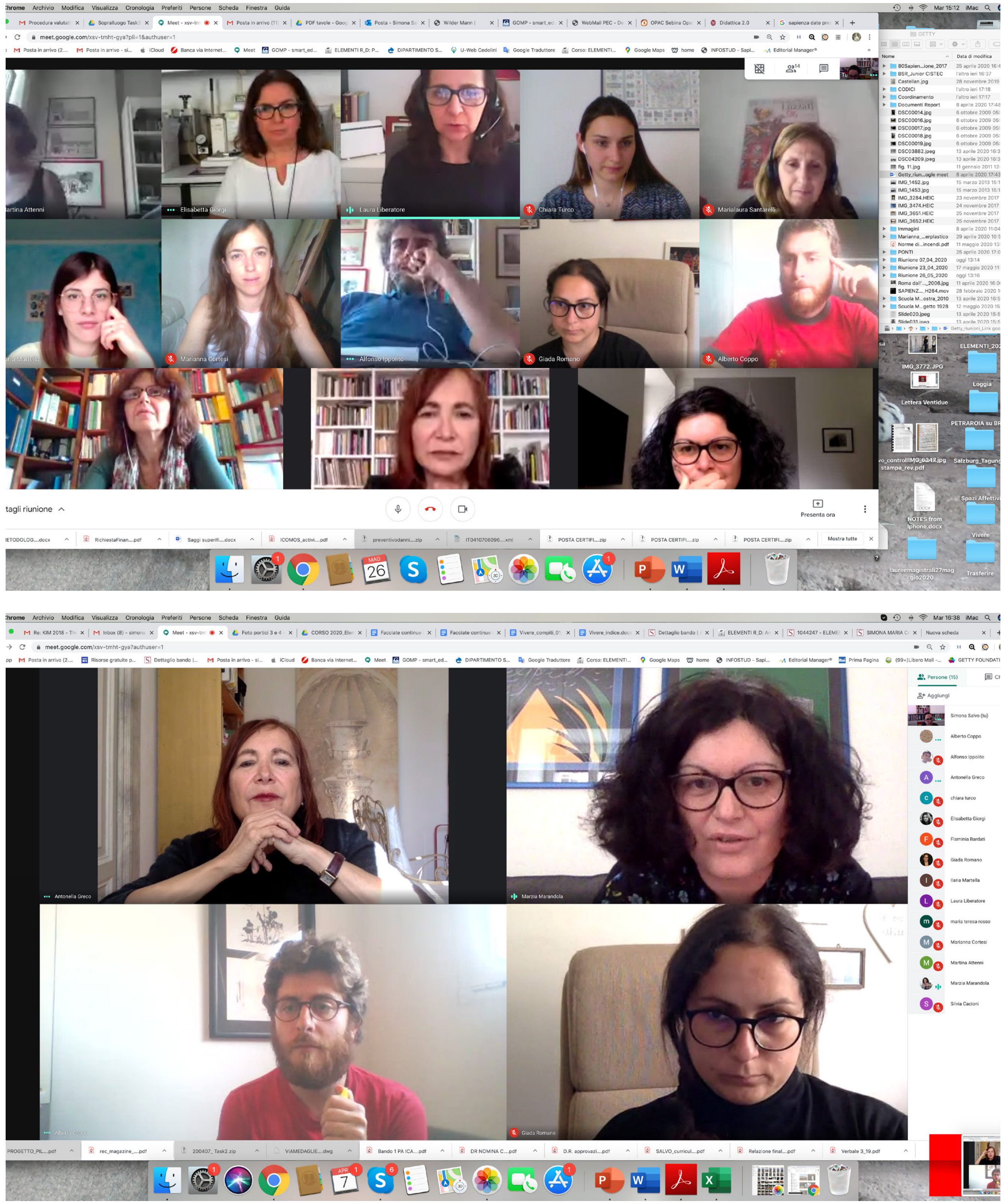


Figure 10 a/b - Research activity in March 2020 shifted from direct investigation to discussion while in lockdown at home due to the pandemic; discussions continued online until summer 2020 (© Salvo 2019 and 2020)

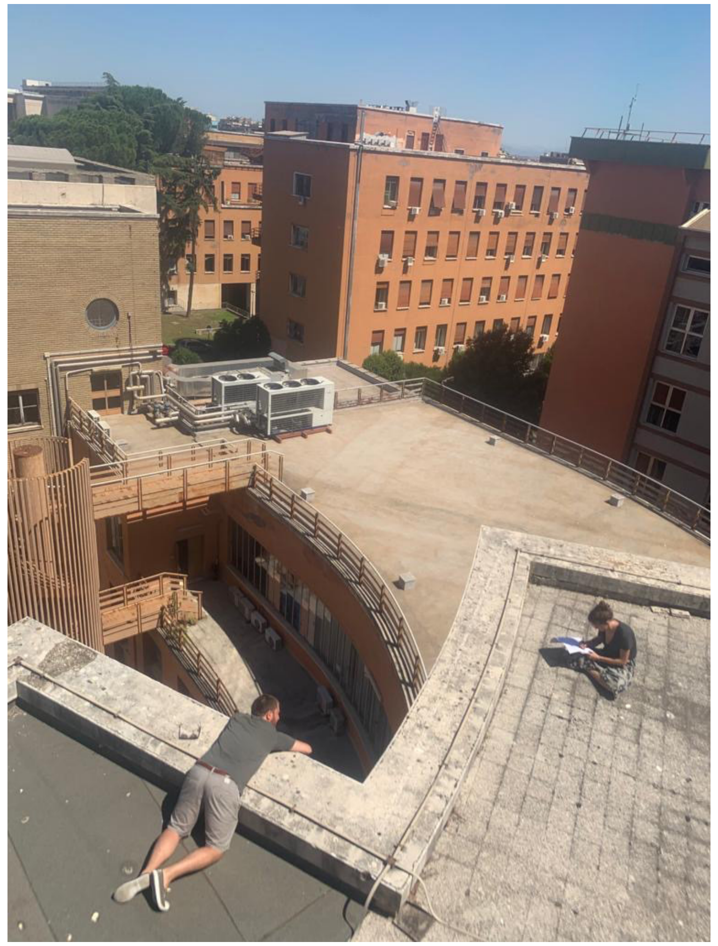


Figure 11 a/b - The last on-site and geotechnical investigations took place in July and August 2020, when pandemic restrictions were somewhat reduced (© Salvo 2020)

Figure 12 - Exploration of the whole building, even its remote corners, was performed during the summer of 2020 in total solitude due to the absence of students and faculty members (© Salvo 2020)

Figure 13 - The photographic campaign by Nicolò Sardo performed between summer 2020 and summer 2021, without students and faculty members (© Salvo 2020)

Figure 14 - Inspection of the fixed and movable furniture required specific expertise (© Salvo 2021)

Figure 15 - The very last surveys in view of the final report. from the start, the 'guardian angel' of our investigative activity (and the building's maintenance) was the caretaker Paolo Mariani (left, in the photograph on the right) who lives on the premises with his family in the porter's house designed by Gio Ponti (© Salvo 2021)

etc.- starting with the Historical Archive of Sapienza University housing the most extensive and interesting documents about the building. Many other archives have been also researched, with interesting results. They include: the Gio Ponti Archives, Milan (written and photographic archive); the State Central Archive; the Capitoline Historical Archive; the Triennale di Milano Historical Archive; the Historical Archive of the Commerce Chamber of Rome; Marcello Piacentini's Archive in Florence; the current archive of the Department of Mathematics at Sapienza University.

Besides the study of archive sources, bibliographic and iconographic documentation has also been collected and catalogued, especially the material produced by famous Italian photographers, such as Giacomelli, Vasari, Cartoni, Alinari, the Istituto Luce, Oscar Savio, Gabriele Basilico, as well as the images in the Bibliotheca Hertziana photographic archive. A detailed catalogue of all the collected and systematized material was made available to other task groups, thus establishing a multifaceted, contextual, historical interpretation of the building's history.

Task Group 1F, instead, investigated the original design of the building's interior, specifically the fixed and mobile furniture, lighting equipment, and finishings and fixtures, closely connected to the original design of the building, to its use, and to the almost 90 years of research and teaching activities that have taken place in the building. This study produced an accurate survey of the rooms and halls still furnished with original artifacts; it highlighted their transformation, current conditions, and corresponding causes for degradation and loss. An accurate documentation of original, authentic, and dated artifacts was also included in this report. Fixed and movable furniture, including doors, has been surveyed and catalogued according to the year of production of each artifact, and the origin of its design.

As a matter of fact, not all fixed pieces of furniture date back to the original phase, i.e., to 1935, for example the many doors added in the late Forties and Fifties to rearrange the interior spaces; however, they should not be considered lesser in value or 'non-authentic' for this reason. The list identifies every piece of furniture as either still in place, moved or lost, indicating (where possible) the date of its movement or elimination. In parallel, Ponti's work in the Thirties as an interior and furniture designer has been examined and assessed, especially his design work for the University of Padua, and other projects in Milan.

Continuous comparison between Ponti's original design drawings and the actual condition of the building, as well as interaction between one scientific research area and another, led to extreme accuracy in the verification of the information. The aim was to accurately identify which were the authentic parts and which the additions, thus reducing inaccuracies and providing a well-based interpretation of the building's current state. It was then possible to proceed with two- and three-dimensional graphic reconstructions (2D, 3D) of the various phases, from the design of the building to its current state. The intent was not merely to achieve philological accuracy, but to inform the critical process with scientific data, capable of steering conservation policies. Thus, many questions emerged in addition to those that remained unresolved after analyzing the historical documentation and observing the artifact.

The survey of the building was performed by Task Group 2 using laser scanner technology; this provided a numerical model of the artifact known as a 'points cloud'. The procedure allowed the research group to acquire an enormous amount of data and develop a very realistic 'digital twin' of the building. On the one hand digital 2D and 3D representations on various scales proved to be graphically useful to document, compare, and verify the results of the interdisciplinary analyses performed by each group on specific architectural elements, such as windows, fixtures, skylights,

Figure 16 a/b - Collection of microscopic samples for laboratory analyses performed by Task Group 3 (© Pandolfi 2021) balustrades, cornices, etc., and provide an overall integrated interpretation of the built organism. On the other hand, the survey has been constantly verified by directly observing the building, which turned out to be much more complex, multifaceted and 'irregular' than its appearance would suggest.

Task Group 4 instead focused on identifying the building's structure and performing geotechnical tests on its foundation soil, comparing the results with the cross-reading of archival documentation and direct observation of the artifact. Hypotheses about the design and construction of the load-bearing structures were developed to accurately interpret all the documents, again mediated by direct observation. Dedicated direct surveys and non-destructive investigations, such as rebar locator testing were also implemented on the structural layout in order to achieve the final 3D models of the original load-bearing system, and any further additions and extensions. The 3D structural models of the building also allowed us to assess its static conditions and possible reactions in time, also in consideration of seismic hazard.

Administrative permission to carry out geotechnical on-site tests by performing boreholes within the University campus in proximity of the School of Mathematics was correctly requested and permitted. The investigation took place in August 2020 and– as already stated – was paradoxically facilitated by the pandemic, because the absence of public on the premises simplified the entire operation.

After performing a site response analysis, the geotechnical investigation highlighted possible amplifications of seismic action due to the characteristics of the foundation soil. The results of on-site geotechnical tests were mapped on a cross section of the building and its surroundings and have contributed to a greater understanding of the very rugged terrain on which the campus was built; this terrain is at the origin of many of the structural problems affecting the buildings on campus, even today.

This research activity constantly interacted with the other groups. More specifically, Task Groups 1 and 6 provided historical documentation; Task Group 2 acquired data regarding the architectural layout of the building, using and integrating it with structural details; Task Groups 3 and 5 gathered data that was useful to better comprehend the building materials and techniques, the way in which its spaces were used, and corresponding dead and live loads.

A more precise hypothesis regarding identification of the structural system was therefore possible; nevertheless, not being able to carry out destructive tests undoubtedly hindered the assessment of its vulnerability regarding gravity and earthquake loads. Foundations and structures- also considered as integral parts of the building's architectural features- underwent several variations both during the design and construction phases, mainly due to the uncertain properties of the foundation soil. Therefore, at the time of the design process (1932-1935), the issue was not to achieve a bold reinforced concrete structure with big span beams- as proposed by contemporary propaganda- but to offer a balanced, reliable solution to Ponti's architectural design, including by adopting very modern construction solutions with verified static and dynamic loads.

Task Group 5 investigated the building's equipment, installations and energy efficiency measures. Since its construction, the building has been equipped with very innovative installations and plant systems: the heating, electrical, and lighting systems. The forced and natural air ventilation systems allowing Ponti to design environments without traditional windows turned out to be a key element when investigating and measuring the microclimate of spaces with large windows. The combination of natural and forced ventilation installed in 1935 allowed Ponti to design halls without traditional openings, as in the library, but also to regulate the microclimate in rooms with big windows (e.g., the drawing halls in the curved wings).

However, current environmental comfort standards dictated that it was necessary to carry out microclimatic measurements in different seasons, also with a view to reorganizing the building's functions and uses.

Energy efficiency of the installations turned out to be pivotal in the evaluation of the residual functionality of the building, in relation to the activities, users, and objects sensitive to microclimatic variations, such as the library's collection of ancient books. In addition to the historical investigation (the old boiler still survives!), Task Group 5 measured the energy efficiency of the building's interior, because internal comfort and energy control are key to supporting the building's current use. The investigation was organized in separate phases. Phase 1 (fact-finding investigation) consisted in identifying and analyzing the building's existing systems, and defining and studying the materials and construction techniques used for the envelope. This task was carried out synergistically with other tasks, especially Tasks 1 and 6. Phase 2 (indoor air quality measurements) was completed by implementing survey and seasonal measurements in most offices, halls, rooms, and classrooms in order to evaluate the internal air quality based on a customized protocol developed in other departments. Finally, data collection was merged into an energy model to complete the Energy Performance Certificate.

While completion of the microclimatic monitoring phase enabled a preliminary assessment of the building's energy class, the analysis of primary energy consumption made it possible to assess the amount of heating and lighting energy needed for the building's uses, with the percentage incidence of renewable sources on total primary energy consumption. At the end of the diagnostic investigations and implementation of the energy model, Task Group 5 elaborated an energy diagnosis and hypothesis regarding energy efficiency improvement, in view of the conservation management plan.

Fire security plans were instead investigated by the Scientific Coordinator since this aspect was a key element of the entire research. This issue required extra work and research, not envisaged by the research program and budget. Fire protection stairs and accessibility retrofits- added in the late Eighties when the University campus buildings were still considered only for their use rather than for their historical significance - are certainly a hot topic as they have spoiled the very harmonious, calibrated space designed by Ponti. Notwithstanding, the three fire escape stairs built in the courtyard in 1985-1989 are still necessary to comply to fire safety regulations of school buildings, dating to 198513. The clash between conservation of the building and the requirements related to its daily use, have coagulated around this topic and its functional reorganization.

Sapienza's intention to deliver a new fire prevention plan in order to redesign- or remove- the fire escape stairs in the courtyard, has been enthusiastically welcomed by the research group. You may well imagine that this decision had opened new perspectives on the future of the building and its re-consideration as an important historical and artistic architecture. Moreover, this was a chance to collaborate with the campus' Management Office and input into the planning of the future transformation of the building based on a scientific value assessment. It was a chance to finally implement an effort involving accurate historical data mapping, detection of authentic parts, and identification of any decay processes and their causes. Unfortunately, an administrative deadlock has stopped the initiative: the next months will tell if this collaboration will come to fruition.

Task Group 6 investigated the current functionality of the building, in close connection with the results of the other task groups, especially Task Group1, 1F, and 5. This is why we developed 3D models of the historical phases of the building, from its current state (2021) in 1935, and established the precise date of construction for every artifact. This was also part of an integrated chronology of events, containing information and data from all tasks; the aim was to obtain a complete, diachronic picture of the building's layout, in close reference to direct or indirect data sources.

Information about the solidity, use, functions, presence and 'untold' story of the building- thanks to personal memories, unconventional sources, and interviews- has been closely combined with the information produced by the other task groups and has finally produced an accurate value assessment of the building, based on the identification and dating of each part in order to highlight areas of maximum /minimum authenticity, and corresponding transformability. The objective was to not only understand how life in the building has changed, from its origin to the present day, and the reasons why these transformations have taken place, but also outline the current demands by the academic community which have changed so radically over the years. Although the 'historical' use of the building as the 'School of Mathematics' has remained unaltered, research and teaching activities have indeed changed a great deal over the years, due not only to the evolution of academic research and teaching at Sapienza and in the field of mathematical studies, but also in relation to systems regulations, security regulations, and an exponential growth in the number of students and teachers. The integrated chronology of 86 years of life, reconstructed not only by tracing data and news in the archives of the Department of Mathematics, but also by relying on the memory of those who have 'lived' and worked in the building for years, provides a complex and diachronic picture of the reasons why so many transformations were implemented.

To provide a more accurate picture of the dizzying increase in students and teachers during the post-war period and up to the end of the millennium, we developed a specific statistical study of attendance in the building. This has proved revealing notwithstanding the fact that these statistics do not refer only to the School of Mathematics.

During the two-year research we interviewed many 'stakeholders' involved in the past and current life of the building: Claudio Procesi, Lamberto Lamberti, and Silvana Abeasis, alumni of the Department of Mathematics who studied at the School of Mathematics in the Sixties, and then went on to work and 'live' in the building; all three have far-reaching memories of its recent history; Rosaria Del Ciello and Lucilla Vespucci, current and former directors of the library of Mathematics; Enrico Rogora, expert in the history of Italian mathematics; Vincenzo Nesi and Isabeau Birindelli, former and current directors of the Department of Mathematics; Pietro Petraroia, former director of the General Direction for Culture of the Regione Lombardia responsible for the restoration of the Pirelli Tower in Milan; Carla Onesti, curator of the Historical Archive of Sapienza University Rome; Bruno Bozzetti, former employee of the Technical Management Office of the University campus between the Eighties and Nineties; Giorgio Ciucci, Alessandra Muntoni, Fulvio Irace, historians of architecture and experts in the field; Lamberto Lambiase, geologist, expert in drilling and geognostic surveys in the University campus.

The last thirty/forty years are the most difficult to retrace, because the habit to archive technical data has been lost, so much so that recent events are much less documented than earlier ones. The library director is in charge of the core activity of the School of Mathematics, and takes care of its most precious space, furniture, and ancient book collection. For this reason, the library directors also constantly contributed to this part of the research, especially Lucilla Vespucci, director of the library from 1983 to 2012, and the current director, Rosaria Del Ciello.

To further understand the complexity of the building we applied philological and scientific precision building a 1:50 scale wooden model of a section of the front building. Building the model meant carefully reconstructing- albeit to scale- the large triple-height library, perhaps the most complex and interesting part of the building. This was a sort of 'operational recognition' of Ponti's ability to prefigure spaces and visual sequences, and establish artistic and architectural effects that are uniquely complex, yet endowed with harmony and beauty.

The model played a specific scientific role since it is based on 2D and 3D representations from the laser scanner survey of the building, cross checked with direct survey, showing the additions and transformations made over the years; these latter parts are visible, compared to the original parts, thanks to the use of a darker kind of wood. Rather than a true 3D representation of the survey, this form of re-construction tested our scientific knowledge of the building, obliging us to deal with the existing object, and assess the weight of the countless additions, from the smallest to the most cumbersome, that took place and overlapped during the building's 85 years of life.

Figure 17 a/b - Making of the wooden model: starting construction after the preparatory phase, January 13, 2020 (© Cortesi 2020)

Figure 18 a/c - Modeling has also included furniture pieces, reproduced in scale with a 3D laser modeler, January 13, 2020 (© Cortesi 2020)

Figure 19 - The model starts taking shape, highlighting additions from original parts recurring to dark wood, January 31, 2020 (© Cortesi 2020)

Figure 20 - Details, from stone cladding to foundation poles, are represented in scale, February 11, 2020 (© Cortesi 2020)

Figure 21 - The definition of the interior starts interfering with the outer shell of the building, March 2, 2020 (© Cortesi 2020)

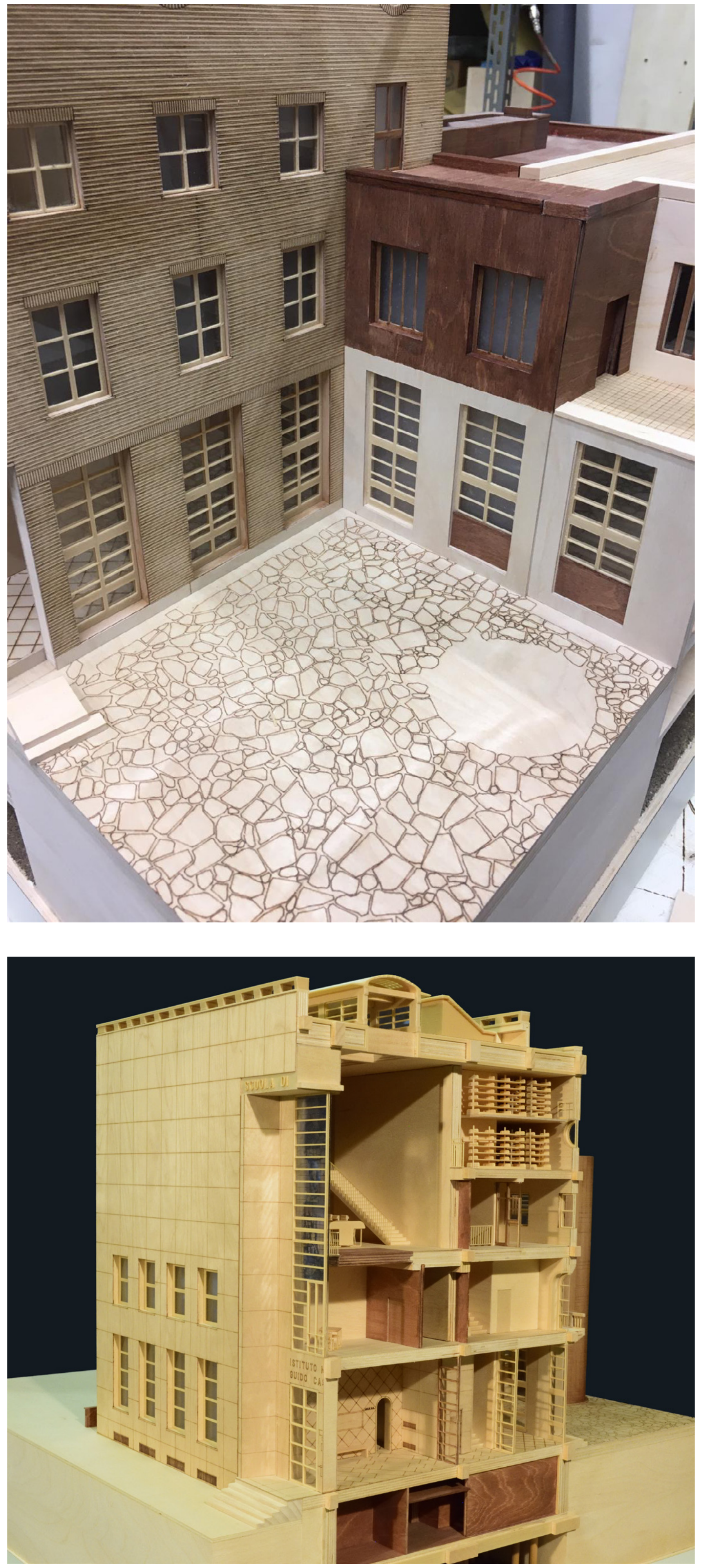
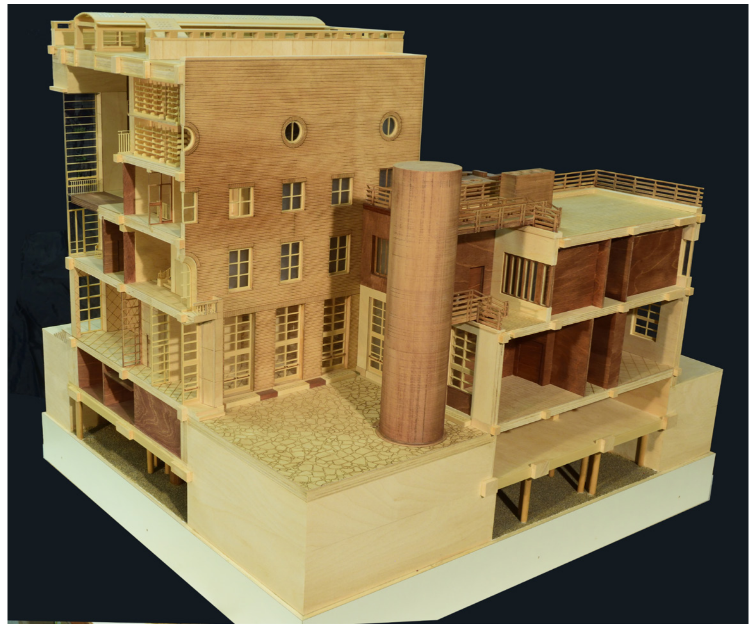


Figure 22 a/b - The overlapping of data, from foundations to structures, from space organization to construction techniques, from furniture to installations, required serious effort, March 2, 2020 (© Cortesi 2020)

Figure 23 a/b - Details, such as the courtyard paving and the stained glass window, have been reproduced for the final effect, March 12, 2020 (© Pontani 2020)



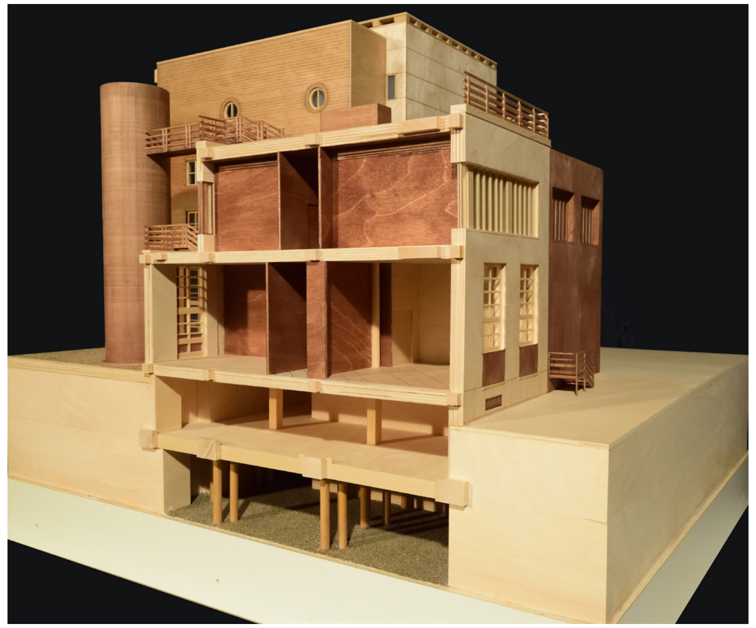


Figure 24 a/c - The completed model (© Pontani + Spazio-fare 2020)

A TWO-YEAR RESEARCH AGENDA AND THE EFFECTS OF THE PANDEMIC

Simona Salvo

The last twelve months of activity were very productive, despite the difficulties and work overload imposed by the pandemic, due to the fact that any kind of progress was 'in remote' (i.e., meetings, scientific evaluation, correction of drawings, administrative reporting, recruitment, etc.). And yet, each task has productively achieved the research goals. There was also an added value: to work in the building and on its premises without the presence of people, activities, and without it being used.

This situation unveiled new aspects of the monument and allowed a much broader and unexpected idea about its future life, management, and conservation, as well as the importance of maintaining it functional, albeit by finding the best way to adjust and fine-tune it together with its dimensions.

Figure 1 - The "Aula Picone" on the ground floor of the front building, during the pandemic (© Salvo 2020)

THE RESEARCH AGENDA, 2018-2021

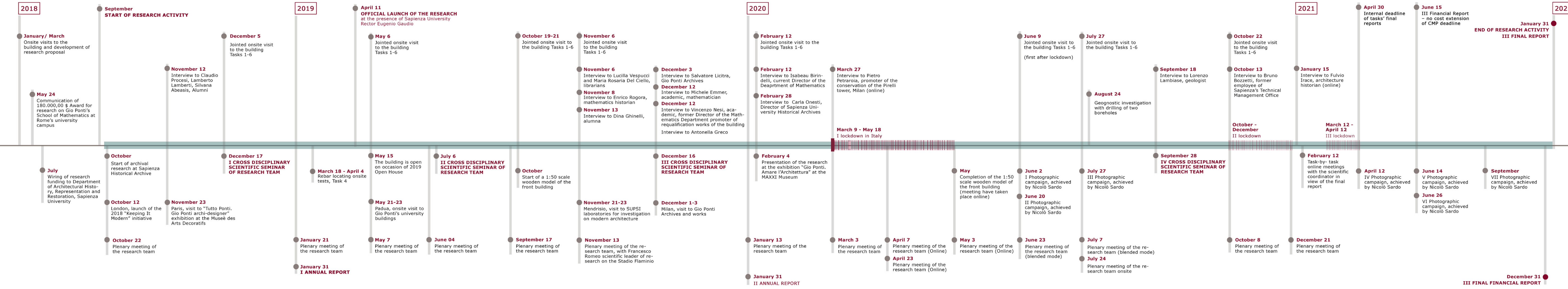


Figure 2 - The research agenda: January 2018 - December 2021 (© Salvo 2021)

OUTCOMES, CHALLENGES, AND FUTURE RESEARCH PERSPECTIVES AS A MEANS OF CONSERVATION

Simona Salvo

There is a thin red line running through the research; it starts with Gio Ponti's project and continues to the current building, sometimes along tracks that lead far from the original input, but then bounce back, continuously soliciting further reflections, including the extreme complexity of the building's spatial layout, which is a new issue. If it is true that Ponti thought of architecture as a crystal, it is also true that his buildings are neither simple nor linear.

Comparing Ponti's greatest achievements, and analyzing the construction site of the University campus in the Thirties, as well as the technical and industrial context Ponti had to deal with, it's no wonder that the culture of that age owes so much to Ponti, but also that Ponti owes so much to that age, and to all those who directly and indirectly shaped his projects.

Merging all the data and cultural stimuli gathered during the research, a thin red line emerges combining many elements of continuity in Ponti's volcanic mind, where volumes, colors and materials took shape linking one object to another: a glass vase to the façade of a building, tableware to the handrail of a staircase, a tapestry banner to a stained glass window, and a skyscraper to a table lamp.

The research objective was not only to recognize the values at stake, but also reweave the threads of a broader discourse involving Ponti himself and his work, his philosophy, and the architectural principles underlying his architectural production: transparency, visual and spatial continuity, lightness, thinness, integration with the arts, and 'finite form'. After two years of research the results consist in greater, more accurate knowledge about the building and its history, but- as mentioned earlier- they also reveal how much ignorance still persists.

In general, it must be said that the most ambitious research goal was to stimulate awareness of the importance of this building (and indeed of other equal gems in the University campus, including the Institute of Physics by Giuseppe Pagano). The objective was to prove that the building can still admirably serve its users not only from a functional point of view, but also in cultural terms, encouraging the public, inside and outside Sapienza university, to enjoy its beauty. But once again this seems wishful thinking, even though Ponti urges us to always look positively to the future. The generous funding of this research is therefore of great encouragement, helping us acquire a better un-

Figure 1 – Students of mathematics in one of the tiered lecture halls during the rehearsal of the 2018 Christmas play (usually a comedy mocking mathematicians), a tradition of the Mathematics Department interrupted by the pandemic (© Salvo 2019)

derstanding of a modernist masterpiece- the School of Mathematics at Rome's university- and a feather in the cap of Sapienza university, to be counted among the many excellent other studies included in the 'Keeping It Modern" Program.

What remains behind is the true, efficient preservation and protection of his architectural works, many of which have been systematically altered. The Pirelli experience has shown the importance of public participation regarding cultural appreciation and conservation. In fact, scientific research is not the only wheel that turns the process of knowledge and recognition of value and beauty. Informed by the same virtuous circularity that triggered the restoration of the Pirelli Tower, research on the School of Mathematics has instilled a desire in the academic community- perhaps also the opportunity, if not the moral obligation- to recover that beauty. Unlike the Pirelli Tower, whose restoration was an institutional choice with a political background, today the future of the School of Mathematics has become a prerogative of those who live in the building and, in a crescendo, of Sapienza's governance.

We therefore intend to continue the research as a way to achieve monitoring and preventive conservation, which could keep the spotlight shining on future transformation and keep people's attention focused on the interest triggered by the building.

Some aspects of the research have therefore been reported: new investigation paths, unresolved doubts and hypotheses, cultural suggestions and, above all, extending the research to the entire campus, not only to its physical artifacts, but also socio-anthropological and cultural aspects. These ideas remain in our minds, and we truly hope we will be given a chance to develop them and, above all, implement a hands-on application.

Figure 2 - On site research work (© Salvo 2019)

NOTES

1. Special scientific support had been then requested to the to the Post-Graduate School in Architectural Heritage and Landscape then entrusted to Simona Salvo, who continued independent investigation work. In 2018, she proposed and obtained the Keeping It Modern Award to further develop research on this building.
2. Archival research implemented between 2011-2013 by Salvo, has been continued, completed and systematized by Tasks 1 and 6 of this research.
3. This project was created by Emanuele Cagliotí and Stefano Catucci within the Master in Lighting Design, Sapienza University, with the scientific supervision of Marco Frascarolo, Alessandro Grassia and Simona Salvo.
4. Salvo 2017.
5. La Pietra 1988, Licitra Ponti 1990a, Romanelli 2002b; Irace 2009; Celant 2011.
6. Ponti 1957a, Aria d'Italia 1954.
7. A synopsis about Gio Ponti's biography may be found at page 16 in this document.
8. Bouilhet-Dumas, Forest, Licitra 2018; Casciato, Irace 2019.
9. Many of Ponti's buildings have been subject to interventions in the past decades, consequently to the growth of interest and appreciation in their regards, but also due to the 'physiological' need to maintain the buildings. Paradoxically, the first to receive maintenance, and sometimes renovation works, are those built in the post-war years. Among these: the church of Santa Maria Annunciata in the Hospital San Carlo Borromeo of 1969 (maintenance works in the 1985 and conservation work of the ceramic cladding in 2009), the so-called 'Trifoglio' building within the Polytechnic in Milan of 1963 (maintenance works in 2008, with changes to the ceramic cladding); the Cathedral of Taranto, 1971 (very recent maintenance works in 2020); the RAS building in Milan of 1962 (today under a radical renovation of facades and interiors); the Pirelli building in Milan of 1960 (subject to exceptional conservation works in 2004 not only as a consequence to the dramatic accident od 2002); the cloister of Notre Dame de Sion in Rome of 1965 (renewed in 2018), and many other. The buildings of the Thirties and Forties, instead, have survived with a higher degree of authenticity, as in the case of the School of Mathematics, counting more additions than demolitions, apart from some exceptions, such as the replacement of the cladding in mosaic tiles with common plaster of the Palazzina Salvatelli in Rome (1939-40). Overall, these buildings have drawn attention only recently, after major awareness of the values at stake has gained momentum. Literature on this topic is rather fragmented and not yet condensed for a synthetic evaluation.
10. We refer to the brilliant conferences on Ponti's multifaceted cultural activity organized by the MAXXI in Rome, within the exhibition "Gio Ponti. Loving architecture".
11. Brandi's writings, to which much of the Italian restoration theory owes a tribute, is rather complicated and difficult to translate. Here we refer to the very well translated extracts of the Teoria del Restauro- the transcript of Brandi's lectures edited by his research younger fellows, published by Einaudi in 1963- in Stanley Price, Talley, Melucco Vaccaro 1996.
12. The research group is coordinated by Simona Salvo and composed by scholars and professors of Sapienza University of Rome, and young researchers who have obtained scholarships for each specific task.
13. Salvo 2017.

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II.
AN ARCHITECTURAL GEM

BACK TO INDEX

ARCHITECTURE AND URBAN LAYOUT

Simona Salvo

The School of Mathematics was designed and built taking into account the urban layout of the University campus, and establishing comprehensive integrated relations with the context. The plan of the campus, considered as an artifact where every piece is part of another on a higher scale and in a strictly related system, thus creates an open dialogue with the building. Far from being designed only as a piece of architecture, the building is therefore a system in the system, and a very fine Gesamtkustwerk. Architecture, building elements, structural inventions, decorations, furnishings, collections of ancient books, and- last but not least- the scientific mathematical acquisitions developed on its premises, generate remarkably complex and rich values that all refer to a broader context involving history, art, architecture, and urban planning.

The construction of Rome's University campus between 1932 and 1935 was a complicated and problematic affair, closely linked to the social situation and history of Italy at that time, as well as to the many cultural transformations that took place, especially in architectural practice, higher teaching, and the urban layout of Italy's major cities, especially Rome. As we all know (this will be the subject of a broader discussion in the next chapter), Benito Mussolini, the "Duce", commissioned Marcello Piacentini with the overall design of the campus and supervision of its construction, entrusting him with technical, political, administrative, and economic tasks; Mussolini also awarded full autonomy and remarkable funding to the Agency entrusted with this venture. The dictator intended to revive the splendor of ancient Rome using fascist ideology and the myth of his personality; Piacentini, aligned with Mussolini's political and cultural program, proposed a regular and quasi-symmetric urban layout for the campus. The design was based on a Latin-cross plan, with a main central alley cut by a perpendicular axis along which the buildings were to be placed. Piacentini kept the design of the Rector's Offices for himself and entrusted very young architects with the design of the others: the project for the School of Mathematics, located in a very important position at the head of the main transversal axis, was entrusted to Gio Ponti.

Although many of the buildings' architectural features had been established by Piacentini, who had selected materials, construction techniques, building materials, and the overall appearance of the buildings, Ponti's building resulted rather complex and sophisticated in comparison to the abstract forms of the others, proving that he retained freedom of expression in that context.

The construction of the Mathematics building began in February 1934, much later than the other buildings on campus; Ponti continually changed the architectural and constructive details of his design even after the inauguration of the campus in October 1935. Still, from the very first drawings (1933), Ponti's project consisted of three juxtaposed volumes, different in shape and size, corresponding to the main functions requested by the mathematicians. Research activity was located in the front prismatic volume facing the central public square of the campus. It hosted classrooms with 50 and 100 seats, offices for faculty members, a boardroom, and a magnificent library for 100,000 volumes. Large and well-lit drawing classrooms dedicated to the teaching of descriptive geometry were placed in the

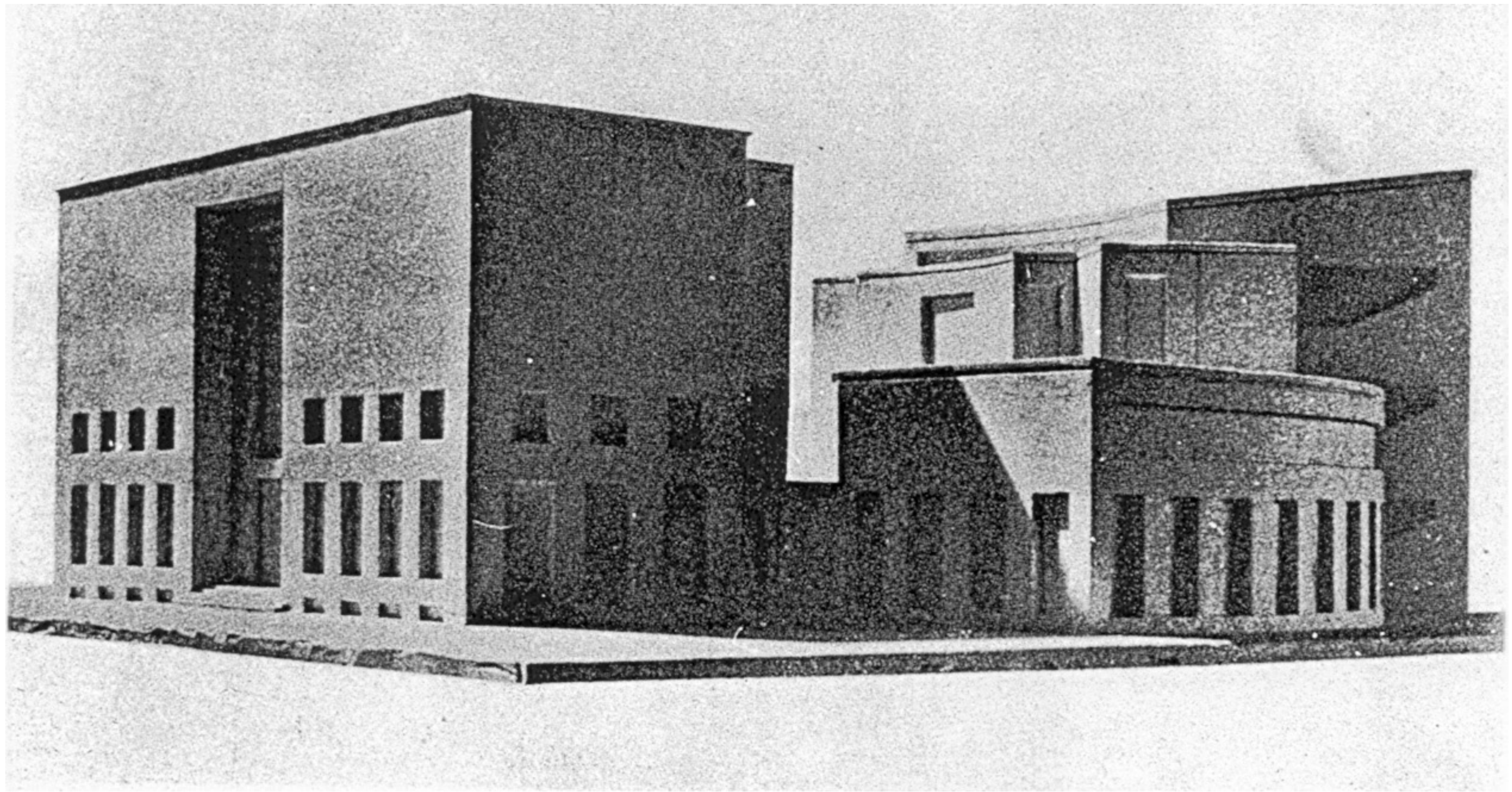


Figure 1 - The first and only model of the School of Mathematics, published by Ceccherini in 1933; the building's shape and architectural features are already perfectly outlined (BBL_pht_06)

curved wings embracing the central theater-shaped courtyard; they were characterized by completely glazed elevations and by a non-traditional 'open space' layout based on the arrangement of the furniture. Large, tiered lecture halls, designed to host the most crowded mathematics courses for students in Mathematics, Physics, and Engineering, were instead stacked on the three floors of the massive tower placed at the rear.

The building's very characteristic windows, different in shape and size depending on the function and vocation of the three blocks, revealed the layout of the interior and made it possible to see right through the building, along horizontal visual axes penetrating the architectural space from one side to the other. This solution enhanced perception of a continuous, fluid inner space. Space fluidity and continuity were further enhanced by the reinforced concrete structure made up of an inventive network of trusses and columns resting on drilled poles and amplified by an excellent, accurate architectural configuration, organized around the courtyard intended as a centripetal void and as the focus of the visual axes crossing the entire system.

Left free to select materials for the outer finishings and cladding, Ponti opted for a cladding in quasi rectangular travertine slabs for the three main façades of the front building, instead of the expected Litoceramica cladding used in almost all the other buildings on campus. He chose a rather precious white Carrara marble and black Italian marble for the entrance hall, and rather "irregular" materials for the interior finishings compared to t used to build the University campus.

The building was therefore designed based on very "Ponti-style" principles[1]- further refined by Ponti later in his career- such as the idea of "architecture as a crystal" and "finite form" (Ponti, 1957, pp. 68–69). The design and construction of the School of Mathematics was probably Ponti's own invention after ending his collaboration with Enrico Lancia; it marked an important change in Ponti's style which, in this case, shifted from the Milanese classicism he had experimented with in the early Thirties to a more explicit modernism.

Moreover, the very characteristic architectural elements present in this project were to appear again in the next project, with more developed technological features. They include the beautiful crowning cornice of the front building, a dark perforated concrete balustrade with clear white travertine sills; this solution was to appear again in many other projects, such as the Liviano in Padua (1934), first Montecatini building in Milan (1936), the Palazzina Salvatelli in Rome (1940), and the Columbus Clinic in Milan (1948). In all these projects, the glass-block skylight used in the library is a very interesting and recurring architectural element with specific architectural importance and material and constructive quality.

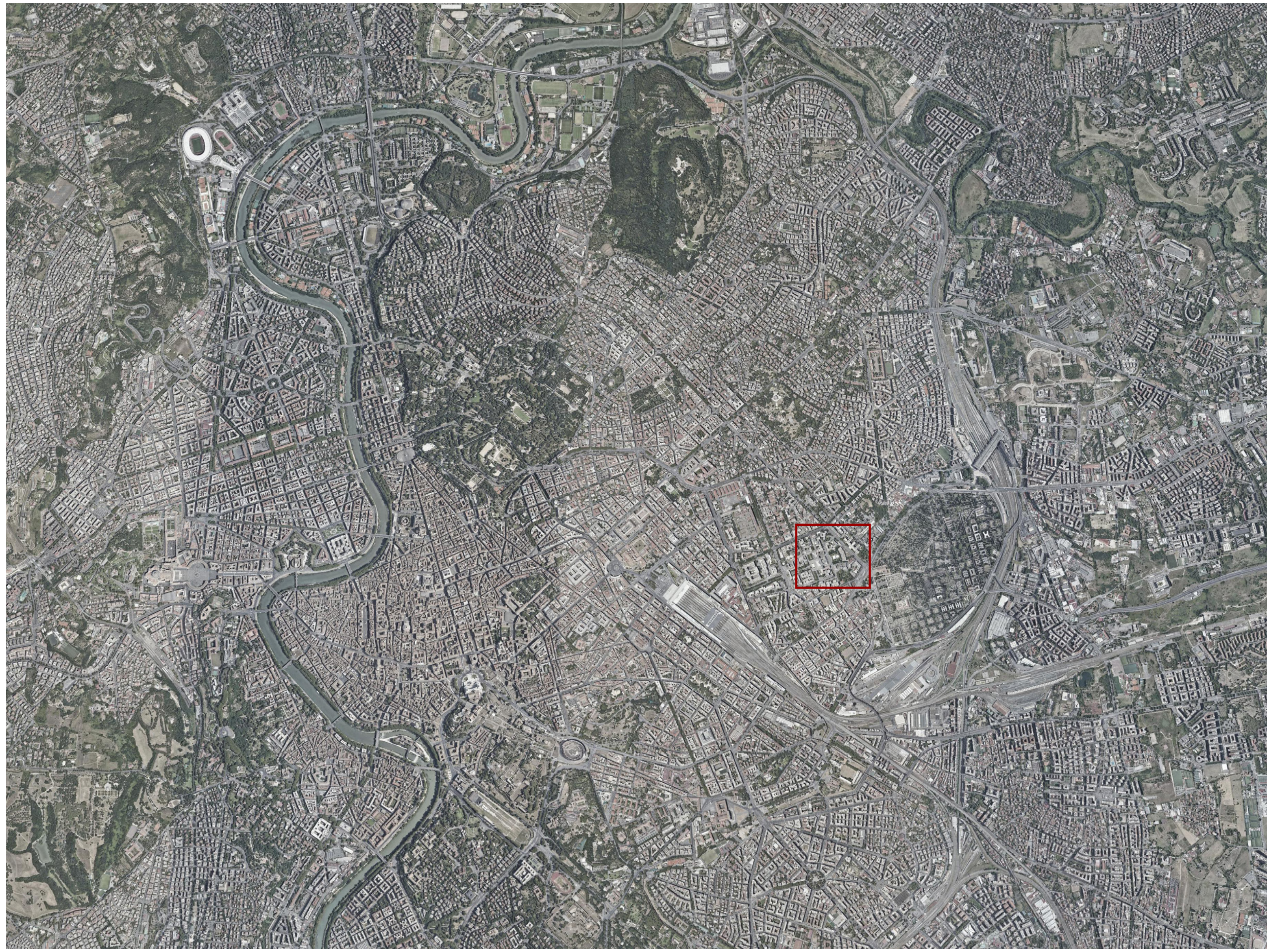


Figure 2 - Sapienza University campus within Rome's urban context (© Google Earth 2022)

THE LIBRARY
Simona Salvo

Unlike his colleagues engaged in the design of the other university buildings, Ponti placed the library at the center of his composition and designed it as the Institute's most unique architectural space.

The triple height library had a large reading hall with four tiers of open bookshelves along the perimeter walls; galleries granted access to the bookshelves. The longer sides were cross-featured by the wide, full height vertical windows in the center of the main façade, permeated by a modulated, colored light, and by a series of corresponding windows on the oth-er side- the end of the aforementioned visual axes - repeating them all the way to the other side of the building, through the courtyard, and all the way across the classroom tower. A huge skylight on the ceiling of the main reading hall let natural soft light fall from above. This consisted of a long prismatic volume made of prefabricated reinforced concrete vaults and glass blocks, with windows that could be opened along the sides. The spatial and light effects must have been incredibly beautiful.

And yet, the library was also a cultural and academic solution, hosting a precious collection of manuscripts, books, and journals which were the pride of the Italian School of Mathematicians at that time, a branch of the broader scientific field headed by the faculty of Scienc-es and Engineering. The collection originated from the less-than-a-hundred books belonging to the Pontifical School of Engineers of Rome, established by Pope Pius VII motu proprio on 23 October 1817. The School was later moved to Palazzo di Sant'Ivo alla Sapienza, while the book collection was transferred to the Alessan-

Figure 1 - The library (© Sardo 2021)

drina Library, although with a separate catalogue. It became an important technical and mathematical library only after 1870 thanks to the initiative by Luigi Cremona, at that time the director of the Royal Application School of Engineers, who reorganized it after a Royal Decree dated October 9, 1873. The School of Engineering was later moved to the convent of San Pietro in Vincoli[2], and in 1876 the former refectory of the friars was rearranged to be used as a library.

The book collection was considerably enriched, initially by Valentino Cerruti (1878-1904) and then Lucio Silla (1904-1921); their careful purchasing policy aimed not only at acquiring specific, scientifically updated physical-mathematical publications, but also entire book collections of historical and bibliographic interest. Donations from important mathematicians also contributed to the affirmation of the library (Antonio Stefanucci's collection in 1882, Eugenio Beltrami's collection in 1900 donated by his widow, and Luigi Cremona's in 1909), as did the acquisition in 1878 of the publications of the Italian Society of Sciences (so-called 'XL'), which chiefly included proceedings of the most important Scientific Academies and Societies in the world (Sinestrari, 1979-1980). In the early decades of the XX century the library expanded even further thanks to personal donations by renown scholars including, Castelnuovo, Volterra, Levi Civita, Severi, and Enriques. With the shift to the University campus in 1935 the intention was to create a space where the book collection could be exploited by its main users, i.e., an appropriate space in the new building of the School of Mathematics. At this point the collection was mainly made up of mathematical books acquired from the library in San Pietro in Vincoli, and by several books and journals focusing on physical, chemical, and human sciences.

Ponti's architectural project was- and still is- considered avant-garde among contemporary Italian universities; it is one of the few examples of a space specifically designed as a library within University campuses. The true novelty of Ponti's project consisted in providing a special space for this use- usually relegated to one of the rooms of the institute buildings, as in the case of Giuseppe Pagano's Institute of Physics- and in inventing the 'ideal' type for an academic library, i.e., a big, naturally lit reading room with completely open bookshelves (840 square meters) and a huge storeroom (roughly 640 square meters) where the books were kept on the three tiers of shelves made of a lightweight, built-in metal structure. And yet, the library was 'exclusively' open to academics and graduate students with special permits. Only after the Eighties was access gradually extended.

In the following years the library specialized even further in the fields of pure and applied mathematics; however, it always maintained its specific focus on the history of mathematics and sciences, shaping what is now the most complete collection of mathematical studies in Italy and one of the biggest in the world. Today the collection roughly comprises 106,650 volumes (56,910 volumes, 31,276 periodicals, 7,000 anthologies) and 1,326 titles of current and discontinued journals of specific interest, as well as several hundred modern manuscripts and autographed correspondence by mathematicians from the most important international scientific communities; the collection of precious texts consists of about 4,998 pieces, of which 1,650 published between 1482 to 1830 (updated data, 2020)[3].

The library, currently considered still functionally and aesthetically valid, has hosted an average of 100 frequent users every year up until March 2020 when closures and restrictions were imposed due to the pandemic. After that, attendance by students and academics has been restricted. The library maintains its original arrangement, mobile and non-mobile furniture, light fixtures, and heating system, as well as the original layout of each artifact: very little has changed, apart from a few alterations, e.g., two corridors have been eliminated. The introduction of digital devices and the collection of e-books and electronic journals has been made available to the public without any drastic changes to the arrangement which, on the contrary, have been an indirect consequence of changes to the electrical and heating systems and safety equipment.

Figure 2 (next page) - Graphic reconstruction of the library in 1935 (© Cortesi 2018)

THE STAINED-GLASS WINDOW

Simona Salvo

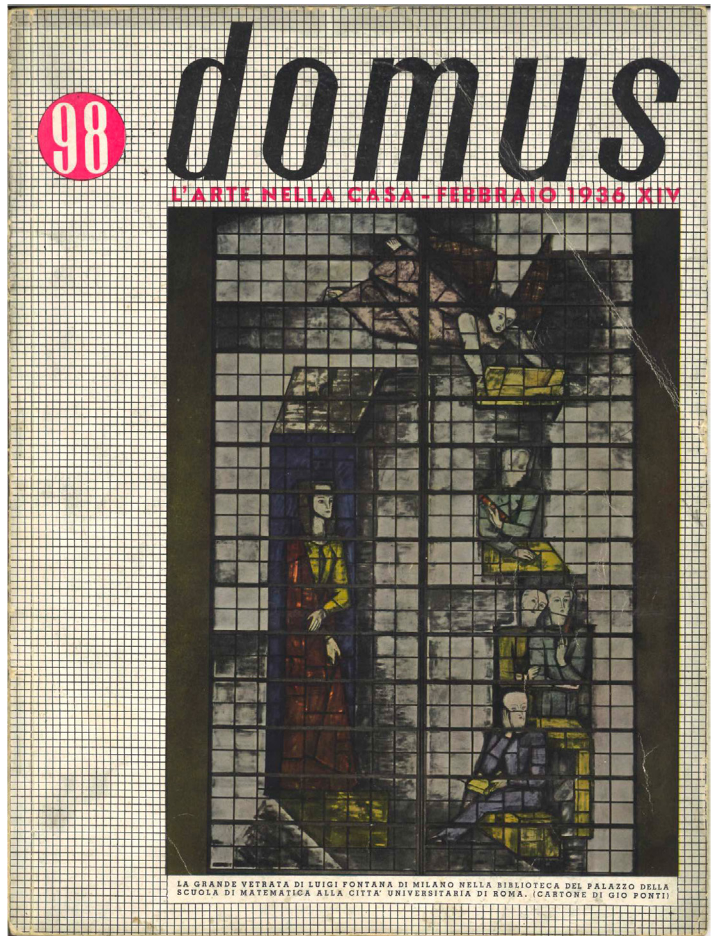


Figure 1 - The only existing photograph of the stained glass window of the School of Mathematics colored in post-production, was published by Ponti on the cover of "Domus", 1936 n. 98 (BBL_pht_32)

Figure 2 - Graphic reconstruction of the original stained glass window, corresponding to the triple height of the library reading hall (© Cortesi 2018)

The element revealing a strong cultural combination of art and architecture, one of Ponti's foremost compositional principles, was the huge, colorful stained glass window on the main façade of the front block, made by the firm Fontana Arte based on Ponti's preparatory drawing.

The relationship between Gio Ponti and the Luigi Fontana & C. company started in Milan in 1881 and rapidly grew also thanks to the diffusion of the Saint Gobain glazing system for production. In 1931 Ponti was appointed artistic director by Luigi Fontana, and the following year he was joined by Pietro Chiesa. The industrial success of those years allowed Luigi Fontana to divide his firm into two: the original company continued producing building elements, while "Fontana Arte", founded in 1934 as an offshoot of the former, was to focus on the production of artistic objects.

Stained glass windows had become part of contemporary architectural language. During this period Ponti worked with Pietro Chiesa and Luigi Fontana on the design of another stained glass window for the pavilion of the International Catholic Press Exhibition at the Vatican in 1936; since this was a temporary exhibit it has unfortunately left no evidence behind, apart from the black and white exhibition pictures.

Perhaps the only contemporary artistic stained glass window, comparable to the one for the School of Mathematics in terms of size and spatial, light, and chromatic effects, is the one depicting the "Charter of Labour", again produced by Fontana Arte based on Mario Sironi's preparatory drawing, under the artistic direction of Pietro Chiesa. This artwork luckily survived, and still acts as a backdrop to the grand staircase in the atrium of Palazzo delle Corporazioni in via Veneto in Rome; it was designed by Marcello Piacentini and Giuseppe Vaccaro in 1932.

The story of the stained glass window for the Mathematics building began in July 1935 when Luigi Fontana was commissioned the work; Fontana designed and built the work at a cost of 3,500 lira based on Ponti's drawings which were mentioned in the test report dated December 1937, but are unfortunately unavailable today.

The iconographic program, colors, and detailed conformation of the work are therefore difficult to deduce based on a few random documents. They include: the black and white photographs taken in October 1935 during the inauguration of the campus; the many publications that briefly illustrated and followed the event; and the picture on the cover of “Domus”, issue 98 of January 1936, and in “Rassegna” published in June of that year. All these images only provide a vague idea of the chromatic structure of the window with its dark shades of red, yellow, blue, pink, and gray glass pieces.

Instead, archival documents informs us that the work was 10.8 high and 4.56 meters wide; it was supported by an aluminum frame supplied and mounted by the “Curti” company. Fontana Arte then assembled the 30 panels of historiated stained glass pieces, completed on the sides of the central opening with plain colored glass pieces without figures, thus maintaining the overall chiaroscuro.

The recto of the figures portrayed on the window faced the interior of the library; the effects they created could be seen during the day due to natural lighting. At night, instead, an inverse but certainly powerful effect was caused by the dim artificial lighting inside; the refined chromatic effects were visible on the white façade from outside the building. Considered as “self-illuminating” architecture, it was a forerunner in Ponti’s production throughout the following decades; the façade of the School of Mathematics is an inescapable precedent of the Master’s post-war architectural poetics, based on the twofold life- day and night- of buildings.

More than a window, it was an architectural element representing a concept hinged onto a spatial vision that only a Master of Architecture likes Gio Ponti, gifted with a masterly sense of space, color and light, could have invented.

Ponti’s drawings between 1933 and 1935 offer proof of his firm architectural intentions: the huge opening placed on the axis of the building, facing the main central public space of the campus, was the key element behind the entire architectural composition.
It not only impressed axiality and symmetry on the entire composition, but also spatially and visually interlinked the parts, based on permeability to light and fluidity of space, organized along horizontal and vertical visual axes.

Despite the complex layout of the blocks that make up the building, classical hierarchy dominates and orders the sequence of spaces. The stained glass window coagulates the criteria of functional gradualness, subordination in the representative nature of the rooms, classrooms and halls, and distributive separation.

This work of art cannot be considered as a mere decorative element since it establishes more than profound links with the surrounding space and its own architectural elements, acting as a filter to light, color, and visual perception. It was a masterpiece of artistic mediation at material, metaphorical, and perceptive level, resulting from a composition of features: the daring overall height of the window highlighted the involvement of the whole interior intended to be used for studies in “Advanced Mathematics”; the various shades of the chromatic composition, necessarily darkened to calibrate the access/excess of light into the reading hall and avoid the glare phenomena; the highly symbolic- albeit enigmatic- iconographic program of the figurative composition intended to attract the attention of the observer.

In terms of size, color and light effects, the stained glass window provided the library interior with a very special atmosphere. However, this was not the true source of light in the library reading room which was kept dark to avoid the over-lighting phenomena and glare that naturally occurred despite facing north; so much so that blackout curtains had to be installed.
Natural light was ensured by a skylight, a parallelepiped equal in length to the width of the hall, covered with prefabricated reinforced concrete vaults and cement glass blocks, and surrounded by iron-framed ribbon windows that could be opened. This wide slit allowed natural light to fall from above, flooding the reading room with homogeneous and suffused light, while only oblique rays entered from the side windows so as to avoid directly hitting the reading tables below.

The reading hall of the library was thus a mystically illuminated space, with colored light effects refracted everywhere on the surfaces: an aquarium of light and brightness well suited for reading. The spatial and light effects were so beautiful that the library of the ‘School of Mathematics’ was considered to be one of the most beautiful in Italy and Europe, especially by international critics.

Unfortunately, archival documents offer no information regarding the production of the stained glass window. It indirectly describes the production technique by referring to the argument between the site manager and “Luigi Fontana” caused by “a copious outflow of water on the internal faces of the glass surface, partly coming from the leaded joints between the glass pieces and chiefly from the gap between the window and the frame to which the window itself is joined”.
We do not know whether the argument was created on purpose to postpone payment of the work, due to the economic difficulties encountered by the Consortium building the campus, but it is true that the company had to repair some damages before being paid.

The stained glass window probably went lost on July 19, 1943 when the San Lorenzo district was bombed by the Allies; a bomb fell on the adjacent Institute of Chemistry causing a displacement of air that probably shattered the fragile glass pieces assembled using slender lead joints. Without any documentation, we can only guess that the detonation proved fatal. As it was broken, even if not completely destroyed, it was probably so badly damaged it had to be dismantled.
The aluminum window frame, on the other hand, was saved, and is still in place today.

THE INTERIORS: FURNISHINGS, DOORS AND LIGHTING FIXTURES

Flamina Bardati, Chiara Turco

In Gio Ponti's project for the School of Mathematics, as in many of his projects, the design of the interiors and of the furniture represented an important matter, equal to architectural design. His drawings indicated precise instructions about the shape, the colours, the materials and their finishes, sometimes asking to modify the models proposed by the furniture suppliers who were entrusted with the work. Such an attention to every detail of the furnishings has left traces in the archival documentation. The companies often asked to adjust the agreed price per item in consequence to the supplementary of work and the major quantity of materials required by Ponti's modifications.

The systematic investigation on furniture and doors, both the original and the ones added later, helps to understand the entire project for the interior- and therefore of the architecture in its entirety- as well as the building's story. In fact, new furnishings were produced for the School of Mathematics in occurrence of the phases of its life, already before the deep transformations from the 1960s onwards.

Therefore, the first step of this research was a preliminary survey of the furnishings and doors existing in the building in 2020 (Figure 1)[4]. The survey immediately revealed the coexistence of objects from different periods and provenience in almost all rooms; thus, contextualization of each item with respect to the main construction and transformation phases was a prior step in view of the identification of each item. For this reason, the analysis of the building's history, based on the archival sources also concerning the entire campus, has been carried out in close collaboration with

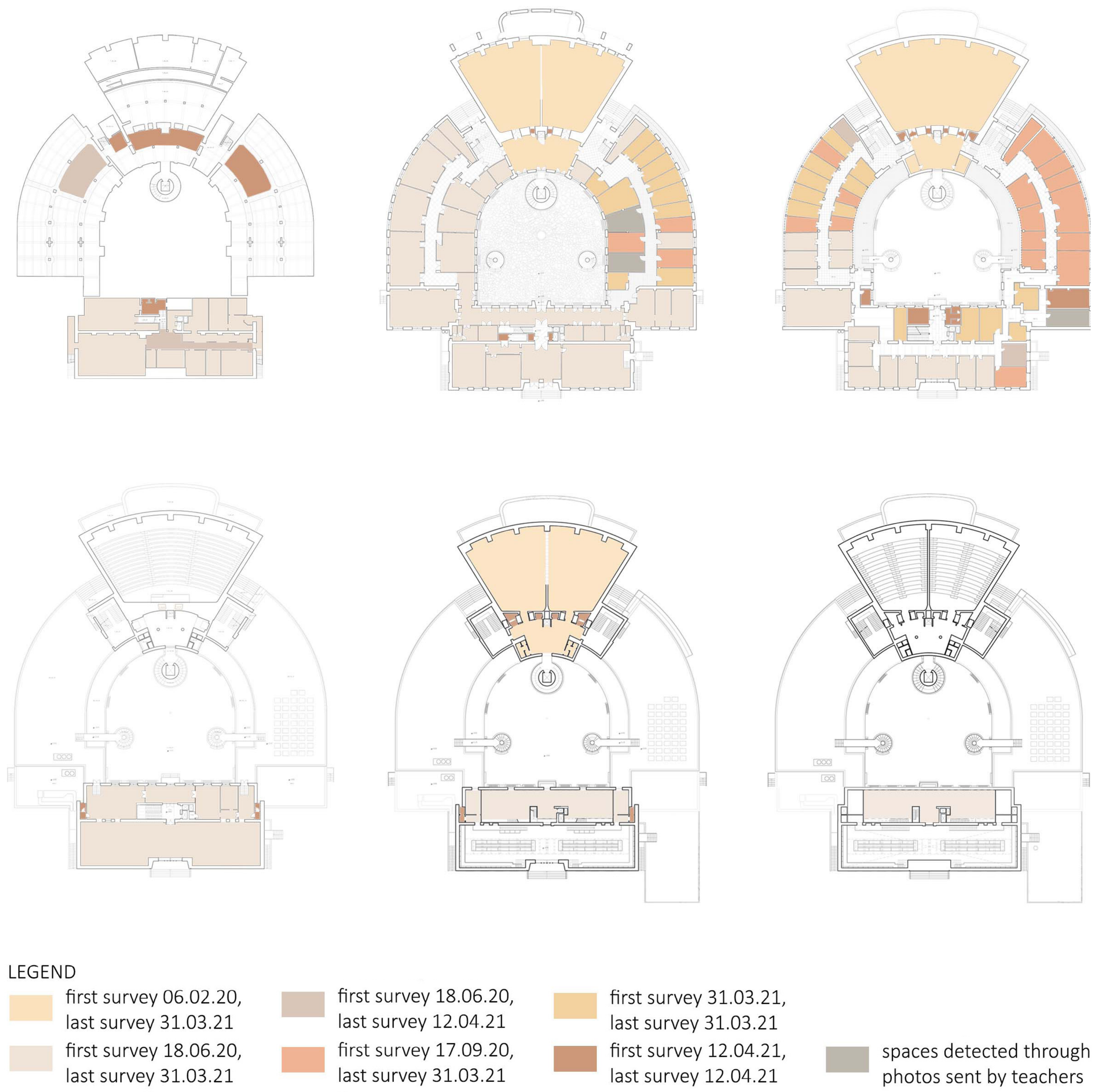


Figure 1 - Chronology of on-site survey of furniture and interiors (© Turco 2021)

the historical critical investigation and developed with a cross disciplinary strategy.
Within the chronological span that frames the life of the building's furnishing- 1935-2020- six major phases have been identified, ranging from the first supply of furniture pieces to their integration, additions and varied alteration;

- Phase 1- 1935-1938
  Design of the first furniture and doors supply.
- Phase 2- 1939-1942
  Transformations, new furnishings, and new doors due to the introduction of the seat of IndAM in the upper floor of the west curved wing.
- Phase 3- 1943-1949
  Completion of furnishing after the war damages due to the occupation by the German troops, then by the allied bombing, and further by the allied occupation.
- Phase 4- 1950-1974
  Integration of furnishing due to major architectural transformations.
- Phase 5- 1975-1980
  Introduction of new furnishings and doors due to further main architectural transformations concerning the front building and the curved wings.
- Phase 6- 1980-2020
  Adaptation furniture to safety standards and new supplies.

The data derived from the analysis of archival sources relating to furnishings and doors (supplies contracts, reports, drawings, photographs, videos) have been compared with the objects identified during the survey, in order to recognise which piece was attributable to the original project and which one to following periods.

During this step of the research, several methodological issues specifically linked to furniture emerge, concerning the dating, the materiality and state of conservation of each item.

The most important is referred to the numerous alterations
- repairs, relocation, dimensional adjustments
due to safety reasons, painting etc.- suffered by the objects over time. In general, furniture is subject to considerable wear, which can involve both its replacement and restoration or maintenance (i.e. loss of the item or modification of its original state), while doors have been very often adequate to safety standards (phase 6, 1980-2020), sometimes replaces or moved, in particular during the phases 3 (1943-1949) and 5 (1975-1980).

Fixed furnishings may also need to be adapted to current safety regulations or to changing needs with consequent modification of the original state, as in the case of the formidable curved rows of integrated desks and chairs of the 3rd floor of the Tower of classrooms, cut to adapt to two smaller teaching space obtained by the division of the 434-seat classroom in 1960 (Figure 5). If this kind of intervention could be dated, other actions as the small, continuous, undocumented maintenance works relating to locks, handles, studs, coatings, glass etc. keep the object 'alive' and usable but alter its original state, making the dating and recognition more difficult. In fact, generally the archival sources only allow to date 'original' doors and furnishings belonging to phase 1 (1935-1938), while, for the following ones, materials and artisanal or industrial processing of the original pieces could help to hypothesize a plausible dating: the "do-it-yourself" actions make often impossible this kind of analysis.

The documents conserved in Sapienza's historical archive, within the section of the CERUR Consortium, and the historical pictures and shootings of 1938-1939, represent valuable sources that allow a scientific analysis of the original doors and furnishings (phase 1, 1935-1938), strictly linked to Ponti's vision of interior architecture. Nevertheless, there are gaps in this systematic reading of the archival sources, such as the presence of lists of furnishings with pairable drawings which do not correspond to any survived furniture, or

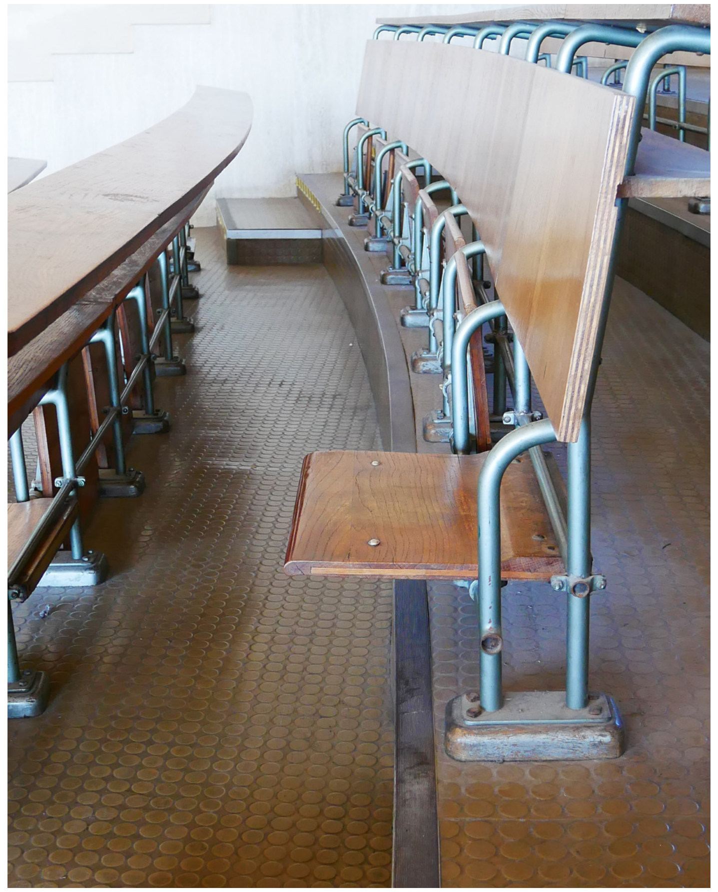


Figure 2 - A row of desks in the tiered lecture hall at the third level supplied by the firm Liporesi; note the chromed steel tubes, sheared in 1960 to adapt the display of the furniture as the room was divided into two (© Bardati 2021)

vice versa the presence of furniture stylistically datable to phase 1- that is the one to be considered original- which is not mentioned in the documents.

Another critical factor concerned the initiative to furnish the rooms modified in 1939 with items similar or identic in shape and materials to the original ones, as in the case of the doors supplied to reorganize the spaces destined to IndAM, explicitly produced following the originals designed by Ponti (Figure 6), or of the teachers' desks for the new tiered lecture hall at the third floor of the tower of classrooms.

Furthermore, it should be noted that not all archival drawings of the 1930s concerning furniture correspond to items effectively purchased. The industries that supplied them often proposed several models and solutions on catalogue, among which the architects made their choice, some of which could also be rejected by the Administration. Similarly, the archival sources mention furnishings that have gone lost during the transformations undertaken from the 1960s onwards, as in the case of the drawing tables placed in the curved wings (ASS_drw_81; ACS_pht_14 and 15; GPA_pht_03) and of the sofa in the Council Hall (ASS_drw_80). Another difficulty has been encountered with the identification of the modifications required by Ponti, as the furnishing sometimes appears quite different from the drawing, as in the case of the coat hangers (ASS_drw_107).

Yet, the greatest difficulty concerns the supply of furniture dating back to phases 4-6 (1950 to today), which has left almost no trace in the archives. These pieces of 'anonymous' furniture represent the most conspicuous part of the building's furnishing, not always of historical or artistic interest, mostly produced in recent times.

Therefore, after a first bibliographic and archival investigation, the corpus of furnishings datable between 1935 and 1980 has been revised, excluding what was subsequently introduced into the building. These chronological limits have been identified as follows: spring 1935 is the date of the first documents related to the inner doors and furnishings of the Mathematics building (ASS_dcm_51; ASS_dwg_75; ASS_dcm_53 and ASS_dwg_76); 1980 is the terminus of several events that subvert the internal organization of the building. The transformation of the professors' lobby into two minor rooms in 1954 and the subdivision of the major tiered lecture hall at the third level of the Tower in 1960, mark the beginning of deep functional changes; the students' protests and occupation of the campus buildings in 1968 and in 1977 contributed to the dispersion of various pieces of furniture (and probably to the shift of pieces from one building to the other); the campaign of further extensive functional modifications of the curved wings dates to the years 1974- 1980. Last but not least, Gio Ponti passed away on September 16, 1979.

Once the chronological limits were established, the following step consisted in drawing up a catalogue of furnishings and doors, in separate series.

Figure 3 - Entrance door supplied in 1939 for IndAM offices in the east wing, replicating the original design of Model B2 produced in 1935 by firm Cantieri Milanesi (© Bardati 2020)

Targeted inspections allowed to further define the items to select for the catalogue and to discover several chairs, armchairs, benches, stools, tables and even blackboards and shelves, stocked in the basement of the Tower of classrooms, and reduced to very bad conditions. Following these surveys, seven main categories of furniture were identified: chairs, tables, lighting fixtures, leaning furniture, suspended furniture, platforms and more, each including specific under categories and types. The catalogue also provides a localization of each specific piece of furniture to its location (as of 2021, at the date of the survey) marked with an identification code on the survey drawings[5]. The mapping resulting from this survey in 2021 was then compared to the original location of the pieces in 1935, when possible[6].

Concerning the doors, a selection of the ones attributable to the original design and following periods, including the transformations of the 1960s-1970s were included in the catalogue. Again, the story of the building was a useful reference to propose dates and relative phases for the doors: 1935-1937 (first project); 1939-1940 (creation of INDAM headquarter); 1954 (transformation of the open lobby on the 1st floor to create two professors' studios); 1969-1980 (extension of the curved wings and subdivision of drawing classrooms into five teaching spaces and in many offices). As in the case of the furniture, an identification code was linked to each door, to allow a precise mapping of the doors on to the survey drawings (as of 2021 at the date of the survey), again compared to the original location or to our hypothesis.

The aim of these catalogues is to allow a more precise knowledge of the furnishing, intended as a specific heritage of the School of Mathematics, very representative of Ponti's idea of architecture where space, interior design and furniture are always considered as a one, but also featuring the aesthetic of the Thirties and of the development in terms of taste, functions and functional needs since then until the present day.

Figure 4 - Chairs, armchairs, tables, blackboards and other old furnishing dating back to the 1930s stacked in the basement of the building (© Salvo 2020)

THE BUILDING OVER THE YEARS
Simona Salvo

The critical success of the newly-built School of Mathematics was immediate and widespread, and probably superseded that of other buildings on campus. Celebrated at first by an attentive international public, it received nearly unanimous appreciation in the years following its inauguration, which obviously subsided after World War II, leaving historiography anchored for years to a careful antifascist architectural critique. Consistently condemned as a product of the fascist Regime, like all the other buildings of the "Ventennio", for years the School of Mathematics was condemned to damnatio memoriae, so much that it disappeared from the books dedicated to Ponti after he died, especially the ones written by historians of architecture and critics of the 'Roman School' led by Bruno Zevi.

Zevi decisively influenced the critical interpretation of the Regime's architecture, harshly commenting not only on Italian rationalist architecture of that period, but also on Ponti's work. He considered the Milanese architect to be an opportunist, a person who tried to gain favor with the contemporary industrial society, accusing him of having a "friendly fascist culture", expressed by a "reassuring stylized classicism". Although Zevi acknowledged that the School of Mathematics was the most interesting building in the University, he opposed the rehabilitation of the building's philosophy since it would boost the evil of fascism (Zevi, 1992, pp.314, 333, 349). However, appreciation for the building and its author survived beyond the borders of Italy.

Other issues that pushed the School of Mathematics into oblivion are the vagueness of Ponti's style in the Thirties, considered not fully "classic" (e.g., his typical houses) and not yet fully "modern" (e.g., his first Montecatini building). This contrast echoes in the comments of the historians of architecture who defined this work "one of the most original buildings of the University campus, a sort of Roman interpretation of Milanese 'neoclassicism' with an allusion, in the rear, to rationalist language" (Ciucci, 1989, p. 133) and "among the most interesting buildings, perhaps the one which, more than others, expresses the ambiguities and oscillations of architectural research in Italy during those years" (Rossi, 1991, rec. 47). So it was meaningless to exclude it from Ponti's works in the Thirties (Romanelli, 2002, p. 73; Miodini, 2001).

In addition, its authorial value was questioned, thus weighing on the evaluation of this building. According to some scholars Ponti's project had been heavily influenced by Piacentini and had been built under the direction of other professionals. This consideration- based on a simple interpretation of the original drawings and contemporary pictures- is an aspect we tried to consider differently after a scrupulous review of the archival documentation and the building itself. Both the documents and the building testify to the fact that Ponti followed the construction process, albeit often in remote, and was able to continually introduce variations to the architectural details, which are clearly authorial, but essentially separate from many of the constraints imposed by Piacentini.

As often happens, artworks are easier to conserve than built architecture; this is the case of the Univer-

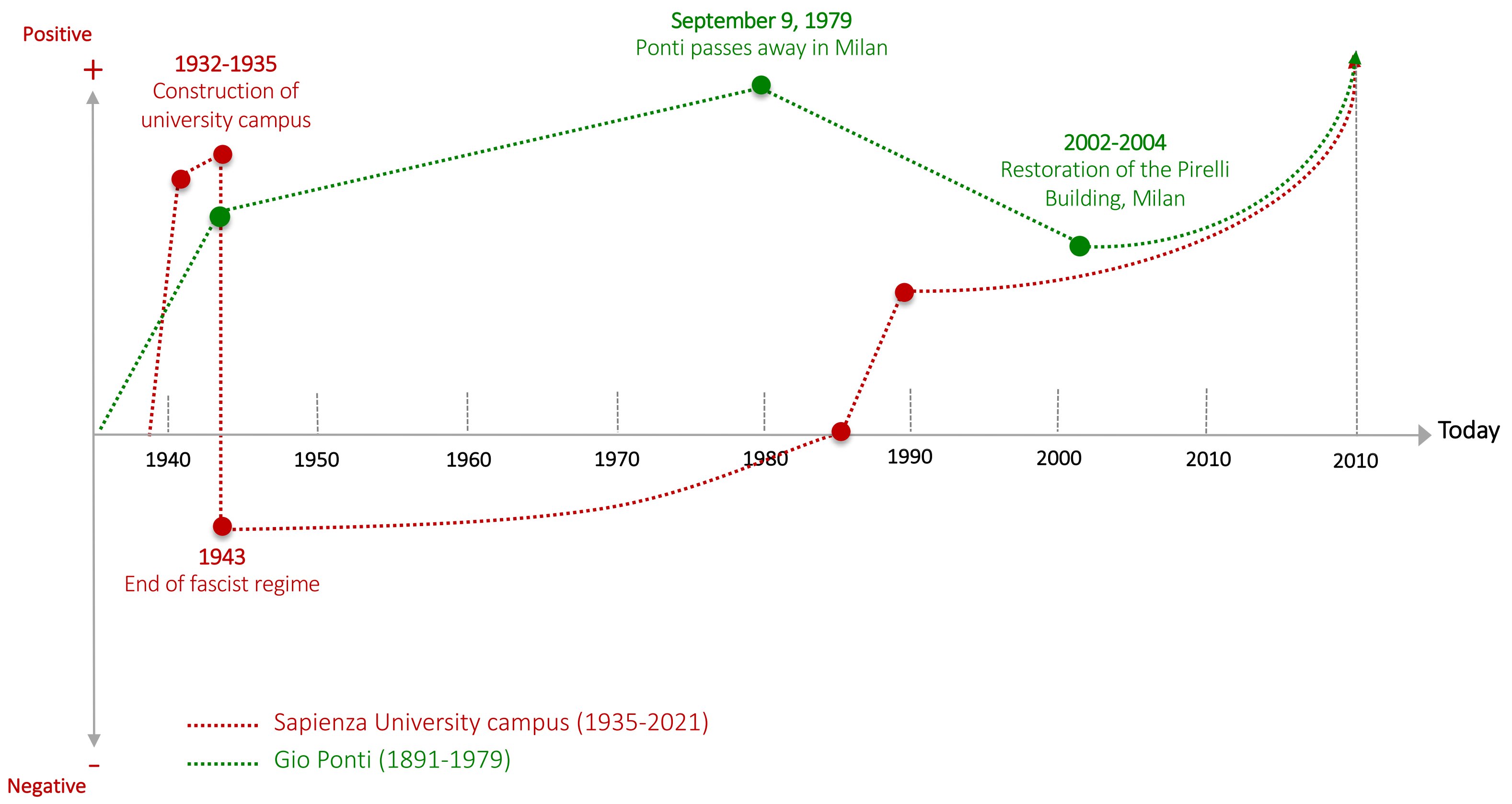


Figure 1 - Appreciation of Ponti's cultural relevance, 1935 - 2021 (© Salvo 2021)

sity campus and of most architectural ensembles built by the Regime. The statue of Minerva by Arturo Martini, built on campus grounds[7], was accurately restored in 1995, while Mario Sironi's mural in the Aula Magna of the Rector's Office was cleaned and restored in 2017[8]. Like many other public institutions, Sapienza's approach to the conservation of its artistic heritage has been certainly more sensible, flexible, and open compared to its approach to its architectural heritage, considered up to a decade ago as real estate. A virtuous circle of knowledge / recognition / conservation of its architectural properties started much later. These three aspects were hindered by its prevalent use values and have only lately been supported by revised historiography and influenced by critical literature based on archival sources that has grown considerably only from 1985 onwards[9]. The process has been boosted by the onset of a shared sense of belonging among Sapienza's community, ready to recognize its identity with the site, enriched over the years by a special 'affective' value and the sedimentation of personal memories.

After decades of oblivion, lack of maintenance, and numerous major and minor transformations, a first turning point came in the late Eighties when cultural appreciation for the building's historical value started to emerge. For decades, the campus and its buildings have been considered an "open work"- term coined by Umberto Eco- ready to be continually transformed based on a pragmatic approach. At first, elevations and extensions, then functional and regulatory compliance to new regulations and, last of all, structural, anti-seismic and energy saving adaptations; all this has resulted in a jumbled mass of all kinds of additions, with no respect for the architectural features of buildings and open spaces. That said, it is very important to emphasize that very few demolitions have indeed taken place[10].

Continuous alterations have forced the buildings' capacity and functionality beyond all limits, often to the detriment of its material conservation[11]. The func-

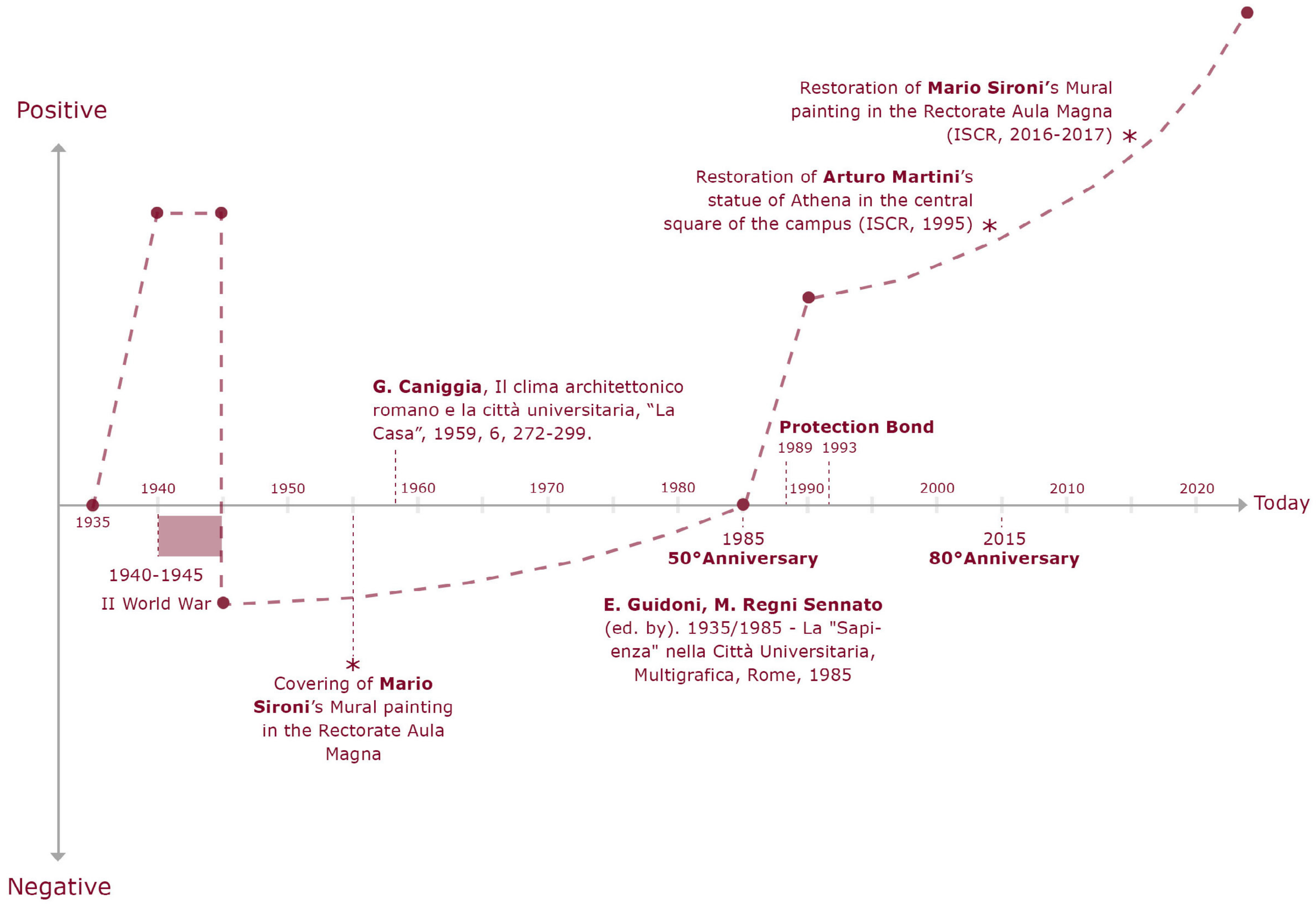


Figure 2 - Appreciation of the historic and architectural value of Rome's University campus, 1935 - 2021 (© Salvo 2021)

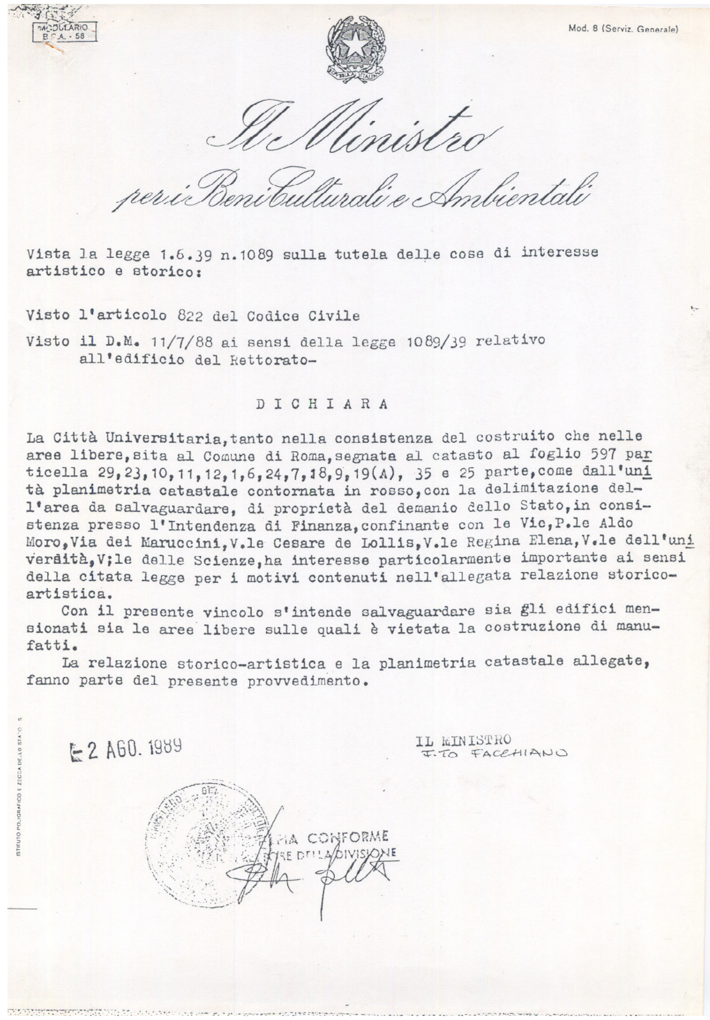
tional transformations and additions triggered by the exponential increase in students and teachers, starting in the Sixties[12], were also due to profound changes in national teaching and research methods. This marked a drastic shift vis-à-vis the guidelines behind the design of the buildings in the Thirties.

The 1989 Protection Decree in favor of the Rome's University campus finally assessed its historical importance, although according to Italian law this official act was due ope legis fifty years after construction[13]. The document states (translation by the author):

"The university campus ... has a specific and important interest pursuant to the aforementioned law [1089/1939] for the reasons contained in the attached historical-artistic report ... Institute of Mathematics - Arch. Giò Ponti.

As appears evident from the general plan of the university campus, the two buildings of the Institutes of Physics and the Institute of Chemistry, with their front elevation recessed, compared to the limit of the main alley, create up an urban space preluding to the great monumental backdrop, i.e., the buildings of the Rector's Office and the Faculty of Letters and Law, but also to the two wings, one occupied by the School of Mathematics, the other by the Mineralogy building.

The School of Mathematics is located on the transversal axis of the Forum. The shape of the building is one of the most original; its front elevation contains the rooms intended for the teaching of mathematics, the library, and a hall for professors. Two double height wings are connected to this considerably tall building with its rectangular plan; they create a curve, containing four big, well-lit drawing rooms, now divided into



Il Ministro
per i Beni Culturali e Ambientali

Vista la legge 1.6.39 n.1089 sulla tutela delle cose di interesse artistico e storico:

Visto l'articolo 822 del Codice Civile

Visto il D.M. 11/7/88 ai sensi della legge 1089/39 relativo all'edificio del Rettorato-

D I C H I A R A

La Città Universitaria, tanto nella consistenza del costruito che nelle aree libere, sita al Comune di Roma, segnata al catasto al foglio 597 particella 29,23,10,11,12,1,6,24,7,18,9,19(A), 35 e 25 parte, come dall'unità planimetria catastale contornata in rosso, con la delimitazione dell'area da salvaguardare, di proprietà del demanio dello Stato, in consistenza presso l'Intendenza di Finanza, confinante con le Vie, P.le Aldo Moro, Via dei Maruccini, V.le Cesare de Lollis, V.le Regina Elena, V.le dell'università, V;le delle Scienze, ha interesse particolarmente importante ai sensi della citata legge per i motivi contenuti nell'allegata relazione storico-artistica.

Con il presente vincolo s'intende salvaguardare sia gli edifici mensionati sia le aree libere sulle quali è vietata la costruzione di manufatti.

La relazione storico-artistica e la planimetria catastale allegate, fanno parte del presente provvedimento.

2 AGO. 1989

IL MINISTRO
F.TO FACCHIANO

Figure 3 - One of the tiered lecture halls in the tower, in its original condition (BFAR_pht_11)

Figure 4 - Protection Decree in favor of Rome's University campus, Ministry of Cultural and Environmental Heritage, August 2, 1989

numerous small classrooms, incorporating the structural columns. At the rear, four large classrooms are located in a tower.

These classrooms have a fan-shaped plan; it is still possible to note the care taken in the design of the very rational furniture made of solid wood with metal parts made of steel tubes. The area with the teacher's desks, similar to a real wall-system, also deserves specific attention.

The architecture of the complex differs: the front building is more aulic, in line with its abstract character; the rear is more functional and utilitarian.

Prior to recent works performed to comply to the regulations in Law 818/85 [fire-safety], the courtyard appeared well-kept, characterized by the rear elevation of the front block, and clad with grey-yellow Litoceramica: the opus incertum travertine paving of the courtyard, with grass in-between the slabs, is currently rather compromised by the presence of three cylindrical-shaped stairs.

As regards the interior, the Aula Magna has been well maintained [main tiered lecture hall III], except for the recently replaced lighting system, while the drawing rooms have been divided up because more space was required. For this reason the columns characterizing the structure on the ground and first floor have been also hidden from view".

However, the preservation of this extraordinary urban and architectural ensemble has remained wishful thinking for decades, until the academic community began to appreciate its cultural importance, in some cases even preceding the work of the management offices, institutions, and even Sapienza's governing body. The core process has only recently begun to take shape, especially thanks to the initiative of the university department directors, especially the directors of the Mathematics and the Physics Departments. They have proved to be more capable than others to ensure the cultural appreciation of these buildings thanks to real acts of protection. These ostensibly marginal interventions, which proved to be crucial to implement the appreciation process, were based on this approach; they triggered the gradual rediscovery and exposure of the buildings' architectural qualities. In the course of three generations (1935-2021), consideration for the urban and architectural importance of the University campus has therefore advanced and sparked several turning points (Ferrarotti, Lionetti, Alì, 1985). However, projects performed on campus buildings are still carried out without an overall strategy, relying chiefly on the resilience that this extraordinary architectural complex continues to implement against all odds.

This excursus would be incomplete without acknowledging the policies and ideology characterizing the buildings and their historical link to fascism; it is still considered a prejudice and requires an additional cultural effort and support by scientific research. In most cases there are several reasons why the 'uncomfortable' memories of such a despicable dictatorship still survive. Sometimes considered as a penchant of

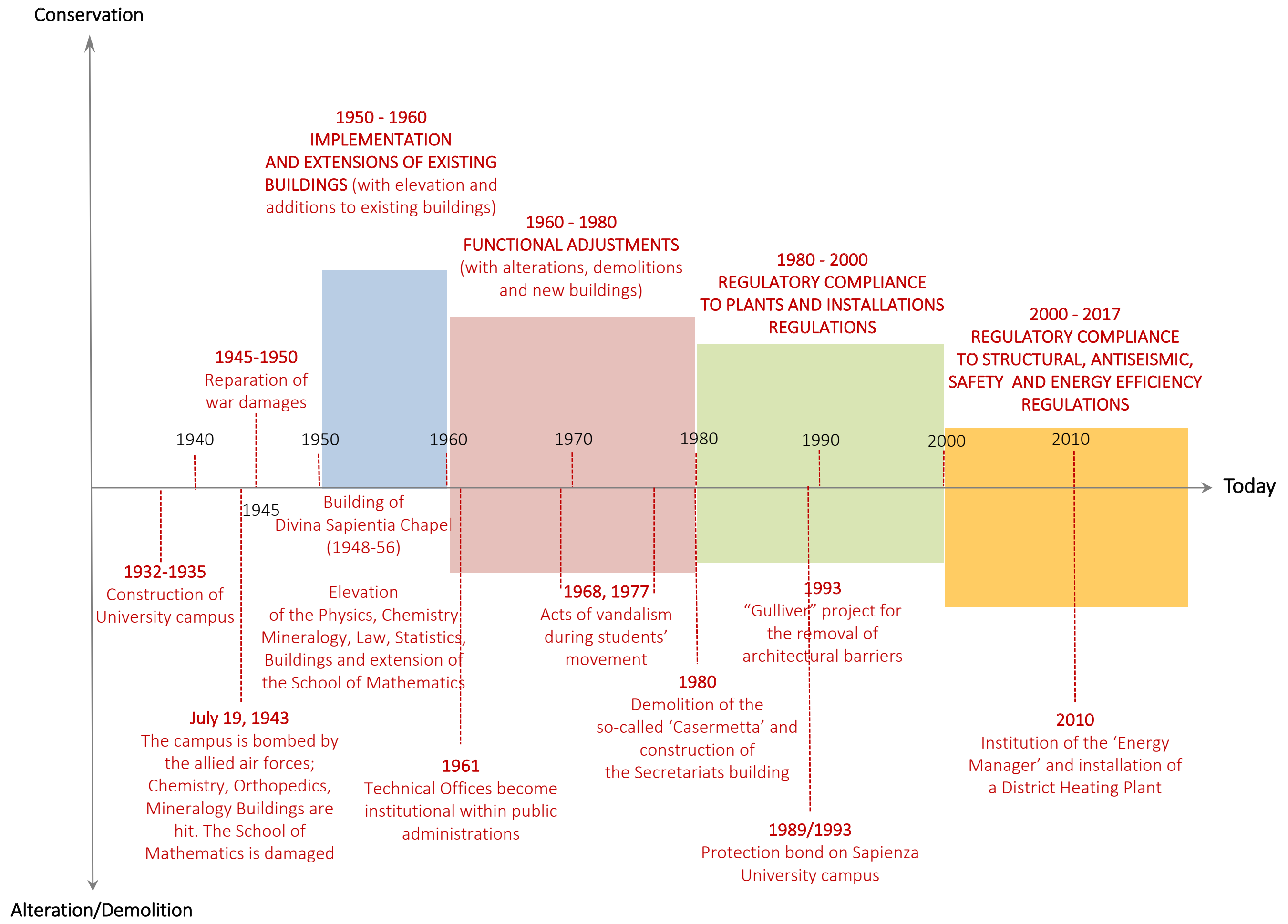


Figure 5 - Type of work on the buildings in Rome's University campus, 1935-2021 (© Salvo 2021)

Italian culture to preserve and benevolently accept rather than eliminate such relics, sometimes as a sort of laziness, sometimes as an urge prompted by the need for infrastructures; whatever the case may be, this attitude has saved a precious heritage that can, above all, still stands as a warning[14] .

The life of the School of Mathematics in the post-war years has not been simple. The very first alterations were implemented immediately after its completion: in 1939 the geometry classrooms in the eastern wing were assigned to the National Institute for High Mathematics (IndAM). Imposed by the powerful mathematician Francesco Severi, first director of the Institute, the drawing rooms in this wing were divided into offices. This alteration not only obliterated the symmetry of the composition and continuity of the interiors, but also eliminated the architectural connection between the front building and the curved wings, thus spoiling an important element of Ponti's project.

Yet, the most painful loss suffered by the building was undoubtedly the stained glass window destroyed during World War II. On July 19, 1943, allied bombs targeting the nearby S. Lorenzo rail yard severely damaged the University campus and shattered most of the window panes of the campus buildings, including the precious stained glass window on the main façade of the front building. The polychrome glass pieces probably either shattered or were damaged to the point that they had to be removed and replaced by normal transparent glass; the blast, however, left the window frame untouched, and in fact it is still in place. Additionally, hard to quantify damage was certainly caused by the occupation of military forces, first the German Army, then American and British soldiers, who used the University campus as their headquarters, probably destroying and removing the precious furniture in the building.

The post-war years saw the beginning of a new chapter in the life of the building. The partnership with the Institute of Mathematics was never in question, but its

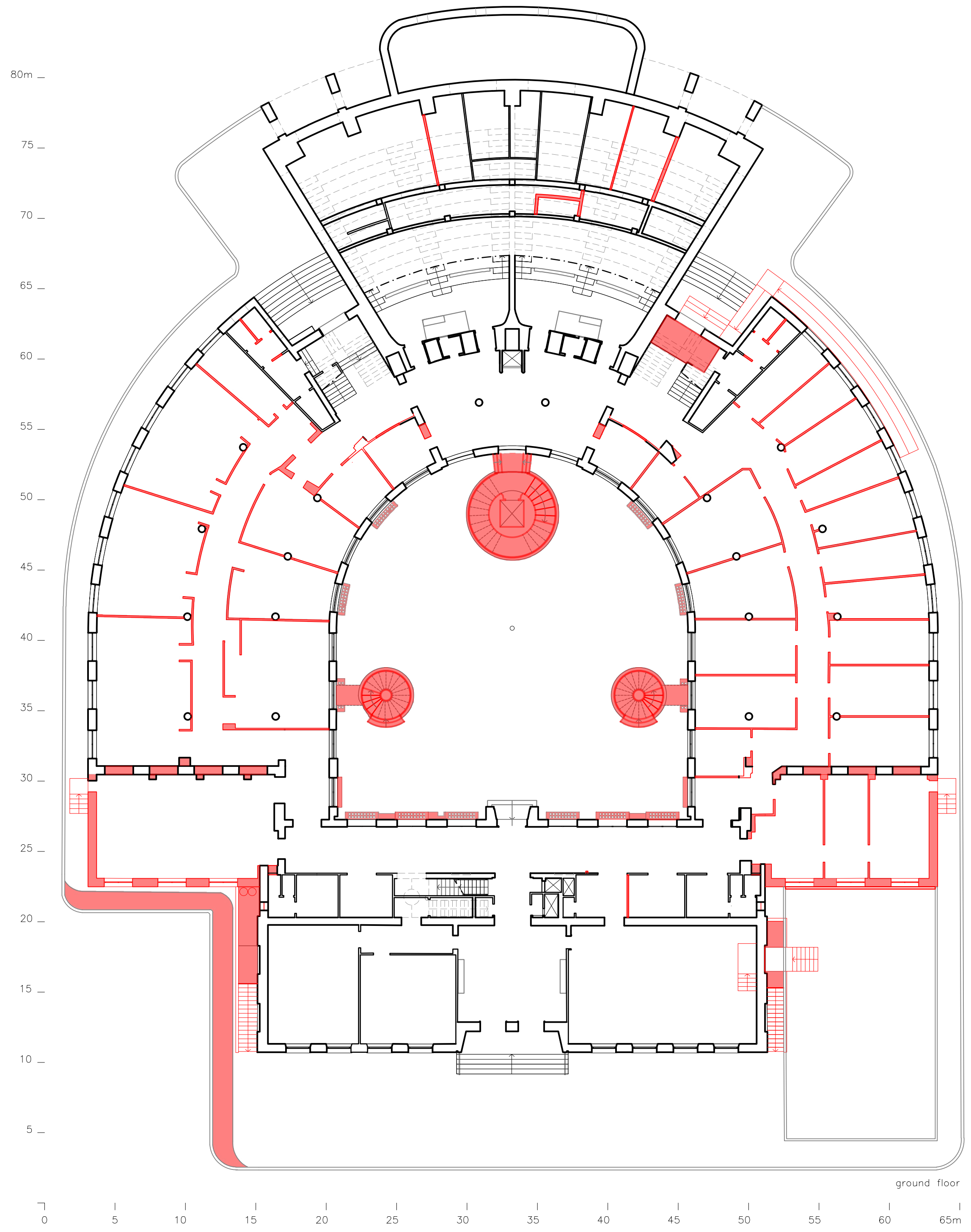


Figure 6 – Ground floor plan of the building; in red, additions from 1939 to the present day (© Cortesi 2021)

original function changed a little; part of the original architectural structure was gradually dismantled and dismembered to create more space for professors and classrooms. These changes affected the whole building, but caused more damage to the more particular spaces, such as the library. At the time, the triple height probably appeared as a waste of space; in 1954 this led to the division of the so-called “professors’ lounge” on the lower floor in order to create two offices. The division was obtained by introducing a horizontal element that closed off the main reading hall, producing a ripple effect on the building. This alteration non only subverted the spatial organization of the front building, but also altered the focal point where the main visual axes intersect; the division became clearly visible on the main façade through the big front window, disfiguring the entire composition.

In the late Fifties the big, tiered lecture hall on the third floor of the Tower suffered the same fate and was divided into two smaller halls; this also involved mutilating the furniture on the rear wall, a system of blackboards / desks / platforms originally designed as a single piece of furniture.

The need to enlarge and modify the space dedicated to didactics resulted in the addition of new buildings on either side of the front building, at the two ends of the curved wings. This extension (1973-1979) eliminated the original side entrances, and invalidated the use of the main entrance, (originally opened only on special occasions), thereby altering the building’s general distribution. In the meantime, the drawing rooms in the east wing, still in their original condition, became obsolete: changes in academic programs, and the fact that students in architecture and engineering were transferred to other venues, encouraged a repetition of the earlier transformation when the IndAM was moved to the west wing; in 1978 this led to further divisions to create more classrooms and offices.

The general layout of the building was also altered; the plastered outer surfaces, originally clear in color to match the white-travertine and yellow Litoceramica cladding, were painted over. Archival documents provide evidence of the general maintenance work performed on the exterior surfaces in 1980 to ‘complete’ the extension of the building and try to uniform the new surfaces with the rest of the buildings, at least as regards their color; after 45 years of service the building did indeed required maintenance. It is unclear whether the reddish color applied on that occasion followed on from an earlier change in the chromatic set-up of the building.

However, the most destructive alterations were the ones implemented in the Eighties to retrofit and update the building so that it would comply with new regulations (fire safety, architectural barriers, energy efficiency). These works were carried out so poorly- and without a general plan- that they became a primary source of damage, coupled with the constant lack of maintenance. This phase lasted until the mid-Nineties and included replacing all the Termolux glass and most of the original metal window frames, closing the

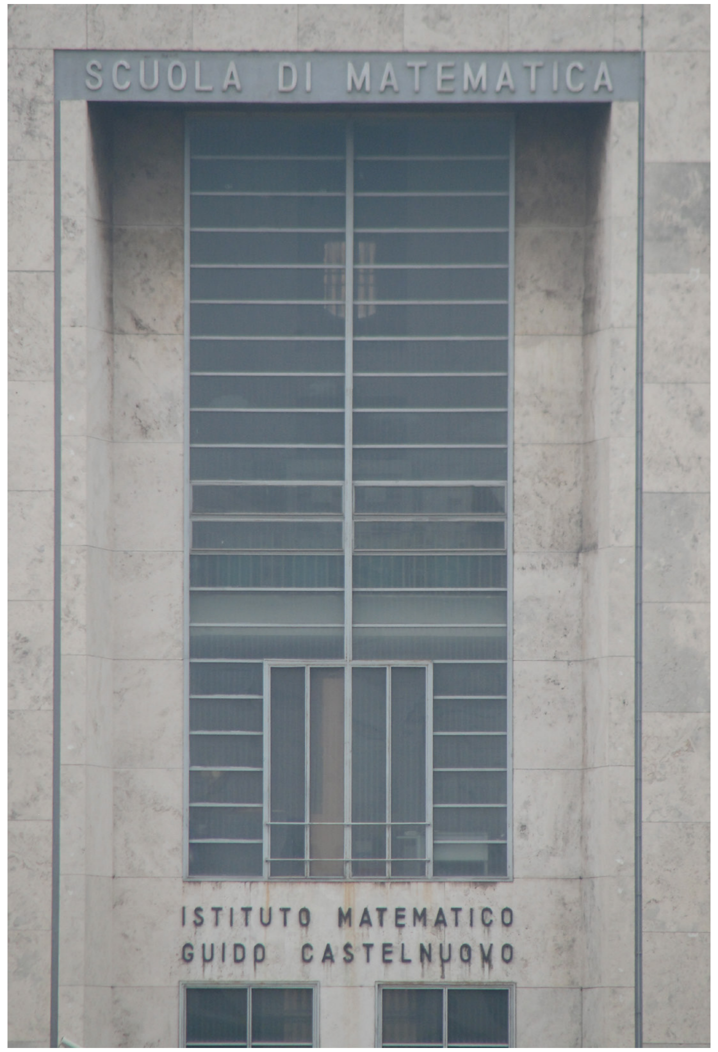


Figure 7 - The big window on the front façade; the horizontal element added in 1954 to create offices on the first floor and furniture placed in front of the window are clearly visible through the glass (© Salvo 2011)

Figure 8 a/b - The small lecture hall with tiered seating on the first floor with the original furniture designed by Ponti (top) and the one on the third floor created in the Seventies (bottom) (© Salvo 2019) parapets of the windows, and adding ramps for the physically challenged and three cylindrical fire escape stairs inside the courtyard.

In addition, cabling and equipment were bundled everywhere, along the corridors and on the roofs; they were adjusted on a daily basis, creating an overall 'background noise' to people's perception of the interiors.

There is no exact date marking another transformation- the skylight in the library- which was not only a decisive architectural element, but also a precious technological system that guaranteed natural lighting and optimal ventilation to the huge space of the main reading hall. The skylight also functioned as a chimney to scoop up and expel warm, moist air through the wide pivoting windows placed on either side. In roughly 1985, a protective roof was placed over the skylight to avoid water filtering down into the joints between the glass blocks and the concrete. This clumsy iron and glass canopy further damaged the skylight rather than protect it; it also dulled its original permeability to light. In addition, the side windows of the skylight were plugged, hindering air convection and generating unfavorable thermo-hygrometric conditions for the conservation of the artifact.

Law n. 10 of 1991- the first to impose severe containment measures to avoid energy dissipation through the building envelope- triggered further changes to the building: the original metal-framed windows of the tiered lecture halls were replaced by new ones in anodized aluminum. The glass of the big window on the main façade was also replaced; the idea was to endow the library reading hall with better homogeneous light since the latter had been partially obscured by the canopy over the skylight. In any case, this intervention did not affect the building's design, as the new glass was not original.

Minimal but essential interventions have been carried out in the last decade (2011-2021), on one hand in order to pursue pragmatic goals, such as reorganizing the interior to benefit the academic staff, on the other to recover, at least partially, the original spaces.

An initial generalized removal of furniture scattered around every corridor and lobby took place based on the Department Head's firm intention to reorganize the interior. An overall decrease in the number of academics, caused by the 2010 university reform, also made it possible to empty two offices, namely the two rooms created on the first floor behind the big front window, thus reinstating the former atrium.
The room was used as a lounge for the academic staff and entitled 'Aula Ponti'. This simple intervention consisted in removing the plaster board partition that had divided the space in two. The attempt to recreate the original space was then completed by placing a glass sheet between the horizontal element and the big front window in order to create continuity with the space above and visually mitigate the horizontal division from the outside. This minimal intervention has made it possible to again explore the architectural concept of building based on the permeability of light and vision (Salvo, 2017). Unfortunately, the work could not include the demolition of the horizontal element added in 1954 because it was considered practically and economically too expensive, at least for the moment.

Removing the horizontal element would reconnect the atrium to the library reading hall, and the latter to the corridor and common areas on the first floor, creating a completely different cultural environment and function, similar to the one that existed in 1935; it would also eliminate the noise that now fills the corridor from the first floor to the library reading room.

With more 'courage', the very original spatial continuity envisaged by Ponti could instead be recreated by simply opening the third side of the room to re-establish the horizontal visual connection through and outside the building, linking the visual focus of the campus to the bronze statue of Minerva-and realign-

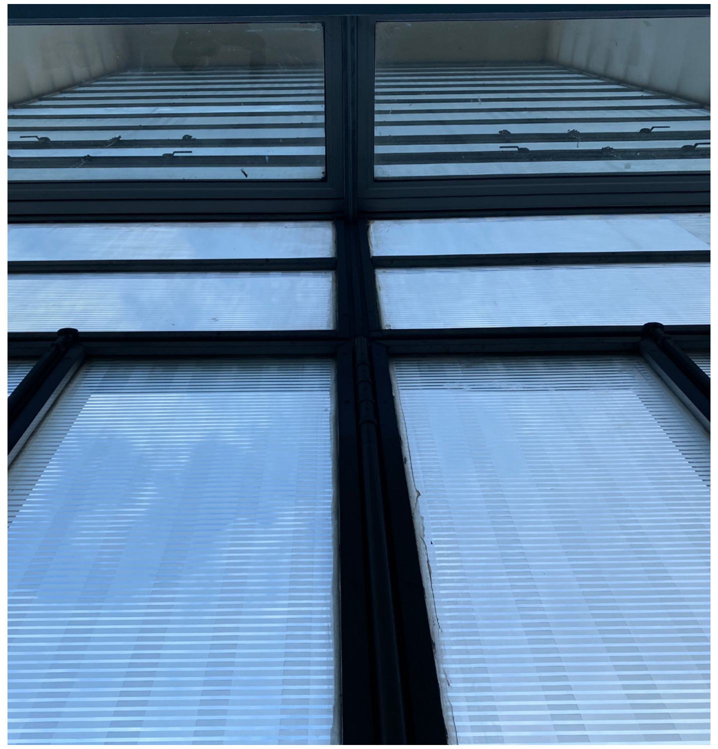


Figure 9 - View from below of the big window on the front façade, seen from the Aula Ponti (© Salvo 2021)

ing the sequence of openings connecting this space to the classrooms in the tower on the other side of the inner courtyard.

Inspired by a very different goal, repairing the roofs and skylight of the library became very urgent during that same period (2012-2013). Left for years without the necessary maintenance, the roofs and skylight needed immediate maintenance as water infiltration was once again a problem in the reading hall, making its use dangerous for people, the furniture, and the books, because large chunks of cement and glass were falling from the skylight. While the infiltrations caused by the malfunction of the waterproof membrane under the roof were serious but could be remedied, the problems caused by the skylight, and by the protective roof on top of it, appeared much more complicated.

The protective roof placed on top of the concrete and glass skylight had become counterproductive as the iron supports had been placed directly on its reinforced concrete structure. As the years went by, the oxidized metal poles damaged the old structure, and rivulets of rust had poured onto the vault, staining the glass surfaces of the skylight.

In addition, the glasshouse effect caused by the gap between the skylight and the shed roof had produced thermal stress and condensation; glass and concrete fragments began to fall from the skylight due to excessive tension along the joints between the two materials. In addition, birds had nested in the interspace between the skylight and the canopy making it a perfect habitat for the growth of vegetation and biological patinas, causing even more damage. Last but not least, the canopy was not only aesthetically invasive because it drastically reduced the amount of light coming from the skylight, it was also visible in all main views of the front building. Removing the canopy was therefore urgent and necessary, although it remained unclear how to ensure that water would not pass through the old skylight.

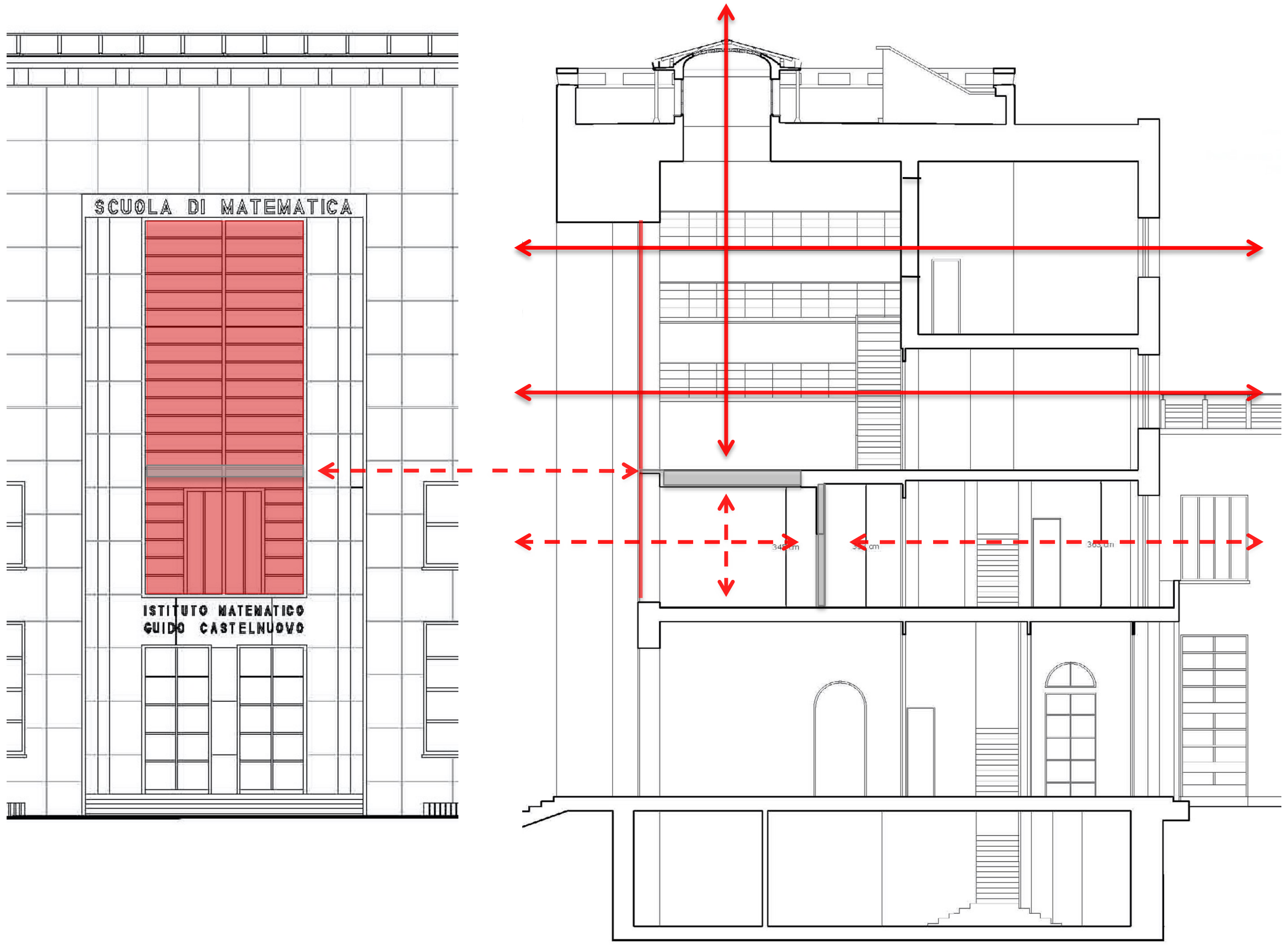


Figure 10 - Visual and spatial axes of the front building destroyed by the addition of horizontal elements, partitions, and the canopy over the skylight (© Salvo 2012)

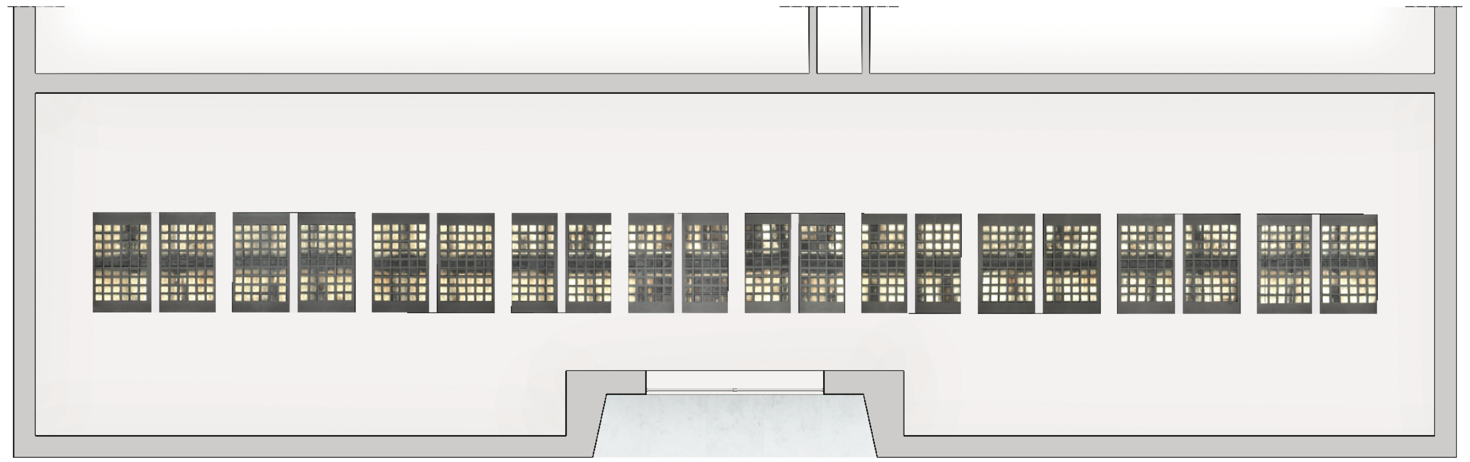


Figure 11 - View from below of the skylight of the library's reading hall before the removal of the canopy (© Salvo 2011)

Figure 12 a/c - Natural lighting in the library reading hall in 1935, in 2011, and today (BBL_pht_30, © Salvo 2011, © Salvo 2020)

Figure 13 a/b - Bottom-up view of the skylight above the library reading hall before and after removal of the canopy (© Salvo 2011, © Salvo 2015)

Repairs were performed between 2013 and 2014. The canopy was removed and the old skylight was painted with a protective material; a fiber-waterproof resin was used for ordinary maintenance, but it was certainly not suited to glass or concrete. In fact, the urgently adopted solution to eliminate serious risks casually overlapped with the removal of the added canopy; although the intent was certainly not to conserve the skylight at its best, the result was apparently very successful as an architectural element.

Speaking in general, the recent work performed on the building has reinstated fundamental spatial values, i.e., perception of the continuity of the glass window and natural lighting in the library. But above all it has provided an opportunity to experiment with space, colors and light, elements that have hitherto been obscured, triggering a process of virtuous re-appropriation between users and the architectural space.

A spark has therefore been lit regarding the re-appropriation of the monument; it will lead to a reconsideration of the real values at stake, no longer merely practical and functional, but also cultural, historical and architectural; this will pave the way for new scenarios and real, feasible conservation work to recover a key part of Ponti's architectural composition by recreating the triple height of the library.
This process of aesthetic and scientific re-appropriation has laid the groundwork for another step in the process, i.e., to reconsider the stained glass window that once adorned the main façade, not only as a work of art and source of light for the library, but also as a key element of the architectural composition.

These are the important premises behind the virtual display of the original image of the stained glass window that was "staged" in November 2017 for the 80th anniversary of the University campus, well before the celebratory context of the current 'Ponti Revival'. The idea to try and reconstruct this object did not involve simply materially recreating the artistic stained glass window built in 1935- which would be impossible and

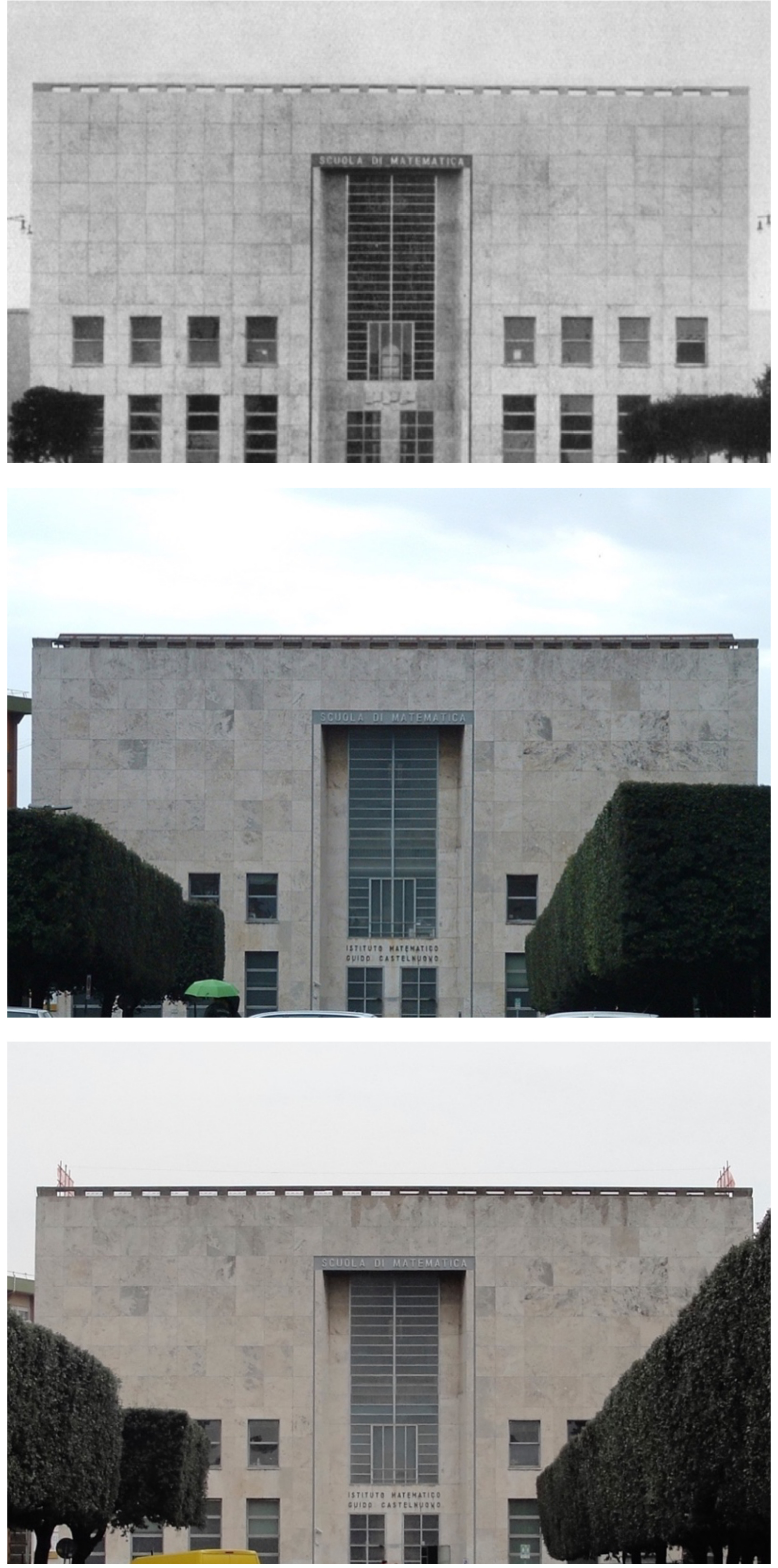


Figure 14 a/c - Main view of the front façade in 1935, before and after removal of the canopy over the skylight (BBL_pht_26, © Salvo 2011, © Salvo 2015)

Figure 15 a/b - The skylight of the library reading hall before and after removal of the canopy; view from the rooftop (© Salvo 2010, © Salvo 2015) rather anti-historical- but proposing a "critical hypothesis turned into an action"; the idea was to trigger awareness about its ephemeral existence. The initiative, developed within the "Master in Lighting Design" and part of the Industrial Design course, was inspired by the idea to project the image (1:1 scale) of the stained glass window directly onto its original metal frame on the façade. For a few minutes, in the evening between November 23 and 24, 2017, the effect of the transparent, colored surface was revived, an event emotionally shared by the public[1].

Although, the building is protected ope legis since 1985, as well as by the explicit decree issued in 1989, in actual fact Sapienza's institutional executive offices, administrators, and technical managers have not yet acknowledged this fact. The School of Mathematics instead deserves to be considered an authentic gem of Modernist architecture and a 'Pontian' masterpiece *ante litteram*.

Figure 16 - Virtual re-enactment of the original stained glass window during the performance on the night of November 23, 2017 (© Lanzetta 2017)

NOTES

1. "Pontian" is a term coined by Gio Ponti's eldest daughter Lisa; see Licitra Ponti 1990.
2. The Institutes of Chemistry and Physics had been moved to newly-built premises in via Panisperna, the former in 1872, the latter in 1880; both moved to the University campus in 1935 in the new buildings designed for that specific purpose.
3. A very recent history of the library has been written by the former director Lucilla Vespucci (from 1983 to 2012) and the current director Maria Rosaria Del Ciello (since 2019), interviewed in 2019. Information reported here also refers to Piccolomo, Vespucci, 1993.
4. This section of the research dedicated to interiors, furniture (fixed and mobile), and inner doors, was performed in October 2019; it established a list of furniture items present in the building according to their design, manufacture, and date of production. This task was hindered by the onset and continuation of the Covid-19 pandemic which meant that it was difficult to access the rooms, and especially the professors' offices; nevertheless, target inspections were performed between June and December 2020.
5. This system of identification is further described in Chapter IV.
6. This part of the research is described in Chapter V.
7. Minerva, the goddess of Wisdom, in Italian 'Sapienza'.
8. Both interventions were carried out by the Istituto Centrale per il Restauro (Central Institute for Restoration) of the Italian Ministry of Culture. The first was directed by Giuseppe Basile (Basile 1997), the second by Gisella Capponi with Marina Righetti of Sapienza University (Billi, D'Agostino 2017).
9. The first fundamental survey of Sapienza's historical archive dates back to Mitrano 2008, followed by Ciucci, Lux, Purini 2012, Nigro Covre, Carrera 2013, and recently Baratelli 2019.
10. They include the destruction of the 'Casermetta', designed by Eugenio Montuori and Gaetano Minnucci, to make room for the construction of the General Services Center, based on a project by Stanislao Chiapponi and Alberto Clementi in the late Seventies. This first demolition, however, made it possible to explore the newly-designed buildings on campus, before assessment of the historical value of the ensemble; see Guidoni, Regni Sennato 1985 and Regni, Regni Sennato 1986.
11. Between the Eighties and Nineties drastic interventions were performed, i.e., the replacement of the original iron-window frames of the Institute of Botany, and the downsizing of the Museum of Mineralogy to create space for teaching.
12. In 1935 there were 20,000 students enrolled in Sapienza University, in 1985 they had increased to 200,000, while today there are about 115,500 students; the current trend is towards further reduction.
13. The Protection Bond was issued on August 2, 1989 by the Ministry for Cultural and Environmental Heritage, Superintendency for Architectural Heritage and Landscape of the Region Lazio, Ministry of Culture.
14. The discussion was fueled by Ruth Ben-Ghiat who rhetorically posed the issue: "Why has Italy left its fascist monuments where they are without discussing them, while the United States has started a controversial process of dismantling the monuments of their confederate past, and France has got rid of the streets that bore the name the collaborationist Marshal Pétain?"; Ben-Ghiat 2017.
15. In light of this research, one can imagine several alterations to the projection proposed for this performance, not least the fact that the images projected onto the window could be seen inside the library during the day, but rather vice versa, as in 2017. This and other notes developed *a posteriori* based on the philological interpretation of the building were made possible thanks to survey, archival research, and direct observation.

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III. THE STORY OF THE BUILDING, 1932-2021

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REDISCOVERING THE BUILDING

Alberto Coppo

The project for the School of Mathematics in Rome represents one of the most interesting architectural achievements in Gio Ponti's architectural work. The project not only witnesses his participation to a central episode of the early Twentieth Century, but also qualifies his undisputed ability to propose an original vision of modernity in architecture[1]. Still, genesis and development of the building's design, and the sequence of changes that led from its conception to its current condition hide many aspects that have not been clarified completely between the folds of the current narrative, and that deserve to be discussed in the light of this research.

However, some issues remain open. Among many, Ponti's role within the artistic direction of the building site, during the final steps of the design process and on the construction site of the building still cannot be framed precisely. On the other hand, the true weight of the CERUR[2] cannot be measured within the solution to a myriad of technical and administrative issues- e.g. the characteristics of the land and the expropriation of the areas involved- that threatened the completion of Ponti's architecture on several occasions.

Research work has therefore consisted in a patient reconstruction of the dense chronology of every single step of the design process that determined the project first and the construction site after, also taking into consideration the role played by the academic community of the mathematicians.

Ponti's very rare and laconic words about this project, except for brief but significant hints in "Amate l'architettura" (Ponti 1957a, p. 56), do not help the historic reconstruction while very little attention has been paid to this work within the main books dedicated to the Master after his death.

Indeed, most of the literature about Ponti has been long concentrated on other of his works, especially those after World War II, and only recently attention has been paid to a broader and more complete consideration of the master's work in the 1930s and 1940s, marginally including the School of Mathematics[3].

The historical context in which the building was conceived certainly doesn't help a serene critical appreciation of this work: propaganda of the fascist regime about the political and cultural meaning of the university campus, to be considered as a wide scale display of public progress and legitimation of the fascist state ideology, has stood for decades in the way of thorough critical studies[4]. Finally, the collective authorship of the entire operation does not help to exactly identify individual contributions and merits, as specific responsibilities.

The first part of this chapter pieces together the threads of the history of the School of Mathematics, from conception to achievement at the end of 1935, when Ponti gradually left the scene although the building, albeit inaugurated, had not being yet completed; the second one proposes a synopsis of the various stages through which the School of Mathematics has reached its current consistency. The construction phases have been identified investigating and cataloguing the precious archival sources stored in Sapienza's historical archives, considering every single advancement of the construction site stated by the payments of the contractors and suppliers responsible for the construction of the building, while the analysis of the architectural elements has been carried out comparing the Special Tender Specifications with the current condition of the building.

The comparison between the original project and the current state of the building evidence that the power

Figure 1 - The right-side elevation of the building in 1935; detail of the junction between front building and curved wings (ACS_pht_08)

Figure 2 - First Montecatini Building, Milan, Gio Ponti, 1936; detail of the junction between with the adjacent Palazzo Valentino (© Cortesi 2019)

of Gio Ponti's design, consisting in the spatial crossings along longitudinal, transversal, and vertical axes, and in the junctions between the three main bodies of the building- front building, curved wings and tower- (Figures 1-2) has suffered a consistent alteration and loss of significance due to the many additions and extensions that have interrupted the visual continuity. The extension of the curved wings (1974–1980) for example, has highly compromised Ponti's original idea of creating volumes 'as crystals', which cannot be extended or modified: according to Ponti «an architectural work is a finite form, which cannot be overcome or enlarged, nor changed» (Ponti 1957a, p. 51).

In a changing context such as that of the university campus, which has coped with the need for space and with continuous functional adjustments in relation to the growing number of students and staff, the School of Mathematics appears to be one of the buildings that has suffered most.

ROME’S NEW UNIVERSITY CAMPUS

Alberto Coppo, Simona Salvo

“As we all know, this district was earmarked for greater development compared to others. It envisaged the construction of the spacious via Nomentana and establishment of the Polyclinic, as well as the project for the future university campus. This ensures the exceptional development of the whole area, which must be carefully regulated” (Sanjust di Teulada 1908, pp. 32-33)[5].

These three interesting reasons are provided at the beginning of the observations contained in the report about Rome’s new Masterplan (1908) (Figure 1). Firstly, they illustrate the key role of the area between via Nomentana and via Tiburtina that was included in the development plan of the Capital as part of the expansion of the city to the east and towards the hills; in the decades to come, this area was the one that grew the most, both in terms of town planning and urbanization[6]. Secondly, they reflect the nature and function immediately assigned to the area, i.e., a “city of knowledge and science” that included medical sciences (Polyclinic) and scientific-humanistic knowledge (university campus); these functions are still acknowledged today (Spano 1935, pp. 135-141). Finally, the idea that “the development (ought to be) carefully regulated” reveals the legislator’s awareness that several stakeholders, such as the university, the army, and real estate speculators, all had their eye on the land in question.

The total land area where the university campus was to be built between 1932 and 1935 amounted to roughly 210,000 square meters, situated between viale del Policlinico, viale Università, viale della Regina, via dei Ramni, viale dei Battaglioni Universitari and Piazzale di San Lorenzo. It was an extremely coveted lot destined to be used in many different ways between 1908 and 1930 when Mussolini chose it as the site of Rome’s new university campus. The land in question was traditionally considered a site for military maneuvers, but in the space of twenty-five years its use was to change to accommodate the university (Di Marco 2012, Di Marco 2016) and residential housing units (mainly terraced houses)[7] .

In fact, several projects that were part of the numerous Master Plans of Rome- the 1909 Master Plan, the General Variation to the 1925-1926 Master Plan, and the 1931 Master Plan- as well as several exponents of the Roman architectural scene concentrated on the development of this part of the city for quite some time. The reason for their interest is the strategic role that this area played in the development of the city: its proximity to the Termini Railway Station, the Polyclinic, the area of Castro Pretorio with its military barracks, and the Verano cemetery, not to mention the fact that it represented the key to the future urban expansion of the Capital[8].

The completion of viale della Regina in 1926 was meant to connect the Verano cemetery area to the residential district of San Lorenzo, built between 1870 and 1930, and to the new “Nomentano” and “Salario” districts built along the consular roads. This new link between via Nomentana and via Tiburtina shaped the north-east edge of the area earmarked for the university campus, further increasing its importance and urban value. In the plan designed by Marcello Piacentini in 1916 and again in 1925 (Ciucci 2010), this new avenue also served as a border, a wide green belt acting as a “green lung” between the old city centre and the urban expansion eastwards.

The land in question was considered a link between the barracks in Castro Pretorio, the pavilions of the Polyclinic to the north, and the residential settlements in the S. Lorenzo district to the south. It was a sprawling uncultivated field used for military exercises[9], and a true urban void with irregular borders. The aforementioned viale della Regina to the north-east was one of the very representative avenues in the city and a sym-

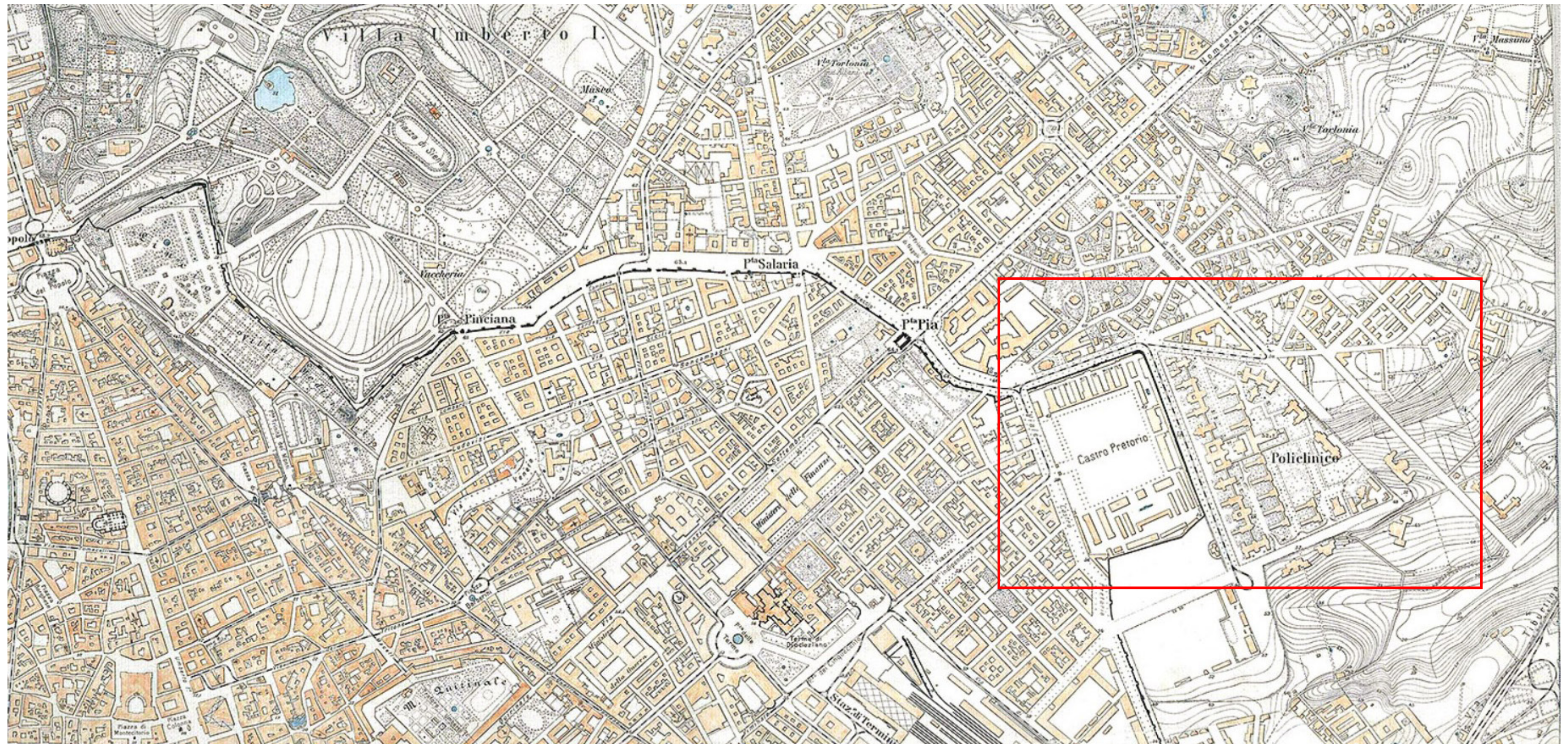


Figure 1 - Map of Rome and the suburbs issued by the Military Geographical Institute, 1907-1924; the rectangle highlights the area where the university campus will be built about ten years later, in 1924

bol of modernity in the Twenties; in the decades that followed many medical institutes were built along this road. Viale dell'Università to the north-west was the only direct link to the old city. The area to the south-east had a less distinct boundary: on one side an artificial hill hid the view of the Verano Cemetery, on the other the newly-built viale dei Battaglioni Universitari, completed with great difficult due to the complicated expropriation of the lots and the construction of unauthorized residential buildings. Finally, the south-west border was the most important: it represented the main monumental entrance to the campus, at that time well represented by the propylaea designed by Arnaldo Foschini.

The final urban plan was a huge compromise. In the first project (1907), the lot was much wider and extended for a considerable stretch in this direction; the university buildings were to be built in this area, all the way to Castro Pretorio. However, the temporary suspension of the first urban plan, and the construction of the Ministry of Aeronautics in 1930, significantly reduced the size of the area. This new area was subsequently adopted by Piacentini for his plan dated 1932. Furthermore, the failure to establish exactly how this area was to be used, and the fact it lay empty for twenty-five years (between the first plan in 1907 and the final one in 1932) led to the construction of informal (and unauthorized) residential buildings for about two hundred families.

In addition, the ground between viale della Regina, viale dell'Università, via del Policlinico and via dei Ramni, varied enormously in its level, rising in the middle and then rapidly decreasing; the deep hollow in the area later became Via Cesare de Lollis. The soil was partly volcanic and partly crossed by strata affected by underground water courses, i.e., a network of cavities and tunnels (Dell'Aglio, Emmer, Meneghini 2001, p. 63).

All the buildings, except for several temporary ones, were to be built in the central part of the lot. Several buildings were already present along viale dell'Università; they had been built as an addition to the plan of the adjacent Polyclinic, i.e., the buildings housing the Forensic Medicine department, the Psychiatric Clinic, and the Anatomy and General Pathology departments. The residential buildings along via dei Ramni, again built without respecting the Master Plan, were also present in the area where the School of Mathematics was to be built.

Therefore, after Mussolini's request, Piacentini began to design the urban plan for Rome's new university campus. Although the area was strategic from an urban point of view, it had unresolved relationships with the neighboring districts, being a more-or-less residual space in rather consolidated, built portions of the city.

Furthermore, the fact so many stakeholders fought over the redesign of this area was because it represented the fast track to becoming leaders of the cultural and political environment in Rome between 1910 and 1930. It is not surprising that Gustavo Giovannoni and Marcello Piacentini invested all their energy in this struggle10. Piacentini's 'unitary solution' - to design a city within a city, closed but not separate - consecrated him as the most skilled architect capable of designing and qualifying such a vast area. Yet from an urban standpoint the project was not connected to the Central Railway Station (Termini), something that was later emphasized in Angiolo Mazzoni's project. Piacentini was forced to drop the idea of building an entrance road that would have boosted the urban plan and flawlessly connected the Rector's Office and the whole campus to the station and the rest of the Capital, reflecting the modernity and development of the new-born Italian Nation (Figures 2-3).

Figure 2 - Detail of the university campus site around 1924, with contour lines and pre-existing structures the location of the Mathematics building is shown in red (© Cortesi 2021)

Figure 3 - Aerial view of the university campus site during construction in 1934 (ICCD_pht_08)

CONCEPTION AND CONSTRUCTION OF THE BUILDING
Alberto Coppo

THE IDEA OF A BUILDING FOR MATHEMATICAL STUDIES

The decision to establish a seat for the "School of High Mathematics"[11] dates to the late 1920s and culminates, under Guido Castelnuovo's scientific authority, with a project dated March 1928 (Azzaro 2012, pp 79-80) for a building located between via Panisperna and via Milano, formerly the seat of other scientific institutes, such as the Institute of Physics and the Institute of Chemistry[12] (Figure 1).

This project is a first interpretation drafted by the Civil Engineering Corps of Castelnuovo's functional program (ASR_dcm_01) and contains in nuce the basic architectural elements developed four years later by Ponti. Two floors with a meeting hall of 100 seats, plus a second hall with 50 seats; a waiting room for professors, a large room for the library with related reading rooms, from 8 to 10 rooms for professors and collections of models, presumably for geometry courses. The project for a small building, about 400 square meters, characterized by an architectural layout free from any formal refinement, more similar to the pavilions of the Polyclinic than to a School with its own specificity, is therefore envisaged (Figure 2).

In 1932, on the other hand, when the project for the Royal University of Rome starts in the area designated by Mussolini, the previous program is extended. Castelnuovo requested the construction of a new building which would not only house the teaching of "Pure Mathematics", but also preparatory classes to the second two-years course for students of other disciplines, and, above all, large classrooms dedicated to the School for Geometric Representation.

These requests mark the first step towards the enfranchisement of Mathematics from the School of Engineering, which was housed outside the new university campus. In search of disciplinary and architectural identification within the university, Castelnuovo wanted Ponti's project to highlight the primary role of Mathematics in the framework of a renewed scientific background to the 'integral architect' conceived by Giovannoni to be the outcome of the course in architecture of the newly founded School of Architecture of Rome.

Moreover, a significant difference with respect to the 1928 project is undoubtedly the conception of a large library- more than one hundred thousand volumes are explicitly mentioned in the catalogue- to allow the separation of the book collection of the Institute of Mathematics from the one of the School of Engineering in San Pietro in Vincoli. In Castelnuovo's and Bompiani's vision, the new library became the centre for mathematical research of the Roman and Italian schools, as well as the true symbol of an academic identity sought by the mathematicians since the first studies of Luigi Cremona at the end of the Nineteenth century (Dell'Aglio, Emmer, Meneghini 2001, pp. 56-57). For this reason, Castelnuovo requested that the rich library of the Italian Society of Sciences- known as the "XL"- be transferred to the new institute due to its high scientific value. The achievement of a large library also had the advantage of largely supplanting the very distant library of the Accademia Nazionale dei Lincei (ASS_dcm_02).

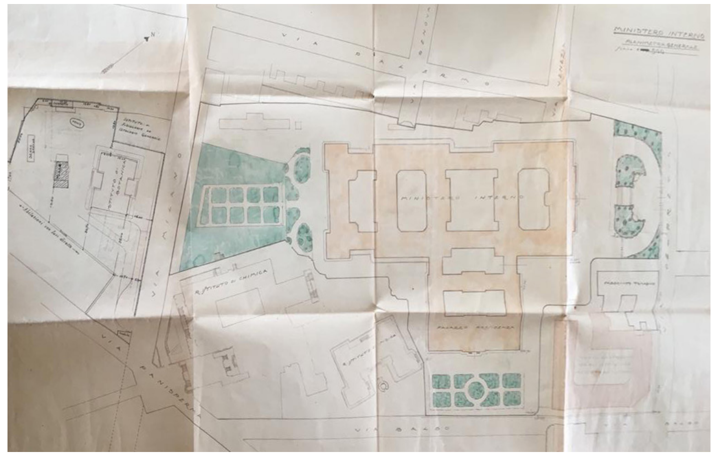


Figure 1 - Preliminary urban plan for the new buildings for the Science Institutes of the university within the area of via Panisperna, 1928; the building destined to the School of Higher Mathematics is in the lower right project (ASR_drw_01)

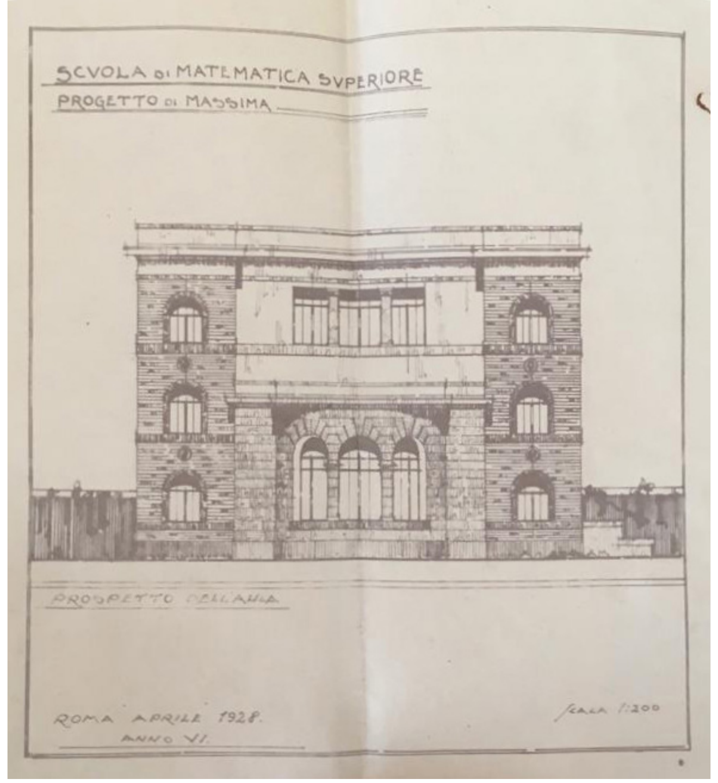


Figure 2 - Preliminary project for the School of Higher Mathematics to be built in the area of via Panisperna, 1928 (ASR_drw_03)

PONTI'S WORK AND PIACENTINI'S CONTRIBUTION

Piacentini's timely work within the CERUR demonstrates the deep interest of the fascist regime for the wide and ambitious urban and cultural operation that stood behind the project for a new university campus (Nicoloso 2006). Ponti's direct involvement in the design process has been widely debated by critics, who have recognized him authoritative role of the elegant and modern review "Domus" and the refined intellectual engaged in directing the Milan Triennale (Pica 1941, p. 127). Ponti's conciliatory character, innovative creativity, attentive to the definition of an Italian architecture of classical matrix, defined the terms of his alliance with Piacentini in the discussions that could arise in the group of architects committed around the design of the buildings (Mornati 1992, p. 345).

Not only the relationship with Piacentini, in the early 1930s, is to be considered more than cordial for the clear attitudinal similarities in conceiving the role of architecture and urbanism: even more important was the common friendship with art critics Ugo Ojetti and Margherita Sarfatti[13]. A positive element, in addition, was the professional collaboration between the two, experimented at the Palazzo delle Corporazioni in Rome- designed by Piacentini and Vaccaro in 1928 and inaugurated in 1932- where Ponti designed the furniture and the lighting fixtures, flanking Mario Sironi and Pietro Chiesa committed with the design and production of the huge stained-glass window[14].

As other architects of the university campus, Ponti received Piacentini's letter of commitment on April 14, 1932, which effectively marks the beginning of the assignment and clearly established the key points of the program (ASS_dcm_04). At the time, Ponti was also known for his role as a cultural promoter- between the Monza Biennial and the Milan Triennial, the magazine "Domus" and the daily newspaper "Il Corriere della Sera", where he discussed issues related to private clients and to the decorative arts.

The building for the School of Mathematics therefore represents for Ponti an important test, finally called upon to achieve his first major public work.
The meeting at Piacentini's office in Rome on May 9, 1932, gathered the designers for the first time. The only absentee, Giuseppe Capponi, was made official five days later (Nicoloso 2006, p. 235). The confrontation, described in Piacentini's letter to Rector Pietro De Francisci in the following days, is proactive (ASS_dcm_05). The architects developed several ideas starting from the plan outlined by Piacentini and been approved by the Duce (Regni Sennato 1985, p. 48). Yet, the formal definition of the buildings was still at a preliminary stage, and it was necessary to establish some common elements; no «accentuation of vertical lines, nor horizontal» in order to reach «a serenity and simplicity for an architecture that will have to hold an Italian character and perpetuity». A precious testimony of this phase consists in an undated copy of Piacentini's plan (Di Marco 2016, p. 302) with several pencil sketches and notes, which hypothesize the shape of the buildings (Figure 3).

The Mathematics building, next to the original rectangular plan- identical to Mineralogy on the opposite side – is sketched as a "C" shaped volume with five semi-circular apses. The author of the sketch is unknown, but it is likely that these are result from a comparison among the different designers, who were careful to develop the backdrop of the main "transept" crossing the central court with the statue of Minerva – or 'Sapienza'- in front of the Rectorate. Although the assignment for the project of each building dates July 5, 1932, contextually to the call of Francesco Guidi, Gaetano Minnucci and Eugenio Montuori to join the team of the Technical Office (ASS_dcm_06, ASS_dcm_07), it is likely to believe that Ponti had started working since the meeting of May 9[15]. In that same meeting, in fact, Piacentini also communicated the deadline for the delivery of the projects at the end of August and invited the architects to contact the respective directors of the institutes. The following appointment was the second meeting held in Rome on August 23 and 24, during which other formal characteristics were defined to give some uniformity to the projects. To seal these principles, that should have impressed a classic trend to the overall aspect of the campus, an excursion was organized to the recent excavations of Ostia Antica, in seek of inspiration from the archaeological ruins (Mornati 2002, p. 54).

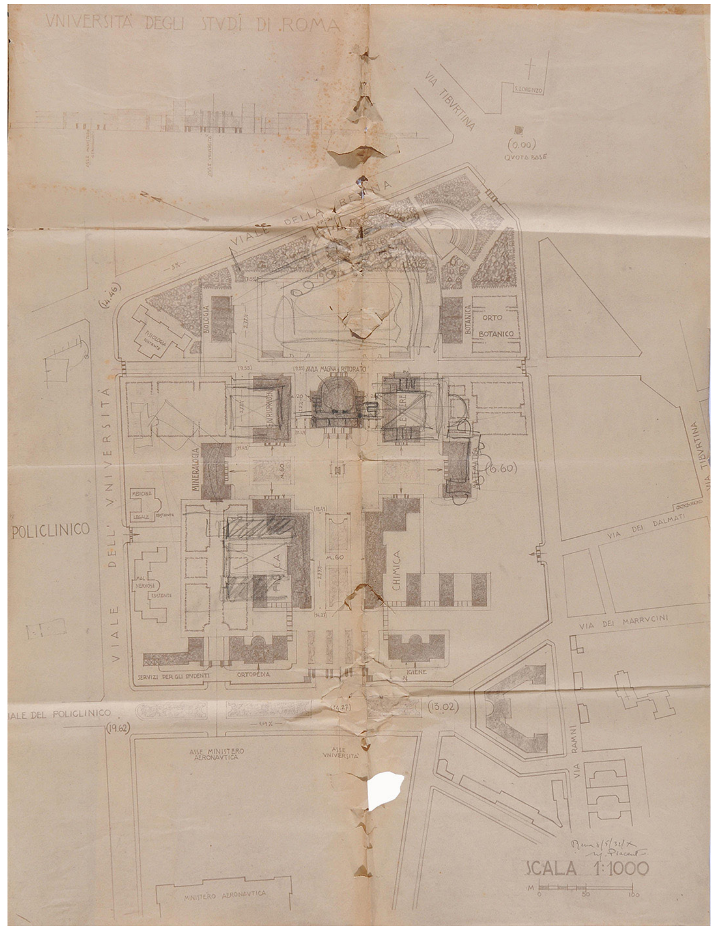


Figure 3 - Preliminary urban plan for the new university campus, May 1932 (ASS_drw_02)

Beyond the two meetings in May and August, there are no other significant dates before the final delivery of the projects on September 30 of the same year.
In the meantime, before leaving the Rector's post to Rocco, De Francisci officially communicated the name of the corresponding architect to Castelnuovo on July 19 (ASS_dcm_08). Almost contextually, on August 12, Piacentini communicates to Mussolini the official beginning of the works for the new campus (Nicoloso 2006, p. 238).

Therefore, the original conception of the Mathematics building developed between May and September 1932, at a crucial moment in Ponti's professional career. The great growth of Milan's upper middle class and its aspiration for self-representation made him a very sought-after architect, as he was able to elaborate refined domestic environments formally and typologically in a modern style. The achievement of the ideas expressed in "Domus" and within the "typical houses" attracted attention beyond Milan, while the association with Emilio Lancia, started in 1922, was beginning to loosen. Thus, Ponti acquired a wide margin of autonomy, and managed this first relevant public commission as an individual commitment. Faced with the decision to entrust several buildings to individual designers, Piacentini instructed Ponti to manage, along with the building for Mathematics, also landscaping, decoration and furniture for the new campus, an assignment, later not confirmed (Ceccherini 1933, p. 595).

The outcome of this design effort, still uninfluenced by the observations made during Minnucci's journey to report about the new university campuses in Europe, and Mussolini's visits to the site, is still unknown; yet a faint trace may be found in a plan dated October 4, 1932 (Figure 4) indicating the cores drilled for the buildings' foundations.

In this drawing, still at an early stage Ponti crystallizes the geometry of the building in its fundamental elements: a front body with a rectangular base, a rear body with a trapezoidal base and two side wings that extend from the latter. The three main parts of the architecture are skilfully connected by a continuous portico which develops along the curved inner sides of the wings, on the heads of the wings themselves (both of which face the central court) and finally on the straight side of the front body, which opens onto an inner space, conceived and a theatre's orchestra.
Ponti designed an architecture made by parts joined by a permeable device to ensure the instantaneous identification of the single volumes and their functions. At the same time, this device, manages to build the space through limited perspectives open to the surrounding space, according to a scheme of transparency used in many other buildings of the University campus. In fact, porticoes will be present also in the following drawings to condition the final design choices, especially in the School of Mathematics (Cerutti Fusco 2003, p. 111)[16].

In this first design solution, the presence of a circular area- and a single focus- in the geometry of the building, starting from the inner central courtyard, is evident (Baratelli 2020), although the same type of theatre was taken by Ponti's personal knowledge of the Vitruvian treatise, and probably also seen in Ancient Ostia (Cerutti Fusco 2003, p. 106).

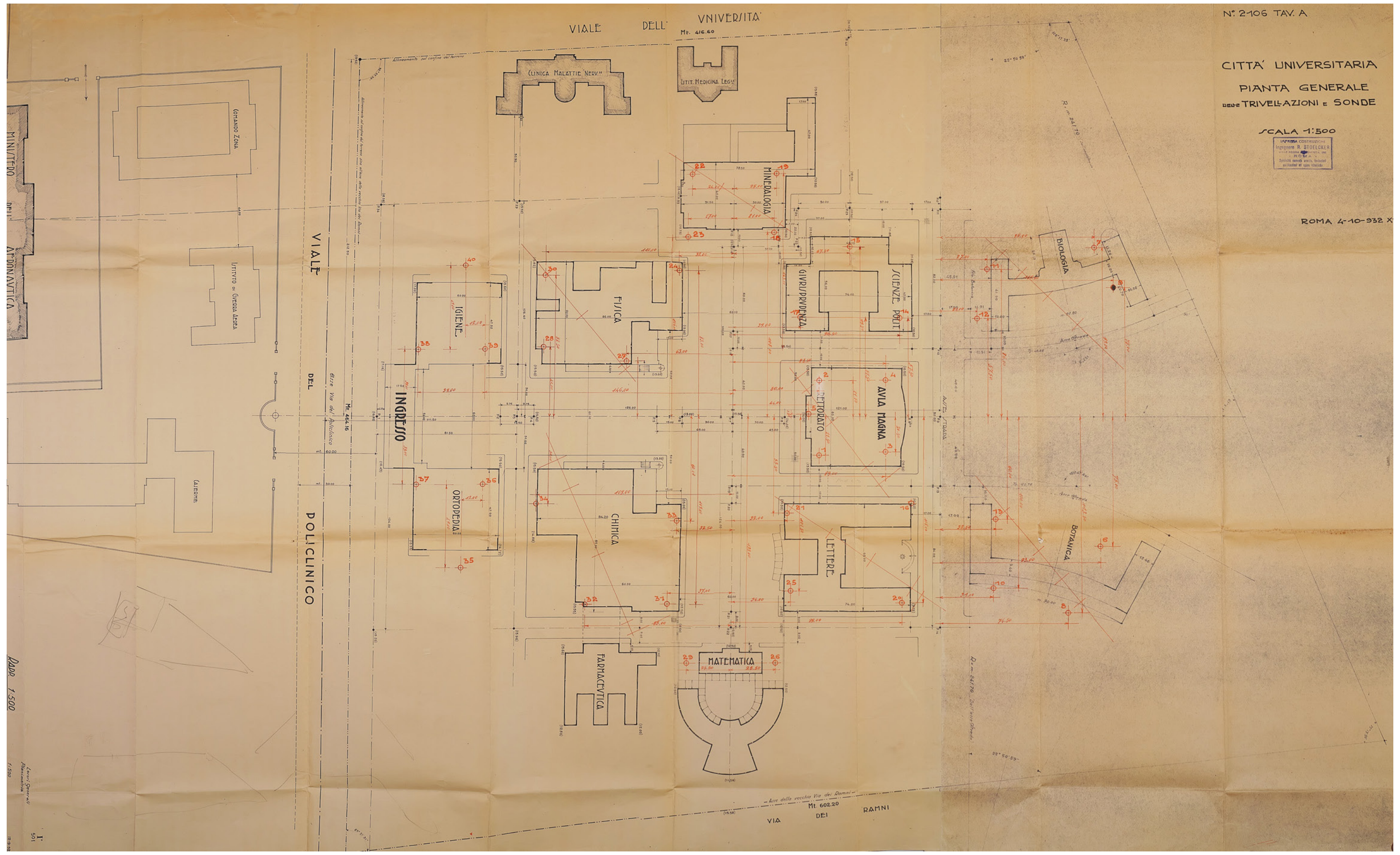


Figure 4 - General plan for the new university campus with localization of geotechnical boreholes and probes to investigate the characteristics of the foundation soil, October 4, 1932 (ASS_drw_03)

GEOLOGICAL SURVEYS

Between July and November 1932, boreholes and drilling tests were carried out in the foundation soil. The contract was committed to the company Stoelcker, able to reach great depth into the ground with pile-beating machines., which undertook most of the drilling works in the area of the university campus in view of the construction of the buildings. At first the company planned to drill poles with 250 mm in diameter to reach the sound and rocky layers of soil, at a depth of about 30 meters, drilling the ground by means of a rotary probe. In September 1932 the two teams engaged in the work were flanked by three other ones equipped with 300 mm tubes to fulfil Piacentini's request of speeding up the work.

In the area assigned to the construction of the Mathematics building, two drillings were carried out: one at a depth of 20.00 meters (No. 26) and one at a depth of 25.60 meters (No. 29) (Figure 5), with pipes of 300 mm in diameter. The results of these surveys lead to the drawing of a geotechnical report, which gathered information about the mechanical behaviour of the soil and identified the most suitable type of foundations (ASS_dcm_10). More specifically, the two surveys carried out in the area for the Mathematics building revealed a layer of backfill with an average thickness of about 13 meters mainly consisting of soil and construction debris of variable ages, rests of a layer of 'cappellaccio' (outcropping rock) and layers of clay of different nature (calcareous and greenish): the first coherent layer was clay, placed at an average depth of 17 meters, which therefore led to the choice of using pile foundations on which to erect the building.

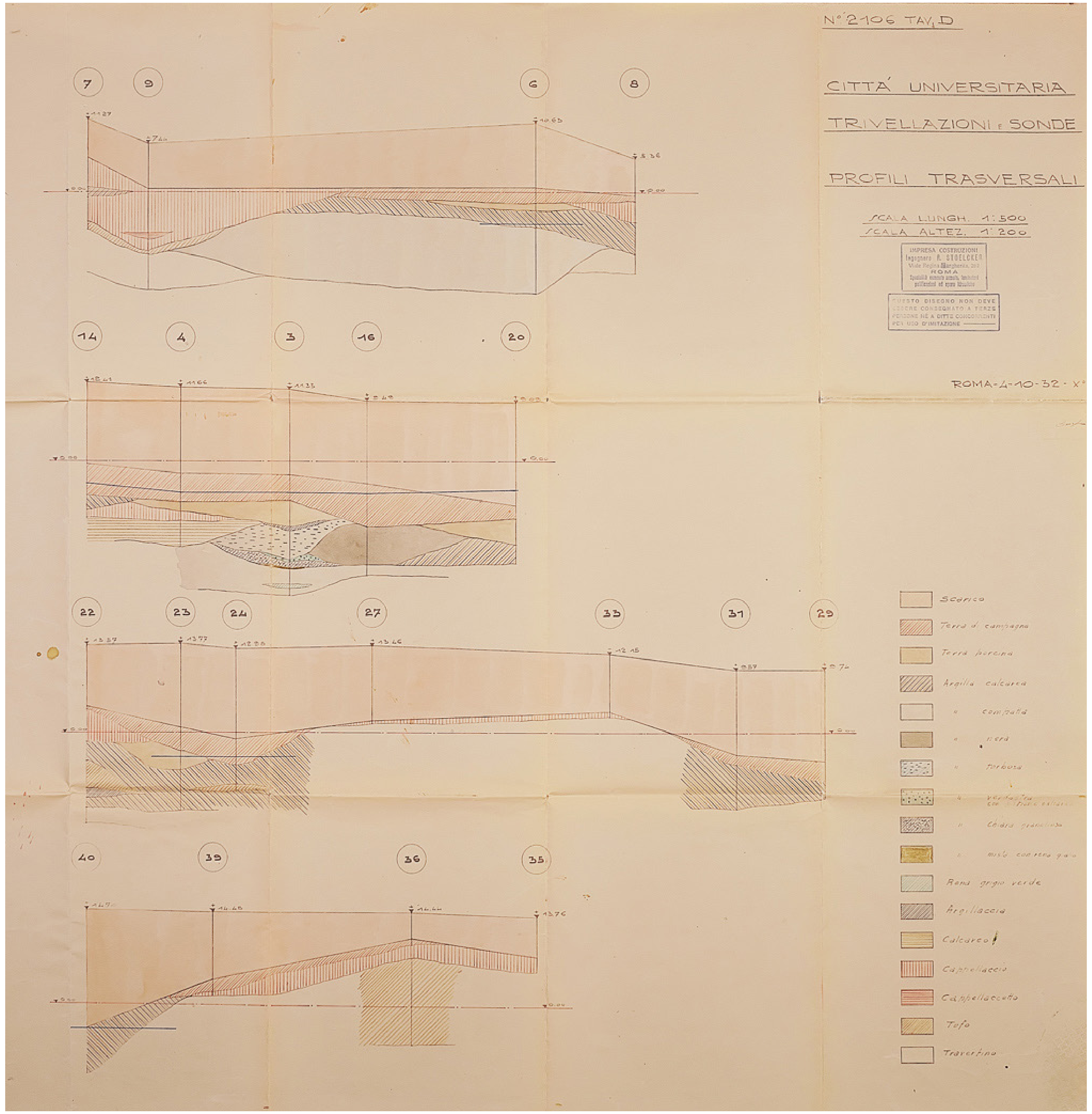
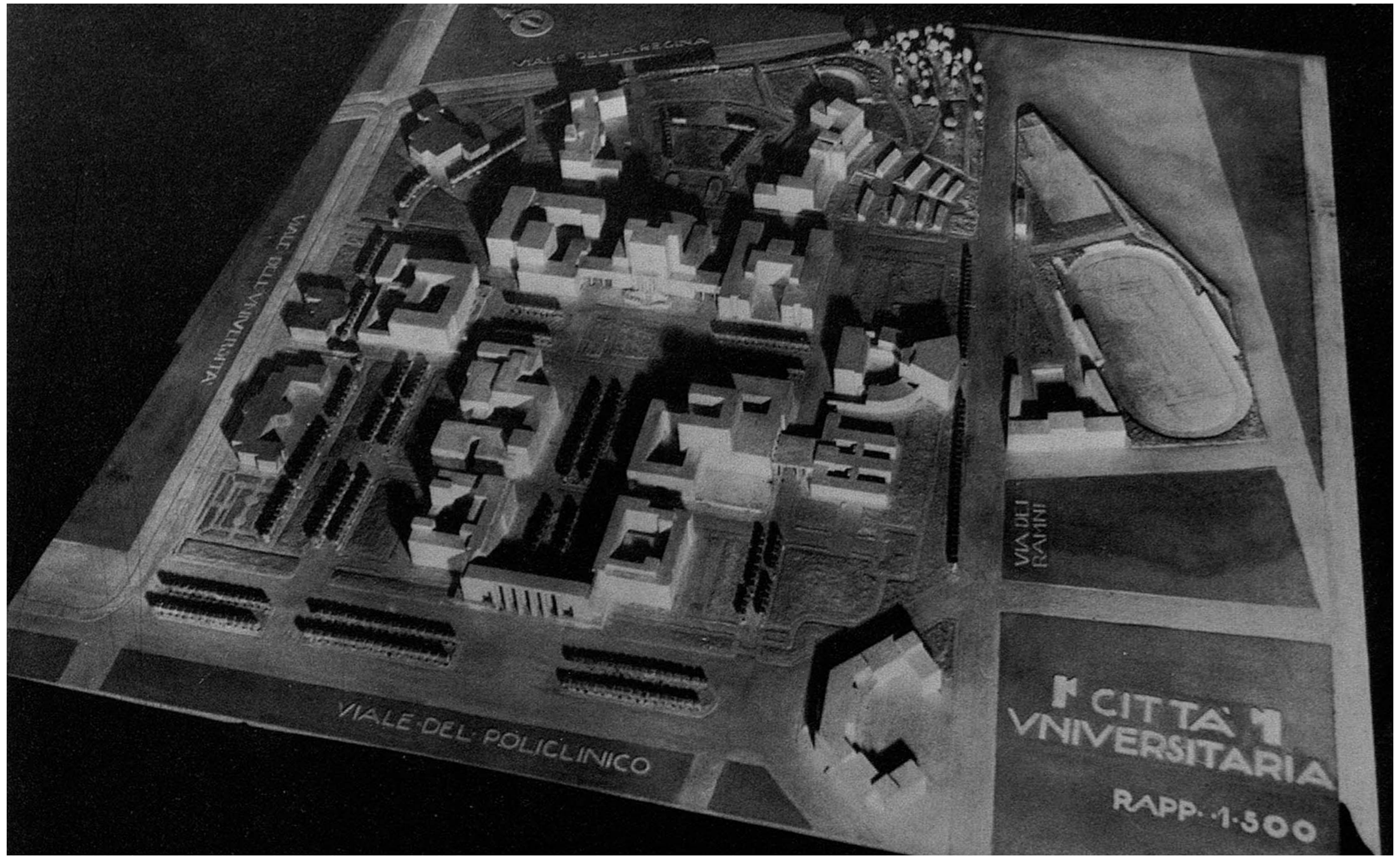


Figure 5 - Soil stratigraphy corresponding to the outcomes of the geotechnical boreholes carried-out in the area of the buildings for Biology, Botany, Law and Political Sciences, Rectorate, Arts and Humanities, Mineralogy, Mathematics, Physics, Chemistry, Hygiene, Orthopaedics, 1932; drawings 23 e 26 are referred to the foundation soil of the Mathematics building (ASS_drw_04)

THE FIRST PROJECT

The first projects were delivered to Piacentini on September 30, 1932, when it was already time to start construction, and with great rapidity the first contracts were signed in view of the inauguration scheduled for April 21, 1935. Yet, during the winter months there were delays due both to bureaucratic difficulties in the approval of some projects by the Civil Engineers Commission of Revision and Trial (ACS_dcm_11, ACS_dcm_12) and to the intense debate developed around the conditions of the soil and the correct foundations to be used. The unexpected time extension probably offered Ponti the opportunity to correspond extensively with Castelnuovo and Bompiani. Exchanges between the three led to some changes in the project that caused strong protests by Rector Rocco towards the middle of October 1932, worried by the «predominance of aesthetic reasons over functional ones» (Dell'Aglio, Emmer, Menghini 1999, p. 65). The changes are not described, but Ponti probably pushed to build large spaces and refined claddings in valuable materials, incomparable to those indicated by the other designers[17]. Whether the designer's intentions were fulfilled or not is impossible to know, but the changes are evident in view of the presentation of the plan for the new campus to Mussolini and to the international press on December 19, 1932. The perspectives that flank this first model[18] (Figure 6) report the final layout of the building with features later abandoned. In one of these perspectives (Figure 7) Ponti's building shows the main façade enriched by a pilaster portal on three levels and completed on the sides by a system of frames that unite the main body to the Letters building and to the Chemistry building.



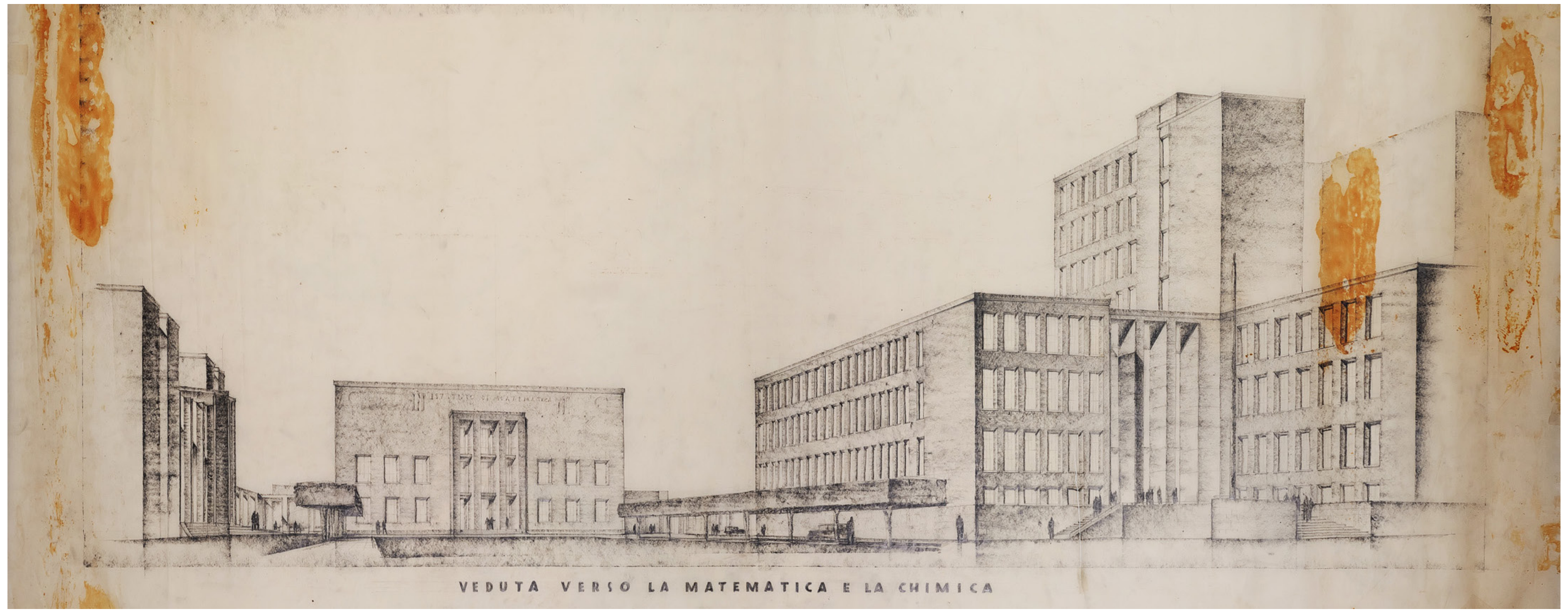
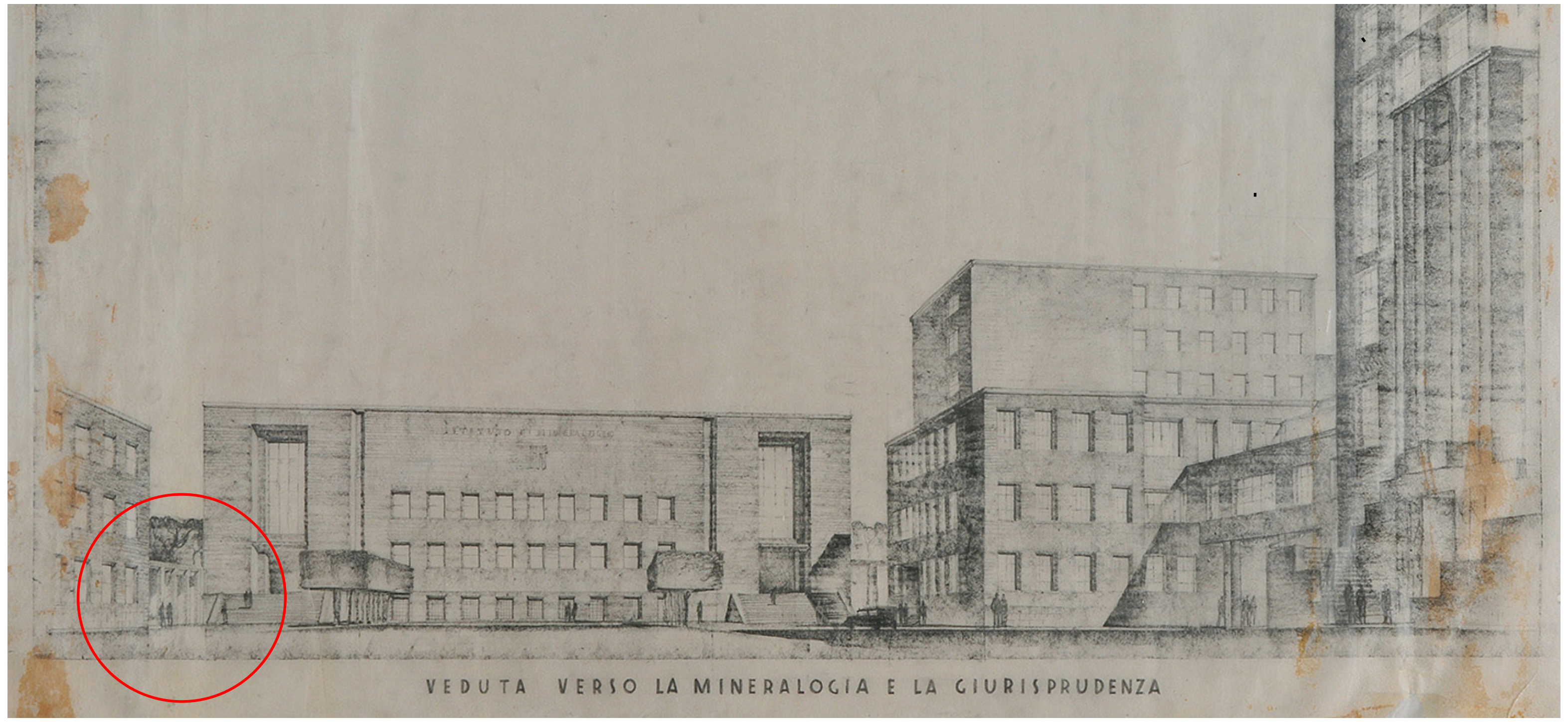


Figure 6 - First model for the new the university campus, December 1932 (BBL_pht_02)

Figure 7 - Perspective illustrating the project for the new university campus: view towards the Mathematics and the Chemistry buildings, December 1933 (ASS_drw_11)

The use of a large portal on the facade will acquire strength in following projects by Ponti, first the Liviano (1934), the Palazzo del Littorio (1934) and the Ministry of Foreign Affairs (1939); and the pillared portico will also be present in the project of the Nursery School and Counselling Centre in Bruzzano (1934). But, while in the latter Ponti mainly exploits the permeable function of the elements, which ensure visual contact with nature, the "portico frame" within the university campus is instead a pivotal element that connects several buildings together, delimiting without closing the entire area of the central square focused on the statue of Minerva (Figure 8).

Although the interplay solution will be later abandoned, it can be assumed that this was Ponti's first choice, which reminds of the trilithic system often used in his building of the 1930s, from the penthouse of Torre Rasini (1933) to the elevation of the Marmont House (1935) in Milan. In addition, in December Gaetano Minnucci presented his report of a three-months trip around university campus of Europe, to offer an "update". Leafing through the pages of this impressive report, the elevation of the Dresden Polytechnic catches the eye (Figure 9): a large vertical window appears in the entrance hall, although the light illuminates the stairs leading to the classrooms and not a large hall. Considering the design of the Granelli Pavilion in Milan (1933), the change in the conception of the entrance of these same months is not surprising: Ponti decides to "excavate" the façade in order to obtain a tall rectangular niche framing a polychrome stained-glass window (Cerutti Fusco 2003, pp. 114-115) later designed and given to Fontana Arte for production[19].



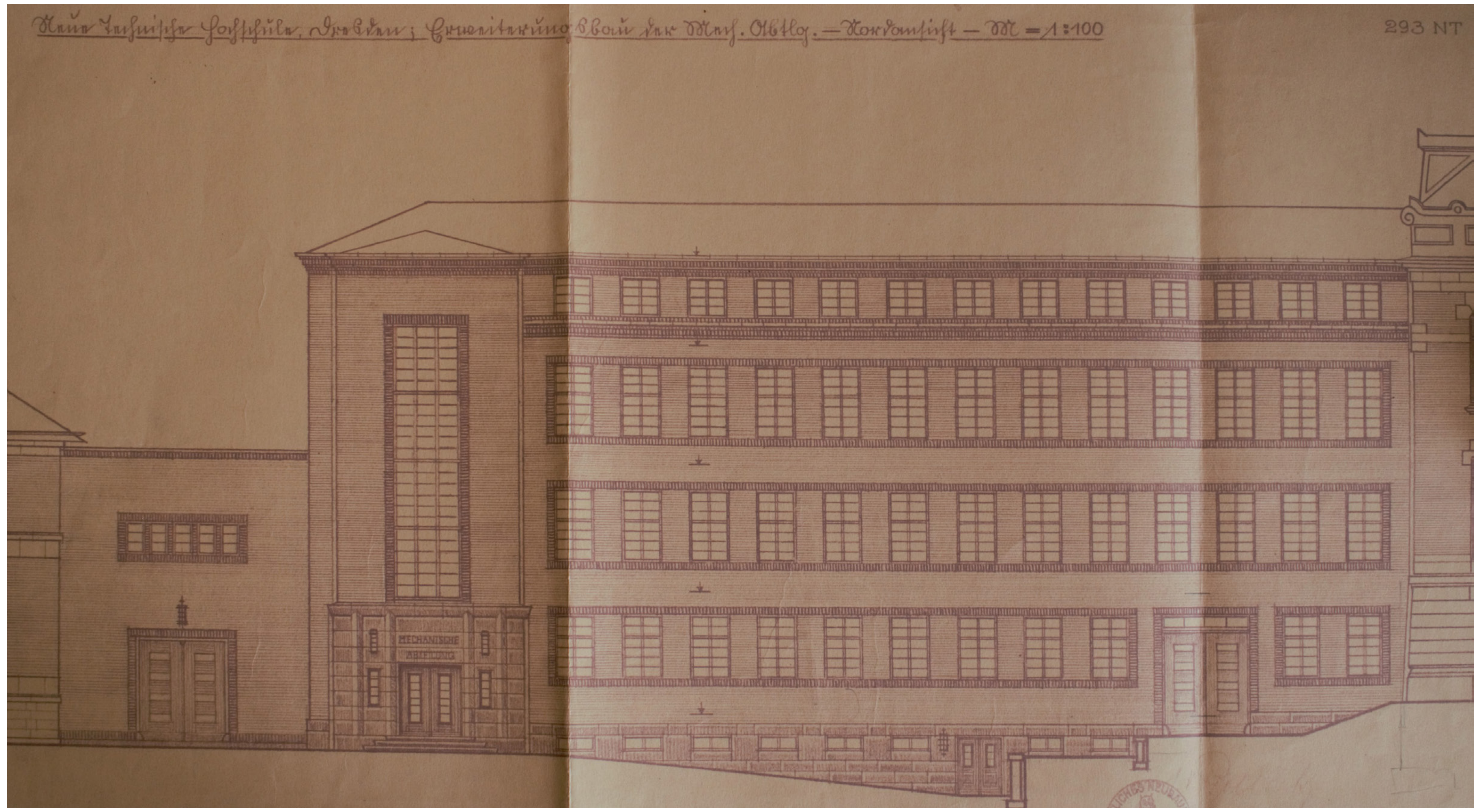


Figure 8 - Perspective illustrating the project for the new university campus: view towards the Mineralogy and the Law buildings, December 1933 (ASS_drw_10)

Figure 9 - Elevation of the new extension of the "Neue Technische Hochschule" of Dresden Polytechnic, 1929; the drawing was part of the preparatory report drafted by Gaetano Minnucci to illustrate technical advancements in the achievement of European new university buildings, 1932 (ACS_drw_09)

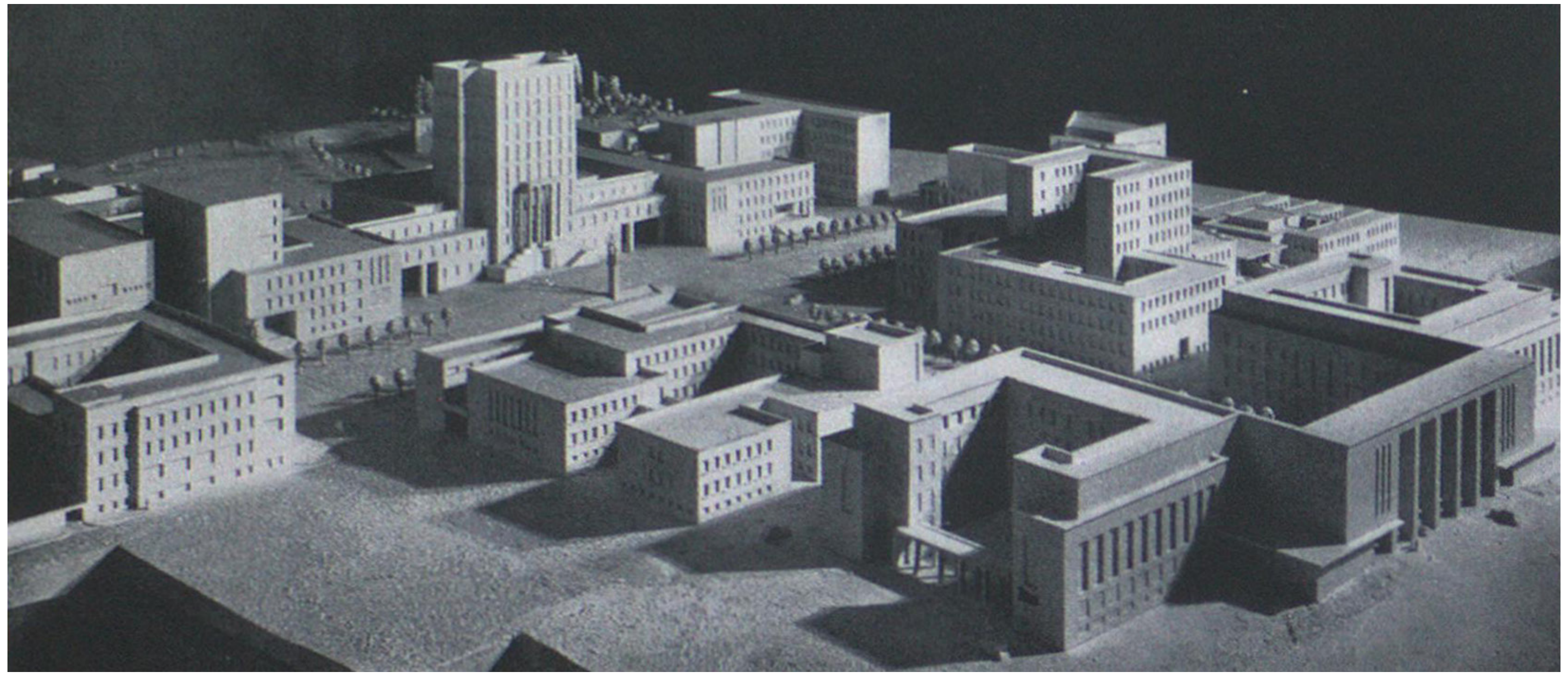
1933, A YEAR OF STASIS

The beginning of the year opens with a controversy fuelled by Ugo Ojetti on the formal characteristics of the new university campus, that he believes to lack in the Italian character obtained by the abandonment of arches and columns. The open clash with Piacentini is followed with deep interest by Ponti, as this debate represents a point of no return for the definition of a national modern architectural language. In an impassioned letter dated March 6, 1933, Ponti defends his work and that of his colleagues, espousing Piacentini's vision in favour of a simplified classicism, worthy of giving life to a modern style featuring fascist Italy (GNAM_dcm_01).

Engaged on the front of the fifth Triennial in Milan between December and March 1933 (AST_dcm_01) and active on the front of the competition for the railway station in Florence (Nicoloso 2018, pp. 144-146), Ponti elaborates new solutions in view of the upcoming visit of the Duce. Meanwhile, in February the company Ferrobeton signs a contract for the construction of the foundations of the School of Mathematics, to be started within the month of the following July (ASS_dcm_17).

Mussolini's visit to the construction site on March 11, 1933[20] probably represented the most important test for Piacentini and his collaborators.
Observing the new model (Figure 10)[21], the Duce had the opportunity to admire the progress of "his" architects, and to approve the final layout, urging the executive works which had remained at a standstill. This is a true turning point as it represents the "first final version" of the project, which will obtain great success on the art reviews of the time.

In the 1933 model, the School of Mathematics (Figure 11) shows substantial differences from the previous version. The connective porticoes that circumscribe the large central square of the Minerva have disappeared, while two permeable diaphragms, placed on



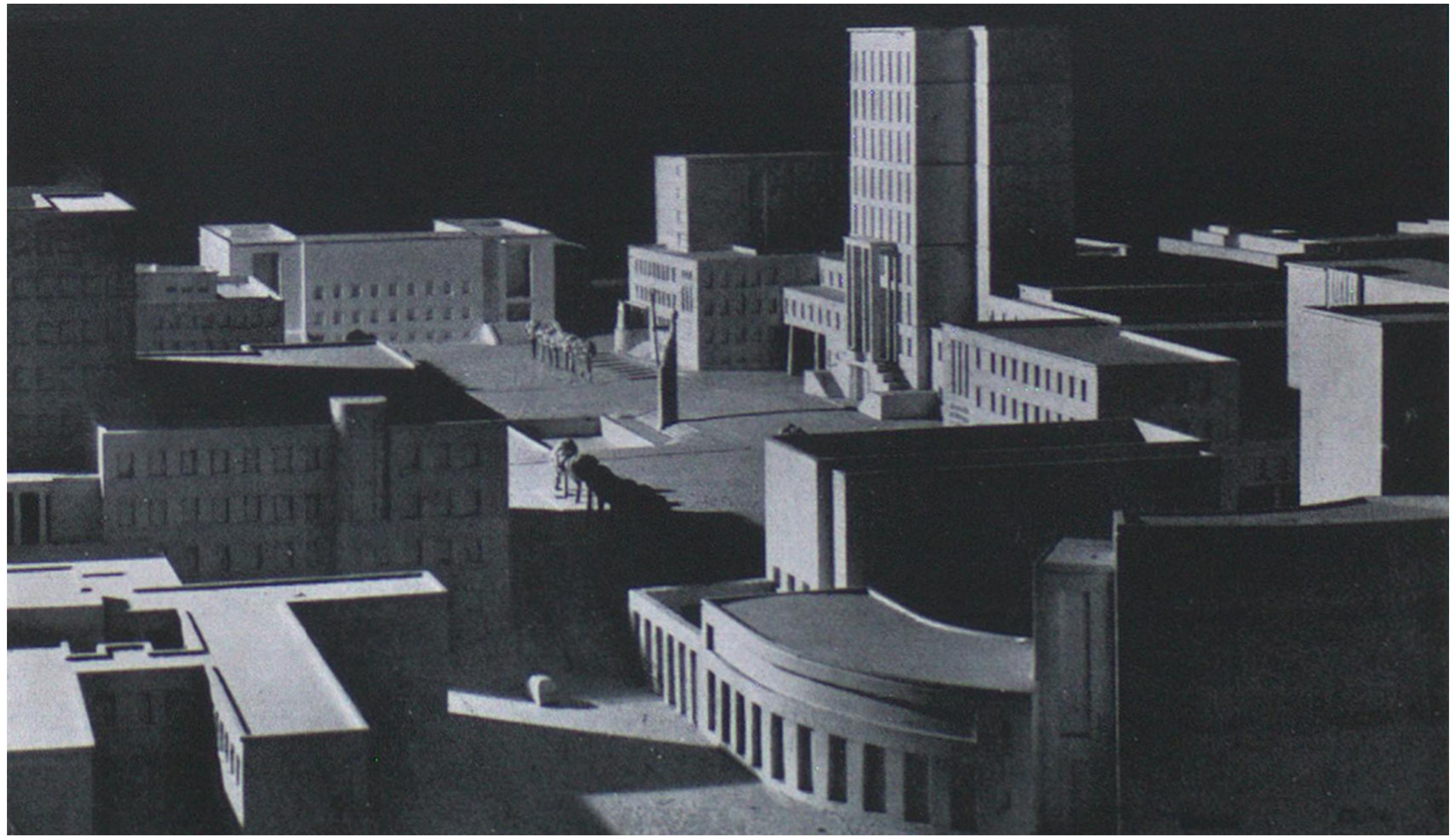
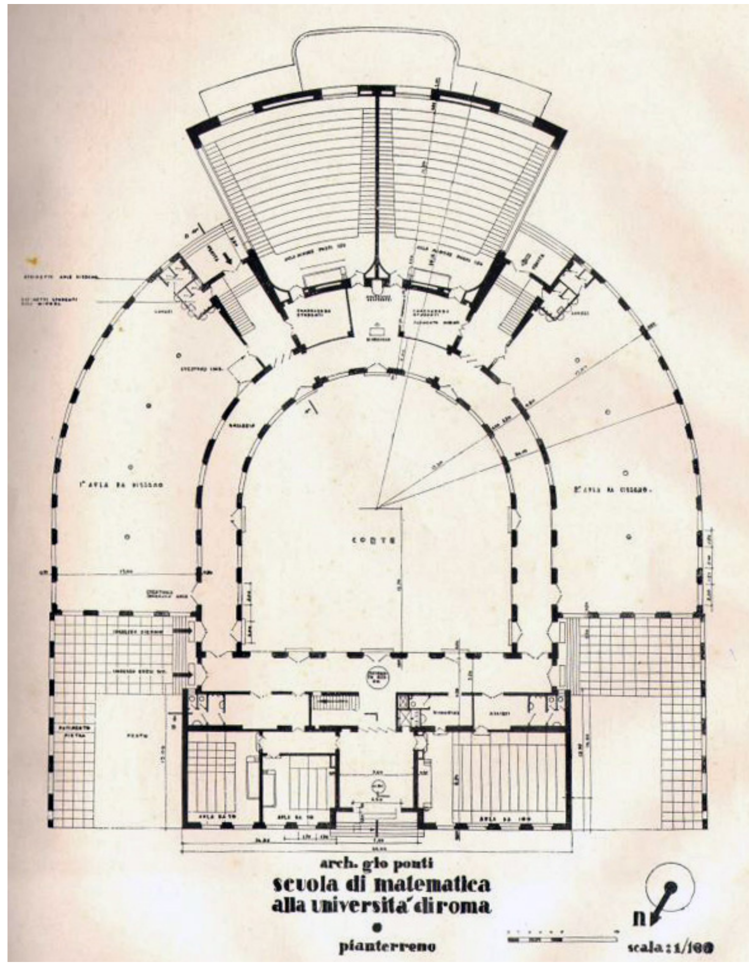


Figure 10 - General view of the second model - or Model 'B'- for the new university campus, March 1933 (BBL_pht_04)

Figure 11 - Closer view of the second model - or Model 'B'- for the new university campus, March 1933; the Mathematics building is in the fore ground, surrounded by porticoes (BBL_pht_05)

the outer perimeter of the building, delimit the open spaces on the sides of the main body. The openings of these diaphragms repeat the rhythmic scanning of the windows along the wings, appearing as their continuation. Finally, the distinction between the two parts of the main body in front of the central piazza of the campus is introduced for the first time. The monumental front elevation corresponding to the library, and the domestic rear, are highlighted troughout a recess on the sides and using different materials to clearly mark the importance of the views: the main square and the inner square.

Faced with these important changes, it is interesting to note that the first series of drawings for the School of Mathematics consisting only of sections and elevations, dates back to March 17, 1933, a few days after Mussolini's visit. The only plan aligned to this series was published by Pacini in August 1933, on the lavish review "Architettura" and exhibited at the Triennale in May of the same year (AST_pht_01). Further modifications are present if compared to the model presented to Mussolini six days earlier. In the plan (Figure 12) the diaphragms no longer run along the free sides of the areas next to the main body, but only on the long side, leaving the one towards the square open; the diaphragms disappear in the side (Figure 13), while they appear, sectioned, in the internal facade of the "rear" part of the building, in an advanced position with respect to the so-called 'Torre delle Aule' (Figure 14). As in the model published by Ceccherini in "Capitolium" (Figure 15), the architectural solution of the diaphragms was definitively abandoned at the end of the year, but this is not to be considered as a minor step. Its presence, although temporary, clarifies the prominent role of the "filter" in the original definition of open and semi-open spaces of the university campus, but also refers to the programmatic value of the arcade itself in Ponti's intention, which becomes a fundamental design element of those years (Cerutti Fusco 2003, p. 111).



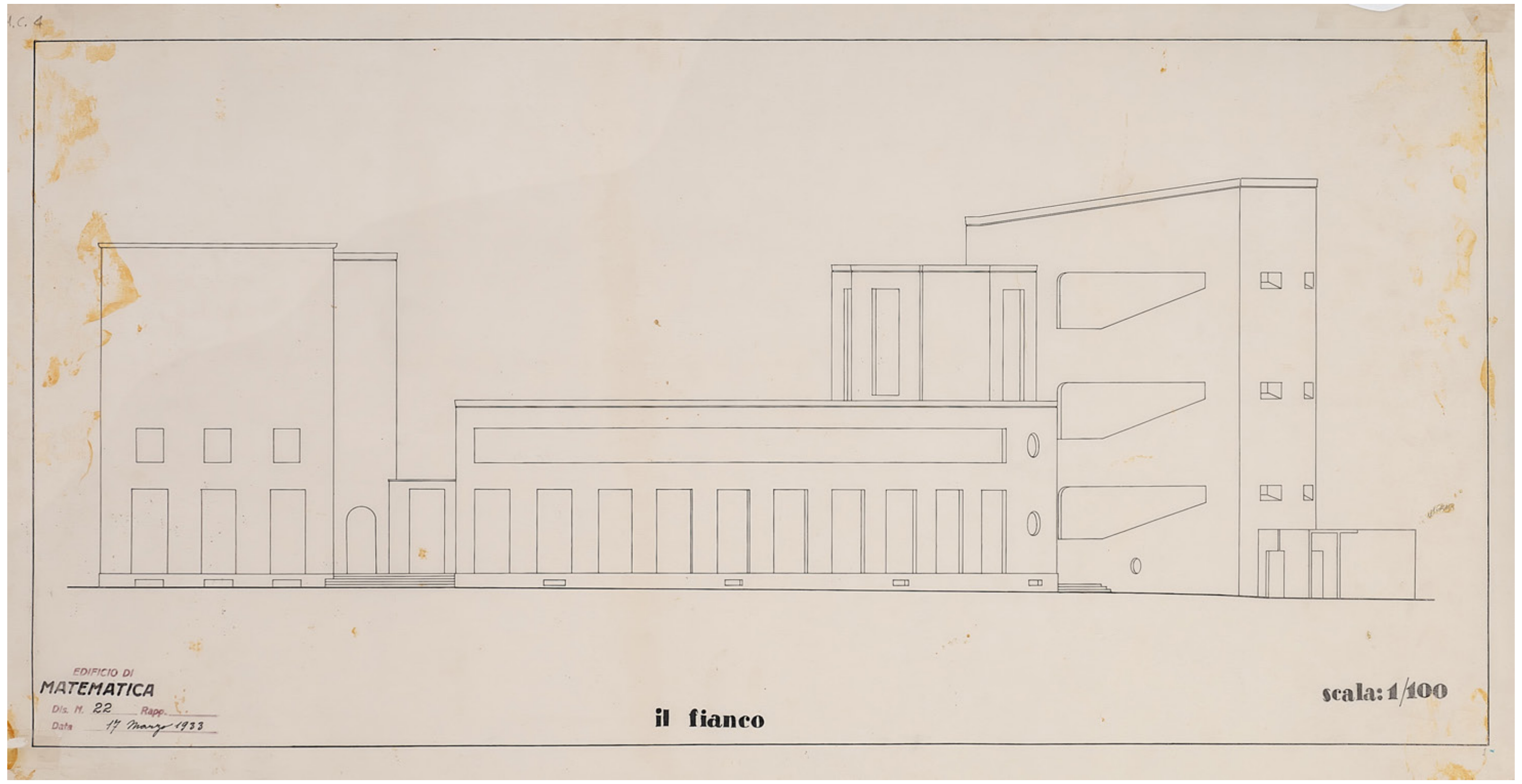
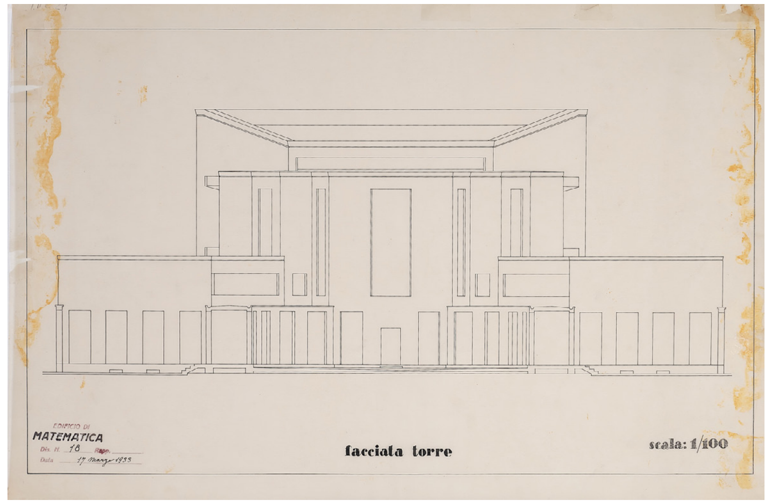
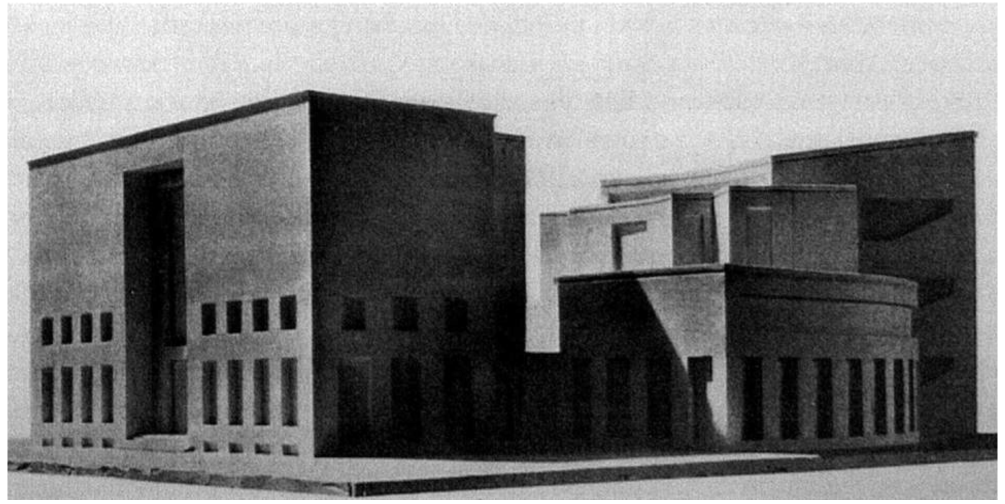
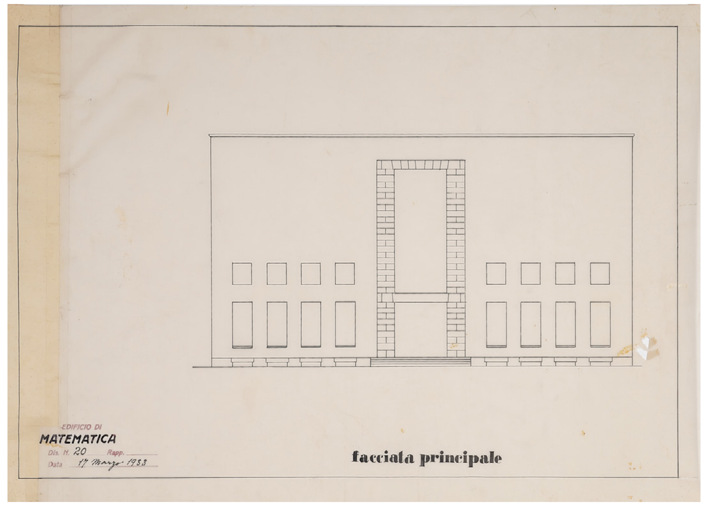


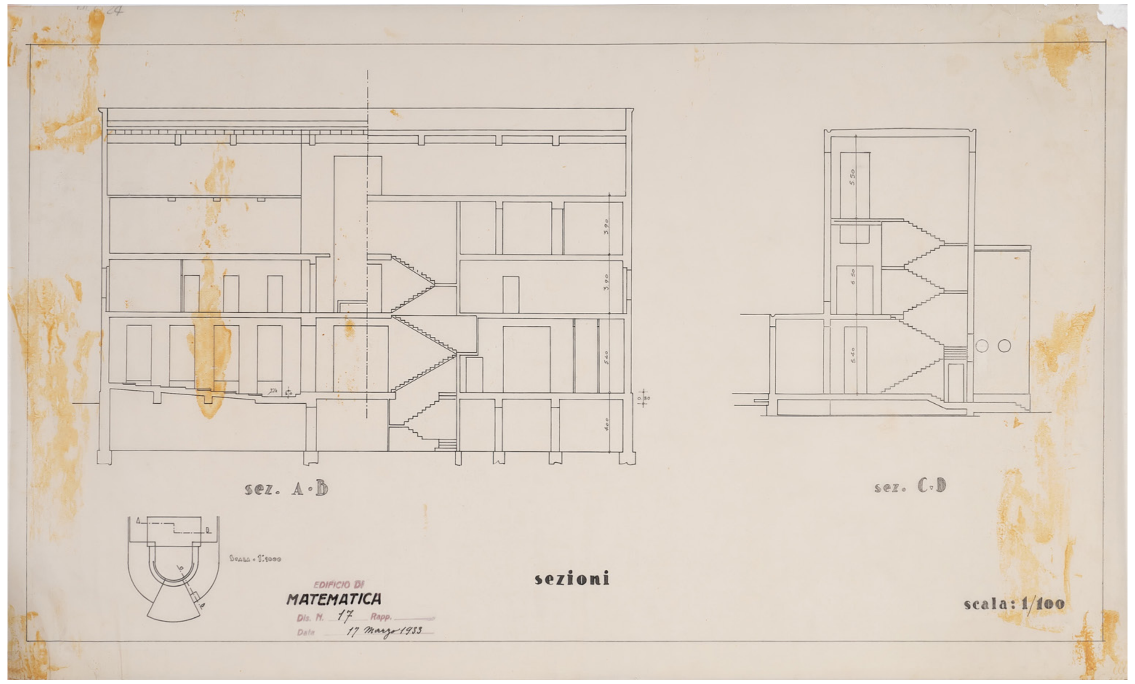
Figure 12 - Ground floor plan for the "School of Mathematics", March 1933 (BBL_drw_01)

Figure 13 - Side elevation for the Mathematics building, March 17 1933 (ASS_drw_20)









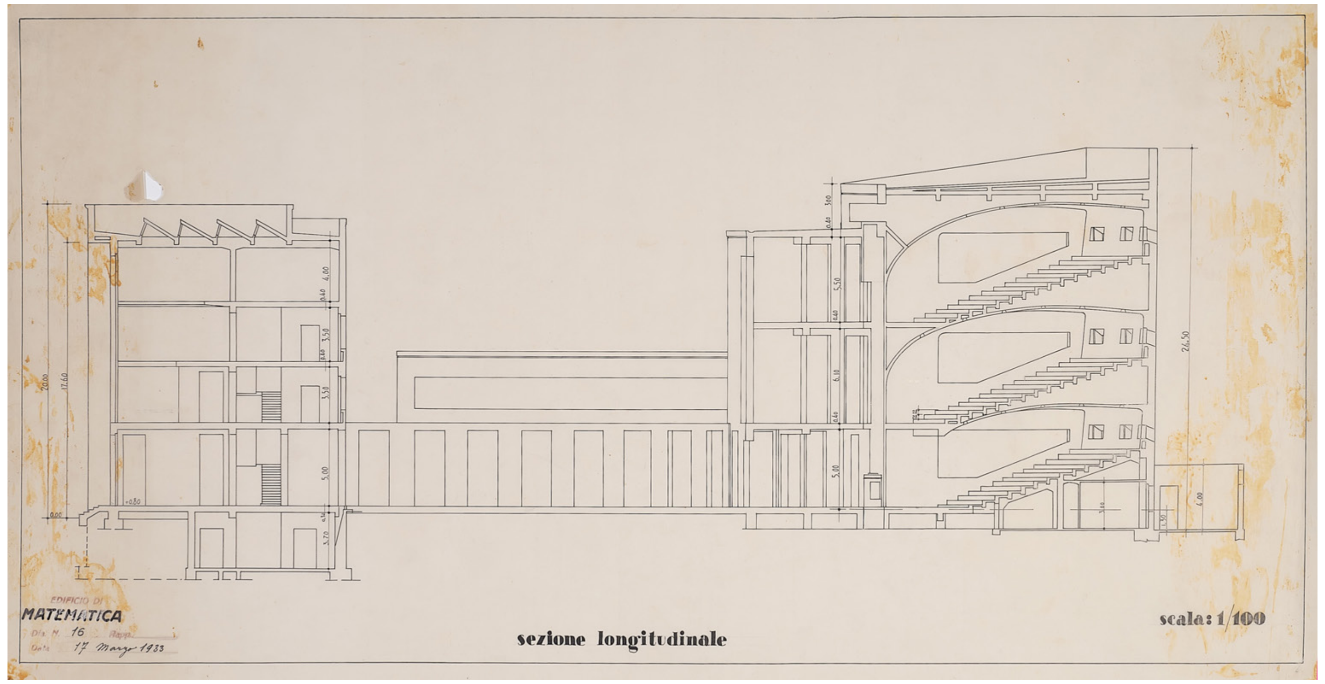


Figure 14 - "Tower Façade" of the Mathematics building, March 17 1933; actually, this is a cross section along the side entrances (ASS_drw_16)

Figure 15 - A view of the model for the Mathematics building, mentioned and visible only in an article published in 1933 (BBL_pht_06)

Figure 16 - "Main façade" of the Mathematics Building, March 17 1933; the design is still at an early stage (ASS_drw_18)

Figure 17 - "Sections" of the Mathematics building, March 17 1933; technical detailing is still at an early stage (ASS_drw_15)

Figure 18 - "Longitudinal section" of the Mathematics building, March 17 1933; many details are still to be defined (ASS_drw_13)

Another crucial aspect is the design of the windows, imagined as continuous horizontal (in the wings or in the tower at the top) or vertical element (in the tower of the classrooms), which breaks the sculptural compactness of the building and illuminates the interiors. There is an evident search of transparency and lightness, which may also be found in the large central open courtyard (Figure 16), in the long ribbon window of the wings and in the windows in the large classrooms.

In March 1933, Ponti began to reflect on the characterization of the main facade. The entrance is no longer highlighted by a protruding frame, but is inserted in a deep central niche that encloses a large window with a stone framing of the window. Moreover, the front body takes on its most distinctive features: the halls on the ground floor, intended for the teaching of “High Mathematics”, are stepped (Figure 17); the large rectangular room on the upper floor, intended for the library, develops in a triple height illuminated by the above-mentioned stained-glass window, that connects three levels of offices, reading rooms and storage rooms facing the inner courtyard.

Natural lighting is- at this stage- guaranteed by the presence of inclined skylights on the ceiling (Figure 18); this lighting solution will be soon abandoned for a new skylight conceived for the large library hall only[22].

For the first time, the “secondary” entrances reserved to students and located on the sides of the main building, are clearly shown, both in plan and in elevation. The different shapes of the openings, arched (mathematics students) and trilithic (drawing students), and the subsequent differentiation of the roofing, represent one of the most interesting features of Ponti’s project, since they highlight an elegant junction between the two different parts, express a harmonious arrangement of spaces visible from afar, and clarify the functional components of the School through recognizable entrances: high mathematics in the main body and geometry in the wings.

While the project was being drawn up, considerable problems emerged regarding the expropriation of the land where to locate the Mathematics and the Pharmaceutical Chemistry buildings. The delay caused by the lack of funds to pay the compensation for the expropriation and the administrative difficulties, kept the building site at a standstill for almost a year, starting in the spring of 1933. The plan of the State General Superintendency for the Construction of Public Buildings (Figure 19) illustrates the situation in April 1933, which was anything but simple. The state-owned land to be expropriated involved not only the building areas- on which there were buildings still to be demolished- but also the road areas, making it impossible to quickly complete the tracing of the main via dei Battaglioni Universitari (ASS_drw_22).

During the summer of 1933 work proceeded unsteadily with the building site yet to begin. On June 23 the Consortium decided to suspend the construction of Chemistry and Pharmaceutics Faculties, entrusted to Pietro Aschieri, and to incorporate the institute into the Botany building, entrusted to Giuseppe Capponi. Therefore, this extremely critical moment that lasted until October 1933, put the construction of the School of Mathematics in serious doubt, considering that the Consortium’s was well aware of the inaccurate economic estimate produced for the entire work (ACS_dcm_16).

In a heartfelt letter by Rector Rocco to Mussolini, 30 million lire were requested for the completion of the building site, but the Mathematics building was not even mentioned among the priority ones. If the necessary funding for its construction was not found, the building would have been postponed sine die, together with the Chemistry, Biology, Zoology and Botany buildings. Fortunately, in a letter dated October 12, 1933 Rector Rocco assures that, after talks with architects and engineers, all eleven buildings will be built with essential furnishings, with a surplus finding of about ten million lire to the first estimate. This sum was in fact granted by Mussolini to speed up the progress of there is an important gap between the project for the building and its subsequent construction. The building site was slowly getting off the ground and Ponti once again had the opportunity to rethink some architectural feature of the project, coming to conceive the structure in reinforced concrete rather than in masonry.

Although Piacentini announced the delivery of the complete project on July 13 (ASS_dcm_21), fundamental modifications of the structure are introduced later, in the following December. Moreover, the unblocking of the areas allows comparison with the ground, whose bad conditions are already known since October 1932 thanks to cores. The composition of the soil – consisting in backfill materials and clays lead to a change in the bearing structure and in the strengthening of the foundations in order to ensure greater stability (ASS_dcm_22).

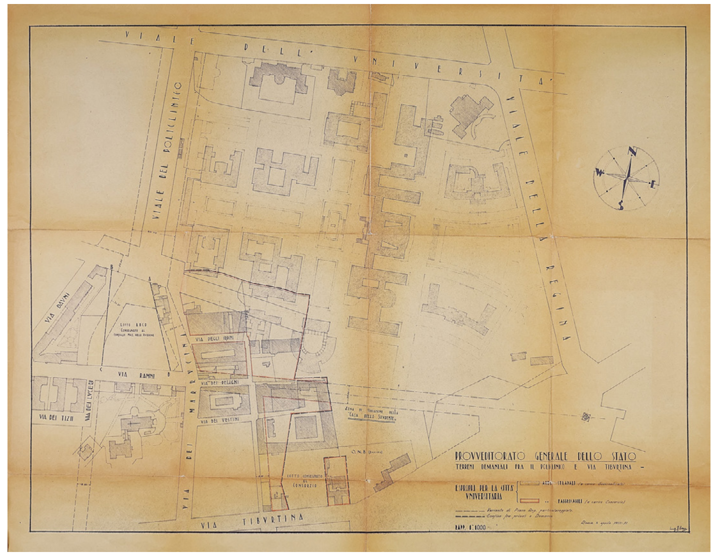


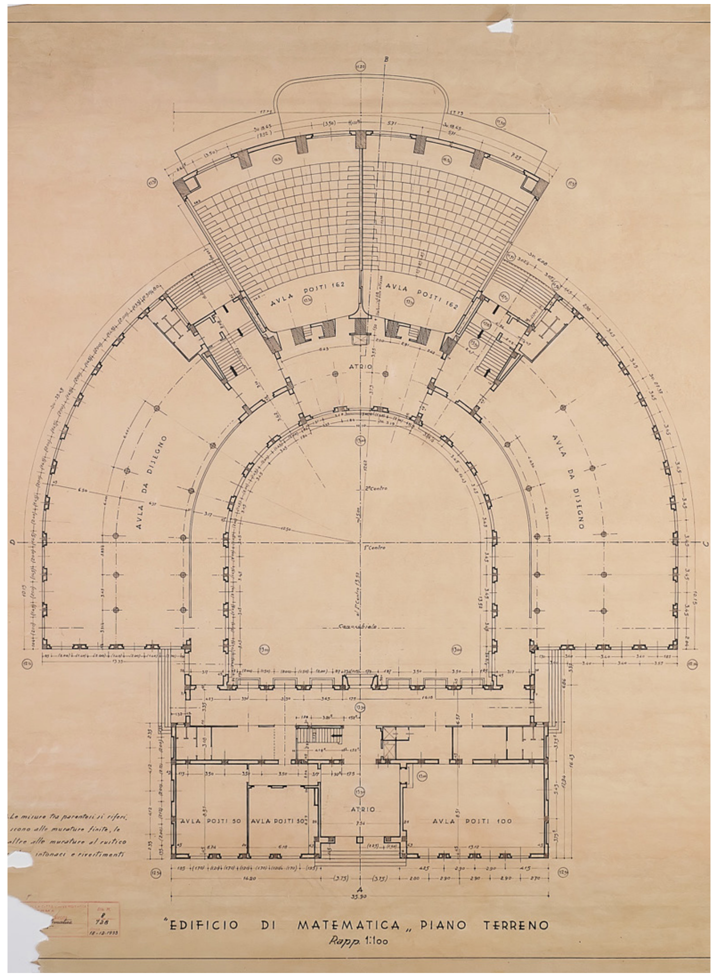
Figure 19 - General plan of the State-owned land between viale del Policlino and via Tiburtina, issued by the General State Services Administration, April 5 1933; the plan highlights land lots to be expropriated for the purposes of the new university campus, among which also the area destined to the Mathematics building (ASS_drw_22)

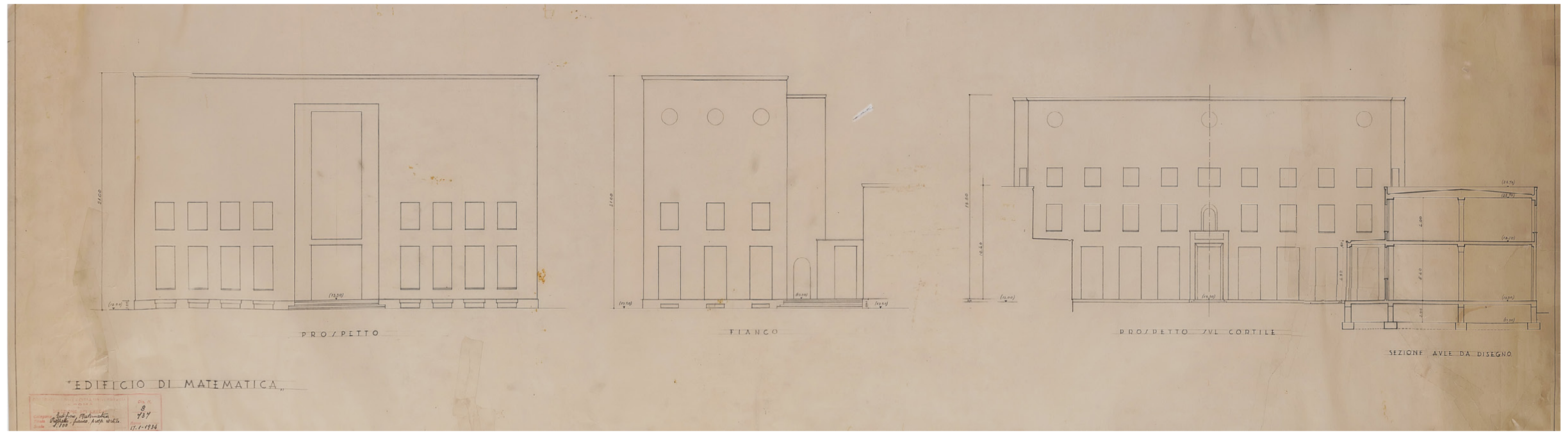
CHANGES IN THE STRUCTURAL DESIGN

Between December 1933 and January 1934, the project undergoes final changes thanks to a precise hierarchical order of the spaces, both in plan and in elevation. In the geometrical setting, a “second centre” is introduced in the design of the courtyard and of the side wings, obtaining a greater harmony between the different parts (Figure 20). It is made clear that the eccentricity of the new focus on the central axis of the building is due to an extremely functional choice: with the same capacity of the rooms, Ponti designed the side staircases with parallel walls no longer converging, such to achieve a “straight line” between the two systems of curvature (tower of classroom and side wings), thus facilitating the insertion of additional service rooms. The date of the plan, however, shows that this solution is the final one since December 1933.

Furthermore, in the rear elevation of the front body, Ponti provides a balcony above a slanted portal, while some circular windows appear on the top level (Figure 21). The central one provides a new visual goal: in addition to crossing the front body from side to side in a transversal sense, it is now possible to look through the entire courtyard, from the library to the tower of classrooms. This is a recurring theme, used especially in Ponti’s typical houses of the 1930s and developed in the 1950s, in the Villa Planchart in Caracas (1952-1955) and in his own house in Milan, in via Dezza (1957). The possibility of trespassing the view of the sequence of spaces is highlighted in the plans by a continuous line that crosses the space and reveals the visual permeability of Ponti’s architecture (Salvo 2017).

A picture of the time (Figure 22) could demonstrate that the foundations of the front body were completed later than those of the remaining building. This mismatch could result from the effort of the company Ferrobeton to rework the foundations of the front building with greater attention.





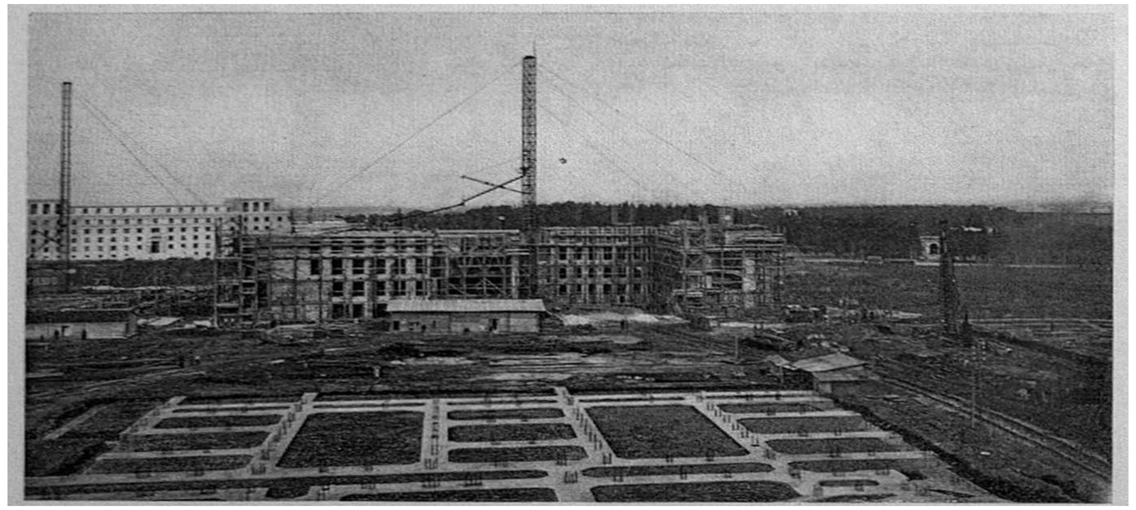


Figure 20 - “Mathematics building, ground floor”, December 18 1933 (ASS_drw_25)

Figure 21 - “Mathematics building”, front, and courtyard elevation, January 17 1934 (ASS_drw_32)

Figure 22 - The construction site of the university campus in 1934; in the forefront the foundations of the Chemistry building, on the right side those of the Mathematics building and in the backdrop the elevation of the Arts and Humanities building at good stage (BBL_pht_08)

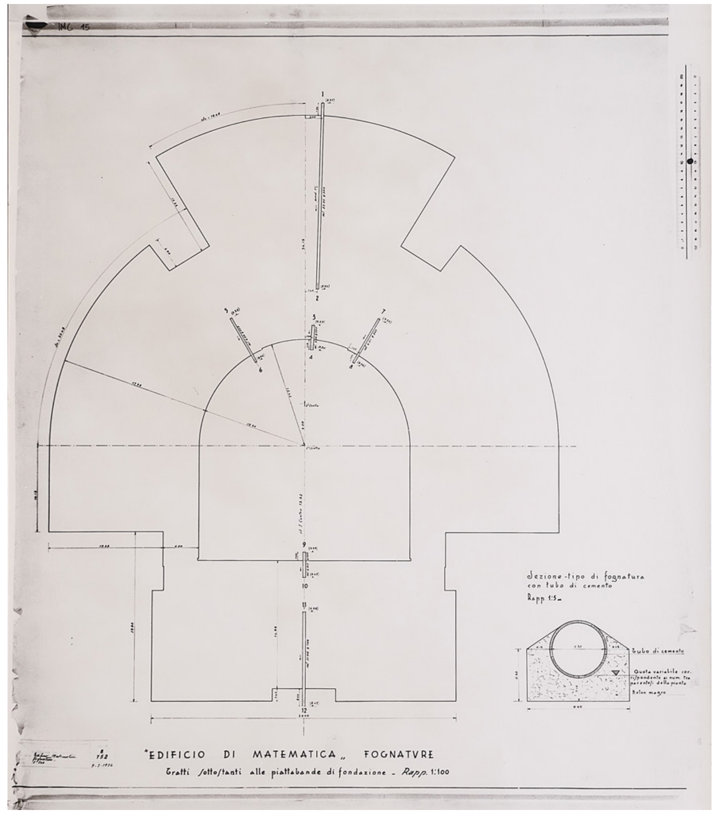
As the foundations works were proceeding, the contractor Adriani, winner of the tender for the construction of the load-bearing structures, contributed by placing the concrete elements of the sewage system under the foundation plates. At the same time, in February 1934, the company De Micheli won the contract for the heating systems of the entire university campus, a work that will last until April 1936. A document shows the floor plan with the system of tunnels that distributes the heating in the buildings of the campus, starting from the thermal power plant located near the Institute for Nervous Diseases (ASS_dcm_49) (Figure 23). There were two distribution networks: one for intermittent operation (heating during daylight hours), and one for continuous operation (heating during day and night hours). The supply pipes that branched off the main networks head on to a command-and-control substation allocated in each building. The command substation of the Mathematics building was firstly placed in the front of the building, but a technical report dating April 1936, however, indicates that the technical rooms of the boilers will be moved at the foot of the tower of classrooms (ASS_dcm_135). The central heating plant is based on a system of hot water at low temperature and low pressure (ASS_dcm_49).

Therefore, the longitudinal section of January 17, 1934 introduces a further theme, later abandoned: the use of truss beams to cover the tiered hall at the third level of the ‘Tower of classrooms’ (Figure 24).

Probably, this is an intermediate study that attempts to resume the research in progress in the Aula Magna of the Rectorate, still under construction. Its elaboration seems more a graphic gesture than the result of a thorough research on the cover of a simple hall; a suggestion that seems to announce a change of pace, exemplified by the complex system of hinges that supports the internal beams of the Tower (with the aula magna).

The conception of such a structure, which allows the realization of slabs up to 60 cm, is probably due to the valuable advice of engineer Guglielmo Zadra, whose name does not officially appear in the documents, but is mentioned by Ponti in the well-known passage in Amate l’Architettura (Ponti 1957a, p. 56).

The acquaintance of Agostino and Guglielmo Zadra with Alberto Alpago Novello and Tomaso Buzzi, well-known associates of Ponti, and Guglielmo Zadra’s move to Milan, lead one to believe in an albeit brief collaboration. However, the working methods, the relationships between Ponti and Zadra, and the lack of recognition of Zadra’s work by the Consortium remain issues unanswered. What is certain is the moment in which this constructive system was introduced into the project: it is February 1934 when Piacentini communicates the successful resolution of the tower structure, right at the time of the beginning of the foundations work (ASS_dcm_23). Also, in this case the authorship seems to be only of Ponti.



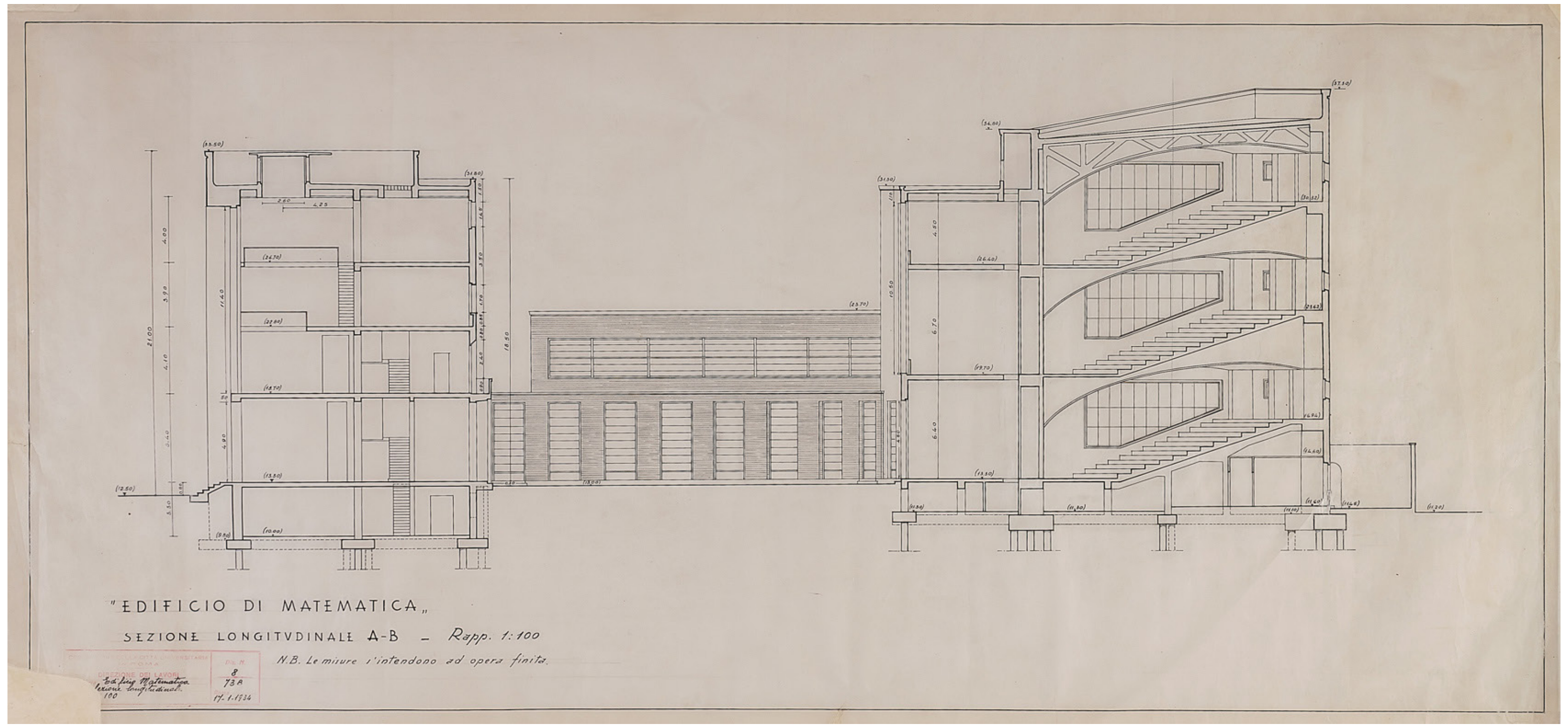


Figure 23 - Plan of the sewage system embedded within the foundations of the Mathematics building, 1934 (ASS_drw_36)

Figure 24 - “Longitudinal section A-B” of the Mathematics building, January 17 1934 (ASS_drw_33)

No less important are the modifications to the front body: the skylights change shape, passing from a series of small, slanted windows to a continuous chimney-like structure that illuminates the library only (Figure 18), while the rooms on the mezzanine floor are still destined for the calculus laboratory, and will later house the book deposit (Figure 25).

The start of elevation work in late winter 1934 and the need to proceed quickly to make up for lost time, imposed a series of choices during work on issues that were now imminent. In the drawing of the front building (Figure 26) and the side (Figure 27), dated February 21, 1934, Ponti envisions a brick cladding for the front body, leaving the recessed frame clad in stone. The final solution, found in the drawing signed on September 25 by the firm Filacchioni committed with the work, calls for a cladding in rectangular travertine slabs with 'sister joints' (Mornati 2001, pp. 281-282) placed under each span of the reinforced concrete top cornice (Figure 28).

The characterization of the central niche, also cladded with the same material, is achieved thanks to two devices: the staggering arrangement of the slabs between the window level and the rearmost level of the entrance, and the presence of a surrounding "scuretto", an accentuated narrow cut that projects a deep shadow on the facade highlights a detachment in the continuity of the surface, from the top inscription 'Scuola di Matematica' to the floor level.

This "scuretto" may be interpreted as a characteristic architectural gesture in Ponti's Milanese work during the 1930s, especially in the design of the first Montecatini Building (1935-1938) and of the Piazzoli House (1938-1940), by means of which the architect elegantly marks the division between his buildings and the neighbouring ones.

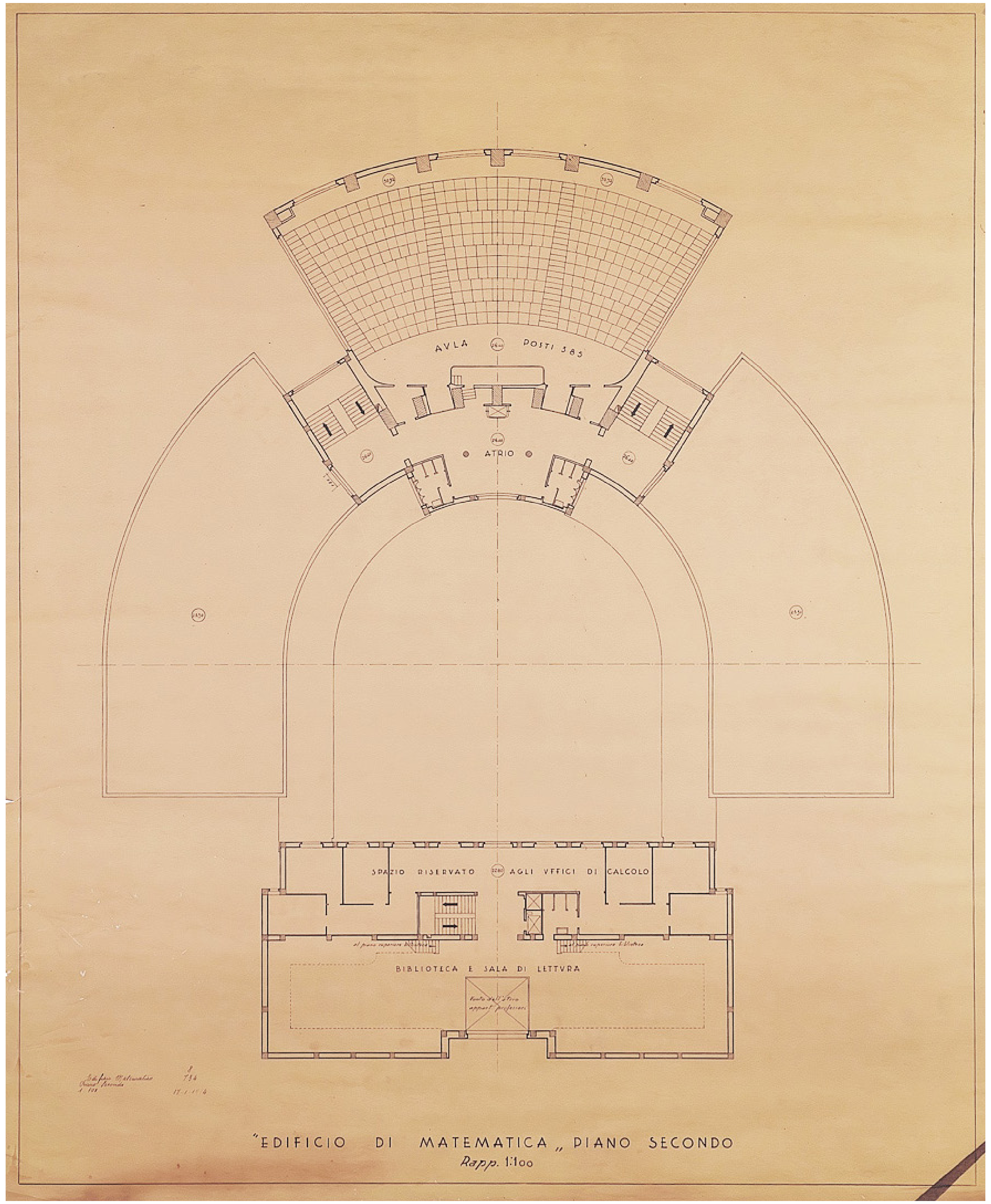
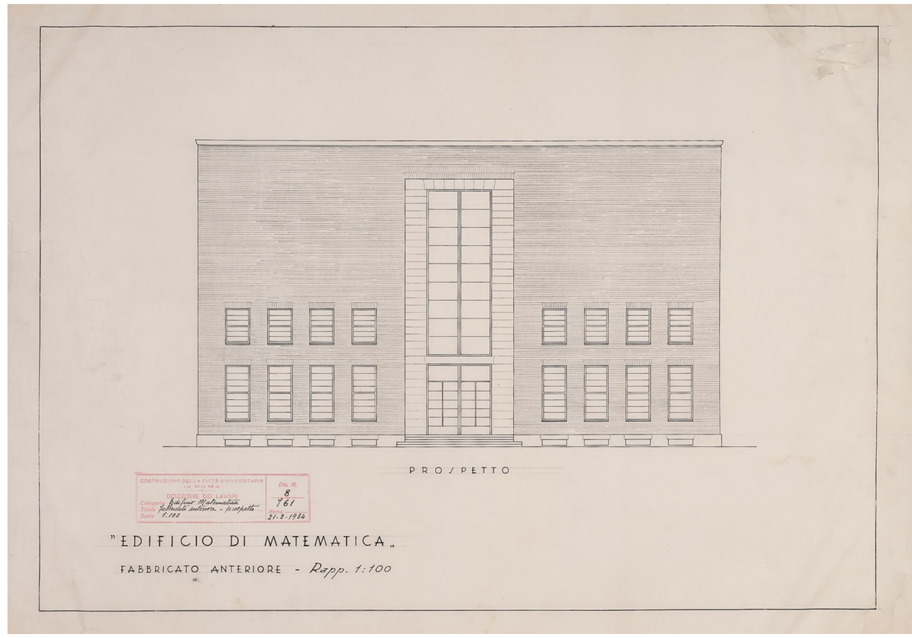
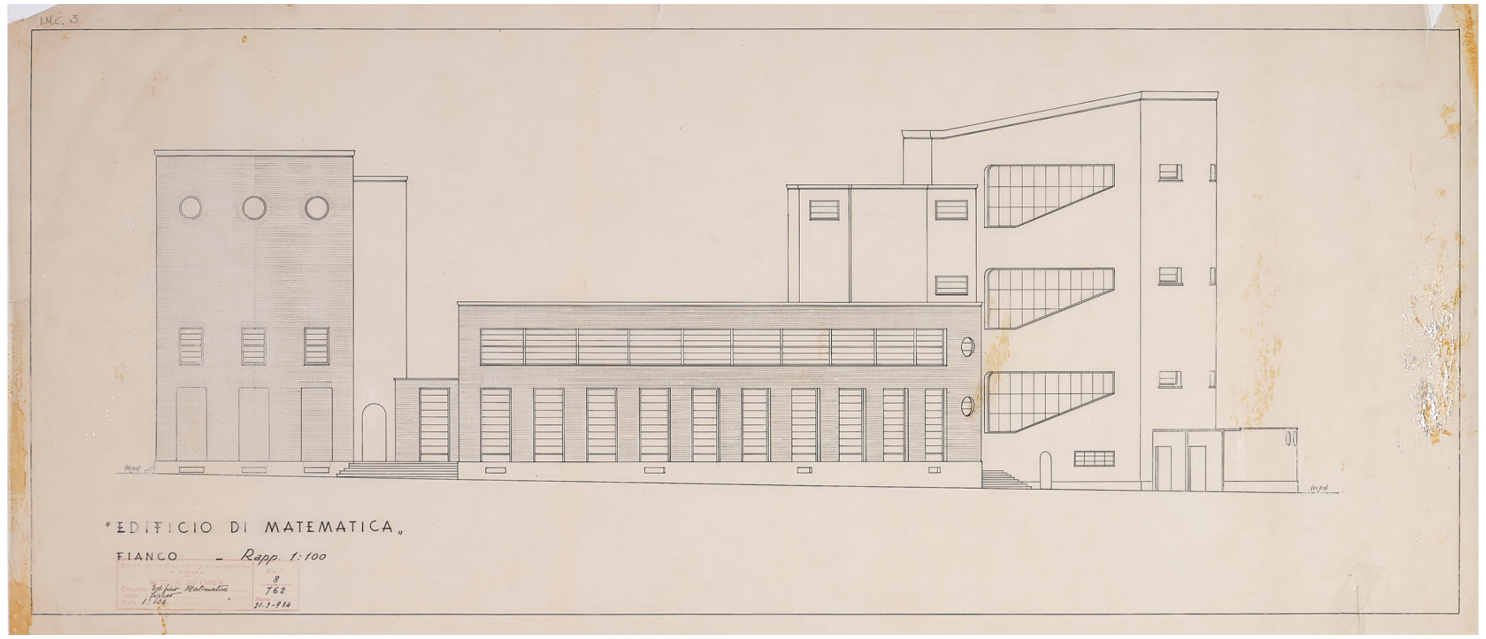


Figure 25 - "Second floor" of the Mathematics building, January 17 1934 (ASS_drw_29)





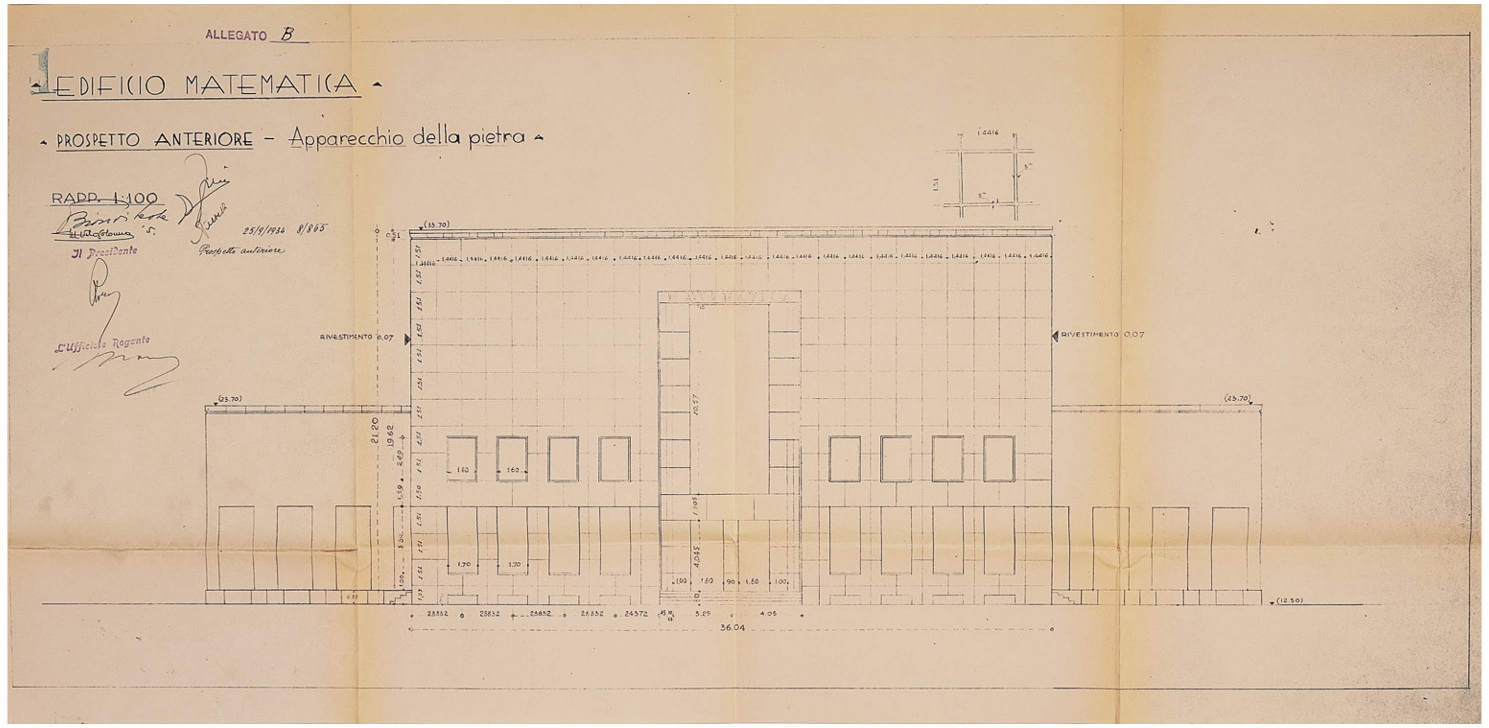


Figure 26 - "Front building" of the Mathematics Building, February 21 1934 (ASS_drw_38)

Figure 27 - "Side elevation" of the Mathematics building, February 21 1934 (ASS_drw_39)

Figure 28 - "Front elevation" of the Mathematics building with detailing of the stone cladding, September 25 1934 (ASS_drw_45)

HOW OFTEN WAS PONTI ON SITE?

On May 30, 1934 the contract is signed with the Adriani firm: from then on the construction proceeds quickly, to the point that Mathematics, despite the initial stasis, is among the buildings that in February 1935 are considered by the Rector Rocco and Piacentini completed in view of the inauguration, rescheduled to October 28, 1935 (ASS_dcm_46)[23]. At this point, Ponti's presence on the site gradually reduces.

1934 was undoubtedly a very intense year for Ponti. On the one hand, his numerous construction sites proceeded at a dizzying pace, on the other, his professional growth seemed unstoppable, now without Lancia, in the Liviano competition in Padua and the project for the Littorio in Rome. The former definitively confirmed Ponti's managerial ability in directing several workers and artists in such a mighty undertaking, both from an architectural and artistic point of view, while the latter confirmed his desire to be a protagonist, without gregarious, in the great competitions offered by the regime. If we also consider the construction site of the first Montecatini building in Milan, whose technical complexity was solved also thanks to the precious help of the new partners, Antonio Fornaroli and Eugenio Soncini, Ponti's consecration at the design level right in the second half of the 1930s remains undoubted.

Although there are no documents attesting Ponti's presence on the construction site, his visits to Rome are still numerous and lead one to believe in a possible detour, once he arrived in the Capital, to the building under construction. The receipt of the "Mussolini Prize for the Arts" on April 21, 1934, the project and the consequent construction of the International Catholic Press Exhibition, inaugurated on May 12, 1935 (Miodini 2001, pp. 161-162), the participation in state exams as a commissioner and speaker at the "Volta Conference" held in October 1936 at the Accademia d'Italia are just some of the reasons for Ponti's travels from Milan to Rome.

In particular, the attribution of the Mussolini Prize evidences the qualitative leap in Ponti's career at an international level: Piacentini himself, as president of the Arts section at the Accademia d'Italia, substantiates this recognition of the Milanese designer, capable of spreading modernity in architecture and in the decorative arts in Italy and beyond, through the experience of the "Biennale" and "Triennale" exhibitions and through the consolidated elegant periodicals Stile and Domus (Reale Accademia d'Italia 1933-34, pp. 289-290, "Architettura" 1934a, pp. 255-256). This recognition was also wisely shared by Edoardo Persico who, in a famous article about Ponti published a few days after the award, describes with acuity the modern character of Ponti's architecture, which according to him interpret the European artistic experimentations with a genuinely Italian flavour (Irace 1988, pp. 18-25).

During the second half of 1934 and throughout 1935 the Technical Office was constantly at work to complete the construction of the building. Protagonists are now the director of the construction site, Saverio Schulteis Brandi, Guidi, Piacentini and Giuseppe Fornari, equally committed in directing the construction firms, verifying the work and solving problems during construction.

Ponti's contributions to the final achievement of the building seem now to be reduced to limited decisions, albeit substantial: the modification of the height of the seats' backrest for the large tiered seating lecture halls from 27 to 34 cm, the replacement of the original paving of the inner courtyard with irregular slabs of travertine displayed as opus incertum (ASS_dcm_144), the use of different and new materials for some of the doors; requested advices for the supply of metal shelving in the library. The artistic direction therefore seems to have turned to an episodic support to the work of the Technical Office. The last two series of drawings, produced between June 1 and June 12, 1935, in fact show a common cartouche for the entire campus, while the name of the designer appears only as a mere under title: these actually represent only a slight update of the building, much of which had already been constructed, evidently to standardize the small changes made on site for the internal divisions, which

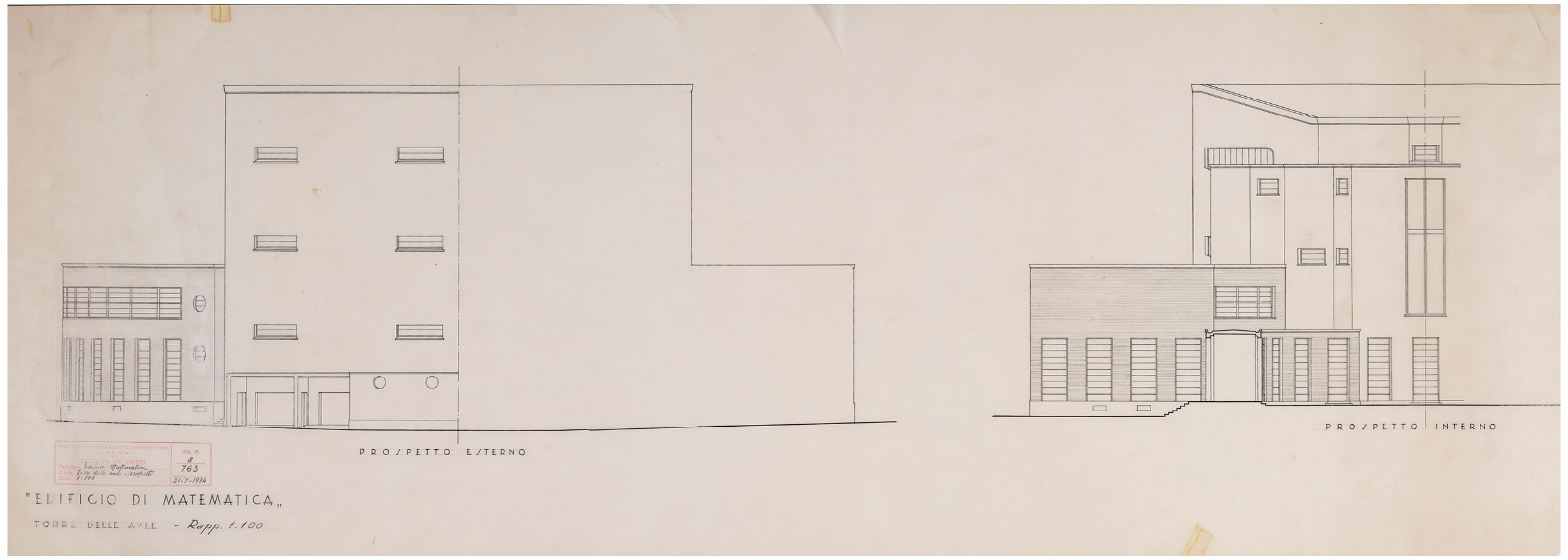


Figure 29 - "Tower of classrooms" of the Mathematics building, outer and inner elevation, February 21 1934 (ASS_drw_40)

were certainly elaborated in view of the publication in December 1935 of a special issue of "Architettura" dedicated to the campus. Similarly, the design of the furniture is not entirely attributable to the Milanese designer- despite his experience in this field and numerous interactions with manufacturing companies. The firms that supplied the furniture for the building recurred to their products of current use, advertised in the catalogue of the Parma & Figli company and clearly evidenced by the label "Bologna" for the well-known design for the counter of the Liporesi company (ASS_drw_76).

Ponti's contribution may instead be confirmed in other parts of the building, which carry further compositional rules and principles represented in the many plans that have come down to us. For example, the drawing for the internal elevation of the tower, dated February 21, 1934 (Figure 29), depicts a "second main façade" facing the courtyard, thanks to the proposition of a large vertical window that crosses the three levels of height of the building.

While the decorated glass-window of the main facade illuminates the triple-height environment, the one corresponding to the tower illuminates the entrance halls and allows reading the various levels: double for the second floor, single for the third. Finally, the same entrance hall on the second floor is designed as an 'inner square', where two balconies facing each other, today inaccessible (Figure 30) express the aim to characterize the inner space as an urban place of meeting and confrontation. This solution is successfully reproposed also for the villa Planchart in Caracas (1952-1955), where the visual contact between the two internal balconies, named after the sun and after the moon, allows one to overlook and appreciate the house from side to side.

Figure 30 - The access to the atrium of the first floor of the Tower of classrooms from the staircase in a picture of 1935 (ACS_pht_22)

BUILDING THE ELEVATION

Between August and October 1934, Adriani began the elevation of the reinforced concrete structures by erecting the beams, pillars and the relative slabs. Considering the special tender specifications, it is clear that the floors were generally constructed in reinforced concrete mixed with brick. Specifications are indicated for the roofing floors of the lower basement with a full slab with ribs, and for the floors of the upper slabs with a full or mixed type, depending on the presence of an underlying false ceiling (ASS_dcm_30). An advertisement on architectural reviews refers to the use of brick-cement slabs of the Bidelta type, also for the School of Mathematics ("Architettura" 1935b).

Between December and March 1935 Adriani continued with the elevation of the reinforced concrete structures and began to build the first partitions and enclosures with ordinary masonry, one-headed bricks masonry and tuff walls. According to the special tender specifications, the panels filling the reinforced concrete skeleton were made in masonry with mixed tuff blocks and brick, or in brick-only masonry due to the proximity of the reinforced concrete pillar to the window compartment. Many ducts for the accommodation of pipes of various kinds were embedded within the thickness of the walls and of the reinforced concrete structures (ASS_dcm_30).

In March 1935 the outer surfaces began to be plastered. Starting from the structure, the first layer consisted of a waterproofing 6 mm thick layer of asphalt, a 6 mm cellulite, a layer of pozzolana "cretonne" (a very rough mortar) and trowelled curl (ASS_dcm_48).

The time between December- March 1935 proved to be crucial to complete the construction in time for the inauguration scheduled for October 28, 1935.

In a report concerning the use of funds for the construction of the campus, signed by Piacentini on February 18, 1935, a plan is attached with the "Implementation Program of the university campus, October 28, 1935" (ASS_dcm_46). The drawing is a prefiguration of what should have been the situation of the buildings on the date of the inauguration. The Mathematics building is classified as «complete and furnished», despite the construction site having been active for over a year, demonstrating the fact that its completion was foreseen, including the finishes: February and March were actually dedicated to contracts and tenders to pursue the completion of the building. In March 1, 1935, the company Filacchioni signed the contract for the supply of stonework within the Mathematics building, with a delivery deadline by March 31, 1935.

In view of completing the building on time, bureaucratic issues also seem to be accelerated: in the case of the supply and installation of Linoleum flooring for the buildings of the university campus, for example, Piacentini quickly approved the offer proposed by the Linoleum Company recurring to a private negotiation. Always in view of speeding up the timetable, the company Curti, which in March 1935 had won the bet for metal and wooden fixtures of Lots III-IV and had declared its difficulty in completing the work in due time for the inauguration, was flanked by the company Coen which had won a further bet (ASS_dcm_51).

A CONSTRUCTION SITE AT DIFFERENT SPEEDS

Between May and July 1935 the front building had been almost completed: the stone cladding of the façade had been put in place after waterproofing the surfaces with layers of asphalt. The facade of the front building was cladded pseudo-square travertine slabs (about 150 centimetres per side and 5 centimetres thick), sawed and sanded on the surface. Above the entrance doors three bulky "fasci littori" in travertine had already been put in place and the travertine cladding was finally treated with a solution of nicotine. The rear façade of the front body was instead cladded with "Litoceramic" tiles, a yellowish ceramic tile produced on purpose for Rome's university campus.

The fixtures were mounted, in iron and in wood, on both the front and the rear facade that opens onto the courtyard. To crown the roofing of the front building, with parapets finished with a 10 centimetres thick travertine cover, with the upper surface partly flat and partly inclined, a special reinforced concrete formwork is cast in place to create a particular "decoration in artificial stone in blocks". Drain nozzles, lead converse and artificial slate pipes with a diameter of 80 mm are also placed on the roof for the drainage of rainwater (ASS_dcm_55).

Work was also carried out to accomplish the decorative apparatus of the building, while bets were presented to furnish the interiors of the front building. In fact, the company Luigi Fontana (thereafter called 'Fontana Arte'), signs a contract to supply and install within the School of Mathematics «a window measuring 10,58 x 4,56 meters in special coloured glass, shaped and cooked at high temperatures and bonded with lead, with decorated glass pieces, engraved with polished grooves, based on Gio Ponti's preparatory drawing»; the cost for such work mounts up to 35.000 lire (ASS_dcm_61). Although the installation of the decorated stained-glass window began in July 1935 and was completed in time for the inauguration, the work was tested and accounted for only in 1937, after the repair of infiltrations emerged during testing. Windows were also installed by the company Faiella & Rubei- committed to supply both buildings of Mathematics and Chemistry- to complete the front building (ASS_dcm_58)[24]. While the exterior of the front building was completed, the reinforced structure of the curved wings and of the tower of classrooms is still under construction: two types of slabs are in fact still under construction at the first floor (Figure 31).

From the “New prices list” dating May 28, 1935, the two slabs (ground floor at 18.67 meters height and first floor at 23.19 meters height) are casted with features that do not match with the prices of the contract. The document says reports that «the roof slab of the ground floor of the Drawing Halls was not supposed to have ribbed beams, it had to have a maximum height of 45 centimetres for the main and secondary beams and the same height also in the connecting beams of the intermediate supports and the supports of one side of the perimeter. To do this, the company adopted a complex reinforcement to lighten some beams, for example those connecting the intermediate pillars that, with the height 45 centimetres, could not bear the load: the result is an increase of costs for the slabs and a reduction in size of the beams. In the roof slab of the first floor of the Drawing Halls, special calculation constraints are imposed for the limited shape of the pillars (20 x 30) along the external perimeter of the building (a three-support beam was considered in the calculation with the maximum negative moment on the central support and the negative bending moment on the side supports equal to zero). The value of the moment on the central support is greater than the solution thought before and resulted in a wider section of the concrete beam with more iron bars» (ASS_dcm_57).

In July 1935 the contracts for the electrical and lighting installations were awarded to the Company SAAR and the hydraulic system to the company Fusi e Macchi (ASS_dcm_95, ASS_dcm_90)[25].

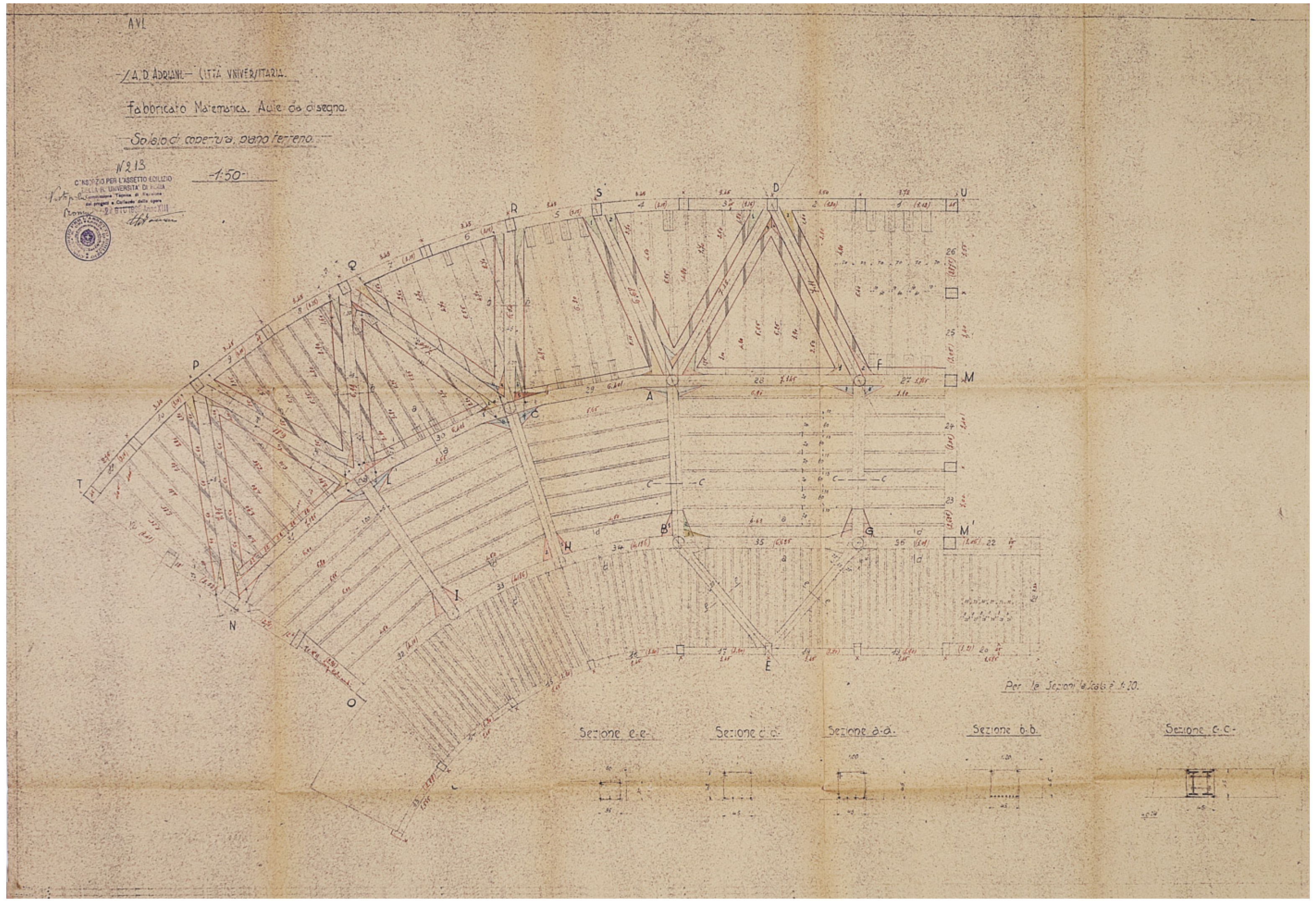


Figure 31 - As-built drawing illustrating technical details of the slabs between ground and first floor of the curved wings, 1935 (ASS_drw_60)

COMPLETING FINISHES, GLAZING AND INTERIOR FURNITURE

Between August and the end of October 1935 the construction had been largely completed: the fixtures were mounted, including the internal wooden ones and those with a curvilinear plan to be placed in the curved wings (ASS_dcm_73, ASS_dcm_78). The crowning with flashings in artificial stones on the curved wings and on the tower of classrooms was ongoing (ASS_dcm_75); the inscription "Scuola di Matematica" consisting of 18 letters in Anticorodal sheets 40 centimetres high and 3 centimetres thick was fixed with metal hooks on the main facade by the company Gaggiottini (ASS_dcm_82); the "marmoridea" (artificial marble) baseboard was applied by the company Vanni (ASS_dcm_83)[26]. The marble cladding of the interior- 2 centimetres thick Carrara marble slabs, 3 centimetres thick Carrara marble steps, 2 centimetres thick white marble subgrades, 2 centimetres thick black-cloud marble slabs and 5 centimetres thick black-cloud subgrades- was also completed (ASS_dcm_87); walls in glass-cement blocks, iron railings and Terranova plaster was laid on the columns (ASS_dcm_89)[27].

Ponti's presence is again detectable with the role of artistic director, defining the last details regarding finishes and furnishings. Ponti decided that wherever the drawings indicated "polished natural wood", the supply of wooden fixtures for the interiors, supplied by the company Cantieri Milanesi, should be in oak wood with a straight vein and polished with white paint (ASS_dcm_74)[28].

The company Liporesi, which had already been committed for the furniture of the Arts and Humanities building and for the Law building, also supplied Mathematics with 1296 oak benches with chromed steel supports to be placed in the tiered seating lecture halls in the tower: yet, given the circular plan of the classrooms, variations to the drawings are needed to ensure that desk, espaliers, and book holder tablet are also curvilinear. To compensate for the cost of such variations and ensure that the price of the benches did not increase, the company suggested keeping the desk table fixed. However, the Technical Office dealt with Ponti further requests regarding the increase in height of the backrest from 27 to 34 cm, which consequently raised the price up to 3 lire per counter (ASS_dcm_92). Finally, to furnish the library hall, the reading room and the book-storage behind it, two companies, Lips Vago and Parma were asked to offer their bets: Ponti's advice was decisive also in this case. The bid was won by the company Parma, considered both economically and technically convenient (ASS_dcm_72)[29].
On October 31, 1935 the university campus was solemnly inaugurated at Mussolini's presence who, in his inaugural speech, mentioned Piacentini, absent due to illness. At this point the School of Mathematics was completed in its structures and its external appearance, but it will take two more years to achieve the very last works (ASL_vdo_09).

THE END OF THE DESIGN WORK

Ponti's hand is clearly present in this building, which differs from other coeval ones in the campus for its greater expressive freedom along with extreme formal rigor. It is a composite architecture that finds its unity in an apparently simple composition (Presta 2005, p. 104), capable of connecting distinct functions and environments, both in plan and in elevation.

What is striking is the fact that the design of the School of Mathematics was clear since the first drawings dating 1932, and maintain the layout intact until the end, as if the original idea based upon the interaction of different volumes, had only been dropped into and adapted to the plan of the campus, not vice versa. The accuracy of the entire project is evident in the architectural joints: in the "indentations" created by the rear staircases to join the wings with the tower of classroom and in the design of the side entrances, different and contiguous at the same time, which reveal the entire "depth" of the building through the transversal corridor of the front body.

Finally, considering Ponti's never ending aspiration to create a Gesamtkunstwerk (Miodini 2001, pp. 51-61), achieved here by means of the stained-glass window that sheds light into the library, the project mirrors the designer's studies on Mathematics as a set of individual discipline. The birth of IndAM in 1939 caused an "internal division" of the west wing's first floor from the rest of the building, which here find a strong expression in the rigorous control of light and its value as a design tool. From the library to the book depository, from the ring corridor to the use of "Termolux" glazing, each space is differentiated according to its functions, alternating the use of transparency, calibrated shading, and different coatings. The most significant room is undoubtedly the library, not only for its cultural importance within the program of the School of Mathematics, but also for its spatial complexity and the evidence of its artistic conception from the outside: evidence that Ponti had thereafter imagined in 1944 more extended and more modern, as a “live show” to be seen from the square (Figure 32).

In addition, specific attention is paid to colour, so characteristic in Ponti’s production, which can enhance visual perceptions (Salvo 2017), and to give grace and strength to the construction. In fact, the project is forced to measure itself against rather rigorous design rules but proves to be able to preserve a strong linguistic autonomy, still today after decades of use and changes, and combining required functionality with implied poetry. The evocative words that Sarfatti dedicates to the building the day after the inauguration of the University campus strengthen this reading: they state that «every detail is treated by Ponti with exquisite elegance, even in the harmonies of colours. Ponti is an inexhaustible imaginative who seeks wealth and inspiration everywhere: in the Gothic cathedrals for the stained-glass window, yet so elegantly original and modern, and in Pompeii for certain constructive and chromatic ideas, perspectives of corners and stairs, and delicately white walls, red protrusions, warm yellow tones of ivory and cold light-blue» (Sarfatti 1935, p. 192).

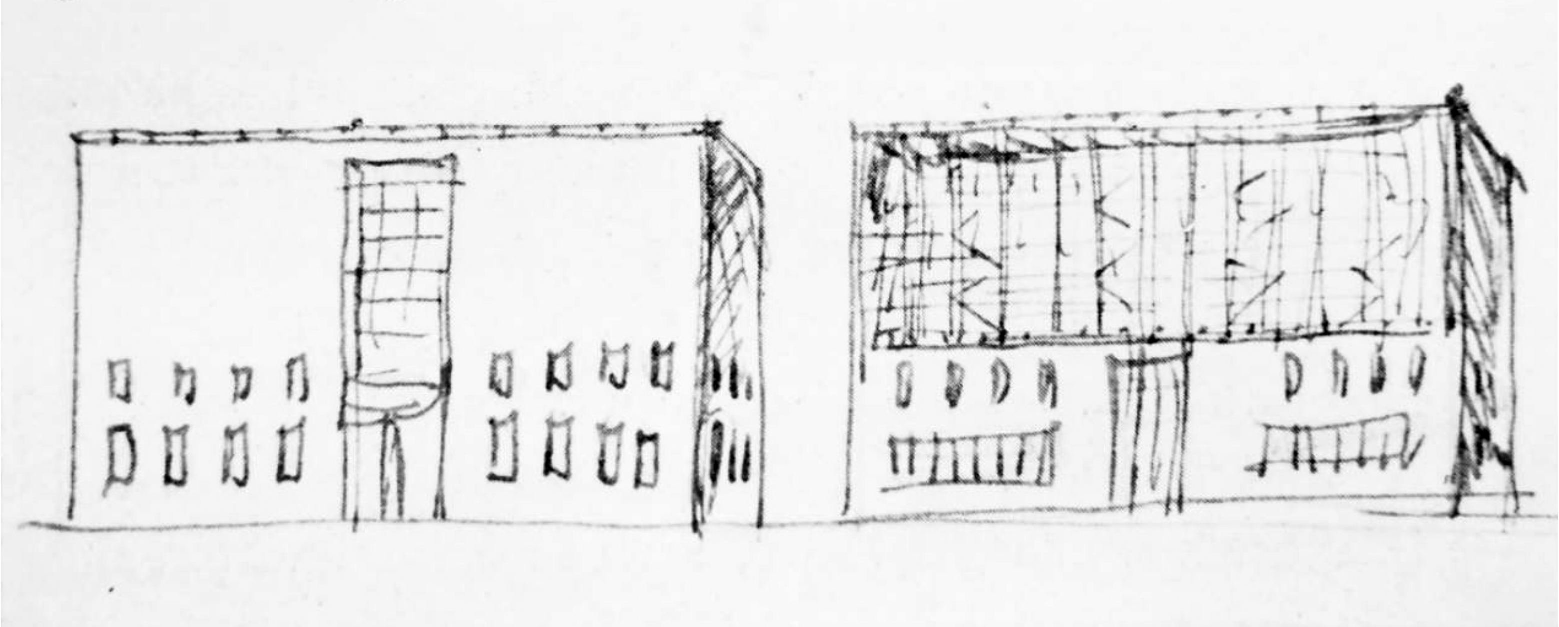


Figure 32 - Ponti’s sketches of the front building of the School of Mathematics dating back to 1944, after construction of the building (BBL_drw_14)

THE VERY LAST FINISHES

Following the inauguration, the interior furnishing, the electrical and lighting systems, and the general finishing of the building were completed between November 1935 and October 1937.

Adriani completed its nineth and last payment report of the works and at the same time Beltrami, Santi and Parma undertook the extensions to their contracts and competed to new tenders to complete the furnishings (ASS_dcm_112, ASS_dcm_115, ASS_dcm_125-126, ASS_dcm_153, ASS_dcm_167).

The assembly of all the windows and their glazing was also completed (ASS_dcm_139); sheets of insulating white diffuser glass of “Termolux” glass, type 4515, with dimensions of 1.20 x 0.60 meters, produced by Balzaretti & Modigliani were installed in the drawing halls of the curved wings (ASS_dcm_116). The application of Terranova plaster on columns and ceilings was also laid over a sand and concrete substrate and a decorative plaster around the entrance portal; the joints between the travertine flashings on the terrace walls are cleaned and plastered; wooden boxes are installed to protect the lever control of 22 windows and glass-cement blocks are placed on the in the skylights (ASS_dcm_187); wooden steps are built to place the professors’ chairs and desks in the tiered lecture halls of the tower (ASS_dcm_127); floors are coated with Linoleum sheets with a special anti-damp paint to replace ordinary concrete screed (ASS_dcm_182); elevators and book mounters are installed by the Otis company in the front building and in the tower of classrooms (ASS_dcm_122); double doors are assembled in fir or walnut or covered in Linoleum by the company Cantieri Milanesi (ASS_dcm_161).

Yet, there is no documentation detailing the construction of the skylight of the library nor its shape. The latter seems flat if we consider the drawing of the section (Figure 33) and a picture of the time (Figure 34). Since the Fifties it is clearly made of vaults of precast reinforced concrete (Figure 35).
The only fixed information about the skylight is related to the presence of a glass-cement block, which appears as a supply on the ninth payment of the contractor Adriani. Again, the testing commission reports defects in the skylight: «the glass-based roof of the library (results) defective both in terms of stability and of tightness to infiltration of rainwater» (ASS_dcm_201).

On September 29, 1937, following a technical-sanitary inspection, the certificate of the state of consistency and habitability is issued by which the building is declared habitable and adequate to school use in its entirety: 121 rooms for a total of 3.571 square meters and 40,681 cubic meters (ASS_dcm_190)[30].

Between October 1936 and January 1939 the works were tested and accounted for. The test visits, carried out for each work, are attended by engineers of the Technical Office and by managers of the companies; whenever the engineers of the Technical Office found defects in the execution of the work, the company was invited to repair to obtain the due payment. This testing phase proved to be critical on several occasions: the more the Technical Office found inaccuracies in the execution of the works, the more the companies complained a lack of recognition for the effort and the commitment proved by the contractors, for their timeliness and for the quality of the services provided vis-a-vis a delay in the payments.

Emblematic is the case of the Adriani company, which was still waiting for the final testing of the works and the signing of the final state in November 1937, although the construction of the building had been completed- in time- two years before (ASS_dcm_191). The situation is documented by a series of observa-

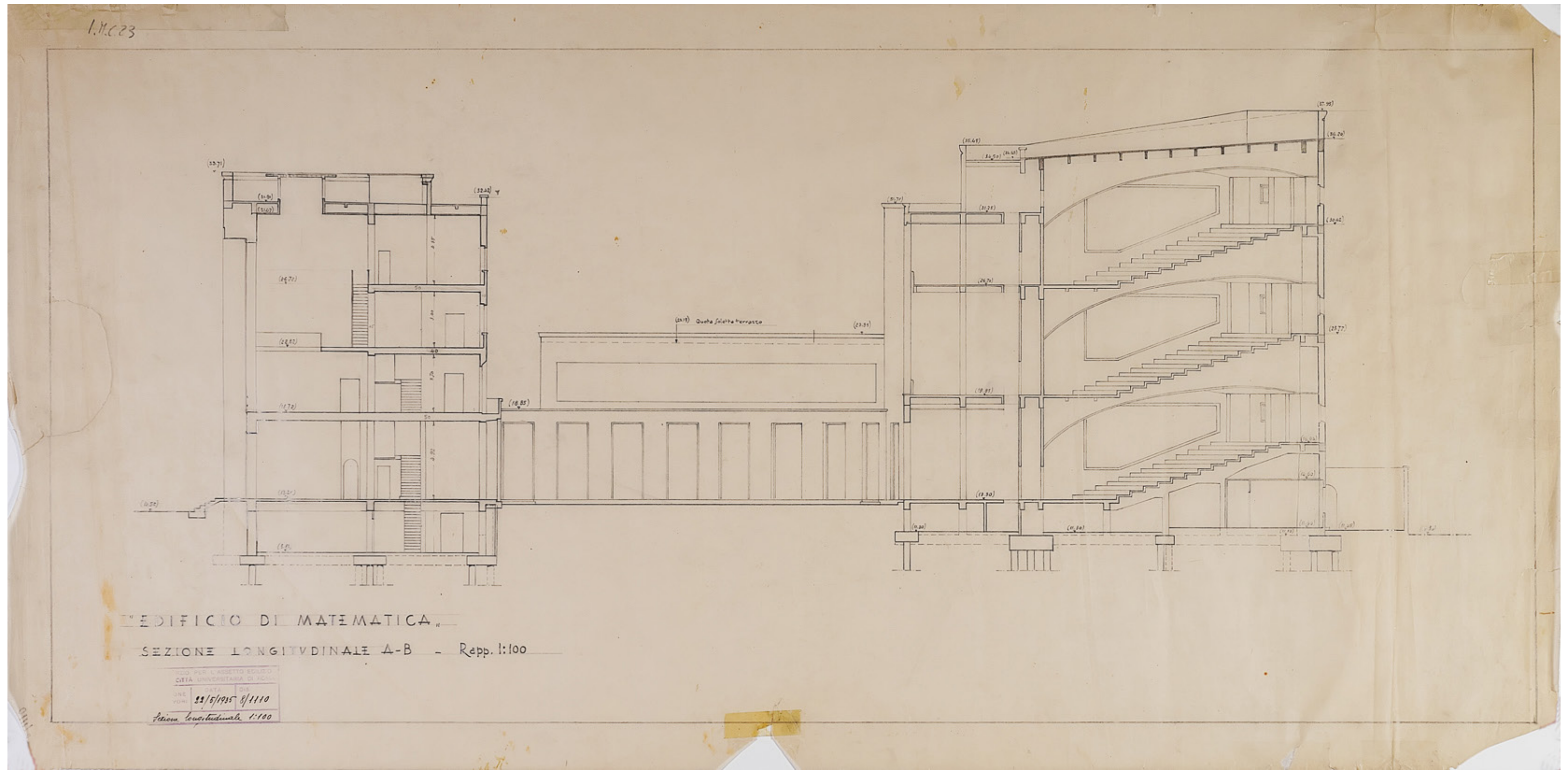


Figure 33 - "Longitudinal section" of the School of Mathematics, March 25, 1935 (ASS_drw_58)

Figure 34 - Aerial view of the university campus, 1935 (BBL_pht_14)

tions with which the company asks for an increased payment in December 1937, due to the rush in finishing the works, which required more time and effort. These observations are only in part accepted by the client, fuelling disputes that last until March 1939, supported by a general tendency to keep the costs low. In this occasion Adriani complains about the «lack here in Rome of (Ponti's) artistic direction, which often resulted in significant delays in the many decisions regarding the finishes» (ASS_dcm_208, ASS_dcm_209)[31].

A similar delay in payments to companies, which triggered a series of disputes, also occurred with the payment of the architects, responsible for the artistic direction of the projects. On July 19 1937, pressed by the architects' requests, Piacentini asked Rector De Francisci to pay them a higher compensation, no longer calibrated on the estimated cost but based on the works actually carried out (more expensive than expected). The request was rejected at first, such that Ponti contacts the Rector personally, as a well-known friend; but De Francisci opposes the financial problems of the consortium to his request. Following a series of reminders of Piacentini, these remaining sums were paid at last in December 1937 (ASS_dcm_179, ASS_dcm_186, ASS_dcm_193)[32].

Plaques, tombstones and busts of illustrious mathematicians- such as Alberto Tonelli, Nicolò Copernico, Barnaba Tortolini- were placed at last in March 1939 to complete the building. These monuments, relocated from Sant'Ivo alla Sapienza to the university campus, in agreement with the Antiquities and Fine Arts Superintendence, were placed along the corridors of the curved wings and near to the tower of classrooms (ACS_dcm_26) (Figure 36).

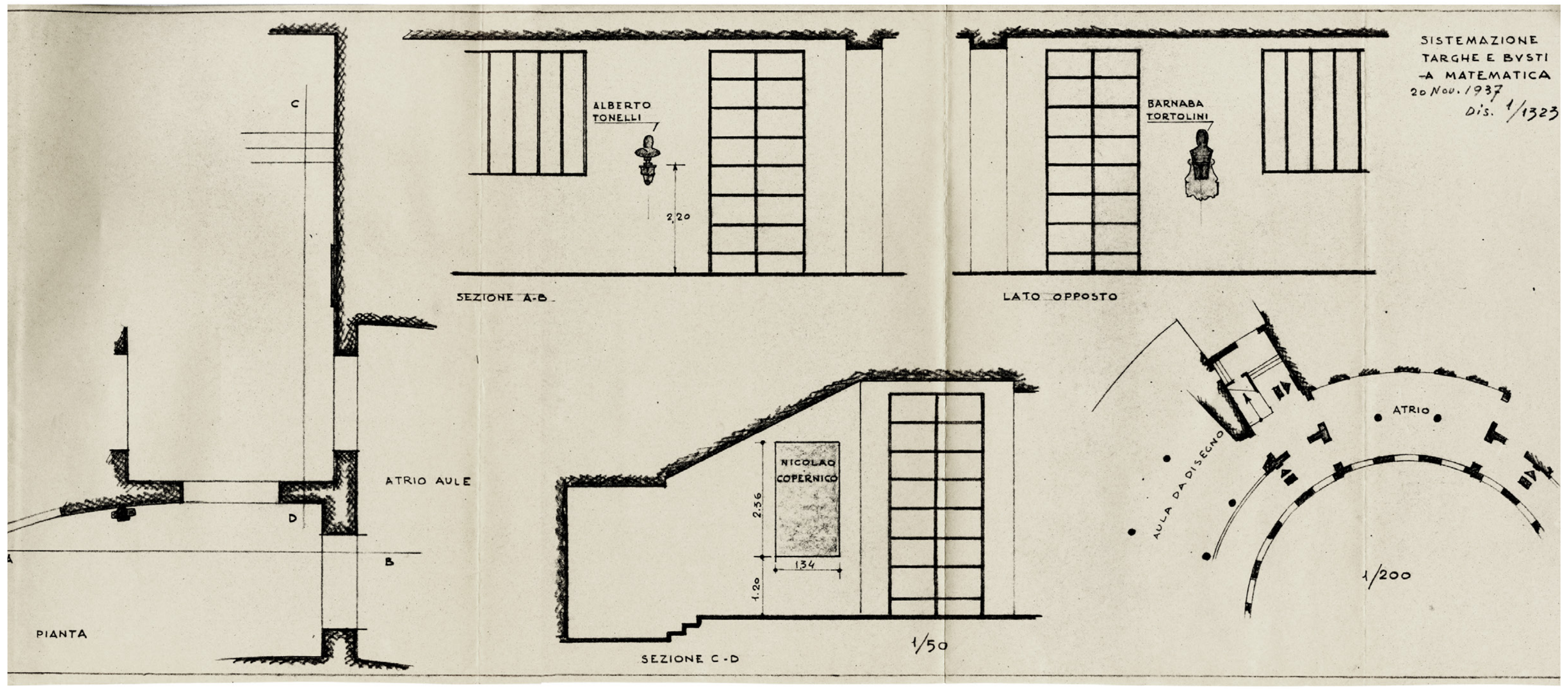


Figure 35 - Aerial view of the university campus in the Fifties (ICCD_pht_01)

Figure 36 - Details of the arrangement of plates and busts in School of Mathematics, November 20, 1937 (ACS_drw_03)

FURNITURE AND INTERIORS, A NEVER-ENDING STORY

Flaminia Bardati *

* Chiara Turco has also contributed to this part of the research

In a letter to Mussolini of October 10, 1933, relating about the works at the university campus, Rector Alfredo Rocco expresses his concern about the delays and the very high costs of such a huge project. Beside expropriations and foundations, both much more expensive than expected, a main reason of the increase of the construction costs is furniture. Deans and professors ask for more and more interior equipment, especially for the scientific institutes. «The problem of the furniture, perhaps not sufficiently evaluated when the estimate was made, deserves the greatest attention», states Rector Rocco (ACS_dcm_16). Yet, ten days later, the University Board of Governors approves an estimate that does not include expenses for furnishings (ASS_dcm_46).

Within this context, the construction of the School of Mathematics seems to start without any explicit mention of furniture, until May 1935 when the sum allocated for the furnishings amounts to 730.000 lire, of which 250.000 lire for students' desks- which had already been ordered- 280.000 lire for the library, 52.000 lire for the drawing tables and 148.000 for 'common furnishings', not yet commissioned. This list is followed by a short note about the delay in the construction of the building and the promise to end by October, if the furniture will be ordered by the month of July (ASS_dcm_53).

As the interior doors were closely related to the construction, their order was slightly advanced: most of them were commissioned to the company Curti (metallic doors of the corridors) on June 4, 1935 and to the company Cantieri Milanesi before August 2, 1935 (wooden doors) .

Despite what written in May, the first specific mention of furniture dates September 9, 1935 and concerns the rows of curved desks for the Tower of classrooms (Figure 1) and bookshelves on the balconies in the library (ASS_dcm_72). The desks, completed with seats, were ordered to the company Liporesi, that had already provided a similar model for the buildings of Letters and Law, where the desks were however are not curved. Even if the bowed shape required more work, the Administration obtained the same price, but Ponti asked to further modify the height of the backrest, from 27 to 34 centimetres; consequently, the company increased the cost of each item of 143 lire[33]. Similarly, the architect proposed further variations concerning the bookshelves and the balconies' handrails, commissioned to the company Parma. Not surprisingly, these are fixed furnishings, strongly integrated with the architectural design and Ponti intended to maintain complete control on each detail.

On October 1, 1935 the company Santi was committed with the production of the well-known system of teachers' desks, which integrated footboards and blackboards, destined to the classrooms of the front building and to the tiered lecture halls of the Tower of classrooms (Figure 2). Santi also provided the footboards for the drawing classrooms, the huge tables of the library reading room and several other minor woodworks (ASS_dcm_84). At the same date, the company Gaggiottini obtained the order for pieces in Anticorodal, an autarchic light alloy based on aluminium, silicon, manganese, and magnesium, characterised by good resistance to atmospheric agents. These were doorframes and noticeboards, handrails for the staircase in the front building, and the letters to compose the writing "Scuola di Matematica" on the main façade (ASS_dcm_82). Nine days later the company Palazzo della Luce was committed with the supply of lighting fixture for several building of the campus, including the School of Mathematics, yet without specific details (ASS_dcm_85), while the company Parma offered a supplementary estimate for library balconies and shelves, which included the modifications required by Ponti (ASS_dcm_91). In November the lighting fixtures specifically conceived for the library, fixed on the reading tables and on the shelves, and those for the Tower of classrooms were ordered to the company S.A.A.R., which also assured much of the electrical works in the building (ASS_dcm_95).

Notwithstanding, the furniture of the School of Mathematics was not complete on the day of the inauguration, October 31, 1935, as the main supplies of furnishings date back to 1936 (Nicoloso 2018a, p. 182)[34]. On January 20, 1936 the company Beltrami obtained a new important order concerning the desks for the

Figure 1 - The rows of curved desks in the tiered lecture hall at the second floor of the Tower of classrooms (© Salvo 2021)

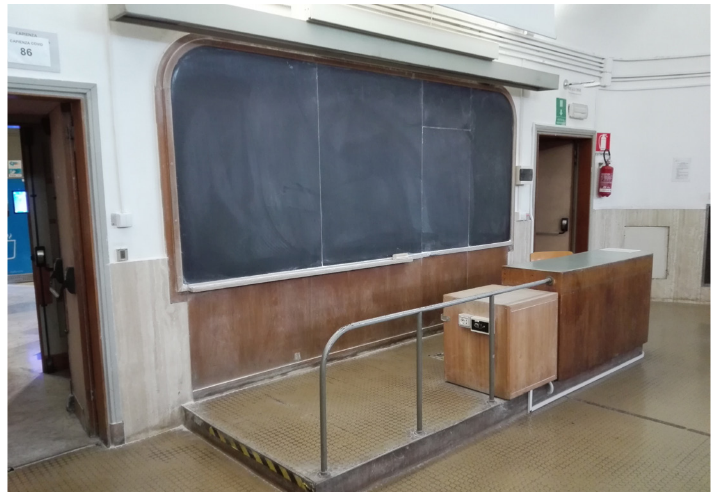


Figure 2 - The system that assembles teacher's desk / railing / footboard / blackboard and wooden wall covering of the right tiered lecture hall at the ground floor of the tower (© Bardati 2020).

Figure 3 - Two-seater desks of the model "Milano" in one of the classrooms at the ground floor of the front building (© Bardati 2020)

Figure 4 - Armchair originally supplied for the Council Hall, currently in a professor studio of the east wing; the "Marocchino" red original covering has been modified (© Bardati 2020)

three classrooms located at the ground floor of the Front building, the drawing tables and two types of stools for the classrooms of the curved wings and the complete furnishing for thirteen professors' offices (ASS_dcm_112). The desks were similar to those supplied for the buildings of Physics, Hygiene and Orthopaedics, ordered on catalogue: the model "Milano", in chromed steel tube, polished oak and Linoleum, for two people, complete of seats. With the exception of the last rows, each table served as the front seat backrest (Figure 3). Of the 72 desks ordered to Beltrami on this occasion, only 31 items survive today in the teaching rooms where they were originally located. 112 drawing boards, complete of stools and 24 high stools for the plaster models were not as lucky, as they have all gone lost during the transformations suffered by the curved wings, fragmented into offices, and classrooms.

The furniture for the professors' offices located at the first floor of the front building included one desk, a small wooden armchair, a rack, a small, squared table and an office cabinet, with closets and open bookshelves. But, as witnessed by further documents, four professors – namely Bompiani, Enriquez, Levi Civita and Picone- requested bigger office cabinets, long as the longer wall in the room (ASS_drw_97, 98, 125 and 126); of these only three small tables and three racks have survived.

In addition to the supply obtained for the library, 8 reading tables and 196 chairs "Model 14" were asked to the company Parma on January 28, 1936 (ASS_dcm_115). On February 24, 1936 a report of the Technical Office underlines the delays suffered by the supply of furnishing for the Institute of Mathematics, pointing out the numerous requests raised by the professors and the necessity to order new items (ASS_dcm_125). Therefore, at the same date, the companies Santi and Beltrami were solicited for several other supplies: Santi for closets and shelves for the drawing classrooms, the professors' lobby and for some offices; Beltrami for the furnishing of the council hall, originally located at the first floor of the front building (ASS_dcm_126). Two huge tables and a small one, 19 armchairs, a canapé and a bookshelf were the main items that furnished the room, but at present only six armchairs survive, modified (Figure 4).

By the end of 1936 most of the rooms were furnished, including the lighting fixtures and some detail elements, such as curtains and doormats. Nevertheless, some supplies were delivered- or paid- during 1937 when other orders had been completed, concerning closets for the professors' offices near the drawing classrooms and the mentioned modified closets for professors Enriquez, Levi Civita and Picone. Furthermore, some a specific treatment was needed after delivery, as in the case of the Linoleum footboards of the single systems "footboard + blackboard + teachers' desk" in the classrooms of the front building and of the tower (ASS_dcm_182).

In April 1938, the entire furnishing is delivered, and all companies fully paid, but the story has not yet come to an end. As the Royal National Institute of Higher Mathematics, IndAM, is founded on July 13, 1939, the need to supply offices and study spaces is again raised. The upper drawing classroom of the west curved wing was chosen as the headquarter of the Institute, fragmented into several little rooms. On this occasion 15 new doors were purchased, made on the original models "B2", "C", "D" and "E" supplied by the company Cantieri Milanesi, as specified in the contract. No news is given nor of the original furnishings, probably moved in the other drawing classrooms, neither of the new items ordered for the IndAM, which today conserves nothing of the facies datable to 1939-1940, except for a big blackboard that belonged to the pre-existing drawing classroom. However, it is possible that some of the existing chairs and armchairs located in other parts of the building, and whose shape, materials and manufacture could date to the end of the 1930s, had been ordered for this Institute.

When Mussolini visited the IndAM on April 15, 1940, his official speech was given in the tiered lecture halls at the first floor of the Tower of classroom, the only hat could offer a seat to a large audience. The railing and desk were removed from the footboard and substituted by a large rectangular table, which probably belonged to IndAM (ASL_vdo_17).

Unfortunately, the air raid on San Lorenzo on July 19, 1943 that hit the campus and damaged thoroughly the stained glass-window on the front façade, and all glazing of the windows of the building, probably also left traces on the furniture.

A report concerning the campus estimates the damages to around 2.631.000 lire (ASS_dcm_228), while Vincenzo Fasolo, Director of the Institute of Drawing, reported that 100 drawing tables and 50 stools with their plaster models were also damaged (ASS_dcm_227). He also noted that it was impossible to give any other clarification but his personal deposition because the furniture was not inventoried. Francesco Severi, director of IndAM, had in fact previously presented a complaint related to the disappearance of several objects after the allied troops had occupied the seat, among which an important typewriter Olivetti. He wrote that some furnishings had been damaged and needed repair, for the sum of 20.000 lire, but without offering further details (ACS_dcm_35). It must be said that during the occupation of the allied troops within the premises of the campus, furniture - especially chairs, armchairs, and tables- may have been moved from the School of Mathematics to other Institutes and vice-versa and it is possible that other pieces entered the building in the post-war years. Yet, at this stage of our research no document allows to identify them .

Further uncertainty regards information concerning furniture gained (and lost) during the second half of the twentieth century. The leitmotiv of this period is a chronic lack of space for teaching, research (especially concerning the laboratory for the huge data processing machines) and professors' offices. As well known, the need of space determined a series of dramatic transformations that modified the building, which has lost its original shape and important functions. These transformations entrained the shift of furnishings and doors, sometimes their loss, and the insertion of new items.

Two doors inspired on the original type "C" by Cantieri Milanesi are datable to 1954, when the professors' lobby in the front building was transformed into two offices (Salvo 2015). It was certainly necessary to purchase furnishings for these studios, but there are no traces of supplies, as in the case of the original furniture of the lobby and the wall lighting fixtures of the same type and dimensions of those still existing in the library (Figure 5).

During the students' protests of 1968, chairs and armchairs similar to those that in the School of Mathematics were photographed by Rodrigo Pais in the entrance of the Institute of Letters (BUB_pht_10, BUB_pht_11), while several desks of the "Milano" model (BUB_pht_03) are portrayed in the same place or perhaps in

Figure 5 - Four of the original six wall lights of the library, supplied by the firm Bianchi in 1935 (© Sardo 2021)

that of the Institute of Law (which is semisymmetric). Again, thanks to Pais's documentation, we have evidence of a table similar to those of the library reading room, used to build barricades in the corridor connecting the building of Law and that of Political Sciences (BUB_pht_08, BUB_pht_ 09). Since same companies had been employed to furnish most of the Institutes, it is very difficult to determine if the furnishing portrayed in these pictures belonged to Mathematics, or if it was shifted to the building once order has been restored.
However, the works to enlarge the building of Mathematics and the renting of some rooms in the seat in via Vicenza undoubtedly mark the beginning of a new phase of furniture supplies. Six offices were obtained in the new additions flanking the front building, which needed new furnishings, but no document allows to pair them with the present objects in the same rooms. New supplies were necessary also for the classrooms in via Vicenza, where on July 17, 1970 some chairs had been delivered, while most of the furnishings was still to be ordered (ASS_dcm_268). We have no drawing or picture showing shape and materials of these chairs.

Despite the rent of the seat in via Vicenza, in the 1970s the lack of room for teaching and, most of all, for the offices, determined the choice to subdivide the drawing classrooms of the Institute of Drawing in the curved wings. The original furniture of the drawing classrooms went completely lost on this occasion, together with 22 wall lighting fixtures of the ground floor corridor, purchased from the firm Bianchi (ASS_dcm_159). They are visible in the shooting by the Istituto Nazionale Luce during the visit of the Libyan notables in 1936 and in the pictures taken of the newly completed building.

Without going into the details of the bureaucratic slowness that characterised the transformation of the building, neglecting the historical-critical assessment about the legitimacy of such interventions, it is important to fix some reference points regarding the purchase of new furniture and doors in these years.

A decision of the University Board of Governors of May 28, 1976 does not mention furniture (ASS_dcm_283). In June 1978 the first floor of the east wing, divided into professors' and staff's offices, is ready for use, such that doors and furnishings should be in place, while the works at the ground floor of the west wing are over but no furniture has been supplied. Documents offer no detail about type and shape of furniture. The works concerning the ground floor of the east wing, where five classrooms were being set up, were starting and the Works Committee of the School of Mathematics considered the furniture a dramatic problem (ADM_dcm_01). An estimate of the costs dating December 26, 1979 lists several works including the supply of new doors, again copying the models of the original doors originally supplied by the firm Cantieri Milanesi, using only pitch-pine or fir for the doors and oak for the frames (ASS_dcm_288). Only two documents mention a supply of blackboards (ASS_dcm_290) and of lighting fixtures (ASS_dcm_300).

The 1980s began with a message of the Rector Ruberti, announcing that from July 1981 the ordinary upkeep of the campus (buildings and furniture) would have been entrusted to the Consorzio Artigiani Universitari (ASS_dcm_301). Together with the cease of the contract with via Vicenza and the transfer of many professors to new offices, such new modality of upkeep shuffled the cards in the shift of furniture within the buildings: above all, repair and maintenance interventions have profoundly altered the appearance of the pieces.

Finally, compliance to safety rules and the insertion of technological devices are still today perpetuating the undaunted decay of the original and quasi-original furniture pieces. And the story is not yet over, unfortunately.

ALTERATIONS, MODIFICATIONS AND ADDITIONS

Marianna Cortesi, Simona Salvo

THE VERY FIRST ALTERATIONS

The School of Mathematics underwent several alterations over a period of time, depending on the different requirements that arose over the years. Mere functional needs initially triggered the division of the rooms, the reduction of the triple height between the library and the professors' lounge, the breaking up of the drawing rooms, the division of one of the tiered lecture halls, and the extension of the curved wings.

Starting in the Eighties alterations were made in order to comply with safety regulations, achieve energy efficiency, and eliminate architectural barriers.
The Nineties saw a timid inversion of this trend, based on a more sensible approach and an initial assessment of the historical and architectural value of the building; it started with the celebration of the 50th anniversary of the campus in 1985 and the protection decree in 1989[36].

As soon as the building was completed, new functional needs emerged, requiring more changes to the building, starting with one of the drawing classrooms in the right wing (room III). This first alteration led to "the fall of the aura" of the building, i.e., the first of many other changes in the layout of the original spaces designed by Ponti.

When the IndAM was founded in 1939, Francesco Severi requested it be assigned rooms in the School of Mathematics[37]. The extension was entrusted to the Catola company; it consisted in a partial elevation of the existing building which was to be equipped with metal window frames created by altering portions of the original windows. The first floor of the front building was also connected to that of the curved wings.
To obtain spaces and offices for the new institute, one of the drawing rooms was divided by building perforated brick partitions clamped to the existing walls. Work started on May 11, 1939 and was completed, on schedule, three months later on August 9, 1939 (ASS_dcm_210, ASS_dcm_211).

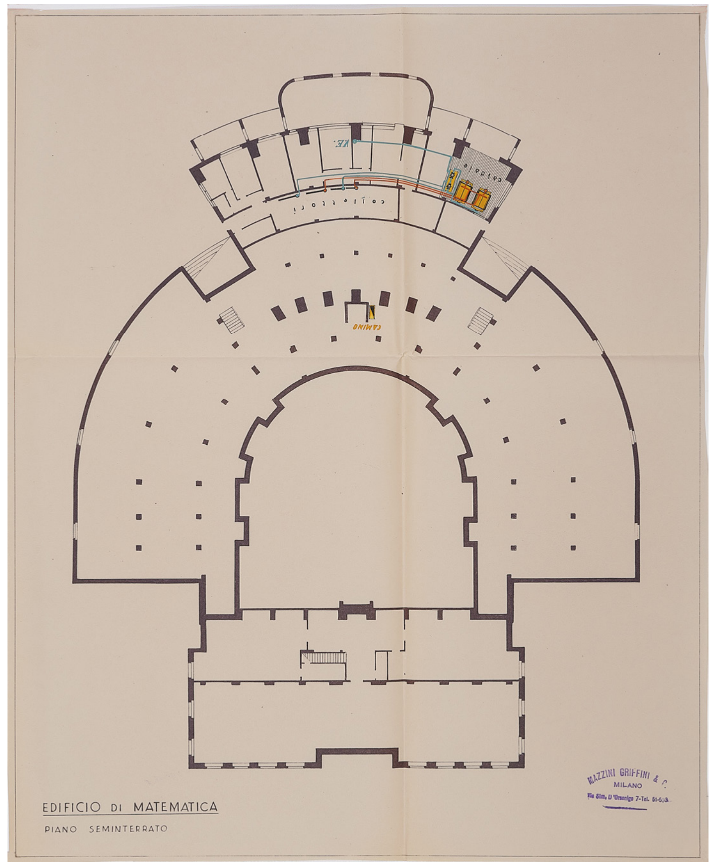


Figure 1 - "Basement plan" of the Mathematics building indicating the intersection between the independent and centralized heating plant, 1942 (ASS_ drw_131)

DURING WORLD WAR II

In March 1942, in the middle of World War II, the Technical Office requested the Mazzini & Griffini company to submit a project for a new thermal power unit so that the heating system of some buildings on campus could be separated, including the system in use in the Mathematics building (ASS_ dcm_219). The company designed an independent radiating heating system connected to the existing central plant; it also supplied mechanical coal burners that had already been tested in the boilers of the Polyclinic's heating systems. In addition, the company signed a maintenance contract for these systems lasting from December 1942 to November 1943, to be renewed annually (ASS_dcm_221).

On July 19, 1943 the campus was hit by allied bombs targeting the nearby central railway station. The bombing proved fatal for the Chemistry building adjacent to the Mathematics building: the explosion destroyed all the glass windows nearby and probably the decorated stained-glass window of the School of Mathematics. There is no proof that this artwork was destroyed, but it is very likely that it broke into pieces; the metal window frame, however, remained intact, and is still in place today[38].

REPAIRING WAR DAMAGES

After the bombings, numerous reports about the state of the building and furniture were necessary to quantify the damage and estimate costs and time for repairs. In a report addressed to the Patrimonial Heritage Offices, the School of Mathematics appeared to have suffered “no damage whatsoever” (ASS_dcm_230). In the list “War damage. List of buildings”, the School of Mathematics was instead defined as “damaged but not destroyed” like other buildings; the estimate of the damages- basically the loss of most of the glass- amounted to 2,631,000 lire (ASS_dcm_228).

In Guidi’s report regarding the situation of the campus on August 30, 1943, he stated that “the damage suffered (by the School of Mathematics) is very serious; by the beginning of November it will be possible to use the classrooms and two of the drawing rooms. Note that the building is full of a huge amount of broken glass and, therefore, if new windows are not provided, the Institute will be completely unusable” (ASS_ dcm_224). A chart attached to the report quantified the amount of broken glass in each building that needed to be replaced: the School of Mathematics appeared to be filled with 1300 square meters of broken glass (ASS_ dcm_225): to ensure the reopening of the School of Mathematics in the month of November, new glass had to be supplied, although the heating system was still not working.

From 1939 onwards, the CERUR Consortium, under the direct supervision of the Civil Engineers Corp, was responsible for carrying out work on the university campus. Since the work was financed by the Government, it was the CERUR Consortium that made the payments and was later reimbursed by the Ministry of Public Works.

Thanks to an agreement signed in August 1943 this agreement changed after the war damages were repaired. In October 1948 the contracts were signed directly by the Civil Engineers Corp, so it was no longer necessary for the Consortium to make advance payments. The total amount paid to contractors and suppliers by the Consortium amounted up to 14,672,000 lire. (ASS_dcm_234). However, the Consortium was responsible for site management and, therefore, the payment of a 2% sum to the professionals in charge of the project. (ASS_ dcm_231). The companies that repaired the damages to the School of Mathematics were: “Ditta Fiorentini Gino” (responsible for major repair works with a contract dated February 3, 1948, regularly and timely carried out by August 7 of that same year), and the “Dalla Betta Antonio” Company. The Consortium called on several firms to supply the glass that was needed, including: The Glass, Balzaretti & Modigliani (for the supply of Termolux), Pietro Sciarra, Casarosa, Magazzini generali specchi cristalli e vetri, and Fiordalisi & Rando.

Figure 2 - The School of Mathematics around 1950 (ICCD_ pht_03)

INITIAL MAINTENANCE

On December 12, 1953, one month after Guido Castelnuovo's death, the School of Mathematics was named after him. To celebrate the event an inscription replaced the three fasci littori that had previously decorated the entrance of the front building. The symbols of the Regime that were present throughout the campus were removed after the war; an old photograph testifies to the removal of the fasci littori and the insertion of the inscription dedicated to Guido Castelnuovo.

Again in 1953, maintenance was still underway to repair the damages caused by the war, including the road network and the central square of the campus; this work was necessary because the International Congress on Surgery was scheduled to be held on campus in the first half of the Fifties.

In November 1958 the Zaccherini company was commissioned the maintenance of the roof of the School of Mathematics. The work consisted in demolishing the old surface, covering the new surface with a layer of pitch, and then adding white grit tiles; the work also included repainting the vertical walls of the terraces and renovating the electric and hydraulic systems (ASS_dcm_237).

The Litoceramica cladding of the façades of many buildings on campus had either been damaged, broken or was missing. The Litoceramica cladding of the inner façade of the School of Mathematics had also been affected by the addition and extension of the curved wings in 1939. The Technical Office had therefore considered restoration, requesting the Piccinelli company to provide a new supply of Litoceramica bricks in the original "Yellow Rome" color to repair the buildings on campus, including the School of Mathematics: in 1959 an order went out for a supply of 7,500 normal grooved pieces and 300 corner strips, ensuring continuity with the ongoing construction work on the university campus[40].

While the maintenance work was still ongoing further alterations were made to solve the urgent problem of space since there was a lack of classrooms and offices for the professors[41].

The additional space was created by inserting floors and partitions, dividing the big, original rooms and halls designed by Ponti into smaller ones. In 1954, the triple height library that ensured a direct link with the professors' lounge was divided by inserting a horizontal division to obtain additional offices on the first floor (Figure 3). During the Sixties the tiered lecture halls on the second floor of the tower were divided into two smaller classrooms (Salvo 2015, p. 193, Mornati 2002 pp. 70-71).

By the end of the Sixties the roofs of the School of Mathematics, like those of many other buildings on campus, were covered in waste materials: rubble, debris, dust, garbage, pine needles, leaves and pigeon nests; if not properly removed, this waste would have clogged the drainage systems. The Tirelli company tasked with removing it was already responsible for the roofs of the School of Mathematics for a total of 132 square meters of the front building, 1,400 square meters of the curved wings, and 572 square meters of the classroom tower (ASS_dcm_258).

In August 1968 the Società Condotte d'Acqua di Roma was entrusted with the construction of the new Physics Building in the empty lot to the left side of the School of Mathematics (ASS_dcm_261)[42].

Figure 3 - A view of the front building in the Fifties showing the separation between library and professors' lounge, through the big center window (ICCD_pht_02)

Figure 4 - The construction site of the new Physics building; on the left, the School of Mathematics with scaffolding around the newly-built extension of the curved wings, 1968 (ASS_pht_11)

ADDITIONS

In 1969 the Institute of Mathematics underwent further, significant alterations. The need to compensate for the lack of space led to two different solutions: an extension was added next to the curved wings and some of the activities of the Institute of Applied Mathematics were relocated to the Faculty of Engineering in via Scarpa. Both projects required building permits from the Municipality of Rome, and approval by the Civil Engineers Corp. In February 1972 the Ministry of Public Works finally granted the authorization together with that of the Municipality of Rome, the Prefecture, and the Superintendency (ASS_dcm_273); the relocation in via Scarpa was entrusted to the Impresa MIT-CO company in June 1972 (ASS_dcm_276). The extension of the curved wings was approved notwithstanding the fact that the special Technical Committee (members included Giuseppe Nicolosi, Gaetano Minnucci, Armando Egidi, Alberto Della Seta, Marcello Paribeni, and Enrico Mandolesi) had expressed its concerns about the project, claiming that "the additional building on either side of the front building eliminates the entrances and does not appear to be in line with what was presumably the architect's intentions, i.e., to separate the front building from the curved ones at the rear, originally separated by a significant joint". The Committee added further remarks to its critique which, nevertheless, acknowledged Ponti's work; the remarks focused on the estimated costs exceeding 100 million lire, so high that the Superintendency for Public Works had to be consulted (ASS_dcm_275). The work was entrusted to the CO.MA.GE company in January 1974; the contract totaled 59,300,860 lire and envisaged the construction of the two extensions within 18 months (ASS_dcm_282).

Steel IPE and HE profiles were used for the load-bearing structure instead of reinforced concrete, as envisaged by the project. The foundations were drilled on single-bladed rotary piles with a diameter of 80 centimeters, instead of percussion drilled piles with a diameter of 37 cm, as in the original project. The envelope was built using "Leca Blocks" to create a double prefabricated concrete and pumice wall (ASS_dcm_299).

In September 1975 the director of the Institute of Mathematics, Lombardo Radice wished to rearrange and divide the rooms occupied by the Institute of Drawing located in the curved wings. This involved reorganizing the unused space and dividing the other rooms adjacent to the IndAM, where the offices and classrooms were to be located (ASS_dcm_283)[43]; on October 10, 1976 the CO.BUT.GE. contractor was awarded a contract for this additional work.

During implementation several changes were made to the project for economic reasons and to save time: the envisaged traditional, solid masonry partitions were replaced by lighter prefabricated partitions, i.e., metal warping and plaster-asbestos panels; the false ceiling was also built using sound-absorbing plaster and asbestos panels; service areas for teachers and students were also added (ASS_dcm_287).

Dividing the curved wings also involved inserting parapets in the full-height iron windows of the curved wings that either faced outwards or onto the courtyard (Mornati 2002 p. 71). The director of the Institute of Mathematics, Francesco Scarpini, turned to the same company (CO.BUT.GE.) to complete the construction of the side extensions and repaint the exterior surfaces of the curved wings and tower, so to create a certain uniformity between the buildings that existed and the ones that had been added. The use of plastic quartz-based paint, indicated in the proposal, was customary at that time[44] (ASS_dcm_289).
The company was also responsible for: reshaping the sidewalks and the edges of the garden adjacent to the curved wings; replacing the entrance to the new ground floor classroom; and repairing the marble floor in the central corridor between the two sides (ASS_dcm_291). Other works involved soundproofing the computer centre and opening a safety door as well as two windows in the ground floor bathrooms of the front building (ASS_dcm_293).

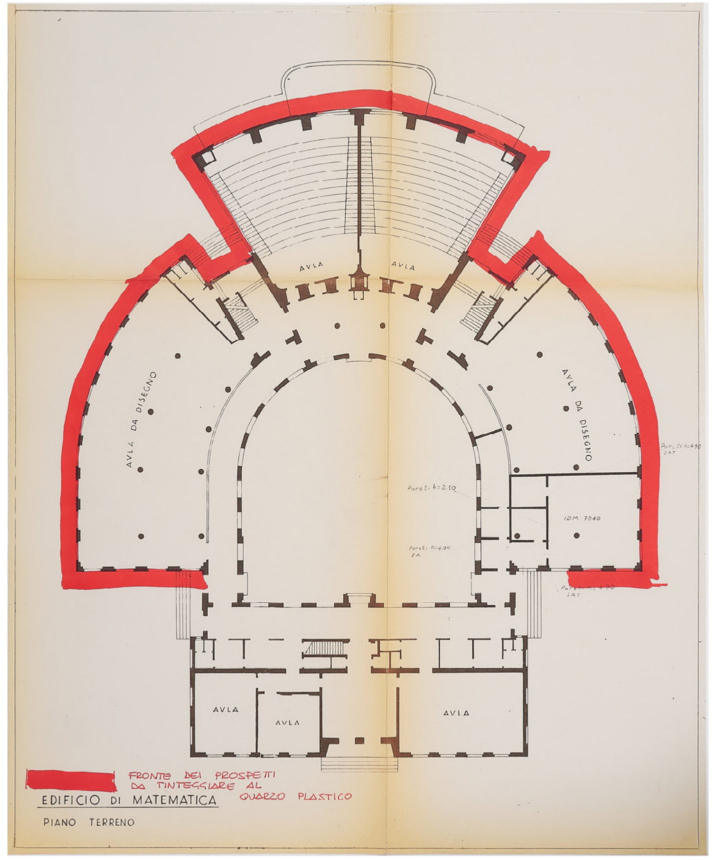


Figure 5 - The ground floor of the School of Mathematics; the bold red line indicates the surfaces to be repainted "with plastic quartz", 1980 (ASS_drw_162).

REGULATORY COMPLIANCE WORKS

Following enactment of Law n. 13 of 1989[45] regarding the elimination of architectural barriers, the Rector Antonio Ruberti instructed the Technical Office to apply these rules when designing new buildings or during renovation, thus raising the awareness of all stakeholders (ASS_dcm_302). This resulted in the insertion of panic handles on all outer doors of the building; in the classroom tower on the first floor, doors with panic handles replaced and enlarged the existing ribbon windows, creating unusual "T" French doors.

Between 1983 and 1984, in the wake of the "computer revolution", a Computer Laboratory was created in the basement of the front building. The room was reorganized and divided up; safety staircases and entrances to the basement rooms were added, and windows were accordingly made usable. Filling the basement rooms with natural light involved a series of interventions in the courtyard, the insertion of concrete glass skylights, and the revision of the courtyard paving where the grass between the irregular travertine slabs was replaced with concrete. Finally, in order to comply with fire prevention Law n. 818 of 1985, three inelegant fire safety stairs were installed in the courtyard, the largest of which had a reinforced concrete core with an elevator (Mornati 2002 p. 71, Mornati 2001 p. 291). Inserting the stairs involved changes to the big central window of the classroom tower and the creation of corridors on each floor.

The 50th anniversary of the campus was celebrated from June 29 to November 15, 1985. The exhibition organized by each department and by the Institute of History of Medieval and Modern Art (Faculty of Letters), in collaboration with the National Gallery of Modern Art and the Department of the Municipality of Rome, was an opportunity to rethink the artistic potential of the campus: it reflected a new-found awareness towards the importance of the historic, artistic, and architectural heritage of Sapienza university.

Figures 6/7 - The inner courtyard of the School of Mathematics in the mid-Eighties when the joints between the travertine slabs of the paving had just been filled with concrete (BFAR_ pht_04, BFAR_pht_05)

THE CLEANING AND CONSERVATION OF THE MARBLE SURFACES OF THE ENTRANCE HALL

On August 2, 1989 the Ministry of Culture issued a protection decree declaring the “specific historical importance” of the campus according to Law n. 1089 of 1939 on the protection of objects of historical and artistic significance[46]. And yet, invasive and irreversible transformations had already taken place. The effects of the protection decree were not immediate, so much so that in March 1990 the Technical Office drafted invasive projects to implement the use of the building; the work consisted in creating a mezzanine floor for shelving and cupboards in the curved wings, an assembly hall with 400 seats in the courtyard, a huge canopy to close this open space, and a room for systems and archives in the basement. Fortunately, this project was not implemented.

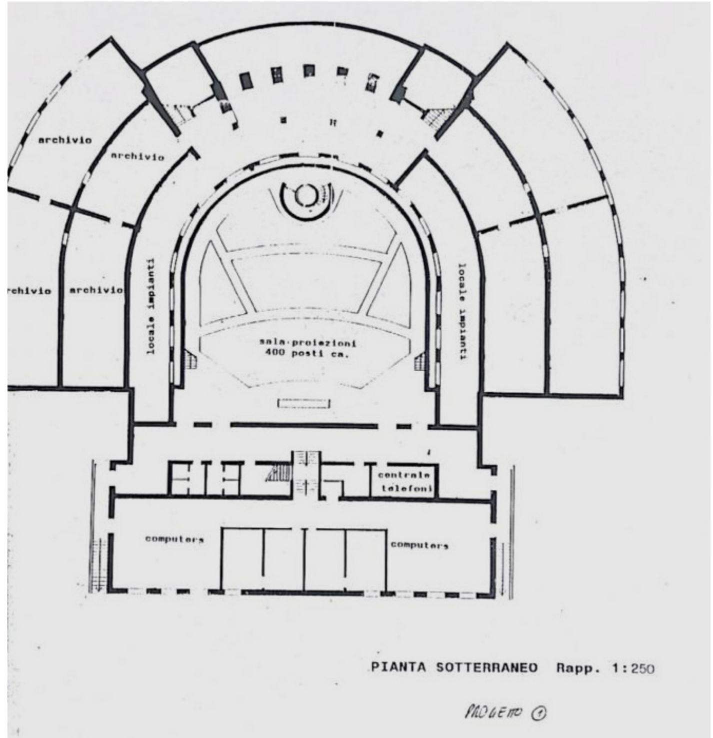
In the mid-Nineties this trend began to be less radical, and projects started to focus on conservation and restoration.

In 1994 Carla Giovannone, a professional conservator trained at the Institute for Conservation and Restoration, was tasked with cleaning and protecting the marble cladding of the entrance hall of the front building (Giovannone 1994); this was an opportunity to also remove the porter’s booth possibly placed there in the Seventies (ACG_pht_01). Adding the canopy over the skylight of the library to prevent infiltration also dates to that period: the canopy, a pitched metal and glass roof, proved to be unsuited to the skylight and was removed in 2012 (Salvo 2015 p. 196).

In 1998 new regulations made the 80 cm handrails of the library’s balconies illegal: the height of the handrails was increased by installing a metal and wood addition (De Cesaris, De Sanctis, Ferri, Marucci 2004).

In 2002, the Management Office decided to replace the deteriorated window frames and glass of the curved wings, which in turn had replaced the original materials provided by Balzaretti & Modigliani to repair the damages caused by the war. The objective was to reproduce the design of the original metal windows; however, the “Termolux” glass was replaced by double opaque glass (Mornati 2002) (Figure 10).

In 2005, the opening between the mezzanine floor and the library reading room was recreated, re-establishing part of the visual connection between one side of the building and the other[47].



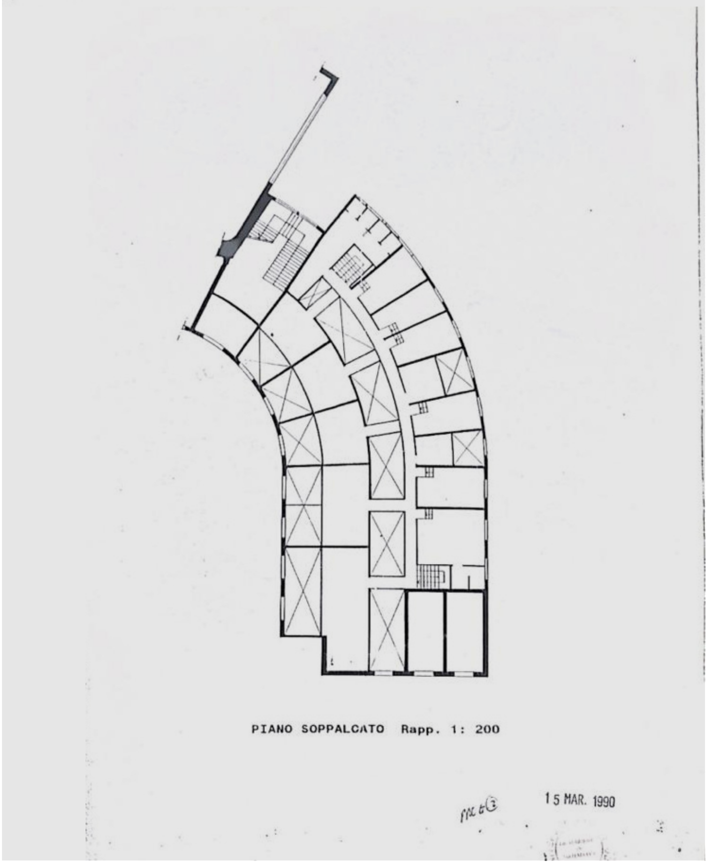


Figure 8 - Project for an assembly room created by excavating the inner courtyard of the School of Mathematics, 1990 (ADM_drw_04)

Figure 9 - Project for a mezzanine on the ground floor of the curved wings of the School of Mathematics to create more workspace and a place to store documents, 1990 (ADM_drw_06)

RECENT WORK

In 2012, several interventions were implemented to reinstate the former professors' lounge in the front building, now 'Aula Ponti'. The plasterboard wall that divided the space into two offices was removed and a horizontal window was opened to separate the library from the room so as to recreate seamless continuity between the two spaces that were once joined, albeit only partially (Salvo 2015, ASMS_pht_09, ASMS_pht_16-30, ADM_dcm_14). In 2013 the protective roof over the skylight was dismantled and the roofs were again waterproofed by covering all the surfaces with fiber-reinforced resin, including the glass blocks of the skylight (Salvo 2015).

No significant projects have been implemented since 2013; the only measures that have been adopted involve ordinary maintenance, systems, or energy efficiency (photovoltaic panels placed on the roofs). The most recent intervention (September 2020) involved replacing the circular wooden windows that provide light to the mezzanine floor of the library: as they were damaged by the infiltration of water they have been unfortunately removed and replaced with new ones.

Figure 10 - Scaffolding around the first floor of the curved wings during the replacement of the Termolux windows, 2002 (ASS_pht_23)

Figure 11 - A view of the roof of the front building during the removal of the metal and glass canopy placed on top of the skylight, 2013 (© Salvo)

NOTES

1. Recent contributions include Mornati 1992, 2001 and 2002, Miodini 2001, Barucci 2002, Cerutti Fusco 2003, Bardati 2003, Salvo 2015, Baratelli 2019, Baratelli 2020. Ponti's personality is clearly portrayed in Irace 1988 and 2009. Also see La Pietra 1988, Licitra Ponti 1990a, Arditi, Serrato 1994, Roccella 2009a, and the more recent, Licitra 2020.
2. Building Consortium of the Royal University of Rome, politically guided by the Rectors and technically guided by Marcello Piacentini, named chief architect, and his collaborator Francesco Guidi, named head of Sapienza's Technical Office from the Sixties onwards.
3. The recent exhibition at the MAXXI Museum in Rome has reinserted the School of Mathematics in the compendium of Ponti's work; Casciato, Irace, 2019.
4. Extensive bibliography on Rome's university campus includes Caniggia 1959, Guidoni, Regni Sennato 1985, Mornati 1994-1995, Mitrano 2008, Ciucci 2010, Muntoni 2010, Azzaro 2012, Nigro Covre, Carrera 2013, Di Marco 2016, Portoghesi 2016a, Beese 2016a, Greco 2018, Azzaro 2018, and Azzaro 2020a, 2020b and 2020c.
5. This contribution refers to two publications, Ciucci 2012 and Baratelli 2019, illustrating the history and importance of the development of the area where the university campus was built between 1932 and 1935.
6. The area east of Rome, opposite the seacoast, became the site of systematic territorial alterations between the Twenties and Thirties. The construction of the garden city "Aniene" changed the land value of the stretch between via Nomentana and the city centre; it coupled the substantial expansion of the city along via Salaria and via Nomentana.
7. This is indicated in the 1931 Town Plan drawn up by a commission participated by Giovannoni and Piacentini and presented to Mussolini on October 28, 1930. Obviously, it was a non-choice pending future decisions, which arrived immediately after the area was earmarked to be used as a university campus, indicated by Benito Mussolini on November 4, 1930.
8. This area, far from the old premises of the university at Sant'Ivo alla Sapienza and via Panisperna, meant that all the institutes were to be in one place, according to the so-called 'unitary solution'; the Commission led by Pietro De Francisci (1930-31) estimated that the construction of the campus would cost 70 million lire.
9. "Campo Pretorio" was considered the boundary along which young gangs clashed with one another in order to 'rule' the territory.
10. Giovannoni's role as director of the Higher School of Architecture prevailed in the architectural world from 1907 to 1930, while he was a member of the Commission for the new university campus. His removal as chief architect of this project perhaps represented his most bitter defeat after having been a protagonist in the early Thirties; this was followed by his failed candidature to become an Academic of Italy in 1929 (he was appointed years later in 1934), his resignation as director of the journal "Architettura e Arti Decorative" in 1931, and his failed appointment as Dean of the School of Architecture in 1935. All these roles passed to Piacentini.
11. Nastasi 1998, Dell'Aglio, Emmer, Meneghini 2001, Roghi 2005. Rome's scientific milieu was characterized by a strong disciplinary link between the School of Mathematics, the Faculty of Mathematical, Physical and Natural Sciences, the Royal School for Applied Engineering, and the Royal School of Architecture.
12. The garden area of the Botanical Institute proved to be strategic due to its proximity to other institutes of the Faculty of Sciences and to the School of Engineering in the cloister of San Pietro in Vincoli (ASR_drw_01).
13. Evidence of the relationship between Ponti and Piacentini may be found in Guido Cadorin's frescoes in the Hotel degli Ambasciatori in via Veneto, Rome (1926-1927) where the two are depicted together with Papini in the middle of an elegant crowd; Greco 1985.
14. There is a definite link between this work of art and Ponti's idea of inserting a stained glass window in the façade of the School of Mathematics. Sironi and Ponti were also in contact through Sarfatti's "Novecento" artistic group; both also collaborated at the Triennale. Chiesa was instead a long-time friend with whom Ponti directed Fontana Arte from 1932 onwards; Mannini 2015.
15. It is likely that until May 1932 Piacentini did not know to whom he could assign each project, and that Ponti's work, like that of any other architect, became increasingly specialized between May and June of that same year, ranging from the general urban plan layout to the definition of the assigned building.
16. The patio-portico was highlighted as one of Ponti's typical architectural elements designed during that period.
17. Although the 3,500 lire budget for the building was limited, and did not permit the use of particularly expensive materials, it is interesting to see how Ponti was ultimately able to create solutions for the entrance hall or his huge stained glass window. Coloring, in fact, is crucial in Ponti's architecture, not only for aesthetic reasons, but also for design requirements.
18. Mario Lupano defines this "Model A" (Lupano 1991).
19. Fontana Arte was founded in 1933 by Luigi Fontana together with Ponti as a branch of Luigi Fontana & Co, active since 1881. In 1934 it purchased the atelier owned by Chiesa, who also became the artistic director of the new company (Deboni 2012).
20. Apart from a preliminary visit with Piacentini on April 6, 1932, this is the third of five visits he made: December 19, 1932, January 1933, March 11, 933, September 14, 1933 and September 1934. In May 1935 the Duce attended the "Littoriali dell'Arte e della Cultura" in the unfinished university campus (ASL_vdo_07).
21. Lupano refers to this as "Model B" (Lupano 1991, p. 123), exhibited in May at the Triennale (AST_pht_01).
22. In the final version, the light flooding the book storeroom, located on the top floor, only came from the circular windows overlooking the courtyard.
23. The inauguration of the University campus was instead to take place on October 31, 1935. The School of Mathematics was only completed much later: the first official event is the First Conference of Applied Mathematics on June 3-4, 1936 (Nastasi 1998, p. 327); classes began regularly in the academic year 1936-1937.
24. The reports of the suppliers, Faiella & Rubei, include evidence of semi-double glazing (that differs from double glazing in thickness, which is about 3 mm), half glass crystal (that differs from crystals in that it does not contain lead oxide), grooved glass, common glass plates, diffuser glass sheets, and "Securit" safety glass.
25. The SAAR company, although not the winner, was given the contract for the electrical system of the Mathematics buildings after a proposal by the Technical Office; in fact the company had submitted complete and satisfactory projects for the systems of the other lots.
26. The Vanni company was presumably called directly by the site manager. In fact, the plinth in "marmoridea" is a much cheaper solution than marble and is much easier (and faster) to place on curved walls; it also "corresponded to Ponti's intentions".
27. In September 1935 the contractor Adriani was hard pressed to supply the construction site with iron. To guarantee part of the work in good time, the Site Director called the Botteri company since it had already executed iron works for lot II.
28. In August 1935, Ponti stated, in agreement with the Cantieri Milanesi company, that for the doors described by the words "polished natural wood", the company should use straight grain oak polished with white paint.
29. In 1934 the Parma company had already worked with Ponti to supply benches for the Liviano, the Faculty of Arts building at the University of Padua. The company was asked to draft a final project including the variants introduced by Ponti: reduction of several shelves, new types of railings, etc.)
30. A certification of the building's habitability was issued two years after the inauguration.
31. Adriani asked for an additional payment of 1,18 lire per square meter to cover the vaulted ceilings of the big classrooms with Terranova plaster. In fact, the estimate had been provided taking into consideration a flat ceiling, that was 20% less than the vaulted surface; in addition, the work required special scaffolding and an ad hoc workforce.
32. In the case of the School of Mathematics, the cost of construction planned in 1932 amounted to 3,500,000 lire, while the amount calculated in the report dating June 1935 increased to 4,180,000 lire. As a result, Ponti's compensation, equal to 2% of the expenditure (1% of the budget and 1% of the advisory), should have been 83,600 lire. In spite of the many complaints he made, at the end of 1937 Ponti received a final payment to complete the original sum of 70,000 lire.
33. Most of the doors the Curti company had been asked to supply were delivered in August 1935, and the remaining few in April 1938 (ASS_dcm_ 54, 73, 206), while the Cantieri Milanesi company delivered several doors in November 1936 (ASS_dcm_74, 78, 161). Instead on October 1, 1935 the Botteri company was commissioned two iron doors for the garage (ASS_dcm_81).
34. In the photographs of the inauguration of the campus, on November 6, 1935, the School of Mathematics does not appear very often, but the writing "Scuola di Matematica" is instead visible; (ASL_vdo_09). The 18 letter plaque and, probably, the doorframes leading into the main entrance hall, had been delivered in time for the inauguration, even if the first payment for the works performed by Gaggiottini is dated January 24, 1936 (ASS_dcm_114).
35. Inspection of other buildings on campus to search for furnishings comparable to those in our catalogue was impossible during this research (2020-2021) due to pandemic restrictions.
36. The alterations and additions carried out up to 1982 have been established based on archival documentation (ASS). From 1983 onwards, data comes from the archive of the Department of Mathematics (ADM). The reconstruction of recent and current events, combining data from different sources- such as verbal declarations, photographs, and direct observation of the building- proved necessary for a complete reconstruction.
37. Racial laws came into effect in 1938; Italy entered the war on Germany's side in June 1940. As a result, IndAM's scientific activity was imbued with a strong nationalist spirit, supported by Mussolini who visited the premises in April 1940; this limited all research activities (BBL_pht_36, BBL_pht_37).
38. A document describing the damage to the building lists the dates of the bombings as follows: September 9, 1943 (university campus); February 12, 1944 (Faculty of Engineering); March 18, 1943 (Polyclinic); June 4, 1944 (explosion of ammunitions at Castro Pretorio) (ASS_dcm_228). This sequence of events may have caused further damage to the glass of the Mathematics building, the stained glass window, and all the other fixtures.
39. The special tender specifications by the Zaccherini company mention "special finishings and supplies", suggesting that the reinforced concrete border crowning the parapets was part of the contract. Evidence supporting this hypothesis comes in the form of the words "concrete with tuff pieces" present in the documentation presented by the Zaccherini company (ASS_dcm_240).
40. This is also true for the "Termolux" supplies, for which the Balzaretti & Modigliani company was recalled.
41. The lack of space was an issue often debated by the board of department directors. During a meeting in May 1955, the director of the Mathematics Department, Enrico Bompiani, claimed that teaching space was insufficient and proposed a general review of the current layout of the building with a view to finding a suitable solution (ASS_dcm_235).
42. In October 1972, the Società Condotte d'Acqua was replaced by the contractor Vigevano to complete the construction of the new Physics building.
43. The redistribution project had been planned earlier and approved in February 1971 (ASS_dcm_283).
44. Nevertheless, chemical analysis of plaster specimens carried out by Task Group 3 show no evidence of plastic quartz.
45. Decree of the Ministry of Public Works n. 236 of 1989 implemented the technical regulation in Law n. 13 of 1989.
46. The document refers to buildings and green areas within the campus; at this stage, the campus was still public property owned by the State.
47. This information has been informally reported by Lucilla Vespucci, former director of the library, during an interview in October 2019, conducted as part of this research.

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ILLUSTRATED CHRONOLOGY

Alberto Coppo,
Marianna Cortesi

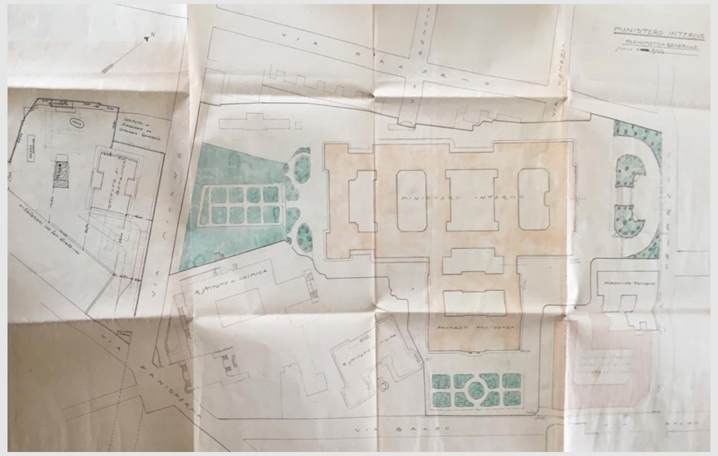
THE PREMISES

After the Unification of Italy in 1871, the Royal University of Rome, which has its historical main seat located in the cloister of Sant'Ivo alla Sapienza in the centre of Rome, seeks a new location, due to the surge of students' enrollment in the early 1900's and to the rise of Mussolini to head of the fascist regime (1922).

In 1909 Rector Alberto Tonelli commits Giuseppe Botto (Civil Engineering), Giovanni Battista Milani and Gustavo Giovannoni (School of Architecture) to design a new general plan to reorganize the many seats of the Institutes spread within the Capital: apart from Arts and Humanities located in S. Ivo, the scientific Institutes are gathered on the Viminal along via Panisperna, the School of Engineering is located in the cloister of S. Pietro in Vincoli, Business in piazza Borghese, and the Academy of Fine Arts in via di Ripetta.

This first plan foresees the location of a campus adjacent to Rome's main hospital, the Polyclicinc, in an area along via Tiburtina near the cemetery Verano. Yet, only a few buildings are built according to this plan, within the area of the current campus, namely the Institutes for Forensic Medicine, Psychiatric Clinic, Anatomy and General Pathology. After many uncertainties and decades-long discussions, the planning of the Ministry of Military Air Force in 1929 in this same area compromises the original plan as it obliterates a large part of the area and its connection to the rest of the city. Then, in 1930 Mussolini decides to destine a smaller nearby area to build the new campus (Di Marco 2012; Di Marco 2016).

Aerial view of Rome in 1919
https://geoportale.cittametropolitanaroma.it/cartografia-storica/20/41/roma-nel-1919



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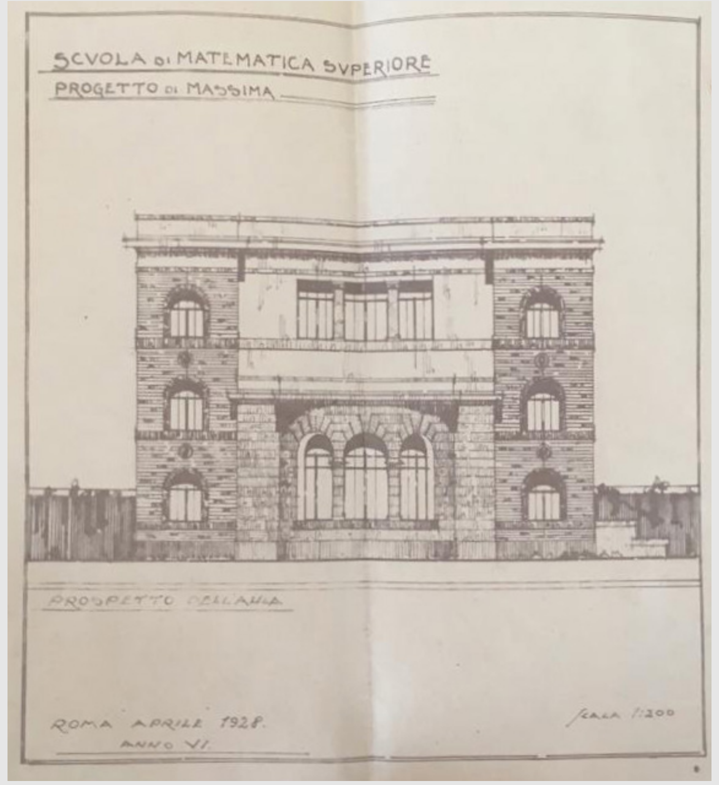

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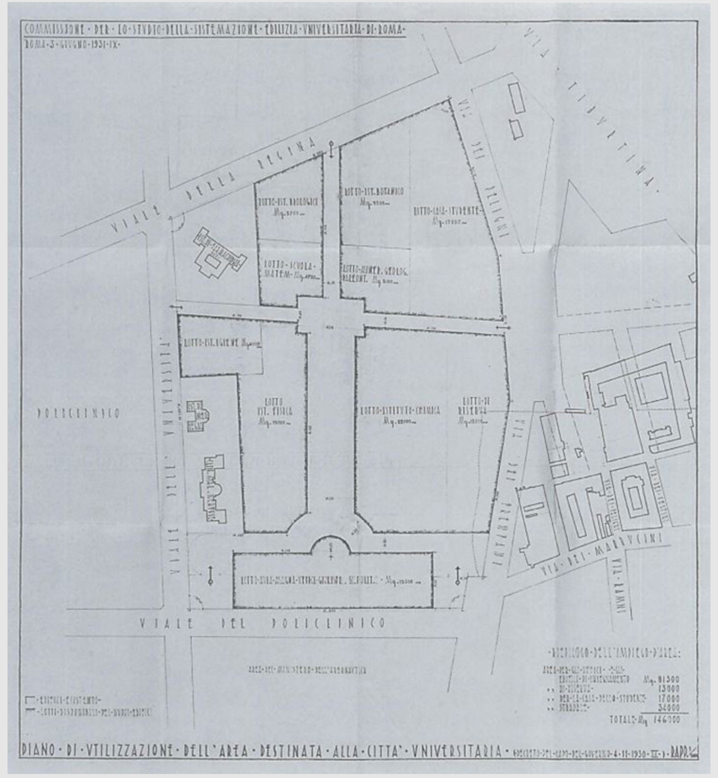


ASS_drw_01

1928, March - Letter from Guido Castelnuovo to Rector Federico Millosevich about the construction of a new building for the School of Mathematics, which should be independent from the School of Engineering within which it has always been incorporated. The area for the new building is located along via Panisperna together with other scientific institutes, such as Physics and Chemistry (ASR_dcm_01).

1928, April - A preliminary project for the School of “High Mathematics” is drawn up by the Civil Engineers Corp (ASR_drw_01, ASS_drw_03).

1928, May 4 - The Civil Engineers Corp advise Rector Millosevich about the approval of the director of the School of Mathematics, Guido Castelnuovo, about the preliminary project for the new building; the estimated costs mount up to 1.2 million lire (ASR_dcm_03).

1930, March - Ugo Frascherelli, Director General of Higher Education, reports to the Ministry of National Education on the project for a new Royal University of Rome. Different solutions are proposed for the planning of a new university campus: the “unitary version” (all institutes in one single area) is excluded, while the “tripartite” one- that is to divide the Institutes into three different areas according to scientific affinity, is preferred; the estimated costs mount up to 35 million lire (ACS_dcm_02).

1930, March - A list of institutes with indication of current locations is drawn up: the Institute of Mathematics does not have an independent seat (ACS_dcm_03).

1930, March - List of necessary interventions for the arrangement of the new Royal University of Rome: the reorganization of the School of Engineering (88 million lire) and the construction of a new building for the School of Mathematics (16 million lire) are included (ACS_dcm_04).

1930, April 14 - The commission for the New Master Plan of Rome begins working. On occasion of its first session, at the presence of Mussolini, divergent positions regarding the location of the new university campus laid out by Giovannoni and Piacentini, clash (Nicoloso 2006, p. 232).

1930, October 28 - Conclusion of the works of the commission for the New Master Plan of Rome, which delivers the outcomes to the Governor of Rome Boncompagni Ludovisi; Piacentini draws up the report.

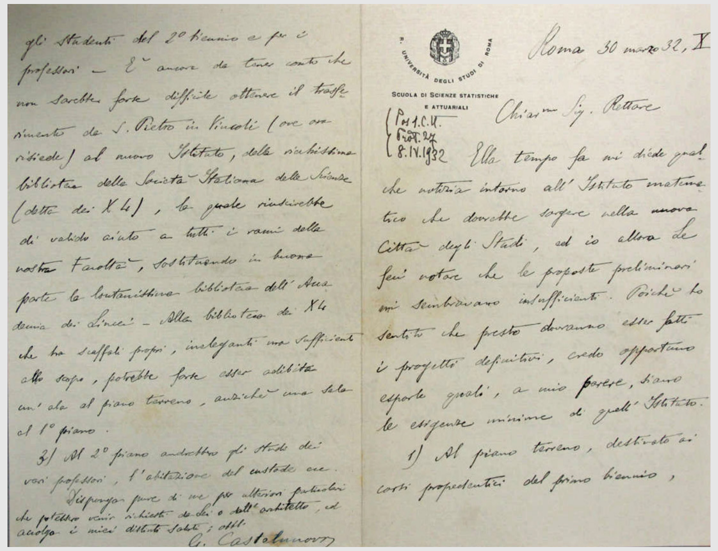
1930, November 4 - Benito Mussolini destines the area near “Castro Pretorio”, between the cemetery and the Polyclinic- to Rome’s new university campus; the bond decree is published the following day (Dell’Aglio, Emmer, Meneghini 2001, p. 63; Nicoloso 2006, p. 232)

1931, March 31 - Inauguration of the II Exhibition of Rationalist Architecture at the Bardi Gallery in via Veneto, visited by Mussolini the day before. Piero Maria Bardi presents here his “Table of Horrors”, which depicts traditional architecture as awful, leading to the opposition between academic architects (Piacentini) and rationalist architects (Pagano, Aschieri and Capponi).

1931, June 3 - First solution for the plan of the new university campus, attached to the report of a commission composed by Pietro De Francisci, Enrico Vallerini, Edmondo Del Bufalo, Ariosto Diotallevi. The plan highlights the layout of crossing aisles that divide the polygonal lot into four areas that connect in the central square, with four different entrances. The lot destined to the School of Mathematics is located in the north-east part, next to the Institute of Biology, (ASS_drw_01; Guidoni, Regni Sennato 1985, p. 30; Azzaro 2018, p. 104).

1931, June 25 - The commission for the new university campus reports to the Ministry of National Education, which states that the “tripartite solution” is not feasible due to higher costs, dispersions, and scarce expandability of the site (ASS_dcm_01).

1931, July 18 - Academic and rationalist architects show signs of detente during the National Congress of Architects. Adalberto Libera and Gaetano Minnucci, albeit reluctantly, dissolve the MIAR (Italian Movement of Rationalist Architects) and Pietro Aschieri is appointed representative of the Union of National Architects, in sign of welcome to younger human resources linked to the Rationalist Movement.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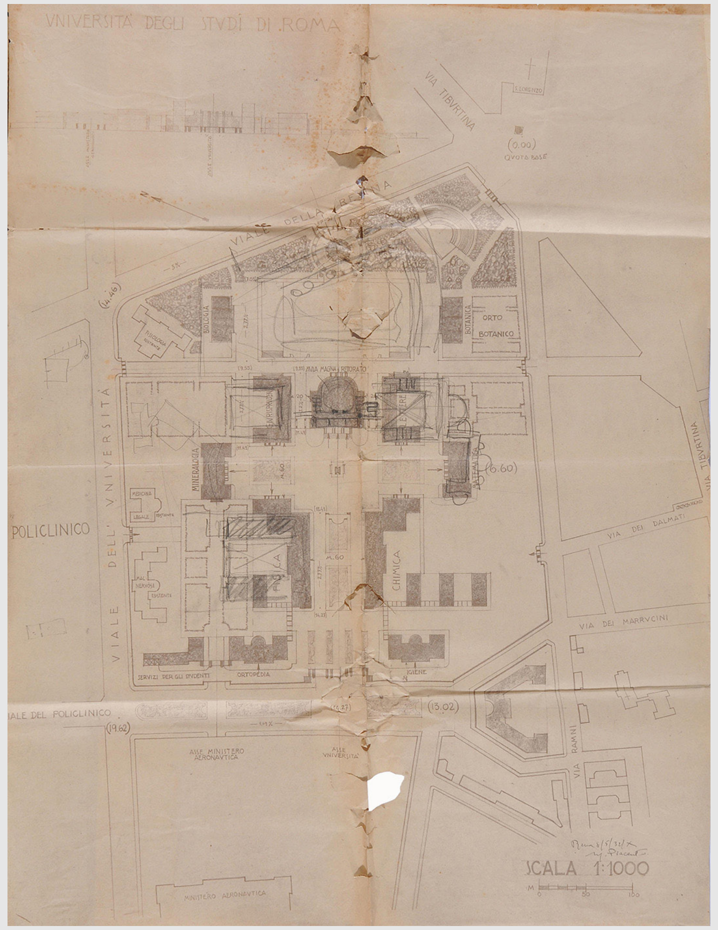
ASS_dcm_02



ASS_drw_02

1932, January - *Architettura*, the official review of the Union of Fascist Architects of led by Alberto Calza Bini, publishes its first issue: Piacentini unseats Giovannoni and takes over the direction of the review. The editorial staff is composed by Plinio Marconi, Gaetano Minnucci, Mario Paniconi and Giulio Pediconi, while Giuseppe Pagano, Adalberto Libera, Giovanni Michelucci and Luigi Piccinato are named correspondents (Nicoloso 2018a, p. 134).

1932, February 18 - Mussolini orders to Balbino Giuliano, Ministry of Education, to display a final project for the buildings of the university campus which will accommodate 10.000 students. Mussolini points at starting the construction in October and schedule the inauguration for 21 April 1935 (ACS_dcm_06).

1932, March 30 - Letter from Castelnuovo, Director of the Institute of Mathematics, to Rector De Francisci lamenting that the proposal for the new building for the School of Mathematics, which is different from the one designed in 1928, appears inadequate (ASS_dcm_02).

THE DESIGN PROCESS

1932, April 4 - The act of founding of the Consortium for the Royal University of Rome- CERUR, is signed. Piacentini is appointed chief architect by Mussolini with the task to design the urban plan and direct the construction site of the campus (ASL_pht_02; Nicoloso 2018a, p. 136).

1932, April 6 - Mussolini visits the area destined to the construction of the university campus, accompanied by De Francisci and Piacentini; the latter presents here his first urban proposal for the layout of the campus (ASL_pht_03; ASS_dcm_03; ASL_vdo_01; Nicoloso 2018a, p. 136).

1932, April 14 - Piacentini appoints Arnaldo Foschini, Giuseppe Pagano, Pietro Aschieri, Gio Ponti, Giovanni Michelucci, Gaetano Rapisardi with the design of the buildings, and traces the first guidelines for the projects, also indicating a brief bibliographical reference (ASS_dcm_04; Mornati 2002, p. 52).

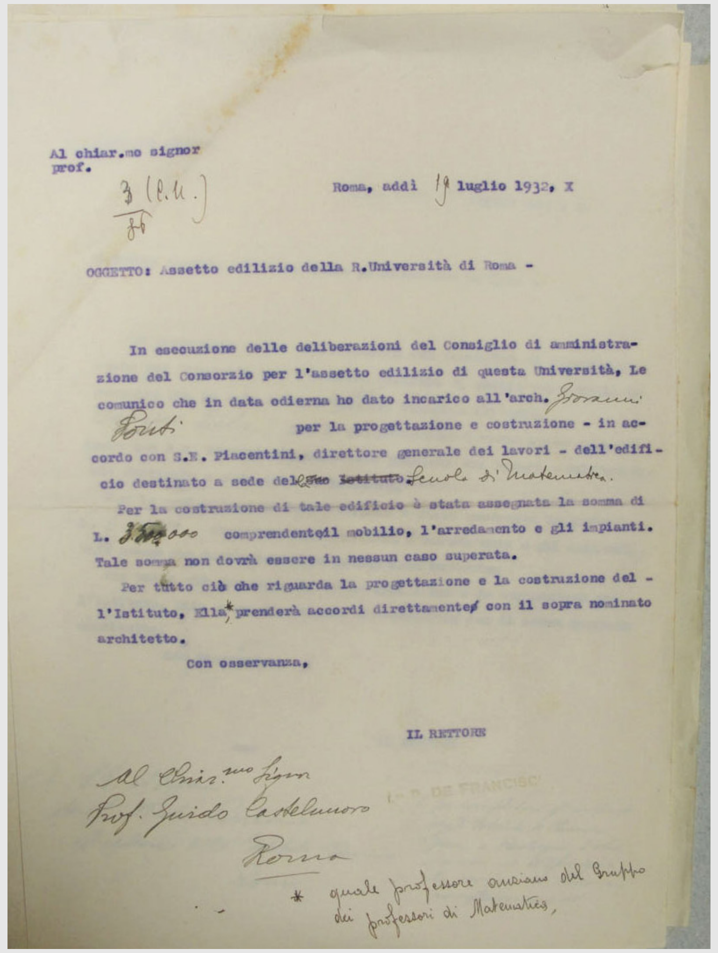
1932, April 24 - Inauguration of the National Exhibition for Building near Porta San Giovanni in Rome, based on a project by Gaetano Minnucci, the first of a series dedicated to the situation of the Italian construction sector.

1932, April 26 - Letter from Mussolini to Ministry Giuliano Balbino, which opposes a clear refusal to Piacentini's first proposal for the layout of the university campus, judged as "excessively decorative and theatrical", and approves a second more essential one (ACS_dcm_08; Nicoloso 2018a, p. 137).

1932, May 2 - Behind Mussolini's recommendation to rely on Italian building materials, Piacentini recommends the use of Carrara marble for the construction of the university campus; the aim is to recover a part of the 70 million lire expenditure that the State has already spent (ACS_dcm_09).

1932, May 8 - Piacentini releases a first "less decorative" plan for the layout of the university campus, where the buildings for Mathematics and Mineralogy are in symmetric position. The entrance portal to the Mathematics building is framed by pillars-walls; a section clarifies the relationship with the surrounding buildings (ARS_drw_01; Guidoni, Regni Sennato 1985, p. 48).

1932, May 9 - First meeting at Piacentini's office in Rome with the architects committed with the projects for the campus buildings at the presence of Rector De Francisci, the Ministry of National Education, the Prefect of Rome, the General Administrator and Engineer Massari (ASS_dcm_05; Azzaro 2018, p. 106). Changes to the plan are made during this meeting: in a sketch the building of Mathematics appears as a C-shaped body around a courtyard, with semi-circular classrooms, juxtaposed to the main body (ASS_drw_02; Di Marco 2016, p. 305).



Al chiar.mo signor
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Roma, addì 19 luglio 1932, X

OGGETTO: Assetto edilizio della R.Università di Roma -

In esecuzione delle deliberazioni del Consiglio di amministrazione del Consorzio per l'assetto edilizio di questa Università, Le comunico che in data odierna ho dato incarico all'arch. Giovanni Ponti per la progettazione e costruzione - in accordo con S.E. Piacentini, direttore generale dei lavori - dell'edificio destinato a sede del ~~suo Istituto~~ Scuola di Matematica.

Per la costruzione di tale edificio è stata assegnata la somma di L. 3.500.000 comprendente il mobilio, l'arredamento e gli impianti. Tale somma non dovrà essere in nessun caso superata.

Per tutto ciò che riguarda la progettazione e la costruzione dell'Istituto, Ella*, prenderà accordi direttamente con il sopra nominato architetto.

Con osservanza,

IL RETTORE

Al Chiar.mo Signor
Prof. Guido Castelnuovo
Roma

* quale professore anziano del Gruppo dei professori di Matematica,

ASS_dcm_08

1932, May 13 - Piacentini's letter to De Francisci summarizing the meeting and the decisions taken in agreement: serenity and simplicity, terrace roofing, external tufa, stone and brick cladding, limited use of plaster. It is also recommended not to exceed in height, to carry out the study of different types of construction and foreign buildings, to set up an experimental cabinet for testing construction materials. The delivery of the general plans is expected by May, while projects for the buildings are expected at the end of August (ASS_dcm_05).

1932, May 14 - Balbino Giuliano reports to Mussolini about Piacentini's arrangements with Balbo for a harmonious arrangement of the central square of the campus. The Prefect assures that the area will be completely cleared of illegal occupations by the end of the month. The site manager (Piacentini) has taken possession of the area where the building of the Technical Office will be located, which will be built immediately. The presentation of preliminary projects is expected by May, the contract for the arrangement of the area by June, the finalization of as-built projects with related tender specifications by the end of August; the signing of contracts launched to start the works by September. All with behind Mussolini's approval, (ACS_dcm_10; Mornati 2002, pp. 56-57).

1932, June 10 - Piacentini's official hiring as general manager and chief architect of the university campus, starting from 1 April 1932 with a monthly pay of 5.000 lire, is signed. It is specified that each architect will be paid a 2% on the net amount of the final balance of the works (except installations) divided as follows: 0.25% for the preliminary project, 0.75% for the final project and 1.00% for the construction management (ASS_dcm_06).

1932, June 10 - Gaetano Minnucci is hired as Secretary to the General Manager and Chief Architect, Marcello Piacentini, starting from 1 June 1932, with a monthly salary of 1.500 lire (ASS_dcm_07).

1932, June 13 - Piacentini's visit to the Modern Architecture and Furniture Exhibition, organized at Palazzo Venezia by the RAMI (Group of Italian Modern Architects), the Italian branch of MIAR, in response to Bardi's Table of Horrors. The exhibition is supported by the Ministry of Education Giuseppe Bottai, the Union of National Fascist Architects, and Piacentini (Nicoloso 2018a, pp. 135-136).

THE BEGINNING OF THE CONSTRUCTION SITE

1932, July 8 - Piacentini approves the bid of the contractor Stoeckler for the construction of foundation drilled piles, with of 250 mm diameter and a depth of about 30 m to reach the compact and rocky ground.

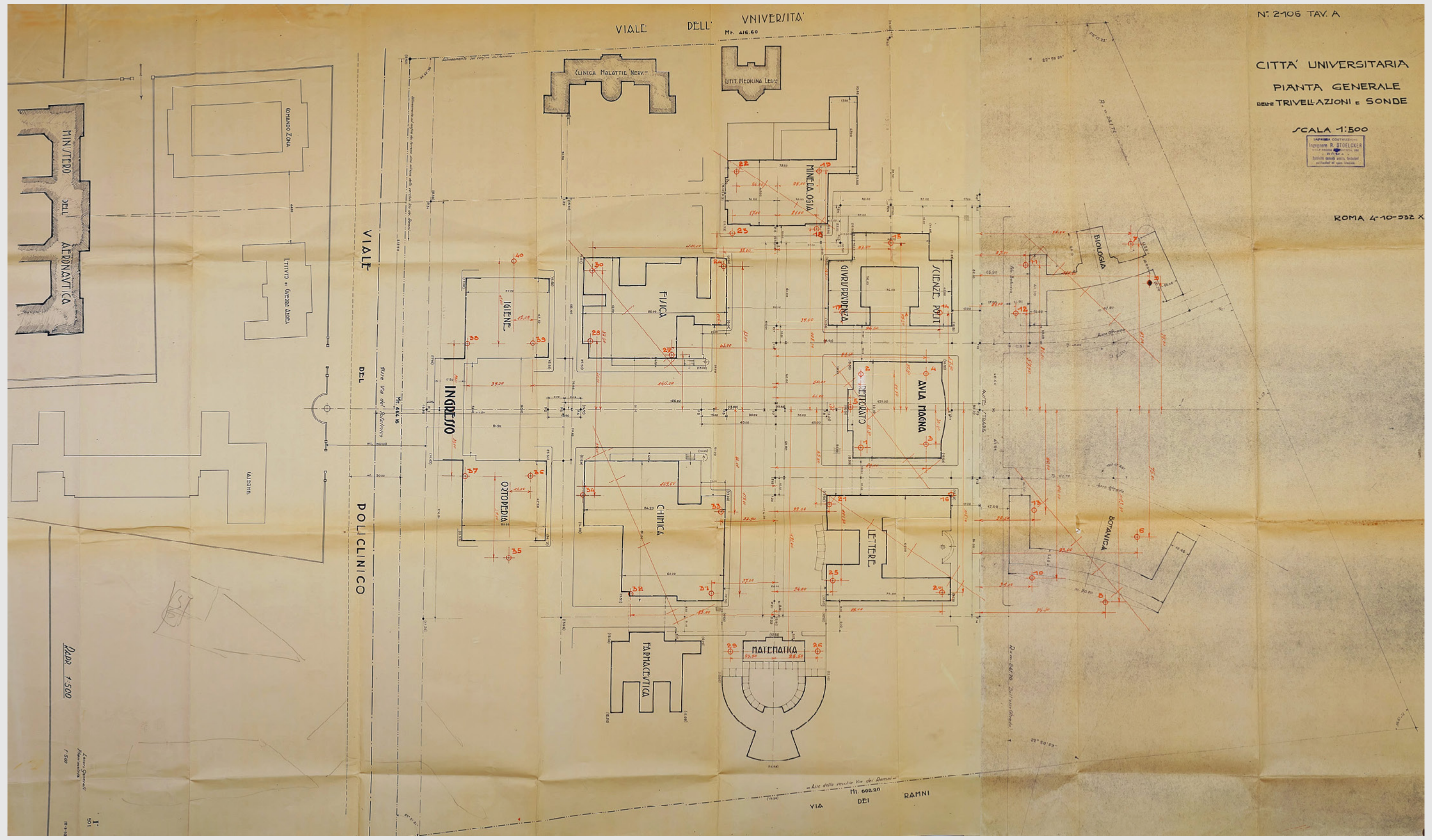
1932, July 15 - Drilling work by Stoeckler starts. On September 7 the contractor requests and obtains the increase of the workers teams and to fulfil the request to speed up the work. The final cost is fixed at a special price of 60 lire per meter of drilled pole, but the assignment is rectified no earlier than December 23 (ASS_dcm_09).

1932, July 18 - Official appointment of the architects with the commitment to design the buildings: Ponti is designated for the School of Mathematics and, initially, also "to design the gardening, decoration and furniture of the new campus" (Ceccherini 1933, p. 595; Guidoni, Regni Sennato, p. 44).

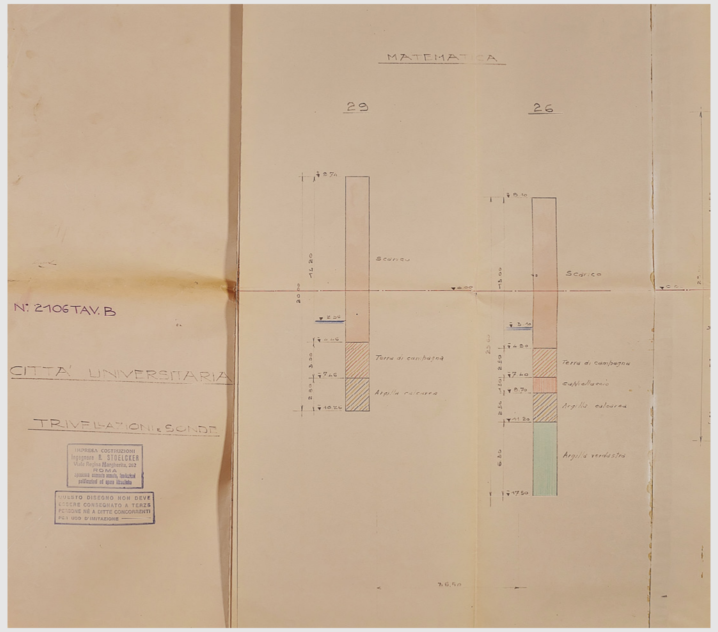
1932, July 19 - Rector De Francisci communicates to Castelnuovo, "senior professor among the Mathematics professors", that Gio Ponti has been committed with the design and construction of the building for the School of Mathematics. The expenditure assigned for the construction of the building is 3.500.000 lire, including furnishings, and installations (ASS_dcm_08; Mornati 2002; p. 55, note 21).

1932, July 20 - Alfredo Rocco is appointed Rector of Sapienza, and President of CERUR; Pietro De Francisci takes over Rocco's commitment as Ministry of Justice.

1932, Summer - The six appointed architects, together with Piacentini, visit the archaeological site of Ostia Antica to admire the recently completed restoration works (Guidoni, Regni Sennato 1985).



ASS_drw_03



ASS_drw_04

1932, August 8 - Piacentini announces to Mussolini the signing of the first contracts and the early start of the works for the university campus, which was programmed for August 17 (Spano 1935, p. 308; Nicoloso 2006, p. 238).

1932, August 22-24 - Meetings among the designers to collectively define the final plan of the campus and the design of the buildings assigned to each; Giuseppe Capponi joins the group (Mornati 2002, p. 54).

1932, September - On behalf of Piacentini's commitment, Gaetano Minnucci journeys through Europe to study foreign university buildings from a formal and technical point of view.

1932, September 1 - Letter from Piacentini to the architects summarizing the decisions taken during the meetings in August. The overall image of the façades should be predominantly given by yellow bricks (so-called 'Litoceramic'), and by other regional stones, while decorative details seen in Ostia are recommended. The proportion of the windows must be kept around 1: 1.5, if not in conflict with special needs of the interior (Guidoni, Regni Sennato 1985, pp. 44, 47; Mornati 2002, p. 54).

1932, September 9 - Piacentini asks the architects to deliver the final projects in scale 1:100, with plans of each floor, sections and elevations, with measurements and indication of the outer and inner materials and finishes, and some construction details of specific interest, in order to develop the estimated costs in view of the elaboration of the general metric computation (Guidoni, Regni Sennato 1985, pp. 44, 47).

1932, October - The contractor Stockler releases the official report *Exploration of the subsoil, foundations, table on the main data on buildings* to advise Piacentini that the subsoil of the area opposes serious difficulties to the foundation works, also based on information obtained from the construction of other surrounding buildings, such as the Institute of Public Health and the George Eastmann Dental Clinic, for which sack masonry shaft foundations had been used. The stratification consists of a thick layer of backfill resting on a valley, certainly the bed of an ancient swamp, that crosses the area diagonally from north-west to south-east. The first homogeneous layer consists of clay and is very deep; under the water table, there are poor-quality peaty clays at great depths and a continuous foundation is therefore excluded. Thus, foundations with concrete poles, cast in situ with steel forms beaten with pile drivers are proposed (ASS_dcm_10).

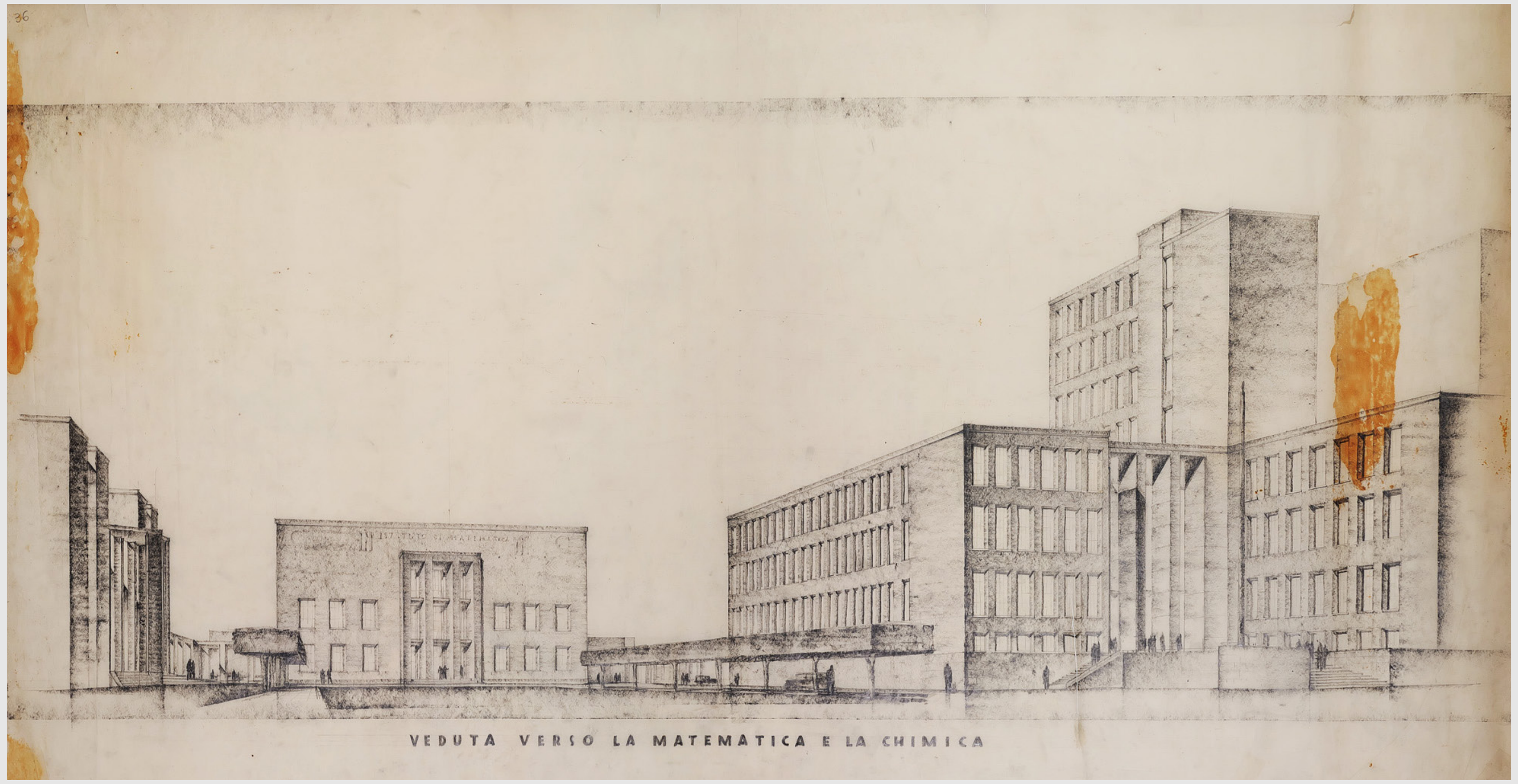
1932, October 4 - A preliminary plan for the Mathematics building is delivered. This shows a portico along the two wings and the respective fronts facing the square. A similar portico is also present along the side of the front building facing the courtyard, which links the different bodies of the building; the entrance portal juts out from the facade (ASS_drw_03).

1932, October 4 - A plan of the foundations for the Mathematics building is drafted upon the preliminary project laid out by Ponti. In the drawing depicting the stratigraphy of the soil, drillings number 29 and 26 refer to the area where the School of Mathematics will be built (ASS_drw_04).

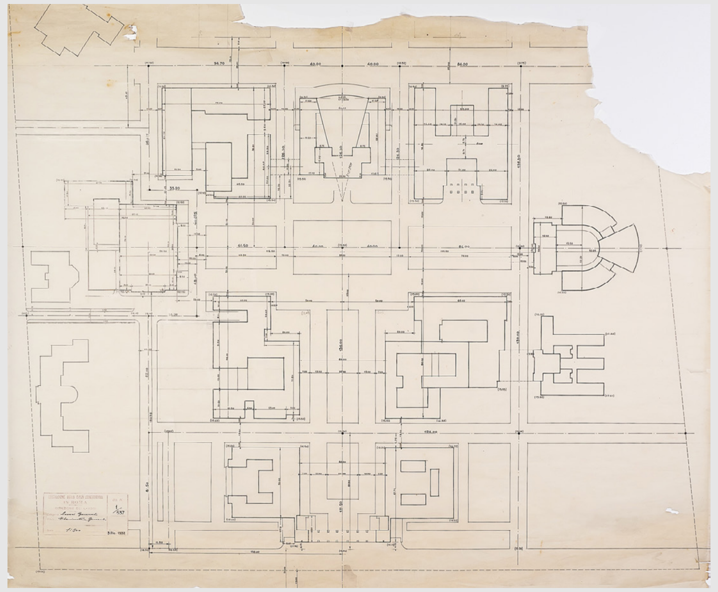
1932, October 5 - Piacentini reports to President Rocco about the foundation works. An important water table is located at an average depth of 12 meters and therefore piling is the best foundation system due to the varying length of the poles to reach resistant soil at any depth. The best construction system is to cast concrete piles on site by drilling the soil or driving a form of steel into it, as in the case of the Ministry of Military Navy, for which piles are used. A cost of 9 million lire is estimated; the advice is to contract specialized contractors to spare time and guarantee the quality of the works (ASS_dcm_11).

1932, October 11 - The Rector advises Piacentini about the role of the professors within the design process, who continue giving advice and suggesting technical proposals. In the case of the Mathematics building, architectural requirements seem to be followed more than the academic ones (Dell'Aglio, Emmer, Mogherini 1999, p. 65; Mornati 2002, pp. 56-57).

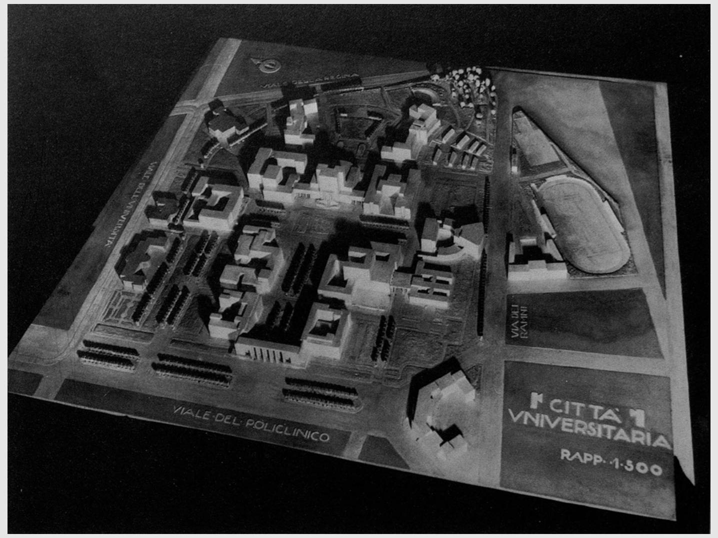
1932, October 28 - Gio Ponti participates to the building of the Ministry of Corporations in Rome (inaugurated on this day), by designing furniture and decorations, especially the waiting room of the Cabinet of the Ministry cladded with majolica produced on a design by Gio Ponti reproducing the Charter of Labor ("Domus" 1935b).



ASS_drw_11



ASS_drw_07



BBL_pht_02

1932, October 29 - Ponti enrols to the Fascist National Party. According to a note from the Prefect to the Duce's Secretariat dating March 9, 1942 "the architect Gio Ponti retains a regular moral and political conduct and is registered to the PNF (Partito Nazionale Fascista) since October 29, 1932 but obtains a backdating to March 3 1925 for the seven years spent in war as soldier.

1932, November 14 - Letter from Piacentini to the CERUR reporting that the contractor Stoeckler has completed the foundation works and has delivered the documents describing drilling and surveys. The total expenditure (which could be specified before) is of 61.837 lire, but the contractor asks for a deposit of 30.000 lire (ASS_dcm_12).

1932, November 26 - Notice from Piacentini to the Duce about the delay of the works, due to the time taken by the Superior Council of Public Works to examine the drawings; Mussolini asks the Ministry Di Crollalanza to speed the pace up (Nicoloso 2006, p. 239).

1932, December - Minnucci publishes Of the buildings for higher education, a full-bodied study drawn up to support the design of Rome's university campus.

1932, December 3 - Planimetric solution showing part of the general arrangement for the buildings represented in the first model; Physiology and Botany buildings are missing (ASS_drw_07).

1932, December 12 - The Technical Office sends invitation letters to the contractors for the construction of the building (ACS_dcm_11). This stage is reached after a dense exchange of documents and a stop and go of the approval of the foundations project presented by Piacentini to Alberto Noli, Superior Inspector of Civil Engineering Corp, a process started in the month of October.

1932, December 19 - During his first visit, Mussolini speaks to the designers and observes the wooden model of the campus, defined by Mario Lupano as the "Model A" (BBL_pht_02; Pagano 1933, p. 39; Lupano 1991, p. 120); the project for the campus is also presented for the first time to the press (Nicoloso 2006, p. 239). On the same occasion the huge perspectives of the project, drawn by Eugenio Montuori, are also shown to Mussolini; these drawings still show the porticoes connecting the various building (ASS_drw_11; Pagano 1933, p. 41; Spano 1933a, p. 19).

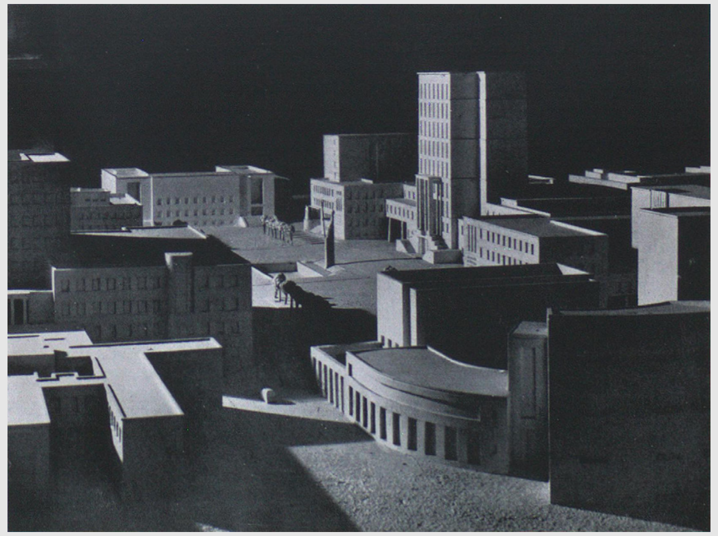
1932, December 20 - Mussolini refuses to increase the two hundred workers currently on the construction site to two thousand to speed up the work. The delay in the progress of the construction is attributed to the lack of approval of the foundation projects. As noted by Piacentini, the projects had been approved and the contractors invited to the tender chosen only by November 30. The Ministry Francesco Ercole therefore assures that work will begin by the end of the month, thus reaching the expected number of workers (ACS_dcm_12).

1933 - Plan showing the situation of the university campus after Mussolini's first visit to the construction site, not exactly datable (ASS_drw_12).

1933 - Printing of the *Price list of works and building materials* released by the Technical Office: this is the most important technical instrument for the construction of the campus, as it will guide all the construction contracts (ASS_dcm_13).

1933, January - Mussolini's second visit to the construction site, highlighting his great attention to this project. The site is not yet fully operational but will be in October 1933 (Nicoloso 2006, p. 239).

1933, January 24 - A CERUR commission assigns the construction of the foundations of Lot 'B' - which includes the Mathematics building- to the firm Ferrobeton, and those of Lot 'A' to the Stoeckler firm, and decides to adopt the "simplex pile" foundation system (ASS_dcm_15).



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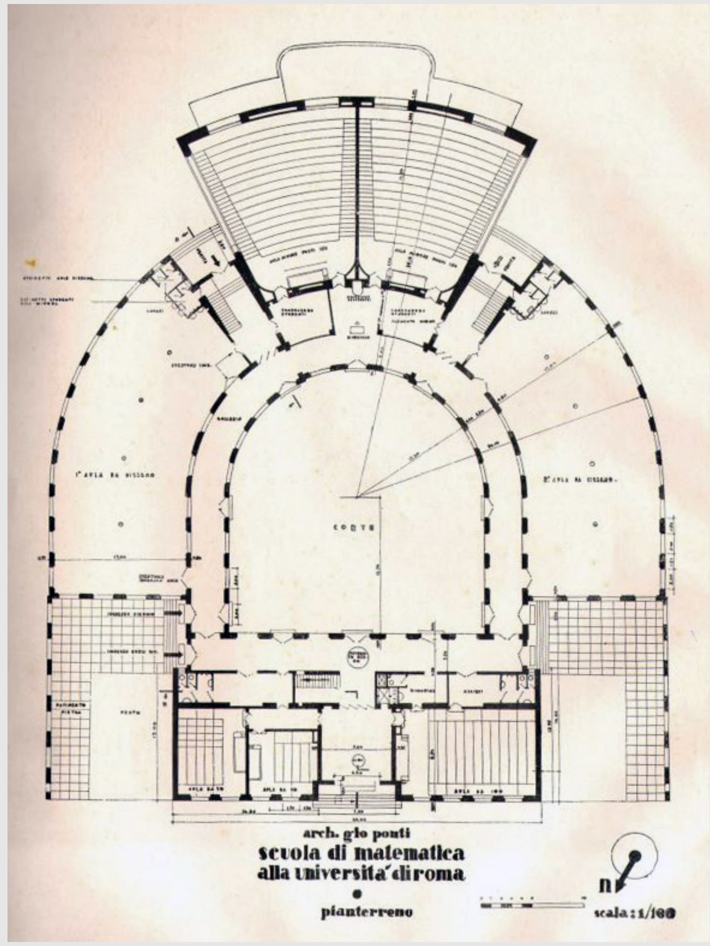

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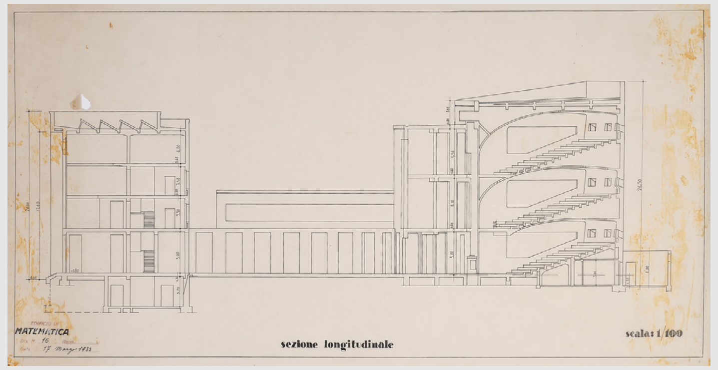
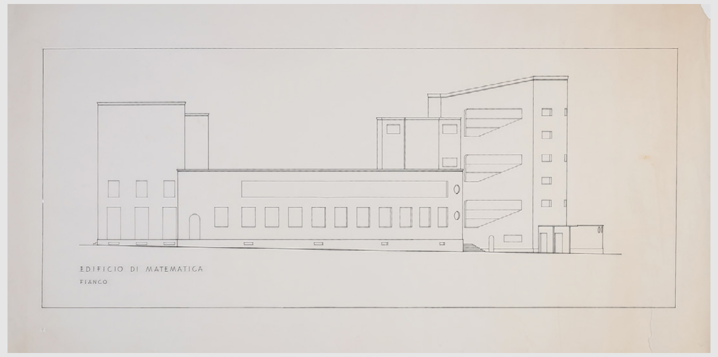


ASS_drw_13



ASS_drw_21

1933, January 24 - Program for the maximum employment of workers on the construction site with different deadlines. Between February 10, 1933 and the end of March the foundations of the Mathematics building are expected to begin. By the end of July, the earthworks and road repairs must be completed, while between the end of July and the beginning of September the elevation works of the Mathematics and Pharmaceuticals building must begin, after expropriations, as well as the heating plant for all the buildings. Finally, from October onwards, all construction sites must be in full working-order (ASS_dcm_16).

1933, January 31 - Controversy between Ojetti and Piacentini "on the use of columns and arches" in the project for Rome's university campus, for which Ojetti laments a lack of strong Italic character due to the absence of arches and columns in the projects for the buildings. The controversy opposes the two who were once friends and will involve Ponti, who will side Piacentini (Nicoloso 2018a, p. 143).

1933, February 7 - Presentation of the foundations project for Lot 'B' drawn up by the contractor Ferrobeton. The contractor envisages the use of simplex a total of 2820 poles, with a diameter of 40 cm per meter, reinforced for 2.50 meters, with an average length of 14 meters (and a maximum of 16 meters); the use of duplex, super simplex and super duplex poles is also envisaged. The contractor is committed to finalize the work in 100 days (ASS_dcm_17).

1933, March - Nicola Spano, secretary of CERUR, publishes an article on the history of the University from 1870 to 1933, anticipating the publication that will be issued in 1935 for the inauguration of the campus. Here, he describes the project for the Mathematics building: "The institute (...) was conceived by the Milanese architect Giovanni Ponti, a keen solver of architectural issues of all kinds, a sensible carver of beautiful idea, merrily prone to ingenious solutions. The Institute is composed of two buildings connected by a portico: one for the School of Pure Mathematics- which has advanced and specialization courses- with classrooms for professors, assistants, and accessories; and one for the two-year courses for aspiring engineers, with drawing rooms and lectures for large numbers of students. In the first building, which represents the front of the Institute, a solemn expression is sought in the order of the elements; a line of rigorous simplicity, that becomes almost an expression of the serene and severe studies it welcomes, is maintained inside and outside. The other building, a structure as a tower with superimposed classrooms, playing on the inclination of the amphitheatres, is truly characteristic and conceived according to functionality" (Spano 1933a, pp. 18-19).

1933, March 6 - Ponti defends the project for the university campus against Ojetti's attacks. He asks Ojetti to appease the ongoing controversy on the architectural features of the campus, because the project is to be considered a magnificent example of collaboration between architects, who have all worked with "passion, direction, diligence, love for art and for Rome". Thus, the issue about the "arches and columns", and his attacks through the review "Tiber", where he defines "repugnant" the architecture under construction, are not justified (GNAM_dcm_01).

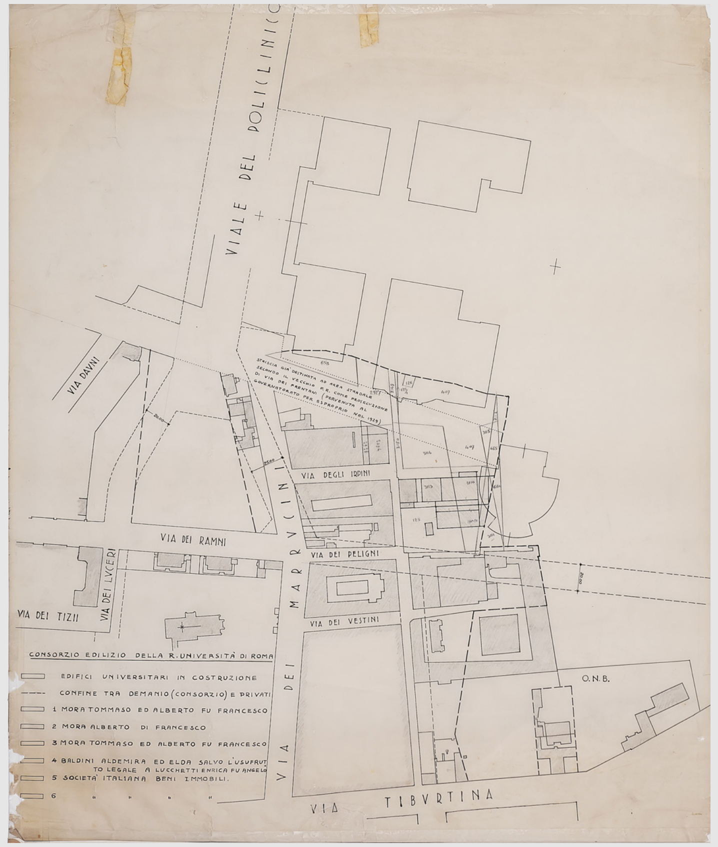
1933, March 11 - Mussolini's third visit to the construction site accompanied by Rector Rocco and the Ministry of Education Giovanni Gentile. During the visit, the Duce examines the model, defined by Lupano as "Model B", also exhibited at the V Triennale in May in Milan (Nicoloso 2006, p. 239).

1933, March 11 - Photo of the model of the campus; the School of Mathematics still presents a series of arcades (BBL_pht_05; AST_pht_01; Pacini 1933a, pp. 178, 179; Pacini 1933b, pp. 477, 479; Spano 1933b, p. 47; Lupano 1991, p. 121).

1933, March 12 - Ojetti attacks the project for the campus once again, in response to Ponti's letter. He refuses the accuses of offence to the project, but reiterates his negative opinion about its formal result, despite Ponti uses the scarce value of the University of Milan as an argument to highlight the merits of the Roman enterprise (Greco 1985, p. 77).

1933, March 17 - The Technical Office drafts a series of drawings showing the School of Mathematics, in concurrence to Mussolini's visit to the site (ASS_drw_13, ASS_drw_21; Pacini 1933b, p. 490).

1933, March-August - The plan of the ground floor of the Mathematics building is published in Pacini 1933b in August, which is very similar to the series of drawings drafted in March (BBL_drw_01; Pacini 1933b, p. 491).



ASS_drw_24

THE CONSTRUCTION OF THE SCHOOL OF MATHEMATICS: THE FOUNDATIONS

1933, March 21 - The drilling works achieved by the contractor Stoeckler are tested according to the opinion of the commission composed by Alessandro Susinno, Alberto Noli and Ferdinando Alfinito. Drilling holes n. 26 and n. 29 are those for the Mathematics building, performed with tubes with a diameter of 300 mm, respectively 25.60 and 20 meters long (ASS_dcm_19).

1933, April 5 - Plan of the state-owned land between the Policlinico and via Tiburtina, which shows the presence of buildings and land to be expropriated in the area destined to the buildings for Mathematics and for Pharmaceutical Chemistry (ASS_drw_24).

1933, April 8 - Rector Rocco writes to Piacentini about the need to have each project approved by the directors of the relative Institute or Faculty. Each architect must ask the director to express an opinion on the project and the letter of approval will be attached to the drawings (ASS_dcm_20).

1933, April 27 - A report on the state of the workers employed on the site states the delay in the construction of some buildings. The expropriation of the area for the IV lot (Chemistry and Mathematics) is still pending, and the works are still to be contracted in mid-November. The construction of Mathematics has not yet started, despite the contractor Ferrobeton has been contracted since February (ACS_dcm_13).

1933, May 1 - Inauguration of the V Milan Triennale where the model of the university campus, under construction, is also exhibited. Ponti participates as member of the organization board.

1933, July 13 - Piacentini proposes to pay Ponti the remaining 0.3%, or the sum of 9.450 lire, considering that the letters of appointment date back to 18 and 19 July 1932 and considering that the architect has already delivered the complete project (ASS_dcm_21).

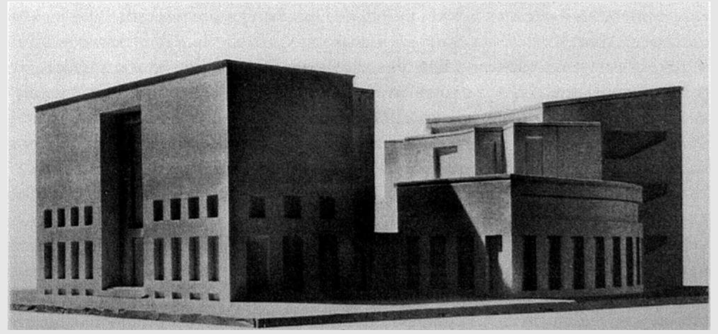
1933, August 5 - Rector Rocco drafts a further study for the arrangement of the area of Castro Pretorio for the further development of the campus, booking every free piece land available, including strips along the via Tiburtina, and those declared not buildable according to the Master Plan, due to the proximity to the cemetery Verano. Rocco accelerates the process for having learned that a study for a different use of the area is underway, which would prevent the planned expansion of the campus. Mussolini is asked to reserve a sufficient area- about 40.000 square meters- for the expansion of the campus, considering the solution that includes the construction of the Ministry of War and the National Social Insurance Fund (ACS_dcm_15).

1933, September 14 - Mussolini visits the construction site for the fourth time and has the opportunity to explore the Institutes of Hygiene and Physics, that are almost completed. The visit is filmed by the Istituto Luce and Mussolini is photographed together with the workers (ASL_vdo_03; ASL_pht_04-06; Nicoloso 2018a, p. 150).

1933, October 11 - Rector Rocco reports various mistakes in the preparation of the first estimate of 70 million lire for the construction of the campus, which do not include the architects' payments and the furnishing of the buildings. If Mussolini is unable to disburse either the requested amount- a total budget of 120-130 million- or a smaller amount within an extended timeframe, the initial budget will allow the achievement only of some buildings. The construction of Chemistry, Mathematics, Biology, Zoology and Botany will therefore be postponed indefinitely, despite the revenues, which could come from the sale of the former seats of the institutes in via Milano, in via Panisperna and at palazzo Carpegna (ACS_dcm_16).

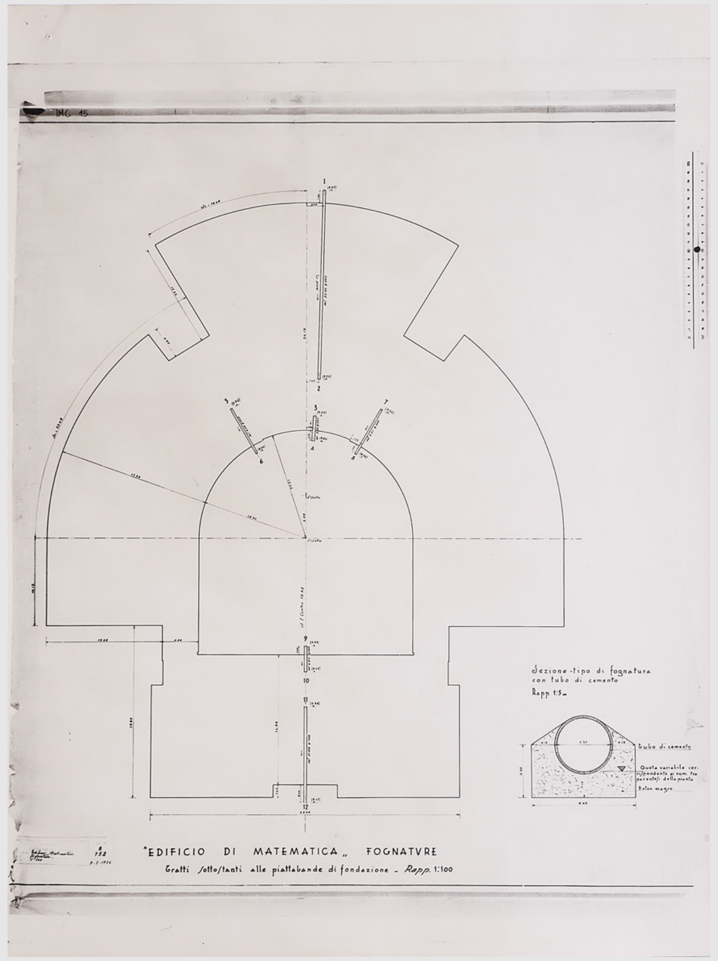
1933, October 12 - Rector Rocco reassures the construction of the university campus, after adding 10 million lire to the first estimate and after having been reassured by architects and engineers that all eleven buildings may be built with indispensable furnishings. However, he recommends to "renounce any ornamental superfluity and any use of not strictly economic material" (ACS_dcm_17).

1933, October 20 - Given the insufficient funds, Piacentini and Rocco present two solutions to complete the construction of the university campus to the Duce; in a private session, Mussolini promises to Rocco another 12.5 million lire for the completion of the campus (Nicoloso 2018a, p. 149).

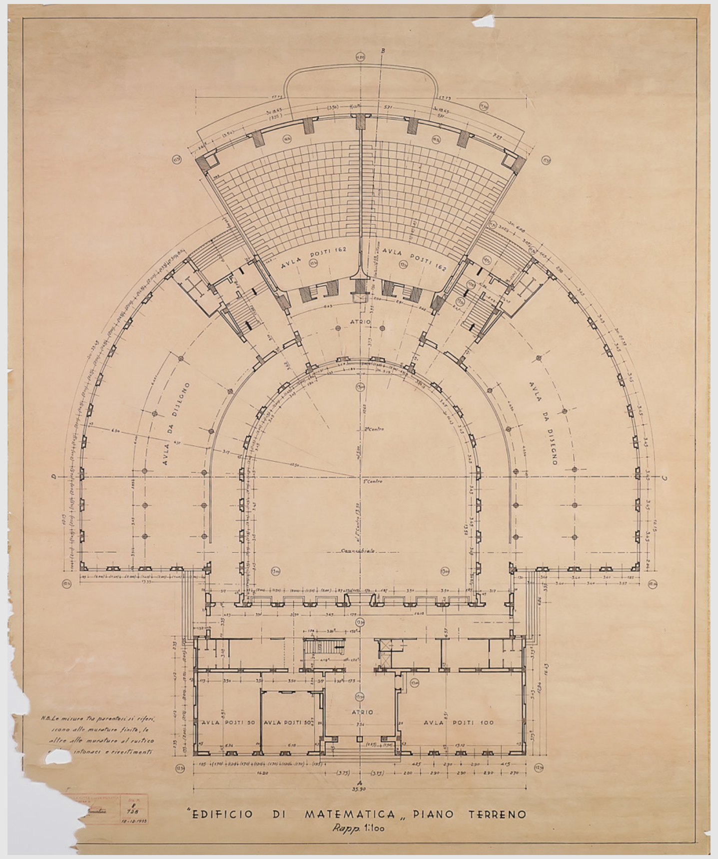


BBL_pht_06

ASL_pht_07



ASS_drw_36



ASS_drw_25

1933, November - A movie shot by the Istituto Luce, shows the foundations of the Chemistry building in the foreground and, in the background, the advanced construction site of Physics building with the reinforced concrete structure almost complete. The construction of the elevation of the building for Law, Arts and Humanities and Rectorate has not yet begun (ASL_vdo_04).

1933, December - An article publishes a picture of the model for the School of Mathematics, with a solution very close to the realized project; the model will never show up again (BBL_pht_06; Ceccherini 1933, p. 598).

1933, December 2 - The Technical Office, in response to a survey of November 18, confirms the impossibility to start the construction of the Mathematics building due to the land expropriation still to come. Major works derive from the revision of the project, which serve as reference for the contracts. An elevation structure in ordinary masonry had been firstly envisaged, but the construction manager opts for a skeleton in reinforced concrete. The contractor Ferrobeton is invited to study the necessary changes. It is therefore decided to use more foundation poles and to ensure greater concentration of poles in correspondence of higher loads and in relation to the load-bearing structure of the building. The solution also considers the changes made to the distribution and to the width of the building (ASS_dcm_22).

1933, December 4 - The CERUR approves the “cheap” solution to complete the construction of the campus proposed by Piacentini on October 20 (in comparison to a solution defined “integral”) and approved by Mussolini. The budget for Mathematics is lowered from 3.5 to 3.3 million lire, while the expenditure for the furnishing of the entire campus, that had not been counted in the initial budget, are reduced from 70 to 30 million.

1933, December 16 - The delay accumulated in the construction of the Mathematics building grows due to land expropriation problems, while other buildings – as Physics and Hygiene- are committed to the contractor already on December 13. The completion of the works had initially been scheduled for March 1933, but the foundations begin only in February 1934.

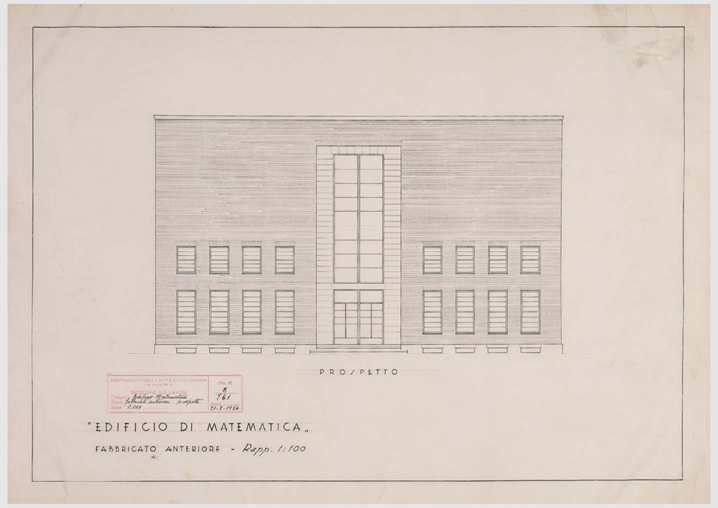
1933, December 18 - The Technical Office drafts a series of drawings from December 1933 until January 1934, in view of the imminent start of the foundation works, in which the Mathematics building is redesigned with a reinforced concrete structure (ASS_drw_25; ASS_drw_29-33).

1934 - A movie shot by the Istituto Luce shows the foundations of Mathematics behind those of the Chemistry building. A step between the foundations of the front body and the rest of the building appears, which would explain the difference in height of the two blocks. A small building is still standing next to the site: it is unclear whether this serves the construction site or is a property that has not yet been expropriated (ASL_vdo_05; ASL_pht_07).

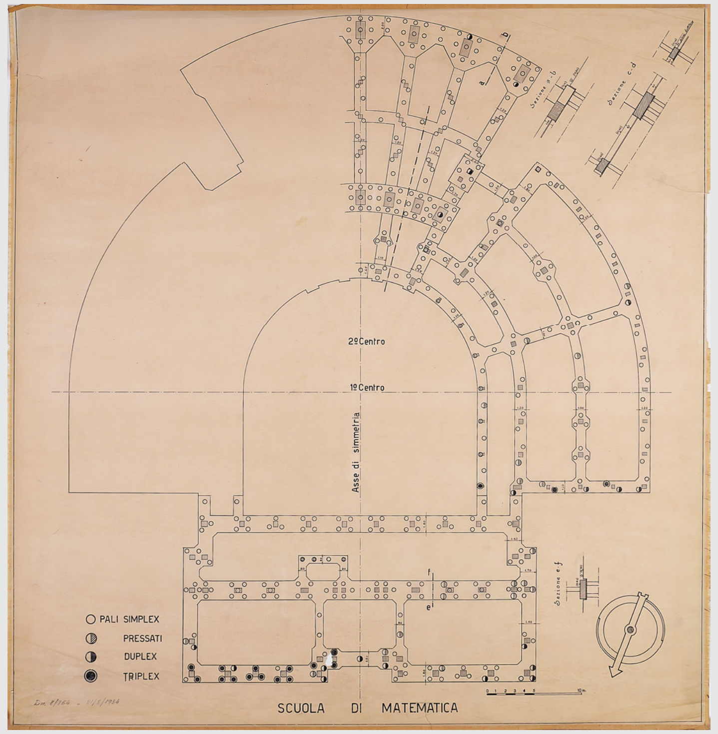
1934, February (1934, March 21) - Rector Rocco proposes to grant Castelnuovo with the membership to the Fascist National Party, although he had previously adhered to the controversial “Manifesto Croce” signed by anti-fascist intellectuals (ACS_dcm_19).

1934, February 1 - Piacentini confirms to Rocco that the foundations work of the Mathematics building have recently begun, in view of the tender for its construction. The building has no special features, apart from the load-bearing structure, which at this stage is meant in reinforced concrete: this is a very complex one due to the presence of large classrooms for drawing courses and lectures. Piacentini reports that Ponti has designed a truly original solution whereby the slab of the lower hall, consisting of a curved surface designed for the best acoustics, fits under the inclined slab of the upper hall, similarly arranged for better visibility; yet there is no reference to the engineer Zadra. Piacentini recommends a tender among the contractors who have offered bids for the Chemistry building (ASS_dcm_23).

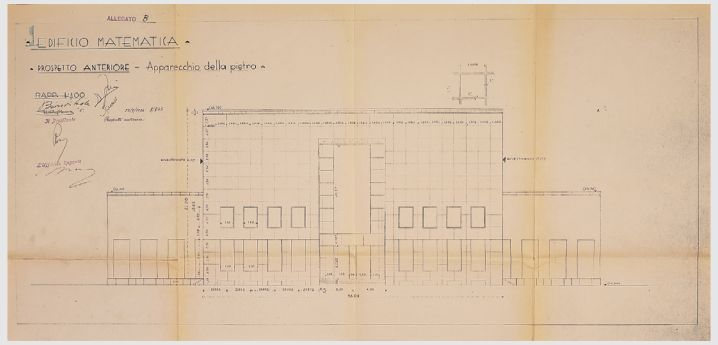
1934, February 9 - Scheme of the sewage system for the Mathematics buildings, in which the ducts are placed under the junction beams that connect the foundation poles (ASS_drw_36).



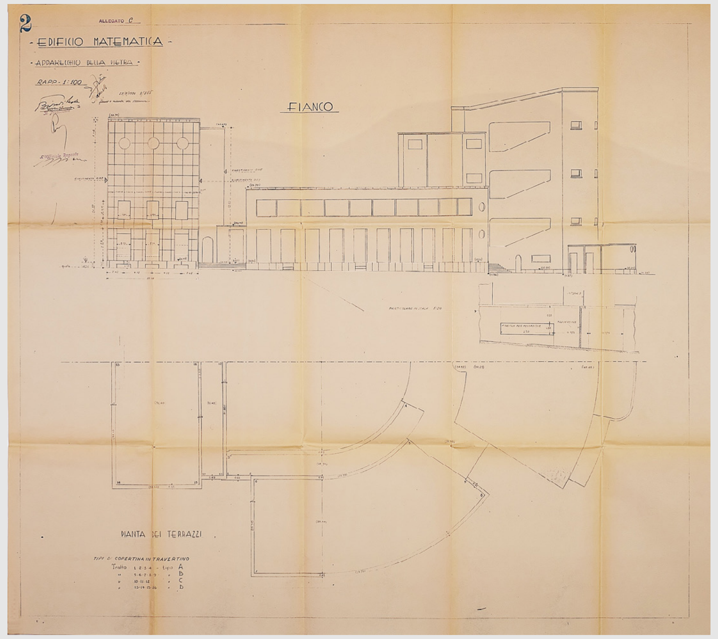
ASS_drw_38



ASS_drw_41



ASS_drw_45



ASS_drw_46

1934, February 21 - Drawing of the main facade with Litoceramic cladding for the entire facade, and a plat band decoration above each window and on the frame itself, where the latter is still provided in slabs (ASS_drw_38).

1934, February 21 - Plan of the foundations where the use of simplex, duplex and triplex poles depends on the consistency of the foundation soil (ASS_drw_41; "Architettura" 1935b, p. 82).

1934, February 22 - The contractor De Micheli wins the tender for the heating plant of the entire campus, which also produces low temperature water (ASS_dcm_29).

1934, March 26 - The contractor Adriani, following a bid for the construction of the Chemistry building, wins the tender for the construction of the Mathematics building over a group of five contractors. The contract, signed on May 30, mounts to 1.658.450 lire and refers to a number of works described in eleven drawings and to the general plan of the area attached to the contract. At this stage the inauguration of the campus is still set for April 21, 1935.

1934, April 20 - Ponti is appointed Commander of the Order of the Crown of Italy by king Vittorio Emanuele III, behind Mussolini's proposal (Gazzetta Ufficiale del Regno d'Italia n. 260, 1934/11/06, p. 5058)

1934, April 21 - Ponti is awarded with the "Mussolini Prize for the Arts". This prestigious acknowledgement is awarded each year by the Royal Academy of Italy; the architecture section is chaired by Piacentini and participated by Cesare Bazzani and Armando Brasini. Ponti probably receives the prize in person during a stay in Rome, during which he visits the construction site of the campus (Pica 1936).

1934, May 30 - The contractor Capecchi signs a contract for gardening works, for a total amount of 170.000 lire. The works also imply the arrangement of a green area that confines the west side of the Mathematics building, the east side of Chemistry and Physics building, the west facade of Mineralogy and Forensic Medicine; the deadline for completion of the works is March 31 1935. The final report of the works, signed on February 6, 1935, contains evidence of the location where trees and bushes have been planted.

1934, July 7 - Ponti wins the design competition for the Palazzo del Liviano in the University of Padua. This is a second turn, as the first competition, banned in 1933 and reserved to architects of the "Three Venices" had gone deserted (Bardati 2003, p. 176).

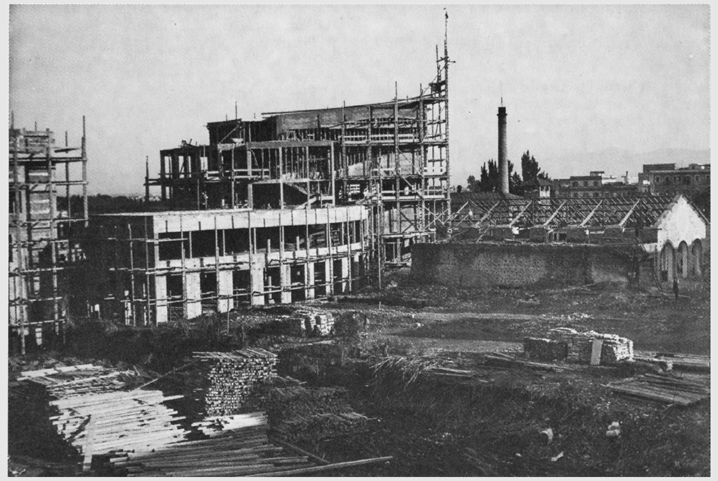
THE CONSTRUCTION OF THE SCHOOL OF MATHEMATICS: THE ELEVATION

1934, August 29 - The contractor Adriani starts working at the elevation of the reinforced concrete structures of the Mathematics building (ASS_dcm_33).

1934, September - Vincenzo Fasolo, director of the School of Drawing, claims the need for a methodical development of studies in surveys and representation to support the teaching of architectural conservation appropriately, assessing the deep connection between geometric drawing, architecture, and mathematics (ASS_dcm_34).

1934, September - Mussolini visits the university campus for the fifth and last time before the inauguration; he will return to the construction site of the campus only on occasion of the "Littoriali dell'Arte" celebrated on April 21, 1935 (Nicoloso 2006, p. 242).

1934, September 25 - The contractor Filacchioni signs the drawings for the travertine cladding of the main facade of the Mathematics building, although the cladding work takes place almost one year later. A crowning frame appears for the first time on top of the façade: its final shape will appear only on the drawings dated March 1935. A shadowed joint frames the stained-glass window of the main facade and separates the opening from the travertine cladding (ASS_drw_45, ASS_drw_46).


BBL_pht_10

ASS_drw_51

1934, October 11 - Piacentini approves the request presented by Adriani to postpone the deadline of the construction work due to difficulties arisen to satisfy the artistic proposals of the architect (Ponti), as well as to satisfy the multiple structural solutions proposed for the slabs before a final decision (ASS_dcm_37).

1934, December 21 - Piacentini proposes to pay Ponti of 1% of the works carried out in the Mathematics building for a sum of 1.100,486 lire; the CERUR approves a few days later (ASS_dcm_40).

1934, December 28 - The construction of the elevation of the Mathematics building proceeds (BBL_pht_10). In addition to the reinforced concrete skeleton, Adriani also proceeds with the construction of brick and stone masonry to tamper the structure (ASS_dcm_41).

1934, December 29 - The contractor Fratelli Feltrinelli wins the tender for the supply of wooden windows in the buildings of Lot IV; the tender had been called on October 9, 1934.

1935, January 17 - A special commission is set up to decide the division between Mathematics and Engineering books, in view of moving the libraries of departments and institutes to the new campus. Castelnuovo and Bompiani state that book purchases had taken place together since the past twenty-five. The commission proposes to allocate 5.000 lire to rearrange and move the library (ASS_dcm_43).

1935, February 10 - The works carried out by Ferrobeton are approved after an inspection carried out on January 21, 1935. The commission reports the contractor 's reserves related to the payments in a secret document (ASS_dcm_44).

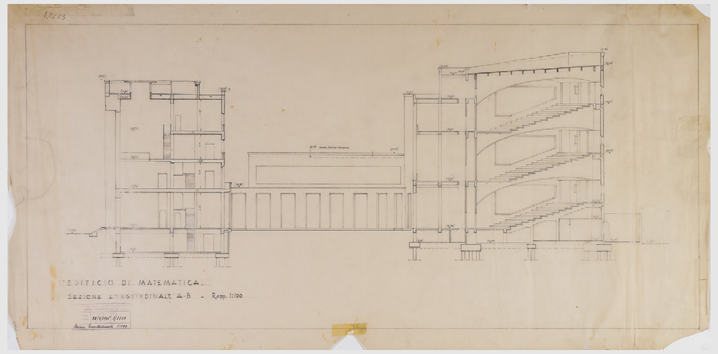
1935, February 15 - A new project for the supply of Linoleum for the entire campus amounts to 446.896,80 lire, after Piacentini had proposed a private negotiation with the firm Compagnia del Linoleum- the only supplier of this material in Italy. The cost for the Mathematics building is of 18.700 lire.

1935, February 18 - In view of the inauguration of the campus, now postponed to October 28, a description of the progress of the construction works and the financial situation of the CERUR is provided. Due to the difficulties of the Ministry of Finance, only 6 over the 12.5 million lire required to accomplish the work had been allocated by 24 October 1934. Notwithstanding, new furniture with modern lines, more comfortable and less expensive, is approved. An estimate drawn by the Technical Office on 27 October 1934, reports that the cost for the furniture, excluding scientific equipment and teaching material, amounts to 12 million, minus 3 already allocated in the initial budget. Therefore, 9 million lire are still needed. At the beginning of 1935, 15.5 million were still missing: 6.5 million had been promised by Mussolini, but not yet allocated. In view of the imminent inauguration, the CERUR decides to begin the arrangement of most crowded Institutes, and those without a proper seat in the old convent of Sant'Ivo alla Sapienza, or in temporary ones, as in the case of the Institute for Mathematics. The Institute of Chemistry, instead, can wait, as it had been recently accommodated in a new building in via Panisperna (ASS_dcm_46).

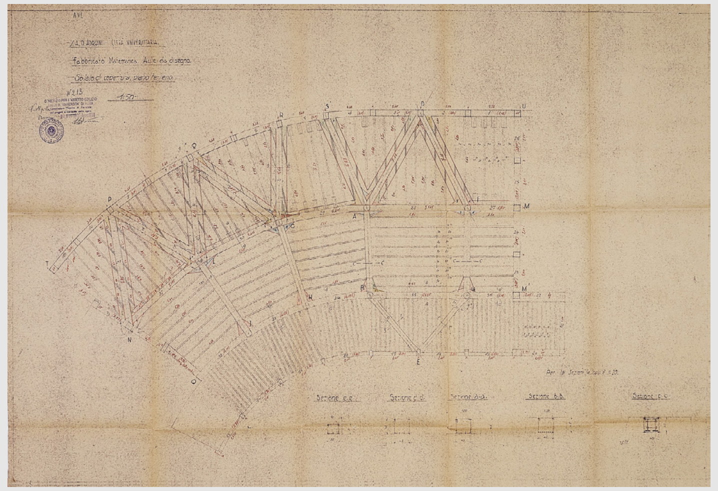
1935, February 18 - A plan attached to the *Implementation program of the university campus as of October 28, 1935 - XIII EF*, shows the good state of advancement of the construction site for the Mathematics building, although this had started only a year before; the building is, in fact, classified as "complete and furnished" in view of the inauguration (ASS_drw_51; Azzaro 2018, p. 109).

1935, March 1 - The contractor Filacchioni signs a contract for 169.000 lire to supply stonework for the construction of the Mathematics building. The completion of the works is scheduled by March 31, 1935.

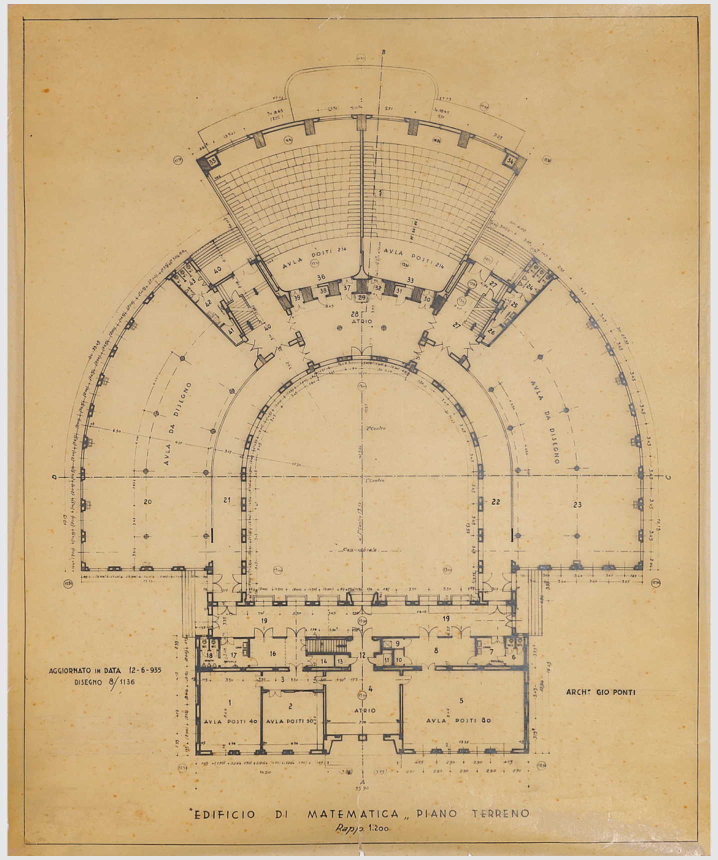
1935, March 1 - The firm Feltrinelli signs a contract for 438.156 lire to supply wooden windows for the Chemistry and Mathematics buildings. The special tender specifications date back to September 10, 1934. The completion of the works is scheduled by March 15, 1935.



ASS_drw_58



ASS_drw_60



ASS_drw_70

1935, March 6 - The contractor Adriani proceeds with the construction of the structures in elevation. In addition to the load-bearing concrete structure and slabs, one-headed tuff and brick masonry walls are also erected; some walls, probably those of the front building, begin to be plastered after the application of an asphalt layer for insulation purposes (ASS_dcm_48).

1935, March 28 - The contractor Coen, called by the Technical Office to flank the contractor Curti in supplying and installing metal windows, signs a contract for 40.000 lire for the supply of 32 iron fixtures (ASS_dcm_51).

1935, April 21 - In a movie by the Istituto Luce showing the "Littoriali di Arte e Cultura", which take place in the university campus still under construction, the central window on the facade of the Mathematics building is covered with a curtain. The facade is clearly visible, but the stained-glass window is covered, while the crowning on top of the facade appears to be completed (ASL_vdo_07; Spano 1935, p. XVI).

1935, May - The total amount of 730.000 lire spent for the School of Mathematics is certified within the list of expenditures laid out at the beginning of the month. Classroom desks have already been ordered for 250.000 lire, while furnishings (shelving?) for 280.000 lire, drawing tables for 52.000 lire and common furniture for 148.000 lire are still to be ordered for the library. Regarding the building: "It is a bit late in construction. We need to press and accelerate, but they promise to complete it by October. For this reason, the furniture must be ordered by July". In the general, an expenditure of 12.000.000 lire is expected for all the furnishings. The plan is to launch a single tender for all contracts with many contractors, to then prepare the various specifications within the month (ASS_dcm_53).

1935, May 11 - Extension of the contract with the contractor Curti concerning Lot III and IV for 269.700 lire. This provides the supply and installation of iron windows: the deadline of the work is March 31, 1935 to place all the windows on the outer facades of the building, excluding the courtyards; May 15 for the remaining ones (ASS_dcm_54).

1935, May 22 - The building appears as then built in a drawing in section; the skylights which shed light in the book deposit adjacent to the library, and the reticular beams on the roof of the tower have disappeared (ASS_drw_58).

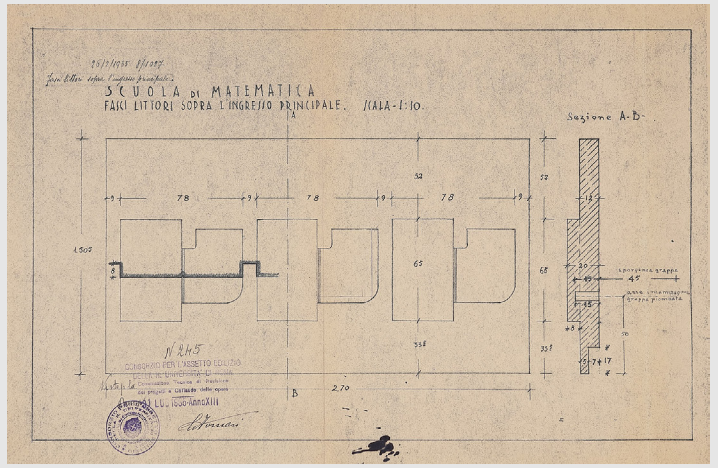
1935, May 22 - New beams and new slabs cover the ground floor of the classrooms, in a drawing attached to the "List of New Prices" signed by the contractor Adriani. Architectural reasons for this new solution are highlighted: no visible ribs, a height of 45 cm for the main and secondary ribs, and similar height of the beams connecting the intermediate pilasters with those along the perimeter (ASS_drw_60; ASS_dcm_57).

1935, June 1 - A series of drawings representing an update version of the project (late 1933- early 1934) are drafted by the Technical Office (ASS_drw_61-66).

1935, June 12 - A further series of drawings is developed by the Technical Office during the completion of the construction site. One of the two garages at the foot of the Tower of the classrooms is further divided into smaller rooms. One of the drawings shows graphic signs on one of the two curved wings with a further fragmentation of the drawing room. We may assume that either the idea of fragmenting those spaces already existed at this date, or these same drawings were used for the alteration of the classrooms achieved in 1939 (ASS_drw_70).

1935, June 13 - The firm Faiella & Rubei sign a contract for the supply and installation of the windows glazing in the Mathematics building; the total amount is 113.600 lire (ASS_dcm_58).

1935, June 28 - As reported in a previous report, 9 million lire are finally allocated for the furniture of the campus. The total amount available is now 91.5 million lire (70 + 12.5 + 9): 8 million are destined to expropriate land and buildings in the area, for the construction and improvement of the Polyclinic and for technical and administrative expenses. The expected completion of all buildings is set for October 28, 1935, with the exception of Chemistry, Botany and part of Biology, which will be ready no sooner than October 1936. A plan attached to the report indicates that the Mathematics building is among the "institutes that will be furnished and finished for next 28 October" (ACS_dcm_22).



ASS_drw_53

1935, July 1 - An additional contract with the firm Fontana- engaged by Piacentini (or Ponti?)- for works at the Mathematics building, extends the submission deed of March 14, 1935 for six windows in the Aula Magna and glass works in the Rectorate. The new contract indicates two separate works: one is referred to the supply and installation of a stained-glass window measuring 10.58 x 4.56 meters with special coloured glass pieces, fired at high heat, bound in lead and decorated, with crystals engraved and polished according to a preparatory drawing by Ponti, for the amount of 35.000 lire; the second refers to the supply and installation of metal and crystal chandeliers with "Fontanit" glass-tiles for 60.654 lire. The deadline for the supply of all works is October 28, 1935 (ASS_dcm_61).

1935, July 2 - Behind the Technical Office's proposal, the contractor SAAR signs a contract for the electrical plant of the Mathematics building. The contractor had submitted complete and satisfactory projects for the plants of the other lots but had failed previous bids.

1935, July 3 - Call for tender for the furnishing of the main hall, the reading room and the book deposit of the library placed in the front block of the Mathematics building. Ponti is called to consult the bid offered by the firms Lips Vago and Parma. Parma wins the offer, later modified to satisfy the requests of the architect (Ponti) to decreases the number shelves and to use a different type of railings. The final offer amounts to 152.000 lire (ASS_dcm_72).

1935, July 8 - Drawings attached to the "List of New Prices" reported by the contractor Filacchioni for the "fasci littori" carved in stone, to be placed above the main entrance of the Mathematics building, and for the cornice that crowns the front building (ASS_dcm_64; ASS_drw_53).

1935, July 11 - On behalf of Piacentini's advice, the engineer Cesare Mariani is hired by the Technical Office to carry out a huge amount of work for the construction site of the Mathematics building, delayed by the very late expropriation of the properties present on the site (ASS_dcm_66).

1935, July 27 - The CERUR approves a reimbursement of travel expenses and related daily allowances to Gio Ponti, for 5.454,75 lire.

1935, August 21 - The contractor Cantieri Milanesi reports that Ponti has decided that the doors should be in straight grain oak wood polished with white paint, instead of "polished natural wood" as indicated in the drawings (ASS_dcm_74).

1935, August 27 - The contractor Filacchioni signs a second contract for the supply of marble works in the Mathematics building, for a total of 104.500 lire; the deadline for delivery is September 1, 1935.

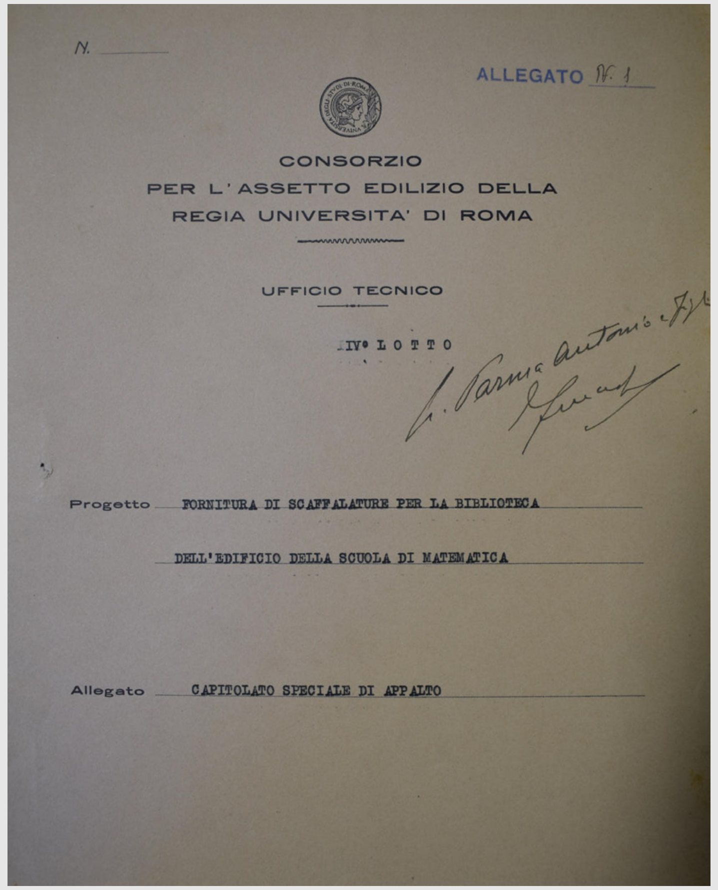
1935, August 28 - Rector Rocco dies of a disease; consequently, De Francisci is reinstated with the role.

THE CONSTRUCTION OF THE SCHOOL OF MATHEMATICS: FINISHES AND WINDOWS..

1935, September 2 - The firm OTIS signs a contract for the supply and installation of two lifts and a book-elevator in the Mathematics building, for a total of 36.500 lire; the deadline for delivery is August 31, 1935 (ASS_dcm_76).

1935, September 4 - Extension of the contract with the firm Fratelli Feltrinelli for the supply of doors, given the good results offered by the firm for the supply of the exterior windows, for 85.000 lire. The work is entrusted in name of the affiliated contractor Cantieri Milanesi, for a total of 75.607,50 lire. The previous month of August, the firm Fratelli Feltrinelli had renamed its industrial sector 'Cantieri Milanesi' (ASS_dcm_78).

1935, September 14 - A report by Francesco Guidi dated January 23, 1936, recalls that at this date the site manager had called the contractor Botteri, which had already supplied iron works for Lot II, to guarantee timeliness of the work included in the main contract signed by the contractor Adriani.



N.

ALLEGATO N. 1

CONSORZIO
PER L'ASSETTO EDILIZIO DELLA
REGIA UNIVERSITA' DI ROMA

UFFICIO TECNICO

IV° LOTTO

Progetto FORNITURA DI SCAFFALATURE PER LA BIBLIOTECA DELL'EDIFICIO DELLA SCUOLA DI MATEMATICA

Allegato CAPITOLATO SPECIALE DI APPALTO

ASS_dcm_91

1935, September 25 - In a movie shot by the Istituto Luce to illustrate the very last works needed to complete the university campus in view of the inauguration, the skyline of the School of Mathematics appears in distance beyond the propylaea in the foreground. Scaffoldings on the front body, close to the large window, suggests that the stained-glass window is being put in place at this time (ASL_vdo_08; ASL_pht_08).

1935, October 1 - The contractor Botteri signs a contract for the supply of railings and other iron works, for a total amount of 25.000 lire (ASS_dcm_81).

1935, October 1 - In extension to previous contracts, the firm Gaggiottini is engaged to supply various works in Anticorodal for 25.000 lire; this includes the supply of 18 letters in Anticorodal to compose the inscription "Scuola di Matematica" to be placed on the entrance portal of the building (ASS_dcm_82).

1935, October 1 - The contractor Vanni is engaged by the Technical Office to supply artificial marble baseboards, considered cheaper in comparison to marble ones, and easier to apply to curved walls, and corresponding to the architect's intentions. The work amounts to 16.000 lire and the delivery deadline is set for October 31, 1935 (ASS_dcm_83).

1935, October 1 - The contractor Santi signs a contract for the supply of two chairs for the tiered lecture halls at the first and second floor and two chairs for those at the ground floor of the tower, eight chairs for the classrooms at the ground floor of the front building, two chairs for the drawing rooms at the ground floor and two at the first floor of the wings, two large double-faced reading tables for the large room of the library. The work mounts to 86,000 lire; in addition, the contractor must also provide ten round windows in Slavonian oak wood, three doors for the book elevator with two-part openings, a door in fir wood, four double-level wall shelves in oak wood, a frame for the blackboard in the assembly hall and two frames, plus other minor works. The delivery of the works is scheduled for October 28, 1935 (ASS_dcm_84).

1935, October 3 - The Italian campaign in Africa starts with the invasion of Ethiopia, and the colony of Eritrea in the north.

1935, October 10 - The firm Palazzo della Luce signs a contract for the supply and installation of lighting fixtures for the Arts and Humanities buildings, Law, Mineralogy, for the Rectorate, and for the School of Mathematics, for a total amount of 100.000 lire (ASS_dcm_85).

1935, October 10 - The contractor Farnese is committed with part of the work entrusted to the firm Macciò, with the latter's consent, for 22.000 lire. The new deed provides the same conditions opposed to the firm Macciò, but given the exceptional situation, the burden of the deposit has been removed and the deadlines and testing have changed. A new price is given to the supply of Litocrom (unalterable matte paint), as the contractor Farnese has its exclusive rights (ASS_dcm_86).

1935, October 22 - The contractor Fusi and Macchi signs a contract for the supply of sanitary and gas installations in the School of Mathematics, for a total amount of 100.000 lire (ASS_dcm_90).

1935, October 26 - The firm Parma signs a contract for the supply of shelving in the reading room and in the book deposit, for 160.000 lire. The shelving system is made accessible by metal catwalks and metal staircases, for a total of 144 shelves, 864 boxes (144 fixed and 720 movable). The book deposit is furnished with bilateral and unilateral shelving systems displayed on two levels, divided by an intermediate metal ribbed slab, and accessed by two metal staircases, for a total of 148 double-sided and 20 single-sided shelves, with 2212 shelves (1896 mobile and 316 fixed). Delivery is scheduled for September 20, 1935 for the shelving system in the library, reading room and intermediate floor of the book deposit; October 15 for the rest (ASS_dcm_91).

1935, October 29 - Piacentini releases a note to the press to explain his absence at the inauguration ceremony due to a long illness. Strong points of the project consist in the great continuity between design and execution, which has not sacrificed the achievement of a classic Mediterranean project in name of modernity, in perfect balance between symmetry and the "Roman art of variety". This is proved, for example, by the fact that, albeit facing one another at the sides of the great central square of the campus, the School of Mathematics is not even in symmetric proportions to that of Mineralogy (BFAF_dcm_01).

BBL_pht_26

ACS_pht_10

BBL_pht_30

BBL_pht_13

1935, October 31 - The firm Liporesi signs a contract for the supply of 1296 oak wood benches with chromed steel supports, identical to those of the Arts and Humanities and of Law buildings, according to a contract of 13 July, for a total of 22.000 lire. Changes to the School of Mathematics consist in the distance between the desks, while the size of the movable part is kept at 42 x 38 centimetres. The deadlines for the delivery of the works are set by September 25, 1935 to complete the classroom desks at the second floor, by September 30 those on the first floor, by October 5 those for the two small classrooms at the ground floor. The architect (Ponti) requests and obtains a higher backrest, from 27 to 34 centimetres (ASS_dcm_92).

1935, October 31 - Official ceremony for the inauguration of the university campus at the presence of Mussolini. In his official speech, the Duce mentions Piacentini, who is absent due to illness. On the same day, the architects visit Piacentini at his villa on the via Camilluccia to offer him a photograph album with inscriptions from each. Mathematics results among the unfinished buildings: in a picture of the inauguration day, a curtain or such covers part of the stained-glass window (BBL_pht_26, ACS_pht_10, BBL_pht_30, ASL_pht_09; ASL_vdo_09; Nicoloso 2018a, p. 182).

THE CONSTRUCTION OF THE SCHOOL OF MATHEMATICS: FINISHES, GLAZING AND FURNISHING....................

1935, November - The Ministry of Education De Vecchi reorganizes the higher education system, integrating the Schools of Architecture and of Engineering within the university courses. The two new Schools are directed by Piacentini (architecture) and Giovannoni (engineering).

1935, November 1 - Official visit of King Vittorio Emanuele III to the university campus. The king is awarded with a degree honoris causa, on proposal of the School of Humanities and Philosophy, at the presence of Rector De Francisci and Ministry De Vecchi (ASL_vdo_10).

1935, November 3 - The League of Nations opposes sanctions to Italy for its colonial aggression to Africa. The provision is enforced on November 18, 1935 and marks the beginning of the Italian autarchic policy.

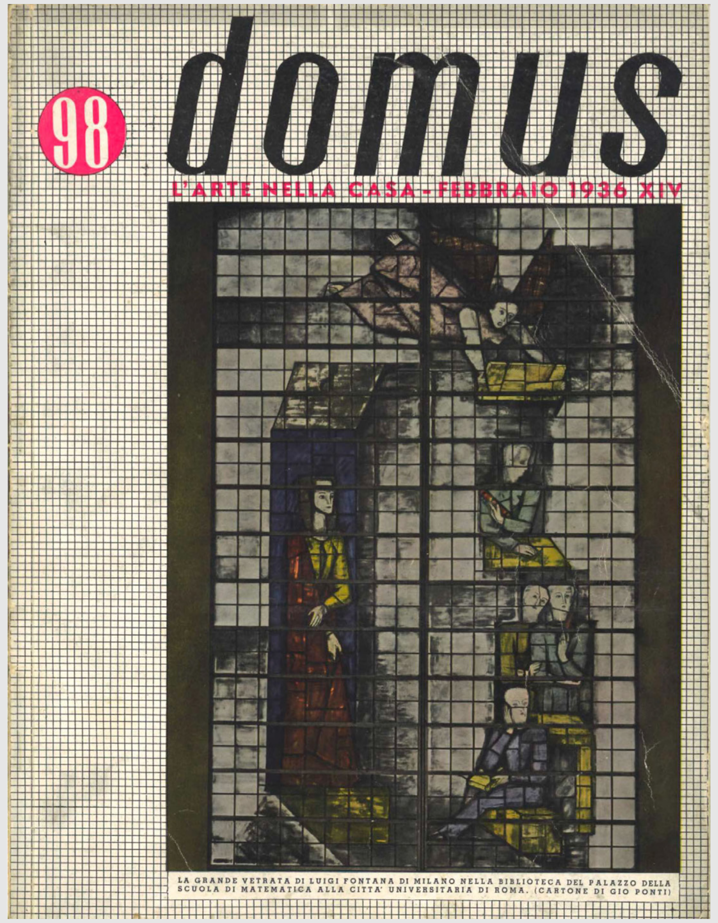
1935, November 8 - The contractor SAAR signs a contract for the supply and installation of the lighting systems, motive power (lift motors and book lifts), (remote) luminous and acoustic signals and lightning rods in the School of Mathematics, for a total amount of 100.000 lire (ASS_dcm_95).

1935, November 16 - In an article written on occasion of the inauguration of the university campus, Margherita Sarfatti celebrates Ponti's and Capponi's buildings. Regarding the School of Mathematics, she states that "every detail is treated by Ponti with exquisite elegance, even the harmonies of colours. Ponti is an inexhaustible imaginative who seeks wealth and inspiration everywhere: in the gothic cathedrals for the stained-glass window, so elegantly original and modern, and in Pompeii for some constructive and chromatic ideas, perspectives of corners and stairs, delicately white walls, red protrusions, warm yellow tones of ivory and cold light blue" (Sarfatti 1935, pp. 187-192).

1936 - The Technical Office drafts a program for the completion of the campus behind request of Rector De Francisci. The first and only planned achievement is the construction of the Tuminelli graphic and publishing plant, completed in 1938 (Guidoni, Regni Sennato 1985, p. 83, BBL_pht_13).

1936, January 16 - The payment of Ponti's compensation of 11.273 lire for the design work of the School of Mathematics is decided on December 27, 1935 and transmitted to Ponti on this date (ASS_dcm_111).

1936, January 20 - The firm Beltrami signs a deed of submission for the supply of two-seater Milan-type desks: sixty without backrest, twelve with final bench, thirteen bookcase-cabinets, thirteen desks, thirteen cupboards, thirteen small tables, thirteen armchairs, one hundred and twelve drawing tables complete with stools, twenty-four stools for wooden models, four desks for chairs, six wall hangers with multiple seats, for a total amount of 136.000 lire, in extension to the contract signed on 10 December 1935 (ASS_dcm_112).



BBL_pht_32

1936, January 28 - The firm Parma signs a new deed of submission, extension of the previous one, for the supply of one hundred ninety-six chairs, model n. 14 on the company catalogue, six reading tables, two reading tables, four filing cabinets made entirely of folded and printed steel sheet (two of type A with 112 open boxes and two of type B with 98 open boxes), for a total amount of 48.525 lire (ASS_dcm_115).

1936, February - Ponti's stained-glass window for the School of Mathematics is published on the cover of the review "Domus", issue n. 98 (BBL_pht_32).

1936, February 14 - Three invoices of the firm Hass are paid for the supply of 'imperial' doormats to be placed at the entrances for a cost of 3.039,20 lire of rayon window curtains for 90 lire, and for the supply of a curtain, application and installation included for 316 lire.

1936, February 24 - On behalf of Piacentini's advice, the firm Balzaretti & Modigliani signs a contract for the supply of Termolux glazing and Vetroplex glass sheets for several buildings of the campus. There is already a special tender specification, dated June 28, 1935, approved by the Technical Commission for Revision and Testing.

1936, February 24 - After completing a list of furniture needed for the completion of the School of Mathematics, the Technical Office announces an internal competition among specialized firms and proposes to entrust the work to the firms Beltrami and Santi (except the metal cabinets, which are entrusted to the firms Parma). The supply is divided into two steps: the first dedicated to essential furniture, the rest when the final cost of the construction and the availability of the allocated funds will be clear. The firm Santi is bound to supply 8 cabinets for the drawing rooms, but since the school year is over, this work is no longer urgent and may be postponed to September (ASS_dcm_125-126).

1936, April 2 - Supplementary report of the Commission for Technical Review and Testing, with Piacentini and De Smaele, reporting the significant changes made during the execution of the works. The occurrence of new needs, such as the heating system of many extra rooms, has forced the project manager to request the raise of thermal potential of the "Velox" boilers with 700,000 calories, for a total of 8.000.000 calories. The firm answers the request by installing two "Velox" type generators. Other particular changes are the displacement of the Mathematics control unit, initially placed at the foot of the front building and then shifted into the classrooms, and the isolation of electric trunks from the main internal distribution network to reach rooms and classes. Seven dissections are required in the School of Mathematics, four for the drawing rooms and three for the front classrooms. The building is powered continuously, day and night, with radiators for 4160 calories, in daytime mode for ten hours with radiators for 163.030 calories, and in nigh time mode for four hours with radiators for 145.830 calories (ASS_dcm_135).

1936, April 30 - The firm Haas releases an invoice for ten curtains in plain cloth, packaged and installed on rails and sliding brass in the professors' room facing the square, two same curtains facing the courtyard, and three made of extra *pequin* cotton with brass profile for the library (ASS_dcm_137).

1936, May 9 - Mussolini proclaims the Italian Empire from the balcony of Palazzo Venezia after the victorious entry of the troops led by Badoglio into Addis Ababa on May 5.

1936, May 12 - The International Catholic Press Exhibition is inaugurated at the Vatican, in the Cortile della Pigna. The exhibition, commissioned by Pope Pius XI, is set up by Ponti with several collaborators and is organized in a year and a half, thanks to the collaboration of the committee in charge, composed of Franco Ratti, Leone Castelli, Bartolomeo Nogara, Monsignore Giuseppe Monti and Alcide De Gasperi (Miodini 2001, p. 161).

1936, May 22 - A group of Libyan notables visits the university campus and the School of Mathematics accompanied by Rector De Francisci, as shown in some pictures (ASL_pht_13-14).

1936, June 3-4 - First Conference on Applied Mathematics organized within the School of Mathematics with the support of the CNR; this is probably the first official event in the building, which is still not fully completed (Nastasi 1998, p. 327).

ACS_pht_08

1936, June 3 - The contractor Filacchioni justifies a price increase for the work achieved at the university campus. In the second List of New Prices, the paving of the courtyard is first designed with common stone slabs, but Ponti opts for the use of travertine slabs *ad opus incertum*, considered more apt to the character of the building (ASS_dcm_144).

1936, July 1 - The invoice of the contractor Gaggiottini, dating December 4, 1935, is approved; it concerns the dismantling and cleaning of the letters in Anticorodal that compose the sign 'Scuola di Matematica' on the main façade of the building, made twice.

1936, July 29 - Piacentini requests to recruit personnel for the Technical Office from June 1 to July 1, 1936, in order to complete the works that are still pending in the university campus (ASS_dcm_150).

1936, August 18 - A picture shot by the Istituto Luce, a French-Belgian delegation visits the university campus; this is one pf the few images that depicts the School of Mathematics in its original condition (ASL_pht_15-16, ACS_pht_08)

1936, September 10 - The firm Beltrami signs a new deed of submission for cabinets-bookcases, a shelf with placard, two small desks, a janitor's table, a typewriter table, two types of desks, four standard folder holders in the professors' offices, for a total amount of 10.500 lire (ASS_dcm_153).

1936, September 10 - The firm Santi signs a new deed of submission for the supply of furniture, under the same general conditions as in February 1936, for a total amount of 17.010 lire. The delivery deadline is set for October 15 (ASS_dcm_154).

1936, October 1 - The firm Bianchi signs a deed of submission in extension to one stipulated on July 16, 1936, related to Lot I. The supply includes several ceiling and wall speakers; delivery is scheduled for October 20, 1935 (ASS_dcm_156).

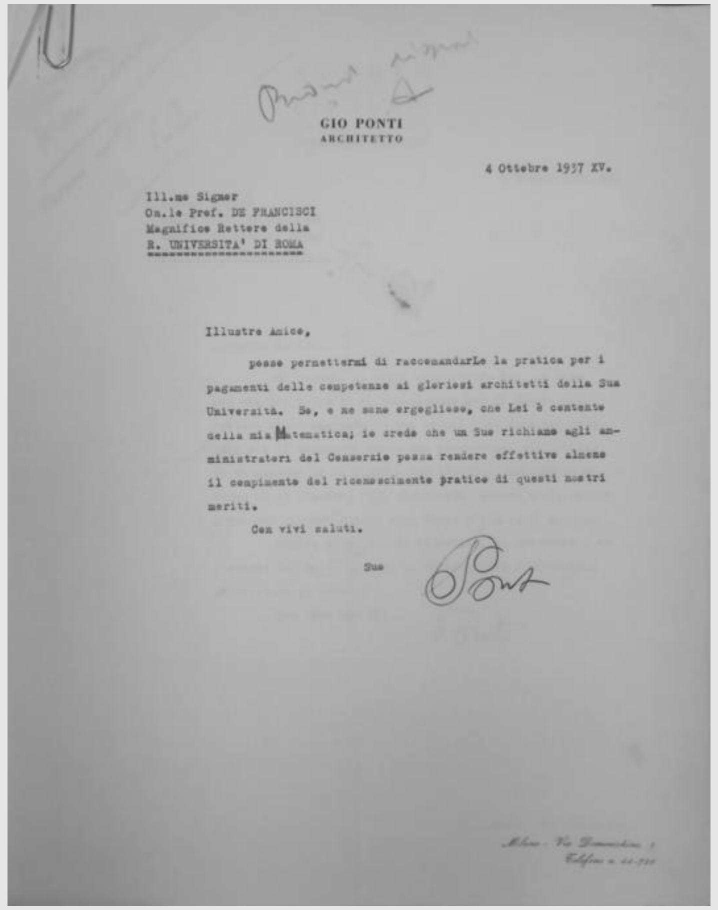
1936, October 18 - General inspection report and acceptance certificate; the latter refers to the works carried out by the firm Farnese, refers to the painting of the walls of two classrooms in the tower, three atriums with related rooms at the ground, first and second floor of the same building, of three toilets near the aforementioned stairs, and of the wooden window frames in all the rooms indicated in the contract (ASS_dcm_157).

1936, November 10 - Report, visit report and acceptance certificate for the works carried out by the contractor Coen. This has satisfied the required conditions, but the movable shutter windows are defective, and the knobs easily disassemble when moved. It is requested: to eliminate the defect in the two drawing rooms, to replace the pins with screw shanks connecting the various pieces with pins with smooth stems; to replace the two hundred iron fixing screws with as many in nickel silver (ASS_dcm_160).

1936, November 18 - Rector De Francisci inaugurates the academic year 1936-1937 which starts the activity in the university campus (ASL_vdo_13).

1936, December 15 - Guidi advances the request to pay an additional deposit to Gio Ponti, because there is a residual of 7.940,35 lire compared to the estimated cost of the construction works which excluded installations and furniture. The cost of the building, which had been established on October 20, 1933, was set at 3.300,00 lire and the designer is therefore entitled to receive 59.400 lire. Following the calculation made, 51.549,65 lire have already been paid: 15.050 lire on December 24, 1932; 9.450 lire on 25 September 1933; 9.904,38 lire on 14 January 1935, 5.782,25 lire on 22 June, and 11.273 lire on December 6 (ASS_dcm_164).

1937, March 1 - The firms Parma, Santi and Beltrami sign a further contract, for a total amount of 99.300 lire, for the completion of the furniture of the School of Mathematics, to satisfy the latest needs of the professors. The firm Santi must provide two glass cabinets for the models in the professors' atrium, a drawstring cabinet in Mauro Picone study, bookshelves in Federigo Enriquez study, and bookshelves in Tullio Levi Civita study. The firm Parma must provide metal cabinets in the professors' offices and in the drawing rooms. The firm Beltrami must provide a wall bookcase, two tables, a blackboard table, a large Moroccan sofa, nineteen Moroccan armchairs in the professors' meeting room, a table in the professors' meeting room and one hundred drawing tables with stools in the drawing rooms (ASS_dcm_167).



GIO PONTI
ARCHITETTO

4 Ottobre 1937 XV.

Ill.mo Signor
On.le Prof. DE FRANCISCI
Magnifico Rettore della
R. UNIVERSITA' DI ROMA

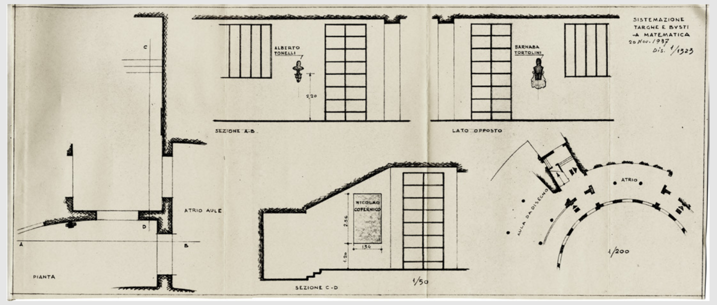
Illustre Amico,

posso permettermi di raccomandarLe la pratica per i pagamenti delle competenze ai gloriosi architetti della Sua Università. So, e ne sono orgoglioso, che Lei è contento della mia Matematica; io credo che un Suo richiamo agli amministratori del Consorzio possa rendere effettivo almeno il compimento del riconoscimento pratico di questi nostri meriti.

Con vivi saluti.

Suo

ASS_dcm_186



ACS_drw_03

1937, March 9 - The firm Parma draws the List of New Prices with the overall price for the painting of the shelves, following the provisions given by the artistic direction. Recurring to the very fine enamel technique, the ceilings of the perimeter galleries of the shelves in the large reading room are painted in two colours: one for the ribbing of the supporting beams and one for the metal sheet ceilings of the galleries (ASS_dcm_175).

1937, March 10 - Detailed description of the components of the counters, consisting of metal frame and wooden boards, within the price analysis of the contract with the firm Liporesi; item 14 indicates "loading, transport from Bologna to Rome and unloading" (ASS_dcm_169).

1937, June 9 - Following previous requests on April 5 and May 19, Ponti again asks to receive the residual payment of 7.940 lire. Likely, after this reminder, a payment is made as in Piacentini's report of July 1, according to which Ponti has been paid 58.459,73 lire (ASS_dcm_177).

1937, July 1 - The Technical Office reports problems due to significant water infiltrations through the grand stained-glass window produced by the firm Fontana Arte. Since reparation works do not prove successful and the firm refuses to provide further ones, the latter decides to appeal to the Inspection Commission for trial against the Technical Office. A note says that the installation of the window took place within the prescribed deadline of October 28, 1935 (ASS_dcm_195).

1937, July 19 - On behalf of the architects' pressing requests, Piacentini pleads Rector De Francisci to release a higher payment, no longer calibrated on the budget of the project but on the consistency of those actually carried out, more expensive than expected. Ponti's new compensation, in the measure of a 1% of the estimated plus 1% of the final cost, now amounts to 7680 lire. Since the payments received mount up to 5.845,97 lire, 1834,02 lire remain to be paid. The request is rejected twice, as described in two different letters in response to further requests from Piacentini, sent to the architect on September 6 and October 11, the latter at Ponti's insistence (ASS_dcm_179).

1937, September 7 - The firm Linoleum defines a List of New Prices for the use of a special cement and pumice layer in the classrooms of the School of Mathematics, plus other small jobs (ASS_dcm_182).

1937, September 9 - The General Commissioner for War Manufacturing announces the ban on the use of iron, the so-called "autarchic measures". From now on, iron frames cannot be used, except for shop shutters and hospital windows (ASS_dcm_183).

1937, September 20 - Report, inspection and test certificate for the works carried out by the firm Santi; no problem is encountered in all three supplies. The final state of the works date from April 6 and March 19, 1937 (ASS_dcm_184-185).

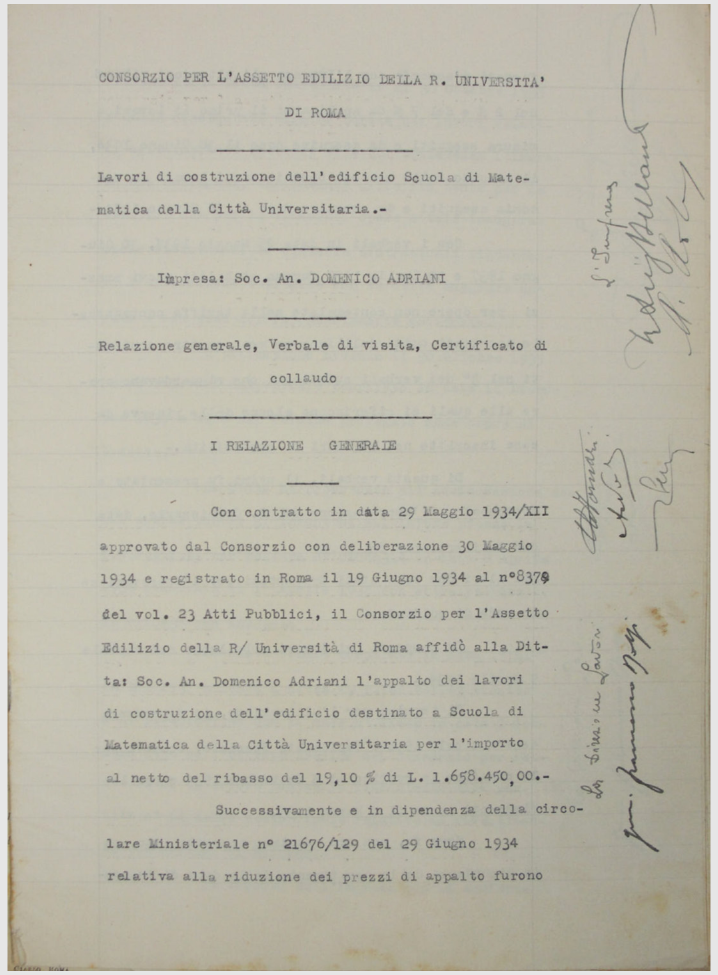
1937, October 4 - Guidi answers to Ponti's request for payment, and reports that he has long since completed his task and cannot do much for the architect (BAF_dcm_06).

1937, October 4 - Further recommendation directly to Rector De Francisci to pay the fees due to the architects. Ponti asks if De Francisci is happy with 'his Mathematics', as he is himself proud of the result. De Francisci replies on October 15, 1937, stating that there are difficulties in arranging for the payment of the remaining sums due to financial problems of the CERUR (ASS_dcm_186).

1937, October 15 - The contractor Adriani provides the last lot of works, which include the application of decorative plaster on the entrance portal, the installation of wooden doors to access the lever control of twenty-two windows, the scraping and re-filling of the joints between the travertine flashings of the terraces (ASS_dcm_187).

1937, October 27 - Spano reports the need to pay 11.540,27 lire to Ponti, based on the total amount of the estimate. The payment is finally approved by the CERUR on December 3, 1937 (ASS_dcm_189).

1937, November 20 - Rector De Francisci sends a plan of the School of Mathematics to the Ministry of National Education, showing where to place the plaques and the busts dedicated to Alberto Tonelli, Barnaba Tortolini and Niccolò Copernico (ACS_drw_03).



CONSORZIO PER L'ASSETTO EDILIZIO DELLA R. UNIVERSITA'
DI ROMA

Lavori di costruzione dell'edificio Scuola di Matematica della Città Universitaria.-

Impresa: Soc. An. DOMENICO ADRIANI

Relazione generale, Verbale di visita, Certificato di collaudo

I RELAZIONE GENERALE

Con contratto in data 29 Maggio 1934/XII approvato dal Consorzio con deliberazione 30 Maggio 1934 e registrato in Roma il 19 Giugno 1934 al n°8379 del vol. 23 Atti Pubblici, il Consorzio per l'Assetto Edilizio della R/ Università di Roma affidò alla Ditta: Soc. An. Domenico Adriani l'appalto dei lavori di costruzione dell'edificio destinato a Scuola di Matematica della Città Universitaria per l'importo al netto del ribasso del 19,10 % di L. 1.658.450,00.-

Successivamente e in dipendenza della circolare Ministeriale n° 21676/129 del 29 Giugno 1934 relativa alla riduzione dei prezzi di appalto furono

ASS_dcm_201

1937, November 20 - The contractor Adriani complains the fact that testing and subsequent signature of the final payment has not occurred, even though the School of Mathematics was built in less than a year and inaugurated on October 31, 1935. It is also recalled that a payment mandate of 92.000 lire has been suspended due to the non-allocation of supplementary funds (ASS_dcm_191).

1937, November 23 - Report, visit and inspection report for the stone works carried out by the contractor Filacchioni, who does not intend to sign the final payment due to differences on the calculation of penalties, consequent to delays of many orders. The dispute ends on May 16, 1939 when the CERUR halves the penalties, partially acknowledging the reasons of the contractor.

1937, November 29 - Report, inspection report and test certificate for the works carried out by the firm Vanni. The inspection takes place on the same day and no problems are found (ASS_dcm_199).

1937, November 30 - Report, inspection report and test certificate for the works carried out by the firm Botteri. No problem is encountered during the visit (ASS_dcm_198).

1937, December - Bompiani reports that the Analytical Geometry course has been given a more applicative character to adapt it to the needs of Engineering courses, while the Descriptive Geometry course in the School of Engineering has been abolished and has become a complementary course within the studies in Chemistry, Mathematics and Physics (ASS_dcm_192).

1937, December 1 - Second inspection for the works carried out by the firm Fontana Arte. Among the documents provided for the occasion, there is also Ponti's preparatory drawing used to verify the correspondence. The inspection is carried out by jetting water from the Acqua Marcia water pipes and directing the flow against the lintel of the window to obtain a grazing waterflow on the surface. An immediate and copious outflow of water occurs on the internal surface of the glass, through the gap between the window and its metal frame. The inspection also ascertains that water trespasses through the splices in several points onto the balcony of the library, with consequent flooding of the floor of the room on the ground floor (ASS_dcm_195).

1937, December 10 - Report, visit report and test certificate for the works carried out by the firm Macci: 25.210,04 lire remain to be paid. The following day, the site manager rejects the reserves expressed by the firm which requests higher compensation due to unforeseen conditions (ASS_dcm_194).

1937, December 10 - Report, visit report and test certificate for the supply of library shelving by the firm Parma, which reports no problem.

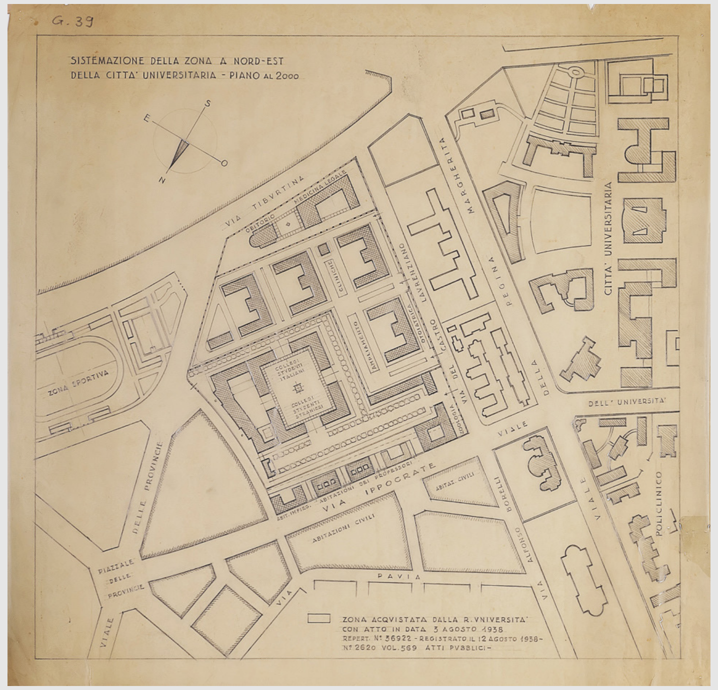
1937, December 13 - Report, visit report and test certificate for the works carried out by the firm Liporesi. No problem is reported, although two months earlier the firm had expressed doubts about the condition of the works in Mathematics, Arts and Humanities and Law buildings, given that they had finished two years earlier and were still awaiting a testing.

1937, December 13 - General report and minutes of the inspection visit for the works carried out by the firm Fontana Arte, pointing out that the inspection is suspended, and the firm is invited to repair damage and inconveniences by August 31, 1938 (ASS_dcm_195).

1937, December 18 - Revision, inspection report and test certificate for the supply of benches, seats and some furniture by the firm Beltrami; no problem is encountered.

1938, January 14 - Report, inspection report and acceptance certificate for the work carried out by the contractor Otis; no problem is encountered during the visit.

1938, January 26 - The contractor Adriani signs the Act of Acceptance of the works drawn after the visits of January 20, 24 and 25 1938. The inspectors notice that the paving of the roof terrace of the drawing rooms shows lifts along the ridges. Since there are no cracks, or detachments, the problem is attributed to elastic deformations of the load-bearing structure and to temperature variations. There are numerous gaps in the plaster due to the swelling of internal parts, while the glass-blocks roofing of the library proves defective in terms of stability and waterproofing. These defects are ascribed to the contractor (ASS_dcm_201).



ASS_drw_129

1938, March 15 - Report, visit report and test certificate for the supply of metal furniture by the firm Parma; no problem is found (ASS_dcm_205).

1938, June 1 - A note communicates that Adriani has carried out consolidation works of the cantilevered slab of the glass-and-concrete roof of the library and has plastered and recovered the “bottaccioli” (ASS_dcm_208).

1938, July 20 - Reserves of the contractor Adriani, already indicated on December 1 1937, are accepted although only in part. These refer to the use of different bricks due to the need of reaching a greater height, to the dosage of cement for the slabs and surrounding beams, to the use of reinforcing rods, to the joists for the metal mesh false ceilings, to the structure of the tower of the classrooms and the construction of the glass-and-concrete roof above the library, to the use of Terranova plaster, to the ‘Veneziana’ paving, to the cladding with lead-polished marble slabs put in place with diagonal joints, to the paving of the courtyard with travertine slabs disposed ad opus incertum, to the Litoceramic cladding of the front body rear facade. To these, one must add a supplement for the works carried out at night in the days before the inauguration, for the inconstant development of the works and for the bank interests due to the two-year payment delay of 92.000 lire (ASS_dcm_208).

1938, July 27 - Hungarian ministries visit Rome; in a movie shot by the Istituto Luce, the guests are walking through one of the drawing rooms at the ground floor (ASL_vdo_16).

1938, August 3 - The university purchases land between via del Castro Laurenziano, viale Ippocrate and via Tiburtina. A project for this lot foresees the expansion of the clinics, a forensic morgue, boarding schools for Italian and foreign students and housing for professors and employees (ASS_drw_129).

1938, October 3 - Inspection visit for the works carried out by the firm Faiella & Rubei; no problem is reported.

1938, October 3 - Report, visit report and test certificate for the completion of furniture supply by the firm Beltrami; no problem is reported.

1938, October 5 - Report, inspection report and acceptance certificate for the works carried out by the firm SAAE; no problem is reported.

1939, January 18 - Report, inspection report and test certificate for the works carried out by the firm Fontana: 35.000 lire remain to be paid, which is almost the entire contracted sum.

1939, February 23-25 - Second Conference on Applied Mathematics, organized in the School of Mathematics with the support of the CNR; the first had taken place in 1936 (Nastasi 1998, p. 327).

1939, March 14 - Rector De Francisci promises to move monuments and tombstones from Sant’Ivo alla Sapienza to the new university campus. In agreement with the Superintendence for Antiquities and Fine Arts, a preventive storage of these pieces is foreseen and, subject to the decision of the directors of institutes and heads of faculties, their subsequent location (ACS_dcm_26).

1939, March 28 - In a note concerning the reserves opposed by the contractor Adriani, the irregular development of the works is considered a consequence of the delays in determining the finishes due to the absence of the Artistic Director (Ponti). The delay, which sometimes lasted weeks and weeks, occurred repeatedly in the choice of the type of plaster, of floors, of coverings, of the Terranova and, in general, of all finishes (ASS_dcm_209).


BBL_pht_38


BBL_pht_39

FIRST ALTERATIONS

1939, June 6 - Submission deed of the contractor Catola to build an extension above the west curved wing of the School of Mathematics, for a total amount of 49.000 lire. The contract includes demolition works to make room for the structure, load-bearing structures and floors, waterproofing, rainwater disposal works from the roof terraces of the new building, supply of wooden and iron frames, electrical and sanitary installations and supply of lighting devices; the project manager is Francesco Guidi. The plan is also to divide the drawing classroom III with perforated brick partitions, clamped into the existing walls, with wooden windows with parts in polished oak, and a partial elevation, indicated in pink in the drawings, equipped with external iron frames (ASS_dcm_210-211).

1939, July 13 - The Royal National Institute of High Mathematics (INDAM) is established by law n. 1129 of July 13, 1939; on September 8 the statute is approved, and Francesco Severi is appointed president (ASS_dcm_213).

1939, August 7 - Enrico Bompiani is the director of the School of Mathematics, after Gaetano Sforza.

1939, November 7 - Report of the inspection report and of the test certificate for the supply of lighting fixtures for Mathematics, Orthopaedics, Hygiene, and Physics, provided by the firm Bianchi. Since 1936 there has been a legal dispute for the seizure of 7.000,00 lire by a collaborator of the firm, Alberto Tombari. The sum is released only after two years.

1940, January 10 - Supplementary appraisal, attached to the report of the project manager, referred to the works of the firm Feltrinelli for supply of window fixtures to the School of Mathematics. The partial amount of Mathematics mounts to 40.440,62 lire (ASS_dcm_214).

1940, April 15 - Mussolini visits the new seat of the Institute of High Mathematics within the School of Mathematics, accompanied by the director Francesco Severi (ASL_vdo_17; BBL_pht_38, BBL_pht_39; ASL_pht_17-18; ACS_pht_33).

1940, June 10 - Mussolini announces the declaration of war against France and England from the balcony of Palazzo Venezia.

1940, July 12 - Report, inspection report and test certificate for the works carried out by the contractor Catola; no problem is encountered.

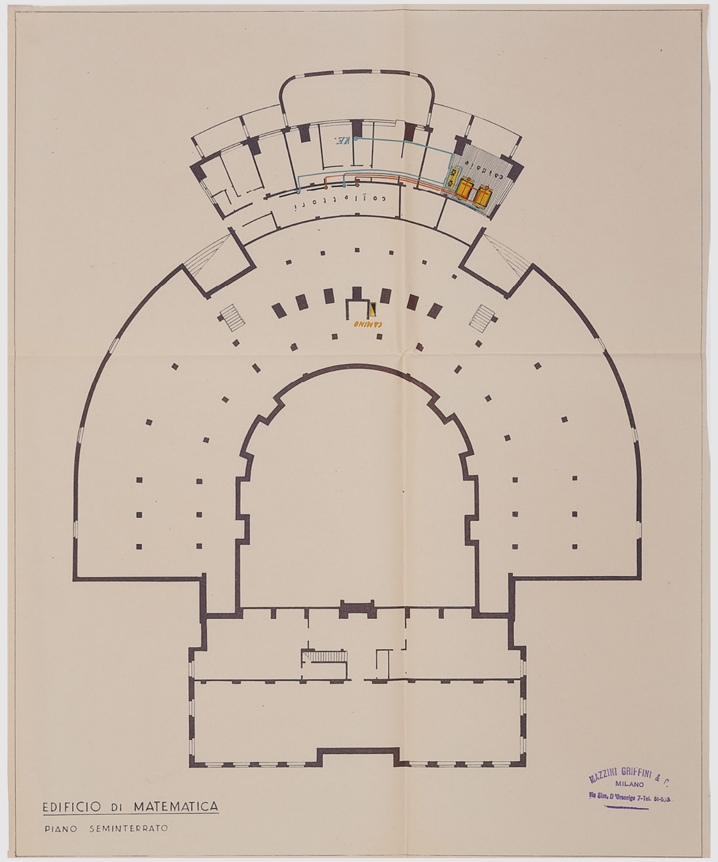
1940, October 14 - Report on the anti-aircraft defence of the university campus. The basement of the School of Mathematics is considered among the many shelters, which provide three hundred places. There are 15750 students, 1800 of which are enrolled at the Faculty of Sciences, and 7700 students of which are in the university campus. Yet, the estimated number of students that may be present in the event of an enemy raid, may amount to a maximum of 1800 (ASS_dcm_215).

1940, October 18 - Guidi opposes reserves to the construction of true anti-aircraft shelters in the campus. Among the proposals for the adaptation of existing spaces for the scope, Guidi considers the basements of the School of Mathematics- under the front building, the courtyard, and the tower of the classrooms- for a total of 450 square meters and an estimated cost of 8.000 lire. Adaptive works consist in closing the window compartments with blocks, in the installation of toilets, in opening an emergency exit, in the installation of fans and of safety deposit boxes (ASS_dcm_216).

1941, March-April - The project manager reports a supplementary inspection of the firm Feltrinelli referred to the four-year suspension of the construction of the Institute of Chemistry. When the works are resumed, restoration and repair activities become necessary, producing a greater expenditure than expected, also for the School of Mathematics. The final costs mount to 60.000 lire, but the sum is presented with consistent delay due to the late availability of the funds. (ASS_dcm_217).

1941, August 25 - Report, inspection report and test certificate for the works carried out by the contractor Curti; no problem is encountered during testing.

BBL_pht_42



ASS_drw_131

ASL_pht_21

1942, March 1 - The university requests further land for future developments as the new Master Plan of Rome is being laid out. The plan indicates the land to be destined to the purposes of the campus, the land sold by the Institute of Public Health, the land used by the State Property, the land to be expropriated and the land owned by the university, *i.e.* the campus and Castro Pretorio (ASS_drw_132; Guidoni, Regni Sennato 1985, p. 83).

1942, March 7 - The firm Mazzini & Griffini present the estimated cost for new thermal control units for the autonomous heating of the campus buildings, including the School of Mathematics, to be integrated with the previous ones. The firm offers mechanical coal burners, which had been tested in the boilers of the heating systems of the hospital Umberto I (ASS_dcm_219; ASS_drw_131).

1942, July 16 - Ministry Giuseppe Bottai anticipates to the directors of the Institutes that German diplomats may request to occupy the campus to organize the armed forces. In this case, the directors must report requests to the Ministry for compliance (ASS_dcm_220).

1942, November 14 - Report, visit report and test certificate for the works carried out by the firm Feltrinelli in the Mathematics and Chemistry buildings, where construction sites were interrupted several times after the inauguration; no problem is encountered.

1943, May 7-9 - Ponti is in Rome, as representative of the Milanese section of the National Fascist Architects Union, to join a Commission for exams, probably for the qualification to the architecture practice. In this occasion, he asks to be received by Mussolini to present the editorial project for the review "Casa al Popolo" edited by Garzanti (ACS_dcm_28).

1943, July 19 - The allied air forces release bombs on the area of the S. Lorenzo railyard adjacent to the university campus. Many bombs fall on the university buildings, especially on the Institute of Chemistry, next to School of Mathematics. The explosion damages the stained-glass window and probably causes its destruction: the precious polychrome glass is shattered but the frame is preserved (BBL_pht_42, BBL_pht_43, Salvo 2015, p. 193).

1943, July 25 - Following the vote of the Grand Council of Fascism Mussolini is dismissed as prime minister. On the same day, by order of the King, the Duce is arrested, and the government entrusted to Pietro Badoglio.

1943, August 20 - De Francisci requests to remove an unexploded bomb buried in a garden between the School of Mathematics and the Gypsotech (ASS_dcm_222).

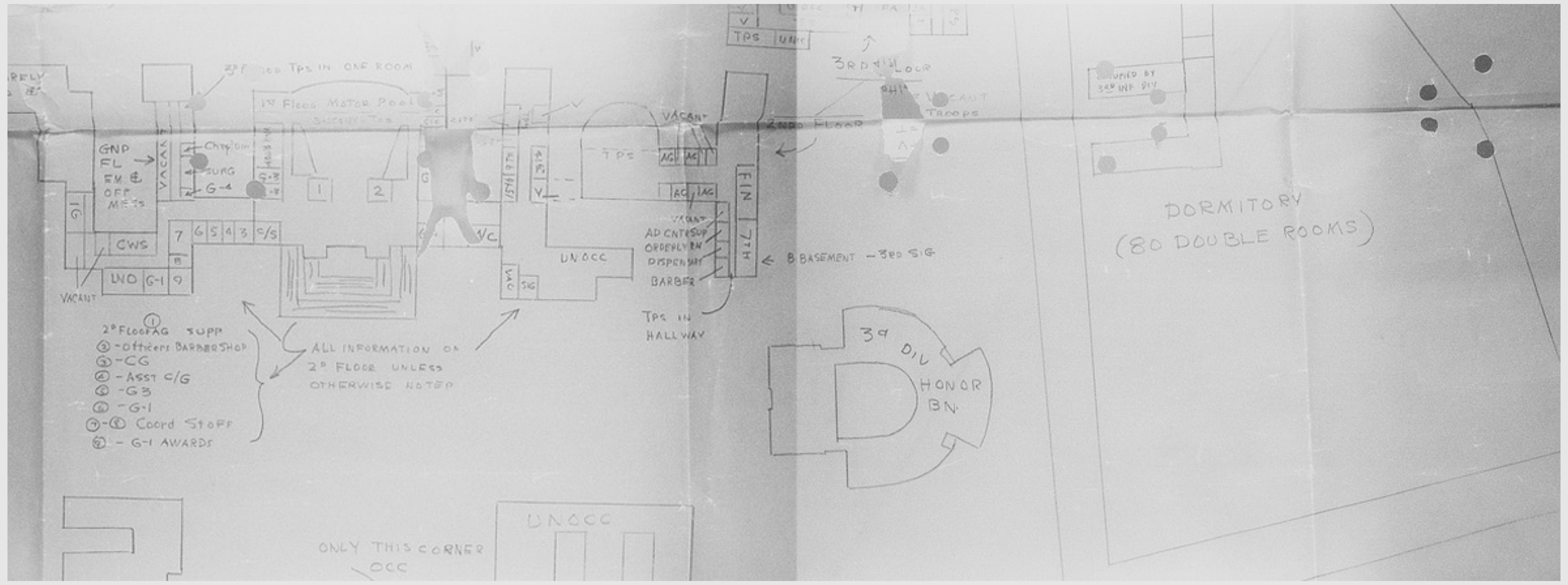
REPARATION OF WAR DAMAGES

1943, August 30 - Guidi draws a report describing the situation of the campus after the bombing and counting the war damages to be repaired in view of the academic year 1943-1944; the School of Mathematics has suffered "very serious damages. By the beginning of November, the classrooms and two of the drawing rooms will need to go back to efficiency. The building has a huge amount of broken glass and therefore if new glazing will not be supplied, the Institute will be completely out of order" (ASS_dcm_224).

1943, September 8 - Civil war explodes in Italy as the armistice is signed on September 3, and the German troops occupy the Italian territory; Rome is invaded two days later.

1943, July-November - Recovery of the university campus following the 51 bombings suffered by the city; reports note that the School of Mathematics has not suffered structural damage but has lost most of its glazing (ASL_vdo_18; ASL_pht_21).

1944, March 24 - Rector Commissioner Cardinali requests funds to the Ministry of Public Works, highlighting the financial difficulties of the Civil Engineers Corp in repairing war damages to the university campus. The works are indispensable to prevent the complete ruin of a complex of "irreplaceable and priceless value". The report lists the expenditures for the works carried out by the Civil Engineers Corp on the buildings of General Physiology, Human Physiology, Law and Chemistry, and those carried out directly by the CERUR on the other buildings (ACS_dcm_30).



ACS_drw_08

1944, June 4 - American troops enter Rome and free the city from the Nazi occupation.

1944, June 4 - 30 - The allied troops occupy the campus and the School of Mathematics. Severi lists the missing and stolen material from the School of Mathematics, and notes that "this material is missing as of June 30, 1944 following the occupation of the premises of this Institute by the allied troops. It should be noted that during the occupation, Italian personnel was hired for various purposes by the allies. On 1 July 1944 an official complaint is brought to the police station of S. Lorenzo, but without consequences" (ACS_drw_08; ACS_dcm_35).

1945, April 29 - End of world war II in Italy is declared after surrender of the German Army and assassination of Mussolini in Milan the previous day.

1946, October 10 - Vincenzo Fasolo, director of the Institute of Design, drafts a list of damages produces on the seat of the Institute, within the premises of the School of Mathematics: fifty plaster models for teaching activity (5.000 lire), one hundred damaged benches (20.000 lire) and fifty model boards destroyed (5.000 lire). The damage amounts to 30.000 lire. He also specifies that "it is not possible to give other documentation other than personal witness, since these objects are not inventoried. The benches are part of the endowment of the Faculty of Sciences, which hosts the Institute of Design" (ASS_dcm_227).

Undated, but 1946 - A report by the Technical Office describes the war damages suffered by each building of the campus. The School of Mathematics is reported as "having suffered no damage whatsoever" (ASS_dcm_230).

1946, November 25 - Following a request of the Ministry of Education Guido Gonella, a list of repairs of war damages is drafted. These amount to 2.631.000 lire: 431.000 lire for works in progress and 2.200.000 lire for those to be carried out; the School Mathematics is referred to as being damaged. (ACS_dcm_34).

1948, February 3 - The firm Fiorentini signs the deed of commitment to repair of war damages suffered by the School of Mathematics; these are completed by August 7.

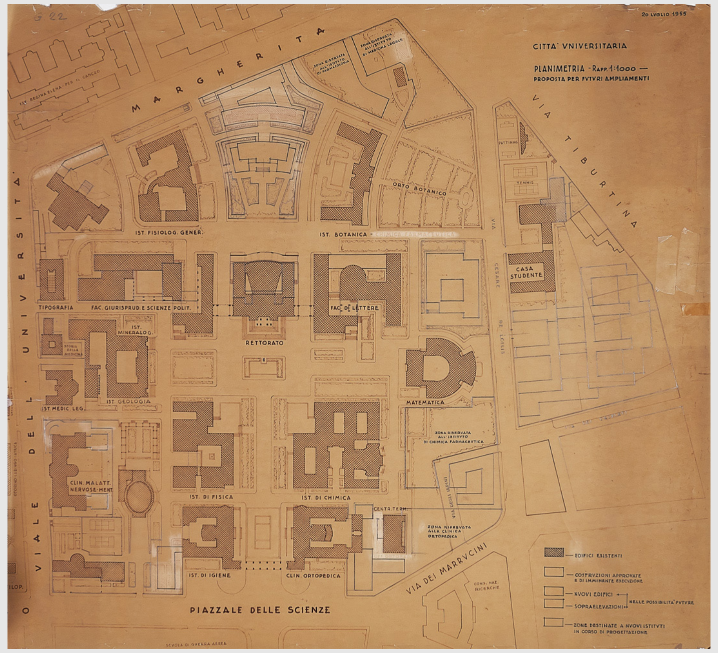
1948, May 26 - Pietro Chiesa dies in Paris due to an illness. After a rather uncertain period for the firm Fontana Arte, its management is entrusted to Emanuele Ranci, a former collaborator of Chiesa. Gio Ponti is then called for advice by the firm Saint-Gobain, and suggests the name of the French designer Max Ingrand, who takes over as director in 1954 (De Boni 2012, p. 21).

1948, January 1 - With the institution of the Republican Constitution, the Reign of Vittorio Emanuele III is dismissed, and Italy becomes a Republic.

1948 - With the Institution of the Italian Republic, the former name of Rome's university "Royal University of Rome" changed into "University of Rome".

1948, December 20 - A memorandum on the relationships among the Ministry of Public Works, the Civil Engineers Corp and the CERUR, defines competences and properties regarding the campus: construction work is under the State's responsibility and is carried out directly by the Consortium under direct supervision of the Civil Engineers. The Consortium provides payments and collects reimbursements from the Ministry of Public Works. The system is the same in case of war repairs, but from October 1948 on, advanced payments by the Consortium are no longer necessary. The Consortium is anyhow still in charge of the project management and of the relative remuneration (2% of the works) although the contracts are stipulated directly by the Engineers Civil Corps. The works are to be directed by the Technical Office to ensure their uniformity and the correct use of the funds. It is also requested that expenditures always go through the university administration, not through the single institutes (ASS_dcm_231).

1950, March 30 - The firm Fiorentini asks for the pending payment for the repair work to the School of Mathematics, for a total of 630.000 lire. As soon as the firm is paid, the works will be reimbursed to the Consortium by the Civil Engineers Corps (ASS_dcm_232).



ASS_drw_133

ICCD_pht_02

1950, July 7 - List of payments to be paid to contractors and firms that have worked to repair the School of Mathematics: Cooperativa il Vetro, Balzaretti & Modigliani, Fiorentini (692.000 lire), Dalla Betta (40.000 lire), various invoices (180.000 lire). The total amounts to 14.672.000 lire (ASS_dcm_233).

1953, December 12 - After Castelnuovo's death on April 27, the School of Mathematics is entitled "Istituto Guido Castelnuovo", following a resolution of the Faculty of Sciences on May 8, 1952 (Tolgliatti 1978).

MORE ALTERATIONS, MODIFICATIONS AND SOME REPAIR WORK

1954, May - Changes are brought to the interior of the School of Mathematics due to the increase of students and teachers. The triple height of the library is reduced by inserting a slab to separate the 'atrium' and obtain two studies. The stained-glass window is also subject to works, probably to replace the glazing, while the window frame is still in place; transom windows will be therefore added later (ICCD_pht_02; Salvo 2015, p. 193).

1955, July 20 - A 'densification' the campus is proposed by filling in the vacant lots with new buildings. The Institute of Pharmaceutical Chemistry is under construction on the lot west to Mathematics and a new building is envisaged to the east (ASS_drw_133).

1955, December 12 - Problems referred to the overcrowding of the Institutes of Mathematics, Physics and Natural Sciences are evidenced by Enrico Bompiani, who claims the absolute insufficiency of classrooms for lectures in the Institute of Mathematics and the need for a general analysis of the spaces of the Institute and their accommodation. The Dean Visco proposes to move the university campus to E42 to solve the current situation (ASS_dcm_235).

1956, October 12 - An extension to the School of Mathematics and the construction of the Secretariats building are proposed in three different solutions (ASS_drw_134-136).

1957 - Ponti publishes *Amate l'Architettura edited by Vitali and Ghirlanda*, Genoa; the text is a revised edition of his *L'architettura è un cristallo,* written in 1945, as a collection of aphorisms and reflections gathered during his years of practice.

1957, January 3 - A project is drafted for the Secretariat and the Students Archives building to be built east of the School of Mathematics. The building is rectangular with inner courtyard, a covered area of 5500 square meters, a height of 20 meters for 4 floors and 70000 cubic meters (ASS_drw_137-142).

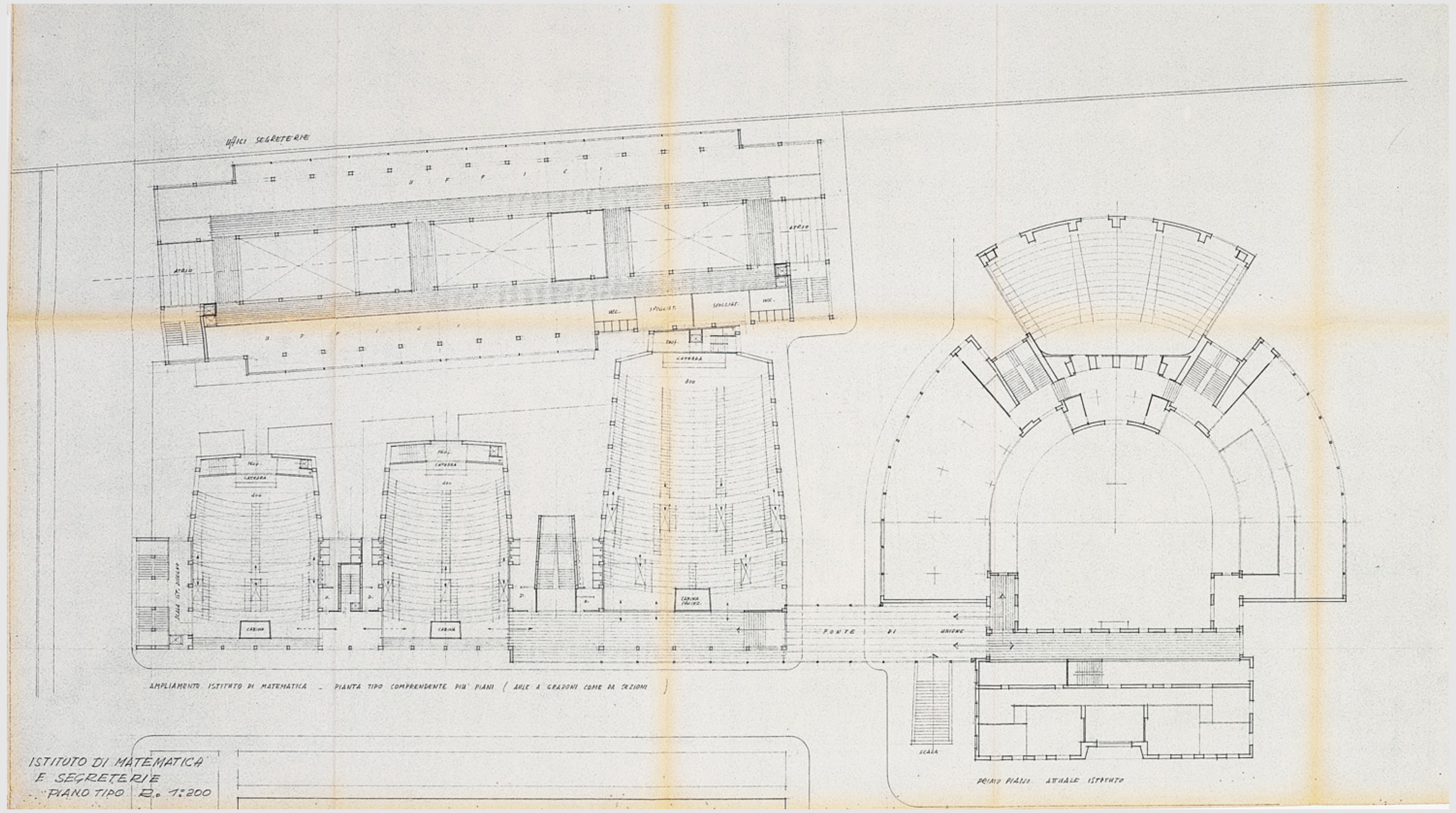
1958, November 7 - Beniamino Segre is the new director of the Institute of Mathematics, after Enrico Bompiani.

undated, but 1958 - Notice about the property of land and buildings that belong to the university. Article 954 of the Civil Code establishes the right of the Consortium to build new constructions on the State-owned land of the university campus within twenty years: requalification works and extensions on State-owned land are solely responsibility of the Public Works Authority (ASS_dcm_236).

1958, November 10 - The contractor Emerigo Zaccherini signs a contract for the renovation of the roof terraces of the Mathematics, Botany, Mineralogy and Geology buildings. The contract mounts to 10.390.000 gross, 8.649.675 net lire (ASS_dcm_237).

1959, February 25 - The contractor Zaccherini signs the List of New Prices for works unforeseen in the arrangement of the roof terraces of Mathematics. These include the supply of protection grids to the water outlets and related finishes (ASS_dcm_239).

1959, April 11 - Memorandum n. 2982 in which Guidi points out the need to restore the Litoceramic cladding, which has been damaged during the war bombings. According to an estimate provided by the firm Piccinelli di Mozzate, 7500 normal fluted 'yellow Rome' tiles are needed, at 40 lire each, for a total of 300.000 lire, plus 300 corner tiles at 70 lire each, for 21.000 lire; the total amounts to 321.000 lire (ASS_dcm_241).



ASS_drw_148

ACP_pht_01

1959, July 15 - Zaccherini completes renovation works of the roof terraces. The contractor signs the final bill drawn up on April 15, 1959 without reserves, but 552.093 lire remain to be paid (ASS_dcm_242).

1959, November 20 - Rector Papi informs the Ministry of Education about the space crisis that the university campus is suffering, due to the construction of new buildings, to the dramatic increase of the student population and to the opening of new courses. The solution implies funding for the construction of new buildings and for the allocation of the necessary land, such as Castro Pretorio (ASS_dcm_244).

1960 - The large, tiered lecture hall with 450 seats at the second floor of the tower is divided in two smaller classes with a partition wall. Many courses offered to students in Engineering are diverted to other classrooms, while Drawing lessons continue to take place in the building (Mornati 2002, pp. 70-71; Salvo 2015, p. 193)

1960, April 7 - Giulio Pediconi drafts a project for the extension of the Institute of Mathematics on behalf of the director's request, Beniamino Segre. The project for the new building, which has an area of 2800 square meters, a volume of 80000 cubic meters and a height of 28 meters and includes the new Secretariat, is designed in agreement with the Technical Office (ASS_dcm_245; ASS_drw_148; Azzaro 2018, p. 120).

1960, June 4 - Two projects for the extension of the Institute of Mathematics and the Secretariats are proposed for different areas. Guidi predicts that, among the four solutions developed, solution A will be adopted although it implies the demolition of the current building with bank, post office and students' associations, and of the small sports field of the ì University Sports Centre. As in other solutions, a basement for the archive and for the data processing system are also provided. A three-storey building at the entrance on Via De Lollis in front of the Students Residence is also designed for staff accommodation instead of the existing one (ASS_dcm_247).

1961 - The CERUR requests a new general solution for the extension of School of Mathematics and for the Secretariat building, while the demolition of the old Students Residence is approved, if no agreement with the director of the Botanical Institute for the new area is found (ASS_dcm_248).

1961 - The Technical Office of "La Sapienza" University of Rome is established and Stanislao Chiapponi is elected Chief Engineer; the role of CERUR expires (Guidoni, Regni Sennato 1985, pag. 84).

1963, April 30 - The Technical Office drafts a preliminary project of temporary buildings in via Scarpa for the Faculty of Engineering. The project includes three classrooms, three drawing rooms and a chemical institute, for an estimated cost of 170.000.000 lire; in May, the loan drops to 100.000.000 lire, including furnishings and equipment (ASS_dcm_251; ASS_drw_154).

1964, July 13 - Preparation of the Special Tender Specifications for construction and related works required for the maintenance of the buildings of the campus buildings and for those outside its premises. The tender is not assigned to any contractor but indicates a three-year lapse of time for the contract, renewable for a maximum of two more years. The amount of work carried out 'on demand' amounts to approximately 40.000.000 lire. Heating systems, refrigerators, air conditioning, elevators, and other specific installation are excluded from the contract. On July 20 the Specifications are approved but with changes: the electrical system is added, and the duration of the contract is reduced to one year with renewal for one more year (ASS_dcm_253).

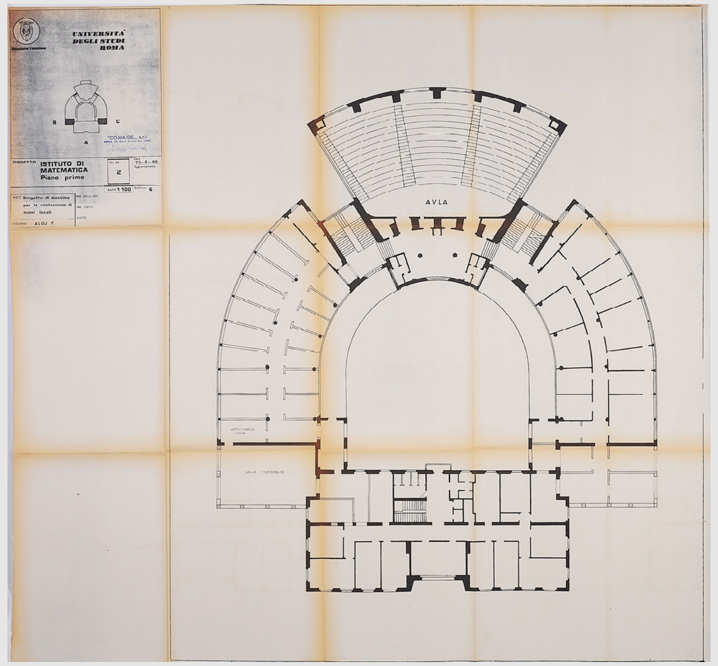
1965, September 30 - October 6 - The Institute of Mathematics hosts the International Symposium of Algebraic Geometry (ACP_pht_01).

THE OVERCROWDING EMERGENCY AND THE EXTENSION OF THE BUILDING

1967, February 15 - Chiapponi and De Martino of the Technical Office report on the need to find new land for the University of Rome. At this point, classrooms for the Faculty of Engineering in via Antonio Scarpa have already been built for a total of 4050 square meters and a volume of 9465 cubic meters (ASS_dcm_257).

ASS_pht_08

ASS_pht_13



ASS_drw_159

1967, July 12 - The extension of the Institute of Mathematics is approved.

1967, November 8 - Guidi proposes to entrust the contractor Tirelli with the disposal of bulky materials- debris, garbage, dust, vegetation ...- collected on the roofs and terraces of the university campus. In the case of the School of Mathematics, three terraces are calculated, of 1400 square meters, 572 square meters and 132 square meters, for a total area of 2104 square meters. The cost amounts to 1.398.000 lire (ASS_dcm_258).

1968, February 23 - Students occupy the university campus, and the Institute of Mathematics. The side entrance of the front body of the building is still untouched. During the students' movement the furnishing of the institutes is deeply damaged, stacked and moved, including the one of the Institute of Mathematics (BUB_pht_01-03; BUB_pht_08-13).

1968, February 29 - The entrance to the Institute of Mathematics is modified. The doors maintain the original partition but with a thicker crossbeam as evidence of a change in the door that no longer opens to the full height; a brighter metal offers evidence of a recent replacement of the window fixtures (BUB_pht_04-05).

1968, August 28 - The Società Condotte d'Acqua di Roma signs a contract for the construction of the new Physics building, east of the Institute of Mathematics, on a project by Roberto Panunzi, and at the cost of 111.927.666 lire (ASS_pht_08, ASS_pht_13).

1969, April - Special tender specifications for the extension of the Institute of Mathematics. The total amount for the construction of the new buildings is 63.436.951 lire (ASS_dcm_262; ASS_drw_159).

1969, July 4 - The Rector requests to the Ministry of Public Works to simplify the procedure related to calls for tender. For works costing more than 3.000.000 lire, the university administration is obliged to submit the projects and the testing after construction to the Civil Engineers Corps. The Rector points out that a commission of engineers from the Ministry of Education could easily examine each project in advance, while the testing of the works could be entrusted to the Civil Engineers Corps (ASS_dcm_263).

1969, September - Administrative work related to the extension to the Institute of Mathematics drawn up by the site manager and signed by the Chief Engineer of the Technical Office. Works include demolitions, piling, masonry, and reinforced concrete works, cut stone, timber, metal, and glass works, colouring and painting works, construction of the plumbing system, heating, and furnishing of the two new buildings. The project is sent for approval to the Municipality of Rome on October 7, 1969 for a total cost of 66.000.000 lire (ASS_dcm_264).

1969, December 10 - Fulfilment of a request of the Dean of the Faculty of Mathematical and Physical Sciences dating November 10, regarding new spaces for the Institute of Mathematics, stating the use of the building in via Vicenza 23, offered by the Italian Reinsurance Union. The annual rent of 36.000.000 lire is charged to the fund of 500.000.000 lire credited to the Ministry of Public Education. The lease contract is signed on December 15, while adaptive works are listed in a report dated July 17, 1970 (ASS_dcm_267).

1970, October 22 - The Higher Council of Public Works imposes an official procedure to issue building permits. Approval must be exceptional to the current regulations of the Master Plan, which according to art. 15 allows an increase in the building index of the area; the extension of the Institute of Mathematics is linked to the Faculty of Engineering in via A. Scarpa. The works, entrusted to the contractor MIT-CO, include masonry construction and the achievement of prefabricated classrooms (ASS_dcm_269).

1971, February 26 - A plan of a standard floor of the building in via Vicenza 23 is attached to a communication from Ferrarese, Director of the Institute of Mathematics (ASS_dcm_271; ASS_drw_161).

BHR_pht_02

1971, April 30 - The Ministry of Education refers to the Mayor of Rome Clelio Darida about the extensions to be built within the university campus. Only thirteen building permits have been released out of the twenty-two listed in the program. Several works are missing, including the extension of the Institute of Mathematics and the prefabricated classrooms of the Faculty of Mathematical, Physical and Natural Sciences within the premises of the Institute in Botany. The projects are stopped by the Special Office of the Master Plan Division due to the absence of the minutes of the Council Commission of July 9, 10 and 14, 1970, which had been approved by the University. Since all the projects have been sent together, the different fate of their approval process is not clear: the issue must be resolved (ASS_dcm_272).

undated, but 1972, March 11) - A report refers about the preliminary project for the construction of new buildings within the campus. After more than two years, the construction permits have not yet been issued. The process resumes after Ferrarese provides the missing documents, and on February 17, 1972, the Ministry of Public Works releases the permits to the Municipality of Rome, the Prefecture, and the Superintendency. Notwithstanding, there are still other provisions to be provided, namely the related resolutions n. 4402 and n. 4403 of July 1971, which have not yet been ratified by the City Council (ASS_dcm_273; ASS_drw_158-160).

1972, October 2 - The contract for the completion of the new Physics building is signed with the contractor Vigevano.

1972, December 18 - The Municipality of Rome releases a permit for the extension of the Institute of Mathematics. The university Technical Committee approves the total amount of 66.000.000 lire, financed by the funds established on July 12, 1972 according to law n. 641 of 1967 (ASS_dcm_274).

1973, February 14 - The Technical Committee, joined by Giuseppe Nicolosi and Gaetano Minnucci, approves the extension project to the Institute of Mathematics, but also expresses perplexity for “the added bodies that overlap the sides of the entrance to the front building, which do not seem to match with the architect’s intention to separate the central body from the ends of the curved wings by means of a suitable recess”. In addition, a plan with yellow/red (demolition/reconstruction) indications must be provided in view of the tender, integrated with a front and a side picture in correspondence with the area of the extension. A longitudinal section should also be provided to offer evidence of the number of superimposed classrooms and their use and prove the adequacy of the width of stairs and exits. A documentation of the current state is also required (ASS_dcm_275).

1973, July 20 - A second tender for the extension works to the Institute of Mathematics is called. The first bid goes deserted and is repeated with a 25% increase to reach 63.436.954 lire (ASS_dcm_277).

1973, July 25 - Dean Montalenti requests to immediately use the premises of the Wuhrer building acquired by the university and approved in June 1973, as a temporary solution. In lack of funding, a list of very urgent needs is provided by each Faculty: for the Institute of Mathematics, prof. G. Da Prato requests to be able to take possession of the classrooms currently used by the Faculty of Engineering for drawing exercises. For the Faculty of Engineering, pending a definitive accommodation, the premises in the Wuhrer area are proposed, equivalent to those currently occupied in the Institute of Mathematics, that is a fifty-seat classroom, two hundred-seat classrooms, a room for archives, an office room and two laboratory rooms. The Technical Office has made an estimate of the construction in the Wuhrer area, of eleven classrooms, laboratories and study and research rooms, also considering toilets and heating systems. The estimate amounts to 145.000.000 lire (ASS_dcm_278).

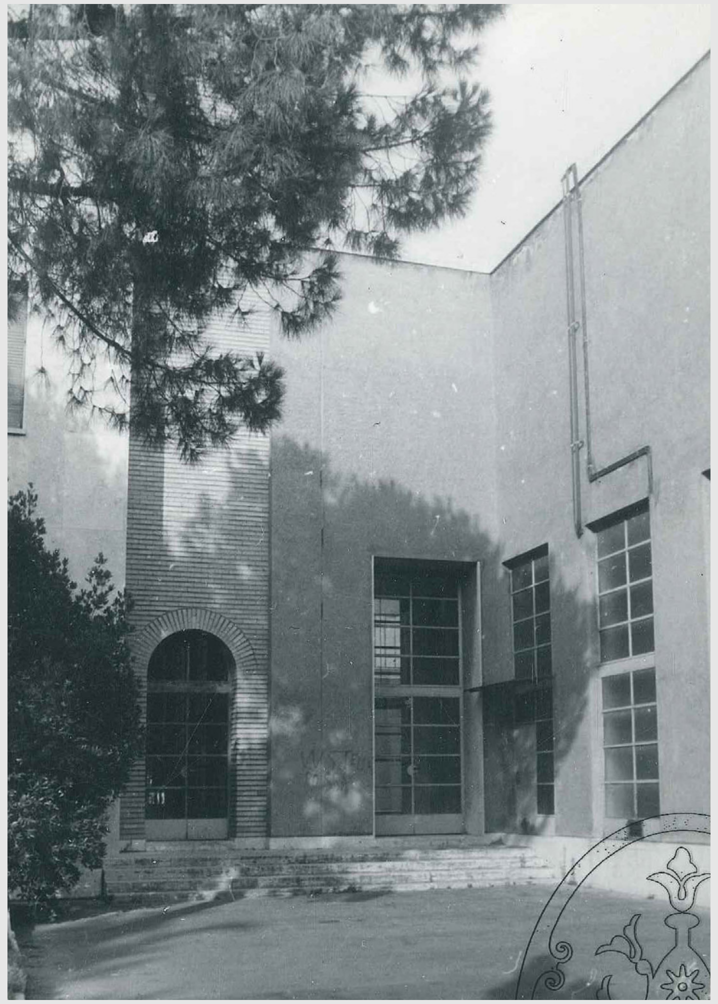
1973, July 27 - Rector D’Avack asks to officially break the contract for the building in via Vicenza 23 as the economic-commercial needs of the real estate market have changed in relation to the leases located in the city centre and destined to other than residential uses (ASS_dcm_280).

1974 - A picture shows inbuilt HVACS and two pivoting new openings on the central window of the main facade of the School of Mathematics, certainly added after 1968 (BHR_pht_02).

1974 - In 1974 the curved wings appear darker than the original colour. The windows of the curved wings are still the original ones, as the fragmentation of the drawing rooms has not yet been achieved. The porter’s house is painted in a light colour, and the garage

AFS_pht_01

BBR_pht_05


BHR_pht_08

opening is still visible. The entrances to the Tower of classrooms are flanked by travertine inscriptions “School of Mathematics, Institute of Design, Faculty of Engineering” (BHR_pht_05, BHR_pht_08).

1974, March 30 - The contractor CO.MA.GE. signs a contract for the extension works to the Institute of Mathematics following a private tender of January 7, 1974; the works mount to 59.300.860 lire and will be completed only in the early 1980s.

1975, September 30 - The director of the Institute of Mathematics asks to arrange the interior of the Institute of Drawing.

1977 - During the students’ protests the marble cladding of the atrium of the Institute of Mathematics is vandalized; furniture is also stacked and used to block the entrance (AFS_pht_01).

1977, January 31 - The accomplishment of the construction of the new Physics Institute is certified within the required time frame; the contract is dated October 2, 1972 and the submission deed dates back to October 8, 1976 (ASS_dcm_286; BBL_pht_39).

1978 - The metal windows of the curved wings are reduced in height by inserting parapets, on both sides of the buildings facing outwards and towards the courtyard. The work is carried out by the firm Vigevano (Mornati 2002, p. 71).

1978, May 24 - The Board of Directors assigns the rearrangement of the Institute of Drawing and the construction of classrooms for teachers and students to the contractor CO.MA.GE. The works had planned in 1968, approved in 1970 for a total amount of 64.000.000 lire. The transformations are now accounted for at 85.960.812 lire after a new appraisal of 1976. During the works, some changes to the project are needed due to economic and time reasons: traditional partitions in solid masonry are replaced with lighter prefabricated blocks with false ceilings in insulating and light material. Furthermore, it is necessary to build toilets for teachers and students, while the revision of the window fixtures has not been accounted since at the date of the first survey (1968) they were still in fair conditions. The variation and the List of New Prices are approved without changes to the total amount (ASS_dcm_287).

1978, June 2 - The Building Commission requests substantial transformations to solve space problem of the Institute of Mathematics and proposes the acquisition of other seats within the campus, to lay a roof over of the inner courtyard, to transfer the Institute of High Mathematics to the building in via Vicenza and recover the space occupied since 1939. The Institute accepts the last proposal but expresses perplexity toward the first two: the acquisition of new spaces meets resistance while the cover of the courtyard is rejected after architectural considerations. The report also mentions that construction works have already started: the new wing at the first floor is almost completed, the furnishings of the ground floor of the right wing is still missing, while work is starting at the ground floor of the left wing, where five classrooms and rooms for the copy service will be provided. The completion of the works is expected before the beginning of the academic year 1978-1979. Serious issues related to the furnishings remain, while the University Commission ratifies the relative integration of necessary expense for the lateral bodies (ADM_dcm_01; Mornati 2002, p. 71).
The report also discusses issues concerning via Vicenza, in view of the shift of all activities back to their seat. Urgent measures must be taken to prevent accidents and to overcome serious shortcomings in the care of the properties and in the control of their use. Furthermore, the Director announces the steps to be taken to regain possession of the premises used by INDAM (ADM_dcm_02).

1979, June 1 - The Committee of the Institute of Mathematics solicitates to continue and complete the extension works, which have stopped for years, for the sake of the life in the Institute.

1979, September 16 - Ponti dies at the age of 87 in his home in Milan in via Dezza.

1980 - The reform of Italian higher education establishes the institution of Departments instead of institutes.

1980, May 30 - Francesco Scarpini, Director of the Institute of Mathematics, requests the supply of blackboards for the new classrooms at the ground floor of the right wing. The supply consists of a 9-meter plus a 3-meter long blackboards on the opposite wall. Scarpini also asks to equip the new classroom with at least 5 double blackboards (3 x 1 meters) that can be lifted vertically and a blackboard (3 x 1,50 meters) for the first room at the ground floor of the right wing (ASS_dcm_290).

BFAR_pht_05

1980, September - The Board of Directors decides the completion of the extension works, as requested by director Scarpini the previous May 30: these consist in the soundproofing of the computer terminal room, the opening of an emergency exit in the Calculation Centre and a window in the toilets at the ground floor. The contractor signs a new contract at the same contractual prices previously taken for an expected cost of 5.700.000 lire (ASS_dcm_293).

1980, September 4 - Director Scarpini requests the completion of the works linked to the extension of the two wings. These consist in painting the outer surfaces to offer homogeneity among existing and new parts, in arranging the sidewalk and garden adjacent to the lateral bodies, in replacing the entrance door to the new classrooms at the ground floor- currently in metal and glass- with a wooden fixture. Finally, he expressed the need to clean the marble flooring of the central corridor around the doormats and reiterates the importance of completing the interiors with the blackboards requested on May 30, 1980. The works are approved on October 3, 1980 and entrusted to the contractor CO.MA.GE. (ASS_dcm_291).

1981, February 28 - The Testing Commission prepares a report on four reserves expressed by the contractor CO.MA.GE. on August 6, 1976. These include the use of supporting structures in steel with IPE and HE profiles, instead of reinforced concrete, and the execution of foundation piles in single piles drilled in rotation (80 centimetres in diameter) instead of piles drilled in percussion (37 cm in diameter) as originally planned, for which the construction manager offers a compensation. In addition, the contractor reports that work proceed with discontinuity because the demolitions took place as lessons and exams were in progress (ASS_dcm_299).

1981, April 15 - Approval of further works for the completion of the Institute (total amount of 57.000.000 lire) with the supply and installation of 24 lighting fixtures at the cost of 40.000 lire each, but the contractor CO.MA.GE does not agree with the new prices. The bid is offered to the contractor SOLAAR (ASS_dcm_300).

WORKS FOR MAIN REGULATORY COMPLIANCE TO FIRE ESCAPE REGULATIONS

1981, July 29 - Rector Ruperti recommends the Technical Office to fully comply with regional and national regulations about the elimination of architectural barriers especially in the case of works regarding new buildings or renovations (ASS_dcm_302).

1981, October 28 - The supply of lighting fixtures supplied by the contractor SOLAAR is certified. The works are delivered on May 20, 1981 and completed in due time, on June 5, 1981; the balance to be paid is 82.470 lire (ASS_dcm_304).

1982 - The second university of Rome “Tor Vergata” is founded; “University of Rome” is not the capital’s unique university anymore and therefore changes its name into “La Sapienza” University of Rome.

1982, January 1 - Following the national university reform, which introduces the statute of departments instead of institutes, the “Institute of Mathematics Guido Castelnuovo” officially becomes “Department of Mathematics”.

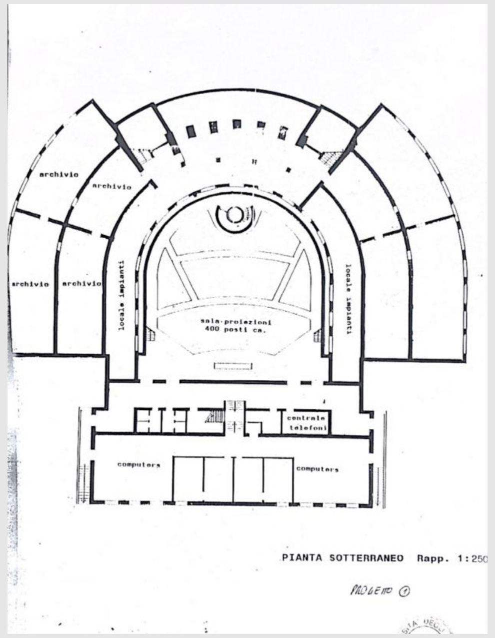
1982, February 17 - Payments to the contractor CO.MA.GE. for an authorized amount of 9.026.740 lire; other requests advanced by the contractor are not accepted (ASS_dcm_306).

1982 - Ponti’s heirs, Lisa, Giovanna, Letizia and Giulio, donate the documents conserved in Ponti’s office to the Centro Studi Architettura Contemporanea of the University of Parma, then directed by Arturo Carlo Quintavalle.

1983 - Refurbishment of the courtyard paving: the joints between the travertine slabs are grouted with cement (BFAR_pht_05, ASS_pht_05; Mornati 2002, p. 71).

1983, May 26 - Director Francesco Guerra of the Department of Mathematics requests an inspection of the Technical Office to repair the sewage system of the Department of Mathematics, to avoid serious danger to the computer centre (ADM_dcm_03).

ASMS_pht_34



ADM_drw_04

1983, October 25 - Following the observations of the two professors Rita Procesi Ciampi and Elisabetta Strickland, an executive committee is established to take care of the decor of the Department of Mathematics. First measures are the elimination of tattered curtains, the management of the notice boards, the layout of information tables and maps, and the organization of the “Afternoon Mathematics Tea” (ADM_dcm_04).

1986-1989 - Three fire escape staircases in metal, the central of which contains a concrete structure with an elevator, are built in the courtyard to comply to fire safety new regulations. The central window of the tower of the classrooms is modified due to the insertion of the central staircase and to provide for fire exits at each floor. Skylights with glass-blocks are inserted in the courtyard to bring light to the basement rooms, while gratings are added to the ventilation windows of the basement in the front body (Mornati 2001, p. 291; Mornati 2002, p. 71) (ASMS_pht_34).

1985, May 10 - The students protest against Figà Talamanca, director of the Department of Mathematics, for the reduction of study spaces caused by the renovations, for the complete saturation of classrooms used for seminars and exams and for the closure of the library on even days. To solve this situation, it is suggested to use the premises in via Vicenza, which are underutilized. (ADM_dcm_05)

1985, May 31 - Director Figà Talamanca requests to equip the basement with two safety staircases to extend the use of the computer room, and with an air conditioning system and an adequate electrical system. The works are not included in the contract for compliance with safety regulations, therefore extraordinary assignment of 85.000.000 lire + VAT is required (ADM_dcm_06).

1985, June 6 - The basement of the front building, which is currently used as deposit, is destined to host the new computer centre for 70 seats and 139 square meters. A bid is proposed to the contractor SIRI, which is already committed with the compliance to fire safety regulations of the Department. The budget is 42.000.000 lire for the air conditioning system, 19.000.000 lire for the electrical system and 24.000.000 lire for building costs, but the Department is unable to cover these expenses with its own budget. A solution is requested to the Board of Directors, in order to have the works carried out with the university budget; in the meantime, the Technical Office carries out an inspection (ADM_dcm_07).

THE RISE OF VALUE AWARENESS IN THE ACADEMIC COMMUNITY

1985 November 15 - 1986 June 28 - In occasion of the 50th anniversary since the foundation of the University campus, the Institute of History of Medieval and Modern Art, in collaboration with GNAM and with the Department of Culture of the Municipality of Rome, organizes an exhibition at Sapienza. The anniversary becomes an opportunity to rethink the potentials and the needs of the campus in the field of the arts (CRDAV_pht_04-06; Guidoni, Regni Sennato 1985).

1987, January 9 - Rector Tecce reports that funding for the regular activity of the Departments is inadequate. It is pointed out that “the situation of the Department of Mathematics is particularly difficult. In fact, it is not tolerable for teachers to be compressed into a completely inadequate building complex” (ADM_dcm_08).

1989 - A further reform of the Italian higher education system is approved, the so-called “Ruberti Reform”.

1989, August 2 - The Ministry of Culture declares the university campus of “specific historic and cultural interest” according to Law n. 1089 of 1939 and issues a protection decree.

1990, March 15 - The Technical Office drafts a scheme plan to increase the usable area of the Department of Mathematics. The curved wings are provided with mezzanine floors to overcome the problem of cupboards and shelving, while a projection room with four hundred seats is planned in the courtyard, to be covered, and installations and archives are provided in the basement (ADM_drw_04).

1990, October 29 - Giacomo Saban, director of the Department of Mathematics, complains with the Technical Office because “despite repeated requests [...] it has not solved the serious problems related to the toilets” (ADM_dcm_11).

ACG_pht_06

AFB_pht_05

AFB_pht_26

Undated, but 1991 - Director Saban claims that: “overcrowding and degradation of the premises and shortage of non-teaching staff of the Department of Mathematics has reached intolerable levels, such to discourage participation to the academic life, with serious consequences on scientific and teaching activity at the various degree courses. In addition, the conditions of the toilets and the overcrowding, are constantly below the minimum efficiency threshold required by law due to lack of maintenance”. The teachers are obliged to share their room with two or three other colleagues; the Department deems formal protest actions necessary (ADM_dcm_12).

1992 - The third university of Rome “Roma Tre” is founded.

1992 - A students protest manifesto, among various requests, claims the restoration of the original spaces of the library, in particular the re-opening of the two reading rooms, according to Ponti’s project. Furthermore, the restoration of the original furnishings is requested, which is also a piece of period design. The manifesto represents an initial value assessment on the side of the students of the architectural value of the building and of its furnishings (ADM_dcm_13).

1994 - Cleaning and conservation work of the marble claddings in the atrium is carried out by Carla Giovannone as part of a restoration process promoted by the Department of Mathematics with the Central Institute of Restoration – ICR. In occasion of the restoration work, the porter’s booth is removed; this was already visible since 1977, in a picture shot during the students’ protests (ACG_pht_06; Giovannone 1994).

undated, but 1995 ca. - A protective canopy is placed on top of the library skylight to prevent infiltrations (AFB_pht_05; Salvo 2015 p. 196).

1997 - The Italian Government establishes the administrative autonomy of universities: from now on ordinary and extraordinary funding of public universities becomes is independently administrated.

1998 - The railings of the library balconies are elevated to comply to new safety regulations (ADM_drw_09-15; AFB_pht_26, De Cesaris, De Sanctis, Ferri, Marucci 2004).

2000 - A further reform of the Italian higher education system is approved, the so-called “Ruberti Reform”.

2002 - The Technical Office replaces fixtures and windows of the curved wings due to severe deterioration; new windows are produced on the trace of the original metal window frames, but with double opaque glazing (ASS_pht_23; Mornati 2002, p. 71).

2005 - A further reform of the Italian higher education system is approved, the so-called “Moratti Reform”.

2005 - The opening between the library and the book deposit, tampered years before, is reopened to re-establish air circulation and the longitudinal axis that crosses the entire front body.

2006 - The naming “Sapienza University of Rome” is created, which coincides in all respects with the official name University of Rome “La Sapienza”.

2007 - In view of reducing energy consumption and to a better sustainability, the university campus is equipped with a trigeneration system based on a gas micro-turbine and a direct smoke absorption machine. This renewable energy production system is able to provide for the needs of “energy clusters”, which group the buildings of the campus in relation to similar energy needs and conditions (De Santoli, Caruso 2007).

2010 - A further reform of the Italian higher education system is approved, the so-called “Gelmini Reform”.

2010, October 12 - The installation of grid connected photovoltaic systems on the rooftops of 28 campus buildings is implemented, which include the School of Mathematics. The rooftops are equipped here with 60 polycrystalline silicon panels spread on a surface area of 670 square meters, with a peak power of 12.9 kW and a production of 16.2 MWh/year.

ASMS_pht_26

ASMS_pht_15

AFB_pht_21

2011, July 20 - The “Theatron”, Sapienza’s Ancient Theatre organization, stages Euripides’ Medea in the courtyard of the School of Mathematics (ASMS_pht_13-14).

2011, July 20 - The “Theatron”, Sapienza’s Ancient Theatre organization, stages Euripides’ *Medea* in the courtyard of the School of Mathematics (ASMS_pht_13-14).

2011, August - The “Theatron” stages Euripides’ *Bacchantes* in the courtyard of the School of Mathematics (ASMS_pht_15).

2012 - Vincenzo Nesi Director of the Department of Mathematics, launches a series of requalification interventions to recover the building. A general cleaning of corridors and lobbies from cupboards and furniture is achieved (AFB_pht_21). In addition, the plasterboard wall that divides the professors’ atrium into two offices is removed to recover the unity of the original space, at least at the first level; a glazed window connects this space with the library in the attempt to re-establish continuity, albeit in part, between the two spaces that once were connected (ASMS_pht_26; ASMS_pht_31; Salvo 2015, p. 200).

2013, June - Disassembly of the metal and glass canopy placed to protect the skylight above the library and waterproofing of the surfaces with fibre-reinforced resins; these are spread on all surfaces of the library rooftop (ASMS_pht_31-32; Salvo 2015, p. 200).

2015 July - August - The “Theatron” stages Euripides’ *Trojans* in the courtyard of the School of Mathematics.

2016 July 13 - 14 - The “Theatron” stages Euripides’ *Ippolito bearer of the crown* in the courtyard of the School of Mathematics.

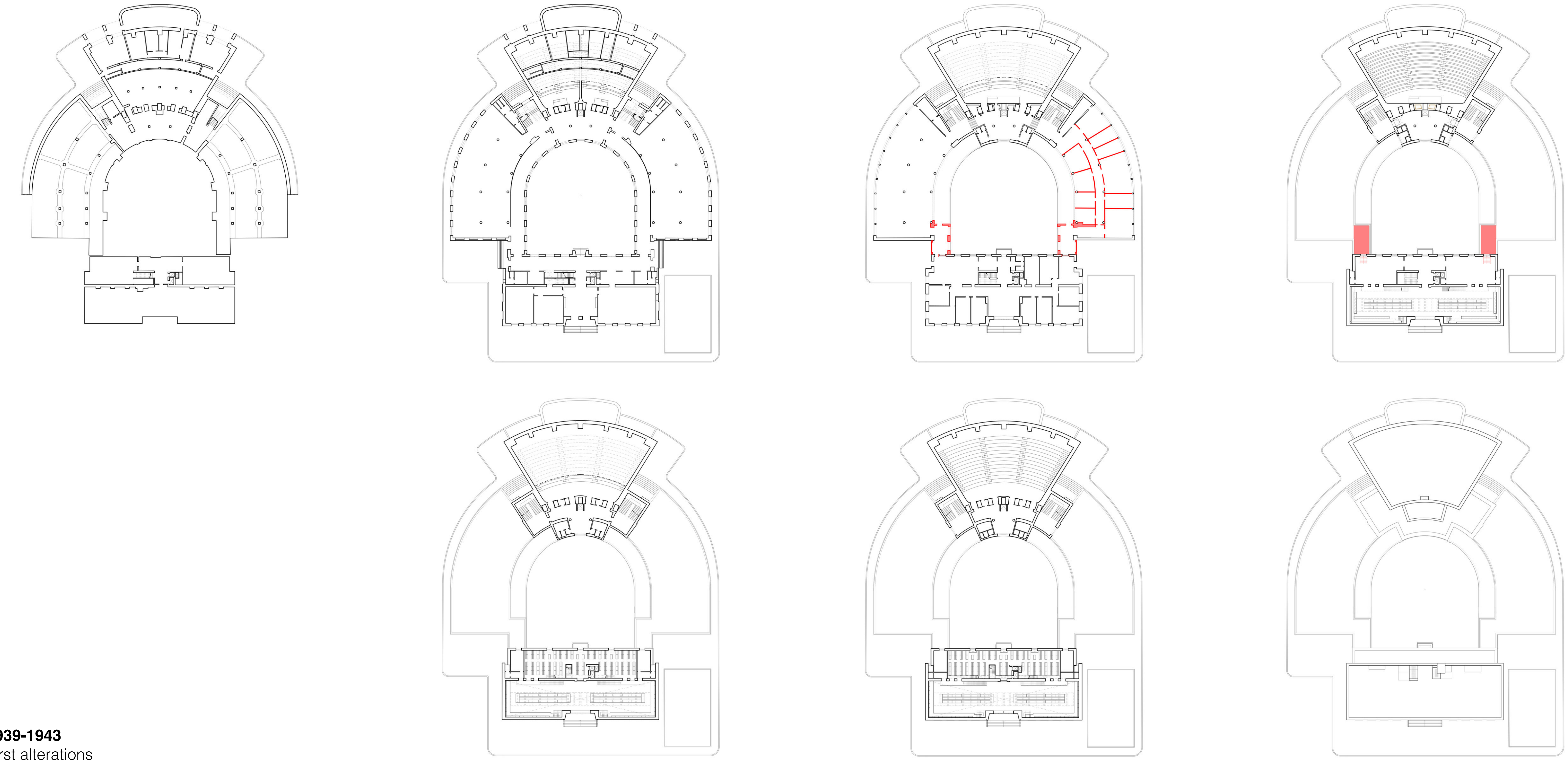
2017 November 23 - 25 - In occasion of the Eightieth anniversary of the University Campus, the image of Gio Ponti’s original stained-glass is projected on the window by means of a nightly lighting installation. The performance is produced by the Master in Lighting Design of Sapienza in collaboration with the Department of Mathematics and the Department of Architecture and Design, and the scientific coordination of Simona Salvo (AVG_vdo_02).

2018, May 25 - The Getty Foundation of Los Angeles awards a grant of 180,000 $ for research and Conservation management Planning on the School of Mathematics within the “Keeping It Modern” program. The research group is composed of members from Sapienza University and coordinated by Simona Salvo.

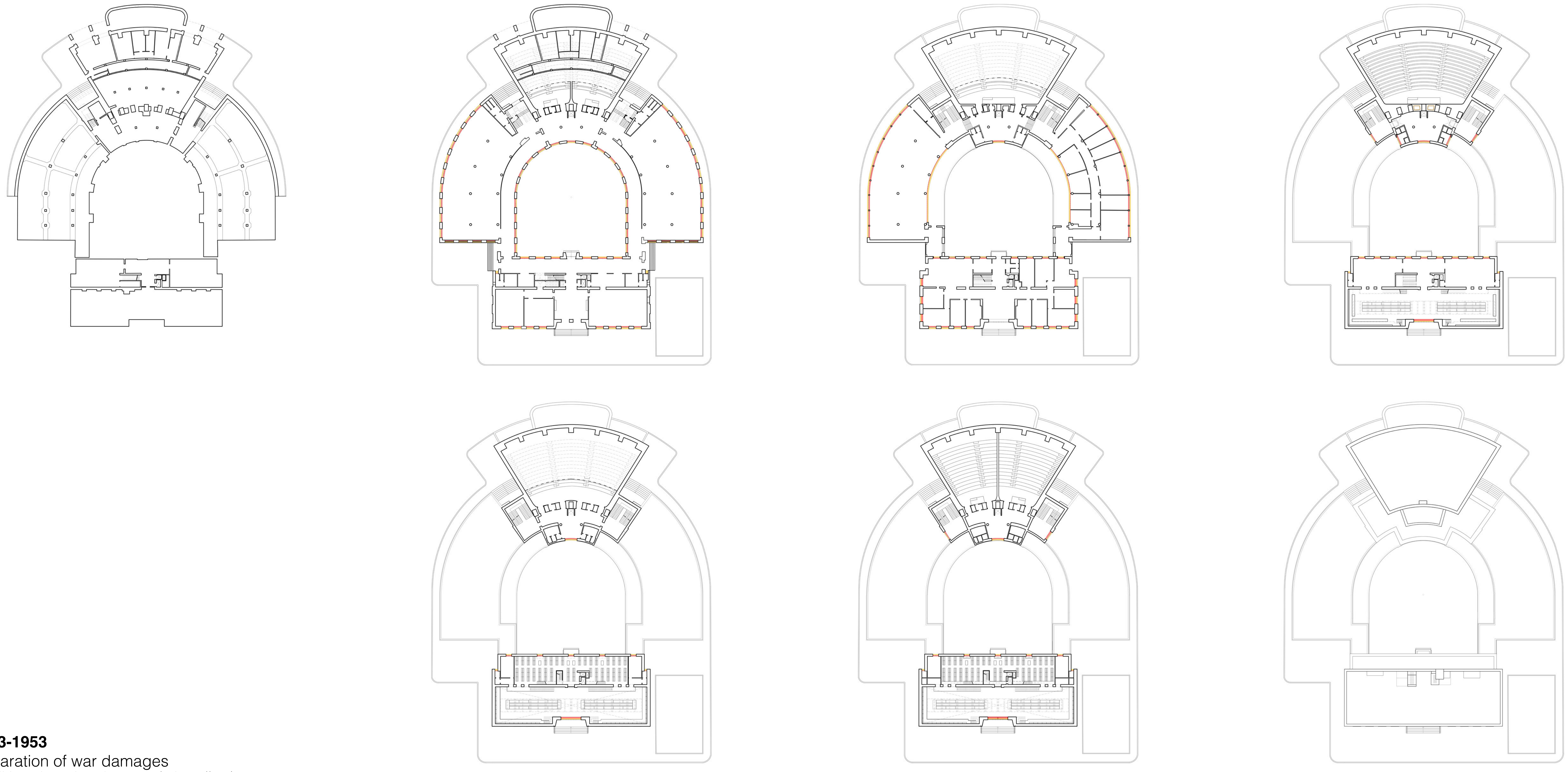
2019, April 11 - Official launch of the research project on the School of Mathematics, funded by The Getty Foundation within the “Keeping It Modern” at the presence of Rector Eugenio Gaudio; on the same occasion, the Department of Mathematics is again entitled to Guido Castelnuovo.

2020 September - The round wooden frames of windows of the library book deposit, which had caused water infiltration due to the persistent lack of maintenance, are replaced with new ones. The precarious conditions of the book deposit, threatened by water infiltrations due to different causes, and above all to the absence of any kind of reparation to the rainwater disposal system, is solved with a radical, non-conservative solution.

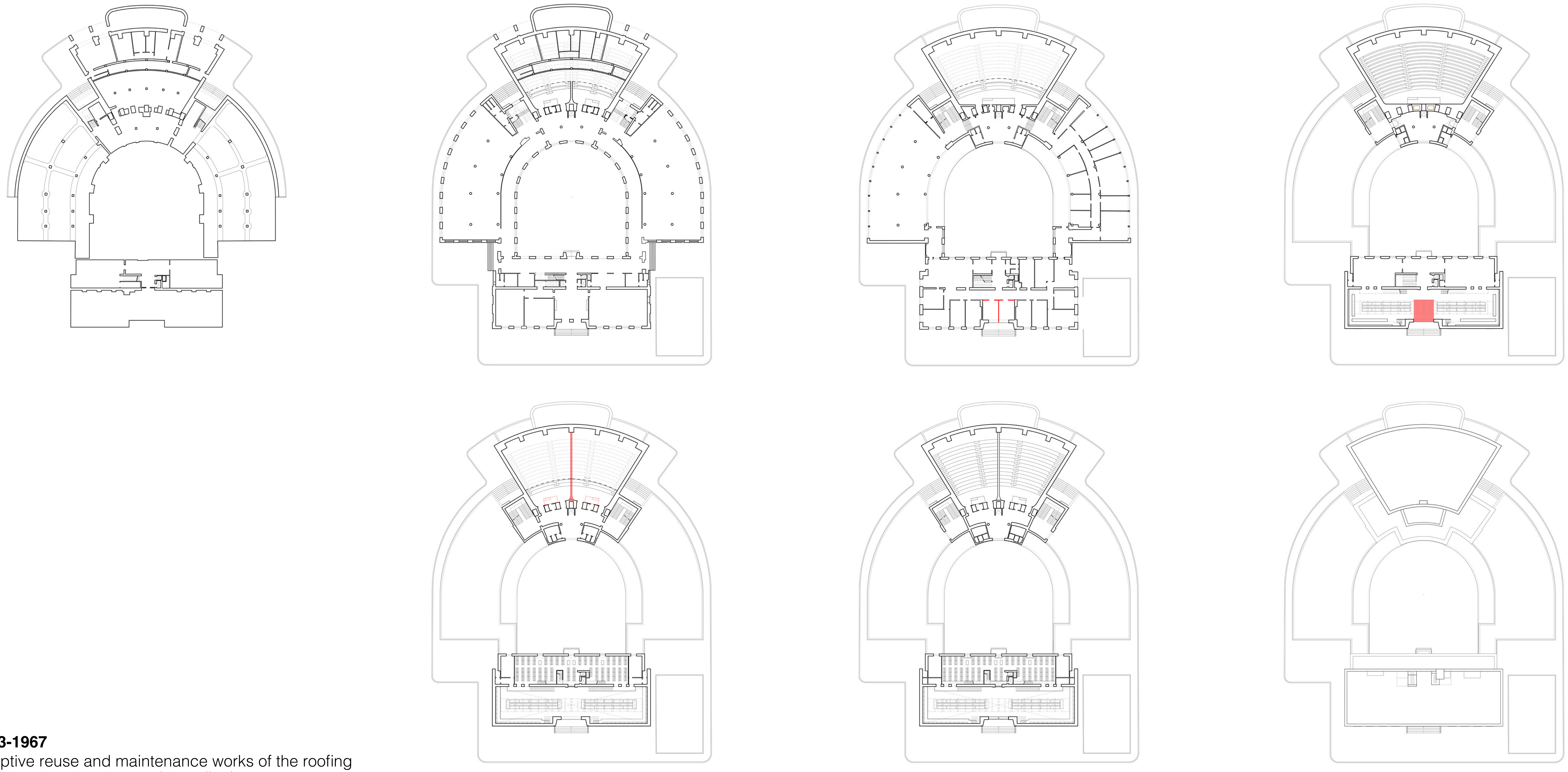
MAPPING OF ADDITIONS AND REMOVALS
Marianna Cortesi



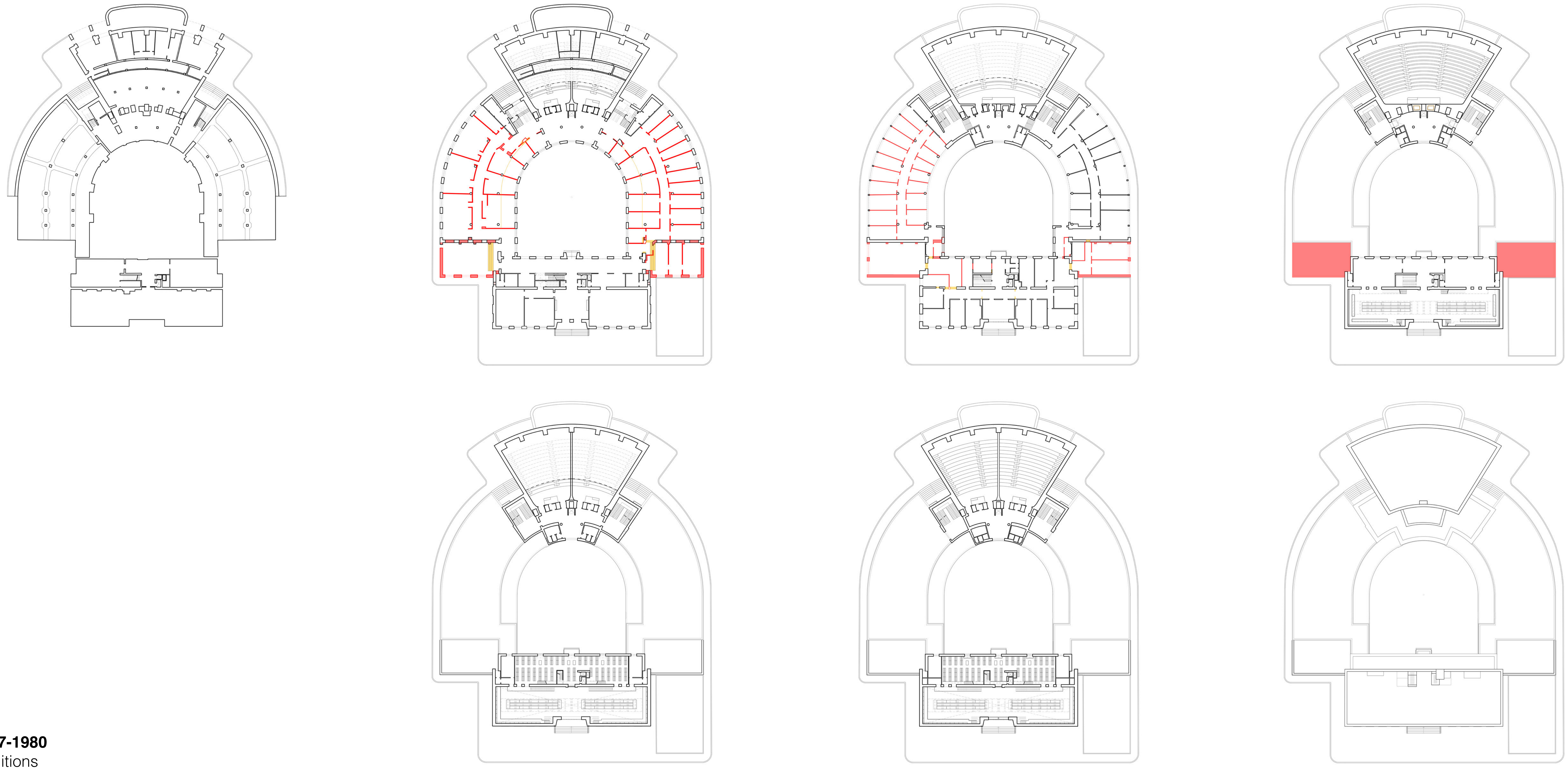
1939-1943
First alterations
(additions in red and removals in yellow)



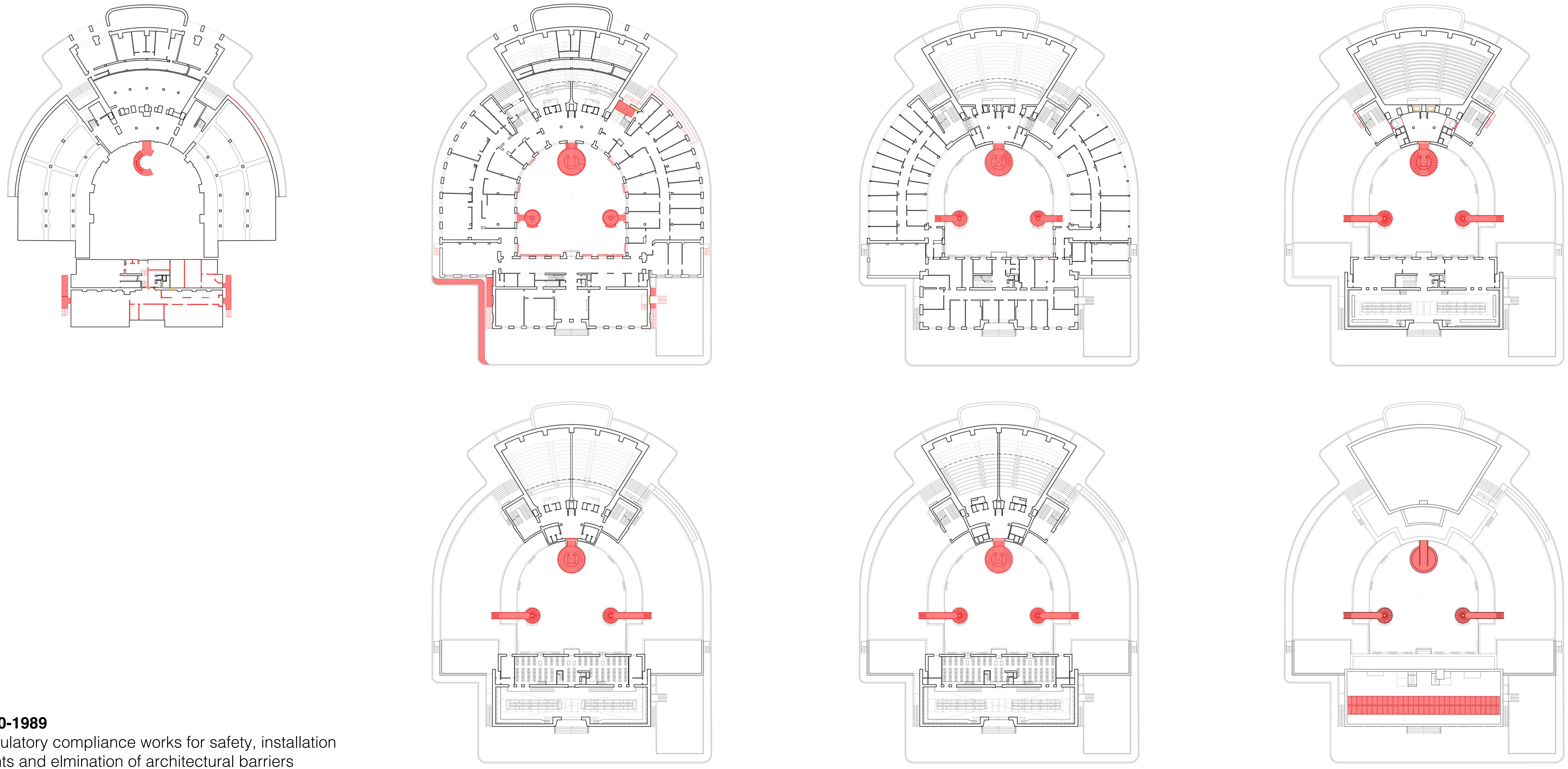
1943-1953
Reparation of war damages
(additions in red and removals in yellow)



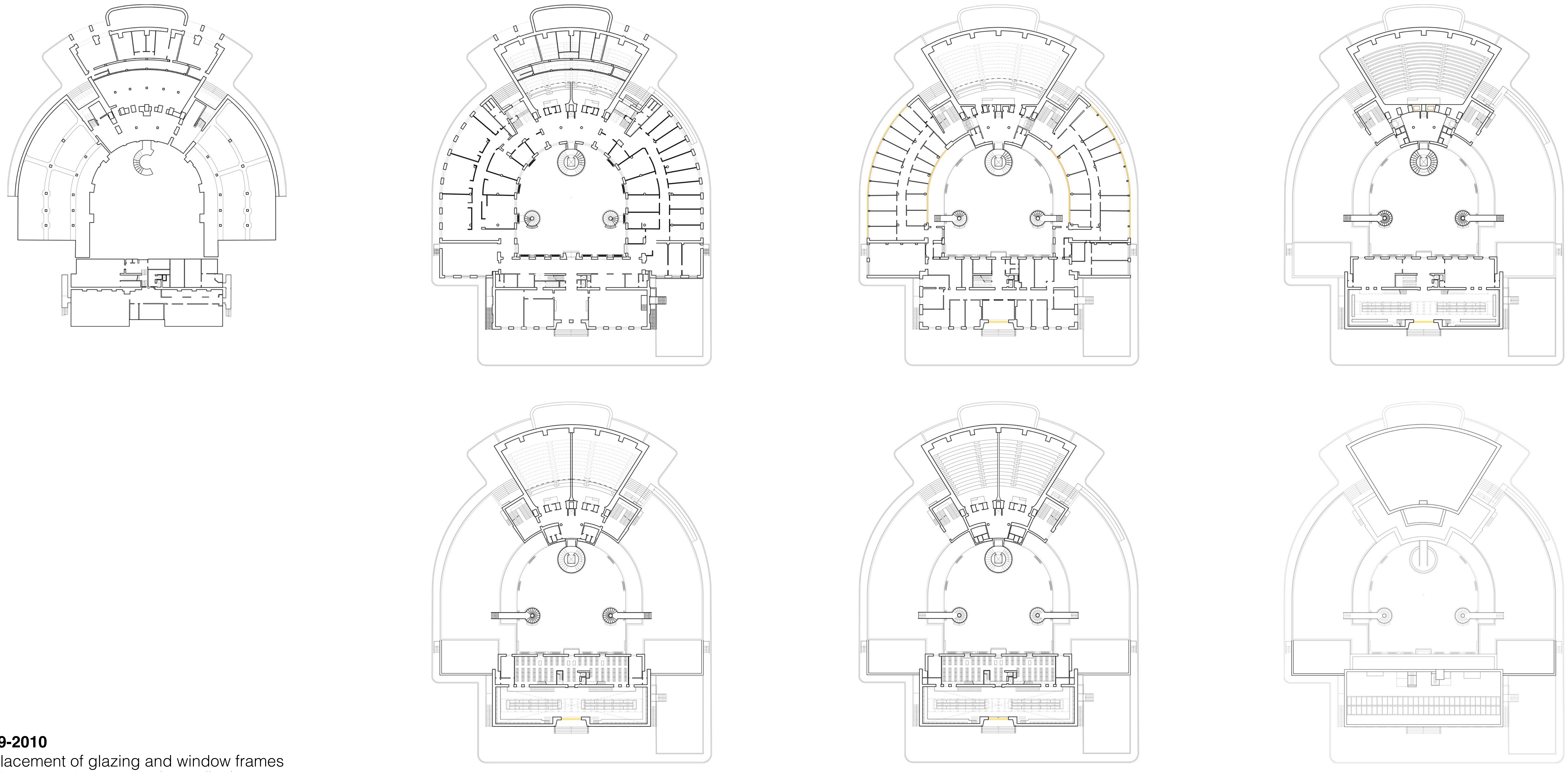
1953-1967
Adaptive reuse and maintenance works of the roofing
(additions in red and removals in yellow)



1967-1980
Additions
(additions in red and removals in yellow)

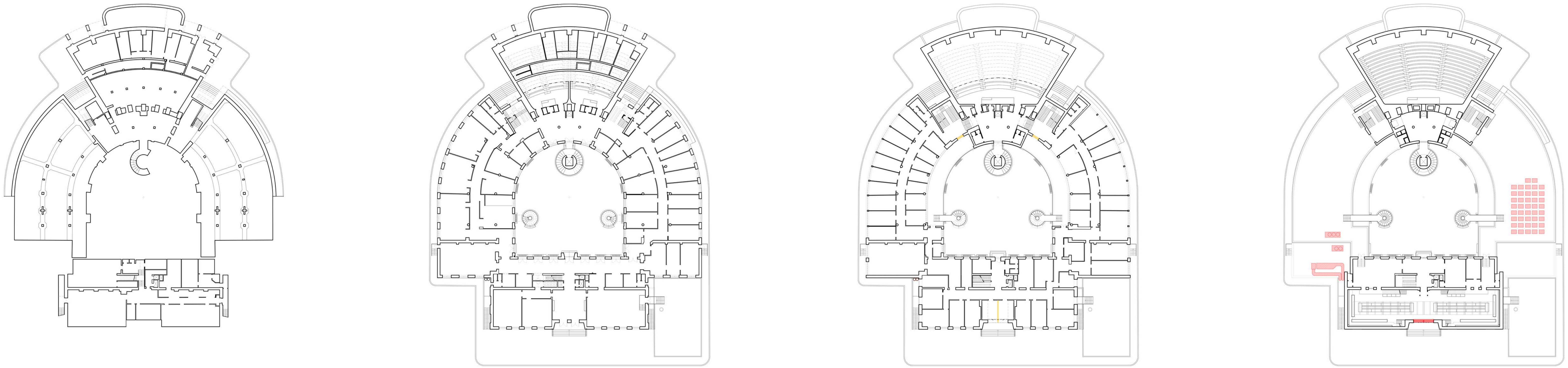


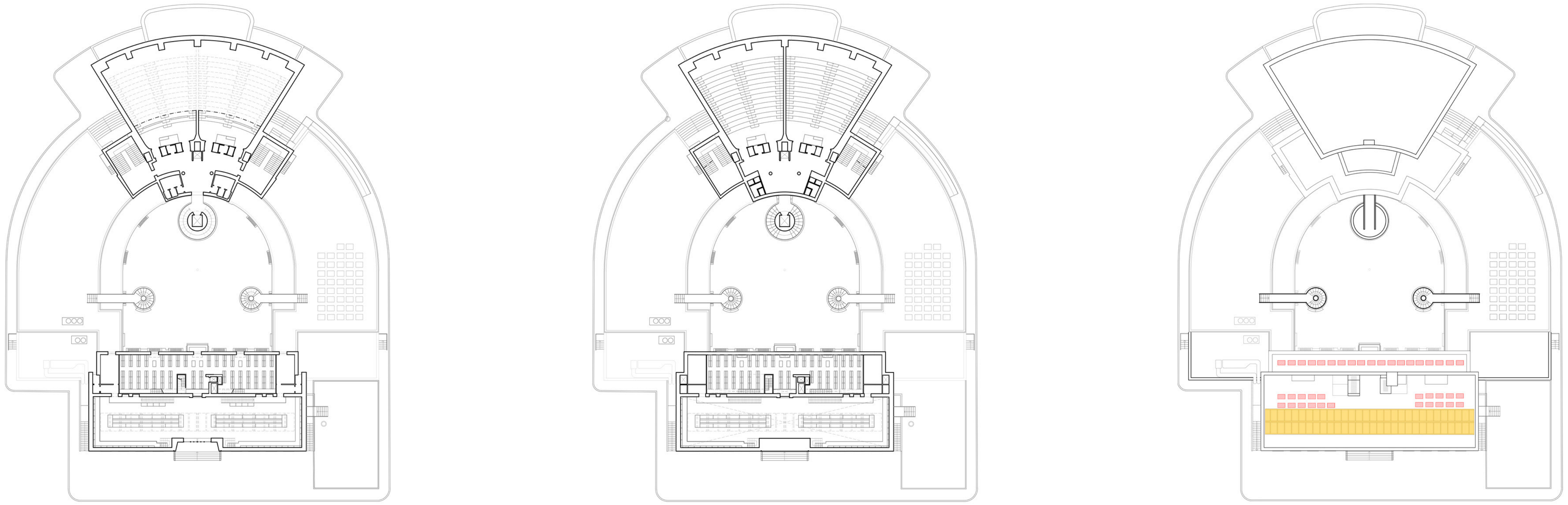
1980-1989
Regulatory compliance works for safety, installation plants and elmination of architectural barriers
(additions in red and removals in yellow)



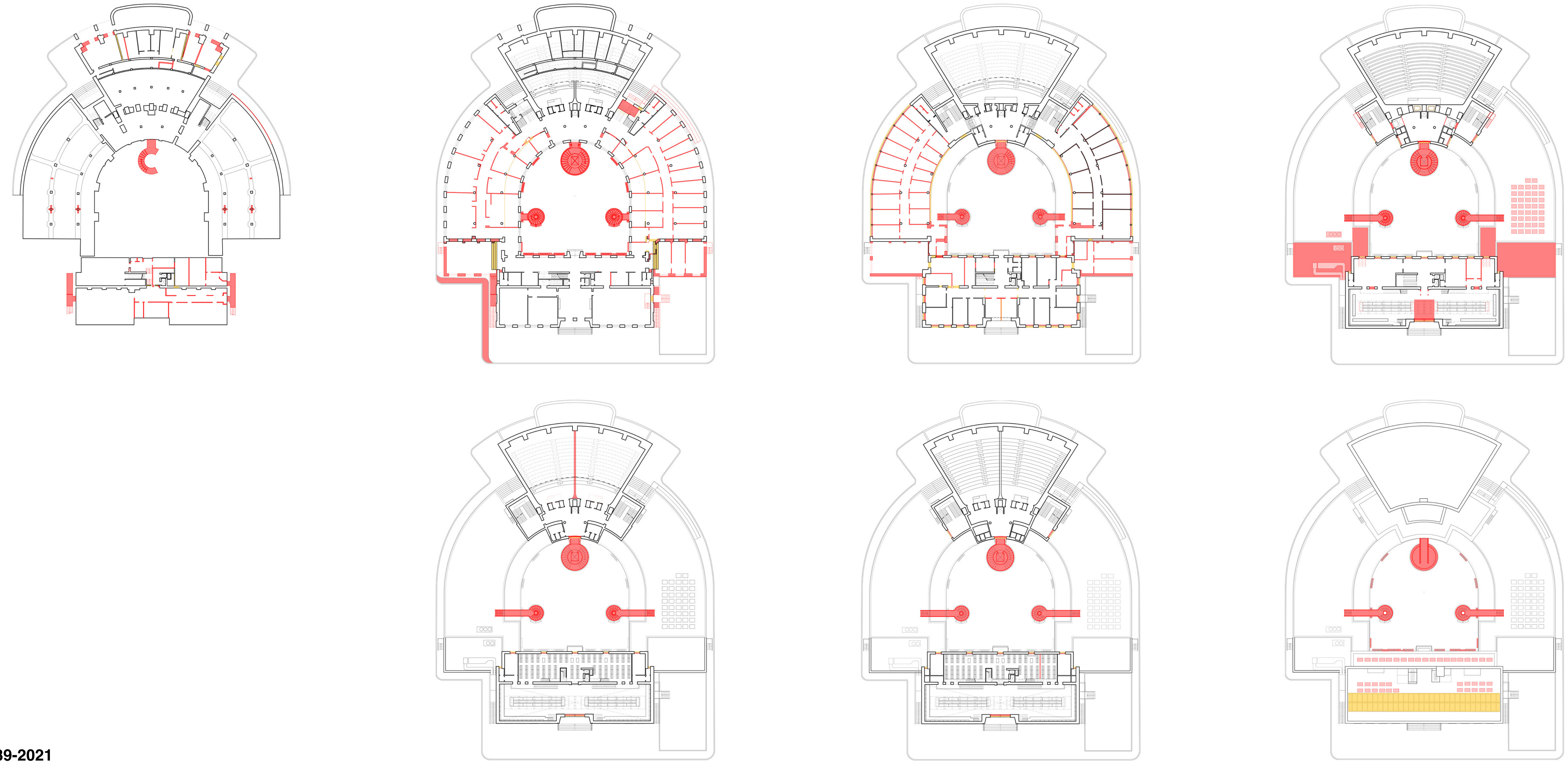
1989-2010

Replacement of glazing and window frames
(additions in red and removals in yellow)





2010-2021
Waterproofing of the library roofing with restoration of the skylight, reorganization of the interiors and requalification works of the professors' sitting room and installation of the photovoltaic equipment
(additions in red and removals in yellow)



1939-2021
Mapping of all additions (red) and removals (yellow)

IV. ARCHITECTURE AND MATERIALITY

BACK TO INDEX

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SURVEY, MODELING AND REPRESENTATION

Alfonso Ippolito, Martina Attenni

INTRODUCTION

The research activity concerns the School of Mathematics, analysed through the survey, the two-dimensional representation of the building, from architectural scale to detail, and three-dimensional models. Objectives of the research consists in updating the documentation of the current configuration of the building; increasing its knowledge through integrated 3D/2D digital models; defining a database for in-depth knowledge of the object, useful for future and specialized analysis.

The program is divided into various phases: survey and analysis of the current condition of the building and its characteristics conducted through integrated methodologies; elaboration of 2D models at various scales; elaboration of 3D digital models. Activity covers the following phases:

- *Survey: integrated massive data acquisition*
The survey activities include a data acquisition campaign carried out with integrated surveying tools and techniques (topography, 3D Laser scanner, Structure from Motion). The acquisition of the entire accessible area has been performed by laser scanning with a 1x1 cm mesh (general scan, $\Delta \pm 5$ mm) and with a 2x2 mm mesh (detailed scans, $\Delta \pm 2$ mm). The topographic acquisition covers important points and useful targets for point cloud registration. The topography will be connected to a network and geo-referenced cornerstones, which will allow the numerical model to be correctly oriented with respect to the world system. The photographic acquisition through SfM and the photographic straightening to obtain orthophotos concern the surfaces that define the elevations of the school of mathematics and detailed elements. The tools used have been provided by the Department of History, Representation and Restoration of Architecture.

- *Survey: integrated 3D/2D modeling*
The integrated survey will allow the construction of different types of models:
- 3D numerical 3D model characterized by the RGB photographic data value,
- 3D numerical model characterized by the value of RGB reflectance data;
- 2D models: plans, elevations, sections scale 1: 100/1:50, geometric and architectural representation
- 2D models (details): plans, elevations, sections scale 1: 20/1:10
- Iconic 3D model, realized to describe the geometric morphological characteristics, the spatial articulation of the building, the configuration of the measured elements.

- *Data analysis, validation, communication*
The final part of this task has focuses on an overall evaluation of several issues closely related to the results of the survey and investigation phase. The first type of comparison concerns the 3D mathematical model and the numerical model, to understand the metric deviation and the geometric differences. The second phase of this secondary activity provides communication of all the acquired data, integrated 3D and 2D models, the results of all the analysis conducted through a digital database useful for subsequent studies and to have an integrated digital documentation, sharable and implementable.

RESEARCH ACTIVITIES INTEGRATED SURVEY

The need to carry out specialized analyses has made indispensable an integrated data acquisition to allow the reading of quantitative and qualitative aspects of the building under examination. At present, the knowledge and the study of built heritage are strongly connected to the methodologies for the massive acquisition of points on surfaces. On the one hand, these methods make it possible to collect an ever-increasing amount of information and are increasingly linked to technological progress (Bernardini, Rushmeier 2002, pp. 149-172). On the other hand, this approach has considerable repercussions on the management of data, often excessively redundant, precisely because acquired without a selection on the metric, geometric and material qualities of the objects analysed (Centofanti, Brusaporci, Lucchese 2014, pp. 31-49).

Although the acquisition phase seems to be totally automatic because it is closely linked to the use of the instruments employed, it is still necessary to make a series of choices in advance regarding the methods of use of the same. On the one hand, this confirms the importance of the role assumed by the survey project, understood in the traditional sense, even at a time when technological devices seem to be increasingly performing and automated. On the other hand, the massive acquisition implies the mandatory reliance on successive operations of the definition of geometric, material, and physical properties, and the extraction of concepts, theories, and thematic and semantic links (Blais 2004, pp. 231-243).

The definition of a multi-scalar approach, in which acquisition criteria are established with respect to predefined objectives, is necessary to optimize the relationship between the information collected and the scale of the models to be built. The collection of a very large amount of data, in fact, may involve geometric overlaps within numerical models, becoming synonymous with a redundancy on which to intervene.

It is therefore necessary to previously dimension the data to be acquired with respect to the objectives of the investigation, optimizing the clarity and unambiguousness of the quality of the information with respect to the scale of the models (Borgogni, Ippolito 2011, pp. 71-78).

The School of Mathematics is a building with a particular morphology, the result of the choices of the designer and of the interventions to which it has been subjected even decades after its construction. The setting of the survey activities has considered the articulation of volumes and the complexity of spaces and architectural solutions used, and has provided for the definition of different methodologies, established within a detailed survey project. To obtain models with a controlled level of uncertainty, the 3D laser scanning constituted the basis to which the data acquired through photographs were subsequently integrated (Vrubel, Bellon, Silva 2009, pp. 2687-2694). The acquisitions of the external facades and of the internal environments have been performed considering the scale of the digital models to be realized, previously established in 1:100 for the geometric restitution, 1:50 for the architectural one.

The scans are characterized by a constant distance of points of 1 cm, reduced to 0.5 cm for some significant portions (the facades with the covering in travertine slabs, the atrium, the counter-façade of the courtyard in litho-ceramic bricks). The acquired data have been integrated with those of digital photographic images, used with a double purpose. The Structure from Motion processes made it possible to process ortho high-resolution images to analyse the type of workmanship and the state of conservation of the travertine slabs or the composition of the Litoceramic recurrences, but also to create models of elements at the scale of detail that the laser scanning was able to acquire not without shadow zones and undercuts.

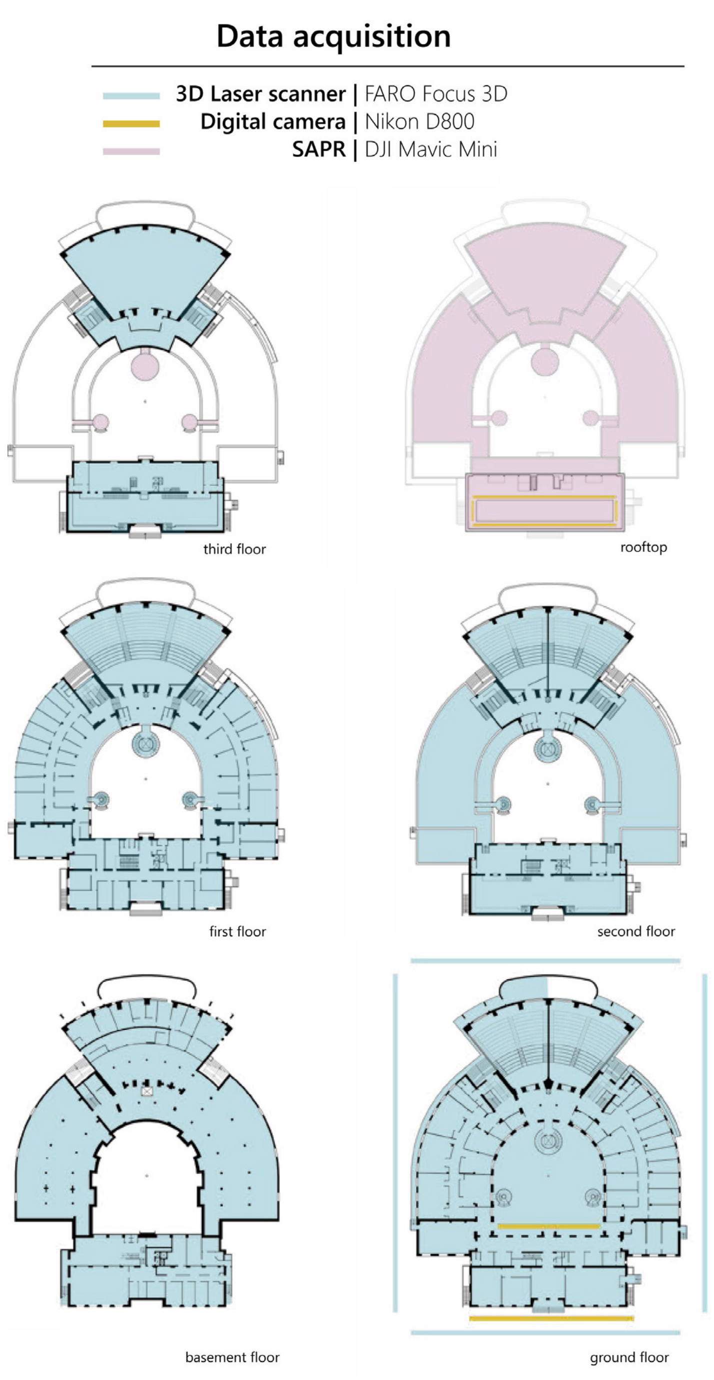


Figure 1 - Surveying project (© Attenni 2020)

The survey, which lasted several months, was conducted with the aim of having a complete coverage of all the environments, from the basement to the roof, also considering the activities that take place within the different sections of the building (classrooms for teaching, calculus laboratory, National Institute of High Mathematics, library).

The numerical models produced constitute a basic documentary apparatus of great effectiveness. The level of detail visualizable on the model allows to appreciate the phenomena of degradation that insist on the object, the traces of processing of materials, the proportional relationships of the parts compared to the whole. The possibility to obtain models with a scale with a very small denominator allows the easy reading of the consistency of the object. It is had therefore the possibility to be able to study the elements analysed through a quantity of such information to confer continuity to a discontinuous model for its nature.

The different passages of scale within the acquisitions allow, on the one hand, to validate the methodology of data collection; on the other, to study the design and construction logic that bind the architecture of the School of Mathematics both to the urban context of the University City, both to the detailed solutions designed by Ponti, confirming the importance of the link between the scale of the model and its information content (Brusaporci 2015, pp. 4195-4205).

Figure 2 - Aerial photogrammetry (© Attenni 2020)

Figure 3 - North elevation, numerical model, RGB view (© Attenni 2020)

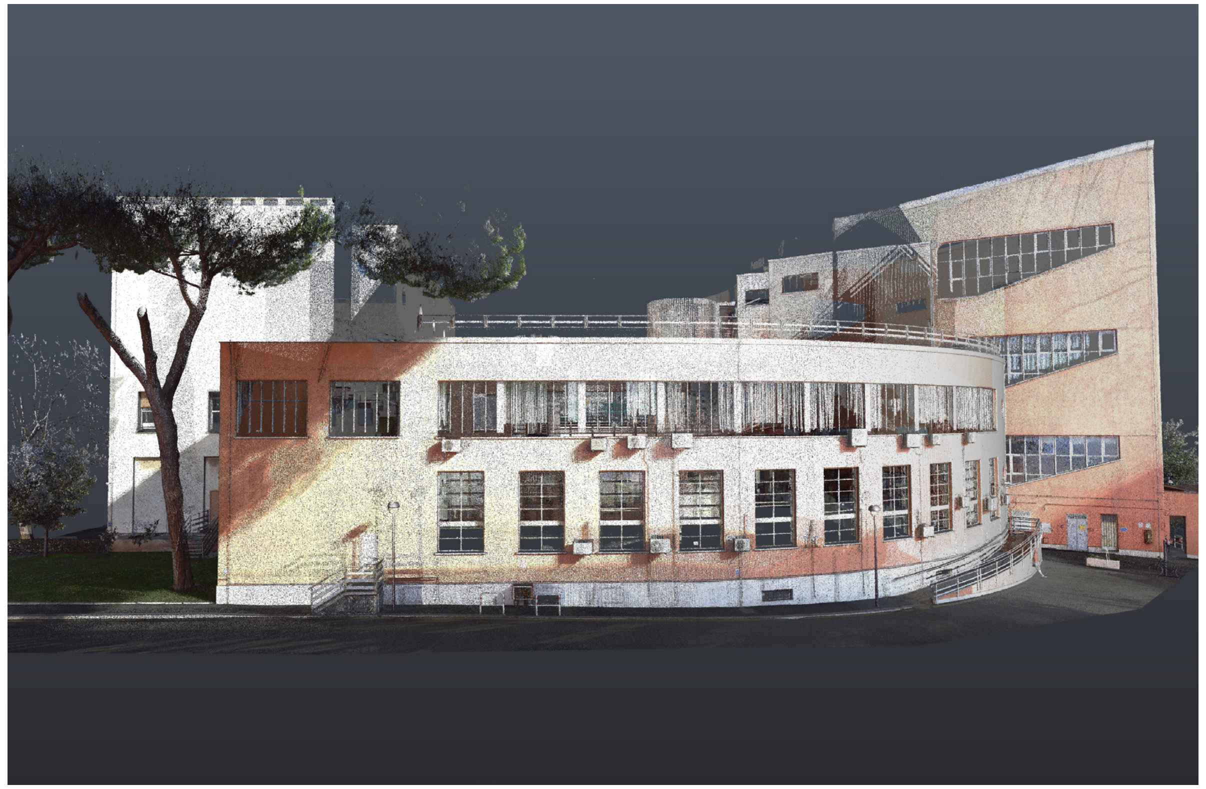


Figure 4 - South elevation, numerical model, RGB view (© Attenni 2020)

Figure 5 - East elevation, numerical model, RGB view (© Attenni 2020)

Figure 6 - West elevation, numerical model, RGB view (© Attenni 2020)

Figure 7 - Perspective view of numerical model, RGB view (© Attenni 2020)

CONSTRUCTION OF MODELS

The models constitute the product of the operation conducted on an object (real or imagined) of selection and extraction of some among the infinite information available. The operations of discretization, therefore, associate the use of high technology tools to the methodologies for the representation, showing how no activity, even if highly technological, is purely automatic. The restitution of data is a complex moment, closely related to what you want to communicate about the object analysed (Gaiani, Benedetti, Apollonio 2009, pp. 60- 73). In this case, 2D and 3D models constitute the data base to propose critical analyses optimizing the results obtained by the joint work of experts belonging to different fields (structures, material analysis, restoration and conservation, technical physics). Two issues were addressed: the first one concerns the will to understand and emphasize the peculiar aspects of the analysed context, characterized by a remarkable geometric and volumetric articulation (Apollonio, Gaiani, Corsi 2010, pp. 717-726); the second one is related to the scale of representation of the 2D models and the level of detail of the 3D models (Fallavollita, Ballabeni, Foschi, Perugini 2015, pp. 31-40).

Numerical/polygonal 3D models- Both types of models have been elaborated starting from the numerical model, obtained from the alignment of the point clouds detected through different laser scans. This step is the result of accurate reflections about the purpose of the models of the artifact that must be replicated within a digital environment. The choices made have considered the potentialities and the characteristics of the hardware and software tools used, which have guided the definition of different types of numerical models: an overall one, necessary to record the geometries and control the uncertainty, others of detail of specific environments or significant portions of the building. The overall numerical model includes the external facades, the atrium and the horizontal and vertical connection environments, the courtyard, the most studied environments within the design process (Ponti classroom, classrooms on the ground floor, second floor and third floor, library). An unavoidable moment is constituted from the editing of the numerical model that previews, in a first phase, the elimination of all the not necessary data and its successive import to the inside of software dedicated to the elaboration. The second phase is basically aimed at reducing the number of points and controlling the overall noise of the model. Those realized are three-dimensional numerical models textured with RGB colour and RGB reflectance data. The textured model allows to define the formal aspects and the state of conservation of the artifact using RGB data obtained from digital images acquired at the same time as the laser scanning by the same instrument: in them the colour data is associated with great precision to the geometric position of the detected points. The thematic model, instead, exploits the symbolic character of the colour to return information related to different aspects. Identifying homogeneous areas on the model through the colour, we highlight the forms, the heterogeneity of materials, their state of preservation and sometimes even the pathologies of degradation. These models, not only replicate the three-dimensionality of the analysed objects with a very low level of uncertainty (Δ=±2cm) but return the surfaces in a continuous manner; moreover, depending on the type of visualization it is possible to communicate different aspects of the analysed objects, from the shape of the surfaces to their regularity or irregularity, to the state of conservation.

Numerical models obtained from the alignment of point clouds

- total model of the building (Δ=±2cm)
- partial model (Δ=±0,5cm) entrance hall
- partial model (Δ=±0,5cm) bridge classroom
- partial model (Δ=±0,5cm) library
- partial model (Δ=±0,5cm) coverage

Textured polygonal models obtained through Structure from Motion processes

- model of the main facade with covering in travertine slabs
- model of the courtyard counter-façade with covering in Litoceramic bricks.

2D MODELS

The characteristics of the building object of the present research have placed the need to document its morphology following a path that, both in the acquisition and in the restitution of information, went from general to detail. The canonical representations in plan and elevation constitute a documentation of the School of Mathematics that allows the study and analysis, preparatory to activities of restoration, maintenance, and management. The use of graphic conventions in the representations has allowed to show at the same time the continuity and the dissimilarity of the matter that characterizes the building. To the complexity of the studied structures corresponds an equally articulated process for the definition of the elaborations. The integration of data in digital environments allows to manage the numerical models directly within a CAD environment, establishing a Cartesian reference system XYZ for the orientation and making sections at multiple levels, which allowed the vectorial restitution through a process of overlay. The point of contact between the products deriving from traditional survey activities and new technologies of massive acquisition is not only found in the operational aspects connected with the restitution of elaborates, but in the modalities according to which the process of knowledge of the external world is articulated. The multi-dimensional reality of the architectural structure has been reduced to its geometric essence by means of discretization operations that have led to the definition of numerous works at different scales of representation[1].

The drawings made at different scales have offered a basis for studies carried out simultaneously by other scholars involved in the research group. In particular those in scale 1:50, together with the mathematical 3D models of some elements (the connecting staircase between the ground floor and the first floor, the irregularly shaped handrail designed by Ponti, the concrete crowning frame), have been necessary for the realization of a three-dimensional physical model, realized by combining traditional methods with those for prototyping (Brusaporci 2017, pp. 66-93).

The information reported at the different scales of representation have allowed to carry out analysis regarding the behaviour of the structures, the transformations and the constructive passages undergone by the building during the years, the analysis of the materials (Huvila 2012, pp. 97-110). The integration between the different competences has been necessary for the development of other thematic elaborations, aimed at illustrating, on one side, the historical events that have interested the construction of the School of Mathematics, on the other side, the state of conservation and the pathologies of degradation present on some significant elements. 2D drawings in scale 1:100, 1:50, 1:20 and views of the 3D model for the material analysis and the state of conservation.

- Introductory table for the understanding of the composition of the concrete crowning. The three types of elements of which it is composed are identified and classified: the concrete one, the one with the travertine threshold, the angular one.
- Sheet for the analysis of the cement element
- Travertine element analysis sheet
- Analysis sheet of the corner element
- Introductory table for understanding the composition of facades with travertine slabs covering
- Sheet for the analysis of slabs
- Sheet for the analysis of the holes, which are related to the continuity of the façade, interrupting it
- Introductory table for the understanding of the composition of the courtyard's counter-façade with the covering in litho-ceramic bricks
- Analysis sheet of significant portions of the courtyard's counter-façade with the litho-ceramic brick facing at the ground and second floor levels.

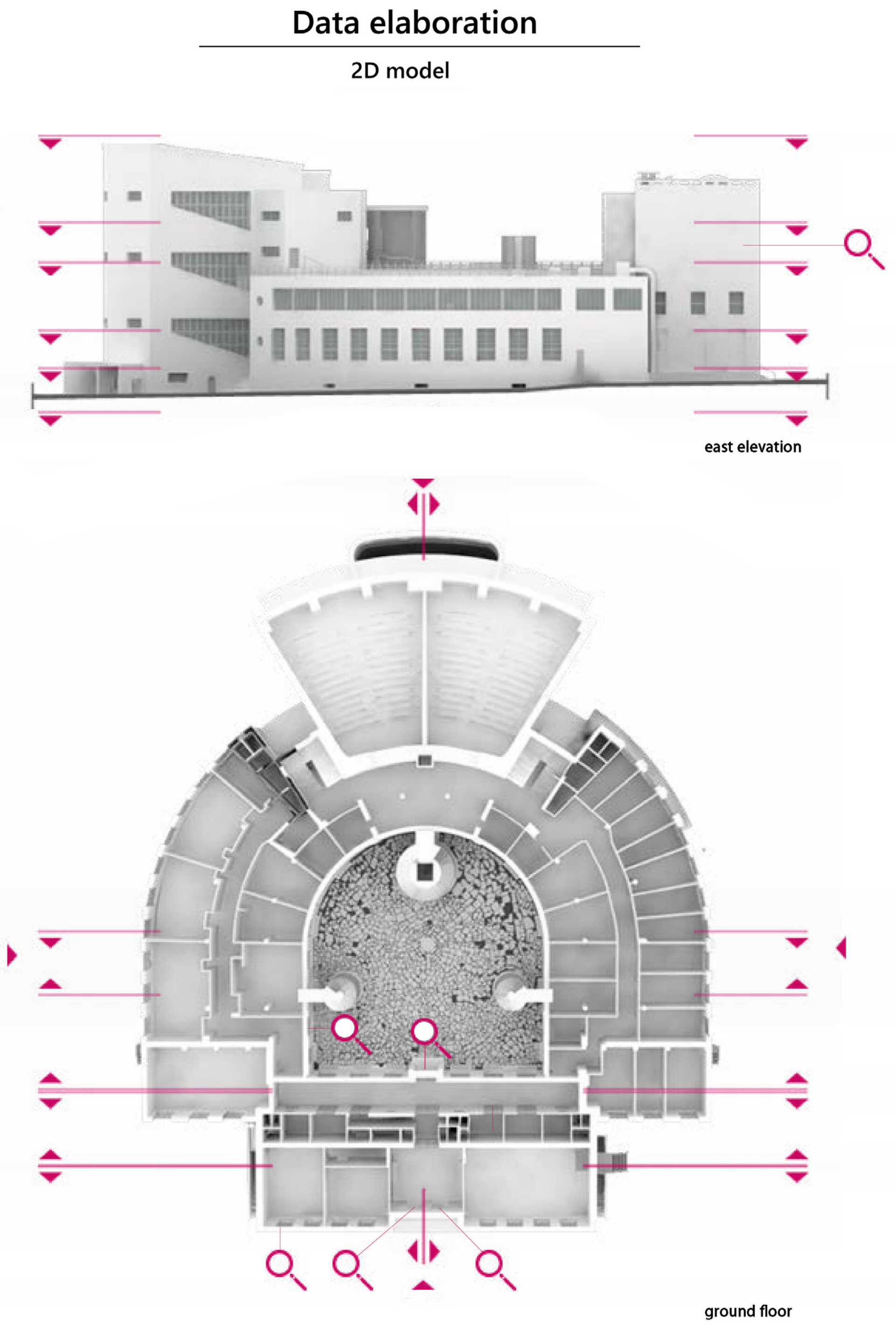
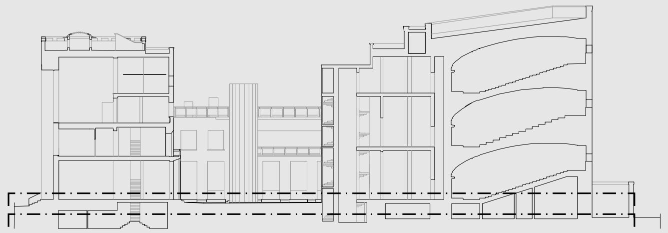
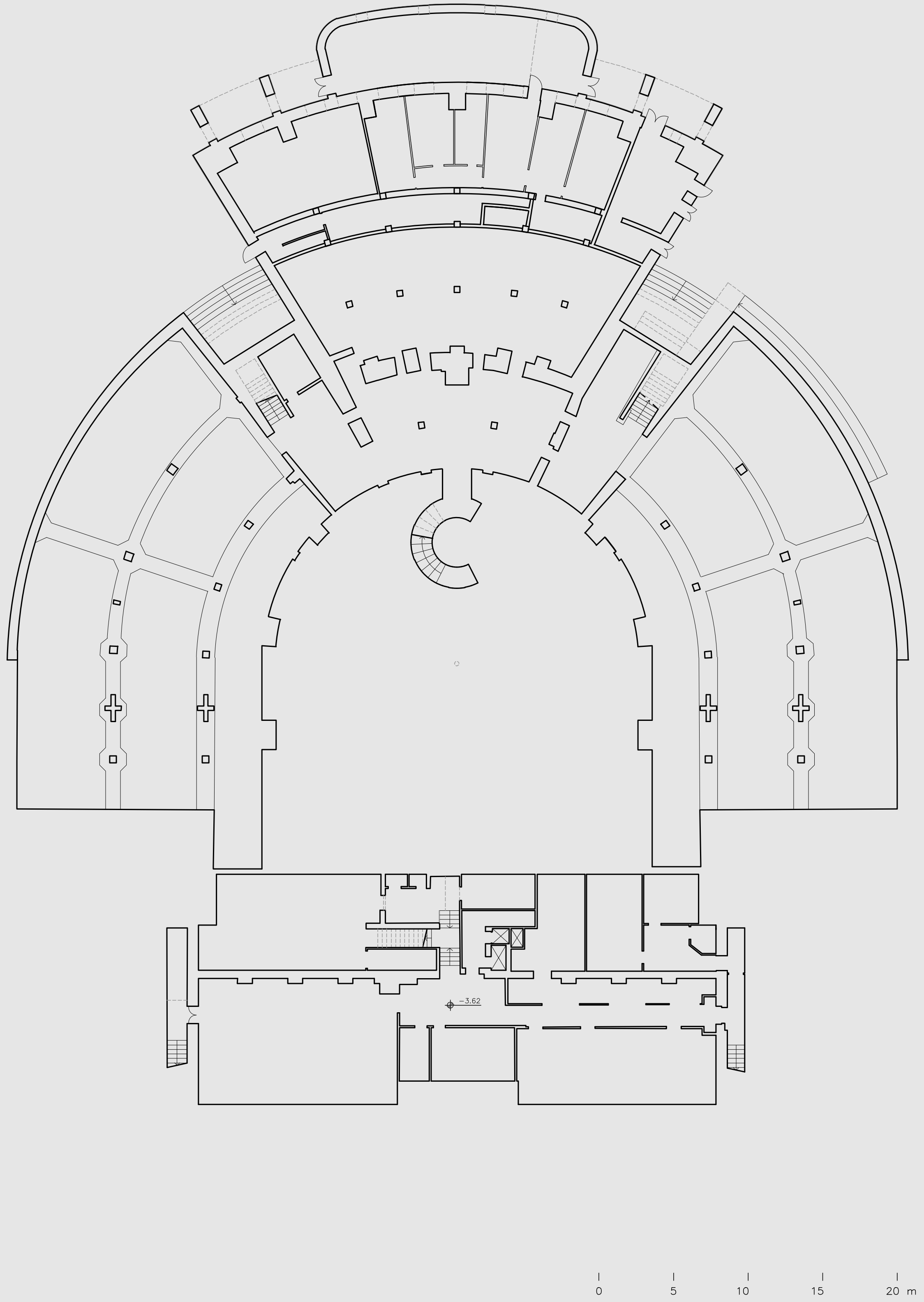


Figure 8 - Data elaboration (2D model)

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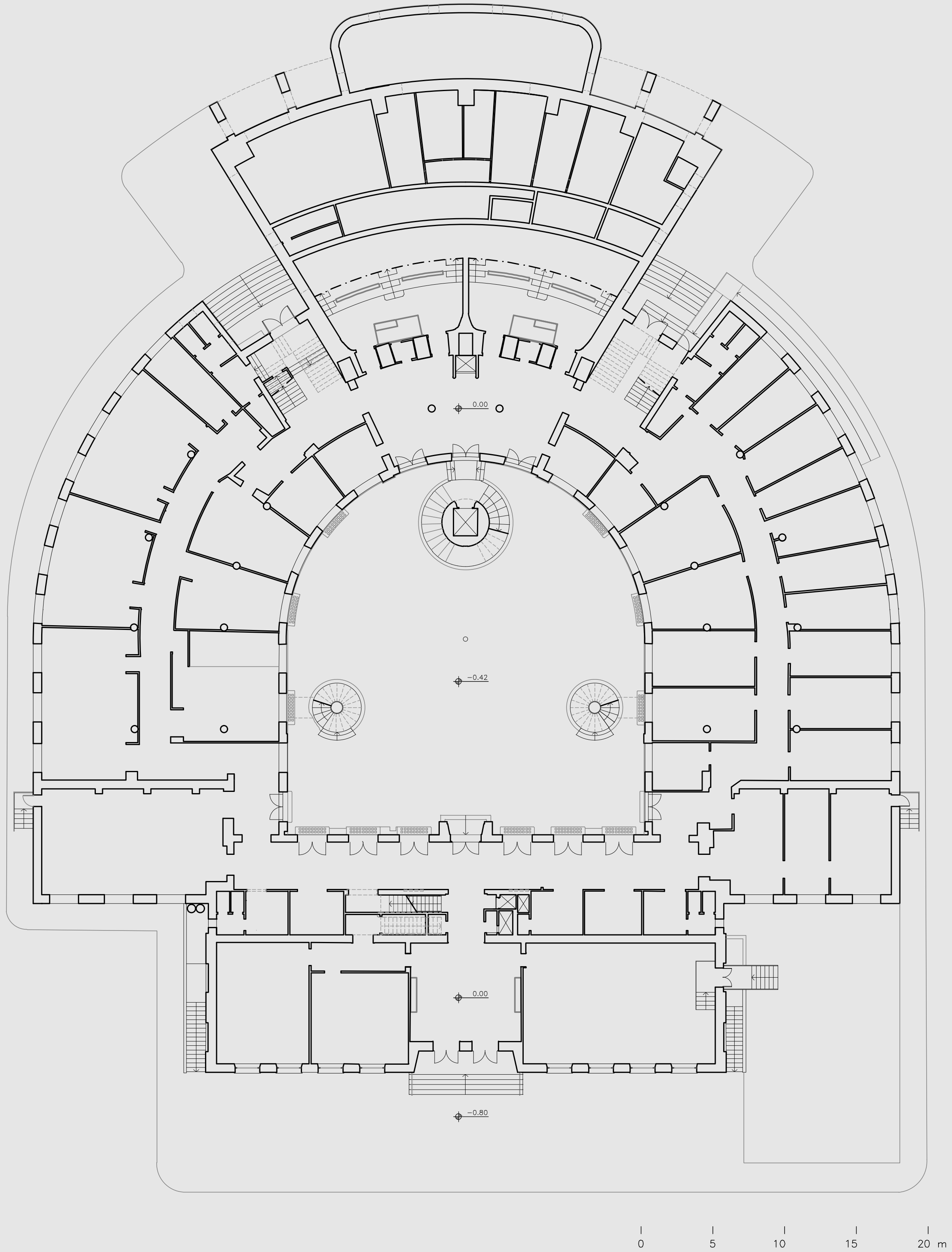
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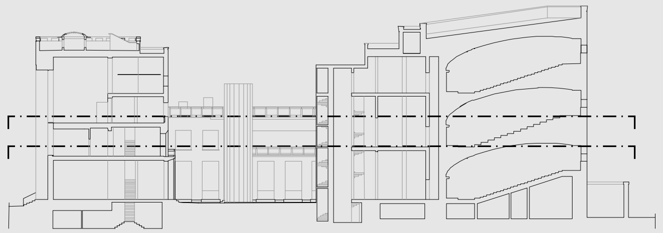

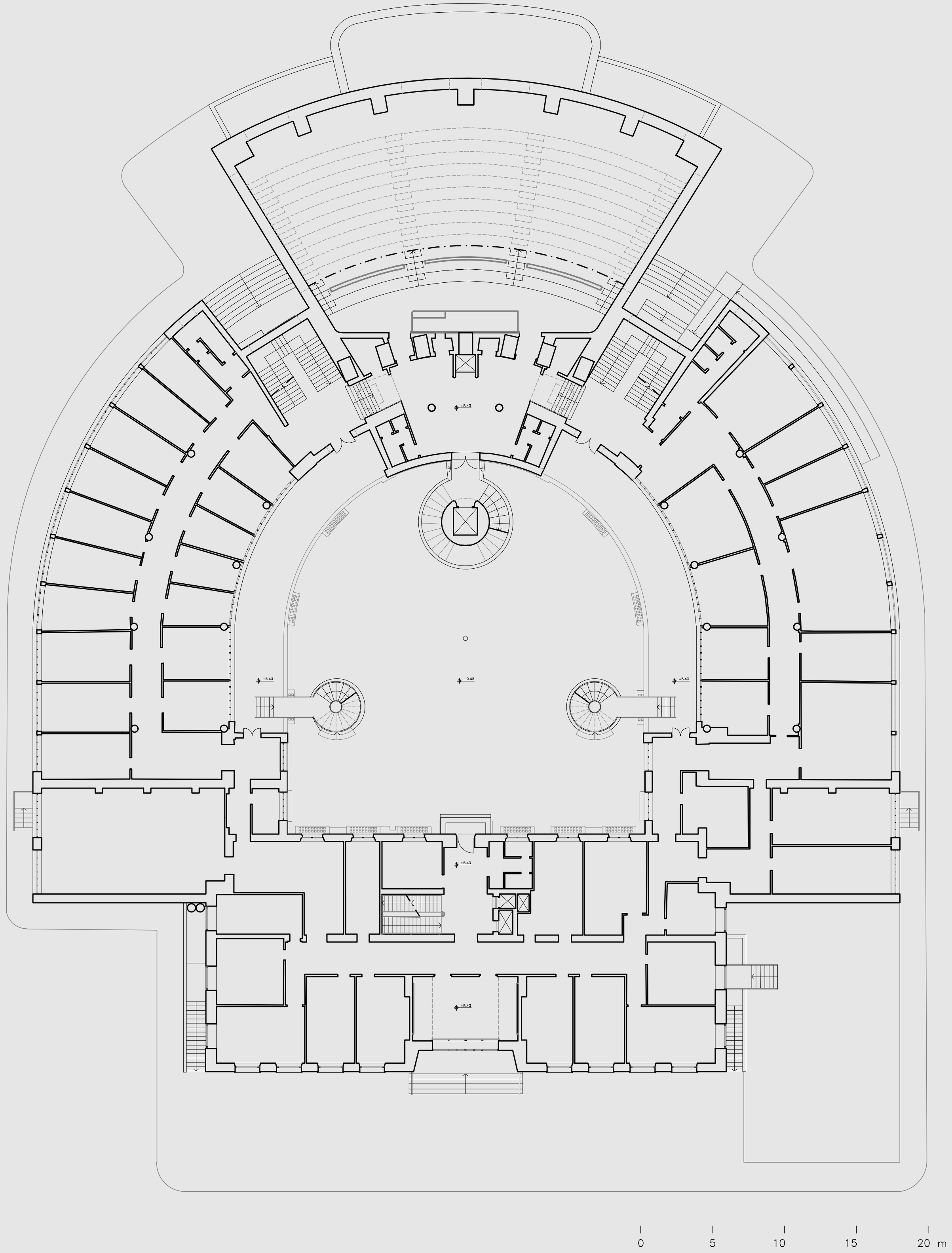
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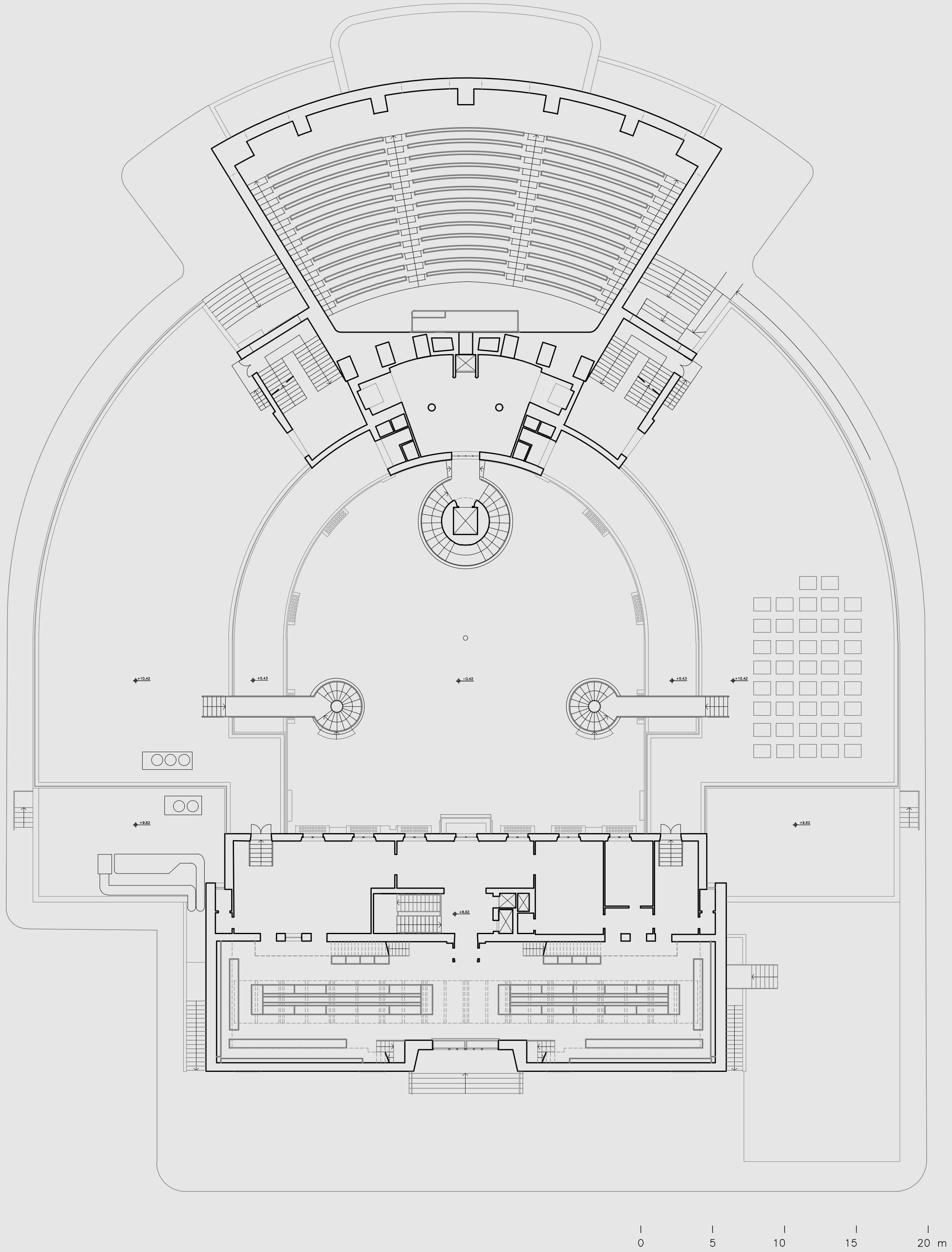
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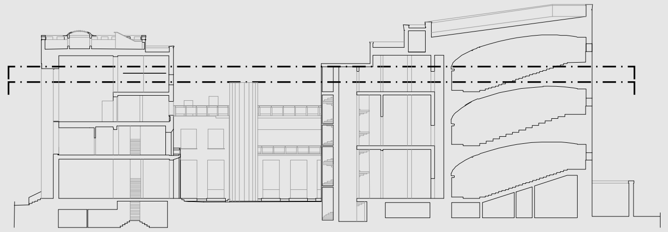

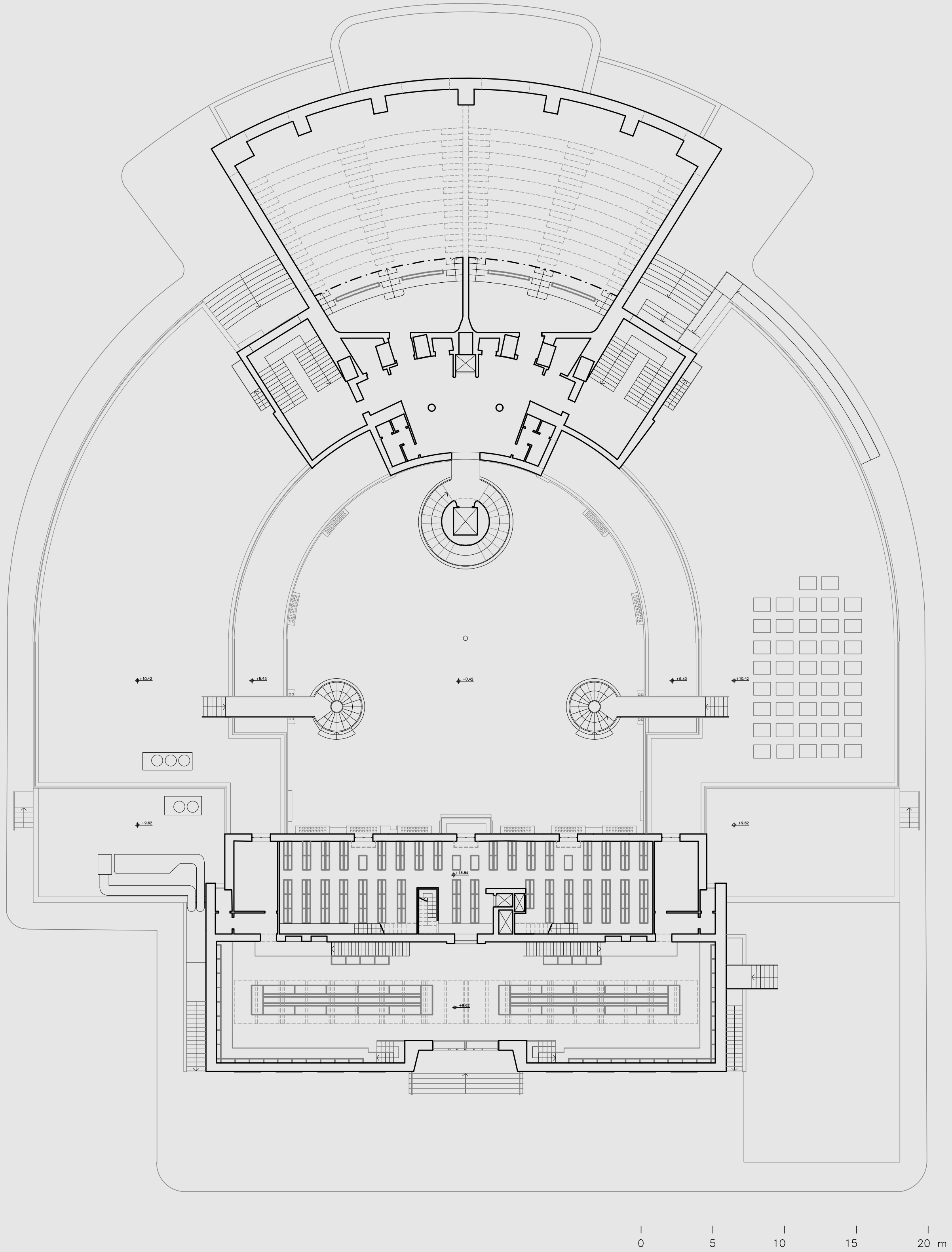
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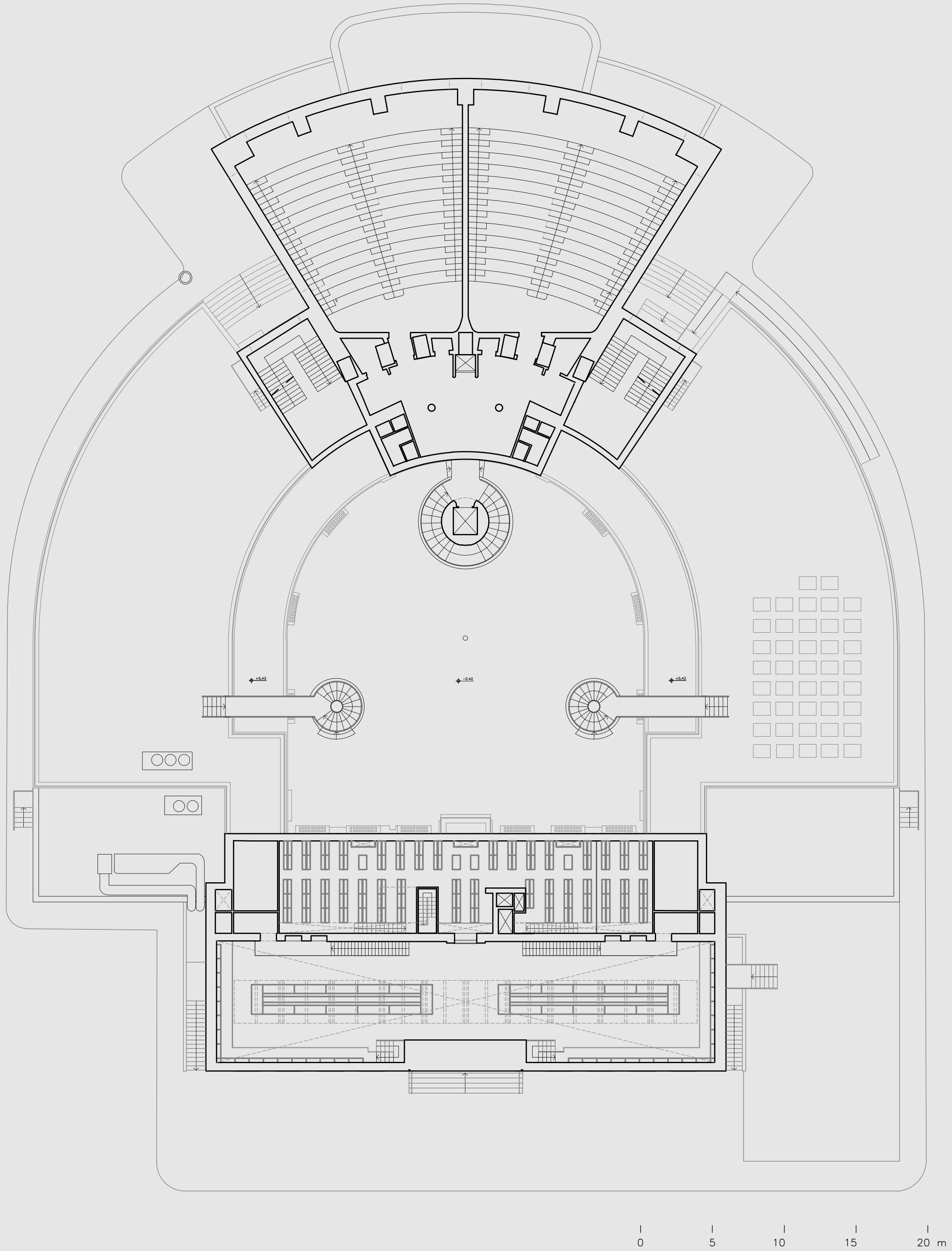
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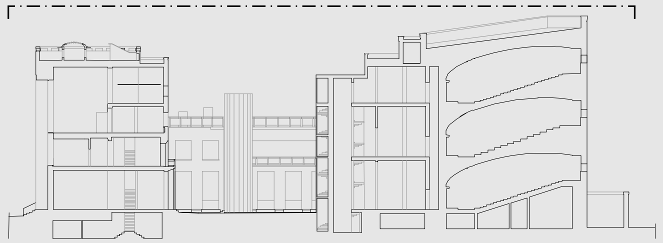

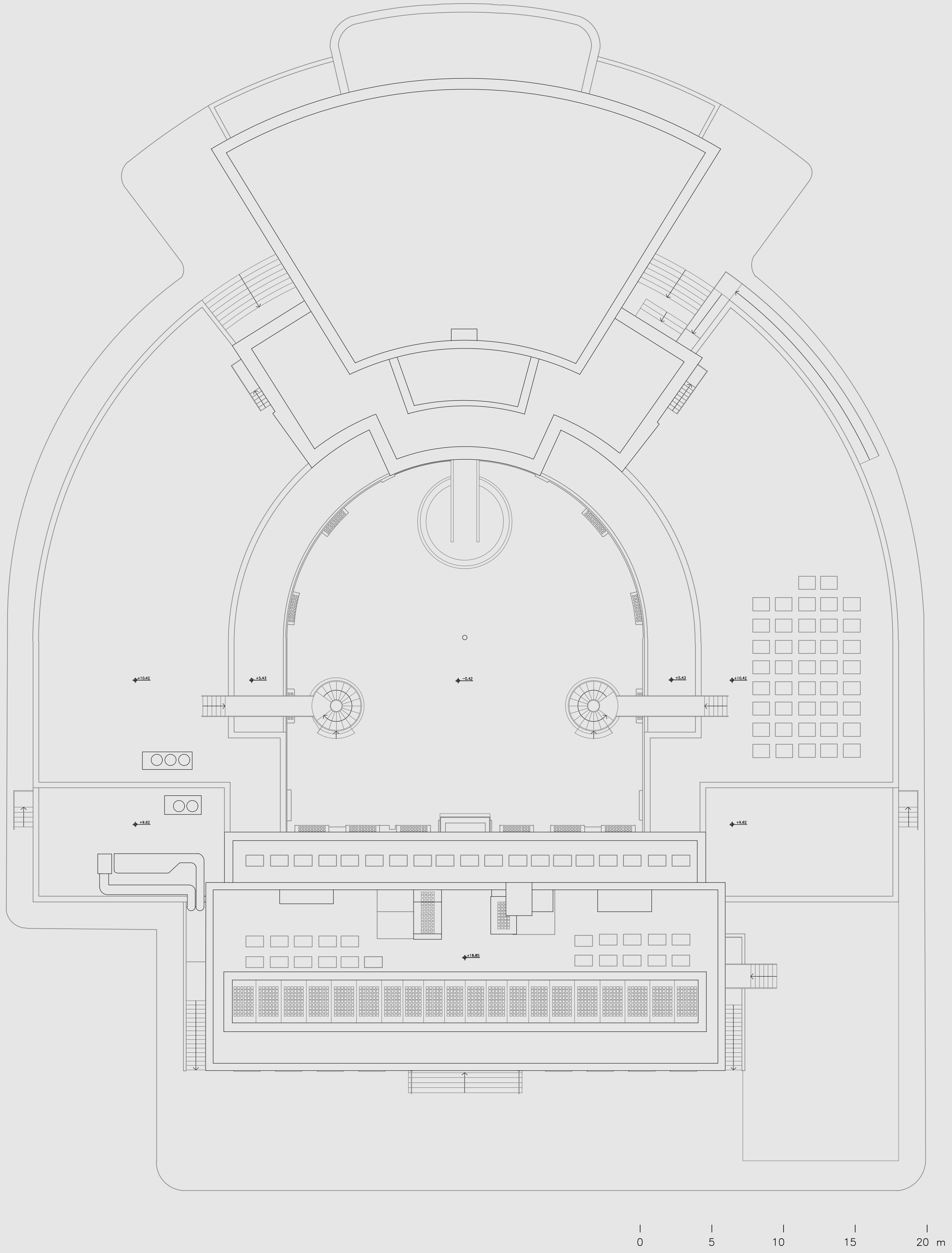

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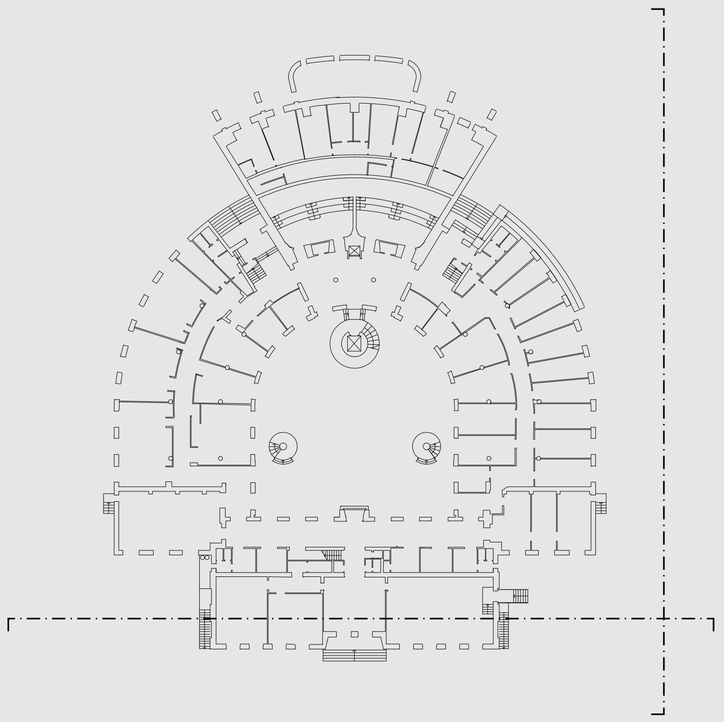

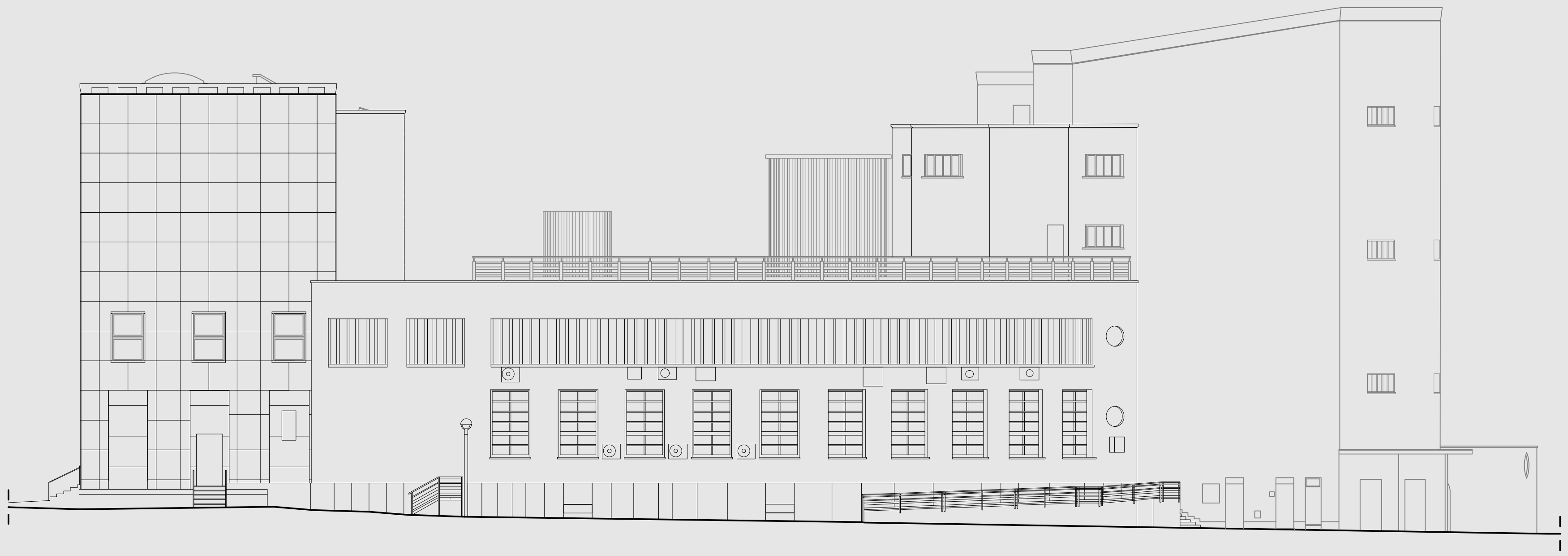

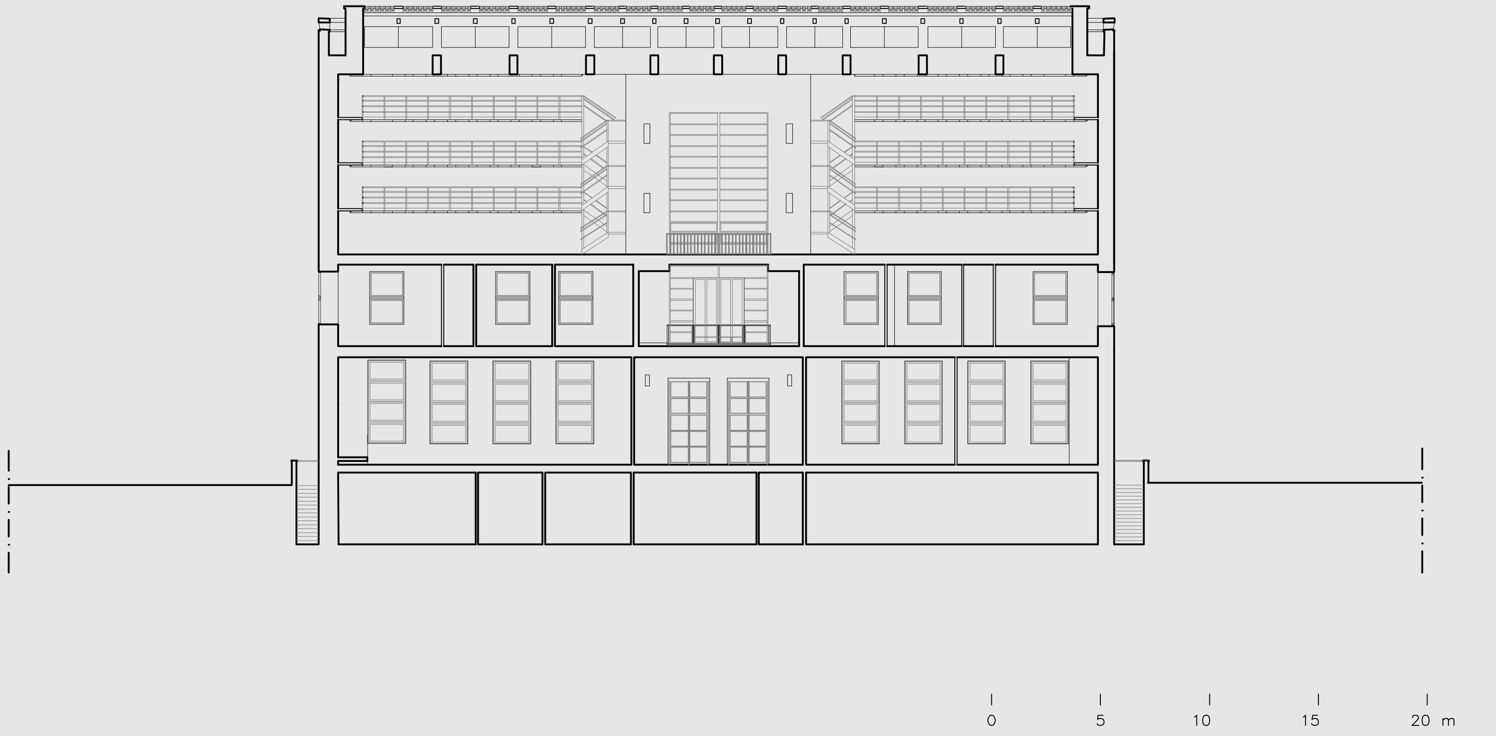
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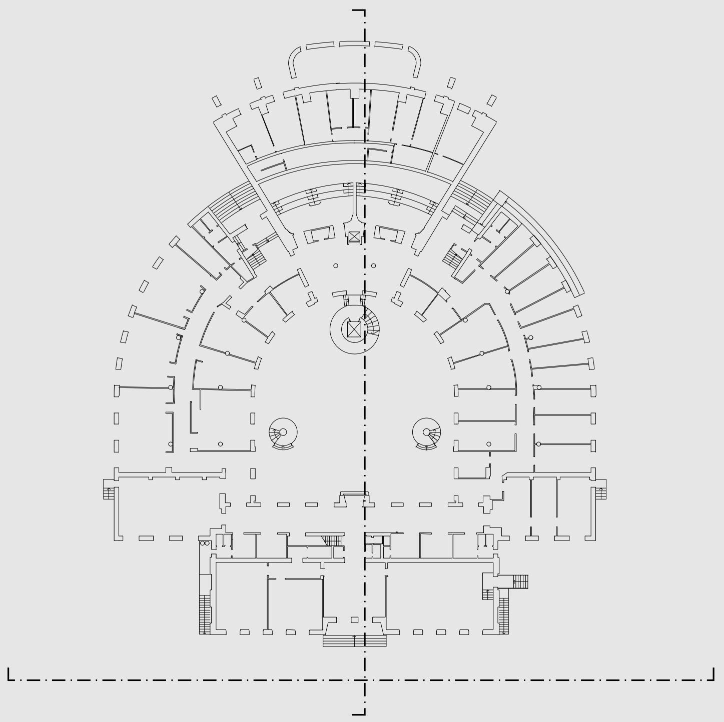

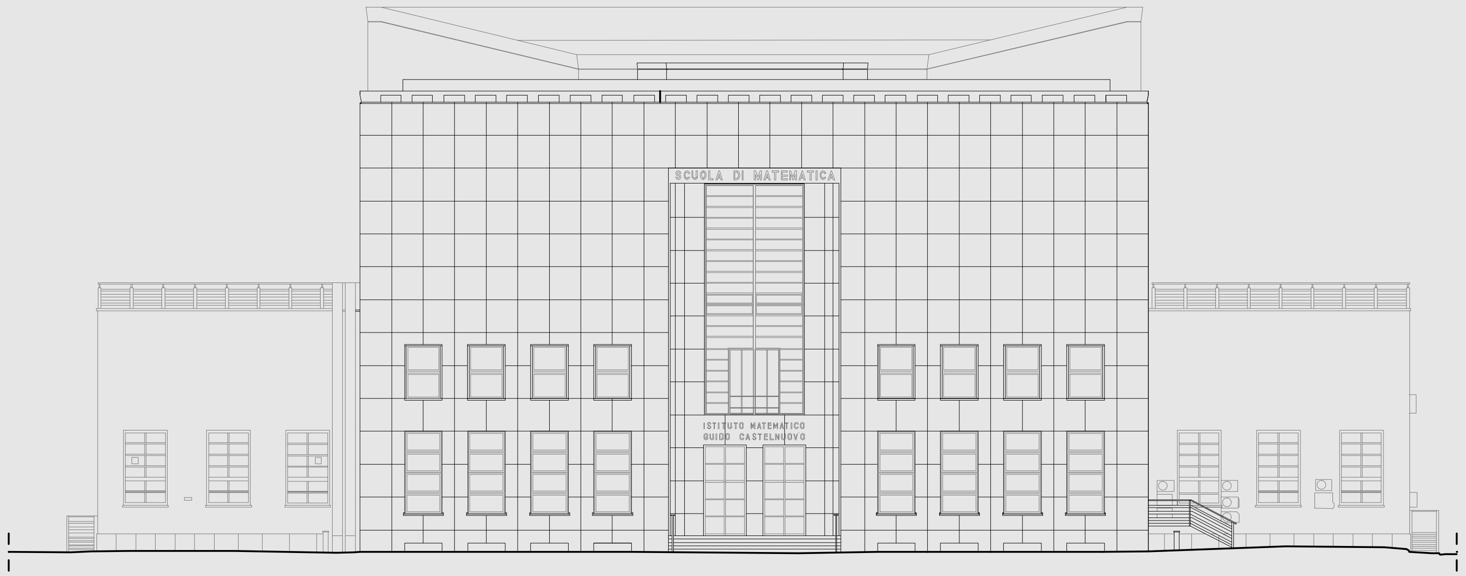
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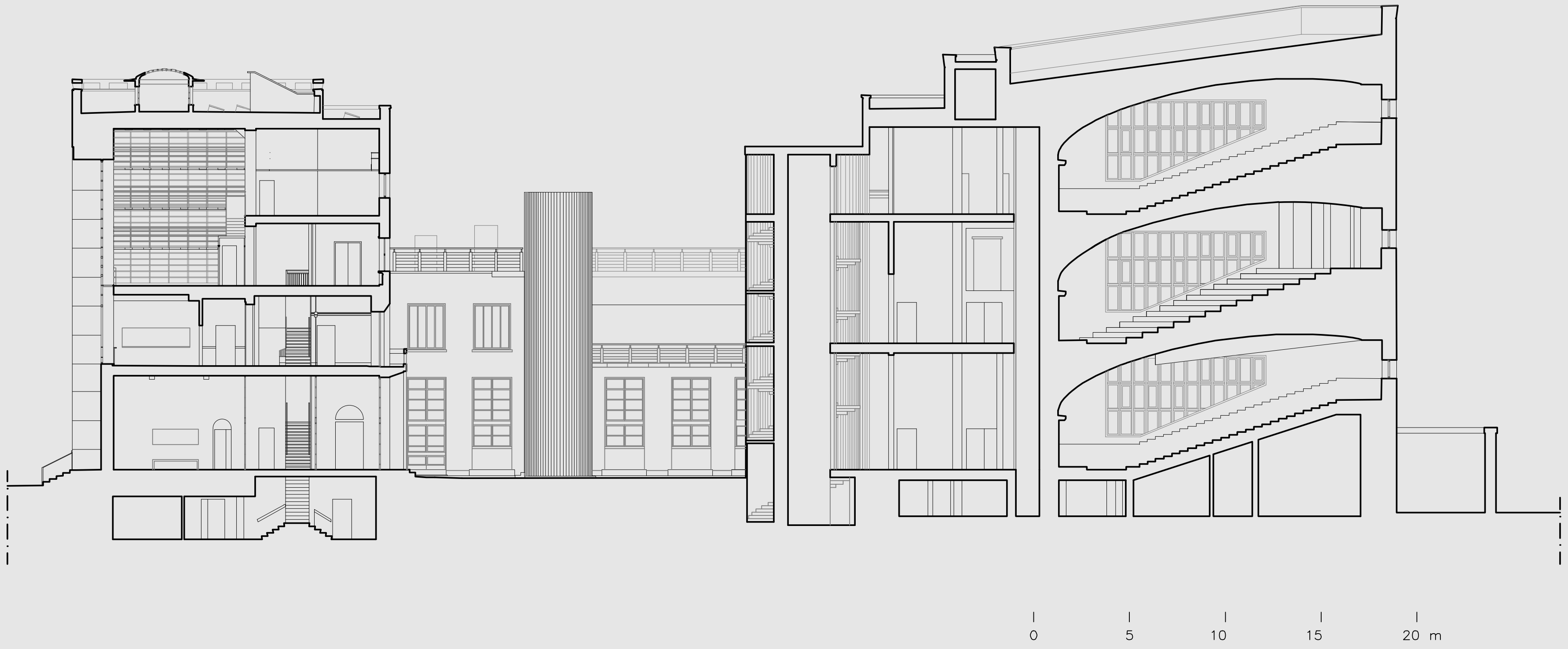
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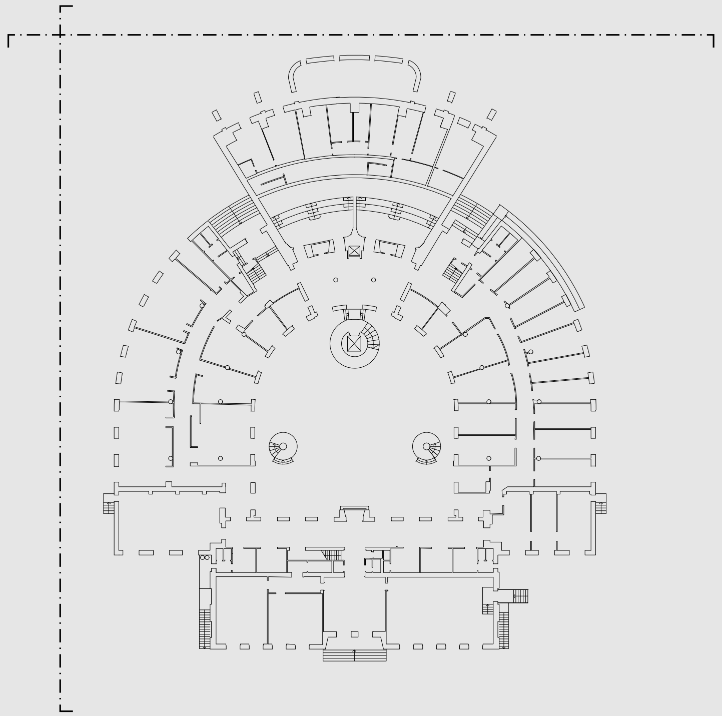

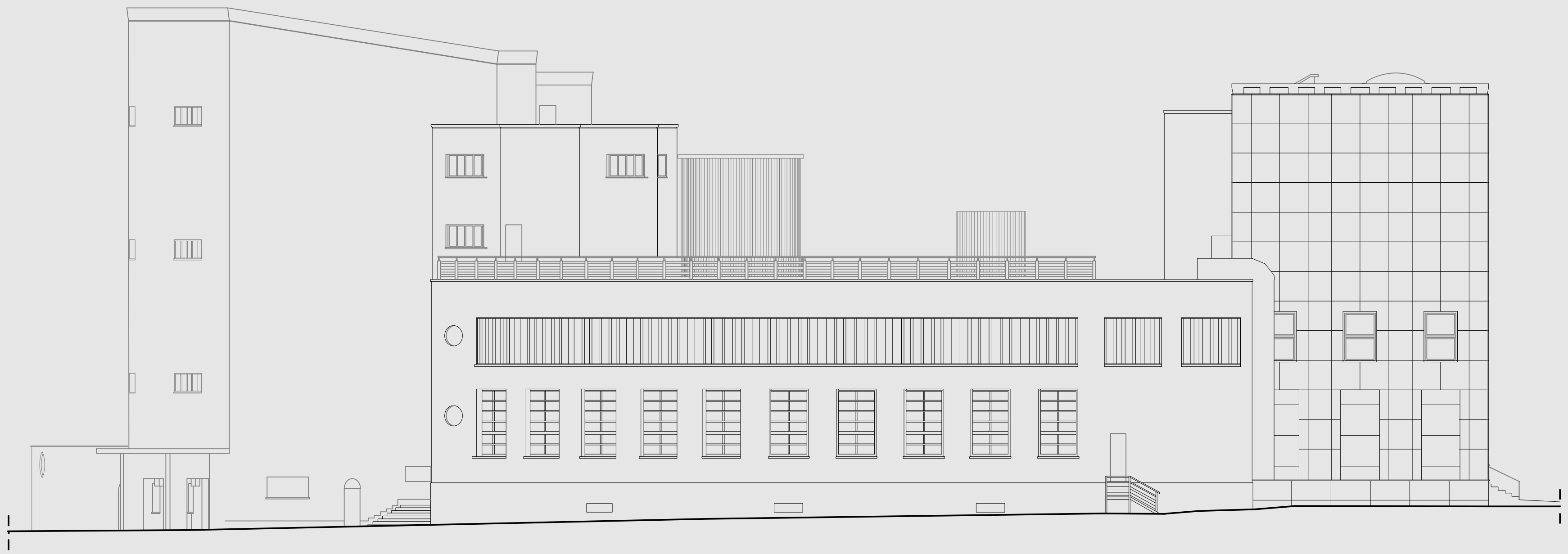

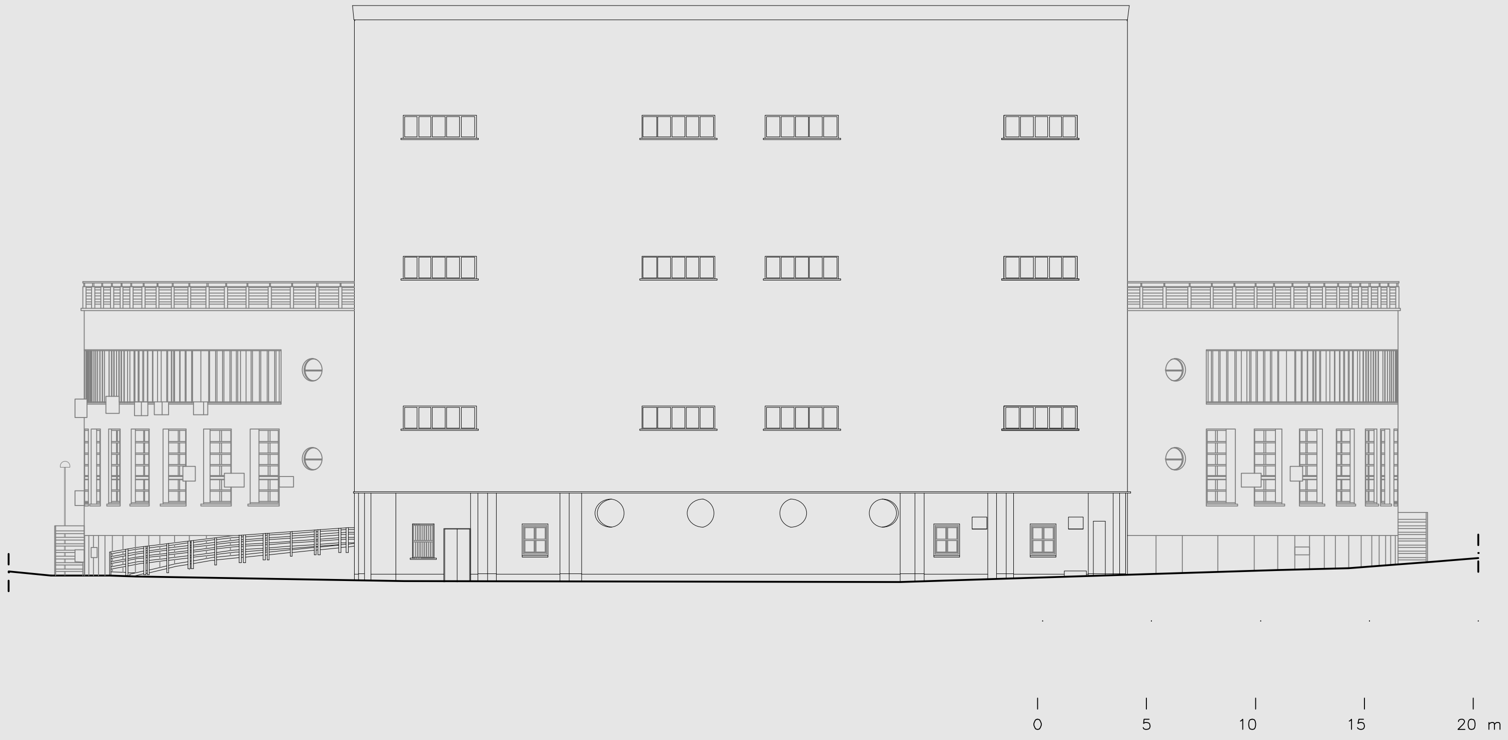
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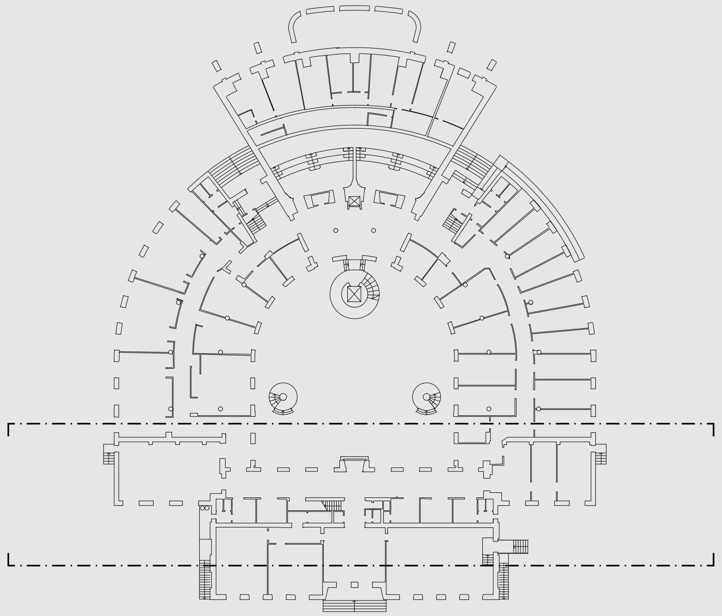

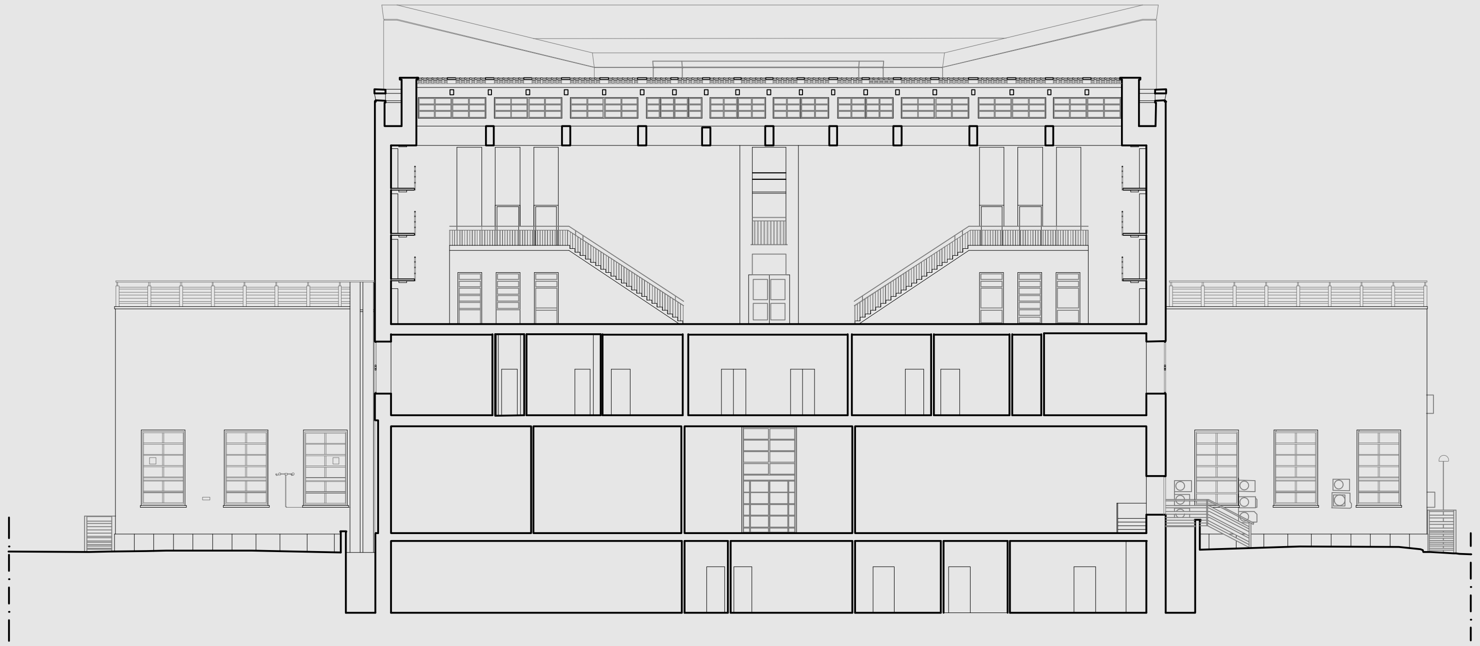

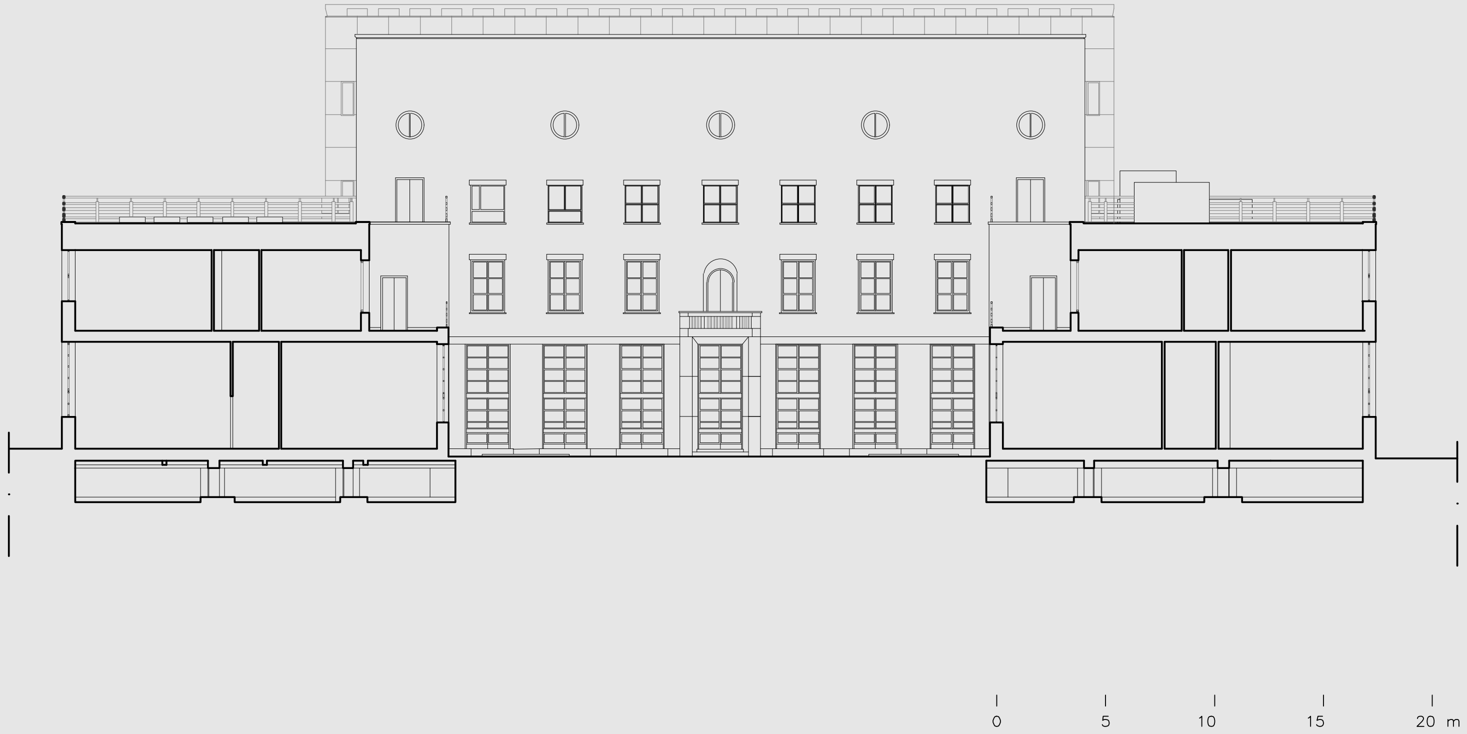
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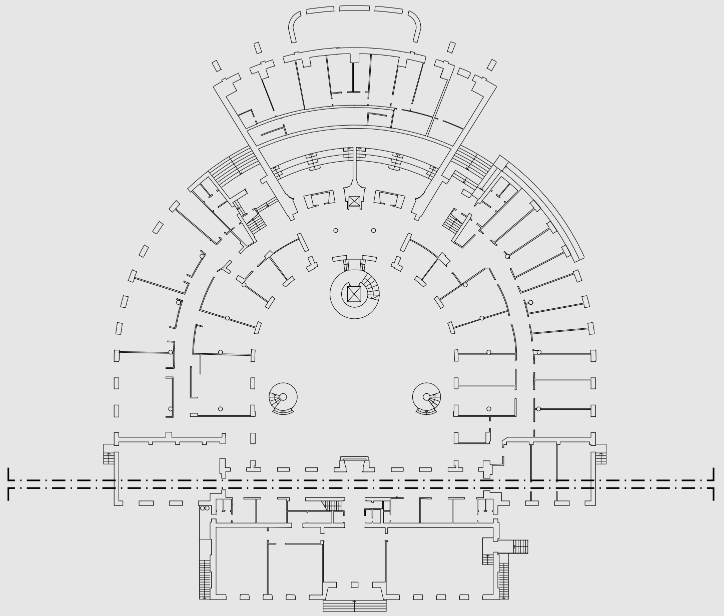

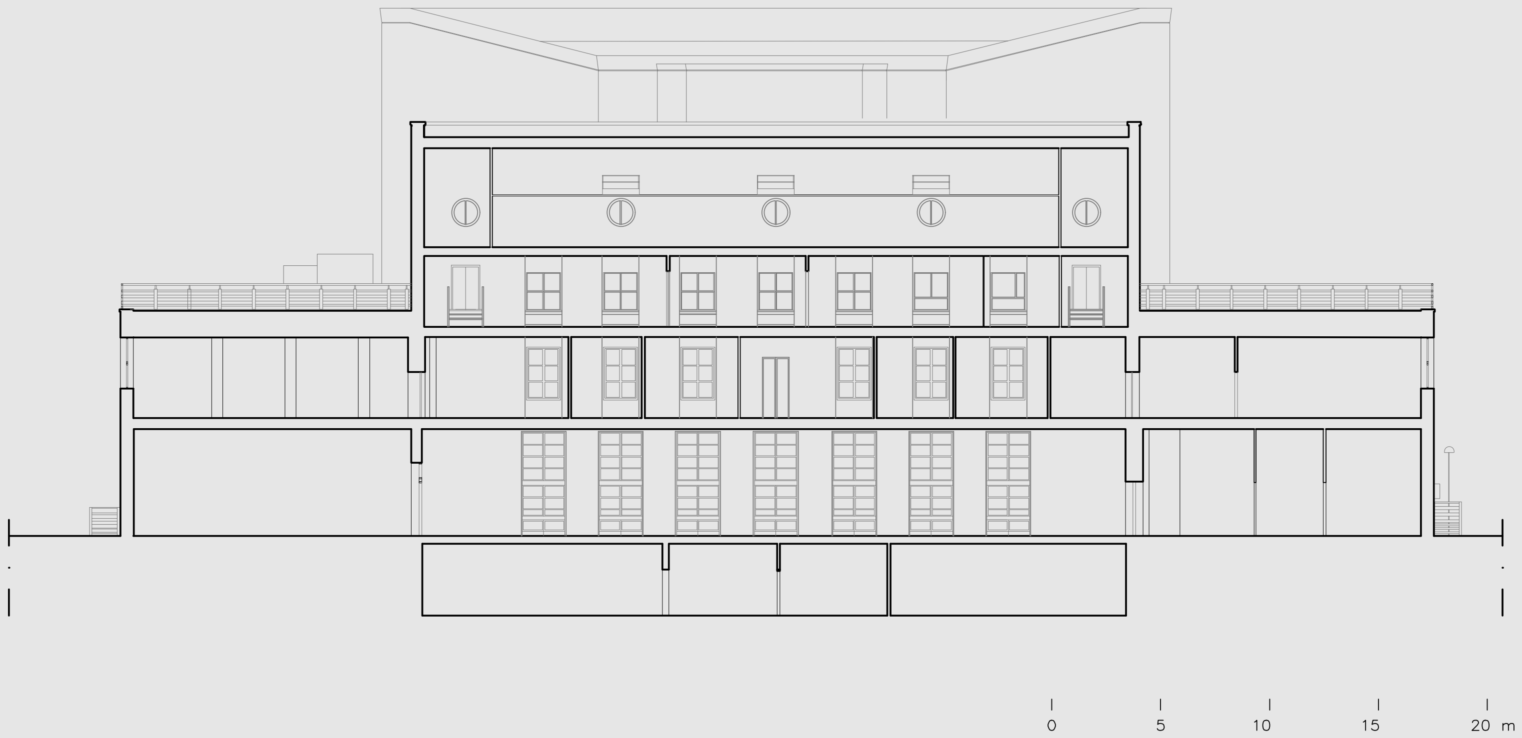
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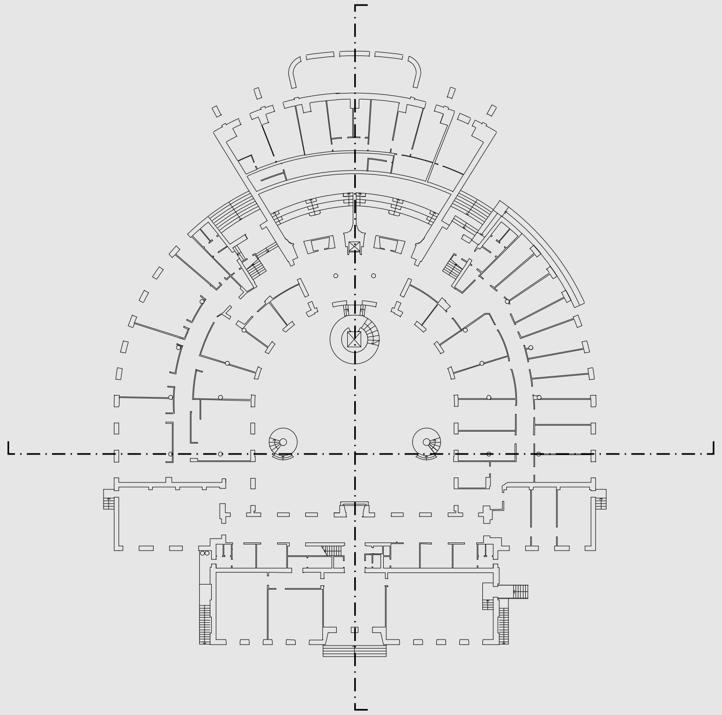

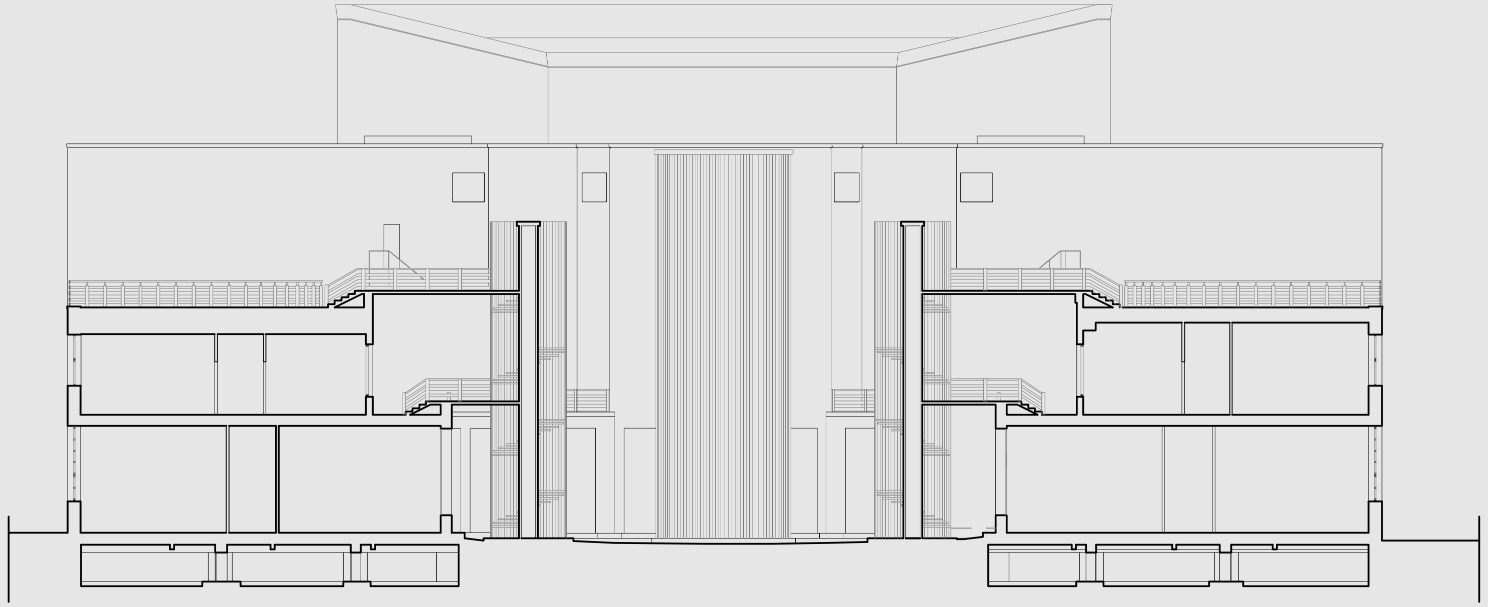

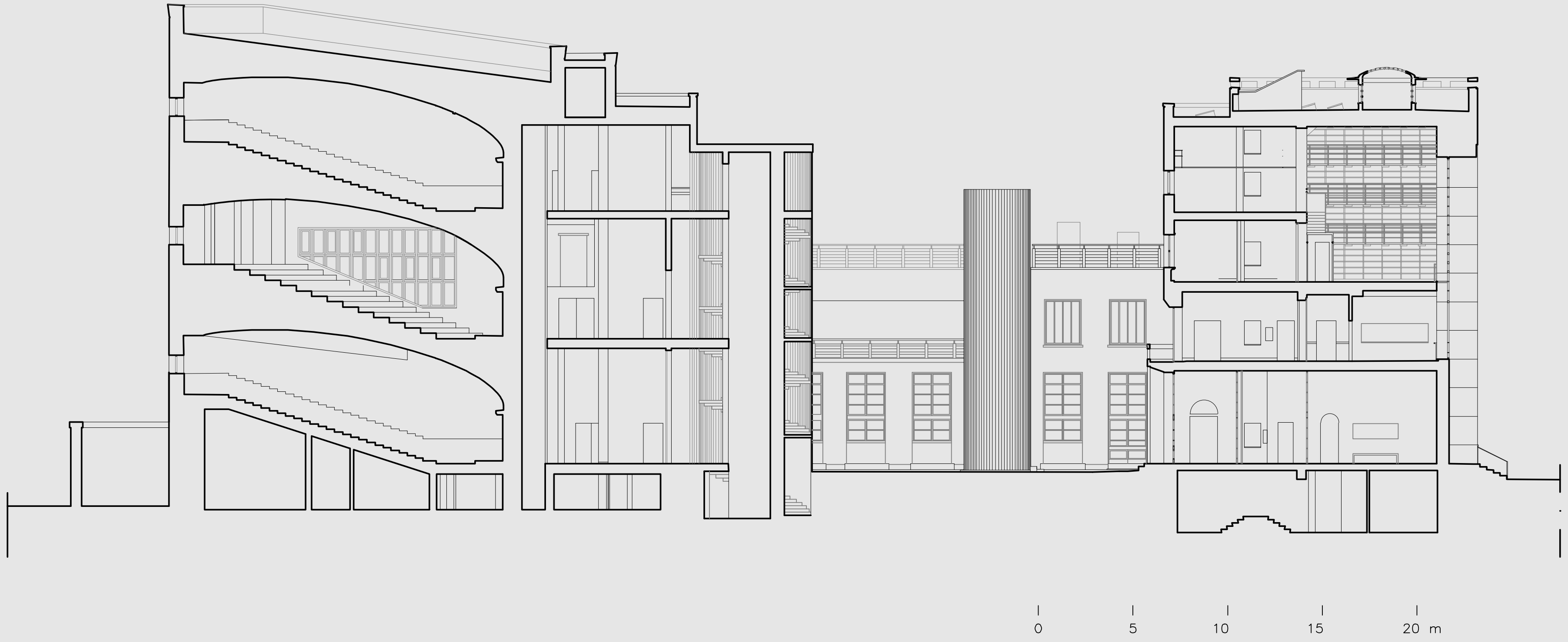
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MATHEMATICAL MODELS

The need to create a 3D model of the entire building arises from the necessity to have a digital replica of the object examined, to which to refer all the considerations derived from the return of the survey and subsequent analysis. The choice has fallen on the NURBS modeling, which allows to describe each shape in a continuous way, through the parametric equations of the surfaces that compose it. The strategy adopted has served for the construction of the mathematical 3D model representative of the current state (2020). The model presents a high level of detail, both in the definition of the geometries and of the architectural elements of the covering. The approach to its construction is therefore confronted with the following issues: the redefinition of the concept of scale of digital models from the geometric and perceptual point of view; the quality and scientific rigour of information with respect to uncertainty; aspects related to the dissemination, interchange and use of heterogeneous data.

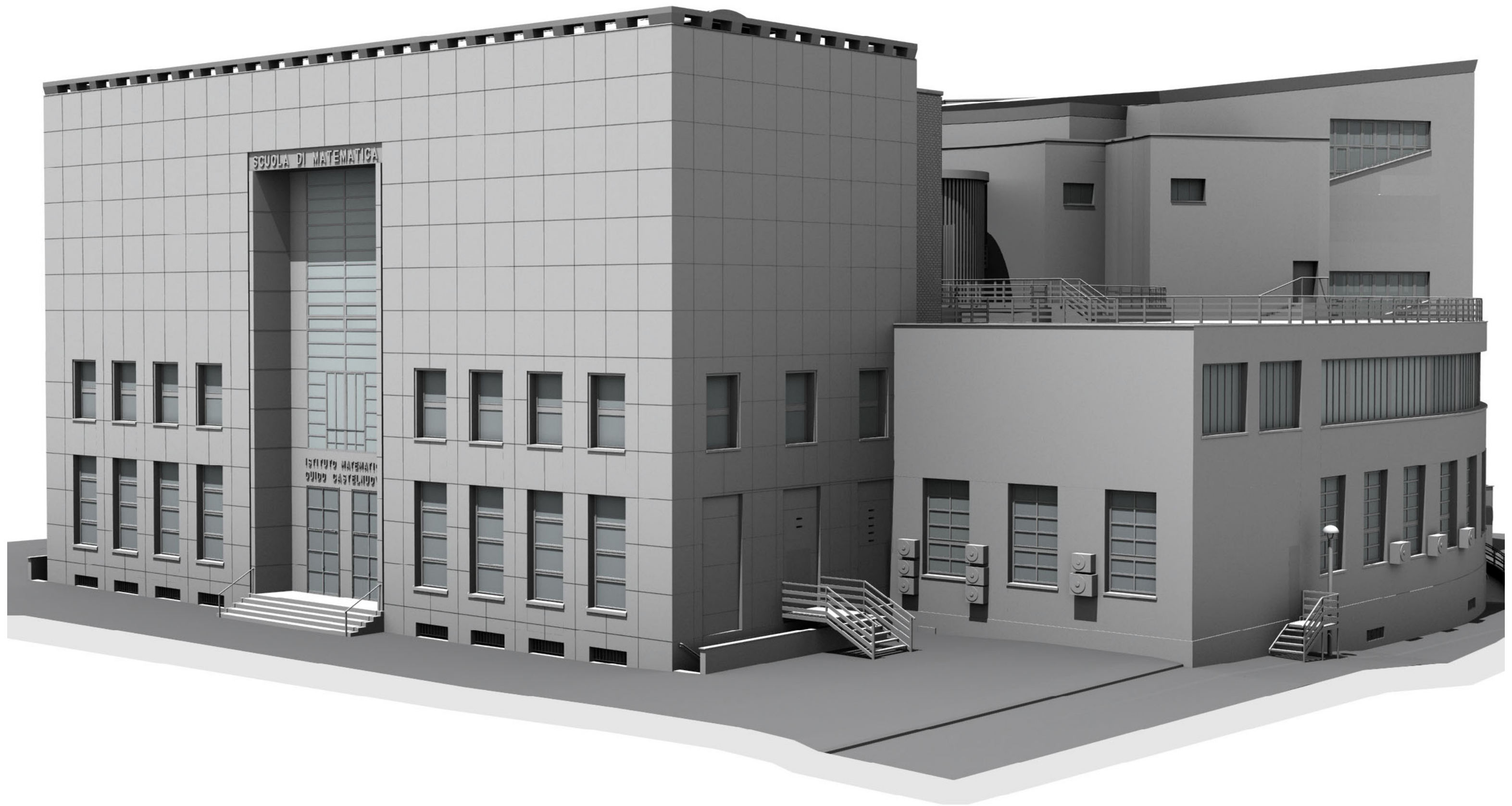

Figure 9 - 3D model (© Attenni 2020)

DATA COMMUNICATION/DATABASE CONSTRUCTION

The need to integrate the results obtained from the work of the various scholars involved in the research project guided the decision to include different types of products in a database. The current mode of communication, now almost totally free from paper and increasingly linked to the use of digital media have favoured the use of a platform capable of containing heterogeneous data. The 3D PDF, currently being defined, allows to connect the large amount of information to interactive 3D models, which you can explore, navigate, measure. The chosen system allows to collect and systematize the contents and the information with respect to the results of the research so far obtained, but it also allows to implement them in the course of time.

The models made are not only the starting point for the collection of information on different aspects of the building, but also the node that connects the past, through links to the classification of historical and archival material, the present, through the survey data and the analytical documentation of the actual state, and the future, through the drafting of a programmed conservation plan for which the aspects discussed above are essential (Bianchini 2016, pp. 115-130).

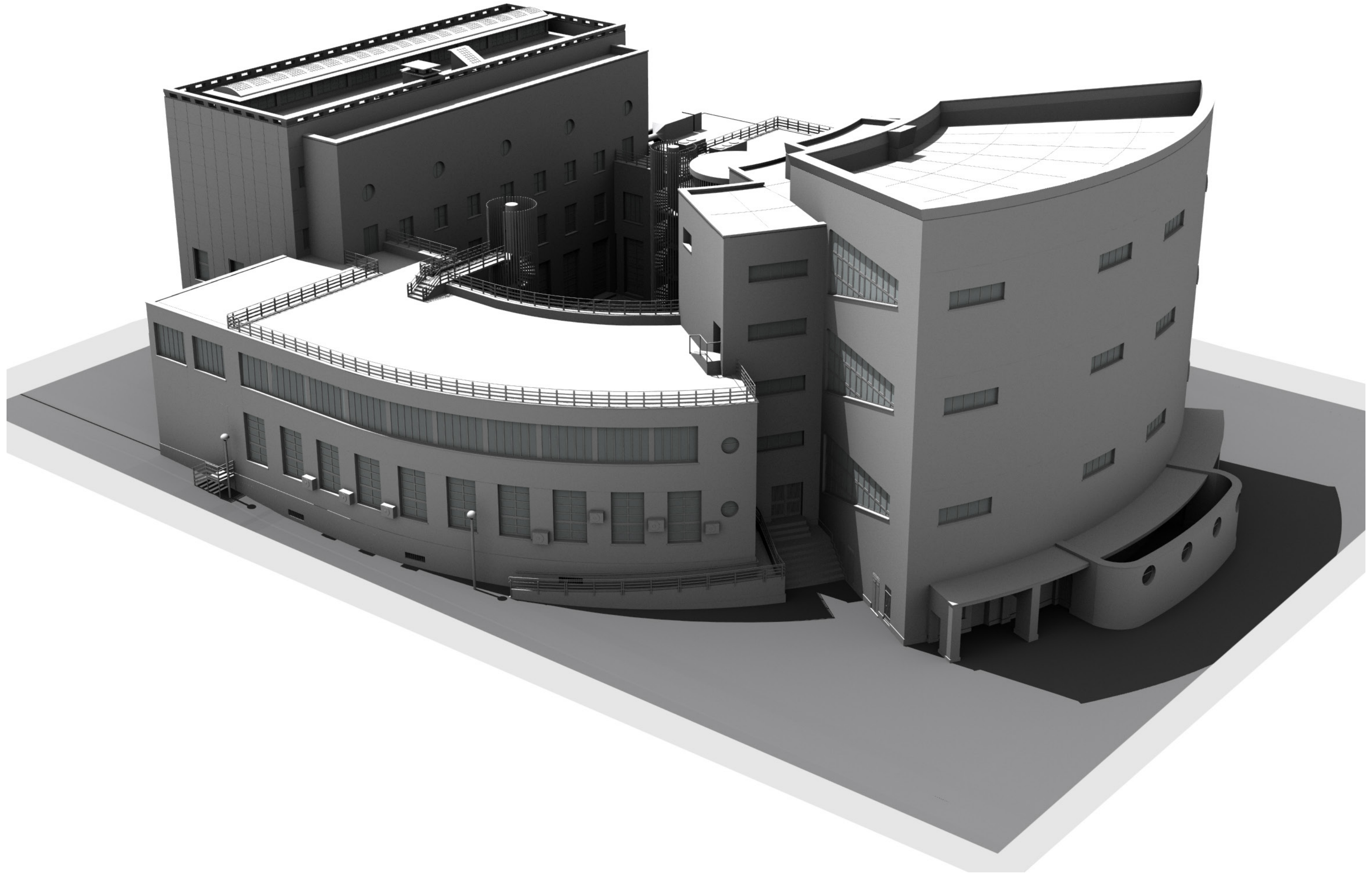

Figure 10 - 3D model (© Attenni 2020)

NOTES

1. Drawings at 1: 100 scale include plans of all levels, four elevations, nine sections and three section sketches; drawings at scale 1:50 include excerpt of all levels north and east elevation and six vertical sections; drawings at 1:20 scale include details of ground floor window, first and second floor window, ground floor entrance doors, portion of the crowning of the concrete coverage, window courtyard ground floor level, excerpt courtyard from the ground floor level to the coverage, library handrail.

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THE LOAD-BEARING STRUCTURE
Laura Liberatore, Luigi Sorrentino, Giuseppe Lanzo, Ilaria Martella

DESCRIPTION OF THE STRUCTURAL LAYOUT
Laura Liberatore, Luigi Sorrentino

As mentioned, the building is composed of three juxtaposed volumes, all of which founded on concrete piles connected by footings. The load-bearing system consists of reinforced concrete frames, infilled with unreinforced masonry walls.

In historical documents, the building is described as one of the smallest of the university campus but characterized by a "complicated reinforced concrete structure", referred to both the curved wings and the tower of classrooms. It is worthwhile reminding that an unreinforced masonry structure was envisaged at the beginning of the design process, subsequently replaced by a reinforced concrete one. The continuous support that would have been provided by unreinforced masonry walls was therefore replaced by point supports (columns), with obvious modifications of the load paths and of the way in which loads are transferred to the soil.

With time, the building has gone through several modifications. In 1939 the curved wings were partially raised; in 1954 a slab was introduced to divide the triple height of the library reading room and separate the so-called "professors' atrium" at the lower level; during the 1970s two new blocks were built as an extension of the curved wings close to the front building; in the 1980s three cylindrical fire-escape staircases were built inside the courtyard. The addition, removal and replacement of partition walls have also contributed to the continuous transformation of the building.

Albeit the entire structure mainly consists of reinforced concrete frames, each block – front building, curved wings and tower of classrooms – has its structural peculiarities. In the following, the foundation system and the structural layout of each block are described. Some details on additions, fire-escape staircases and infill walls are also given.

Foundations

During the design process, the use of different foundation systems was discussed, including timber piles and pier foundations. The latter were considered a more reliable system not requiring highly specialized skills. And in fact, a number of buildings in the proximity of the university campus are built on piers. Nonetheless, their use was set aside due to the poor soil characteristics encountered, i.e. the low stiffness, the significant inhomogeneity and the presence of the water table at about 12 meter depth from the ground surface.

The foundation was finally built with cast in place concrete piles and footings. Three types of piles were adopted, namely "Simplex" (simple or tamped), "Duplex" and "Triplex".

The Simplex pile is formed by driving a casing with a shoe (driving tip) into the ground down to the required depth. The concrete is cast into the shell, which is then slowly withdrawn. The shoe can be either left

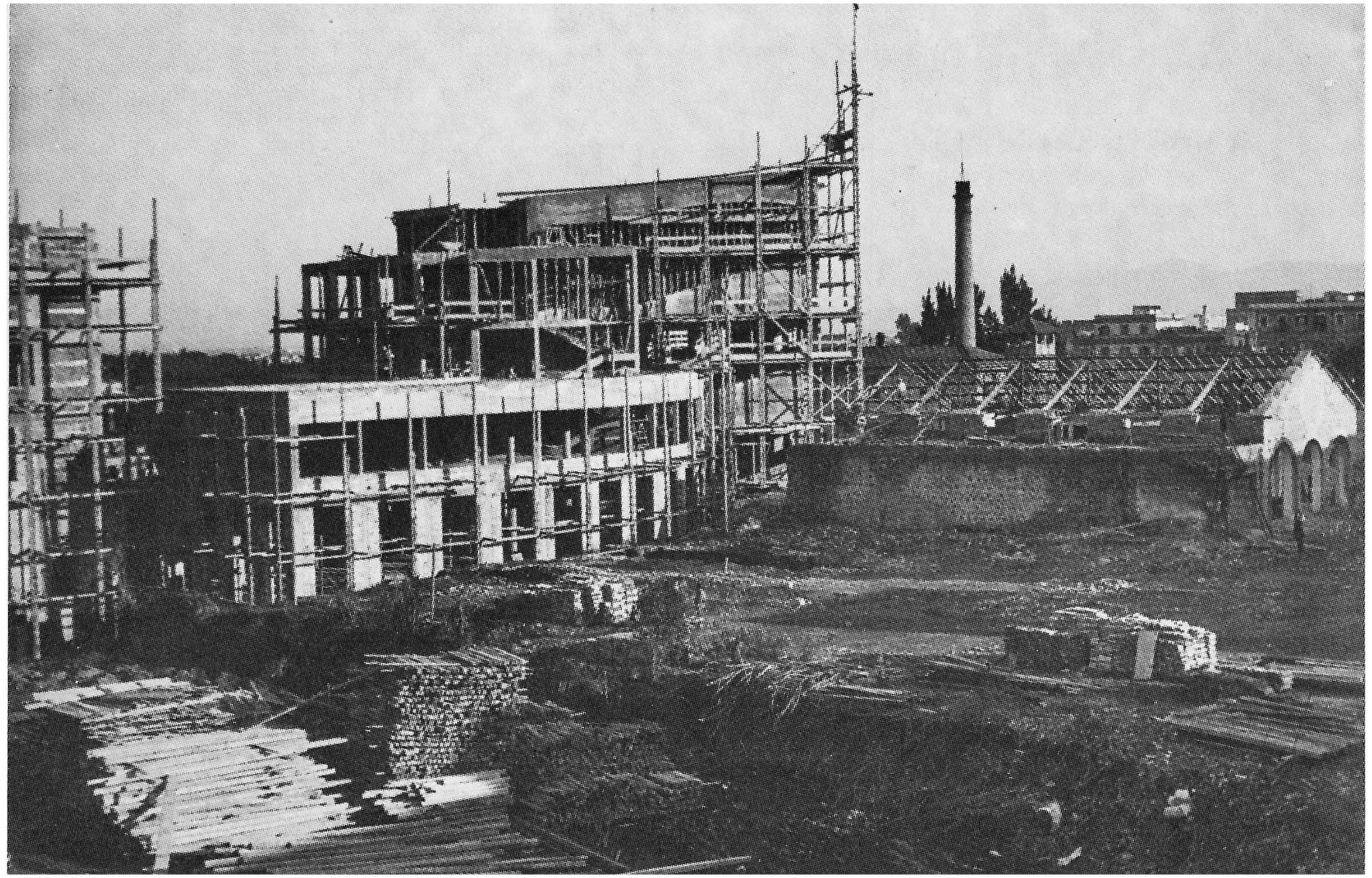


Figure 1 - The building under construction in a picture of 1935 (BBL_pht_10)

in the ground or retrieved together with the casing according to the shoe type; it is unclear which type was adopted in the School of Mathematics. In the tamped Simplex pile, the casing is struck with a hammer at short intervals as it is withdrawn, thus vibrating and tamping the concrete. The Duplex pile is produced by driving again the casing into the concrete. In this way, the concrete is forced to expand, thus compacting the ground laterally. Finally, the Triplex pile is obtained by repeating this operation once again. Steel bars may be inserted in the concrete for the entire pile length or for a portion. According to historical documentation (ASS_dcm_16), the upper 2,5 meters of the piles were reinforced with steel bars.

Based on a drawing dated 1934, the total number of piles is 580, distributed as reported in Table 1. The pile lengths vary between 14,0 meters to 17,5 meters. The location and type of piles were set based on both the intensity of gravity loads (larger under columns, stairs) and the inhomogeneity of the soil mechanical characteristics. A thickening of the Triplex piles is observed at the north-northeast side of the building. Detailed calculation of the concrete quantity used for the pile construction, which is provided in the “Costs analysis” developed by the firm Adriani entrusted with the construction of the building (ASS_dcm_26), allows to determin their diameter, which is equal to 400 millimeters for the Simplex piles, 570 millimeters for the Duplex and 700 millimeters for the Triplex.

Footings connect the columns and spread their load to the piles. The lying depth of the foundation of the front building is about 1.3 meters below that of the rest of the building. In fact, the basement level of the front building once hosted technical and storage rooms (today partially converted into IT laboratories). In some historical pictures a portion of the building footings is visible (BBL_pht_08). Width and depth of the footings change according to the column layout and to the applied loads. Minimum width is 1 meter, while maximum width (under the columns of the tower of classrooms) is about 3 meters. The depth is 0.6

Pile type	Front building	Curved wings	Tower of classrooms
Simplex	123	170	247
Tamped Simplex	12	14	0
Duplex	10	10	4
Triplex	14	6	0

Table 1 - Number of foundation piles according to drawing ASS_drw_41 dated 1934

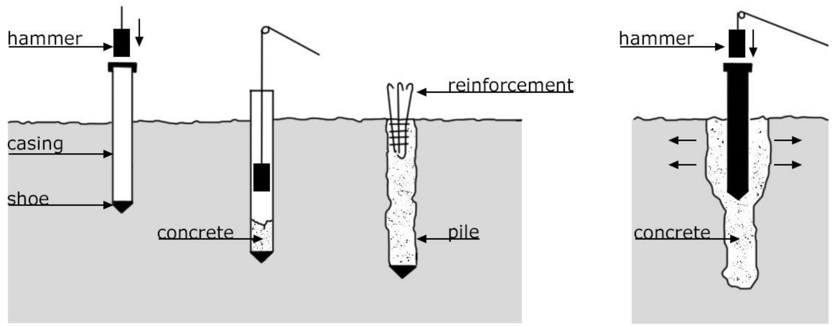


Figure 2 - Foundation piles: a) tamped Simplex; b) Duplex (© Martella 2020)

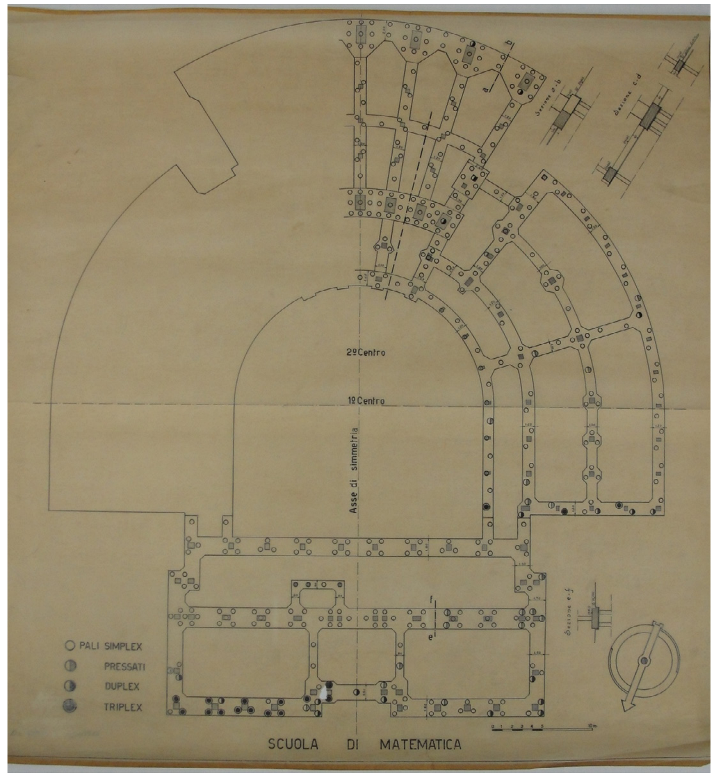


Figure 3 - Plan of the foundations as of February 21, 1934 (ASS_drw_41)

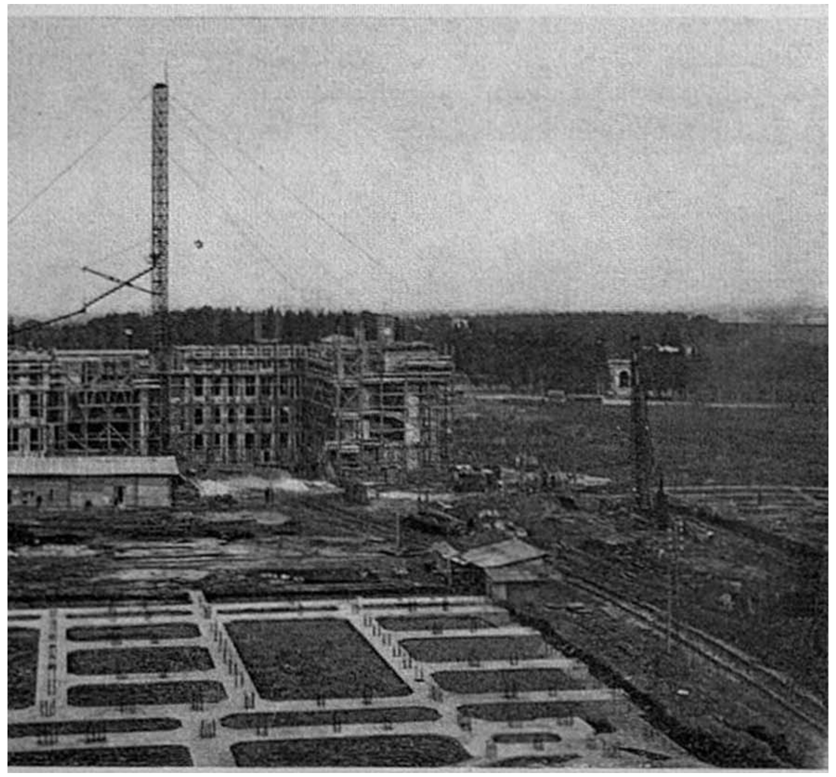


Figure 4 - The construction site of the university campus in a picture of the time; a portion of the footings of the School of Mathematics is visible on the right (BBL_pht_08)

meters except for the footings under the big columns of the tower, which are 0.8 meters deep.

Concerning the additions, deep reinforced concrete footings and beams are visible. Moreover, according to available documentation (ASS_dcm_299), drilled piles (diameter of drill 800 millimeters) were produced. No data were retrieved on the foundation of the three staircases placed in the courtyard in the 1980s.

Front building

Notwithstanding the apparent simplicity of the front building, which at first sight could seem regular both in plan and in elevation, several structural peculiarities characterize this part of the architectural composition. First of all, the presence of misaligned beams- i.e. beams not converging to a column- is observed at the basement level. This peculiarity may be ascribed to the different arrangement of the columns of the main façade, of the central alignment and of the courtyard façade, which is due to the different location of the windows on the two opposite façades.
Another structural specificity concerns the double height of the library reading room. The central part of this room consisted of a triple-height until 1954, when a slab was inserted to isolate the underlying atrium.

The wide skylight placed on the roof represents another distinctive trait of the building. It was built in reinforced concrete linear elements supporting a glass brick vault. The structural layout of the roof slab is still uncertain due to presence of a false ceiling, which does not allow direct inspection of the situation. However, according to the historical documentation, this was built as a ribbed reinforced concrete slab, while hollow block ribbed reinforced concrete slabs were built at the intermediate levels.

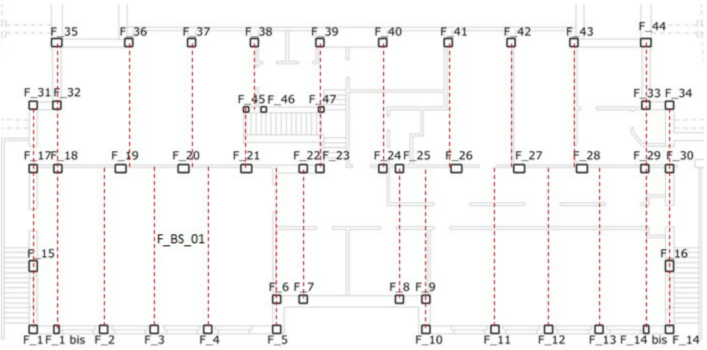


Figure 5 - Basement level of the east addition (© Liberatore 2020)

Figure 6 - Basement level of the front building, room F_Bs_01 (© Sorrentino 2020)

Figure 7 - Basement level of the front building, red dotted lines represent the presumed disposition of transversal beams (© Martella 2020)

Figure 8 - Slab between the "Atrio dell'appartamento dei professori" and the library reading room (© Salvo 2020)

Figure 9 - The skylight of the library reading room: view from a lateral window (© Liberatore 2020)

Curved wings

The curved wings consist of two levels above ground, the upper one having a narrower width than the lower. The slabs are supported by columns having rectangular or circular cross sections. More specifically, the external columns, i.e. those along the perimeter of the wings, have a rectangular cross section while the internal columns, arranged along two alignments, have a circular cross section. At the basement level, all the columns have rectangular cross section.

In a drawing dating back to 1933, five circular columns are reported for each internal alignment. While the pile foundations were designed and built accordingly, only four columns were actually built, as shown in a 1935 drawing. To limit the stress increase on the soil under the columns close to the missing one, a cruciform column was added in the basement where the upper levels column is missing. This reduction of the number of columns might explain their slight vertical misalignment between basement and ground level highlighted in Figure 12 a and b. Probably, in order to compensate the lack of alignment of the columns an additional beam runs parallel to the one centered on the basement columns.

The slabs at the first and second levels are different to one another. In fact, the first level slab is characterized by a particular arrangement of skewed beams, as shown in Figure 13, whereas at the first level a more conventional slab supported by main curvilinear beams and transversal joists was built. The reason for such difference emerged from the analysis of historical documentation. At the ground level, in order to reduce the depth of the beams within the slab thickness (450 millimeters) skewed beams were used to transfer the vertical loads directly to the columns. In addition, mixed steel-reinforced concrete beams were adopted with special clay blocks of 600 millimeters (width) x 400 millimeters (depth). These blocks are also mentioned in administrative documents dated 1938 and 1939 illustrating the work of the companies “Vinaccia”

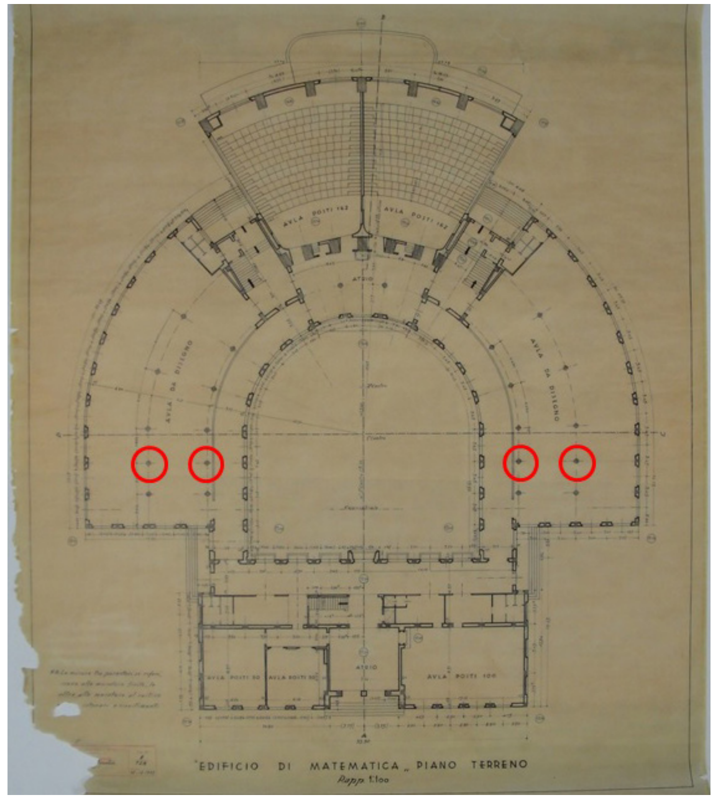


Figure 10 - Plan of the ground level as of December 18, 1933 (ASS_drw_25). Columns highlighted with red circles are not present in a drawing dated 1935 as well as in the building

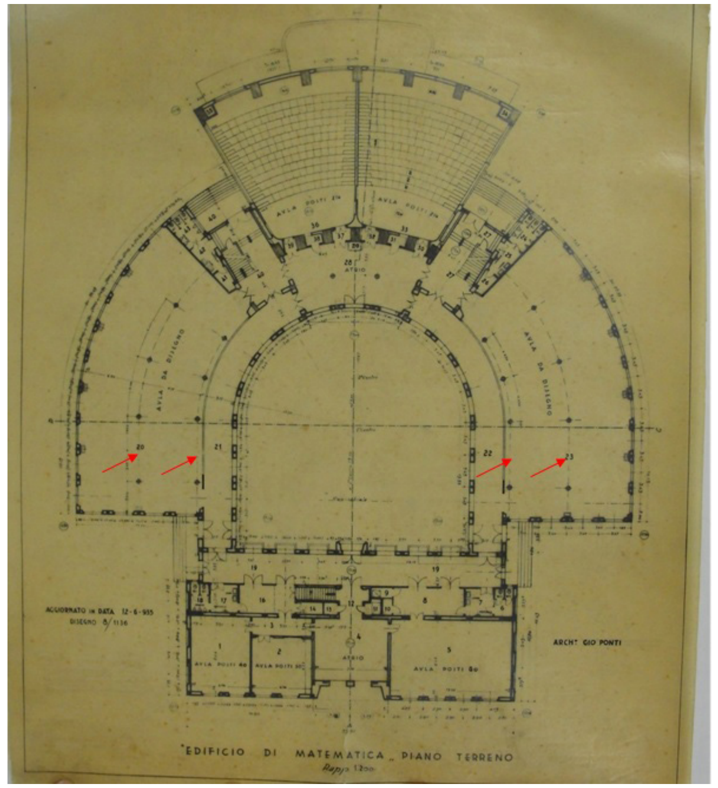


Figure 11 - Plan of the ground level as of June 12, 1935 (ASS_drw_70). Locations in which additional columns were planned in 1933 are highlighted with red arrows

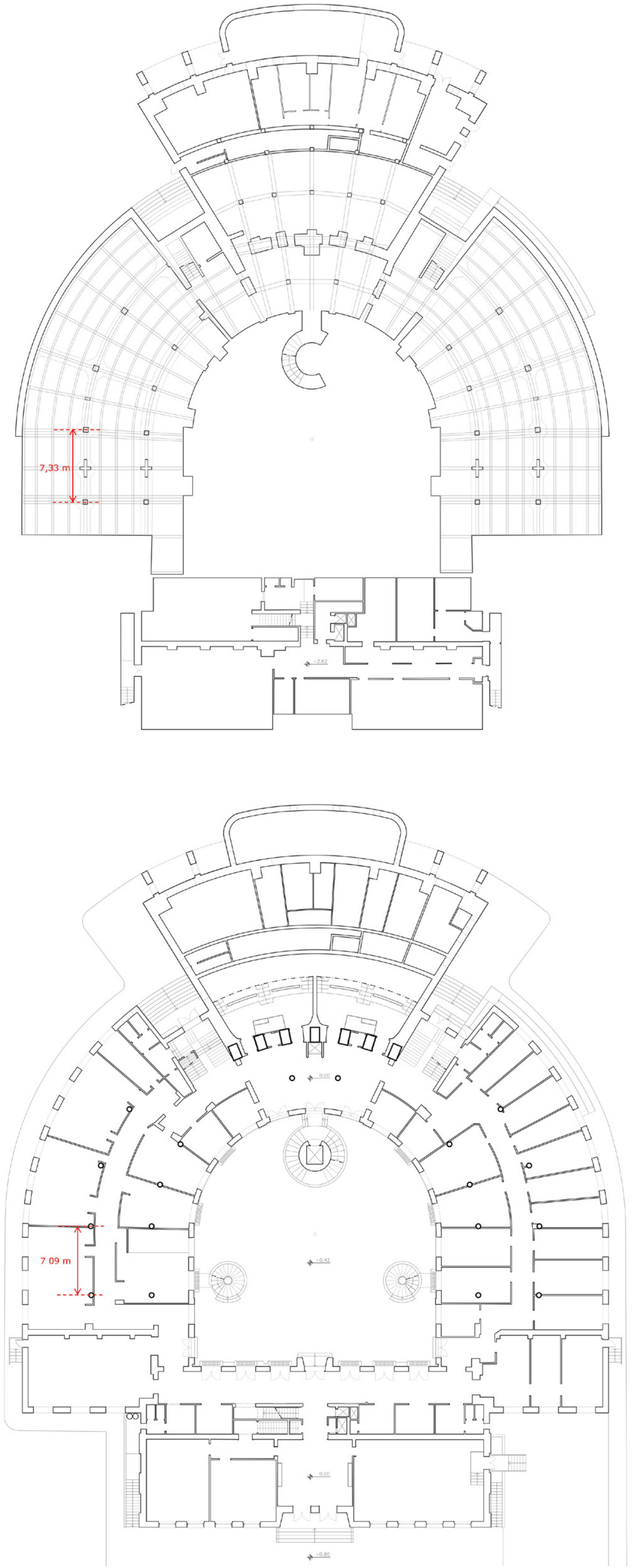


Figure 12 - Front part of the east wing: a) basement level; b) ground level (© Martella 2020)

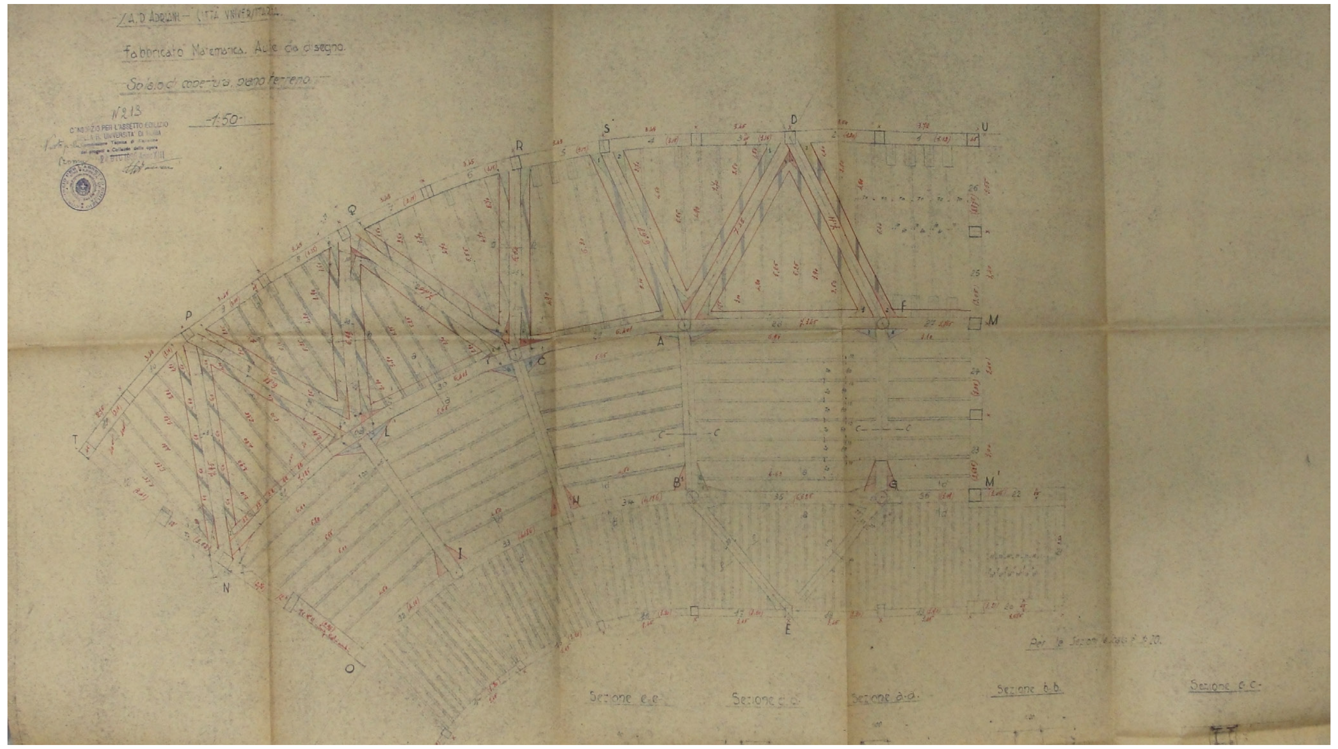
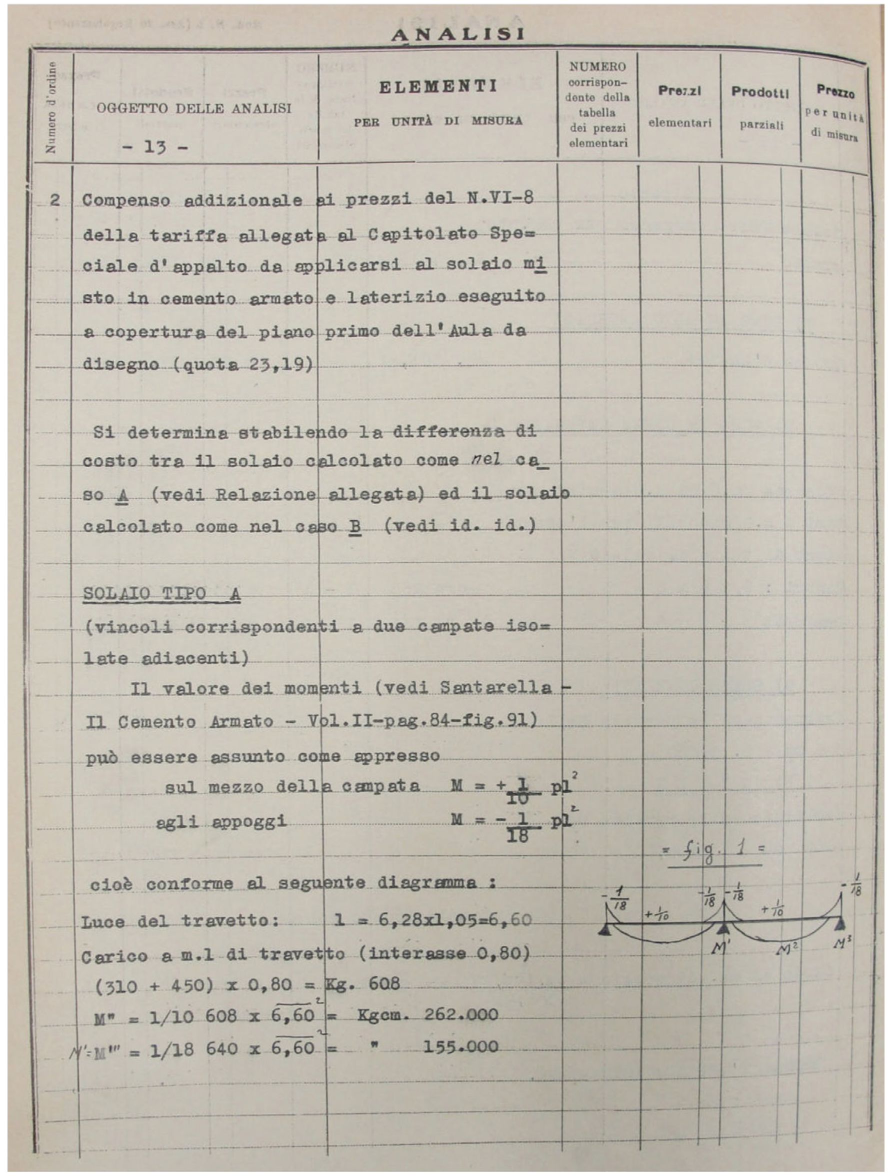


Figure 13 - Ground-level slabs of the curved wings in a drawing produced by the company Adriani as technical administrative documentation of the construction site, as of June 24, 1935 (ASS_drw_60)

Figure 14 - A view of the ground level of the west wing in the original configuration (ACS_pht_15)

Figure 15 - An advertisement of the bricks produced by the company Frazzi and used to build the slabs (BBL_pht_23)



ANALISI

Numero d'ordine	OGGETTO DELLE ANALISI - 13 -	ELEMENTI PER UNITÀ DI MISURA	NUMERO corrispondente della tabella dei prezzi elementari	Prezzi elementari	Prodotti parziali	Prezzo per unità di misura

2 Compenso addizionale ai prezzi del N.VI-8 della tariffa allegata al Capitolato Speciale d'appalto da applicarsi al solaio misto in cemento armato e laterizio eseguito a copertura del piano primo dell'Aula da disegno (quota 23,19)

Si determina stabilendo la differenza di costo tra il solaio calcolato come nel caso A (vedi Relazione allegata) ed il solaio calcolato come nel caso B (vedi id. id.)

SOLAIO TIPO A

(vincoli corrispondenti a due campate isolate adiacenti)

Il valore dei momenti (vedi Santarella - Il Cemento Armato - Vol.II-pag.84-fig.91) può essere assunto come appresso

sul mezzo della campata $M = +\frac{1}{10} pl^2$

agli appoggi $M = -\frac{1}{18} pl^2$

= fig. 1 =

cioè conforme al seguente diagramma :

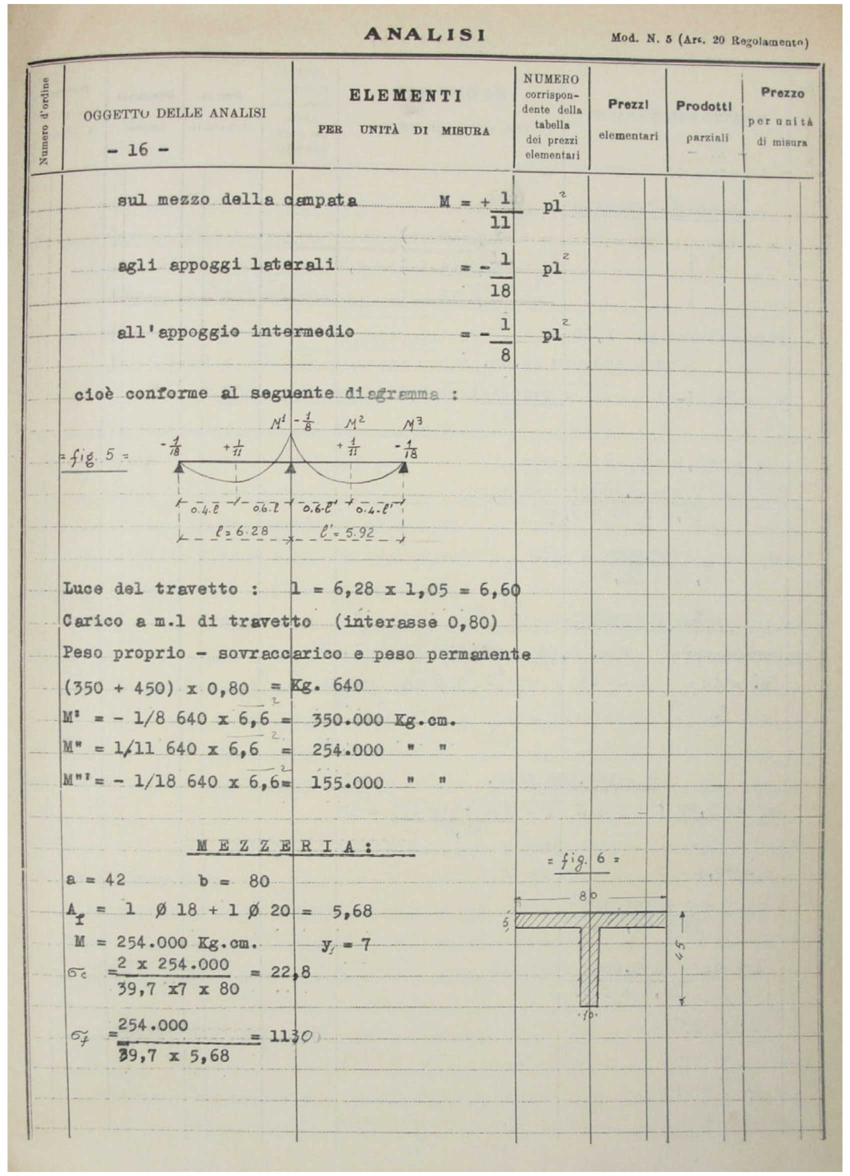
Luce del travetto: l = 6,28x1,05=6,60

Carico a m.l di travetto (interasse 0,80)

(310 + 450) x 0,80 = Kg. 608

M" = 1/10 608 x $\overline{6,60}^2$ = Kgcm. 262.000

M'=M''' = 1/18 640 x $\overline{6,60}^2$ = " 155.000



ANALISI

Mod. N. 5 (Art. 20 Regolamento)

Numero d'ordine	OGGETTO DELLE ANALISI - 16 -	ELEMENTI PER UNITÀ DI MISURA	NUMERO corrispondente della tabella dei prezzi elementari	Prezzi elementari	Prodotti parziali	Prezzo per unità di misura

sul mezzo della campata $M = +\frac{1}{11} pl^2$

agli appoggi laterali $= -\frac{1}{18} pl^2$

all'appoggio intermedio $= -\frac{1}{8} pl^2$

cioè conforme al seguente diagramma :

= fig. 5 =

Luce del travetto : l = 6,28 x 1,05 = 6,60

Carico a m.l di travetto (interasse 0,80)

Peso proprio - sovraccarico e peso permanente

(350 + 450) x 0,80 = Kg. 640

M' = - 1/8 640 x $\overline{6,6}^2$ = 350.000 Kg.cm.

M" = 1/11 640 x $\overline{6,6}^2$ = 254.000 " "

M''' = - 1/18 640 x $\overline{6,6}^2$ = 155.000 " "

MEZZERIA:

= fig. 6 =

a = 42 b = 80

A_f = 1 Ø 18 + 1 Ø 20 = 5,68

M = 254.000 Kg.cm. y_1 = 7

$\sigma_c = \frac{2 \times 254.000}{39,7 \times 7 \times 80} = 22,8$

$\sigma_f = \frac{254.000}{39,7 \times 5,68} = 1130$

Figure 16- A view of the first level of the west wing in the original configuration (ACS_pht_14)

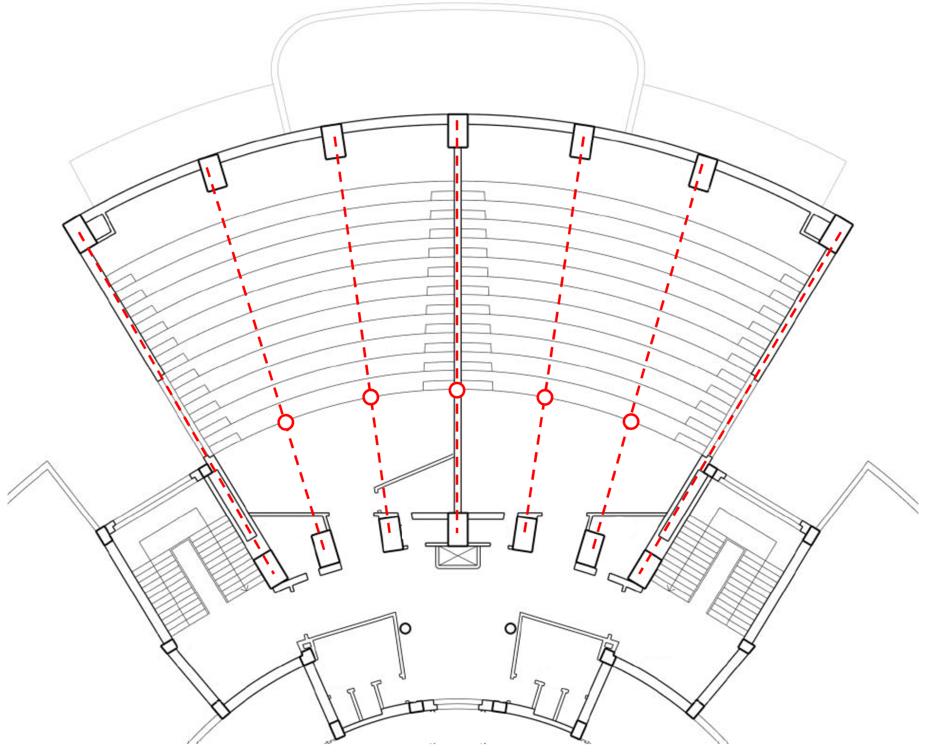
Figure 17 a/b - First level of the curved wings: a) initial static schemes of the joists; b) joists cross section and modified static scheme as reported in a historical report (ASS_dcm_56).

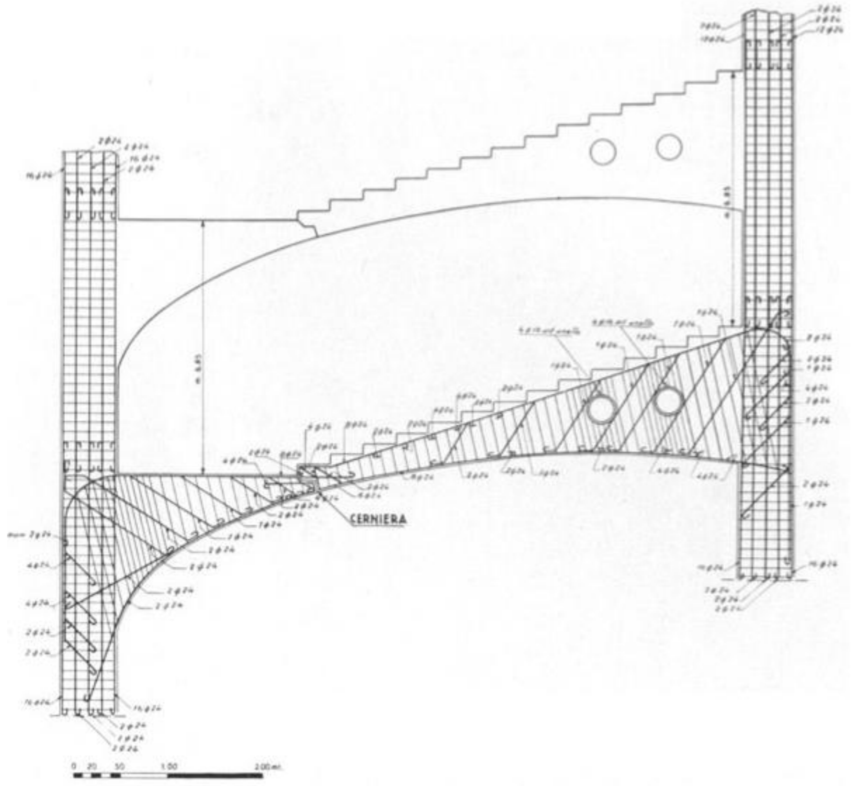
and "Frazzi". At the upper level, a different solution is adopted. The central curvilinear beam is thicker, as clearly visible from historical photographs. The increased size allowed adopting a more conventional system with secondary beams supported by the main beams. The thickness of the slab is 450 millimeters, and the same blocks of the bottom level are used. The static schemes used to design the joists, are included in a report dated March 25, 1935 (ASS_dcm_56). For such joists, a modified hypothesis in the flexural moment calculations brought to the increase of the reinforcing steel area.
Finally, as mentioned above, in the late 1930s the ground level of the curved wings was partially raised. More specifically, small portions close to the front building and overlooking the courtyard were built, as shown in Figure 18.

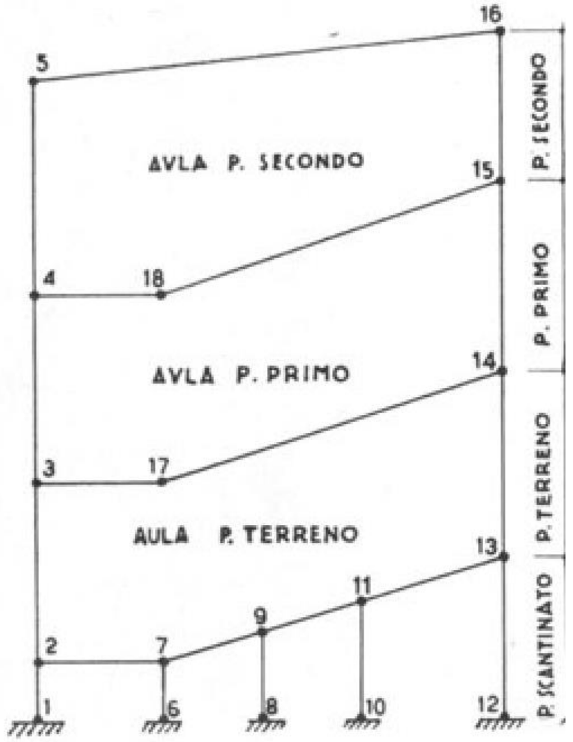
Tower of classrooms

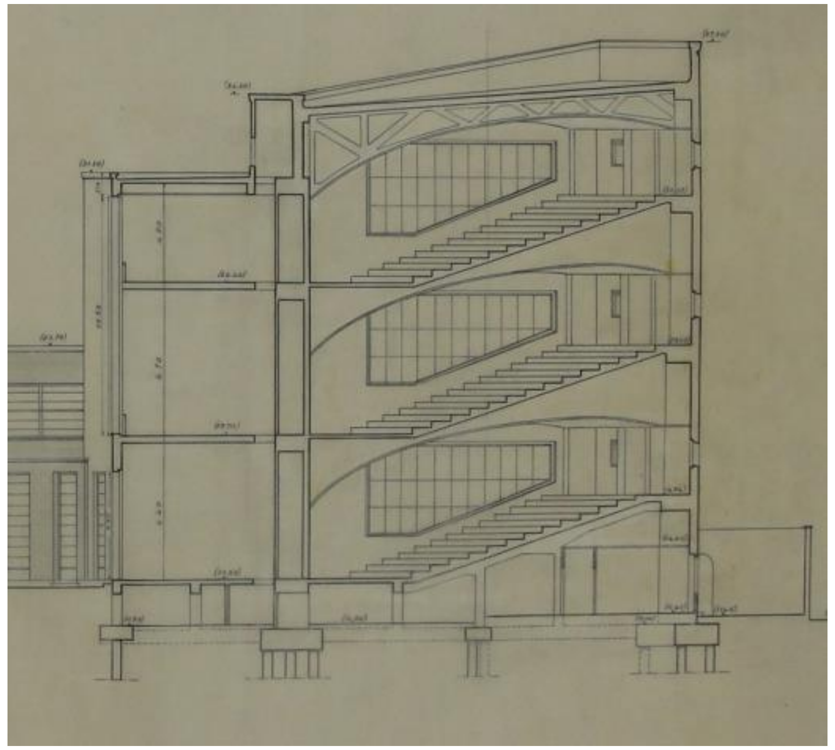
The tower of classrooms represents an interesting example of reinforced concrete structure and highlights the strong link between architectural and structural issues. This link, which is evident in this part of the building, shows the structural awareness of Ponti. For the design, the involvement of engineer Zadra- often recalled by Ponti for his contribution to the structural design of this part of the building- represents a rare case, if not unique, of collaboration during the construction of the university campus. Unfortunately, not much is known about this collaboration.
The structure is made of seven frames arranged in a radial manner. Large columns, having cross-sections dimension 0.9 meters x 1.5 meters, support 16-meters-span beams. The beams of the external frames are continuous, whereas the five internal beams of the first and second levels have an intermediate hinge at about one third of the beam length.
This solution allowed the reduction of the beams' depth at the hinge location. In addition, it permitted to define the bending moment distribution. This type of beams was most frequently adopted for bridges (Gerber girder).

Figure 18 - A view of the courtyard in the original configuration, before 1939 (ACS_pht_10)









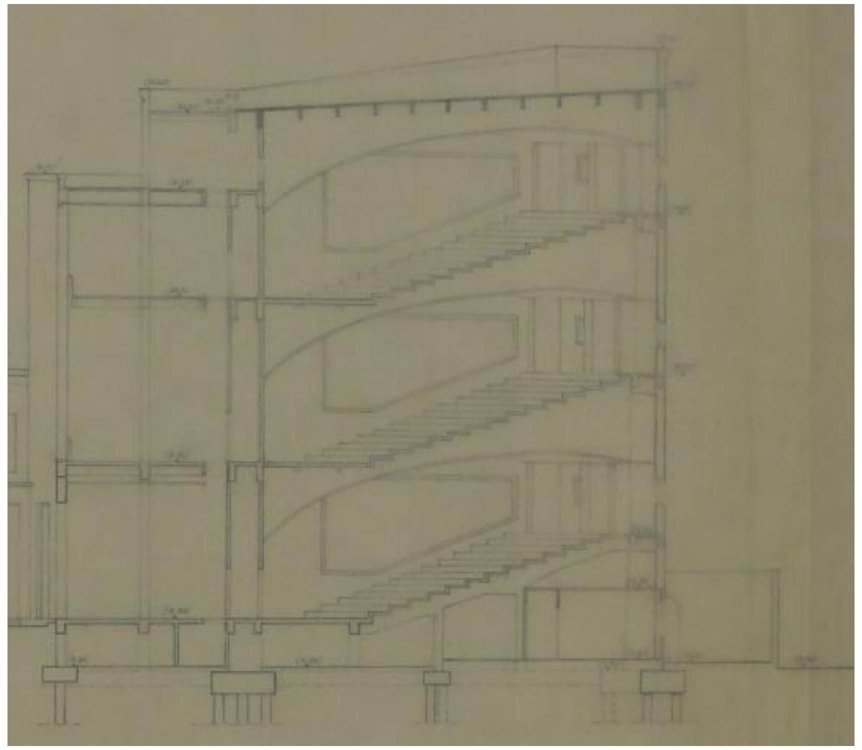


Figure 19 - Schematic representation of the beams at the intermediate levels of the tower of classrooms

Figure 20 a/b - Beams of the tower of classrooms as reported in the review “Architettura”, 1935 dedicated to the construction of the university campus: a) details on the reinforcement (BBL_drw_12); b) structural model of the frame (BBL_drw_11)

Figure 21 a/b - Excerpts from the sections of the tower of classrooms dated a) January 17, 1934 (ASS_drw_33) and b) May 22, 1935 (ASS_drw_58)

A sketch of the structural model shows an internal frame. At the basement level, two central additional columns were built to support the beams. At that level as well as at the roof level the beams are continuous, i.e. without the hinge. It is interesting to mention that in a 1934 drawing, a truss beam is present at the roof level, while none can be found in the building. Figure 22 a and b show partial views of the beams of the first level, while visible parts of the reinforced concrete roof beams are shown in Figure 22 c and d. In the direction transversal to the main beams, reinforced concrete or steel joists are observed. According to the historical documentation, such elements served to hang the curvilinear ceiling of the rooms.

In the area facing the classroom entrances, two circular columns are present. They are located so as to continue the ideal curvilinear line of the column of the wings that overlook the courtyard. Finally, adjacent to the tower of classrooms, there are two staircases that join the wings with the tower. Such stairs are supported by reinforced concrete columns and beams. In Figure 22 b one of such beams, adjacent to a curvilinear beam of the tower, is visible.

Figure 22 a/d - Structural elements of the tower of classrooms as seen from: a) first level, room T_Fr_10 (© Liberatore 2020); b) first level, room T_Fr_09 (© Liberatore 2020); c) third level, room T_Tr_06 (© Martella 2020); d) roof level, room T_Rf_01 (© Sorrentino 2020)

Added bodies and fire escape staircases

Two additions built between 1976 and 1979 consist of double-level volumes flanking the front building and in continuation of the the curved wing. Initially, a reinforced concrete structure was envisaged for these bodies (ASS_dcm_262), and in fact reinforced concrete elements (footings, columns, and beams) were used at the basement level, whereas rebar location testing and visual inspections have not highlighted the presence of steel at the ground and first levels. Nevertheless, according to a document dated February 28, 1981 (ASS_dcm_299), the firm CO.MA.GE entrusted with the construction of these additions, claimed to have used steel profiles IPE and HE instead of reinforced concrete elements. Infill cavity walls produced with concrete Leca-blocks and foundations on drilled piles are mentioned in the same document.

Figure 23 shows the basement level of the east addition, where it is possible to note the presence of a hollow block ribbed reinforced concrete slab. The point of contact between a beam of the addition and a beam of the wing is highlighted in Figures 23c, where a polystyrene sheet separating the two beams is visible. From the structural point of view, added volumes and curved wings are separated, although the absence of an adequate joint may represent a source of vulnerability in case of an earthquake.

The fire escape staircases built into the courtyard in the 1980s are made of steel. The central one, bigger than the lateral ones, has a reinforced concrete core, which encloses an elevator. A specific assessment of their structural behavior is not carried out in this study. They are structurally independent from the main buildings, i.e. the gravity loads are directly transmitted to the soil, with the exception of those related to the walkways, which are partially supported by the structures of the main building.

Figure 23 a/d - Views of the basement of the additions, seen from the east curved wing: a) and b) structural elements (© Liberatore 2020); c) detail of the junction between a beam of the addition and one of the curved wing (© Martella 2020); d) junction detail between a beam of the addition and the wall of the wing (© Liberatore 2020)

Figure 24 - One of the two minor lateral fire-escape staircases in the courtyard (© Sardo 2021)

Masonry infill walls

Masonry walls are present in the building as external infills and internal partitions. In the historical documentation, more specifically in the "Progress reports" of the works dating from December 28, 1934 to October 15, 1937, the following types are mentioned:

- tuff masonry with brickwork courses (998 m^3)
- rough-hewn tuff masonry (247 m^3)
- rubble core tuff masonry (35 m^3)
- solid clay brickwork with lime mortar (657 m^3)
- solid clay brickwork with cement mortar (68 m^3)
- single wythe solid clay brick masonry with lime mortar (2937 m^2)
- single wythe solid clay brick masonry with cement mortar (25 m^2)
- vertically-stacked solid clay brick masonry (1022 m^2).

Moreover, according to the "Terms of Contract" for the partial elevation of the curved wings, dated June 6, 1939 (ASS_dcm_211), the internal partitions used in drawing room III are made of vertically-stacked hollow clay bricks. In general, masonry types used to build the School of Mathematics are quite stiff compared to the infill panels adopted nowadays in Italy, which are often cavity walls made of hollow clay bricks.

The identification of each type of masonry within the building is not straightforward because the walls are mostly covered with plaster or brick ("lithoceramic") cladding. However, the following hypothesis can be made, some of which being corroborated by visual inspections:

- single wythe solid clay brickwork and vertically-stacked solid clay brick masonry are probably used as internal partitions;
- tuff masonry and multiple wythe solid clay brickworks are used at the basement level and as external walls.

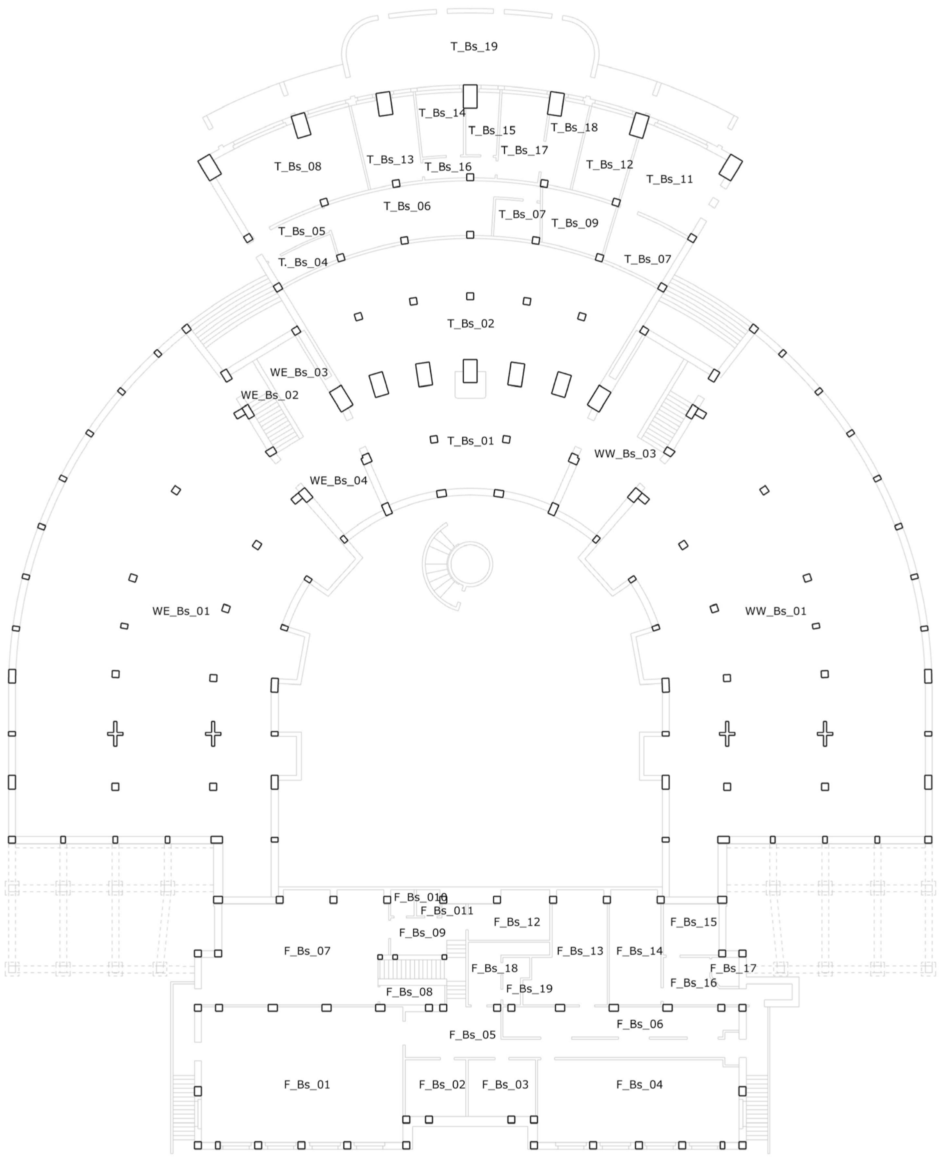
Figure 25 shows some examples: in Figure 25 a and b a solid brick masonry and a rough-hewn tuff masonry used at the basement level of the curved wings are visible; masonry wall made of solid clay bricks at the basement level of the tower of classrooms is shown in Figure 25 c; an enclosure wall at the roof level of the tower of classrooms made of tuff masonry with brickwork courses is shown in Figure 28d; the same masonry is also used at the first level.

Concerning the volumes added in the 1970s, according to the “Analysis of costs” dated September 1969 (ASS_dcm_264), and to a later document dated February 1981 (ASS_dcm_299), the use of the following types of masonry was envisaged:

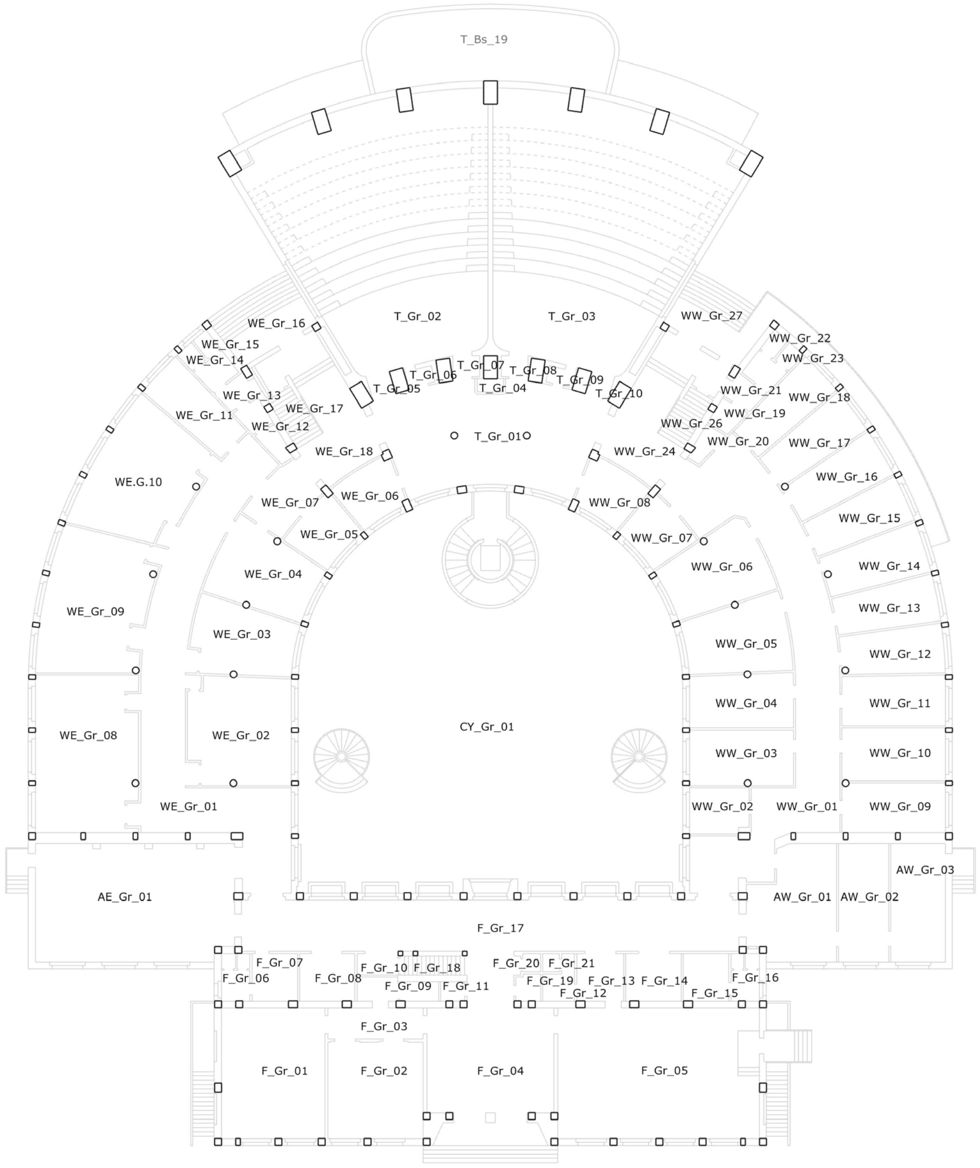
- clay brick masonry to fill the openings (windows/doors) of the existing walls;
- hollow clay brick masonry at the first level for internal partitions;
- concrete-block cavity walls at the ground and first levels for external walls.

Finally, internal drywall partitions made of gypsum and asbestos were also used according to the “Agreement on new prices for additional works at the first level” signed on November 8, 1976 (ASS_dcm_284). In Italy, the use of asbestos was forbidden only in 1992.

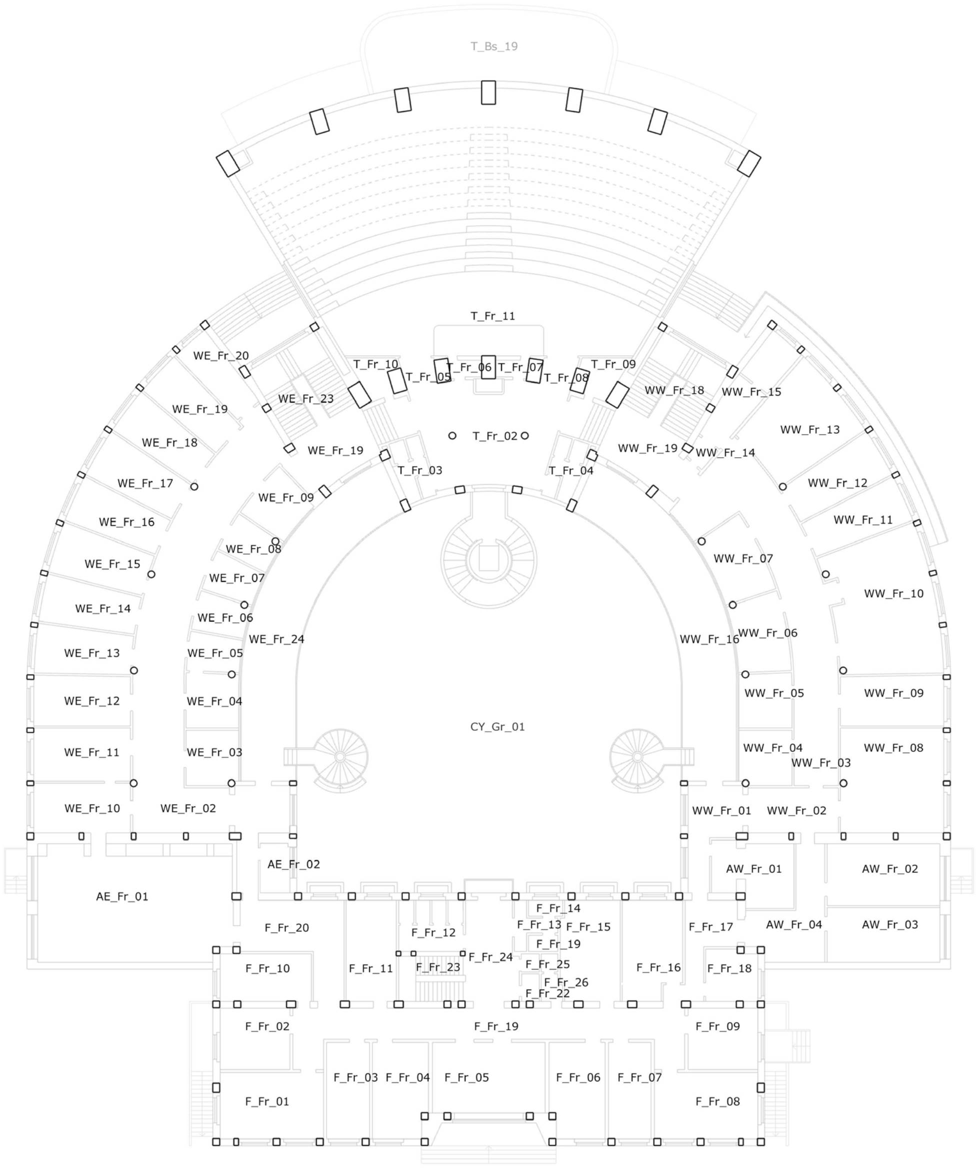
Figure 25 a/f - Different types of masonry built as infill of the reinforced concrete structure: a) room WE_Bs_01 (© Martella 2020); b) WE_Bs_01 (© Sorrentino 2020); c) room T_Bs_01 (© Martella 2020); d) room T_Tr_09 (© Martella 2020); e) room T_Fr_9 (© Liberatore 2020); f) room T_Fr_9 (© Liberatore 2020)



Basement Level

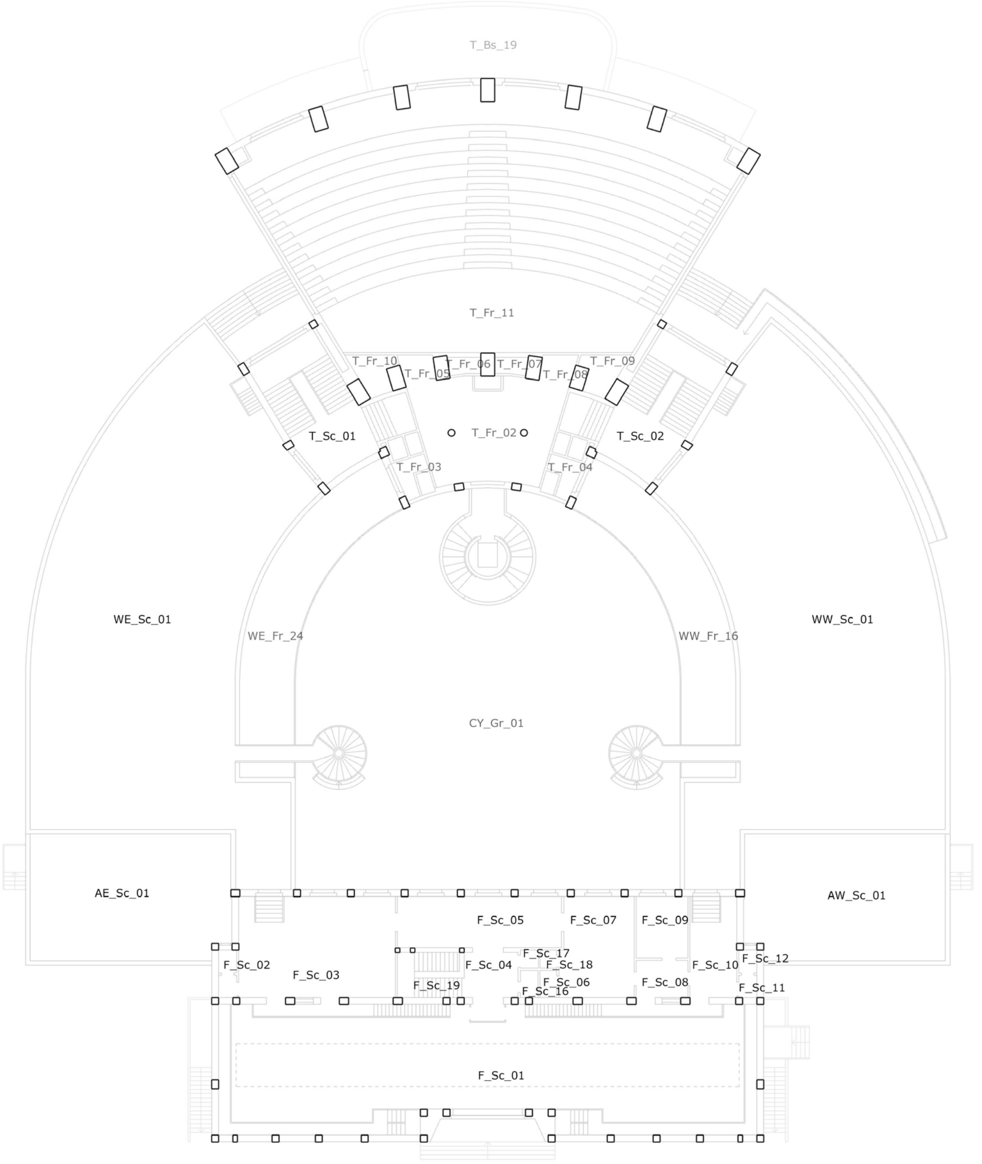


Ground Level

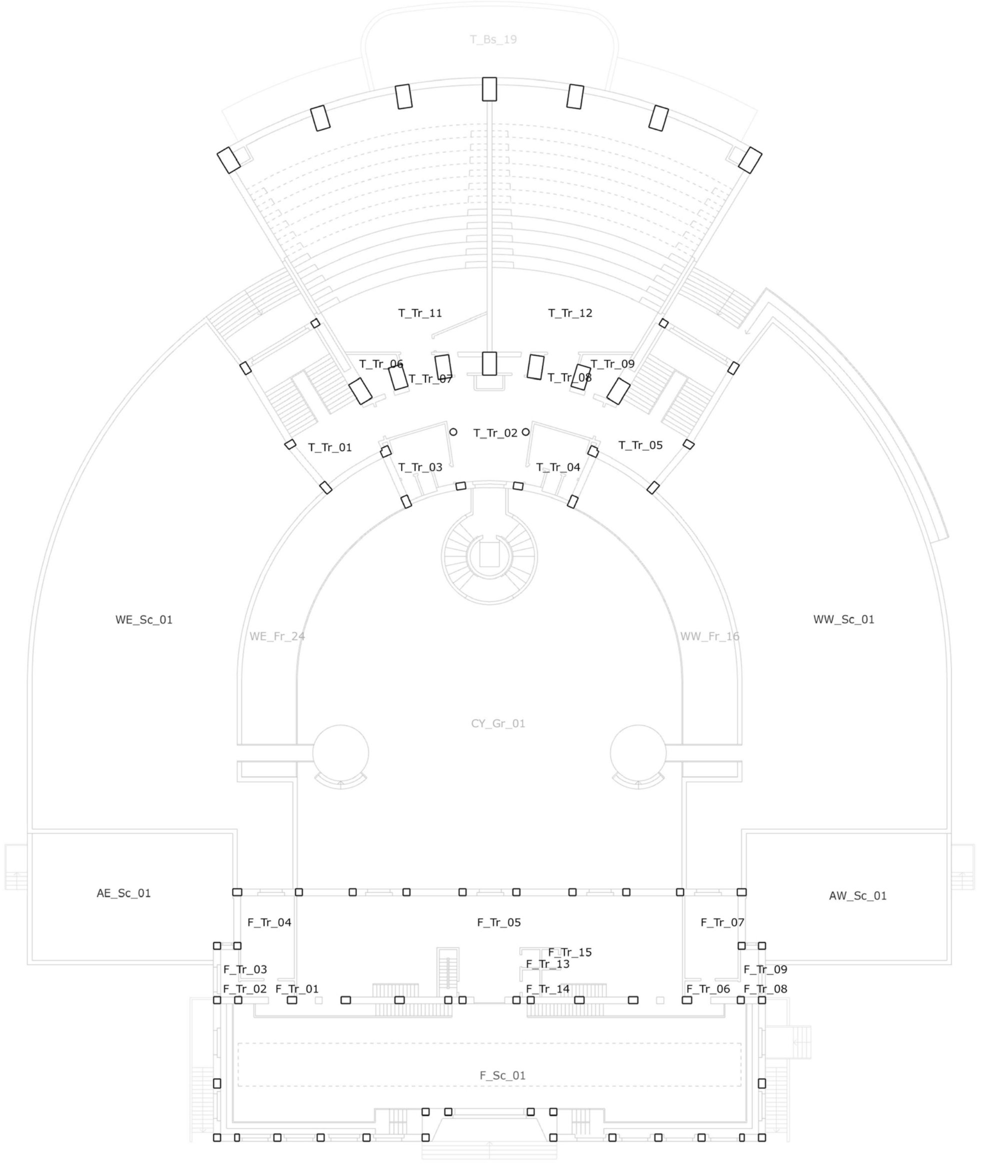


First Level

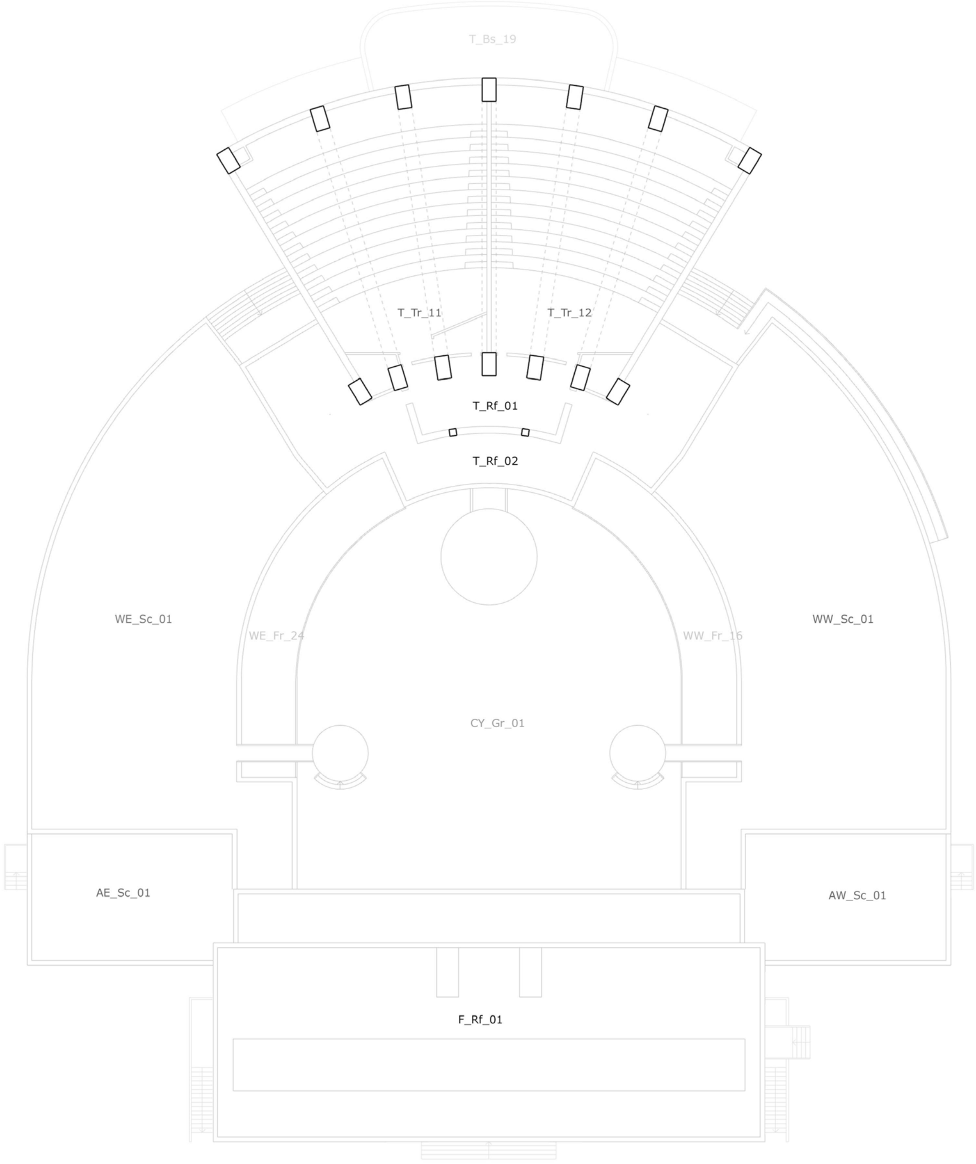
Room Codes



Second Level



Third Level



Roof Level

Room Codes

GEOTECHNICAL INVESTIGATION AND SEISMIC SITE RESPONSE ANALYSIS

Giuseppe Lanzo

Introduction

The activities carried out to determine the influence of soil characteristics on seismic actions to be used for the structural analysis of the building are summarized in this chapter. More specifically, these activities have been carried out according to three main steps: 1) historical seismicity and geological outline of the investigated area; 2) geotechnical and geophysical campaign in order to build a ground model for seismic analyses; 3) results of site response analyses and definition of free-field acceleration response spectra.

Historical seismicity and geological outline of the investigated area

Historical sources report that Rome has experienced significant earthquake ground motions in the past. The macro seismic MCS intensity of these events has reached VII on at least six different earthquakes (Galli, Molin, 2013). The majority of these earthquakes originated from the Apennines mountain chain, east of Rome, with epicentral distances of about 100 km. Damage distribution seems to have been mainly controlled by soil amplification related to the subsoil conditions. This is therefore of paramount importance to identify the geological and geotechnical characteristics of the soil deposit underneath the building under observation.

An excerpt of the geological map of the area is reported in Figure 3. The geology can be broadly described as consisting of the following units, from bottom (oldest) to top (youngest):

- a thick layer of Pliocene sandy-clayey unit of marine origin, the so-called “Vatican Mountain Formation” (MVA), constituting the geological bedrock;
- fluvial-palustrine deposits of Middle Pleistocene belonging to the so-called “Santa Cecilia Formation” (CIL), to the Palatine Unit (PTI) and the so-called “Stratified Tuffs Formation” (SKF);
- Holocene alluvial deposits of the river Tiber;
- anthropogenic deposits, which locally reach 10-15 meters depth.

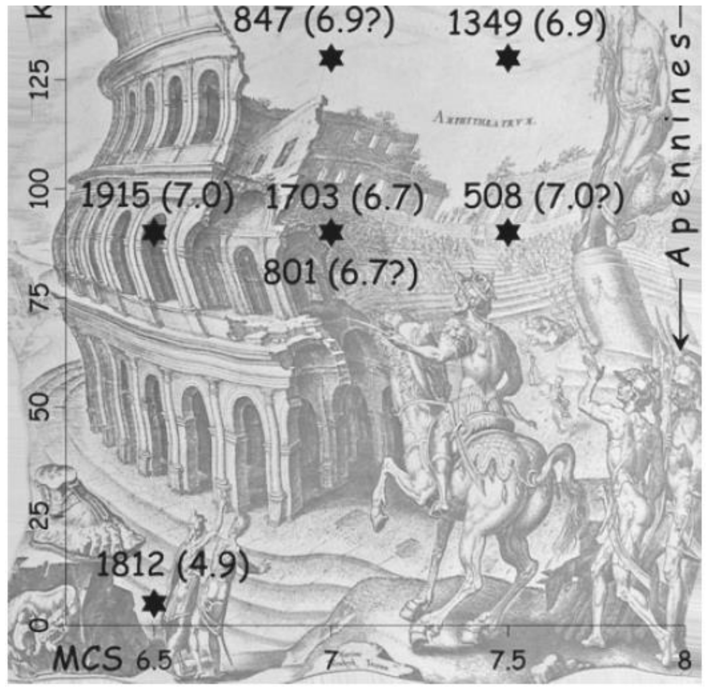


Figure 1 - Epicentral distance versus site intensity (IS > VI MCS); in brackets Mw values modified from CPT11. Note that the more severe effects in Rome derive from Apennines seismogenic earthquakes (BBL_drw_15)

Figure 2 - On site geotechnical investigation consisting in practicing two continuous borehole drillings, August 2020 (© Salvo 2020)

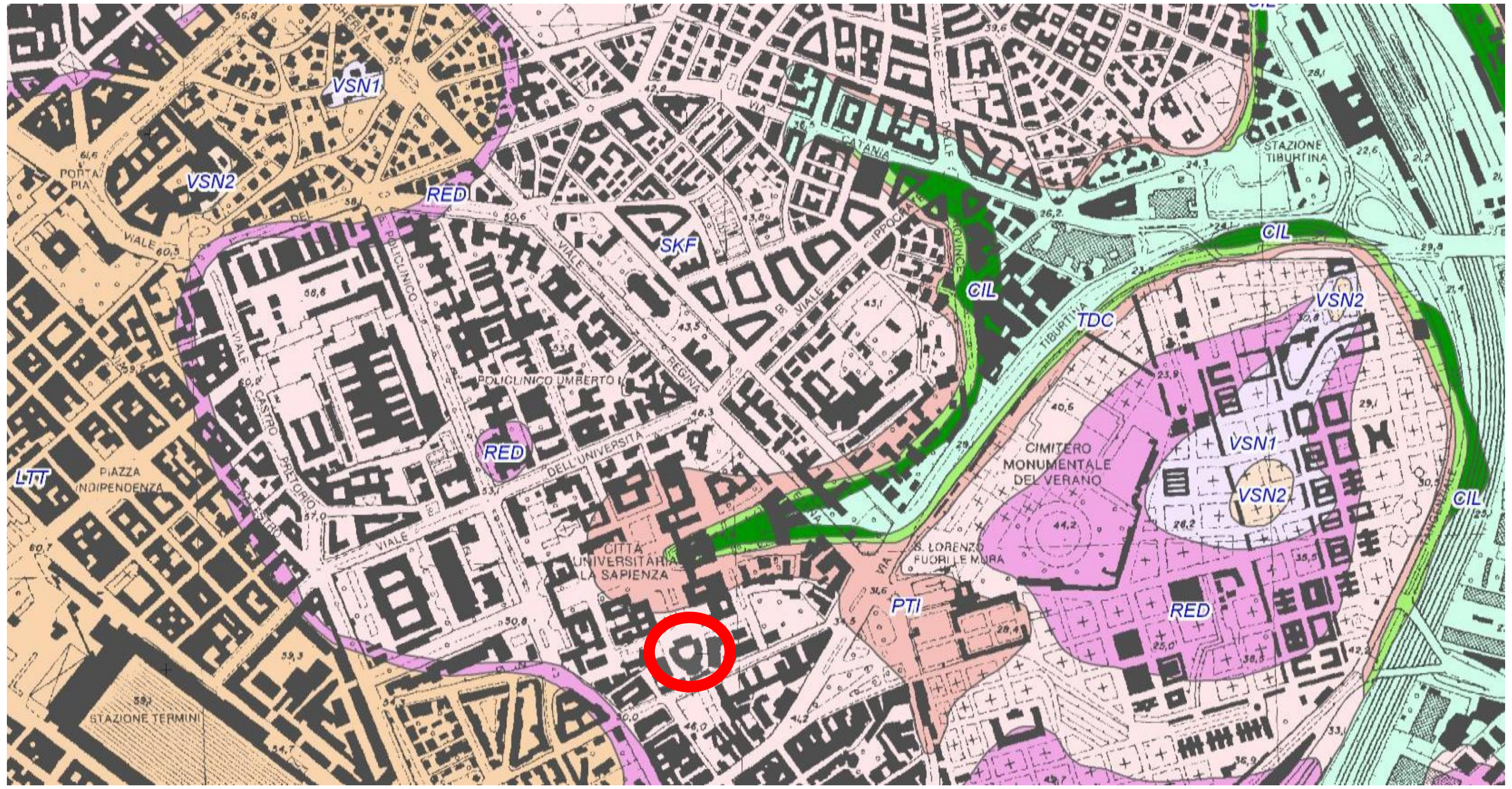


Figure 3 - Excerpt of the geological map of the area with the main geological units; in red circle the location of the building (BBL_drw_16)

SFT bb

(SFTbb) alluvial deposits within the river channels
Sand silt and clay with organic component, presently transported and deposited within the Tiber River and Aniene river channels. Maximum thickness 10 m.
HOLOCENE

RED

Massive chaotic coarse -ash matrix supported, red, purple to dark grey, unconsolidated ignimbrite, with up to 15% of coarse lapilli to block sized volcanic, thermometamorphic and intrusive xenoliths (max 20 cm diameter)- The juvenile is made of dark, poorly to moderately vesicular, cpx-, lc- and bt-phyric scoria up to 24 cm dimension. The same crystal assemblage is found as fragments within the matrix. Maximum thickness 35 m. Gas-pipes are frequently observed at the top of the imbrignite. The chemical composition is tephri-foiditic(6); The radiometric age is 457+/- 4ka(3). “Pozzolane inferiori”; “Pozzolane di S. Paolo” Auctt.
MIDDLE PLEISTOCENE p.p.

SKF

(SKF) STRATIFIED MULTICOLOURED TUFFS FROM SACROFANO
Alternation of ash and lapilli-sized fallout beds, made of grey scoria and yellow to white pumice clasts, variably altered to paleosoils, interbedded with reworked and palustrine levels.
Three well recognizable sn- and cpx-phyric pumice lapilli fallout beds are present in the middle portion of the formation (Granturchi Auctt.). Maximum thickness 14m. The provenance is from the Sabatini Volcanic District. The radiometric age of one fallout bed is 488+/- 2KA(3).
MIDDLE PLEISTOCENE p.p.

PTI

(PTI) PALATINO UNIT
Massive chaotic, unconsolidated to cemented, grey to black, lc- cpx- and bt-bearing, ash-matrix supported ignimbrite, with black scoria lapilli and lava xenoliths. Tree-mold are present. A well sorted, mm-size, black, poorly vesicular scoria fallout bed up to 25 cm thick underlies the main imbrignite. A 30 cm thick accretionary lapilli-bearing ash bed is present toward the top. Maximum thickness 10 m. The chemical composition is phono-tephritic(6). “Tufi Antichi” e “Tufi pisolitici” Auctt. p.p. The radiometric age is 533 +/- 5 ka(3).
MIDDLE PLEISTOCENE p.p.

CIL

(CIL) S. CECILIA FORMATION
Alternating fluvial conglomerate, sand and silt beds with volcaniclastic component. Maximum thickness 40 m.
MIDDLE PLEISTOCENE p.p.

A geotechnical and geophysical campaign has been carried out with the main objective to characterize the stratigraphy and to determine soil properties for geotechnical earthquake analyses. The results of the in situ survey have been summarized in the Ground Investigation Report carried out in September 2020 (GEOTER, 2020).

The in situ investigation, consisted in: a) two continuous coring borehole drilling SM1 and SM2, 30 meters and 40 meters deep respectively from the ground surface; b) one seismic test (MASW1); c) 2 passive geophysical measurements (HVSR1 and HVSR2). Location of the boreholes and geophysical tests (MASW and HVSR) are illustrated in Figure 4. Photographs of cores drilled from borings are illustrated in Figure 5 where materials recovered at interval depths of 5-10 meters and 25-30 meters are presented. The different soils encountered can be clearly distinguished, more granular in the upper part (5-10 meters) of the soil deposit and more clayey in the lower part (25-30 meters). Based on the visual inspection of the cores recovered in the boreholes SM1 and SM2, a detailed description of the soil stratigraphy has been performed. Two

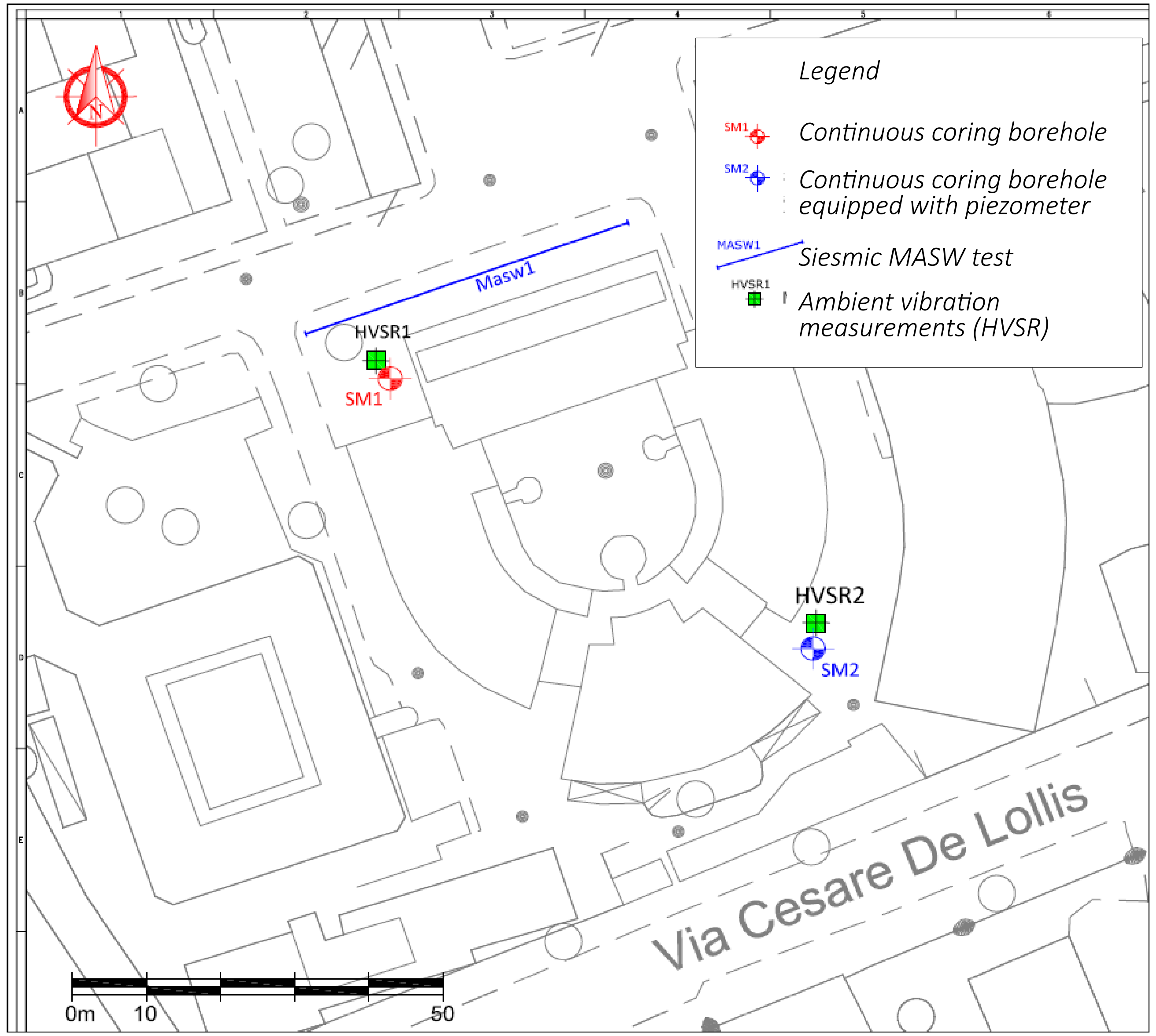


Figure 4 - Location of in situ investigations (© Lanzo 2021)

Figure 5 - Cores drilled in the borehole SM1 at interval depths of 5-10 meters and 25-30 meters from ground surface (© GEOTER s.r.l. 2021)

ground water tables have been identified, the first at about 10 meters depth from the ground surface and the second one at about 25 meters depth from ground surface.
A stratigraphic cross-section passing through the verticals SM1 and SM2 has been reconstructed in Figure 6. The main lithotypes identified in the investigation include:

- brown anthropogenic fill (R);
- brown clayey sandy silt transported and deposited within the tributaries of the river Tiber, mixed with pyroclastic sandy materials (LAS);
- pyroclastic brown silty sand (PS) of limited thickness;
- silty sands/sandy silts (SL) characterized by different thickness in SM1 and SM2;
- clayey silt (LA) constituted by a light greyish fine-grained material; sandy gravels (GS) which constitute the basal layer of the deposit resting over the Vatican Clays Formation (MVA), which has not been encountered during the survey, which can be encountered in the area about at 50-55 meters depth.

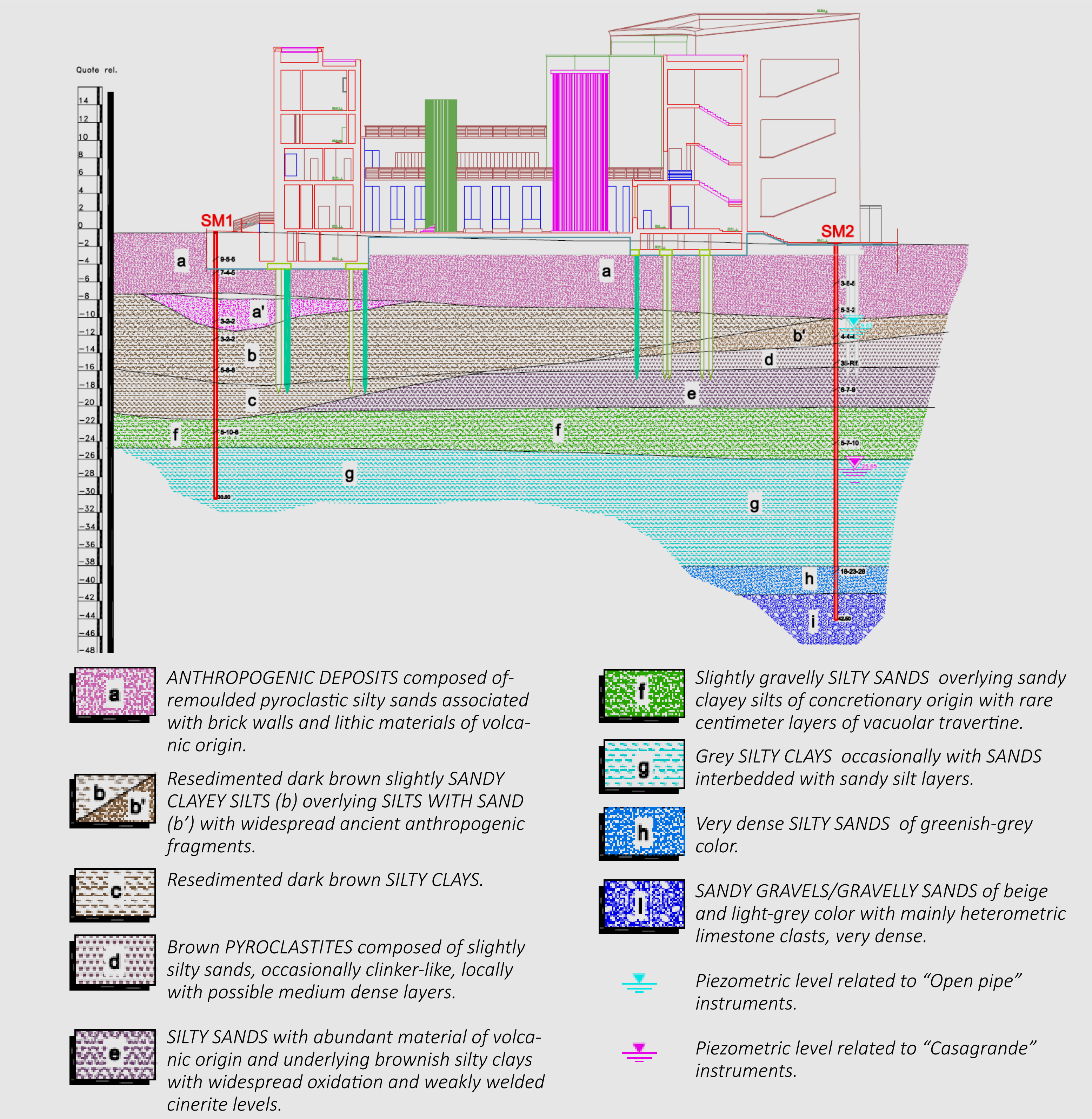


Figure 6 - Stratigraphic conditions reconstructed under the building along the cross-section through the two investigated verticals SM1 and SM2 (© Lanzo 2021)

On the undisturbed samples retrieved during the borehole survey, standard and advanced cyclic geotechnical laboratory tests have been carried out at the Geotechnical Laboratory of the Department of Structural and Geotechnical Engineering (DISG) of Sapienza University of Rome. Table 1 lists these samples with indication of recovery depth and the corresponding lithotype as well as the main physical (i.e. grain size distribution, Atterberg Limit tests, natural moisture content, etc.) and mechanical tests (i.e. oedometer tests, direct shear tests) carried out. Special attention has been paid to the soil properties under cyclic loading conditions, which were investigated through a special device (Double Specimen Direct Simple Shear - DSDSS), originally developed at the University of California at Los Angeles (UCLA) (Doroudian, Vucetic, 1995). The results were interpreted in terms of standard cyclic parameters, i.e. the secant shear modulus (G), normalized with respect to the maximum shear modulus (G_0), and damping rattio (D). In Figure 6 the variation of these parameters with the cyclic shear strain amplitude (γ_c) for two lithotypes is illustrated.

The ambient vibration technique HVSR (Horizontal-to-Vertical Spectral Ratio) was carried out as part of the geophysical investigation in order to estimate the site resonance frequency (f_0). The HSVR1 curve shows a clear peak at 2.28 Hz, which can be interpreted as the resonance frequency of the sandy and clayey layers overlying the basal gravels. The MASW (Multiple Analysis of Surface Waves) test was performed in front of the entrance of the building of the School of Mathematics, near the ambient measurement HVSR1. A joint inversion of MASW and HVSR was carried out and the data elaboration, constrained by borehole information in the upper 30 m, allowed the determination of the shear wave velocity Vs profile.

Borehole	Sample	Depth (m)	Lithotype	Physical tests	Mechanical tests		
					Oedometer	Direct Shear	DSDSS
SM1	CI1	17.50-18.00	LAS	x	-	-	-
SM1	CI2	25.50-26.10	LA	x	x	-	x
SM1	CI3	28.50-29.10	LA	-	-	-	-
SM2	CI1	19.50-19.80	SL	-	-	-	-
SM2	CI2	31.50-32.10	LA	x	-	x	x

Table 1 - List of "undisturbed" samples with indication of the type of test carried out (© Lanzo 2021)

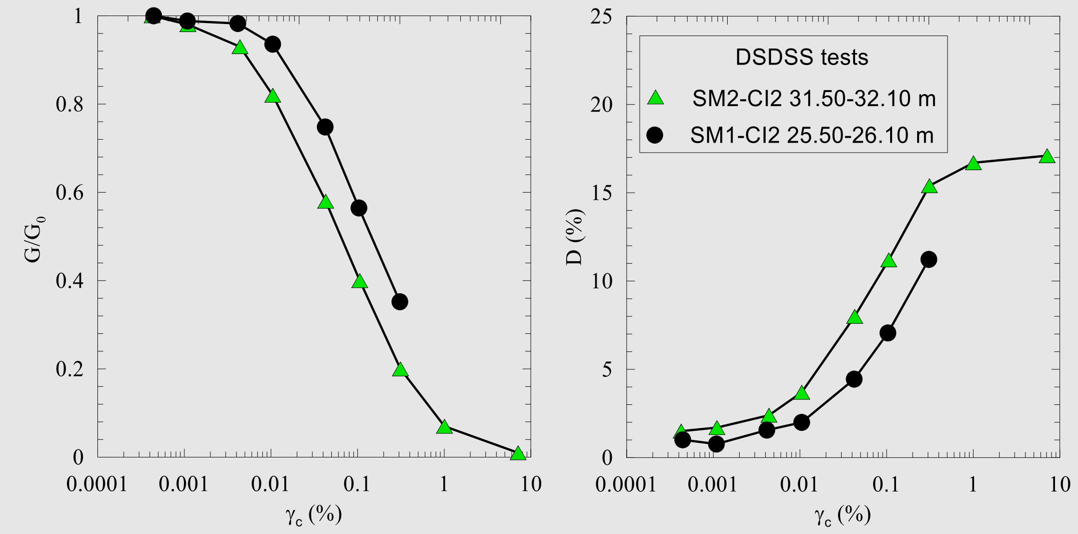


Figure 7 - Normalized shear modulus (G/G_0) and damping ratio (D) curves from DSDSS tests (© Lanzo 2021)

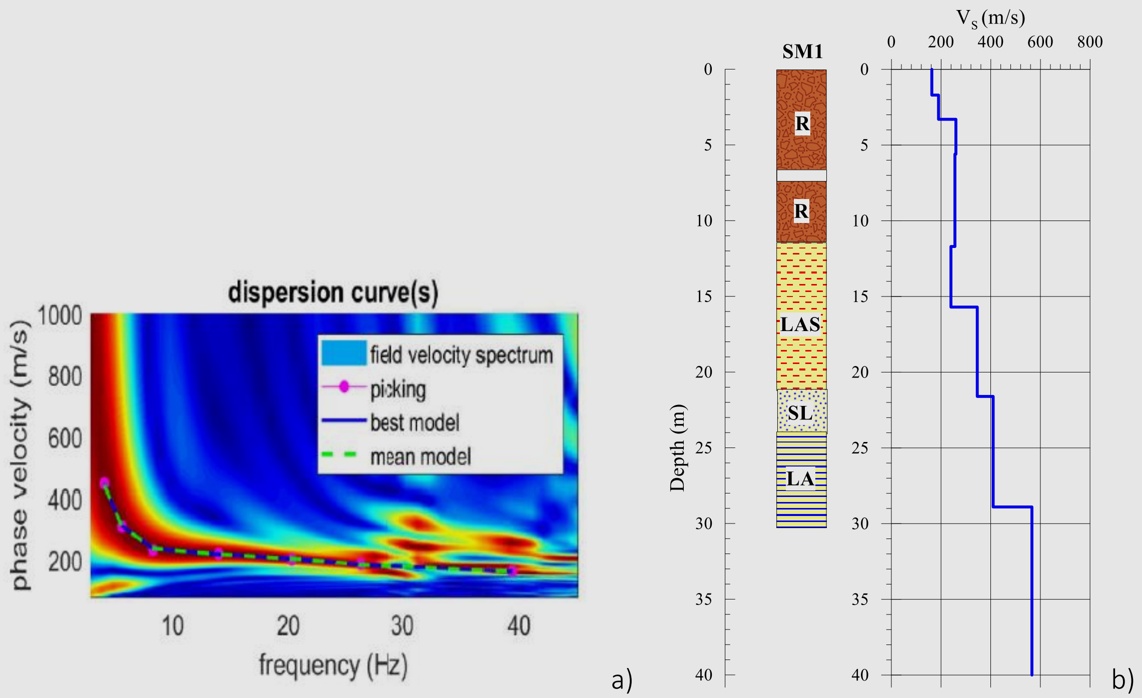


Figure 8 a/b - a) Dispersion curve of the MASW test (© GEOTER s.r.l. 2021); b) shear wave velocity (Vs) profile from joint inversion of MASW1 and HVSR1 (© Lanzo 2021)

Results of site response analyses and definition of free-field response spectra

Based on the information gathered from in situ surveys and laboratory tests, a 1D model for seismic site response analyses at the site has been developed. Different layers have been considered, roughly grouping the different lithotypes identified in the investigated verticals. In some case the same lithotype was divided in two sub-groups because of differences in physical and/or mechanical properties. Physical properties of the layers were taken from laboratory tests whereas the shear wave velocity values were deduced from the results of MASW test. Nonlinear cyclic soil properties (G/G_0-γ_c and D-γ_c curves) were based on the results of DSDSS tests. Those lithotypes, for which measurements were not available, were assigned physical and mechanical properties retrieved from the literature.

Before performing the numerical analyses to determine the seismic action for Ultimate Limit State (ULS) condition, a preliminary linear visco-elastic 1D analyses was carried out at SM1 location in order to validate the subsoil model in the linear range. Specifically, the computed transfer function between bedrock and soil surface was calculated and the computed fundamental frequency (f_0= 2.30 Hz) was obtained. This frequency was compared with the experimental one from HVSR technique (f_0=2.28 Hz) and was found to be in overall agreement, thus corroborating the subsoil model developed for the seismic response analyses.

The 1D analyses have been carried out with the well-known computer code Strata (Kottke, Rathje, 2008). The program performs equivalent linear site response analyses in the frequency domain, using acceleration time-histories as input motions. The nonlinear behavior of soils is addressed via an equivalent linear approach: an iterative procedure is required to ensure that the properties used in the analysis are compatible with the computed strain levels in all layers.
The 1D site response analyses have been carried out by applying as input motion a suite of seven natural accelerations time-histories, which were spectrum-compatible with the target ULS response spectrum. The spectrum compatibility has been ensured in the range of periods of interest 0.33-1.3 seconds calculated according to Italian Building Code NTC18 [Norme Tecniche per le Costruzioni (NTC), 2018] as 0.2T-2T, where T is the fundamental period of the structure, here assumed as T=0.65s. The seismotectonic background showed that the seismicity of Rome seems to be essentially related to moderate magnitude events (5.5-6.0) at short distances (d<20 kilometers) and high magnitude (6.5-7.5) earthquakes farther than 90-100 kilometers. These two magnitude-distance pairs were therefore assumed to select the natural accelerograms for site response analyses.

Results of the numerical analyses are illustrated in Figure 9 in terms of 5% damped elastic response spectra of horizontal component computed 1.0 meters below the ground surface, approximately corresponding to the foundation level. Average spectrum calculated from site response analyses as well as the average spectrum regularized into NTC18-type spectral shape (Working Group, 2008) are shown; this NTC18-type smoothed spectrum represents the final product of this part of the study. In the same plot, the ULS target input response spectrum and subsoil class C spectrum according to NTC18 are also illustrated. A substantial amplification of ground motion can be observed, especially in the period range 0.25-0.6 seconds.

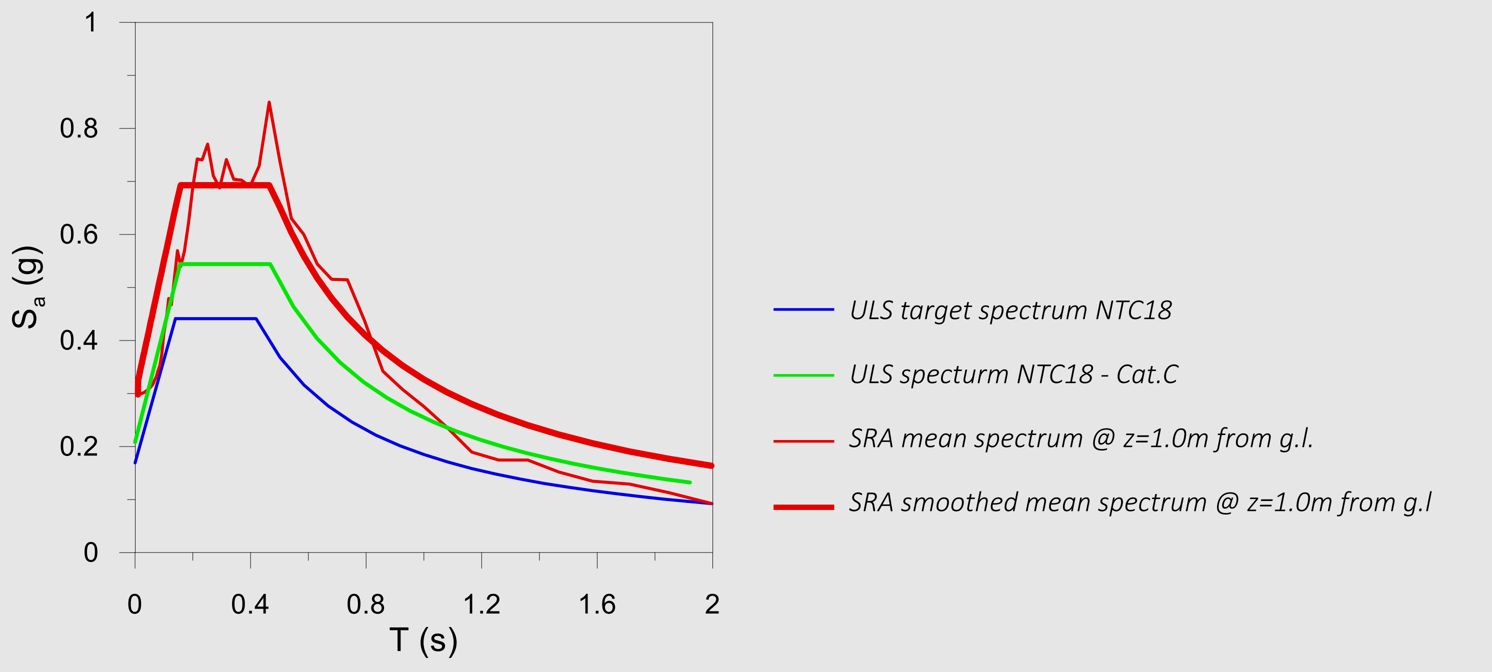


Figure 9 - Average response spectrum and average smoothed NTC18-type response spectra calculated from 1D site response analyses along with target and subsoil category C spectra from NTC18 (© Lanzo 2021)

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STRUCTURAL INVESTIGATION

Laura Liberatore, Luigi Sorrentino, Ilaria Martella

In situ investigations

In situ surveys have been conducted to gather information on structural elements and on their state of conservation. Specifically, visual investigations, geometrical measurements and rebar locating tests have been performed. Methodologies and results are reported in the following sections.

1. Visual inspections

Visual inspections have been carried out on visible parts of the structure. This part of the research oriented the assessment of the state of conservation of the structures and guided the planning of rebar locating tests: data has therefore been gathered and recorded directly on the blueprints; sketches have been drawn; general views and details have been photographed. Wherever possible, a geometrical survey of the cross section of columns and beams, as well as of frame span and height, have been implemented. This activity allowed to verify consistency between the original drawings and the built structure, representing a preliminary step to the implementation of three-dimensional (3D) structural models, where sections and spacings are basic parameters affecting the calculation of the internal forces. These activities have been performed more extensively in the basement level of the curved wings, where beams, columns and foundations are neither plastered nor cladded, and can therefore be analyzed duly. It was also possible to use a caliper to directly measure the diameter of some rebars that were exposed due to spalling phenomena. This information was also useful for the calibration of the rebar locating tests.

At the basement level of the front building, location and dimensions of visible beams, i.e. not hidden by false ceilings, have also been surveyed. Other partially accessible structural elements have been found in the tower of classrooms. More specifically, limited parts of the large columns, of the curvilinear beams and of the enclosure masonry are visible in the technical rooms.

Visual inspection allowed the identification of areas where concrete and steel are deteriorated. Structural concrete appears in good conditions almost everywhere in the building; yet there are parts of the structure where spalling of concrete cover, corrosion of rebars, cracks and superficial degradation has occurred. These phenomena are more evident where the surface of the reinforced-concrete structure is more exposed, especially at the basement level of the curved wings and of the front building and at the upper levels of the latter and of the tower of classrooms, as described later on.

It is important to underline that plaster, false ceilings and cladding impede the inspection of most of the structural elements, which have therefore not been surveyed as destructive investigation – albeit very limited – has not been allowed.

Figure 1 - View of the concrete structure from the installation room at the foot of the Tower of classrooms (© Cortesi 2020)

1.1. Front building

The book deposit of the library at the third level of the front building, is one of the most deteriorated parts of the entire building, affected by cracks and superficial distress. These phenomena are due to different causes: i) infiltrations through skylights; ii) updating or modification of installations; iii) interaction with the steel-frame structure present inside the archive.
At the basement level, oxidized rebars and spalling of concrete appear in some beams. Corrosion occurs where cracked concrete enables water to reach the rebars, or humidity accesses the concrete by diffusion during carbonation. In both cases, corrosion leads to an increase in the volume of the steel, and, consequently, to cracking and possible spalling of the concrete. Areas affected by these drawbacks are located on the North-Northeast side of the front building, in the technical rooms and in the book deposits, especially close to the window openings. Interventions on installations have caused additional damage, as shown in Figure 3d, where damage produced by a pipe passing through a hole in the slab and a pipe improperly supported by an exposed rebar are highlighted.

Figure 2 a/d - Front building, book deposit at the third level of the library: a) smeared cracks on the surfaces close to the skylight (© Martella 2020); b) smeared cracks, vertical and horizontal cracks on the beam intrados (© Liberatore 2020); c) inhomogeneity due to interventions on installations (© Liberatore 2020); d) damage due to the interaction with the steel slab (© Liberatore 2020)

Figure 3 a/d - Front building, basement level: a) infiltrations on a perimeter wall (© Martella 2020); b) corrosion, concrete cracks, detachment of plaster (© Liberatore 2020); c) corrosion of bars and spalling of concrete in the technical room (© Liberatore 2020); d) corrosion of bars and spalling of concrete, improper interaction with installations in the technical room, highlighted by red circles (© Liberatore 2020)

1.2. Curved wings

The absence of plaster at the basement level of the curved wings has allowed to observe quality and conditions of the concrete surface, which is generally smooth and without visible significant imperfections. The west wing has been not surveyed extensively due to the narrower height of the room; probably, the situation is similar to that of the east wing, which is accessible. Here, oxidation of reinforcement and spalling of the concrete have been noticed on some beams close to the courtyard side, adjacent to the sky-lights. Structural elements appeared less deteriorated in more inner areas of the wing, albeit oxidation of transversal reinforcement due to the reduced concrete cover is visible in some beams; oxidation of longitudinal reinforcement is also visible.

As noted at the basement of the front building, an additional cause of deterioration of the concrete structure is the inappropriate use of rebars to hang installations- pipes, ducts and wiring- which appears systematic at the basement level of the east wing.

Figure 4 a/d - East curved wing, basement level: a) bars oxidation, spalling of concrete, cracks in the masonry wall (© Martella 2020); b) bars oxidation, spalling of concrete, cracks in the masonry wall (© Martella 2020); c) oxidation of stirrups and longitudinal bars and consequent spalling (© Liberatore 2020); d) oxidation of stirrups due to reduced concrete cover especially at the lower side corners (© Martella 2020).

Figure 5 a/f - East curved wing, basement level: a) pipes hanging on longitudinal reinforcements (© Liberatore 2020); b) stirrup oxidation, pipes hanging on longitudinal re-inforcements (© Liberatore 2020); c) stirrup oxidation, pipes hanging on longitudinal reinforcements (© Martella 2020); d) hole in the reinforced concrete slab for the passage for cables (© Martella 2020); e-f) hole in a reinforced concrete beam for the passage for pipes (© Sorrentino 2020).

1.3. Tower of classrooms

The conditions of the structural elements of this part of the building at the basement level are similar to those of the curved wings. In addition, two columns are affected by oxidation and spalling close to longitudinal reinforcement. The interaction with installations is less invasive here, albeit present. At the other levels, structural elements are mostly hidden by plaster, cladding and false ceilings. However, those that are visible appear in good state of preservation (Figure 23, “Description of the structural layout”).

Figure 6 a/f - Tower of classrooms, basement level: a) oxidation of stirrups and longitudinal reinforcement, spalling of concrete cover (© Martella 2020); b) oxidation of longitudinal reinforcement and spalling of concrete cover (© Martella 2020); c) oxidation of stirrups (© Martella 2020); d) brackets for cables fastened to beams, oxidation of longitudinal reinforcement and spalling of concrete cover at the column bottom (in the red circle) (© Martella 2020); e-f) brackets for cables fastened to beams (© Liberatore 2020).

2. Rebar locating tests

Rebar locating tests (also known as covermeter testing) have been performed to detect the presence of steel beneath the concrete surface, to identify the orientation of reinforcing bars, and to estimate their diameter and the thickness of concrete cover. This test is based on the principle that a magnetic field is affected by the presence of steel, thereby allowing the detection of presence and characteristics of the steel rebars. The rebar locator is moved across the search area of the tested element and emits a sound increasing in pitch the closer its head is to a reinforcement bar.

Limitations to the reliability of this instrument are:

i) cannot detect reinforcement deeper than 120 or 180 mm according to the used instrument;

ii) does not identify the quality of concrete cover.

In addition, test results may be affected by the presence of more than one reinforcing bar in the tested area, as in presence of laps, stirrups and double layers.

However, if reinforcement is not congested, it is possible to map out longitudinal and transversal steel rebars within the examined area. Elements with smooth concrete surfaces have been tested, given that accuracy is reduced in case of rough or undulating surfaces. The presence of plaster also diminishes the accuracy because of the greater distance between instrument and rebars. Likewise, interference effects may occur near metal structures of significant size, such as window frames, shelving, steel pipes, wiring, corner bumpers. Therefore, specific attention has been paid to avoid, where possible, the above-mentioned conditions.

Data sheet page number(1)	Level	Element id	Element type	Section dimensions(2) (cm)	Longitudinal bar diameters(3) (mm)	Transversal bar diameters(3) (mm)	Step of transversal bars(4) (cm)
1	Basement	F_11	Column	40x45	16	12	30.0
2	Basement	F_14bis	Column	40x45	22, 28	-	28.5
3	Basement	F_41	Column	45x60	20, 25	9, 10	20.25
4	Basement	F_12-F_27/28	Beam	30x75 30x105	18	10	19.5 (m) 16.0 (s)
5	Basement	F_41-F_42	Beam	60x75	14	**5**, 9	12.0 (m)
6	Ground	F_28	Column	70x45	18, 20, 25	12, 14, 16	21.3
7	Ground	F_29	Column	45x45	25	12	16.7
8	Ground	F_37	Column	50x45	18	9	15.3
9	Ground	F_47	Column	35x35	20	14, 16	18.0
10	First	F_7	Column	40x45	-	-	30.0
11	First	F_20	Column	60x45	18, 20, 22, 25	10	20.0
12	First	F_28	Column	60x45	22	14	20.0
13	Second	F_7	Column	30x45	18, 20	10	18.0
14	Second	F_43	Column	45x45	25	-	17.5
15	Third	F_20	Column	45x45	18, 20	11	17.75
16	Third	F_21	Column	35x45	18	11	22.0
17	Third	F_28	Column	45x45	22	-	20.7

(1) For some elements two data sheets were drown (A and B), each one related to a different test area.

(2) For circular column, the diameter *d* is reported. Values reported in red are supposed (not measured).

(3) Values in bold are obtained from the caliper.

(4) For the beams: (m) = step in the middle of the beam, (s) = step in the area close to the support.

Table 1a - Rebar locating tests in the front building: list of tested elements and summary of measured data.

A summary of rebar locating tests performed on the building is reported in Tables 1 a,b,c. The number and location of tests have been selected to investigate various column and beam types at different levels. For instance: in the curved wings, both square and circular columns have been examined; in the tower of class-rooms, large columns have been tested at the different levels. Wherever possible, elements have been tested on two perpendicular faces. Beams have been tested where not hidden by false ceilings.

Data sheet number[1]	Level	Element id	Element type	Section dimensions[2] (cm)	Longitudinal bar diameters[3] (mm)	Transversal bar diameters[3] (mm)	Step of transversal bars[4] (cm)
18	Basement	WE_2	Column	30x45	18	10	17.0
19A/19B	Basement	WE_12	Column	cruciform, width 20	16, 18	12, 14	16.6
20	Basement	WE_22	Column	44x44	18, 20	9, 8	16.2
21	Basement	WE_10-WE_14	Beam	45x65	**14**	**9**	20.0 (m)
22	Ground	WE_4	Column	25x45	18	16	16.75
23	Ground	WE_5	Column	75x45	22, 25, 30	12, 14	20.0
24	Ground	WE_9	Column	*d*=45	-	-	9.0
25	Ground	WE_14	Column	45x25	25	16	15.5
26	Ground	WE_22	Column	*d*=45	30	-	9.4
27	First	WE_8	Column	*d*=45	22	-	10.0
28	Ground	WW_7	Column	45x30	18, 20	14	21.3

(1) For some elements two data sheets were drawn (A and B), each one related to a different test area.

(2) For circular column, the diameter *d* is reported. Values not measured are reported in red.

(3) Values in bold are obtained from the caliper.

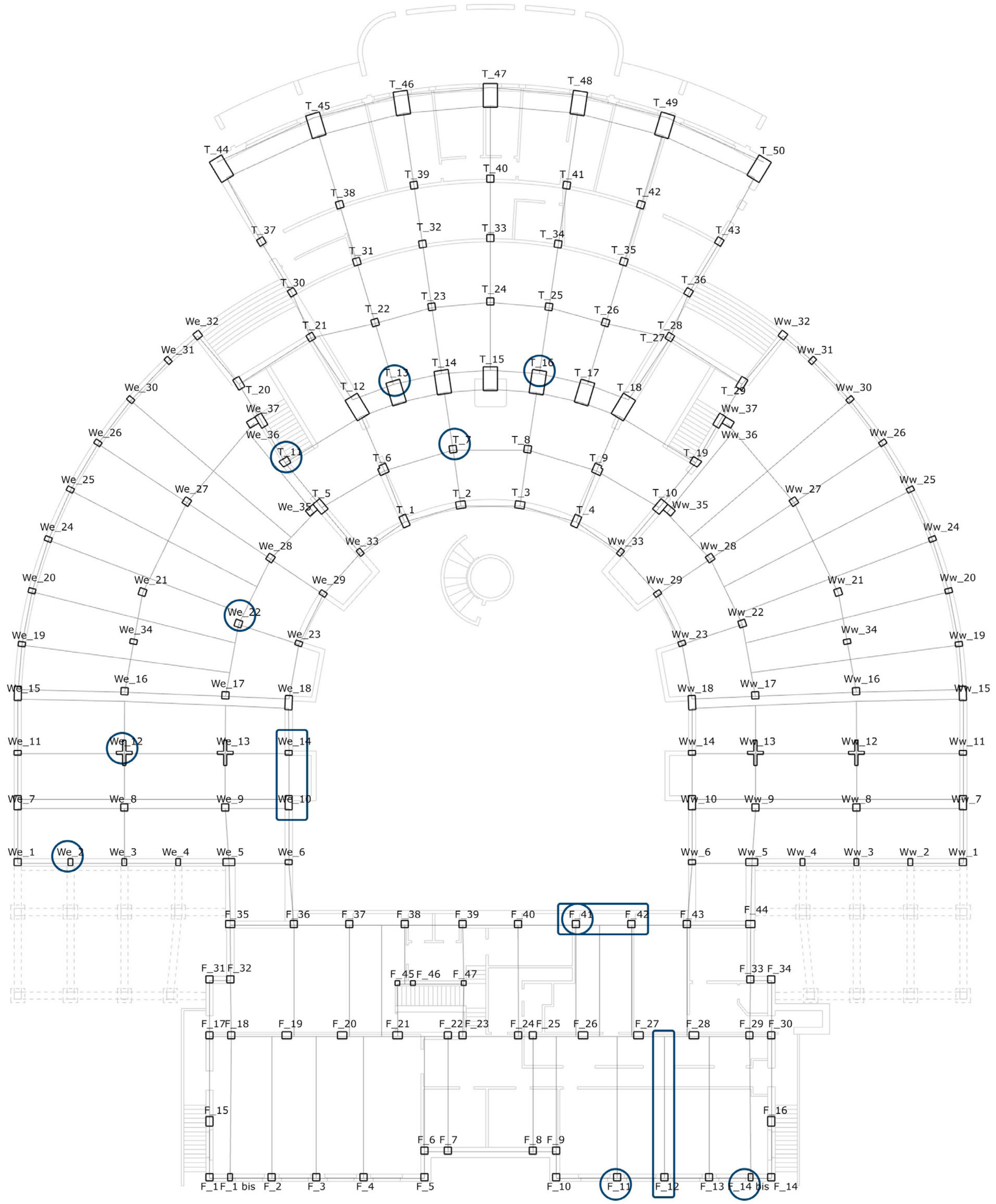
(4) For the beams: (m) = step in the middle of the beam, (s) = step in the area close to the support.

Table 1b - Rebar locating tests in the curvilinear wings: list of tested elements and summary of measured data, from 18 to 27 east wing, 28 west wing.

Data sheet number[1]	Level	Element id	Element type	Section dimension[2] (cm)	Longitudinal bar diameters[3] (mm)	Transversal bar diameters[3] (mm)	Step of transversal bars[4] (cm)
29	Basement	T.7	Column	40x45	16, 18, 20	11, 12	20.0
30	Basement	T.11	Column	30x45	**18** (digital 16)	**9**	15.0
31	Basement	T.13	Column	90x150	28, **35** (digital 32), 44	-	20.0
32A/32B	Basement	T.16	Column	90x150	28	14, 16	21.3
33	Ground	T.2	Column	45x45	20	12, 16	22.3
34	Ground	T.4	Column	45x75	16	10, 11, 16	20.3
35	Ground	T.8	Column	*d*=45	22	12, 16	17.3
36	Ground	T.16	Column	90x150	25	12	20.0
37	Ground	T.17	Column	90x150	32	9, 12, 16	18.3
38A/38B	Ground	T.45	Column	90x150	22, 25	14	22.0
39	First	T.2	Column	45x45	25	16	18.0
40	First	T.7	Column	*d*=45	16	12	13.3
41A/41B	First	T.14	Column	90x150	18, 22	11, 12, 14, 16	20.0
42A/42B	First	T.45	Column	90x150	22	10	20.0
43A/43B	Third	T.45	Column	90x150	20, 22	10	20.0
44	Third	T.17-T.18	Beam	30x65	**18**	6, 9	20.0 (m)
45	Third	T.17-T.49	Beam	curvilinear, width 42	-	14	-

[1] For some elements two data sheets were drawn (A and B), each one related to a different test area.
[2] For circular column, the diameter *d* is reported. Values not measured are reported in red.
[3] Values in bold are obtained from the caliper.
[4] For the beams: (m) = step in the middle of the beam, (s) = step in the area close to the support.

Table 1c - Rebar locating tests in the tower of classrooms: list of tested elements and summary of measured data.



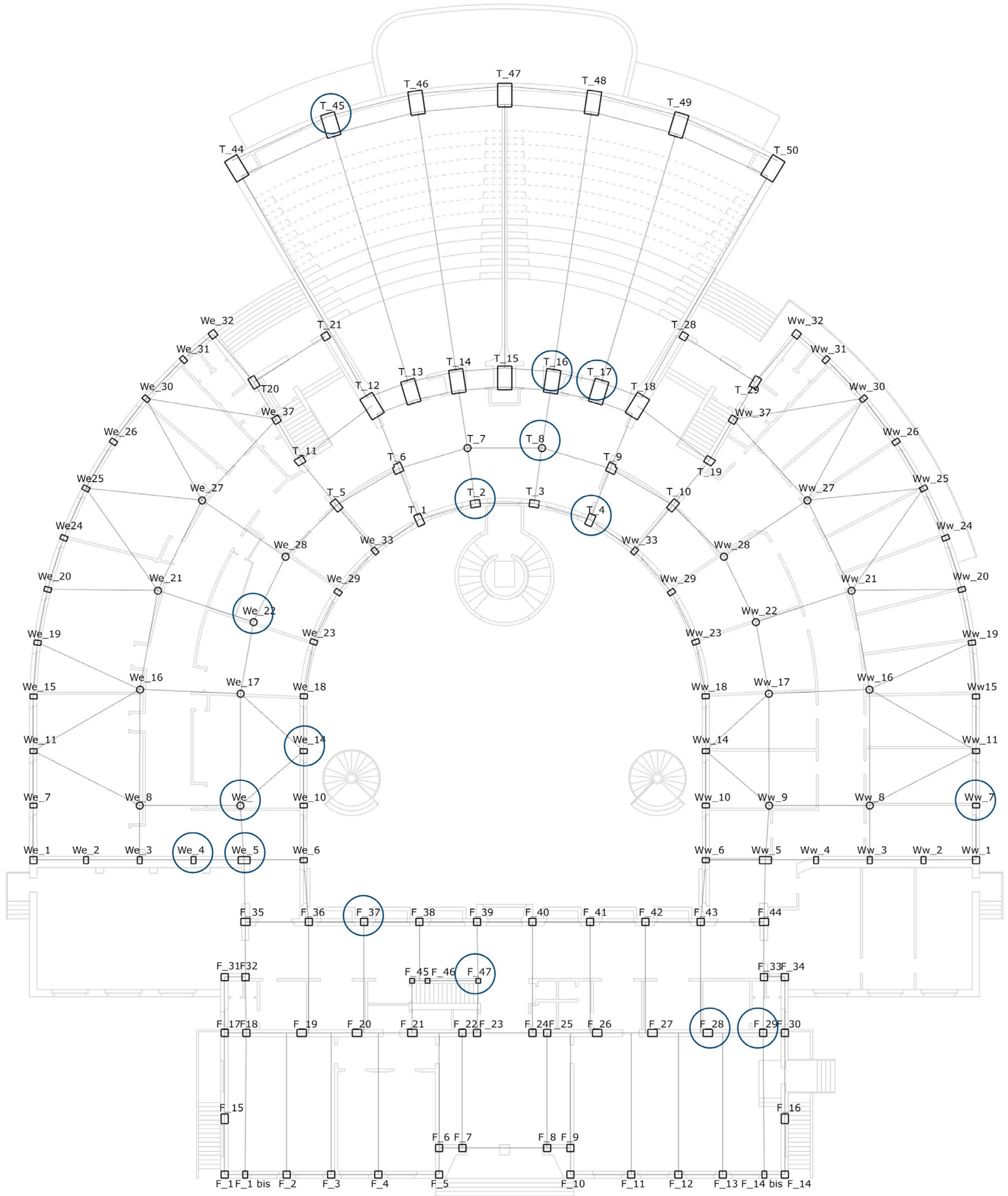
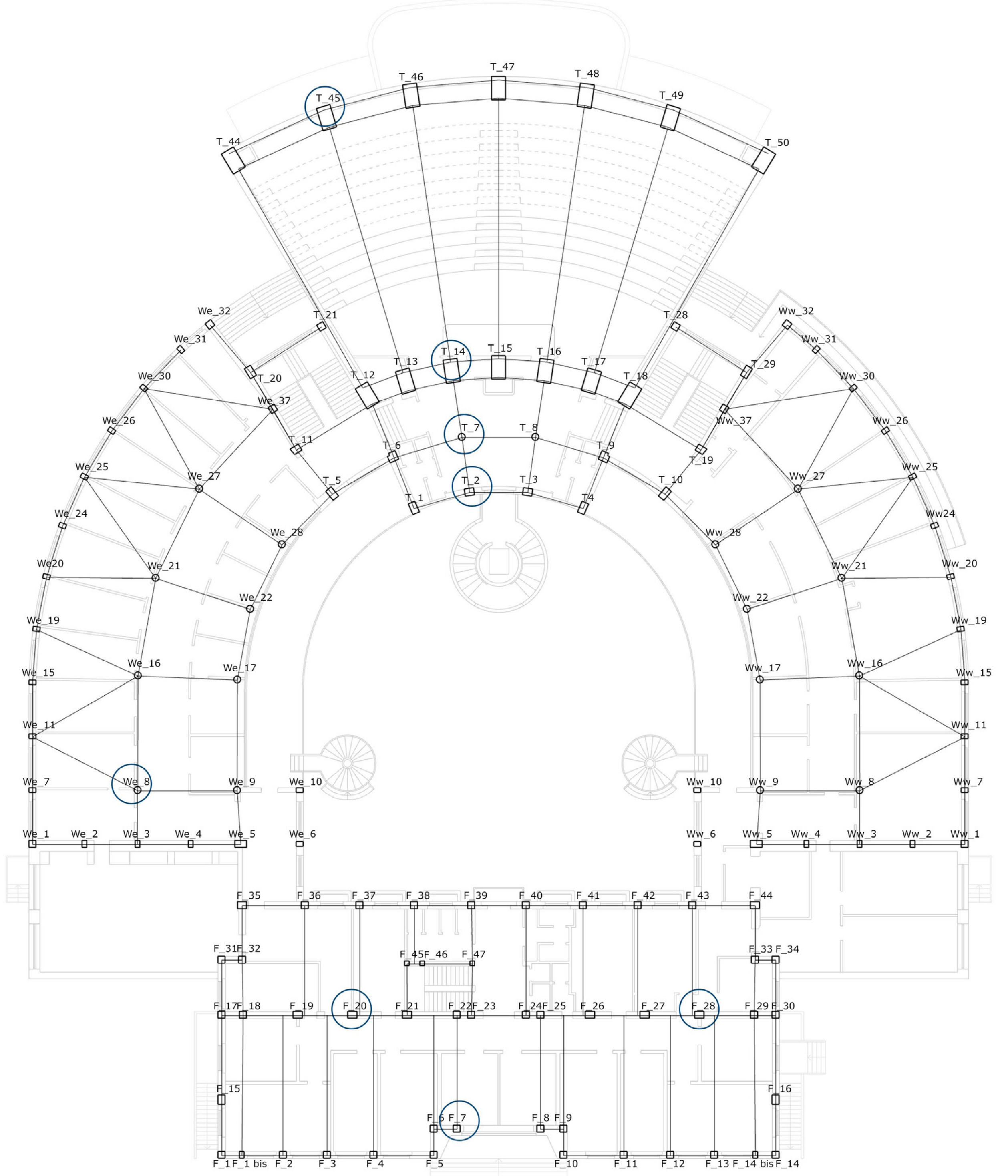


Figure 7 - Structural elements identification numbers and location of the rebar locating tests, basement level (© Martella 2020)

Figure 8 - Structural elements identification numbers and location of the rebar locating tests, ground level (© Martella 2020)



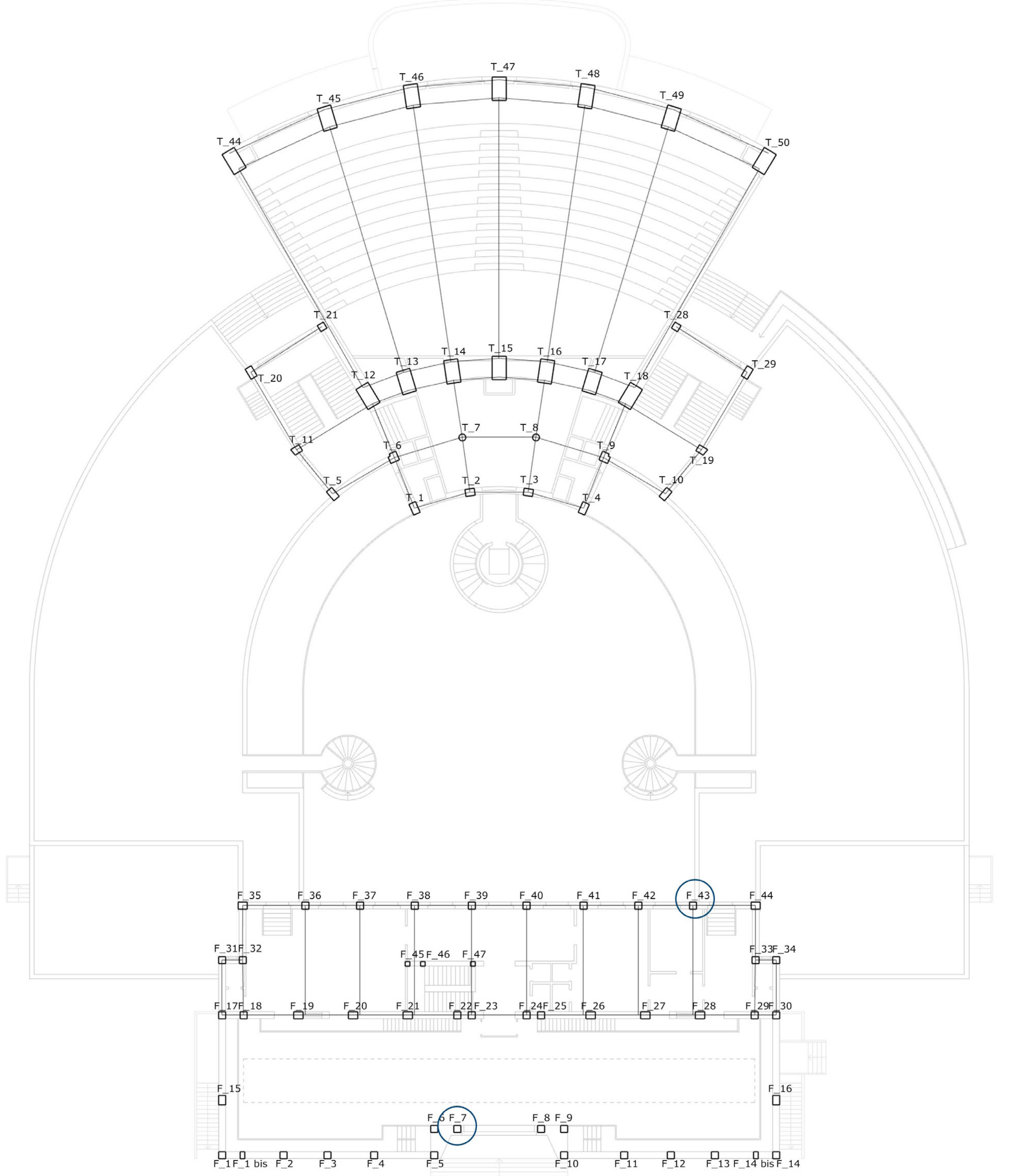


Figure 9 - Structural elements identification numbers and location of the rebar locating tests, first level (© Martella 2020)

Figure 10 - Structural elements identification numbers and location of the rebar locating tests, second level (© Martel-la 2020)

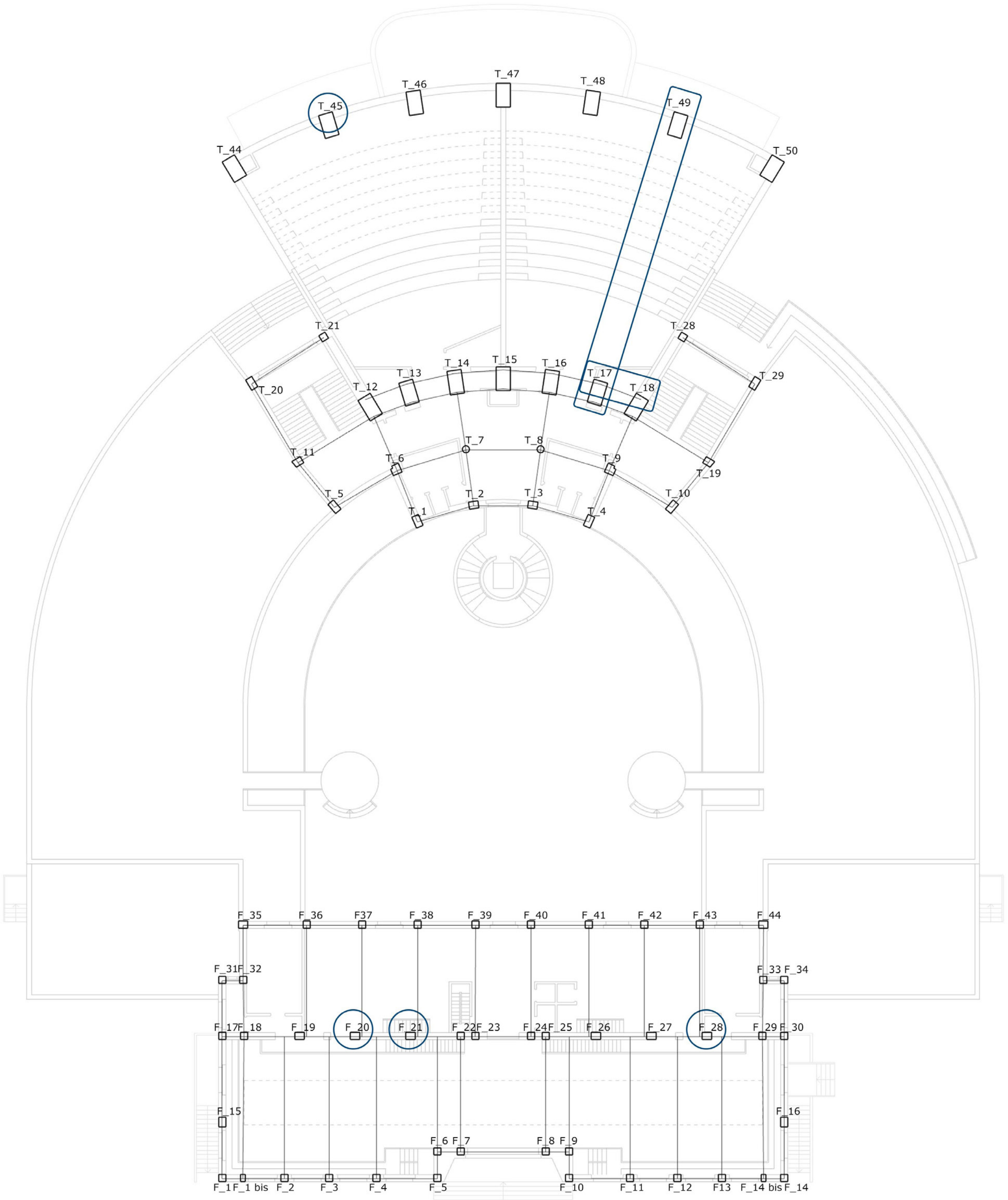


Figure 11 - Structural elements identification numbers and location of the rebar locating tests, third level (© Martella 2020)

A specific record card has been prepared to draw sketches and collect data on site, then revised and interpreted. To this aim, dimensions measured with the caliper resulted particularly useful to acquire information about the reinforcement bar diameters. Compiled data sheets have been revised, redrawn and completed with a photographic survey. Some of them are shown in the following figures 12/35.
The final version of the sheets reports:

- information needed to identify the location of the element;
- measured cross section dimensions;
- number and dimension of reinforcing bars;
- spacing between bars and distance of the bars from the external surface.

This distance equals the thickness of the concrete cover, if the concrete surface is not plastered. Position of tested area from the floor (in case of columns) or from the closest wall (in case of beams) is also reported. Data related to the amount and position of rebars, together with the cross-section dimensions of reinforced concrete structural elements have been used for verification and assessment purposes in the following steps of the research. Measured data has been also integrated with those retrieved from the scarce existing historical documentation on structures, consisting of original plans and technical documentation.

In addition, rebar locating tests have been performed on the concrete top portal of the front building. These tests revealed that reinforcement is present only in the horizontal elements of the balustrade – as clearly visible in consequence of concrete spalling – which act as beams where reinforcement enhances bending strength, whereas the supporting blocks are not reinforced, as these are subject to vertical loads of modest entity. Because the instrument cannot detect very deep rebars, it is not possible to establish if inner rods are present to connect the balustrade to the roof structure.

Finally, the walls of the additions were tested to verify the presence of steel or reinforced-concrete columns. No metal mass has been detected, thus corroborating the hypothesis that the elevation of these parts relies on a masonry load-bearing structure or on steel frames that are embedded too deep within the wall to be detected. Further investigations, including adequately powerful ground penetration radar or destructive tests, would be necessary to clarify this point.

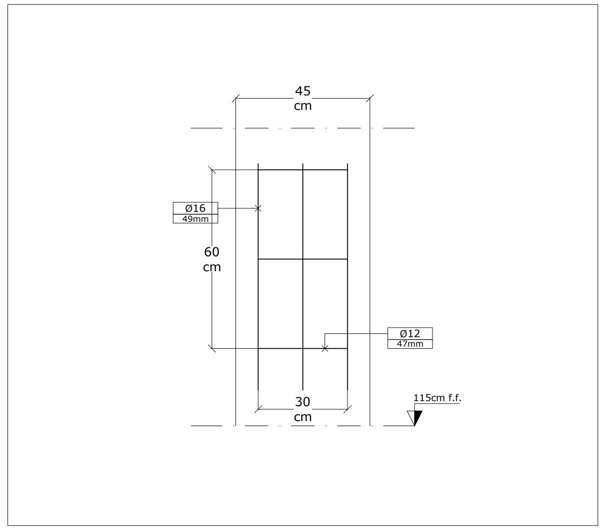
LEGEND:

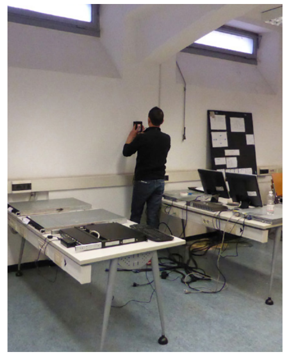
1 In brackets: Italian Element ID (used in photos)

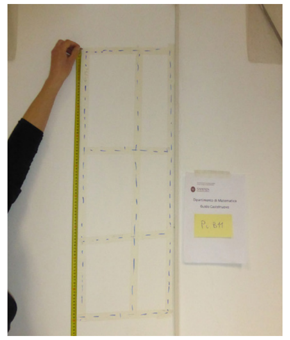
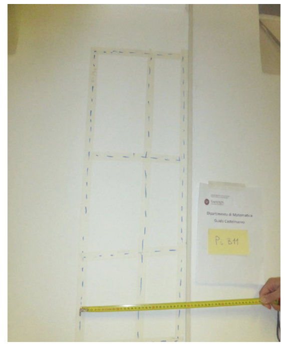
2 | Ø# | Bar diameter (millimeters)
  | #mm | distance of the bar from external surface (millimeters)

3 f.w. : from wall

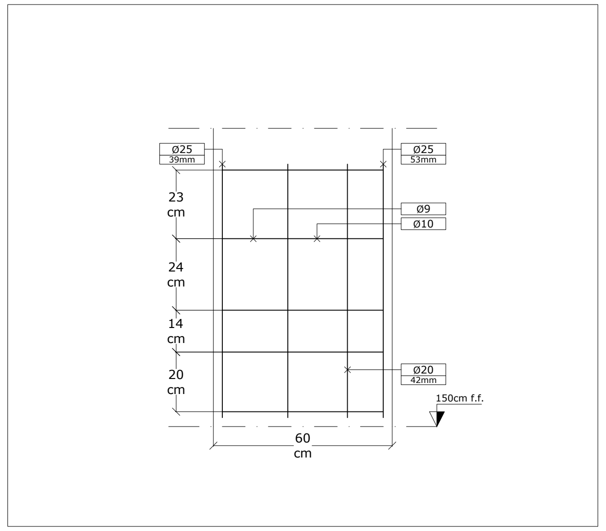
Date / Time	April-08-2019 / 5:15 p.m.
Block	Front
Level	Basement
Room ID	F_Bs_04
Element ID	F_11 (B.11)
Element type	Column
Photo	188 to 197



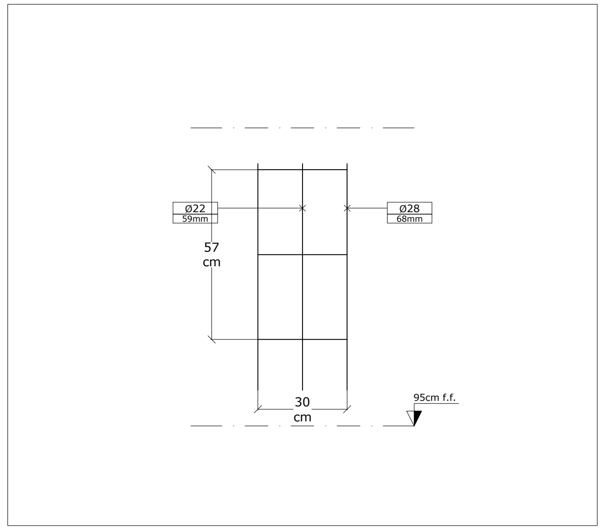


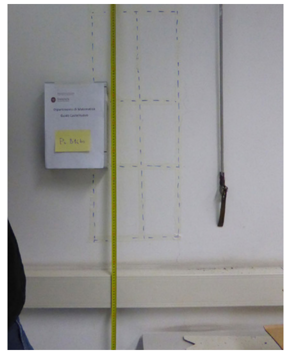
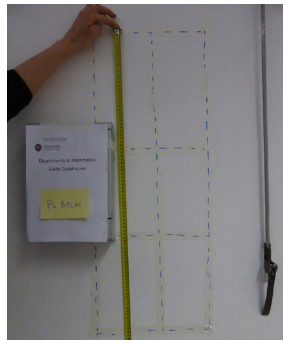
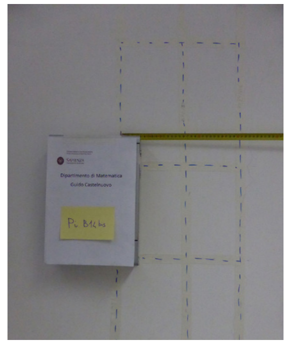



Date / Time	March-18-2019 / 11:06 a.m.
Block	Front
Level	Basement
Room ID	F_Bs_13
Element ID	F_41 (B.41)
Element type	Column
Photo	704 to 705

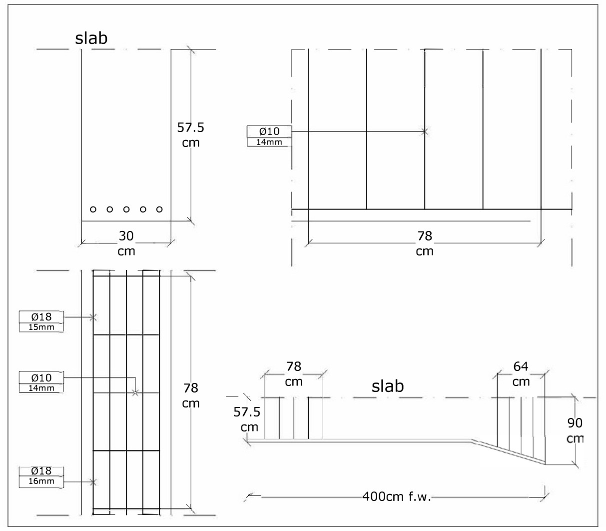



Date / Time	April-08-2019 / 5:15 p.m.
Block	Front
Level	Basement
Room ID	F_Bs_04
Element ID	F_14bis (B.14bis)
Element type	Column
Photo	183 to 187

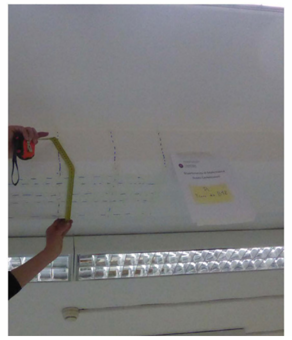


Date / Time	April-08-2019 / 5:35 p.m.
Block	Front
Level	Basement
Room ID	F_Bs_04
Element ID	F_12-F_27/_28 (B.12-B.27/.28)
Element type	Beam
Photo	198 to 209








Figures 12/15 - Rebar locating tests data sheets (© Martella 2020)

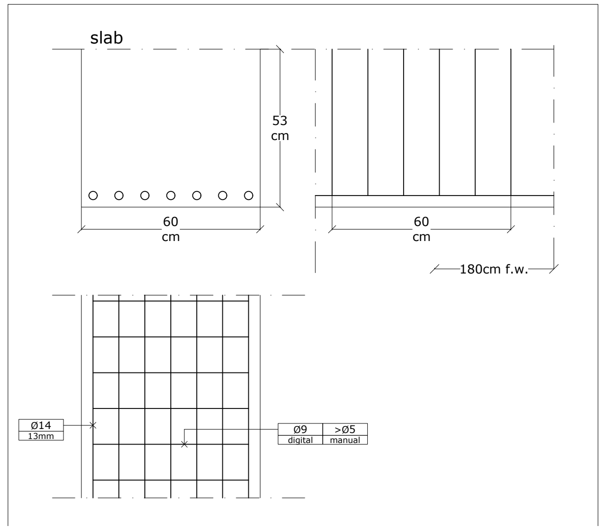
LEGEND:

1 In brackets: Italian Element ID (used in photos)

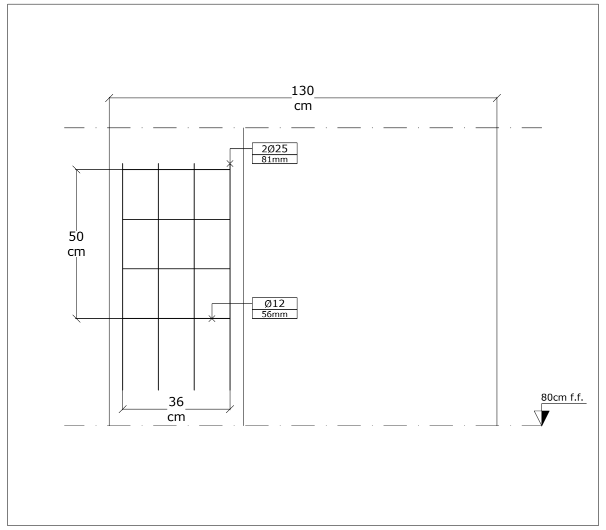
2 | Ø# | Bar diameter (millimeters)
  | #mm | distance of the bar from external surface (millimeters)

3 f.w. : from wall

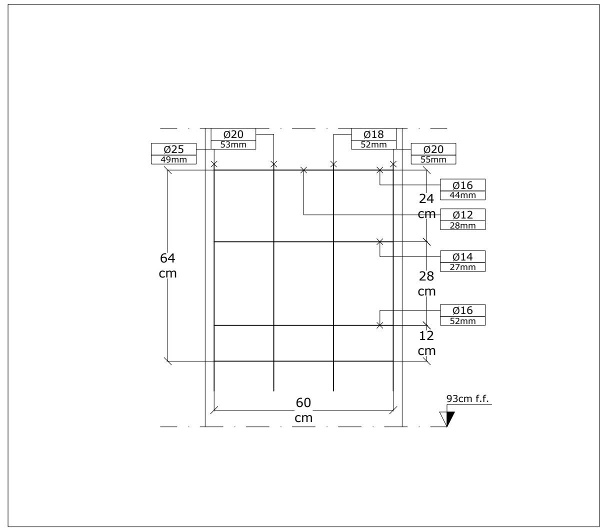
Date / Time	April-08-2019 / 4:35 p.m.
Block	Front
Level	Basement
Room ID	F_Bs_13
Element ID	F_41-F_42 (B.41-B.42)
Element type	Beam
Photo	164 to 165 / 170 to 182

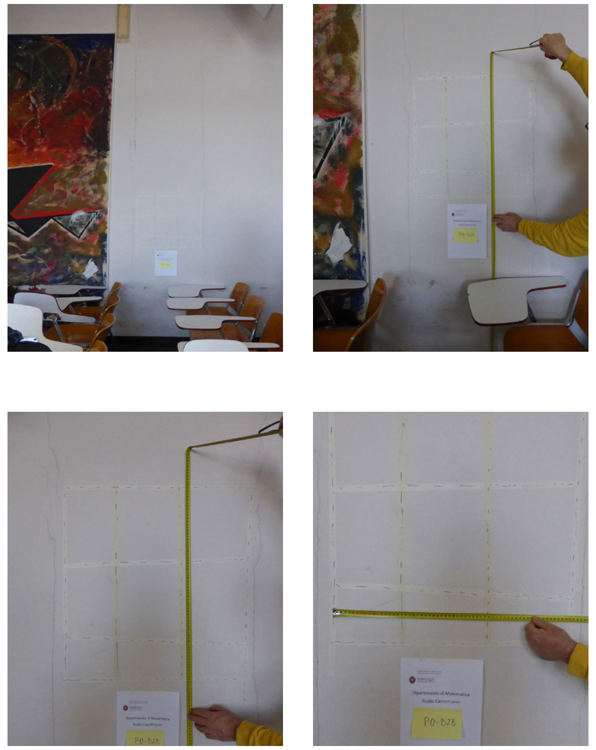


Date / Time	March-25-2019 / 11:45 a.m.
Block	Front
Level	Ground
Room ID	F_Gr_05
Element ID	F_29 (B.29)
Element type	Column
Photo	854 to 860

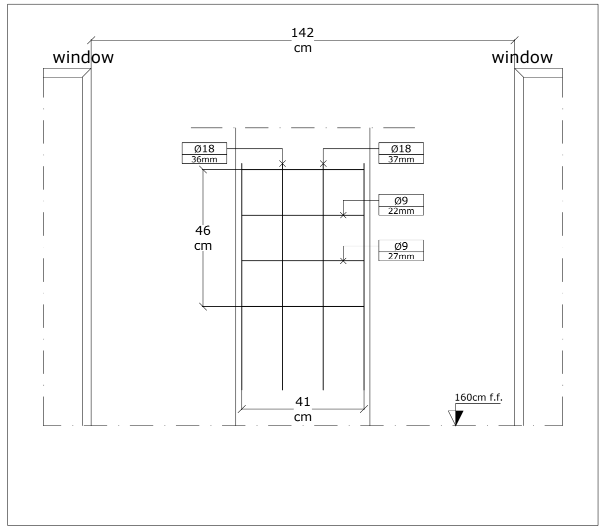


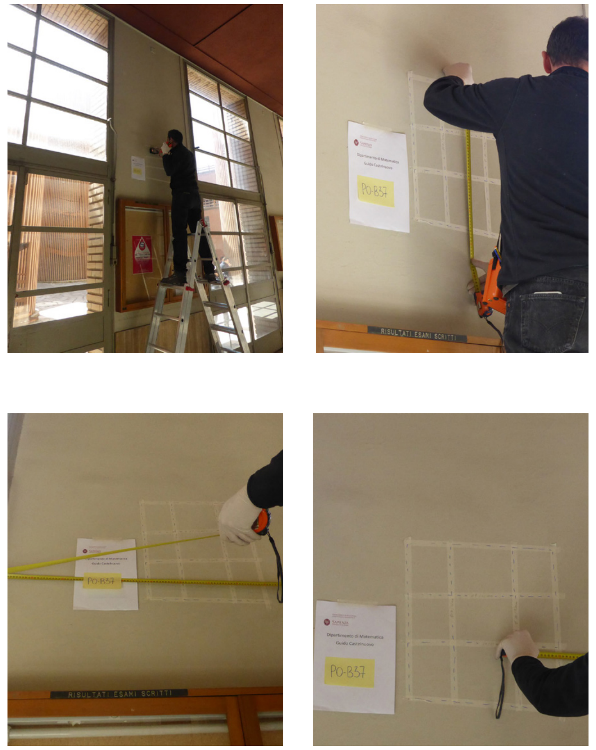
Date / Time	March-25-2019 / 12:10 a.m.
Block	Front
Level	Ground
Room ID	F_Gr_05
Element ID	F_28 (B.28)
Element type	Column
Photo	862 to 866





Date / Time	March-25-2019 / 10:45 a.m.
Block	Front
Level	Ground
Room ID	F_Gr_17
Element ID	F_37 (B.37)
Element type	Column
Photo	839 to 847





Figures 16/19- Rebar locating tests data sheets (© Martella 2020)

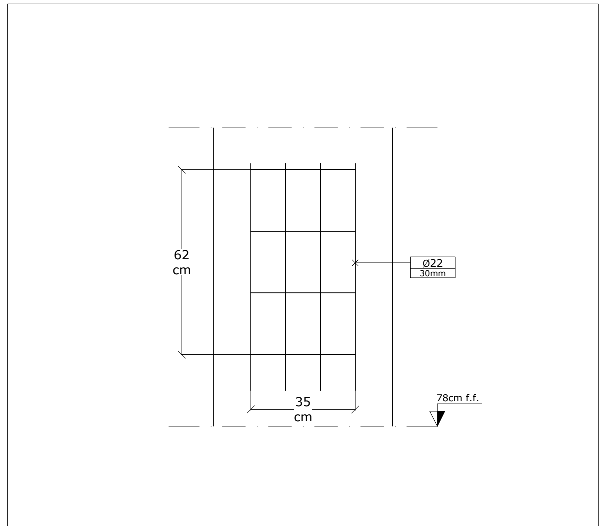
LEGEND:

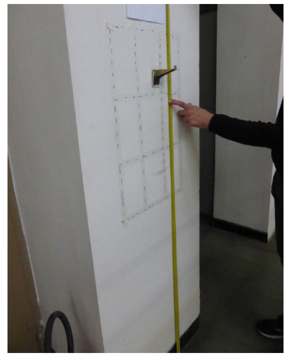
1 In brackets: Italian Element ID (used in photos)

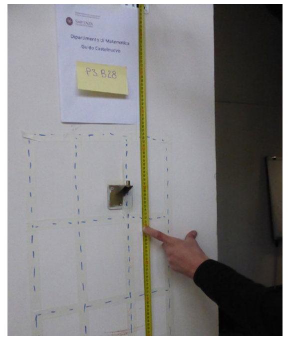
2 | Ø# | Bar diameter (millimeters) |
|---|---|
| #mm | distance of the bar from external surface (millimeters) |

3 f.w. : from wall

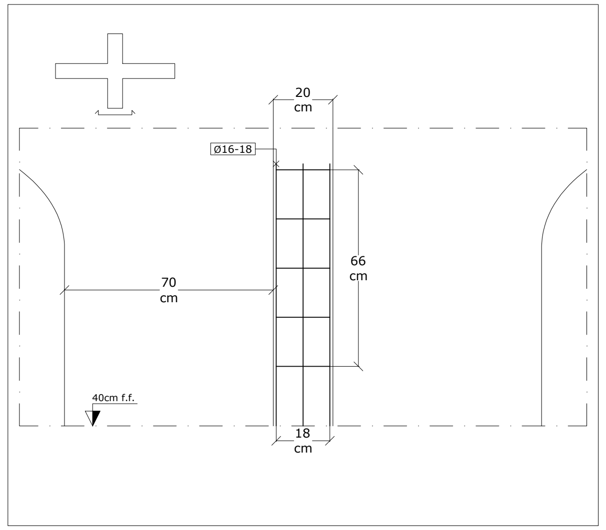
Date / Time	April-08-2019 / 11:45 a.m.
Block	Front
Level	Third
Room ID	F_Tr_06
Element ID	F_28 (B.28)
Element type	Column
Photo	126 to 135



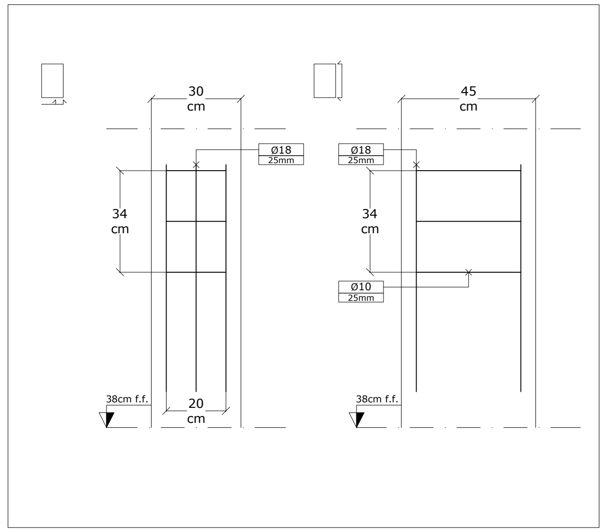


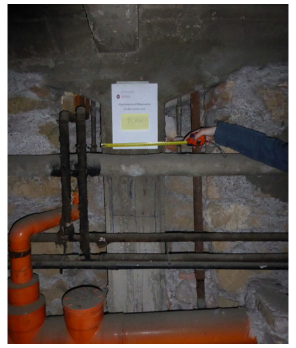


Date / Time	March-27-2019 / 12:16 a.m.
Block	Wing East
Level	Basement
Room ID	WE_Bs_01
Element ID	WE_12 (AS.12)
Element type	Column
Photo	953 to 955 / 958 / 959 / 961 to 963

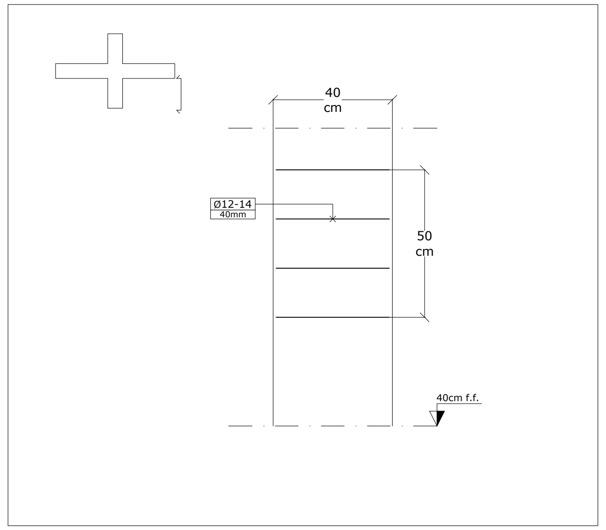


Date / Time	March-27-2019 / 2:50 p.m.
Block	Wing East
Level	Basement
Room ID	WE_Bs_01
Element ID	WE_2 (AS.2)
Element type	Column
Photo	966 to 968





Date / Time	March-27-2019 / 12:16 a.m.
Block	Wing East
Level	Basement
Room ID	WE_Bs_01
Element ID	WE_12 (AS.12)
Element type	Column
Photo	953 to 955 / 958 / 959 / 961 to 963



Figures 20/23 - Rebar locating tests data sheets (© Martella 2020)

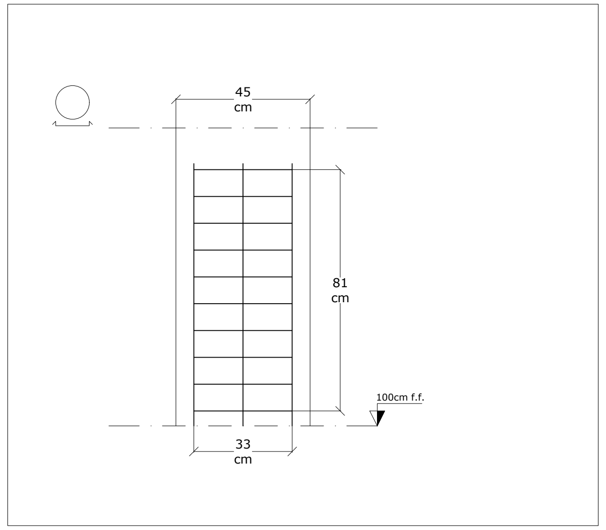
LEGEND:

1 In brackets: Italian Element ID (used in photos)

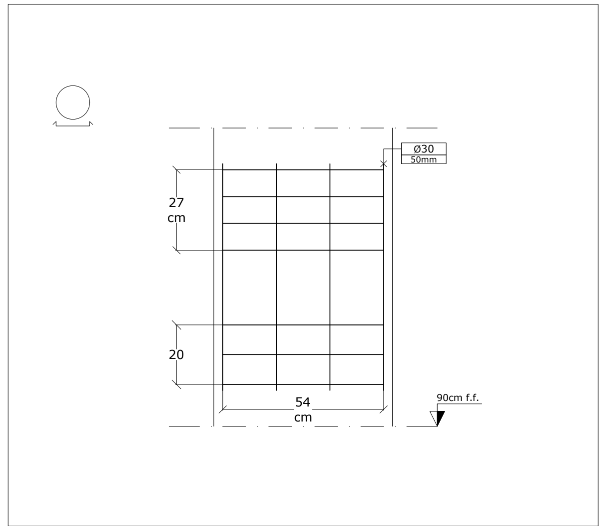
2 Ø# Bar diameter (millimeters)
#mm distance of the bar from external surface (millimeters)

3 f.w. : from wall

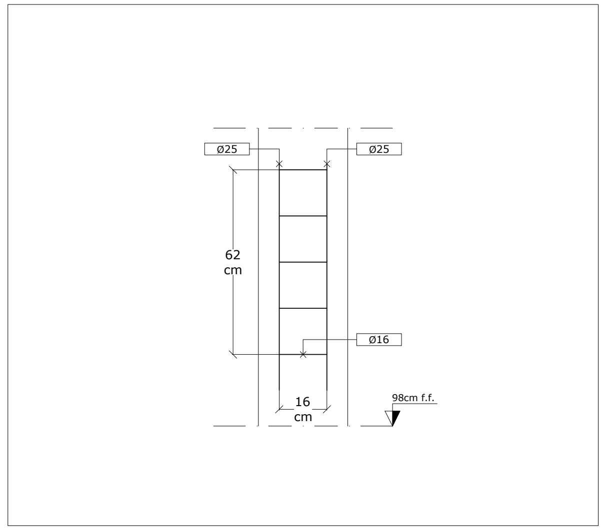
Date / Time	March-25-2019 / 2:45 p.m.
Block	Wing East
Level	Ground
Room ID	WE_Gr_02
Element ID	WE_9 (AS.9)
Element type	Column
Photo	15.31.54 / 15.31.55 / 15.32.02 / 877 to 881

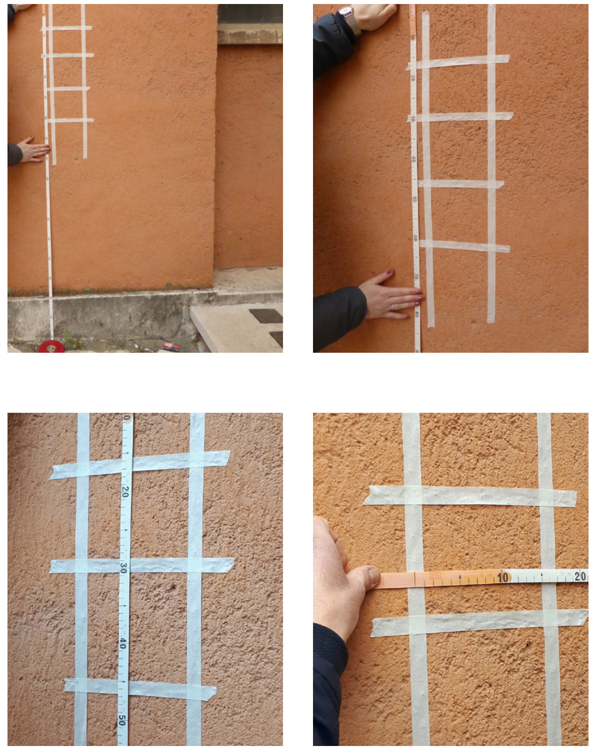


Date / Time	March-18-2019 / 12:15 a.m.
Block	Wing East
Level	Ground
Room ID	WE_Gr_03
Element ID	WE_22 (AS.22)
Element type	Column
Photo	735 / 737 to 741 / 744 to 746 / IMG_1120 to 1124

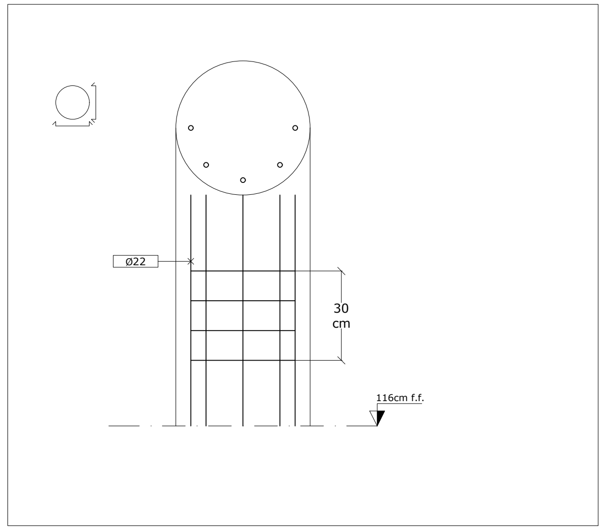


Date / Time	March-18-2019 / 12:30 a.m.
Block	Wing East
Level	Ground
Room ID	CY_Gr_01
Element ID	WE_14 (AS.14)
Element type	Column
Photo	795 to 796 / 13.22.41 / 13.22.55 / 13.23.15





Date / Time	April-05-2019 / 12:15 a.m.
Block	Tower
Level	First
Room ID	WE_Fr_02
Element ID	WE_8 (AS.8)
Element type	Column
Photo	007 to 016



Figures 24/27 - Rebar locating tests data sheets (© Martella 2020)

LEGEND:

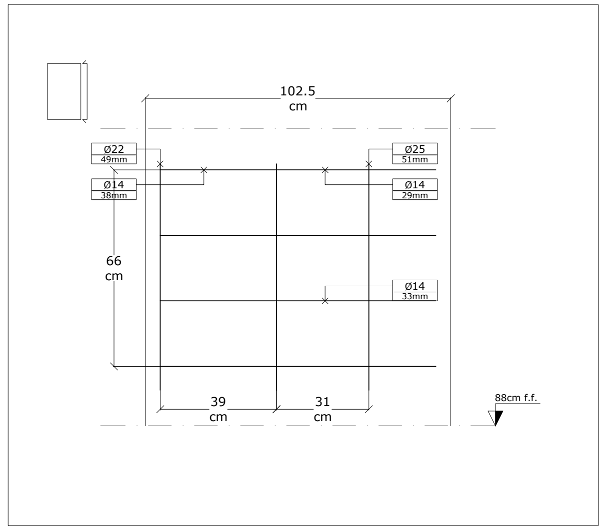
1 In brackets: Italian Element ID (used in photos)

2

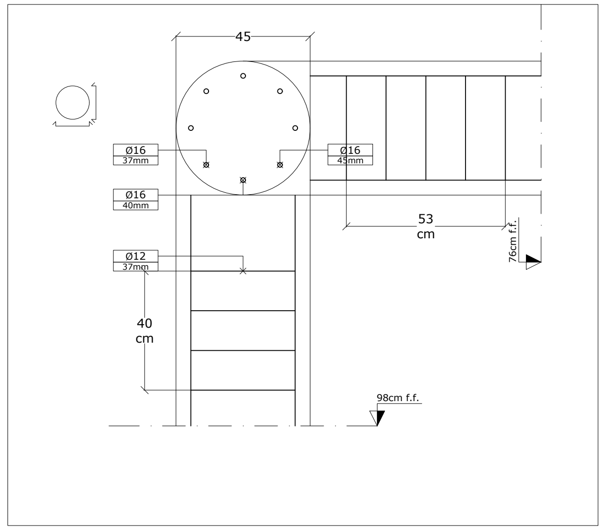
Ø#	Bar diameter (millimeters)
#mm	distance of the bar from external surface (millimeters)

3 f.w. : from wall

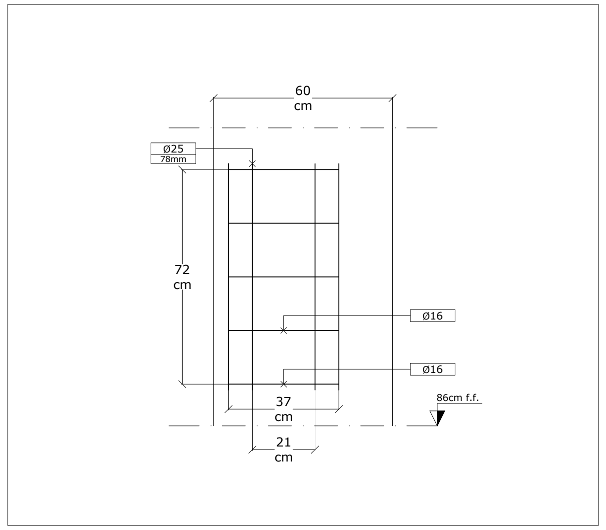
Date / Time	March-25-2019 / 8:25 a.m.
Block	Tower
Level	Ground
Room ID	T_Gr_02
Element ID	T_45 (T.45)
Element type	Column
Photo	809 to 817



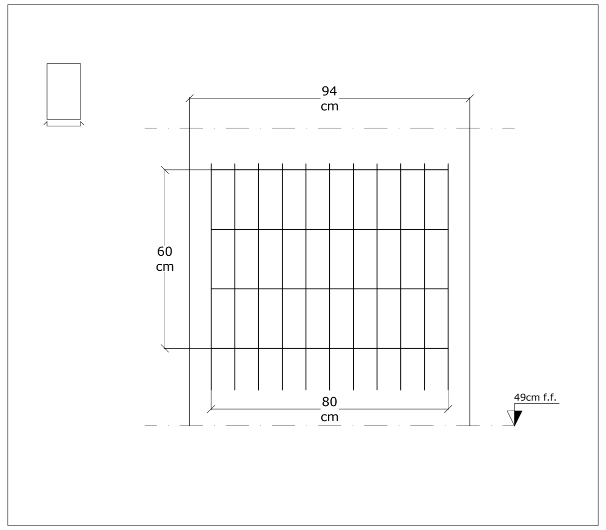
Date / Time	April-05-2019 / 4:45 p.m.
Block	Tower
Level	First
Room ID	T_Fr_02
Element ID	T_7 (T.7)
Element type	Column
Photo	061 to 071



Date / Time	April-05-2019 /4:10 p.m.
Block	Tower
Level	First
Room ID	T_Fr_02
Element ID	T_2 (T.2)
Element type	Column
Photo	055 to 060



Date / Time	April-05-2019 / 3:00 p.m.
Block	Tower
Level	First
Room ID	T_Fr_02
Element ID	T_14 (T.14)
Element type	Column
Photo	046 to 054



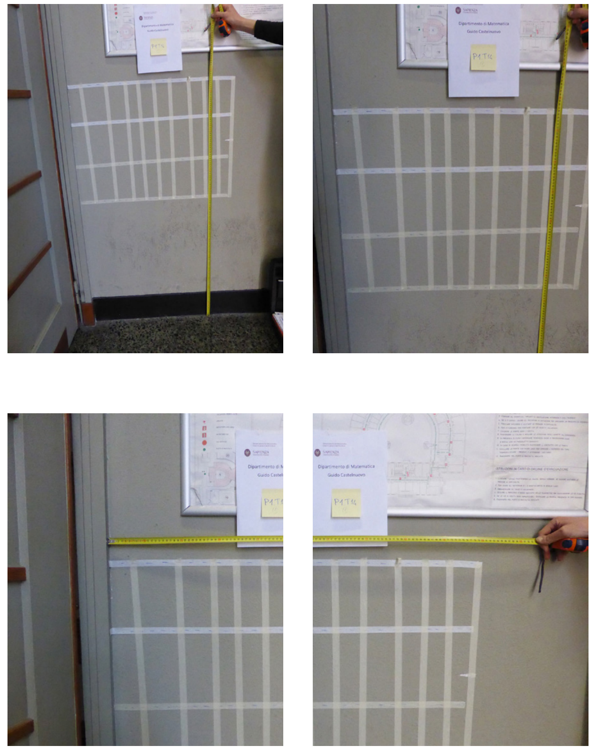


Figure 28/31 - Rebar locating tests data sheets (© Martella 2020)

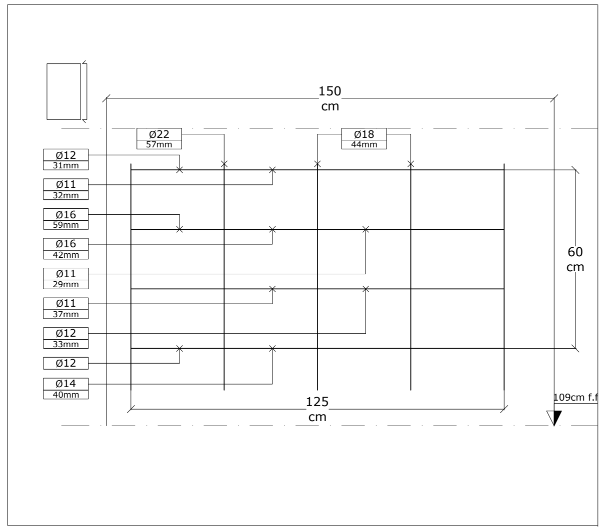
LEGEND:

1 In brackets: Italian Element ID (used in photos)

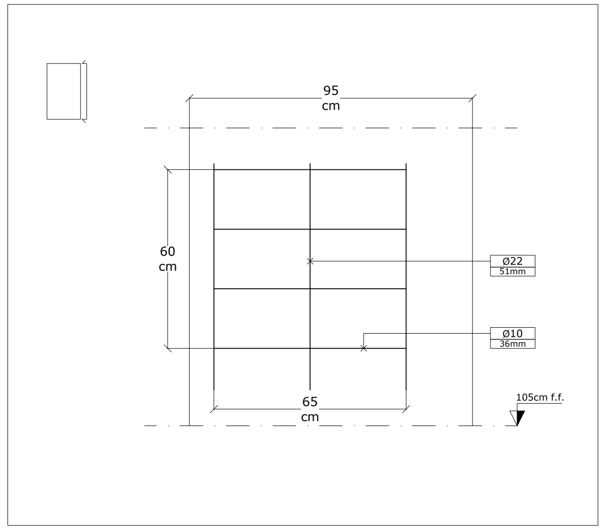
2 | Ø# | Bar diameter (millimeters)
  | #mm | distance of the bar from external surface (millimeters)

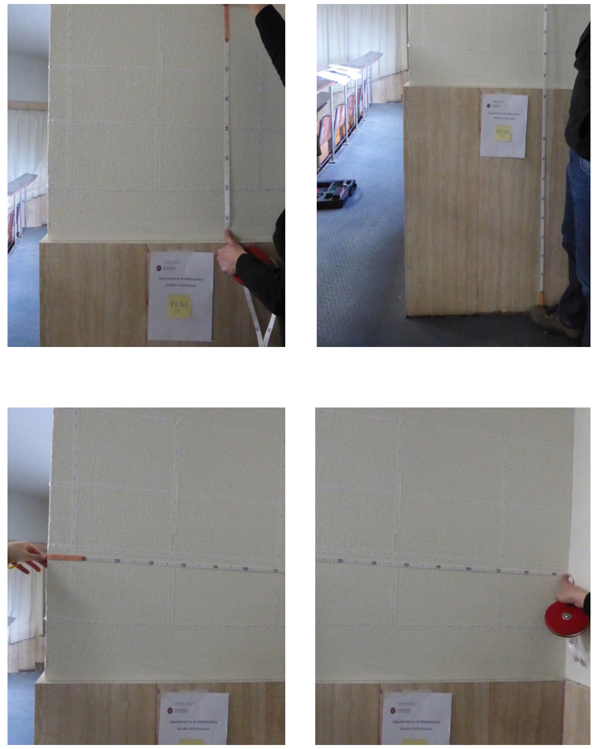
3 f.w. : from wall

Date / Time	April-05-2019 / 3:00 p.m.
Block	Tower
Level	First
Room ID	T_Fr_05
Element ID	T_14 (T.14)
Element type	Column
Photo	046 to 054

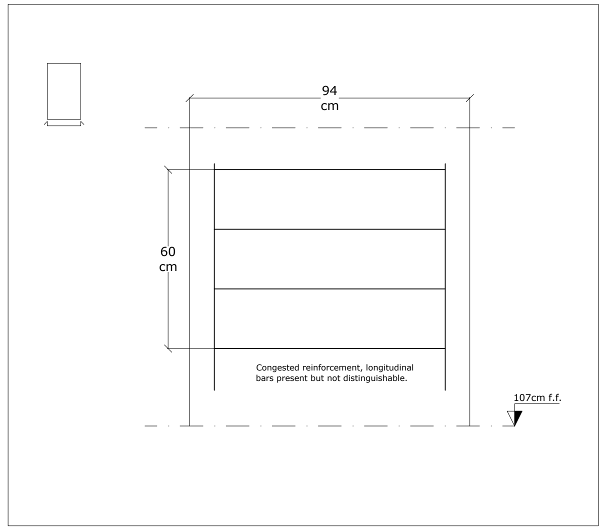


Date / Time	April-05-2019 / 1:20 p.m.
Block	Tower
Level	First
Room ID	T_Fr_11
Element ID	T_45 (T.45)
Element type	Column
Photo	029 to 044

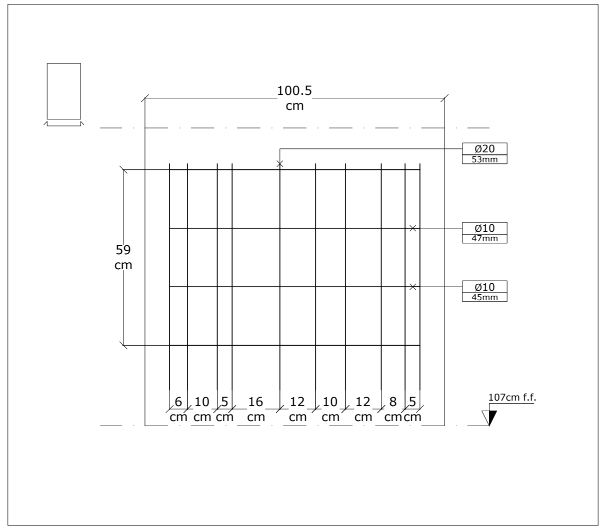




Date / Time	April-05-2019 / 1:20 p.m.
Block	
Level	First
Room ID	T_Fr_11
Element ID	T_45 (T.45)
Element type	Column
Photo	029 to 044



Date / Time	March-27-2019 / 8:35 a.m.
Block	Tower
Level	Third
Room ID	T_Tr_11
Element ID	T_45 (T.45)
Element type	Column
Photo	897 / 900 to 910



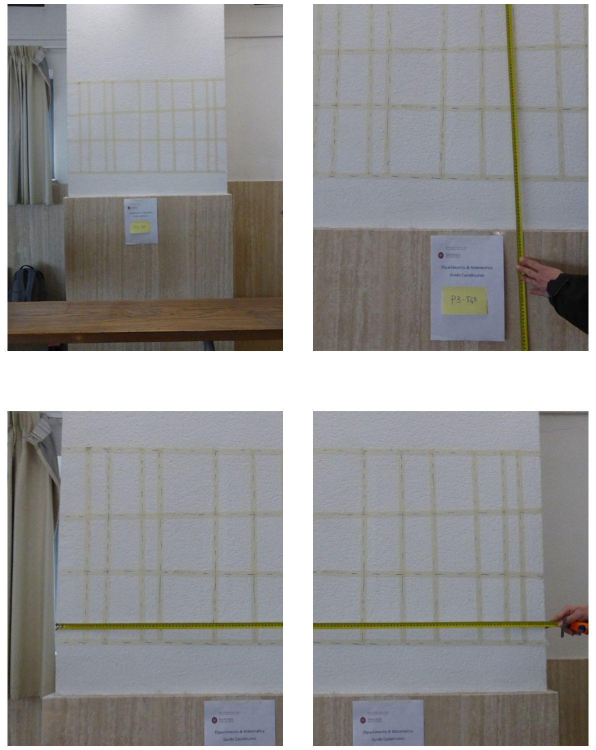


Figure 32/35 - Rebar locating tests data sheets (© Martella 2020)

Structural analysis

Introduction

The School of Mathematics was built between 1934 and 1935, with their foundations being designed and built in 1934. Therefore, the structural design had to comply with the Royal Decree "Rules for the acceptance of hydraulic binders and for the execution of concrete structures" [RDL 1213/1933].

Nowadays, new buildings must comply with the rules of the code in force: Decree of January 17, 2018, "Technical Standard for Constructions" [NTC 2018], and relevant explanatory document published by the Higher Council of the Public Works [Circolare del Ministero delle Infrastrutture e dei Trasporti 7/2019].

It is evident that the 1933 regulation is completely different from the current one under many aspects. Methods adopted for the structural design of the building reflect the knowledge of the time. For instance, the design of structural elements was based on the so-called allowable stress method, in which elements of the structure were sized and reinforced in such a way that the internal stress induced by the loads at any point did not exceed threshold values, depending on the material. Nowadays, the standard in force (NTC 2018) resorts to the semi-probabilistic limit state method, in which different limit states are considered: the structure must be able to meet functional performance (service limit states) and strength performance (ultimate limit states, ULSs) associated to different values of the applied actions, i.e. the effect of such actions (internal forces, displacements, deformations) must not exceed the limit values of each limit state.

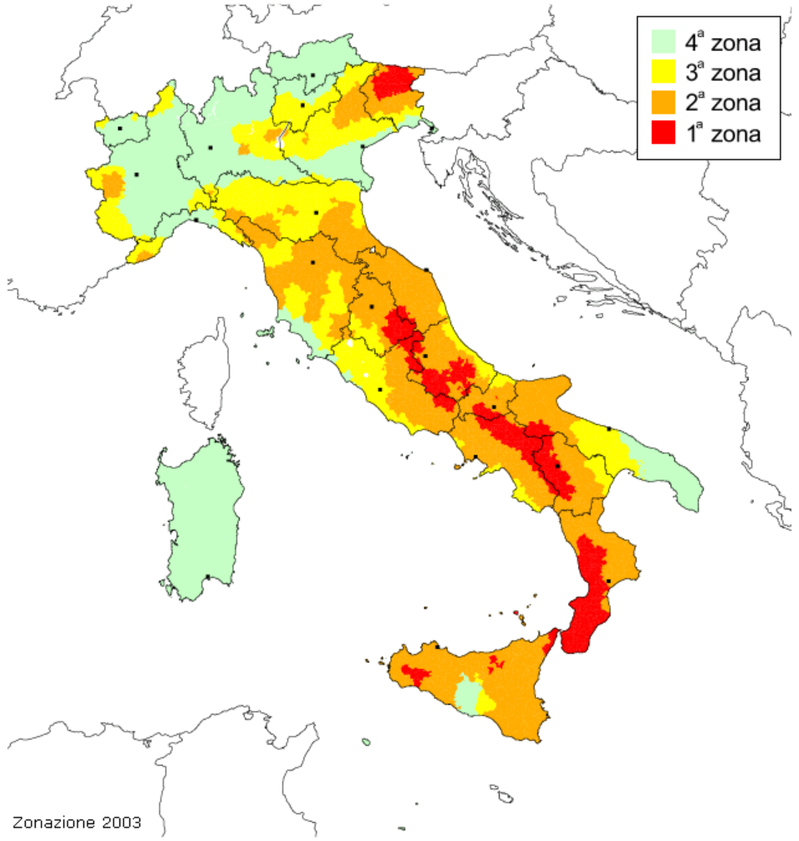
Another significant aspect, probably one of the most important, is that under the current code seismic action needs to be considered for any location in Italy, whereas when the School of Mathematics was built few zones were considered seismic-prone areas and Rome was not among them.

The seismic classification has been updated several times in the last century [Mollaioli 2018, Oliveto 2011]. Since the 1908 Messina and Southern Calabria earthquake until 1974, municipalities were classified as seismic prone and subjected to specific construction standards only after being severely damaged by earthquakes. In 1981, the national territory was reclassified in three seismic zones, which, however, covered only half of the country (Figure 36). After the 2002 Molise earthquake, the whole country was again reclassified in four seismic zones [OPCM 3274/2003] (Figure 37). Finally, following am ad hoc study [Stucchi 2004] (Figure 38), the expected maximum acceleration at the site is no longer defined by the seismic zones but considered a function of: geographic coordinates of the site, return period and different percentiles of the spectral ordinates confidence level, i.e. 16th, 50th and 84th [NTC 20088]. A brief summary of this evolution is presented in Table 2.

Two different numerical models of the buildings were here developed in order to take the transformations of the building and the code updates (seismic zones, methods, etc.) in due account. The first model considers the building in its original condition and layout (as of 1935) and analyses it under the effect of vertical loads, as prescribed at the time of construction. The second model considers the building in its current condition and layout (2021) and analyses it also considering the seismic actions prescribed by the current building code, as better specified in the following section.

Year	Modification to codes
1909	One seismic zone (limited to a small part of Italy) with earthquake loads depending on the building height; contains prescriptions about building dimensions and distances.
1927	Introduction of a second seismic zone; earthquake loads depend on the building height.
1937	Change in the seismic coefficient (earthquake load).
1962	Seismic coefficient in zone 2 increased.
1975	Introduction of a response spectrum, constant values (equal to the 1962 seismic coefficient) up to 0.8 s and decreasing hyperbolic curve for higher periods.
1984-1986	Introduction of a third seismic zone (Figure 62), significant increment of the number of municipalities classified as seismic prone.
1996	Introduction of the limit states method, as alternative to the allowable stress method (both methods were permitted).
2003	Introduction of a fourth seismic zone; the entire territory is included in the seismic classification (Figure 63). Introduction of the capacity design method. Spectrum shape derived from Eurocode 8.
2008	Technical Standard for Constructions. Site-specific peak ground and spectral accelerations defined for different probability of exceedance according to a classification proposed in 2004 (Figure 64).
2018	Revision of the 2008 Technical Standard; response spectra are the same as in the previous code.

Table 2 - Evolution of the Italian Seismic Code during the 20th century.



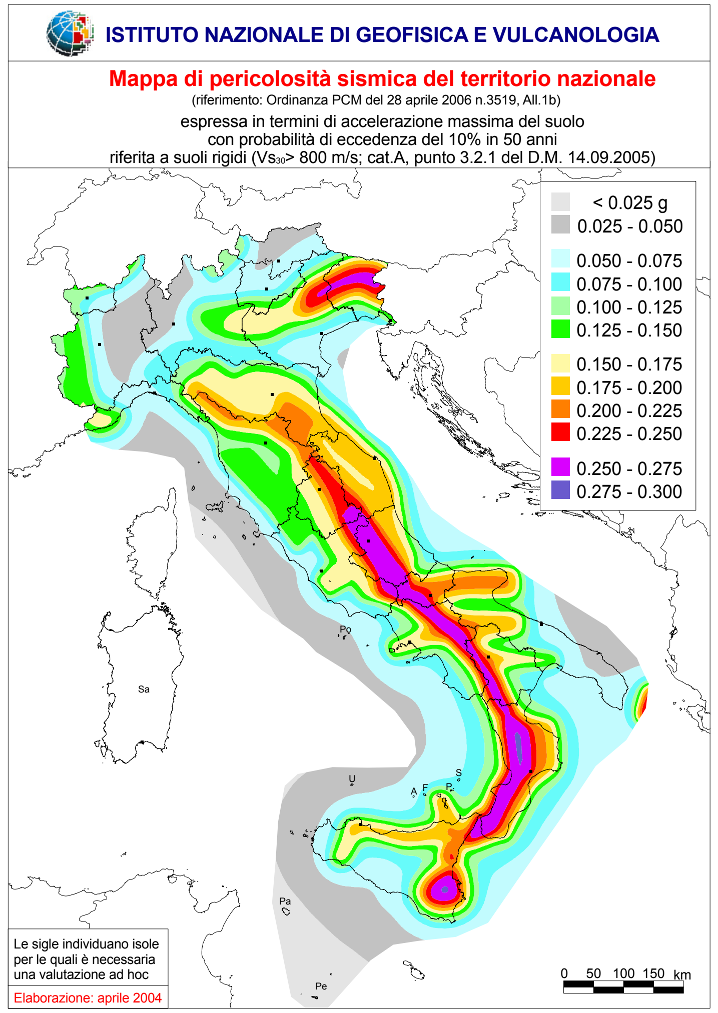


Figure 36 - Seismic classification in 1984 (BBL_drw_17)

Figure 37 - Seismic classification in 2003 (BBL_drw_18)

Figure 38 - Seismic classification in 2004 (BBL_drw_19)

Numerical analysis

The two 3D models of the frame structure were implemented within a finite-element computer program [Analysis Reference Manual SAP2000 2009] in order to calculate the internal forces due to different load combinations.

The first model makes reference to drawings dated 1934 and 1935 as well as direct surveys. Major modifications of the second model, with respect to the first one, are the slab placed in 1954 to separate the "Atrio dell'appartamento dei professori" (lobby of the accommodation of the professors) from the library reading hall and the addition in 1974 of the two volumes to the front of the curved wings; moreover, installations added in 1995 to comply with regulations are considered as applied loads. The three fire-escape staircases built in the inner courtyard in 1985 are not included in the model, being irrelevant to the global structural evaluation.

Both models were implemented making use of frame elements to represent columns and beams as well as shell elements for the modeling of slabs and unreinforced masonry walls of the two additions. The use of these elements required knowledge of geometrical characteristics and material mechanical properties of the considered elements. These parameters were estimated on the base of gathered data, as described in the previous sections. For instance, the value of the concrete elastic modulus is approximately determined by means of historical technical documentations and past codes, whereas geometrical measurements are based on the historical documentation and on direct surveys.

The model of the 1935 building was analyzed under gravity loads only, the obtained section forces (axial and shear forces as well as bending moments) were used to design the steel reinforcements. This assessment helped to either corroborate or reinterpret the data obtained with the rebar locator testing.
The model representing the 2021 building was studied considering also seismic actions. For these analyses, the seismic action was determined according to the soil characteristics, which noticeably affects the seismic wave transmission. In order to obtain the seismic action for the site, geological investigation and geotechnical analyses were preliminary performed, as reported in detail in section "Geotechnical investigation and seismic site response analysis".

The 1935 layout

1. Building code, technical literature and construction practice at the time of design

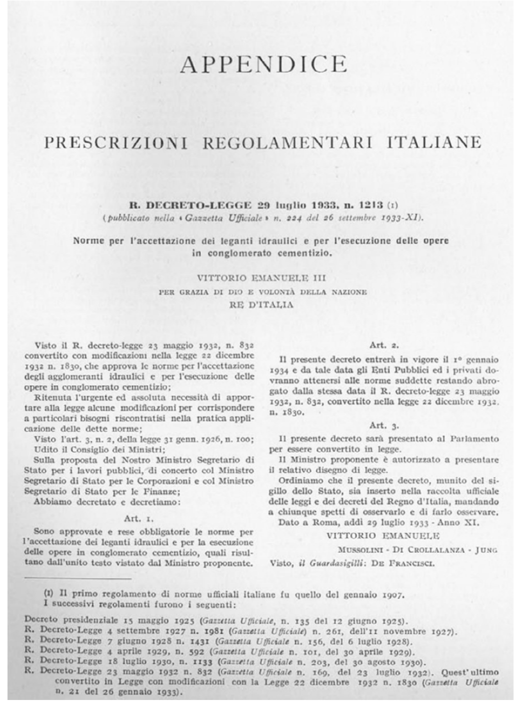
As mentioned above, the Royal Decree n° 1213 of 1933 was in force when the building was designed and built. The study of indications and prescription included in this code was useful to integrate the knowledge of the building as we assume that design and construction complied with prescriptions encompassed in the code. Main data is summarized in the following.

Requirements for materials

- Compressive strength of Portland cement after 28 days must not be less than 45 MPa;
- Compressive strength of high-strength Portland cement after 28 days must not be less than 60 MPa;
- Compressive strength of concrete after 28 days must not be less than 30 MPa;
- Compressive strength of concrete is determined by experimental tests on four cubic specimens. The material strength is estimated as the average of the three highest results;
- Reinforcement is made of bars of cast and homogeneous steel without defects, cracks, burns and voids;
- Tensile strength of steel is determined by experimental tests on specimens having length equal to ten times the rebar diameter;
- Tensile strength of steel must be between 380 and 500 MPa, and the failure strain between 27 and 21%, respectively.

Maximum values of allowed stress

- Stress in concrete subjected to compression usually shall not exceed a quarter of the compressive strength at 28 days;
- Stress in steel rebars under tension shall not exceed 120 MPa.



APPENDICE

PRESCRIZIONI REGOLAMENTARI ITALIANE

R. DECRETO-LEGGE 29 luglio 1933, n. 1213 (1)
(*pubblicato nella «Gazzetta Ufficiale» n. 224 del 26 settembre 1933-XI*).

Norme per l'accettazione dei leganti idraulici e per l'esecuzione delle opere in conglomerato cementizio.

VITTORIO EMANUELE III
PER GRAZIA DI DIO E VOLONTÀ DELLA NAZIONE
RE D'ITALIA

Visto il R. decreto-legge 23 maggio 1932, n. 832 convertito con modificazioni nella legge 22 dicembre 1932 n. 1830, che approva le norme per l'accettazione degli agglomeranti idraulici e per l'esecuzione delle opere in conglomerato cementizio;

Ritenuta l'urgente ed assoluta necessità di apportare alla legge alcune modificazioni per corrispondere a particolari bisogni riscontratisi nella pratica applicazione delle dette norme;

Visto l'art. 3, n. 2, della legge 31 genn. 1926, n. 100;

Udito il Consiglio dei Ministri;

Sulla proposta del Nostro Ministro Segretario di Stato per i lavori pubblici, di concerto col Ministro Segretario di Stato per le Corporazioni e col Ministro Segretario di Stato per le Finanze;

Abbiamo decretato e decretiamo:

Art. 1.

Sono approvate e rese obbligatorie le norme per l'accettazione dei leganti idraulici e per la esecuzione delle opere in conglomerato cementizio, quali risultano dall'unito testo vistato dal Ministro proponente.

Art. 2.

Il presente decreto entrerà in vigore il 1° gennaio 1934 e da tale data gli Enti Pubblici ed i privati dovranno attenersi alle norme suddette restando abrogato dalla stessa data il R. decreto-legge 23 maggio 1932, n. 832, convertito nella legge 22 dicembre 1932, n. 1830.

Art. 3.

Il presente decreto sarà presentato al Parlamento per essere convertito in legge.

Il Ministro proponente è autorizzato a presentare il relativo disegno di legge.

Ordiniamo che il presente decreto, munito del sigillo dello Stato, sia inserto nella raccolta ufficiale delle leggi e dei decreti del Regno d'Italia, mandando a chiunque spetti di osservarlo e di farlo osservare.

Dato a Roma, addì 29 luglio 1933 - Anno XI.

VITTORIO EMANUELE

MUSSOLINI - DI CROLLALANZA - JUNG

Visto, *il Guardasigilli*: DE FRANCISCI.

(1) Il primo regolamento di norme ufficiali italiane fu quello del gennaio 1907.
I successivi regolamenti furono i seguenti:

Decreto presidenziale 15 maggio 1925 (*Gazzetta Ufficiale*, n. 135 del 12 giugno 1925).
R. Decreto-Legge 4 settembre 1927 n. 1981 (*Gazzetta Ufficiale*) n. 261, dell'11 novembre 1927).
R. Decreto-Legge 7 giugno 1928 n. 1431 (*Gazzetta Ufficiale* n. 156, del 6 luglio 1928).
R. Decreto-Legge 4 aprile 1929, n. 592 (*Gazzetta Ufficiale* n. 101, del 30 aprile 1929).
R. Decreto-Legge 18 luglio 1930, n. 1133 (*Gazzetta Ufficiale* n. 203, del 30 agosto 1930).
R. Decreto-Legge 23 maggio 1932 n. 832 (*Gazzetta Ufficiale* n. 169, del 23 luglio 1932). Quest'ultimo convertito in Legge con modificazioni con la Legge 22 dicembre 1932 n. 1830 (*Gazzetta Ufficiale* n. 21 del 26 gennaio 1933).

Figure 39 a/b - Technical code in force a) and Engineer's technical manual popular (BBL_pht_44); b) at the time of construction (BBL_pht_45)

Rules for static calculations and construction

- Specific weight of the reinforced concrete is usually assumed equal to 24 kN/m³;
- Longitudinal reinforcement area of columns subjected to axial loads must not be less than 1% of the column cross section for sections having an area less than or equal to 1600 cm², and 0.7% for sections having an area greater than or equal to 6400 cm², for intermediate sections the above percentage will vary according to a linear law.
- Transversal ties in columns must be distributed at a short distance, never greater than the smaller side of the column section, nor to ten times the diameter of the longitudinal rebars;
- Normal modulus of elasticity of concrete is assumed equal to 20 GPa.

The Engineer's Technical Manual [Colombo 1933], was a fundamental tool for structural design in the 1930s. It included methods and schemes to be adopted and other data not explicitly reported in regulations. For instance, values of live load (q_k) to be applied to slabs for structural verifications are specified:

- attic rooms: q_k = 0.8-1.0 kPa
- roofs: q_k = 1.1-1.6 kPa
- residential rooms: q_k = 2.0-2.5 kPa
- ballrooms and meeting rooms: q_k = 3.0-5.0 kPa
- factories with machines: q_k = 3.0-15.0 kPa
- storage buildings: q_k = 5.0-25.0 kPa

Observed evidence of the age of the structure is also the presence of plain rebars and inadequate transverse reinforcement in columns. Moreover, other typical (yet not directly surveyed) drawbacks found in existing reinforced concrete buildings, resulting in poor structural behavior are:

- non-ductile detailing in beam–columns joints, including poor or absent confining reinforcement;
- inadequate lap splices;
- transverse reinforcement not adequately anchored around the longitudinal rebars.

2. Modeling considerations

Frame elements are linear elements which connect two nodes. Biaxial bending, torsion, axial force, and biaxial shear are considered in the characterization of the mechanical behavior. A frame element is completely defined by its geometry and by the material mechanical characteristics. The beam-column joints are modeled by means of rigid elements (offsets). Shell elements are three or four-node area objects and their geometry is defined by in-plane contour and by thickness. Because analyses are carried out in the linear range, the unique datum required to define material deformability is the elastic modulus. Concerning the constraints, elements are fully restrained at the base while the internal hinges of the long beams of the tower of classrooms are modeled by resorting to the moment release option. A schematic view of the model is reported in Figure 40.

Dead loads are calculated based on the weight per unit volume of the materials, whereas live loads applied to slabs are derived from those indicated in the 1933 Engineer's Technical as follows:

- office rooms: q_k = 3 kPa;
- classrooms: q_k = 3 kPa;
- library and storage rooms: q_k = 5 kPa;
- roof: q_k = 2 kPa.

Given that the roof was walkable, the load related to residential rooms was applied. The weight of internal partitions is considered as a distributed load per-unit area (pressure) whereas the weight of thicker walls (generally external enclosure masonry walls) is applied as uniformly distributed load per unit length. For the mixed slab of the curved wings, an equivalent reduced value of the thickness is employed, to obtain the correct load per-unit area.

A concrete C25/30 having an elastic modulus E = 31 476 MPa was considered for columns, beams, and slabs. For the mixed slab of the curved wings, a homogenized modulus was adopted to obtain the actual stiffness, taking into consideration both the presence of steel beams and of modified value of the thickness. Static linear analyses were performed to obtain internal forces (axial and shear forces, bending moment) used for the element sections design, i.e. to design the reinforcement. Modal analysis was carried out to evaluate the vibration modes and period of vibrations of the structure with the aim to compare such characteristics with those obtained for the building in its current configuration.

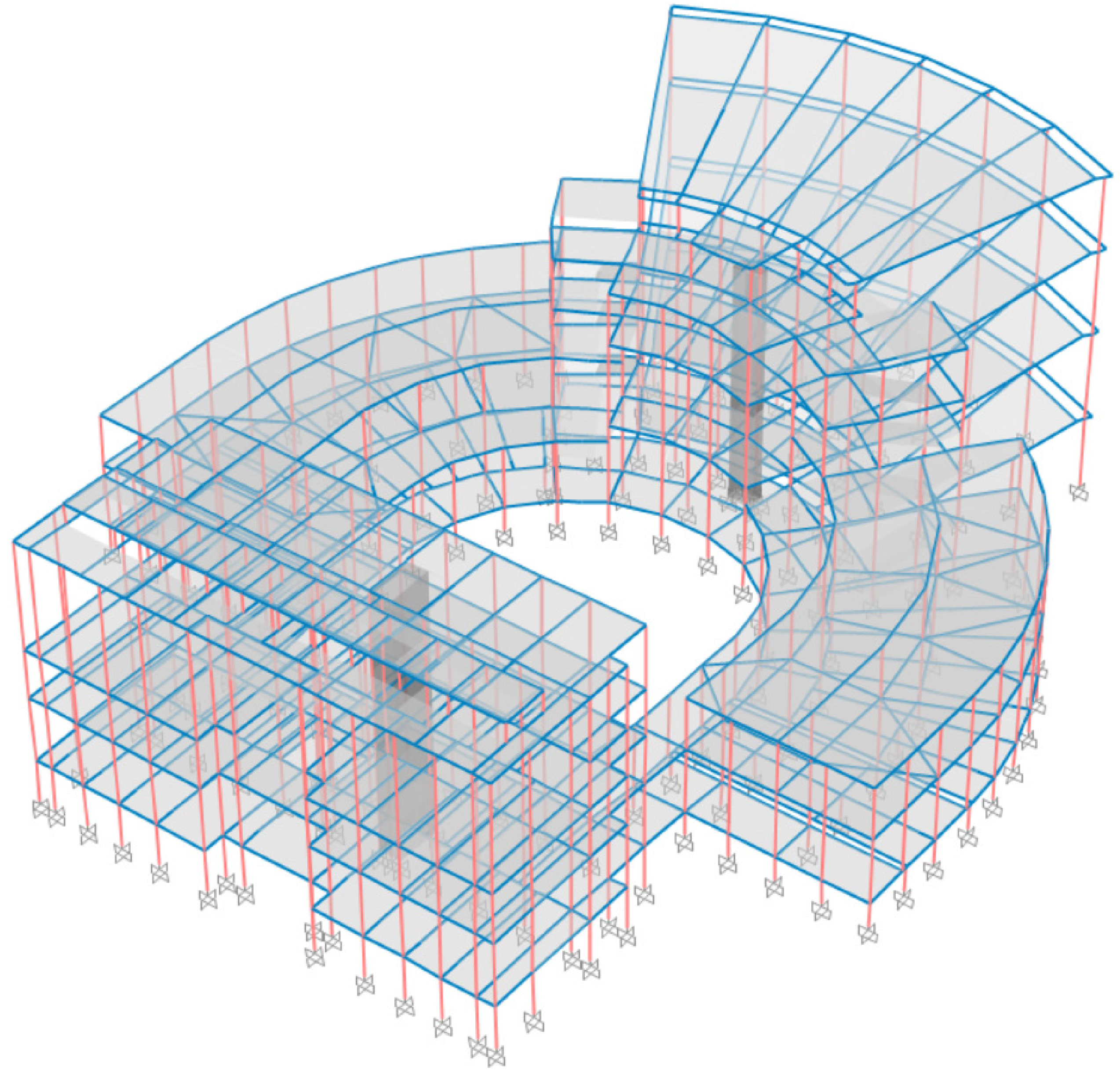


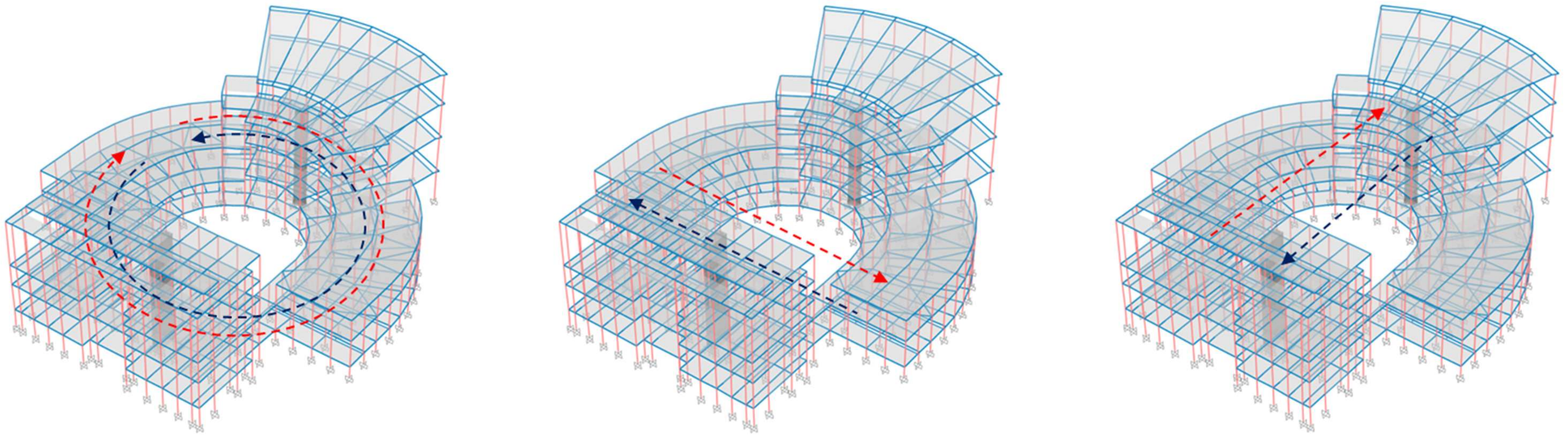
Figure 40 - 3D model of the building in its original configuration in 1935 (© Martella 2020)

3. Results of numerical analyses and member section design

The qualitative representation of the first three vibration modes obtained by the modal analysis is shown in Figure 41. Periods of vibration and modal participating mass ratios for the first twelve modes are reported in Table 3. Such values indicate that the first mode is mainly torsional, i.e. displacements follow the curvilinear contour of the tower of classrooms. However, a translational component in the x direction (direction parallel to main front) is also present. The second mode is mainly translational in the x direction. In this case, a rotational component is also present. Finally the third mode as well as the fourth one are translational in the y direction, i.e. in the direction normal to the main front. Higher modes involve masses not greater than 7% in each direction. Period of vibrations are equal to 0.60 s, 0.53 s and 0.50 s, for the first, second and third mode, respectively. It is worth mentioning that the numerical model does not include the stiffening effect of unreinforced masonry infill walls, the presence of which decreases the vibration periods. As for static analysis for each element type, i.e. beams and columns with different cross-section dimensions, the maximum internal forces are selected and used to design the reinforcement bars. Such forces are reported in Table 4 and Table 5.

The design of beams was carried out considering the bending moment and the shear to estimate the longitudinal and transversal reinforcement, respectively. Columns are designed considering the axial load and bending moment, as usual at the time of construction when shear forces were not taken into account in the design of columns.

The number, position and diameter of rebars for each section types are then calculated according to the allowable stress design method. It is important to underline that such values are obtained considering specific hypothesis about the adopted materials, the geometry and the position of the structural elements, aiming at a simulation of the original design of the building. However, no experimental data is available on material strengths, for which destructive tests would have been necessary. Other aspects deserving further investigation are related to the beams and slab characteristics. Inspection of slabs was not possible and only few beams were visible; therefore, some hypotheses were based only on data gathered by historical documents.



First mode — *Second mode* — *Third mode*

Figure 41 a/c - 1935 model, qualitative representation of the first three vibration modes (© Martella 2020)

Table 3 - 1935 model, vibration periods and modal participating mass ratios.

Table 4a - 1935 Model, maximum internal forces in columns: front block and wings.

Table 4b - 1935 Model, maximum internal forces in columns: stairs and tower.

Mode	*T* (s)	M_x (-)	M_y (-)	M_{rz} (-)
1	0.60	**0.21**	0.00	**0.48**
2	0.53	**0.43**	0.00	**0.23**
3	0.50	0.00	**0.48**	0.00
4	0.38	0.00	**0.23**	0.00
5	0.38	0.01	0.00	0.00
6	0.34	0.07	0.00	0.00
7	0.27	0.01	0.00	0.05
8	0.25	0.00	0.02	0.00
9	0.20	0.05	0.00	0.03
10	0.19	0.01	0.00	0.01
11	0.19	0.00	0.02	0.00
12	0.16	0.00	0.00	0.00
Highest values are in bold face. *M* = Modal participating mass ratio: M_x in the *x* direction (parallel to the main front); M_y in the *y* direction (normal to the main front); M_{rz} about the *z* direction (rotational about the vertical axis).				

	Section dimensions	Maximum internal forces		
Front Block	(cm x cm)	*P* (kN)	*M*2+ (kN m)	*M*3+ (kN m)
F47 Pi	30×30	440.87		3.49
F45 P1		130.52	10.92	
F42 Pi	45x45	1225.86	13.28	
F3 P1		131.47	87.62	
F327 Pi	60x45	2036.82	3.99	
F35 P2		298.14		61.49
F16 Pi	60x45	986.06	11.52	
F16 P2		248.46	36.28	
Wings				
WE30 Pi	30x45	647.58		27.84
WE11 P1	20x30	195.53		55.78
WE17 Pi	45x45	904.40	30.64	
WW37 P1		302.95	66.02	
WE35 Pi	45x65	241.54		16.11
WW15 Pi	45x90	616.88	76.75	
T20 Pi	45x75	1023.15	34.82	
T29 P1		565.84	82.68	
WE27 Pi	55x55	1637.55		25.48
WE21 Pi		1451.46	53.47	
P = axial force, *M*2 and *M*3 = bending moments				

	Section dimensions	Maximum internal forces		
Stairs	(cm x cm)	*P* (kN)	*M*2+ (kN m)	*M*3+ (kN m)
T20 P2	45x75	130.19	49.42	
T29 P2		129.85	51.27	
T21 P0	45x45	634.99		9.84
T28 P0		418.61	53.74	
T11 P2	60x45	125.83	33.52	
Tower				
T8 Pi	45x45	816.47	9.45	
T43 Pi	40x40	260.20	24.29	
T4 Pi	45x75	834.65		15.40
T4 P2		138.52		71.47
T2 Pi	45x60	838.87		3.86
T3 P2	45x45	145.92		57.68
T9 Pi	60x60	1127.18	7.90	
T6 P0		839.80		84.92
T15 Pi	90x150	3901.05		32.54
T17 P3		743.50		1705.69
P = axial force, *M*2 and *M*3 = bending moments				

	Section dimensions	Maximum internal forces		
Front Block	(cm x cm)	*V* (kN)	*M*2+ (kN m)	*M*3+ (kN m)
F21-F38 P2	30x65	97.62	121.73	
F18-F35 P3				-144.91
F26-F27 P3	45x60	285.30		
F4-F20/21 P1			140.93	
F4-F20/21 P1				-180.29
F26-F27 P1	50x80	289.48		
F20-F21 P1			116.94	-141.44
F15-F17 P1	55x75	168.41		-164.64
F16-F30 P1			96.65	
F4-F20/21 Pi	R30x75-30x105	89.02	93.58	-130.07
F2/3-F19 P3	45x80	132.53	212.57	-153.12
Wings				
WW15-WW16 Pi	30x70	46.69	53.34	-61.40
WW22-WW28 P0	45x30	55.97	22.42	
WE17-WE22 P0				-46.19
	45x45IPE			
WE27-WE36 Pi	45x65	277.24		-196.89
WW21-WW27 Pi			134.17	
WW9-WW14 P0	50x30	24.33		-22.08
WE9-WE14 P0			15.39	
WE8-WE16 P0	45x45	72.66		-97.53
WW8-WW16 P0			62.64	
WW27-WW30 P0	85x45	68.88		
WE30-WE37 P0			70.64	-96.31
WW28-WW29 Pi	R30x45-30x60	28.26		-34.28
WE28-WE29 Pi			9.76	
WW21/34-WW20 Pi	R30x50-30x60	61.47	55.60	-92.00
WW17/22-WW21/34 Pi	R30x50-30x65	55.64		-83.98
WW27-WW28			54.65	
V = shear force, *M*2 and *M*3 = bending moments				

	Section dimensions	Maximum internal forces		
Stairs	(cm x cm)	*V* (kN)	*M*2+ (kN m)	*M*3+ (kN m)
T9-T10 P2	45x30	53.11		-41.04
T18-T19 P2			32.55	
WW33-T4 Pi	45x50	47.14	15.80	-30.33
F21-F46 P0	30x65	29.45		-24.36
T10-T19 P2	45x65	76.98		-72.30
T19-T29 P3			37.53	
Tower				
T47-T48 P1	30x75	261.12		-136.79
T16-T17 P3			94.37	
T15-T16 P0	30x80	137.64		-194.14
T14-T15 P0			152.24	
T15-T16 P1	30x90	167.03	217.66	-246.46
T8-T16 P3	40x50	67.80	54.93	-84.34
T49-T50 PI	40X60	102.64	58.66	
T44-T45 P0				-114.51
T44-T45 P3	40x80	32.95		
T48-T49 P3				-40.96
T8-T16 Pi	45x80	148.50		
T3-T8 P1			103.36	-333.24
T21-T22 Pi	45x85	60.94		-57.41
T26-T28 Pi			39.18	
T18-T28 Pi	R40x70-40x90	79.13	30.44	-69.09
T40-T47 Pi	R45x80-45x90	111.64	82.91	-104.05
hinge-T46 P0	42x60-42x350	381.01		
hinge-T46 P1			694.95	
hinge-T45 P1				-1630.84
T17-hinge P1	42x290-42x60	482.62		-2106.09
T15-T47 P3	Roof beams	533.03		-1230.00
T14-T46 P3			1488.11	
V = shear force, *M*2 and *M*3 = bending moments				

Table 5a - 1935 Model, maximum internal forces in beams: front block and wings.

Table 5b - 1935 Model, maximum internal forces in beams: stairs and tower.

The current layout (2021)

1. Code requirements and seismic hazard

«The problem of safety in existing buildings is of fundamental importance in Italy, not only for the high vulnerability, especially to seismic actions, but also for the historical, architectural, artistic and environmental value of a large part of the existing building heritage» (Commentary to the Italian Building Code [Circolare del Ministero delle Infrastrutture e dei Trasporti 2009], Chapter 8). Therefore, according to the NTC 2018, safety assessment must be carried out when one of the following situations occurs:

- evident reduction of the resistant and/or deformation capacity due to: significant deterioration and decay of the mechanical characteristics of materials, significant deformations also resulting from foundation issues; damage caused by environmental actions (earthquake, wind, snow and temperature) or by exceptional actions (shock, fire, explosion);
- serious design or construction errors;
- change in use of the building or parts of it, with significant variation in the variable loads and/or change of use involving the transition to a higher use class;
- execution of non-structural interventions that interact with structural elements and reduce their capacity and/or modify their stiffness;
- execution of structural interventions;
- works carried out in the absence of or non-compliance with the housing title required at the time of construction, or with technical building regulations in force at the time of construction.

Safety assessment and planning of interventions on existing buildings can be carried out with reference to the ULS only, except for class IV constructions in use (buildings with important public or strategic functions, also with reference to the management of civil protection in case of calamity). The seismic verification can be performed with respect to the life safety limit state (LSLS). This limit state involves that the structure shall withstand an earthquake maintaining its bearing capacity to gravity loads and retain a safety margin against collapse due to horizontal seismic actions.

As mentioned, the structural design of the School of Mathematics did not consider earthquake-related actions, as in the 1930s the area was not considered seismic-prone. As a matter of fact, the city of Rome was not included in the seismic classification until 2003 (Table 2), which reminds us that also alterations and additions to the building did not consider seismic actions. Therefore, a linear dynamic analysis to investigate if the building is safe against such actions was implemented in this research: more specifically, a modal response spectrum analysis, which resorts to a linear-elastic model of the structure and to a design spectrum, was carried out. The spectrum was defined by means of a site response analysis (SRA), based on the geophysical and geotechnical characteristics of the soil, as described in section "Geotechnical investigation and seismic site response analysis". The 5% damped elastic response spectrum is shown in Figure 42 together with code spectra. These curves represent the horizontal acceleration, Sa (g), plotted against the structural period of vibration T (s). More precisely:

- ULS target spectrum NTC 2018 – Categories B, C and D are the code spectra prescribed for the LSLS on soil type B, C and D, respectively;
- SRA mean spectrum @ z = 1.0 m below ground level is the average response spectrum derived from SRA;
- SRA smoothed mean spectrum @ z = 1.0 m below ground level is the SRA mean spectrum regularized into NTC 2018-type spectral shape.

Figure 42 highlights that the spectrum obtained by the site response analysis is larger than the one prescribed by the code for categories B and C, and also the onne related to category D when periods are smaller than about 0.65 s.

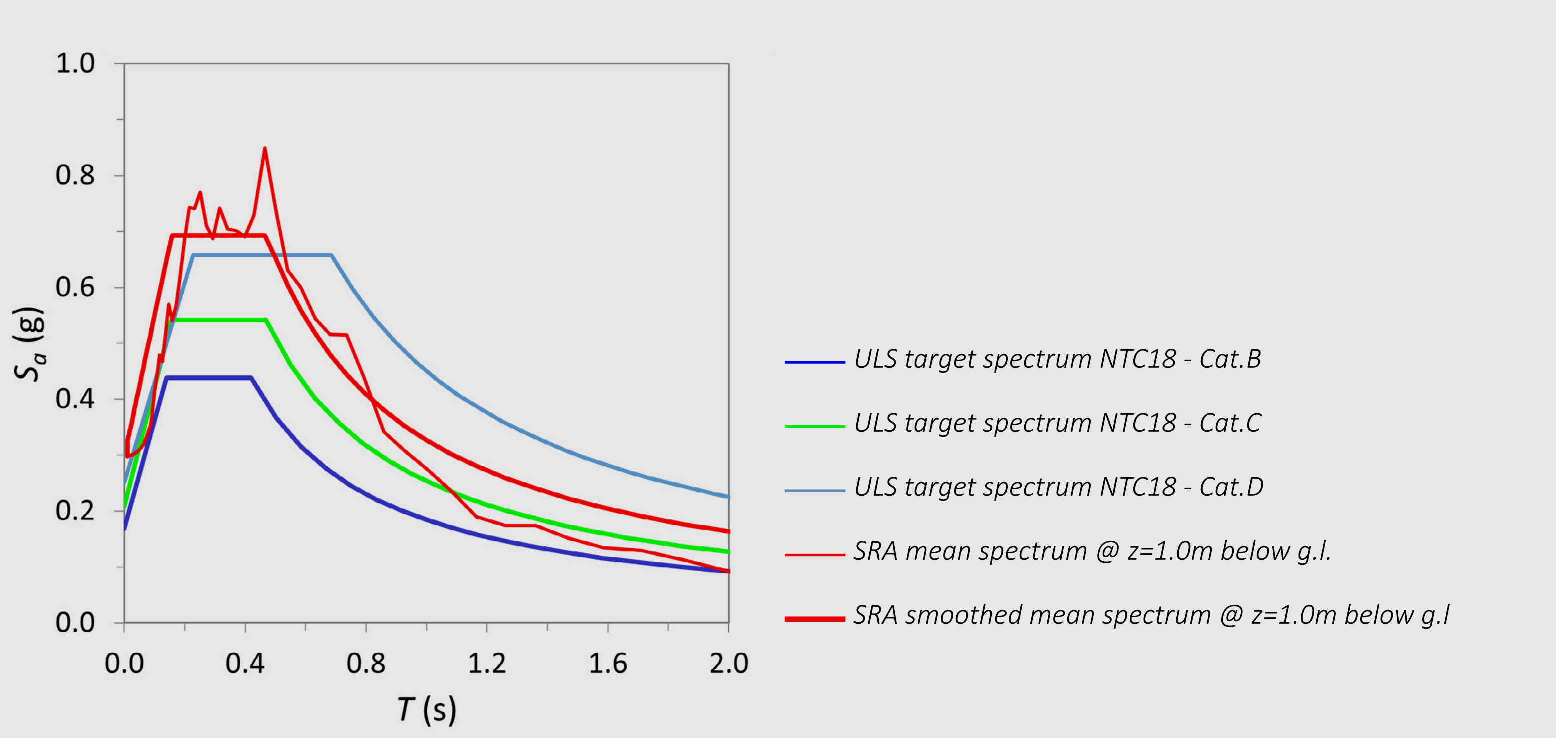


Figure 42 - Elastic response spectra.

2. Modeling considerations

A 3D model of the building in its current configuration was implemented as well. However, this model differs from the previous (1935) one for the presence of the two additions and other modifications. A schematic view of the model is reported in Figure 43. In synthesis, modifications taken into account are:

- partial raising of the curved wings in late 1939;
- construction of the enclosure slab in 1954;
- addition of new volumes to the curved wings in 1974;
- addition, removal and/or replacement of partition walls.

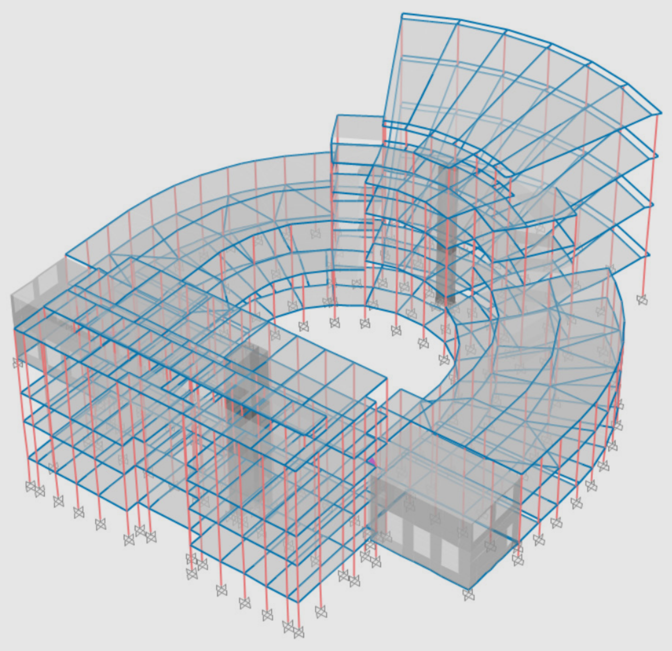
Applied dead and live loads are those indicated in the current technical code. Live loads depend on use and occupancy of the building/room. Values of live load adopted in the numerical analysis are:

- office rooms: q_k = 3 kPa
- classrooms: q_k = 4 kPa
- library and storage rooms: q_k = 6 kPa
- roof slabs: q_k = 0.5 kPa

The roofs are currently not walkable, except for maintenance services; thus, the applied load is lower than that applied in the 1935 model; however, the weight of solar panels is included, where present. Moreover, considering: i) the internal partitions added after 1935, ii) the different code live loads in classrooms and library and the presence of added parts, the model of 2021 presents a greater mass than that of 1935.

It is worth noticing that in both models, unreinforced masonry walls are considered only as applied loads although they may influence the seismic response of the building. Such influence can be either negative or positive depending on many different features. For instance, when infill walls are regularly distributed in plan and elevation, they may significantly contribute to withstand seismic actions, reducing deformation demand and enhancing energy dissipation capacity; irregular arrangements of infills, instead, may lead to critical distribution of plastic hinges, high inelastic deformation demand and brittle failures [Liberatore et al 2018]. In the School of Mathematics, various types of enclosure walls and internal partition are present, with different stiffnesses and strengths; unfortunately, it is impossible to identify the type of each wall and no information on mechanical characteristics is available. Concerning seismic actions, the elastic spectrum (SRA smoothed mean spectrum @ z = 1.0 m below ground level) was divided by the behavior factor, which takes into account the structural ability to dissipate energy.

A modal response spectrum analysis was performed to estimate the internal forces used for the verification of the structural elements.



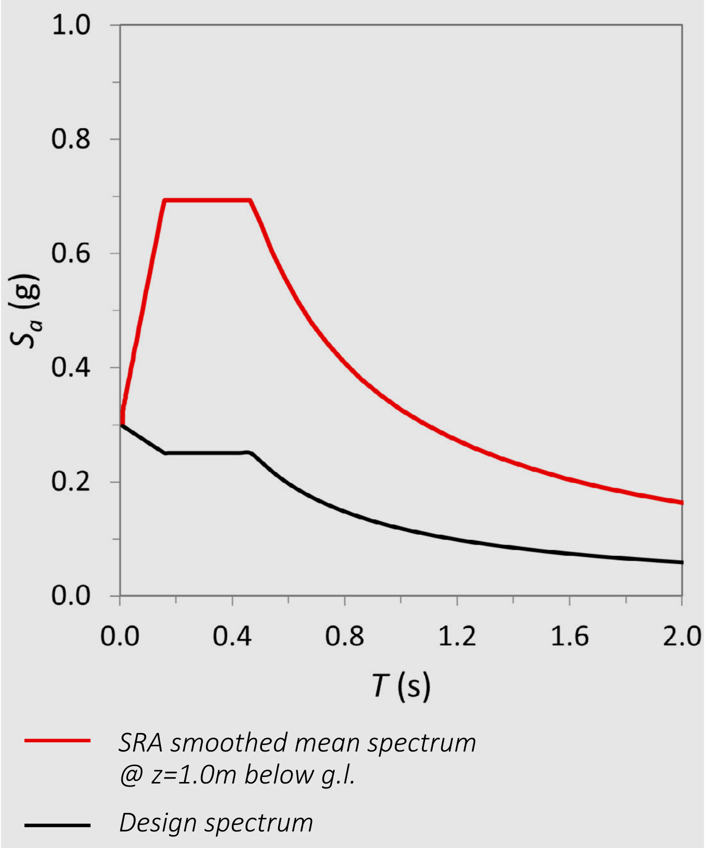


Figure 43 - 3D model of the building in its current configuration, in 2021 (© Martella 2021)

Figure 44 - Elastic and design response spectra (© Martella 2020)

3. *Results of numerical analyses and assessment for earthquake loads*

Periods of vibration and modal participating mass ratios gathered from the modal analysis are reported in Table 6 for the first twelve modes. The comparison with those obtained for the 1935 layout (Table 3) highlights the difference, in terms of vibration modes, between the two models. In fact, the first mode is mainly translational in the x direction (participating mass ratio 16%) with a smaller torsional component (9%). This is attributable to the presence of the additions that hinder the torsional displacements. The second mode is mainly torsional but a translational component in the x direction is also present. Finally the third mode is translational in the y direction. Periods of vibration are equal to 0.80, 0.49 and 0.47 s, for the first, second and third mode, respectively. Contrarily to what expected, the first period of vibration of the 2021 model is higher than that of the 1935 model. This fact would suggest a more deformable structure but in fact, the first mode in the two cases corresponds to different ways of vibrating of the building and to different amount of vibrating masses.

The internal forces calculated by means of the modal response spectrum analysis are used to verify the structural elements. Also in this case, for each beam and column maximum internal forces are considered (Table 7 and Table 8). Comparing these values with those reported in Table 4 and Table 5 it appears that, as expected, the internal forces of the 2021 model are greater. For example, looking at the 2021 model, a column of the tower of classrooms (dimensions 900 x 1500 mm2) is subject to a maximum bending moment equal to 2328 kN m, while in the 1935 model, the maximum bending moment was equal to 1706 kN m (increment of about 35%).

Internal forces reported in Table 7 and Table 8 are used to carry out the safety verifications, which were performed in accordance with the 2019 Commentary to the Italian Building Code. This document requires that material strength is divided by confidence factors, which depend on the attained level of knowledge (Table 9). A confidence factor equal to 1.2 was chosen even though tests on materials, i.e. compression tests on concrete samples and tension tests on rebars were carried out being destructive investigations not allowed.

Mode	*T* (s)	M_x (-)	M_y (-)	M_{rz} (-)
1	0.80	**0.16**	0.00	**0.09**
2	0.49	**0.17**	0.00	**0.28**
3	0.47	0.00	**0.36**	0.00
4	0.34	0.03	0.00	0.03
5	0.33	0.00	**0.25**	0.00
6	0.28	0.00	0.00	0.10
7	0.24	**0.14**	0.00	0.00
8	0.18	0.07	0.00	0.08
9	0.17	0.00	0.00	0.00
10	0.17	0.00	0.02	0.00
11	0.16	0.00	0.00	0.00
12	0.16	0.00	0.00	0.00

Highest values are in bold face.
M = Modal participating mass ratio: M_x in the *x* direction (parallel to the main front); M_y in the *y* direction (normal to the main front); M_{rz} about the *z* direction (rotational about the vertical axis).

Table 6 - 2021 model, vibration periods and modal participating mass ratios.

	Section dimensions	Maximum internal forces				
Front Block	(cm x cm)	*P* (kN)	*V2* (kN)	*V3* (kN)	*M2+* (kN m)	*M3+* (kN m)
F47 Pi	30x30	627.88	2.38			5.27
F45 P1		186.31		51.77	50.62	
F42 Pi	45x45	1734.72		20.12	21.53	
F43 P2		557.74		883.39	333.98	
F33 P2		442.01		202.44	355.73	
F27 Pi	60x45	2823.62		9.16	20.78	
F44 P2		528.90		1122.16	504.92	
F16 Pi	60x45	1380.91	12.23			27.43
F16 P1		773.49		126.64	235.31	
F16 P2		307.41		103.52	434.07	
Wings						
WW30 Pi	30x45	937.69	65.31			36.83
WW20 Pi		790.12	79.19			44.66
WW11 P1	20x30	221.89	36.49			76.37
WW28 Pi	45x45	1321.46	55.59			71.46
WW1 Pi		90.42		52.38	104.22	
WE35 Pi	45x65	370.59		32.34		31.39
WW34 Pi		368.45		33.72	19.05	
WW15 Pi	45x90	905.14	65.37		144.08	
T29 Pi	45x75	1462.08	57.44			75.40
T29 P0		1149.29	349.24			429.06
WW27 Pi	55x55	2408.51	31.95			18.00
		492.25		108.63	61.28	
WW21 Pi		2201.88	16.99		91.64	
P = axial force, *V2* and *V3* = shear forces, *M2* and *M3* = bending moments						

	Section dimensions	Maximum internal forces				
Stairs	(cm x cm)	*P* (kN)	*V2* (kN)	*V3* (kN)	*M2+* (kN m)	*M3+* (kN m)
T10 P2	45x75	151.45	44.22			84.50
T5 P2		151.45	43.65			88.32
T21 P0	45x45	1175.14		53.75	88.14	
T19 P2	60x45	141.49	31.60			66.10
Tower						
T8 Pi	45x45	1168.21	9.94			12.77
T25 Pi		356.03	9.98			5.61
T43 Pi	40x40	395.98		5.32	22.40	
T1 Pi	45x75	1203.59	52.04			75.78
T4 P0		851.45	254.35			275.15
T1 P0		854.66	253.09			278.41
T2 Pi	45x60	1187.37	13.91			19.01
T3 P2		183.28	43.54			86.75
T3 P1	45x45	538.42		43.37	139.88	
T9 Pi	60x60	1597.87		30.10	44.30	
T6 P0		1166.17	359.32			399.84
T15 Pi	90x150	5098.06	994.00		555.93	
T12 P0		4011.69	1331.65			1766.57
T12 P1		2592.39	937.14			2327.66
P = axial force, *V2* and *V3* = shear forces, *M2* and *M3* = bending moments						

Table 7a - 2021 Model, maximum internal forces in columns: front block and wings.

Table 7b - 2021 Model, maximum internal forces in columns: stairs and tower.

	Section dimensions	Maximum internal forces		
Front Block	(cm x cm)	*T* (kN)	*M*2+ (kN m)	*M*3+ (kN m)
F30-F34 P2	30x65	160.97	353.20	-353.20
F26-F27 P3	45x60	313.29		
F33-F34 P3			299.50	-299.50
F26-F27 P1	50x80	432.80		
F33-F34 P2			757.54	-757.54
F33-F44 Pi	55x75	455.60		
F15-F17 P1			296.52	-296.52
F4-F20/21 Pi	R30x75-30x105	150.32	161.21	-221.65
F2/3-F19 P3	45x80	142.58		
F10/F11-F26 P3			318.11	-318.11
Wings				
WW15-WW16 Pi	30x70	84.37	97.88	-112.56
WW22-WW28 P0	45x30	91.88	37.12	-74.91
	45x45IPE	125.57		
			149.94	
				-149.94
WW27-WW36 Pi	45x65	479.54		-371.78
WW21-WW27 Pi			251.37	
WW9-WW14 P0	50x30	40.04		-36.86
WE9-WE14 P0			25.68	
WE8-WE16 P0	45x45	132.50	117.16	-181.21
WE8-WE11 P0	85x45	115.25	122.06	
WE30-WE37 P0				-157.02
WW22-WW23 Pi	R30x45-30x60	59.68	18.97	
WW28-WW29 Pi				-70.37
WW26-WW27 Pi	R30x50-30x60	129.93		-190.90
WW21/34-WW20 Pi			104.63	
WW17/22-WW21/34 Pi	R30x50-30x65	112.16		-167.69
WW27-WW28 Pi			100.76	
V = shear force, *M*2 and *M*3 = bending moments				

	Section dimensions	Maximum internal forces		
Stairs	(cm x cm)	*T* (kN)	*M*2+ (kN m)	*M*3+ (kN m)
T9-T10 P2	45x30	79.44		
T28-T29 Pi/P0			75.02	-75.02
WW33-T4 Pi	45x50	68.81		
WW33-T4 P0			84.88	-84.88
F21-F46 P0	30x65	67.60	141.35	-141.35
T10-T19 P2	45x65	124.56	44.69	
T5-T11 P3				-74.91
Tower				
T47-T48 P1	30x75	383.38		
T46-T47 P1			255.03	-255.03
T12-T13 P0	30x80	318.55	414.89	-414.89
T13-T14 P1	30x90	211.15	260.21	-312.02
T8-T16 P3	40x50	120.02	99.14	-154.27
T49-T50 Pi	40X60	150.18		-168.35
T47-T48 P0			165.53	
T49-T50 P3	40x80	40.51	94.39	-94.39
T9-T18 P0	45x80	230.97	493.65	-493.65
T21-T22 Pi	45x85	82.26	49.50	-75.76
T12-T21 Pi	R40x70-40x90	119.61		-106.14
T13-T22 Pi			85.56	
T40-T47 Pi	R45x80-45x90	165.12	123.51	-151.37
hinge-T47 P1	42x60-42x350	571.88		
hinge-T47 P0			2065.69	-2065.69
T17-hinge P1	42x290-42x60	661.28	1480.24	
T13-hinge P1				-2835.83
	Roof beams	642.26		
			1785.44	
				-1549.28
V = shear force, *M*2 and *M*3 = bending moments				

Table 8a - 2021 model, maximum internal forces in beams: front block and wings.

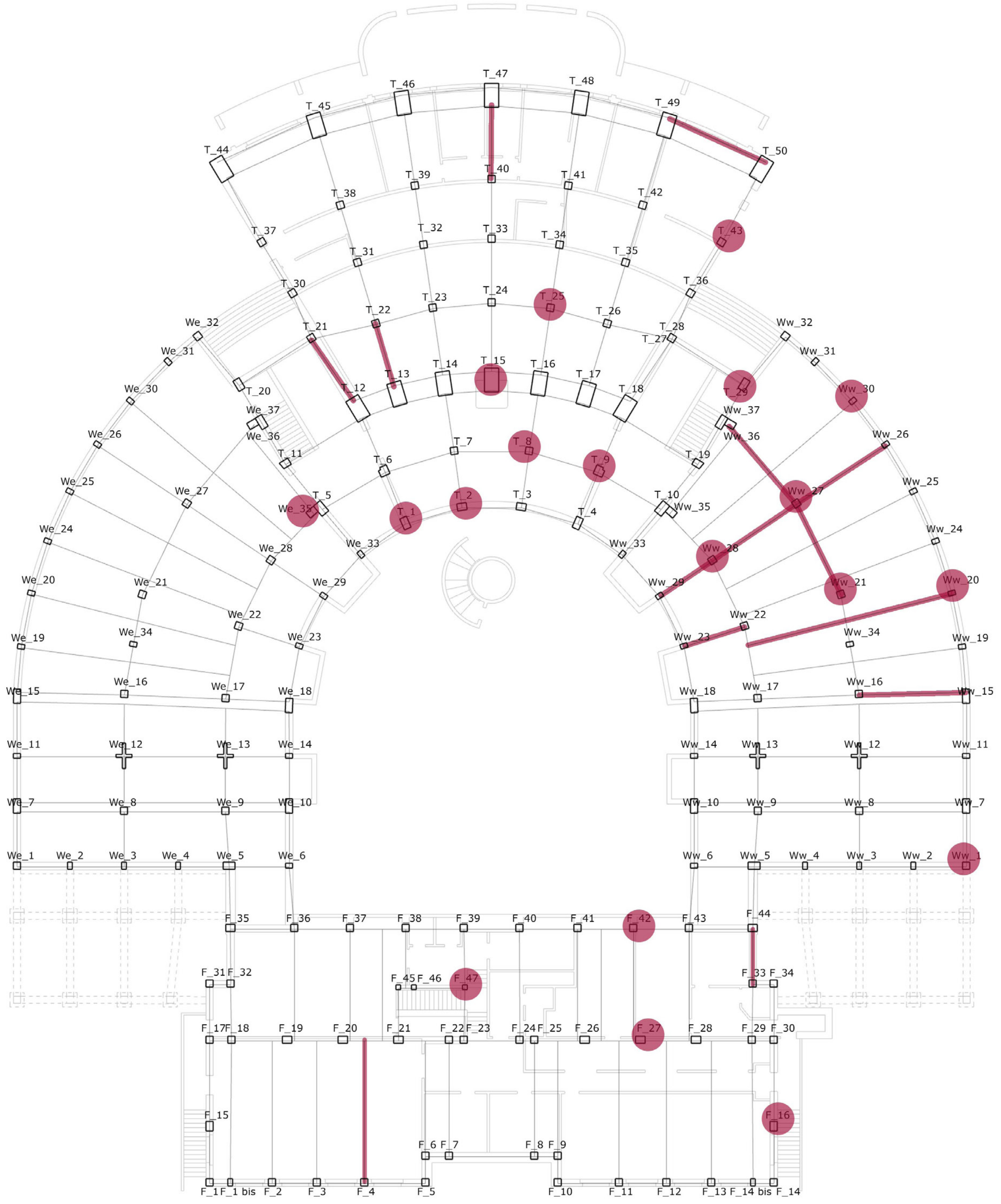
Table 8b - 2021 model, maximum internal forces in beams: stairs and tower.

Knowledge level	Geometry	Details	Materials	Type of analysis	Confidence factor
KL1 (limited knowledge)	Deduced from original outline construction drawings with sample *in-situ* checks or from comprehensive survey	Simulated design in accordance with relevant practice and from limited *in-situ* inspections	Default values in accordance with standards of the time of construction and from limited *in-situ* testing	- Lateral force procedure - Modal response spectrum analysis	1.35
KL2 (normal knowledge)		From incomplete original detailed construction drawings with limited *in-situ* inspections or from extended *in-situ* inspections	From original design specifications with limited *in-situ* testing or from extended *in-situ* testing	All	1.20
KL3 (full knowledge)		From original detailed construction drawings with limited in-situ inspections or from comprehensive *in-situ* inspections	From original test reports with limited *in-situ* testing or from comprehensive *in-situ* testing	All	1.00

Table 9 - Knowledge levels and confidence factors (according to Eurocode 8-3 and 2019 Commentary to the Italian technical standard for Constructions).

Elements having a demand greater than the capacity (not satisfactory elements) are identified in Figure 45 through Figure 49, and their number is significant. This outcome is due to the application of the seismic action on the one hand, and to the assumptions made for the numerical analyses and for the safety verifications on the other. For instance: live loads prescribed in the current codes are different from those used during the building design; the material strengths used for the safety verifications are reduced by a factor equal to 1.2; methods of verification used in 1935 and 2021 are based on different approaches. More relevantly, the building was not conceived, designed and built to resist earthquake loads, hence it has not an optimal configuration and the recommended details. Therefore, such underperformance is not unexpected as it is common for most buildings of that time located in Rome.

On the ground of these results, it appears worthwhile to deepen the knowledge of some aspects related to the structural capacity of the building. More precisely, it is recommended to: assess the concrete and steel mechanical characteristics by means of experimental tests on samples; deepen the knowledge on beams and slab of the front building; investigate beam-column joints and other details necessary to estimate the structural ductility and perform nonlinear analyses. Finally, based on what reported on what was reported in previous sections, the following actions are also suggested: assessment of the grade of concrete carbonation; removal of improper interactions with installations and repair of damaged elements.



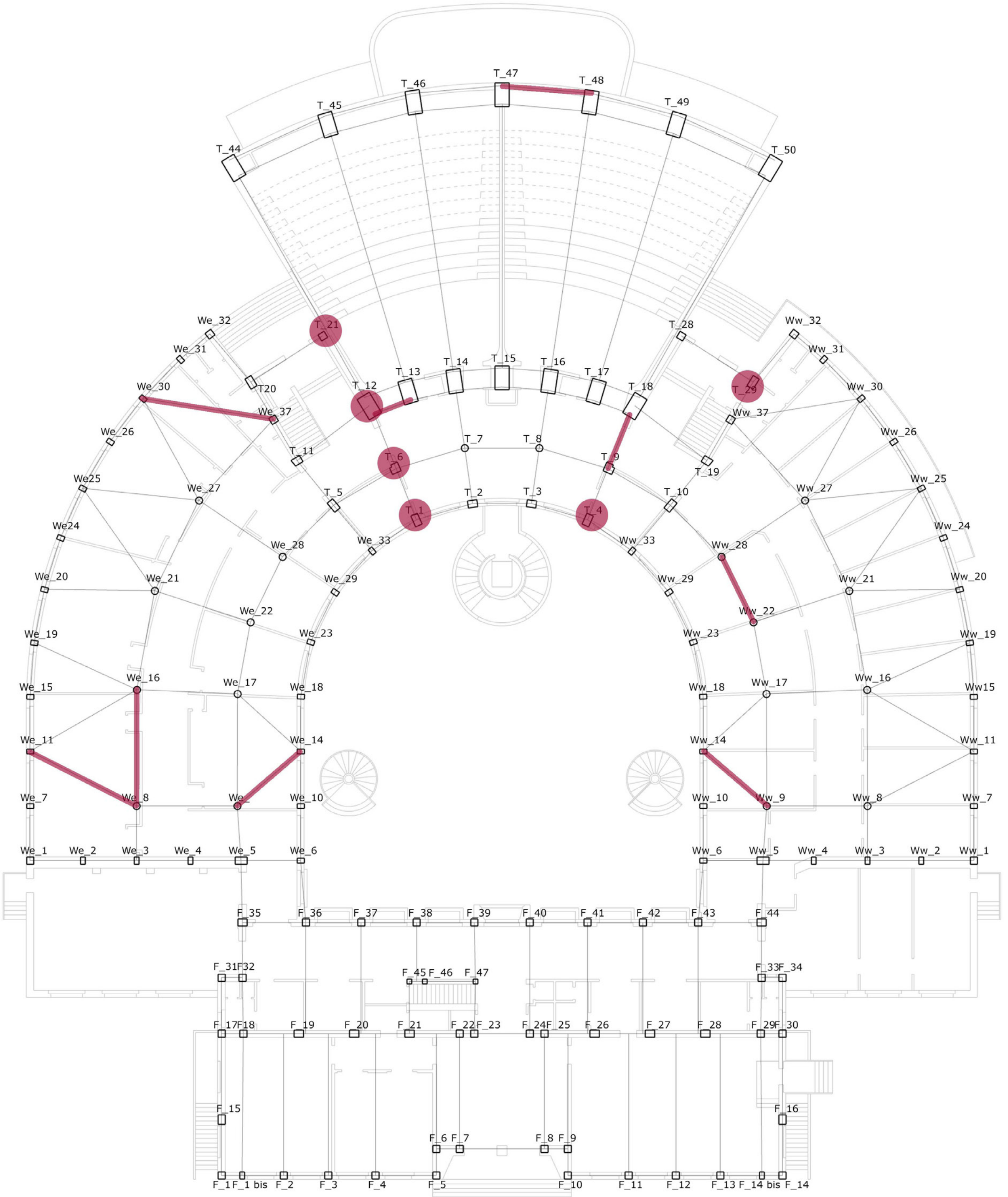
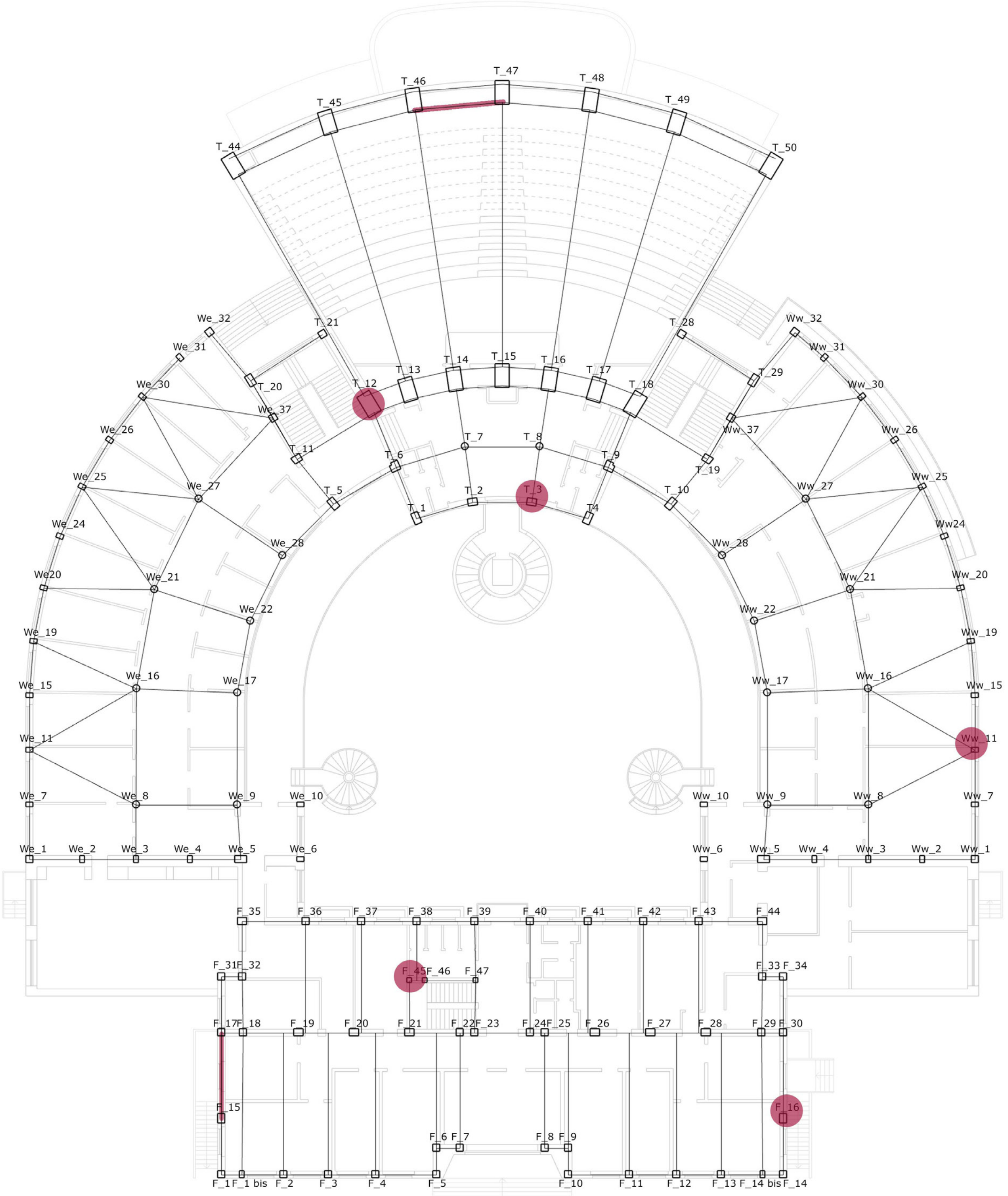


Figure 45 - Not satisfactory structural elements: basement level (© Martella 2020)

Figure 46 - Not satisfactory structural elements: ground level (© Martella 2020)



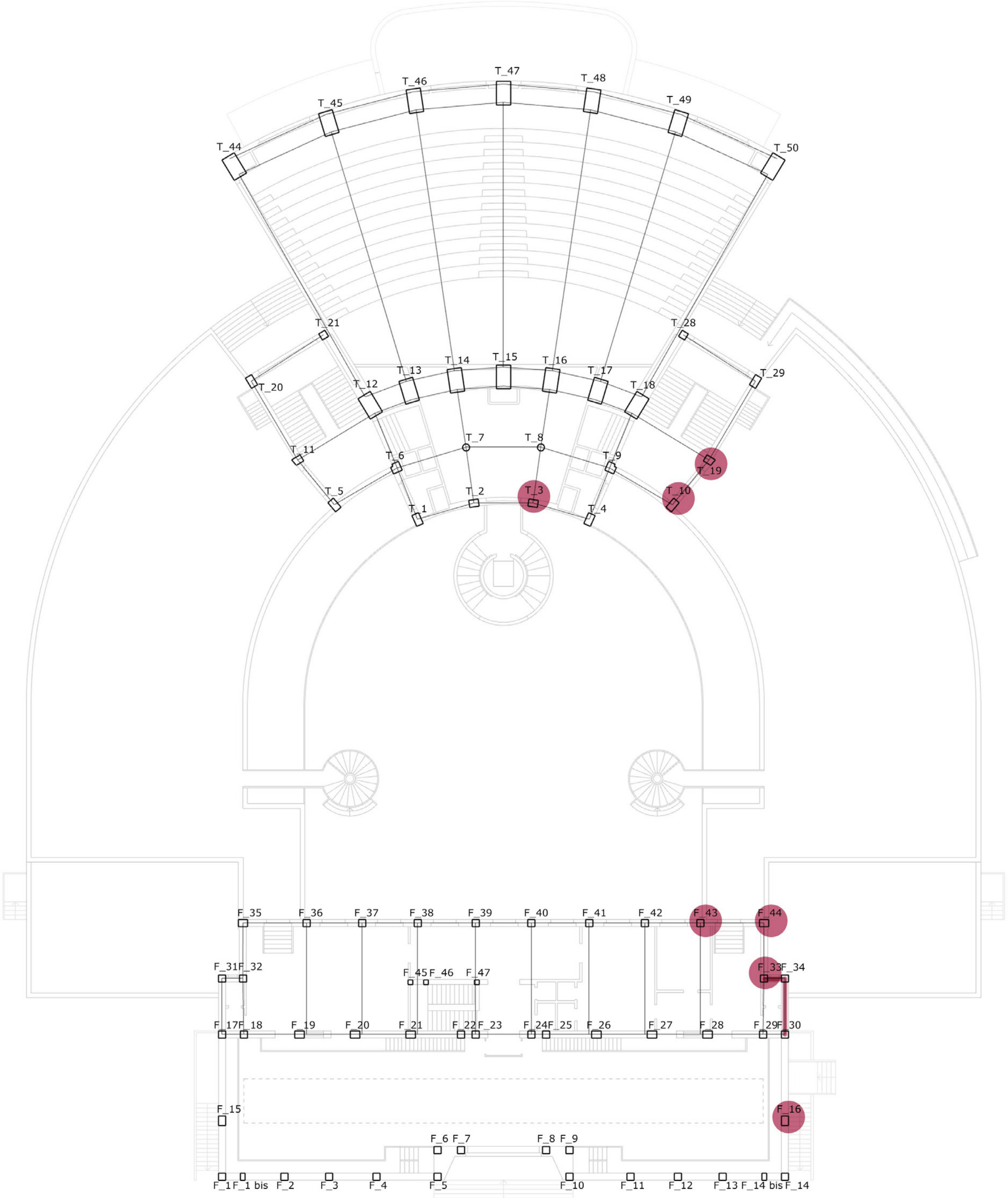


Figure 47 - Not satisfactory structural elements: first level (© Martella 2020)

Figure 48 - Not satisfactory structural elements: second level (© Martella 2020)

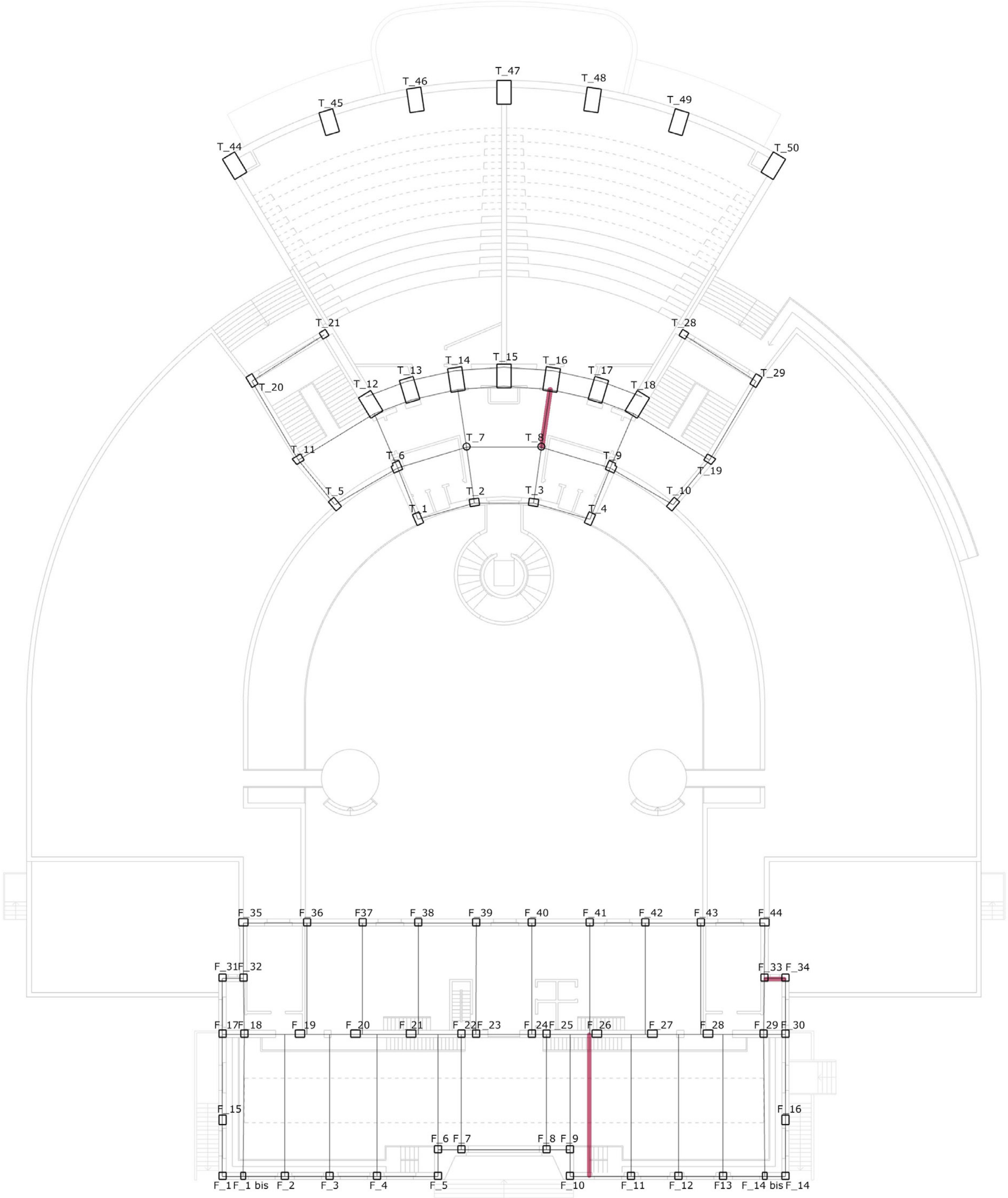


Figure 49 - Not satisfactory structural elements: third level (© Martella 2020)

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SCIENTIFIC INVESTIGATION ON CONSTRUCTION MATERIALS*

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** Chiara Porrovecchio has also contributed to this part of the research.*

PURPOSES, INVESTIGATION METHODOLOGY AND SAMPLING METHODS

Analytical investigations allow the characterization of materials and the definition of the construction techniques and their state of conservation [Campanella 2007]. Great attention must be paid to the materials' classification, distinguishing original ones from those employed over time, for maintenance or reparation purposes.

The purpose of the analytical characterization of the original materials is to identify their composition and frame them within their production, and therefore with the original construction site. Moreover, their state of conservation requires a precise identification in view of the definition of conservation management planning [Della Torre 2018]. To achieve a comprehensive identification of the original construction materials that are present in the building, the intersection of scientific data and bibliographical-historical information, i.e. the description of the construction site and the related documentation, is necessary.

The complexity of the structure, together with the multiplicity of materials employed, has led to a critical selection of the construction elements to be investigated. Geometric surveys associated to archival data have proved essential for the definition of the sampling phase. After inspection, construction materials such as travertine, mortars, cements, plasters, linoleum, and clinker have been selected for sampling and/or for in situ investigation in view of the chemical-physical characterization.

Sampling has been carried out in full respect of the integrity of the building, preserving its overall aspect. Least invasive solutions have been preferred. The entire sampling process has been documented, providing an appropriate photographic documentation for each phase. Uniquely signed samples are duly organized according to their typology and sampling area. Great effort has been invested to identify the most suitable analytical techniques for the investigation and study of samples. High sensitivity instruments have been preferred to favor minimum sampling, therefore reducing damaging to the minimum [D'Amico 2022]. In case of unavoidable sample cutting, a sample material has been kept aside.

Various laboratory techniques have been applied in the study: a brief description of their operating principle and potential is described as follows.

- *Fourier-transform infrared spectroscopy (FTIR)* is a molecular spectroscopy technique based on the interaction between matter and IR radiation. The analysis results in a spectrum characterized by a series of effects in specific range which are peculiar for each chemical bond vibration (mainly stretching e bending). This technique allows the unique sample characterization, and it is particularly suitable in the study of organic matter such as bitumen, drying oil and biological deposits [Lombardi, Santarelli 2009].

- *µ-Raman spectroscopy* is an instrumental methodology complementary to the FTIR thank to its different selection rules. It analyzes light scattering induced phenomenon on the sample instead of IR radiation. The result is a specific spectrum for each material. The sensitivity in relation to metal bonds is higher than FTIR. This is the reason why Raman can be used for crystalline phase characterization for example in mortar or concrete [Baraldi 2018]. Moreover, the microscope instrument integration allows the exact placement of the laser ray for a better discrimination of different phases.

- *Scanning electron microscopy (SEM*) The signal is produced by the electron-sample interactions. The analysis reveals information about the sample including external morphology and chemical composition [Elsen, 2006]. This technique could be, also, used for X-ray mapping. Element maps became useful for displaying element distributions in textural context, particularly for showing compositional enrichment.

- *Thermal analyses (TG-DTA)* The thermogravimetric analysis (TG) provides a thermogram indicating the weight variation the sample underwent pursuant a controlled heating. The integration with the differential thermal analysis (DTA) allows the identification of the processes involves in changes [Moropoulou 1995]. It is an instrumentation particularly useful for the characterization and quantitative determination of inorganic matter such as concrete components.

- *X-ray diffraction (XRD)* is a non-destructive technique for characterizing crystalline materials. It provides information on structures, preferred crystal orientations (texture), and other structural parameters. The XRD pattern is the fingerprint of periodic atomic arrangements in each materia. It lets the operator the simultaneous identification of the totality of crystalline phases present in a sample [Moropoulou 1995], easing the characterization of complex matrices as it is in the case of the Litoceramic.

The multy-analitical approach adopted in this investigation work yielded a complete overview of the materials.

CONCRETE CROWNING FRAME

Concrete of the crowning frame has been carefully investigated. During on-site visits, each constituent material and element of the crowning frame has been observed, (Figure 1) mapping its deterioration [NORMAL 1/88]. The frame consists of an alternation of solid components and voids with recurring dimensions, made exactly as shown in historical drawings that are part of the technical-administrative documentation that was produced by the construction firm (ASS_drw_54).

Every part of the crowning frame has been codified to analyze the state of conservation of each portion and evaluate the status of the deterioration problems. Mapping of the diffusion of deterioration processes (Figure 2) proves the very bad state of conservation of the crowning frame [UNI 11182/2006]. The conditions of the frame are particularly compromised on the south-east side, where some portions of concrete are completely detached, or missing. In several portions reinforcing rebars are visible and diffusely corroded (Figure 3). Corrosion occurs when concrete loses its high alkalinity; consequently, the conditions of passivity of the iron bars are not met [Arya, Vassie 1995]. The application of two different corrosion inhibitors is made evident based on their light blue and pink color (Figure 4). The presence of corrosion inhibitors highlights that corrosion issues occurred repeatedly over time, a symptom that the frame has never been fully and properly maintained. The mechanical action of the steels is stressing the structure causing detachment of concrete, and often its fall-out. When in situ observation suggested further investigation, samples were collected. The exact sampling location of each element has been reported in 3D representation.

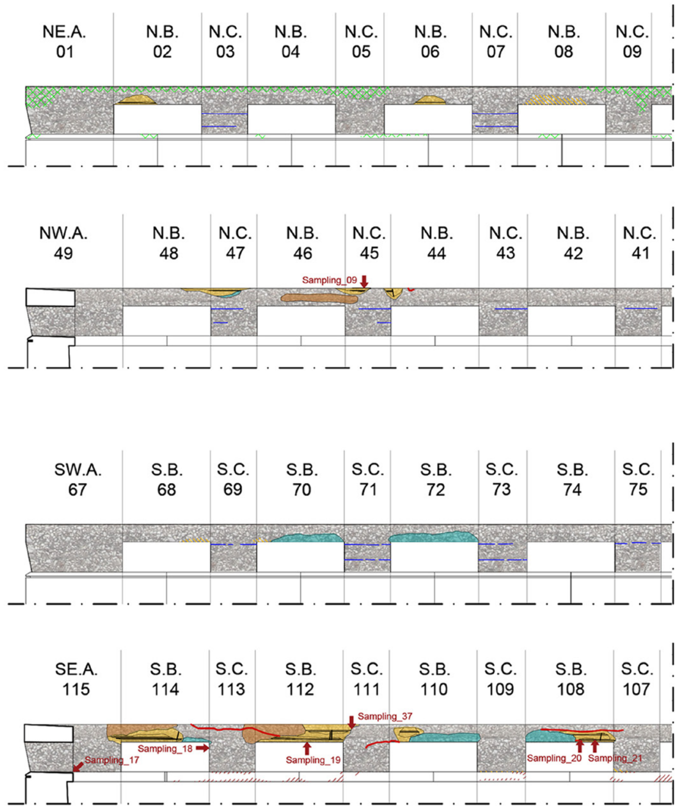


Figure 1 - South elevation, exterior. Photographic processing with reference to coding of each element (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

Figure 2 - Analysis and mapping of the crowning frame state of conservation; outer and inner sides (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

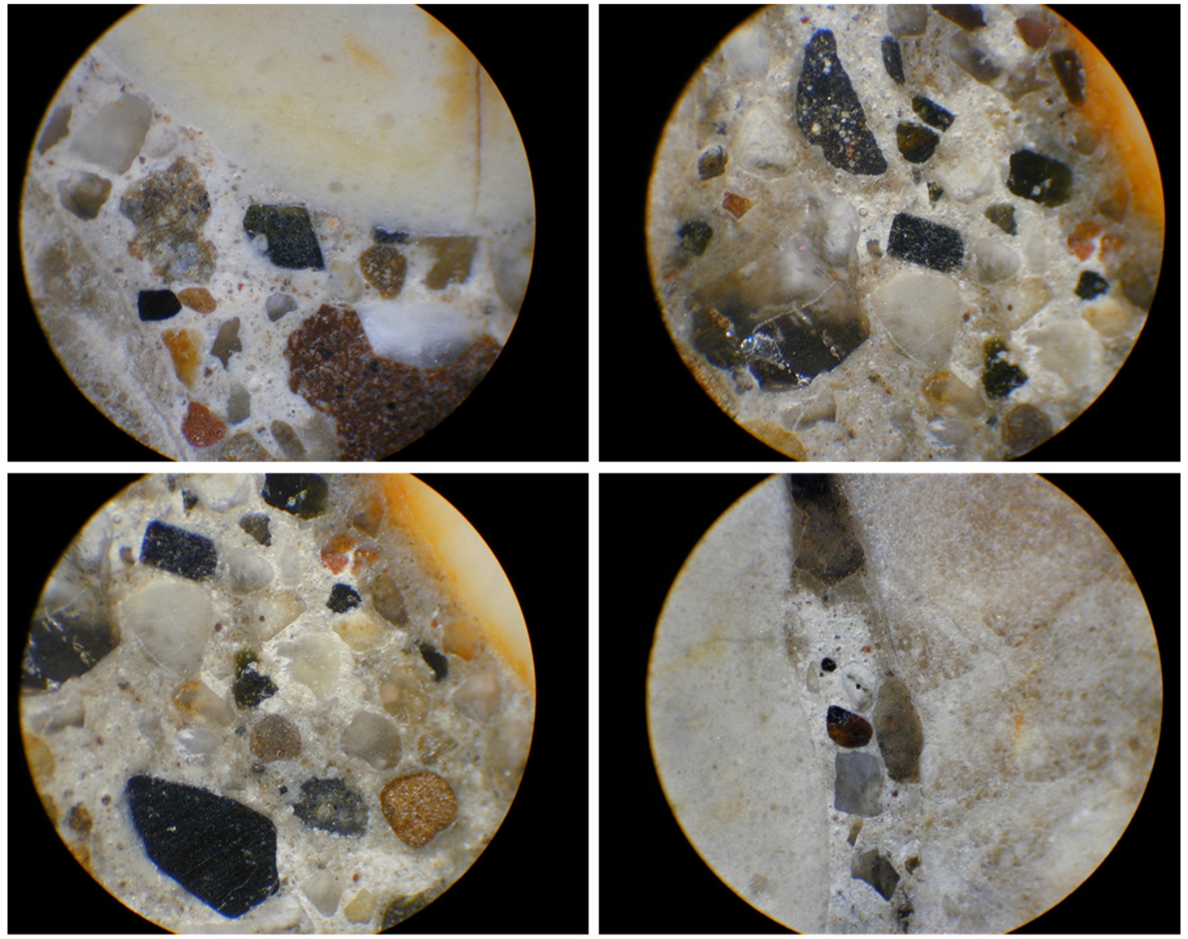
Figure 3 - Corroded reinforcing rebars of the crowning frame (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

Figure 4 - Residues of corrosion inhibitors on the reinforcing rebars of the crowning frame (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

FTIR spectra has allowed a preliminary screening of the material, offering indication of the presence of quartz in the samples. On behalf of microscopic observation of a resin-embedded sample (Figure 5), concrete has been investigated: a bonding limestone paste together with a coarse aggregate with variable grain size. The carbonate nature of the gravel gives a grayish color to the entire structure.

SEM analysis of the matrix instead revealed the presence of dispersed iron slag (Figure 6). Concrete of the crowning frame was made up of blast furnace cement in accordance with contract specifications. Evidence of the presence of such cement is also offered in the archival documentation illustrating the construction site and listing the supply of construction materials (ASS_dcm_25). The use of this type of concrete is justified to produce the crowning frame, as it was not necessary to use a Portland cement, more suitable for foundations than for this type of construction. The use of building materials in those years was regulated by extremely rigorous tender specification about the selection of appropriate quarries and about the mechanical and chemical characteristics of the individual components [Petrignani 1940]. The indication contained in the documentation concerning the use of concrete in the crowning frame corresponds to the characteristics identified with scientific analyses. The use of washed river sand is confirmed by microscopic observation of well smoothed-out aggregates. The material is original, and it has been cast in reinforced formworks. The practice of formworks for the implementation of concrete is proved by the presence of linear marks on most of the elements, traces of the construction technique. Moreover, residues of the concrete pouring process are present at the base of the elements. Such material has been investigated through DSC-TG and the results were compared with the concrete. A clear correspondence has been observed.

Concerning the state of conservation, problems related to the deterioration of concrete must have been recognized soon after construction, as defects occurred in the structure. It is possible to observe that a treatment with a bituminous mortar has been added to protect the superficial parts, often used to fill in fractures or detachments of material from the concrete. The application of an asphalt mortar to pro-



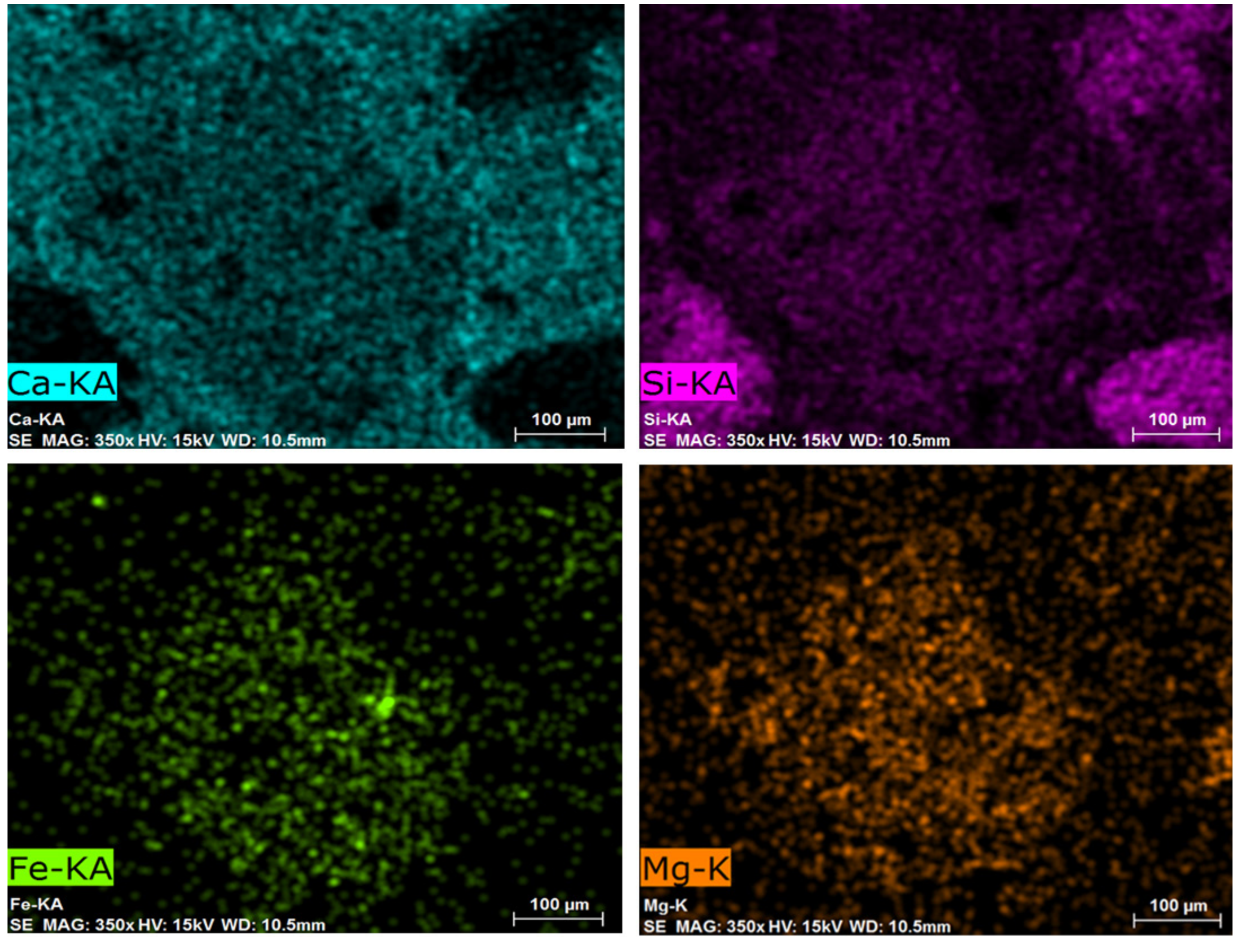


Figure 5 a/d - 7x microscopic observation of a concrete resin-embedded sample collected on the crowning frame (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

Figure 6 a/d - X ray mapping, Elemental distribution of Ca (blue), Si (purple), Fe (green) and Mg (orange) of a samplecollected from the concrete crowning frame (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020) tect parts of the element is still visible in many of the components (Figure 7). The binding with the original concrete structure and the chemical composition resulting from FTIR and DSC-TG analyses, suggests that this was added immediately after the construction. In fact, bitumen treatments are little distinguishable from the original nature of the concrete; aggregates are analogue.

Another feature, that is the presence of dark concretions composed of gypsum on the inner side of the lateral concrete elevation, proves the ongoing deterioration of the concrete (Figure 8).

These are identified as degradation products of the underlying concrete. As a matter of fact, if concrete is exposed to urban air pollution, an action of sulfation caused by rainwater to the carbonate filler may occur [Marinoni 2003]; as a result, a gypsum precipitate is deposited. Over time, the concretion will grow, and different thermo-mechanical behavior compared to the characteristics of the concrete may cause serious damage, up to the disintegration of the underlying material.

Considering the above, the conditions of the crowning frame appear very critical especially on the southern side, with a concentration of highly degraded elements. From the overall study of conservative analysis data, the degradation of concrete is almost always related to the exposition of rebars. On the other hand, there is no negative interaction between the reinforced concrete elements and the travertine sills on which they lay upon that are mainly affected by biological colonization and surface stains. Forms of degradation with relative loss of material are observed only on three of the horizontal travertine sills, in all cases insisting on portions not directly connected to the reinforced concrete structures.

The exposure of the crowning frame elements makes insolation, with consequent thermal stress, one of the most probable causes of degradation [Korotchenko 2017]. Direct insolation activates physical phenomena of differentiated thermal expansion between cement and concrete aggregates, favoring phenomena of disintegration. The large average size of the aggregates (gravel) produces considerable mechanical stress because of thermal volumetric expansion. The position of the reinforcement bars inside the crowning elements is rather near to the surface. The thinness of the concrete cover, in this specific case, is not adequate to isolate the reinforcements from thermal stress. This aspect of the construction technique therefore favors phenomena of differentiated expansion also between concrete and rebars. The crowning frame is also particularly exposed to all other climatic phenomena. The action of rain produces cement erosion and penetration into the porosity of concrete causing internal damage related to the action of possible frost and thaw cycles [Cai 1998].

A widespread phenomenon generally observed on reinforced concrete works is carbonatation. The gradual penetration of atmospheric carbon dioxide into the porosity of concrete leads to the modification of calcium hydroxide in calcium carbonate. The reaction produces a reduction of the pH values and leads to a depassivation of the internal rebars and their exposure to corrosion phenomena [Roberts 1981]. Carbonation process also leads to an increase of the material porosity. The effects of concrete carbonatation mechanisms on the crowning frame are consistent, according to in situ observation. It is therefore likely that carbonatation is also taking place.

Another phenomenon, quite widespread in the Roman area, is chlorides attack to reinforced concrete. Chlorides react with calcium hydroxide and calcium aluminate hydrate generating products with a significant increase in the volume of the conglomerate and consequent disintegration by mechanical stress. The activation of alkali-aggregate reactions (AAR) is less likely in this case. This chemical degrading mechanism is activated by the presence of aggregates containing amorphous silica [Arya, 1995]. No evidence of this phenomenon was found on the structures under consideration. Amorphous phases of silica were not identified by analytical-diagnostic investigations.

Elements SE.A. 115, S.B. 114, S.C. 113, S.B. 112, S.C 111, S.B. 110, S.C. 109, S.B 108, in reference to the mapping, are representative for further observations and study insights. They show the described degradation criticalities, and they have been subject to interventions of which remains readable trace. These have been subject to sampling and analytical diagnostic study of the materials.

Figure 7 - Asphalt mortar integration on concrete of the crowning frame (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

Figure 8 - Dark concretions affecting concrete of the crowning frame (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

TRAVERTINE CLADDING SLABS

As for historical recognition, the travertine slabs that clad the facade are original. In the archival documents dated 1934 there are drawings describing the front building elevation with details of the 5 centimeters thick slabs cladding, dimensioned exactly as they have been surveyed for this research (ASS_dcm_25, 1934). Signs of machine cutting are clearly visible, especially in correspondence to the west elevation if observed with grazing light. Concerning the state of conservation, the travertine cladding appears in good condition, notwithstanding the presence of evident cracks and natural porosity, which over time have led to the absorption of dirt, yellowing processes and water percolation stains, especially in the upper part (Torraca, 2009). Travertine for the slabs was chosen without specific bleaching of the surface, and many dark areas were already present at the time of their positioning. The fact that areas of dirt were not extensive suggests that the façade's limited exposure to pollution has not compromised its conservation.

Other than for the cladding of the façade, travertine was also used for window thresholds, openings and entrance portals, both on the main elevation and on the inner court. Therefore, the different workmanship, position and installation, influence the different state of conservation of each element. As highlighted in figure 9, in spite of a fairly good condition, there are areas more prone to the accumulation of stain and crusts in the soffits of the openings on the north, east and west elevations. The thresholds of doors and windows show similar problem: horizontal surfaces are subject to more or less consistent deposit also depending on the geometry of the object itself. The lower part of the building, also, shows several capillary fractures. Travertine elements suffering the worst state of conservation undoubtedly are those that compose the entrance portal to the inner courtyard of the building. The portal, surmounted by a balcony with a travertine balustrade, presents deep cracks, caused by the coexistence of iron bars and travertine that seriously compromises the conservation of the entire element. The general state of the single travertine slabs, however, is not particularly compromised.

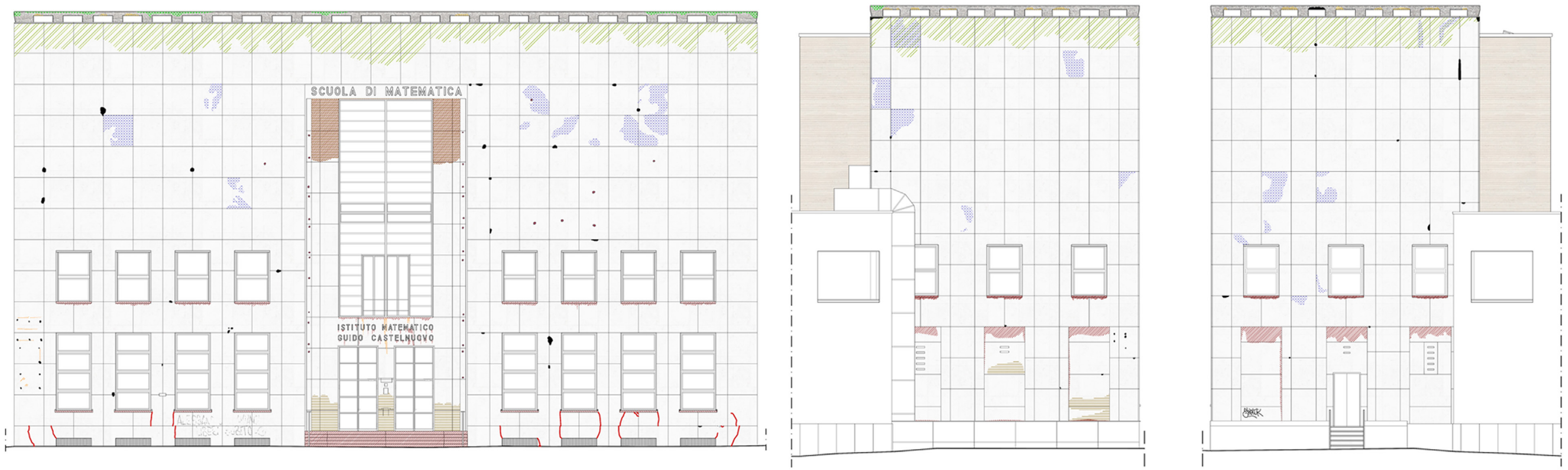


Figure 9 a/b - Analysis and mapping of the state of conservation of the travertine slabs cladding; north, east and west elevations (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

Figure 10 - Litoceramic analysis campaign in the inner courtyard (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

Figure 11 - Detail on Litoceramic technique during survey (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

Figure 12 - Engraving of the producer's name "Ceramiche Piccinelli S.A." on a Litoceramic brick (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

Figure 13 - Section of embedding mortar of the Litoceramic cladding (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

Figure 14 - Section of gap mortar of the Litoceramic cladding (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

LITOCERAMIC CLADDING

A rich archival documentation certifies the use of clinker bricks- so called "Litoceramic"- for the cladding of the rear façades of the front building (ASS_dcm_192, 1938). Litoceramic is a ceramic material obtained from a clayey raw material fired at extremely high temperatures. The product is a stable compound with excellent qualities of compression resistance. The Industria Ceramica Piccinelli di Bergamo started the production of this material at the beginning of the Thirties- for which it obtained a specific patent- and received an immediate response in the building industry of that time. As mentioned above, Litoceramic represents one of the main cladding materials of this building, and of many other within the university campus (Figure 10/11). A careful examination in several stages has been performed. A combination of investigation techniques has allowed a complete characterization of elements and mortars, of the construction technique and of the state of conservation.

As sampling the Litoceramic from the façade would have compromised the overall aspect of the wall facing, the investigation proceeded upon an erratic brick crammed inside the warehouses of the building, and still bearing the ancient inscription of production (Figure 12).

Analytical tests carried out on the sample (FTIR, µ-Raman and XRD) confirm the nature of the material. Litoceramic is a product with high hardness and a compact paste resulting from a high vitrification process. The matrix is added with silicate minerals and the thermal analysis confirms the firing temperature reported in the specifications of the material, advertised on reviews and reported archival documentation attached to the construction contract. Moreover, Litoceramic appears in different shades of yellow, as requested in the contract documents.

Further studies were conducted on Litoceramic application: as far as the façade overlooking the courtyard is concerned, elements are bedded with a cementitious pozzolanic mortar (Figure 13). Instead, the mortar used for the finishing of the outer surface of the joints between the bricks, was composed of cement and very fine volcanic aggregate. The addition of a white calcareous carbonate aggregate produced a certain roughness and color spotting (Figure 14). It is very likely that a silicate-based waterproofing treatment, such as Silexin, was also applied to the surface of the refurbishment.

Regarding the construction technique, Litoceramic is applied with great regularity: the mortar in the horizontal joints is very well laid out, while vertical joints are not sealed. Absence of mortar cannot be attributed to degradation as the phenomenon would be far too diffused and homogeneous. The different uses of sealing mortar are therefore due to design intention, probably to better define a chiaroscuro effect.

There is archival evidence of the reintegration of missing parts of the cladding with bricks of the same material and of the same production (ASS_dcm_227). In fact, reintegration is hardly recognizable from original cladding placed during construction.

During analysis of the Litoceramic cladding of the rear façade, a difference in the color of the mortar has been detected around the travertine balcony overlooking the inner court. Within this area, with a fairly clear perimeter, a lighter mortar than the one used on the rest of the elevation has been detected, as if it were a layer of very compact color superimposed on the existing one (Figure 15,16).

The analysis of historical pictures has proved that the color variation was present since at least 1936. Moreover, the area perfectly corresponds to the shape of the large vertical opening of the entrance, in the main elevation (ICCD_pht_03).

As different hypotheses are possible, the direct observation was rendered recurring to graphic software to allow the extrapolation of the different levels of geometries and colors (Figure 17).

The state of conservation of the Litoceramic appears fair, due to the intrinsic characteristics of the material i.e. waterproofness, mechanical resistance and high compactness [Maccari 1933]. Litoceramic is in fact resistant to atmospheric agents and has high durability to weathering and temperature changes. Major alterations are ascribable to anthropic damages, such as cuts, and holes caused by the growth of plants. Lack of maintenance therefore represents the only relevant cause of damage (Figure 18). An overall evaluation of the state of conservation of the Litoceramic coating has suggested to deepen the analysis through the identification of one square meter samples of the surface. The selection has fallen on those portions of cladding considered more representative for all the constituent elements.

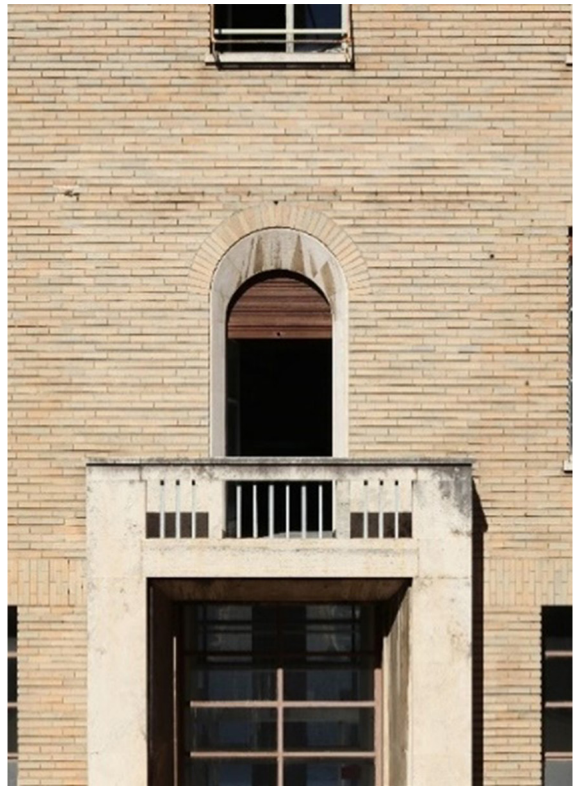


Figure 15/16 - Identification of the area of Litoceramic cladding characterized by mortar of different colours; graphic representation (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

Figure 17 - Litoceramic cladding of the front building rear facade. Drawing of the analysis area. Chromatic tests to isolate the levels of the mortar and the masonry curtain (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

Figure 18 - Upper curtain at the courtyard entrance. On the highest line it is possible to notice the detachment of a clinker strip (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

FAUX TRAVERTINE PARAPET CAPPING

A detailed study has been carried out on the upper terraces of the tower of classrooms, more specifically on the upper cornices that profile the perimeter of the building, which have been finished with a marmorino plaster to create a faux travertine surface around the flashings (Figure 19).

Marmorino is a limestone mortar prepared with slaked lime and marble powder [Collepardi 1997]. The latter has a double function: it slows down carbonation processes and increases the plasticity of the mixture before its application. Above all, its specific characteristic consists in the fact that, once the mortar is applied, it produces a finishing layer characterized by the same compactness and sparkling effect of marble surfaces. In the case of the School of Mathematics, marmorino must have been chosen as coating of the upper cornice to offer a diffused marble-effect of great intensity (Figure 20). Yet, a further observation must be added. As marble and travertine converge in terms of chemical composition, and differ mainly for the petrogenesis, a clear distinction of the two is rather complex. The use of travertine powder instead of marble to produce marmorino should therefore be taken into consideration.

Therefore, faux travertine mortar has been applied on previously built concrete elements as a finishing layer. Thermal analyses, coupled with microscopic observations, have revealed a definite compositional similarity with cement plasters used on the outer surfaces. In fact, both materials are characterized by similar main constituents and therefore also show a similar thermal behavior. A further very interesting peculiarity has been encountered in the microstructure of these material, which contain a predominant red pozzolana. According to the Italian standards [UNI EN 197-1: 2011], both may be classified as pozzolanic cements of type IV.

Compositional screening by FTIR as well as µ-Raman investigations of the nature of aggregates suggests, in fact, full correspondence. It is therefore possible to state that the concrete is also coeval to the construction of the building. On the other hand, flooring, and plaster on the interior walls of these terraces is not original. These observations correspond to the description of the works carried out in 1958 on the terraces. In the archival documentation referred to these works, reference is in fact made to the demolition of the paving and to the stripping of plaster, followed by their replacement (ASS_dcm_240).

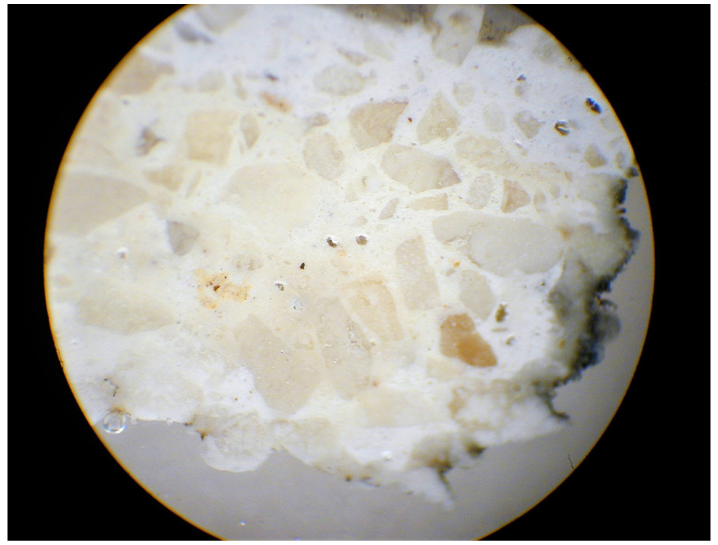
The state of conservation of the faux travertine capping parapet is very bad. The marmorino layer is cracked and detached from the cement matrix, such that fragments are ready to fall out almost everywhere. Faux travertine frames of the upper terraces of the tower of classrooms are therefore in serious danger. Degradation processes are caused by exposure to the action of insolation and climatic phenomena. This element is a valuable historical witness and part of the architectural featuring of the building, which requires attention and conservation work performed by highly

Figure 19 a/d - Details of the marmorino cornices (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020) specialized personnel. In any case, since it is a fragile material that remains particularly exposed to degrading agents, monitoring and maintenance must also be accurately planned.

Interesting considerations may also be proposed around the bitumen used to guarantee the adhesion of the marmorino layer to the concrete matrix of the cornices (Figure 21). The spectroscopic analysis on the sample resulted in a very complex spectrum (Figure 22).

Bitumen, in fact, consists of a multitude of high and low molecular weight compounds, including hydrocarbons, resins, paraffins, waxes, fats, heavy oils, lignins, proteins and asphaltenes. Unlike asphalt, however, bitumen is free of solids, i.e. minerals [Lombardi, Santarelli 2009].

The spectrum obtained on bitumen sample was compared with the internal database of CISTeC (Research Centre in Science and Technology for the Conservation of the Historical-Architectural Heritage) and that of Heritage-Lab of “Sapienza” University, from which full correspondence was found with bitumen extracted in the locality of Selenizza, Albania. Historical sources in fact tell that during World War II the area of Selenizza was occupied by Italian military corps. Therefore, the technical office of the Italian Navy invited the Italian industry to intervene for the exploitation of bitumen deposits. Consequently, the Selenizza mines were given in concession from 1920 to 1943 to Italian Society of Mines of Selenizza (SIMSA), owned by the Italian Engineer Leopoldo Parodi Delfino [Ritrovato 2017].



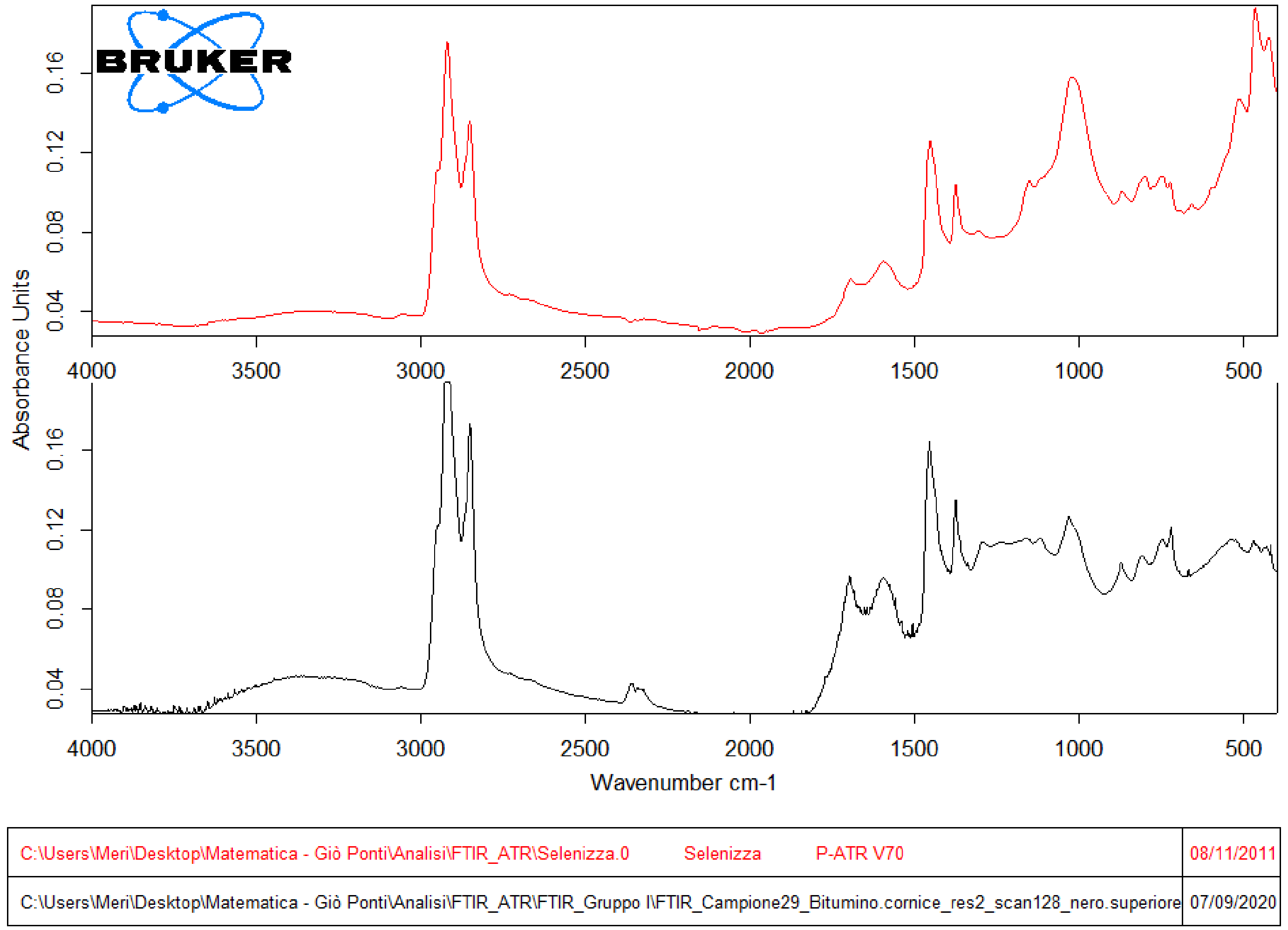


Figure 20 - Microscopic observation of a piece of marmorino in a resin embedded sample collected on the terrace of the tower of classrooms (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

Figure 21 - Bitumen sampling from the terrace of the tower of classrooms (T_RF_03) (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

Figure 22 - Comparison of FTIR spectrum obtained on bitumen collected from the terrace of the tower of classrooms (in black) compared to bitumen extracted in Selenizza, Albania (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

Figure 23 a/d - Linoleum flooring in the book deposit of the library (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

LINOLEUM FLOORING

In the interwar period (1918-1940) Linoleum stood out on the building market as autarchic material largely employed for floorings. Several documents testify an extensive use of Linoleum for the construction of the university campus (ASS_dcm_91), and in the School of Mathematics. This material was in fact found during inspections of this research, and representative sampling was carried out on the floor of the library book deposit (Figure 23).

Since this type of material is of predominantly organic nature, investigations were carried out entirely by IR spectroscopy. From literature data, in fact, it is known that Linoleum is mainly composed of oxidized linseed oil [Gorrée 2002]. During the manufacturing process, cork powder, wood powder, resin, and mineral dyes, in varying proportions according to the types to be produced, are mixed. The blend thus obtained is smoothed at high pressure on a supporting layer of jute canvas. Once this process is done, the jute canvas is varnished with oil paint on the reverse side, to protect and waterproof the material. Thus, product undergoes a curing period of around two months, after which it can be laid down.

Investigations on the sample confirmed literature data regarding the composition and the production process of Linoleum flooring. A further detailed study was carried out, comparing the FTIR spectra obtained with those resulting from the analysis of a sample of Linoleum used by Gio Ponti at the Palazzo del Liviano in Padua. Full correspondence was found between the two samples confirming the use of similar materials and applications.

Linoleum identified in the library archives is therefore to be considered original. It is a mixture of green pigmented siccative oils with a longitudinal streaking effect due to specific processing. The dark amber color is symptomatic of the oxidation of the oils in the mixture. In addition, aging has caused the material to stiffen. Several fractures, lifts and detachments highlight a bad state of preservation.

The Linoleum of the library's reading room is instead no longer the original. However, it is in a state of preservation that does not cause concern.

INNER PLASTER

The archival documentation referred to the construction site reports the use of Terranova plaster produced by the Terranova company, which was widely distributed during the fascist period, especially in Northern Italy (ASS_dcm_82). This type of plaster required the use of mortars with specific grain size and with suitable materials [Di Battista 2006]. As a cement binder base, aggregates were chosen of carbonate or pozzolanic nature. On the surface they were then painted and worked in different ways to ensure either a shiny or a rough appearance. Although these plasters were mainly used for exteriors, in the School of Mathematics they have been used for the interior where the use of Terranova plaster has been in fact confirmed by the archival documentation and recognized by this investigation work.

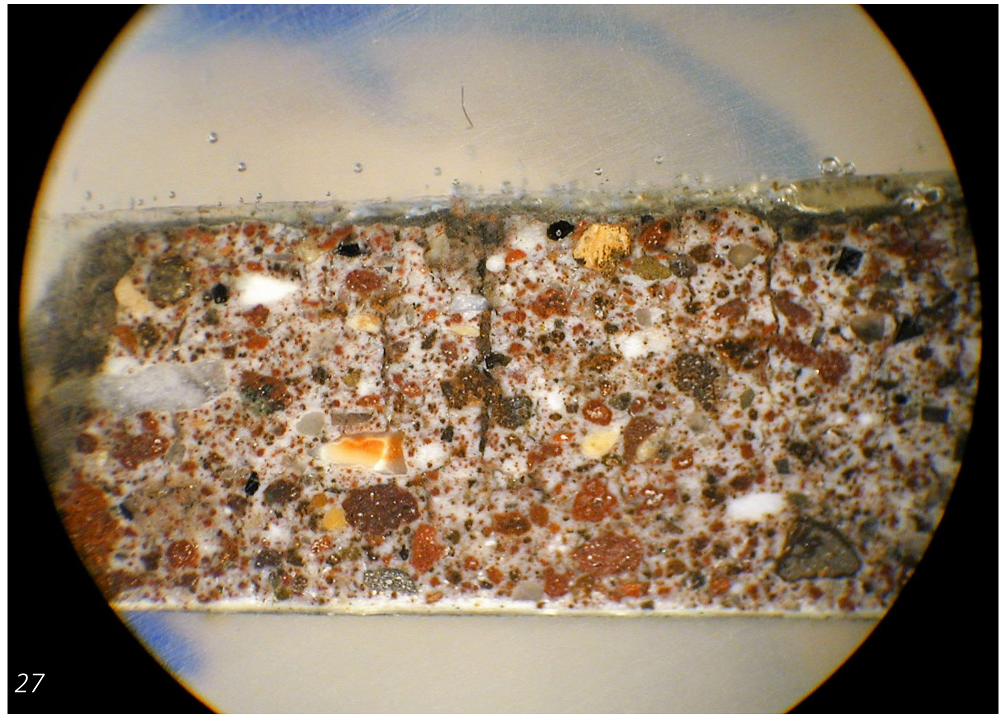
Throughout inspections, the presence of Terranova plasters inside the building has been recognized, more specifically on the ceilings, with a burgundy red coloring, and on the columns with greyish-green tones. The very exposed position of Terranova plastered surfaces (Figure 24) and the impossibility of removing material without producing visible gaps, allowed only a visual inspection. From has been possible to ascertain, the state of conservation of this material is still optimal, most likely ensured by indoor exposure.

Terranova is not the only type of plaster that coats the internal surfaces of the building. An in-depth investigation was carried out on the plasterwork of the library archives. Plasters samples taken from the walls of the library book deposit in correspondence of the round windows are made of a pozzolanic mortar. Indeed, the investigations (Figure 25) carried out on the sample- i.e. FTIR, µ-Raman and DSC-TGA- revealed a carbonate matrix loaded with red pozzolanic material of medium fine grain with a superficial CaCO3 plaster shave (Figure 27). This pozzolanic mortar presents characteristics that are similar in terms of color, distribution, shape of grains, and type of aggregate, to that of other mortars found in the building as preparatory layers. This correspondence proves the authenticity of this material.

Authenticity cannot, instead, be recognized to the plastered surface of the wall in front of the porthole windows of the library archives (Figure 26). The multi-analytical approach adopted for the study of the sample collected in this area allowed its characterization. This plaster may be classified as Portland concrete mortar protected by a lime-gypsum based surface treatment (Figure 28). These characteristics suggest a later application of a layer upon the original plaster.

Regarding their state of conservation, both plasters in the library book deposit show evident fractures and detachments, a type of damage indicating structural movements to be monitored and controlled periodically. In addition, water infiltration that cause salts and mold to appear have been detected, causing degradation to specific areas of plastered surfaces, a symptom of a non-suitable microclimate for its proper conservation, and of water leaks from rain ducts embedded in the outer walls.

Figure 24 - Terranova plaster inside the building: burgundy red ceilings and greyish-green columns (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)



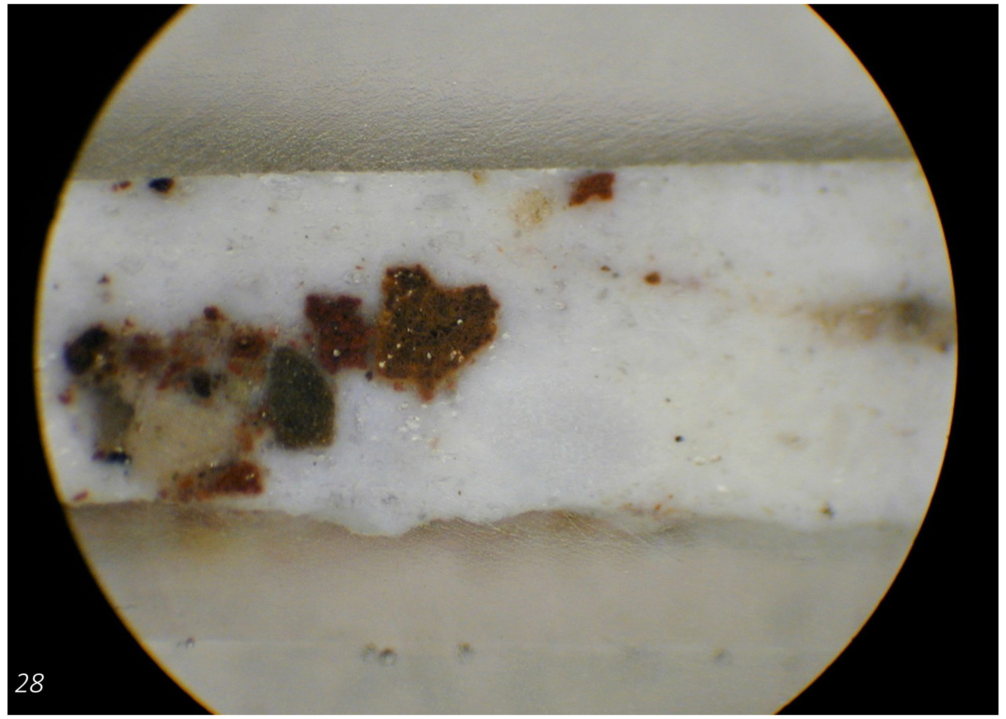


Figure 25 - Detail of a porthole which shed light in the library book deposit (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

Figure 26 - Detail of the wall in the library book deposit (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

Figure 27 - Microscopic observation on sample taken from the wall of the library book deposit (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

Figure 28 - Microscopic observation on a sample taken near the porthole of the library book deposit (© Santarelli, Giorgi, Ciacchella, Pandolfi 2020)

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WHAT'S WHAT: A CATALOGUE OF FURNITURE AND DOORS

Flaminia Bardati, Chiara Turco

FURNITURE

There are many discrepancies between the furnishings documented in the archival sources and those currently present in the School of Mathematics. Many original items are lost, while many pieces of furniture were added to the building without leaving trace in the documents. This is partially true also for elements that are present in the building from the very beginning, such as the black marble benches and the wall lighting fixtures that furnish the atrium of the front building, which are clearly visible in the historical photographs but are never specifically mentioned in the archival documentation. However, at present, every piece of furniture retaining artistic or historical interest deserves to be considered and cataloged, in view of its correct conservation, albeit its unknown origin. This also applies to the doors, which have been listed here in a specific catalogue.

Cataloguing the furniture implies, above all, to survey all the objects according to a specific methodology. This step consists in organizing the entire set of furnishing in categories and typologies, quantifying the items related to each type. In the case of the School of Mathematics, seven categories of furnishings have been identified, and associated to a color reported in the catalogue: seats, tables, lighting fixtures, leaning furniture, suspended furniture, platforms. Every category includes several types of items, characterized by different shapes and/or materials, which belong to different phases, quite often not documented.

Figure 1 - Two seater desks of the "model "Milano" at the ground floor (© Salvo 2021)

In order to systematize all the collected information, the catalogue also describes the details of all the selected objects, organized by categories and types. For each typology the catalogue registers the total number of items found, their location (at the time of the last inspection, as of 2021), the date of production (documented or hypothesized), and the state of conservation. More specifically, every single selected item is associated to a code that allows to identify its location, category, type, quantity. For example, the code “F_Sc_01_chr_a_01 / 50” identifies and item located in the front building (F), second floor (Sc), room 1 (01that is the library, corresponding to a Parma chair (chr_a), numbered from 1 to 50 (1/50).

Each sheet provides:
- macro category (color);
- type code + associated coloured symbol, instrumental to mapping;
- photograph;
- item code, which allows mapping and counting of items survived;
- state of conservation (original, modified, delocalized);
- notes;
- associated archival documentation;
- date of production (documented or hypothesized).

<table>
<tr><th>MACRO-CATEGORIES</th><th></th><th>FURNITURE CODES</th></tr>
<tr><td rowspan="4">SEAT</td><td>chr: chair</td><td>chr_a: @; chr_b: *; chr_c: |</td></tr>
<tr><td>ach: armchair</td><td>ach_a: £; ach_b: §; ach_c: # ; ash_d: >
ach_e: $; ach_f: ç ; ach_g: %</td></tr>
<tr><td>stl: stool</td><td>stl_a: \ ; stl_b: /; stl_c: }</td></tr>
<tr><td>bnc: bench</td><td>bnc_a: [; bnc_b: °</td></tr>
<tr><td rowspan="3">TABLE DESK</td><td>tbl: table</td><td>tbl_a: @; tbl_b: #; tbl_c: *; tbl_d: ^
tbl_e: $; tbl_f: +; tbl_g: >; tbl_h: %
tbl_i ç; tbl_l: ¢ ; tbl_m: ¶; tbl_n: ¤</td></tr>
<tr><td>tsk: teacher's desk</td><td>tsk_a: §; tsk_b: "; tsk_c: &
tsk_d: £; tsk_e: [</td></tr>
<tr><td>dsk+chr: desk+chair block</td><td>dsk+chr_a: x+o; dsk+chr_b: X+O</td></tr>
<tr><td>LIGHTING FIXTURE</td><td>lfx: lighting fixture</td><td>lfx_a: @, lfx_b: *, lfx_c: #, lfx_d: &</td></tr>
<tr><td rowspan="3">LEANING FURNITURE</td><td>obf: office cabinet</td><td>ofb_a: ^; ofb_b: &; ofb_c #; ofb_d: @</td></tr>
<tr><td>bks: bookshelf</td><td>bks_a: $; bks_b:); bks_c: £</td></tr>
<tr><td>hdr: handrail</td><td>hdr_a: ¶; hdr_b: §</td></tr>
<tr><td rowspan="4">SUSPENDED FURNITURE</td><td>ntb: notice board</td><td>ntb_a: #; ntb_c: $</td></tr>
<tr><td>cth: coat hanger</td><td>cth_a %; cth_b: ¶</td></tr>
<tr><td>blb: blackboard</td><td>blb_a: £; blb_b: §; blb_c: ç</td></tr>
<tr><td>ast: ashtray</td><td>ast_a: @</td></tr>
<tr><td>FOOTBOARD</td><td>ftb: footboard</td><td>ftb_a: >; ftb_b: §; ftb_c: ç</td></tr>
</table>

Chr_a @ (tot. 88 + undefined number in the basement floor)

LOCATION and QUANTITY	STATE	MATERIALS	NOTES	SOURCES	DATING
F_Fr_05_chr_a_01/12 F_Sc_01_chr_a_01/50 F_Sc_03_chr_a_01/14 F_Sc_05_chr_a_01/07 F_Sc_07_chr_a_01 F_Sc_10_chr_a_01/03 F_Tr_04_chr_a_01 WE_Bs_01_chr_a_undefined	01-12: original, delocalized 01-50: original 01-14: original, delocalized 01-07: original original, delocalized 01-03: original, delocalized original, delocalized original, delocalized	chromed steel tube; seat and back in polished oak	Parma Company, n. 14 of the catalog, modified by Ponti. Originally 196 objects. Perfect state of conservation, in use.	ASS_drw_83 ASS_dcm_115 ASS_dcm_155 ACS_pht_16 ACS_pht_30 ACS_pht_31 BBL_pht_33 GPA_pht_05 GPA_pht_06	1936

Figure 2 - Categories and typologies of the furniture catalogue: coloured symbols are associated to each typology, thereby allowing the mapping of each item on plans (© Bardati 2020)

Figure 3 - A sample of the furniture catalogue; the sample shows chair model 14 produced by the firm Parma (© Bardati 2020)

Further on, the survey and cataloguing activity has referred to materials and production processes. This phase of the research allowed to date non-documented furniture, also helping a thorough understanding of the materiality of such a peculiar heritage.
The "seats" category is one of the richest and comprises 15 typologies, including chairs, armchairs, stools, and benches; yet the origin of only four types is documented from the 1930s, while the others seem to belong mainly to phases 1- 3 (1935-1949) or to the beginning of phase 4 (Figure 4).

Chairs are of three types: The Parma model (chr_a, documented in the 1930s) consists of at least 88 items; chr_b (16 items) and chr_c (2 items) probably date both to phases 1- 3 (1935-1949).

Armchairs are of seven types, most of which probably date back to the same phases 1- 3: ach_a (14 items); ach_b (6 items); ach_d (14 items) and ach_e (4 items). As none of these is mentioned in archival sources directly related to the School of Mathematics, it is possible that they were purchased for other Institutes of the university campus and entered the building later, probably in the post-war years or after 1968. Such hypothesis is based on the shape but also on the type of materials and on workmanship, in particular padding with belts, springs, and jute. Ponti was one of the designers who participated to the industrial program of Pirelli of 1933-1940 concerning the experimentation of foam-rubber produced by Pirelli for furniture padding, as evidenced in Franco Albini's editorial "La Gommapiuma Pirelli alla VI Triennale"[1]: the use of jute instead of foam rubber could prove a dating at the end of the 1940s and, at the same time, the exclusion of Ponti's authorship.

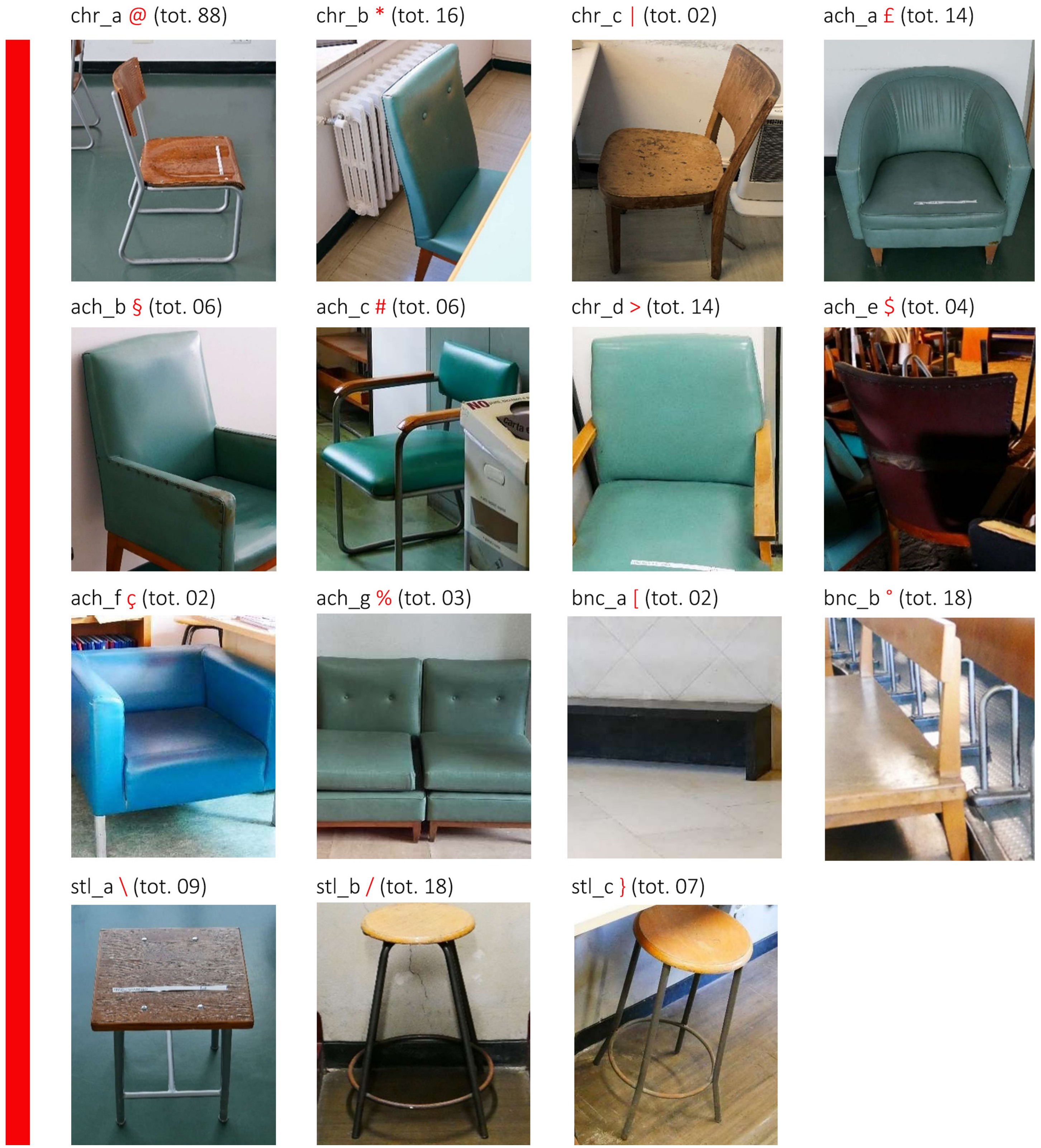


Figure 4 - General overview of chairs, armchairs, benches, and stools included in the furniture catalogue: coloured symbols are associated to each typology, thereby allowing the mapping of each item on plans (© Bardati, drawing Turco 2020)

For the same reasons, armchairs ach_f (2 items) and ach_g (3 items), characterised by padding in expanded polyurethane, were purchased later, probably during phases 4- 5 (1950-1980), during which the furniture of the building required to be renewed and integrated. The armchairs of the Council Hall (ach_c, 6 items) are the only documented in the 1930s.

Concerning the stools, only one type (stl_a, 9 items) is documented in the 1930s, while the two others (stl_b, 18 items and stl_c, 7 items) are probably datable to the 1950s.

Benches bnc_a, corresponding to the two black marble benches of the atrium, are visible in the 1936 photographs and certainly belong to the original design, while bnc_b (18 items), appear in a picture taken by Carlo Severati between 1983 and 1992, and are therefore datable to phases 4- 5 (1950-1980), as the increase of number of students required the supply of many more seats, probably for the tiered lecture halls of the Tower.

As shown by the mappings and by the item codes in the following chapter, many objects have been delocalised and mixed without logic, nor a criterion regarding their dating, original function and location, stylistic homogeneity with other furnishing etc. Many of them are waiting to be repaired or have been stacked in the basement, where humidity represents a true danger, especially for the wooden frames and for the paddings.

Moreover, the catalogue lists only few among the original lighting fixtures (Figure 5). At present, all 102 spherical pendent lamps produced by the firm Bianchi and supplied in September 1936 (ASS_dcm_159) with three different diameters (40 cm, 35 cm, 30 cm and 25 cm) have gone lost, and have been replaced by rectangular ceiling lights. Photos of the 1930s show their presence them in the lobbies of the Tower of classrooms, in the drawing halls of the curved wings and in the annular corridor at the ground floor; but

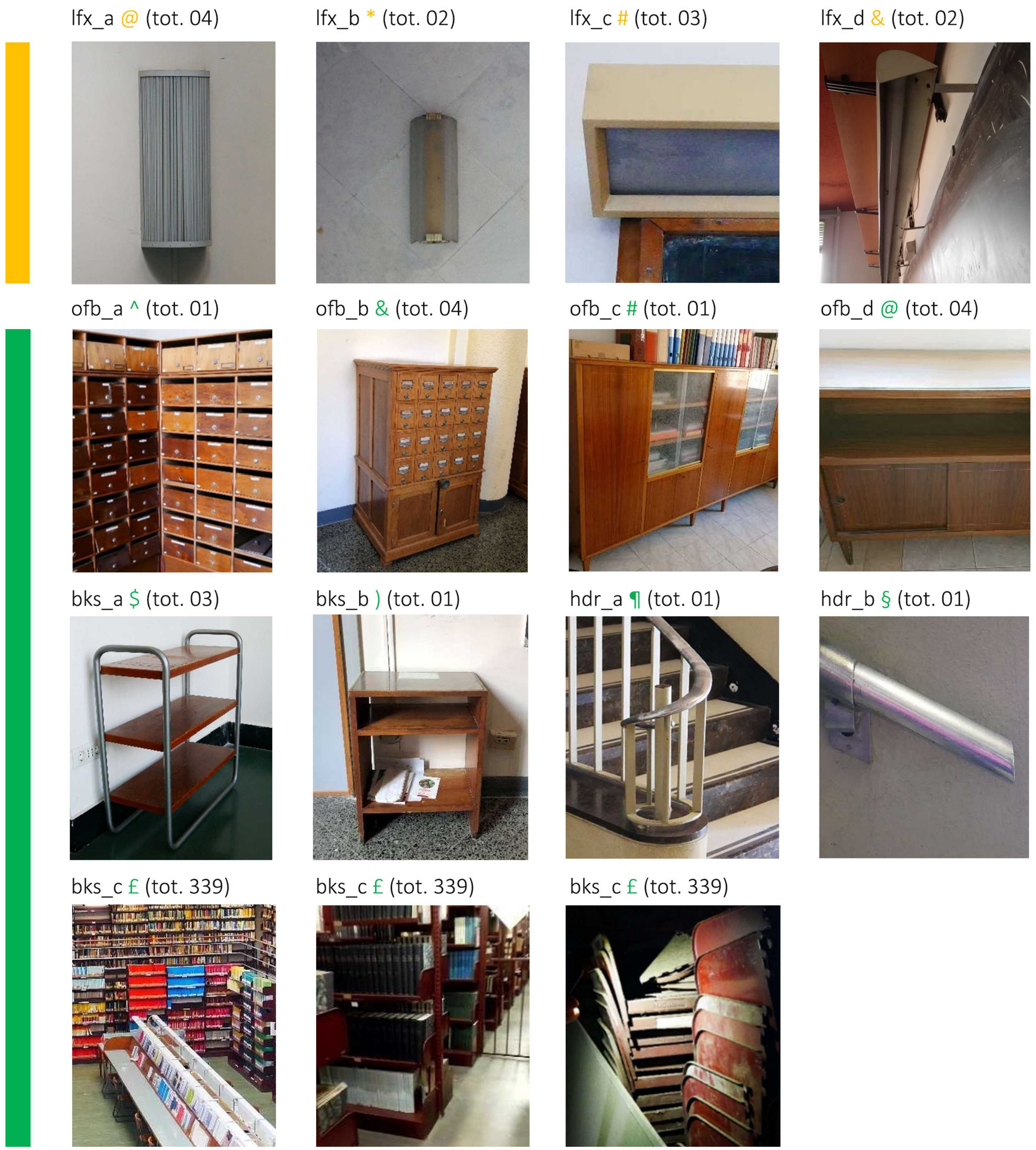


Figure 5 - General overview of the lighting fixture and furnishing included in the catalogue: coloured symbols are associated to each typology, thereby allowing the mapping of each item on plans (© Bardati, editing Turco 2020)

most probably they had been used in all rooms of the building, with few exceptions. This was in fact a basic model, adopted many in other Institutes of the university campus, which but Ponti seemed to very much appreciated for its shape. He adopted this same type in other projects of the 1930s, such as the reading room of the Liviano building at the university of Padua, the Italian Institute of Culture in Wien and the Vetrocoke building in Milan.

Also, the lamps that had been designed on purpose by the firm S.A.A.R to be fixed upon the big reading tables and on the shelves of the library have been all replaced, as well as the fixtures characterised by a parabolic shape, which projected grazing light on the blackboards' surfaces of the classrooms. This kind of lamps have been replaced by more modern and safe ones (lfx_c), but two items of this type still survive (lfx_d): one in a professor's office in the front building and one in the IndAM offices, where blackboards and lamps were all replaced in 1939.

Some of the most interesting original lighting fixtures were commissioned to the firm Bianchi and consisted of hemicylindrical wall lights composed by several small cylinders in opaline glass, enclosed by two semi-circular plates of painted metal (lfx_a). The supply included 6 items 90 centimetres tall, destined to the library and to the professors' lobby, 22 items 65 centimetres tall placed in the annular corridor, as witnessed in pictures and movies of 1936, and 7 items 45 cm high, whose destination is unknown. Four lamps at present in the library are copies of the originals (Figure 6). The wall lights of the main atrium (lfx_b), in place since 1935 as shown by the photos of the Thirties, are not listed among the supplies by Bianchi or by Palazzo della Luce (Figure 7). They could correspond to Ponti's specific request as a similar model is used in the atrium of the Montecatini building (1936) and placed near the elevator.

Figure 6 - Replicas of the wall light of the library supplied by the firm Bianchi (© Bardati 2020)

Figure 7 - Wall light of the main atrium in the Front building (© Bardati 2020)

The richest category includes tables and desks and includes 17 typologies (Figure 8), not considering the integrated model Milano by the firm Beltrami, which assembled desks and seats, and those for the tiered lecture halls of the Tower produced by the firm Liporesi.

Beside four types of tables documented in phase 1 (1935-1938) and supplied by the firm Santi (tbl_d), by the firm Beltrami (tbl_e and tbl_g) and by the firm Parma (tbl_n), plus one item that is attributable to the same phase (tbl_f), it is very difficult to date other tables currently in the building, especially those present in the library and in some professors' studios.

In most cases, materials (oak and sometimes Linoleum) and shape of the legs could suggest a dating span between the 1940s and the 1950s, when new furnishing entered the building whether to compensate what was lost during the occupation or to purchase new furniture needed by the increased number of students and professors. Obviously, it is possible that some of these tables were purchased for other Institutes and have been moved to the School of Mathematics after the occupation of the building by the allied troops at the end of World War II, or after 1968: yet details concerning shapes and manufacture also encourage other hypotheses. Thanks to the colour, the woodwork process, and the shape of the legs, six comfortable writing desks with drawers hanging

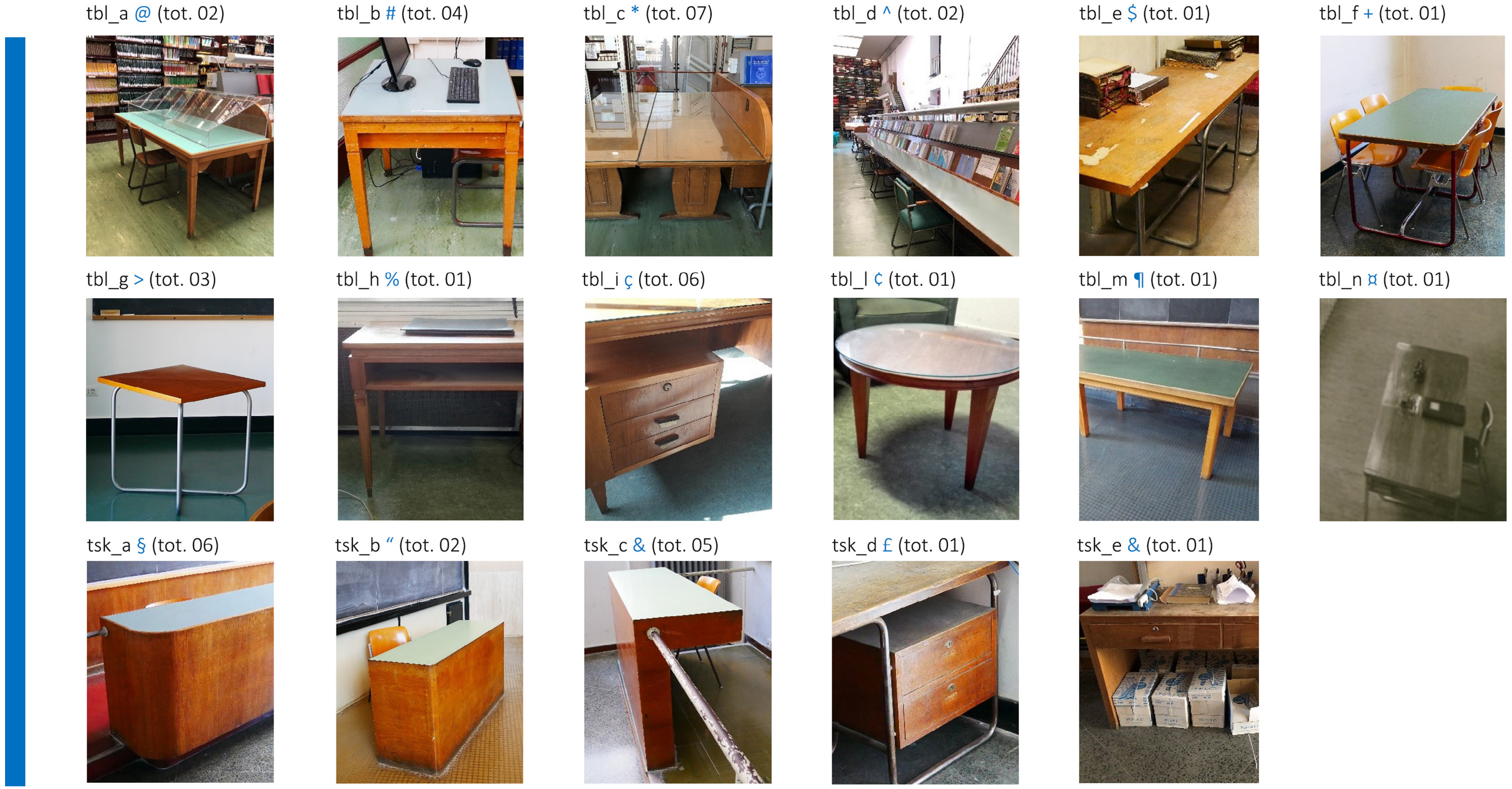


Figure 8 - General overview of tables and teachers' desks included in the furniture catalogue: coloured symbols are associated to each typology, thereby allowing the mapping of each item on plans (© Bardati, editing Turco 2021)

from the wooden structure (tsk_b), are to be linked to some large office cabinet (ofb_c) and to some smaller closets (ofb_d). Very probably they were part of the supply to the furnishing of a few new professors' studios in two main occasions, both dating to the beginning of the 1970s. These were the years when the building in via Vicenza was rented for the purposes of the Institute of Mathematics, and when the newly built additions to the sides of the front building had been completed and were ready for furnishing. Nevertheless, the style of these items appears quite too decorated for the 1970s.

The lack of archival documentation not only impedes a correct dating but also hinders any hypothesis about Ponti's possible authorship in occasion of the new supplies of furnishing or, as for phase 1 (1935-1938), about Ponti's request of small but significant modifications in the models proposed by the firms. An example is the small round table, at present in a professor's studio (tbl_l), which is very similar to the "Anna" model designed by Ponti for the Borletti family in 1932. The thin silhouette of a table without drawers, both in a rectangular and in a square version (tbl_a and tbl_b), also with a drawer (tbl_h), recalls Ponti' research. There is in fact a red thread connecting these of the 1930s, and his later works with De Poli in the 1940s,

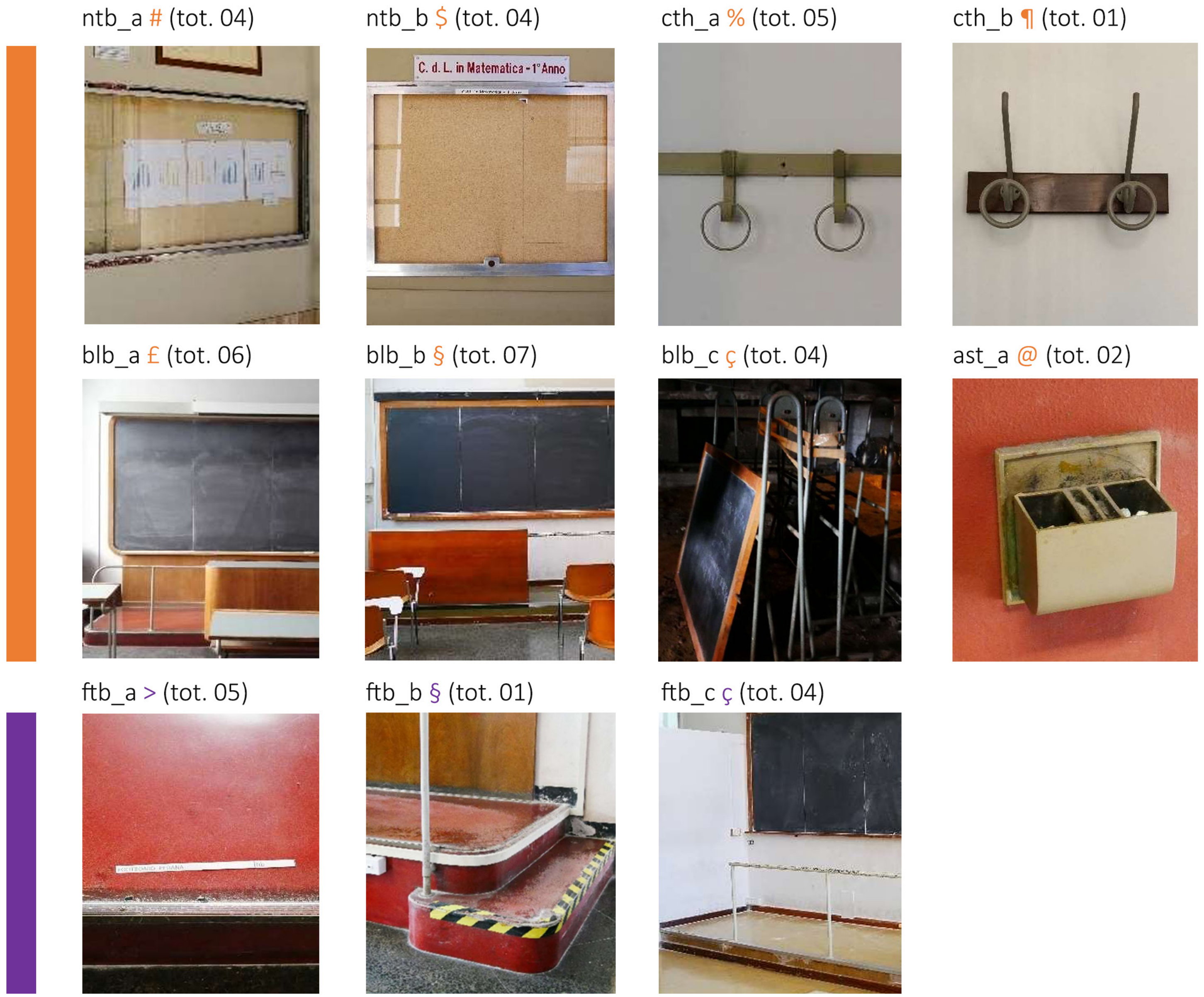


Figure 9 - General overview of suspended furnishings and of footboards included in the furniture catalogue: coloured symbols are associated to each typology, thereby allowing the mapping of each item on plans (© Bardati, editing Turco 2021)

up to the console designed for the hotel rooms of the Hotel Parco dei Principi (1960), although similarities are not strong enough to propose his authorship, even if limited to few modifications the firms' basic models.

The teachers' desks open another interesting chapter. As said, seven teachers' desks in spirit-polished oak (tsk_a), conceived as a one-block assembling the wooden wall veneering, the blackboard, the footboard, and the steel railing (Figure 9), were ordered to the firm Santi in October 1935. All the elements composing this block, described as *cattedra* in the documents, were ordered to Santi, except the blackboards. They all followed the same design, with the writing desk positioned sideways and the railing continuing to the end of the footboard. But there were differences concerning the dimensions- according to the size of the classrooms' dimensions – and according to the presence of a door cut into the blackboard, which lead to the professors' dressing room, as a filter between the lobby and the tiered lecture halls. This specific solution allowed the professors to enter the classrooms without using the same paths and doorways used by the students, somehow underlining a distinction between the Maths professors and the students in Engineering. In fact, no similar solution is present in the other classrooms in the front building where Mathematicians taught to students in Math.

Such a composition of elements in a unique functional block may be considered as one of the very first occasions for Ponti to design *a parete organizzata* (organised wall), a *leitmotif* of his, already present *in nuce* in a drawing of the 1920s[1]. Six of the seven original blocks survived: three are still in the tiered lecture halls at the ground and at the first floors of the Tower, while three are still in the classrooms of the Front building. Unfortunately, one large block disappeared in 1960, as the tiered lecture hall at the third floor of the tower was split into two smaller rooms. The new teachers' desks for these new classrooms are copies of the original ones, but without footboard and integrated blackboard and with relevant differences in terms of woodwork and materials. In the desks supplied by the firm Santi, the oakwood grain is disposed vertically, and a single sheet of wood draws a large quarter of a circle in correspondence of the external corners (Figure 10). The table is also a single piece with the drawers and its top consists of a thin wood frame that borders the surface, filled in with a sheet of Linoleum. The new desks copy the general shape of the models, but with very different details. They are made by several pieces of oakwood veneering with horizontal grain unless in the corners, where a smaller element with vertical grain rounds up the corners; the top- here in laminated plastic- has no frame.

The order to the firm Santi included four *cattedre* also for the drawing classrooms, but at the end of the description it is clearly specified that the supply does not include writing desks, which in other cases were accompanied by a detailed description of the desk and its joints to the other elements. Therefore, with the term *cattedra* the firm Santi indicated the one-block complete of footboard, wooden wall veneering, railing, and writing desk. Only in the case of the drawing classrooms, the desks were not supplied by Santi- probably for economic reasons- but by Beltrami (tsk_d), only one of which survives although stacked in a closet. At present, there are four footboards with railings in the east wing, which are bigger than those ordered to Santi and lacking the Linoleum finishing as in the original ones. However, it is possible that the footboards of the 1930s have been fixed to fill the wider walls of the new classrooms. All the teachers' desks that are currently in use in this part of the building are copies of the original model and are very similar to those produced in 1960.

The direct observation of the items selected for the furniture catalogue evidences that the main materials that identify the furnishings are chromed steel tubes and polished oak. This is true for the items supplied by all firms: Parma that produced chairs for the library, tables for the reading rooms; Liporesi that produced the curved desk and seats for the Tower of classrooms; Santi that produced the big reading tables for the library, the teacher desk with railing for all classrooms destined to High or 'Pure' Mathematics; and Beltrami that produced the armchairs for the Council Hall, the stools and teacher desks for the drawing classrooms, the tables for the waiting room of the Council Hall, the *Milano* desks for the classrooms of the Front building, and the whole furniture for the professors' studios. Undoubtably, these materials encountered the taste and the style of the times, and Ponti uses them in many projects of the 1930s, concerning office buildings but also residences, as in the case of the table for the Marmont House in Milan (1934-1936).

Figure 10 - Teacher's desk in spirit-polished oak and Linoleum supplied by the firm Santi. Detail of the round shaped corner with vertical wood grains (© Bardati 2020)

Experimental or autarchic materials, as Anticorodal and Linoleum, also characterize many objects belonging to the phase 1 (1935-1938). As said, Linoleum was used to veneer the surfaces of footboards and desks, while Anticorodal was used for many different objects supplied by the firm Gaggiottini. Besides the inscription “Scuola di Matematica” on the main façade, other smaller signs mark the original rooms. A hierarchy among the different rooms of the School is underlined by the use of different materials along the staircases: these are richer in the Front building where the steps and paving in marble and the handrail in Anticorodal open the way to the first floor and to the library (Figure 11).

Figure 11 - Handrail in iron and Anticorodal by the firm Gaggiottini; the helix dynamically guides the upward movement from the first to the second floor (© Bardati 2020)

DOORS

Concerning the doors, 18 typologies have been identified, often on the base of archival documentation (Figure 12). The doors catalogue adopts the same methodology as for the furniture and is organized in chronological phases and typologies. Only four main phases have been identified for the doors:

- Phase 1- 1935-1937 (the original project);
- Phase 2- 1939-1940 (foundation of the IndAM and alteration of the first floor of the west wing);
- Phase 3- 1954 (alteration of the professors’ lobby to obtain two offices);
- Phase 4- 1969-1980 (additions to the curved wings and fragmentation of the drawing classrooms in the east and west wings).

The doors supplied in occurrence of phase 1 have been the model for the following phases, with few exceptions and changes, mainly concerning the manufacturing process and the finishing materials, sometimes also the dimensions (Figure 13). Therefore, the main objective of the research was to identify the original doors, which was not an easy task as these have been thoroughly modified (surface, colour, handles, locks, hinges).

The huge metal-frame doors at the ground floor supplied by the firm Coen are clearly recognizable along the corridor (drs_c), despite the several alterations to the handles, glazing and panic bars. The firm Gaggiottini supplied the Anticorodal frame of the entrance door (drs_a, with modified opening system) and the veneering of other doors in the main atrium of the Front building, which are characterised by rounded arches (drs_b). Other doors, as those of the library (drs_h) and of the elevator (drs_e and drs_f), are also original, and the same goes for the doors that open in the blackboards of the tiered lecture halls of the Tower. Wooden doors that are mostly used in the building are those supplied by the firm Cantieri Milanesi: designed by Ponti, who required a specific wood processing (ASS_dcm_74), they are scattered everywhere in the building and are most often kept in the original condition or have been only slightly modified (drs_A; drs_B1; drs_B2; drs_C; drs_D; drs_E; drs_f; drs_G and drs_H).

The doors’ catalogue contains details of all selected items, organized by phases and types, such as to provide all the collected information. The catalogue registers the total number of items of each typology, their dimensions, their location, their state of conservation. Also in this case, each item is associated to a code that

PHASES — DOORS CODES

Phase 1 (1935-1937)
drs_a: *; drs_b: ^ ; drs_c: °; drs_d: >; drs_ e: <; drs_f: " ; drs_g: |
drs_ h: \; drs_i: +; drs_ l: / ; drs_ A.: A; drs_ B1.: B1; drs_ B2.: B2
drs_ C.: C ; drs_ D.: D ; drs_ E.: E ; drs_ F.: F ; drs_ G.: G; drs_ H.: H

Phase 2 (1939-1940)
drs_ B2.: B2; drs_ C.: C ; drs_ D.: D ; drs_ E.: E ; drs_ F.: F
drs_ G.: G; drs_ H.: H

Phase 4 (1954)
drs_C. C

Phase 5 (1969-1980)
drs_m: ° ; drs_n: $; drs_ A.: A; drs_ B1.: B1; drs_ B2.: B2; drs_ C.: C
drs_ D.: D ; drs_ E.: E ; drs_ F.: F ; drs_ G.: G; drs_ H.: H

Figure 12 - Phases and typologies of the door catalogue: coloured symbols are associated to each typology, thereby allowing the mapping of each item on plans (© Bardati 2020)

drs_a * (tot. 02)

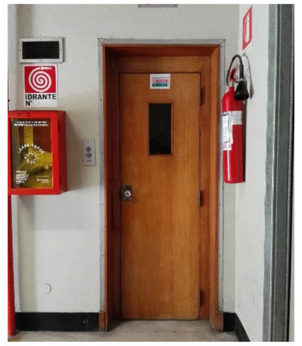
drs_b ^ (tot. 02)

drs_c ° (tot. 08)

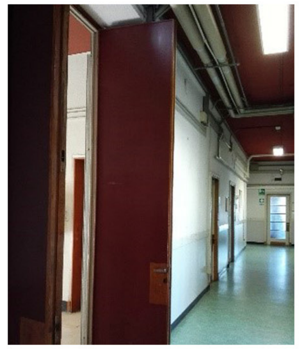
drs_d > (tot. 02)

drs_e < (tot. 02)

drs_f ”(tot. 03)

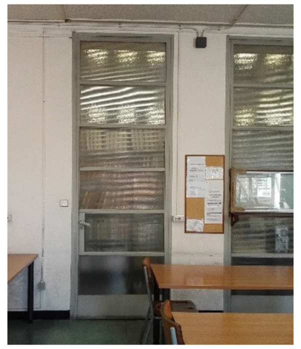


drs_g | (tot. 01)



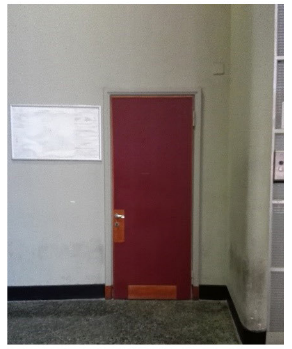
drs_h \ (tot. 01)

drs_i + (tot. 06)



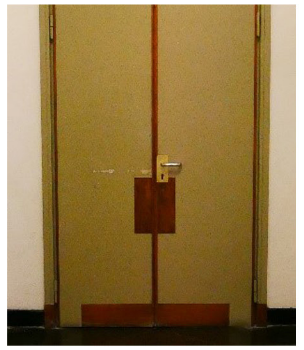
drs_l / (tot. 03)

drs_A. A (tot. 07)

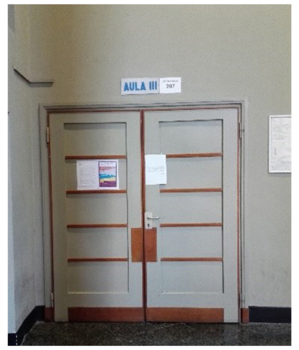


drs_B1. B1 (tot. 08)

drs_B2. B2 (tot. 10)



drs_C. C (tot. 10)

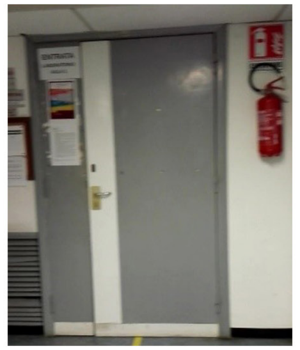


drs_D. D (tot. 29)

drs_E. E (tot. 17)

drs_F. F (tot. 09)

drs_G. G (tot. 03)



drs_H. H (tot. 07)

Figure 13 - General overview of the catalogue of doors produced during phase 1 (1935-1938): coloured symbols are associated to each typology, thereby allowing the mapping of each item on plans (© Bardati, editing Turco 2021)

allows to identify type and location: the item code F_Fr_19 / 01_drs_E._01 identifies items located in the Front building (F) at the first floor (fr), connecting rooms 19 and 01 (19/01), the door type “E.”.

Each card, as in the case of the furniture catalogue, provides information regarding:

- phase (color);
- type (code) + associated coloured symbol, which allows the object to be mapped;
- code, which allows its location within the building;
- state (original, modified, delocalized);
- archival documentation, drawings or picture associated with to object;
- dating;
- image;
- notes.

Ponti invested much of his aesthetic principles in the design of the doors, as in the case of the arched entrance doors and, among all, in the doors produced by the firm Cantieri Milanesi. Again, he uses this same type of door in many other projects of the 1930s, as in the case of the house model for the *VI Triennale* in Milan, in the Marmont House in Milan, in the Hotel “Paradiso del Cevedale” near Merano, in the Italian Institute of Culture in Wien and in the Vetrocoke Building in Milan, but also at the beginning of the 1940s, as in the case of the the Palazzina Salvatelli in Rome (Figure 14) and the Columbus Clinic in Milan. Yet, the idea of alternating painted wood and glass is anticipated in a sketch of the 1920s[2], showing a solution very close to type “E” later used in the School of Mathematics. Doors are architectural elements used by Ponti to underline hierarchies among different parts of the building and among spaces, by linking a specific design solution to rooms with specific functions. Apart from the doors made special in terms of dimensions or specific position- such as the elegant main entrance doors, the huge doors opening onto the professors’ offices and onto the library (drs_g), and the series of metal and glass doors that rhythmed the annular

Figure 14 - A door in the Palazzina Salvatelli in Rome (1939-1940), replicating type “E” of the same model produced by the firm Cantieri Milanesi (© Salvo 2019)

corridor of the wings' ground floor, the more common doors produced by the firm Cantieri Milanesi allowed Ponti to distinguish the rooms and their functions. The contract signed by this firm in September 1935, itemizes 9 models of doors: 4 double winged and 5 simple ones. These may be divided into two main groups, with or without glass, each of which including several types, differing in dimensions and surface finishing. Generally, the structure and the frame are in fir, painted with white *cementite*, while the lower and middle bands are in spirit-polished wood (Figure 15).

Types A and B1 are not painted but finished with a thin Linoleum sheet that assured a more compact visual effect and a good maintenance over time. Types B2 and D, supplied in several different width, are the most used. At present they are painted in grey, red or in pale green, also used to paint several walls of the building, but it is not certain if these were the original colours, as the pictures of the 1930s are in black and white. Types G and H are very similar to B2 and D, even if their lower and middle bands are not polished but painted and were used for less important rooms (as closets and the rear of the blackboard doors, or doors at the basement level). Most of the models C and E (respectively double and one-winged doors) carry glass panelling, separated by listels in polished wood; in Type F, glass is only present in the upper part of the door. Such a variety of solutions allowed Ponti to characterise rooms and functions also by using similar, yet different, doors.

Model B1 is used for the doors which give access to the tiered lecture halls of the Tower, and therefore conceived for large numbers of students (434 seats), while model C is used for exterior ones, that give access to the lobbies of the Tower, and to the offices adjacent to the drawing classrooms at the first floor of the wings. Type E identified all professors' studios in the Front building and two rooms with same dimensions, located at the third floor and accessible from the library. Type F was used for the toilets, with a very different veneering, for the door of the lift at

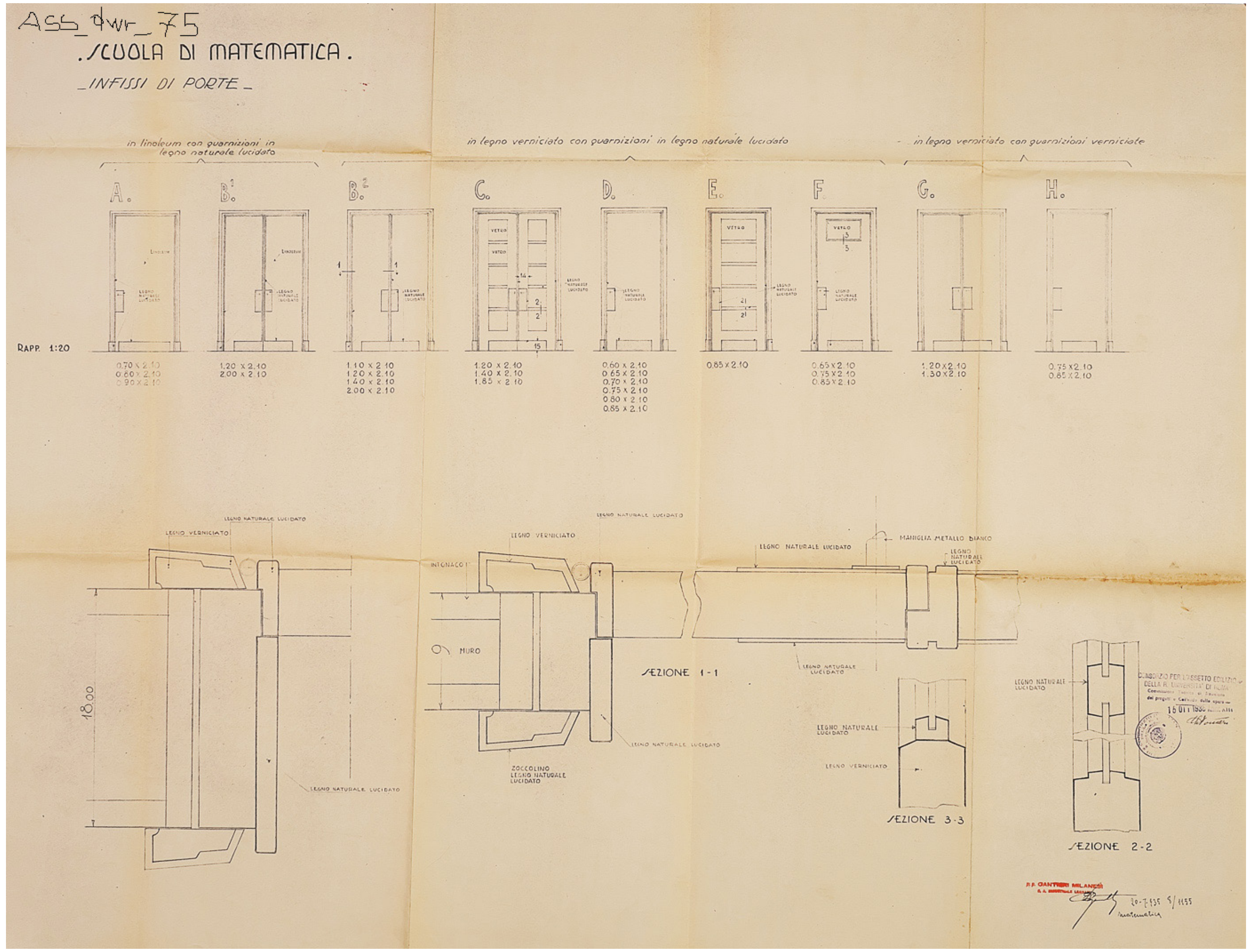


Figure 15 - The doors supplied by the firm Cantieri Milanesi; the drawing specifies models, materials and finishing processes (ASS_drw_75)

the ground floor of the Front building. Here, the door is veneered with a sheet of black rubber with thin vertical flutings; the door opposite the lift has the same finishing (Figure 16). Such an effect recalls Ponti's research around furniture, as in the case of the small closet for the Marmont House[3].

Almost all doors of the following phases use these as models. The contract describing the works necessary to adapt the first floor of the west wing to the purposes of IndAM, clearly specifies that all doors must be identical to those that were already in the building: the models chosen were B2, C, D and E. In this case, as the chronological gap is very small, the difference with the original ones of 1935-1938 is almost invisible. One cannot say the same for the two doors produced for the offices obtained from the professors' atrium in the front building in 1954. The model is still type C produced by Cantieri Milanesi, but proportions, materials and manufacture are of inferior quality. Finally, the doors produced in occurrence of further main transformation works copy the models B1, C, D and E, but replace Linoleum with laminated plastic and the handwork processes with the industrial ones. It must also be said that all the doors which open onto classrooms or public rooms have been equipped with safety handles, thereby introducing elements that compromise the original aesthetic idea.

Figure 16 - The door of the elevator at the ground level of the front building (© Bardati 2020)

V.
INTERACTION BETWEEN THE BUILDING AND USERS OVER A PERIOD OF TIME

BACK TO INDEX

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FUNCTIONS, USES, AND STATISTICS, 1935-2021

Simona Salvo, Marianna Cortesi

Gio Ponti's building has been home to Sapienza's Institute of Mathematics since 1935. This is not just a practical piece of information, but highlights the fact that the building, designed in 1935, was chosen to host one of the best scientific research institutes in Italy, both in the past and now. The names of the building and institute have changed over the years, while the many reforms that have been implemented in past decades have modified the Italian academic system, and also Sapienza University. So, although the building's function has remained unaltered throughout the decades, its use has instead radically changed.

As is well known, continued use is one of the best ways to preserve architecture: in the case of the School of Mathematics this has saved the building from major interventions, but it has also been the main source of 'stress' for its material conservation due to the continuous adjustments it has endured to accommodate the changes in academic activities and regulatory compliance. In other words, the use of a building is a watershed in architectural conservation.

Investigating the way in which the School of Mathematics has functioned and been used in its almost ninety years of life was therefore a key topic in this research, given that continuous and qualified occupation of the building- in line with the scope for which it was designed- is not only a value, but also partially guarantees its conservation. Its continuous use ensures that the site is maintained and cared for on a daily basis; it also establishes a crucial relationship between users and the building, and is the premise for its appreciation and, therefore, its assessment and conservation.

The daily presence of a caretaker, who also lives in the building, is a true asset for its continuous maintenance and care. The 'porter's house' was designed by Ponti as part of the original building in 1935 and has always been used by the porter and his family. This has ensured that the building has always been cared for throughout the years, somehow compensating for the lack of care by the governing body. This is why we have considered the presence of the porter in the building as a key element in the conservation plan.

Researching the functions and uses of the building over a period of time was implemented as follows:

- historical research in archives;
- analysis of research and teaching in the School of Mathematics from the Thirties to the present day;
- identifying the courses taught in the building;
- surveying statistical data regarding increases in the number of students, professors, and staff in the building from 1935 to the present day;
- analyzing the link between the different uses and recurring compliance with safety regulations; trying to find data regarding the use of the more notable spaces in the building, such as the library and courtyard.

We have also recovered and collected statements by those who attended courses in the building in the early Sixties and have continued working there as academics until their retirement; we also interviewed people who have lived in the building, considering it their private home, i.e., the former and current porters.

By merging this information with our analysis of the interiors and furniture we have been able to make our historical reconstruction more accurate, as well as detect weak and strong points.

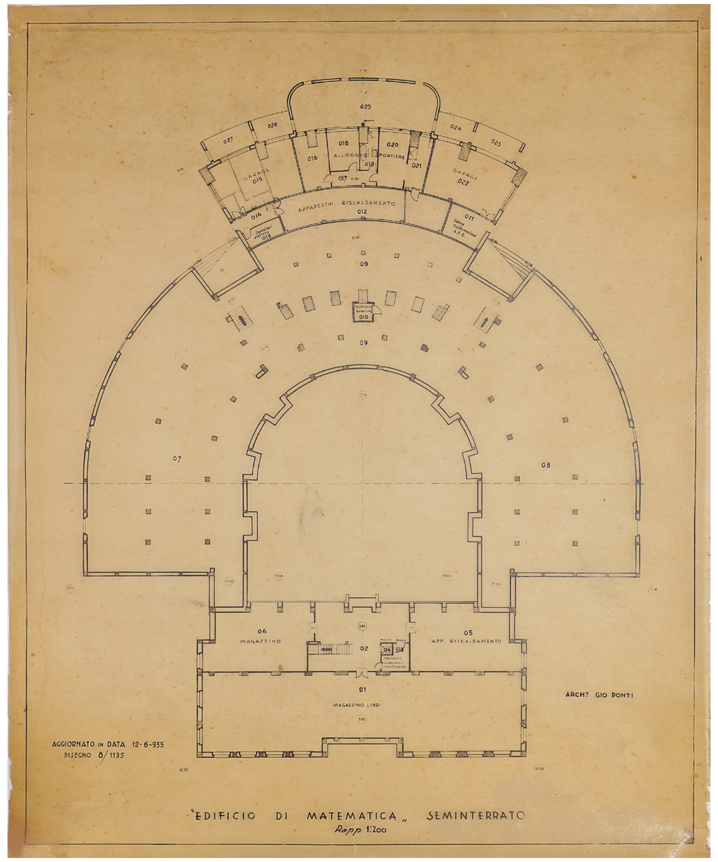


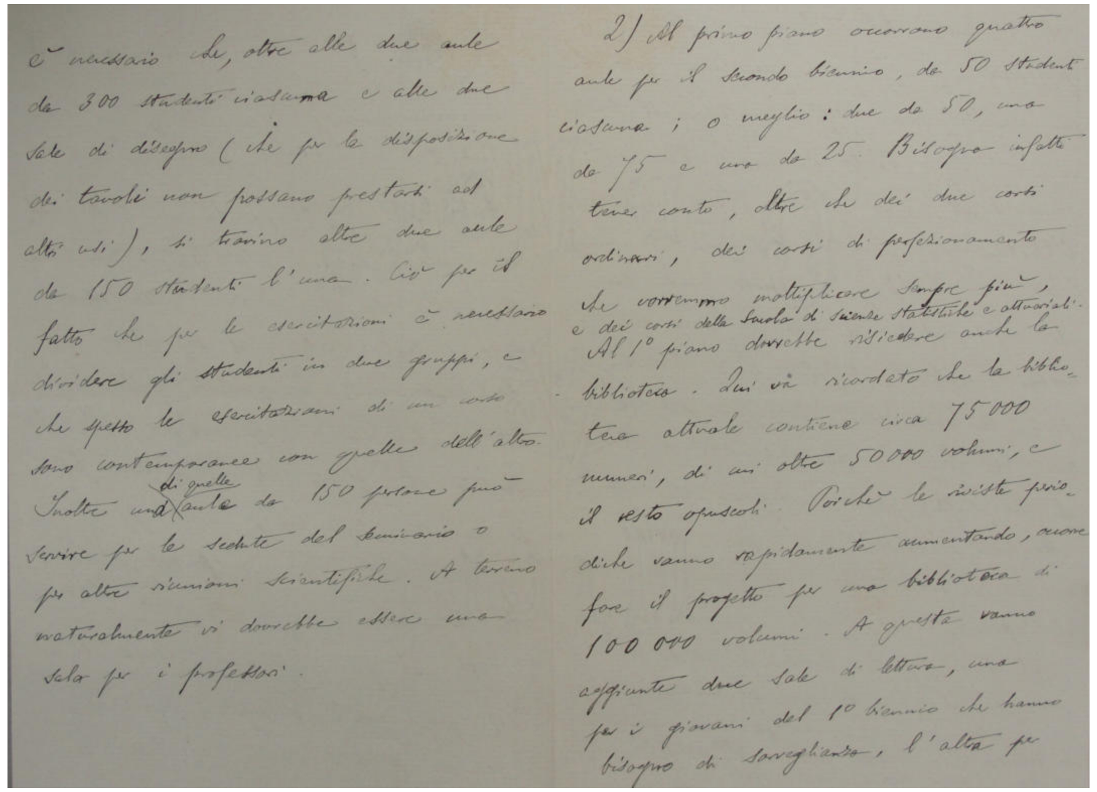
Figure 1 - Plan of the basement designed by Ponti in June 1935; details are provided regarding the house of the porter and his family, located at the foot of the classroom tower with its systems and garages (ASS_drw_69)

A HISTORY OF HOW THE BUILDING HAS BEEN USED

The history of the building, and its archival documentation, shows that one idea was paramount for Marcello Piacentini when he designed the general plan of the University campus and assigned the projects for each building to select architects: it was to ensure that the buildings were functional. To achieve his goal he adopted a dual method: he encouraged each architect to communicate with the older and younger academics of the future Institute, in this case Gio Ponti and the well-known mathematicians Guido Castelnuovo and Enrico Bompiani[1]. Archival documents clearly illustrate the correspondence between the three- Ponti, Castelnuovo, and Bompiani- and the exchange of information regarding the space needed for teaching and research activities, as well specific rooms, such as the library.

It is interesting to note that as far back as 1928 there had been an attempt to commission a building for the Institute of Mathematics in the area around via Panisperna, as part of a group of buildings to be used by other scientific institutes. The functional program drafted at that time by the Civil Engineering Corps was not very different to the one developed by Ponti a few years later in 1932[2].

Apart from the list of courses to be held in the classrooms[3], other spaces were specifically requested by the two academics, i.e., the professors' rooms, big halls for crowded activities such as seminars and scientific meetings, and a library big enough to contain the numerous books collected by the Institute of Mathematics and housed in the library of the School of Engineering at San Pietro in Vincoli4. Ponti's very original library- on three floors and designed as a closed box with walls completely covered in bookshelves- was certainly a great architectural invention, inspired by Castelnuovo's request to house up to 100,000 volumes. A similar input probably came from Enrico Bompiani, but this time it had to do with the need for big, well-lit halls, where it would be possible



è necessario che, oltre alle due aule da 300 studenti ciascuna e alle due sale di disegno (che per le disposizioni dei tavoli non possano prestarsi ad altri usi), si trovino altre due aule da 150 studenti l'una. Ciò per il fatto che per le esercitazioni è necessario dividere gli studenti in due gruppi, e che queste le esercitazioni di un corso sono contemporanee con quelle dell'altro. Inoltre una di quelle aule da 150 persone può servire per le sedute del Seminario o per altre riunioni scientifiche. A termine naturalmente vi dovrebbe essere una sala per i professori.

2) Al primo piano occorrono quattro aule per il secondo biennio, da 50 studenti ciascuna; o meglio: due da 50, una da 75 e una da 25. Bisogna infatti tener conto, oltre che dei due corsi ordinari, dei corsi di perfezionamento che vorremmo moltiplicare sempre più, e dei corsi della Scuola di Scienze statistiche e attuariali. Al 1° piano dovrebbe risiedere anche la biblioteca. Qui va ricordato che la biblioteca attuale contiene circa 75000 numeri, di cui oltre 50000 volumi, e il resto opuscoli. Poichè le riviste periodiche vanno rapidamente aumentando, occorre fare il progetto per una biblioteca di 100 000 volumi. A questa vanno aggiunte due sale di lettura, una per i giovani del 1° biennio che hanno bisogno di sorveglianza, l'altra per

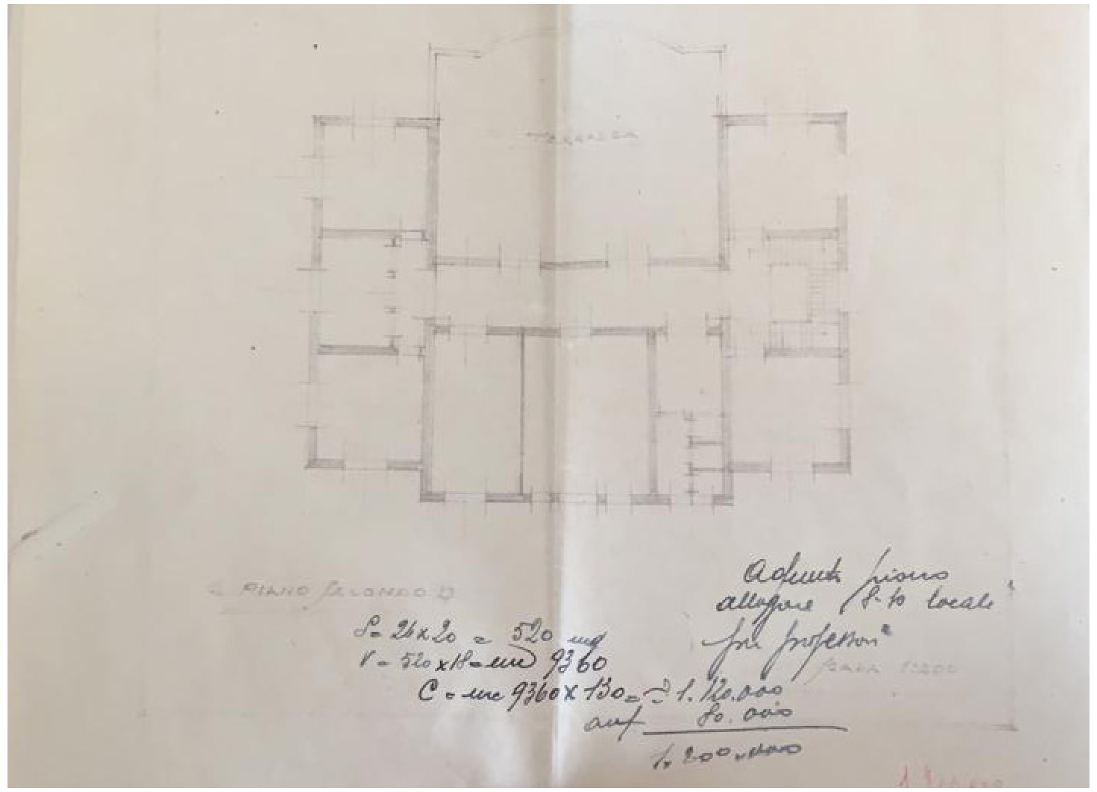


Figure 2 - Letter from Guido Castelnuovo to the Rector Francisci, March 30, 1932, explaining which spaces and rooms in the building were to used by the School of Mathematics in the new University campus, (ASS_dcm_02)

Figure 3 - Plan of the ground floor of a building to be used by the Higher School of Mathematics drafted in 1928 by engineer Tullio Nicoli on behalf of the Civil Engineering Corps Technical Office (ASR_drw_02)

to teach "Drawing and Descriptive Geometry", and big tiered lecture halls, given the many students that would enroll in courses on "pure mathematics".

At the time there were very few professors' offices because there were just 23 full professors, of which only eight were 'resident' and therefore entitled to have private office space in the front building, to be used for research in 'Higher Mathematics'. In fact, there are exactly eight rooms on the first floor, all with similar surface areas; they all give onto the central square of the campus5. Three less prestigious offices on the same floor overlooked the courtyard and were probably earmarked for younger, recently-hired professors who did indeed arrive over a period of time6. The 'professors' lounge', at the junction between the landing of the staircase and the very silent corridor of the offices, was directly connected to the reading room in the library.

After the inauguration of the building and University campus on October 31, 1935, it took several more months to complete the curved wings and the classroom tower, as well as finalize the finishings and furnishing of the School. Although the first academic year on campus was inaugurated in 1935, it is likely that the School of Mathematics was only up to full speed the following year. A picture of Libyan leaders visiting the building in May 1936 is proof that construction was indeed complete[7].

A little less than three years later, a rather substantial part of the building- the second floor of the curved west wing- was assigned to the National Institute for Higher Mathematics (IndAM). This assignment was requested by Francesco Severi, one of the most famous mathematicians of his age, very close to Mussolini, and so influential he could allocate this distinguished venue within the School's premises to the newly-established institute. In many ways this initial alteration to Ponti's project undoubtedly subverted the functionality, harmony, and balance of the building. Despite this turn of events, this very first addition should be considered 'historical', and should therefore not be removed.

The history of the country also undoubtedly influenced the way in which the building was used; remember that the campus was bombed, occupied by Nazi military forces, then by the Allies, and finally returned to its academics in the Spring of 1945. It is interesting to note that Sapienza's yearbooks[8], drafted annually from 1934 onwards, continue to be seamlessly published9. Yearly issues were initially interrupted during World War II and then began again, albeit purged of any reference to fascist propaganda, which was instead very frequent in the years prior to the war. Archival documents reveal that the building was damaged during this period and, most of all, its furniture was mistreated and ended up in other campus buildings.

Notwithstanding the symbolic and ideological fascist content that influenced the founding of the University campus, after the war all the buildings remained in place, including the School of Mathematics. The most obvious fascist symbols were of course removed, in some cases only scraped away, and the campus restarted its activity as early as 1946. This must be emphasized in order to also underline the importance of the continuous functional use of these buildings over a period of time, especially during the darkest post-war years when the 'uncomfortable memory' aroused by this and other buildings was much less important than their strategic function. This also highlights the fact that use is the watershed that exists between the building's importance, but also its worst deterioration.

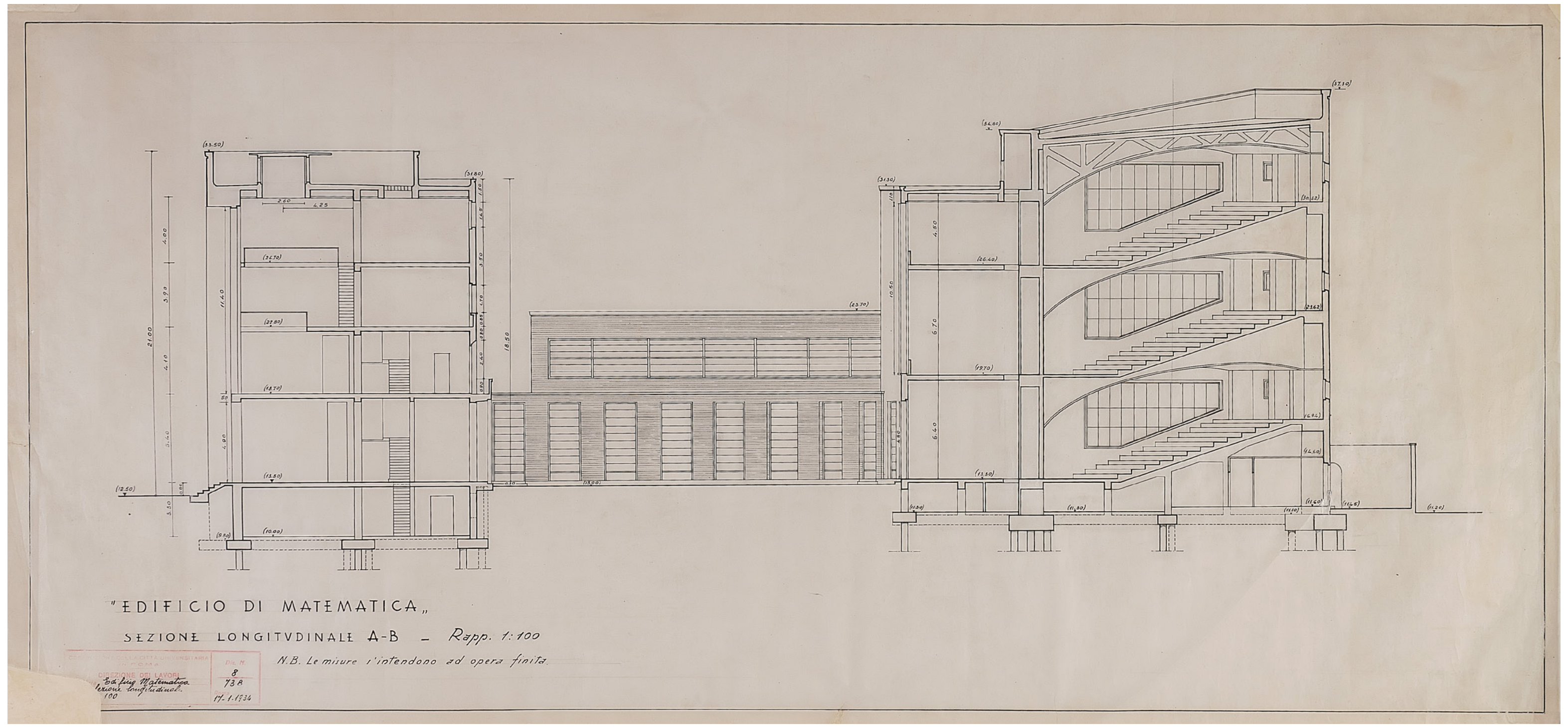


Figure 4 - Longitudinal section of the front building, drafted by Ponti in January 1934; it is easy to see that he envisaged a direct link between the corridor, the professors' lounge and the library (ASS_drw_33)

The ten post-war years- from 1946 to 1955- were dedicated to repairing the damages caused by the war and reactivating research and teaching: it wasn't long before the number of students and teachers began to steadily increase. This was true for nearly all study courses at Sapienza and in other Italian universities, but the increase was even greater for courses in Natural and Life Sciences, and especially in Mathematics and in Physics in Rome and in other major academies (Salvo 2019). The graph showing the number of students enrolled in the faculty is unequivocal.

The next two decades- from 1956 to 1975- saw numbers increase exponentially not only thanks to the social and economic boom initially enjoyed by Italy, but also to easier access to university courses by all high school students pursuant to the reform of the education system after the students' movements in 1968. This trend remained stable for years, despite the suppression and merging of many courses, first and foremost when the first two-year courses in Engineering were transferred from the Mathematics building to the School of Engineering off campus. An initial deceleration and inversion of this trend began in the Eighties and has continued steadily until just recently.

According to the latest data- i.e., in 2020- there are 2,131 first-year students enrolled in courses on Mathematics, Physics, and Natural Sciences, plus another 4,418 students in the following years of those courses, for a total of 6,549. But these statistics do not reflect the number of students that actually use the School of Mathematics. As a matter of fact, the use of rooms on campus has become chaotic, depending on the greater or lesser flow of students in the many study courses proposed by the Faculty of Sciences, i.e. Mathematics, Physics and Natural Sciences. When courses are being organized for the academic year, the assignment of halls and classrooms depends on the space available: this means that students enrolled in other courses may easily be present in the School of Mathematics, even if they are not students of Mathematics.

In 2019, for example, the tiered lecture halls in the Tower- some of the very few that can accommodate up to 435 students (in compliance with fire escape regulations) in the Faculty of Sciences- have been assigned to first-year Biology courses which need the space due to an unexpected increase in the number of enrolled students. This complicates the reassignment of the classes and use of the building, forcing a yearly revision of where the courses can be held.

The library, instead, is a case apart. Variation in the numbers of students and professors has only indirectly influenced its functional organization because the number of employees has remained much the same: from two in the Thirties- the director and one assistant - to a maximum of five in the Nineties, and a current average of four.

Unlike the increase in the number of students, attendance in the library has not grown proportionally. The fact that 'paper' books are available is not linked to the study of Mathematics, since scientific progress is now published chiefly online or in scientific reviews rather than in traditional books. Attendance in the library is certainly steady, but this is mainly due to the fact that students are always searching for a place to study. The original reading halls in the library overlooking the courtyard have therefore been assigned to students, but have been separated from the main reading hall by plugging doors and corridors. In the past the library has also been used for more unusual events, such as theatrical performances, assemblies, and special ceremonies, including the kick-off of this research awarded by The Getty Foundation.

Sources of information

From 1935 to 1985- 1935-1985: La Sapienza nella città universitaria, Università degli studi di Roma La Sapienza, Multigrafica, Rome 1985, p. 149.

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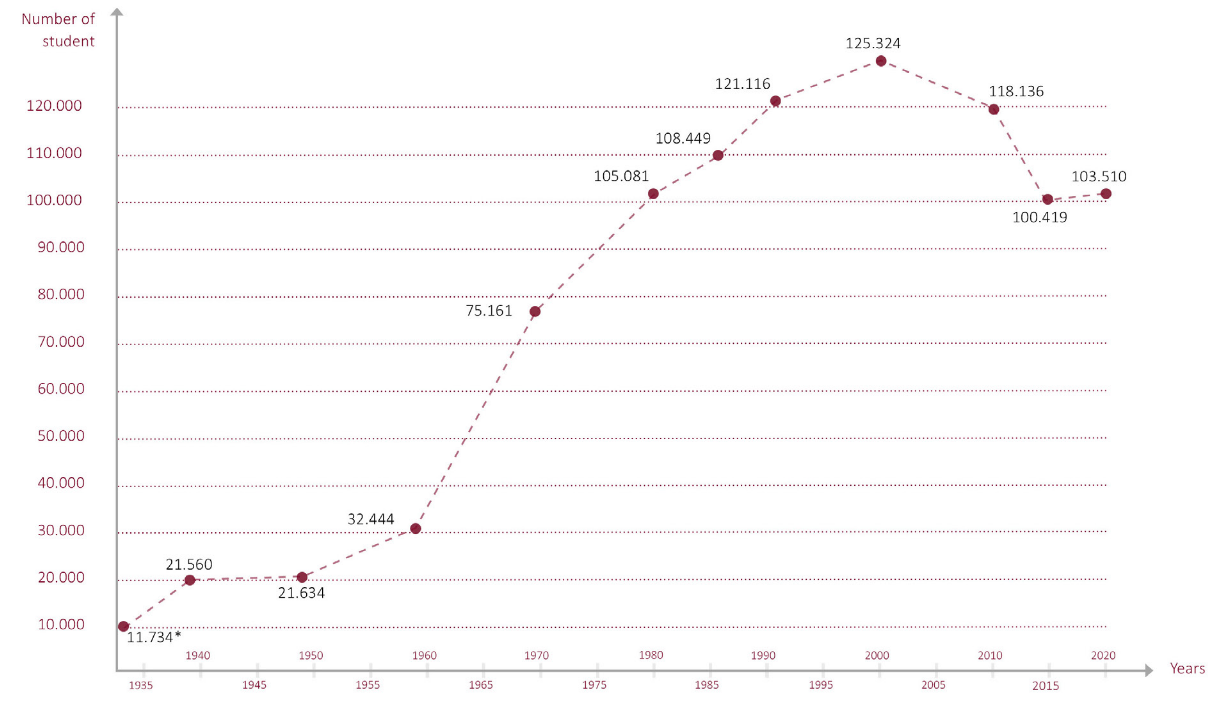


* 7488 of which in the new university campus

Figure 5 - Students enrolled at Sapienza University from 1935 to the present day (© Salvo 2020)

MATHEMATICAL RESEARCH, TEACHING METHODS AND PONTI'S FURNITURE

A Mathematician- either an academic, student, researcher, or professor- needs a blackboard, while a Geometry teacher needs a drawing table. This must have been very clear to Ponti as he began to design the building and its interiors, especially the furniture; and it is still true today, although technological instruments have changed the tools and their location. Ponti's specific focus on the design and details of the blackboards and drawing tables is part of his general approach to architecture considered as Gesamtkunstwerk, a rule that influences his architectural work and is embodied by the School of Mathematics- an early, true masterpiece.

Research on the building's furniture has shown that the design of the interiors and furnishings were a significant part of Ponti's commitment and a rather complicated aspect of the construction process both technically and economically. Most of Ponti's solutions regarding the furnishings are 'embedded' in the architectural design of the space, sometimes with strict reference to the systems (heating and lighting).

One good example is the study tables in the main reading room of the library incorporating the heating system and designed to be located right under the skylight since this is the only source of natural light in the room; another is the huge blackboards on the rear wall of the tiered lecture halls; the blackboard / teacher's desk / footboard / and an 'exclusive' entrance door for professors are rolled into one: a prototype of contemporary wall systems. They should all be considered 'inventions' with a special historical, artistic, and technical value, albeit mirroring an academic structure and a community of teachers and professors that has long disappeared.

The strong hierarchy between the academic staff, the separation of spaces between students and teachers, and the use of traditional slate blackboards and chalk are all aspects that have gradually been replaced by a much more integrated academic community, by informal relationships between students and professors, and by the use of technological hardware and software. This is of course true in any academic environment, but has strongly impacted the design of classrooms and halls in a very delicate and refined environment such as that of the School of Mathematics where everything was meticulously designed by Ponti, "from the spoon to the city".

Figure 6 - One of the many blackboards designed ad hoc by Ponti for each classroom and lecture hall (© Salvo 2020)

Figure 7 - Integration of architectural features, cladding, furniture, and finishings in a corner of the main entrance hall (© Sardo 2021)

MATHEMATICS FOR MATHEMATICIANS, PHYSICISTS, ARCHITECTS, AND ENGINEERS

The School of Mathematics originally hosted not only students in mathematics in the Faculty of Sciences, which included Mathematics, Physics and Natural Sciences, but also students of the School of Architecture (Dall'Aglio, Emmer, Menghini, 2001)[14] and students enrolled in the first two years of the course in Engineering[15]. For decades it was also home to the Institute of Drawing, where drawing and descriptive geometry were taught in the drawing halls located in the curved wings, tailor-designed for drawing sessions.

In 1961 the course in Mathematics and Physics was gradually eliminated until it was no longer taught in 1969; however, this did not affect the general increase in the number of enrolled students. In 1961, the first two-year courses in Engineering also began to move from the School of Mathematics to the School of Engineering; the process was completed in 1976, but there is no precise indication as to when exactly the students of Engineering left the building.

In the Sixties the Institute of Drawing also started to downsize[16] as this discipline was slowly absorbed by the School of Architecture. Available data ends in 1963; we know that its directors were Vincenzo Fasolo (since 1934) followed by Giulio Pediconi in 1955 who continued until the Institute was closed. However, a Geometry and Drawing course for Mathematicians was still active up to 1960. Although these events did not determine a decrease in the number of students and professors, they were probably compensated by an increase in the number of students in Mathematics.

After the Institute of Drawing was no longer present in the building, and students in Mathematics grew in number, another setback occurred: the drawing halls in the curved east wing were divided up (in 1939 Francesco Severi had already turned the halls in the west wing into the Institute of Higher Mathematics). This is also reflected by a change in the names of the courses for mathematicians: "Analytical geometry and elements of projective and descriptive geometry, and drawing" was simplified to "Geometry I" and "Geometry II", while "Rational Mechanics and Drawing" in 1960 simply became "Rational Mechanics", reflecting the fact that the Institute was no longer present.

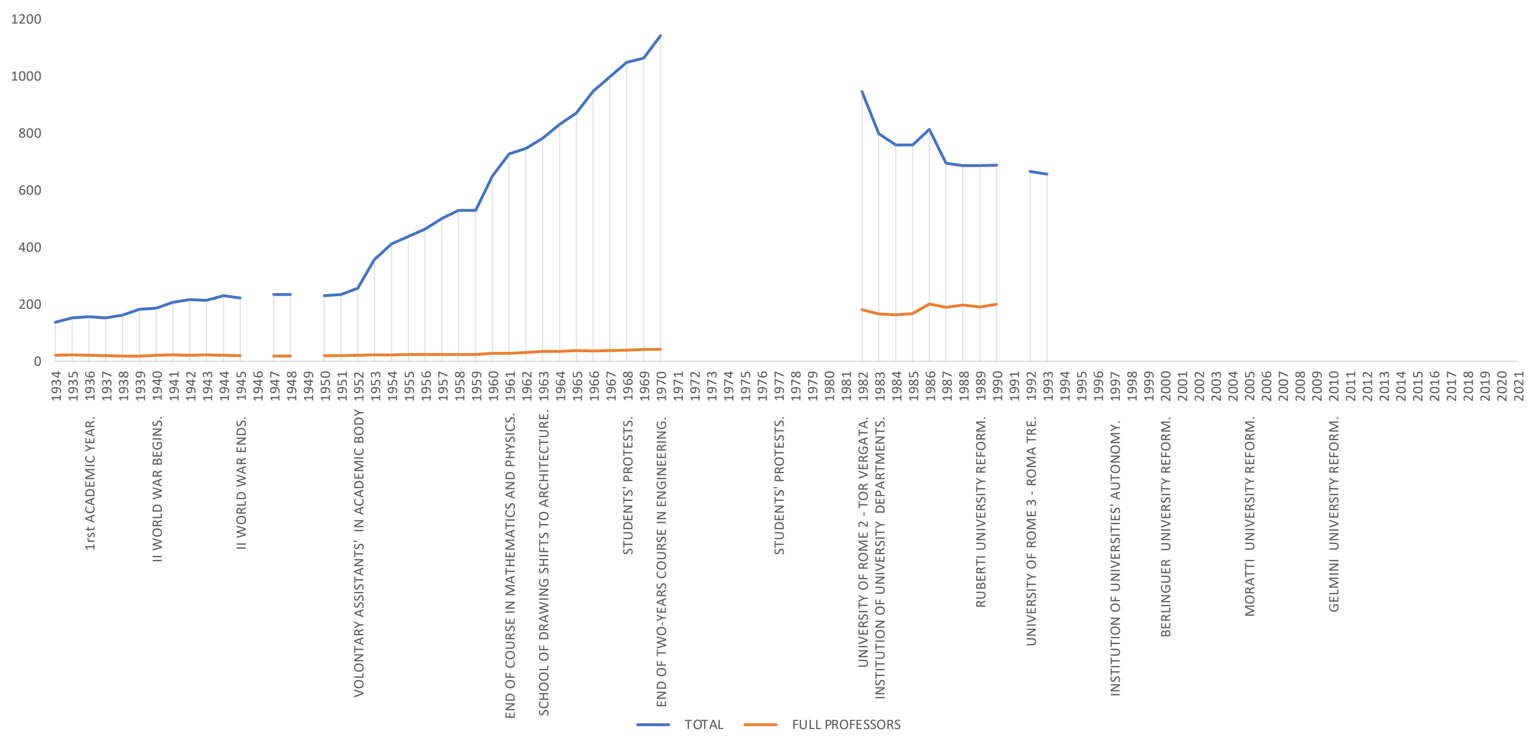
Figure 8 - Rows of curved desks in the tiered lecture hall on the second floor of the classroom Tower (© Salvo 2021)

STUDENTS, TEACHERS, STAFF, 1935-2021

The exponential increase in the numbers of students and professors has undoubtedly impacted the conservation of the building and the preservation of its original configuration. Although this is true for all the campus buildings in Rome's university, analyzing the relationship between the enrollment trends relative to the Faculty of Sciences, and the continuous search for space that characterized the period from 1965 to 1985, has been crucial in order to establish the changes made to the building, and accurately assess their authenticity and significance.

Graphs and charts provide evidence of the dramatic increase in numbers that marked the central decades of the XX century. Archival documentation and the frantic correspondence between the Directors of the Department of Mathematics, the Dean of the Faculty of Sciences, and the Rector, emphasize the lack of space for teaching and research. However, when reviewing these statistics, one should consider that the numbers refer to all the students enrolled in Natural Sciences courses- Physics, Mathematics and Natural Sciences- as well as several changes that are hard to detect and extrapolate; for example, the evolution of academic careers, changes in study courses, etc. This means that a more than accurate calculation of the number of students and professors at any given date is practically impossible, although the general trend is unequivocal.

The situation was such that two other premises were rented so courses could be held: the so called 'via Vicenza' and the Wuhrer building. This increase was implemented at a time when in 1983 the Departments were newly designed, at national level, as official and administrative academic institutions; it also mirrors the founding of Rome's second university "Tor Vergata" in 1982, and Rome's third university "Roma Tre" in 1992.



* Professors include assistant professors which appeared in the academic tenure track from 1952 onwards, and researchers, which appeared in the academic tenure track starting from 1980.

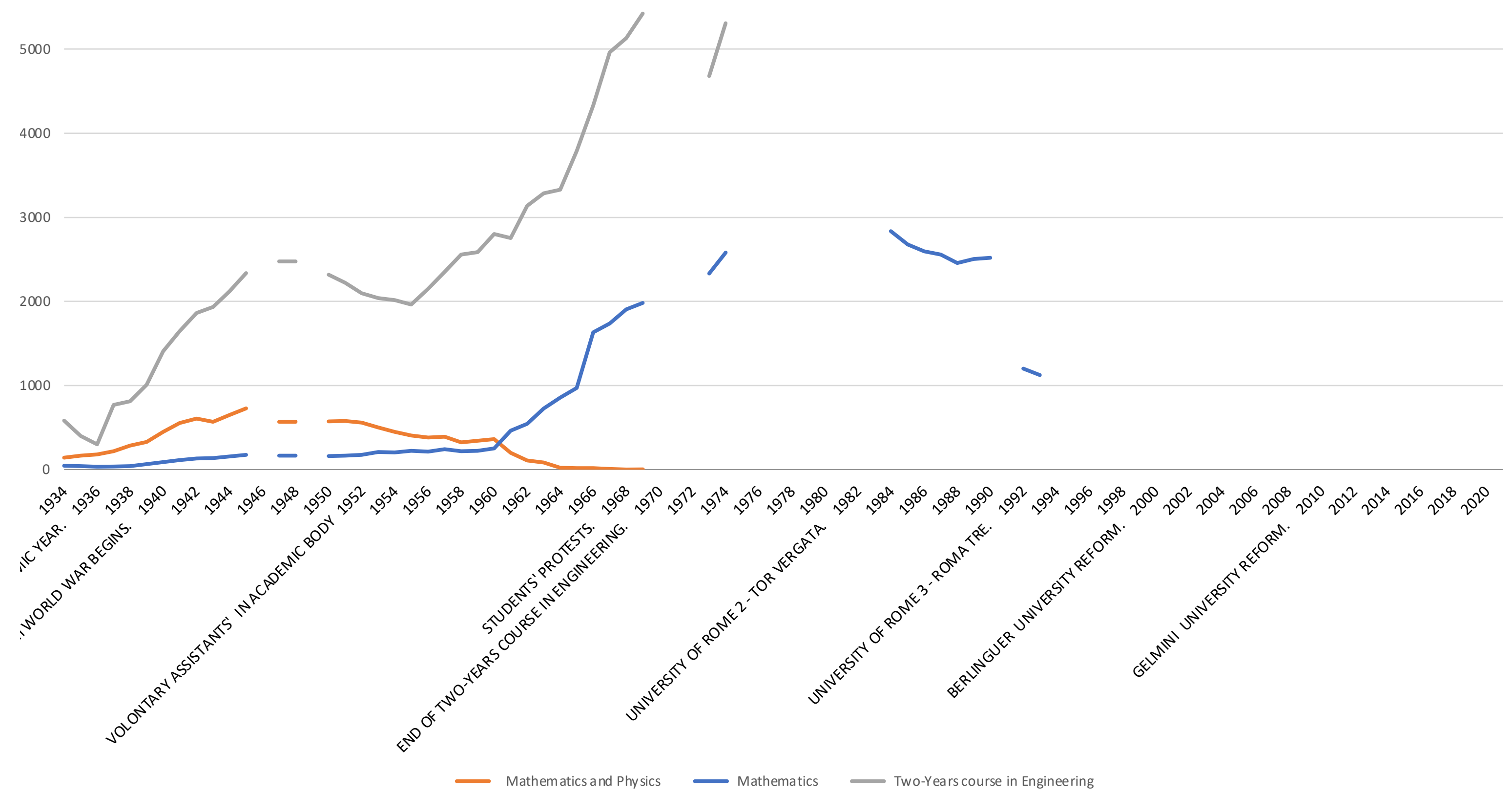


Figure 9 - Statistical study of the number of academics in the Sciences Course (© Castellan 2020)

Figure 10 - Statistical investigation on the number of students in the School of Mathematics (© Castellan 2020)

The overcrowding of the building and the changes in its functions, especially in the curved wings, inevitably affected the heating, electrical, fire safety, and communications systems. Without a general plan the upgrading, compliance, and updating of the wiring, ducts, cables, and machinery was performed piecemeal, rather than based on a strategic conservative approach. The result was an invasive presence of bundles of cables along corridors and in offices, as well as the unprepared installation of technical devices in classrooms and halls to allow the use of technological equipment especially during the pandemic (i.e. digital screens, video cameras, computers, etc.)

Yet one key consideration is that almost no demolition has occurred since 1939. This is true of most Italian buildings built during that period which are often unrecognizable due to the bundling of additions, and not due to demolition or destruction. This is to be deemed positive in terms of conservation of authenticity; it also makes it possible to reinstate the original condition by accurately and gradually removing the insignificant additions, at least ideally.

Figure 11 - Front building, first floor, bundling of cables, ducts, and wiring in the office corridor (© Sardo 2021)

MEMORIES: INTERVIEWS WITH PROFESSORS EMERITUS, ACADEMICS, SPECIALISTS, AND ORDINARY PEOPLE

One commonly shared opinion within Sapienza's academic body, especially by mathematicians and architects, is that the School of Mathematics is a true gem, and that its library is probably the most interesting interior not only on campus, but probably throughout all modern Italian university buildings. This opinion is certainly based on many individuals' sensitivity, on the presence of old photographs, and certainly on a cliché; as a result, many people appreciate the building, but without having personally experienced the architectural space.

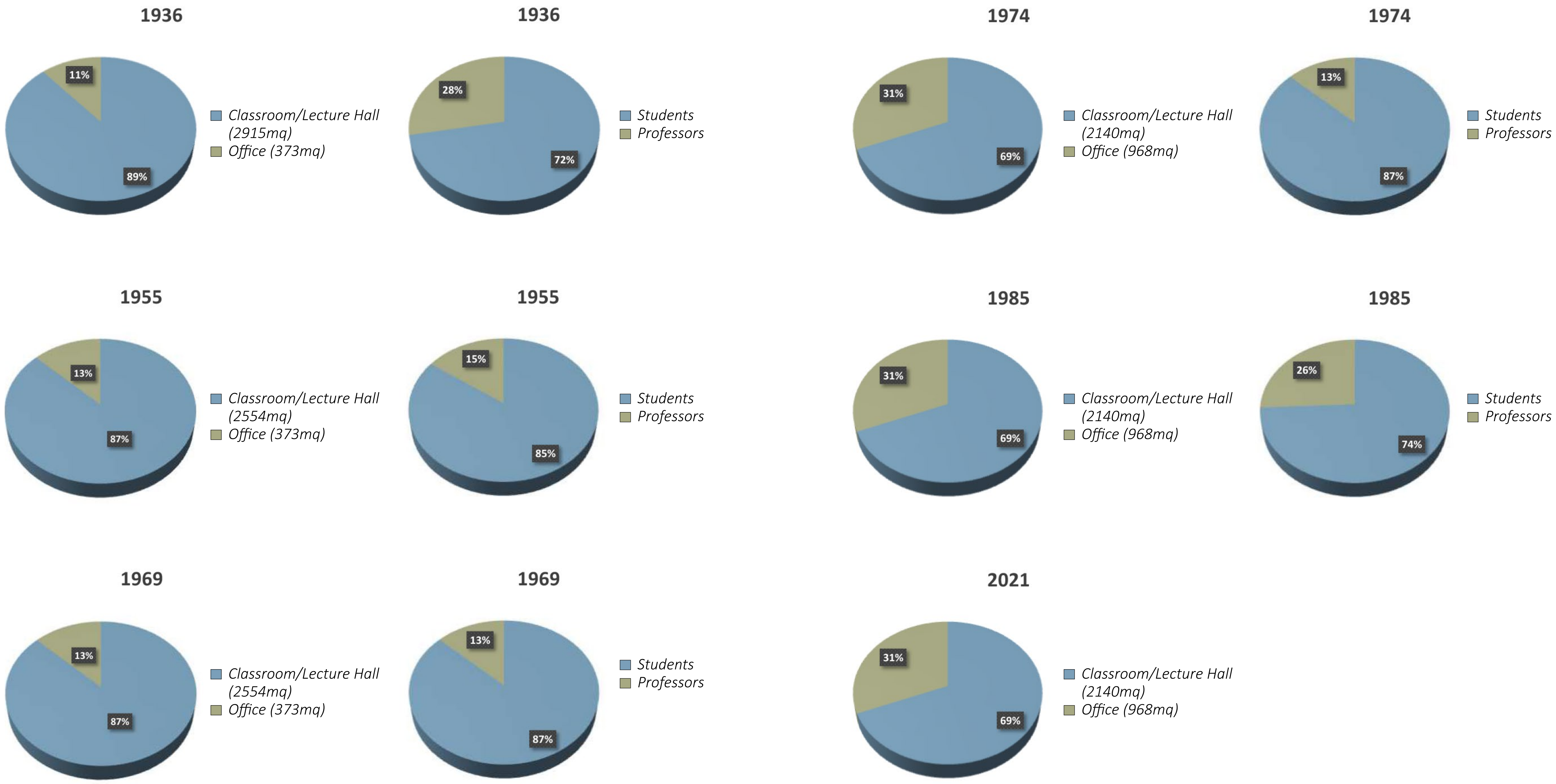
For this reason, and to revive the personal memories of those who have used the building in the past, as well as provide scientific evidence of the trend of growing appreciation for the building, we conducted a series of interviews that have proved enlightening for several reasons. We have collected memories, experiences, opinions, knowledge, and information from different sources, starting with those who are more acquainted with Gio Ponti: Fulvio Irace; experts in the field of Architectural Modernism in Italy, such as Giorgio Ciucci and Alessandra Muntoni; experts in contemporary Italian arts, such as Antonella Greco; those who met him and shared his everyday life, such as his nephews Salvatore Licitra and Alberto Rosselli; those responsible for the Department of Mathematics, the former director Vincenzo Nesi and the current director Isabeau Birindelli; and those who live and deal with the building every day: the porter Paolo Mariani and the caretaker Beniamino Iezzi. Specific insight into the microcosm of the library was possible thanks to the memories and input by the former and current directors, Maria Rosaria Del Ciello and Lucilla Vespucci.

A very interesting view of the cultural context that inspired Ponti's project for the School of Mathematics is provided by Enrico Rogora's studies and Michele Emmer's research on the relationship between art and mathematics, both focusing on this building. Afterwards we interviewed people who were key figures in the past history of the building and who could tell us stories that have never been recorded, neither in archives, nor in old photographs. They include: famous alumni of the Department of Mathematics- Claudio Procesi, Lamberti, Silvana Abeasis, Lamberto Lamberti – and Bruno Bozzetti, a former employee of Sapienza's Technical Office.

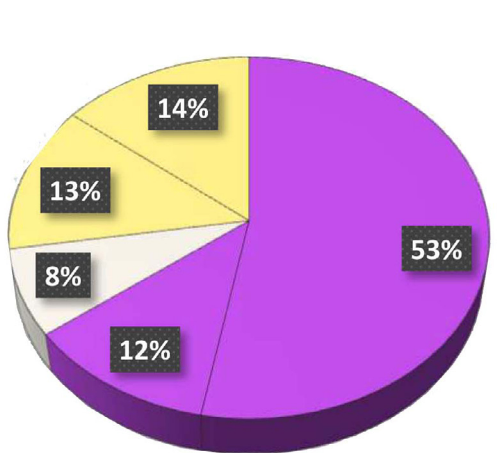
The idea to broaden the scope of our study from the building to the University campus was supported by Carla Onesti, director of the Sapienza Historical Archive; it was also prompted by a desire to achieve specific insight into the geology of the site. This was crucially important in order to assess major structural and seismic risks for the building, data provided by geologist Lamberto Lambiase.

Given the culture of restoration that reigns in Italy and the role of conservation management planning, we had a very rewarding discussion with Pietro Petraroia about conservation issues, with a special focus on the restoration of Ponti's major works.

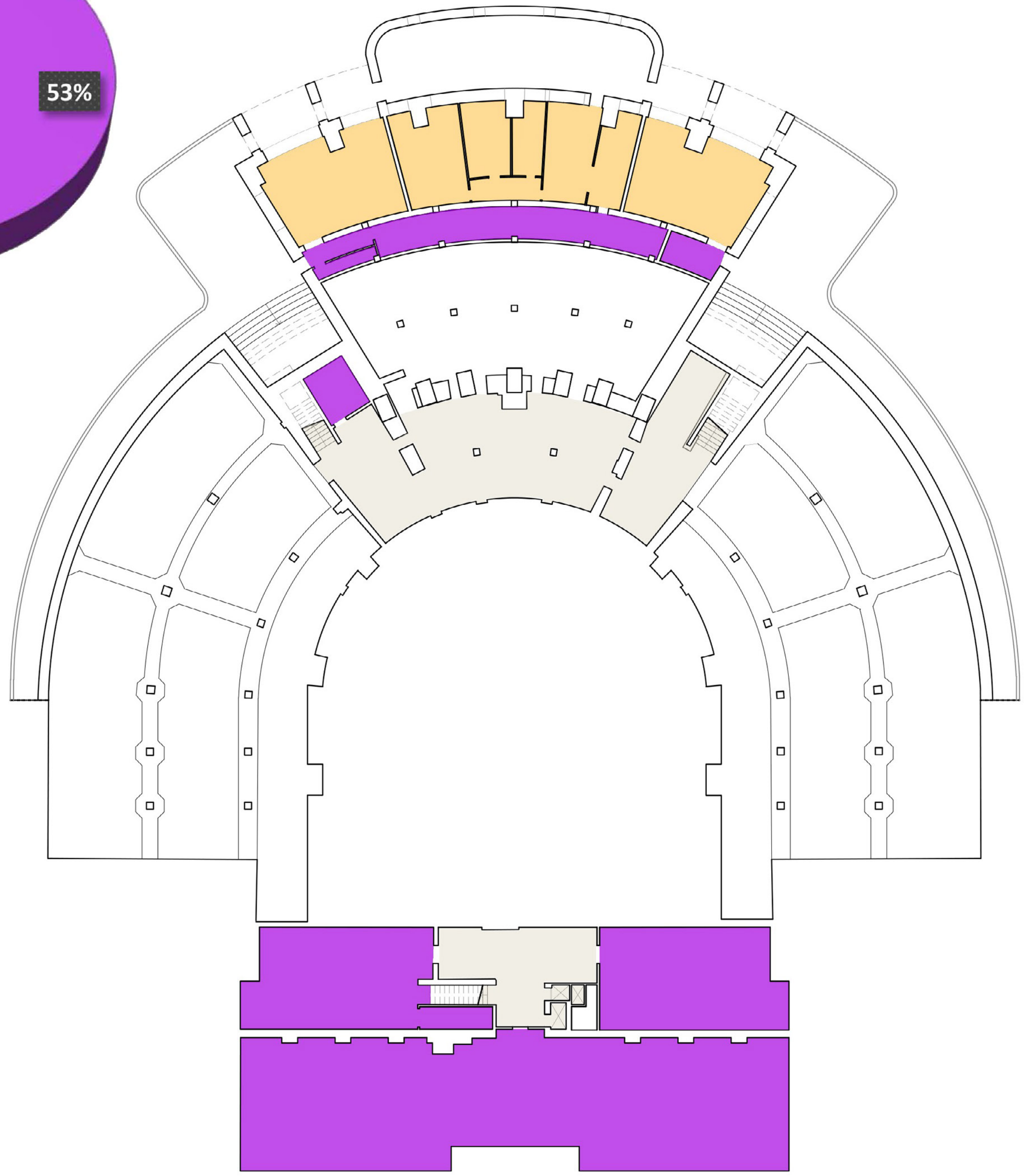
Figure 12 - Chairs in the library (© Salvo 2020)

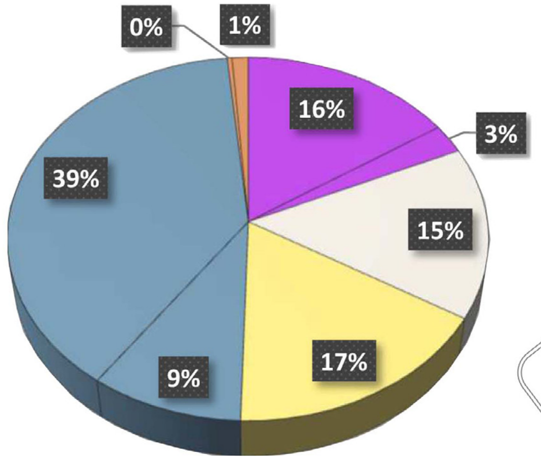


Comparison between the number of users (professors and students) and square meters destined to research (offices) and teaching (classrooms), from 1936 to today; information has been retrieved on statistical data, archival documentation and direct survey (© Castellan, Cortesi, Salvo 2020)

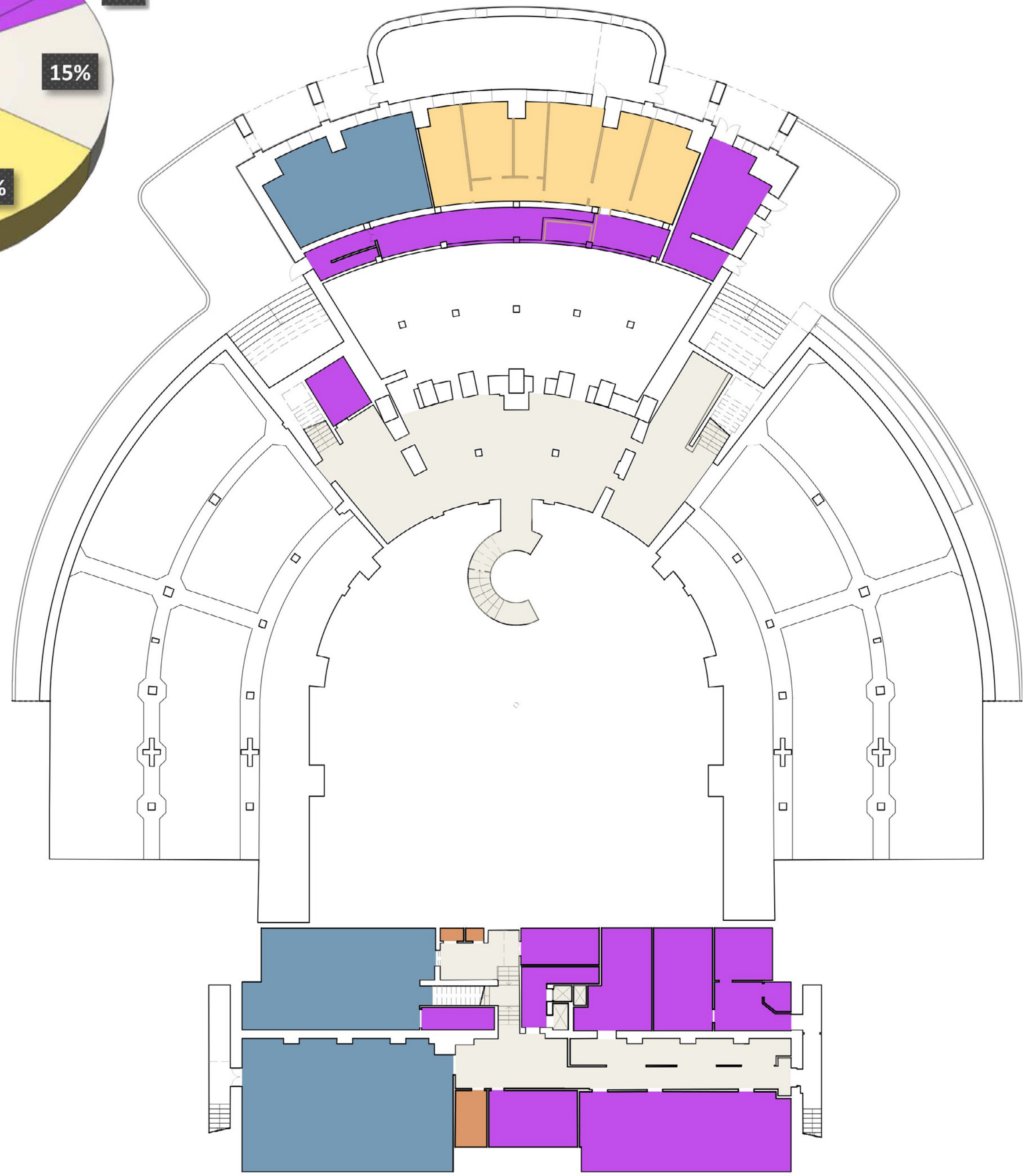


- Storage room (348mq)
- Equipement room (77mq)
- Distribution (51mq)
- Caretaker's house (87mq)
- Garage (94mq)

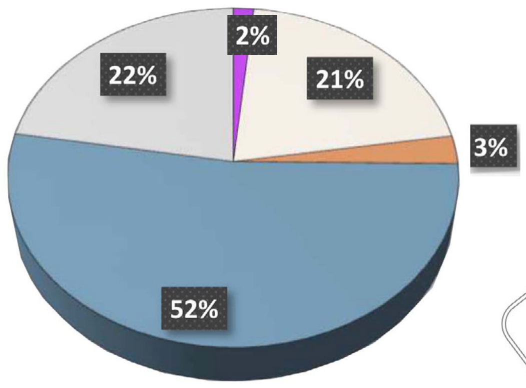




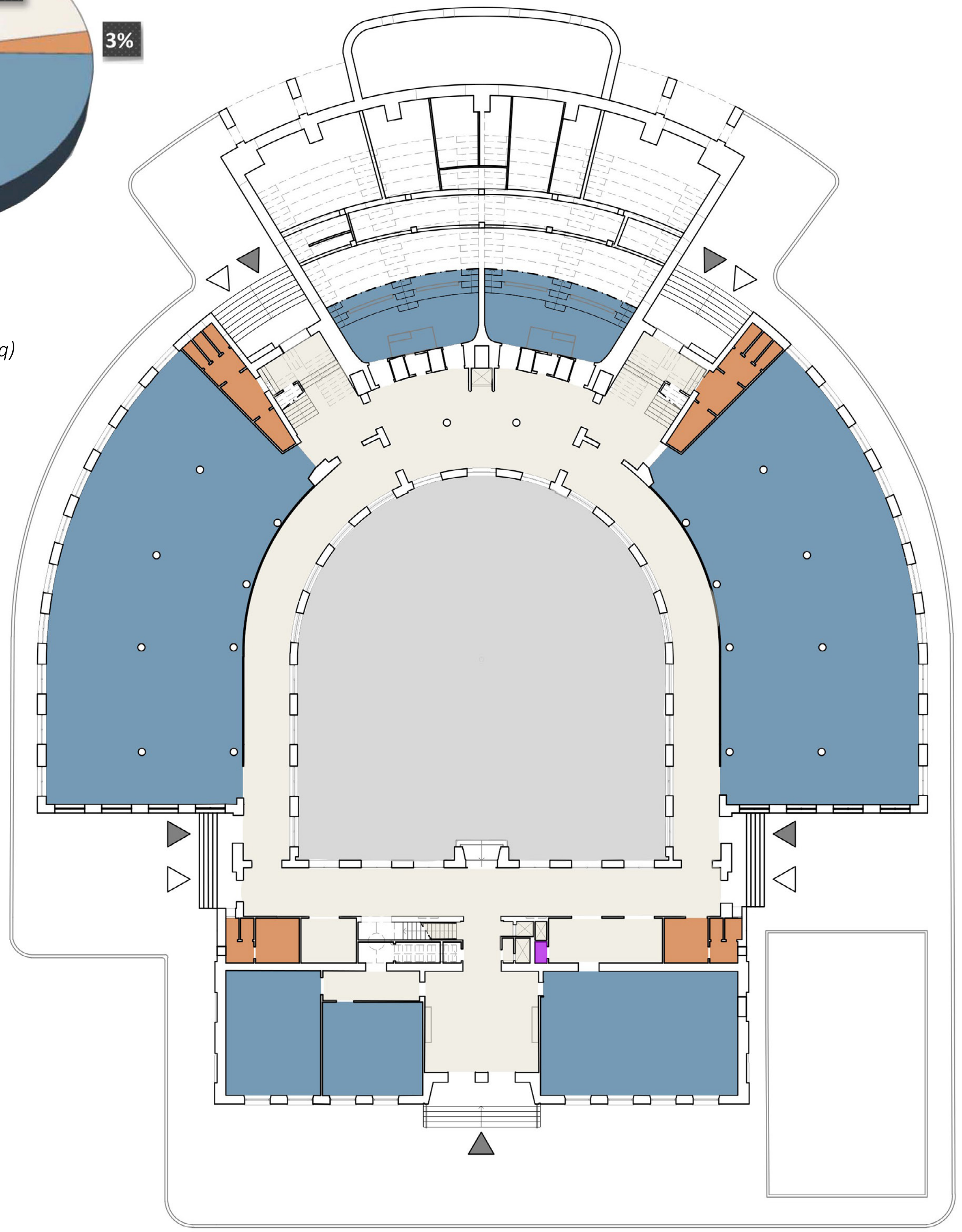
- Storage room (348mq)
- Equipement room (77mq)
- Distribution (51mq)
- Caretaker's house (87mq)
- Doctorate hall (55mq)
- Calculation laboratory (226mq)
- Restrooms (2mq)
- Infirmary (7mq)



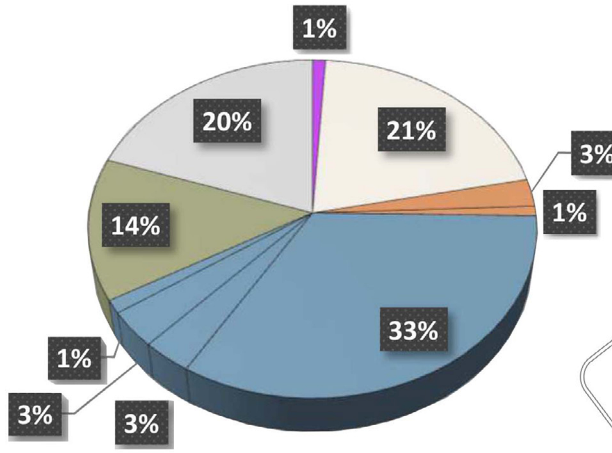
1935-2021
Basement floor



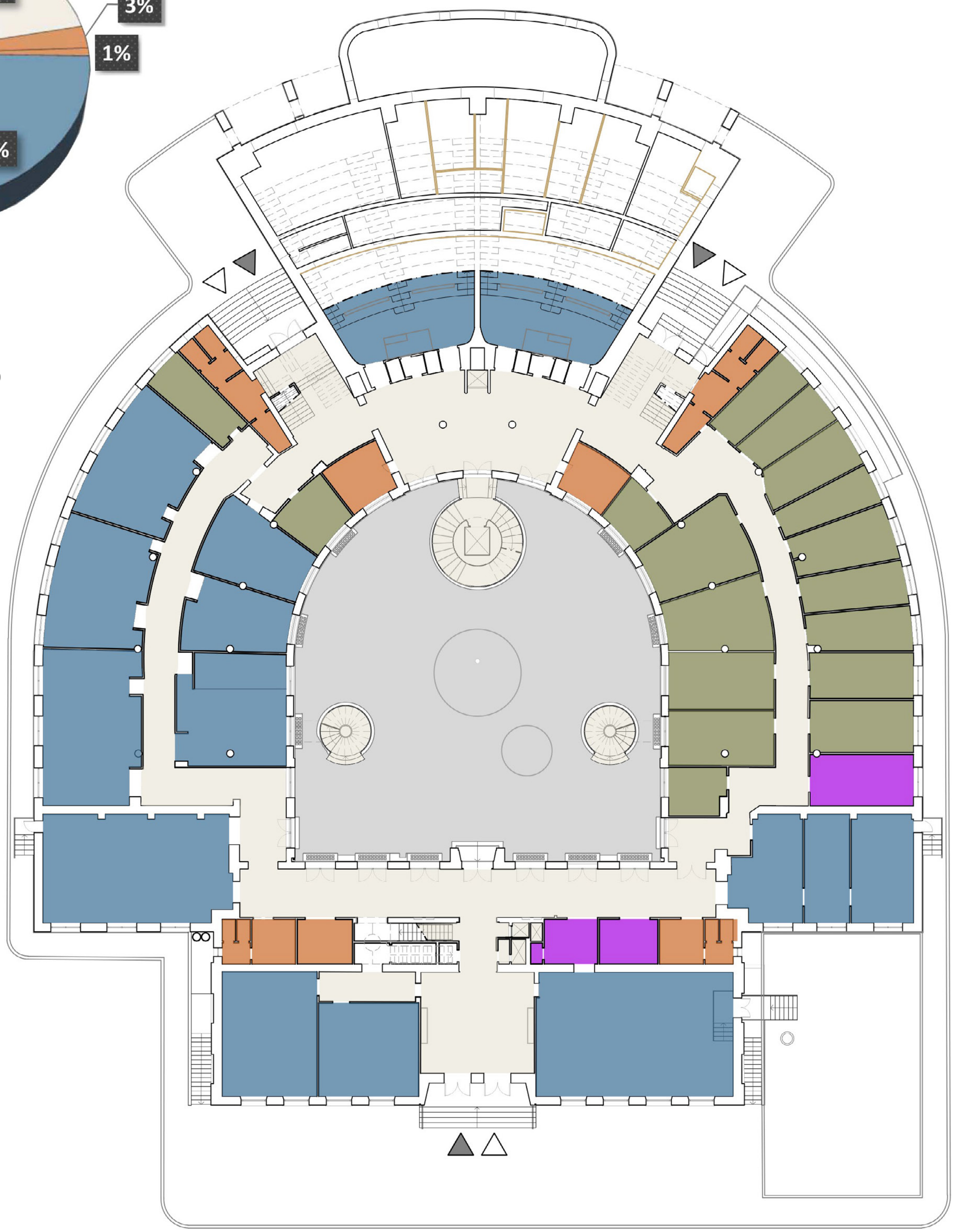
- Storage room (41,6mq)
- Distribution (543mq)
- Restrooms (70mq)
- Classroom/Lecture Hall (1365mq)
- Courtyard (580mq)

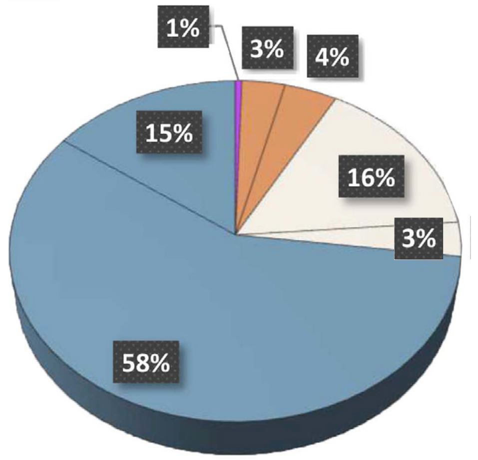


1935-2021
Ground floor

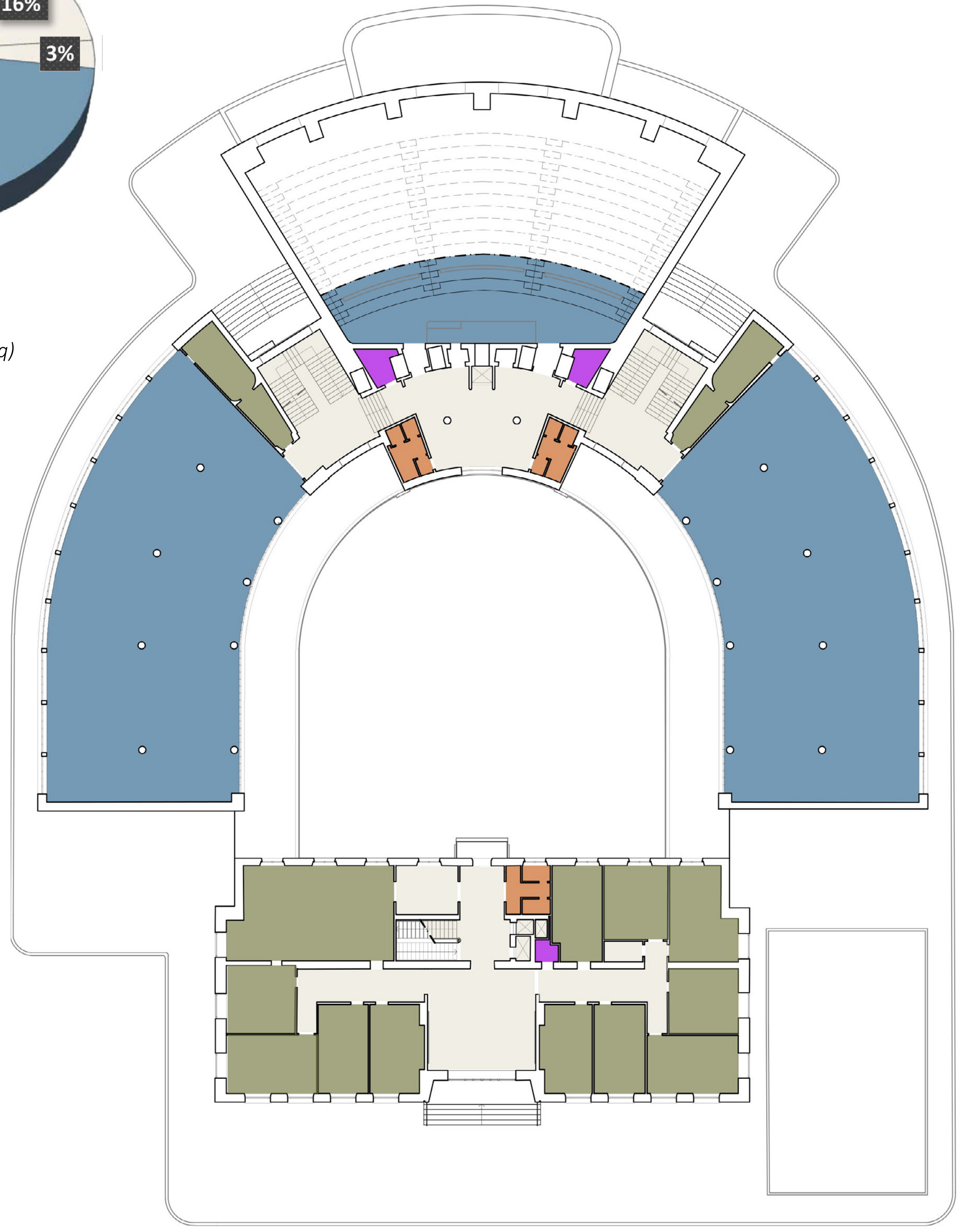


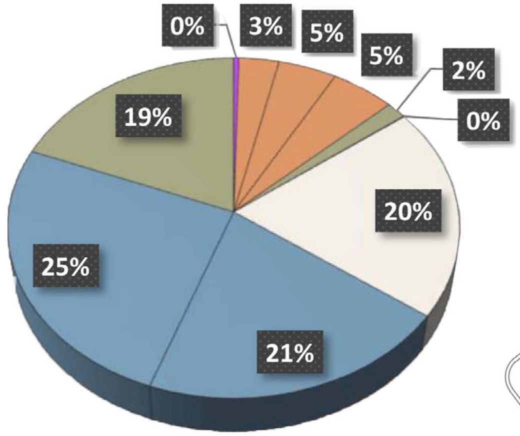
- Storage room (27mq)
- Distribution (552mq)
- Restrooms (70mq)
- Reception (24mq)
- Classroom/Lecture Hall (892mq)
- Calculation laboratory (87mq)
- Study Hall (7mq)
- Doctorate Hall (33mq)
- Office (362mq)
- Courtyard (527mq)



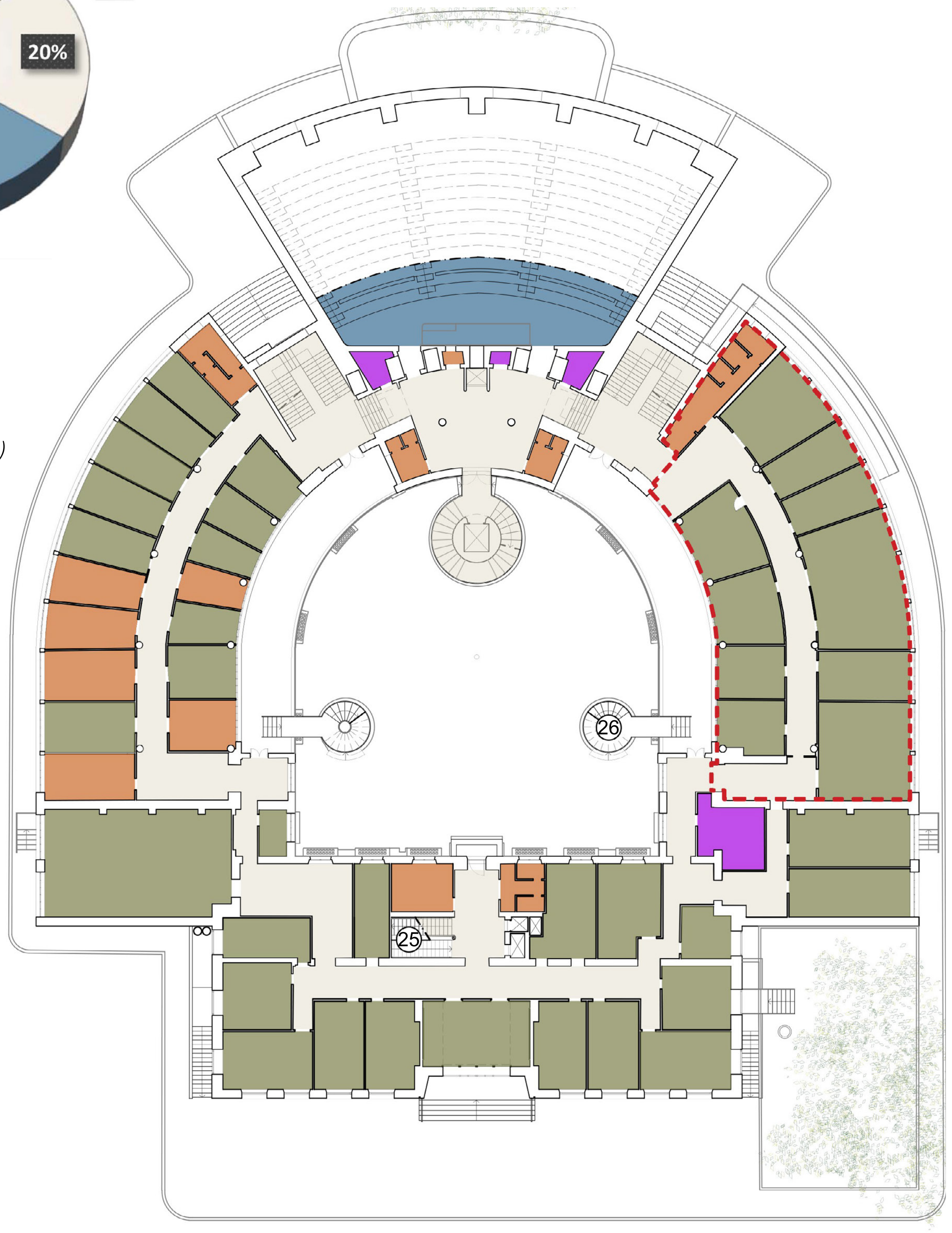


- Storage room (41,6mq)
- Distribution (543mq)
- Restrooms (70mq)
- Classroom/Lecture Hall (1365mq)
- Courtyard (580mq)

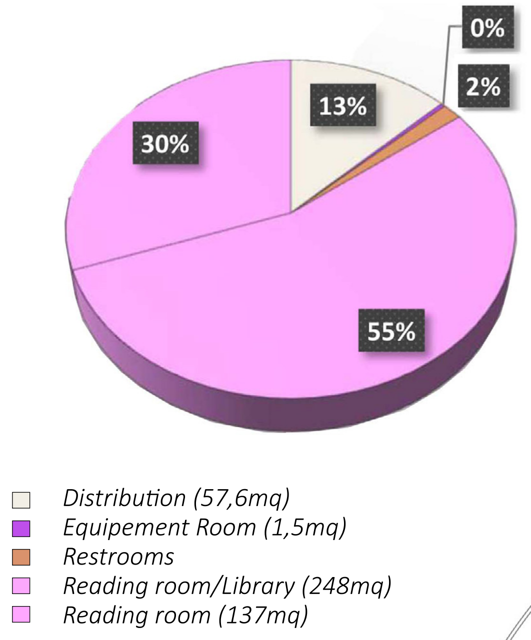


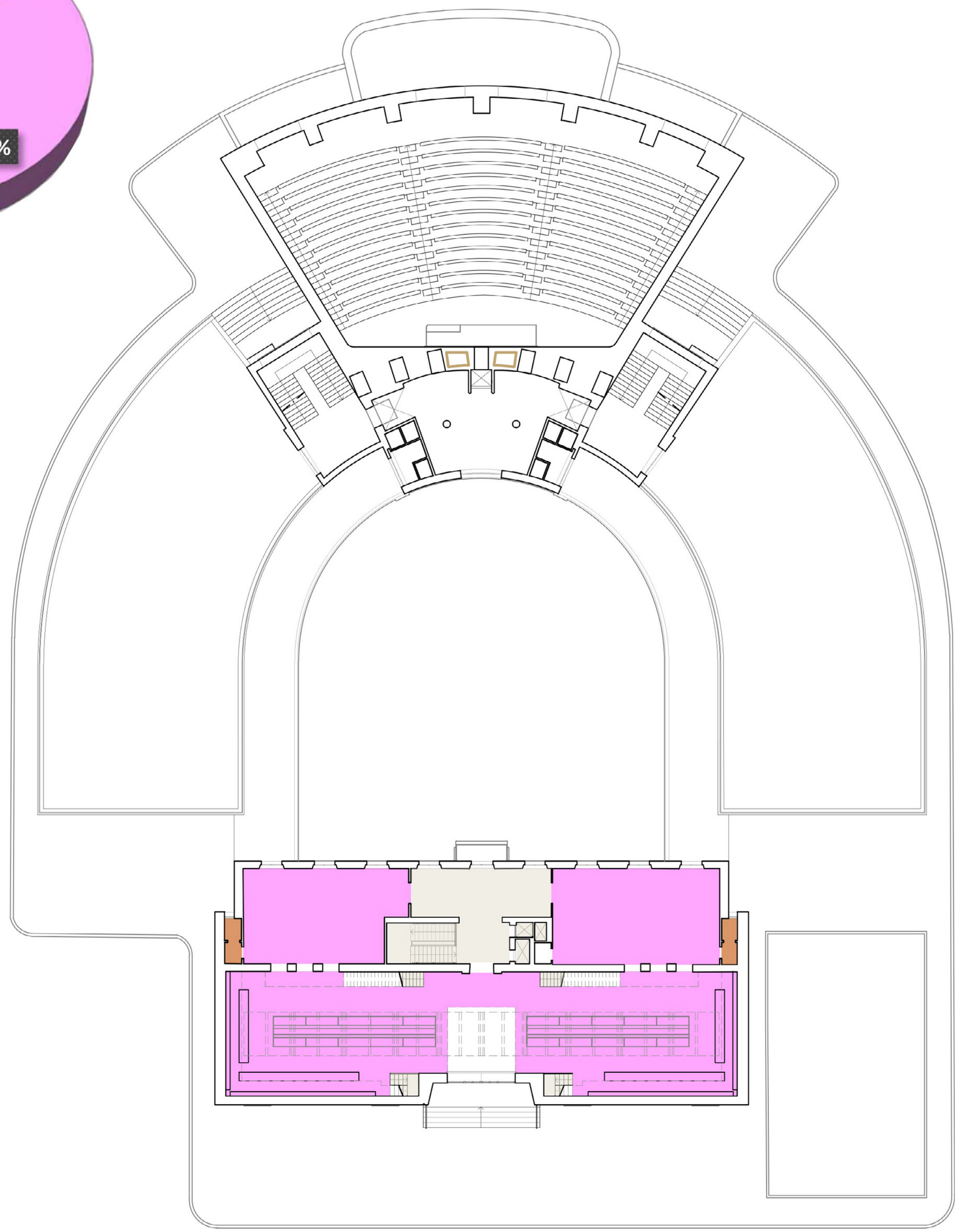


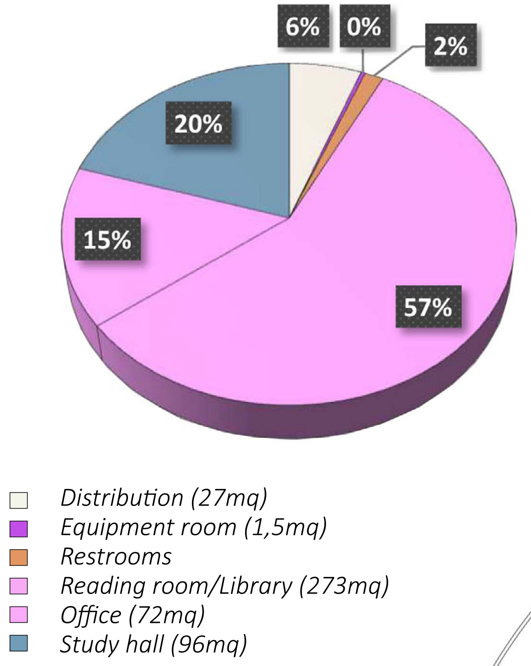
- Equipment room (8,2mq)
- Restrooms (63mq)
- Board room (92mq)
- Administration (101mq)
- Ponti Hall (32mq)
- Infirmary (1,2mq)
- Distribution (405mq)
- Classroom /Lecture Hall (414mq)
- Office (514mq)
- National Institute for Higher Mathermatics (381mq)

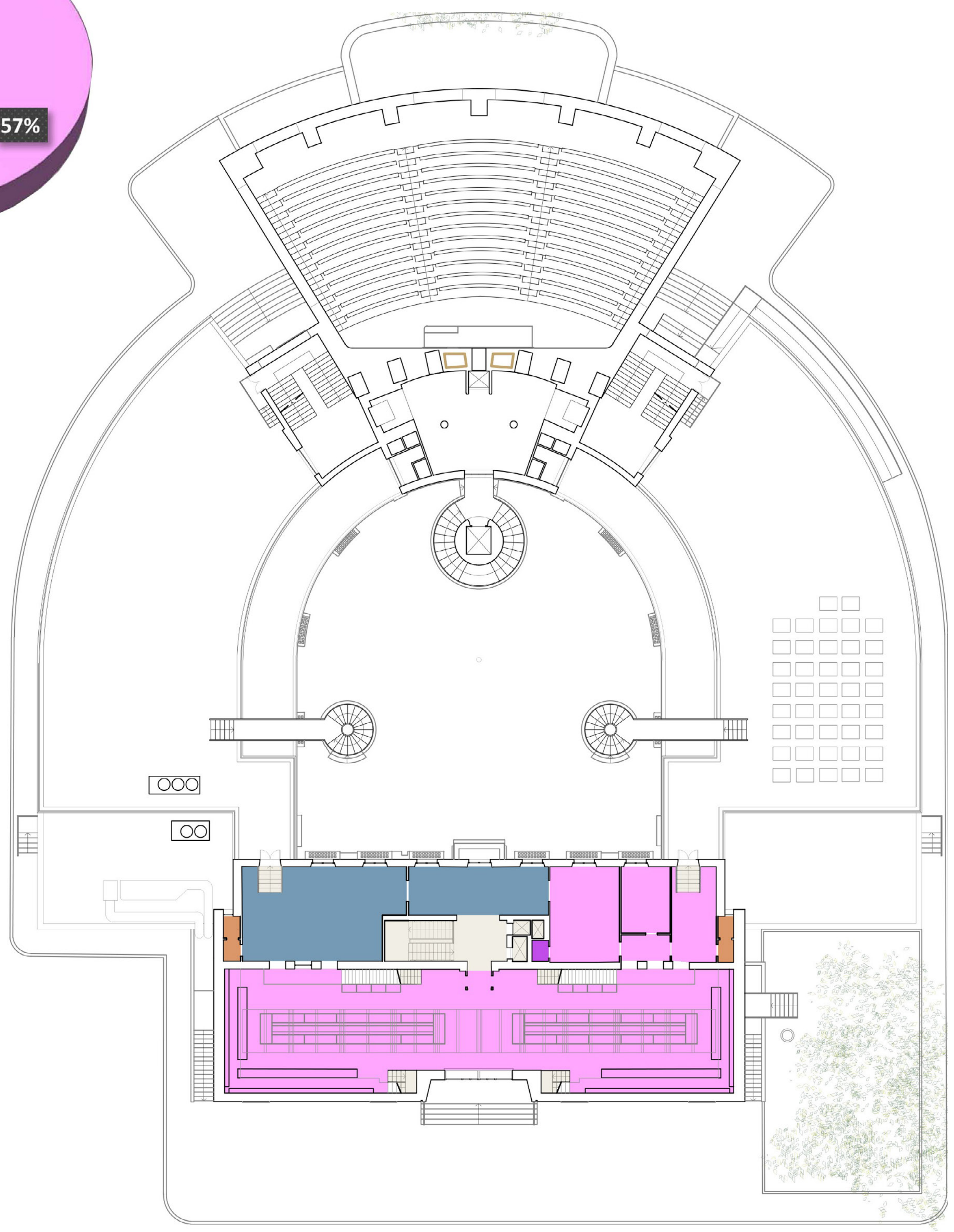


1935-2021
First floor

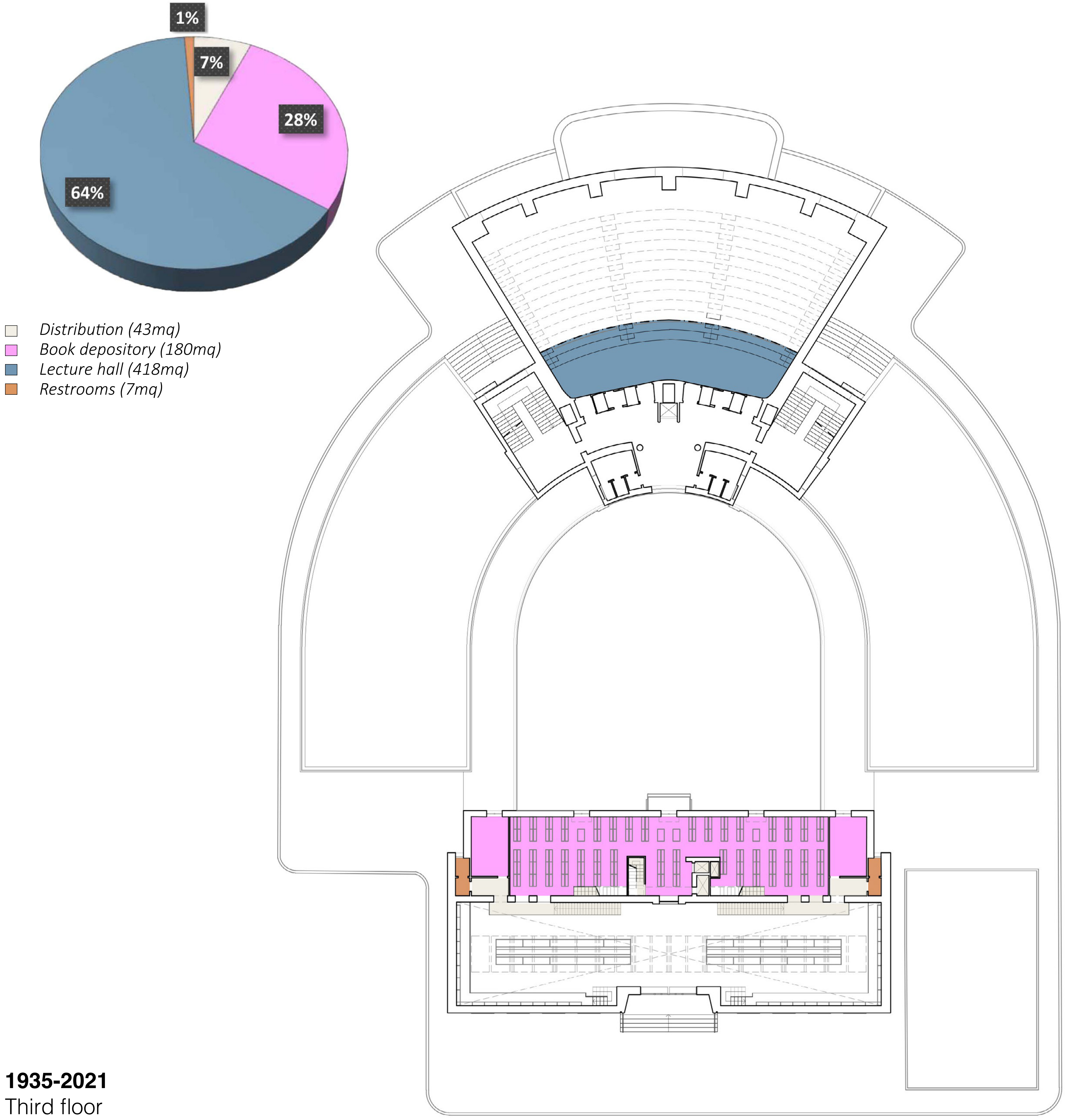


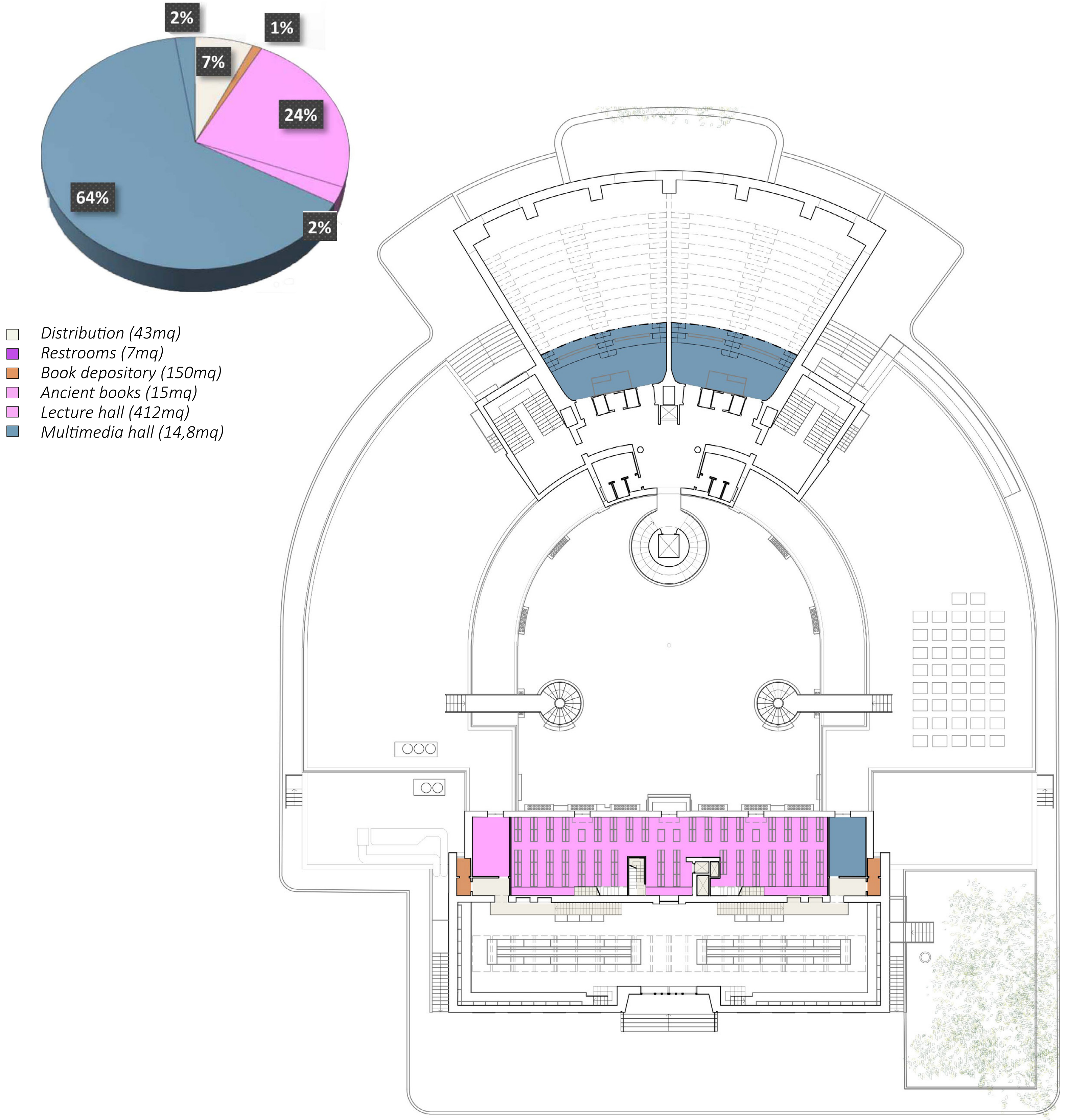




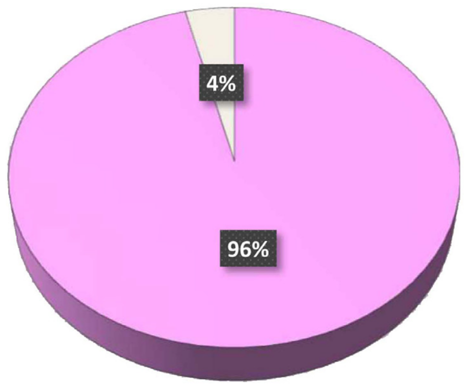


1935-2021
Second floor

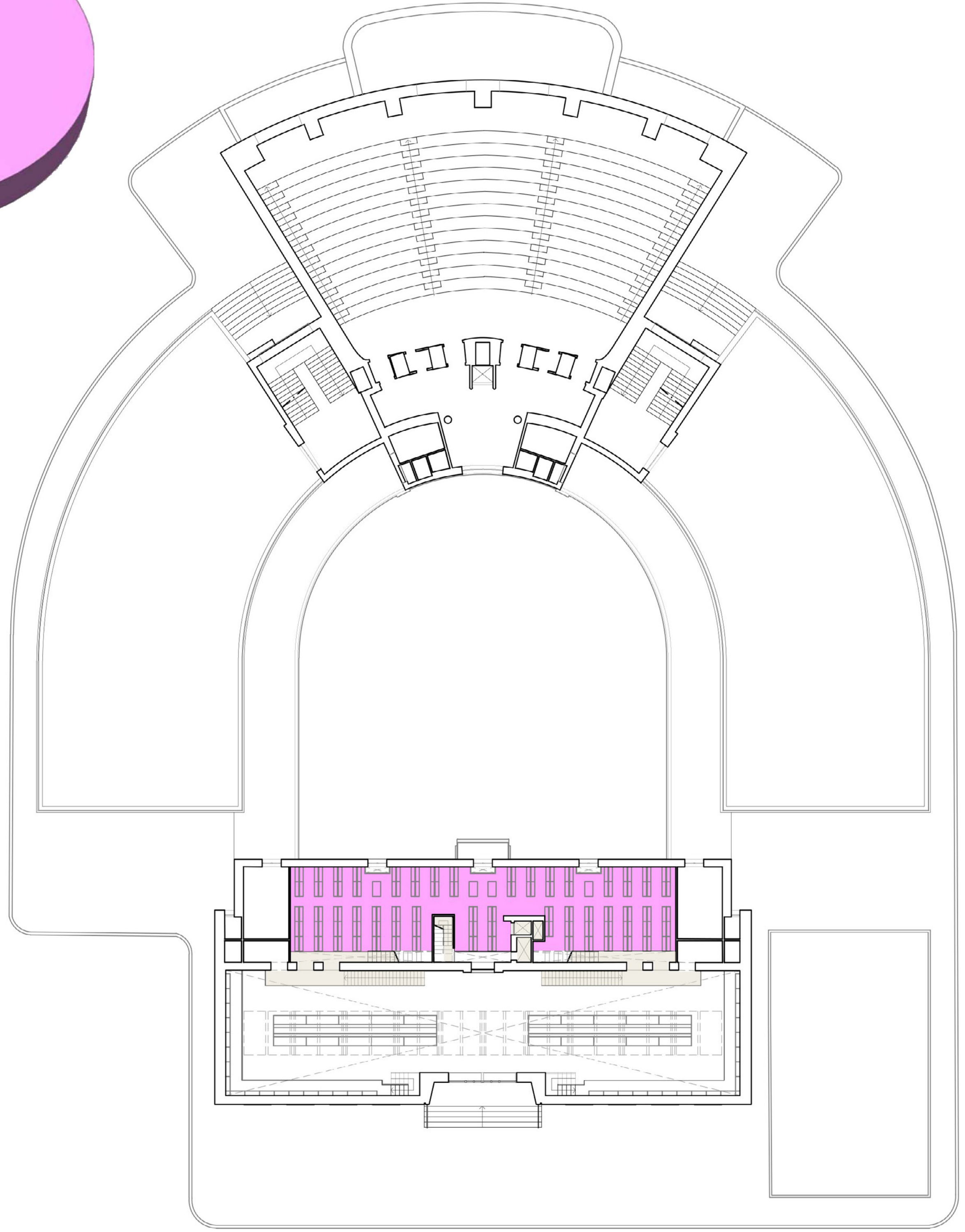


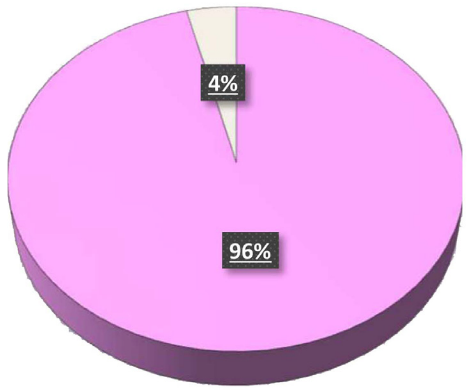


1935-2021
Third floor



Book depository (150mq)
Distribution (6mq)





Book depository (150mq)
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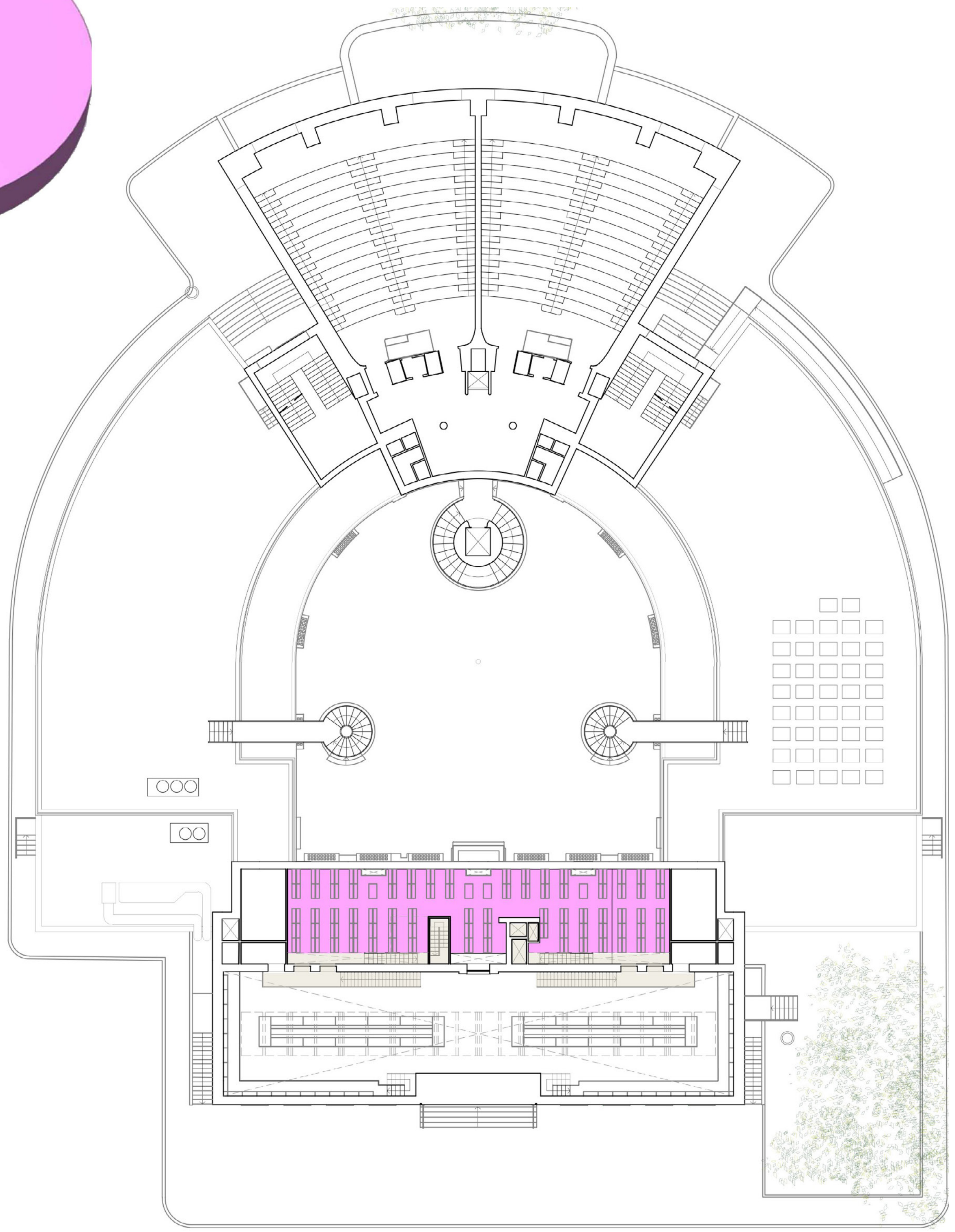

1935-2021
Fourth floor

NOTES

1. ASS, CERUR, b. 44, fasc. 378; ASS_dcm_08
2. The building designed in 1928 was much smaller; it had one meeting hall with 100 seats, and a second hall with 50 seats, a lounge for professors, a large room for the library with related reading rooms, another 8 to 10 rooms used not only by the professors, but also to house collections of models, presumably for geometry courses.
3. The following courses could be held in the building: Algebra, Analytical and Projective Geometry, Descriptive Geometry, Infinitesimal Analysis, Rational Mechanics, Advanced Analysis, Superior Geometry, Complementary Mathematics, Mathematical Physics, Advanced Mechanics, Probability Theory, and Differential Geometry. Other courses in mathematics such as Experimental Physics, General Chemistry, Astronomy, Geodesy, Advanced Physics, and Theoretical Physics were taught in the buildings of the Institute of Physics and Institute of Chemistry across the street.
4. The collection of books on mathematics belonged to the Royal Superior Institute of Engineering, together with the Library of the Mathematics Seminar, and that of the School of Science History. Guido Castelnuovo was already the director of the library in 1934; records show that in 1933 the collection included 41,000 volumes, 37,960 pamphlets, 253 journals, and 12.600 visitors.
5. It is interesting to note that the project drafted by the Civil Engineering Corps also included eight offices at the four corners of the quadrangular plan, on two floors, and were therefore identical in terms of position, view, and number of windows.
6. In 1940 there were 11 professors, in 1950 they increased to 24, in 1960 to 28, in 1970 to 42. When the university was reformed in the Eighties, changes in the organization of the School shuffled the cards in such a way that data does not allow us to compare numbers.
7. ASL_pht_13.
8. The name of Rome's first university has changed over the years. It was called "Studium Urbis" when it was founded in 1303 by Pope Boniface VIII, and then renamed "Sapientia" in the mid-16th century. In 1632 the name "Studium Urbis Sapientiae" became official when the institution was established in the convent of S. Ivo alla Sapienza, the premises of the university together with many other sites located in the city center. The name remained until 1870 when, with the unification of Italy under King Vittorio Emanuele II, the name was changed to "Royal University of Rome Sapienza". With the advent of fascism and the foundation of the University campus, the name "Royal University of Rome" was adopted and then dropped in 1948 when the Italian Republic was established; the name changed to a more simple "Università di Roma". Over the years, with the foundation of a second university in Rome in 1982 and then a third one in 1992, it was necessary to qualify the name "University of Rome" which, in 1982, officially became Università di Roma "La Sapienza"; the name "Sapienza University of Rome" was created in 2006, a name that coincides in all respects with the official name.
9. We found no records of the academic years 1946 1967, 1947-1948, 1949-1950, 1975-1976, and 1991-1992; they were probably not printed from 1999 to 2004; records for 1982-1984 do not report statistics concerning the number of students who attended the Department of Mathematics; records for 1973 to 1975 do not show statistics concerning the number of professors; records for 1970- 1973, 1976- 1982 and 1994 to the present day do not report any statistics at all. From 2014 onwards, records only show the number of students enrolled each year, more or less 200 students per year.
10. Law n. 910 /1969 liberalized access to universities by eliminating the constraints imposed by the 'Gentile Reform' (1923) that required a 'Classical' High School diploma- a traditional five-year diploma with courses in ancient Latin and Greek- as mandatory in order to enroll in university.
11. See the many chapters dedicated in this book to the study and survey of the interiors by Flaminia Bardati, with Chiara Turco.
12. Obviously, the big stained glass window on the main façade, corresponding to the triple height of the library's main reading room, was not meant to let light into the hall as the pieces of glass were all very dark and the window faced north, so very little light entered the room. The real source of light was the skylight and the side windows.
13. This should be taken into due consideration especially in view of compliance to safety regulations since doorways, corridors, and entrances are the first to be damaged and compromised by alterations.
14. Mathematics was, and still is, a key course as regards degrees in Mathematics, Mathematics and Physics, Engineering, and Architecture.
15. The first two-year courses in Engineering held in the School of Mathematics were: Mathematical Analysis I and II, Analytical Geometry and Descriptive Geometry, Rational Mechanics, and Drawing I and II.
16. The relationship between the School of Mathematics and the School of Architecture has lasted to the present day. Since it was founded, and up to the Fifties, the Royal Superior School of Architecture in Rome included courses in mathematical analysis, descriptive geometry, and applications of descriptive geometry, all taught by mathematicians on the premises of the School of Mathematics, together with students enrolled in the first two years of Engineering.

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TECHNICAL ISSUES, COMFORT AND ENERGY EFFICIENCY

Francesco Mancini, Giada Romano, Maria Rosso

BASIC BUILDING SYSTEMS

The study of the building has highlighted a crucial symbiosis between the architectural design and the layout of the plant system. Such intimate integration between apparently diverse aspects derives from the capacity to merge a deep knowledge of the building's thermal behaviour and the ability to design its volumetric development accordingly. In Gio Ponti's project, the 'integrated' design of the different aspects gave rise to an admirable combination of architecture and environmental comfort.

The architectural development may be compared to that of an amphitheatre, where the planimetric layout around an "unhinged semicircle'" develops in planimetry and in elevation. The void of the internal courtyard arranges in fact three main different bodies: the front building, the curved wings and the tower of the classrooms.

This research has proved that specific architectural and plant solutions were designed for each of the buildings, in order to achieve both environmental comfort and Indoor Environmental Quality (IEQ) according to the various different activities carried out in each.

The study of the different buildings has therefore been discussed separately, in full coherence with the original design concept in distinct bodies, in order to explain the synergic relationship between architecture and plant systems that originally rendered the interior spaces particularly pleasant and functional.

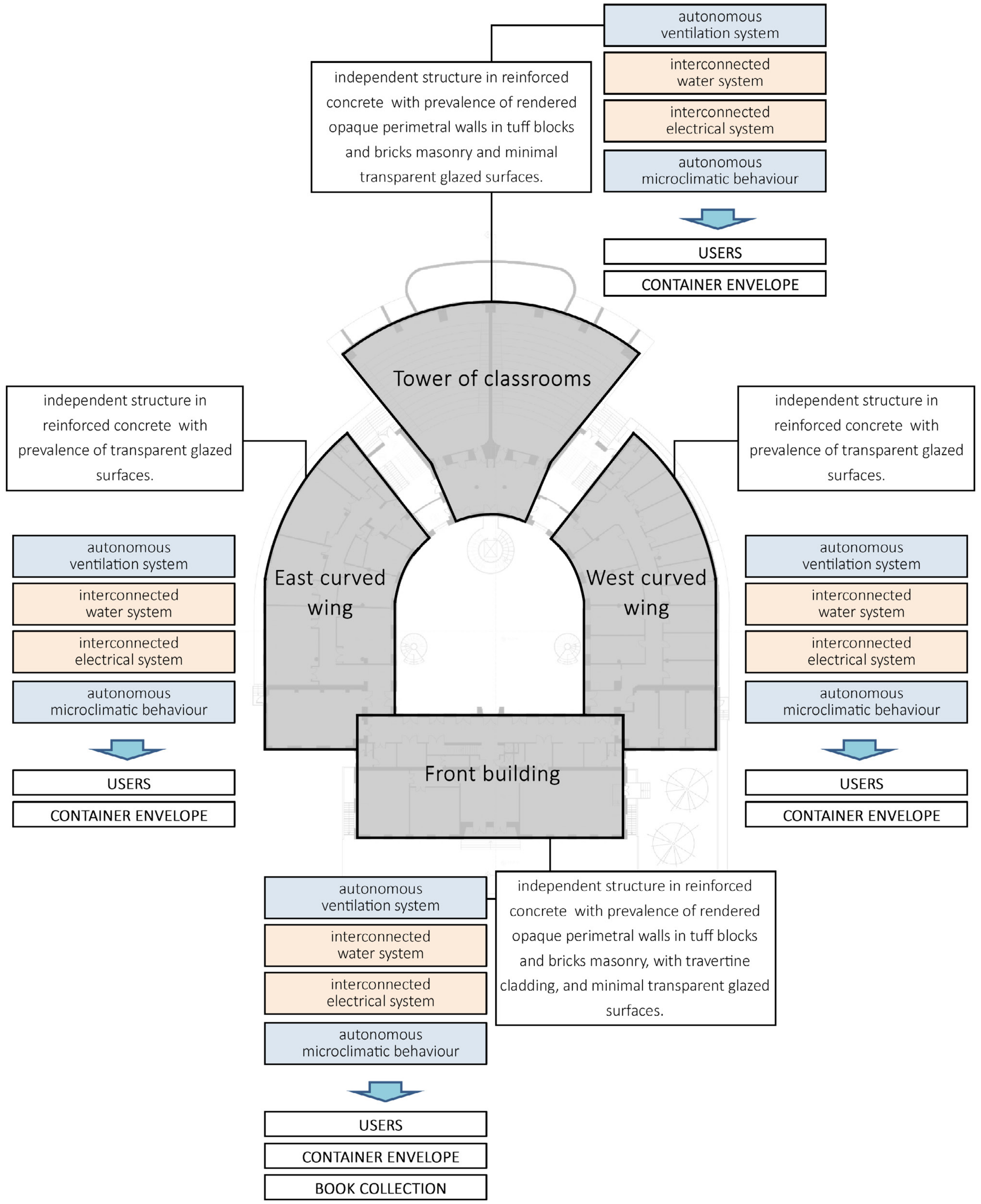
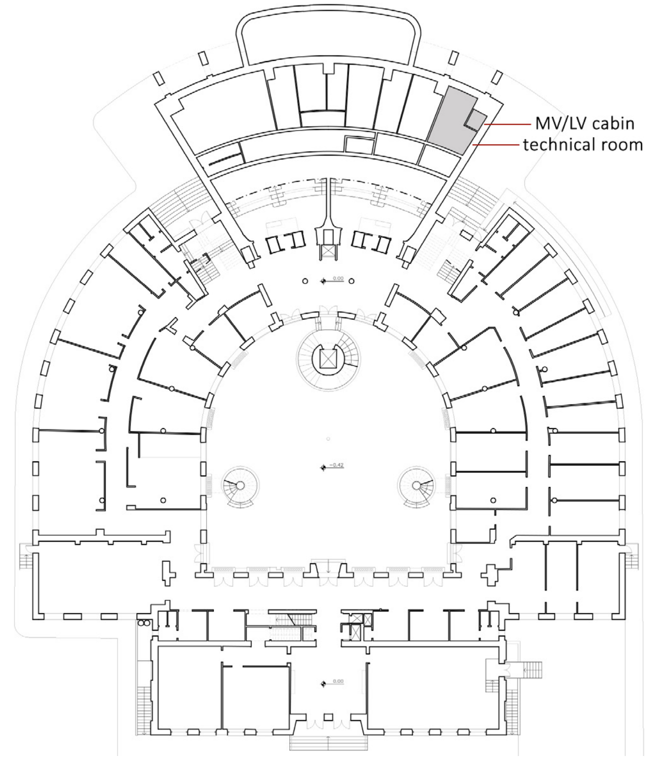


Figure 1 - Technical plant engineering and architectural features according to the main bodies of the building (© Mancini, Romano, Rosso 2020)

The School of Mathematics is equipped with essential technological systems, which satisfy functional needs and achieve environmental comfort. More specifically, the building is equipped with electrical systems for the supply of motive power and lighting, with heating systems serving the entire building, with cooling systems serving some parts of the building and in some case single rooms, with mechanical ventilation serving some parts of the building and with domestic hot water systems. Electricity necessary for the operation of the building is supplied through a Medium Voltage/ Low voltage (MV/LV) transformer substation, located in its original location (since 1935) at the ground floor of the Tower of classrooms, with access from the outside.

The distribution pipes that feed the area panels start from the General Low Voltage Switchboard (QGBT) and branch off through appropriate ducts in the shaft or under the pavements. The connections for the power supply of motive power and lighting depart from the area panels.



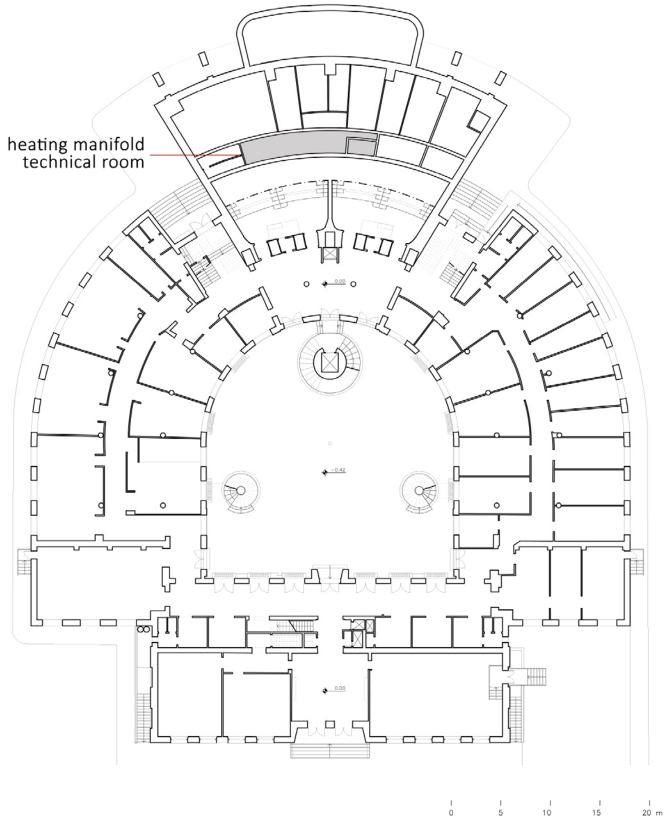
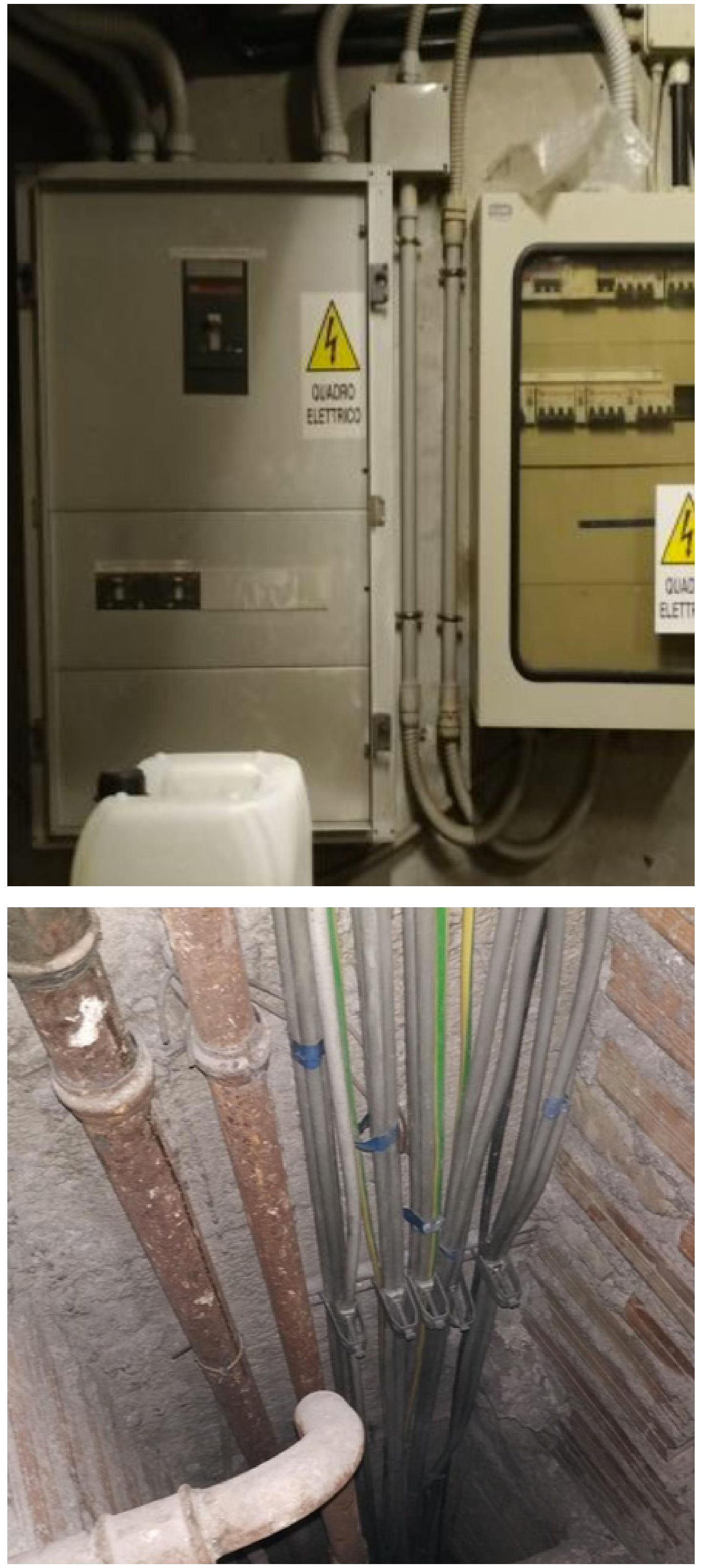
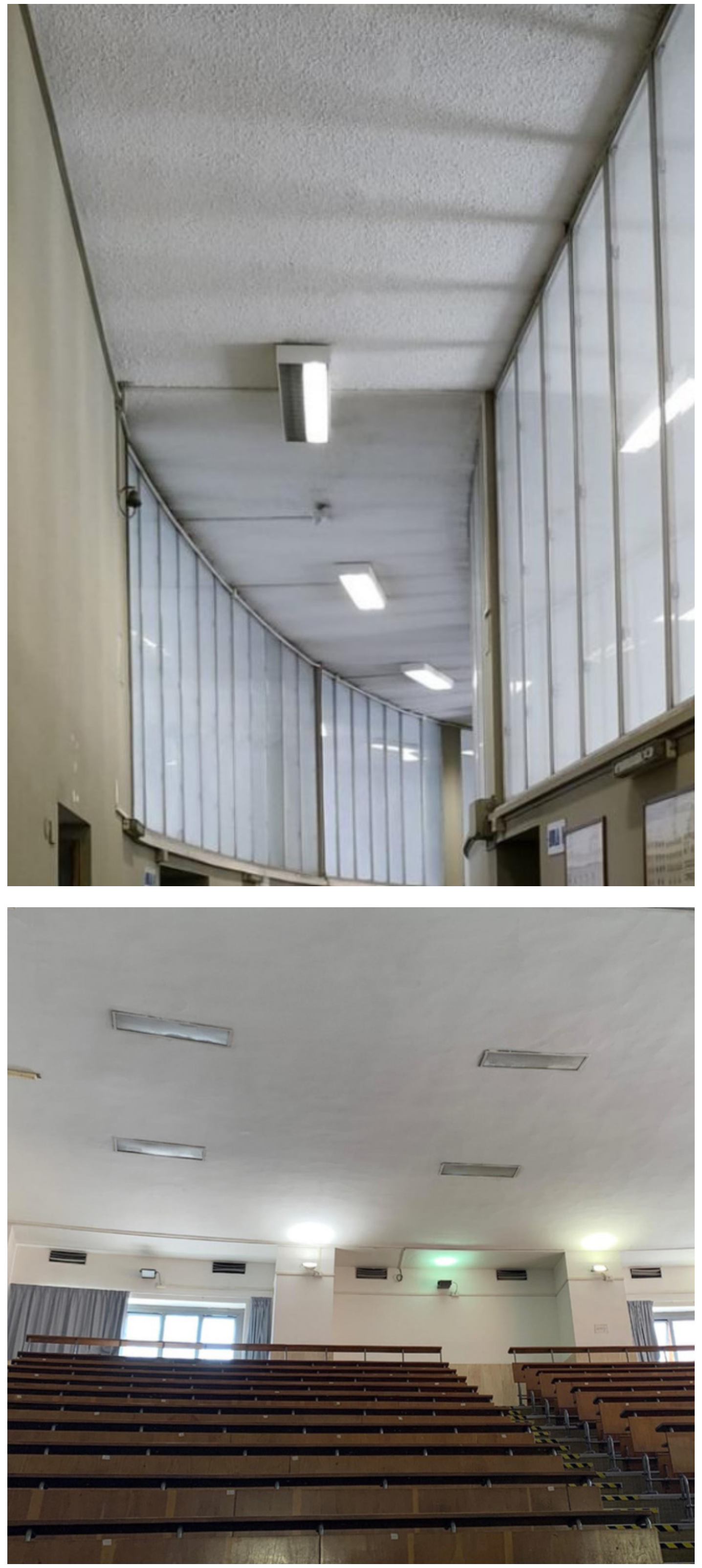


Figure 2 - Location of the Medium Voltage/Low Voltage cabin, in grey (© Rosso 2020)

Figure 3 - Location of the heating manifold technical room, in grey (© Rosso 2020)

Figure 4 a/b - Original equipment and signage of the heating manifold technical room (© Salvo 2021)





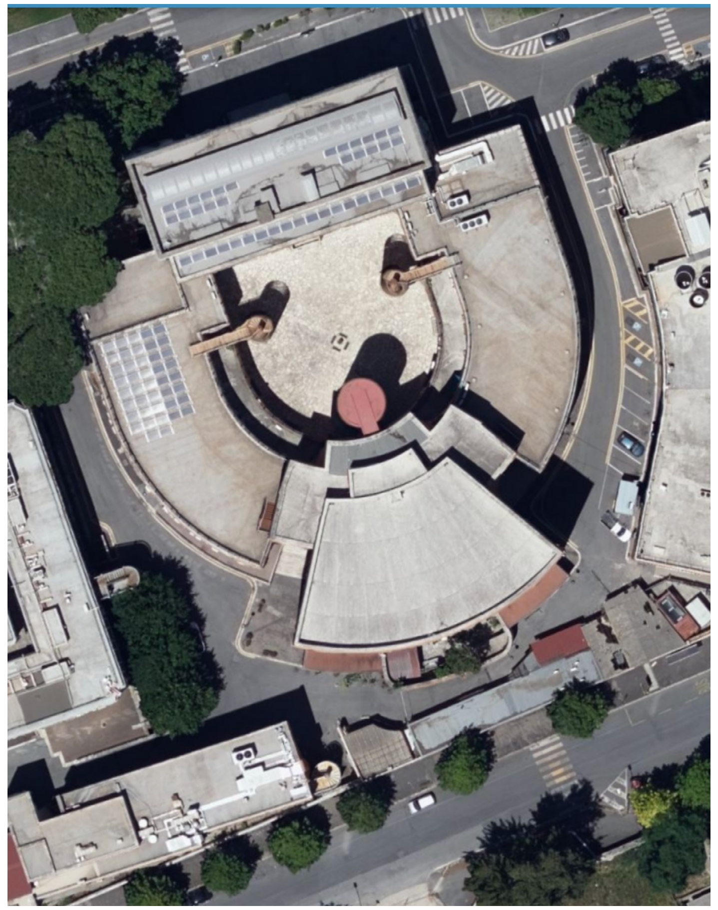


Figure 5 a/b - One of the zone switchboards and a cable duct (© Mancini 2020)

Figure 6 a/b - Original integrated ceiling lights in the tiered lecture halls and non-original ones (© Salvo 2021)

Figure 7 - Aerial view of the PV system (https://g3w-suite.cittametropolitanaroma.it/it/map/inquadramento-territoriale/, 2022)

A photovoltaic system has been recently installed on the roofs of the Front building and of the east curved wing in an integrated way with an azimuth orientation of- 22° south and an inclination of 10°. This grid connected system operates in parallel with the low voltage electricity network of the university campus and in an on-site exchange regime with the Municipal medium voltage distribution network (ACEA). This is part of a higher scale system implemented throughout the entire campus, which allows to cover the energy needs of the School of Mathematics and of other campus buildings, although only in part. The general system consists of two subsections: one dedicated to the building of the Rectorate and placed on its roof (on the roof of the Rectorate); another dedicated to the buildings of Arts and Humanities, and to the School of Mathematics.

In regard to the heating system, the building is connected to the university District Heating Network, through a secondary branch that starts from the substation of the nearby Institute of Pharmaceutical Chemistry and arrives in a technical room located at the foot of the Tower of classrooms; from here the distribution backbones branches off, housed in underground rooms of the nearby buildings through a distribution manifold.

Figure 8 - The PV system on the rooftop of the front building (© Salvo 2021)

HEATING, COOLING AND VENTILATION SYSTEMS

The front building consists of a parallelepiped that develops on three levels, plus a basement: the ground floor is divided into three sections and consists of an atrium and side classrooms; the first and second floors are occupied by offices and by the library, with reading hall, study rooms, deposits for storage of books, archive offices and services, all distributed by staircases within the same library. The orientation of this body in north /south, since all the windows face north and overlook the main aisle of the campus, or south and overlook the courtyard.

The classrooms, offices and halls of the front building are heated by radiators, most of which are still positioned in their original location- i.e. the one established in 1935- due to the few plan changes that have taken place in this part of the building over time. The original position is easy to detect as radiators are housed inside niches obtained in the walls, and protected by metal grates, so to appear perfectly integrated into the architectural system. Air exchange takes place through natural ventilation, thanks to the presence of windows in every room.
Ventilation and heating systems of the library have also been worked out with specific attention to the architectural configuration of this space, and to its specific activities. The two systems are closely linked and have therefore been detected in close reference. The main reading hall of the library consists of one single volume, naturally lit through a wide skylight that covers the entire longitudinal length of the space and by a large vertical window positioned on the central axis of the façade, crossing the entire height of the block, which therefore sheds light in the interior and beyond, reaching the rooms placed on the other side of the building. Air exchange originally took place mainly through the windows that flank the above skylight, while a strong circulation of air originally was guaranteed by the interconnection of spaces from level to level and from side to side.

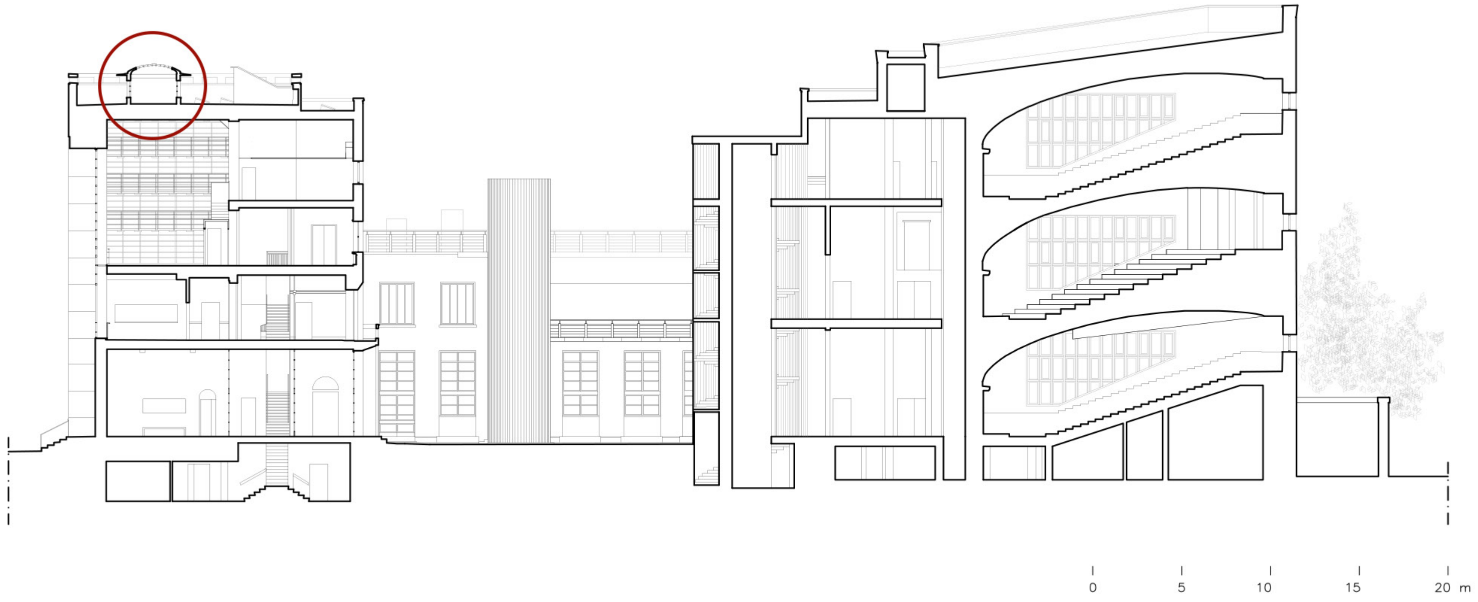


Figure 9 a/b - a) location of the skylights above the library; b) view from the rooftop (© Salvo 2021)

Figure 10 - A radiator of the front building (© Salvo 2021)

Today the opening system of these windows cannot be operated easily as they can be opened only from the outside, accessing on the roof terrace; in addition, recent maintenance works have laid varnish on hinges and fixtures, which are now stuck in the closed position. Since there is no evident system that can operate these windows from inside the library, it is probable that these were meant to be kept constantly open, to guarantee air exchange in the reading room where operable windows are absent. This hypothesis is supported by the jutting cement cornice of the skylight, which was probably designed to protect the pivoting windows in the open position in order to protect them from the rain.

The refrigeration units for the management of the cooling system of the library are positioned on the rooftop of the east curved wing, flanked by another Air Handling Unit (AHU) positioned next to each dedicated refrigeration unit, which serve the rooms at the basement level of the building.

The two curved wings that embrace the central courtyard are symmetrical and connect front block and tower through a central corridor. To date, the situation of the installations in the two symmetric bodies is different in consequence to the different use of the two, as one is destined to offices and classrooms, and the other is only in part dedicated to offices and hosts IndAm on the upper level, which is organized and managed apart. The original drawing classrooms, consisting of large open spaces, have been subdivided in order to optimise their use due to the change in academic courses and programs, and to the high increase of the number of students. This fragmentation of the original open space has not only altered the functional and architectural organization of this part of the building but has also affected the internal microclimatic balance among the rooms, significantly worsening the indoor environmental quality, or comfort. The cross current air that once allowed natural air circulation and a full air replacement in the rooms, is today impeded by the

Figure 11 a/b - a) View of the refrigeration unit with Air Handling Unit dedicated to the library rooms placed on the rooftops (© Salvo 2021) and detail (b) (© Mancini 2020)

Figure 12 - Detail of the Air Handling Unit (AHU) (© Mancini 2020)

presence of the corridor and of the many partitions along the entire length of the wings.

However, natural light is guaranteed in each classroom by the presence of wide windows, while heating is also guaranteed by the presence of radiators. The current situation is rather different from the original especially at the ground floor, where full-height windows have been reduced by one third, and rest on travertine sills under which the radiators are located. The presence of such wide glazing in all rooms, versus the scarce natural air circulation, renders microclimatic discomfort perceived more in the summer season, and for this reason HVACs systems have been installed in many rooms for cooling.

The Tower of classrooms consists of an amphitheatre-like body, which develops its curvilinear side towards south, with very few openings, and is wedged into the courtyard with a semi glazed façade, overlooking north. Lighting fronts are concentrated to the sides facing east and west, with large, contoured windows that allow a sufficient level of natural lighting for the use of these large halls during the day. While the building envelope is pierced by a limited number of openings compared to the imposing continuity of the outer wall- probably also dictated by the need to limit wind pressure on fragile surfaces- it is evident that the shape of this body was conceived to accommodate the tiered lecture halls.

Electrical heating, cooling and ventilation systems
The original electrical system of the School of Mathematics has undergone significant changes to comply to the constantly evolving legislation and to the changing needs of the academic community. Classrooms have increased in number and decreased in dimensions throughout the subdivision of the original halls. The demand for motive power for various uses has also changed and increased in general with the introduction of several systems for summer cooling (HVAC), which in many cases serve individual rooms. All these

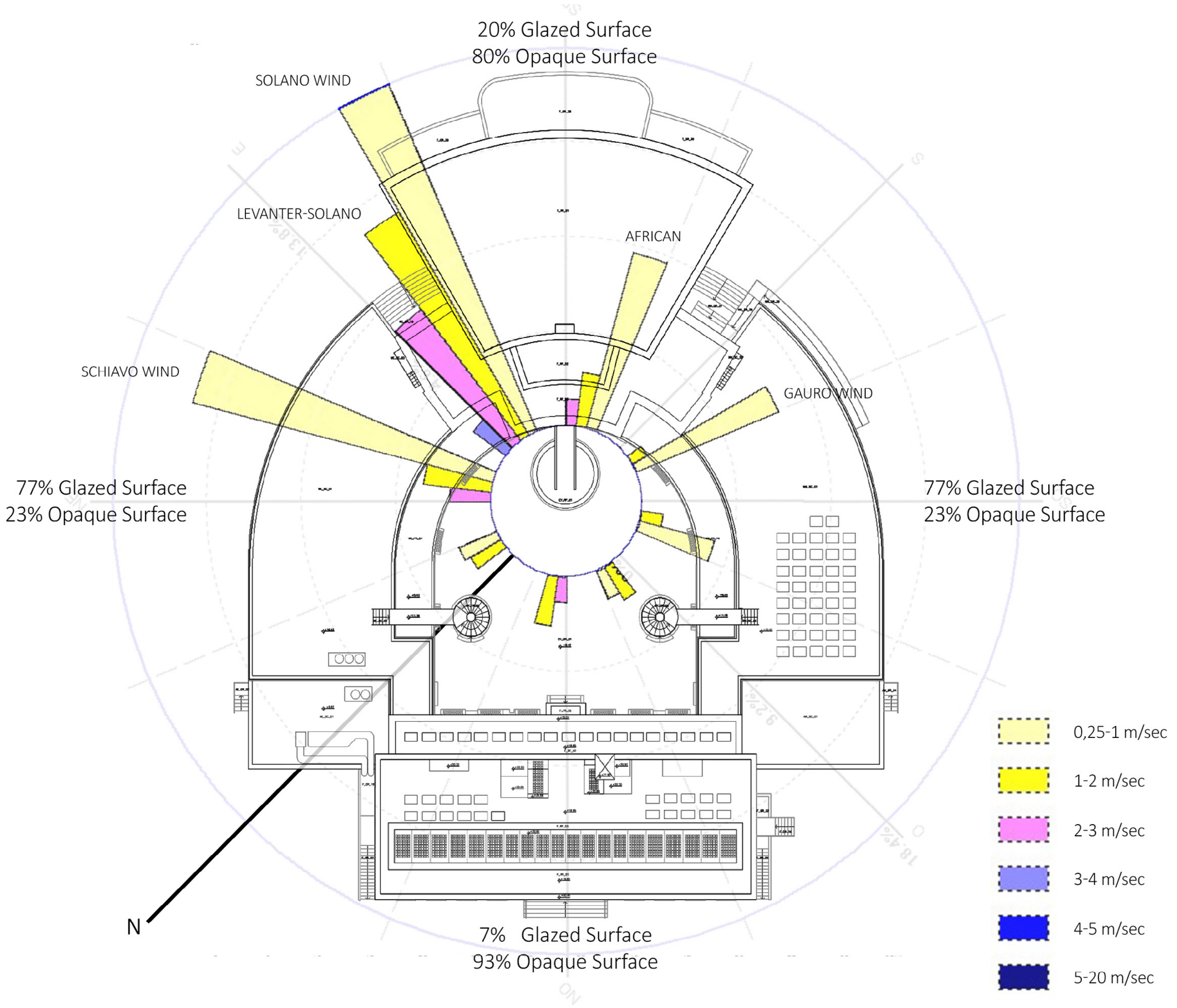


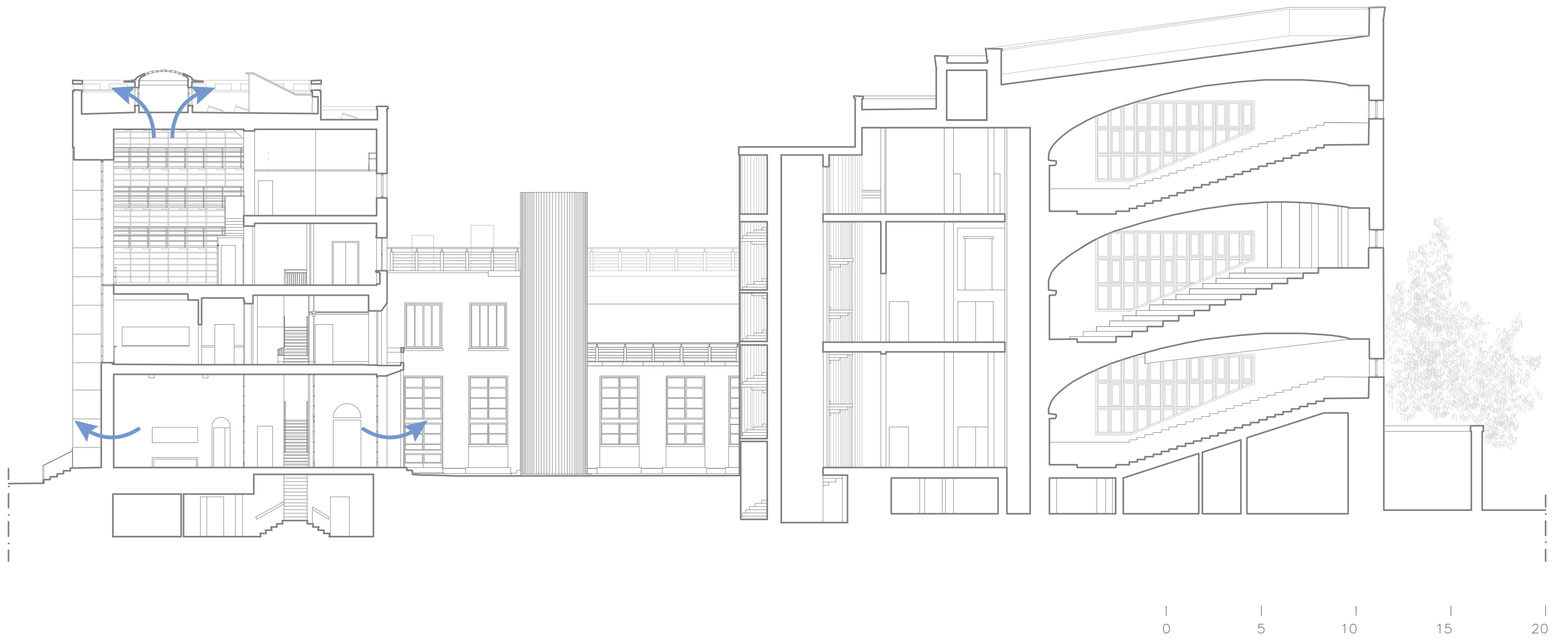
Figure 13 - Orientation diagram of the building, with percentage of opaque and glazed surfaces and prevailing compass wind rose (source of climatic data: http://www.arsial.it/portalearsial/agrometeo/E2_5.asp year 2020)

changes have implied the passage of new cables and ducts, and the installation of new ceiling lights, also altering or replacing the original fixtures. The electrical substation has been instead kept in the original position, as evidenced by the plate positioned above the manifolds, which tells the name of the original supplier of the heating system, the Florentine firm "Giuseppe De Micheli & Co". Cold water distribution lines for toilets and for other building's uses depart from this same room, while domestic hot water for the toilets is produced using local electric boilers.
Observing the cross section of the front building, the original ventilation system, which guaranteed circulation and supply of fresh air in a semi closed room recurring to a rather brilliant architectural solution, appears evident.

Due to the heating effect, a vertical convective motion of rising warm air is generated, thus allowing the exchange of air induced by the ribbon windows on the sides of the skylight. At the level of the study tables, instead, a horizontal circulation is guaranteed by the presence of aligned entrances, openings and windows, all placed one in front of the other.

The all glass vertical window on the front façade - which lost its decorated stained-glass work during World War II and was reinstated thereafter with common transparent glazing – has altered its lighting function today due to the drastic changes in the space organization of this part of the building: the insertion of a slab between the once called 'professors' atrium' and the reading hall of the library has in fact interrupted much of the air and light flow from level to level, thereby also limiting air currents produced by an excessive ascent speed given by the notable height of the library reading hall.

The original location of the heating terminals – or radiators – in this part of the building appears in the few historical photographs of the newly built library, designed in perfect harmony with the function of the space, the furniture and the overall architectural



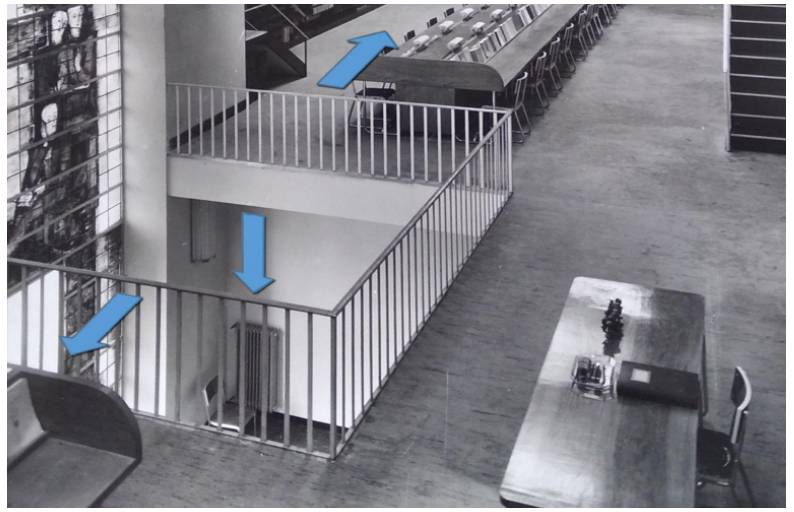


Figure 14 - Detail of air flow in the library reading hall in the original situation (ACS_pht_30)

Figure 15 a/c - Details of opening systems to operate windows out of direct reach (© Rosso 2020)

Figure 16 - Section of the front building with direction of air flow in the library reading hall in the original situation (© Rosso 2020)

space. On the first floor, as in most rooms, radiators were positioned near the windows. In the reading hall of the library, given the huge space to heat and in absence of traditional windows, radiators had been integrated in the body of the study tables, as a further demonstration of an integrated design between architecture, furnishings and installations. Therefore, a battery of continuous radiators heated the room longitudinally, very near to the users, which received immediate comfort. The entire space was therefore well heated at least for 150 centimetres of height, except for the area between the vertical window and the main entrance. Such careful and clever positioning of glazed elements (windows) and of radiators allowed the users to benefit from the natural lighting of the skylight without being affected by temperature gradients and by glare produced by the huge window. In addition, the location of the radiators in the centre of the room was- and still is- also functional to the conservation of the books on the shelves along the entire perimeter walls of the room.

Probably, after the subdivision of the triple height, and in consequence to the locking of the windows on the skylight, radiators were replaced with fan coils in order to cool the room during the summer. This alteration may be also linked to the rise in temperatures due to the reduction in air circulation produced by the same alteration and by the closing of originally open passages with doors and partitions. However, the combination of alterations has led to a decisive worsening of the environmental comfort in the winter season, and probably to a more dangerous microclimate for the conservation of the book collection[1]. More specifically, the presence of radiators and cooling systems may produce the deterioration of the book collection due to the rising of hot air currents, which are forced by the action of the fan coils and channelled through the narrow section that has been created above the study tables.

Figure 17 a/b - a) The library in 1935 (BBL_pht_30); b) the library in 2020 (© Romano 2020)

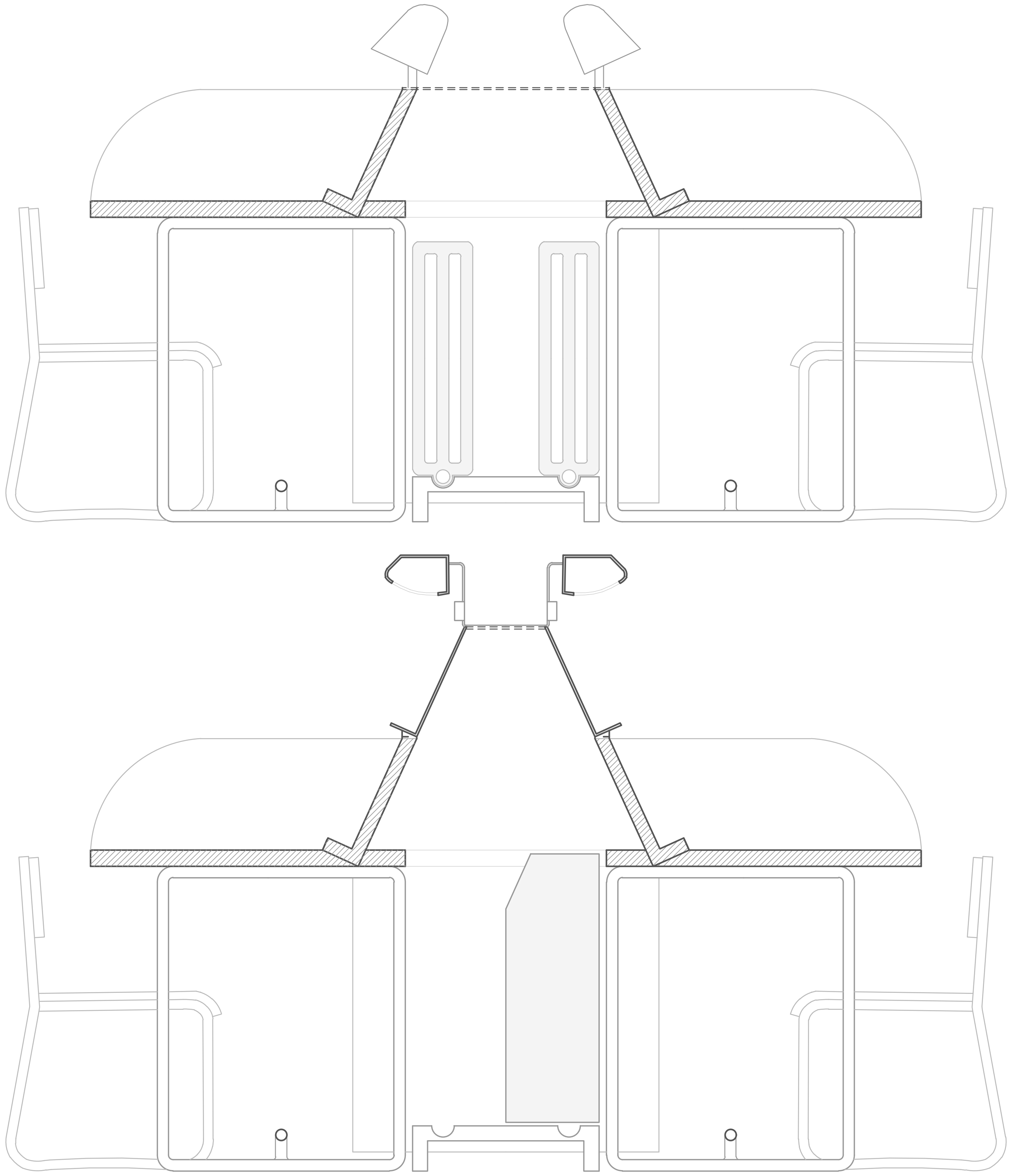


Figure 18 a/b - Reconstruction of the original situation and current condition with modifications due to the change of the lighting fixtures and the embedded radiators with fan coils (© Cortesi 2021)

The situation, both for users and collection, is different during the summer, when comfort is significantly improved thanks to the fan coils that have also been installed in the rooms adjacent to the rooms intended for books storage.

As the curved wings are semi-symmetric in respect to a north/south axe, they are both oriented east/west; yet, thanks to their curvilinear conformation, they collect natural light also from the south. The percentage of transparent surfaces of the building envelope is higher here than in the other blocks.

The original configuration allowed the optimal use these classrooms for technical drawing, which in fact needed maximum daylight. Large, glazed surfaces on both sides of the halls (full height glazing on the outer wall and ribbon glazing on top of the corridor wall) at the ground floor allowed for considerable natural lighting and adequate ventilation of the rooms, as well as access to the room both from the internal courtyard and from outside the building. At the first floor instead, again full height ribbon windows on both sides of the classrooms were set to shed natural light on the tables and for natural ventilation of the rooms.

Figure 19 - The reading tables of the library with evidence of subsequent modifications due to the change of the lighting fixtures and of the embedded radiators with fan coils (© Petraroia 2020)

Figure 20 - View of the curved wings in the original configuration (ACS_pht_10)

Figure 21 a/b - The original configuration of the drawing classrooms at ground and first floor (ACS_pht_15, ACS_pht_14)

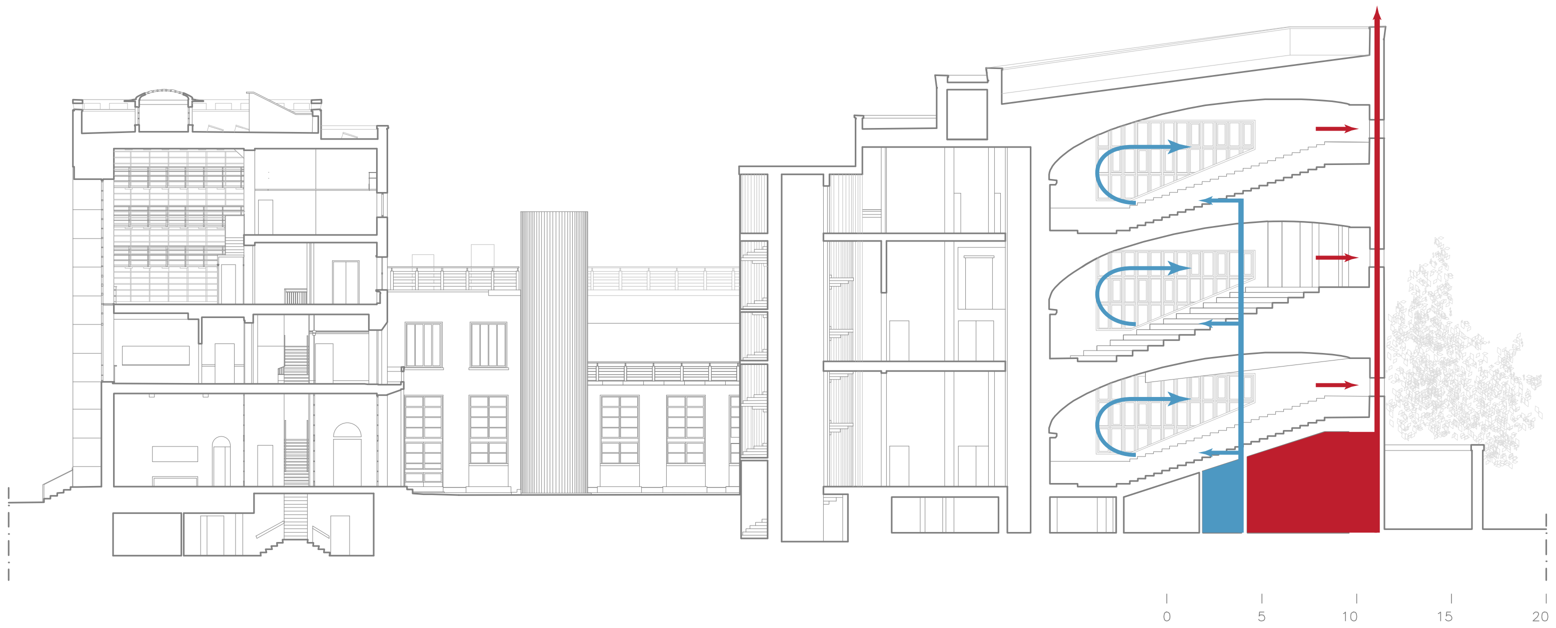
Cleverly positioned radiators under or near the windows allowed the classrooms to be heated avoiding air currents, especially in such large rooms, both at the ground level and at the upper floor, according to the different position of the few opaque surfaces.

Unfortunately, these rooms have undergone thorough changes over the years: the inner space of the west wing has been fragmented as early as 1939, while the east wing was radically altered in the late 1970s. In both cases the wide, open spaces have been fragmented to obtain smaller offices and classrooms, thereby disrupting the very fine- and fragile- balance established by Ponti's design among natural lighting, heating, and ventilation.
Ventilation of the tiered lecture halls stacked in the tower was instead produced mechanically, given the high level of crowding for which these halls were intended and given the difficulty in managing natural ventilation. For this reason, in these halls the huge windows on the side walls were not all operable except a few, plus the ones in the rear wall, probably due to guarantee safety. However, they were not sufficient to ensure correct air exchange.

The boilers serving the heating system of these halls are located at the foot of the Tower, together with the heat transfer fluid distribution centre. The boilers are since long obsolete and no longer in use, but are still in their original position. They consist of two parallel fans for delivery and expulsion of heated air, and of dampers to regulate the air flow to the different distribution channels.

Figure 22 - One of the columns incorporated in the walls added to fragment the drawing rooms at the first level of the curved wings (© Salvo 2021)

Figure 23 - The main tiered lecture hall at the third level, in the original condition (ACS_pht_18)



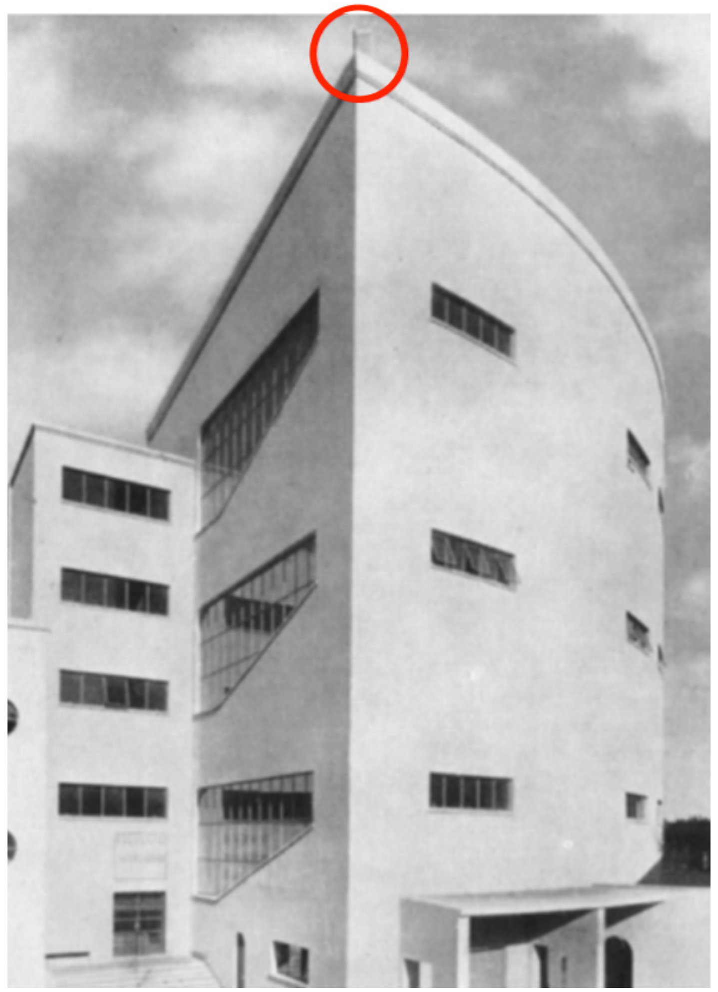


Figure 24 a/b - Diagram of hot air circulation system in the tiered lecture halls: blue arrows indicate the delivery section of air, red expulsion (© Mancini 2020), and an image of the tower of the 1930s where the chimney is still visible (ASS_pht_05)

Figure 25 - Technical rooms at the foot of the Tower of classrooms where fans for delivery and expulsion of heated air are locate, on the right (© Salvo 2020)

Figure 26 a/c - The delivery section of the heating system of the Tower: (a) heating coil, (b) humidification coil, (c) regulation damper (© Romano 2020)

Since it is not possible to directly survey the path of the heating ducts, it can be assumed that the ducts reach the cavity between ceiling and slabs, which worked as a “distribution plenum” to deliver warm air into the rooms through vents that were integrated with the steps of the tiered halls, which are still visible today. Air was then expelled through recovery grids positioned in the upper part of the back wall of the halls. To improve the heating of the classroom, radiators were also positioned in the lower part of the side walls, which have unfortunately been replaced with fan coils.

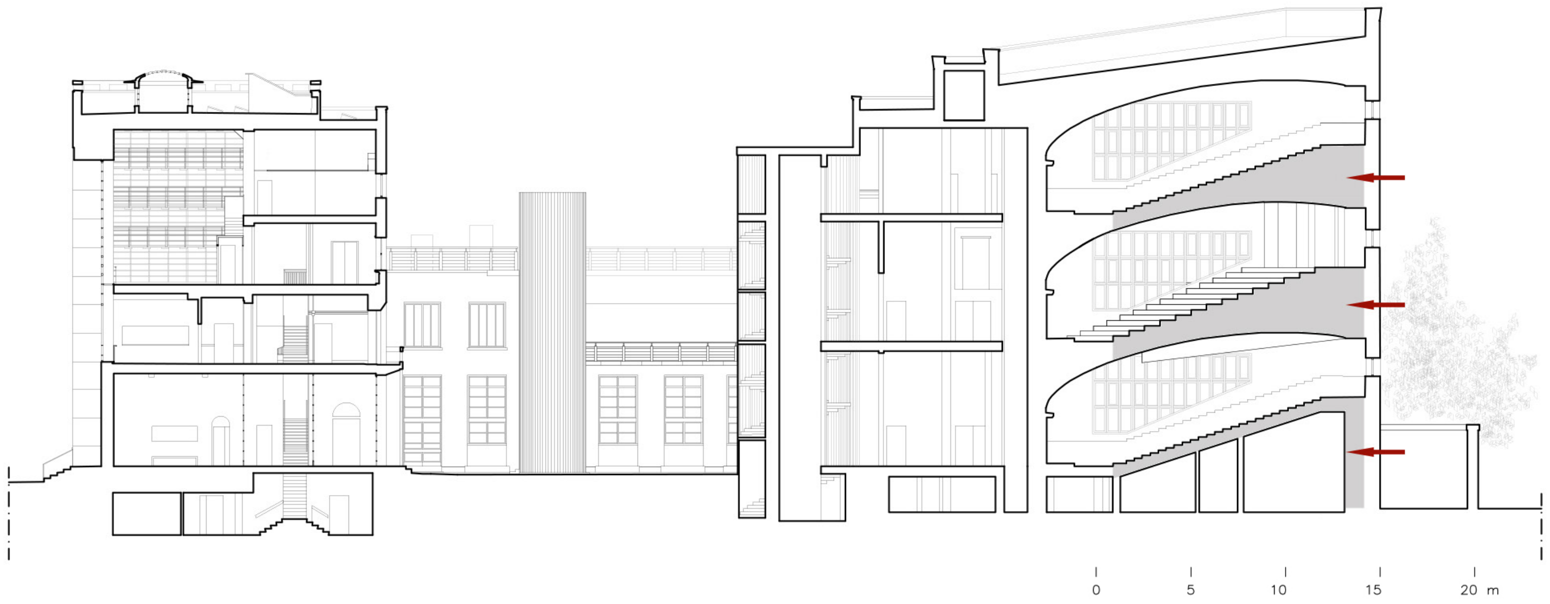


Figure 27 - Scheme of airflow in the tower of classrooms, assuming that the cavity between ceiling and slab works as distribution plenum (© Mancini 2020)

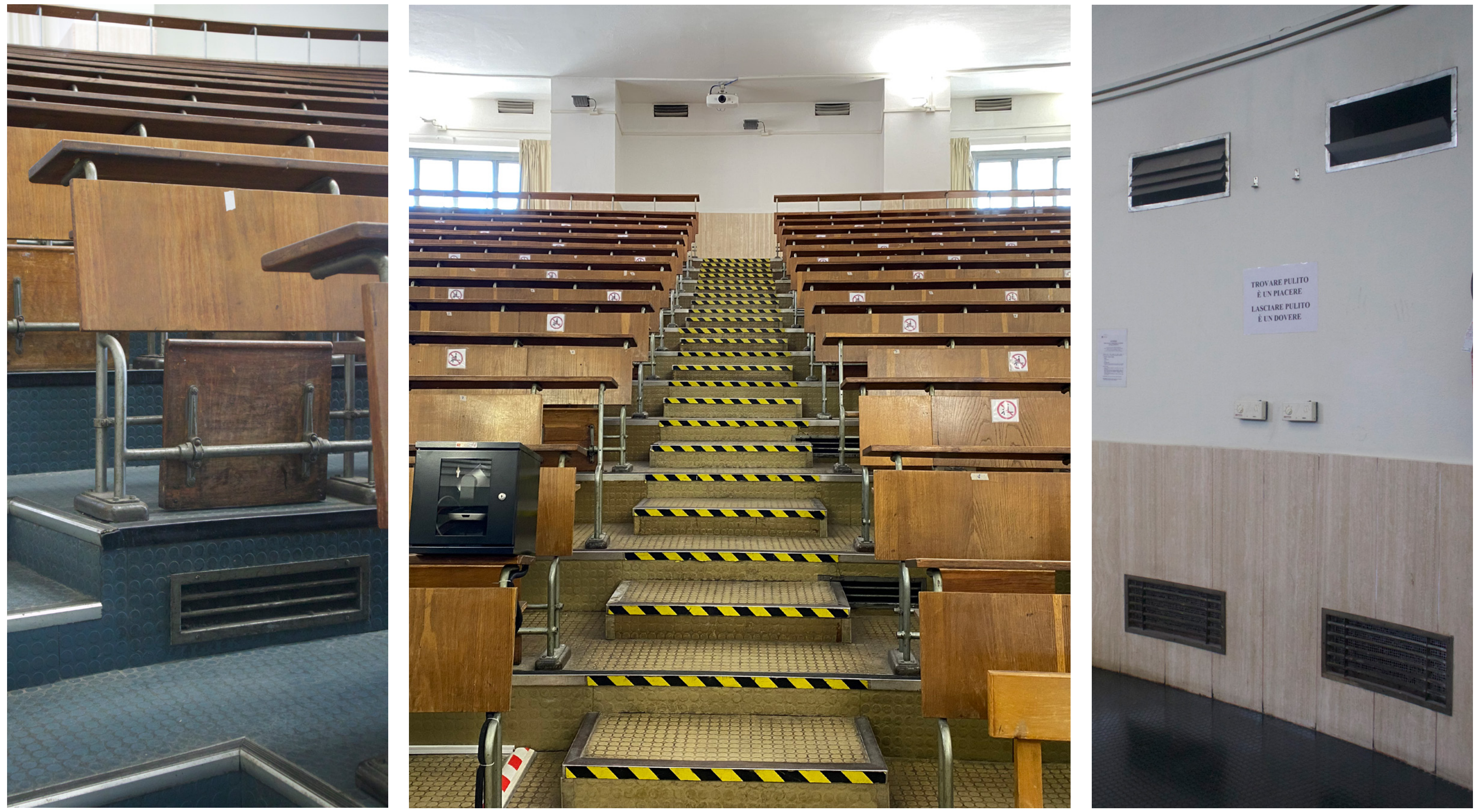


Figure 28 a/c - Original delivery vents (a), return grids (b) and radiators (c) in the tiered lecture halls of the tower (© Salvo 2021)

THE GLAZED SURFACES

One of the main features of this building relates to its windows and to the glazed surfaces of the building envelope. These are not only architectural features but also means for technical management of the interior comfort, or discomfort. Windows are therefore a critical element where functional instances clash with the preservation of heritage values. Therefore, a closer investigation around the system of window fixtures in the building is essential to understand values at stake and limits of intervention.

This analysis was again implemented in strict consideration of the different characteristics of the three bodies of the building, therefore following the tripartition in front building, curved wings and tower. The results of this investigation were therefore necessary to value the microclimate in each body and elaborate hypothesis of indoor microclimate improvement.

An abacus of the window fixtures has been collected, to report basic materials (wood /metal) of the window frames, window typology, type of opening, presence of gaskets, putty and sealings, type of windowsill, and type of glazed surfaces; this analysis has been repeated for all 151 windows present in the building, providing a complete catalogue of the situation in 2020.

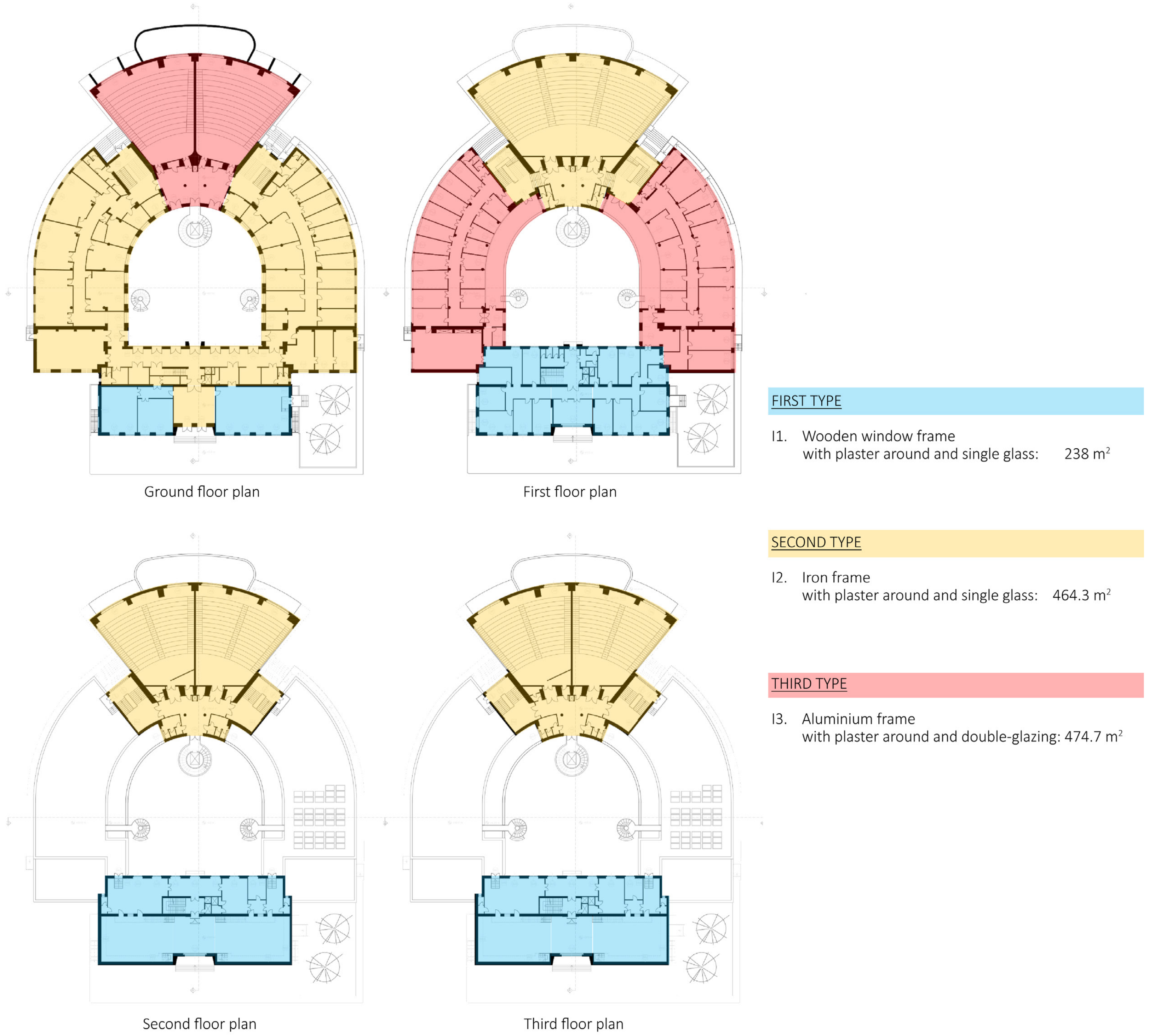


Figure 29 - Mapping of types of window frames in wood, iron and aluminum (© Romano 2020)

Following, a more detailed elaboration of the information has been reported directly on the survey drawings of each level of the building. A description of each window frame is provided describing three main variables- general information, window identification and specific features- each associated to alphanumeric codes: mapping allows to position information of each window for a synthetic reading of the overall situation.

This coding system has allowed mapping on the four main levels of the building, and for all three blocks: front building, wings and tower of classrooms, according to their orientation. Following, in addition to this first synthetic coding system assigned to each frame, more detailed information has been added:

> I- general information concerning block and room (A – Front building, B – Tower of classrooms, C1-C2 East and West curved wings), and orientation;
>
> II – position within the corresponding façade in view of microclimatic investigation;
>
> III – description of opening system, material of frame, type of glazing, type of putty, and material of windowsill.

This mapping system has produced a total of 18 sheets: four providing synthetic overall information of the fixtures for each floor; four technical sheets for each of the three bodies of the building (front, wings, tower), to which more detailing sheets were added to provide information of fixtures that were not included in the coding. Each summary sheet instead indicates: location (block front block / tower / wings); orientation (north, south, east, west); description of the technical characteristics; an image and the identification code.

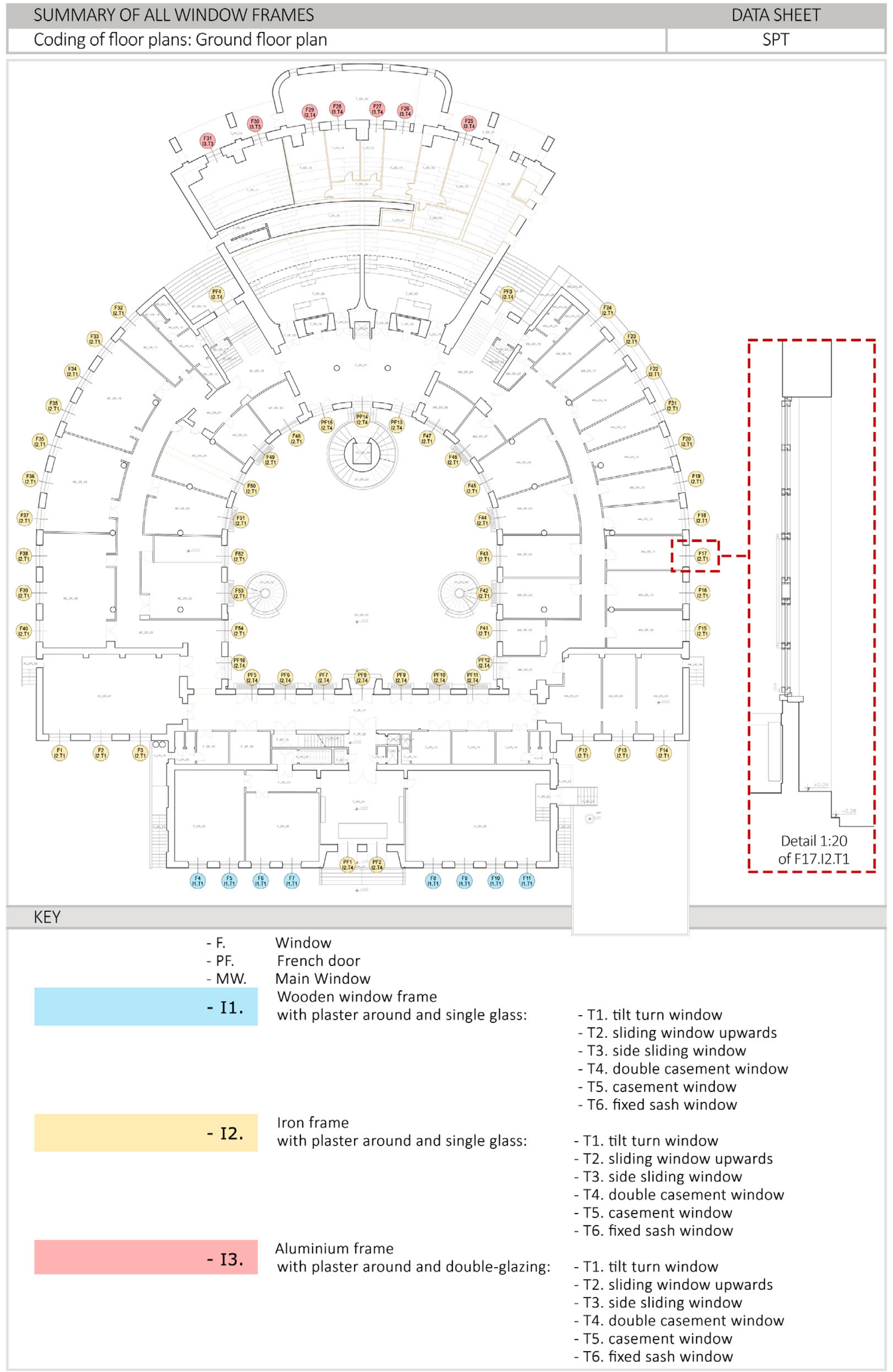
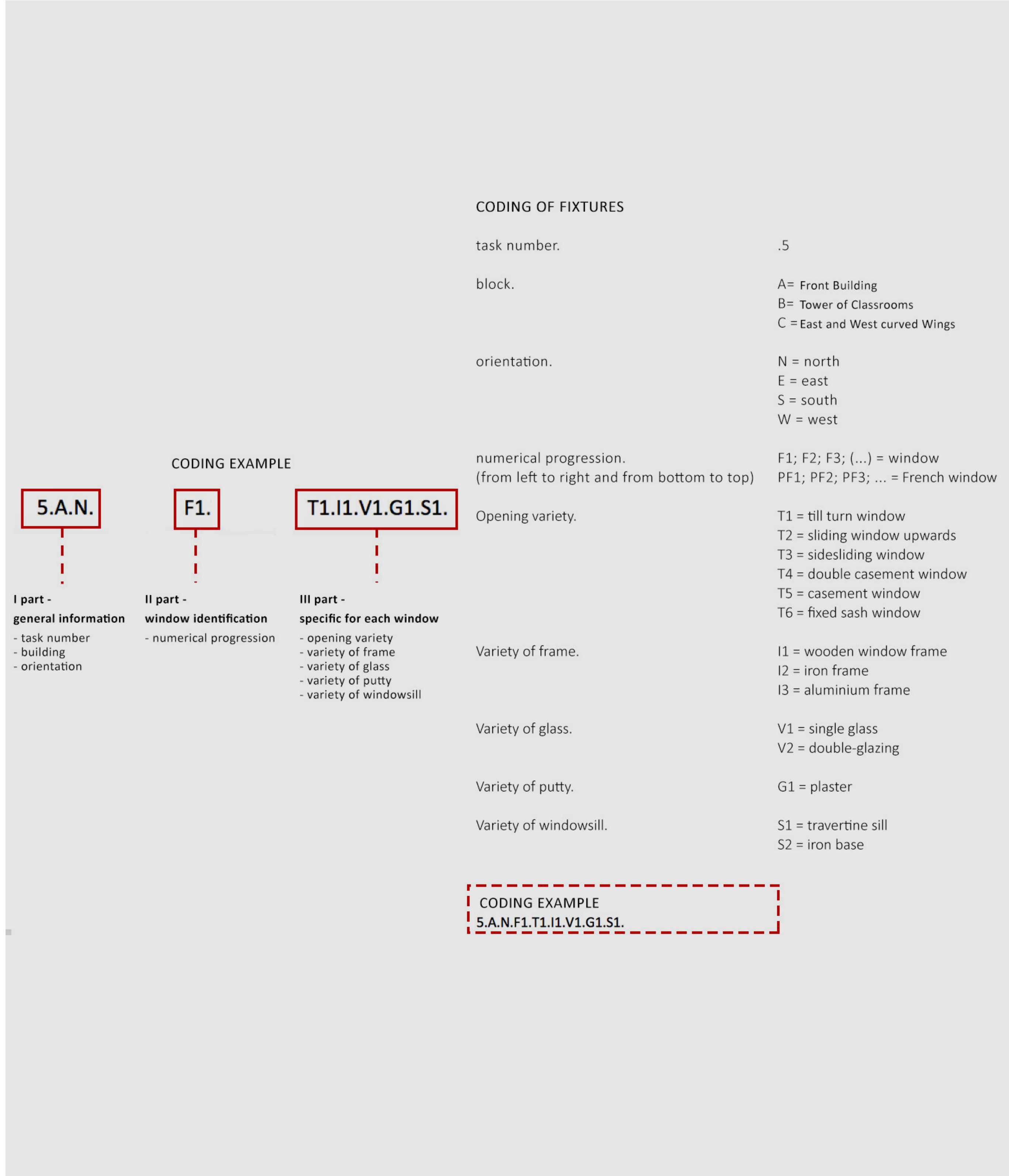


Figure 30 - Sample of window mapping at the ground floor, with detail of one type of window (© Romano 2020)



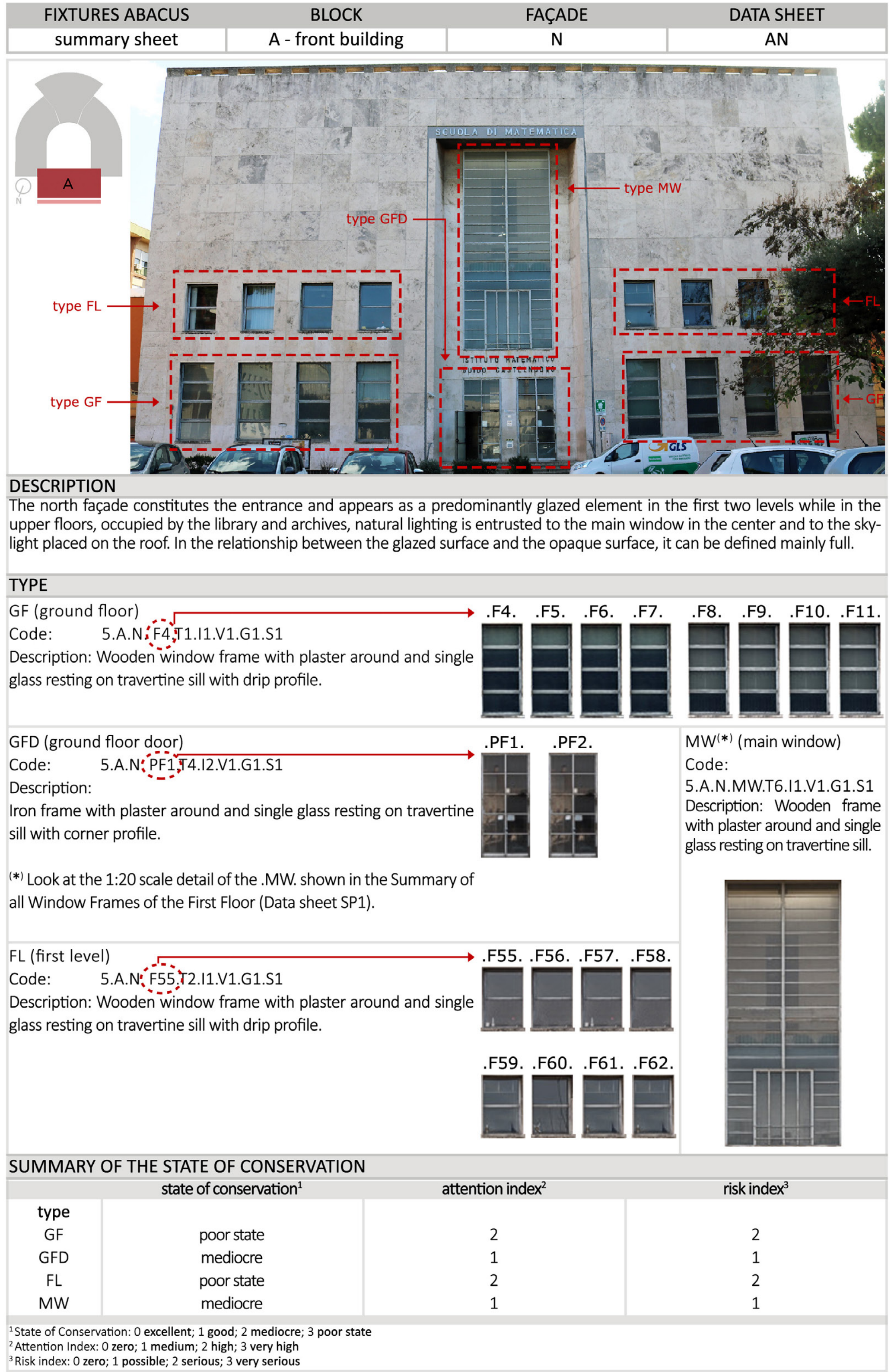


Figure 31 - Coding scheme of window fixtures (© Rosso, Romano 2020)

Figure 32 - Sample of the summary sheets which provide a general abacus of the window fixtures, referred to the windows on the north façade of the front building (© Romano 2020)

The evaluation of the state of conservation of the window fixtures has been developed providing indexes based on the severity of the decay process; this was estimated through a risk index (RI) associated to an attention index (AI) as shown below:

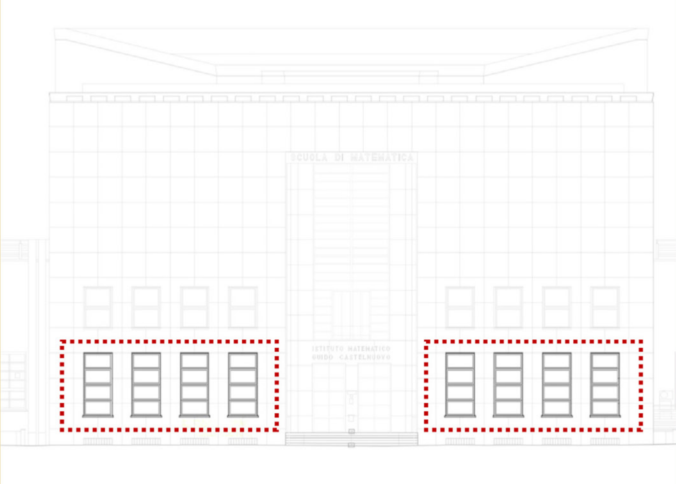
- (0) excellent state of conservation = zero attention index; currently, the situation does not require checks or instrumental investigations;
- (1) good state of conservation = medium attention index: the situation requires checks over time, even if at the moment there are no signs of danger;
- (2) average state of conservation = high attention index: further investigations may be necessary;
- (3) poor state of conservation = very high attention index; interventions must be immediate given the criticality of the situation.

As the attention index increases, risk index condition obviously also increases according to the following progression:

- 0 = zero risk;
- 1 = possible risk: mitigation/attenuation interventions are recommended;
- 2 = serious risk: attenuation interventions are recommended;
- 3 = very serious risk: urgent interventions are recommended.

PHOTOGRAFIC SURVEY

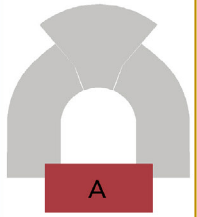
GEOMETRIC SURVEY



GUIDELINES

WE RECOMMEND REPLACING THE FIXTURE WITH ONE WITH THERMAL BREAK WITH OPEN JOINT AND LOW EMISSION GLASS.
THIS SOLUTION REPRESENTS A COMPROMISE THROUGH THERMAL, ACOUSTIC, AESTHETIC AND DURABILITY INSULATION FACTORS.
IN THIS WAY THE HEAT LOSSES OF THE BUILDING ARE REDUCED, IMPROVING THE ENERGY PERFORMANCE.

KEYPLAN



BLOCK
BLOCK A_FRONT BUILDING _ GROUND FLOOR

ORIENTATION
SOUTH

PERIOD
_1935

GEOMETRIC DATA
AMOUNT = 8

S_{total} = 52,24 mq [8 elementi]

S_{total} = 6,53 mq [1 elemento]
S_{glass} = 4,60 mq
S_{frame} = 1,93 mq

TECHNICAL DATA
WOODEN WINDOW FRAME WITH PLASTER AROUND AND 6mm SINGLE GLASS

U_{total} = 5,62 W/mqK
U_{glass} = 0,80 W/mqK
U_{frame} = 4,82 W/mqK

OPENING DETAIL
HALF FIXED SASH WINDOW AND HALF SLIDING WINDOW UPWARDS

WINDOWSILL DETAIL

Figure 33 - Sample of analysis sheets of fixture types (© Romano 2020)

PLANT SYSTEM INVESTIGATIONS

The overall result of the above-mentioned investigations highlighted the fact that the entire building is equipped with plant systems dedicated to its "basic" use, while its different bodies (front, wings and tower) are characterized with specific technical solutions and plant engineering, to achieve specific environmental comfort and, more in general, Indoor Environmental Quality (IEQ) in close consideration of the different activities carried out in each. These specificities consist in the very careful characterization of the building envelope, in the fine tuning of the ratio between opaque and glazed surfaces in order to maximise the positive effects of natural lighting and natural ventilation, with integration of systems mechanical ventilation where necessary.

INDOOR ENVIRONMENTAL QUALITY MEASUREMENTS

In order to assess the Indoor Environmental Quality (IEQ) of the building, seasonal measurements of temperature, relative humidity and air quality have been carried out throughout. Monitoring campaign took place in summer, autumn, and winter[2]. A direct measurement method was used, recurring to specific instrumental analysis techniques, carried out during several days of inspections, and by integrating the collected information with data provided by the "Regional Environmental Protection Agency" (ARPA) of the Lazio Region referred to the same days. Comfort values assumed are:

- a temperature of 20°C in the winter season and of 26°C in the summer season, with a deviation of ± 1°C;
- a relative humidity of 50% with a deviation of ± 5% in both seasons.

The set of pollutants monitored to assess Indoor Air Quality (IAQ) allow us to describe both indoor and outdoor air quality. Table 1 shows a breakdown of air quality classes according to the concentration values of the pollutants.

Classes	CO_2 [ppm]	TVOC [ppm]	PM_{10} [µg/m^3]
Hazardous	1,501 ÷ 5,000	0.431 ÷ 3000	141 ÷ 750
Unhealthy	1,001 ÷ 1,500	0.262 ÷ 0.430	91 ÷ 140
Moderate	601 ÷ 1,000	0.088 ÷ 0.261	31 ÷ 90
Good	340 ÷ 600	0.000 ÷ 0.087	0 ÷ 30

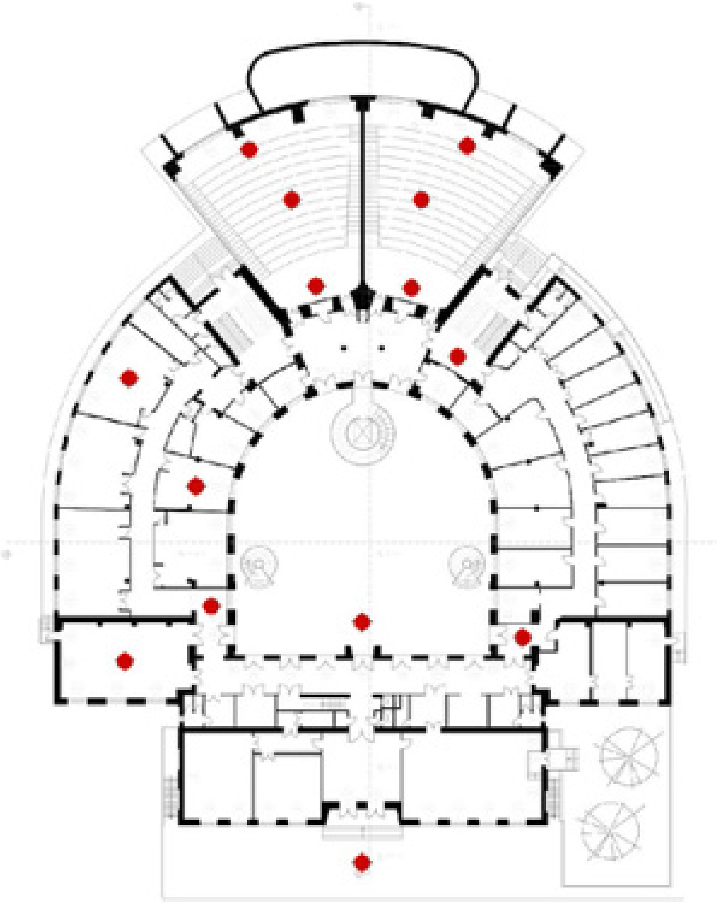
Table 1 - Concentration values of pollutants and classification of air quality (© Mancini 2020)

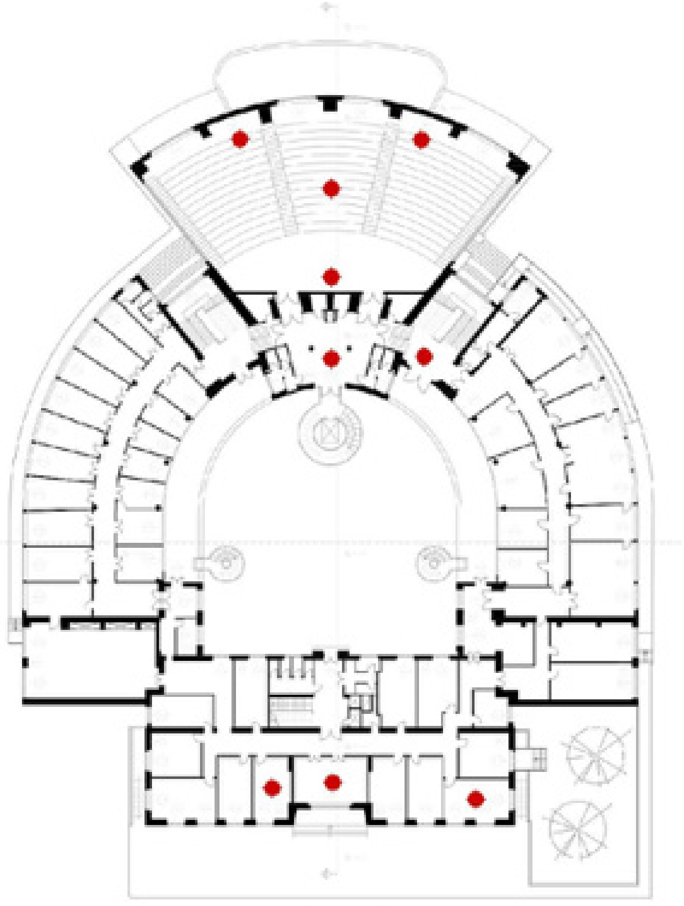
THE PROTOCOL

As monitoring of IAQ is the goal of this part of the research, hourly average values were collected by carrying out samples of short duration, 30 minutes each. The reference timing was fixed from 10 am to 4 pm. During the reference period, sampling of the monitored parameters (VOC, PM10, CO2) was carried out with closed windows and by positioning the samplers in the centre of the room at a height of 150 centimetres for a 30-minute time lapse. All probes for thermo-hygrometric characterization have been fixed at a height of 100 centimetres from the floor; the equipment used to determine IAQ parameters has been positioned at a height corresponding to the average height of human upper respiratory tract, for the entire duration of the sampling. In order to identify the contribution of the external environment to the indoor concentration levels of monitored pollutants, measurements of the same pollutants have been carried out almost simultaneously in order to acquire information about the extent of the external contribution.

Concerning the front block, specific attention has been paid to the library, aiming at a closer investigation of levels of pollution with respect to human perception but also of the prestigious book collections stored on open air bookshelves, in the book deposit and in adjacent rooms. In addition to the central part of the library reading hall, monitoring therefore took place at different heights- 210 / 420 / 630 centimetres from the pavement- starting from the entrance and in correspondence of the bookshelves; the offices and study rooms adjacent to the main reading hall of the library have also been analysed.

Concerning the curved wings, one among the many classrooms has been chosen in the east curved wing at the ground floor to monitor the situation of pollutants. Concerning the tower of classrooms, measurements have been concentrated in the tiered lecture halls I, III, V at the three different levels of this building; in this case, the significant difference in height of each hall - 420 meters distance between the first seat and the last step- has required many different measurements within the same rooms.


Ground floor plan


First floor plan

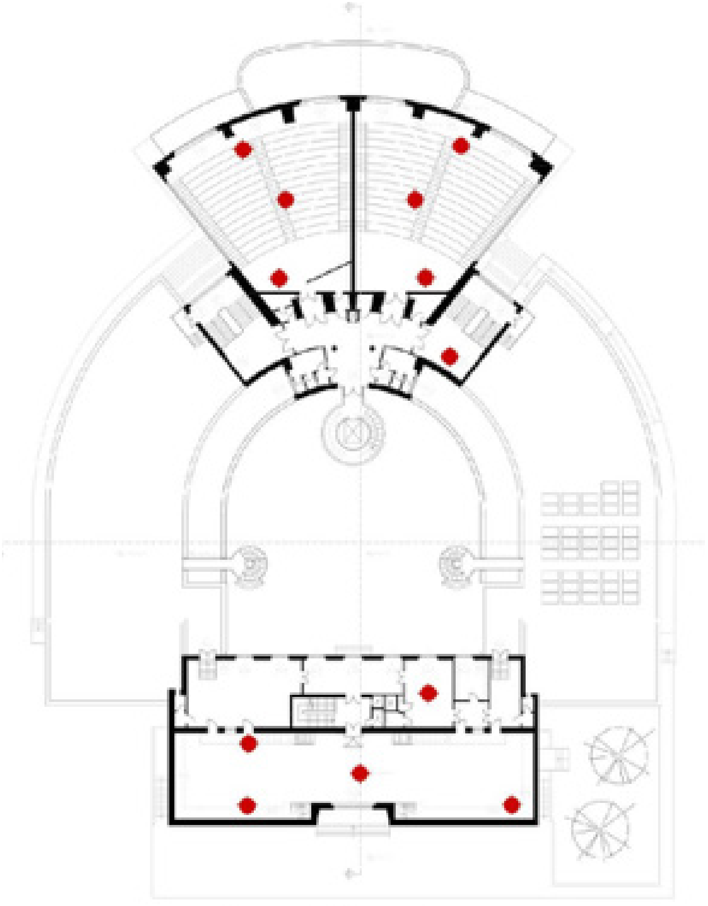

Second floor plan

Figure 34 - Positioning of measuring points for IAQ sampling at the three levels of the building (© Mancini, Romano 2020)

OUTCOMES

Summer monitoring campaign has taken place in presence of very few students and teachers and/or in almost empty classrooms. The cooling system was generally off. No significant difference between indoor and outdoor values has been noticed. CO2 values, as well as VOCs measured indoor and outdoor indicate good quality levels (blue band of the graphs), while the PM10 values are at predominantly of moderate quality (green band). Overall, all three pollutants detected are in acceptable quality classes, both for human health and for the proper maintenance of the book collections conserved in the library. Conditions of thermo-hygrometric comfort are instead lacking in the rooms, as expected in absence of a suitable cooling system.

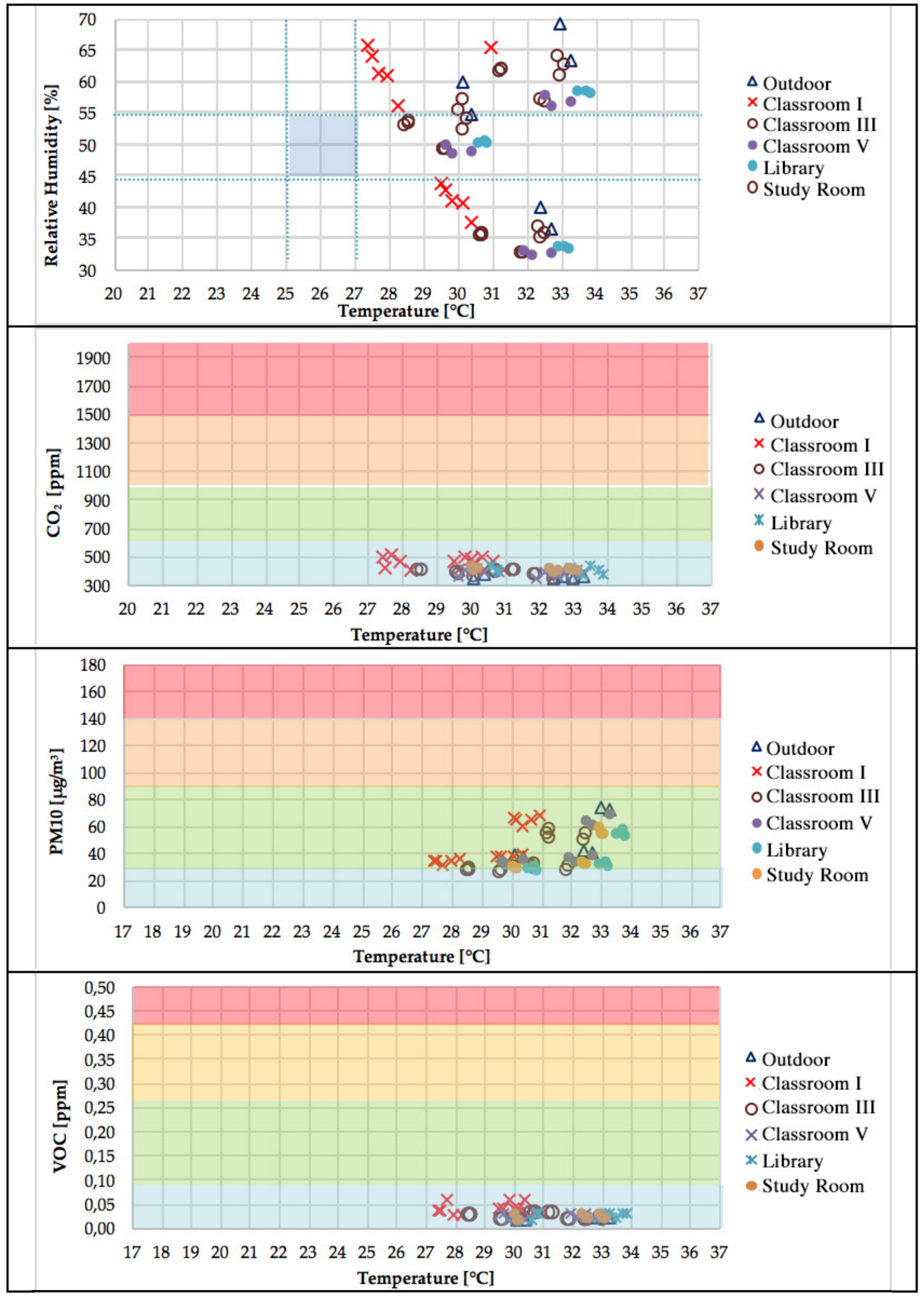


Table 2 - Results of measurements in the summer season (© Mancini, Romano 2020)

Autumn monitoring campaign has taken place as the air conditioning system was turned off and classrooms were half full, given the start of the academic year in the month of September. Also in this case, similar parameters emerged from the outdoor and indoor surveys. The CO2 values have been found halfway between good and moderate (blue-green band), PM10 values within the moderate values level (green band), while VOCs have been observed at a good level of quality (blue band). The parameters measured during the autumn season are slightly worse than in the summer, but still acceptable, and guarantee human health and the correct maintenance of the book collections. The expectations for the spring season are roughly the same, being the two seasons both of transition between summer and winter conditions.

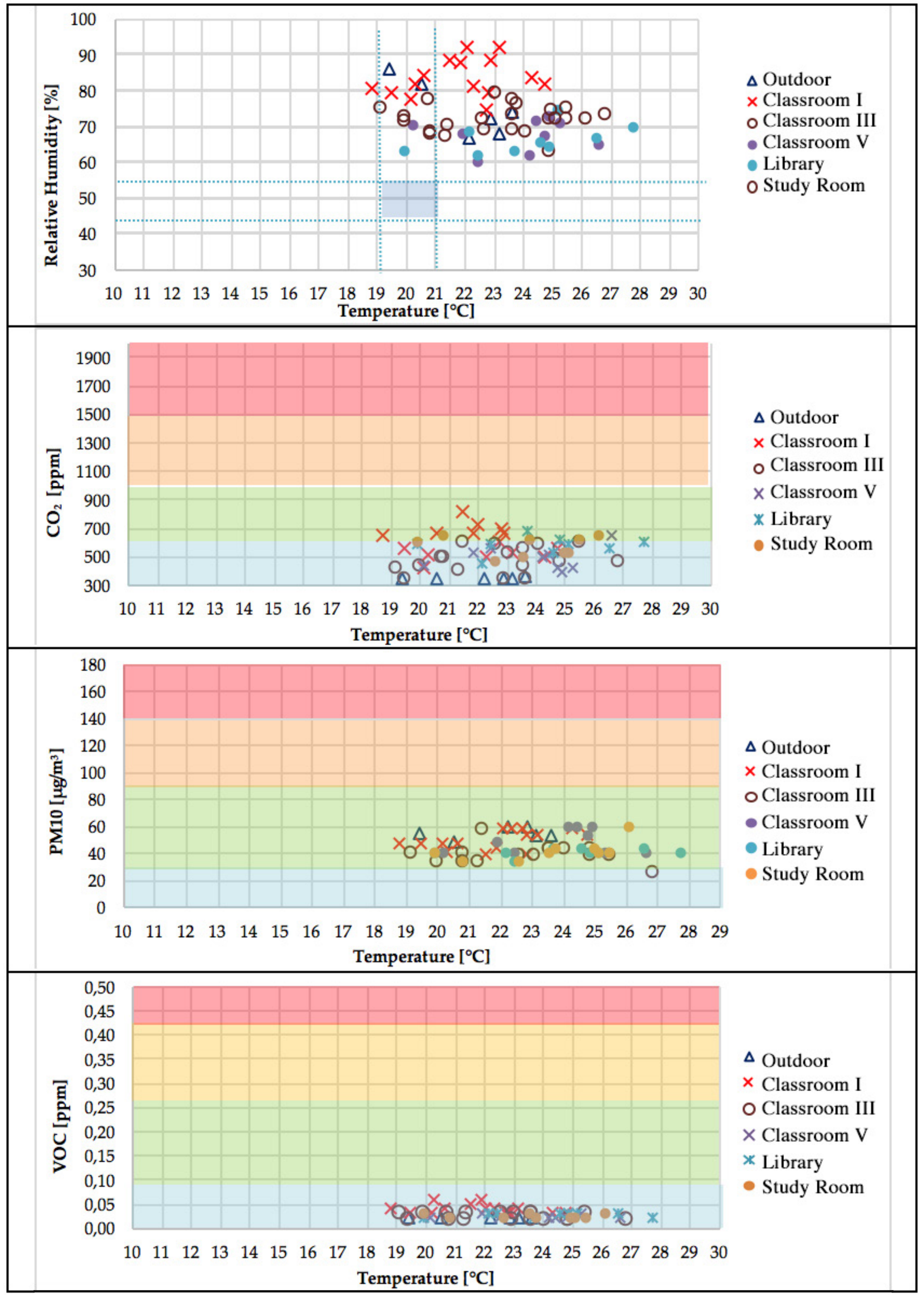


Table 3 - Results of measurements in the autumn season (© Mancini, Romano 2020)

The winter monitoring campaign has taken place as the air conditioning systems was on and the classrooms were half full. CO2 levels surveyed correspond to unhealthy quality class (orange band) in the study room, which was the only one full of students (80-90 people present during the monitoring campaign), while the quality resulted average good (blue-green band) in other environments. PM10 values fall between moderate and unhealthy levels for all environments (green-orange band), while VOC levels fall once again in the good range (blue band of the graph).

It is closer to the conditions of thermo-hygrometric comfort in all rooms, except for the library, where the conditions are acceptable. In general, the slight deterioration of the quality classes of the pollutants detected in this period of the year- which in any case remains at acceptable levels – may be explained with the fact that more people were present in the rooms, the windows were closed, and the air conditioning system was switched on.

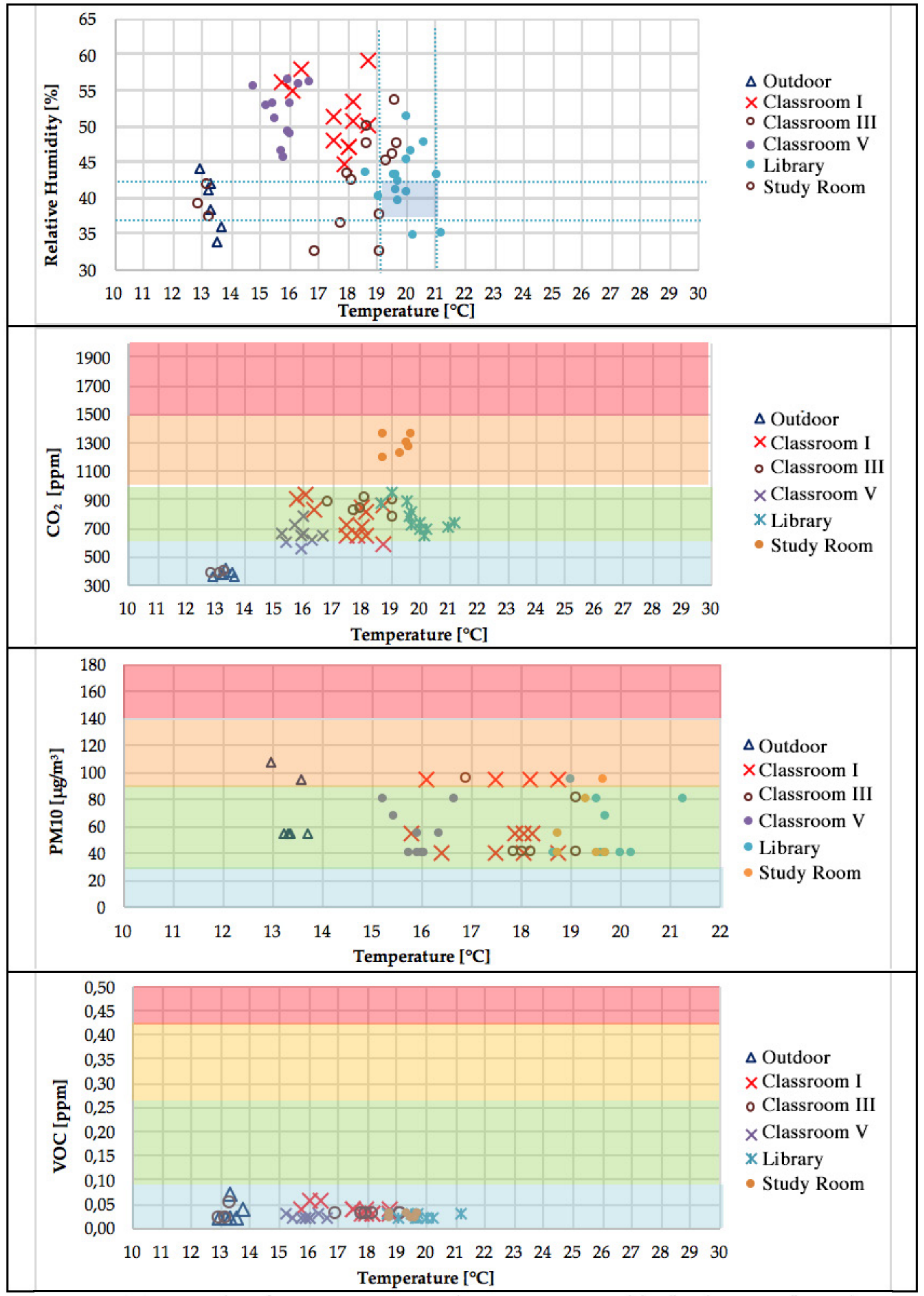


Table 4 - Results of measurements in the winter season (© Mancini, Romano 2020)

ENERGY PERFORMANCE CERTIFICATION

Energy Performance Certification (APE) is a document required by the Italian law that provides a framework of information about the energy performance of the building envelope and of its installations. To this kind of certification is tied much of the late tax credit in case of building requalification- which is granted only if the work guarantees improvement of two grades of energy performance. Requalification works supported with a tax credit system guaranteed by the State have received enormous impulse after the pandemic, as European financing system is based on climate change, sustainability and energy sparing, which explains the overall importance of this certification in Italy, today. Beyond this, Energy certification, described as follows, represents the Italian official system of measuring buildings' energy performance[3].

Current Italian legislation (Inter-Ministerial Decree of 26 June 2015, adaptation of national guidelines for the Energy Certification of Buildings) provides for the calculation of energy performance in buildings, the use of national technical standards UNI/TS 11300. These standards define the procedures for the Italian application of UNI EN ISO 13790:2008 and are aimed at all possible applications herby envisaged: design rating, energy assessment of buildings through the calculation of standard conditions (asset rating) or in specific climatic and operating conditions (tailored rating).
The School of Mathematics has therefore been analysed in its entirety, but also according to 4 thermal zones- front building / curved wing east / curved wing west / tower of Classrooms- to investigate the energy performance of each in detail, in respect of Article 6 of Legislative Decree 192/2005. Energy services considered in the evaluation of the energy performance of the building are:

- winter air conditioning;
- production of domestic hot water (DHW);
- lighting and transport of people or things.

The intended use of the building corresponds to "E.7-School buildings of all levels and similar", (i.e. primary, secondary, high schools and universities) according to Presidential Decree 412/93. More specifically, the calculation of the energy performance of the building allows to determine:

- global non-renewable energy performance index EPgl,nren, which determines the energy class of the building (alphabetical indicator for classes G-F-E-D-C-B-A1-A2-A3-A4, where the letter G represents the highest consumption class and, therefore, the worst energy performance) obtained in comparison to a reference building (identical in terms of location and geometry, but equipped with standard walls and systems);
- energy performance index (winter and summer) of the building envelope as a ratio between the useful needs (winter and summer) and the distribution of the building.

A synthesis of the elements analysed and the results obtained within each block is found in the next pages.

ENERGY PERFORMANCE CERTIFICATION IN THE CURRENT CONDITION

Front building

To simulate energy behaviour of the building envelope of the front building implemented with dedicated software, reference has been made to the results of the investigations carried out by contextual research - dedicated to historical matter, structural understanding, construction techniques, study of functions and uses over time and to value assessment- and to information collected during inspections. Listing of opaque structures includes floors, which have been modeled as brick-concrete elements of variable thickness, between 35 and 40 cm, and perimeter walls, which have been modelled as tuff blocks alternating with parallel rows of red bricks, plastered with lime mortar, with the exception of the main and rear façade, which are cladded with travertine slabs and Litoceramics, with an overall thickness of about 80 cm. Transparent surfaces are all single glazed, mostly windows with wooden frames, resting on travertine sills and without solar shading systems.

Energy services considered in the calculation of the energy performance of this part of the building are winter air conditioning, production of domestic hot water (DHW), lighting and transport of people or things.

The heating system of these spaces is connected to the university campus district heating network, through a secondary branch starting from a substation which reaches a technical room from which the backbones branch off through a distribution manifold and heat exchangers. Distribution boxes are housed in the basement near the block. The production of domestic hot water (DHW) for the toilets is produced locally using local electric boilers. Lighting fixtures in this part of the building are equipped with tubular fluorescent lighting lamps with an average diameter of 38 mm while the transport of people or things is entrusted to an electric lift, whose motor is at the top of the shaft, with automatic scrolling cabin doors.

In light of the information acquired the calculation of the energy performance of the front building, at present, has resulted in a non-renewable global energy performance index EPgl,nren = 87.6 kWh/m2 year, thanks to which the energy class of the building has been defined as corresponding to the E class. The winter energy performance index is of low quality, while the summer performance is of medium quality, based on the analysis of the parameters described above.

Curved wings

For the simulation of the energy behaviour of the building envelope of the curved wings implemented with dedicated software, reference has been made to the results of the investigations carried out by Tasks 1-3-4-6, and to the information collected during the inspections. Listing of opaque structures is not different from the Front building.

Transparent surfaces are all single glazed, with aluminium or iron window frames except for the first floor where they are double-glazed with aluminium frames, resting on travertine sills and with solar shading consisting of Venetian blinds placed inside classrooms and offices. The energy services considered in the calculation of the energy performance of the building are winter air conditioning, production of domestic hot water (DHW), lighting and transport of people or things.

The heating system of these spaces is connected to the university campus district heating network, through a secondary branch that starts from a substation, and arrives in a technical room from which the backbones branch off through a distribution manifold and heat exchangers. Distribution boxes are housed in the basement near the block. The production of domestic hot water (DHW) for the toilets is produced locally using local electric boilers.

In light of the information acquired, the calculation of the energy performance of the Curved wings C1 and C2, at present, has resulted in a non-renewable global energy performance index EPgl,nren = 141,8 kWh/m2 year, thanks to which the energy class of the building has been defined as corresponding to Figure 35.

Tower of classrooms

For the simulation of the energy behaviour of the building envelope of the Tower of classrooms implemented with dedicated software, reference has been made to the results of the investigations carried out by Tasks 1-3-4-6, and to the information collected during the inspections. Listing of opaque structures is not different from the Front building. Transparent surfaces are all single glazed, with aluminium or iron window frames, resting on travertine sills and with solar shading consisting of fabric curtains placed inside the classrooms.

The energy services considered in the calculation of the energy performance of the building are winter air conditioning, production of domestic hot water (DHW), lighting and transport of people or things. The heating system of these spaces is connected to the university campus district heating network, through a secondary branch that starts from a substation, and arrives in a technical room from which the backbones branch off through a distribution manifold and heat exchangers. Distribution boxes are housed in the basement near the block. The production of domestic hot water (DHW) for the toilets is produced locally using local electric boilers.

In light of the information acquired, the calculation of the energy performance of the Tower of classrooms B, at present, has resulted in a non-renewable global energy performance index EPgl,nren = 123,7 kWh/m2 year, thanks to which the energy class of the building has been defined as corresponding to F class. Both the winter energy performance index and the summer performance index are of low quality.

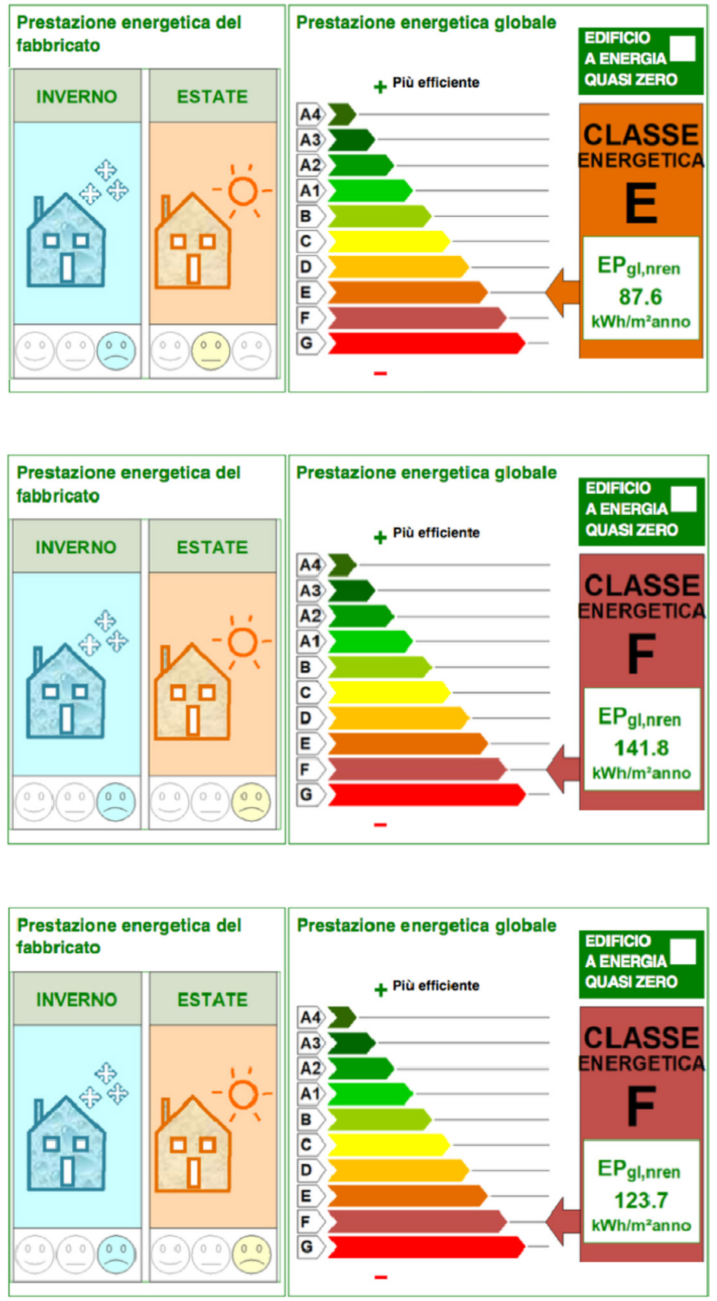


Figure 35 a/c - Energy Performance Certification of the front building, curved wings and tower of classrooms in the current condition (© Mancini, Romano, Rosso 2020)

CONSIDERATIONS ABOUT THE GLAZED SURFACES

The common feature of all the window fixtures in the building, and especially in the front body, consists in having a single glass, including the huge window of the library facing north, which was once decorated with stained-glass and today carries plain white transparent glazing. The state of conservation of the window fixtures is not good, in general, especially in the case of the wooden window frames. Therefore, replacement of single glazing with new double-glazing- and in some cases of the entire window fixture, including frames- would significantly increase the comfort of the interiors, but would affect the overall value of the building as these mostly authentic original pieces.

Assuming the historicity of these elements as a prevailing instance, especially in regards of the main window of the library, focusing on more conservative interventions, such as the insertion of air curtains or the integration of a double frame on the existing one appears to be necessary.

Concerning the curved wings, recently replaced glazing, installed in a disorderly manner and without any coordination, clearly disfigure the façades of the building.

Instead, in the tower of classrooms, the ventilation system is to date insufficient to ensure a complete air exchange of the tiered lecture halls, and its regulation according to the presence of students. However, since the halls are wide and spacious and have large single-glazed windows on the sides, no discomfort situations have been detected according to the measurements performed by this research. Nevertheless, the design of a new air conditioning system would help to significantly improve the internal conditions.

ENERGY PERFORMANCE CERTIFICATION ACCORDING TO REQUALIFICATION HYPOTHESIS

Front building

To identify which are the most effective strategies for improving the energy behaviour of each block, a further simulation has been made recurring to the software used for Energy performance Certification, simulating a post requalification situation. Keeping the opaque elements of the building envelope unchanged, the situation after replacement of the existing window fixtures, with thermal-break, open joint and low-emission double glazing and solar shading systems, but maintaining the original frame where possible, is simulated. In the case of the main window, where the preservation of the original window frame is undisputed, the insertion of a glazed counter wall with a PVC frame may be a possible solution.

Energy services considered in the calculation of the energy performance of the fornt building are winter air conditioning, production of domestic hot water (DHW), lighting and lifting of people or things. As far as the heating system is concerned, the building remains connected to the university campus district heating network, while high-efficiency silenced heat pumps are proposed to generate heat, which also allow almost costless production of domestic hot water (DHW) for the toilets. Furthermore, about the distribution subsystem, the installation of thermostatic valves coupled to electronic thermostatic heads is proposed for each heating radiator, to regulate the inflow of hot water according to the temperature of each room.

Concerning the electrical system, the implementation of the existing photovoltaic system placed on the roof is suggested, being this the only way to acquire adequate energy performance; yet, the current PI system displayed on the roof top is not sufficient to gain a substantial increase of the energy class, and is aesthetically disturbing considering the view of the rooftops from other buildings.

Concerning the lighting system, the replacement of bulbs with energy-saving LED elements is proposed and the insertion of timers for automatic switch-off of lights at pre-set times, differentiated by areas, while the lifting of people or things remain unvaried.
Considering the proposed requalification solutions for the front building, the calculation of energy performance results in a non-renewable global energy performance index EPgl,nren = 74.8 kWh/m2 year, thanks to which the energy class could increase to level A1, significantly higher than the initial one. The winter energy performance index is of high quality, while that of the summer performance remains of medium quality, based on the analysis of the parameters described above.

East and west curved wings

As in the previous case, opaque elements of the building envelope remain unchanged, while the replacement of the existing window fixtures, with thermal-break, open joint and low-emission double glazing and solar shading systems, but maintaining the original frame where possible, is simulated.

Energy services considered in the calculation of the energy performance of these buildings are winter air conditioning, production of domestic hot water (DHW), lighting and lifting of people and things.
As far as the heating system is concerned, the building remains connected to the university campus district heating network, while high-efficiency silenced heat pumps are proposed to generate heat, which also allow almost costless production of domestic hot water (DHW) for the toilets. Furthermore, about the distribution subsystem, the installation of thermostatic valves coupled to electronic thermostatic heads is proposed for each heating radiator, to regulate the inflow of hot water according to the temperature of each room.

Similar measures as in the previous case may be adopted for the electrical system, bulbs and timers for the automatic switch-off of the lights at pre-set times differentiated by areas.

Considering the proposed requalification solutions for the front building, the calculation of energy performance results in a non-renewable global energy performance index EPgl,nren = 57,3 kWh/m2 year, thanks to which the energy class could increase to level C, which is higher than the initial one. The winter energy performance index is of high quality, while that of the summer performance remains of medium quality.

Tower of classrooms

As in the case of the front building, the opaque elements of the building envelope remain unchanged, while replacement of existing window fixtures should be considered with due attention, as in the previous case. Same considerations are referred to the heating and electrical system, and to the installation of energy sparing devices.

Considering the proposed requalification solutions for the front building, the calculation of energy performance results in a non-renewable global energy performance index EPgl,nren = 74.8 kWh/m2 year, thanks to which the energy class of the building as corresponding to level C, higher than the initial one but lower than the front building. A due to summer air conditioning and the share of renewable energy sources from which it is served. Both the winter energy performance index and the summer performance index are of high quality, based on the analysis of the parameters described above.

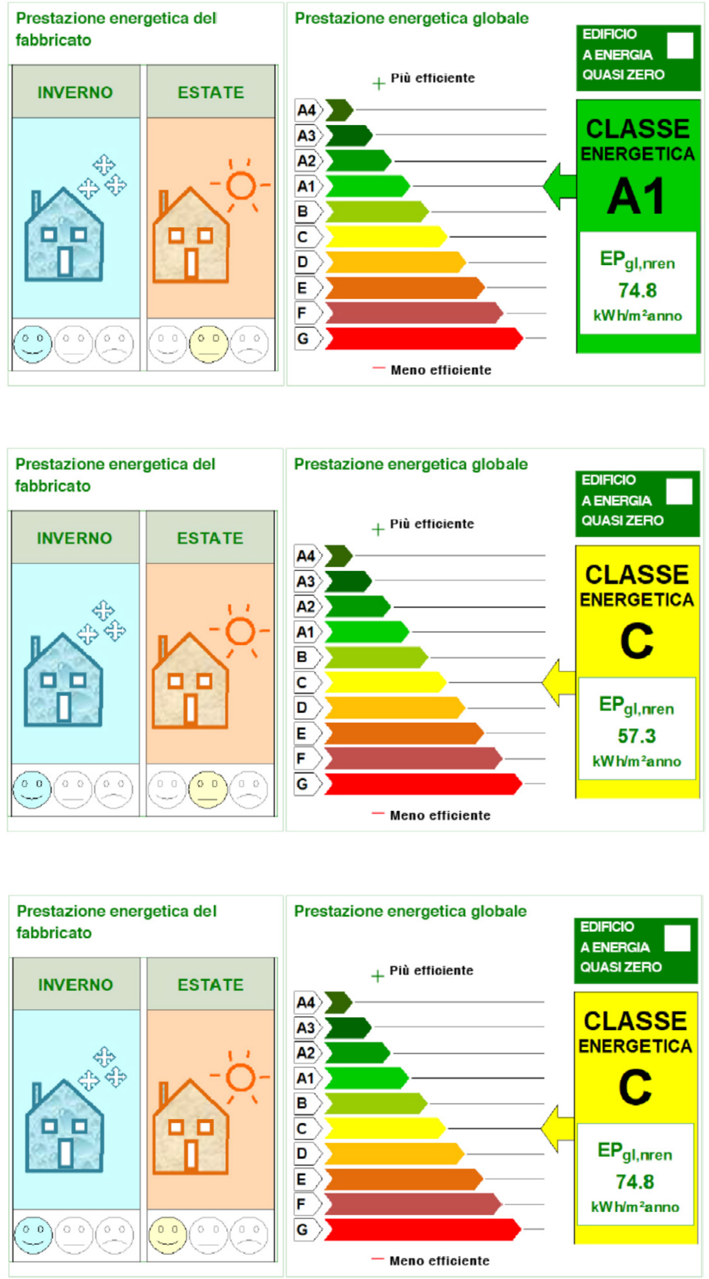


Figure 36 a/c - Energy Performance of the front building, curved wings and tower of classrooms after requalification (© Mancini, Rosso, Romano 2020)

Further interventions following the simulation of energy requalification, assessments and analyses carried out may consist in:

Conservation and improvement of the building envelope:

a. No specific intervention on the masonry structures, except for periodic maintenance;
b. Implementation of (internal) mitigation systems for window frames belonging to those environments where it is necessary to improve the microclimate;
c. Replacement of mechanical window opening systems where necessary;
d. More specifically, as the main window in the library is imbued with historical value, it is advisable to:
   i. add an internal glazed counter-wall with PVC frame;
   ii. replace glass only, leaving the original frame;
   iii. insert an air destratifier.

Improvement of the air conditioning systems:

a. Front Building:
   iv. Installation of thermostatic valves on all radiators;
   v. Library: creation of a horizontal barrier to limit rising air currents in the central area of the reading tables during the winter season;
b. Curved Wings:
   vi. Installation of thermostatic valves on all radiators;
   vii. Study rooms: replacement of current systems serving individual rooms with a centralised heating/cooling system.
c. Tower of Classrooms:
   viii. Installation of thermostatic valves on all radiators;
   ix. Tiered lecture halls: requalification of the original thermo-ventilation system, especially taking into account its historical value;

Improvement of electrical system:

a. implementation of PV systems to support the existing electrical system;
b. scheduled replacement of bulbs with LED lamps;
c. insertion of timers for automatic switching-off of lights according to pre-established times and functions differentiated for external areas, common areas such as corridors, lobbies and classrooms.

NOTES

1. The book deposit, which is adjacent and in special continuity with reading hall, stores books of minor and major value; yet, the ancient book collection, with pieces dating back to the XV century, has been moved to another room of the library, closed and with a separate management for safety and security reasons.
2. Survey during spring was not possible due to the pandemic, which has precluded access to the campus for months.
3. This explains why the sheets hereby presented in this study report measurements and outcomes in Italian, as they have been processed with official software approved by the Italian government.

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MAPPING A MOVING HERITAGE: CHAIRS, ARMCHAIRS, DESKS, TABLES

Flaminia Bardati, Chiara Turco

The story of the building and the individual stories of many pieces show that furniture and doors of such an interesting and important building as the School of Mathematics should be considered historical heritage to be preserved.

One of the furniture's prominent characteristics is that is a "moving" heritage. Of course, doors move less easily than furnishings, but during the main transformations they are subject to replacement, alterations, delocalisation, or are simply turned to change the sense of the opening for functional reasons or for compliance to safety ruling. Instead, except for a few fixed elements of some of the classrooms, furnishings have been very easily moved. In fact, the Italian word for "furniture" is "*mobile*", which means something that "can be moved". Furniture of the School of Mathematics has been moved continuously, even nowadays in consequence to daily needs, such as a change in the professors' studios, a meeting in the reading room of the library etc.; but during the life of the building at least four critical happening are identified which have stimulated, encouraged or caused the relocation, and the loss of furnishing:

> 1943-1944: allied bombing of San Lorenzo (July 19 1943), which caused damage to various parts of the School of Mathematics, according to a report concerning the INDAM furniture, probably to be extended to other parts of the building, and following occupation of the building by the allied troops;
>
> 1968: student occupation of the university campus, during which desks, tables, chairs and blackboards from all the Institutes were used to erect barricades. It is most probable that much of the furnishings of the School of Mathematics shifted to other buildings on this occasion while pieces from the other buildings may have done vice versa.
>
> 1974: alteration of the curved wings, which caused the loss of almost all the furnishings of the drawing classrooms and the purchase of new furniture for the smaller classrooms obtained by their fragmentation.
>
> 1977: further student occupation of the university campus. The School of Mathematics is also occupied, and the furnishings may have been moved at least within the building, as shown in a picture of the atrium of the time with chairs and tables from other rooms, some original and other presumably of recent purchase. On this occasion, furnishings did not only leave the building, but was also moved in from other Institutes. In fact, we may not exclude that some elements currently present inside the School of Mathematics come from other Faculties, especially chairs and armchairs. But this aspect opens completely new research, extending the survey to every other building of the campus.

Such continuous moving of the furnishing pieces renders monitoring even more difficult, which means that preservation and conservation become a real hard task. The mapping offered in this document shows the current location of each piece of furniture compared to the original position, documented or hypothesized, when possible. This allows to critically consider whether the current situation respects the solution conceived by Ponti, or if the architect's idea has gone completely lost.

At the same time, mapping visualizes, and therefore helps to quantify, the loss of original pieces or, in other terms, how much historical fabric we are missing today. Last but not least, the mapping also highlights the presence of furniture pieces that remain unused - albeit in good conditions- as in the case of the items stocked in the basement or in some closets, waiting to be repaired, or removed.

As the issues concerning furnishings and doors are different, two different series of mappings have been produced.

Concerning the furniture, all the items listed in the catalogue are identified on the plans of the building, organized by levels and indicating:

> - the current location of the item, verified on site;
> - the original location of the item in 1935 (if possible).

The legend allows to identify any item, and links it to the furniture catalogue.
As for doors, all the items listed in the catalogue are identified on the plans of the building, organized by levels, indicating:

> - the current location, verified on site;
> - the original location in 1935 (if possible);
> - the doors removed between 1937 and today;
> - the doors transformed for compliance to safety standards.

The legend allows to identify any item and link it to the door catalogue.

Legend

- *Seats*
- *Table & Desks*
- *Lighting fixtures*
- *Leaning furnishings*
- *Suspended furnishings*
- *Footboards*
- *Exemple location*

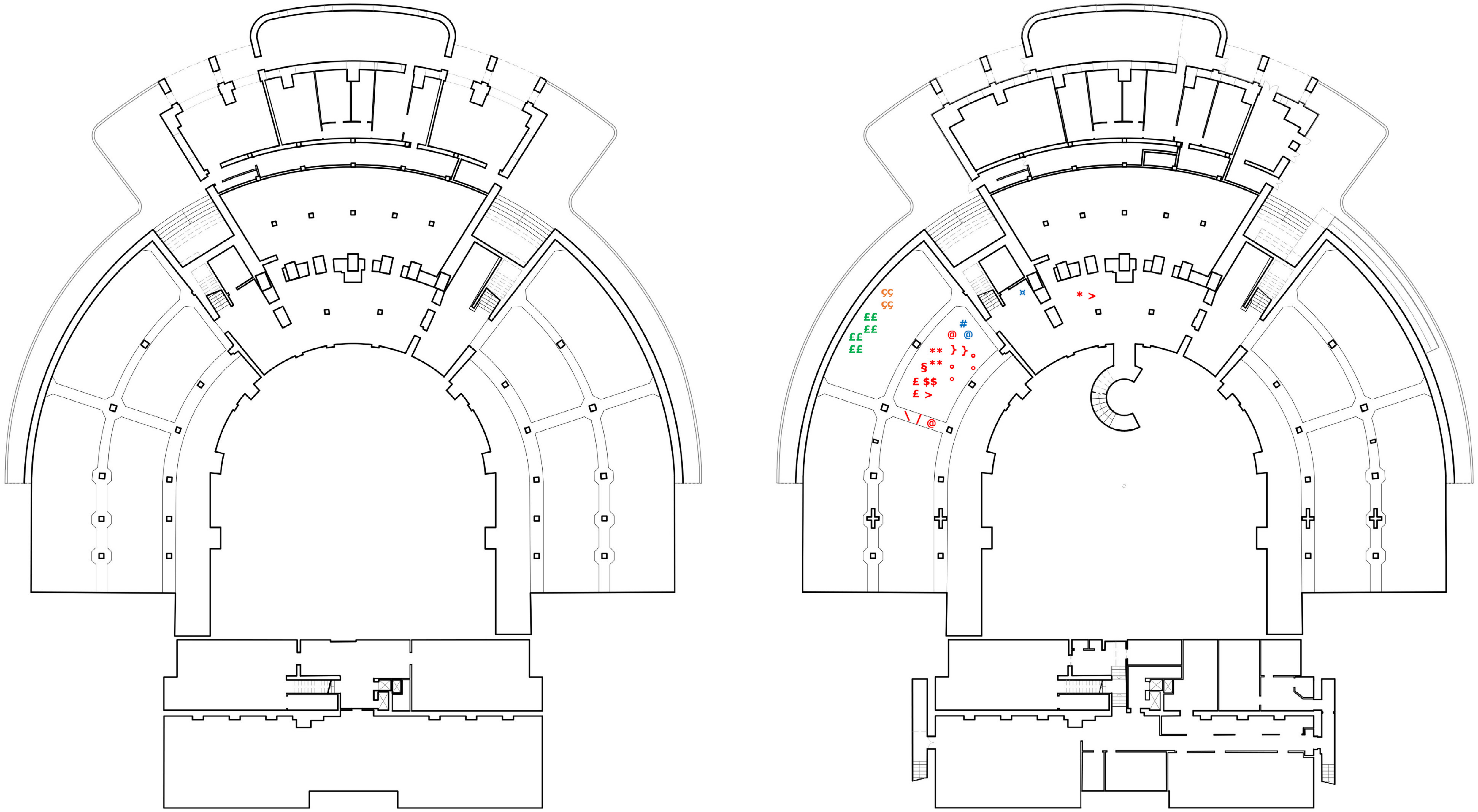


Figure 1 - Mapping of furniture in 1935 and 2021, at the basement level (© Bardati, Turco 2021)

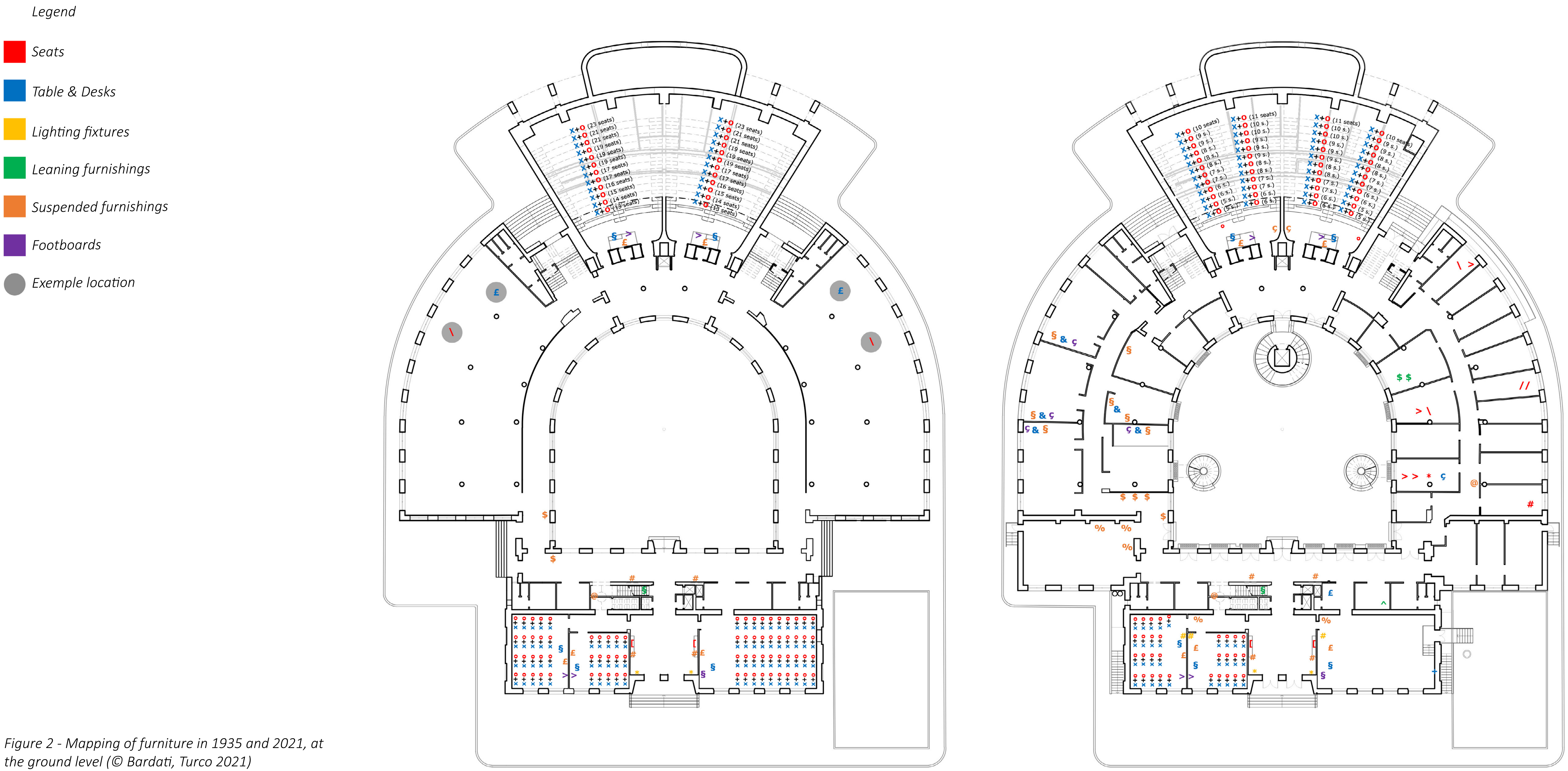


Figure 2 - Mapping of furniture in 1935 and 2021, at the ground level (© Bardati, Turco 2021)

Legend

Seats

Table & Desks

Lighting fixtures

Leaning furnishings

Suspended furnishings

Footboards

Exemple location

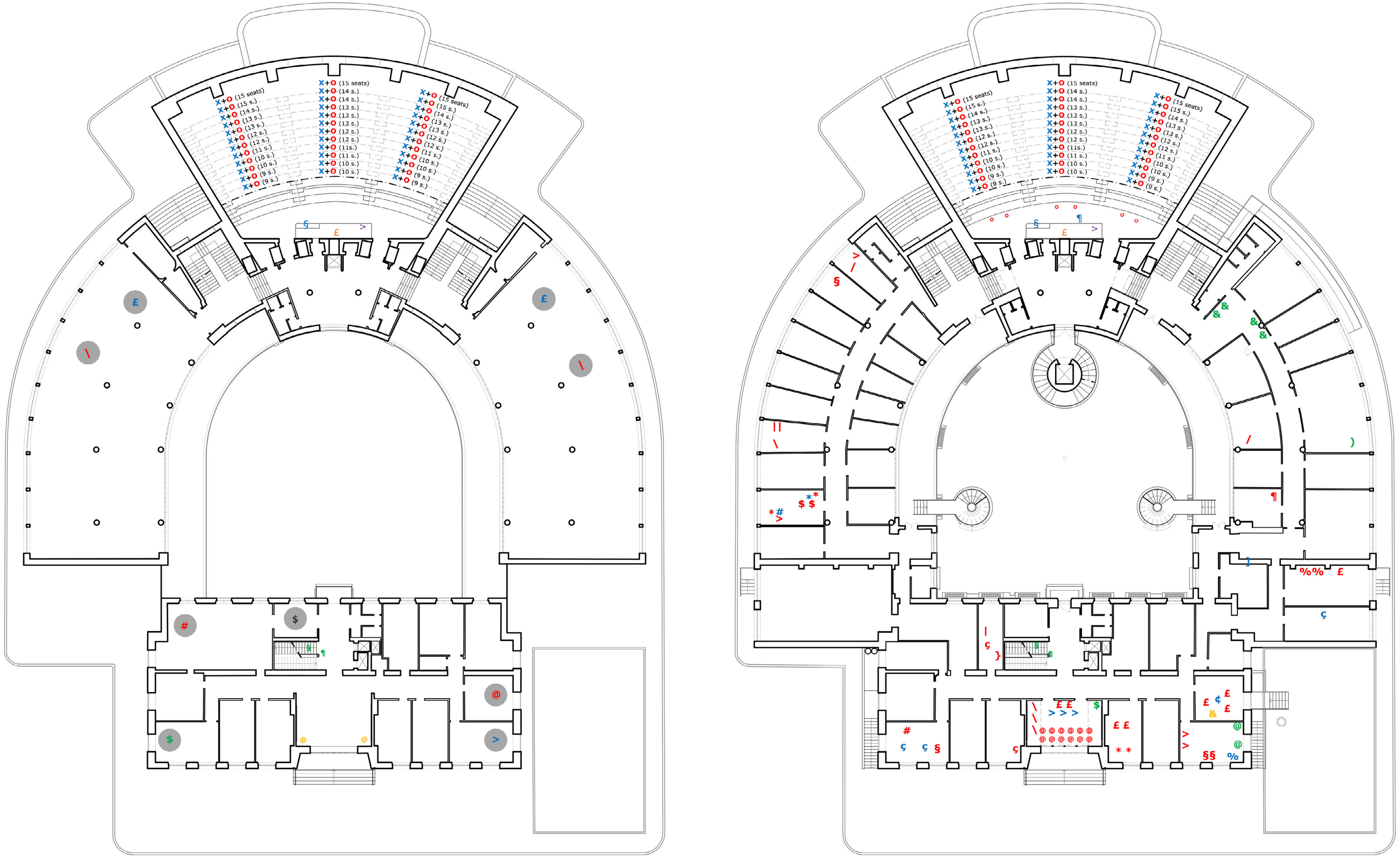


Figure 3 - Mapping of furniture in 1935 and 2021, at the first level (© Bardati, Turco 2021)

Legend

- *Seats*
- *Table & Desks*
- *Lighting fixtures*
- *Leaning furnishings*
- *Suspended furnishings*
- *Footboards*
- *Exemple location*

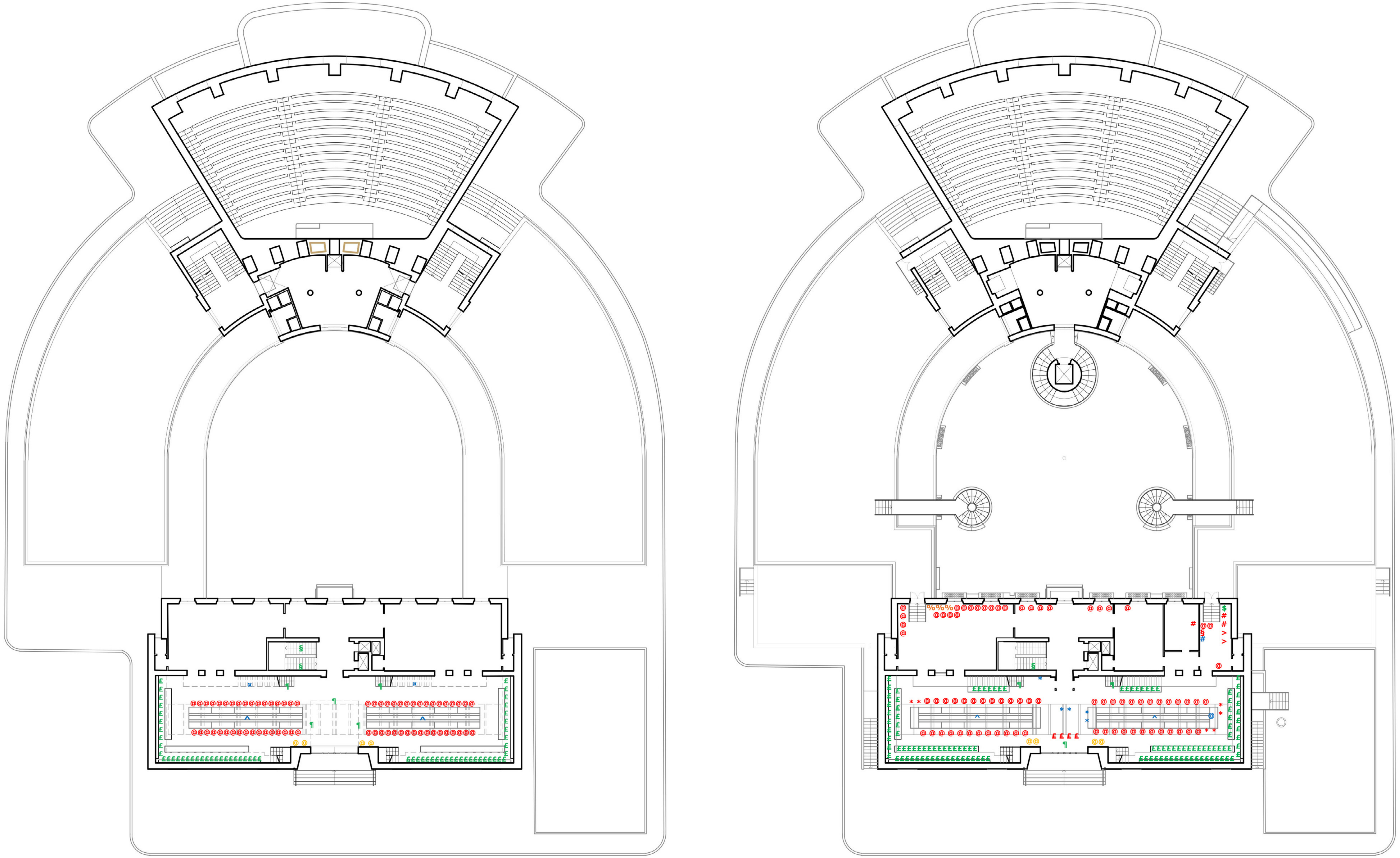


Figure 4 - Mapping of furniture in 1935 and 2021, at the second level (© Bardati, Turco 2021)

Legend

- *Seats*
- *Table & Desks*
- *Lighting fixtures*
- *Leaning furnishings*
- *Suspended furnishings*
- *Footboards*
- *Exemple location*

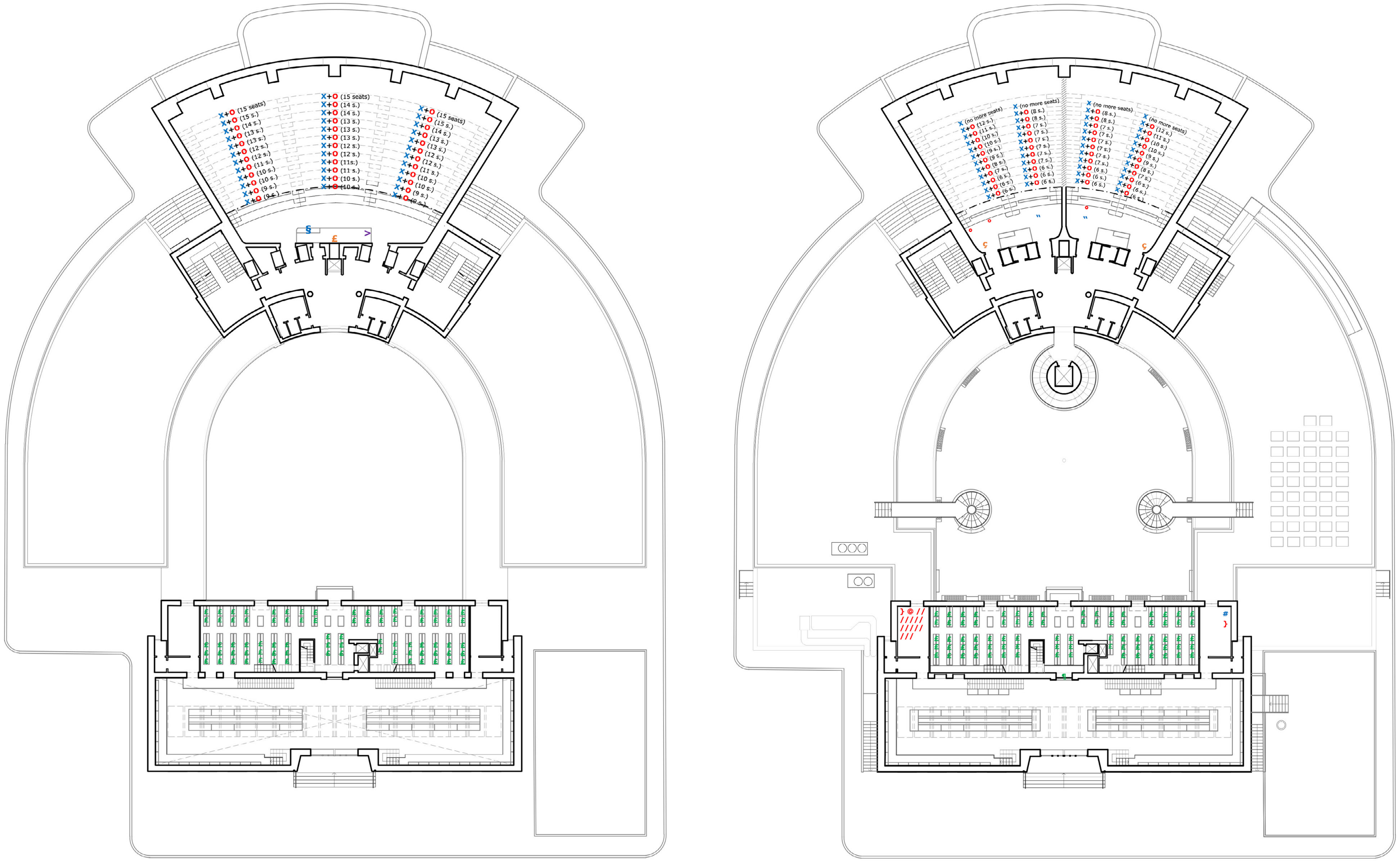


Figure 5 - Mapping of furniture in 1935 and 2021, at the third level (© Bardati, Turco 2021)

Legend

- *Seats*
- *Table & Desks*
- *Lighting fixtures*
- *Leaning furnishings*
- *Suspended furnishings*
- *Footboards*
- *Exemple location*

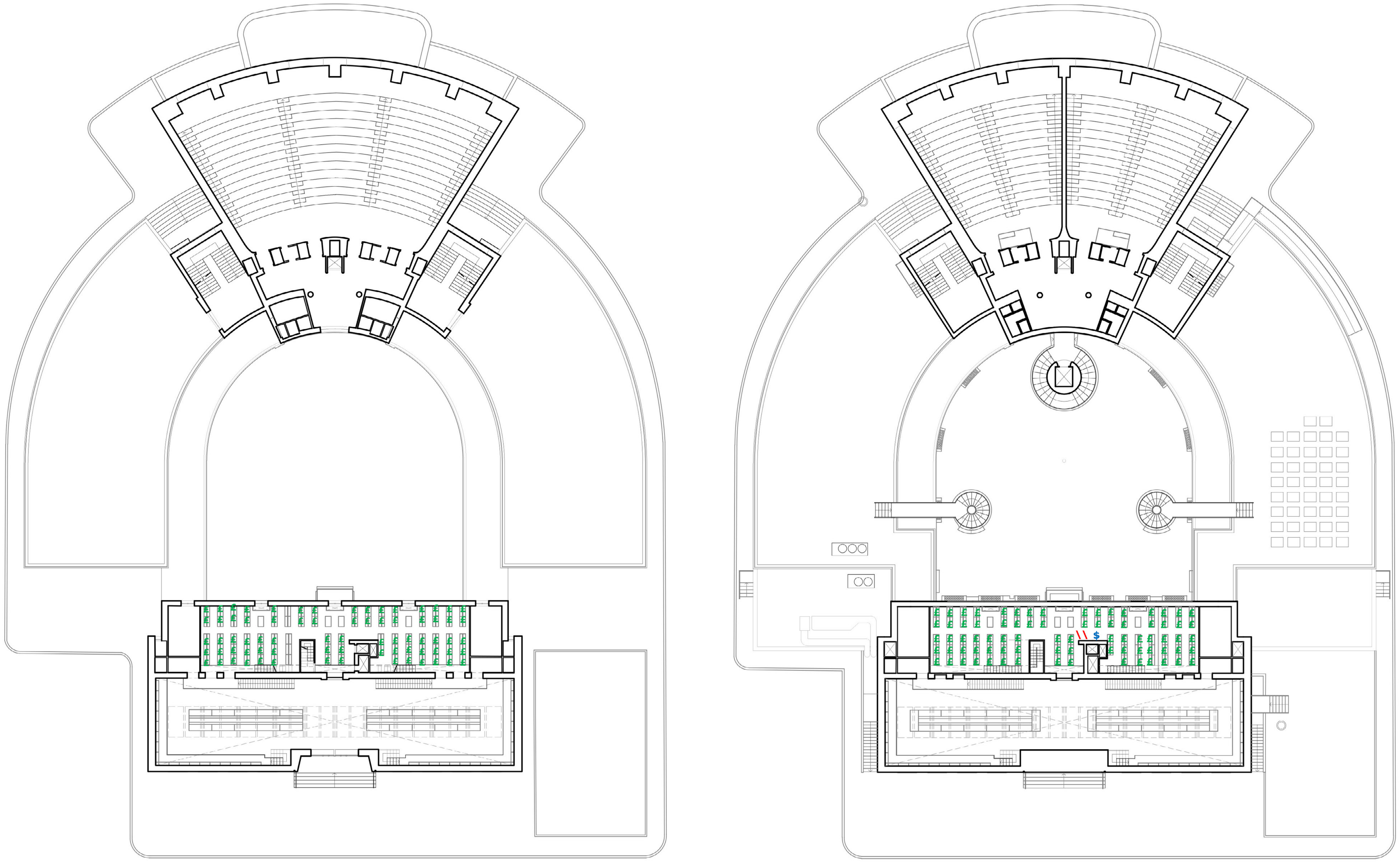


Figure 6 - Mapping of furniture in 1935 and 2021, at the fourth level (© Bardati, Turco 2021)

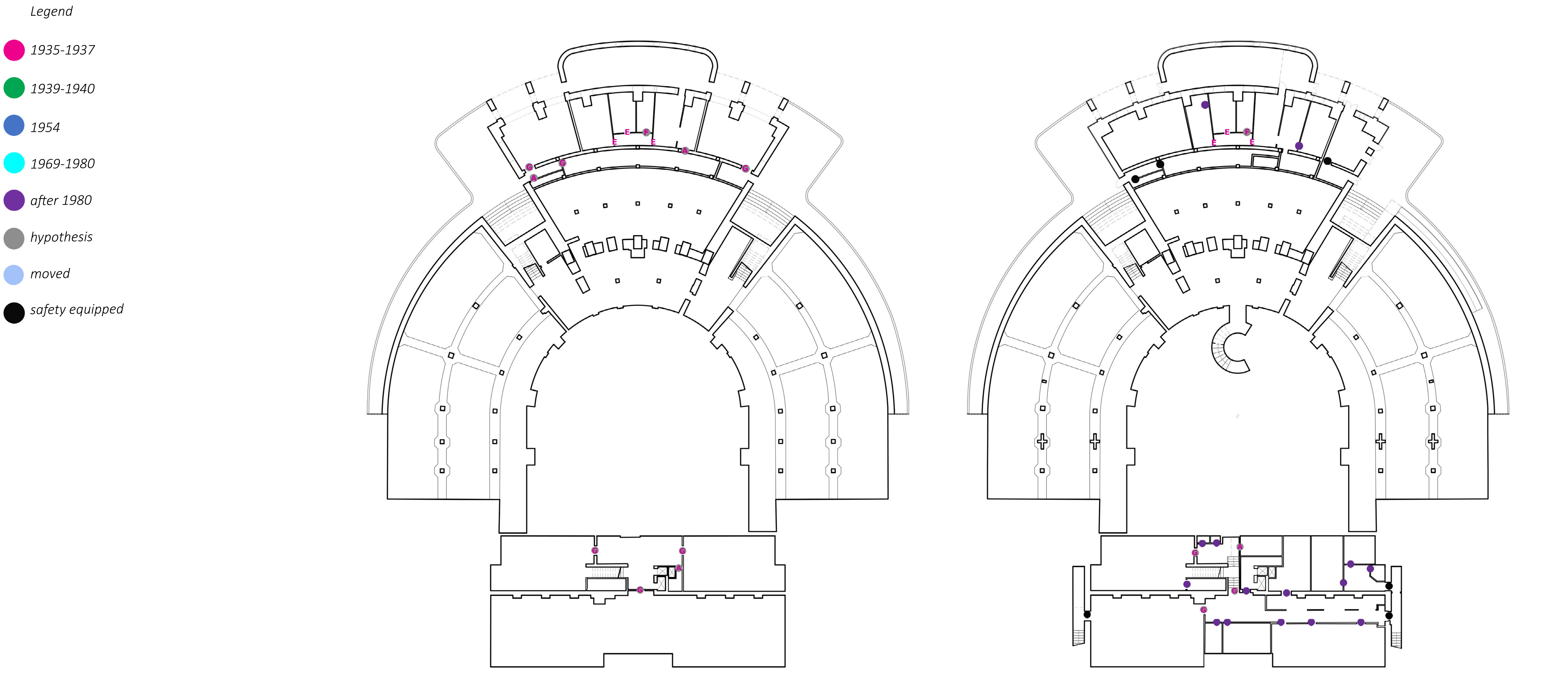


Figure 7 - Mapping of doors in 1935 and 2021, at the basement level (© Bardati, Turco 2021)

Legend

- *1935-1937*
- *1939-1940*
- *1954*
- *1969-1980*
- *after 1980*
- *hypothesis*
- *moved*
- *safety equipped*

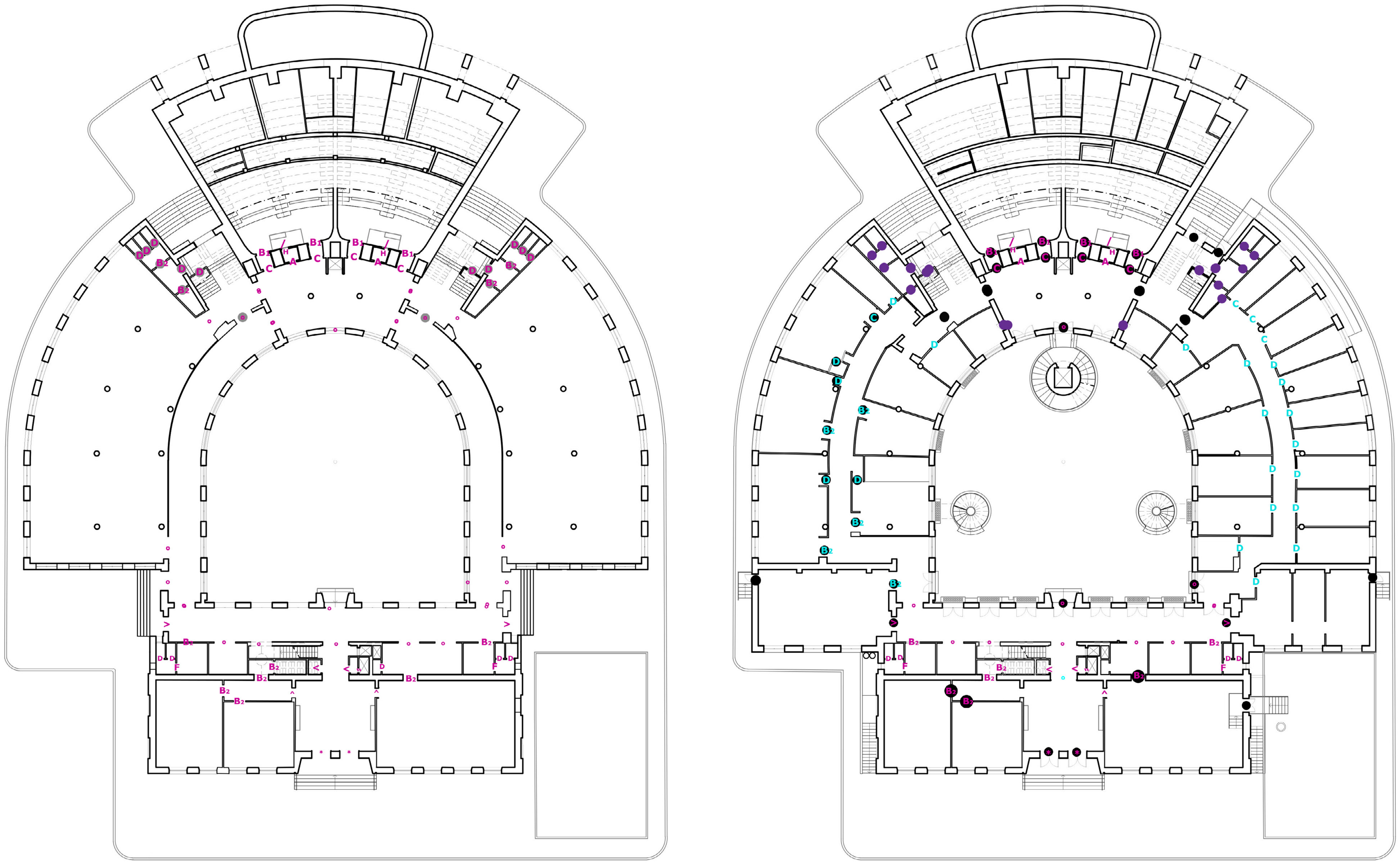


Figure 8 - Mapping of doors in 1935 and 2021, at the ground level (© Bardati, Turco 2021)

Legend

- *1935-1937*
- *1939-1940*
- *1954*
- *1969-1980*
- *after 1980*
- *hypothesis*
- *moved*
- *safety equipped*

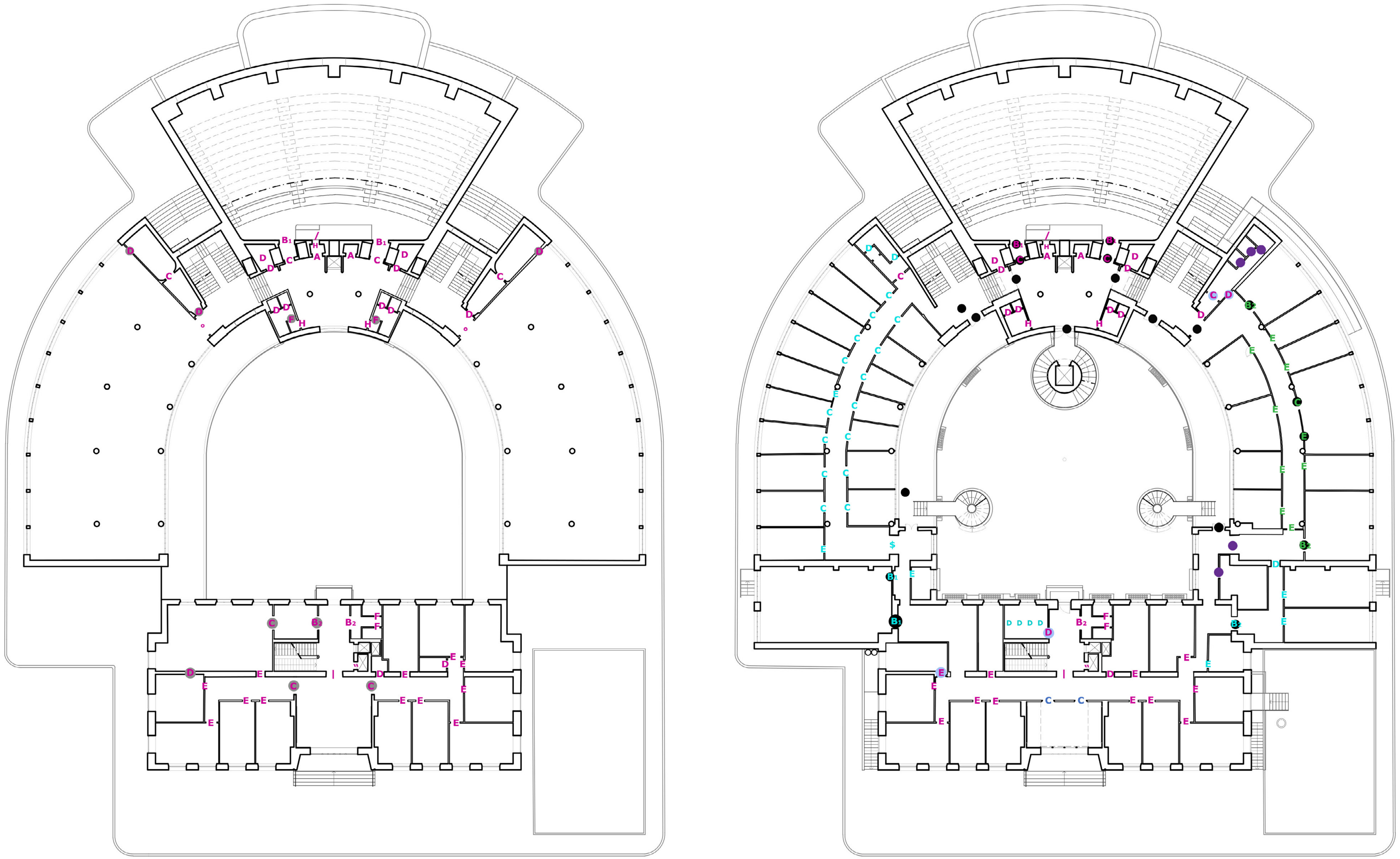


Figure 9 - Mapping of doors in 1935 and 2021, at the first level (© Bardati, Turco 2021)

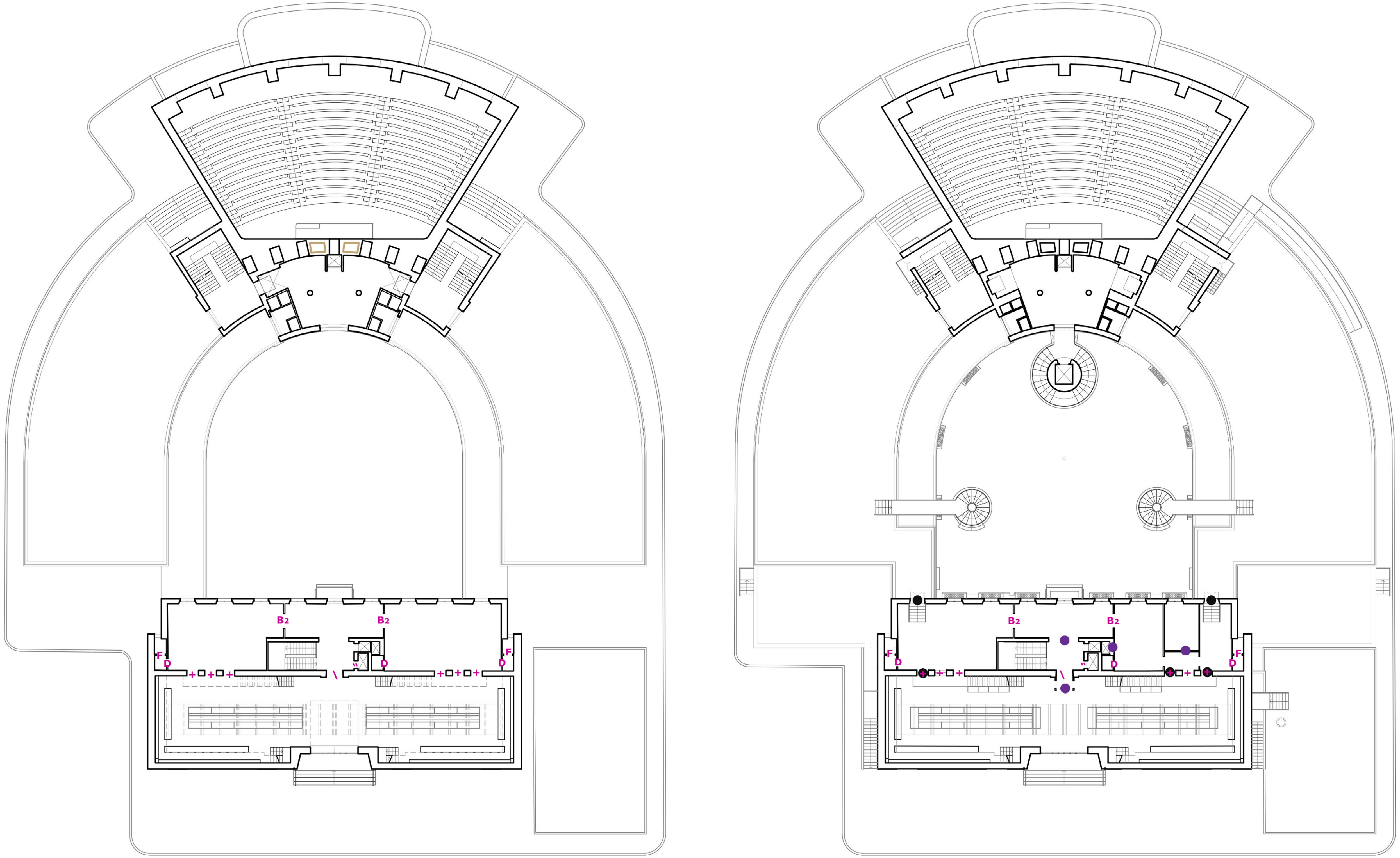


Figure 10 - Mapping of doors in 1935 and 2021, at the second level (© Bardati, Turco 2021)

Legend

- *1935-1937*
- *1939-1940*
- *1954*
- *1969-1980*
- *after 1980*
- *hypothesis*
- *moved*
- *safety equipped*

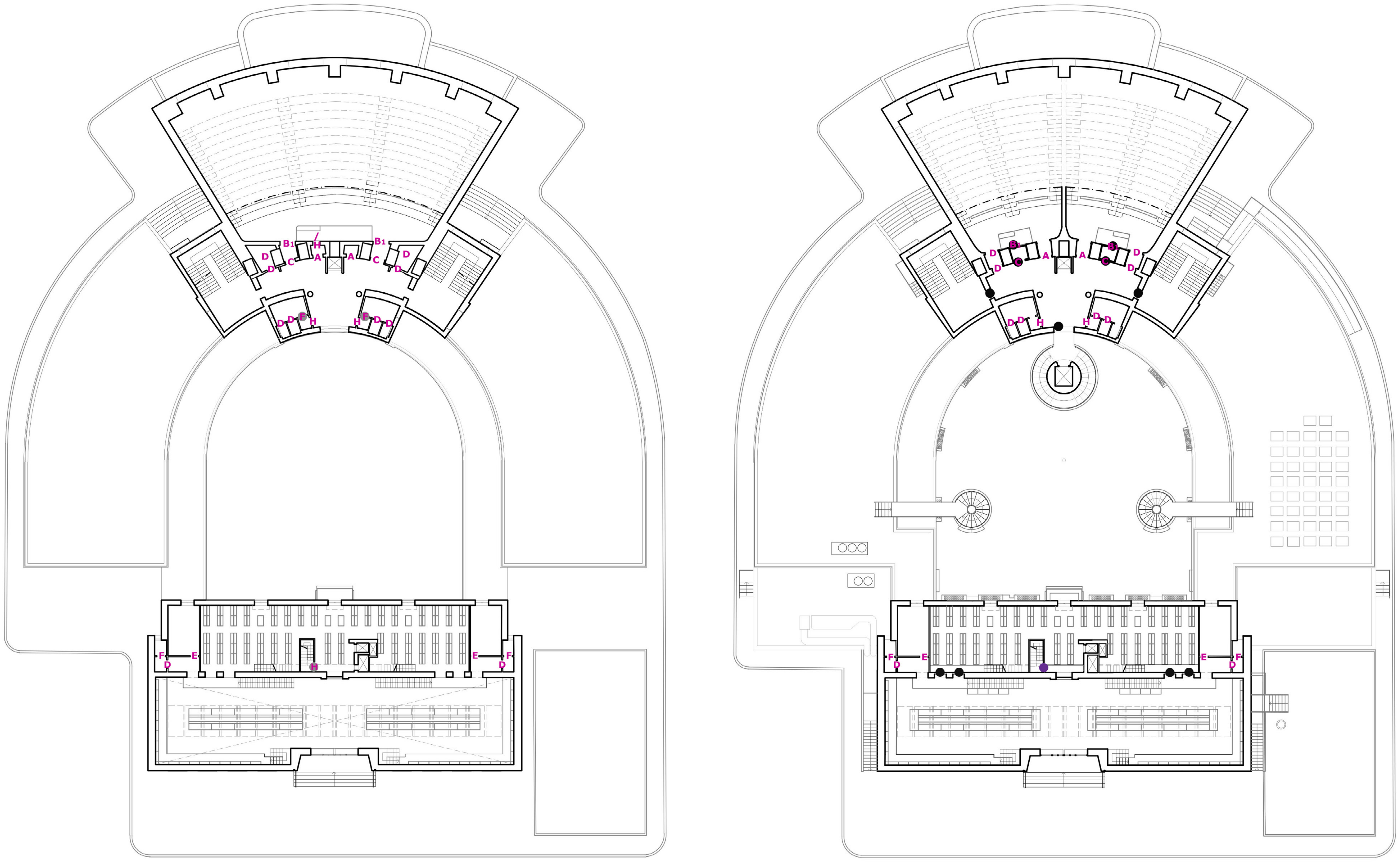


Figure 11 - Mapping of doors in 1935 and 2021, at the third level (© Bardati, Turco 2021)

VI.
FUTURE PERSPECTIVES

CONSERVATION, APPRECIATION, ENHANCEMENT, USE

TIMETABLE OF INTERVENTIONS AND MAINTENANCE

LOVE YOUR CHAIR AND IT WILL LAST FOREVER!

BACK TO INDEX

Figure 1 - Aerial view of the University campus in the urban context in 2014 (https://g3w-suite. cittametro-politanaroma.it/it/map/inquadramento-territoriale/, March 2022)

SCIENTIFIC RESULTS OF THE RESEARCH AND VALUE ASSESSMENT

The main issue that should be considered when drafting a conservation plan for the School of Mathematics concerns the building's relationship with the rest of the campus. Since the building's function is linked to that of the other buildings on campus, and the campus works as a system, in turn connected to the rest of the city, it is also obvious that appreciation of its architectural and historical value depends on a comparable approach to its context. Due consideration should therefore be paid to the drafting of a general conservation plan for the whole campus, which of course involves issues that are not part of the scope of this research.

Almost 90 years of uninterrupted life inside the campus have undoubtedly reinforced its importance, adding layers upon layer of history, and creating memories produced by years of seamless use.

Yet the changes made to the campus- above all the fact that all the voids and empty spaces between the original buildings have been filled and there have been (albeit few) demolitions[1]- have altered the sophisticated architectural relationships established by Marcello Piacentini's plan. In the case of the School of Mathematics, the insertion of the Pharmaceutical Chemistry building to the right (in the Seventies), and the New Physics building to the left, has had a huge effect on the very refined, stereometric and chromatically elegant composition proposed in Ponti's original project.

In the original plan the context emphasized the idea that the building was the result of the juxtaposition of different stereometric volumes, to be used in different ways, and surrounded by enough space to create perspective views that not only made each building visible, but also enhanced the visual effect of "volumes under natural light". In addition, the inner courtyard was certainly not designed to be a simple void resulting from the layout of the volumes, but another accu-

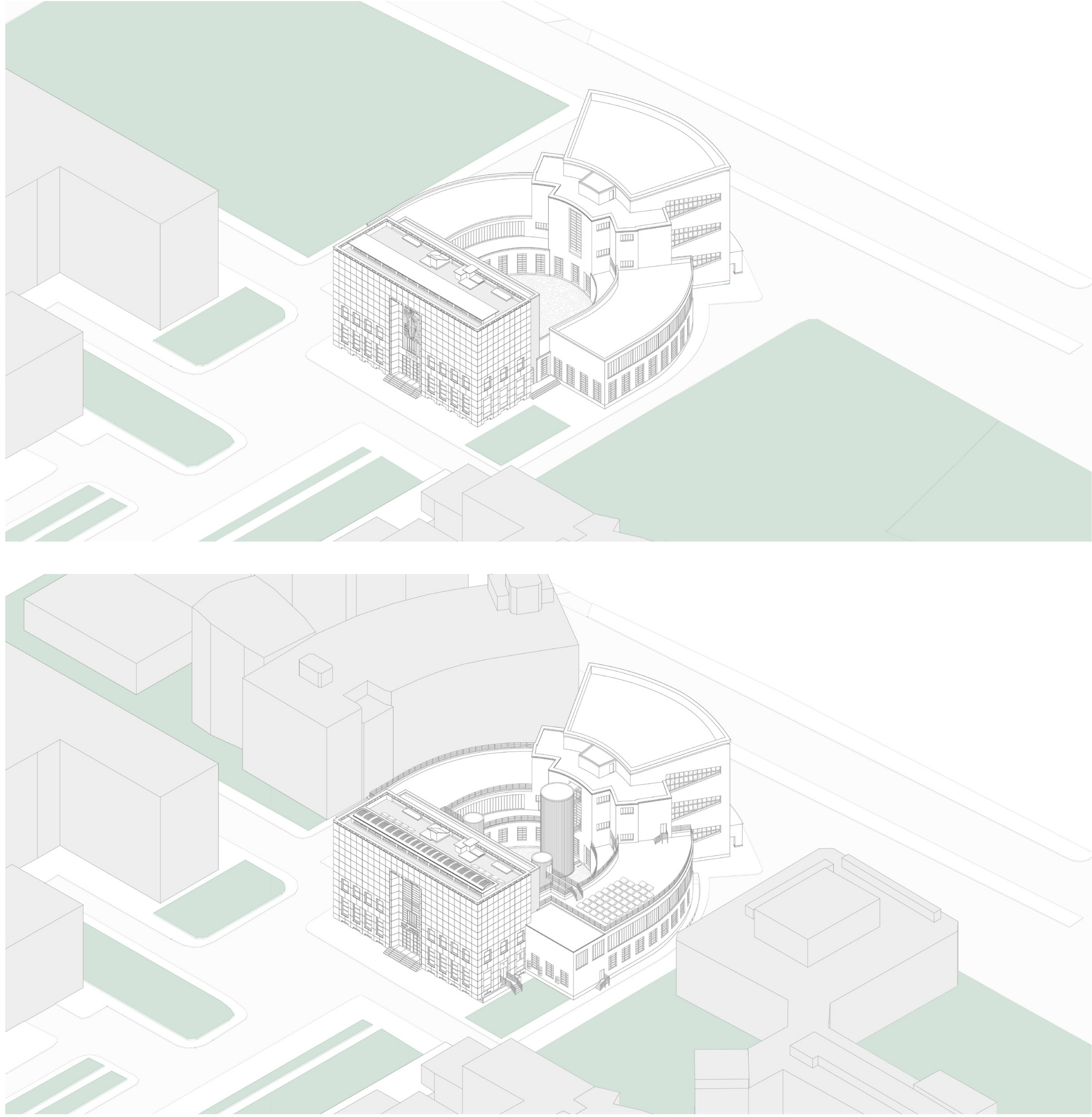


Figure 2 a/b -The building and its surroundings in 1935 (a) and today (b) (© Cortesi 2021) rately designed (empty) volume, geometrically defined as the core on which the composition was based.

As often declared in principle, the idea that the School of Mathematics is an excellent Gesamtkustwerk reinforces its integration not only with the urban environment, but also with its content- decoration, furniture, finishings, collections- thus providing remarkably complex and enriching values. The architecture and its building elements, structural inventions, furnishings, collection of documents and books in the library, and last but not least- scientific progress in the field of mathematics developed on the premises, represent a material/immaterial heritage that deserves to be protected and perpetuated in its entirety.

A systematic assessment of the value of the building must therefore include a reference to its morphology and its division into several blocks, since this structured the design process from the start and still represents its main compositional feature. This assumption defines not only the relationship between the School of Mathematics and the rest of the campus, but also Gio Pont's architectural production in the Thirties as well as contemporary Italian architectural culture.

Old drawings have made it possible to reconstruct the design process from the very beginning, in April 1932; they reveal Ponti's initial ideas of how he wished to design a building as a composition of volumes.
The project is based on the organic, balanced, and harmonious composition of three blocks- the front building, curved wings, and classroom tower- arranged around the courtyard; although they differ in shape, typology, function, rendering, and distribution, they are interrelated. These volumes maintain their own specific identity throughout the design phases and during construction thanks to their very distinct characteristics, ranging from the load-bearing structure to the completion of finishings and furnishings, albeit rendered in an admirable organic design of the whole.

The alterations implemented over the years have endangered and partially compromised the visibility of such a clear juxtaposition, especially the extension of the two curved wings when the new buildings were added at each end; this seriously affected the overall perception of the building, the way it is approached, and its distribution.

A conservation plan should therefore respect the intrinsic organization that shapes the building and allows the very original composition of volumes- front building / curved wings / classroom tower /courtyard- to guide its reorganization and future transformation. It should be used as a systematic approach, to be adopted not only in functional terms, but also as the principle behind any kind of adjustment. Respect for the original composition of the volumes also represents a guideline for a definitive approach to urgent issues, such as the fire escape system and layout.

In addition, a clear and meditated approach to critically understand each addition should be adopted. The

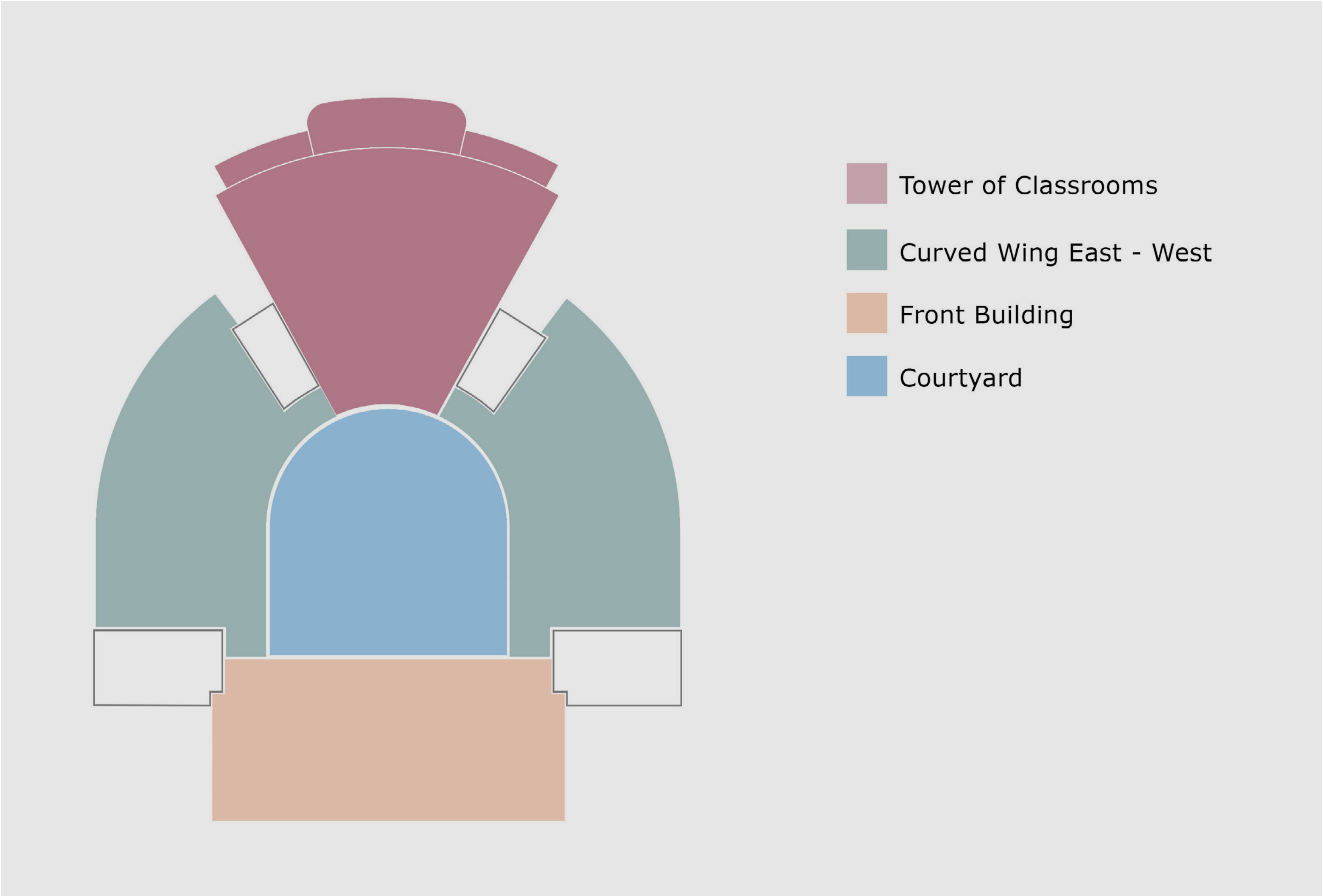


Figure 3 - The three blocks around the courtyard corresponding to the original concept of the building (© Salvo 2021)

reconstruction of the precise sequence of additions, thanks to archival research regarding its history, has provided scientific documentation to support the evaluation of each added element, the reason for its addition, the period it was implemented, and its 'status' in the current image of the building.

A general approach could be adopted towards the policy involving the removal of additions, considering that all the campus buildings have either been added to, elevated, or enlarged by adding new volumes. Additions were in fact envisaged from the start: in 1932 Mussolini and Piacentini already agreed that the number of students and academics would increase in the near future, so Piacentini told 'his' architects to design foundation systems that could support any increase in height of the buildings, and therefore accommodate this trend. The many changes implemented just after the war, between 1945 and 1955, seamlessly continued on from the construction in the Thirties[2]. Materials, such as the Litoceramica cladding, were produced in great quantity for the repairs and extensions; craftsmanship, for example the design and production of doors, were added during the reorganization of the interior spaces that had either been added or divided. Today these changes are very difficult to distinguish from the ones 'designed by Ponti'[3] and sometimes represent obvious continuity in the overall design, thereby making it difficult to tell the difference between the original parts and the additions.

This approach allowed us to accurately assess the value of all the original parts of the building and identify- either thanks to a philological interpretation based on archival documents and critical reconstruction, or to material evidence and scientific analysis (i.e. sampling, testing, and chemical/physical study)- the material authenticity of the original pieces which must, of course, be preserved. However, the approach must also fully respect the important layers of memory, because their significance is due not only to the original concept, but also to their aged, weathered, and historicized state.

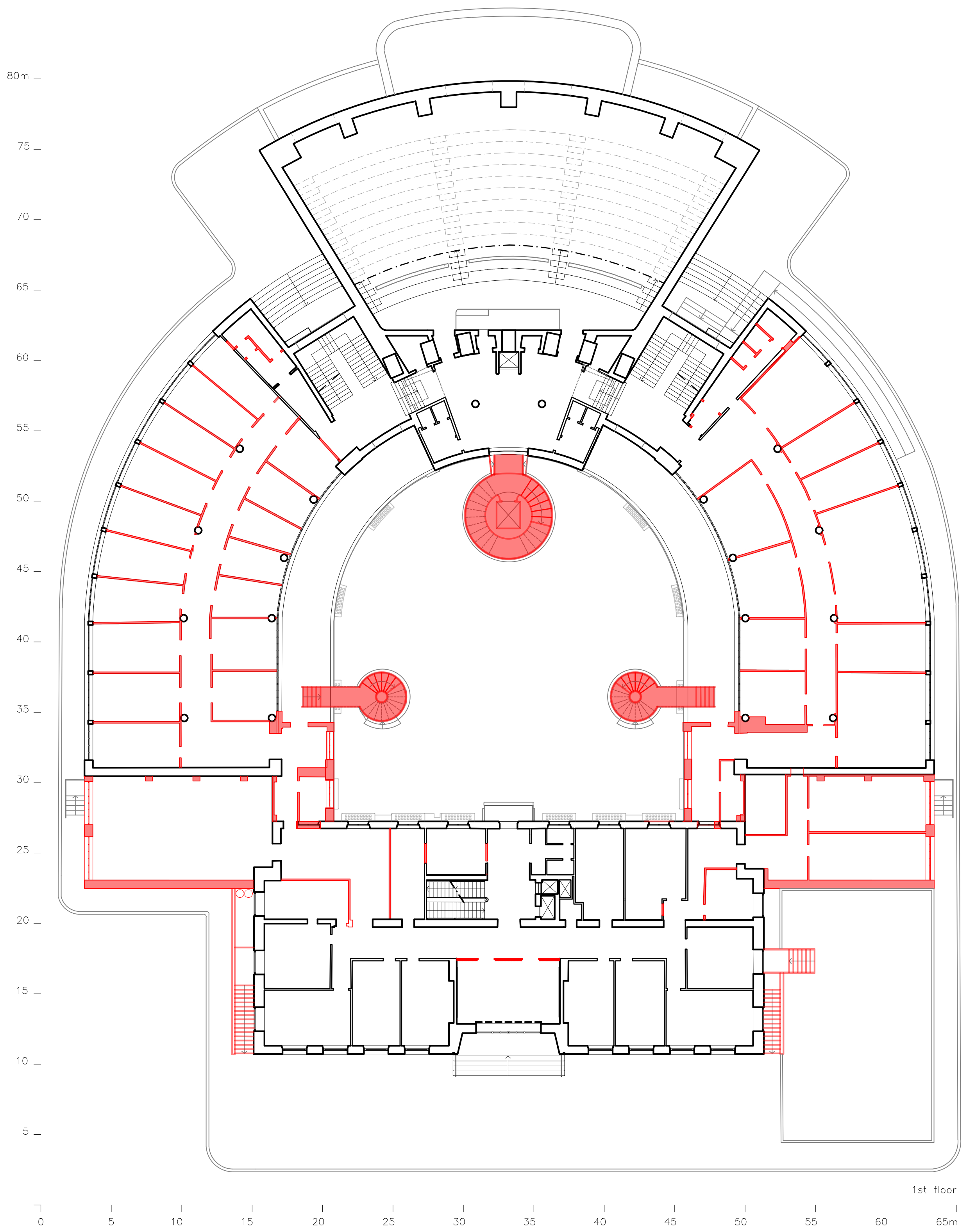


Figure 4 - Additions to the building from 1939 to 2021; plan of the first floor (© Cortesi 2020)

As a result, the design and planning guidelines regarding conservation policies do not refer to the original building, but to the current aged and weathered 'entity'. Some additions must therefore be accepted, and some removed, based on philological analysis and critical interpretation. The two main additions to the front of the curved wings are to be considered irremovable, not only for practical, functional, and economic reasons, but also because they are now part of the way the building has evolved, as well as a footprint of life on campus. They should be maintained not because of their materials, architecture, or structure, but as a 'sign of development'; these aspects should be duly considered during a second phase when it will be necessary to insert new functional or technical elements, especially in order to comply to contemporary requirements.

Luckily, the building does not require radical alterations- apart from having to comply to fire safety regulations- but instead does need to be revitalized so that its architectural features can be perceived and its original spaces, that now appear disjointed, can be recomposed. This can be achieved by removing specific additions or by integrating important losses, based on critical, scientific, and philological considerations. The review of the lost stained glass window- that should be considered the most damaging architectural loss to the building- should also be a part of the agenda.

Figure 5 – The stained glass artwork projected into the windows of the main façade in November 2017 (© Lanzetta 2017)

THE BUILDING IN 2021

The current overall state of the building appears rather discouraging although, all in all, there is a fair balance in terms of material authenticity. Generally speaking, this is true for much of Italy's architectural heritage that has suffered more from natural destruction than anthropic action; it is even truer in the case of many modern buildings in Italy.

In general, substantial alterations and additions prevail over demolitions, so much so that the original state could be restored by simply removing the additions rather than through reconstruction.

The historical analysis of the School of Mathematics and a study of the building's functions and uses over the years reveals a relentless attitude to cancel out the fact the building is made up of separate blocks. From the start- i.e., the establishment of IndAM in 1939 in the curved west wing- the building has been seen and organized according to its four main floors (ground, first, second, and third), ignoring Ponti's idea of blocks connected by stairs or entrances. Since then, in a crescendo, Ponti's composition has been disaffirmed by a horizontal spatial organization, rather than by respecting its initial block concept. Consequently, the reorganization of the accessibility, functions and flows should be envisaged. Plans regarding fire safety, air conditioning, interior comfort, and energy saving would also benefit greatly from an overall interpretation of the building's organization.

As regards material conservation, the building has suffered very few material losses if we exclude the stained glass window on the front façade and the elimination of the two stepped entrances on either side of the front building. The former deserves an ad hoc discussion as this work of art played a very special architectural role in the composition of the building, while the latter have been plugged due to the additions to the east and west wings. These entrances are probably still present under the new paving, but undoubtedly cannot be recuperated.

As mentioned earlier, intentional demolition is very limited and chiefly employed to adapt the building to new uses, comply with new regulations, or adjust specific areas to current use.

The building has a specific material 'strength' and architectural resilience, which has allowed it to resist changes and aging. This assumption debunks the idea that modern architecture is fragile, especially as regards Italian buildings constructed in the first half of the XX century. There may also be precise reasons for this resilience, reasons which should be considered during the value assessment process.

One first reason involves Ponti's design; the latter is based on a seemingly traditional architectural idea- symmetry, harmony, and concept- but open to experimentation. This may be considered a 'quasi-perfect' synthesis of the two main contemporary Italian architectural trends- rationalism and traditionalism- that Mussolini (and Piacentini on his behalf) intended to merge into one national mainstream with the construction of the University campus, naturally under fascist leadership.

Another fact to be considered refers to the very solid Italian building tradition that relied on the skills of craftsmen, the use of very resistant materials, and a well-tested, centuries-long construction technique. These characteristics influenced the adoption of modern and industrial techniques, such as the use of reinforced concrete for structures and exposed architectural elements, as in the case of the crowning frame of the front building which is suffering from a persistent lack of maintenance and man-induced damages, suffice it to name one: the installation of the Faraday cage.

To this we must also add the very good work performed by the companies entrusted with its construction and the professional skills and great attention paid by the site managers and technical staff of the CERUR Consortium. It is still possible to appreciate indications regarding care for the details, which did not only depend on Ponti's design, but relied on a very strong construction tradition, for example, the very accurately calculated baseboard of the walls.

Notwithstanding the use of a reinforced concrete skeletal structure, Ponti's building remains opaque and solid, as does much of the Italian architecture built in the Thirties which is easily distinguishable compared to European architecture where transparency, elevation from the ground, and the thinning of the building envelope, was not just a visual effect, but also a revolution in the architectural concept and construction. While Ponti developed the principle of the 'curtain wall'- or the 'wall as a curtain', as per Semper- detaching the elements of the building envelope from one other, other designers instead developed the same idea by dematerializing the wall itself.

On the other hand, and perhaps unexpectedly, underestimation of the historical value of this architecture is partially responsible for the modest interventions performed over the years, and with a very low material impact. These are mainly maintenance projects, reduced to their minimum requirement, or the low-profile redevelopment of the interiors, with all kinds of additions (walls, installations, furniture, signage, etc.) rather than demolitions.

Of all the changes, the windows, many of which have been replaced, modified, altered, or left to fall into ruin without maintenance, have paid the highest price, together with the furnishings.

Today the interiors reflect a pale image of what they originally looked like, considering the colored finishing - plaster and paving- the fixed and movable furniture, the lighting fixtures, and the very austere atmosphere in the premises of a very silent place of study.

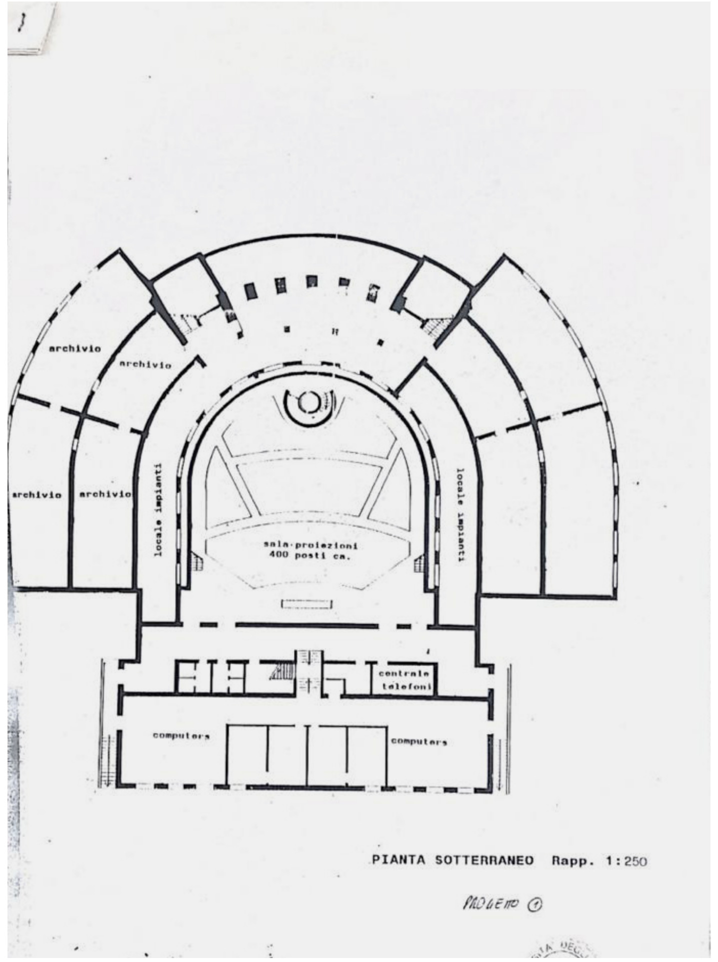


Figure 6 - A detail of the baseboard along the staircases of the classroom tower, a typical detail in the traditional construction methods used in Rome in the Thirties (© Salvo 2021)

Figure 7 - Archival documentation from the Nineties showing the intention to double the ground floor of the curved wings, and cover the courtyard with a canopy to create an auditorium (ADM_dwg_04)

It is important to remember that one of the last proposals regarding functional changes to the building dates to 1990 when the Protection Decree was already in force. It consisted in further dividing up the curved wings, introducing horizontal elements to separate two floors and double the interior space, and excavating an underground auditorium in the courtyard, which would have also been covered with a metal and glass canopy.

Luckily these projects were not implemented, but they still represent a very dangerous precedent, especially because the redesign of parts of the original building is still considered possible. For this reason, redefining the Preservation Decree of 1989 should be considered as a preliminary step to guarantee the conservation of the monument.

Each part of the building has been influenced in a different way by changes, alterations, and modifications. Nowadays it is rather hard to pinpoint the changes that have taken place. When we interviewed several alumni who as young students had studied in the building in the Seventies and Eighties, we realized that almost no one could provide a clear picture of its original interior, especially the drawing halls that has so quickly become unrecognizable. Not many realized that the tiered lecture halls had been divided, while the alteration of the triple height of the library was widely recognized as an alteration- the most painful- probably because beautiful pictures of the original situation have survived and are displayed in the reading hall for direct comparison.

On the other hand, in opposition to its ostensible clarity, the School of Mathematics is a very complicated building.

Figure 8 - Student's desks and seats in a tiered lecture hall of the tower: alterations to, and mistreatment of the furniture is clearly visible (© Salvo 2021)

The front building is by no means the one with the most losses, alterations, and additions, especially because this is the most architecturally and artistically distinguishable part of the complex, and the one that deserves to be preserved the most. Breaking up the triple height of the library, eliminating the discontinuity between the front building and the wings, as well as the additions on either side, has unbalanced the perception of the space: the albeit few additions have wrought extensive damage.

The interior and exterior appearance of the curved wings has been completely altered. The reduction in the number of windows has made the elevation banal; it has been further aggravated by changing the color of the painted exterior, a faded 'Sapienza-red' which is now orange. The juxtaposition and disconnection between the white travertine prism of the front building and the chromatically stronger wings and tower - now perceived as seamless- creates an effect that does not match Ponti's harmonious design. Of course, we don't know what the original color of the building was, as the idea of "color" is in itself vague, nor can we either describe or faithfully reproduce it. Today we can only establish tonalities, shades, and chromatic relationships, relying on contemporary black and white pictures, and classify them using scientific analysis in order to establish a philological interpretation.

The interiors of the wings were modified immediately after the construction of the building and have certainly lost their main feature: the free, wide open space where drawing tables and stools emphasized the freedom of spatial organization. Unfortunately, this is ostensibly an irreparable modification as no teaching activity currently requires such a free, wide-open space. Further considerations involve the furnishings which, in the case of the drawing rooms, has been completely lost. This is an exception in the School of Mathematics where the furniture participates in its material authenticity and integrity. Likewise, the layout of the interior space is an issue; the permanence of IndAM in the curved west wing may hopefully be considered a debatable issue when the functions in the Department of Mathematics have to be rebalanced; this will reopen perspectives regarding the functional rearrangement of the whole building.

A much lower level of authenticity and spatial values involves the extensions added in the Seventies on either side of the front block; the latter are 'reworkable' and can be modified.
Within the layout of the volumes that make up the School of Mathematics, the classroom tower is the least visible, notwithstanding its size. In Ponti's original concept, the 'tower' could probably be seen from a distance, a view that is no longer possible due to the bigger and smaller buildings that have been constructed nearby. This part of the building is currently considered a 'rear', almost hidden from view. Its volume can only be partially seen from via De Lollis as it emerges from the tall boundary walls of the campus. The inversion of the relationship between the scales of the buildings is another effect of the "urban densification" of the campus, especially between the building and the boundary walls, occupied mostly by shacks and deposits.

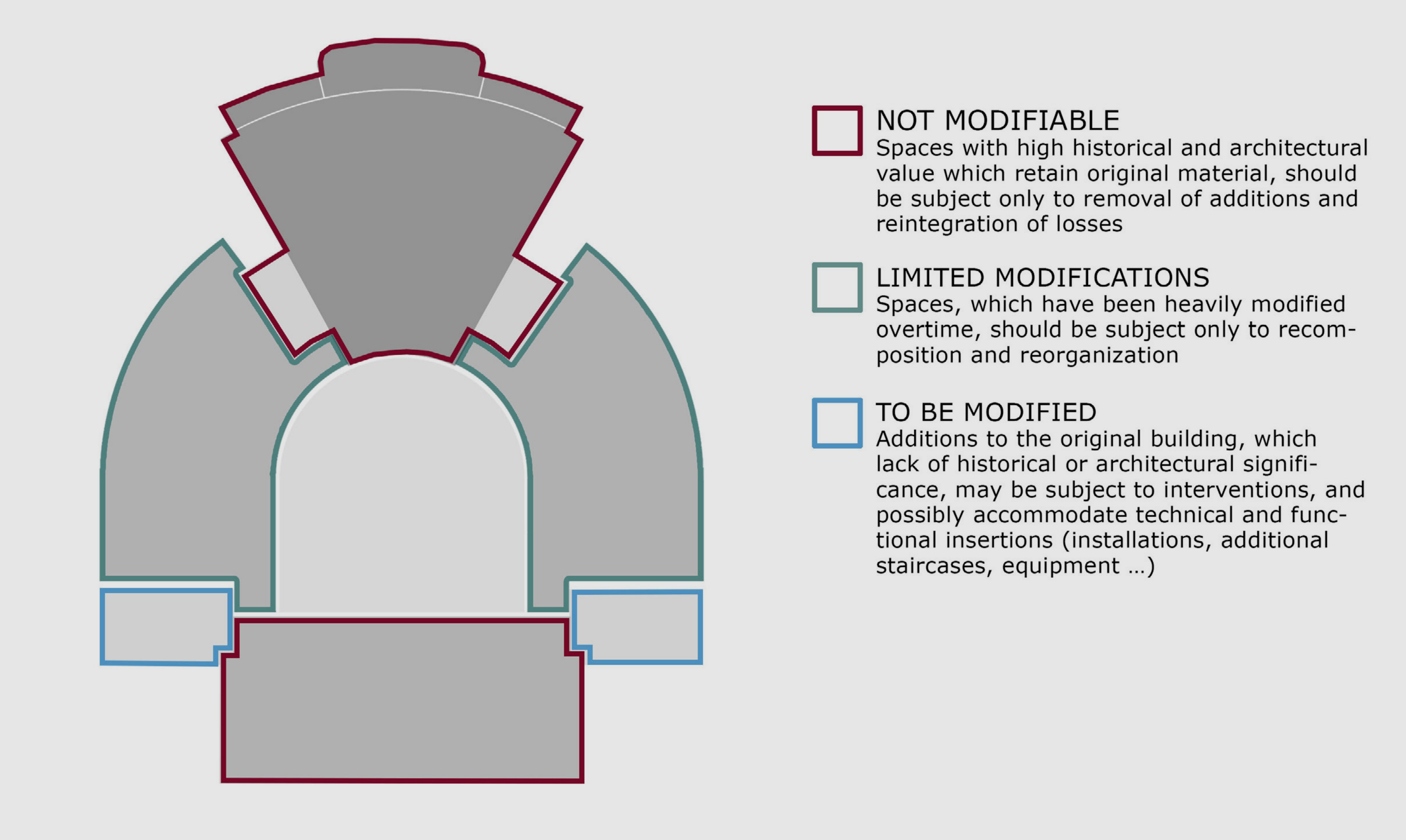


Figure 9 - The three blocks of the building have been modified over the years, albeit each in a different manner (© Salvo 2021)

The interiors of the classroom tower are the ones with the least changes; they have remained more or less as they were in 1935. The few alterations concern the ground floor tiered lecture hall that has been divided into two smaller halls, and other changes concerning the finishings, window fixtures, ceilings, minor alterations to the furniture, additional technological equipment, firewalls, panic handles, and fire safety doors to comply with safety regulations.

The courtyard is the key around which all the architectural components of the building are arranged and morphologically and functionally merge. Ponti probably thought of a quiet, 'focused' space at the centre of the building with a rather timid domestic feature: the grass joints between the travertine slabs of the paving. Most of the peaceful and domestic appearance of the courtyard disappeared when the fire escape stairs were built; it deteriorated even further when the grass joints were filled with concrete. The great potential of this inner open space came to light when Greek Tragedies were organized by Sapienza's theater company, part of the Department of Science of Antiquities.

However, the very powerful acoustic performances prove counterproductive during normal working days; they act as a sounding board for even the softest noise and chatter. Consequently, the courtyard is currently 'off limits' for any kind of activity during normal working days as the noise produced by the chatter disturbs work in the offices and classrooms around it. Material and functional degradation, and the presence of the bulky stairs, have therefore eliminated the key role of this space in the architectural composition. Its recovery depends on a combination of actions: the first involves a general functional reorganization of the building and a revision of the fire safety system.

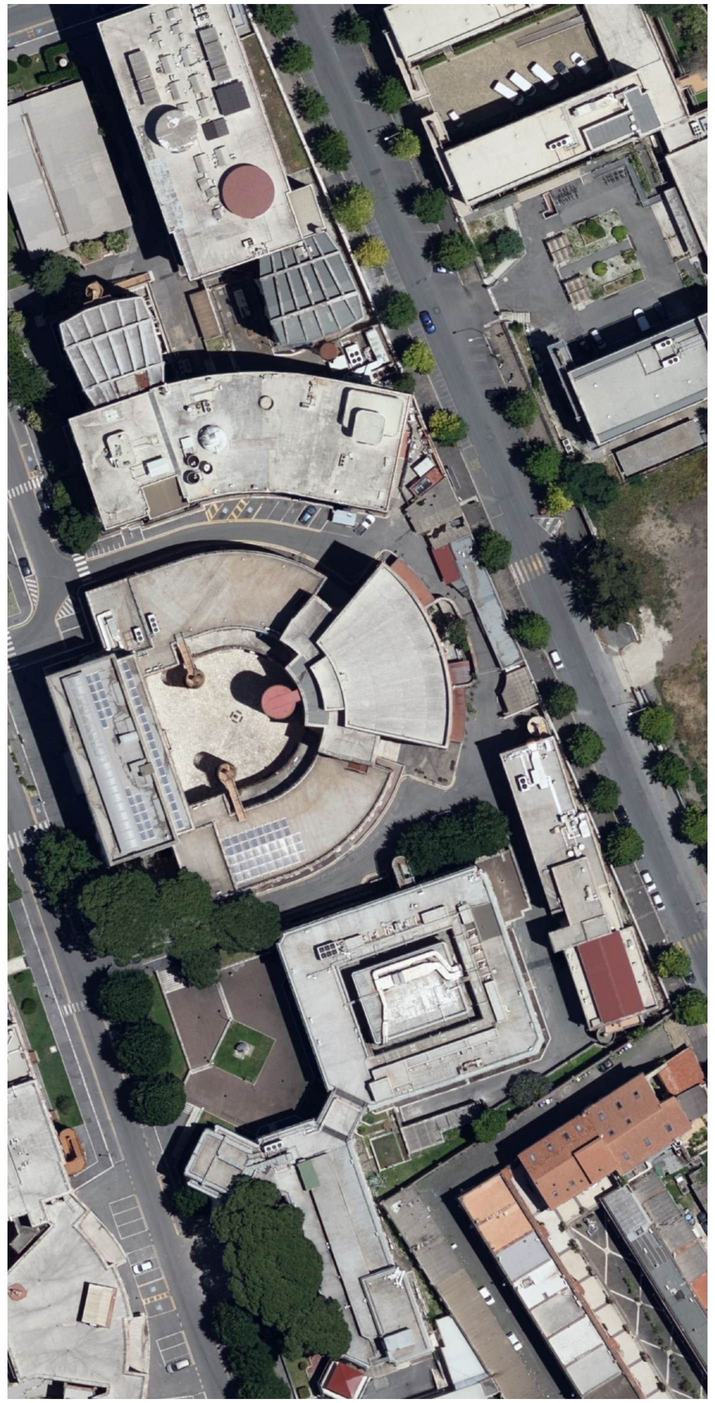


Figure 10 - An aerial view of the building showing how close it is to the bigger and smaller buildings nearby, especially at the 'rear' (https://g3w-suite.cittametropolitanaroma.it/it/map/inquadramento-territoriale/, March 2022)

Figure 11 - The Greek tragedy "Bacchae" staged in the courtyard tested the acoustics of the courtyard (© Salvo 2015)

One last observation: no planning was performed before several systems were placed everywhere in the building (air ducts, HVACs, photovoltaic panels, cooling towers, wirings, etc.). In addition, elements such as the ramp for the physically challenged in the rear of the building (currently out of order) are still functional, while the elevators in the front building and the tower, as well as the book lift in the library (which still has almost all its original elements and still works perfectly), are at risk because they do not comply to regulations.

Unfortunately, further alterations are ongoing; they are not based on scientific knowledge or critical understanding, and have been implemented without taking conservation issues into consideration. They include the replacement of the very characteristic round window frames of the book depot in the winter of 2021 and by a stop-and-start and not always honest intention to respect the cultural value of the building.

In the context of the substantial changes currently being made to academic institutions in Italy, especially Sapienza University[5], the very uncertain future of this monument (and other outstanding buildings in Rome's University campus) should therefore be able to rely on a general, far-sighted conservation program.

There are at least three sources of damage that may impact the conservation of the building: the physiological weathering and aging of the materials; interaction with human beings and their use of the building; and finally the weather. These should of course be considered systematically, i.e., due to the many complex interactions they create since this initiates a reverberation between endogenous and exogenous causes of degradation.

Figure 12 a/b - The round wooden frames of the window of the book depot before (a) (© Salvo 2015) and after (b) replacement (© Salvo 2021)

Figure 13 - Scrapped window frames in the basement before disposal (© Salvo 2021)

The physiological weathering and aging of the materials should be a primary concern; it can be contrasted by developing a maintenance program. The main focus should obviously be the load-bearing structure. This has been considered as providing a good response, notwithstanding the slight change in terms of the permanent loads in static conditions. Dynamic conditions - regulated by recent seismic codes- should instead be considered carefully, mainly as regards interaction with the foundation soil. While a strong, destructive seismic action may not be considered as a first-degree alarm in the area of Rome, minor earthquakes may instead represent a real danger, considering the overall condition of the building. Vibrations, caused by low intensity seismic loads, may affect the stability of the travertine slab and Litoceramica cladding, or of any other overhanging load, including the skylights and the unstable fragments of the concrete crowning frame. It follows that earthquakes may affect safety issues although they do not directly involve the building's load-bearing structure.

In this case the solution consists in performing more research regarding the materials and construction itself so as to gain more knowledge about the consistency, conditions and stability of each piece. It is not surprising that each task group involved in this research has stated that it is necessary to continue and complete in situ investigations, with the proper support- e.g., using movable scaffolding or a movable arm to reach the upper parts of the elevation- and, above all, with permission to collect more than microscopic samples.

The limits imposed on the study of materials and construction techniques has made it impossible to obtain a complete picture- and map- of the real conditions of various features, such as the adhesion of travertine slabs to the façade, the Litoceramica cladding, and the surface plaster of the exterior walls.

Figure 14 - The travertine cladding on the southwest elevation photographed with sidelight in order to show the degradation of the slabs (© Salvo 2020)

One alarming issue is the stone cladding of the main façade made up of more or less square travertine slabs. The chipped edges along the joints reveals that, without mortar joints, they do not absorb excessive thermal expansion. This suggests that the slab anchoring system is not completely secure, despite its very good resistance over the years. In addition, we cannot say that the cladding system ensures the perfect adhesion of each slab. This same situation is applicable to the Litoceramica cladding and the plastered surfaces, especially the ones facing south and southeast.

The situation of the fair-face concrete crowning frame of the front building is even more alarming. It is a very significant architectural element and a key feature in Ponti's design of the front building, as well as a beautiful artifact in terms of design, construction, materials, and technical solutions.

Figure 15 a/b - The condition of the fiber-reinforced resin coating applied in 2013 on the roof and skylights of the library (© Salvo 2021)

Figure 16 - The layer of fiber-reinforced resin coating applied in 2013 has aged quickly and crystallized (© Salvo 2021)

The surfaces and substantial parts of this element have been practically left without any protection, and certainly never maintained, so they are constantly deteriorating: the concrete cover is falling, the concrete component of the surfaces is being washed out, and crusts and deposits are forming. The entire element is thus left to be consumed and decay; the deterioration is more severe on the sides facing south and southeast, subject to stronger thermal cycles. Most of the pieces have fallen onto the terraces and not on the street because the position of the cornice on the southern side of the building is just above a lower terrace, so it is here that the pieces have fallen rather than on the courtyard. This should not reassure us regarding the evolution of the degradation process of all the surfaces that will speed up in the years to come. In short, we foresee that the degradation of the crowning frame will represent a safety hazard for the community and a conservation problem for the building. For this reason the issue should be urgently addressed.

Another issue that must be given due consideration is the deterioration of the materials applied during the most recent maintenance project. The waterproofing applied using fiber-reinforced organic resins in 2013 is gradually but steadily becoming less solid. This material is generally guaranteed for no more than ten-years, in optimal conditions, which is certainly not the case here. The accelerated deterioration of this material is now alarming, especially as regards the skylight on the library roof, due to very specific conditions: the very high summer temperatures that have peaked in the last five years, combined with very strong rainfall; the application of heterogenic materials such as cement, concrete and glass; the total lack of maintenance; the combination with concomitant causes of decay, e.g., mechanical and chemical effects due to the presence of birds. All this has created an intolerable situation.

The result is very visible and consists in the plasticization and crystallization of the material, with ensuing shrinking and breaking. As a result, the protective layer is no longer seamless, allowing water percolation under its surface. We expect to very soon see the effects of this infiltration with the percolation of water through the glass blocks and the loss of glass and concrete pieces. One first urgent action consists in an accurate inspection of the situation and then the removal of this layer and the application of thin layers of either non-organic protective materials or acrylic resins, to be maintained and repeated every five years.

Obviously climatic change is clearly also affecting the protection of the roof, especially given the situation described here. Strong rainfall, combined with high summer temperatures due to the fierce sun in polluted urban environments, are causing a rapid acceleration of the decomposition of protective materials and constituent materials. This is due to chemical and physical processes, but also to mechanical and biological actions that should be observed and possibly accurately measured over a period of time as it is easy to forecast that the rate with which this kind of deterioration processes occurs will easily escalate.

Figure 17 - Fragments of the concrete crowning frame that have fallen on the roof of the library depot (© Salvo 2011)

CONSERVATION MANAGEMENT PLANNING AND THE ITALIAN RESTORATION CULTURE

As we all know, conservation in Italy is a long-established tradition that sinks its roots in the country's cultural landscape and is closely linked to archeology, art, and architecture. The reason for this very specific approach to pre-existing artifacts depends on a great many factors, and requires a very long discussion that would be inappropriate here. However, it is very important to remember that the overwhelming presence of 'old things'- from archaeological ruins to works of art, from buildings to infrastructures- has profoundly influenced and shaped the way the Italians deal with the physical remnants of history with which they share their world. This relationship has shaped a specific culture, imbued with a scientific and critical approach, and defined in Italian by the word *restauro*, a word that has a very specific meaning and involves several different kinds of interventions.

As the relationship between objects and the observer depends on the latter, we can assume that the approach to monuments has never become definitive and that it changes depending on changes in contemporary culture over a period of time.

One of the greatest challenges faced by Italian culture, and tackled by institutions, has involved understanding, acknowledging, and managing the huge complexity of this enormous cultural heritage which, in some ways, hinders the further development of the country, and sometimes everyday life.

After World War II (probably the chief anthropic cause of damage in the past century) and after several natural disasters, namely the great flood of Florence (1966), and the numerous earthquakes that have struck the country from north to south (Friuli, September 1976, Valnerina, September 1979, Irpinia, November 1980), the Istituto Centrale per il Restauro and the Italian Ministry of Culture started working on a new scientific approach to tackle the complexity that Italy's Cultural Heritage has made so difficult to preserve.
It redeveloped its traditional approach based on the consideration of single isolated objects within their broader cultural environment. It was not just a matter of reconsidering the scale of analysis and intervention, but of achieving a systemic framework capable of detecting the network of relations within which every single element had to be considered, and then accurately assess the rate of its decay. Conservation planning was actually a version of Cesare Brandi's idea of 'preventive restoration' (*restauro preventivo*), present in nuce in his restoration theory and methodology; it was further developed during studies by the Istituto Centrale del Restauro he had founded in 1939 with the intention of embracing conservation as a transdisciplinary activity, to be implemented over a period of time[7].

In the late Seventies, thanks to the hard work performed by Giovanni Urbani, who had taken over from Brandi as director of the Istituto Centrale del Restauro, the project developed into a pilot plan[8]. The plan essentially established a systemic approach to prevent damages and control national heritage. It created an efficient framework regarding its value (documentation and cataloguing), its specific vulnerability (knowledge about propensity of the artifact to deteriorate and age), the dangers associated with the context (study of the natural and anthropic environment), and the scientific identification and measurement of its exposure to risks[9].

The original Italian idea of conservation planning was based on a strategic vision: "contrary to the notion of selective and therefore fragmented protection, it instead postulated a totally innovative vision based on organic and systemic actions regarding the dynamic interdependencies binding the constituent elements of the territory, considered on a regional scale and in its cultural and non-cultural elements"[10]. The idea not only involved a specific vision of history, philosophy, and art, but also the country's political economy, institutions, and social and cultural assets.

Of course, transdisciplinary evaluations were crucial, but the true novelty consisted in the systematic view of the physical-chemical evolution of objects in their environment, considered within a long-term predictive context, and with a strict operational approach.

To avoid arbitrary evaluations regarding the priority of the interventions, and to provide scientific parameters and measurements of the degree of deterioration, the so-called *Carta del Rischio* (Map of Risk) began to take shape in the Eighties; it involved the territorial mapping of the cultural landscape based on the theory of risk and assessed according to the equation

Danger x Vulnerability x Value = Risk

Note that if any of the terms is equal to 0, there is no risk: seismic risk may also be measured using a similar equation. A graph that relates time to deterioration is known to generate a parabolic line with an exponential increase: this indicates that deterioration does not proceed constantly with time but worsens dramatically over a period of time. Given the above, maintenance - considered as the programmed and managed care of the object- becomes the only affordable approach to preserve heritage and ensure it remains as authentic as possible.

The goal of the Map of Risk was- and still is- the drafting of conservation programs technically based on scientific knowledge and accurate measurements: identification of the rate of deterioration, spacing out of actions over a period of time, and cost evaluation. In addition, the idea was to move beyond the constant approach to act in an emergency situation, or react in terms of repairs, and trust in the fact that the prevention was the response to a preferred holistic and ecological approach that was also economically favorable.

Conservation planning, as proposed by the "pilot plan" produced for the Regione Umbria, also considered landscape based on "a territorial integrated vision… a living framework of the relationship between communities and the natural resources of the place and the stratified material evidence of their cultures"[13].

Unfortunately, there were several reasons why the Pilot Program and the Map of Risk were never implemented at national level but later salvaged by the Regione Lombardia in the late Nineties and brought into effect at the turn of the century (1997) as the "Polo Lombardo della Carta del Rischio del Patrimonio Culturale" (Lombard Center for the Map of Risk of Cultural Heritage)[15]. Due to the increasing frequency of natural disasters in Italy (another series of earthquakes, in Umbria in September 1997, in L'Aquila in 2009 and Central Italy in 2016), the need to save the cultural heritage at risk encouraged the Italian government to re-launch the Map of Risk project[16]. Unfortunately, very little literature on this subject has been published except in Italian, although there is growing interest in this matter, especially recently, and the international dissemination of this literature would be a benefit for all[17].

This is just a very brief excursus to highlight the fact that, thanks to this very elegant and refined cultural approach to heritage conservation, Italy has continued working on the implementation of a model to manage the protection, conservation and enhancement of our national heritage, notwithstanding a lack of resources[18].

In this scenario, modern buildings are 'considered last' although they host and support the Italians' everyday life.

Efforts in this direction are summarized in some publications[19], but are chiefly reflected by the activities of the Regione Lombardia; the latter has promoted a special research program regarding XX century properties, in collaboration with university research centers[20]; the program was responsible for the restoration of the Pirelli tower curtain wall in 2002-2004[21]. Based on this first important result in the Lombardy region, the original theory of preventive restoration and conservation management planning was further improved: "predictive (or preventive) and maintenance practices are not sustainable unless they are as part of the ordinary, continuous management of cultural heritage, especially architectural heritage, taking into account its immediate context together with its current use by owners and users"[22].

However, this approach would be incomplete if we did not recall the constant Italian tendency to wait for an emergency, to enact a recovery only after the damage done, intervening without a strategic, planned approach to the conservation of the cultural landscape. This is also an institutional problem involving numerous stakeholders- mainly national and regional- which has lately called into question the institutions directly responsible for their properties, such as Universities.

The School of Mathematics is one of the very good examples of the typical situation regarding the current state of modern buildings with extraordinary historical and architectural value: a strategic function, a monumental value (on paper), an exponential value acknowledged by specialists, but with very little awareness of its value by the public, and an inversion between achieving functional needs and ensuring heritage values.

Effective conservation management planning for this one building is undoubtedly very limited in the absence of a crucial broader view. We should think in terms of scale (e.g., considering the University campus as an organism that 'lives' beyond its boundaries and involves the city of Rome), and in terms of the political involvement of Sapienza's management- the Rector, the Administrative Director, the Technical Management Office, and the Energy Manager- as well as the academic community and all the students. In addition, without adopting a long-term view of management activities we cannot hope that a conservative approach will take root and become 'culture', instead of just remaining a theory and method, albeit refined and unique.

The scope of this very brief overview is to underline the context within which this research has been developed, on the one hand involving scientific data regarding the material nature of the building, closely correlated to its specific environment and the life that has taken place in it and, on the other, paying great attention to the specificities and needs of its inhabitants, which are the main stakeholders of its future life. The goal was to investigate, understand, interpret and monitor the acknowledged value that still binds the users- Sapienza's scientific and administrative community- to this and other buildings on campus.

We believe that Sapienza's stakeholders are the recipients of the ecological, holistic, and systemic approach proposed by conservation management planning.

CONSERVATION MANAGEMENT PLANNING, STRATEGIES, AND ACTIONS

The primary output of this research consists in defining a systemic conservation strategy to tackle the complexity generated by the merging of several variables, stakeholders, and behaviors. The problem is not (just) scientific or merely technical, neither is it exclusively administrative, operational, or cultural; it is a complicated combination of all these aspects.

An initial attempt to tackle conservation management planning should therefore consider a dual perspective: on the one hand, implement operations to ensure the material conservation of the building, thus providing protection and repairing the most exposed elements physiologically damaged by ageing and weathering; on the other, remodel the relationship between the building and its users. Although not separate, the two aspects should be treated differently in terms of urgency, strategies, and actions. In both cases, any alterations to the building should respect two key conditions: all work should follow the original concept behind the building, and be based on scientific evidence and critical interpretation, bearing in mind current functional requirements.

The possibility to invest significant resources in this task is objectively limited due to the enormous upcoming expenditure that Sapienza is bound to face since it has to independently administer its funds. Although preservation and enhancement of Sapienza's architectural heritage is regulated by law, it is clear that managing this situation will be anything but easy.

It is therefore of primary importance to revive not only the conscience of the community, but also the need to take control of this cultural asset. Sapienza's academic community is prepared to become a "heritage community"- as described in the 2005 Faro Convention- a role that past experiences have shown it is ready to take on.

Sapienza's academic community thus plays a dual role: that of stakeholder, active in terms of expressing cultural demands, and that of an actor who boosts appreciation. While professionals, scholars and technicians are of great importance in this context- producing scientific information and designing conservation strategies- administration is responsible for managing the process. In this context, a forward-looking, multi-annual plan is crucial, coupled with Sapienza's accountability in terms of conservation and maintenance of its own architectural heritage.

In a nutshell, the conservation of the School of Mathematics and Rome's University campus is a matter of governance.

This Conservation Management Plan is based on these premises; the timescale and interventions involved are based on this approach.
Another essential step that needs to be taken, involves redefining the Protection Decree; it has to be integrated and thoroughly updated to suit the current situation. The decree could, for example, be imbued with a renewed sensibility towards modern built heritage and be based on a scientific framework that is now available with a much broader cultural reference, perhaps also integrating the general decree with an ad hoc document dedicated to the School of Mathematics. This should include the building's fixed and movable furniture, reflecting the overall value of *Gesamtkustwerk*.

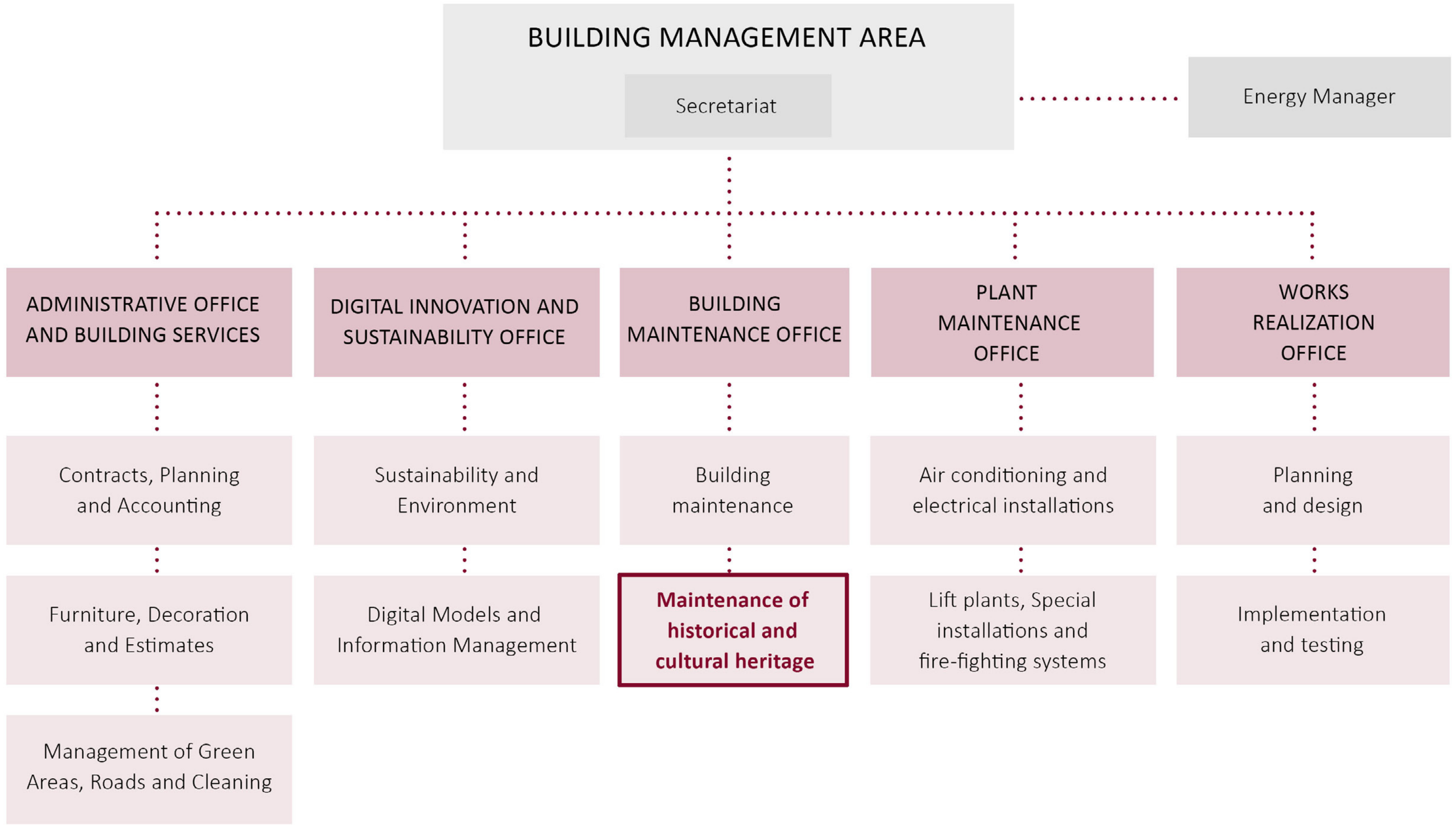


Figure 18 - Organization of Sapienza's Technical Office; an office responsible for the maintenance of the University's historical and cultural heritage is envisaged, but is not yet operational (© Salvo 2021)

Figure 19 - The fire escape stairs in the courtyard in the Eighties (© Salvo 2021)

Figure 20 - Fire safety regulations in Italy since the Eighties. The law of 1985 - later Decree of 1986 - involved the installation of the three fire safety stairs in the courtyard (Salvo 2021)

Apart from urgent conservation and protection measures for specific endangered parts and elements such as the concrete crowning frame, one priority of the conservation management plan should be preliminary operations regarding 'preventive restoration'. The idea is to plan indirect but effective actions to revive the community's interest and awareness towards this heritage: an initial, important project could be to re-propose the reenactment of Ponti's stained glass window (already displayed in 2017) based on the data and information collected during this research. Today this operation would be scientifically correct, but also groundbreaking, visible, and communicative, with long-lasting benefits that would 'surf the long wave' of Ponti's revival.

Finally, the reenactment of the stained glass window would initiate a virtuous circle, encouraging both cultural appreciation and the material conservation of the building. In addition, it would clearly reveal how the horizontal element effectively divided up the triple height of the library: the fact its removal is so important would become a shared initiative, requiring the courage to reinstate Ponti's very special architectural concept. The cultural resonance of such an initiative would certainly reach an international public and become as meritorious as the conservation of the Pirelli curtain wall. It would also attract the attention of an ever-growing audience towards the School of Mathematics.

At the same time, two strategic initiatives should be undertaken prior to any further steps: decide/plan/achieve a reduction of the number of people in the building and redesign its fire safety layout. These preliminary actions will effectively prompt further interrelated conservation regarding the building's materiality and use. These may be considered as specific 'restoration' projects involving the removal of additions and the integration of lost parts, based on the guidelines of the Italian theory of restoration.

Most of the conservation issues affecting the School of Mathematics should be considered in light of the damage caused by the overload of functions and users. Burdensome functions and excessive crowding cause consumption, and also produce counter effects, making it harder to comply to fire safety regulations, which are much stricter if the building is overcrowded. Excessive use is counterproductive as it places more pressure on exploitation rather than cultural appreciation. Appropriate, ongoing use should also be guaranteed, in continuity with the past, preserving the binomial reference to the School of Mathematics as a place and institution for research and teaching in the field of mathematics.

In consideration of Gio Ponti's idea of 'daytime and nighttime' architecture, the possibility of opening the building to the public at night, especially the library and the courtyard (and some study rooms), could be considered as a means of enhancement. This last consideration would pair perfectly with the initiative of re-enacting the nighttime projection of the original stained glass window.

One last consideration about the use of the building refers to the permanence of the porter's residence within the building. This not only represents an element of continuity with the past, but also ensures the best use of this part of the building; it also guarantees the continuous presence of a custodian to look after immediate requirements, small repairs, and also record even the slightest changes.

REGULATORY COMPLIANCE TO FIRE SAFETY REGULATIONS: AN URGENT ISSUE

The School of Mathematics is famous within the University campus for the three huge fire escape stairs placed in the courtyard in the late Eighties; they are considered invasive and responsible for spoiling the building's architecture.

The stairs were built to comply with the fire escape regulations issued in 1985-1986, but paradoxically they were in complete contrast to the new up-and-coming process to re-evaluate the historical importance of the building established by the Protection Decree of 1989. The result was devastating and rather disrespectful of the architectural context. The three steel-and-concrete cylinders were probably placed in the courtyard based on a rather old-fashioned rule according to which a building's exterior appearance is more important than its interior due to its higher public impact.

However, the courtyard plays a crucial role in the architectural layout, now compromised by the fire escape stairs. Their insertion has impaired the perception of the visual axes of the spatial sequence crossing from one side to the other of the building and establishing an ideal 'optical telescope'. In addition, it has materially damaged the paving, the elevation, and the window frames, in particular the huge central window to which the metal stairs are attached. Notwithstanding the many attempts to find a document about their installation, none were found regarding the process used to install them.

They are an essential part of the building's fire safety equipment and therefore considered 'irremovable'; nevertheless, they have not been maintained and are practically never used. In 2011 the Director of the Mathematics Department, Vincenzo Nesi, reported the damages and water infiltrations that made the two smaller ones unusable. These stairs were then closed (and are still closed and useless for safety purposes),

Figure 19 - The fire-escape staircases placed in the courtyard in the 1980s (© Salvo 2021)

Law 818 of December 7, 1984 (also **Circular of the Ministry of the Interior 36, December 11 1985**) - Temporary authorization for activities subject to fire pevention controls, and integrative rules of the National Corps of the Firefighters.

Decree of the Ministry of the Interior 218 of September 16, 1992 - Fire safety standards for school buildings

Decree of the President of the Republic 418 of July 30, 1995 - Fire safety safety standards for buildings of historical interest, containing libraries and archives.

Legislative Decree 139, of March 8 2006 - art. 15 «Reorganization of provisions relating to the functions and tasks of the National Corps of the Firefighters».

Decree of the President of the Republic 151 of August 1, 2011 - Regulation to the simplification of fire prevention procedures.
34.2.C - Archives and libraries with quantities of paper exceeding 50.000 kg.
67.4.C - Schools with more than 300 people.
72.1.C - Building declared of historical importance according to Law 42 January 22, 2004, containing libraries and archives.

Ministerial Decree of August 3, 2015 and Ministerial Decree of August 7 2017 - Approval of technical fire prevention standards

Figure 20 - Fire safety regulations in Italy since the 1980s. The law of 1985 - then Decree of 1986 - implied the installation of the three fire-safety staircases in the courtyard (Salvo 2021)

while the main central stair has recently undergone costly maintenance.

The stairs have recently proved to be ‘useful’ only on unexpected occasions; they were used during theatrical performances as ‘stage equipment’ to allow actors to perform and be clearly seen by the public sitting in the courtyard, for example during the Greek tragedies staged by the Theatron company of Sapienza University.

The stairs in the courtyard of the School of Mathematics have therefore become a problem of their own, i.e., a thorny issue, for three reasons: a) the building has to comply to fire safety regulations; b) classrooms, especially in the bigger tiered lecture halls in the tower, are overcrowded; c) the functional organization of the building has been ever-changing during the last three decades, which means the fire escape plan must necessarily include the fire escape stairs in the courtyard; and finally d) the fact that they are obsolete and must be updated. The partial or total removal of these stairs, or their maintenance for fire safety reasons, is therefore an issue compounded by various problems, and should be approached as such, bearing in mind that academics, students, and administrative staff all agree they are invasive and would be very glad if they were removed. Indeed, their installation obviously contrasts with the assessment of the historical and architectural value of the building, finally drafted- at least verbally- by experts, policy makers, professionals, academics, students, and the civil society at large.

The question of whether to remove them or not should be based on a clear technical, legislative and organizational picture of the situation. Information has been collected by interviewing technical officials and specialists in the field of fire safety compliance that are currently working on this matter at Sapienza’s Technical Office. In addition, specialized experts have been hired to develop safety plans for all the campus buildings that are dealing with the same issue. However, the problem can only be solved by acting on several

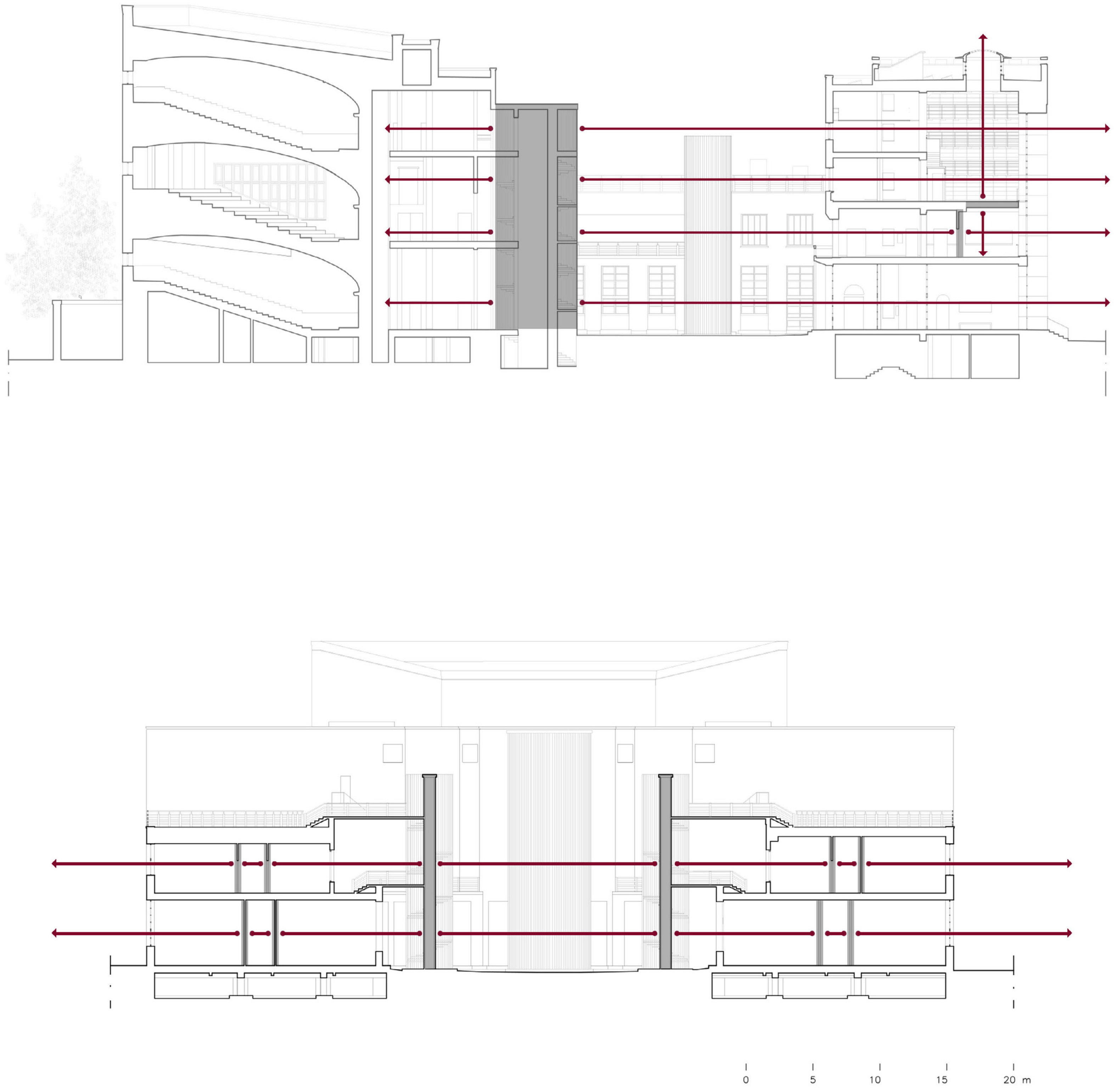


Figure 21 a/b - The visual axes crossing through the building (© Salvo 2021) fronts and by reaching a compromise in order to assist in the conservation of the building.

One initial assumption is that, based on the fire risk assessment, there is a high level of risk within the building's premises. This depends on its function (schools, etc., where many individuals gather), its fire load (especially in the library and book depot, compounded by the presence of old books and manuscript collections combining a high fire risk with exceptional heritage value), and the activities that may take place in the building.

As shown in Figure 23, compliance to fire safety rules has been determined by dividing each floor into fire compartments (or homogeneous areas), and by surveying the horizontal continuity of the building and relative calculation of surfaces, number of escape routes and exits. The fire risk evaluation therefore currently refers to horizontal compartments rather than to homogenous 'blocks'.
This could be carefully re-determined based on a historical analysis of the building and precise data regarding its original layout and juxtaposed volumes which should be considered separately in view of a revision of the fire safety organization. Such an alternative assessment would reduce the maximum distance to reach the exits and safe places, making it possible to redistribute fire escape corridors and stairs, which are undoubtedly necessary but could be relocated elsewhere, in a more strategic and appropriate location than the courtyard.

The fire safety compliance resolution therefore needs a multifaceted strategic approach, combining the issues and values at stake into one comprehensive observation.

An initial consideration is that a sufficient supply of water should be available in case of fire. Since the building has a high fire load due to the huge amount of paper present, especially in the front building and basement, a huge amount of water has to be available.

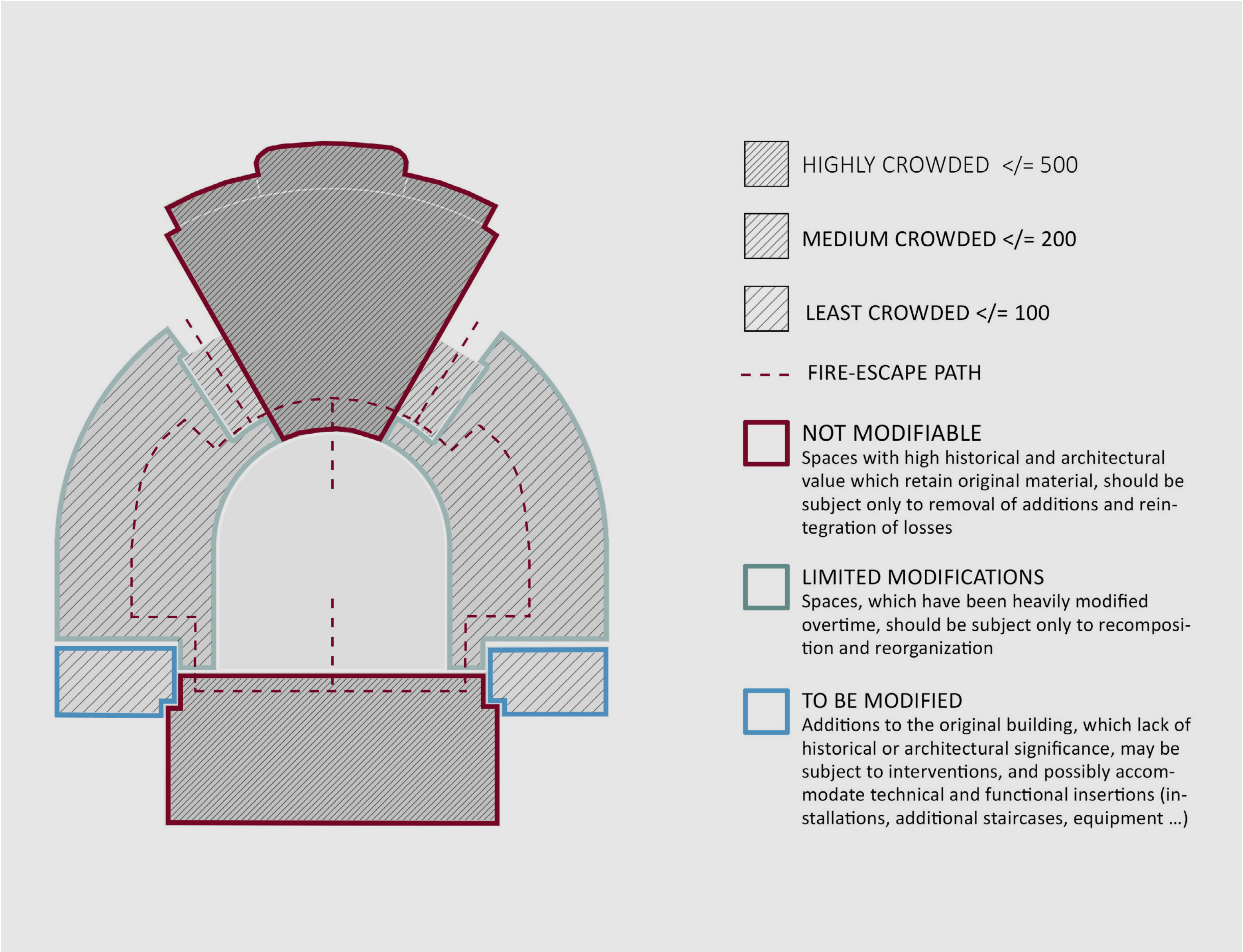


Figure 22 - Plan showing the fire escape paths, crowded areas, and level of applicable modifications according to their historical and architectural values (© Salvo 2021)

	Compartment / Homogenous Area	N.of doorways/ width cm	Exit Modules	Flow capacity Per unit	Flow capacity Total	Crowding	Verified	Max. length of safety path (m)	Maximum length of safety path (D.M. 26/08/92)	Verified	Minimum width of safety path (m)	Min. width of safety path (m) (D.M. 26/08/92)	Verified
1	Front Building, Basement floor (*IT laboratories, deposit, archives*)	N=2 / 120 m N=1 / 100 m	5	60	300	110	YES	15	60	YES	1.20	1.20	YES
2	Tower of classrooms, Basement floor (*PhD students' rooms*)	N=1 / 90 m	1	60	60	27	YES	5	60	YES	1.80	1.20	YES
3	Front Building, Ground floor (*Offices, classrooms*)	N=2 / 180 m N=1 / 100 m N=2 / 80 m	9	60	540	490	YES	35	60	YES	1.40	1.20	YES
4	Tower of classrooms, Ground floor (*Lobby and tiered lecture halls I and II*)	N=2 / 190 m N=1 / 120 m	8	60	480	400	YES	5	60	YES	9.00	1.20	YES
5	Front Building, First floor (*Studies, offices, assembly rooms*)	N=3 / 110 m N=1 / 145 m N=1 / 190	8	60	480	200	YES	20	60	YES	1.20	1.20	YES
6	Tower of classrooms, First floor (*Lobby and tiered lecture hall III*)	N=1 / 120 m N=1 / 140 m N=1 / 190 m	7	60	420	435	NO	5	60	YES	9.00	1.20	YES
	Tiered Lecture Hall III	N=2 /180	6	60	360	434	NO						
7	Front Building, Second, Third, Fourth floors (*Library, reading rooms, offices, archive*)	N=3 / 120 m N=1 /140 m	8	60	480	115	YES	40	60	YES	1.50	1.20	YES
8	Tower of classrooms, Third floor (*Lobby and tiered lecture halls IV and V*)	N=2 / 1.90 m N=1 / 1.40 m	8	60	480	396	YES	5	60	YES	3.00	1.20	YES
	Tiered Lecture Hall IV	N=2 /180	3	60	180	198	NO						
	Tiered Lecture Hall V	N=2 /180	3	60	180	198	NO						

Figure 23 - Chart showing crowding, flow capacity, length of safety paths, and corridor width of the building's fire compartments (© Salvo 2021)

Compliance to fire regulations requires that an independent firewater ring main and a water pump be installed in the immediate vicinity of the building, for example in the basement, provided this space is cleared from garbage- an absolutely crucial requirement. However, installing a fire ring main involves digging a roughly one meter deep hole in the basement; this seriously threatens the continuity and stability of the foundations which will lose the ground counter-push in an almost century-long consolidated situation.

Secondly, the chief issues that affect compliance with fire regulations depend on how crowded the halls and rooms are (the number of people in each room) and the size of the openings (the width of the doors and corridors), given that university buildings comply to the regulations regarding schools. Therefore, since the classrooms in the tower in particular are overcrowded, the number of people must be reduced to avoid invasive interventions such as opening new doors and widening the existing ones. Reconfiguring fire safety paths to suit current crowding would not only require making alterations to the original spatial layouts, but also to the fixed furniture, such as the original doors, floors, and teachers' desks; it would also include eliminating the very original doors cut into the blackboards. On the other hand, a less than 20% decrease in the number of people present in the tiered lecture hall on the first floor- from 434 to 360- and less than 10% on the third floor- from 198 to 180 in each room- would be sufficient to avoid alterations.

Figure 24- Multifaceted fire safety planning strategy (© Salvo 2021)

Thirdly, the possibility of removing/relocating the fire escape stairs should be assessed against the need to protect escape routes throughout the building, and thus produce more damage. According to the specialists entrusted with reviewing the fire escape plans, removing the stairs from the courtyard would require

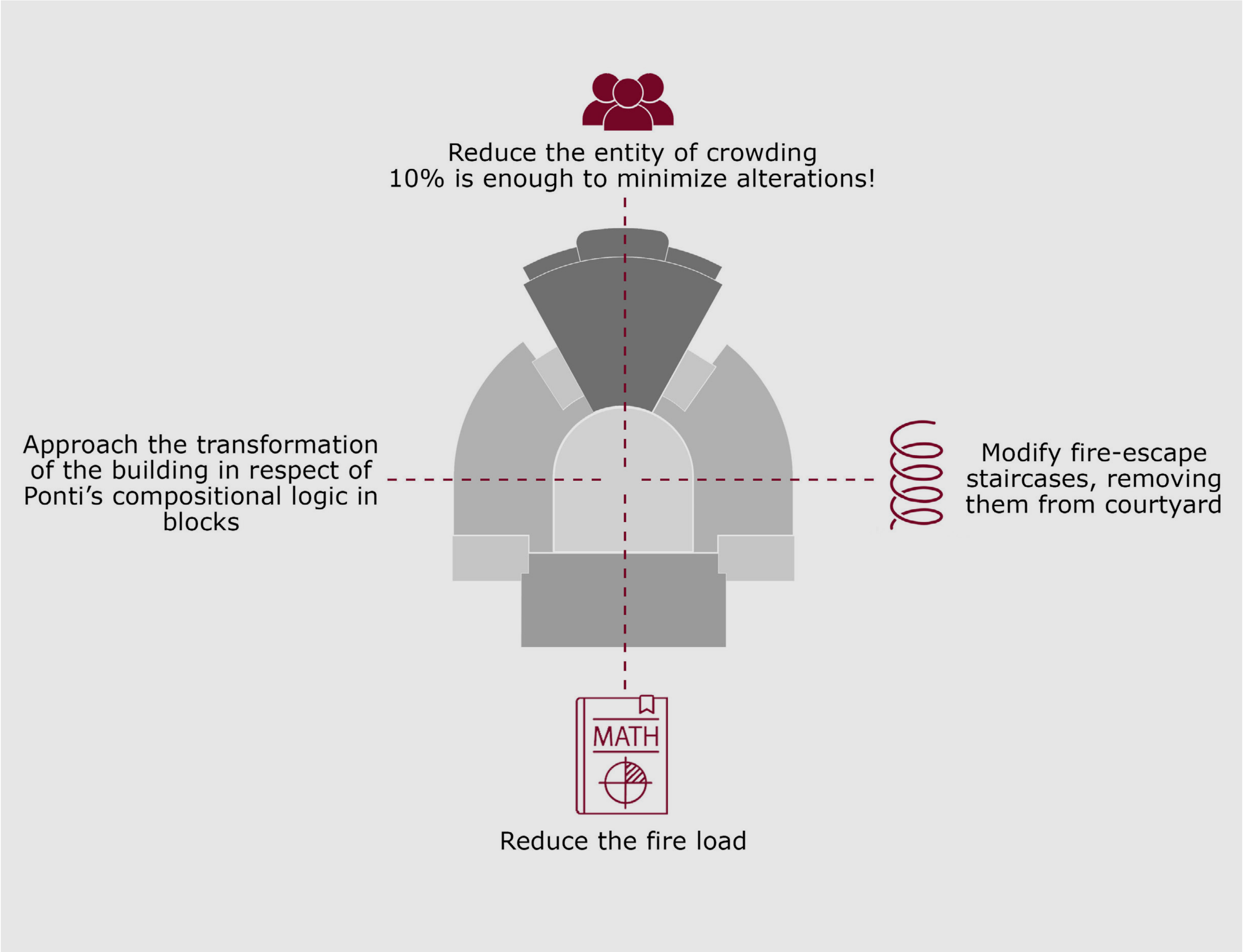
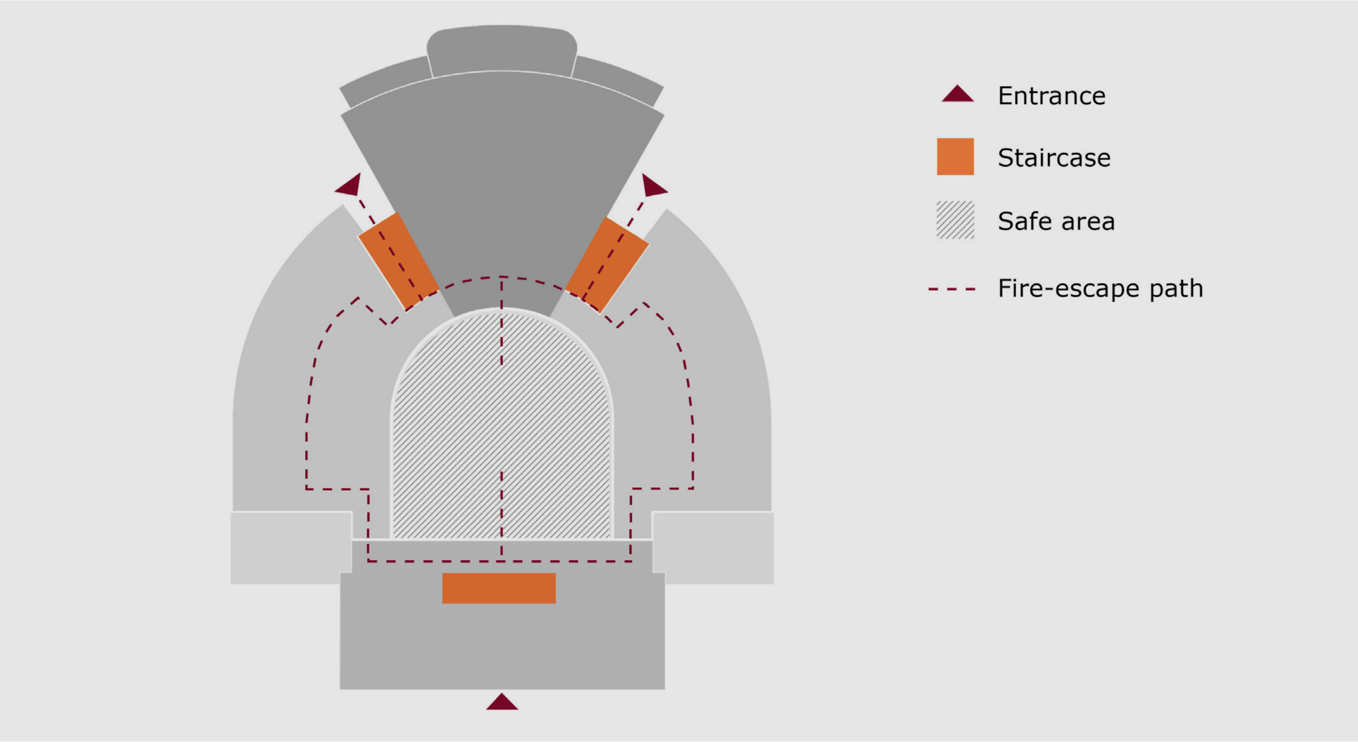


Figure 24 - Manyfold strategy to approach fire safety planning (© Salvo 2021)



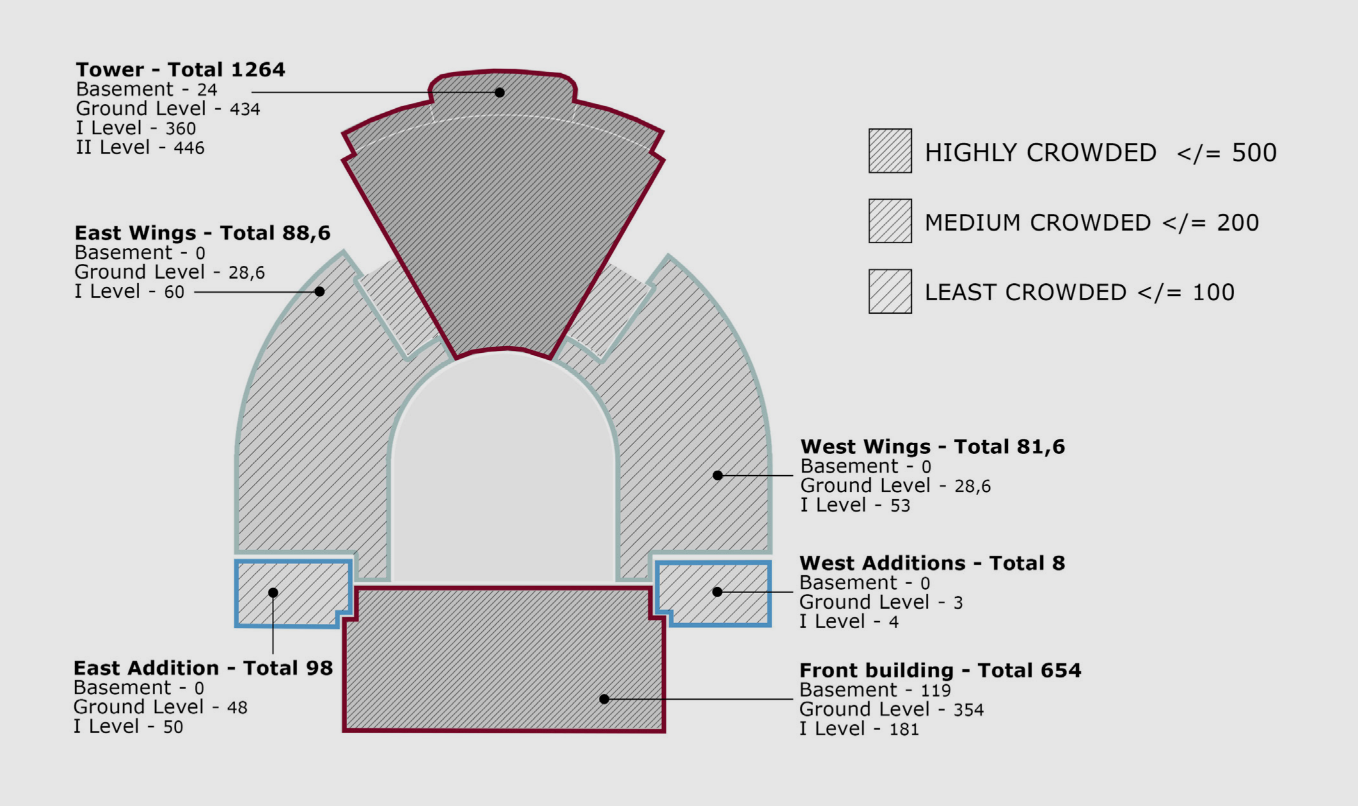


Figure 25 - The original distribution of the building: the three main blocks were separate and had independent entrances, paths, and staircases (© Salvo 2021)

Figure 26 - The overcrowding in each block, calculated as the sum of each floor: the 10% reduction of people present (and removal of additional bookshelves with journals) would be sufficient to avoid further modifications (© Salvo 2021)

the construction of two new ones elsewhere, with a minimum width of 120 cm, preferably in a symmetrical position (this would also respect the building's 'innate' symmetry). Whatever the solution, the relocation of the fire escape stairs must take into consideration that the building's spatial layout is complex and should not be separated from the overall reconfiguration of the distribution and position of interiors, paths, and entrances.

Although the purpose of the intervention is to ensure the safety of those who live and work in the building, the conservation of the building is also important, and possible. Compliance to fire safety regulations should therefore be conservative in order to avoid further damages. It is useful to remember that the building is protected by a decree issued by the Ministry of Culture: damages to the building are punishable by law.

In addition, alterations should not:

- produce a visual impact on the interior and exterior of the building, including the courtyard;
- affect the original concept of the building divided into separate blocks;
- affect the 1935 part of the building, and instead concentrate on the added parts;
- impact the original distribution, especially junction points between the blocks;
- occupy more space than necessary.

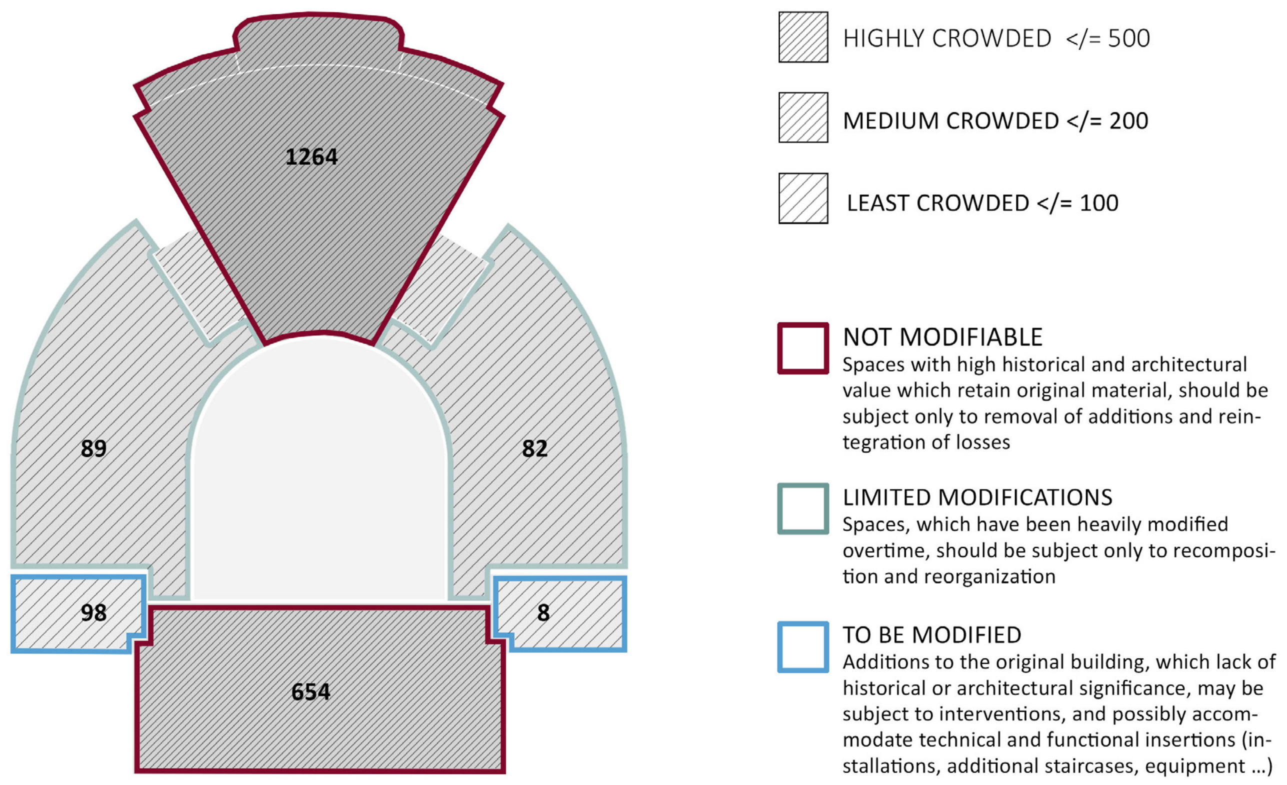
EVALUATION / SOLUTION	IMPACT								
	IMPACT ON USE	IMPACT ON HERITAGE VALUE	IMPACT ON STRUCTURE	IMPACT ON HISTORICAL VALUE OF THE BUILDING	IMPACT ON ARCHITECTURAL VALUE OF THE BUILDING	IMPACT ON AESTHETIC PRESENTATION OF THE BUILDING	COSTS	COMPLIANCE TO REGULATION	COMMENTS
LEAVE SITUATION UNALTERED	-	-	-	-	-	-	-	*	* NOT POSSIBLE - Lateral fire-escape staircases are no compliant and MUST be updated
REDUCE CROWDING OF 10-20%	VERY POSITIVE	POSITIVE	POSITIVE	POSITIVE	POSITIVE	POSITIVE	-	POSITIVE	PRODUCTIVE - Reduction of crowding - about 10-15 % in the tiered lecture halls - should be taken into consideration in any case, whichever decision is undertaken, as this facilitates the solution to compliance. Today the building bears a higher functional load than due; moreover, the presence of students (not only Math students) is concentrated in the Tower of classrooms and on specific days. Current statistics and forecasts on number of students and professors should be carefully analyzed, together with the distribution of math students in other building.
REPLACE THE EXISTING STAIRCASES IN THE COURTYARD WITH NEW ONES	POSITIVE	NEGATIVE	NEUTRAL	NEGATIVE	NEGATIVE	VERY NEGATIVE	NEGATIVE	POSITIVE	COUNTERPRODUCTIVE - Except for the immediate
REMOVE ONE OF THE THREE EXISTING STAIRCASES BUT COMPLY FURTHER TO FIRE REGULATIONS	POSITIVE	POSITIVE	NEUTRAL	POSITIVE	NEUTRAL	POSITIVE (?)	NEGATIVE	NEUTRAL	NOT PRODUCTIVE - This intervention implies important changes along the escape paths, and insertion of fire-resistant doors and panic handles. This kind of alterations have already affected the connection between curved wings and tower of classrooms, especially at the three levels of the lobbies.
SHIFT FIRE ESCAPE STAIRCASES FROM THE COURTYARD: TO <u>OUTSIDE</u> OF BUILDING	NEGATIVE	NEGATIVE	NEUTRAL	NEGATIVE	NEGATIVE	VERY NEGATIVE	NEGATIVE	NEUTRAL	COUNTERPRODUCTIVE - Several alterations to the distribution would be necessary in addition to the replacement of the staircases, but without improving the perception of the original conception of the building
SHIFT FIRE ESCAPE STAIRCASES FROM THE COURTYARD TO <u>INSIDE</u> OF BUILDING: IN THE TOWER OF CLASSROOMS	VERY NEGATIVE	VERY NEGATIVE	VERY NEGATIVE	VERY NEGATIVE	VERY NEGATIVE	NEGATIVE	VERY NEGATIVE	NEUTRAL	COUNTERPRODUCTIVE - This option implies a significant impact on the consistency of the original building and on the inner distribution.
SHIFT FIRE ESCAPE STAIRCASES FROM THE COURTYARD TO <u>INSIDE</u> OF BUILDING: WITH DUE CONSIDERATION OF THE HISTORICAL ANALYSIS	POSITIVE	POSITIVE	NEUTRAL	POSITIVE	NEUTRO	POSITIVE (?)	NEGATIVE	NEUTRAL	RESOLUTIVE - This research has identified areas of the building that are more/less sensible to alterations in terms of impact on heritage value and functional value. The correct positioning of the fire-escape staircases should not involve parts with high authentic consistency. Fire prevention could become an opportunity to recover valuable parts of the building.

Figure 27 - Compliance with fire escape regulations and interventions on the fire escape stairs: assessment of intervention options (© Salvo 2021)

An assessment of the pros and cons would suggest that it is also possible to shift the stairs to a less visible and invasive position, perhaps relocating them in a least sensitive position within the added volumes. The new position of the fire stairs should have the following characteristics: it should not affect the original building, i.e., have no impact on the parts of the building that date back to 1935; produce the least possible visual impact, but improve the perception of the original spaces, exterior and interior, including the courtyard.

On the other hand, the stairs should be placed where the external and internal routes for safe transit meet, or define places; they should possibly respect the original symmetry of the distribution, thus enhancing the original spatial block concept.
Given the fact that the current situation does not satisfy the regulations, and that changes must be made, said changes should enhance the building, possibly correct previous alterations, and involve the additions and not the original building fabric. It is important to reach a necessary compromise between a reduction in available space- e.g. seats, chairs, and study areas - and the conservation of the building, reconsidering crowding as a decisive factor.

One last important task is to update the protection decree; it should consider the furniture as significantly inputting into the building's value and indicate how to ensure preservation based on the conditions that accompany change.



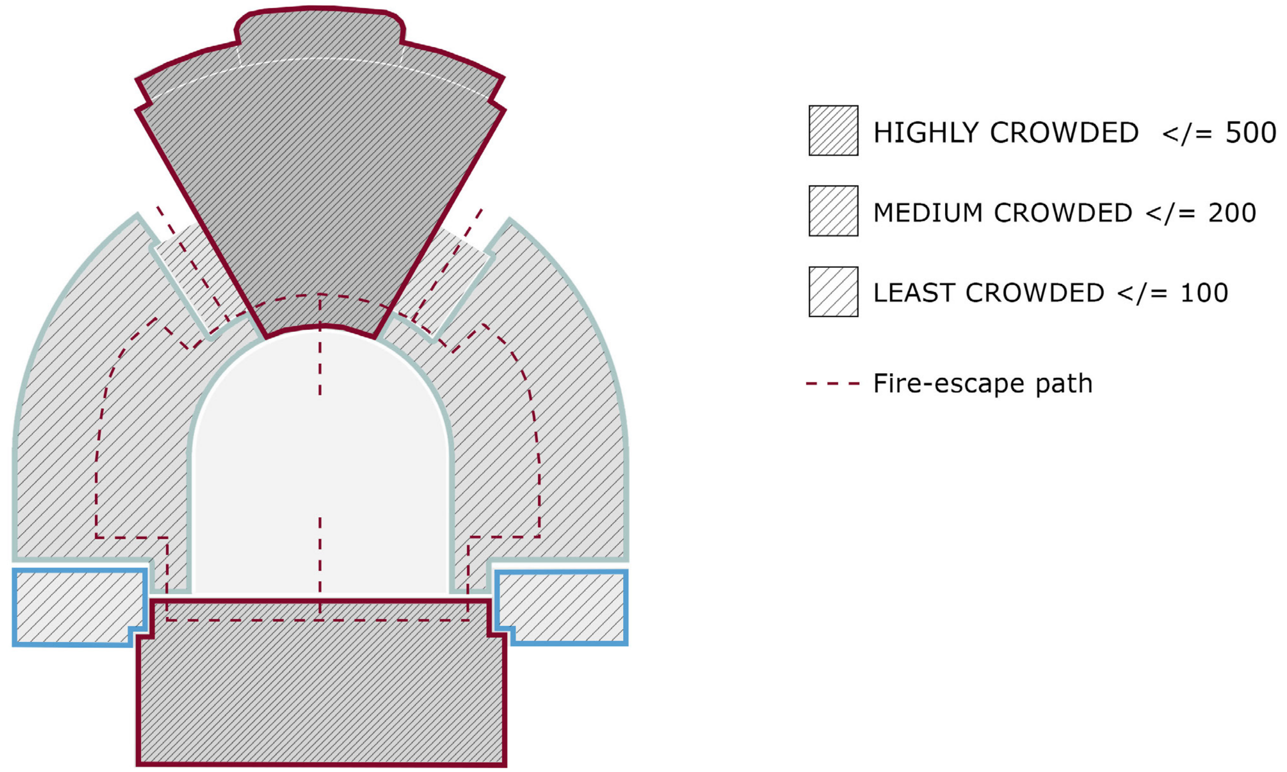


Figure 28 - Crowding and preference to modify the blocks based on a historical and architectural value assessment and authenticity (© Salvo 2021)

Figure 29 - A contextual interpretation of spaces, crowding, and fire escape paths, suggests that the two added blocks on either side of the front building are suited to accommodate functional additions and installations, including fire safety stairs (© Salvo 2021).

REALIGNING CONSERVATION PLANNING TO THE ORIGINAL CONCEPT OF THE BUILDING

A coherent conservation plan for the School of Mathematics should carefully evaluate each addition and establish a conservation /removal policy for each addition based on an assessment of its historical value and coherency with the concept of the building and current contingencies. And yet, the overall approach does not propose any kind of reconstruction or restoration of the original state of the building, as it was in 1935, which is instead a philological point of comparison for a critical assessment.

Undoubtedly the 1939 elevation of the curved west wing and the 1974 extensions on either side of the front building cannot be dismantled now since they are to be considered consolidated and irreversible. Instead, certain conditions can be discussed, modified or reinstated. They include: the presence of the IndAM in the curved west wing, the position of the fire escape stairs in the courtyard, the division of the triple height of the library with the ensuing loss of a decorative and colored filter; and the distribution of the interior spaces.

Instead, conservation policies should be established based on the original concept of the building and the overall value assessment that initially refers to the three-block design.

The approach is defined in terms of urgent measures, preliminary conservation, restoration, and enhancement interventions, depending on their priority, scope and impact.

As discussed in previous paragraphs, regulatory compliance to fire escape legislation is urgent and cannot be postponed. If considered in the context of a general reassessment of the building, this implies reorganizing functions and accessibility, including reducing overcrowding, especially in the classroom tower. A plan to reorganize all the systems- especially the electrical and photovoltaic systems- is part of the initial approach to further preliminary interventions.

The building requires general monitoring and maintenance, two interventions that are necessary for all buildings, especially old buildings. Traditional maintenance operations consist in meticulous, periodical monitoring of downspouts; the latter are all embedded in the walls and have already produced leaks, infiltrations, and breakages. Downspouts are loosely linked to the roofs and sewage system; these are two of the building's major weak points. In the last ten years the relationship between the building and natural elements- rain, wind, and sun- has become very unique. Scientists and specialists commonly observe that in Rome climate change has produced effects in terms of rainfall and increased temperatures, combined very intense meteorological events. Frequently considered as the 'tropicalization' of the weather, rainfall appears concentrated and severe in the intermediate seasons, combined with strong winds, while temperatures may rise drastically in the summer for considerable periods at a time. The consequences of these phenomena on the School of Mathematics appear to accelerate damage in the most exposed parts- namely the upper cornices- and in more and more problems regarding humidity, moisture (moss, efflorescence, etc.) and the growth of thick vegetation on the roofs and, in the general, in between the joints. The rate at which these damages multiple has not been specifically measured; this makes monitoring, attention to, and continuity in research even more valuable.

Front building

This is certainly the most important feature of the complex, and the library is undoubtedly its most valuable space. Regaining the triple height of the reading room is crucial to reestablish Ponti's architectural concept and should be considered a step towards a 'chain reaction' of virtuous interventions.
In other words, the elimination of the horizontal element added in 1954 is an excellent initiative, highlighting a new approach to the building's conservation. The operation is quite easy, affordable, and localized, but requires a new perspective with which to view the future of the building. In practical terms, it would require that several working areas be eliminated, i.e., one or two offices.
This would provide enough space to reorganize the functions and uses of the offices on the first floor and library reading room. A transparent partition between the 'Aula Ponti' would be enough to mitigate the direct link between the two floors and, as a result, any thermal and acoustic disturbance. A new policy regarding behavior in the library would also be necessary.

Material conservation refers instead to the conservation and care of the most exposed parts, especially the crowning frame, skylights, roofs, and the travertine balcony; work is urgent since these parts also represent a possible public safety hazard. In addition, the structure and travertine cladding of the balcony overlooking the courtyard should be monitored and investigated further. An accurate monitoring of the travertine cladding of the front façade and the Litoceramica cladding of the rear façade are less alarming, but should also be considered since earthquakes may loosen these unstable elements.

Finally, the big window in the middle, once occupied by the stained glass window designed by Ponti, deserves a special mention. The destruction of this work of art, designed and built in 1935, should be considered a true 'loss', as it is impossible to recover other than through virtual reconstruction with the support of AR digital technologies, as in the case of the 2017 projection. This experience could be repeated, considering the amount of scientific data acquired during this research, and become a permanent fixture. An open competition call for ideas to compensate the loss, with new translucid colored glass for the big window, would highlight this matter both nationally and internationally.

Figure 30 - The main facade of the School of Mathematics at end of the lighting performance that re-enacted the stained-glass window designed by Ponti, on the night of November 24, 2017 (© Lanzetta 2017)

Curved wings

The interior of the curved wings has long been altered by dividing the open spaces designed by Ponti for the drawing classrooms. There is very little chance that these will regain their original layout, although technically it would be rather easy. Secondary changes, such as the plugging of the windows for one third of their height is also technically possible, but again does not represent a priority for the conservation of the building.

More could be done, at least to highlight the parts that have been added to the original ones- e.g. by using different colors of paint or plaster with diverse effects on the added surfaces, e.g., on the ceiling of the "Aula Ponti"- as well as the continuity of the original open spaces, for example by inserting transparent glass windows along the upper part of the partitions; indeed, this has been implemented in some rooms. The original paving, a green 'battuto alla veneziana' floor, which has survived in good condition, may very well represent said continuity.

The removal- or reorganization- of the signage, systems, wiring, and ducts, which add background noise to the perception of the spaces, would contribute to the correct perception of the interiors. In addition, the exterior appearance of these volumes would benefit from the removal of metal parapets and balustrades on the roofs, in combination with the revision of the existing fire escape stairs.

Certainly, both the west wing and the whole building would greatly benefit from moving the IndAM to other premises, as the Department would regain not only space for teaching and research purposes, but also spatial and functional continuity, which is currently not available because this Institute is not open to students and professors. This could be considered a preliminary step towards solving regulatory compliance with fire safety regulations. General revision, maintenance, and conservation is also required for the exterior and interior finishings, especially the color of the painted plaster on the exterior.

Figure 31 - One of the classrooms created by dividing the drawing rooms in the curved wings (© Salvo 2021)

Classroom Tower

Although this part of the building retains most of the original fabric, the few additional partitions and fire walls have damaged perception of the space, especially in the main lobby and tiered lecture hall on the first floor. This is why the revision of the fire safety plan represents a potential source of damage unless it is accurately drafted taking into consideration the values at stake.

Again, there is little chance that the additions will be removed since this is not a priority for the conservation of the building. And yet, a careful design of the treatment of the surfaces- color, plaster rendering, etc.- would improve the general appearance of these magnificent spaces.

On the contrary, it is a matter of urgency to focus on the protection of the fixed furniture- the teachers' and students' desks and seats- and save it from the continuous damage produced by the installation of any sort of equipment. A dramatic increase in this kind of damage has been produced very recently during the pandemic when these halls were equipped with IT equipment (computers, cameras, videos screens ...) in view of either remote teaching or a combination of remote and in-person teaching.

Figure 32 - The lobbies of the classroom tower towards the courtyard, on the ground floor (© Salvo 2021)

Figure 33 - The big vertical window providing light to the lobbies on the three floors of the classroom tower; top-down view (© Salvo 2021)

Figure 34 a/b - The landings on the first floor (a) and second floor (b) of the staircases in the classroom tower (© Salvo 2021) Figure 36 - The tiered lecture hall on the second floor in March 2021 during installation of IT equipment for remote teaching (© Salvo 2021)

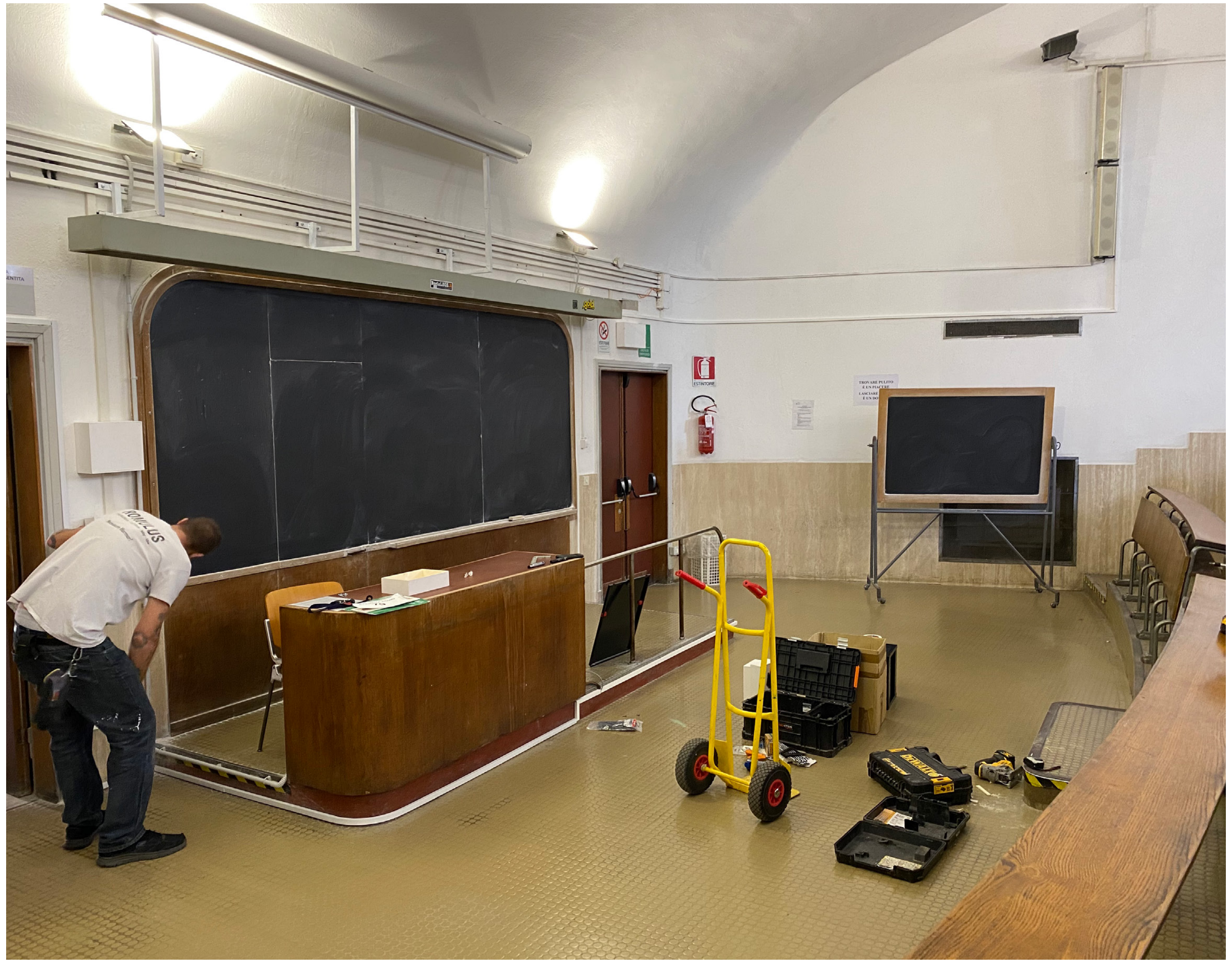


Figure 35 - The hall of the classroom tower on the first floor; note the niche over the door leading to the staircase, closed by a wall and a fire door (© Salvo 2021)

Figure 36 - The tiered lecture hall on the second floor in March 2021 during installation of IT equipment for remote teaching (© Salvo 2021)

Courtyard

The courtyard has a great architectural and functional potential, currently hindered by the presence of the fire safety stairs. Hopefully these will soon be removed as part of the reorganization of the general plan for the building. In any case, an urgent solution should be found regarding their material degradation, interaction with the roofs, and the exponential growth of vegetation where the courtyard touches the building. Should the joints be once again filled with grass and periodically maintained, this ostensibly non-influential detail would contribute to the correct interpretation of this key space in Ponti's composition.

Furniture and collections

The first thing that has to be done to protect the furniture from being broken up even further is to revise the Protection Decree, perhaps by drafting a specific document for the School of Mathematics, integrating and enhancing the general decree referred to the University campus. The document could benefit from this research and acknowledge Ponti's work as Gesamtkunstwerk, not only highlighting its historical and architectural values, but also the value of its furniture and book collections that should be considered integral parts of the building. The decree should consider the fixed and movable furniture as a historical 'witness', but also as a typical product of Ponti's design since he worked closely with many companies that already produced very modern furniture in the Thirties. In order to protect this important heritage a complete and systematic inventory must be provided, perhaps on behalf of the work already done within this research; each piece must be classified so that no action - such as moving, changing, repairing, adjusting or disposing of said pieces- can be implemented without specific authorization.

Raising awareness by initiating an information campaign targeting the academic staff and students would also help to increase respect for these historic pieces and instill pride among the entire community since they are the ones who have the opportunity to continue using and appreciating them. The cleaning staff should also be trained to correctly handle and clean the furniture, surfaces and frames, using the most appropriate cleaning supplies.

Naturally, a general reorganization plan should initially focus on cleaning, repairing, preserving and maintaining the original pieces; it should include guidelines for choosing new pieces of furniture, and probably also the removal of the redundant, insignificant objects that clutter the rooms. In the end, at least one space - i.e. the professors' lounge in the front block- could be philologically recreated using the original furniture plus a few integrations. This would provide an example of an original "Ponti interior", similar to the reconstruction of the interiors designed by Ponti and displayed at the exhibition entitled Tutto Ponti archi-designer held in Paris in 2018.

The ancient book collection, so closely linked to the creation of the library and the birth of the School of Mathematics, also requires specific, professional treatment. This treatment should be included in the conservation management plan and could represent a further, invaluable expansion of this research.

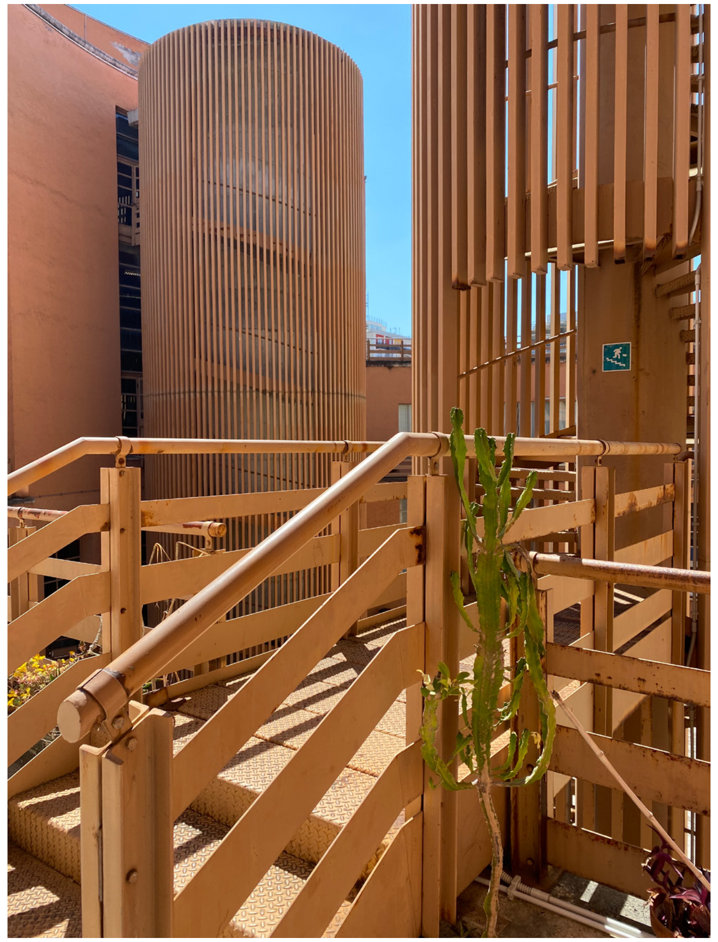


Figure 37 - Visual effects produced by the metal cages of the fire escape stairs (© Salvo 2021)

Figure 38 - Reconstruction of the interior of the Rector's Office at the University of Padua designed by Ponti in the late Thirties, and displayed at the exhibition Tutto Ponti archi-designer, Musée des Arts Decoratifs, Paris 2018 (© Salvo 2018)

NOTES

1. Demolition only affected the so called 'Casermetta' (military barrack), designed by Gaetano Minnucci and Eugenio Montuori, to create space for the secretariat building in the late Seventies.
2. Continuity between pre- and post-war Italian life has been a matter of discussion during the complex process of elaborating the difficult heritage left by the dictatorship in all aspects of Italian culture; it should perhaps be assumed as a general framework for critical interpretation.
3. The same may be said for the metal and wooden window frames. The first, the so-called 'ferrofinestra', had been repeatedly produced by the Curti company before and after the war, while the wooden frame belonged to Italy's long-standing traditional that continued well after the war.
4. The IndAM had wanted to move to new premises for years, but unfortunately at this point the solution had not been found.
5. Sapienza is one of the biggest universities in Europe; the reform of Italian education system, enacted by law in 2010, strongly impacted academic life, which is now adapting to the new conditions.
6. Italy has the highest number of World Heritage sites (58 against the 48 in China although the latter are spread in an incomparably bigger territory); this indicates the complexity of Italian cultural heritage.
7. Brandi 1956.
8. Pilot program 1976.
9. A concise but effective narration of the cultural background, story, and protagonists of the "Pilot Program for heritage conservation planning in Italy" is provided in Petraroia 2022.
10. Petraroia 2022, p. 3 (translated by S. Salvo).
11. Castelli 1997, La Carta del Rischio 2001; Accardo, Giani, Giovagnoli 2003.
12. Pilot Program 1976.
13. Petraroia 2022, p. 15.
14. Guidelines 2005. Following the issue of the General Act on Cultural Heritage n. 42, 2004, in 2017 the Ministry of Culture revived the Conservation planning project – referred to article 29/ paragraph 5 of the law – and organized a research group to establish the guidelines for its implementation at national level.
15. Biscontin, Driussi 1999.
16. Petraroia 2014.
17. In English: Accardo, Giani, Giovagnoli 2003; Accardo, Altieri, Cacace, Giani, Giovagnoli 2003. The project is also described in La Carta del Rischio 2001; Petraroia, Della Torre 2008 and more recently, in relation to its digital implications, in Accardo, Cacace, Rinaldi 2005.
18. Maintenance and conservation planning are part of the requirements indicated in the General Law for the protection of cultural heritage n. 42 of 2004; these requirements are compulsory for public administrations.
19. Canziani 2009.
20. La conservazione programmata 2003; Petraroia 2006.
21. Salvo in print, but 2022.
22. Petraroia 2022, p. 40-41.
23. The stairs in the courtyard were installed shortly before the Protection Decree of 1989: "Before the recent adaptation to the regulations established by Law 818/1985, the courtyard appeared well maintained, with the internal elevation of the building in gray-yellow Litoceramica: the paving made of irregular travertine slabs with grass joints is compromised by the presence of three cylindrical-shaped stairs", Protection Decree Declaration of historical significance of Rome's University Campus, August 2, 1989, Ministry of Cultural and Environmental Heritage.
24. In 2011, 2012, 2013 Sapienza's Ancient Theatre organization 'Theatron' staged a Greek tragedy in the courtyard. These performances highlighted the architectural qualities of this area, recalling the classical matrix on which Ponti based his design. These plays became an annual summer performance attended by a huge crowd.
25. This is also due to the permanent lack of space within the University campus, especially as regards study courses in Sciences, so much so that classes of specific courses sometimes 'migrate' from one building to the other depending on the number of enrolled students; these changes are modified accordingly each year.
26. According to Italian law, this cannot be more than 60 meters.
27. Installing the firewater ring mains in the basement requires lowering the paving by one meter; it should be preceded by preliminary trenching in order to test the situation.
28. IndAM has long since deliberated to move to new premises, but unfortunately has not yet found a new venue; Cacace, Giovagnoli, Gaddi, Cusano, Bonanni 2014.

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TIMETABLE OF INTERVENTIONS AND MAINTENANCE
Simona Salvo

* All interventions should be accompanied by a photographic campaign, survey and research; mapping of the state of conservation prior to the intervention should be drawn up and updated during the works.

	URGENT	PRELIMINARY	CONSERVATION	MAINTENANCE	RESTORATION	VALORIZATION & ENHANCEMENT
			TO BE PROGRAMMED	TO BE REPEATED *SEE CHRONOPROGRAMME	"ONCE ONLY"	"HAULING INTERVENTIONS"
BUILDING	REGULATORY COMPLIANCE to FIRE ESCAPE LEGISLATION - installation of firewater ring main in the basement. REORGANIZATION of FUNCTIONS AND USES REORGANIZATION of ACCESSIBILITY – pairs with compliance to fire safety rules. ROOFS - cleaning, removal of dirt, rubble and waste, vegetation. BASEMENT FLOOR - cleaning, retrieve of furniture, removal of debris, garbage and dirt. PLANNING OF INSTALLATIONS REORGANIZATION - removal of improper interaction of wiring, ducts and cabling of all kinds, with reinforced concrete structures (basement level); reorganization of wiring, ducts and cabling in corridors, aisles and lobbies behind false ceilings. DOWNPIPES - Inspection, cleaning, reintegration, and reinstatement of finishes.	REORGANIZATION of TEACHING ACTIVITY - decrease of number of users (students and teacher). The scope is to reduce crowding of classrooms, especially tiered lecture hall III, IV, V NON-DESTRUCTIVE SAMPLING AND ESSAYS - Planning and execution of further specific preliminary investigations REDESIGN of FIRE SIGNAGE – replacement of current system with new design TRAINING of CLEANING STAFF - about products to be used, specific accuracy towards furniture, window frames, stone paving, and cladding WINDOW FIXTURES - inspection, fixing, replacement of broken parts HEATING SYSTEM – Installation of thermostatic valves on all radiators ENERGY EFFICIENCY - Improvement of building envelope with addition of double glazing, where possible REPLACEMENT of lighting with LED bulbs and lamps INSERTION of timer s for automatic switching-off of lighting system according to time/use/area	FIRESCAPE STAIRCASES - removal and re-establishment of corresponding finishes: door and window fixtures of the Tower of classrooms, courtyard paving plastering of facades. SEWAGE SYSTEM AND MANHOLES - unblocking and cleaning REINFORCED CONCRETE STRUCTURE - repair elements damaged by oxidation / spalling / blemishes	ROOFS – monitoring, removal of dirt, rubble and waste and cleaning every 1 year WINDOW FIXTURES – inspection, fixing, replacement of broken parts SEWAGE SYSTEM AND MANHOLES - periodical unblocking and cleaning DOWNPIPES – Inspection and cleaning		REDEFINE THE PROTECTION DECREE – revised value assessment and inclusion of furniture CONTINUE ARCHIVAL RESEARCH (see box 1) COMPLETE INVESTIGATION ON MATERIALS AND CONSRUCTION TECHNIQUES with minimal destructive sampling with support of scaffolding and /or movable arms (see box 3) COMPLETE INVESTIGATION ON LOAD-BEARING STRUCTURES AND TESTS ON CONCRETE (see box 4) COMPLETE SURVEY OF ENERGY EVALUATION AND DEFINE COMFORT VARIABLES (see box 5) CONTINUE SCIENTIFIC DISSEMINATION INSTALLATION OF NIGHT LIGHTING SYSTEM REORGANIZATION OF ENTRANCE AND SURROUNDING PUBLIC SPACES REORGANIZATION OF INDAM - delocalization to other prestigious seat or reorganization within the building

Conservation Management Plan,
Timetable of interventions (© Salvo 2021)

	URGENT	PRELIMINARY	CONSERVATION	MAINTENANCE TO BE REPEATED *SEE CHRONOPROGRAMME	RESTORATION "ONCE ONLY"	VALORIZATION & ENHANCEMENT
FRONT BLOCK	CONCRETE CROWNING FRAME - consolidation, cleaning, reintegration, protection. TRAVERTINE BALCONY ON THE COURTYARD – propping, removal of broken pieces, cleaning, passivation of metal clamps, re-adhesion of pieces, protection. BOOK DEPOSIT SKYLIGHT - LIBRARY SKYLIGHT – monitoring of waterproofing resins applied in 2013	TRAVERTINE CLADDING – monitoring. LITOCERAMIC CLADDING – monitoring. ENERGY EFFICIENCY – Replacement of single glazing of the great window with double glazing	LIBRARY SKYLIGHTS GLASS-CEMENT BLOCKS - removal of waterproofing resins and application of protective film (to be monitored and repeated). BOOK DEPOSIT SKYLIGHTS GLASS-CEMENT BLOCKS - removal of waterproofing resins and application of protective film (to be monitored and repeated). LIBRARY SKYLIGHT WINDOWS – removal of paint, reactivation of operability, maintenance of hinges and handles. TRAVERTINE SLAB CLADDING – cleaning, reintegration, protection. LITOCERAMIC CLADDING - cleaning, reintegration, protection. CONCRETE CROWNING – Cleaning, reintegration of rebar covers, where necessary, protection. METAL INSCRIPTION - inspection of anchoring system and cleaning. WIRING, DUCTS AND CABLING – revision and reorganization INSTALLATION of thermo-hygrometric system ad hoc for the ancient book collection	LIBRARY SKYLIGHT WINDOWS – monitoring and inspection TRAVERTINE SLAB CLADDING - Cleaning and application of biocide, if necessary, every 6 months / monitoring of joints and cracks every 1 year / monitoring and comparison of overall condition and with previous mapping every 1 year CONCRETE CROWNING - Cleaning of surface, disinfection from biological deposits every 6 months / monitoring and comparison of overall condition and of cracks and grout adhesion with previous mapping, application of protective film every 1 year / application of converter on exposed iron bars where necessary 2 years / LITOCERAMIC CLADDING - Cleaning and application of biocide, if necessary, every 6 months /monitoring of cracks and adhesion of bricks every 1 year / monitoring and comparison of overall conditions with previous mapping every 2 years. DOWNPIPES - monitoring and cleaning WOODEN WINDOW FIXTURES - inspection, fixing, replacement of broken parts, protection METAL WINDOW FIXTURES – LIFT + ELEVATOR - maintenance of electric mechanism, of surfaces and finishes. FINISHES - MARBLE PAVING Cleaning, monitoring of slabs and protective treatment FINISHES - LINOLEUM PAVING Cleaning and monitoring LIBRARY and BOOK DEPOSIT SKYLIGHT - monitoring of glass cement blocks and window fixture.	LIBRARY - reinstatement of the triple height of the reading room with removal of slab and partition wall at level I (Aula Ponti). INTERIORS - Recomposition of original furniture in at least one of the professors' offices with light fixtures, windows, doors and colors.	STAINED-GLASS WINDOW - Permanent installation of a nightly projection of the image of the original stained-glass window designed by Ponti on the window on behalf of the knowledge acquired with this research.

	URGENT	PRELIMINARY	CONSERVATION	MAINTENANCE TO BE REPEATED *SEE CHRONOPROGRAMME	RESTORATION "ONCE ONLY"	VALORIZATION & ENHANCEMENT
CURVED WING EAST	REVISION OF COOLING TOWERS	REPLACEMENT of individual heating and cooling system with centralized system	FACADES - investigation of detached patches of plaster, removal of last layer of paint, consolidation, painting with lime-based paint with apt color. STONE INSCRIPTION - inspection of anchoring system and cleaning		CLASSROOMS at I LEVEL – reinstatement of distribution aisle on courtyard side and remodulation of single classrooms. OFFICES at II LEVEL – reinstatement of distribution aisle on courtyard side and remodulation of single classrooms TREATMENT OF SURFACES – removal of red paint, reintegration and consolidation of plaster and reestablishment of clear color (white-travertine).	
CURVED WING WEST	REVISION OF PHOTOVOLTAIC SYSTEM	REPLACEMENT of individual heating and cooling system with centralized system	FACADES - investigation of detached patches of plaster, removal of last layer of paint, consolidation, painting with lime- based paint with apt color. STONE INSCRIPTION - inspection of anchoring system and cleaning	DOWNPIPES - monitoring METAL WINDOW FIXTURES – Monitoring, minor replacements, cleaning with special products, coating WOODEN WINDOW FIXTURES – Monitoring, replacement of broken parts, protection of surface with oil FINISHES - PAINTED PLASTER - Cleaning, monitoring FINISHES - MARBLE PAVING - Cleaning, monitoring of slabs and protective treatment FINISHES - LINOLEUM PAVING - Cleaning and monitoring	OFFICES at I LEVEL – reinstatement of distribution aisle on courtyard side and remodulation of single classrooms INDAM - Redistribution and reorganization TREATMENT OF SURFACES – removal of red paint, reintegration and consolidation of plaster and reestablishment of clear color (white-travertine)	
TOWER of CLASSROOMS	FAKE TRAVERTINE FLASHINGS - consolidation, cleaning, reintegration, protection. PREVENTION FROM DAMAGES TO FIXED FURNITURE IN THE TEARED LECTURE HALLS (students' and teachers' desks) -	REQUALIFICATION of the original thermo-ventilation system	ELEVATOR – revision of electrical system, minor replacements, cleaning and protection of surfaces FALSE CEILINGS in TIERED LECTURE HALLS – removal and restoration of original ones	DOWNPIPES - monitoring METAL WINDOW FIXTURES – Monitoring, minor replacements, cleaning with special products, coating FINISHES - PAINTED PLASTER - Cleaning, monitoring FINISHES - MARBLE PAVING - Cleaning, monitoring of slabs and protective treatment FINISHES - LINOLEUM PAVING - Cleaning and monitoring CURTAINS - Replacement in the tiered lecture halls	TIERED LECTURE HALL II LEVEL - removal of partition wall and reinstatement of one hall. OUTER SURFACES – removal of red paint, reintegration and consolidation of plaster, layer of new paint color on philological basis (white-travertine?)	

	URGENT	PRELIMINARY	- CONSERVATION	MAINTENANCE TO BE REPEATED *SEE CHRONOPROGRAMME	RESTORATION "ONCE ONLY"	VALORIZATION & ENHANCEMENT
COURTYARD	MAINTENANCE OF CURRENT FIRE SAFETY STAIRCASES - in wait of changes to the general safety plan	PAVING – readjustment of travertine irregular slabs and reestablishment of grass joints	-	PAVING - maintenance of grass joints; check stability of travertine slabs. BASEMENT SKYLIGHTS - Monitoring, minor reparations	REMOVAL OF FIRE SAFETY STAIRCASES	PERIODICAL STAGING of THEATRICAL PERFORMANCES – in agreement with the department of Ancient Studies, Sapienza University
FURNITURE	REMOVE PIECES FROM BASEMENT - select furniture pieces that are subject to excessive usury, damaged or in bad conditions. PRELIMINARY INVENTORY - labeling and cataloguing of each peace, collection and recovery of furniture pieces in the basement and in other building of the campus.	INVENTORY – Coding of furniture – fix or movable – with number corresponding to catalogue.	CLEANING CONSERVATION AND PROTECTION OF PIECES MINOR REPLACEMENTS IN FIXED AND MOVABLE FURNITURE	METAL JOINTS AND HINGES - Monitoring, cleaning, lubrification with handy oil. TAPESTRY - Monitoring and control, treatment. WOODEN SURFACES - Monitoring, cleaning, surface treatment	MAJOR REPARATIONS AND REPLACEMENTS REPLACEMENT OF DAMAGED PIECES	PHILOLOGICAL RECOMPOSITION OF ONE INTERIOR WITH ORIGINAL PIECES REVISION OF PROTECTION DECREE – Inclusion of furniture within specificities. CONTINUE SURVEY AND INVENTORY OF FURNITURE (see box 1f)
ANCIENT BOOKS COLLECTION	EVALUATION OF RISKS (fire, humidity, insects, …)	REORGANIZATION AND SHIFT OF COLLECTION TO APPROPRIATE ROOM PROFESSIONAL CLEANING and DUSTING of the books, especially on open shelves INSTALLATION OF SPECIAL MICROCLIMATE SYSTEM for ancient books collection storage room	INSTALLATION OF SPECIAL FIRE SAFETY SYSTEM IN THE ROOM FOR ANCIENT BOOKS COLLECTION INSTALLATION OF THERMO-HYGROMETRIC REGULATED SYSTEM AND MONITORING	PERIODICAL REMOVAL OF DIRT FROM BOOKSHELVES AND SPECIALIZED CLEANING OF ANCIENT BOOKS COLLECTION		ORGANIZATION OF DIDACTIC VISITS AND EXHIBITIONS

	INTERVENTION		YEAR 1												YEAR 2				YEAR 3		YEARS 4-5	YEARS 6-10	YEARS 10-20
			MONTH 1	MONTH 2	MONTH 3	MONTH 4	MONTH 5	MONTH 6	MONTH 7	MONTH 8	MONTH 9	MONTH 10	MONTH 11	MONTH 12	MONTHS 13-15	MONTHS 16-18	MONTHS 19-21	MONTHS 22-24	MONTHS 25-30	MONTHS 31-36	MONTHS 37-60	MONTHS 61-120	MONTHS 121-242
BUILDING IN GENERAL	ROOFS	Monitoring, and cleaning						*						*				*		*	*	*	*
	WINDOW FIXTURES	Inspection, fixing, replacement of broken parts												*				*		*	*	*	*
	SEWAGE SYSTEM AND MANHOLES	Periodical unblocking and cleaning						*						*				*		*	*	*	*
	HYDRAULIC SANITARY SYSTEM	Periodical maintenance												*				*		*	*	*	*
	ELECTRIC SYSTEM	Periodical maintenance (elevators and lifts)												*				*		*	*	*	*
FRONT BLOCK	LIBRARY AND BOOKDEPOSIT SKYLIGHT	Monitoring of glass cement blocks and window fixture												*				*		*	*	*	*
	LIBRARY SKYLIGHT WINDOWS	Monitoring and inspection												*				*		*	*	*	*
	CONCRETE CROWNING	Monitoring and Protection			*			*			*			*		*		*	*	*	*	*	*
	TRAVERTINE SLAB CLADDING	Monitoring and cleaning												*				*		*	*	*	*
	LITOCERAMIC CLADDING	Monitoring												*				*		*	*	*	*
	DOWNPIPES	Monitoring and cleaning						*						*				*		*	*	*	*
	WOODEN WINDOW FIXTURES	Monitoring, replacement of broken parts, protection of surface with oil												*				*		*	*	*	*
	METAL WINDOW FIXTURES	Monitoring, minor replacements, cleaning with special products, coating												*				*		*	*	*	*
	FINISHES - MARBLE PAVING	Cleaning, monitoring of slabs and protective treatment												*							*	*	*
	FINISHES - LINOLEUM PAVING	Cleaning and monitoring												*							*	*	*
CURVED WINGS	FAUX TRAVERTINE CORNICES	Monitoring, cleaning from vegetation, mapping of degradation processes			*			*			*			*		*		*	*	*	*	*	*

Conservation Management Plan ,
Timetable of Maintenance works (© Salvo 2021)

	DOWNPIPES	Monitoring and cleaning						*						*				*		*	*	*	*
	WOODEN WINDOW FIXTURES	Monitoring, replacement of broken parts, protection of surface with oil												*				*		*	*	*	*
	METAL WINDOW FIXTURES	Monitoring, minor replacements, cleaning with special products, coating												*				*		*	*	*	*
	FINISHES - PAINTED PLASTER	Cleaning, monitoring																*			*	*	*
	FINISHES - MARBLE PAVING	Cleaning, monitoring of slabs and protective treatment												*							*	*	*
	FINISHES - LINOLEUM PAVING	Cleaning and monitoring												*							*	*	*
TOWER OF CLASSROOMS	DOWNPIPES	Monitoring and cleaning						*						*				*		*	*	*	*
	METAL WINDOW FIXTURES	Monitoring, minor replacements, cleaning with special products, coating												*				*		*	*	*	*
	FINISHES - PAINTED PLASTER	Cleaning, monitoring																*			*	*	*
	FINISHES - MARBLE PAVING	Cleaning, monitoring of slabs and protective treatment												*							*	*	*
	FINISHES - LINOLEUM PAVING	Cleaning and monitoring												*							*	*	*
COURTYARD	PAVING	Monitoring and cleaning of grass joints; check stability of travertine slabs						*						*				*		*	*	*	*
	BASEMENT SKYLIGHTS	Monitoring, minor reparations												*				*		*	*	*	*
FURNITURE	METAL JOINTS AND HINGES	Monitoring, cleaning, lubrification with handy oil						*						*				*		*	*	*	*
	TAPESTRY	Monitoring and control, treatment						*						*				*		*	*	*	*
	WOODEN SURFACES	Monitoring, cleaning, surface treatment						*						*				*		*	*	*	*
ANCIENT BOOK COLLECTION	BOOKSHELVES	Cleaning, removal of dust						*										*		*	*	*	*
	BOOKS AND DOCUMENTS	Monitoring, cleaning, removal of dust, xylophagous insects check			*			*			*					*		*	*	*	*	*	*

LOVE YOUR CHAIR AND IT WILL LAST FOREVER!

Flaminia Bardati

The furnishings and doors of the School of Mathematics represent a heritage of great historical and artistic interest, which deserves to be preserved and enhanced. The abacus and the inventory mapped on each plan of the building constitute a first tool to monitor the consistency of this heritage and gain the attention of the public, with the aim of urging Sapienza to provide each item with an inventory number and plan the restoration of some of the pieces.

As in the case of the building, some furnishings- at least those dating back to the 1930s- should be officially protected, so to monitor and orient any intervention planned on these objects, perhaps also with the supervision of a special committee including experts in the field of furniture conservation and the Governance of the School of Mathematics. This would oversee the planning interventions and initiatives, providing precise instructions about materials, colours and work processes to be delivered to upholsterers and carpenters in charge of repairs and restoration works. In addition, technological upgrading of the classrooms - which has been and will be necessary in future – will be correctly approached, especially in view of applying microphones, digital devices and wiring to fixed furnishings, in order to reduce the visual impact and the material damage produced by cables and technical boxes, notwithstanding the major costs that this implies.

Still, this heritage risks every day to be further modified and damaged due to lack of consciousness of its value. Therefore, one of the main objectives consists in reviving the daily users' awareness of the historical

Figure 1 - A chair 'Model 14' by Parma and a stool by Beltrami, abandoned in the basement albeit in perfect conditions (© Bardati 2021)

and artistic importance of these 'old', 'uncomfortable', 'odd' furnishings.

Almost all professors, scholars, students and staff that work (or 'live') in the School of Mathematics know that a famous architect named Gio Ponti designed the building, but few of them know that he also designed the furniture and the doors, and even fewer are able to discern original items from copies or others; probably none are aware of the fact that they are personally responsible for the conservation of such a heritage.
To raise the daily users' awareness of the importance and uniqueness of the "chair left in the darkest corner of their offices", usually covered by piles of paper and books, it is essential to trigger off a virtuous process of appreciation, conservation, enhancement, and correct use.

A brochure with short descriptions of each item, describing their history and indication their correct use, would definitely help to render the academic community a "heritage community" (As in the Faro Convention of 2005), and encourage their personal involvement in maintaining the furniture properly.
Such scope could be also reached by enhancing some specific sets of original furnishings, which appear most interesting: panels with short descriptions of the room and its furniture in the original display and condition, completed with historical pictures, could be placed in the atrium and in the classrooms of the front building, in the main hall of the library and in the classrooms of the rear Tower, in order to offer a general historical overview of the rooms and the basic information concerning seats and desks of current use.

When possible, and with slight effort, the objects that pertain to a specific room could be put back in their original location, as in the case of the Parma chairs that could be gathered in the main hall of the library, while other chairs today in the room could be moved elsewhere. The reading room of the library- which today is stacked with non-original furniture of all kinds - could take great advantage from a similar 'clean up'.

Figure 2 - A teacher's desk supplied by the firm Santi and a students' desks 'Model Milano' supplied by Beltrami (© Bardati).

Furniture of the Tower of classrooms also deserves much attention and care, as it participates to the general concept that structures one of Ponti's most interesting parts of the project. The rows of curved desks for the students, with integrated seats, represent a characteristic ensemble of the original design of the fan-shaped tiered lecture halls. They are similar to other desks supplied by the firm Liporesi for other buildings of the campus, but their curved shape renders them unique, such that the drawing of every row with its own dimensions and number of seats had to be provided for production. These have been heavily damaged in two occasions: in 1960 due to the subdivision of the tiered lecture hall at the third floor, and more recently due to regulatory compliance of the smaller classrooms at the ground floor where the fire escape paths have been adjusted in dimension. Furthermore, several seats of the tiered lecture halls have disappeared after breakage of small parts. The original supply provided by Liporesi consisted of 96 rows of variable lengths, for 1296 seats, but at present there are only 132 rows (72 'half-rows' and 60 normal rows) for 1086 seats: this must be preserved from further loss.

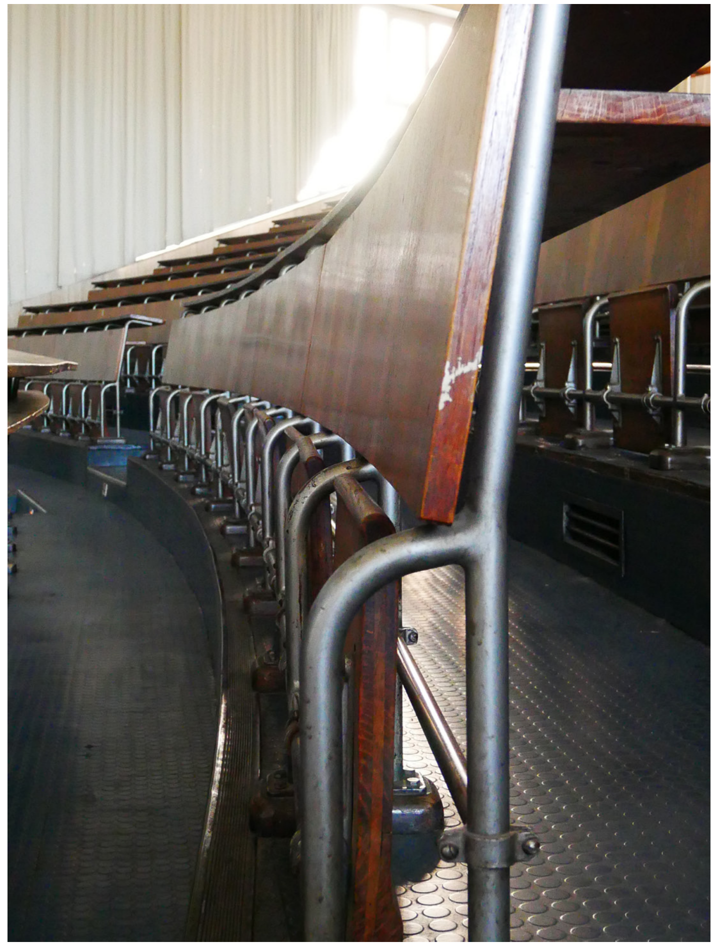

Figure 3a - A row of curved desks and seats by the firm Liporesi in the Tower of the classrooms (© Bardati 2021)

Figure 3b - One of the seats of the tiered lecture halls, dismissed for breakage of a metal part and stacked in the basement for disposal (© Salvo 2021)

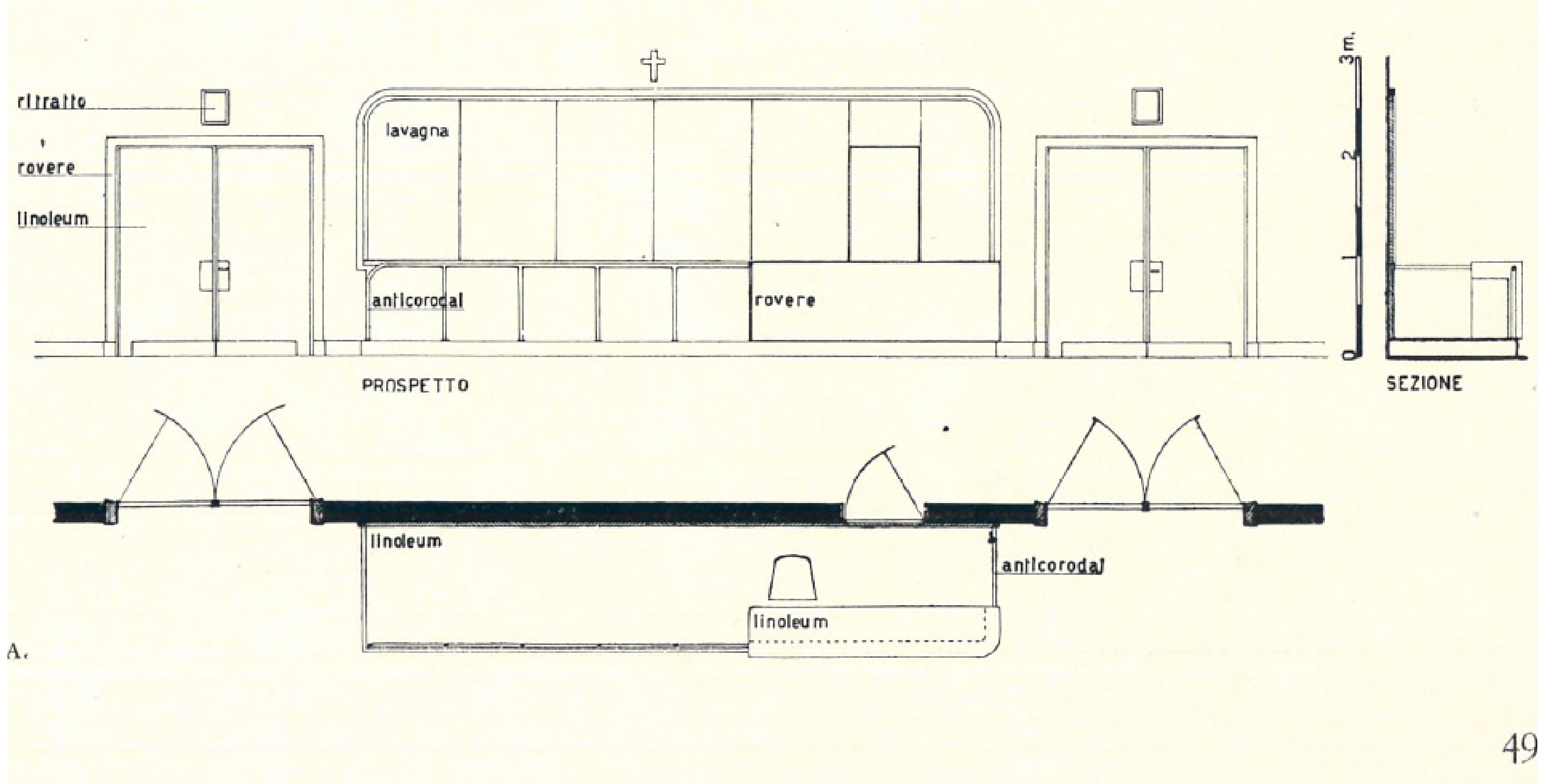

Figure 4 - The ‘wall system’ including footboard / blackboard / desk / railing and wooden wall veneering, with the door opening leading to the changing room; plan, elevation, section (BBL_drw_10)

Figure 5 - The blackboard on one of the tiered lecture halls with the door opening onto the changing room in the current condition (© Bardati 2021)

In the same classrooms the integrated ensemble composed of footboard / blackboard / desk / railing and wood veneering is also very characteristic of Ponti’s design, especially thanks to the door opening in the blackboard, that makes this “wall system” a tridimensional element that also includes the professors’ changing room, today obsolete. In 1935 this separate access to the classrooms was the expression of a precise and strong hierarchy between professors and students in their daily life at the campus, but nowadays, considering the experience imposed by the pandemic that has shown the importance of separating pathways, this distinction could turn useful. Therefore, the use of blackboard door and changing room could be easily retrieve, without the need for special safety equipment as they would be used by one person at a time. In any case, the containment of technological equipment for teaching purposes should also be observed.

Finally, the furnishings in chromed steel tube (tables, racks, armchairs), that has survived all odds but is currently dispersed in many rooms of the building, represent a lot with specific stylistic features, although they originally belonged to different rooms. Part of them has been placed in the “Aula Ponti” at the first level of the front building, while other pieces could be placed in the reading room of the library. This room still retains the original fixtures (apart from the addition of emergency exit,) and could be the right space where to recompose an interior the 1930s: such set-up would certainly arouse appreciation, respect, and care for what remains of the original furniture conceived by Gio Ponti for the School of Mathematics.

APPENDIX

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ABBREVIATIONS

Abbreviations have been used to indicate the provenience of archival documents, which have been a cross reference to all tasks of investigation. The code related to each document therefore indicates archive, typology of document (drw = drawing / dcm = document / pht = photograph / vdo = video) and progressive number with which the document has been filed in the research repository. The list of archives investigated during the research may be found in the Appendix at the end of this report.

Ex. ASS_dcm_05 = Sapienza Historical Archive_ document_ number 05

Archive Abbreviations

ASS = Archivio Storico Sapienza Università, Sapienza University Historical Archive

ADM = Archivio del Dipartimento di Matematica “Guido Castelnuovo”, Sapienza Università di Roma, Archive of the Department of Mathematics, Sapienza University

BFAR = Biblioteca della Facoltà di Architettura, Sapienza Università di Roma, Library of the School of Architecture, Sapienza University

Carlo Severati Archival Fund: BFAR_pht_11 (p. 49); BFAR_pht_04 (p. 94); BFAR_pht_05 (pp. 94, 128)

BFAF = Biblioteca della Facoltà di Architettura, Università degli studi di Firenze, Library of the School of Architecture, University of Florence

BUB = Biblioteca Universitaria, Università degli studi di Bologna, University Library, University of Bologna

ACS = Archivio Centrale dello Stato, State Central Archive
Gaetano Minnucci Archival Fund, 141, 254: ACS_pht_10 (pp. 114, 168, 276); ACS_pht_14 (pp. 167, 276); ACS_pht_18 (p. 277)

Gaetano Minnucci Archival Fund, 142, 256: ACS_pht_08 (pp. 61, 116); ACS_pht_22 (p. 79); ACS_pht_15 (pp. 166, 276); ACS_pht_30 (p. 273)
Gaetano Minnucci Archival Fund, 207, 205: ACS_drw_09 (p. 69)
Ministero Pubblica Istruzione Archival Fund, 33, 27: ACS_drw_03 (pp. 85, 117)
Allied Commission Control Archival Fund, 17, 1181C, 10404_144_16: ACS_drw_08 (p. 122)

ASR = Archivio di Stato di Roma, Rome State Archive

Genio Civile Archival Fund, 1028, Edifici universitari: ASR_drw_01 (pp. 64, 101); ASR_drw_02 (p. 250); ASR_drw_03 (pp. 64, 101)

ASC = Archivio Storico Capitolino, Historical Capitoline Archive

CSAC = Centro Studi e Archivio della Comunicazione, Università degli Studi di Parma, Study Centre and Communication Archive, Parma University

GNAM = Galleria Nazionale d’Arte Moderna, National Gallery of Modern Art, Rome

MAXXI = Museo Nazionale delle Arti del XXI Secolo, Centro Archivi di Architettura, Architecture Archive Center, MAXXI National Museum of the XXI Century Arts

AST = Archivio Storico, Triennale di Milano, Historical Archive of the Milan Triennale

ICCD = Istituto Centrale per il Catalogo e la Documentazione, Central Institute for Catalogue and Documentation

Aerofototeca Nazionale, Sara Archival Fund: ICCD_pht_08 (p. 63)
Aerofototeca Nazionale, Fotocielo Archival Fund: ICCD_pht_01 (p. 85)
Gabinetto Fotografico Nazionale: ICCD_pht_03 (p. 91); ICCD_pht_02 (pp. 92, 123)

ASL = Archivio Istituto Luce, Istituto Luce Archive, Cinecittà S.p.A., Rome

Frame da Giornale Luce n. B0453 del 1934, “Roma. Come proseguono i lavori della “Città universitaria”: ASL_pht_07 (p. 108)
Frame da documentario del luglio-agosto 1943, “La Città universitaria bombardata”: ASL_pht_21 (p. 121)

BHR = Biblioteca Hertziana, Fototeca, Istituto Max Plank per la Storia dell’Arte, Phototeque of the Bibliotheque Hertziana, Rome

Walter Kruft Archival Fund, NEG. U.Fi D611d17: BHR_pht_02 (p. 126)
Eberhard Schroter Archival Fund, NEG. U.Fi D611c13: BHR_pht_05 (p. 127)
Eberhard Schroter Archival Fund, NEG. U.Fi D611b09: BHR_pht_08 (p. 127)

ANS = Accademia Nazionale delle Scienze, National Academy of Sciences

ANL = Accademia Nazionale dei Lincei, National Academy of the Lincei, Rome

ASCCR = Camera di Commercio di Rome, Archivio Storico, Historical Archive of the Chamber of Commerce, Rome

ASCCM = Camera di Commercio di Milano, Monza-Brianza e Lodi, Archivio Storico, Historical Archive of the Chamber of Commerce oh Milan, Monza Brianza and Lodi

CRDAV = Centro Ricerca e Documentazione Arti Visive, Centre for Research and Documentation of Visual Arts, Rome

GPA = Gio Ponti Archive, Gio Ponti Archive, Milan

AFG = Archivio Francesco Guidi, Francesco Guidi Private Archive
AFS = Archivio Francesco Succi, Francesco Succi Private Archive

ACP = Archivio Claudio Procesi, Claudio Procesi Private Archive

ARS = Archivio Regni Sennato, Bruno Regni and Marina Sennato Private Archive

ACG = Archivio Carla Giovannone, Carla Giovannone Private Archive

APL = Archivio Ditta Palazzo della Luce, Palazzo della Luce company Private Archive

ASMS = Archivio Simona Maria Salvo, Simona Maria Salvo Private Archive

AFB = Archivio Flaminia Bardati, Flaminia Bardati Private Archive

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This is the list of the documents produced during the research funded by the Getty Foundation with the 2018 "Keeping It Modern" award and supported with a grant of 180.000,00 $. The research, developed between 2018 and 2021, would not have been possible without financial and cultural support form the Getty Foundation, to which we are deeply thankful.

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About Gio Ponti
* Selection of references dealing with the architect's artistic production (especially the projects in Rome of the 1930s), his editorial activity, and his projects for the University of Padua, and are therefore directly related to the School of Mathematics.

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