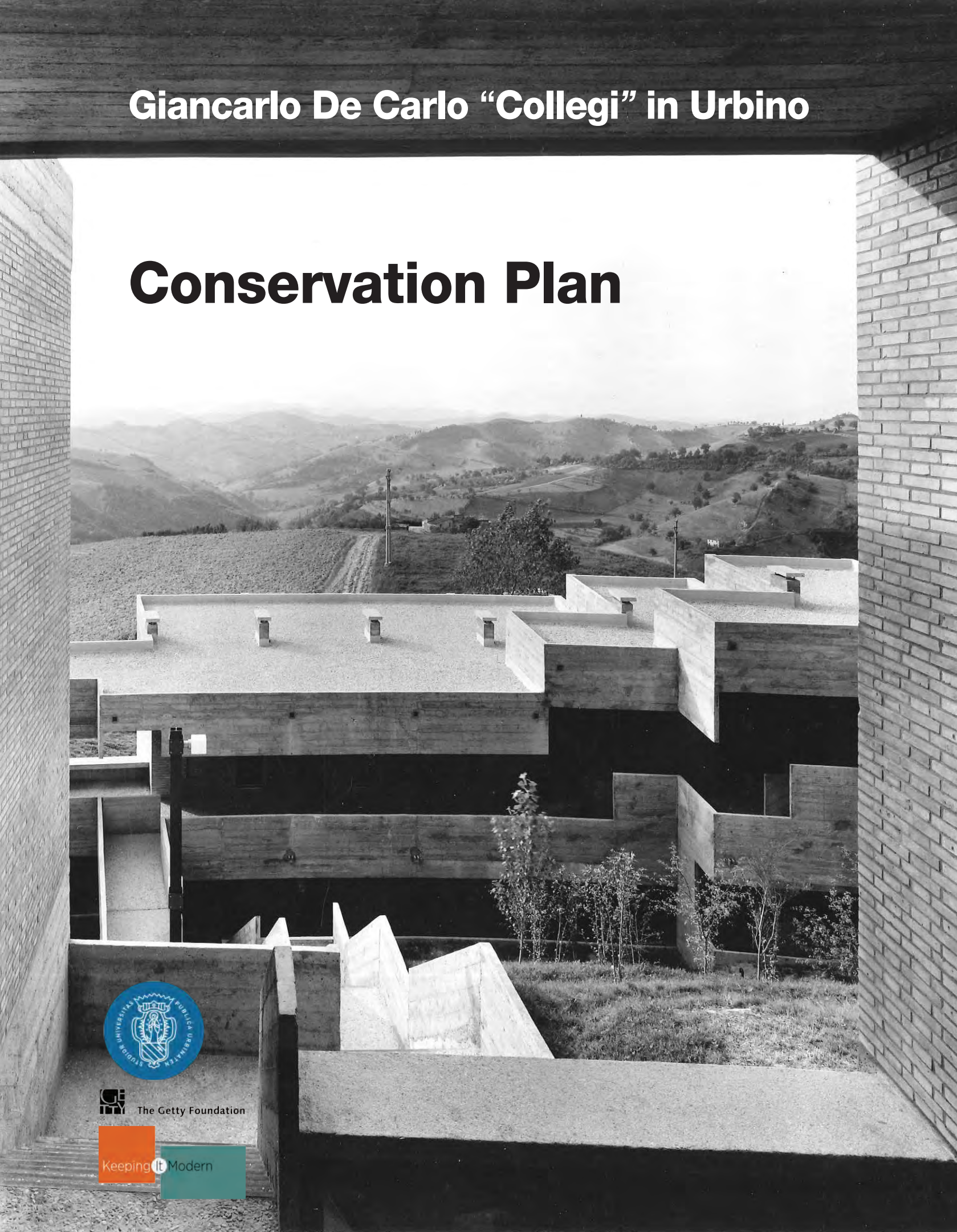
Giancarlo De Carlo “Collegi” in Urbino

Conservation Plan



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Keeping It Modern

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MTA Associati
Principal investigators: arch. Monica Mazzolani, arch. Antonio Troisi.
Research Group: arch. Andrea Chiarolini, Angela Mioni, arch. Jennifer S. Porro.
Task: Giancarlo De Carlo and the "Collegi";
The patterns of the city and of the landscape;
Social value of the Complex: Stakeholders
Written correspondence, projects at the municipal archives, testimonials;
Description of Complex;
From the description of the building to the identification of the opportunities for change;
Window and door frames: The current conditions, Analysis of the window frames and the knots in the woodwork, Looking for a solutions, Types of intervention;
Enhancement of the building's envelope performances: The Pilot site, Windows;
Towards a sustainable transformation; Chart of transformation, Change Management Policies: Plan Objectives, New buildings inside the area, Internal modifications;The "Colle",The "Tridente", The "Aquilone", The "Vela".
Doors and windows frame.
(Annex: 4. Concrete surfaces; 6. Survey of selected windows type and drawings and analysis of the new solution; 9. Interventions on the envelope in the "Collegi" and on the pilot site; 10. Lecture, workshop and publication)

Politecnico di Milano
ABC Department of Architecture, Built environment and Construction engineering
Principal investigators: arch. Ph.D. M.Paola Borgarino, prof. Stefano Della Torre (supervisor).
Research Group:, arch. DS. Cristina Ciovati, arch. DS. Margherita Pedroni.
Stages: Alessandra Ledda, Emiliano Martino (Scuola di Specializzazione in Beni Architettonici e del Paesaggio)
Task: Description of Complex;
Identification of the functional areas;
From the description of the building to the identification of the opportunities for change;
Fair-faced concrete: Identification of the typologies of concrete and textures, Abacus of concrete materials, Identifying the causes of deterioration and areas at risk, Abacus of deterioration and damage, Checking the depth of carbonation and stability of reinforcements: diagnostic insights, Mapping and score evaluation of the state of conservation, The Pilot Site;
Exposed brick surfaces (part III);
Window and door frames: Abacus of the typologies;
Setting of the conservation / maintenance program;
Towards a sustainable transformation; Chart of transformation, Change Management Policies: Plan Objectives, New buildings inside the area, Internal modifications;The "Colle",The "Tridente", The "Aquilone", The "Vela".
Facing concrete;
Doors and windows frame;
Exposed brick surfaces (part IV);
(Annex: 1. Description of the complex; 4. Concrete surfaces; 5. Doors and windows frames)
Web site (www.collegiurbino-decarlo.it): arch. DS. Cristina Ciovati

DASTU Department of Architecture and urban Studies
CECH Laboratory Climate and Energy for Cultural Heritage
Principal investigator: prof. Davide Del Curto
Research Group: prof: Cesare Maria Joppolo, arch. Ph.D. Andrea Luciani, arch. Luca P. Valisi, ing. Mara Bellebono.
Task: Enhancement of the building's envelope performances
(Annex: 8. Results of the terminal analysis and of the building simulation;
9. Interventions on the envelope in the "Collegi" and on the pilot site)

Institute for the Conservation and Promotion of Cultural Heritage (ICVBC) of the CNR National Research Council
Principal investigator: Dr. Antonio Sansonetti
Research Group: Dr. Moira Bertasa, arch. Danilo Biondelli, Dr. Riccardo Negrotti, Dr. Roberto Bugini.
Task: Fair-faced concrete: Characterization of the material, The Pilot Site
(Annex 3. Concrete Diagnostic Data)

Università degli studi di Urbino CARLO BO
Department of Economics Society Politics – DESP
Principal investigator: prof. Guido Maggioni
Research Group: Dr. Eduardo Barberis, Dr. Nico Bazzoli, Dr. Giovanni Torrisi, Dr. Elisa Lello, Dr. Fabrizio Pappalardo, Dr. Alba Angelucci.
Task: Social value of the Complex: Value attributed by students over time
Spaces and users;
From the description of the building to the identification of the opportunities for change;
Towards a sustainable transformation: New uses and transformation.
(Annex: 2. Sociological investigation - Documentation)

Università degli studi di Urbino CARLO BO
Preservation and Restoration School
Dipartimento di Scienze Pure e Applicate - DiSPeA - Scuola di Conservazione e Restauro
Principal investigator: prof. arch. Laura Baratin
Research Group: Dr. Giovanna Scicolone, Dr. Elvio Moretti, arch. Alessandra Cattaneo, Dr. Francesca Gasparetto, Dr. Alice De Vecchi, Dr. Sara Bertozzi.
Task: The Interiors - survey and mapping of a private room's furniture;
Furniture;
(Annex: 7. Survey and mapping of the state conservation's furniture and intervention proposals)

Università degli studi di Urbino CARLO BO
Technical department
Principal investigators: ing. Fabio Fraternale
geom. Luiselle Spadoni
Task: Maintenance and management issues

Regional agency for study entitlement University of Urbino
ERSU
Principal investigator: ing. Gabriele Giglioni
Task: Maintenance and management issues

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arch. Biagio De Martinis - Commission for the Archaeological, Architectural and Landscape Heritage of the Marche Region; Dr. Giovanna C. Scicolone, contemporary art restorer, teacher in University of Urbino and several Academies of Fine Arts; Ing. Roberto Cioppi – head of town planning of the Municipality of Urbino.; prof. Stefano Della Torre - Politecnico di Milano; prof. Luc Verpoest - Department of Architecture, Urbanism and Planning - Katholieke Universiteit Leuven

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Application of the protective treatments and tests on the repair techniques: Cesare Portosa

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The Vision of the University

Traditionally a centre of studies in law since its foundation in 1506, nowadays the University of Urbino is renowned mostly for teaching and research in the life sciences, humanities, economics and language studies.

With almost 15,000 students and 6 departments is increasingly gaining recognition attracting students from all over Italy and abroad. During the 1960s/70s, the University succeeded in buying up quite a number of palaces in the old center which have since been restored and used as faculty and department buildings transforming the town in a "city campus". While the student body and faculties gradually increased and developed over time it was under the long and presidency of Senator for Life Carlo Bo that the University enjoyed unprecedented growth in size and prestige, prompting the former president of the European Community Commission, Roy Jenkins, to state that "the University of Urbino is an incisive presence in contemporary thought, contributing in original ways to the cultural and intellectual life of Europe". This was also the period where architect Giancarlo De Carlo designed and built the University Halls of Residence, which can accommodate 1,500 students.

The complex covers about 62.000 square meters, was designed to provide a unique life experience, not just an accommodation, and common and public spaces, in which people can meet informally, study, discuss, relax or simply hangout, prevail the over the private ones. And, unusual in those days, men and women shared the same spaces, and there was no clear demarcation between the areas that are dedicated to the students and those that are open to the citizens.

The University has always considered the "Collegi" as a very important facility to permits students and teachers to fully participate the university's life both within the campus and within the "city campus". It has been since the opening of these facilities that thousands of students have had the possibility to stay in Urbino coming from far away, both from Italy and abroad. This has been important for these former students but also for the University that, compared to other institutions of similar size, has had the chance to be attractive and to provide an excellent quality of the services offered, not available in other places. Thus, the Urbino's "Collegi" have been and will continue to be instrumental for the university to maintain its attraction and to qualify as an institution capable of offering a high quality services to registered students.

Maintenance of the "Collegi" has always been a problem: the size of the complex and the vulnerability of materials and architectural elements represent unquestionable critical points. In addition, the use of the complex is an open issue, because the common spaces are largely unused or misused, the public services (as the shops) were never activated and the meeting spaces lack appropriate furniture, lights, comfort and cosiness. Having this in mind the university have applied and obtained a planning grant from the Getty Foundation within the "Keeping It Modern" program in 2015 (http://www.getty.edu/foundation/initiatives/current/keeping_it_modern/grants_awarded_2015.html).

The general aim of the project is to provide a sustainable balance between conservation and change, develop specific procedures and guidelines and propose improvement and new uses consistent with the value(s) of the complex. A proactive strategy, based on care, constant monitoring and early interventions requiring a strong strategic vision and involving skills, analysis and solutions is now put in place.

The University in the current year has already committed more than € 10 Ml for the execution of this plan and will continue to invest, permitting new generations of students to actively take part to the university life and build their future on the ground of an institution fully devoted to the quality of teaching and to the promotion of continue interactions among people from different countries and with different attitudes.

The Vision for the "Collegi" is to retain a high-quality offer of facilities and services to the students and other users; to schedule ordinary lessons in the class rooms and in other areas to increase the use of common spaces and to strive for maximum sustainability and accessibility while respecting and, where possible, enhancing the heritage value and significance of the original buildings. It is important to have an agreed vision for the conservation and management of the "Collegi". Such a vision will underpin every aspect of the Estate's future care and provide common aims and objectives to which everyone involved in the management of the Estate can agree. The "Collegi" site is unique and faces challenges with regards to the need for adaption and development for the College's high-quality offer to continue. Given the challenges facing the current complex of "Collegi" it is essential to agree appropriate principles on which change can be planned and implemented and on which the development and adaption can be successfully achieved. Identifying and agreeing these principles, as part of a long-term vision for the site, is the primary aim of this Conservation Management Plan.

The University is proud to recognize the unbelievable contribution of several national institutions and several key professionals that have now make possible this draft of the conservation plan. A special thanks to:

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The "Conservation Plan" of the "Collegi Universitari di Urbino"[1]: framework, achievements and new challenges.

The conservation planning methodology represents, at the international level, the main and more significant reference for a sustainable management of the built cultural heritage.

In very simple terms, a Conservation Plan can be defined as: "a document which explains why a place is significant and how you will sustain that significance in any new use, alteration, repair or management (...) It is based on a very simple thinking process which starts with describing what is there, why it matters, what is happening to it and the principles by which you will manage it and then sets more detailed work programmes for maintenance, management, access, use or other issues" (Heritage Lottery Fund, 2002).

In the approach that that concept underlies, conservation does not exclude change (which is an essential component for transmission to the future of any living heritage) but any transformation should be carefully weighted taking into account the value(s) of the building and should be based on comprehensive studies (historical research; analysis of the significance; condition assessment; analysis of the current and potential risks...); in some way, the Conservation Plan define the "limits of acceptable change", which means that it identifies the significant parts of the heritage site, that must be kept as much as possible, the areas (less important or already transformed) where interventions are possible and should be located, the suitable uses and the conservation measures to be taken.

Finally, the plan should also include appropriate management tools and a set of policies to conserve, manage and interpret the

[1] The "Collegi" are intended as University's dorms, and the name refers to the original concept of a Campus, experimented by De Carlo in the years of his professorship in USA and applied to the Urbino Complex. The "Serpentine", "Tridente", "Colle", "Vela" and "Aquilone" are names attributed to each Unit by the workers themselves during the construction.

cultural significance identified in the site. The draft of a Conservation Plan is therefore directed towards a sensible change and to a "proactive" attitude, which requires a conscious, shared and careful evaluations, to prevent and control the impacts of any decision on the long run.

The Conservation Plan is a document quite diffused in the UK and in Australia, where that methodology was used for the first time and where there are already several important experiences, including some emblematic applications on 20th Century architectural heritage, as the Sydney Opera House Conservation Plan, prepared for the first time in 1993 and revised several times since then; Kerr 1993, 1999, 2003. Contrariwise, it is a rather new methodology for southern Europe, where there are no applications on modern heritage, despite precisely in that field that approach seems to be particularly promising.

Indeed, the ICOMOS Madrid Document "Approaches For The Conservation of Twentieth-Century Architectural Heritage" (ICOMOS ISC20C 2011- 2014) that, at this moment, is the main reference for the conservation of modern architecture, stresses the need for a full understanding of the building and identifies the Conservation Plan as the most appropriate management tool to balance conservation and change and organise the interdisciplinary studies that are the essential reference for any decision about the conservation of the authenticity and integrity of a modern construction.

"The methodology used to assess the significance of the architectural heritage of the twentieth century should follow a culturally appropriate conservation planning approach. This will include comprehensive historical research and significance analysis in the development of policies to conserve, manage and interpret the identified cultural significance. It is essential that such analysis be completed before works start to ensure that specific conservation policies are provided to guide development and change. Conservation Plans should be prepared". (2.2: Use a methodology that assesses cultural significance and provides policies to retain and respect it, prior to commencing work)

Indeed, materials, architectural elements, technical equipment, but also interiors, furniture and associated art works should be identified and assessed, as well as the context (landscape and urban setting) and the intangible meanings (e.g. the historic, social, scientific or spiritual value) of the site to define sustainable intervention strategies and introduce the unavoidable changes.

Besides, the same Document underline the role of prevention as a key strategy to ensure the conservation of the modern materials and architectural elements and recommends the implementation of a specific Maintenance plan within a more general Conservation Plan, since "continual and appropriate maintenance and periodic inspection is consistently the best conservation action for architectural heritage and reduces long-term repair costs" (2.5: Provide for maintenance planning).

To test on a large scale the Conservation Planning approach for 20th Century architectural heritage the Getty Foundation launched in 2014 the "Keeping It Modern" programme, an international grant initiative that supports the creation of conservation management plans that "guide long-term maintenance and conservation policies, the thorough investigation of building conditions, and the testing and analysis of modern materials" (http://www.getty.edu/foundation/initiatives/current/keeping_it_modern/).

The program is part of the Conserving Modern Architecture Initiative (CMAI), a "comprehensive, long-term, and international program" whose goal is to advance the practice of conserving twentieth-century architecture, "through research and investigation, the development of practical conservation solutions, and the creation and distribution of information through training programs and publications" (http://www.getty.edu/conservation/our_projects/field_projects/cmai/) and is directed to important buildings of the 20th Century, that have the potential to serve as model at the international level.

Thanks to the "Keeping It Modern" grant, the outstanding architectural significance of the complex has been recognised at the international level, as well as its potential to be a reference for the conservation of modern materials and architectural elements, e.g. for other "brutalist" buildings or for complexes that faces similar problems, also in terms of functional adaptation.The preparation of the conservation plan of the "Collegi" of Urbino by Giancarlo De Carlo represents a significant challenge for several different reasons.

The research realised in Urbino is aimed at testing the methodology of the conservation plan on a complex building, in which different (and often opposite) needs must be considered, including the need to understand and, in some way, redefine the complex of meanings that makes that place significant. For that reason, the studies realised for the preparation of the plan include both technical issues and analysis that explore the "immaterial" value that the building has for different kinds of stakeholders.

One of the aim of the conservation plan is therefore to collect, explore and discuss different point of view expressed by different stakeholders, in an approach that is complex and interdisciplinary, since it include a comprehensive evaluation and understanding of the values that are represented in the complex, as the architectural significance, the social value, the connection with landscape and the historic city, and the different meaning experienced everyday by the over 1100 students and workers that live, study and meet in those spaces.

At the same time, the Conservation Plan is aimed at suggesting feasible solutions and development scenarios which includes several aspects (conservation procedures and guidelines, identification of new functions and uses, energy efficiency - to improve the indoor comfort and reduce the operating costs, facilities, new connections with the city...), also taking into account the specific issues of the site (as the size of the complex, the need of working while the rooms are occupied by the students and the accessibility problems, since a large part of the complex is not accessible by vehicles; accessibility is a crucial issue to be faced to make possible a regular maintenance routine...).

Reuse (in particular when dealing with a "non iconic" building or with a building that, to be preserved, must be used) poses indeed some challenging theoretical problems, as the preservation of the intangible meanings when introducing new functions.

One of the recurring problems in the "Collegi" is that the common spaces and the common services are not used. Nevertheless, this almost never happens for the poor quality of the spaces; in most cases, desertion and discontent depends on management choices, as a lack of flexibility and limited opening hours.

In interpreting the reasons for a misuse of spaces, and comparing it with the characteristic of users we tried to identify, among the users, the ones with the most suitable characteristics, considering people as a factor of sustainability. For example, in the case of the "Tridente" nucleus, which imposes a level of close coexistence, the space seems better matching to the first-year students, that need to be encouraged to socialize. On the contrary, it turns out to be uncomfortable for the older ones needing more privacy.

The research work realised should also be framed in a wider context. As said before, in the Italian context the Conservation Plan is a completely new tool, very far from the current management practices, that in most cases underestimates the need for a thorough knowledge of the building and to define the works starting from a an overall scenario; besides a new approach is

even more difficult to introduce for modern architecture, also due to a general lack of recognition and, therefore, protection.

Actually, the "Collegi" are en emblematic example of the difficulties that the protection of a "modern" building still faces in the Italian context.

Despite the international appreciation, and despite an official recognition of the intellectual rights of the author, that includes all the masterpieces realised by Giancarlo De Carlo in Urbino (MIBACT, Direzione Generale Arte e Architettura e Periferie urbane, Riconoscimento ai sensi della legge sul diritto d'autore L.633/42), there is no real control on the interventions that, day by day, change the building and the surrounding landscape, since the building is not listed[2] and the area is not subject to any landscape protection and, more in general, modern heritage is not included in the strategies for cultural promotion of the city, that is a tourist hub of primary importance, inscribed in the UNESCO World Heritage List since 1998 (http://www.sitiunesco.it/?p=32).

To overcome that gap, in the preparation of the Conservation Plan the local authorities in charge for the heritage protection (Soprintendenza Archeologia, Belle Arti e Paesaggio) and a representatives of the municipality (Comune di Urbino) have been involved as part of the scientific committee with the aim of defining, since the first steps of the project, a shared system of goals, possible changes and limits and define an broad strategy of protection and promotion, in the awareness that the "Collegi" are a part of a city and an heritage that belongs to the whole community. A coherent program involving both the Municipality and the University and directed to improve the connection between the inhabitants and the students needs to be launched in the next years. For that reason, during the implementation of the project, a public meeting were organized to present the results and social communication channels have been activated (project website, Twitter, Facebook) to ensure the maximum dissemination and discussion. For the same reason, a Scientific Committee have been established since the beginning of the project.

As a (provisional) conclusion, we can state that the researches realised for the preparation of the conservation plan has no presumption of giving definitive answers but rather constitutes the first step of a process, in which some important objectives have been defined and some problems have been reframed and

[2] According to the national legislation, to list a publicly owned building that was built less than 70 years ago an express acknowledgment of a value is needed that recognise "a special interest related to politics, military, literature, art, science, technology, industry and culture, or as evidence of the identity and history of public or religious institutions" (D.Lgs. 42/2004 e s.m.i. Code of the Cultural and Landscape Heritage, art. 10, comma 3 lett.d).

studied, collecting a significant amount of data that can support further researches and projects. Indeed, in the next years it will be necessary to realise substantial interventions, to adapt the buildings to the regulations, and in particular it will be necessary to improve the seismic behaviour.

In August 2016 the province of Urbino have been affected by the earthquake which destroyed many towns of central Italy; fortunately there were no damages but the high seismic risk of the area requires appropriate interventions which ensures the safety of students without jeopardize the buildings. In this regard, in April 2017 a funding have been requested to realise significant upgrading work, that will require appropriate analysis and a detailed project.

The preparation of the Conservation Plan has been the chance to start a process that will have to be supported in the coming years to consolidate the results achieved and to face new challenges.

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I Part

Historical significance of the complex

Giancarlo De Carlo. (Photo Kunstgewerbeschule, Zurigo)

Giancarlo De Carlo and the "Collegi"

Biography (by Naomi Miller)

Architect and planner, educator and editor, writer and speaker, thinker and innovator, Giancarlo De Carlo is well known in his native Italy and abroad as a founder of Team X (Ten) and as a pioneer in participatory architecture. Born in Genoa, the son of a naval engineer, he studied structural engineering at Milan Polytechnic from 1939 to 1943. On graduation, he was called for naval service to Greece. In Milan from 1943 to 1945, De Carlo was active in the Resistance movement and in anti-Fascist circles together with Giuseppe Pagano, Franco Albini and other members of the *Movimento di Unità Proletaria*. At the same time, his interest in architecture was stimulated by *Le Corbusier's Oeuvre Complète* and *Alfred Roth's Die Neue Architektur*. Following the end of World War II, he published critical works on Le Corbusier and William Morris. From 1948 to 1949, De Carlo studied at the Venice School of Architecture and collaborated with Albini on the development plan for Reggio Emilia.

De Carlo's career in both architecture and city planning was launched in the 1950s, together with expanding intellectual circles, the latter including Carlo Doglio, Delfino Insolera and Italo Calvino, and briefly as a member of the editorial board of Casabella. A participant in CIAM (*Congrès Internationaux de l'Architecture Moderne*) De Carlo became known as a modernist who honours the heritage of the past.

Few architects who emerged in the generation following World War II have been as prescient in perceiving the problems and possible solutions in contemporary architecture and urbanism. Both part of and counter to the mainstream, De Carlo has succeeded because of his deeply embedded historical consciousness and his total immersion in the problems of contemporary society. A master craftsman, De Carlo harbours enormous respect for technological inventions and the design principles of modernism, including its utopian goals. Nonetheless, he has protested against the rigidity of the Modern Movement and the International Style. In his multifaceted career, however, his name will inevitably be lined with Urbino, the hill town in the Marches, where Renaissance architecture reached its summit in Federico da Montefeltro's Ducal Palace. His work in Urbino is ongoing,

beginning with his master plan and now clearly visible in his buildings for the University of Urbino.

When international modernism was at its zenith, De Carlo condemned the preoccupation with style divorced from the social realities of the day. While remaining open to the enriched possibilities of post-modernism, he decried its superficiality, even frivolity. In fact, he believed that architecture was too important to be limited to the narrow domain of architects. Rather, it is the architect's "responsibility" to humanity that constitutes the basis of his life and work. Evidence of this creed is found in De Carlo's housing complexes, where he encourages participation between architect and users, a type of collaborative planning fully cognizant of the needs of inhabitants. Mindful of the inhumanity of postwar housing, with its disregard for scale, social realities and historical circumstances, he challenged the idea of "minimum living standard" as set forth at the CIAM conference in Frankfort (1929). Instead, De Carlo advocated an architecture based on current problems, one that considered the urban context as the primary force.

Still, a paradigm for architect/client collaboration is the Village Matteotti in the industrial town of Terni, 60 miles northeast of Rome. Meetings with the steelworkers and their families led to a continuous collaboration in planning with the architect, who assumed the role of educator as well as designer and builder. Here, every phase of the project was considered in conjunction with the users, who were directly involved in all phases of construction. When completed, the Village Matteotti raised the standard for workers' housing. Unlike Terni, the housing at Mazzorbo, begun in 1980 on an island in the Venetian lagoon, focused primarily on morphological considerations. Because of the distinct identity of Mazzorbo's residents, De Carlo emphasized the unique setting and a strong vernacular tradition in his effort to design new forms that evoke the past by articulating and enriching it, with the use of local colour and variety in building types and plans.

Beginning with his Town Plan (1958-1964), De Carlo's work in Urbino continues to these days. It was the Collegio del Colle, the dormitories for the University of Urbino (1962-1966), that initiated the dialogue between the old city and its surroundings. Additions to the college from 1973 created patterns that conform to the topography of the landscape, always simulating the memory of earlier times and fostering a greater sense of community among the students.

Many of De Carlo's proposals have since come to fruition: restoring the Mercatale, reviving the old approach from Rome, and providing access to students and tourists along Francesco di Giorgio's 15th-century ramp (discovered while restoring the 19th-century theater) leading to the Ducal Palace. Abandoned buildings have been rehabilitated and converted to modern facilities. Brilliant insertions in the town fabric are demonstrated by the glass-enclosed hemicycle of the School of Education, which seems to be carved from the surrounding walls, the courtyard of the Law School, its domes illuminating the spaces below and, most recently, the Faculty of Economics, built upon its medieval structure. Contradictions between inside and outside contribute to the continuity between old and new.

Aside from appointments as visiting professor at Yale University, the Massachusetts Institute of Technology, Cornell University and the University of California at Berkeley, De Carlo was professor in the schools of architecture at the Universities of Venice and Genoa. In 1976 he founded the ILA&UD (International Laboratory for Architecture and Urban Design). This forum of international students meets annually in Urbino, Siena or other Italian cities, develop projects for the adaptive reuse of old buildings, such as the Hospital of Santa Maria della Scala in Siena, the renewal of industrial areas in Genoa, or new interventions in the Arsenal in Venice. In addition to these pursuits, De Carlo, always a prolific writer, founded Space and Society, an Italian/English quarterly journal that addresses global urban and architectural topics.

Since 1995 De Carlo has entered competitions for the School of Architecture in Venice and for the redesign of three piazzas in Trieste. Recent projects include university facilities, civic works and conversions in Pavia, Siena, Catania, the Republic of San Marino, Lastra a Signa, Pistoia, Venice Lido and Urbino. The latter includes the "Data of Francesco di Giorgio", the restoration and transformation of a city observatory into a multimedia centre. It is little wonder that De Carlo has been made an honorary citizen of Urbino and, on the occasion of his 80th birthday in 1999, was given the key to the city of Venice.

A CIAM delegate from 1952 to 1959, a member of Team X, an honorary member of the American Institute of Architects from 1975, the American Academy for Arts and Sciences from 1978, the Royal Institute of British Architects from 1981, the Royal Incorporation of Architects in Scotland and the Bund Deutscher Architekten, De Carlo has been the recipient of prestigious awards, including the Patrick Abercrombie Prize (1967), the Wolf Prize (1988), the Medaille de l'Urbanisme(1992), the Royal Gold Medal of the RIBA (1993), Sir Robert Matthew Prize (1996), the Grand Prix "A/mbiente" in Buenos Aires (1999) and the Italian Gold Medal for Culture and Art (2004). In addition, De Carlo has been awarded the Doctor Honoris Causa from the Lund University in Scotland, the Technical University of Nova Scotia (Canada), the Oslo School of Architecture, the Heriot-Watt University in Edinburgh, the Uni-

versité Catholique-Louvain, the Université de Genève, the Buenos Aires School of Architecture, and the Faculty of Humanities in Catania. On the occasion of receiving the Royal Gold Medal of the RIBA (1993), De Carlo spoke of "promising signs...emerging from our present state of confusion". Proving to be both realist and idealist, he hopes that "perhaps organizing and giving form to the three-dimensional physical space will become architecture's raison d'être once more".

NAOMI MILLER

Selected Works

He has worked on many architectural projects built in Urbino, Terni, Milano, Cervignano, Riccione, Matera, Pavia, Alessandria, Mirano (Venice), Mazzorbo (Venice), Catania, Siena, Republic of San Marino, Colletta di Castelbianco (Savona). Among them: the Student Centre, the Faculties of Law, of Education, of Economics, for the University of Urbino; the Master Plan, the Faculties of Genetics, of Engineering, of Science, for the University of Pavia; the Faculty of Liberal Arts and Philosophy for the University of Catania; the Faculty of Biology and Pharmacy for the University of Siena; a Hospital in Mirano (Venezia); housing and a sports centre in Mazzorbo; the new Gates of the Republic of San Marino, the new Piazza Bucintoro at the Lido of Venice; the new seat of the Law Courts in Pesaro; a new nursery school in Ravenna.

Among the works in phase of design or implementation are: new Science Laboratories for the University of Urbino; re-use of an old industrial building for Lecture Halls for the School of Law of the University of Catania; Auditorium and Lecture Halls for the School of Law of the University of Catania in the Purità complex; Elevator Tower for the Palazzo degli Anziani in Ancona; three new wards for the Hospital of Mirano, Venice; Auditorium for the Technical High School 'Cattaneo' at San Miniato, Pisa; re-use of the Orto dell'Abbondanza in Urbino as Town Observatory; new Sports Centre for the University of Siena; two housing blocks in the Central District of Beirut, Lebanon.

He has also developed many urban design projects. Among them: the plans for the town of Urbino in 1958-64; for the centre of Rimini; for a sector of the historic centre of Siena and for an area of the town expansion; for the reuse of old industrial settlements in Castelfiorentino, Cervia, Genova, Pistoia (carried out with ILA&UD), Alessandria; for the historic centre of Lastra a Signa, Firenze; the rehabilitation programme for the historic centre of Palermo; the rehabilitation project for the district of Pré (Genoa) and for the "old harbour" carried out with ILA&UD; projects for the "old harbour" of Genoa carried out with the School of Architecture; projects for an office and housing district in the area of Via Stalingrado, Bologna; for a housing and office block in the area of the old Markets of Genoa; the new plan for the town of Urbino in 1990-94; rehabilitation project for the ancient Village of Colletta di Castelbianco, Savona; rehabilitation project for a housing area in Sesto San Giovanni, Milan; Masterplan for the rehabilitation of the area of the Piagge along the river Arno, Florence.

He has taken part in several national and international competitions. Among them: the University of Dublin, 1964; the Cultural Centre for Riyad, Saudi Arabia, 1966, 2nd Pz; a Hospital in Mirano (Venice), 1967, 1st Pz; the new Town Hall of Amsterdam, 1967; the plan for the town of Plovdiv, Bulgaria, 1968, 3rd Pz; the design for a new community centre, Perugia, 1976, 1st Pz; the redesign of the Pirelli-Bicocca industrial area, Milan, 1985-86; a new intervention along the Avenida Diagonal, Barcelona, 1986, 2nd Pz; the City Museum (Landesmuseum), Salzburg, 1989; the redesign of the Lizza area in the historic centre of Siena,1988-89, 2nd Pz; urban services in the general markets area of Bologna; 1994; the new building for the School of Architecture at San Basilio, Venice 1998 ; the redesign of three piazzas in Trieste, 1999; the redesign of three piazzas in Milan, 2000; the redesign of the pier "Ponte Parodi" in Genoa, 2001; the design of a new urban park in the area Garibaldi-Repubblica in Milan, 2003-2004.

Giancarlo De Carlo and Urbino

"I can say that I loved this city - Urbino – the instance I saw it. The first time was in 1951, when Carlo Bo stopped the car on the 4th kilometre of the Pesaro road, just after Trasanni and, pointing at the Urbino skyline told me: the real Italy".[1]

What appeared to Giancarlo De Carlo, at that time in his thirties, was the image of a village in which the Palace dominated, in continuity with the landscape, a predominantly agricultural land. The University of Urbino, ancient and prestigious for having being established in 1507, in the 50s counted about 3,150 students, a small number compared to the overall 300,000 that were enrolled in the Italian Universities, but had an invaluable artistic legacy: the Ducal Palace, a wonderful historic centre rich of buildings and monuments of rare beauty, a territory that remained untouched since the times of Raffaello and Piero della Francesca, claiming to be discovered and valued.

In the years of the centre-left governance of the country, the measures by Prime Minister Fanfani for the educational system improvement were conveyed in a multiannual plan of investments on Schools and Universities, and offered the University Dean the financial resources he needed for further developing the "Libera Università di Urbino". Like the Duke of Montefeltro in the past, Carlo Bo had a farsighted vision that he shared with the Major of the City, and the two institutions worked together to achieve high quality results, where history had a foundation role in every transformation process. If the figure of Carlo Bo and his "longevity" as a Dean has been the key for the success of a long-term program of University achievements, the shared vision with Mayor Egidio Mascioli was as well decisive. De Carlo commented on their mutual understanding by saying that"... he has not got a formal culture, but (...) he is a man gifted with deep wisdom and extraordinary human and political sensibility. The miracle was that he fully agreed with Carlo Bo and that they understood perfectly each other in a few words. Carlo Bo, the Dean, a highly sophisticated intellectual and Egidio Mascioli, the Mayor, a former miner and a seasoned politician, have been Urbino's propellant since the end of the second world war through the seventies: each with a different but equally generous vision of the world, a rare virtue that led them to understand each other."[2]

The University and the City believed in the need to strengthening the cultural institutions as a whole and shared a will to coordinate with each other on the theme of the redevelopment of the historic centre and the conservation of the landscape: while the Mayor commissioned the new Masterplan, the Dean commissioned the restoration of the Bonaventura Palace to host the Rectory and the administrative offices. This was the first of a series of actions that led to the refurbishment of many of the historical buildings

1 Da *Parole di risposta* in *Un architetto e la città*, Quattroventi, Urbino 1990.

2 Franco Bunçuga. *Conversazioni con Giancarlo De Carlo, architettura e libertà.* Eleuthera. 2000.

and to their transformation into Faculties and Departments of the University.

While the Masterplan was imposing itself as a model for the conservation of Historical Centre and the control of the expansion in the outer territory, the illuminated politics of the University found its utmost expression in the impetus given by Carlo Bo to its development and achievements: the new Faculties mark the beginning of the widespread diffusion of university buildings in the historical centre.

This is the context that frames GDC projects for the University and the City Council in Urbino: from 1952 to 1954 he supervised the refurbishment of the Palace hosting the University Headquarters; in 1955 he designed the housing for the university employees; between 1958 and 1964 he worked on the Masterplan; from 1960 to 1965 he realized the first nucleus of the "Collegi": 150 beds with dedicated facilities; from 1966 to 1968 the Faculty of Law; from 1968 to 1976 the Faculty of Magistero; from 1969 to 1972 the Mercatale and the restoration of the Teatro Sanzio; from 1973 to 1983 the New "Collegi" of the University; from 1990 to 1995 the new Masterplan; from 1992 to 2001 the Faculty of Economics at Palazzo Battiferri; from 2000 to 2002 the venue of the Fondazione Carlo and Marise Bo at Palazzo Passionei; since 1992 the Observatory of the City in the former spaces of the Data by Francesco di Giorgio Martini.

During his long term relationship with Urbino, De Carlo could contribute to the strategic choices that determined the destiny of the city in its relationship with the territory and in the transformation of its historic centre, that the influential role of the University contributed to preserve from abandonment and degradation; and finally to the shaping of its character throughout an architectural language inspired by the context. It is rare that an architect can influence so deeply the political decisions, and has the opportunity to assess their impact on the physical transformations. This special circumstance is greatly due to the farsightedness of the politicians, who recognized the importance of establishing constraints to the urban growth and of the value of conservation in a phase characterised by uncontrolled growth. It is also due to the strategic vision of the University as a driving force of the local economy, and its becoming together with the Municipality the guardian of the "Genius Loci." "If Urbino had a chance to live, and not only to survive, it was thanks to a more sensible and open model of University, which - unique case – could blend the ambitions and the expectations of the whole city."[3]

[3] Carlo Bo, *De Carlo in Urbino*, in Giancarlo De Carlo, *Quaderni di Imago* Bassoli Fotoincisioni, Milano 1964.

De Carlo had the chance to deepen his understanding of the city's morphology within a context amazingly homogeneous, as commented by Pierluigi Niccolin in an interview: "an aviation pioneer told me that when he flew over Urbino with his small plane it was difficult for him to locate the city because he could not disentangle it from the equally complex and quite similar pattern of the surrounding landscape"[4]. De Carlo also learned the patterns that regulate the use of materials and enriched them with new figures inspired by those that have created the historical context, which will be able to renew shapes and combinations in a seamless continuity with the past. This allowed him, when the project for the "Colle" offered him the chance to put it into action, to express in unprecedented forms and intangible meanings, a renewed historical context in its full organicism. Van Eyck wrote this unique description of the project:

"What makes this building a home and a city (in short the reason of its success) besides the consistent use of the same construction, the same vocabulary, the same materials and the same colour everywhere, Is another shrewdness. It is its being two places at the same time: open and closed, indoor and outdoor, large and small, with both individual and collective significance. It belongs to the building to the same extent as it belongs to the area and in fact with this arrangement the building is the area and vice versa (.....) I think I have never seen a building that gives more (from inside) to the landscape of how much it receives, by interiorizing it, articulating it and differentiating it: in fact, to being able to receive as much, it would be necessary to make a very long walk in the countryside."[5]

The work of De Carlo in Urbino has always tackled issues concerning the insertion of a contemporary language within a monumental historical context, both directly through the re-use of historical buildings and indirectly as in the case of the "Collegi", where a new settlement merges with an "anthropized" landscape of particular value and aims at protecting its intrinsic qualities and "historical" legacy. The experience earned in historical and monumental contexts, together with his conviction of working in the present, have given De Carlo an ability to measure his work with history and to produce, with contemporary materials and language, architectures that are intimately intertwined with the context they belong to; the project for the "Collegi" is an outstanding demonstration of his rewarding achievements in this field.

[4] *Conversazioni su Urbino*, interview by Pierluigi Niccolin to GDC in "Lotus" n. 18, 1978

[5] Aldo Van Eyck, *Il Collegio Universitario di Giancarlo De Carlo a Urbino,* in "Zodiac" n.16, 1966

International influences and links to the Milanese context

A key aspect of De Carlo's contribution to the cultural debate during the years that precede the design of "Collegio del Colle" is a thorough understanding of the international context that he had achieved in the field of architectural research and he had nourished in the years of reconstruction in the Milanese setting.

Having been trained as a practitioner under the influence of key figures such as Franco Albini and Irenio Diotallevi, from post-war onwards De Carlo joined cultural groups of politically committed intellectuals who were sensible to the experiences developed in other countries, and looking at architecture as to a tool of urban and ethic reconstruction of the country. In Milan, a city devastated by the bombings of the war, they supported reconstruction as an opportunity to apply the principles that emerged from the debate on contemporary city, included the issue of architectural language and the relationship between the present and the past.

Ernesto Nathan Rogers, Editor in Chief at Casabella from 1954 to 1965 and associate partner of BBPR with Belgiojoso and Peressutti (Banfi had died in Mauthausen in 1945) was a source of inspiration for De Carlo thanks to his ability to combine architectural practice with theoretical research. At that time he was making scholarly studies on the relationships between the evolution of the cities and their history, a topic that he proposed to debate at the 1951 CIAM conference - the International Congress of Modern Architecture, of which he was vice-chairman. At Hoddesdon that year De Carlo was firstly introduced as a young member of the Italian committee.

Carlo. (Photo Cesare Colombo)

De Carlo owes to Rogers the involvement in the MSA (Movement of Architectural Studies), an opportunity that will bring him closer to the international debate and to the chance of elaborating on

the value of tradition as a driver of contemporary architecture. Rogers appointed De Carlo as a member of the editorial committee of "Casabella Continuità", the magazine that he joined until 1956. Over the years a rising interest in urban design, seen by Giancarlo De Carlo as a tool for driving post-war transformation, will lead him far from the ideas that the magazine was spreading. De Carlo opposed to the promotion of seamless continuity with the past that the magazine was proposing, because he saw it as a lack of committment to experimentation of new forms of relationship between architecture and social contexts, and a missed opportunity to search for more dynamic processes in the transformation of the city. The leaving of Casabella marks an important step in Giancarlo De Carlo evolution because it anticipates the detachment of the young members from the Ciam, a fracture that substantiated at the 1959 Otterlo Conference, and gave birth to the Team X. De Carlo's militancy in this new group and the friendships that tightened him to the other components would have been formative and stimulating his own architectural practice in the following years. One of the most significant events of the Team X for De Carlo was the meeting held in Berlin in 1965, attended by some of the architects most closely linked with him: Jose Candilis, Ralph Erskine, Aldo van Eyck, Peter and Alison Smithson, Herman Hertzberger.

One of the topics discussed more in depth was the issue of identity in new urban developments; on this concern Hertzberger presented case studies in Amsterdam, and Giancarlo De Carlo showed the project for the "Collegio del Colle", which was highly appreciated by the attendees "*....was seen as a successful, innovative response to the issues that had been discussed within Team X . The basic motive of the plan was a quest for an architecture that respected the human dimension and the human experience.*"[6]

De Carlo had expressed his rejection of the dogmas of the Modern Movement[7] in his writings on Architecture and Urban Planning dated 1964 by proclaiming his architecture as freed from them with the following motivation:

"*they accused me of everything and particularly of having betrayed the principles of Modern Movement enunciated by Le Corbusier and encoded by his exegetes (...) I asked that my architecture - like all the architectures that have qualities - is considered as the result of forces coming from many directions: forces that are a real expression of the features of the places and the cultures of their inhabitants*".[8]

[6] Max Risselada, Dirk van den Heuvel. *Team X 1953/81 In search of a utopia of the present*. Rotterdam. NAI Publishers. 2005.

[7] G. De Carlo, *Questioni di Architettura e Urbanistica*. Maggioli Editore. Roma 1964.

[8] Franco Bunçuga. *Conversazioni con Giancarlo De Carlo, architettura e libertà.* Eleuthera. 2000.

However, it is possible to find, even in the "Collegi", an evolution of architectural aspects that link to Le Corbusier's five points, although De Carlo never addressed them in a dogmatic way: the flat roof at the "Colle" and the "Serpentine", the roof garden at the "Vela", the "Tridente" and the "Aquilone"; and finally the free façade, where each living unit is marked by a window having the same width as the cell, closely recalls Le Corbusier's ribbon windows.

It may also be added that in the "Collegi" De Carlo is not pursuing the full integration with the landscape from which the complex is surrounded. However the idea of extending the residences in the surrounding space - that Samona' had noticed in his review to the exhibition held in 1963[9] - was considered one among the latest achievements by Le Corbusier.

De Carlo rejected any connection with Le Corbusier on the issue of typology, which he didn't consider a primary aspect in the evolution of the living unit while his interest focused on the definition of an individual space that complemented the collective where the common activities are carried out; the individual space, although not big, should have for De Carlo enough quality to thoroughly encompass the user living experience.

At Milano Triennale with Walter Gropius, Ignazio Gardella and Franco Albini, 1948.

From the modernist legacy De Carlo inherits and re-interprets the ethical approach to the use of "standards" and aims at preserving the consistency of the design process. He attributes to the Modern Movement the merit of having pulled architecture "out of the arena of academic naturalism". His interest moves towards urban design as a synthesis of architecture and town planning,

[9] G. Samona', *Official report on the occasion of the exhibition on Le Corbusier's body of work*. Casabella Continuita' 274. Pag. 12. 1963.

by opposing to the duality road-building the idea of the urban fabric that:

".... is based on the overturning of one of the concepts of the Athens Charter but is born within the same Ciam and begins to develop in the work of designers who joined the Team X (...). Land is no longer a tray on which to superimpose volumes, but an integrated environment where spaces, streets, buildings, green and paved systems interact. This is a strategy that has been developed concretely amongst the very first at Atelier 5 in the residential complex of Halen in Berne in 1961 that, though inspired in many regards to Le Corbusier and its Unité, spreads its masses horizontally. The green, homogeneous and public tray at the base of buildings, is replaced by a landscaped built environment that creates privacy thresholds between the collective staircase and the private ones ..."[10]

De Carlo's research at the "Collegi" runs in parallel to some of the aspects that characterize this project by Atelier 5. Concerning the elevations, linguistic experimentation is completely original: the facade is an expression of the structural unit - the size of the cells. In Halen the volume fits in the hill without merging its tectonic lines with those generated by the landscape and it is the presence of the terrace roofs, the zenithal light on the internal paths and the vertical cuts that cross the volumes that establish a dialogue with the slope. In the "Collegi", on the contrary, the volumes fully fit with the topography and the landscape with which the complex merges.

1977. Team X meeting at Bonnieux.

[10] A.Saggio. *Il Vuotometrico, Architettura dello spazio*. www.arc1.uniroma1.it/saggio/raccolta/29.vuotometrico. 2000.

Students Residences in Urbino are also inspired by a social utopia of Howardian roots that considers thespace as a scene where community life takes place, and sees the relationship with nature as an antidote to urban densification and to the overwhelming suburban growth.

De Carlo was proposing, as a model debated and discussed within the Team X, the low - rise approach also targets a "network" aggregation model that encourages the encounter and the exchange of experiences among the people. One among the many projects that developed the theme of the network was the Free University of Berlin by Candilis, Josic and Woods for. Designed between 1963 and 1973, it proposed a large building where paths and building units are served by overlapping layers that mitigate the isolation of the activities in a tall building. The project targeted a synthesis that overcomes the separation between functions and re-proposed patterns diffused within European cities where public and private intertwine and give the form to the city itself.

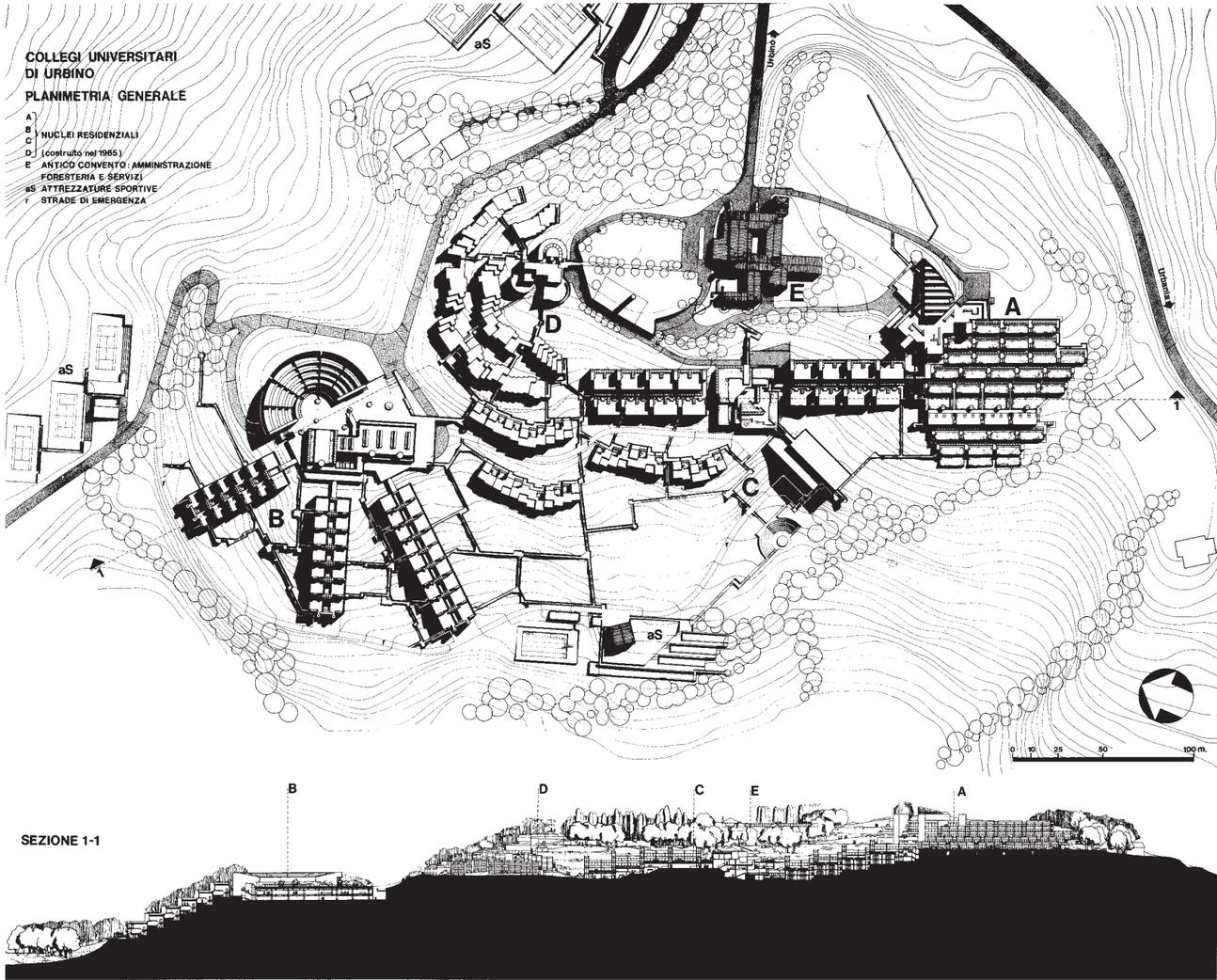
In the "Collegi" this comprehensiveness also includes the landscape, the form is the outcome of a conceptual commitment to create seamless continuity between the city, the university and the nature. The final outcome is an innovative experimentation of "*ground-scraping" organization that creates more possibilities of communication and exchange ...*"[11]

Mutual influences among Team X members are easy to be found in the projects of the same years and relate to the shared values: the relationship with the landscape, the attention to the social, geographical and historical context of the project, the use of raw materials (especially exposed bricks and concrete), the lack of formal superstructures that matched the relationship between function and form. The X Team meetings offer De Carlo valuable opportunities to discuss new projects and it is in this context that the old and new "Collegi" takes its definitive physiognomy on the track of Anglo-Saxon campuses such as New Court at Christ's College, Cambridge 1966-70 by Denis Lasdun or St. Andrews University, Scotland 1964-68 by James Stirling, just to name a few.

In 1966, De Carlo was appointed as visiting professor at Yale University, invited by Paul Rudolph, and this new experience broadened his understanding on students and faculties interaction in University campuses. In 1972, the Dutch magazine Forum devoted a monograph to De Carlo and Michael Ragon, quoting the "Collegi" of Urbino and commenting on De Carlo's achievements as to one of the most influential architects of the post-war Italian architecture. These acknowledgments were followed by many others by magazines and international institutions, but it is in Lotus, namely in the conversation with its Editor in Chief Pierluigi Niccolin, that Urbino's experience is framed for the first time in an organic way as a systematic and comprehensive process that proves its great value.

[11] Max Risselada, Dirk van den Heuvel. *Team X 1953/81 In search of a utopia of the present*. Rotterdam. NAI Publishers. 2005.

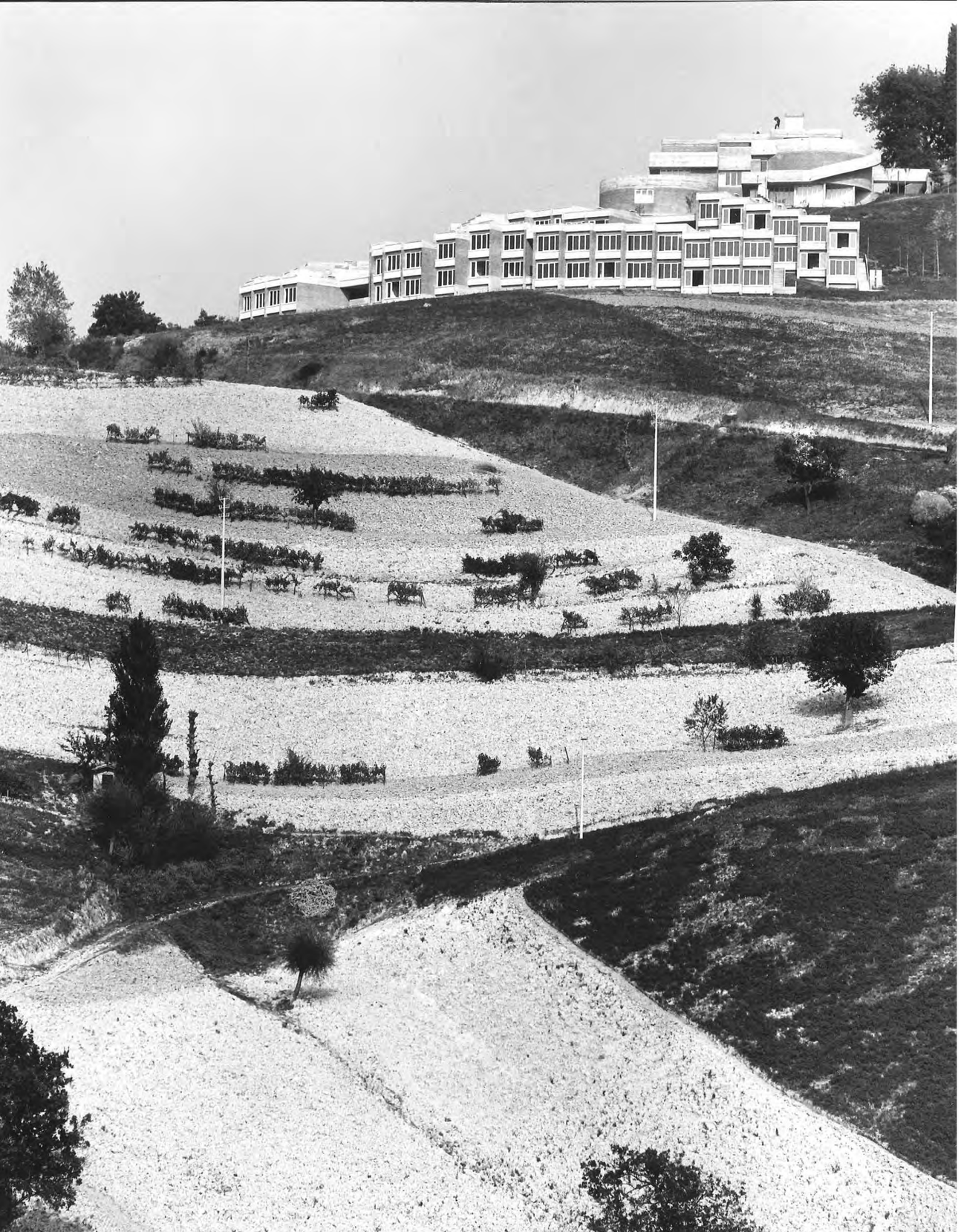
"Colle dei Cappuccini". Site plan and longitudinal section.



Relationship with the landscape

In the period before the construction of the "Collegi", Giancarlo De Carlo was simultaneously working on the Master Plan of the city and on the expansion plan of the University. The study of the city and the relationship with the territory became a crucial part of its research and the basis for the development of projects that followed.

Architecture becomes significant when establishing strong relationships with the context, and at that time it was essential to know the specificity of Urbino so as to propose models of growth and transformation. You could say that the particularity of this city is inherent in the urban structure resulting from the process of growing, processing and layering time, rooted in local culture, but manifested by a predominant atmosphere, a sort of constant duality. De Carlo describes this duality by identifying some of the city's discrepancies: despite its small size Urbino appears magnificent to visitors; it is a city of the province but also a capital; marginal in economic terms but essential from a cultural point of view; capable of self-preservation and yet, at the same time, changing profoundly when needed, according to needs and tastes over time.



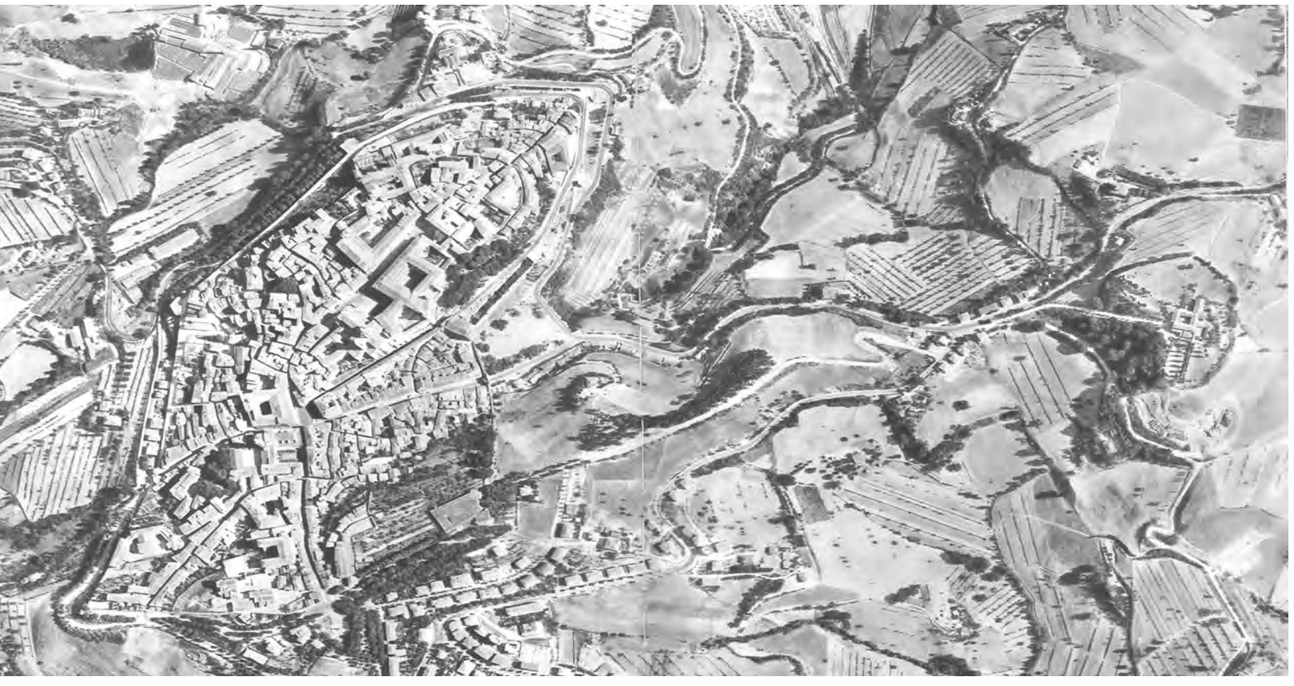
"Colle". Top view of the residential cells. (Photo Kunstgewerbeschule, Zurigo)

View of the town and of the landscape from the south-east side. (Alinari 1910-1920)

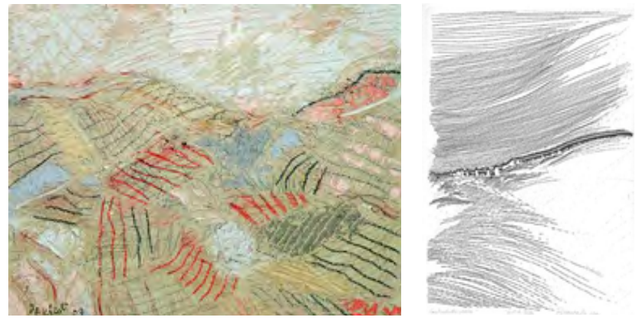
In the early sixties in the last century, the city was facing a turning point, a transformation that first affected the economy and society. Agricultural production, which had always supported the city and the land became unproductive, the countryside and the consolidated rural-social structure, based on large estates and on sharecropping, depopulated. This change also had strong repercussions on the physical environment: the secular equilibrium between city and territory began to alter, losing its economic and social structures. This process began in those years, but the landscape that De Carlo knew, when it comes to Urbino, was still the result of Nature's anthropic work that had lasted for centuries. The outcome of this transformation of Nature - beginning with deforestation in the Middle Ages and constant and meticulous care in the following centuries - was a territory of extraordinary beauty, possessing a diversity of shapes generated by the overlap of the geometric patterns brought by cultivation with the undulating morphology of Montefeltro.

In the same period of time, the city also established a new role for itself, centred on the cultural and educational pole of its University and its Carlo Bo. While the development of the University meant new potential growth that could regenerate the old town, opening up new perspectives for bringing out the best of its historic centre, on the other hand it cut and ended an ancient link between the productive territory and the city, relegating the countryside to the passive and marginal role, providing the backdrop of a romantic landscape.

Bird's eye view of the territory.



In the preliminary documents of the Regulatory Plan, an analysis of perceptions of the city takes the territory into account, and includes the city without any interruptions, its forms permeating in a single dimensional scale. The first aerial photographs were available In those years and, perhaps for the first time, allowed an understanding of the relationship between the city's texture and shape and morphology of the territory with agricultural patterns clearly visible. On the first pages of the volume of the Plan there is a double-page view of an aerial photo where the city and the territory appear as complementary parts of the same design; artificiality and naturalness are combined both in the historical city and in the geometric patterns generated by rows of trees combined with arable crops.12 This geometric sequence of parallel lines, organized on the level curves, is visible in the aerial photos as a sequence of linear elements pattern that intersect themselves, following the morphological diversity of the Montefeltro landscape. Artificial patterns of agricultural texture alternate with vegetative sections in areas that are difficult to cultivate because too steep or along the ditches. The resulting image is a series of lines and solids that overlap with one another. Diagonal lines dominate among horizontal and vertical lines.



A Tullio Pericoli painting and a Renato Buscaglia prints represents the Marche landscape.

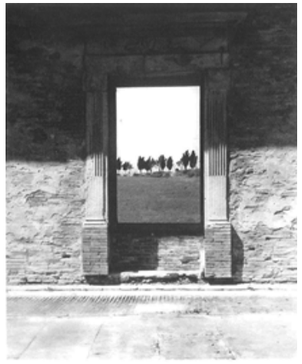
The formal and historical value of this vegetal but anthropic context, the reciprocity between agricultural tissues and the historical city, the mix of geometric patterns and organic forms become a reference for the "Collegi" architectural composition and a refence point for the relationships of individual parts within the surrounding landscape. The cell sequences of the the "Colle", oriented to follow the curves on different levels, or the alternating dug-out garden terraces of the the "Vela", or the sequences of room blocks opposite the "Tridente" which cut through the curves

[12] *"The pattern of the Town and the pattern of the country side are homologous. If you analyze a section of a cultivated countryside (...) you realize that nature here is man-made. If you analyze a section of a urban fabric (...) you see that the man-made is natural. But what is really remarkable is that the man-made quality of nature and the natural quality of the man-made both obey the same aesthetic laws*". Architecture in an Age of Skepticism. Denis Lasdun - Giancarlo De Carlo - The University center of Urbino – Oxford University Press 1984

at right angles, all offer a reference to the landscape patterns and create a dialogue with it. Variations in the composition and height of the cell sequence, its volumes, and how the room blocks are assembled, are all a result of the varying shape of the hillside. The typology and volumes of the "Collegi" have been planned, as we shall see, to offer experimental models of complex sociality, that are also closely connected to the site. They are designed with varying dimension offsets, from the minimum ones of the single cells in the "Colle" to the more visible ones within the multi-room blocks of the the "Tridente".

No boundaries between natural and artificial

Cities and territories are therefore a matter of mutual dependence and this characteristic also emerges within the city and also in the style of buildings. The landscape shows up in the buildings whose facades overlooking the streets or squares would be typically crafted. Instead the typical façade of Urbino focuses outwardly, indicating its receptiveness to the land, emphasizing its aesthetic value, and recognizing, perhaps for the first time, the role of landscape. This recognition of the landscape as a backdrop and representation has deep historical references in the Italian Renaissance culture, as can be deduced from iconography, and finds in the city of Urbino such a strong articulation that it influences the forms and the language of architecture.



The roof garden of the Palazzo Ducale. (Photo Cesare Colombo)

"Colle". Pathways and residential cells. (Photo Cesare Colombo)

In Palazzo Ducale openings in the walled garden frame the "Colle delle Vigne" act as a subtle framing of pictorial images.[13] The façade with its turrets, oriented towards the countryside, makes

[13] "In this large open-air hall, the landscape is inhabited, the wall let the countryside penetrate the city through the architecture, projecting the building beyond itself". Giuseppe Bartucci. Architettura della città di Urbino da Francesco Di Giorgio a Giancarlo De Carlo. Diabasis. 2014.

this rotation even more emblematic, becoming the privileged scenery of those who look at the city from outside.

This "representation" of the landscape is also constantly present in the colleges, articulated on multiple levels. At the crossroad of an external path, framing of the land is constantly present and becomes a significant event, a focal point, a vision, similar to the Palazzo Ducal. In each room, a large window overlooks the countryside and frames it from the inside. Thus, a relationship, this time solitary and intimate, of contact with nature is established also in a private space. The sequence of white frames provides the structured prospect, a continuous succession of openings towards Urbino's countryside.

The "Colle" has been defined by A. Van Eyek[14] as a threshold building, a definition that also perfectly befits other colleges based on this constant dialogue with the landscape. There is no boundary, nor is there an effective limit between the building complex and the country; nature and buildings are complementary and engage each other without interruption.

But this natural environment is not permanent nor immutable. In fact, since the time of the construction changed significantly, the textute of vineyard rows have disappeared and the vegetation, planted and spontaneous, has grown overthrow the small building. But if the forms of nature have changed, paradoxically are the colleges, as well as the historic city, which still tell us about the new landscape and the missing one.

A few years after the completion of the "Colle", the University asked De Carlo to develop a new residential project that would contain about a thousand students: it was a new city. However, while a city historically metabolizes its transformations over centuries, here there was no time and the process had to be simulated. Growth simulation is one of the keys to reading the articulation sequence that from the historical site of the "Convento dei Cappuccini" spread to the valley. A transformation can be discerned from the "Colle" to the "Serpentine" and the others, as a development of parts, where volumes and residential typologies define numerous entities as defined parts of a single organism.

[14] Aldo Van Eyek . Zodiac n°16, 1966.

"Colle" . From the north side. (Photo Kunstgewerbeschule, Zurigo)

The differences between the blocks are therefore not a result of the time of completion, but of a simulation of the historic city's growth process. The various residential typologies was a means to addressing the need for privacy and sociability for the students. The increased concentration of functionality in the college's common areas needed to offer an attractiveness compared with the historical city and to contrast the tendency for "individualistic closure."

De Carlo said: "*I noticed that the students tended to live in this building, as though it were a hotel. The common areas were rarely used intensively [...] In their rooms they lived very privately. At times I saw cards with the words "Do not disturb" on their doors. This is terrible: it is represents hotel living, where you do not communicate with anyone and live practically in secret. For this reason, I completely changed the overall organization of the complex. I introduced many intermediate spaces between private e communal areas.*

"Colle". Top view of the residential cells. (Photo Kunstgewerbeschule, Zurigo)

There are a certain number of more public spaces, that change the scale with each step, from the gathering of small groups to bigger ones, arriving at the large, open spaces where many people can come together even with the city's residents."[15]

An informal network of polarity and paths links the "Collegi" and is again it is the historic city that appears as the structural point of reference. There are no main crossings and each college seems to have its own autonomy, although the common spaces, present in every college, which are indeed polarities, needed to host different activities with the aim of offering broader functionality. Originally the canteens were two, one was planned at the "Tridente", the other in the "Vela", where the auditorium-cinema was also planned; in the "Aquilone", a library and commercial activities.

[15] Benedict Zucchi, *Giancarlo De Carlo*, Butterworth Architettura: Oxford 1992, p.86.

The duality of Urbino buildings

Earlier, we spoke of the theme of duality of Urbino buildings and how this feature amplifies the relationship between landscape and city. Returning to this topic and analyzing it more broadly, we can observe that the building facades overlooking the streets and squares seems to have a more subdued language that De Carlo defines domestic.[16] He himself notes that this is also evident in the Palazzo Ducale, perhaps with greater emphasis on the extraordinary quality of his architecture: the 'simple' facades of the Piazza Rinascimento and the eloquence and typical style of its paired "turrets". This adaptation to the rules of the city seems to favor the unity of urban scenic sequences, giving them a uniformity of language also in materials, leaving the richest and most monumental part for interior courtyards and exterior views.

The legacy of the Renaissance architecture and in particular the comparison with the figure of Francesco di Giorgio Martini, whose contribution underscored the typical features of the genius loci, seems to be central even in De Carlo's 20th century works, ever present both in buildings built for the university in the old town and in the "Collegi". Several constant features connect the two architects, underpinning duality in this case: the first is undoubtedly the use of the section as a project tool for managing the relationship with the lay of the land. The Palazzo Ducale stables (La Data) and the Santa Chiara convent are extraordinary models of how a site structure creates architectural and engineering solutions. Equally, section management forms the basis of the "Collegi" work regulating the articulation of the body of building and their constant adaptation to variations in the site's elevation. Although many parts are set high on the hillside, they achieve the quality of natural light thanks to the use of skylights, and this situation brings us to the scenario of the duality of the modest and glorious character of Urbino's buildings. From this analysis and from an extraordinary capacity for planning emerges the compositional diversity of the residential complex.

The second theme that binds the two architects is linked to the compositional structure of the buildings and the relationships between the parts. "Even the smallest building of Francesco Di Giorgio is a city,"[17] wrote Peter Smithson referring to the Convent of Santa Chiara and Palazzo Ducale. In the "Collegi", the composition of functional parts, organized with gradual transition between the more or less public and private ones, has an urban dimension because it reproduces the complexity of the historic city and applies the same use of space. Each "collegi" has its own distribution system leading to a central public space. The whole is made up of fragments of a town that can be considered autonomous and accomplished thanks to the completely informal connections between the various colleges, placed almost casually in the network of external paths.

[16] Denis Lasdun. *Architecture in an Age of Skepticism.* Giancarlo De Carlo. The University center of Urbino. Oxford University Press 1984.

[17] Peter Smithon. *The Ducal Place in Urbino a response to Giancarlo De Carlo's reflections*. Space and Society n 34.

Unity of the materials

The "Collegi" were completed with simple technologies to achieve complex configurations. The materials are mainly bricks and reinforced concrete, both being structural and left visible as its facade.

The uniformity of materials used is an unchanging feature of the place. From noble palaces to local houses, from military works to agricultural buildings, the town is built entirely with bricks produced by local kilns. We know that the external walls were originally plastered, but over the centuries, the use of brickwork became more and more commonplace, and for example, the buildings of the architect Pietro Ghinelli in Urbino, in the second half of the 19th century, used brickwork not only in the façade, but for all the stylistic and decorative elements which in the past were made of stone.

The bearing walls of the "Collegi" are very simple: two-headed septa of hollow tiles layered with Gothic brick texture. All the upper parts finishing the brickwork, such as architraves and stairs, are in reinforced concrete cast in wooden moldboards of 10 to 20 cm, positioned mostly horizontally.

It is a construction system of extreme simplicity, which characterizes all the residential areas and partially, public spaces, where some thoughts and conclusions can be drawn. Using bearing walls of brick, De Carlo rejects the freestyle planning and skeleton structure for a shell system, favoring what he himself defined many years later as the crustacean model versus the vertebrate model. The cells in the valley set wide and composed in blocks, partially embedded in the earth and sloping downhill. The skeleton structure is organized in such a way to achieve the wide spaces of the "Tridente" and the "Vela". In these instances the septa of concrete and bricks are often combined with skeleton structures to free up the central areas designed for communal activities.

Considering the structural nature of the cells and their serial repetition, the "Collegi" seem closer to traditional building forms and technologies that to the guidelines of the freestyle planning of the modern movement; However in the communal spaces, structures, materials and light combine to give new and surprising results.

The refined carpentry for the concrete casting is particularly visible in the areas destined for communal activities and the connecting paths of the residential cells. Concrete achieves an expressive character, like a drawing in negative that allows us to appreciate the extraordinary technical capacities of the carpenters.[18]

"Colle". Common pathways. (Photo Kunstgewerbeschule, Zurigo)

The canteen structure or the vault space, the spiral stairs at the "Tridente" are particularly eloquent, as are the curved skylights in the inner pathway of the "Aquilone" and the "Vela", and the skylights in the central space of the "Aquilone". Materials seem modelled to express a receptiveness to light, capturing it on the prints left by the woods fibres, ushering it into the premises across the surfaces of multiple shapes, lending impressions of the external environment even to those areas without windows.

This extraordinary collection of shapes achieved with slats and cast concrete reinforces, as Naomi Miller reminds us, the quality of the carpenters. Once again, through these complex and endless structures, appears the vestiges of an ancient culture in which the local community can recognise itself - even in the use of concrete, albeit completely extraneous to local tradition.

[18] Denis Lasdun, *Architecture in an Age of Skepticism*. Giancarlo De Carlo. The University Center of Urbino. Oxford University Press 1984.

As a formal element, this material assumes the function that stone had in historical buildings, used to mark openings and moldings, to complete the mass with frames and decorative elements in general. Thus the design of wood fibers and slats, visible in negative on the concrete, can be considered as the only decorative element of the complex.

Collegio del Colle under construction. (Photo Francesco Borella)

These considerations on the materials can be applied in general to the whole complex but with differences between the "Colle", realized first, and those concluded almost twenty years later. In the "Colle", for example, light structures and parapets have a minimum thickness, close to 10 cm, and the supporting parts for the windows are bush-hammered on the surfaces, some of them prefabricated with molds on site.

The state of the concrete is clearly in better condition than in the later colleges despite the difference of time elapsed between the two constructions, a clear sign of its good quality.

The later "Collegi", even if built at the same time but by different companies, do however have differences between them, mostly in the composition of the concrete and in the type of reinforced concrete used, differences that, as we will see, are the cause of the various types of decay detected.

Social value of the Complex

Value attributed by students over time

The "Collegi" of Urbino retain a profound social dimension within them, rooted in the constant dialectical relationship between design idea and end users. The "Collegi" are characterised by a dense practical and symbolic implications, influenced by the production of multiple meanings that the inhabitants associate with the building complex. As a matter of fact, De Carlo's work is not simply a space for residential purposes, but qualifies as a place, or as a framework for structuring social interaction, a structure of feeling, and a center of socially constructed meanings.[19]

In this section we will focus on the recognized value the "Collegi" have for those who live or have lived within their walls, using a set of representations emerged during our sociological research. We will therefore assume the views of the inhabitants, with the aim of highlighting the overlapping images and narratives that make this place very peculiar.

The picture emerging from our research results highlights a number of meanings attributed to the complex of the "Collegi", which testify to the presence of different values recognized by our interviewees in this context. Constructions of sense mainly relate to the experiences lived, that holds together spaces, practices, functions and perceptions. We will therefore try to follow this path by highlighting the main interpretations we have found, pointing to some changes that have occurred over time.

As cultural sites

The architectural heritage left by De Carlo is recognized as an important historical-artistic value by the people who live there, aware of the peculiarity of this complex and of the social goals inherent in the project. The "Collegi" are therefore generally perceived as a culturally relevant place for both their forms and the ideals that have determined them. This recognition, however, appears to be weaker among the current residents than the older ones: the increasing distance from the time of construction involves less understanding of the architectural quality of these

"Colle". Terrace of common service building. (Photo Kunstgewerbeschule, Zurigo)

[19] Massey, D. B., Jess, P. M., Dell'Agnese, E., & Perrone, S. M. A. (2006). Luoghi, culture e globalizzazione. Torino: UTET libreria.

spaces and their intrinsic value, probably in relation to the temporal distance both from (a) the "deeds" that characterize these innovative buildings and their role in the Italian collective residential architecture and (b) from the moment of full efficiency of the structure. Almost 90% of the "pioneers", but only 30% of the current inhabitants attribute a high or very high historic-artistic value to the building complex.

As a place of social relations

The cultural value of this complex is not limited to its structure, but it is also recognized in its aggregating and socializing function for the student community. The concentration of students together with the availability of comfortable meeting areas such as blocks, aisles common areas, have always stimulated the development of cultural initiatives, parties, film projections and self-organized seminars. These activities characterize the exchanges and interactions that spontaneously emerge in the colleges, combining with other forms of sociability promoted by this structure. The chance to meet so many people, to share one's daily life with friends and to make new friends and relations is – from the point of view of both old and current residents – the greatest benefit offered by life at the "Collegi". This central value of the place, however, seems to suffer a drop in customer satisfaction over time: of all the users involved in the research, 82% of current residents are satisfied with sociability, and 93% among the oldest. Likewise, 71% of old residents were satisfied with the initiatives organized within the Colleges' premises, while today only 22% are.

As a "place inside a place"

The experiences of aggregation and sharing are at the center of memories recalled by former residents. For a long period of time, the "Collegi" have seemingly functioned somewhat like a self-contained and almost self-sufficient context in respect of the town, a space full of relationships and rich in moments of encounter that give daily life its fuller meaning. Until quite recently, most residents went to the city center only to attend lessons, while both study and leisure activities tended to be experienced within the complex. Systemic factors and context factors, however, undermined this way of living the site, favoring today's greater flow of users towards the historic center – a change not always positively evaluated.

The "Collegi" and their place identity

Although the context has changed a lot in time, the inhabitants of the "Collegi" do not seem to be simple users of the structure, but they perceive themselves as a well-defined, distinct, community, which originates from the particular context in which it is inserted. This area of Urbino, typologically distinct from the others, represents an enclave of students, geographically integrated, but socially and morphologically different from the rest of the urban context. These elements of social and spatial distinction have an influence in providing to "Collegi" residents a certain sense of belonging, which takes on an identity value, as it is shown by the "us" repeatedly used by respondents in answering the research questions. Recognition in a particular socio-spatial circumstance thus becomes a mechanism for the formation of identity, so that it appears possible, according to one of the respondents, to delineate a division between two groups: the students of the "Collegi" on one side and those of the center, on the other.

As a "place of experience"

Such contextual characteristics make life in the "Collegi" a particularly significant time in users' life cycle, a stepping point in marking their transition to adulthood. Taking part in this community, individuals are thrown into a specific relational dimension, affecting both their daily experience and the ex-post representation of the period they spent in Urbino. This stimulates feelings of fondness and nostalgia for an important phase of their own growth. The central element of such a period is the separation from the family and the acquisition of an autonomous living space that allows students to obtain some independence without necessarily having to deal directly with all aspects related to full housing independence. Experience in the "Collegi" therefore assumes the value of a transition between housing dependence and full independence. A form of dwelling somehow filtered, where services, regulation of the behavior and gratuity of the accommodation allow a soft transition to the responsibilities, duties and burdens of adulthood.

As a "place of residence"

The structure, impressive and detached from the old town, on the one hand risks isolating residents from the activities that animate the city, on the other strengthens and consolidates the sense of belonging to a common context, characterized by a transient but intense form of living. By virtue of these aspects, this environment acquires a family dimension, made of known intersticial spaces, of crossings and people with whom the everyday life is shared. Such confidence with the environment and the people who live in it allows resident students to recognize the "Collegi" as a home rather than just a living space, a room or a dorm. A place that feels just tame, but clearly different from the usual student apartment located in the historic center, described by the inhabitants of the colleges as a sphere of restricted relationships.

As a "domestic place"

The perception of the "Collegi" as a home tends to convey this place in terms of familiarity and domesticity. And it is the term ‘family’ that most frequently emerges from the stories of students and, in particular, of female students: within the personal spaces (room and block), perceived by many students as private and domestic spaces, strong bonds between roommates are emerging, based on the daily sharing and the intimacy of what they consider their home. These relationships are often compared to relationships of kinship and sometimes placed in continuity (or even substitution) with the ties that characterize the family of origin. Values and meanings of the "Collegi" are thus embodied in their perceptible forms, in the activities and relationships that characterize them, but also in the association of this place to a specific life stage; as transient as it is, it is anyway central in the experience of students’ individual development and education. In some cases, such constructions of sense provide elements of identification in a socially and spatially bounded community characterized by a strong attachment to its architecture, both from a symbolic and material point of view.

Stakeholders

Stakeholders are considered all those who have a direct relationship with the complex and who can be considered beneficiaries or administrators of the asset such as: directors, professors, resident students, foreign students and researchers, associations, employees, holders of Conventions, regular guests and casual guests, the owners. But also, citizens and students of architecture, researchers and professors who attend the Complex and study it, may be considered Stakeholders.

Considering the fragility of the complex, each person should, in a different way, assume responsibility for maintaining it, which corresponds to an equivalent level of involvement. Using the structure is a privilege that "imposes" caution and respect but also the sharing of some principles that can reasonably reduce fuel consumption and simplify maintenance. Through greater awareness each of these people can improve their relationship with space to learn the codes of use and become itself a cultural mediator capable of contributing to spreading.

Students and faculties - For responsible use of the structure

- Edit a synthetic version of the first sections of the CMP to raise awareness of the importance of buildings and the context in which it was thought; This should follow some recommendations concerning how to use common spaces as an introduction to "student houses Rules and regulation".
- Take the opportunity of the presentation of the CMP to update "student houses Rules and regulation" in participated meetings with representatives of students and with who are required to comply with it, to share responsibilities.
- to provide clear indications on the use of spaces update appropriate graphic signage, particularly about the space free study which may be enriched with libraries and reading spaces where partitions should protect areas from those of talk and provide a tea corner.

Occasional guests

- Edit a synthetic version of the first paragraphs of the CMP so as to make them aware of the building’s importance, along with the planimetry with the indication of the room Associations and groups of interests.
- A targeted program of visits, projections and introductions to "Collegi" could be offered, on request, with a contribution, which could be held in the Lecture room of the "Colle".
- With the same purpose can be provided a corner that collects all the publications about similar structures, De Carlo’s work and the "Collegi" themselves. The choice and the way of act it could be shared with interest groups, such as local cultural associations, to offer insights.

Citizens

- Many citizens living in Urbino do not know the "Collegi", CAI’s association is carrying out a valuable introductory work by organizing Urban Trekking groups through "Collegi" in the evening. The number of visitors can be increased by creating events and match walks to activities open to the public.
- In the "Tridente" Square events and shows can take place and, on a weekly base, some of the banks in the local market could provide its presence.

Spett. Impresa Montagna – Pesaro

c.p.c. Geom. Lucio Scaglioti – Urbino

Giancarlo De Carlo Architetto 20145 Milano via Mascheroni 18 telefono 46.90.759

16 agosto 1974

Oggetto – Nuovi Collegi Universitari, Urbino
Collegio B –

Vi trasmetto i disegni sottoelencati, relativi alle seguenti questioni che mi sono recentemente sottoposte:

a) strada interna, scale e predisposizioni per i parapetti delle scale

b) passaggi della strada interna verso la campagna.

Per quanto riguarda la questione a):

E' data una tavola con pianta e sezione dei casi tipo (da completare con le tav. al 100 dei vari bracci per collocare al giusto posto i vari tipi e individuare i lati verso i quali sono sistemate le scale – di tali tavole (UR 139-6 e 139-7) si allega alla presente una copia – Notare che le scale sono staccate dai muri laterali mentre i pianerottoli sono in adiacenza – Notare anche che sono indicate le posizioni dei montanti e degli attacchi al muro dei parapetti e che le relative predisposizioni di fori per l'ancoraggio sono fornite dalla tavola di dettagli pure allegata –

Letter handwritten by Giancarlo De Carlo to the construction company.

Written correspondence, projects at the municipal archives, testimonials.

Research was carried out across different sectors, with the most valuable findings coming from the following sources: analysis of written correspondence collected at the De Carlo Fund at the IUAV in Venice; research at the municipal archive of Urbino; and testimonials collected from the architects who had worked with De Carlo on the project.

About 800 documents were researched at the Venice archive from which 136 of the most representative ones were selected. These documents are just a small part of the long correspondence that starts from the early 60s, continuing into the early 90s. We selected those sources that seemed most relevant to better understand the project, the building site issues, and the complexities of financial aspects leading to its development.

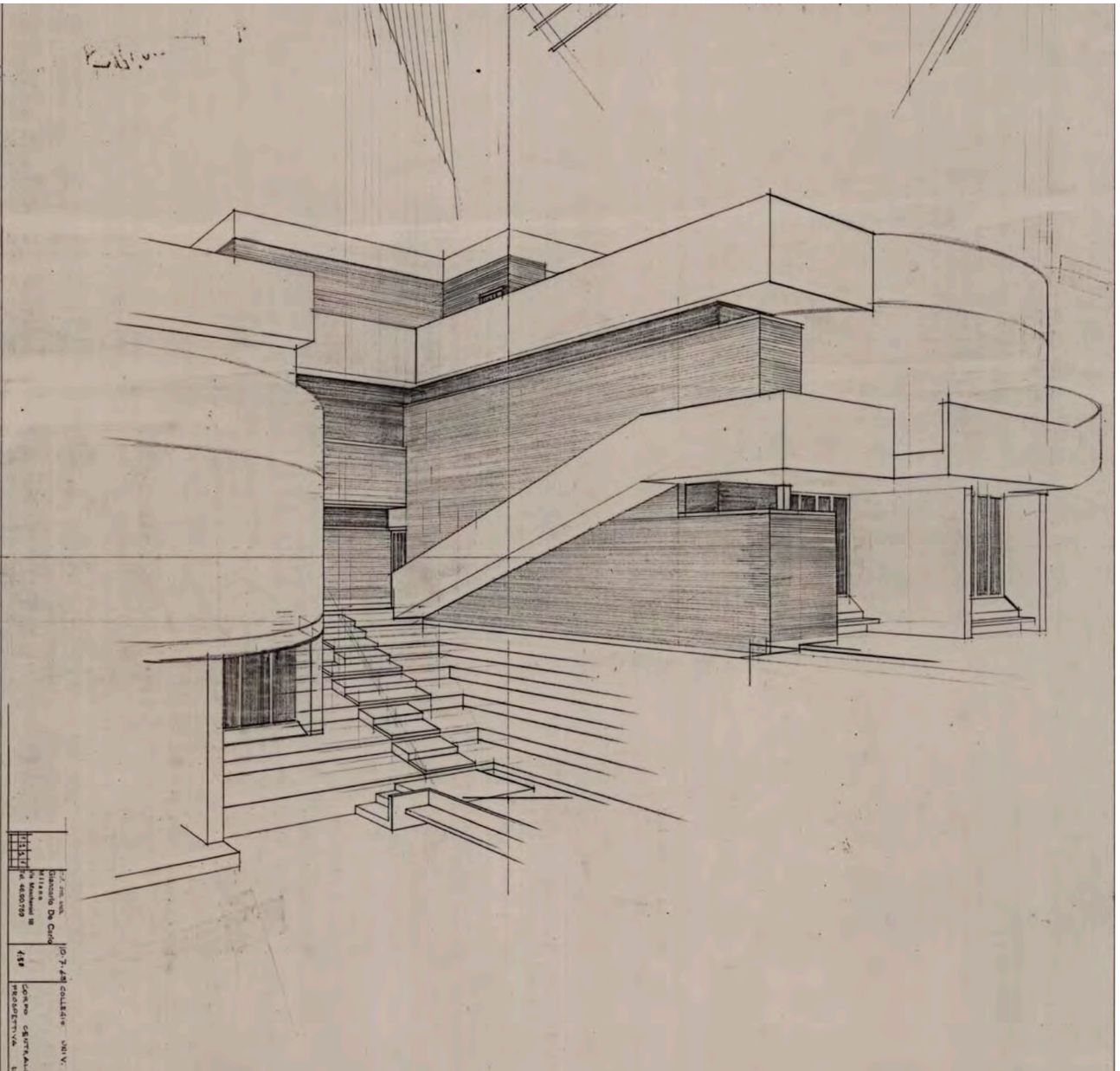
First, it must be said that the text reflects the tensions among those involved in the development of the Complex and the enormous commitment needed to get on with the work. To deepen these aspects a survey was conducted among the architects working on the project aiming to reconstruct a clearer picture of the events and overall atmosphere that was surrounding them. Through interviews, we were also able to get a good deal of technical information on the materials and construction techniques applied.[20]

Finally, all the materials available in the municipal archive of Urbino were analyzed, where there was a copy of the projects submitted for the examination of the building permits and diverse variant practices of several colleges. Our research revealed around 100 unclassified documents in the De Carlo archive: copies of original

[20] In particular: Arch. Francesco Borella who worked on the project and the construction site of the Collegio del Colle; Arch. Antonio Vecchi and arch. Giancarlo Mountagna who participated in the design and building phase of the new colleges, Arch. Paolo Spada, who supervised the restoration work in the 90's. In the archive of Francesco Borella, copies of the executive project of the Central Block (not present in IUAV archives) of Collegio del Colle have been found, as well as a series of slides documenting the construction site.

drawings, reports and images of models that have been scanned and integrated into the Fund. Unfortunately, our research at the University archives, which were largely destroyed, gave less positive results, exept for the discovery of some original drawings of the furniture for the "Collegio della Vela".

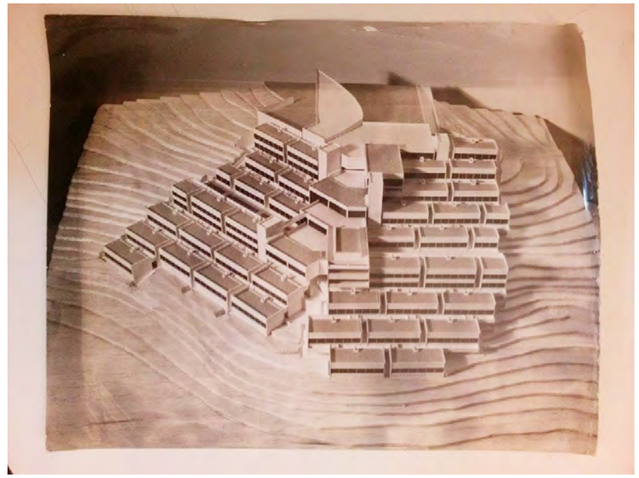
We summarized those aspects that seemed more interesting paying particular attention to those that may be relevant to the Conservation Plan.



"Colle". Perspective view of common space building.

The planning of the Complex was not developed in a single phase, but through a series of changes and adjustments, determined by the shape of the site, availability of areas and the relationship with the Municipal Building Commission. Many projects were completed in different phases starting with the "Collegio del Colle" where a first solution, in contrast with the one delivered, was abandoned. In the early 70s, given the increasing number of students, the University began thinking about the construction of other colleges and examining the possibility of using prefabricated systems. Before focusing on the location of the new sites in the surrounding areas close to the "Collegio del Colle", De Carlo and the University also examined other sites like Pineta and Pian Severo. Following an acquisition of other areas on the Cappuccini hill it was possible to achieve a more extensive development and design for a brand new development called Collegio B (Tridente).

The "Collegio A" design (which included what is now commonly referred to as the "Vela" and the "Aquilone"), subsequently received the approvals of the Superintendence for the landscape constraints that protect the views from the city. Its development was not straightforward and several changes were required following a request of the Municipal Building Commission to reduce impact on the site.[21]



Model of first solution of Collegio A.

Even the "Collegio del Tridente" project required substantial changes during construction, particularly in its central part.

[21] In the minutes of the meeting with the Superintendent Trinci in February 1973 it was noted that a part of the College was part of a restricted area. An inspection was carried out with favorable remarks and some doubts regarding the Third College (College C), whose position was considered "..a cause for concern in terms of maintaining a harmonious relationship between construction zones and green areas of the Colle".

Originally the canteen was not planned in its present position and was smaller, and in the program a restaurant was needed in the "Collegio della Vela". For budget purposes, the University decided to build a kitchen and a large canteen that would take up the entire space on the first basement level, below the square that was originally designated for the garage. A work-in-progress variant, quickly developed, designed to provide a garage under the canteen, in a second basement level.

This correspondence provides us with an extensive knowledge of the design but also of the financial issues resulting from the acquisition of several mortgages[22]. The University's technical office was set up in 1976 when the new colleges were being built, and before that date the reference figures on site were: Adolfo Sartori, who played a leading role in the construction of the "Collegio del Colle", and Lucio Seraghiti; both were not University employees at the time. The simultaneous management of the three sites ("Collegi del Tridente", "Aquilone" e "Vela") became so difficult that De Carlo considered it necessary to move four architects from his studio in Urbino to work with the two local technicians. Reduction and programming of economic resources becomes a constant and assiduous task, and the project was reviewed in several stages to reduce costs and meet the demands of the University.

On the matter of materials, the correspondence points out how some choices were never called into question, the use of bricks and cement for example; for others, research was articulated and extensive. On the windows of the "Nuovi Collegi" for example, built with wooden frames as in the "Collegio del Colle", selection was based on a wide and articulated search for solutions that would improve performance and durability. In the early stages, various types of frames were considered by consulting different producers of steel and aluminum windows. The detail drawings also included metals window sills and roller blinds. From the testimonials, it turns out that the final choice seems to have been determined by respecting overall coherence with what had already been put in place at the "Collegio del Colle", and with the need to reduce costs, as requested by the University.

As time goes by and in the absence of maintenance, the wooden frames began to have problems caused mainly by condensation. Low efficiency and poor durability was evident by the end of the 1980s and the University, in agreement with the architect, decided

[22] In a letter to Carlo Bo, alarmed about the financial situation, De Carlo writes. "My concern is that we are in a dilemma that needs to be resolved. Cariplo (the Bank) gives us funding only if we present a progress report, so we need to work to have the finance." Carlo Bo writes to De Carlo: "Please kindly control the costs as much as possible."

to intervene, seeking solutions to the problem and replacing the most damaged windows.[23]

The bricks used at "Tridente" were produced by Pica (local kilns), measuring 25x12x5 cm. All the structural part of the masonry had been sized on this brick. Considering that the brick-resistant section was 60% of the total, it was possible to build light bricks walls up to two floors, and use reinforced concrete structures for the most complex parts where concrete walls were covered with strips obtained by sawing the same brick, thereby maintaining homogeneity of materials.

"Collegio del Colle" under construction. (Photo Francesco Borella)

The far faced concrete structures are certainly one of the most important characteristics of the Complex and some of the current problems we found were also described in historical documentation. It is conceivable that some technical choices were the result of a difficult management of funding. For example, in the "Collegio del Tridente", the use of electro-welded nets instead

[23] In 1988 De Carlo wrote to the Dean of the University about the glass condensation problems. Windows with simple glass had been adopted to reduce costs, but condensation in the winter months deteriorated the lower parts of the frame. He proposed replacing all windows with double glazing, considering that these changes would certainly reduce energy consumption and help manage costs.

of bars was more than likely dictated by the need to accelerate work and reduce costs on-site, which due to the absence of a proper sizing of the concrete cover, is one of the causes of the deterioration that we see today. The problems that we find today are not recent, and they are reported in communications between the Architect and the University. Already in the late 1980s, following an external technical review, the University, supported by the Architect, decided to intervene with sampling at the Collegio del Colle. Restoration solutions were studied and three types of finishes were prepared: with a smooth surface, with the design of inverted molds, with the surface bushing. The last one was then chosen.

Another peculiar feature of the complex is the terrazzo flooring. Many types of "graniglia" were made and sampled with blends of different marbles and cement. The selected one was composed of the following formula: Graniglia Musso n.2 / 3 80%, Garda pink marble 20% on normal cement, gray plastic strips.

It is also interesting to note that in the "Collegio del Tridente" a solution for hot water was studied using solar panels and a mixed circuit. Again for budget reasons this plant, absolutely innovative in its time, was not used.

Concerning distribution, the vision of the colleges as a part of the city often came back in the documentation and texts. In a 1978 article that describes the Complex, De Carlo talks about the range of activities to be provided:

"*For example, a nucleus contains large classrooms for conferences and meetings, another a general library, another a cinema, the first also a space for performances, the second a place for outdoor projections and some shop spaces, Third also a restaurant (900 - 1000 meals)... All include meeting rooms, seminar, reading, music, games; but in each of the nuclei places have a different character. The presence of activity and the different character of the places will offer a wide range of choices and will generate movement and exchange; not only between the university students living in the various parts of the complex, but also between themselves and the citizens living in the various sectors of the city, who will find in New Colleges more opportunities than those existing in the city center.*"[24]

However, over the years this process did not start as planned, and about ten years later the same architect had to acknowledge with some disappointment that: Various fully equipped bars have not been put into operation; shops are still empty or used as

[24] Interview. Corriere Adriatico 8 December 1978

deposits because it seems that the City does not want to grant licenses; other spaces, for music or small meeting groups are not used because they have not been nearby the services that were provided or because no one explained or indicated what their real purpose was ..."

Chronology of architectural works

Please find here following the main dates of the construction of the colleges and of the most important projects of requalification and upgrading of them.

The "Colle"

Authorization to work execution n. 73/A del 12/6/1962

Work start 1962 - End of works 1965.

The "Tridente" (Block "B")

Authorization to work execution n. 122/54/A del 6/7/1974

Work start 1974 - End of works 1978

The "Vela" (Block "A")

Authorization to work execution n. 188/73 del 23/11/1973 e 50/81 del 16/4/1981

Work start 1974 - End of works 1979-1980

The "Aquilone" and the "Serpentine" (Block "C")

Authorization to work execution n. 189/73 del 23/11/1973 e 51/81 del 16/4/1981

Work start 1974 - End of works 1979-1980

"Collegio del Colle" under construction. (Photo Francesco Borella)

II Part

The "Collegi" as a system: articulation, characterising elements, functions.

Overall image of the "Collegi".
(Photo Fulvio Palma, Urbino)

Description of the Complex

The general layout of the Complex comprises student's dorms, facilities and services, common to the five colleges that are: the "Colle", the "Tridente", the "Serpentine", the "Aquilone", the "Vela" and the Cappuccini Convent.

The Cappuccini Convent, which is named after the oldest nucleus, is at the centre of the system and has only partly been restructured and used as a forestry and technical office of the University. The rest of the University's ownership has remained unaltered during the time and the Church and the Sacristy, owned by the Archdiocese of Urbino, are currently not used.

Barycentric between the Convent and the "Colle" is the thermal station body, located on the side of the "Colle" parking. Pipes move from there, lying beneath the paths and the perimeter of the gardens, to feeds the substations that serve the individual colleges.

The "Colle"

The first residential block, built between 1962 and 1965 on the "Colle dei Cappuccini", includes 150 single rooms arranged around a large service building.

The building materials are the ones that will then be used throughout the complex: load-bearing bricks, facing out to the outside, and concrete, in different colours and surface finishing. The doors and windows frames are in white-painted wood.

Residences

footprint 2310 sqm;
rooms tot. 3270 sqm; coverted paths 1350 sqm.

Each block includes between 12 and 20 rooms on two levels, each accessible from an outdoor covered path.

The room have private bathrooms, and "custom" furnishings (wardrobe, book shelves, lamps, ...). The walls are complely plastered and painted in white.

Inside the rooms is used coloured linoleum (the original pavement have been substituted in 2006 with a new material, of the same color but in squared tiles rather than in large rolls).

Each room has a large sliding window open on the landscape. The rooftop are flat.

The interior and exterior paths are paved with 2 different kinds of concrete.

Part of the residences are used as guestrooms or for short-stay students (as post graduate reseachers of foreing students).

Service building

Tot. 1558 sqm; footprint: 718 sqm.

The service building, on 4 levels (the first partially underground), includes living and study areas, reception and an apartment for the director, a conference room, a canteen with a kitchen, offices and service spaces.

Access is from Level 4, from the parking lot and connects to the lower level common areas, which gives access to the external pedestrian paths that leads to the residences.

In the interiors, the walls are both plastered and left without coating; the ceiling is in most cases covered with a rough plaster.

The common areas has cast floors, whilst the conference room is paved with porphyry cubes and the service spaces has common tiles. The large terraces are paved with large concrete squares. The rooftop is flat and cannot be accessed.

Any of the doors or windows have been realised on design, as well as the furniture.

Footpath and roof view from the service building of "Colle". (Photo Kunstgewerbeschule, Zurigo)

The "Nuovi Collegi"

In 1973, eight years after the completion of the "Colle", De Carlo a was asked to extend the complex. The program he made allowed to add a thousand new beds for students and common areas for academic and cultural activities, and new common services, as the canteens.

The same materials used as the "Colle" were used and the same layout of the rooms was also proposed on over-lapped terraces arranged according to the level curves with the exception of "Tridente", whose arms "cut" the contours of the hill instead to follow her.

The "Tridente"

The first of the new colleges to be realized is also the most complex from the spatial point of view.

It includes 352 single rooms (10,80 sqm) in three "bracci" (arms).

Residences

Footprint: 1065,80 sqm ("braccio" 1 – 6 blocks); 1232 ("braccio" 2 – 7 blocks); 1582,70 ("braccio" 3 – 9 blocks).

In each "arm" rooms are arranged symmetrically around a large internal street that follows the slope.

organized in groups of 16, 8 single rooms for each side (four for each level), with common facilities (kitchens, common areas, toilets) and a common space on two levels. The common areas of the residences are equipped, among other things, with a kitchenette and a large table.

Besides, the students have access to the terraces on the roof and to the exterior path (with steep metal stairs) that connects all the roofs.

The services are shared by 16 occupants and are located above the internal room.

The external paths have been realised fairly recently, and are slightly different from the project.

Service building

Foorprint: 5050 sqm
Lev. 1 (-7.45): 3951.80 sqm
Lev. 2 (-4.00): 4582 sqm
Lev. 3 (+0.20): 1580 sqm + 2261 sqm square
Lev. 4 (quota +3.55): 586 sqm + 319 sqm terrace

The service building, on 4 levels, contains collective services, such as meeting rooms, study rooms, classrooms, a canteen with kitcken and a parking.

The first 2 levels create a sort of basement on which, at level 3, there is a public square.

The supporting structure is realised with concrete pillars (the detail if the connection pillar beam can be observed in the parking and in the canteen), that follows a radial and grid arrangement.

Side façade of two of the three "arms" of the "Tridente". (Photo Antonio Garbasso)

Some od these elements have been streinthened to improve the seismic performances by using using fibre reinforced composites. The outer walls are in bricks withput coating.

The "Serpentine"

The complex, comprises 152 single rooms divided into 3 blocks, each of which includes 6 (blocks CX and CY) or 7 (block CZ) "units", with 8 single rooms. The units develop on two levels, each with four single rooms.

On the lower floor there is a double height space with the function of common space, a kitchen and shared bathrooms. Upstairs, connected by a steep iron staircase, there are four rooms and a

hanging. Each unit has a private terrace on the roof; the rooftop is flat.

All the units has the same elements and are very similar but they are all different from each other.

Footprint: 2314,70 sqm

715,60 sqm (block CX, 6 units); 731,40 sqm (block CY, 6 units); 867,70 sqm (block CZ, 7 units).

Internal view of the double height common space of the "Serpentine". (Photo Giorgio Casali. Università Iuav di Venezia - Archivio Progetti, Archivio Giorgio Casali)

The "Aquilone"

The Complex has 128 double rooms with private bathroom (256 students) arranged on two parallel rows and an internal road that develops according to ground level curves. The density and mode of aggregation of the rooms refers more directly to the density of the historic centre of Urbino. The rooms are arranged in transversal blocks, each with four double rooms on two levels and connected to the inner road through a steep stairway such as the "Tridente" and "Serpentine" stairs. The main building includes a large conference room, classrooms and study areas, spaces

that were destined for shops but not currently used, a library and several classrooms / studios that open onto the roof terrace.

The library

Footprint 678 sqm (tot. 1871,40 sqm+ terraces 642 sqm)

The library has an inclination of 45 degrees from the service building; is accessed through the concrete spiral staircase on level 4 and through the ramp that goes down to the library and connects to a covered walkway that runs through the entire building, and ends in the huge external staircase in reinforced concrete, which is the second access point to the library (form levels 2 and 3).

The continuity of the path is underlined by the pavement (in washed gravel) that visually connects the two accesses.

From level 3 a second external staircase can be accessed that connects the library to the laboratories at level 4 (currently used by UTSA – University of San Antonio, Texas).

The structure of the building is constituted by a regular grid of reinforced concrete pillars, with circular and rectangular section, one of which is partially inserted into the masonry, and by some concrete walls covered with bricks. The other vertical structures are realised with load bearing masonry and concrete walls, left without plaster (on the inner side, at levels 2, 3 and 4).

The building is organised in 4 levels, and the interior layout allows better natural lighting while handling the different levels of the building site.

The reading room, on 2 levels (lev. 2 and 3) is the main space of the building and is enlightened by a huge window, but is protected by the sunlight.

The lower level (lev. 1), connected by an spiral staircase to the reading room, is used as a service space.

The upper level (lev. 4) has independent access from the terrace, partially inaccessible for security reasons, partially used as a roof- garden.

Service building

Footprint: 1115 sqm

The building has a square plant, with 5 levels and gives access to the residential blocks C-D (from level 7), A-B (from level 5) and to the library (from level 5).

A regular grid of concrete pillars and concrete walls (with a brick cladding) constitutes the bearing structure; the other walls are built with hollow bricks without coating.

The full-height central space, lit by the skylights on the roof terrace, is the key element of the construction, around which spaces dedicated to specific functions, paths, and freely usable spaces are arranged.

The central space is characterised by parapets in reinforced concrete, with a red metal handrail, that is also in the 4 stairwells that link the different levels.

The stairs are accessibile from the central space and are paved with washed gravel, as all the "public paths" of the building.

The choice of the paving materials indicates and highlights the function of the spaces: the common areas are paved with a "seminato"; the interior and exterior paths (stairwells, stairs, ramps, paths that connects the services to the residences) are in washed gravel; the spaces for culture and leisure (external theatre, central space) are paved with stone (cubes of porphyry), whilst in the service spaces there are small tiles.

The different levels also determines the choice of the functions: as in the "Vela" building, the upper levels was supposed to host the functions used also by the citizens, whilst the lower levels were mainly for the students.

The main access is from the pedestrian footbridge at level 9, that connects directly to the roof theatre, the terraces and green roof.

At level 8 there should have been a bar and other shops, that have never been realized and now most spaces are just used as storages.

At level 7 there should have been a conference room (nowadays the space have been divided in two rooms) and 2 rooms for the TV, now used as storages; the TV room on level 8 (instead of the bar) is used only for special events, as the football matches.

In the common spaces there is still part of the original furniture as the wooden benches, the tables, the partitions in wood ("carabottino"), the ashtray, the baskets...

The residences

The rooms (128 double rooms with private bathroom, 256 students) are arranged in 16 blocks, located at different height, divided in 4 wings (A-B and C-D) with 4 blocks each, located at the two sides of the service building. Each block contain 8 rooms, on two levels, that can be accessed from the internal path by climbing a metal ladder.

Above, an exterior path connects the blocks and give access to the roof terraces.

The central "piazza" in the distribution volume of the "Aquilone". (Photo Giorgio Casali. Università Iuav di Venezia - Archivio Progetti, Archivio Giorgio Casali)

"Vela" unit with the theatre back on the left, green terraces and the volumes of rooms. (Photo Fulvio Palma, Urbino)

"The Vela"

Footprint: about 6400 sqm.

So called for the theatre's feature, which is at the highest level.

The layout is based on the "main axis" that starts from the "Aquilone"; the same inclination of 45 degrees is recalled in the common areas.

The two buildings are connected through a double height space (from lev. 2 to lev. 4) and, at lev. 5, through an external path.

It has 156 single rooms and 33 doubles (222 students), built to terracing in parallel lines shrinking.

It consists of a vertical block developed on eight levels, connected by a stair tower that characterizes the entire construction.

The rooms are partially superimposed and are set in blocks of 6 single rooms or 3 double rooms.

The rooms are arranged in two different layouts: the first for the six single rooms of about 9 sqm each, it has a common part that includes services (bathrooms and kitchen), near the corridor (levels 7-6-5-4-2 and 1); the second for the three double rooms includes a shared private bathroom of about 27 sqm each (at Levs. 8, 3 and 3bis).

The common services and the interior path are enlightened by the skylights that are visible along the external path.

All the rooms (with the exception of those of the level 3bis) have a "french window" that gives access to the external path and to the terrace- roof.

As in the "Aquilone", there are open niches along the corridors prepared for the stop and for the meeting; most of there spaces keep the original furniture (the concrete seats, tables and cabinets of different colors depending on the level).

Common areas include theatre, studio and leisure facilities, open to small green terraces and a patio. At level 5 and 8 the common spaces are unused or used as spaces for the individual study, whilst De Carlo conceived each level with a specific identity. As in the "Aquilone", the upper levels (that can be accessed by car) should host functions open to the city (as the theatre at level 8 and the space for musical perfomances at level 7) whilst the lower levels (the canteen, at lev. 6, the living at lev. 5 and the TV room at lev. 5 and 4) should have been for the students.

The load-bearing structure is composed of a regular mesh of concrete pillars and concrete walls with a brick cladding.

Ownership and management

The "Colle", "Serpentine", "Aquilone" and "Vela" are owned by the University of Urbino and managed by E.R.S.U. (Ente Regionale per il diritto allo studio universitario) di Urbino.

The "Tridente" is owned and managed by E.R.S.U.

Polarity

The indoor core of the "Colle" / lecture room / breakfast room of the "Colle";

The outdoor core of the "Tridente" / the square / the canteen / theater and the services of the "Tridente";

The indoor core of the "Aquilone" / the multi-storey square / the open air theater / the library of the "Aquilone";

Library / theater / study area of the "Vela" are connected by an external, only partly suitable for vehicle path, and partly by an internal corridor that gives access to the rooms of the "Aquilone". Paths and external stairs that articulate along the slopes of the "Colle", at the side of the "Tridente" arms, at the foot of the "Serpentine", between the "Tridente" and the "Aquilone" extending like a light and almost invisible cross-link through the green slope.

In De Carlo’s mind at the two extremes, in the central space of the "Tridente" and "the Vela", the students find the canteen and could choose either, depending on the proximity. A third dining spot with the kitchen at the "Colle" was meant for guests’ breakfasts, including outdoor dining and more private dinners. The "Aquilone" had to be a predominantly diurnal centrality because it was conceived as a multi-storey square with shops and ended with the library. The "Vela" canteen smaller than that of the "Tridente" was completed by the presence of the Theater which, especially in the evening for students, could constitute an attraction capable of giving life to all the surrounding spaces. In this way, polarities connected to the network of paths would ensure mobility throughout the system and the correct use of all spaces.

Accessibility

According De Carlo’s idea "Discovering the Colleges" begin from the "Colle": you climb up the hill to the Convent, park your car, turn down the tree lined path and walk through the central body and along the external paths to descend to the "Tridente". Or, if your destination is the "Aquilone" or the "Vela", you should turn around the Convent, in front of Technical Office and reaching a carriageway from which an open stairway, bridge you to the "Aquilone", or proceed to the "Vela".

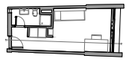
The carriage able entrance, mainly for service and maintenance, was placed at the foot of the "Colle", coinciding with the present Giancarlo De Carlo street, running around the "Tridente"’s central body and reaching the foot of the three arms, surpassing them to serve a sports area, which was not realized, placed at the foot of the system, and reach the library of the "Aquilone".

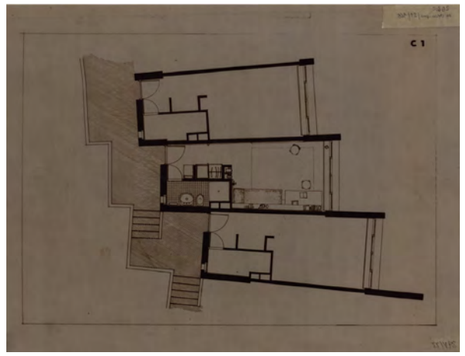
The system did not envisage cross-carriage traversable maintenance path or even other forms of mechanized connection. This render difficult the day-to-day management of the rooms and the timely maintenance of the buildings which is, in some parts, almost inaccessible.

The green system

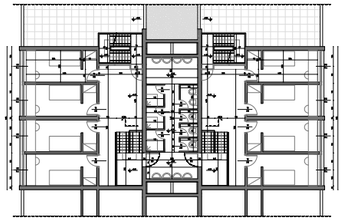
The System of Buildings in the "Collegi" is born together with the Green System, which can be said complementary. First, the close relationship between the orography and the layout of the buildings allows to enjoy, in each room, of the exclusive view of a large portion of landscape without fearing introspection from other guests of the "Collegi", or visitors who go on the outdoor corridors. Then the direction of the paths the position of the openings and the perspectives that recall the facades of the old town centre towards the landscape are designed to maximize their perception. The choice of the essences - all indigenous -, the materials with which the paths, the benches, the rest areas, are realized like organic part of the landscape, on which the lichens draw textures as if they were organic surfaces. The paths, as it moves away from the built, slightly "slip" into the vegetal soil and almost disappear.

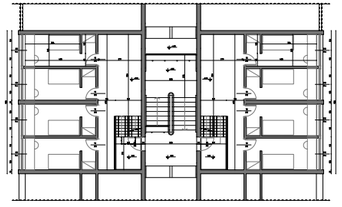
"Vela". View from the terraces roofs.
(Photo Antonio Garbasso)

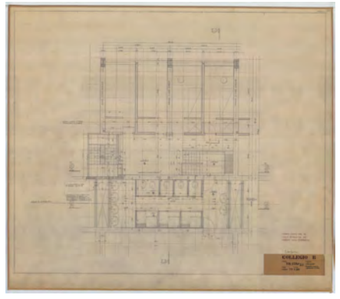




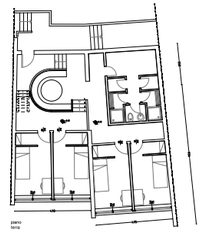
"COLLE"
Single room with bathroom= 20,50 sqm

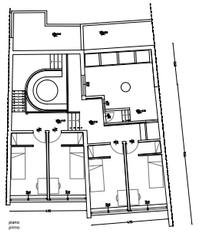


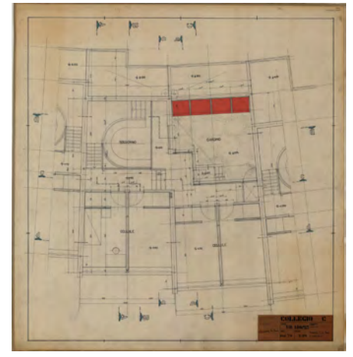




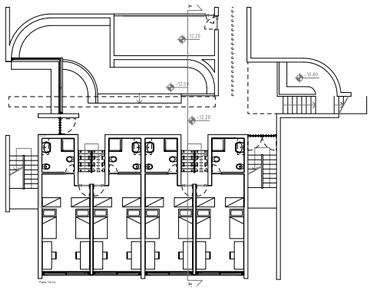
"TRIDENTE"
Footprint of the residential unit= 116,50 sqm
Single room= 10,90 sqm

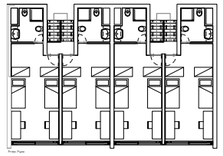


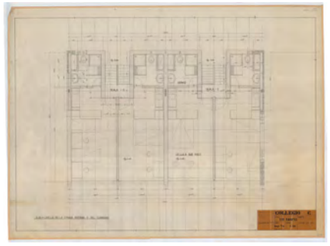




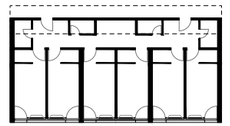
"SERPENTINE"
Footprint of the residential unit= 101,00 sqm
Single room= 11,50 sqm

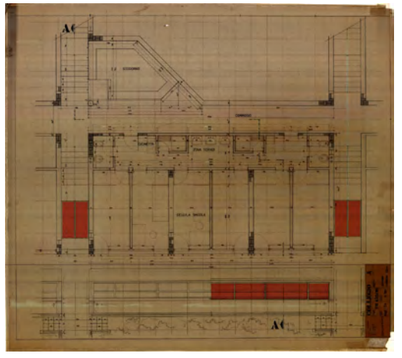






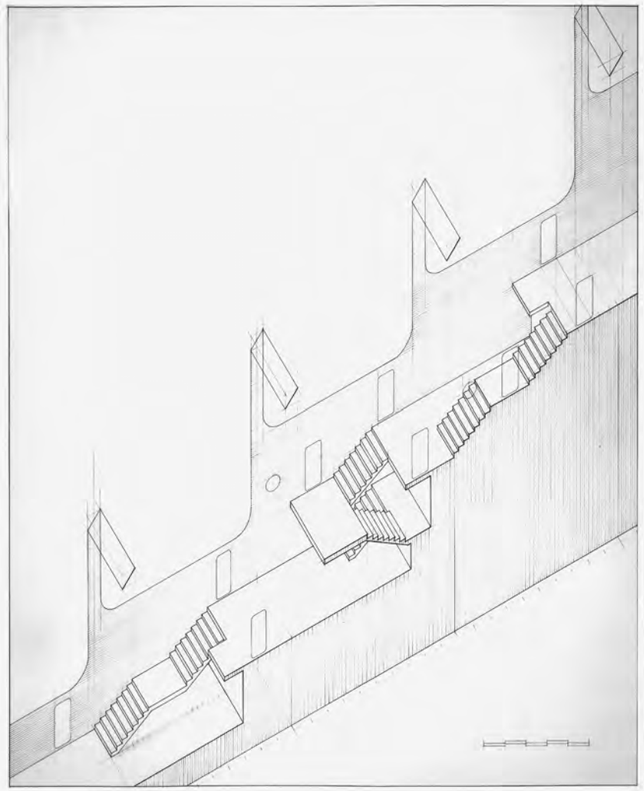
"AQUILONE"
Footprint of the residential unit= 116,60 sqm
Double room with bathroom= 27,00 sqm

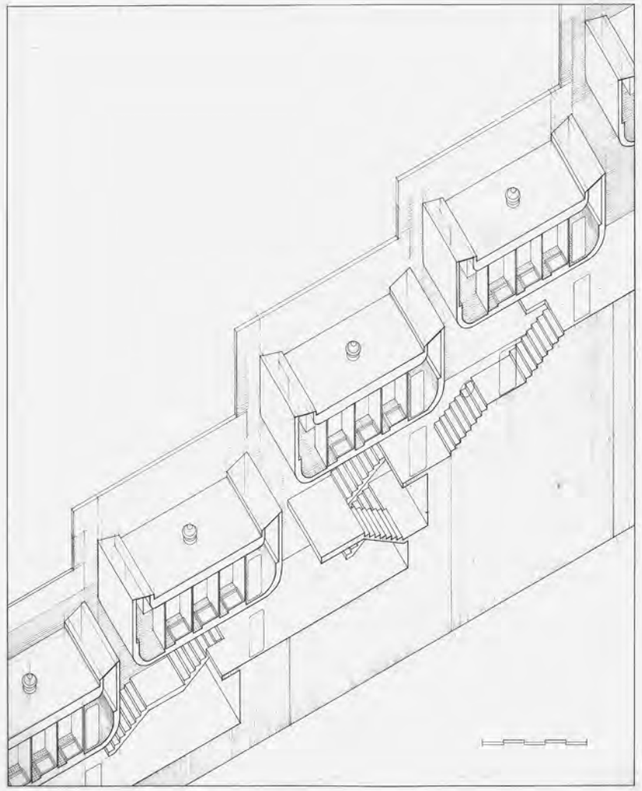


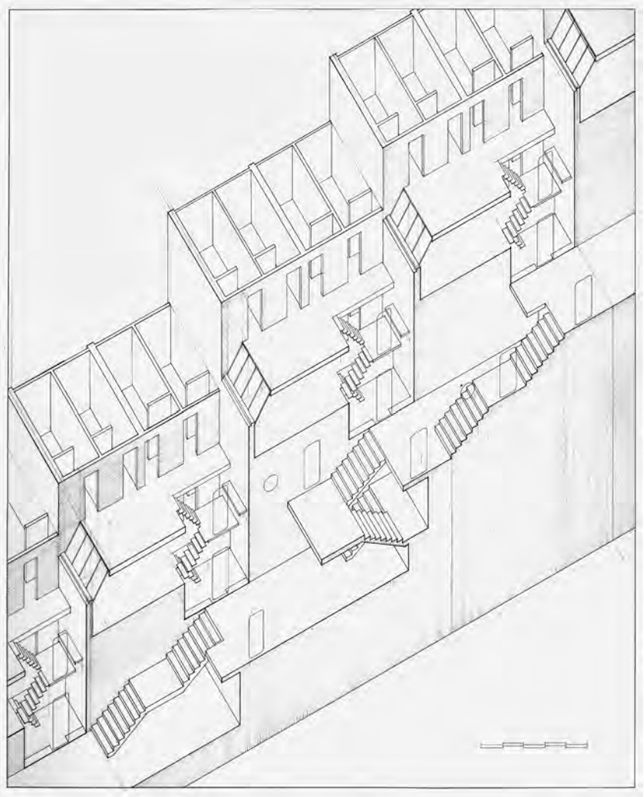


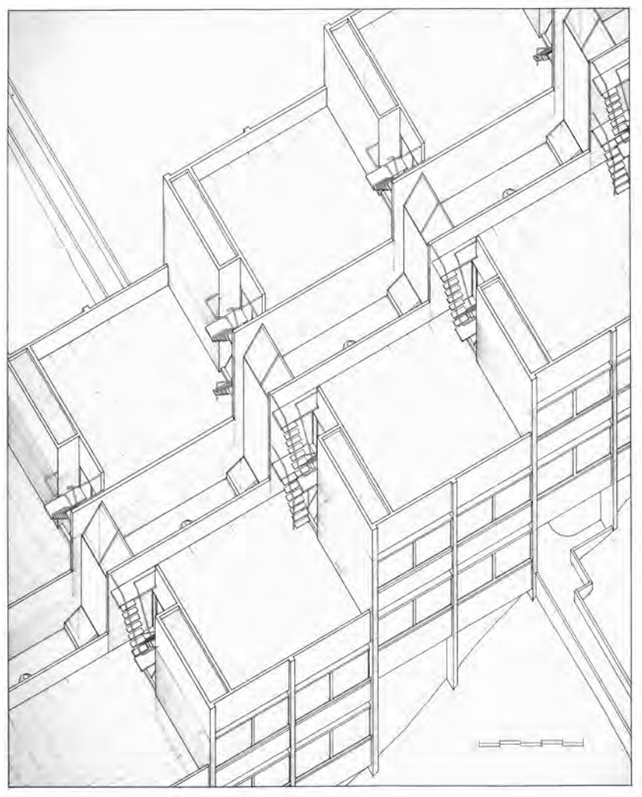
"VELA"
Footprint of the residential unit= 92,30 sqm
Single room= 10,50 sqm
Double room with bathroom= 30,15 sqm
(accesible to the disabled students)

The Students room dimension and arrangement of private and common spaces: "Colle" and "Nuovi Collegi". Original drawings









Internal road at the "Tridente", with the skylight over the stair, original drawing.

Internal road at the "Tridente" across the bathroom body, original drawing.

Section across thed ouble height internal room at the "Tridente", with the skylight over the main internal road, original drawing.

Axonometry viewed over the roof of the "Tridente", original drawing.

Identification of the functional areas

The data are organized as follows:

- common spaces (that are in most cases freely accessible to anyone, but that do not have a specific function);
- common functions (as the canteen, or the library), that has a specific, collective use, that implies peculiar features, equipment, furniture or technical needs;
- kitchens and related service spaces (storage, spaces for the kitchen's staff), residences; services to the residences (as the laundries);
- offices, concierges and spaces for the employees;
- public toilets;
- archives and storages;
- technical spaces;
- spaces that are not used or not accessible;
- internal paths (with and without services for the students, as the living spaces along the corridors;
- outdoor paths.

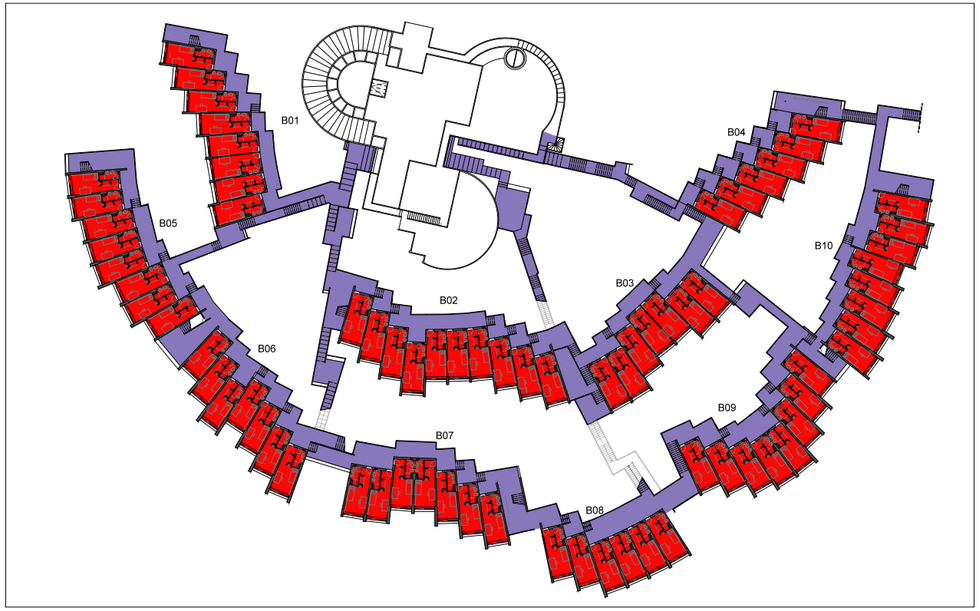
The exterior spaces (terraces, roof gardens, roof terraces) are described on the plans by identifying the type of pavement (green roof, concrete slabs, concrete casting).

IDENTIFICATION OF THE FUNCTIONAL AREAS

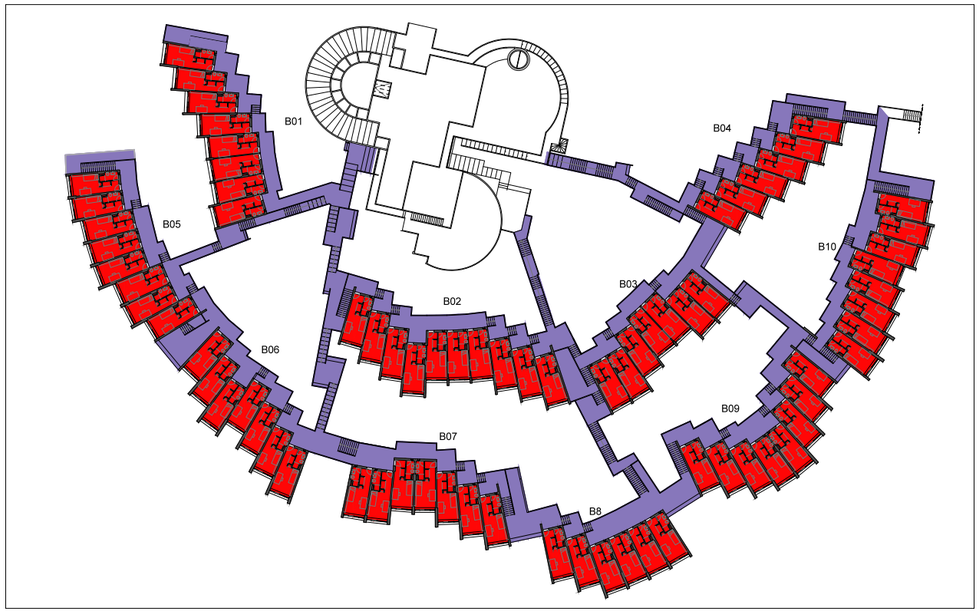
- Common spaces
- Common functions
- Residences
- Services to the residence
- Kitchens and related service spaces
- Offices
- Concierge and other rooms for the staff
- Public toilets
- Archives
- Technical spaces
- Unused spaces
- Internal routes
- Internal routes
- Outdoor paths

Annex 1. Description of the complex.

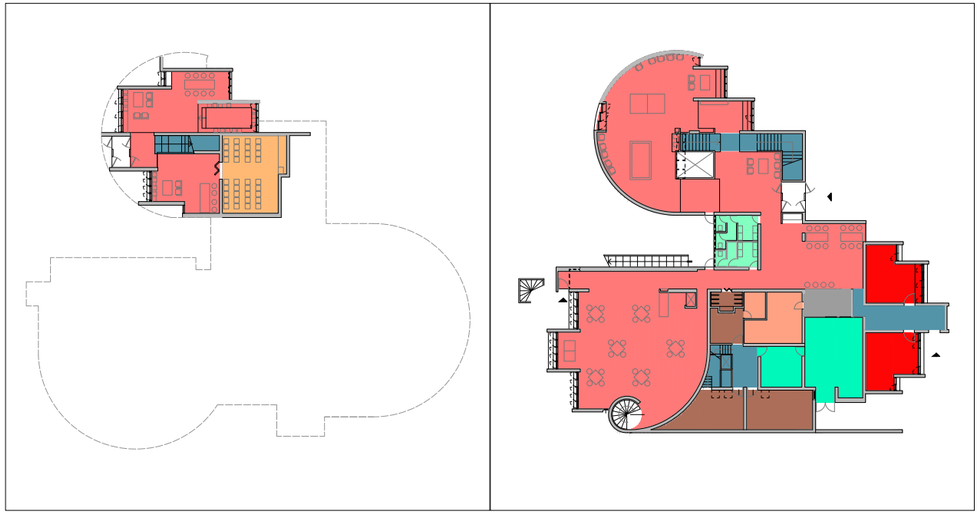
The "Colle"



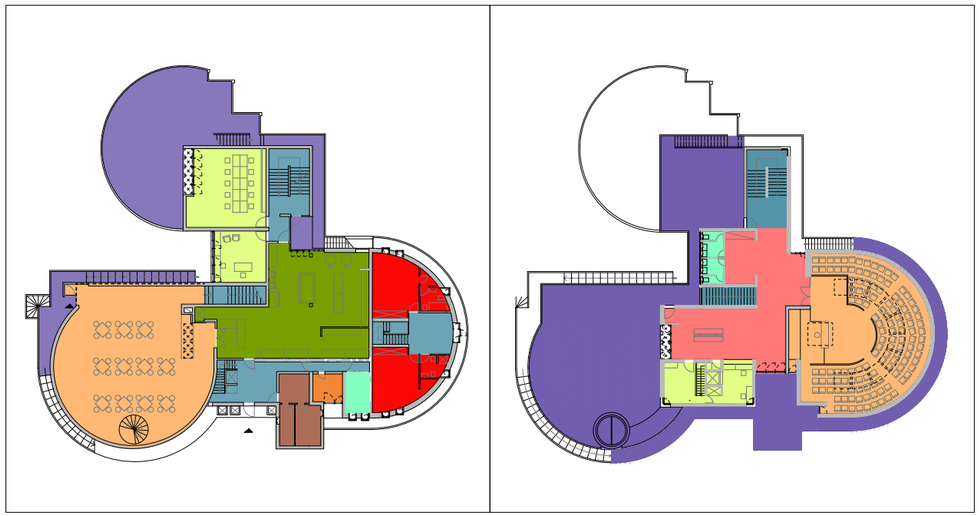
Level 1 | RESIDENCES



Level 2 | RESIDENCES

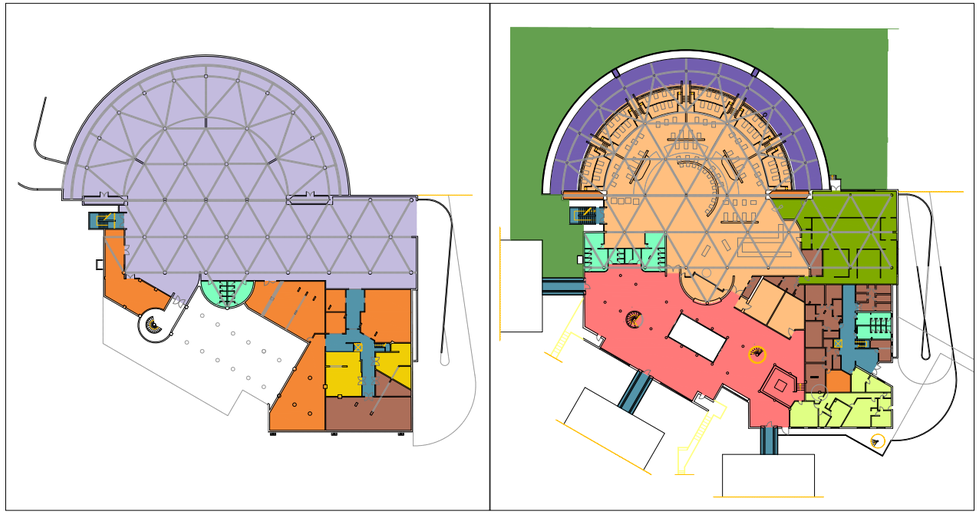


Levels 1 / 2 | SERVICE BUILDING

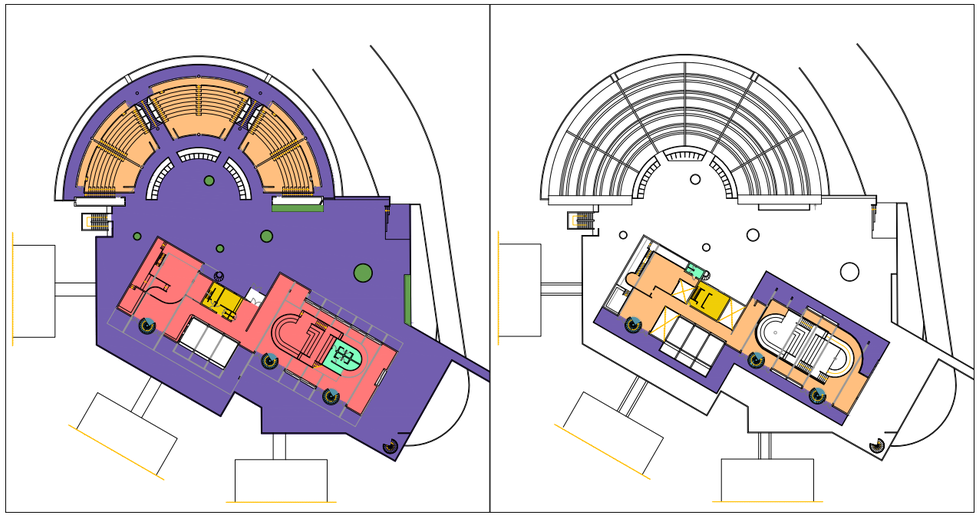


Levels 3 / 4 | SERVICE BUILDING

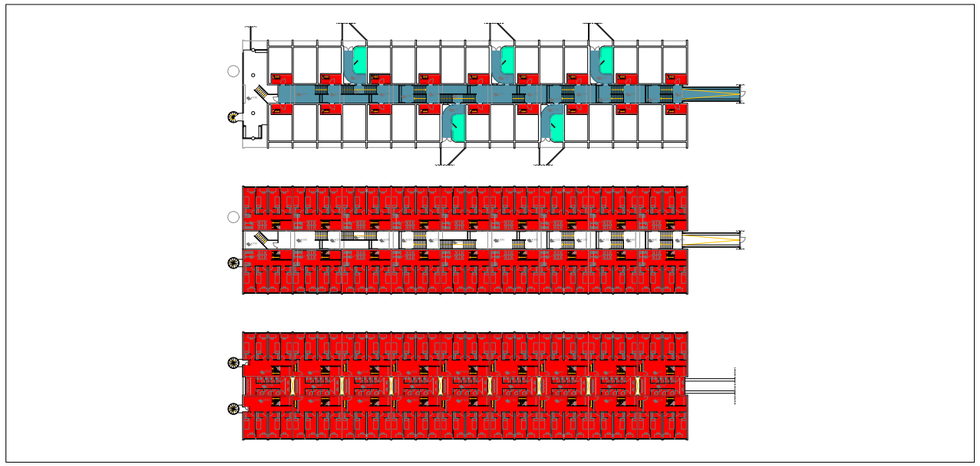
The "Tridente"



Levels 1 / 2 | SERVICE BUILDING



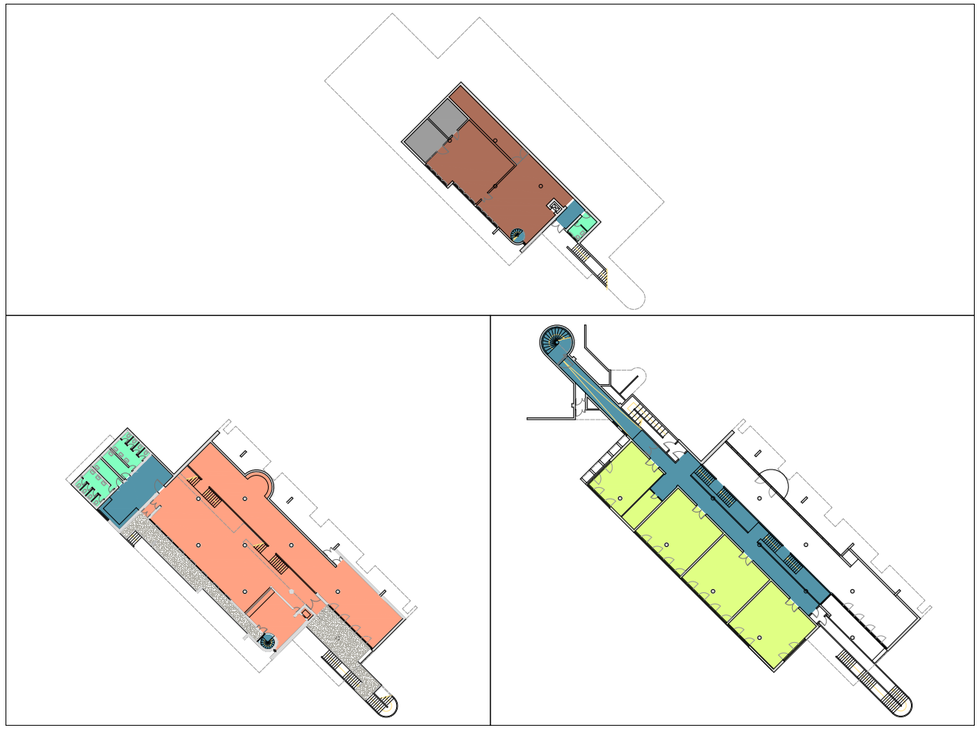
Levels 3 / 4 | SERVICE BUILDING

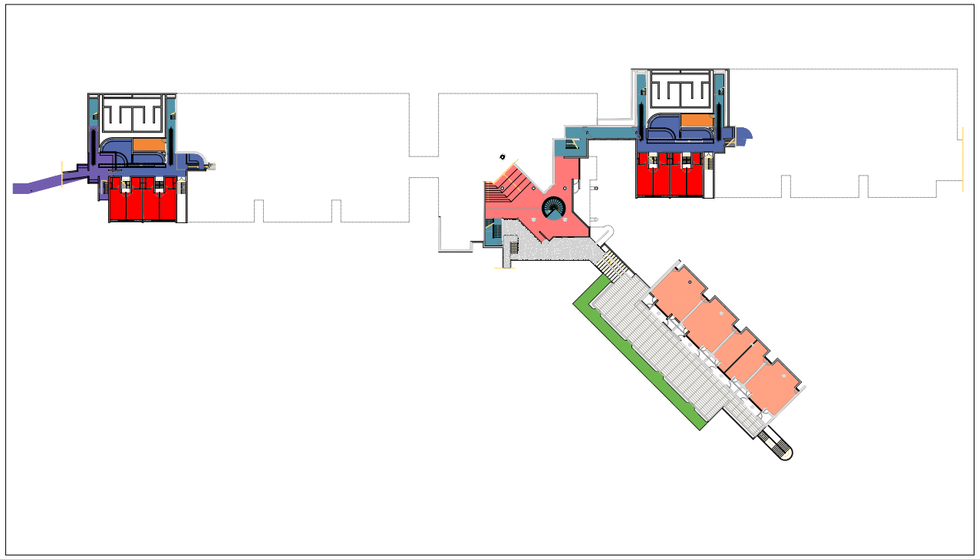


Levels 1 / 2 /3 |RESIDENCES

The "Aquilone"

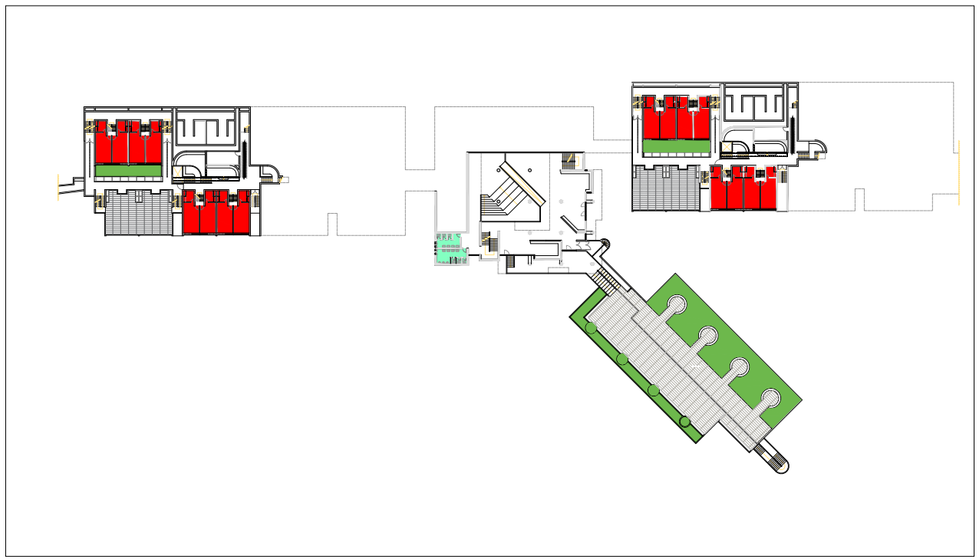
Levels 1 / 2 /3 |LIBRARY

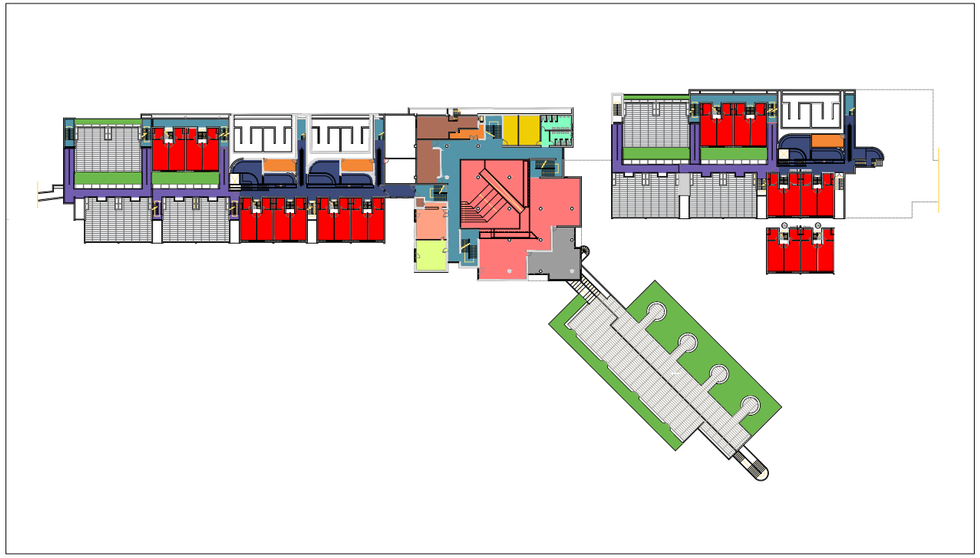




Level 4-5 |RESIDENCES AND SERVICE BUILDING

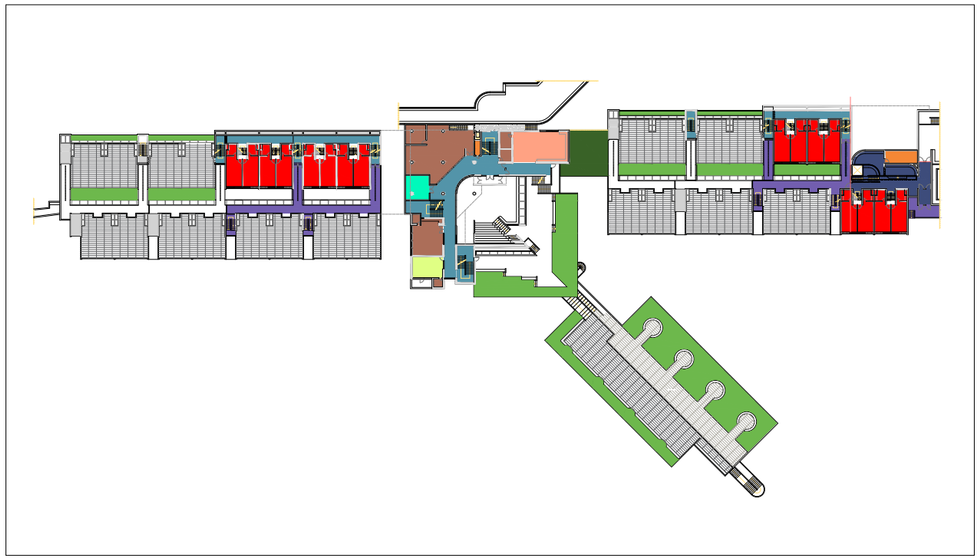
Level 6 |RESIDENCES AND SERVICE BUILDING

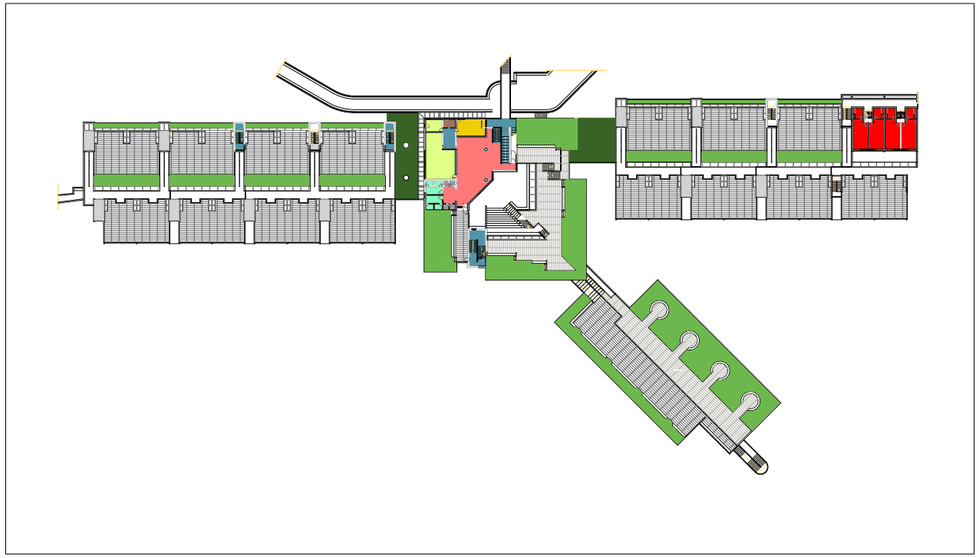




Level 7 | RESIDENCES AND SERVICE BUILDING

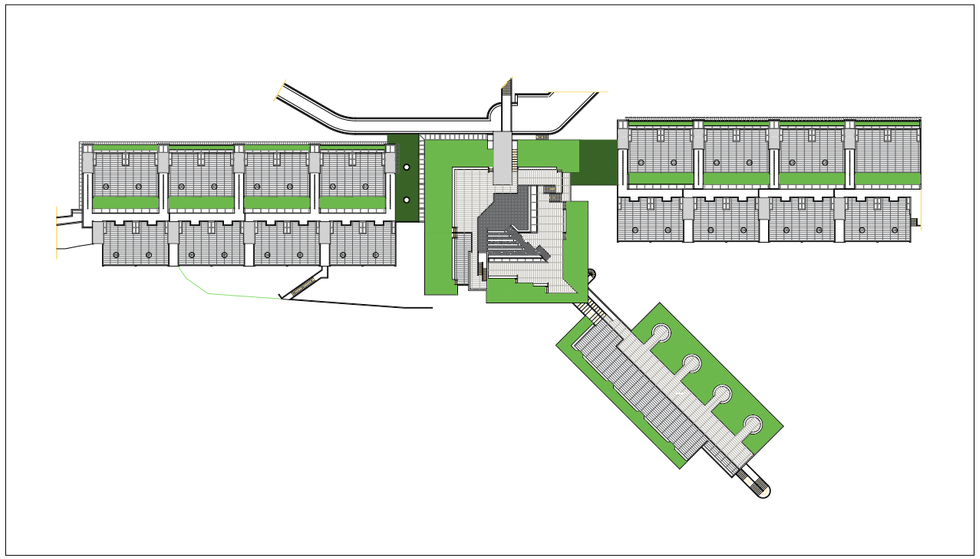
Level 8 | RESIDENCES AND SERVICE BUILDING



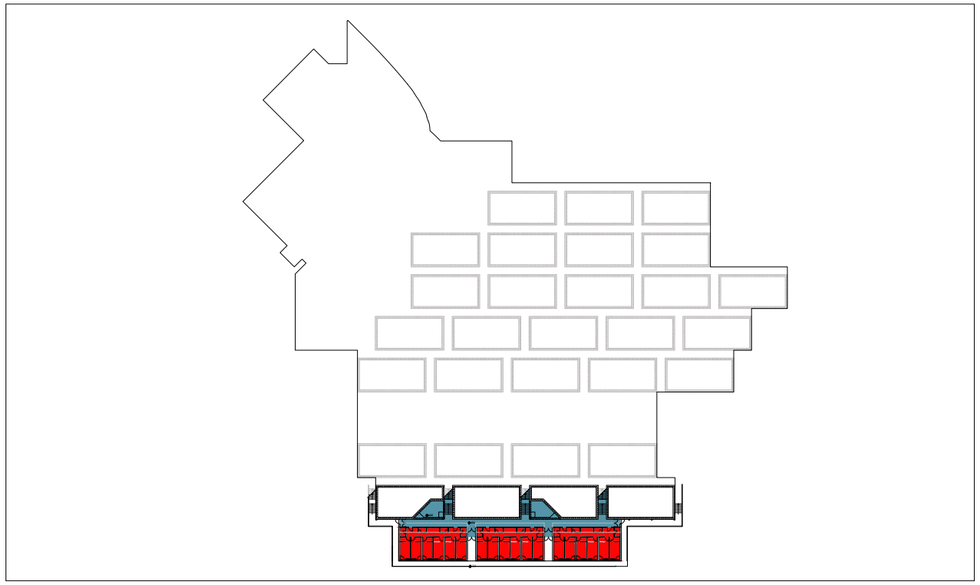


Level 9 | RESIDENCES AND SERVICE BUILDING

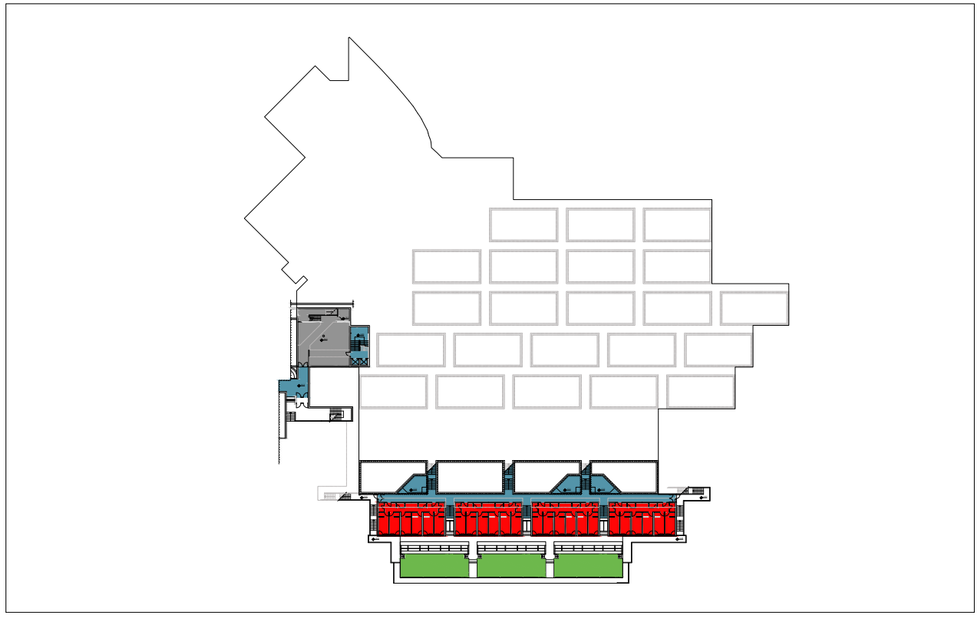
Level 10 | RESIDENCES AND SERVICE BUILDING



The "Vela"



Level 1 |RESIDENCES AND SERVICE BUILDING



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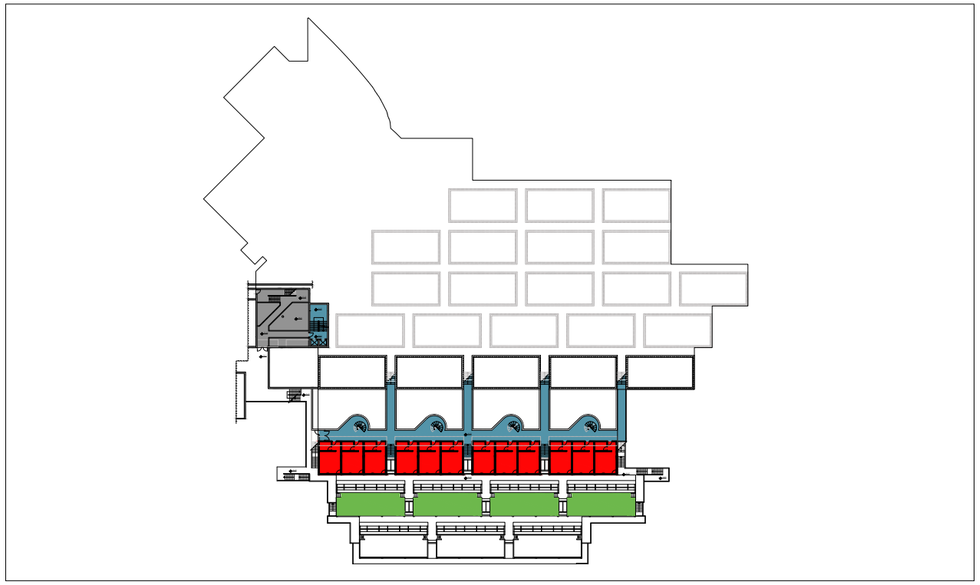

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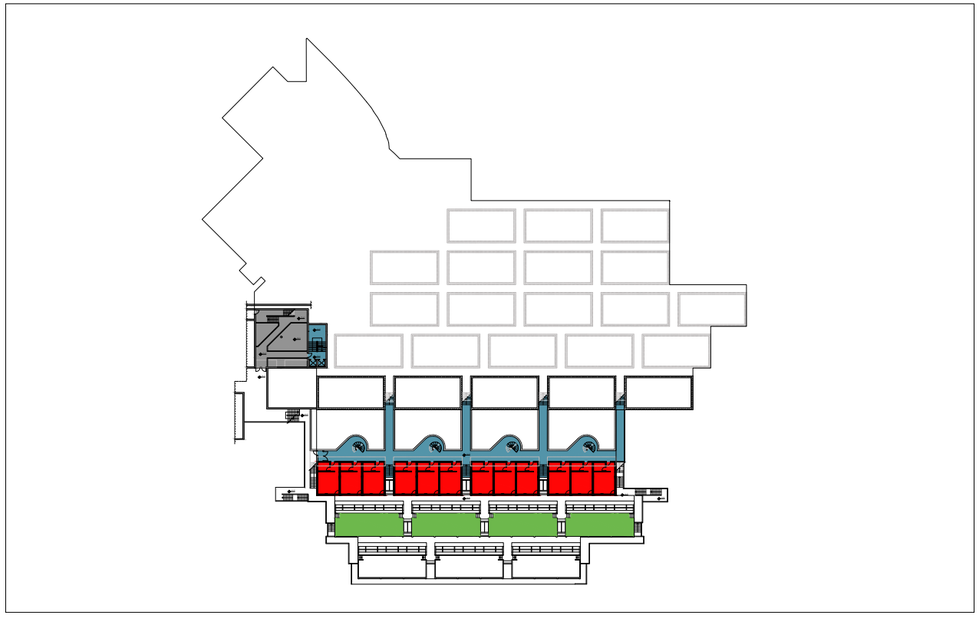

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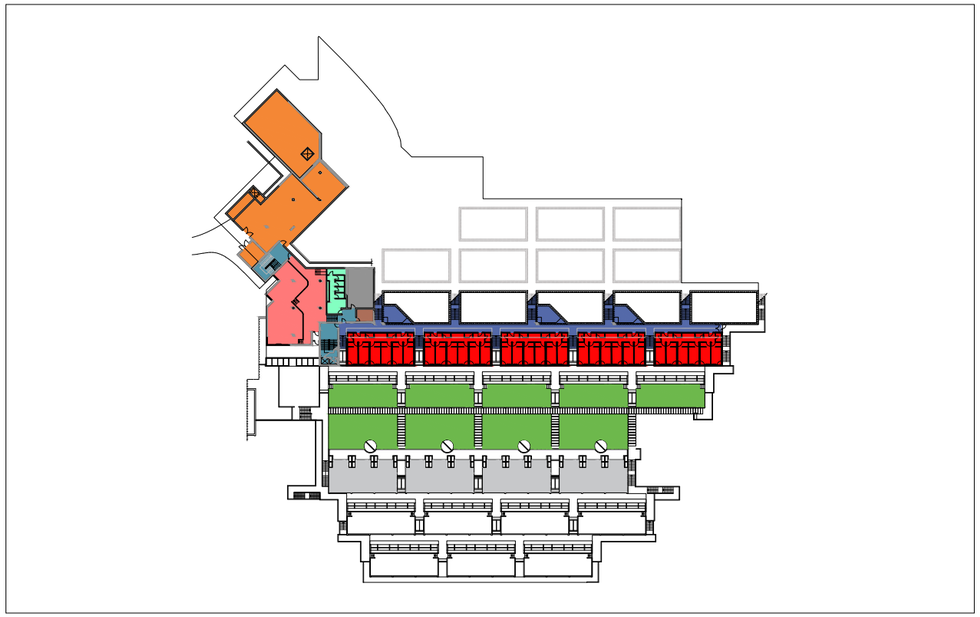

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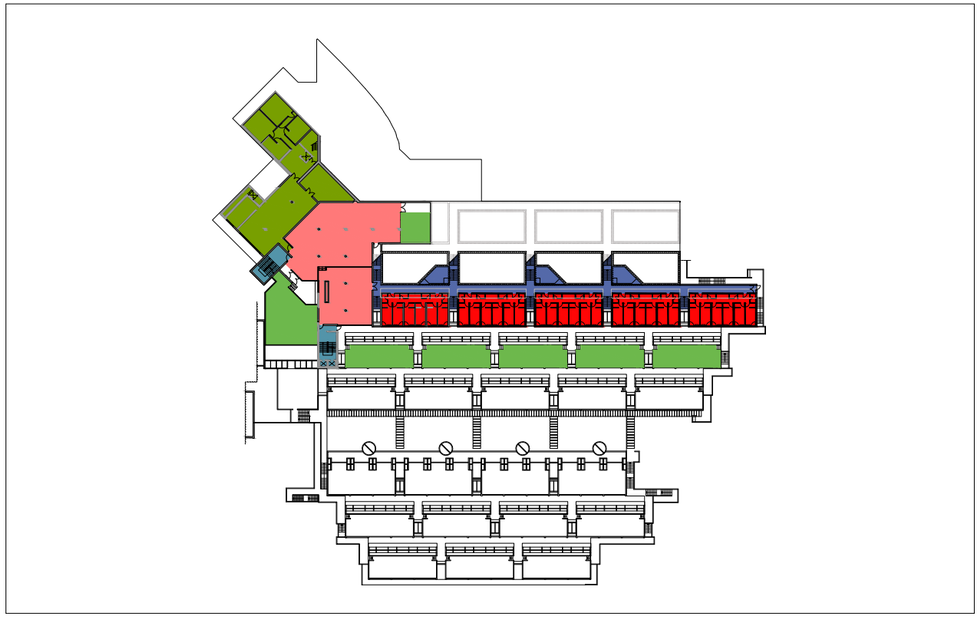

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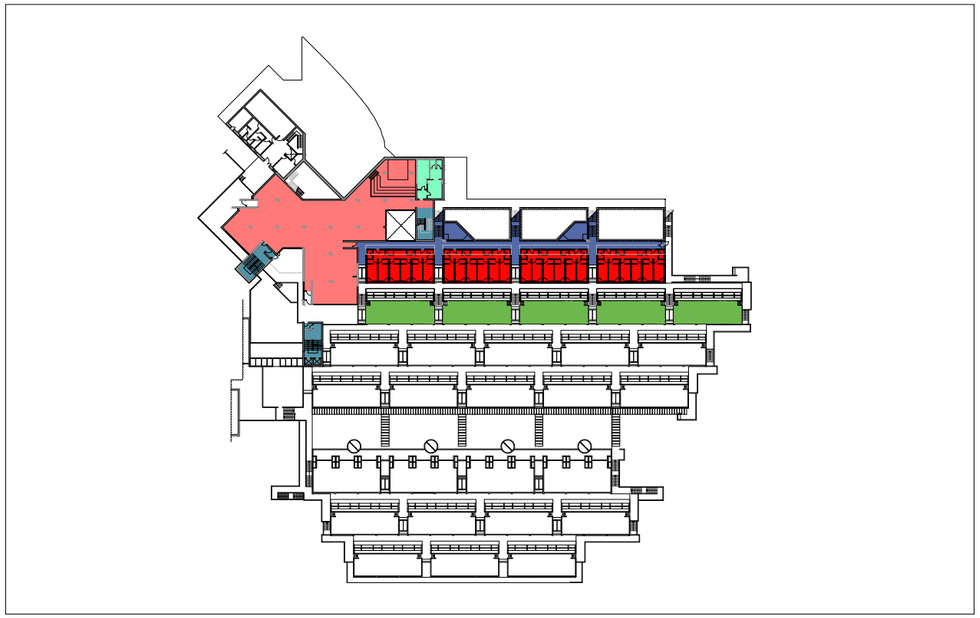
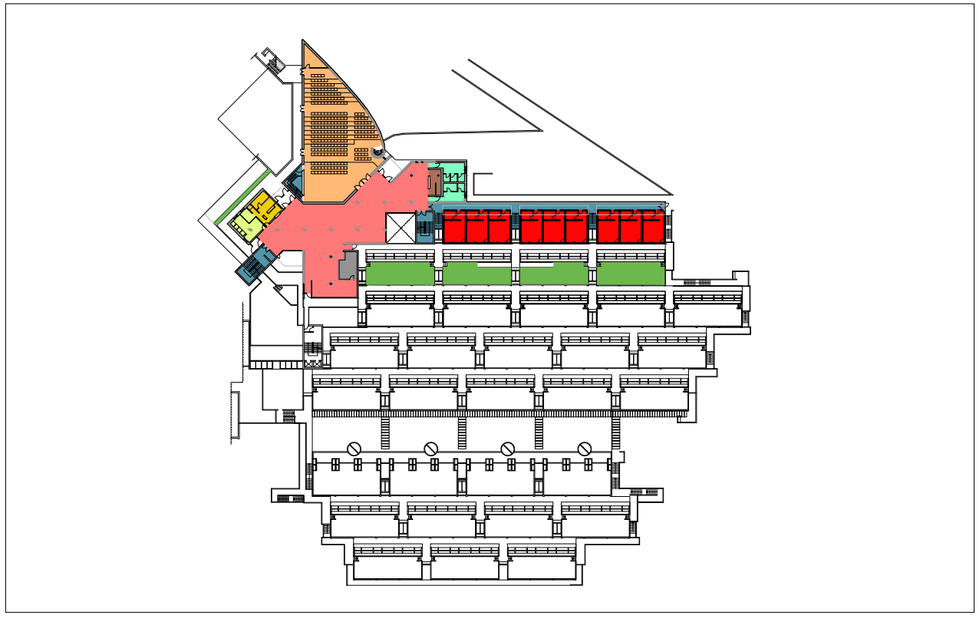
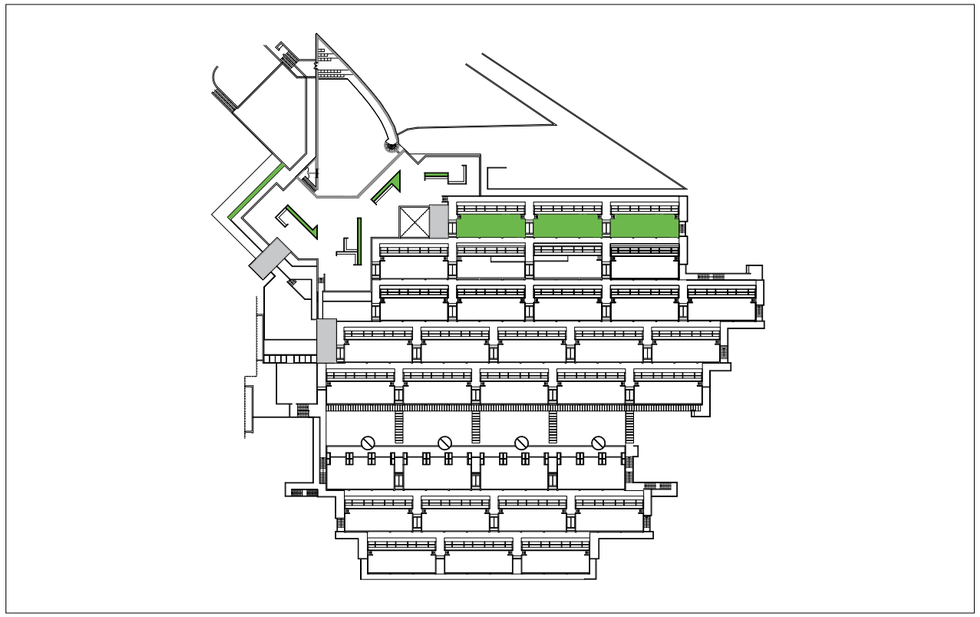


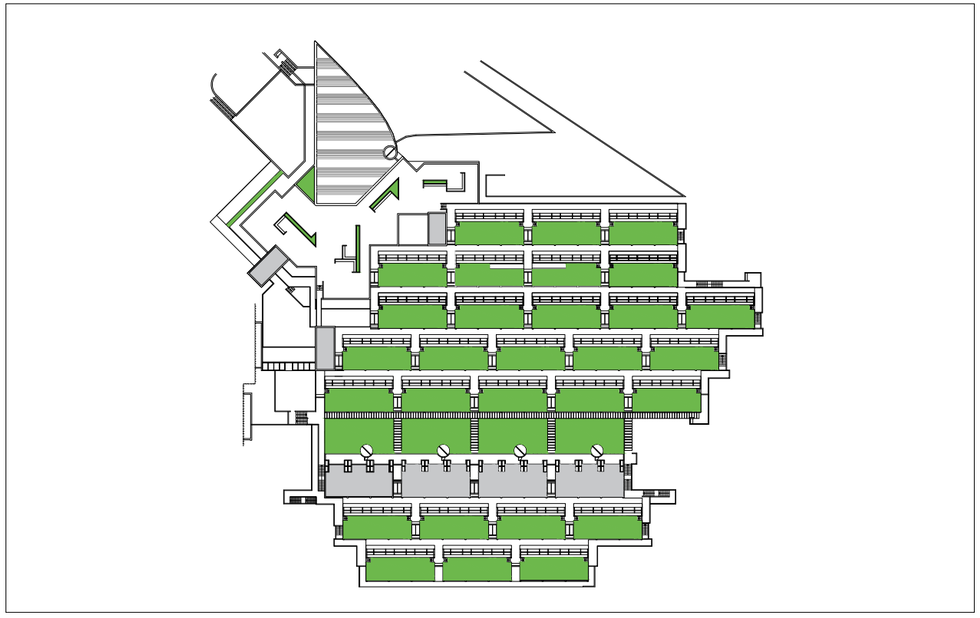
Level 7 | RESIDENCES AND SERVICE BUILDING



Level 8 | RESIDENCES AND SERVICE BUILDING

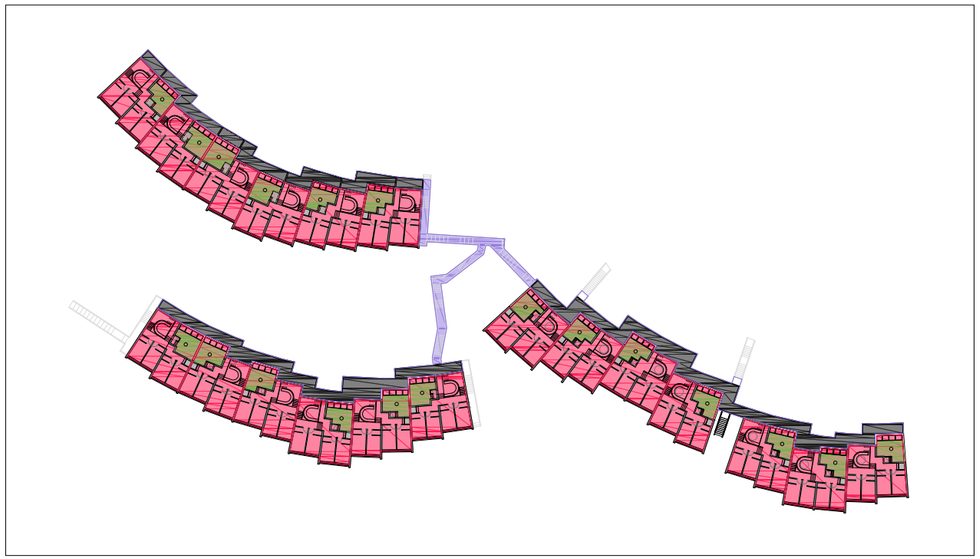


Level 9 | RESIDENCES AND SERVICE BUILDING



Level roof | RESIDENCES AND SERVICE BUILDING

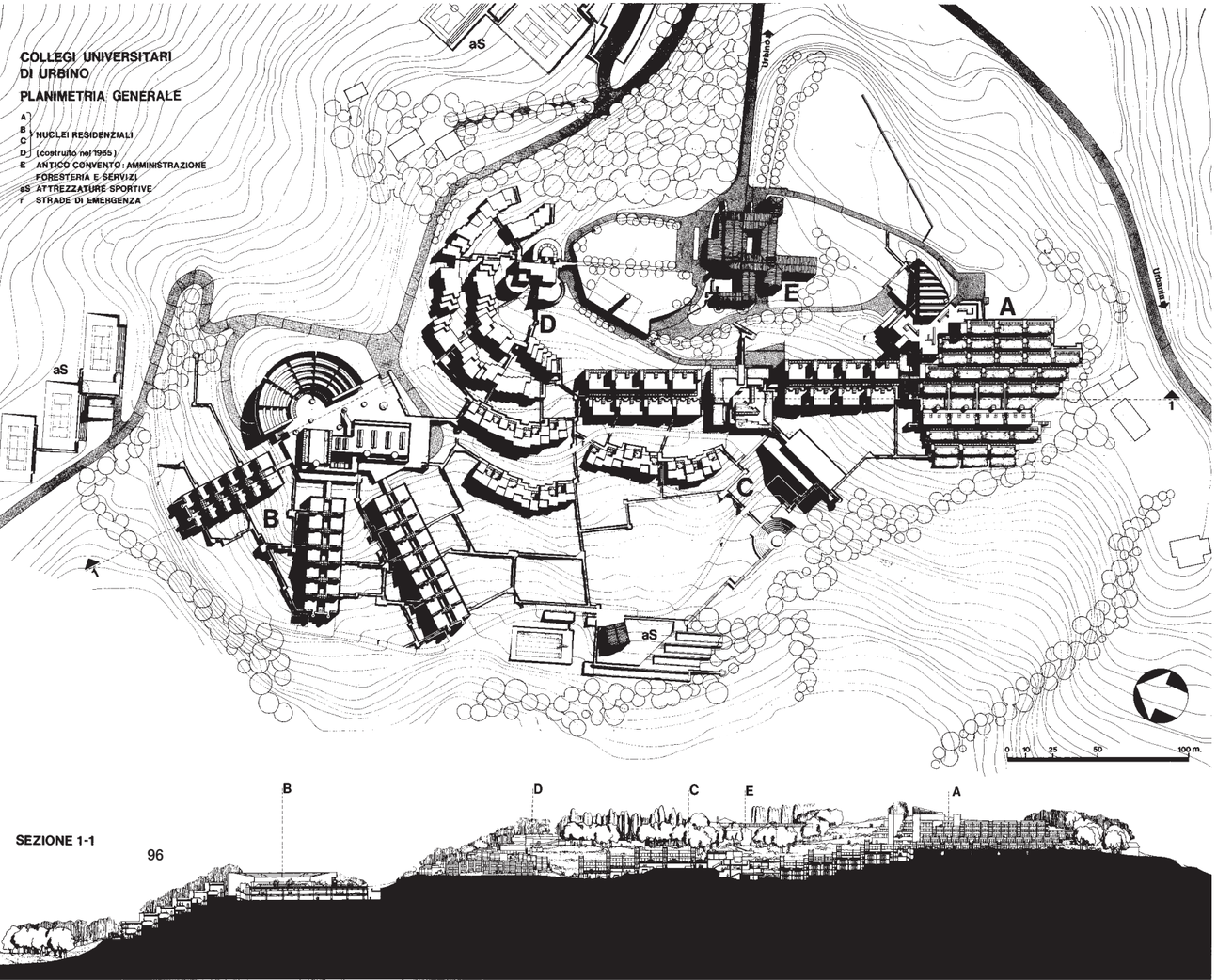
The "Serpentine"



Level 1 | RESIDENCES

Level 2 | RESIDENCES

"Colle dei Cappuccini". Site plan and longitudinal section.



Maintenance and management issues

Completed restoration work and open issues

The progressive implementation of new regulations on fire safety, anti-seismic, plant engineering, energy efficiency and a progressive degradation of reinforced concrete structures, waterproofing under roof gardens and flat roofs, fixtures and other infrastructures, make necessaries a series of interventions, aiming to solve these difficult issues.

The challenge is not easy: both for the overall size of colleges, which can be compared to a small town, and the obvious logistical difficulties associated with the lack of a roadway within a large part of the complex.

This latter problem seriously limits the possibility of using mechanical means for excavation, earth moving, casts and repairs of reinforced concrete, supplying and moving of materials and manpower on-site.

The internal and mostly pedestrian pathways consist of passages of a width of less than 2 meters and bounded by concrete reinforced parapets. Moreover, due to the location of the whole complex, along the slopes of a hill, these paths mainly made of stairs ramps interspersed by landings and passage areas, generally exceed the admitted ratio specially for workers carrying loads.

As an example, just think to replace the waterproofing membrane under the roof gardens covering the rooms of the "Vela" where you have to remove and then to replace more than 90 cm of plant-soil plus the thickness of the washed gravel drainage, which means more than 1,700 m^3 of materials which must be excavated and carried by hand.

Also for the recovery of reinforced concrete walls, it is essential to draw up a strategy of a sustainable measures: in addition to find alternative solutions to the transport by hand of all materials resulting from demolition, it is essential to find a specialized industrial product, in ready-made bags, easy to handle and be prepared with the use of a bucket and a simple mixer but especially formulated to get a final aesthetic result (colour and texture) as closely as possible to the original one. Such a product with is not currently available in the market.

To achieve a quality and finishing homogeneity, the main difficulty is therefore to find an industrial partner willing to modify

its standard production to meet our specific needs while keeping costs at a reasonable level.

Therefore, it is essential to analyse and evaluate each intervention both from a technical and cost-saving purpose, according to the various contextual conditions, among which, for example, it must be considered that the "Collegi" house up to 1500 students in addition to all the personnel in charge for management of the facilities and this service of accommodation cannot be interrupted. Consequently, the "Time and Ways" schedule of the works must to be carried out considering all the issues related to the use of the buildings by the current "population".

At the University "Collegi", until mid-1990s, there were 16-18 maintenance workers, by E.R.S.U. and University, who worked only for the maintenance of the facilities.

Following a general staff reduction in both companies, unfortunately the maintenance workers have been progressively and drastically reduced and today we have permanently only five under the University directions. Despite the efforts, it is a "contingent" totally inadequate to the needs of the facilities which, time passing, show more and more their age and the reduction of an ordinary maintenance suffered in the meantime.

In the current circumstances, it is even difficult to solve provisionally emergency situations and therefore it is not conceivable to schedule maintenance work which, instead, would be of vital importance to slow down the degradation of the facilities themselves.

The annual average expense by the University for the exceptional (unscheduled) maintenance of the "Collegi" owned by University, namely "Vela", "Aquilone", "Serpentine" and "Colle" (maintenance of "Tridente" is carried out by " E.R.S.U. as owned by the region of Marche) among staff, supplies and services stands at around 200.000 euros, resources which cannot certainly be ignored but unfortunately not sufficient to preserve the complex.

Building works of ordinary maintenance, by E.R.S.U. through an external company and by University with its maintenance workers are as follows:

- minor waterproofing works;
- restoration of plaster, application of dehumidifying plasters;
- execution of small masonry;
- restoration of tile cladding;
- coatings and walls in plasterboard;
- substitution of linoleum floor, tiles, paving slabs;
- washable tempera painting;
- cleaning up and sanitation from moisture and fungi of walls with suitable products;
- removing of any clogging in the pipes of the main lines.

The cost supported by E.R.S.U. amounts to approximately 100.000,00 €/year.

Electrical works of maintenance, incurred by E.R.S.U. through an external company, are the following:

- replacement of bulbs;
- minimal changes to electrical installations to meet new needs;
- a 24-hour ready intervention for general switches reset and checking of their working.

The cost supported by E.R.S.U. amounts to approx. 60.000,00 €/year.

Green maintenance works, incurred by E.R.S.U. through an external company, are the following:

- grass cutting of a surface of 55.000 m²;
- pruning and hedge trimming;
- tree trimming;
- street and walkways cleaning.

The cost supported by E.R.S.U. amounts to approx. 40.000,00 €/year.

Maintenance works pertinent to sanitary water system, incurred by E.R.S.U. through external companies, are the following:

- replacement of sanitary equipment;
- replacement of gate valves;
- operations of piping restoration;
- operations of discharging piping restoration.

The cost supported by E.R.S.U. amounts to approx. 20.000,00 €/year.

Carpentry maintenance works, incurred by E.R.S.U. through external companies, are the following:

- replacement of doors and windows;
- replacement of handles and hinges;
- repair of doors and windows;

The cost supported by E.R.S.U. amounts to approx. 15.000,00 €/year.

The expenses incurred by E.R.S.U. - relating to the service of the heating management, contracted by an external company, amounting to approximately € 800,000.00 / year and the electricity expenses amounting to approximately € 260,000.00 / year - must be added to the above mentioned costs.

Requalification and upgrading

Description of works	Year
Electrical system upgrading in the bedrooms of the "Colle"	1997-1998
Furniture refurbishment in the bedrooms of the "Colle"	2002
Fridge units refurbished in the canteen of the"Tridente"	2002
Bedrooms of eighth level of the "Vela" for disabled refurbished	2003-2005
Laundry service installed in the college of the "Aquilone" (3 washing machines and 3 driers)	2005
Laundry service installed in the college of the "Tridente" (2 washing machines and 2 driers are available in each "arm"	2006
Dining room of the "Colle" soundproofed and air conditioned	2006
New water and heating system in the bedrooms of the "Colle"	2006
Laundry service installed in the college of "Vela" (2 washing machines and 2 driers)	2007
Some bedrooms areas of the roof membrane replaced in the college of the "Tridente" due to leakage	2008-2014
Some areas of the "Tridente" square repared due to leakage (overall surface 200 m² approx.)	2008-2015
Electrical systems upgraded in the central body	2008
Fire fighting water system installed in all the colleges and the garden of "Colle" equipped with a lifting group and a water tank	2008
Meeting room of the "Colle" restored	2011
The roof membrane replaced in the college of the "Tridente" due to leakage	2011
Photovoltaic system 81 kw placed on the roof of the central body of the "Tridente"	2011
100 Windows replaced in the college of "Tridente"	2012
104 Windows replaced in the college of "Tridente"	2013-2014
Installation of gates and vehicle access bars for garage of the "Tridente" and car identification badge system	2013
Installation of access gate to internal road along the wings of "Tridente"	2013
Installation of vehicle access bars and gates and car identification badge system along the ways of the "Serpentine", "Vela", "Aquilone" and "Tridente"	2013
Substitution of roof membrane of the classrooms around the of "Tridente" square due to leakage	2013
Retrofit of 1 classroom of tridente (lighting, air conditioning, seats, painting, electric curtains, video and audio system)	2013
Retrofit of 3-4 classroom tridente (lighting, air conditioning, seats, painting, electric curtains, video and audio system)	2014
Retrofit of 2-5-6 classroom tridente (lighting, seats, painting, electric curtains)	2014
Thermal power station and substations upgraded	2013-2014
Fire prevention and electric system updated to the current rules, seismal adjustments and restoration of concrete external walls at the "Tridente"	2016-2017

It is important to underline that in 1981 "Opera Universitaria", in charge for maintainance under direct administration of the University, was trasformed into E.R.S.U., which is the current institution in charge for maintainance and dipending from the Marche Region.

The thermal system

The thermal power station of the "Collegi" was updated in 2014, as part of the heating management service of the buildings managed by E.R.S.U. The station, producing hot water for heating and sanitary use for all "Collegi" ("Colle", "Vela", "Aquilone", "Serpentine" and "Tridente"), was obsolete: the generators did not guarantee high performance; all the hot water system, steam-driven, resulted in low distribution efficiency and maintenance works were needed.

For the above-mentioned reasons, a radical upgrading was carried out, with a complete dismantling of all equipment of the power station (boilers, heaters, pumps and pipes), the installation of new high-performance generators, new heaters modulating temperature, new pumps, new pipes, the introduction of a cogenerator, the replacement of the domestic hot water production system from being generated by steam to hot water, by the introduction of technical water accumulators and instant exchangers.

Finally, the hot water expansion system was transformed from an open tank to a closed one; water and sanitary treatment systems were installed by using "softeners".

Following a thorough energy analysis of all structures, thermal output has been adequately reduced.

The thermal power station was characterized by a total power of 7,350 kW, divided into six generators, five of which were powered by gas and one fueled by diesel.

- generator 1 by hot water, power 1861 kW: hot water output to heat all the "Collegi";
- generator 2 by hot water, power 1861 kW: hot water output to heat all the "Collegi";
- generator 3 by hot water, power 1861 kW: hot water output to heat all the "Collegi";
- generator 4 by steam, power 698 kW: hot water and sanitary output of the "Colle", "Aquilone", "Serpentine", "Tridente";
- generator 5 by steam, power 698 kW; hot water and sanitary output of the "Colle", "Aquilone", "Serpentine", "Tridente";
- generator 6 by steam, power 372 kW; hot water and sanitary output of "Vela".

Generators 1, 2, 3, 4, 5 were gas-fired and located in the thermal power station; generator 6 was diesel fuel and located in the substation of the "Vela".

Through a ring placed in a tunnel, which connected and still connects the "Vela", "Aquilone", "Serpentine" and "Tridente" , the hot water produced by generators 1, 2, 3 was circulating through a pump system and was taken from the sub-stations of the relating colleges. The "Colle", being close to the power station, was directly powered by it. A similar ring, always placed inside the tunnel, parallel to the previous one, was used to distribute steam to produce hot and sanitary water by means of special kettles.

The sub-stations of the "Colle", "Vela", "Aquilone", "Serpentine" and the ones under the wings of Tridente were, and still are, equipped with heat exchangers to separate the main ring from the secondary circuits. The central body of the "Tridente" and the rooms of the "Colle" were instead powered directly from the main ring without a heat exchanger.

The water expansion system was open-type tank.

Thermal power station equipment has been replaced; the power station has been completely dismantled and rebuilt with high performance boilers, modulating temperature heaters, pumps with inverters, cogenerating plant, new piping and insulation, new exhaust pipes, new electrical systems, remote control system.

The expansion system has been transformed from an open tank to a closed one.

Specifically, three pressurized generators of 1,731 kW each have been installed for a total of 5,193 kW and a plant of cogeneration of a thermal power of about 650 thermal kW and about 630 electric kW. The installed thermal power is 5,843.00 kW, with a reduction compared to the existing one of about 1,500.00 kW. The gases of the cogenerating station exhausts through a double-insulated steel chimney, which has been inserted in one single piece inside the existing one.

The work allows remarkable fuel savings, thanks the high performance of generators and modulating burners and allows an output of electricity, for an estimated total of about 2.200.000 kWh per year that is fed into the Enel network. At the end of the contract of the heat management, this energy can be used directly by E.R.S.U., since it could be input into the electrical network of the rest of "Collegi".

Heat exchangers have been installed for the heating circuit of the bedrooms of the "Colle" and for the heating of the central part of the "Tridente", which were not present in the initial plant.

Also, the hot and sanitary water system has been replaced; the whole steam distribution network, including boilers, has been removed; moreover, seven tanks with a capacity of 2000 lt. each of "technical water" have been added as follows:

- two in the substation hot and sanitary water - "Colle";
- two in the substation hot and sanitary water - "Aquilone" and "Serpentine";
- two in the substation hot and sanitary water - "Tridente";
- one in the substation hot and sanitary water - "Vela".

Thirteen modules of quick production of hot and sanitary water have been combined with the above -mentioned tanks:

- three in the substation hot and sanitary water - the "Colle";
- four in the substation hot and sanitary water - the "Aquilone" and the "Serpentine";
- three in the substation hot and sanitary water - the "Tridente";
- three in the substation hot and sanitary water - the "Vela";

This system allows to supply hot water according to the actual demand of the users; furthermore, the bacterial issues have been solved, since the original boilers and of hot water tank have been removed.

All the electrical installations of the thermal power plant and substations have been renewed and a remote-control system has been installed to detect how all the equipment operates and to regulate thermally all circuits, the switching on and the switching off of boilers and CHP.

The electrical system

The electrical systems serving the "Collegi" are powered by two medium-voltage electrical supplies, located in the cabin near the "Colle".

The first supply, feeding the electrical systems of all colleges, excluding the central heating plant, is equipped with three medium / low voltage transformers, by 400 kVA, which in turn, supply the electric low voltage panel, located inside the room with the transformers.

The electric panel has an exchange section with a 388 kW generating set, equipped with a built-in tank for 120 lt of diesel, whose purpose is to supply electricity to a part of the lighting circuits of the "Collegi":, in the event of a breakdown in the public distribution network.

The power supply circuits of the general panels of the five "Collegi": "Colle", "Serpentine", "Aquilone", "Vela" and "Tridente" originate from the main electric low voltage panel; each circuit consists of a pair of conductors that provide electricity to the preferential users connected to the generator, and to non-preferential users which can stand the interruptions in the supply of electricity. The conductors are laid in the underground tunnel connecting the buildings which are part of the complex.

The main electric panels of each college feed a network of area panels, the extension of which is depending on the facilities in the building.

The rooms of "Colle" are equipped, one by one, with electric switchboards; those of the other "Collegi": are equipped with switchboards for each room block. The most important services

(canteen, administrative offices, garage) are equipped with area panels.

The terminal circuits supply, in the majority, lighting devices and sockets for civil-type plugs; electrical appliances with a greater power are gathered in the technical premises (pumping stations, elevators, ventilating machines) and in the kitchen (electric ovens, dishwashers, etc.).

Generally, the components of the electrical system date back to the time when buildings were constructed; both the electrical low-tension panel, placed in the electric cabin, and the electrical panels of the colleges (except for the "Tridente") are still the original ones. Therefore, maintenance works are difficult because spare parts of switches cannot be found.

Instead, the switchboards at the service of the rooms or the ones of the room blocks have been upgraded with the insertion of magnetothermal differential switch (residual current circuit breaker); this has improved both the safety level of users and the selectivity of the facilities, as it is easier to find the breakdowns.

Over the years, several interventions have been carried out to equip the complex with new services, which have become necessary due to technological upgrading (mainly internet) or to changes in safety requirements regulations or firefighting and surveillance. Such interventions were carried out using plastic tubes and ducts against the original design, not to affect the original fair faced surfaces but creating an aesthetic incongruity

Here we're describing the second electrical supply, which we mentioned at the beginning. It must be said that it has been activated in recent years, following the installation of a 1544 kW thermal flow rate generator. The cogenerating power plant, which produces both electricity and heat at the same time, is connected to a low / medium voltage transformer which empower the public distribution network with the electricity produced during its operational time. The cogenerating power plant also, empower the electrical panel of the thermal power station.

Finally, on the roof of the "Tridente", there is a 81 kW photovoltaic plant, linked to electrical general panel of "Tridente".

Alignment with regulations

The "Tridente" need to be adapted to fires prevention regulations, mainly concerning the electrical system of accommodation facilities.

To updating Fire preventions system, the following work is required:

- replacing the stairs between the inside common space and the first and second floor's rooms with a lower ratio one;
- removal of the linoleum in the rooms with a fire-proof flooring material;
- replacing of the access doors of the rooms with a self-closing device;
- changing the doors operation directions;
- removal of the single steps along escape ways to facilitate the exit in case of emergency ;
- the installation of panic bars on the emergency exits;
- the partitioning of areas EI 120, EI 90 or EI 60 to reduce the risk of fire spread;
- realization of smoke-proof filters;
- compartmentation of the kitchens;
- compartmentation of equipment rooms and/or warehouses;
- treatment with intumescent paint for pillars and beams to increase fire resistance;
- adaptation, by increasing the Hight of all parapets and banisters of staircases.

Regarding the electrical system the following interventions have been planned to improve safety conditions against electrical hazards and to increase the continuity of electrical service operation during the black outs:

- installation of new differential 30 mA switches, instead of the current 500 mA, on all circuits which supply electricity to fixed sockets and to lighting fixture;
- removal of the existing cables according to a new layout with low emission of exhaust and toxic gas;
- substitution of the main electrical panels and minor electrical panels;
- improvement of emergency and safety lighting system;
- realization of a fire detection system;
- realization of a sound diffusion system.

In addition to fire and accident-prevention safety interventions, special facilities will be realized to improve the services for the residents and to reduce electricity consumption; such interventions include the realization of the following installations:

- the access control management and supervision, based on transponder readers for the automatic opening of the access doors to the blocks and individual rooms;
- the automated lighting control in the rooms and common areas;
- the telephone system for the communication between the room and the concierge;
- the arrangement of a wi-fi network for the connection of computers to internet of resident students.

Main maps collecting the students expectations of the dorms program.

Spaces and users

The "Collegi" are an example of those architectures that place the social dimension at the center of their meaning. However, the various developments and new needs that emerged over the decades seem to expose the original project to various tensions, highlighting the need to intervene in the regulatory, technical and functional adjustment of its spaces.

These issues are of focal importance in the drafting of a conservation plan that aims to give new value to this site by outlining a set of guidelines that can be useful both for refurbishment purposes and for adapting space to new needs that have emerged over the years.

In this perspective, this section introduces the results of a social research that focussed on the users of the "Collegi" and their daily lives, providing a picture of their experience which can be useful in order to define a strategy for the recovery and renewal of its spaces. The central element of this report is the analysis of uses, in order to reconstruct a picture of the actual use of spaces in this building complex. In doing so, we will start from a comparison of changing uses over time, to focus later on the current uses, and highlight some specific aspects, strengths, and problems.[1]

[1] The sociological section collects the results of a quantitative research campaign under the project, which envisages a) a CAWI (n = 518) administered to users and former users of the "Collegi"; B) a series of interviews and focus groups with users, former users, employees and collaborators of the facility manager; C) a participatory observation of daily life in the "Collegi"for a period of three months; D) observation and mapping of people's flows and social interactions in collective spaces. The campaign involved 7 researchers and collaborators at the University of Urbino Carlo Bo, supported by 4 student assistants. A more detailed research report - in Italian - is enclosed a Annex.

Changes in use of spaces

A battery of CAWI's (Computer Assisted Web Interview) questions administered to current and former residents of the "Collegi" dealt with the frequency of use of some spaces and its change over the years. As spaces are located in different residence halls, this also allows us to say something about how users exploit the different buildings of the complex.

The "Tridente" remains a central hub for collective uses (see Tab.1): the presence of the canteen makes it pivotal for interactions between users and structures. Although its use seems to be slightly more occasional and irregular than in the past, there are practically no people who have not resorted to it. For other Tridente spaces, after a peak in the period 1995-2004, we note a fairly significant drop in their use. This is particularly true of the amphitheater, whose accessibility has been very limited in recent times, and the same can be said about the study hall, the bar, the terrace and the square in front of the entrance. In short, the social function of the "Tridente" area seems to have diminished in favor of a more instrumental use associated with the canteen. This change may also be caused by the worsening accessibility of some spaces, originated by organizational choices, by degradation and also by the need to adapt the building to stricter safety rules: "Tridente amphitheater" – now closed 12 hours a day and with more limited uses than in the past – is the example mentioned most frequently in the interviews.

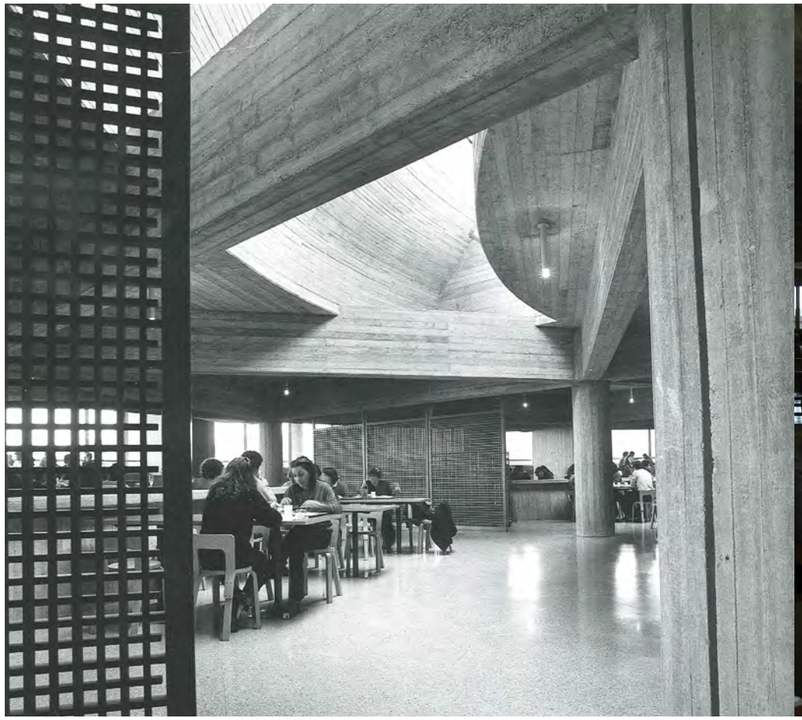
	Before 1995	1995-2004	2005-2009	2010-2012	After 2012
Canteen	6,2	6,4	6,0	5,6	5,6
Square	4,3	4,7	3,7	3,1	2,0
Bar	2,9	3,3	2,4	2,3	1,4
Terrace	2,3	2,2	2,1	1,5	1,1
Study hall	2,2	3,1	2,0	1,7	0,9
Amphitheater	2,1	2,4	1,5	1,4	0,5

Tab.1. Average use of "Tridente" spaces (days per week).

In the case of the "Aquilone" building, the trend is less linear: its library and its study hall are fairly used, averaging about two days a week throughout the first decade of the 2000s, while it is much lower before and after. Both the obsolescence of its equipments, and the reduction of the opening time may have played a role in causing the change in respondents' evaluations. The use of the external spaces of this residential hall are affected by the same trends. The use of the "Vela" spaces is more steady in time, though at a much lower level: because of its isolated position, the spaces of this residential hall are mainly attended by those who have a room there. Finally, the common areas of the "Colle" – due to its location, and to numbers and typology of its users – have an even more limited and occasional use, and nowadays some areas, as the study hall, are virtually empty all time.

"Tridente". internal view of the canteen with the flowerbeds under the skylights. (Photo Antonio Garbasso)

Internal view of the canteen in the "Tridente". (Photo Giorgio Casali. Università Iuav di Venezia - Archivio Progetti, Archivio Giorgio Casali)



The outdoor spaces common to all structures are fairly well attended. Green areas maintain some attraction, stable over the last decade, close to 2.5 days of average weekly use. The pathways, which function as linkage between buildings, enjoy almost daily use, approximately 4 days a week or more over the last ten years.

Respondents who have arrived at the "Collegi" at different times also give different opinions about the spaces considered important (see Table 2). We have asked which spaces constitute the main place of memory in their life experience at the "Collegi". There is a certain tendency to "privatize" the life experience of Urbino's residence halls, with the increasing importance given to the room in recent students' generations. This phenomenon is matched by a lesser overall significance of the "Collegi" for its users: this living space remains important today, but looks to be somewhat less relevant than in the past.

Interviews confirm this perception, highlighting how the amount and significance of time spent in structures diminished, with a switch in the center of gravity from the "Collegi" to the town centre, particularly for leisure activities.

	Before 1995	1995-2004	2005-2009	2010-2012	After 2012
Room	2° (73,8)	2° (60,6)	1° (71,1)	1° (78,3)	1° (83,1)
Canteen	1° (78,6)	3° (59,5)	3° (60,5)	2° (61,4)	2° (68,5)
Block	3° (65,5)	1° (75,5)	2° (64,5)	3° (56,6)	3° (63,7)

Tab.2. Grading and percentage of mention of the places of the more important memories by year of arrival to the "Collegi" (3 main places).

Picture taken during a focus group session with the students from UTSA and living in the "Colle" during their stay abroad.

Meeting the Needs and Adaptations

The construction of the "Collegi De Carlo" was ended – though not completed – more than 30 years ago. Changes in organization, as well as in youth condition, have been significant and affect the perception of the period spent in this complex in various ways. In addition to the "physical" aging of the structure, there may be a "social" aging, due to the changing housing needs and to the emergence of new ways of socializing in a university space. One could mention, for example, the technological change and today's importance of computer connectivity on the one hand; or the different meaning of sharing a room and common spaces for new generations less accustomed to share domesticity with peers even before university experience, as many of them grow up with no siblings[2].

The CAWI questionnaire also included questions about needs (studying, socializing, residential comfort and privacy, as central dimensions in students' experience) and their fulfillment. The spaces considered are students' bedrooms, different study halls and other facilities (such as the canteen) located in the building complex.

As far as study needs are concerned, the only space that seems "to keep up with the times" is the "Vela" study hall (see Fig.1), which is considered to be a suitable place for study by 80% of users. Other spaces – such as the "Tridente"'s study hall and bedrooms – see a level of satisfaction cut by a half comparing the "pioneers" with the current users. This view is probably influenced by a perceived obsolescence of various sections of the building complex that can affect comfort (e.g., furniture, air conditioning ...) and by organizational changes (opening hours) or by both aspects (involved, for example, in the accessibility and quality of the computer network or the library).

The satisfaction for social needs, on the other hand, is also decreasing, but the negative trend is less strong in time (see Fig.1). The canteen, for example, remains a context of fundamental social relations, albeit with a reduction in full satisfaction and a rise of partially satisfied users. The blocks and the bedrooms are also fundamental places of social relations: being semi-private and semi-public spaces, they allow – especially in some residence halls – to diversify uses, now providing privacy, then providing a chance to meet other persons.

[2] Between the censuses of 1981 and 2011, the average number of family members decreased from 3.0 to 2.4. See: seriestoriche.istat.it/fileadmin/documenti/Tavola_3.1.xls (last visit: January 5, 2017)

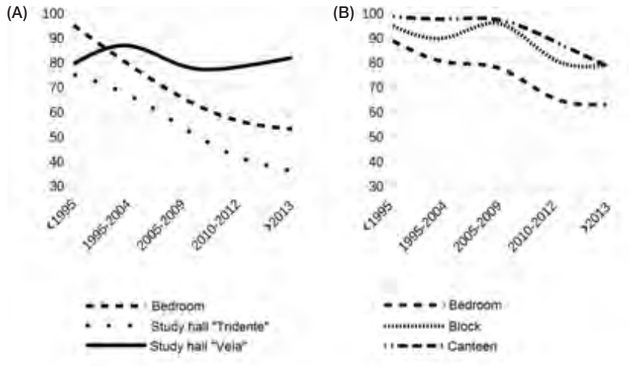


Fig.1. Perceived responsiveness to the study needs of different "Collegi" spaces (sums of answers "very" and "fair") for period of entrance in the "Collegi"(%). (A) study needs; (B) social needs.

Social uses both of the blocks and of the study halls is less widespread since 2010, likely due to the changed rules of use and the enforcement of existing norms: for example, as underlined by many interviewees (both current and past students and workers), the lack of places for loisir and parties – and the dissuasive actions taken by the staff to avoid the use of blocks for this purpose – seems to have been reinforced in recent years, as a result of an increased concern for security. It follows that the "Collegi" are less used for social reasons, as it is clear from the evolution of sociability perceptions in former students of different cohorts.

As for housing needs, however, ratings of room size and adequacy of space remains quite high, though falling from 95% of the early users to 63% of current ones. There may well be a change in expectations in the different generations, as evidenced by the growing dissatisfaction with the size of the rooms. The newer generations are accustomed to enjoy more space for themselves. Between the 1981 and 2011 census, the number of occupants per room in Italian houses dropped from 0.76 to 0.57, and the room per person also increased accordingly. There are still critical issues that possibly depend on the aging of the building complex - as is illustrated by the growing dissatisfaction with furniture and other services.

The assessment of the adequacy of the "Collegi" to privacy demands shows a greater attention to this issue, given that the room features have remained largely unchanged. Several interviewees – in particular female – have pointed out that this was likely a critical issue also in the past, but it is more strongly perceived today.

There is a growing attention to the consequences of sound-proofing of walls and windows. At the same time the negative effects on privacy related to factors that are permanently present in all periods (such as inspections conducted by the staff; the sharing of bedrooms, bathrooms and kitchens with the neighbors, and the number and diversity of neighbors themselves) are essentially less changed over time or are subject to nonlinear and non-significant trends. Anyway, differences between different residence halls in the complex are clear, mainly related to architectural features of bedrooms and blocks (number of beds per room, number of rooms per bathroom, layout of shared aisles): the "Colle" is considered to better protect privacy, with its single rooms with ensuite bathrooms, closely followed by the "Serpentine" (which have a kind of semi-private "sitting room" in every block). If space is perceived to be inadequate to the needs, users may be tempted to act to modify it to make it their own. Despite increasing perceptions of inadequacy of rooms and dissatisfaction, however, changes to the room did not increase rapidly over time. As a matter of fact, modifying bedroom is a widespread behavior and structural element of life at "Collegi", which cannot increase much (see Table 3). The mode of intervention is differentiated according to the type of room and furniture available, but it is possible to trace a common tendency to broaden the width of the bed by using the shelves provided and in finding useful solutions to increase the space available and make the ambience more aesthetically pleasing.

	Before 1995	1995-2004	2005-2009	2010-2012	After 2012
Furniture arrangement	95	100	98	91	93
Decorative elements	64	81	74	78	87
Décor	70	74	77	82	82
Electrical components and lighthin	21	33	41	45	31

Tab.3. Changes to selected aspects of rooms per "Collegi" entry period (%).

Satisfaction for the experience in the "Collegi"

Based on the results of our CAWI, the overall satisfaction and many issues relate to the life experience at the "Collegi" are strongly related with the time of arrival. The more distant is the enrollment, the more the experience is seen positively: early users are very satisfied with their experience: almost 90% of them and less than 15% of current users give this opinion. It is certainly possible that some sampling bias could lead to distortions in the results, but links with some structural (e.g. social and structural obsolescence of buildings) and organizational (e.g. regulations

and their implementation) changes are also evident. An example may be found in the canteen (see Fig.2), in which the effects of massive increase in users during the 1990s is compounded with the fact that collective catering – despite significant efforts to make more flexible and pluralize its supply – cannot be reconciled with the recent trend towards diversification of tastes and food practices. People nowadays increasingly characterize their identities through food, as it emerged during the focus groups with students who frequently complain about the scarce variety of dishes for those who – by choice or for medical reasons – practice special dietary regimes.

Several indicators point out that the worsening of user satisfaction is not linear over time, but reflects some "threshold effects", where the perceived change could likely have occurred. These variations need to be taken into consideration because they may give directions or at least suggestions on the source of discontent and, if necessary, on how to deal with it. The items which exhibit this trend seem to be the ones related to a change in organizational modalities of the service. Satisfaction for regulations and management – object of a specific question – has this same trend, highlighting the need to strengthen a dialogue on the rules between the managing authority and the users[3].

Further examples are satisfaction for maintenance, cleaning and the bar, study halls, amphitheaters and transport services (see Figure 2). For the first three items there may be an effect linked to the change and partial outsourcing of the service that matches obsolescence effects. In the case of maintenance, however, already a quarter of the early users highlighted faults, and the share of unsatisfied interviewees is stable around 60% already from the central cohort of joints since 2005.

[3] Nearly 80% of the early users are very or fairly satisfied with the regulation and management of the "Collegi", while the figure is stable around 35/37% for students arrived since 2005 onwards. Organizational criticalities could also be reflected in the satisfaction for the relationship with the staff (a question on this issue was included in the CAWI). Overall, however, the answers are positive (80% satisfaction for concierge staff) and even with some improvement in current users (it also has to be considered that in the last cohort of residents there are persons with less experience in the context that can consider helpful and appreciate the support given by staff for settling and orientation).

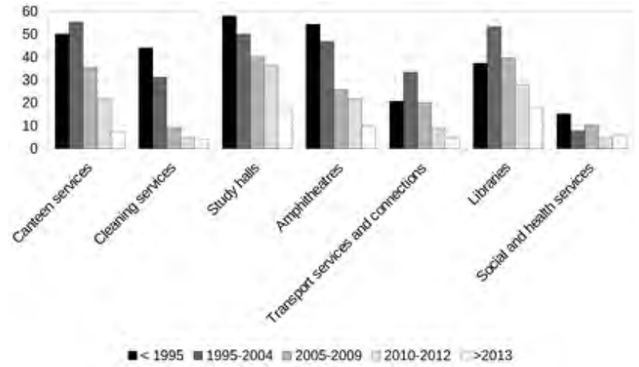


Fig.2. Very satisfied for some aspects, facilities and services at "Collegi" for year of arrival at "Collegi" (%).

Concerning study halls, transport services and amphitheaters, the drop in approval rates is evident in the more recent phase, likely linked to changes in usage conditions (e.g. opening times) that are not compliant with the needs of the users. For study halls, however, the satisfaction remains particularly high. For amphitheatres and transport services, the most significant deterioration occurs since 2010.

It is also interesting to note that some objectively critical aspects - as noted by other teams of the Keeping It Modern project - do not seem to pose any particular concern to the students interviewed, both female and male. The case of heating is quite glaring: those who complain about the air conditioning of the rooms are about just over a quarter of the respondents and do not reach half even considering those expressing a very limited satisfaction. The slight increase in dissatisfaction over time is not statistically significant.

Differences between the design idea and the actual use of spaces

In evaluating current uses, substantial differences arise between the design idea that has shaped the spaces and the use that is actually made of it. The most noticeable misalignment is related to the large three-story space of the "Aquilone", which is nowadays used as a study hall, although it was initially designed as a center for cultural and social activities. This space was also intended to accommodate shops, favoring a continuous exchange between students and permanent residents. This divergence between design idea and use practices also involves the lack of sports facilities, that were planned in the initial project. Therefore, the "Collegi" have never been able to fully function as an integration

context between students and permanent residents. These issues have influenced the crossing and the fruition of the site, helping to define it as a city in the city, contiguous but not organic to the rest of the urban context[4]. Other differences cannot be related to the incomplete status of the complex, but to other factors, among which are the aforementioned modes of managing the complex and the changing needs of users[5].

The many common spaces present in each residential hall are often perceived by users as being unused, especially in the recent period, where there is a decrease in fruition in favor of greater use of the most protected and restricted environments of housing blocks. Among the common areas most affected by the depletion of uses should be mentioned the Tridente amphitheater. Due to safety and security reasons, recently the Management Authority (ERSU) has been closing it at night hours. This caused decrease in use, limiting the aggregation opportunities for which it had been designed. Peculiar to the "Tridente" is also the regulation of the coffee bar. It has two counters on two sides, but only the one facing out on the canteen is now open. This partial opening, coupled with the chronic shortage of chairs and tables, makes it primarily a passage rather than a stopover.

The spaces of other residential halls also show some misalignments. The "Colle" walkways, for example, conceived as connecting spaces, acquire in several cases an aggregate and intermediate function between the public space and the private space; this function is covered in the other "Collegi" by the housing blocks. For similar purposes, even the double rooms of the "Aquilone" are often transformed into places of sociability.

To the differences listed above, specific of certain spaces, are to be added the tendencies common to the entire complex. Among them, the use of the small kitchen in each block is particularly important. Actually, the stoves supplied are used to prepare full meals that will replace those provided by the canteen. This form of use differs considerably from the function of simple heaters for which they have been conceived and is linked both to the possibility of creating convivial moments inside the blocks and to a low appreciation that some users have for canteen food.

[4] Bazzoli, N., & Torrisi, G. (2017). I "Collegi del Colle dei Cappuccini di Urbino" come luogo di partecipazione, integrazione e conflitto. In G. Maggioni (ed.), Urbino e le sfide della città-Campus. Milano: Franco Angeli.

[5] Dolciami Crinella, S. (1997). Dalla città del silenzio: conversando con Carlo Bo, Mario Luzi, Giancarlo De Carlo. Urbino: Quattro Venti

The kitchen use is quite revealing of the changing needs of the dwellers, and how this influences the transformation of spaces and their significance. Cooking in the blocks, if not even in one's own room, is a widespread practice among students, highlighting the importance of cooking in their cultural background. Over the last twenty years, however, food culture has gained an increasing importance in the consumer society, becoming more and more often an identity practice and an instrument for creating socializing opportunities[6]. Cooking is in fact a sharing activity and represents for the inhabitants of the "Collegi" a need to respond to through the autonomous redefinition of the kitchen space. In this transformation, this space takes on a new value, becoming a means of satisfying personal tastes, as well as a catalyst for convivial moments. Preparing food in autonomy also allows dwellers to tame their living space, in order to perceive it more like a family home.

Private space, collective space and threshold space

The intertwining between private and collective space is a feature that defines the interior of the "Collegi". The blocks are an example of balance between private bedrooms and common aisles, to be understood both as intermediate space and place of strong interaction.

The various spaces are marked by a gradual opening process from private to public, where the bedroom represents a space dedicated to intimacy, felt as personal and individual. Exiting the room one moves from the personal sphere to the shared dimension of the block, made up of typical relationships of cohabitation. In the block aisle one lives with roommates as in a traditional home, rules and rituals are established, and students structure their daily coexistence. Similarly, to a home context, one chooses who is permitted to enter and who is not, thus avoiding fortuitous interactions that characterize the collective spaces, external to the intimate social circle. Collective spaces, in fact, are specially organized to stimulate passages and crossings that can result in unexpected encounters.

The importance attached to the block as a center of day-to-day relationships is clarified in several interviews and focus groups, where the home feeling is crucial to student perceptions. Though De Carlo conceived the blocks of the different residential halls in the complex as fluid spaces of relationship between the two main dimensions of the public and the private, their use has changed considerably in recent years, increasingly enhancing functions

[6] Sassatelli, R. (2015). Dimmi come mangi e ti dirò chi sei. Ceto medio e alimentazione. In R. Sassatelli, M. Santoro, & G. Semi (cur.) Fronteggiare la crisi: come cambia lo stile di vita del ceto medio. Bologna: Il Mulino.

of socialization. In fact, there is a widespread perception of a substantial increase of relationships and interactions that develop within the blocks. These spaces increasingly tend to meet the very same needs - albeit filtered by selection mechanisms - for which common spaces have been designed.

Blocks tend to be enriched with activities ranging from simply spending time with friends to real organized leisure opportunities also open to the public. This new trend, therefore, entails a transfer of social interactions from the collective spaces into the space, porous and permeable, of the blocks. These spaces are therefore bent to the changing needs of users, gaining a special significance in the spatial and functional articulation of the complex. They represent at the same time a space in-between public and private, an environment of dense and daily relations between neighbors, a place of leisure and aggregation.

The aggregating function of the block is of fundamental importance for the inhabitants of the "Collegi" and the use of this space is intense as its structural characteristics can facilitate the permanence of fruition ("Serpentine" and "Tridente"). In cases where the atmosphere of the block is lacking, mechanisms for self-production of this environment emerge.

In the "Aquilone", for example, where tables and chairs are external to its double bedrooms, the interior space of some rooms is adapted to the socialization function. In the case of the "Colle", however, where there are only rooms facing directly on the walkways, there is an informal use of certain sections of these paths, which display more diverse activities (from drinking in company to playing cards, up to hair-cutting together).

Main critical features of space

Although the adaptability of spaces is undoubtedly a strong point for the "Collegi", according to the respondents, the structure presents various types of problems, which can be summarized in the following list:

- The block is unsuitable for socialization. Many would like more comfortable seats (couch, armchairs).
- Problems in reaching gathering spaces in case of emergency.
- Safety of external stairs that are degraded and slippery.
- Coffee bar that does not stimulate aggregation because it lacks adequate surrounding space.
- In the Tridente, there is a scarcity of sitting places which causes its limited use.
- Need to pay more attention to cleaning, often referred to as inadequate.

- Poor bedroom sound-proofing, especially at the Tridente, in the area close to the kitchen.
- External classrooms underutilized.
- The Tridente study hall lacks sound-proofing, so that nois from the canteen and from entries is significant.
- The Aquilone Library has too short opening times to be properly and widely used.
- General poor use of common spaces, both external and internal.
- Need for better leisure facilities (e.g. table football, table tennis, pool tables, etc.).
- Limited access to the Tridente amphitheater. It should be allowed for use by students with multiple activities within it
- Hazard of starcases inside the blocks that reportedly is often cause of accidents
- Lack of personnel for ordinary maintenance
- The difficulty of moving goods on stairs does not facilitate the provision of services
- Lack of a suitable facility to allow students to organize parties
- Poor extraordinary maintenance
- Need for better use of Vela, Tridente and Aquilone's terraces

Using common spaces and people flows

Through the mapping of people's flows and social interactions that take place in the common spaces, it has been possible to see how these environments are affected by crossings and relationships.

Fig.3. Map Flow and Social Interaction Chart ("Tridente" Canteen Plan).

This survey tool, organized according to three observations for each site, has allowed to understand the forms of use of collective spaces, ensuring an accurate description of their uses.

"Tridente":

- Amphitheater – Frequent crossing site, but users not interested in stopping there. Most people flows from the main entrance door to vending machines (closed after 7-8pm);
- Study hall - Very busy on both floors, even at night. Very crowded in the periods before the exam sessions;
- Outside (terrace) - Scarcely used. Few people stop there and the flows are concentrated in the access area to the amphitheater vending machines;
- Square - Used mainly as a crossing, with few people stopping at the benches. The part of the yard near the outer classrooms and the one close to the classroom are scarcely used;
- Canteen - Highly used. Tables located further away from the service area are less used. The area in front of the toilets and the toilets themselves are under-utilized;
- Canteen area - Many people use it as a passage to access blocks, the coffee bar, the canteen and the winding staircase leading upstairs. The sector with the winding staircase leads to the under-utilized amphitheater. The paucity of seats affects the use, which appear quick and sporadic;
- Canteen square (Aquarium) - Used for smoking with stops especially in evening hours;
- Staircase linking "Tridente" square and "Serpentine"- Very used, especially when the canteen is open.

"Aquilone":

- Study hall - Used as a passage on each floor, the tables and seats located on the middle floor are scarcely used, especially the round tables placed next to the stairs. Greater use at weekends;
- Library - Scarcely used, tables and seats are often empty;
- entrance - Much used as a passage but not for stopping-by. Seats are often empty;
- external classroom – Much frequented for crossings, but few people stay there. The flows are much higher on the weekend;
- Laundry - Used especially on weekends, when it becomes a place of interaction while queuing up;
- TV Room - Almost unused;
- Corridor ("Vela" Lift Side) - Used only as a passage area with little use of seats;

"Vela":

- Study hall Level 6 - Well used with adequate ratio between demand and supply of seats.
- Study hall Level 7 - Used mainly on weekends. During the week is almost empty.
- Entrance - Very frequented for passage and also used as a place of interaction; the round tables area is nearly empty.
- Outside Level 4 - Almost unused during the week, while on the weekend it is frequented and functions as a socializing place.
- Outside entrance floor space - It is used as a crossing space with few opportunities to stop and interact.
- Path to supermarket- Quite used, with frequent daily passages according to weather conditions.

Gender differences in use and perception of spaces

Extending and deepening the analysis, it is possible to note some divergences between the trends that characterize the use and perception of space by female and male students. In particular, it is possible to define three areas concerning the use and perception of spaces that are differently characterized by males and females within the "Collegi". These are:

- Use and perception of personal spaces
- Use and perception of common spaces
- Safety

The first and most obvious distinction between female and male students relates to the definition and negotiation of the meaning of personal space. First of all, it is possible to detect the tendency of girls to define the personal space of the bedroom as a private space, an island where privacy, serenity and self-definition can be found. Any intrusion by outside people (be they personnel or uninvited students) into this private space is therefore perceived as a trespassing, an invasion of the space of intimacy, a serious offense.

It is common among students to change the room arrangement through modifications of the layout and use of furniture, and the addition of more or less cumbersome furnishings. This personalization of the space, rather than enhancing the functionality of the room, assumes the character and meaning of space appropriation through differentiation, reinforcing familiarity and sense of belonging in the context of "Collegi".

This renegotiation of the meaning of personal space often also affects the block aisle. In most cases interviewed students perceive the block as a personal space to be shared with their roommates only. This way they end up also to include this area in the domain of the private sphere, thus conceptually separating it from the over-exposed environment of the collective spaces of the "Collegi".

Although the distinction between the personal space of the room and that of the common areas also emerges in male student responses, this tendency seems to be less clear and less marked in terms of domesticity and intimacy. The modification of the furnishing arrangement, though also present amongst boys, is mainly aimed at increasing its functionality and only marginally improving its sense of warmth and familiarity.

The connotation of the block aisle also assumes for them a different meaning than that of the female students. The feature of intermediate space, however open to sharing and sociability, is most felt by male students, who do not perceive it as a group's own space. The ambiguity of this space, contrary to what happens among girls, is resolved by including it into the public sphere of relationships. This aspect is closely related to the fact that relationships with the closest kins (those with whom the block is shared) are not described in terms of familiarity or group. The community dimension is present, but associated with the general dimension of the "Collegi", to be lived, therefore, within the public sphere.

The use and perception of common spaces also differs between female and male students, although not so clearly as it arises in personal spaces. Males tend to use more frequently and with more ease common areas such as the canteen, study halls and, above all, "relaxation areas". They tend to feel comfortable within such spaces and they widely and frequently use them, regardless of their functionality. Female students, on the other hand, use these spaces in a largely functional way and, for this reason, their use of study and dining rooms is more frequent than that of relaxation and socialization spaces.

The use and perception of common areas, however, cannot be evaluated if not in continuity with what is said in relation to personal spaces. In fact, the clear distinction between personal space and common spaces that characterizes the perception of female students interviewed is reflected in the different approach they have to the two types of space and the different bonds they create in the two different contexts. They attribute to personal space the familiarity and intimacy characteristics that translate into the reproduction of a domestic sphere. The 'public' connotation of common spaces is therefore almost a consequence of the strong 'private' characterization of personal spaces. Male students, on the other hand, live the transition between personal and common space much more fluidly and indistinctly, attributing to both the first and the second type of space different levels of public-ness, without ever perceiving any space as really private or domestic. Finally, the issue of safety and security emerges mainly from girls' reports, while it is less felt by the boys. The open character of the structures creates a sense of insecurity in girls, fueled by some unpleasant episodes occurred at night.

The regulation of the "Collegi" prohibits the stay of non-residents during night hours and for this reason surveillance measures are mainly implemented to counteract the phenomenon of illegal occupancy of rooms. Paradoxically, these measures are perceived by students as a further and greater invasion of their private space, which creates the feeling of being exposed on two fronts: both from the outside and from inside the structures. The feeling of being exposed also inside their room, and hence in their private and personal space, makes them feel vulnerable and in constant danger.

The presence of armed security services, in addition, rather than infusing security and protection seems to increase the perception of insecurity. This primarily depends on the domestic connotation that some "Collegi" spaces have for the students: some are unwilling to accept the presence at "home" of an armed man. In fact, this presence, as well as that of the staff controlling the rooms at night, affects the perception of the domesticity of the environments, exposing to the public, external, and unfamiliar spheres one of the most intimate moments of life (the time of rest and sleep).

In this sense, male students, as annoyed as they are by the intrusion in the personal space of the room and the ease with which they can enter and leave the residence halls, do not express a discomfort as strong as that felt by the female students interviewed with respect to their perception of security. These qualitative data are also confirmed by the results of CAWI, which show that the percentage of male respondents who are "afraid" within the "Collegi" is significantly lower than females (7% and 28% respectively).

Perception of "Collegi" premises by employees

Those who work in various occupations within the "Collegi" express fairly homogeneous views over many of the issues dealt with during the investigation. Respondents cover different roles within the building complex, have a different familiarity with the environment and with residents, and therefore evaluate and perceive spaces and relationships from different points of view. Nonetheless, some issues and problems emerge from all interviews as well as some positive points that could be evaluated

and considered so as to enhance strengths and resolve the more critical issues.

The main issues that have been addressed can be summarized in the following points:

- Adequacy of spaces
- Appearance
- Social Relations within the "Collegi"

The adequacy and functionality of the "Collegi" premises is generally assessed very negatively by the employees, both in terms of their perception of the needs of the resident students and in relation to their own needs in day-to-day work. The most critical points are the poor maintenance, the inadequacy of internal and external connections among different facilities and the little space available to residents. The issue of maintenance is crucial because, in addition to being a problem for residents, it is also a critical issue for employees, as it makes their work (especially cleaning) more difficult and frustrating. Bad maintenance does not create problems only from a hygienic point of view and for the satisfaction of cleaners (mostly women, plus two men occasionally performing heavier jobs), but they influence their perception of security within the structures, considered low.

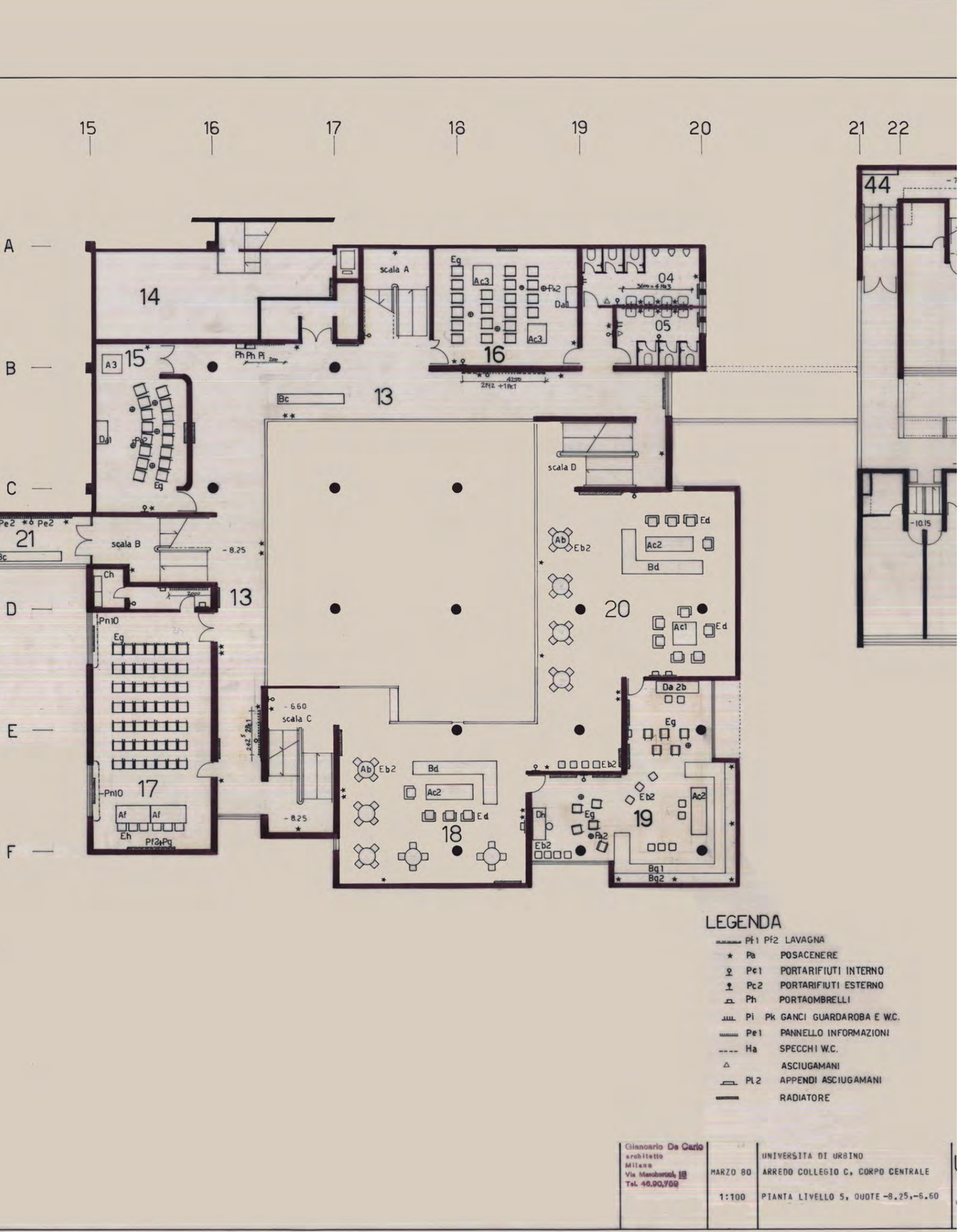
The connections between the different areas of the same residence hall and among the different residence halls are the second sore point that emerges from the interviews and the focus group with workers. This issue, once again, is particularly felt by the cleaning staff, having to move in and between different environments, bringing with them all the tools and products necessary for carrying out their work. The presence of stairs, often difficult to walk through, the lack of many handrails, and the distance between the different buildings and blocks of the complex make moving between residence halls very difficult and constitute a perceived danger by workers. While agreeing on the issue, all respondents are aware that this limitation of the building complex is difficult to overcome, as it depends on the structure of the "Collegi".

However, the issue does not concern only employees, but any person with a physical impairment. Apart from the few rooms specifically designed to accommodate people with disabilities (located exclusively in the "Vela"), many of the "Collegi" premises are impracticable for anyone with mobility limitations.

Concerning the workers' point of view about the residents' living conditions, there is an awareness of the inadequacy of spaces for the needs of students, both in terms of rooms and block functions

as well as the recreational dimensions. The minimal furnishings and the little space available make the students often adapt the spaces to their needs by moving some components or adding new ones. This creates difficulties for employees who have to move heavy items to put them back in their original position once the tenant has left his/her bedroom.

Annex 2. Sociological investigation - Documentation.



From the description of the building to the identification of the opportunities for change

For each part of the building, were identified: the characterizing elements, the critical issues and the opportunities for change.

Levels of Significance

This chapter sets out the evaluation criteria that guide each part of the Complex into its potential for transformation, considering its architectural features and the social value that has been attributed to it. A set of plants follows the classification of the common spaces made based on the judgment attributed to the elements expressing the qualities of form of space and competence in execution combined with the compositional value that had been attributed to it within the overall design.

LEVELS OF SIGNIFICANCE

Indoor Outdoor

Very High significance
represents the most valuable themes, features, built fabric or spaces within the site. These elements are essential to the understanding and appreciation of the place and as being key contributors to its overall character and setting as well as its local, national and international importance.

High significance
is attributable to a theme, feature, built fabric or space which has a high cultural value and forms an essential part of understanding the historic value of the site, while greatly contributing towards its character and appearance.

Medium significance
is attributable to a theme, feature, built fabric or space which has some cultural importance and helps to define the historic value, character and appearance. These elements are often important for only a few values.

Low significance
is attributable to a theme, feature, built fabric or space which has minor cultural value and which may – even to a small degree – contribute towards the character and appearance of the place.

Use / Satisfaction

The Current Usage evaluation was based on the results deriving from the intensity of space use and the satisfaction level found comparison between yesterday and today. The basis on which the data was processed comes from the inquiry conducted by DESP and is attached to this document.

LEVELS OF USE

Indoor Outdoor

The highest level of use in both past and present.

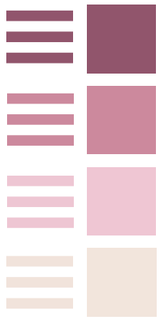
Maximum level of use in the past and currently less.

Past and High level of use and High / Low level of currently use.

Average / Low level of use in both past and present.

LEVELS OF SATISFACTION

Indoor Outdoor



The highest satisfaction level in both past and present.

Maximum satisfaction level in the past and currently less satisfactory.

Medium / low satisfaction level past and high at present.

Medium / low satisfaction level both in the past and present.

The "Colle"

Service building

Characterising elements

- Main access to the complex.
- The use of the same material both for internal and external path leading from the main entrance to the rooms.
- The use of the same furniture, wooden frames and skylights. custom made for this building and well preserved.
- High quality of the materials and their installation.
- Visual connection with the landscape.

Critical issues

- Common spaces (as the living rooms) are under-utilized, despite being easy to reach and of free access to the students for studying purposes. Low quality of comfort and flexibility (privacy; thermal comfort; technical equipment; confortable and flexible furniture; lighting) and low degree of use by the students and the guests; that is why these spaces are mainly seen only as a link from the main entrance to the rooms.
- Access to lev. 4 is only used by those who live in the "Colle", whilst the students who live in the others to reach the rooms and the services use more frequently the pathway that crosses the "Collegi" and along which are the bus stop for Urbino and the square of the "Tridente" (access to the canteen).
- Terraces are not used.
- The Conference room is normally closed and is underused.
- The canteen is used only for breakfast; the dining room has low architectural quality and poor visual connection with the landscape.
- Accessibility: most buildings are not accessible by wheeled mobility device users.

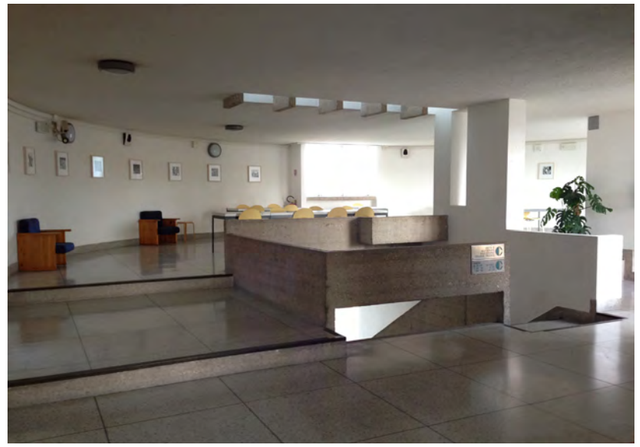
Opportunities for change

- Despite being the oldest building, the "Colle" is the best preserved part of the complex and the one where the design is developed to encompass every single detail. For that reason, its vocation can be exploited also to accommodate tourists traveling for cultural purposes, scholars and architecture enthusiasts. The apartment of the Director can host families and groups.
- The use of the "Colle" as access to the environment of the "Collegi" and, more broadly, to modern architecture in Urbino, can be emphasized by providing to the visitors the information on the complex and on the other architectures by Giancarlo De Carlo in Urbino and its surroundings. Partnerships with stakeholders such as the Tourist Info Center at the Mercatale in Urbino and the "Fondazione Ca'Romanino", which are already promoting the city and the architectures by De Carlo, should be facilitated. The canteen can be used as a bar/restaurant also for the external guests, and extend the operating hours. Some tables can be placed on the panoramic terraces.

The service building of "Colle"

The service building of "Colle" viewed from West, in the foreground the path leading to the rooms.

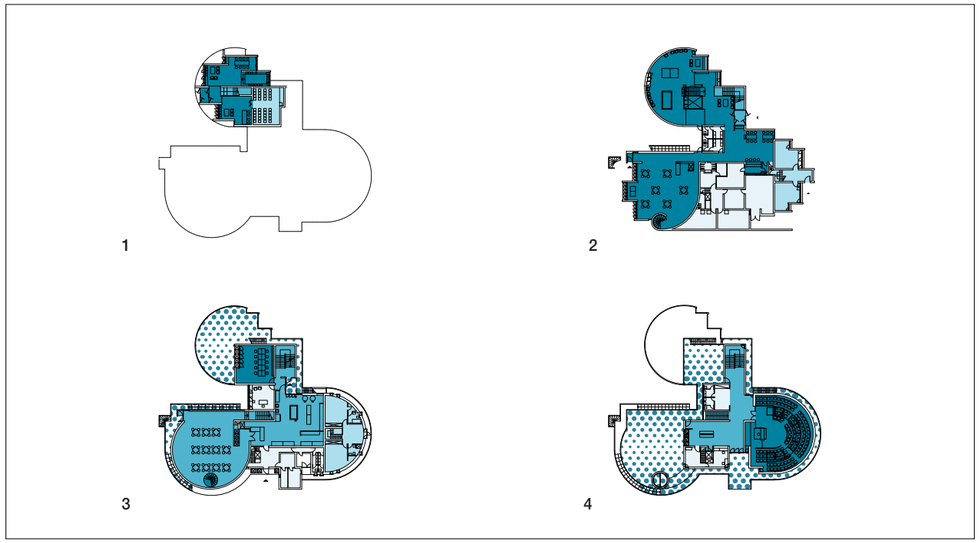
Pedestrian network inside the "Colle".



Internal study rooms inside the "Colle".

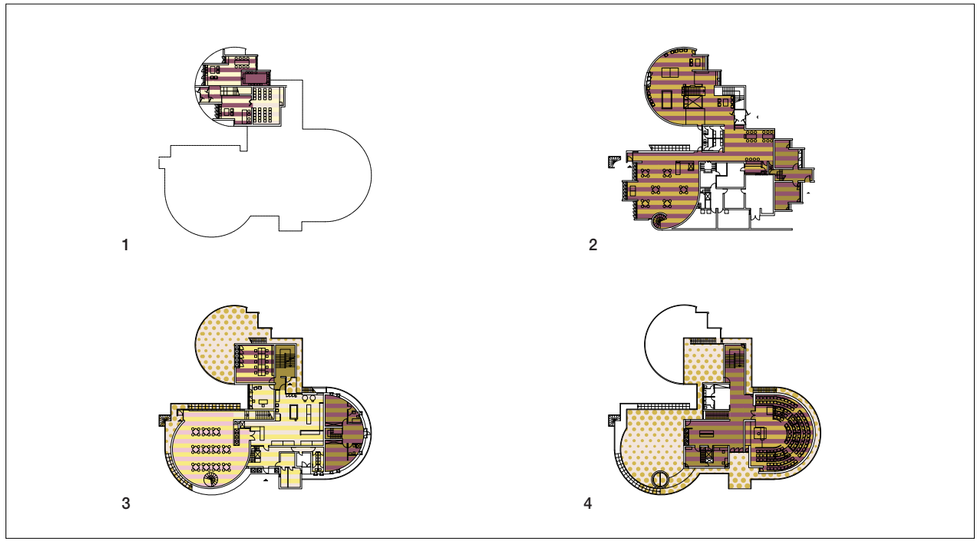
View from the study rooms inside the "Colle".

Auditorium for 200 people inside the service building of "Colle"



Levels 1 / 2 / 3 / 4 | SIGNIFICANCE

Levels 1 / 2 / 3 / 4 | USE / SATISFACTION



Residences

Characterising elements

- Covered pathway.
- Harmonious integration with the landscape.
- Proper dimension of the rooms, private bathroom.
- Presence of original windows and furnishings in almost all rooms.
- Good conservation conditions (the bathrooms have been renovated and the linoleum flooring has been refurbished).

Critical issues

- The wooden windows are suffering from decay and in some cases not anymore operable.
- Accessibility: stairs and other barriers make the residences non accessible to wheeled mobility device users.

Opportunities for change

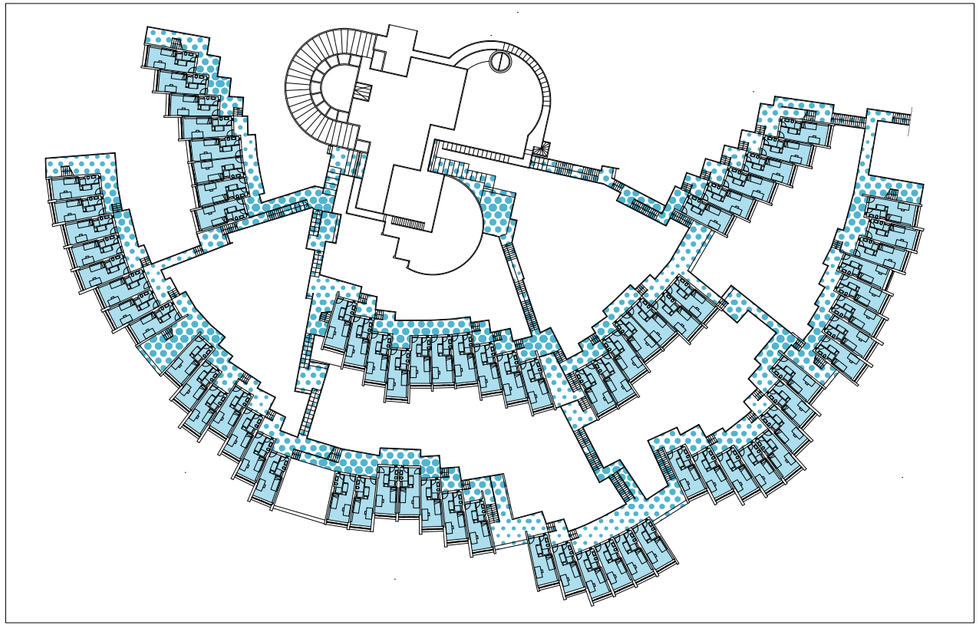
- The residences can accommodate external users (scholars/ cultural tourists / architectural heritage lovers).

View of the "Colle" from the "Tridente" square".

Rooms at the "Colle".

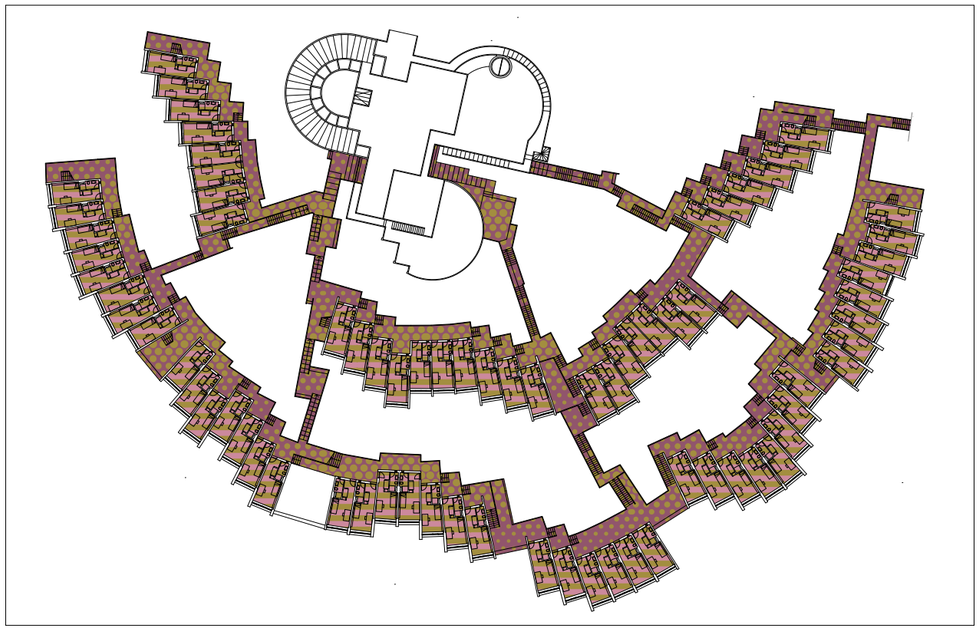
Double floor body of the "Colle" cells.

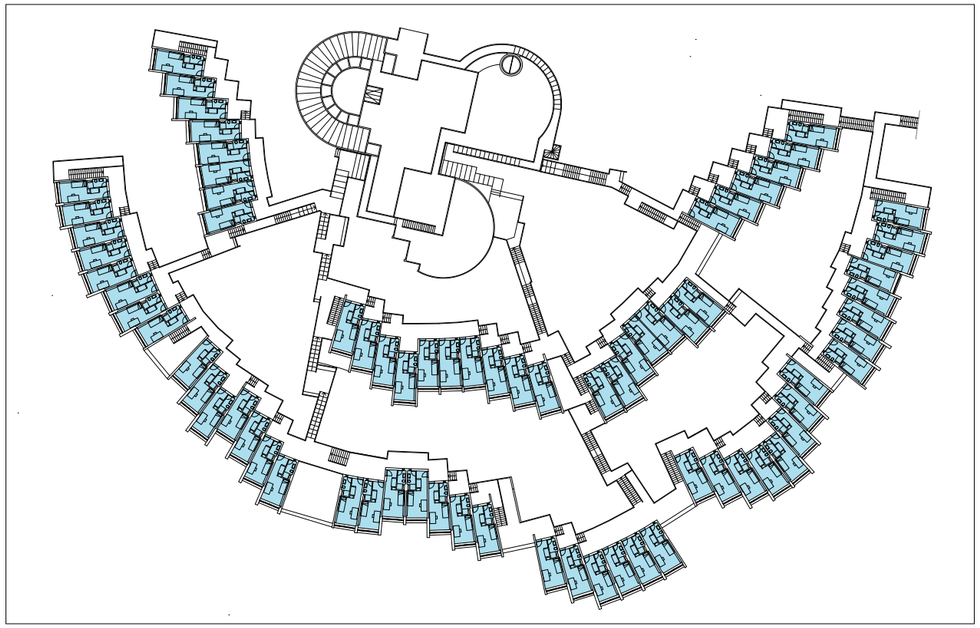
Internal room of "Colle".



Level 1 | SIGNIFICANCE

Level 1 | USE / SATISFACTION





Level 2 | SIGNIFICANCE

Level 2 | USE / SATISFACTION

The "Tridente"

Service building

Characterising elements

- The "public" space of the square.
- The internal patio.
- The concrete spiral staircases.
- Common functions: the canteen, the conference rooms, the auditorium.
- The radio, as a function that involves directly the students.

Critical issues

- The connection between the building and the square is low, since there is only an access door.
- The auditorium is not used and even not accessibile for most of the day, due to security reasons.
- The conference rooms are underutilised.
- The common spaces used as study rooms are lacking do not have the necessary equipment, are inadequately illuminated, noisy and does not guarantee and adequate thermal comfort.
- The texture of the concrete elements has been altered in recent maintenance works. In some cases the intervention included a reinforcement using fiber reinforced polymer products (FRP), resulting also in an increase of the dimension of the elements.
- Water seepage from roof and terraces.
- There are inappropriate furnishings and floorings in the common areas (e.g. the wooden pavement of the little auditorium)
- The space of the canteen cannot be divided to be used by small groups.

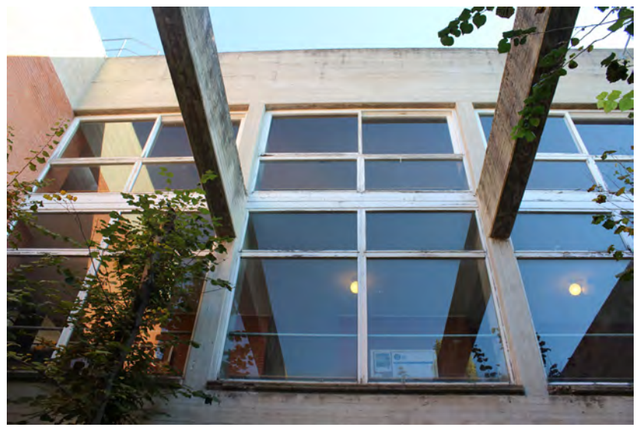
Opportunities for change

- The service building of "Tridente" has a central position with respect to other colleges.
- Accessibility (public route, bus stop; a ramp provide access to the square, and can be used also by the disabled people)
- the conference rooms can be used for conferences and congresses.
- Reuse of the auditorium and terrace on Lev. 4: that space could host a multifunctional space (bar, multimedia library, seminars and training courses, info point for work, stages and volunteering...), as is the case, for example, of the Idea Stores in London. The auditorium can be open on the square. That service can also complement the activities of the canteen, extending the opening hours, and be also used by external users (e.g. it can provide the lunch break for the conferences). The technical and service spaces on the lower level can be easily connected thought the bathrooms block that already exists.
- The common space at Lev. 2 can be redefined by introducing new furnishings.
- The number of spaces that are directly managed by the students can be increased, as already happens for the radio.

The "Tridente" piazza from the external service road.

Entrance to the "Tridente" and the shelter leading to the "Canteen".

"Tridente" from inside the patio.



Living out of the canteen looking towards the patio.

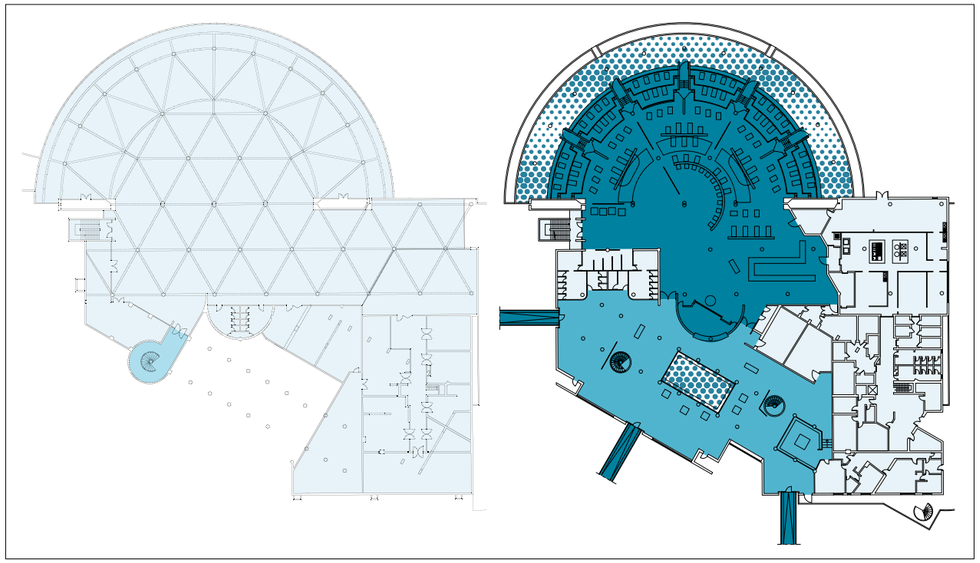
"Tridente" study rooms.

"Tridente" double floor living room.

"*Tridente*" *the theatre.*

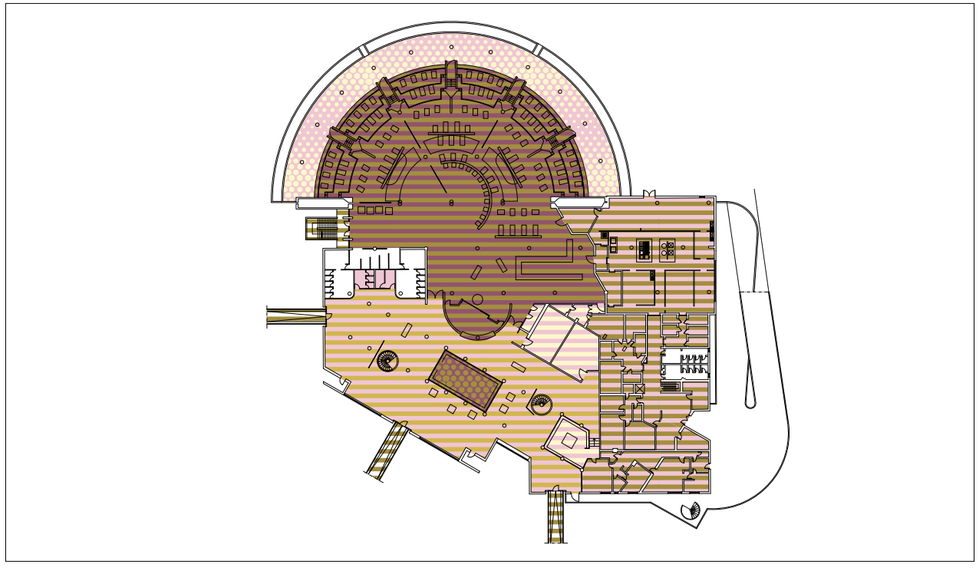
The student lounge and the stairs leading to the ground floor.

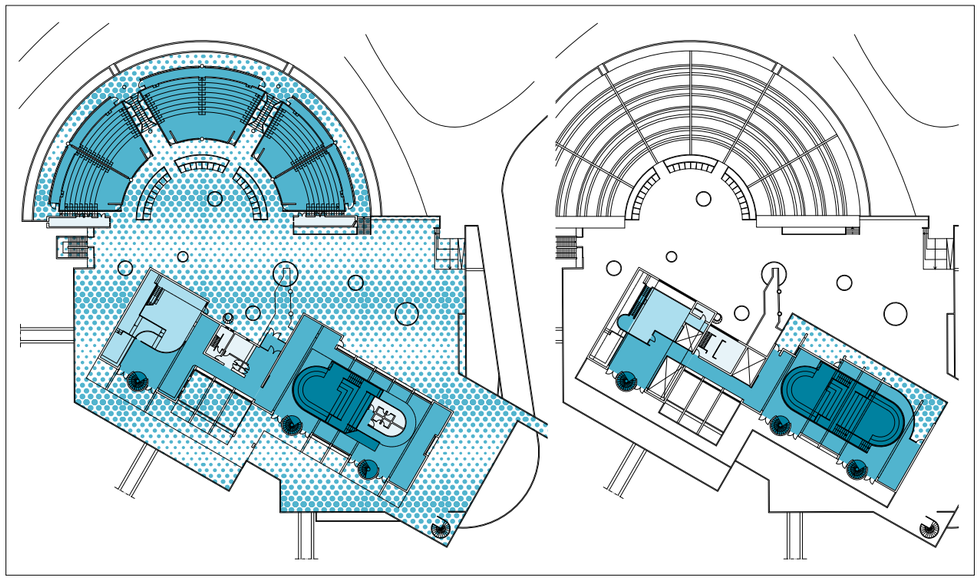
"*Tridente*"*the tube leading to the rooms.*



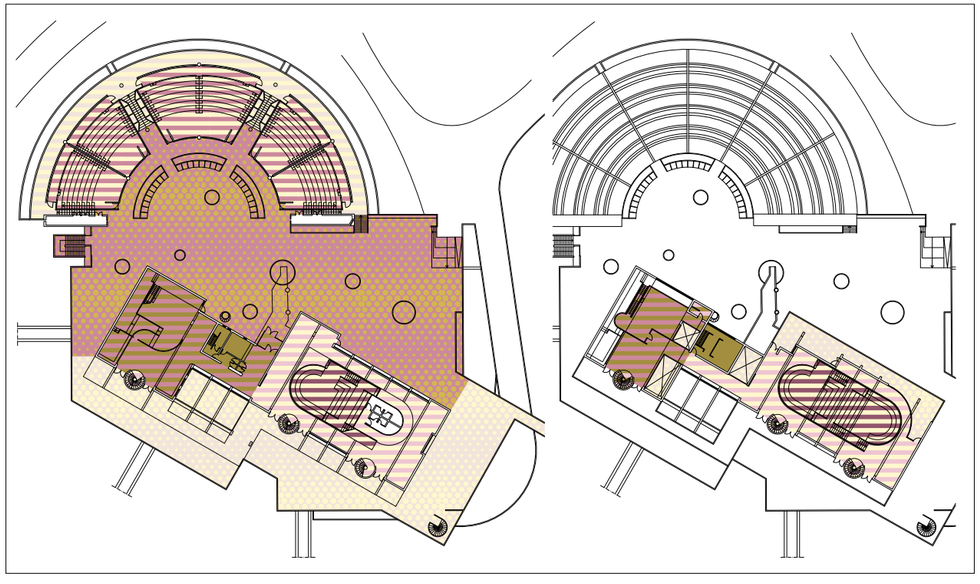
Levels 1 / 2 | SIGNIFICANCE

Levels 1 / 2 | USE / SATISFACTION





Levels 3 / 4 | SIGNIFICANCE



Levels 3 / 4 | USE / SATISFACTION

Residences

Characterising elements

- Internal pathway and access to the pathway from the service building.
- Roof terraces and external path.

Critical issues

- The spaces of the rooms and of the block are very narrow and must be shared by a numer of students (8 for the kitchen and the living room, 16 for the bathroom).
- Almost all of the windows have been replaced with new elements that are different from each other and not consistent with the original design.
- The terraces are seldom used and sometimes the use is not proper (recently fires were burned that damaged the sheaths, as well as involving a risk).

Opportunities for change

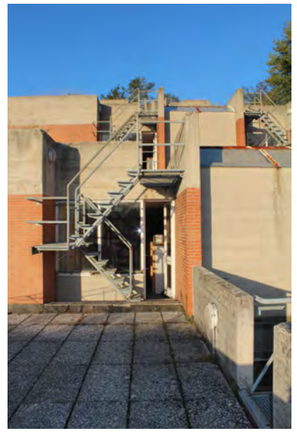
- Small kitchens can be realised on the roof to free the common space in the blocks.

"*Tridente*" north façade of an "arm".

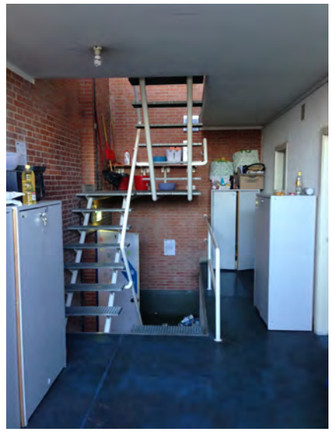
"*Tridente*" the path leading to the service road.

"*Tridente*" top floor.

"*Tridente*". The stairs to the terraces.

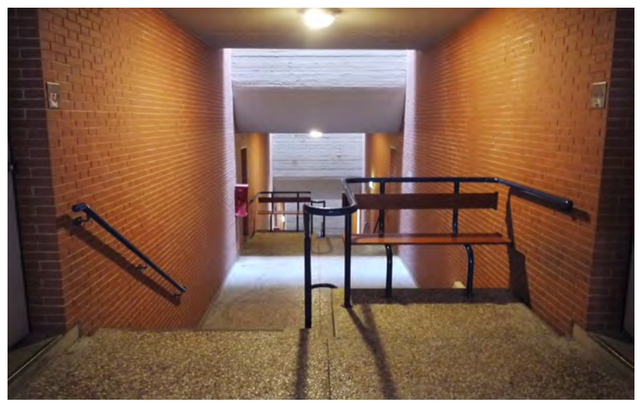


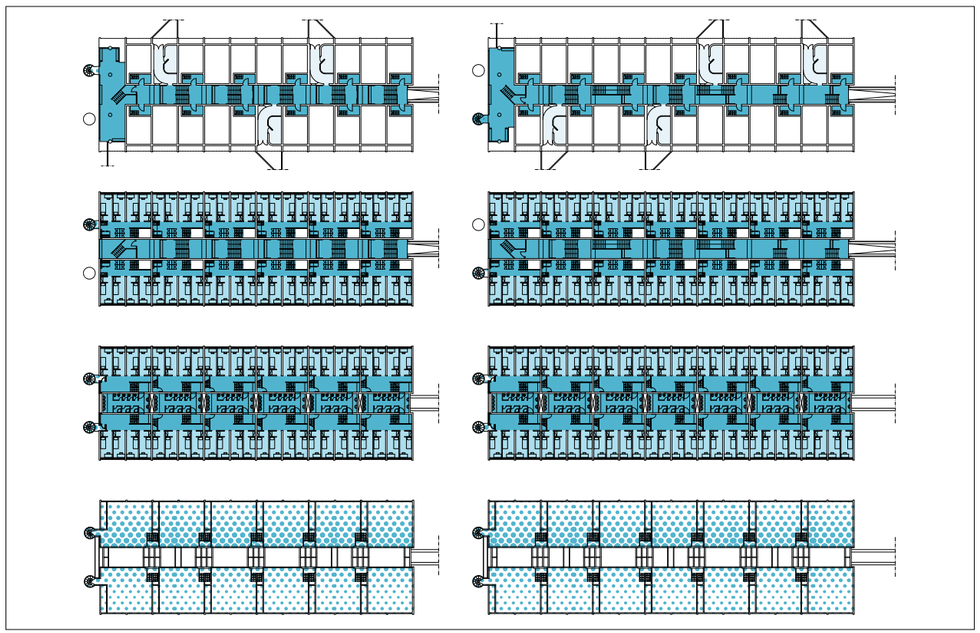
"*Tridente*". Stair inside the double floor living.



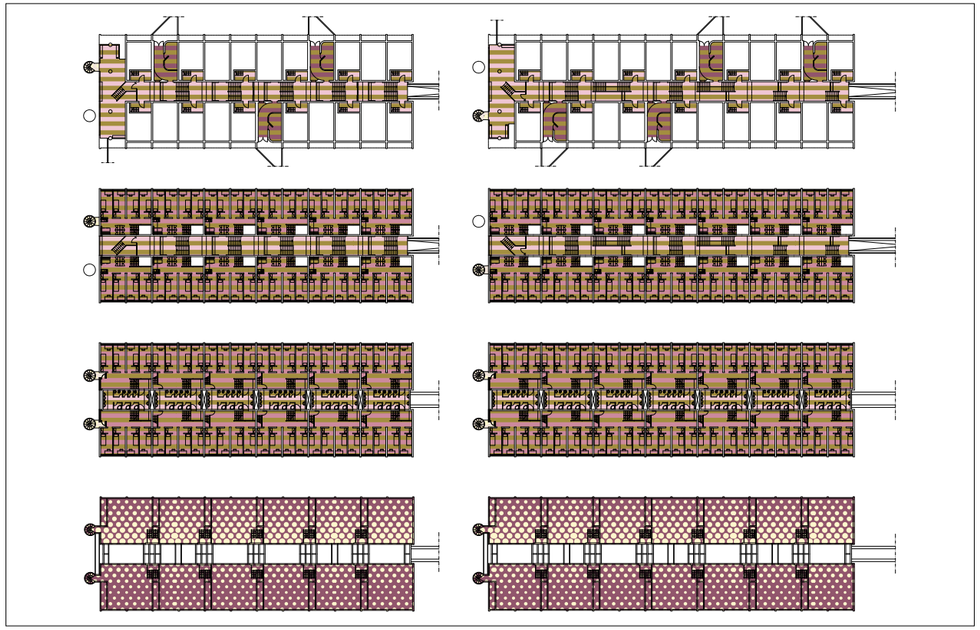
"*Tridente*". Common space: the table and the skylights.

"*Tridente*". Internal road leading to the students units.

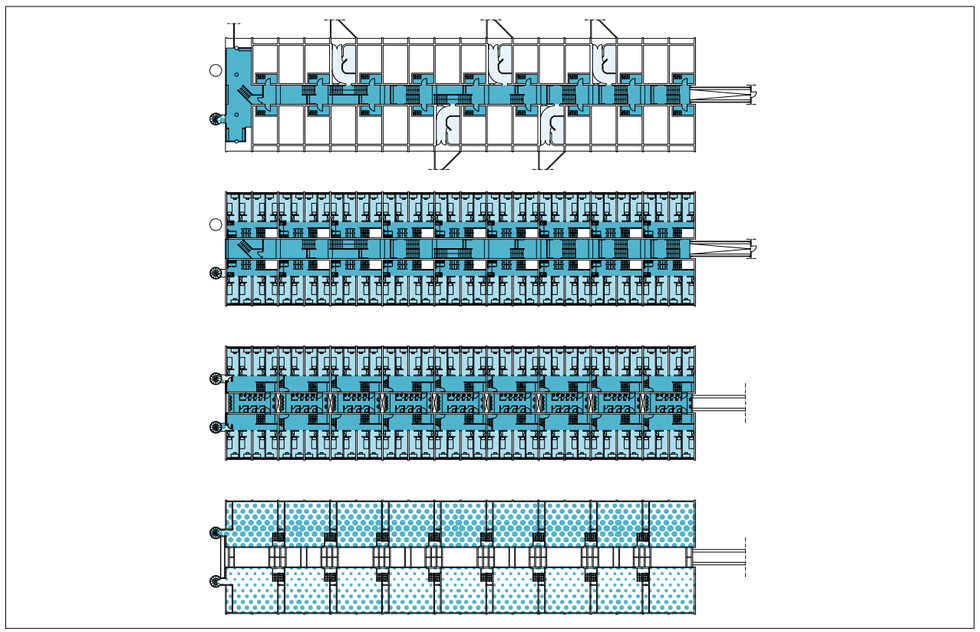




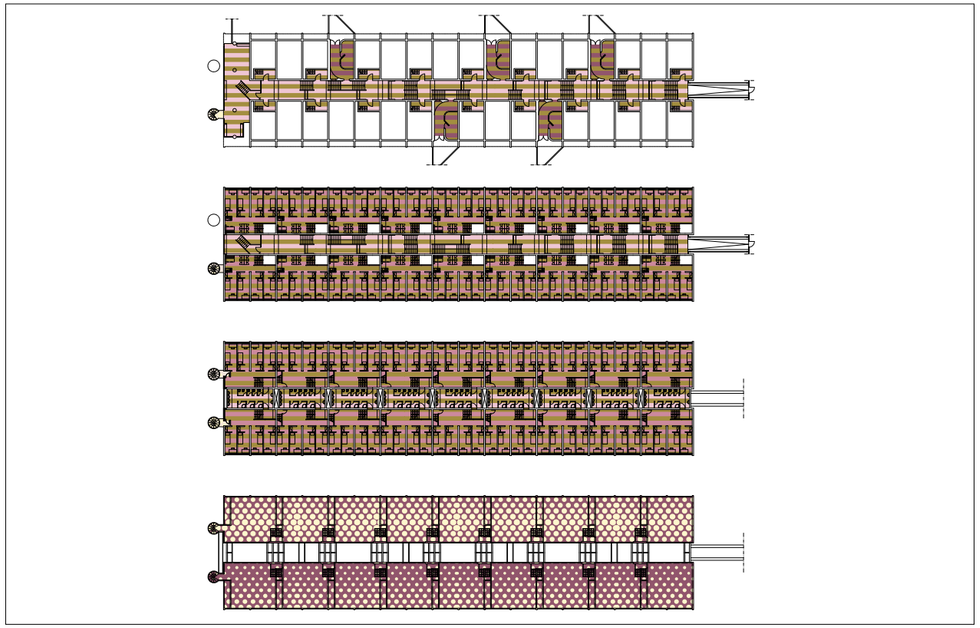
Levels 1 / 2 / 3 / 4 | SIGNIFICANCE



Levels 1 / 2 / 3 / 4 | USE / SATISFACTION



Levels 1 / 2 / 3 / 4 | SIGNIFICANCE



Levels 1 / 2 / 3 / 4 | USE / SATISFACTION

Library

Characterising elements

- Original frames (e.g. the large windows of the reading rooms that are protected form the weather and consequently well preserved).
- Continuity of the pathway from the entrance to the exterior stair.
- Continuity of the reading room in the two levels.
- Use of different types of floorings matching with the different use of the spaces.
- Materials: exposed bricks and concrete, red-painted metal (for the handrails).

Critical issues

- The degree of brick attachment on concrete structure should be checked to identify areas of detachment that are not noticeable.
- The size of the columns is a critical element for the seismic security of the building; an improvement of the building structural performance is required by law, but it should be done without altering the characteristic space features or changing the texture of the materials.
- At Lev. 3 (offices) the presence of extended crack along the walls suggests a collapse of the cantilevered part. The evolution of the crack pattern should be monitored to understand the progression of the movement and attest the causes.
- The reading room cannot be divided, to host different study needs (e.g. to host workgroups, individual study, seminars ...).
- Decay of the floor in vegetal fibre.
- Accessibility: the laboratories on Lev. 4 can only be accessed from the terraces; the railings of the interior stair don't comply with current building regulations.
- The spaces are under-utilized: the library is closed in the evening (when the students return from Urbino) and its equipment is out-dated (e.g. the workstations).
- Unused or under-utilized areas.
- Furniture lacks of coherence with the building features.

Opportunity for change

- Possibility to provide independent access.
- Possible connection with the upper level to create an independent teaching unit.
- Possible independent use of level 4.
- Use of outdoor spaces; increased use of roofing terrace.
- Provision of seamless continuity of interior space at level 2, currently interrupted by the emeroteca.

View from the "Aquilone" terrace.

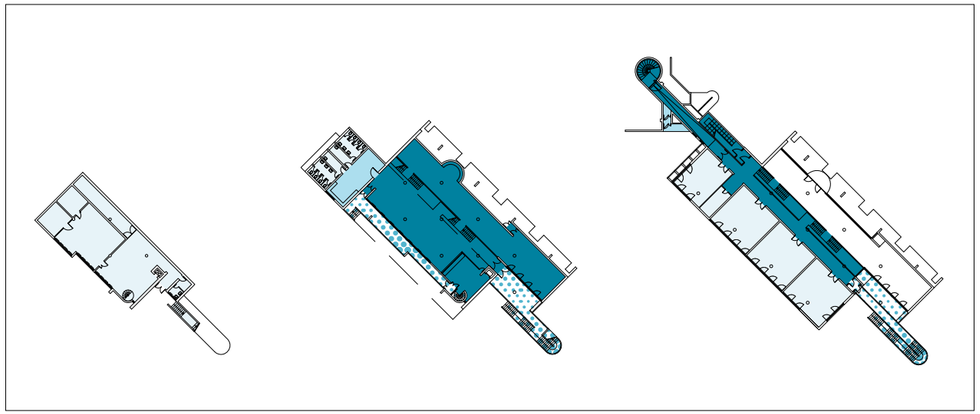
The terrace on the roof of the "Aquilone" library.

Inside the Aquilone" library.

The reading area on the first floor, inside the "Aquilone" library.

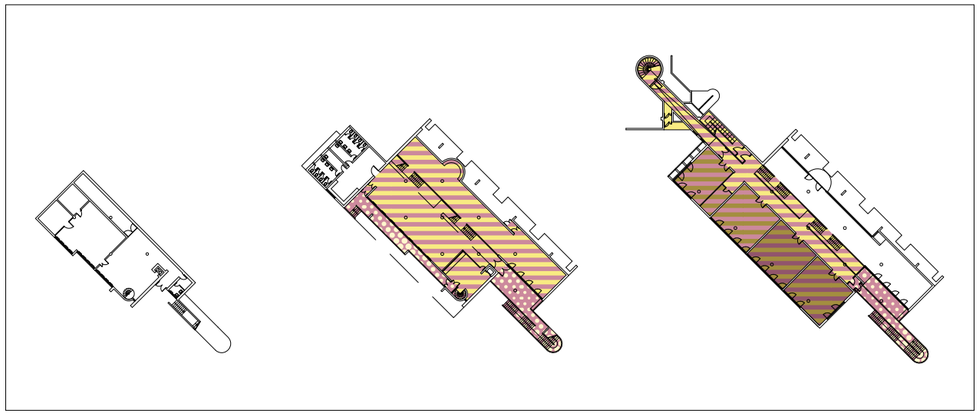
The ground level on the "Aquilone" library.

The "Aquilone" library, east side entrance.



Levels 1 / 2 / 3 | SIGNIFICANCE

Levels 1 / 2 / 3 | USE / SATISFACTION



Service building

Characterising elements

- The building acts as a square (a place of crossing paths, around which different functions aggregate).
- Continuity of the pathway.
- Quality exposed surfaces.
- Good match between flooring material and space use.
- Solid wood casement windows.

Critical issues

- The common space is used as a study room, but it lacks thermal and visual comfort, individual spaces for privacy and proper utility networks.
- Some functions were never activated.
- The TV room is rarely used.
- Furniture lacking coherence with the building.
- Music room has structural problems.
- Some areas are non accessible.

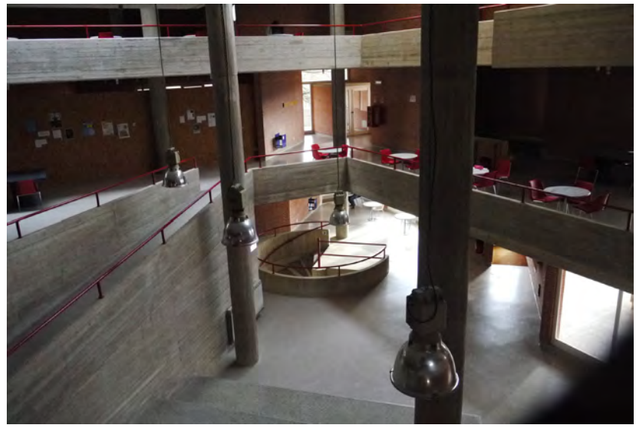
Opportunities for change

- Possible relocation of the functions currently settled in the library in the unused spaces; they could be re-organised to better match with the users needs and become reading rooms for individual study, group activities and seminars, by providing adequate furniture, as lockers, seats and workplaces that can be organised in different ways.

"Aquilone". The roof theatre.

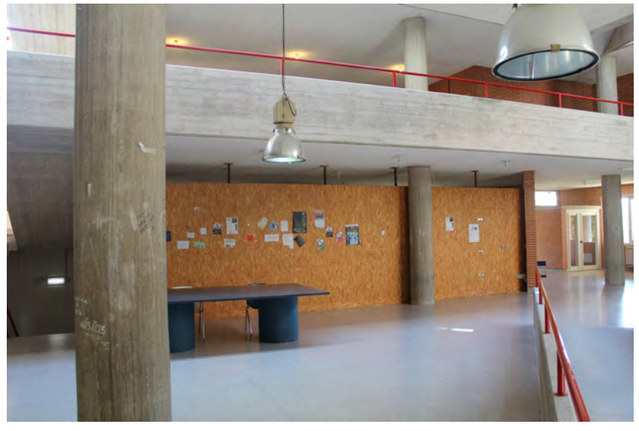
"Aquilone". The central body seen from the terrace.

"Aquilone". The rooms seen from outside.



"Aquilone". The internal "Piazza" with rooms around the balconies.

Inside the "Aquilone" central piazza, lower level.



"Aquilone". Central piazza, towards the first level.

Residences

Characterising elements

- Continuity of the internal and external pathways.
- Roof terraces.
- Skylights.
- Common areas along the internal pathway.

Critical issues

- The external spaces and the common areas in the internal route are not used.
- Intensive use of rooms, even for inappropriate functions (as cooking or store food into the closets).
- Poor thermal confort (rooms and internal route).
- The internal pathway should be compartmented to ensure fire safety.

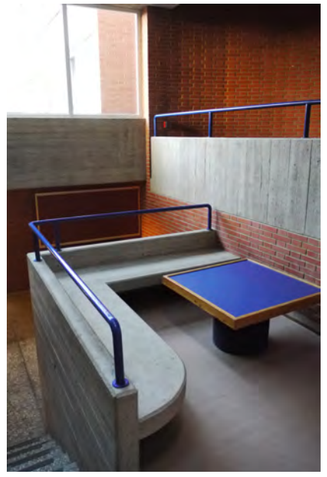
Opportunities for change

- Little kitchen can be realised in the common spaces along the pathways, using the technical spaces also as a storage, to discourage the habit of cooking, keep food and eating in the rooms.
- Fire safety can be assured reaching an "equivalent level of safety" with alternative elements or system as automatic sprinkler systems, alarms, fire extinguishing curtains.

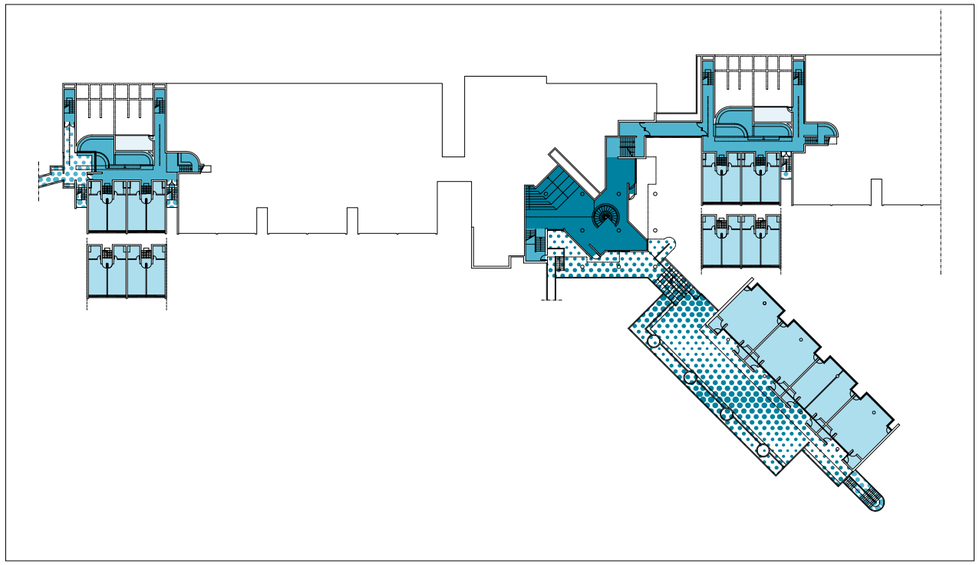
"Aquilone". Corridor with the skylight, the stairs leading to the terrace and a sitting area.

"Aquilone". Corridor leading to the rooms with the common areas at a lower level.

"Aquilone". Dorms, common area.

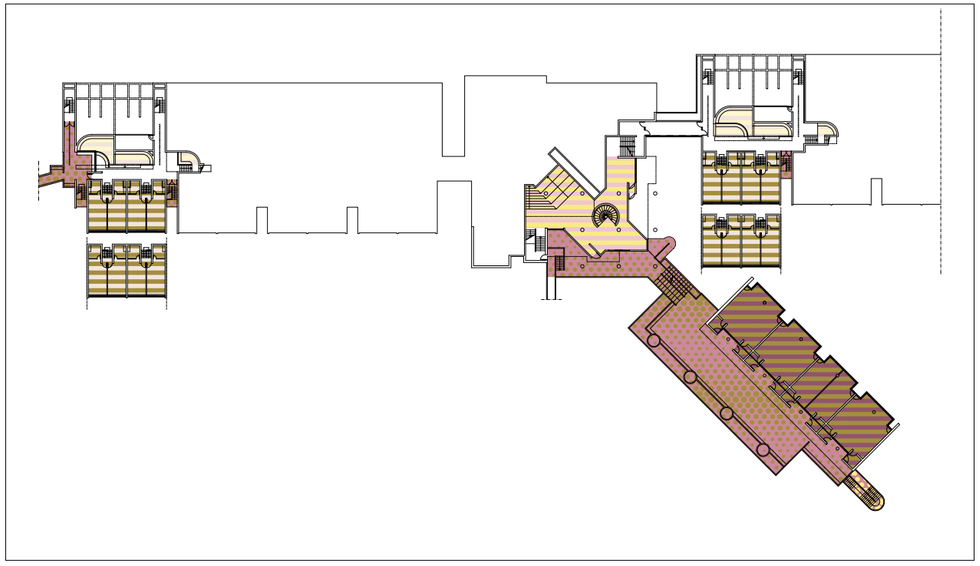


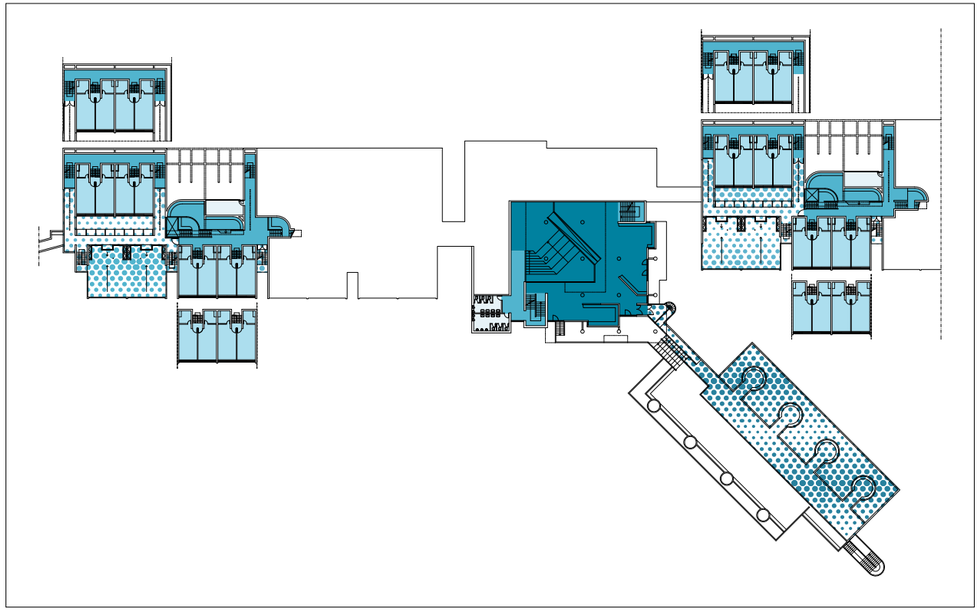
Inside a "Aquilone" bedroom.



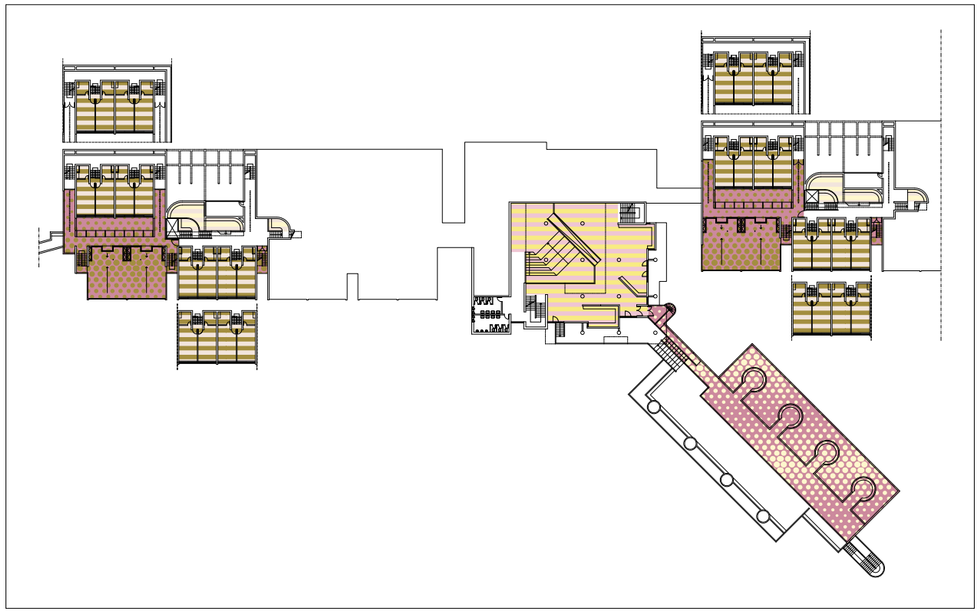
Level 4-5 | SIGNIFICANCE

Level 4-5 | USE / SATISFACTION

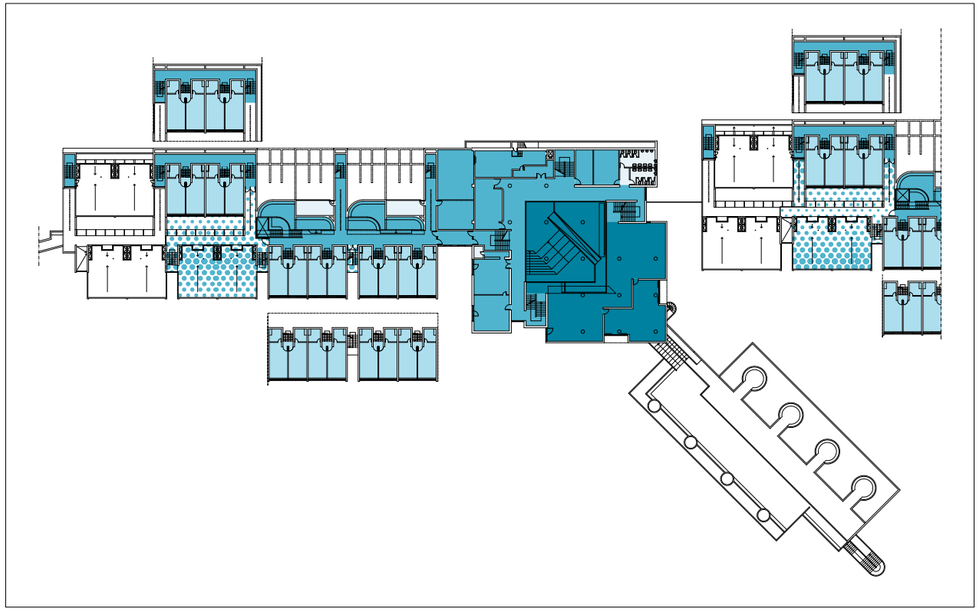




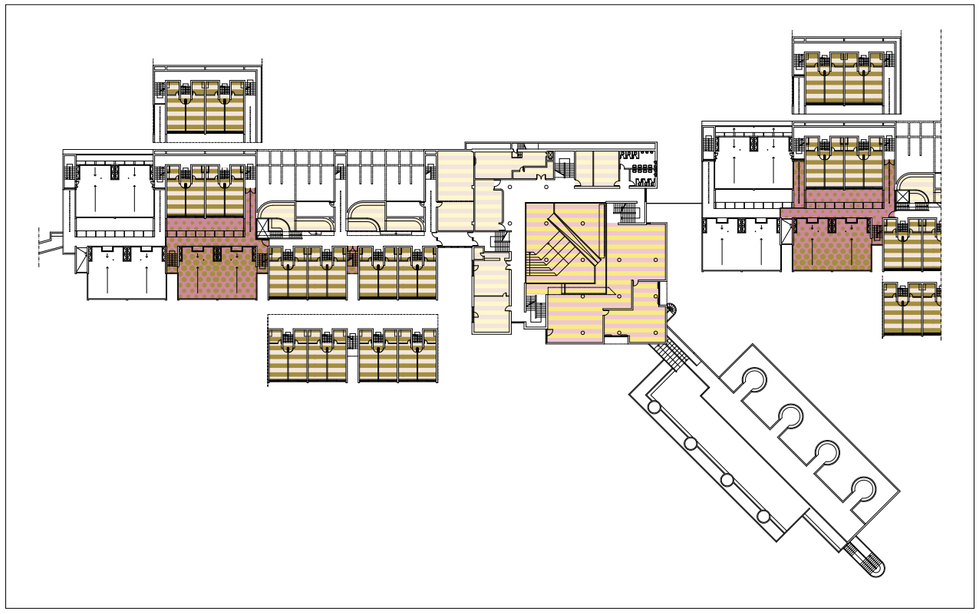
Level 6 | SIGNIFICANCE



Level 6 | USE / SATISFACTION



Level 7 | SIGNIFICANCE



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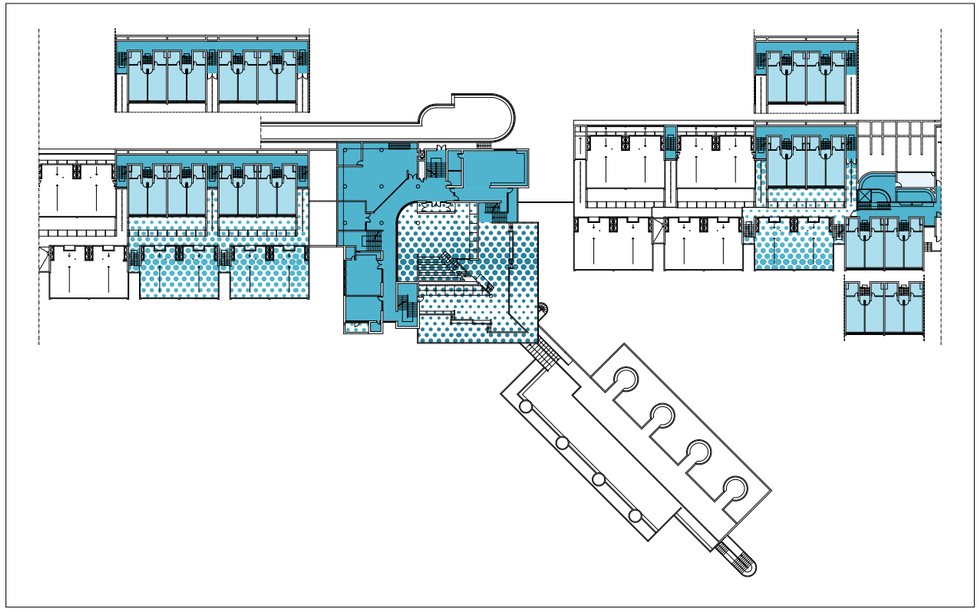
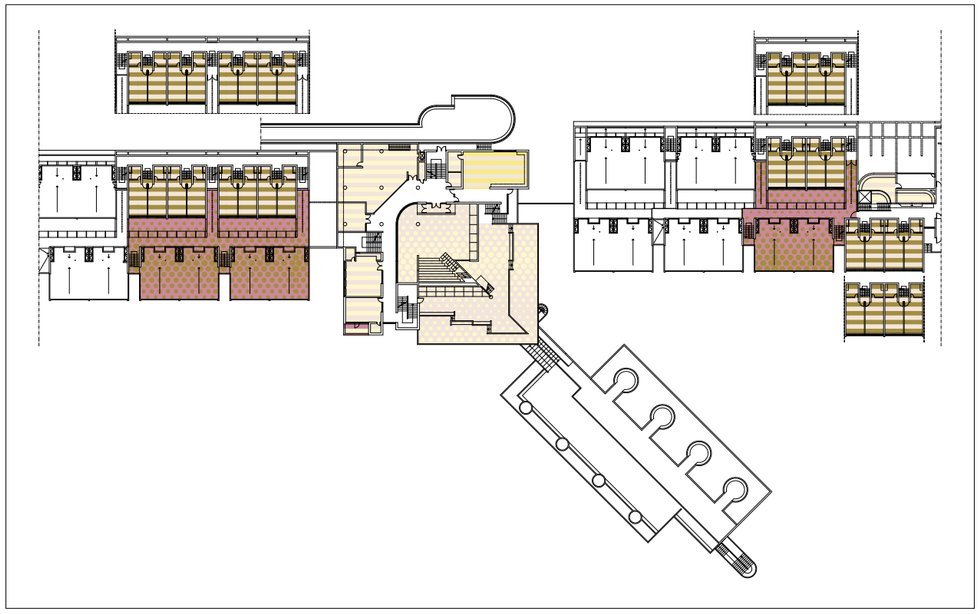
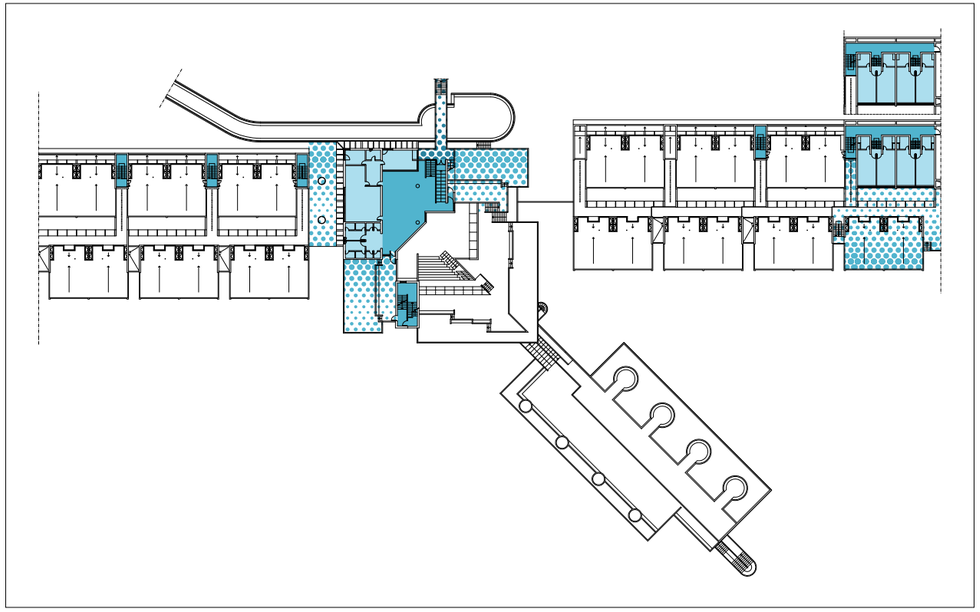


Level 8 | SIGNIFICANCE

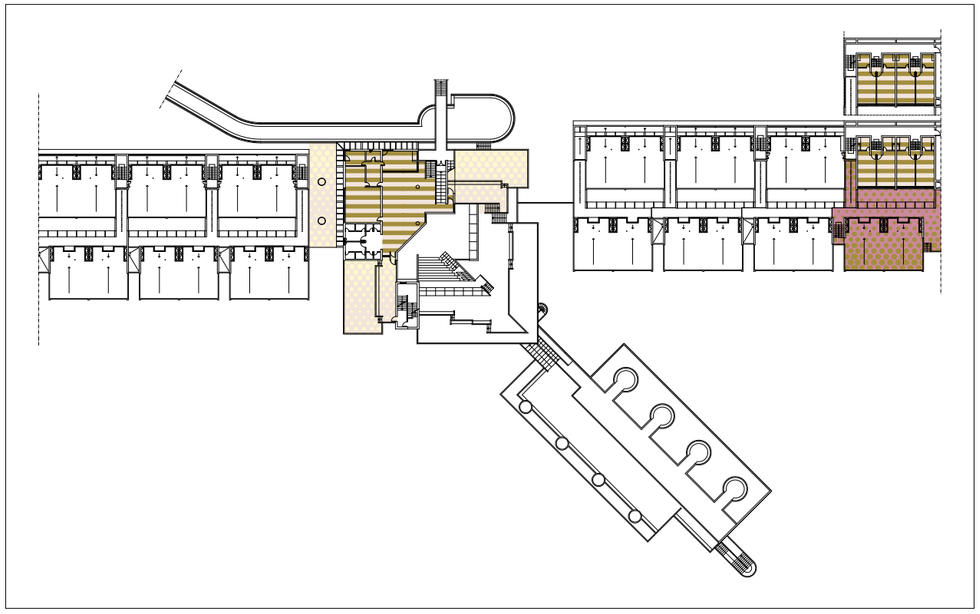
Level 8 | USE / SATISFACTION





Level 9 | SIGNIFICANCE

Level 9 | USE / SATISFACTION



The "Vela"

Characterising elements

- The auditorium.
- The internal patio at Lev. 5-6-7.
- The external staircases and walkways.
- The external spaces and green roofs (that are, in most cases, "private" to the block).
- Metal walkways.
- The "internal garden" at Lev. 4.
- The common living located along the internal walkways; the furniture has different colours depending on the level.accessibility: the upper level (Lev. 8) is accessible to the wheelchairs and the rooms have already be prepared to accommodate disabled users. A platform lifts connects to the lower level.

Critical issues

- The "Vela" is very far from the canteen and other services.
- The common spaces into the blocks are very small; due to the distance from the canteen and a certain proximity to a grocery store, most students prepare their meals into the block, using the hotplates that were designed to be used just for the breakfast. Despite the regulations that doesn't allow them, the students store food in their bedrooms.
- Detachment (to be assessed through an appropriate diagnostic) of the brick cladding of the stairwells.
- Decay of the metal walkways, that are inaccessible for security reasons.
- The railings are not compliant with the regulations.
- The terrace on Lev. 9 is not accessible for security reason
- In the residential blocks there are frequent seepages from the roof-garden; maintenance works are very difficult because of the need of removing about 60 cm of soil to reach the sheath.

Opportunities for change

- The spaces on Lev. 6 can be used for a common kitchen; that change can free spaces inside the block, reduce the hygienic problems related to the food storage and lower the risks of fire. the common space inside the blocks could therefore be reorganised by enlarging the toilets and placing more suitable furnishings.
- The study room could be re-organised to better match with the users needs by providing adequate technical equipment, furniture and more confortable workplaces.
- The laundry can be relocated in one of the TV rooms that is not used on Lev. 4 and 5.
- The use of the external spaces can be increased and become more agreeable, by adding furniture.

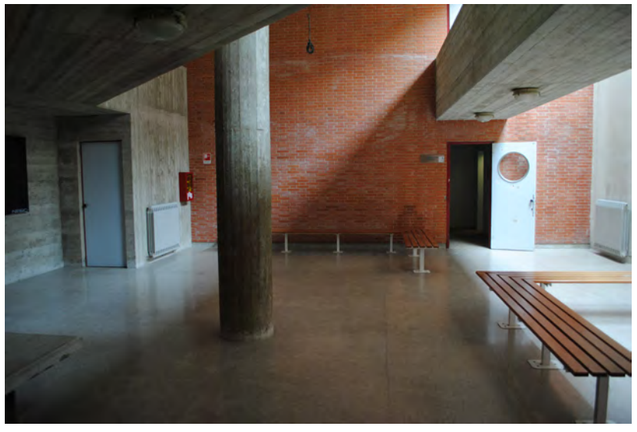
"Vela". Unit exit towards the terraces.

"Vela". Terraces.

"Vela". Bridges.

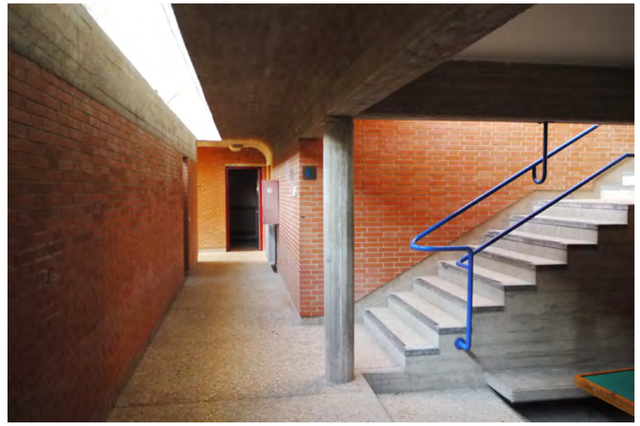
"Vela". Rooms window towards the terrace.

"Vela". Theatre.



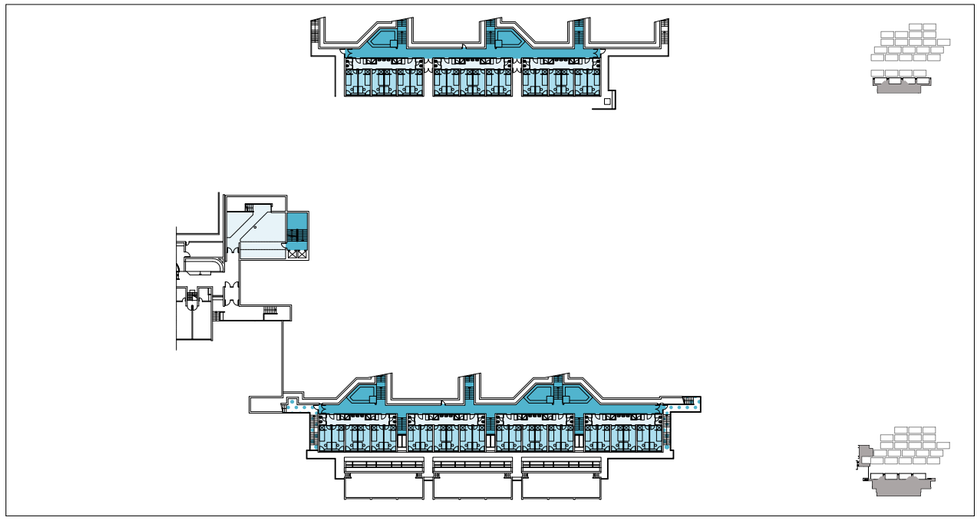
"Vela". Common area.

"Vela". Study area.



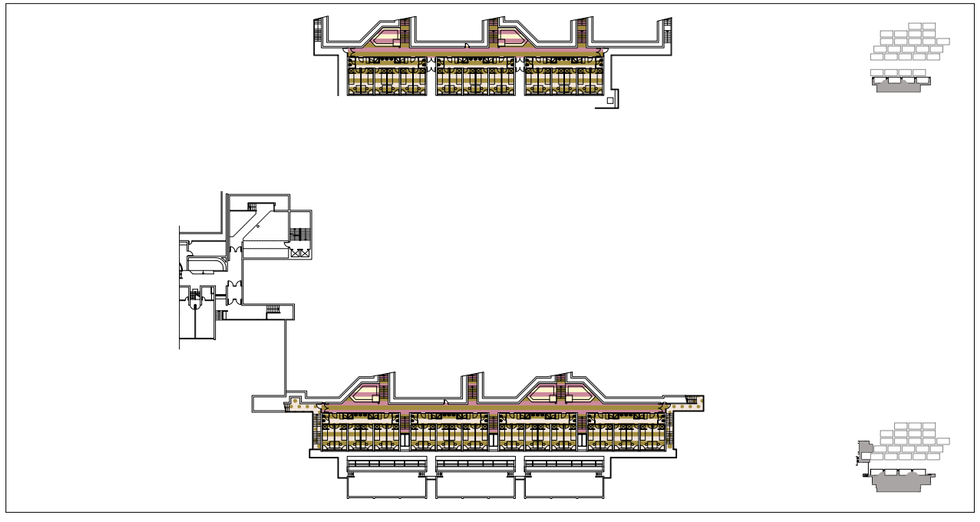
"Vela". Corridor leading to the rooms.

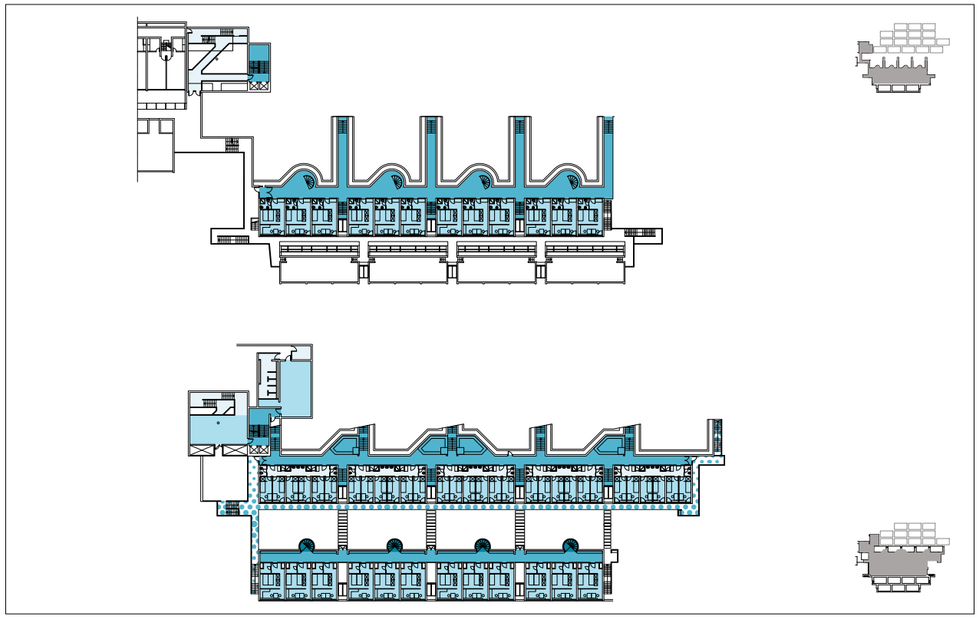
Vela". Common area with lockers.



Levels 1 / 2 | SIGNIFICANCE

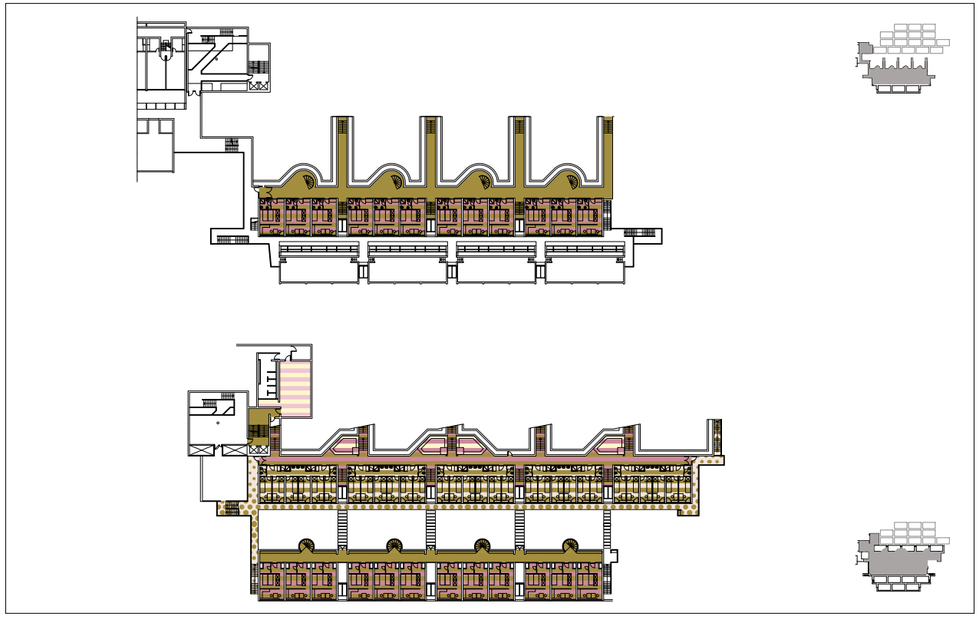
Levels 1 / 2 | USE / SATISFACTION

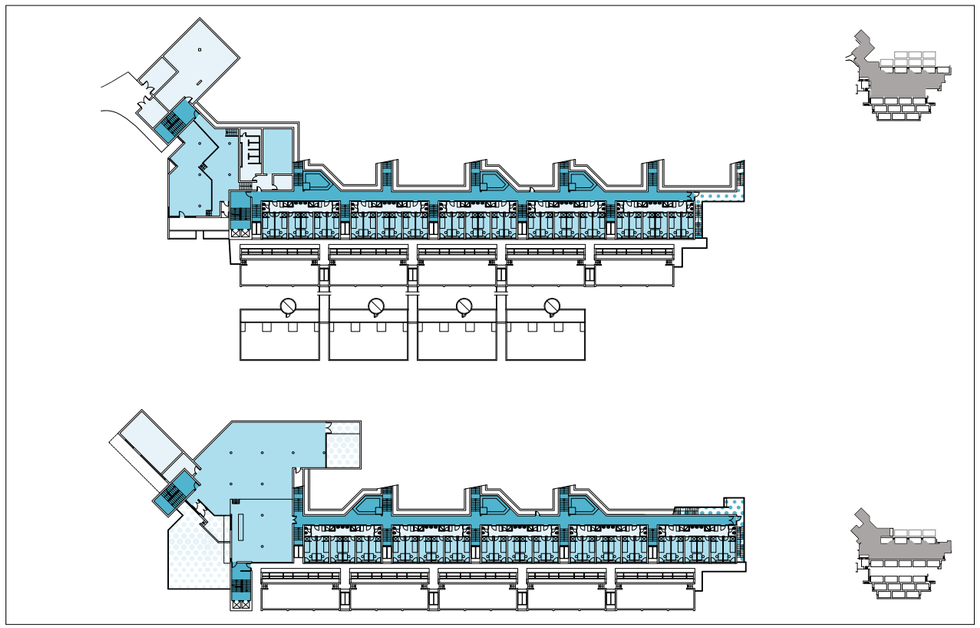




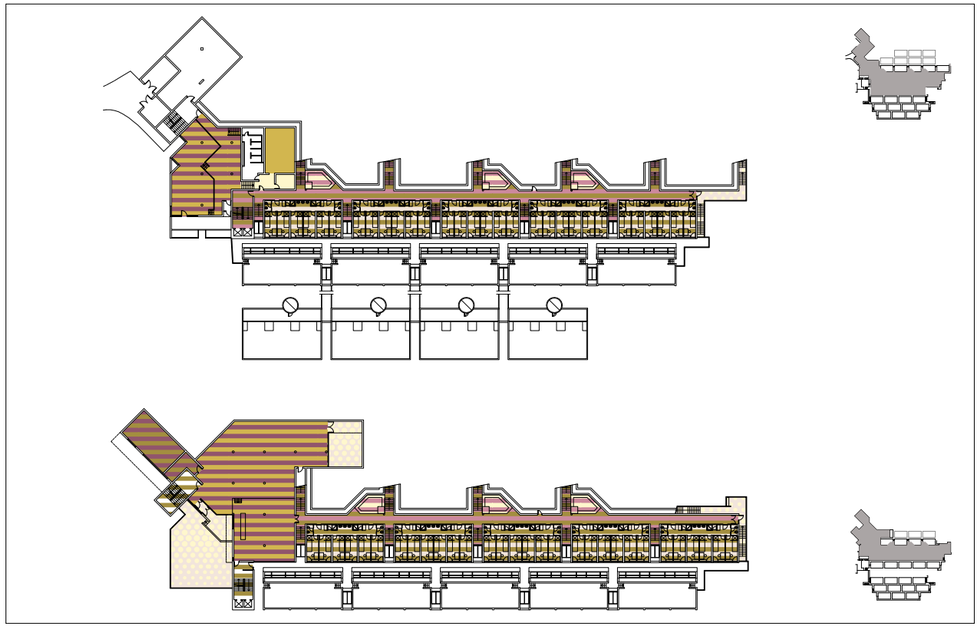
Levels 3 / 4 | SIGNIFICANCE

Levels 3 / 4 | USE / SATISFACTION

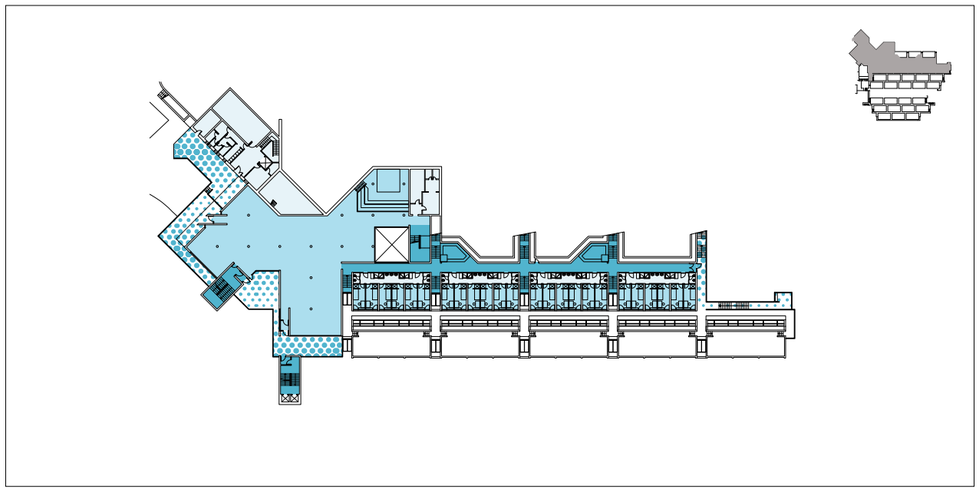




Levels 5 / 6 | SIGNIFICANCE

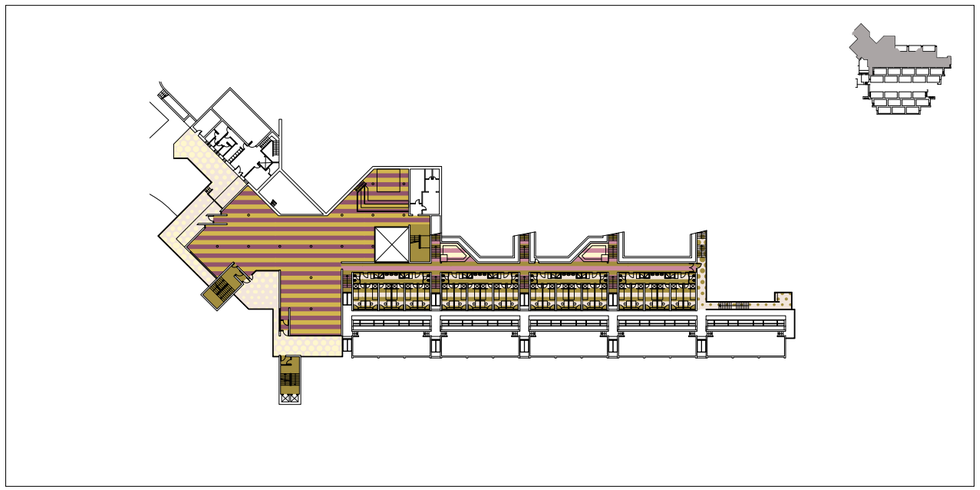


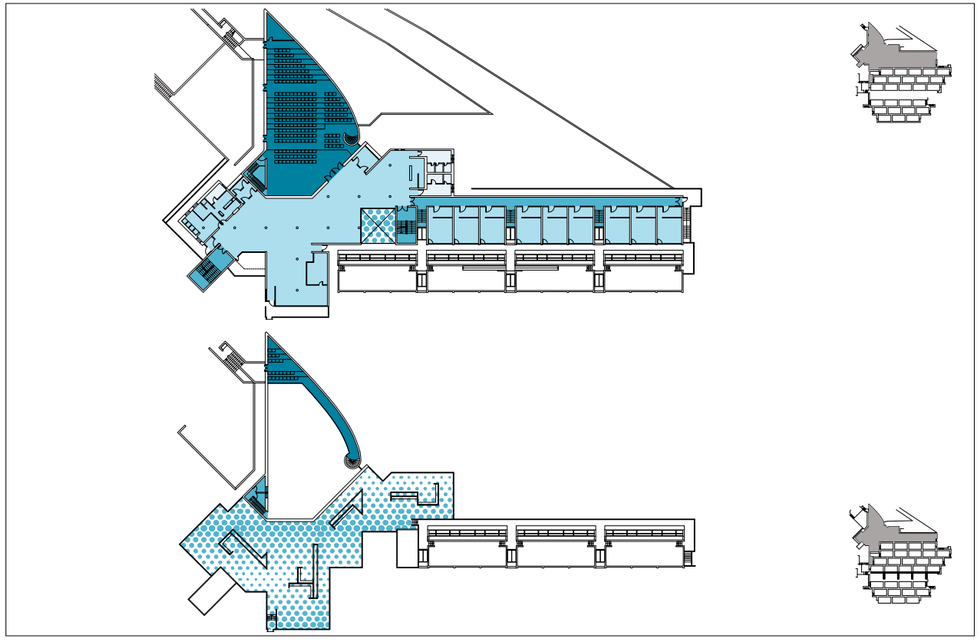
Levels 5 / 6 | USE / SATISFACTION



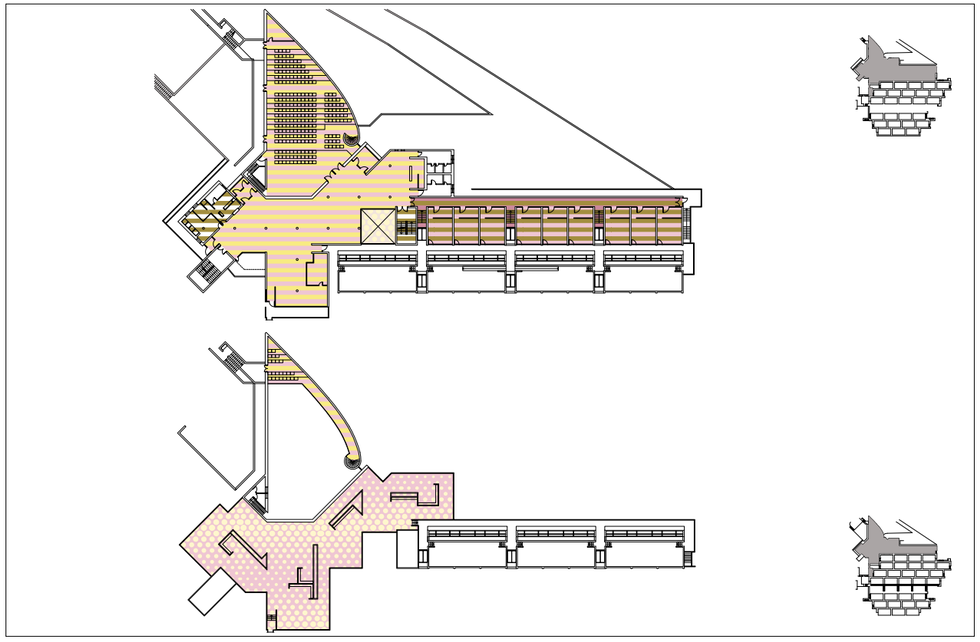
Level 7 | SIGNIFICANCE

Level 7 | USE / SATISFACTION





Levels 8 / 9 | SIGNIFICANCE
Levels 8 / 9 | USE / SATISFACTION



The "Serpentine"

Characterising elements

- Common living room and facilities.
- Use of the material (brick) in the common spaces.
- Private terraces.
- The spaces of the Serpentine are those that most favour the community life.

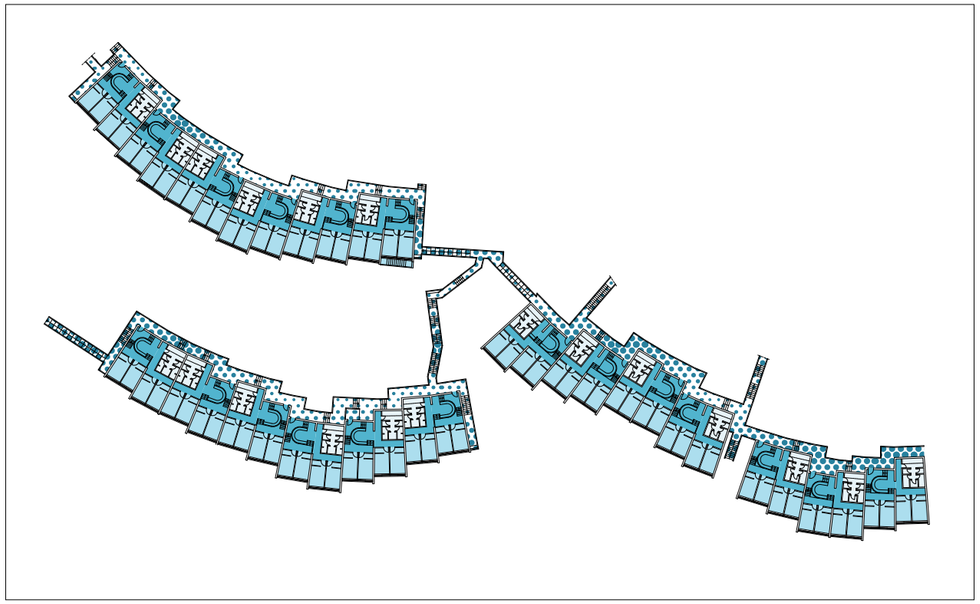
Critical issues

- Seepage of water form the roofs and terraces.
- A significant number of doors and windows has been changed.

The roof of the cells containing the bedrooms of the "Serpentine".

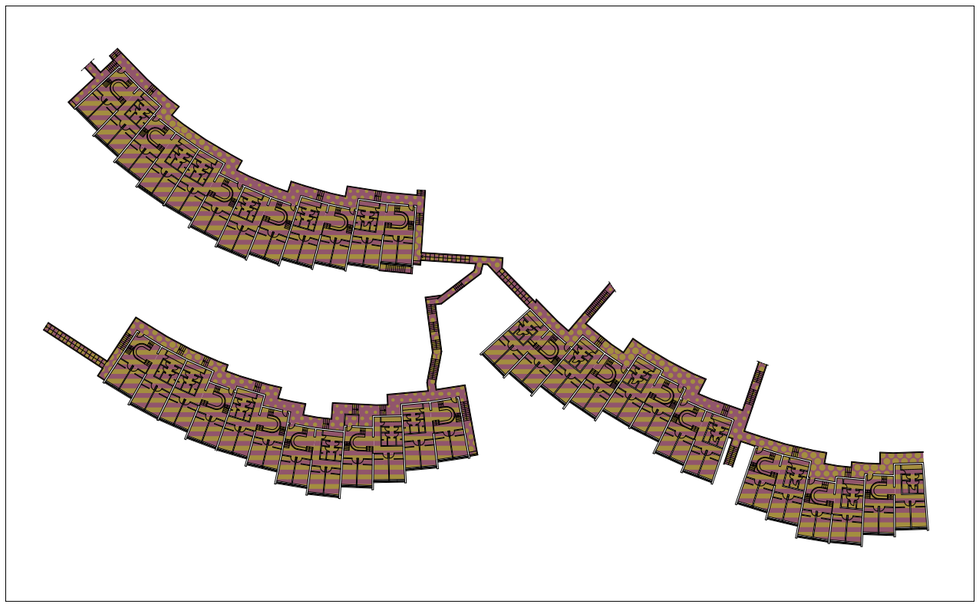
The roof of the cells containing the bedrooms of the "Serpentine" and the paths through the outdoor landscape.

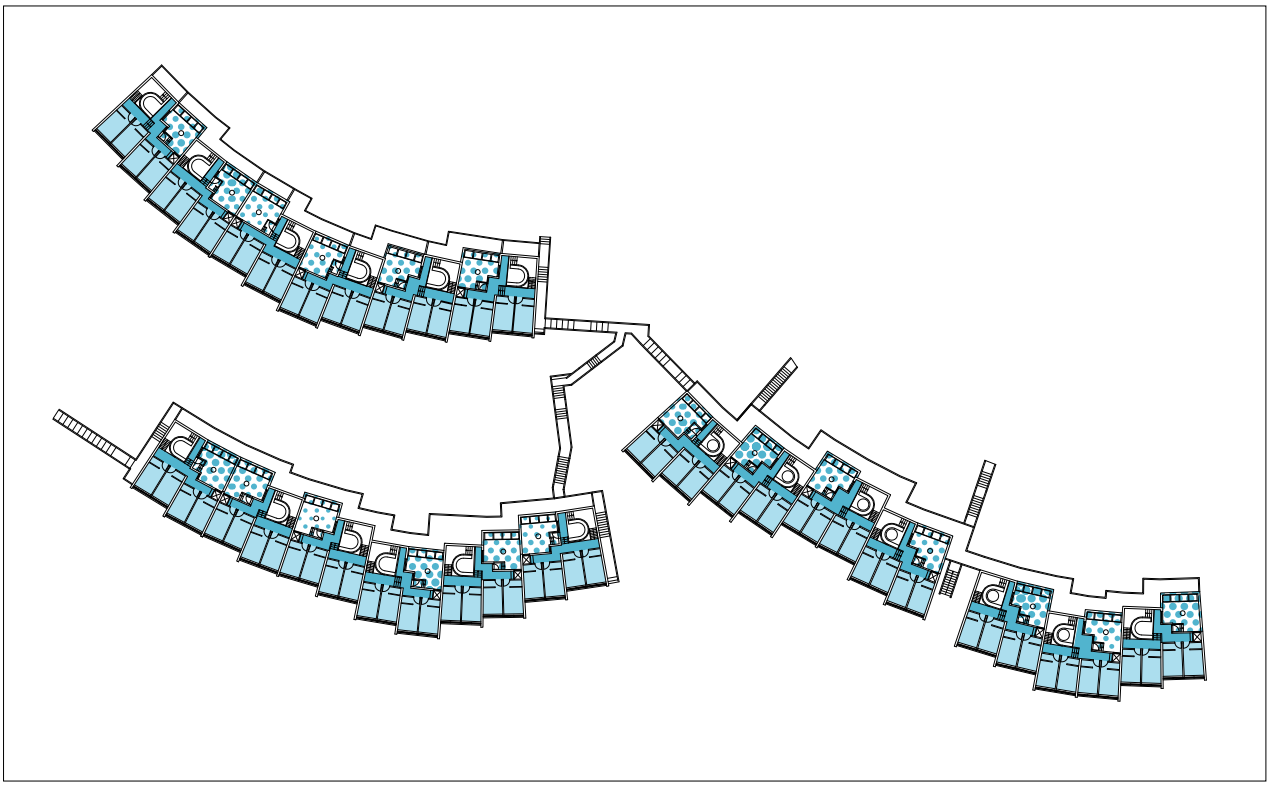
The façade of the cells containing the bedrooms of the "Serpentine".



Level 1 | SIGNIFICANCE

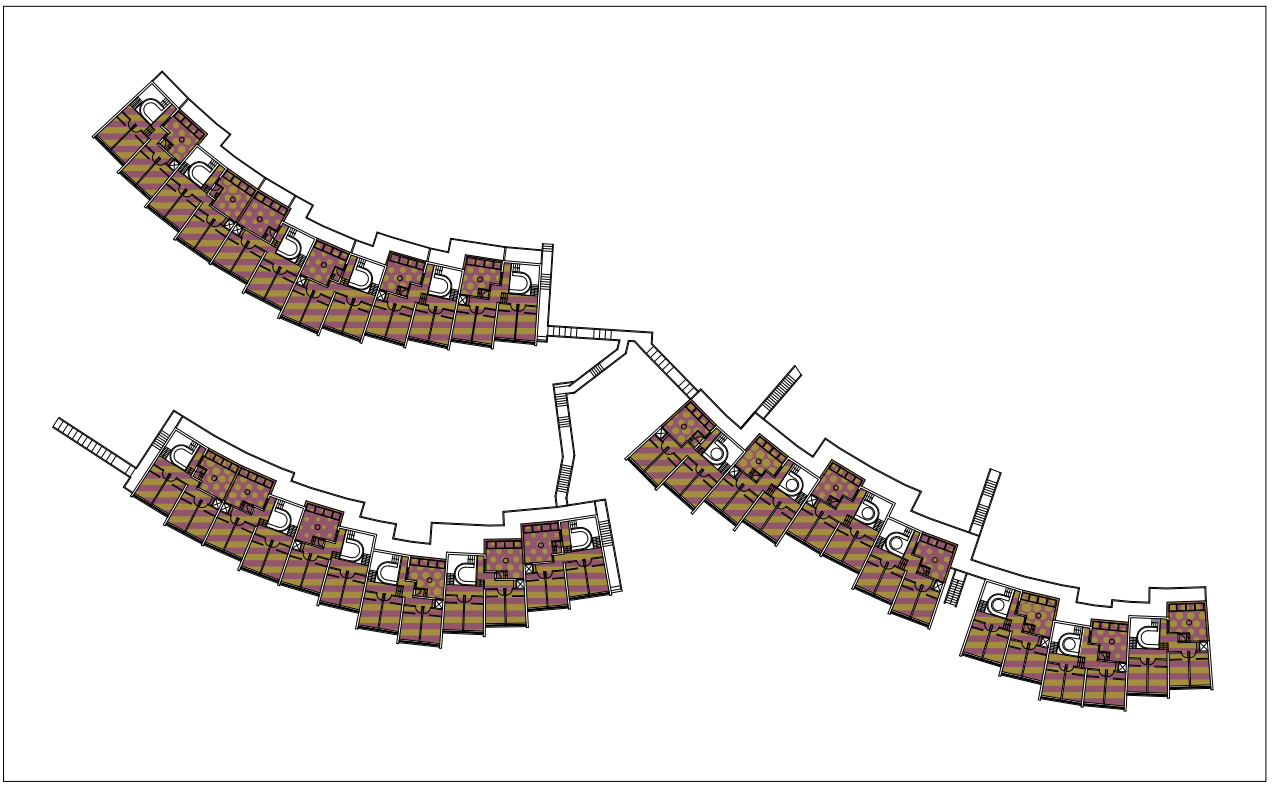
Level 1 | USE / SATISFACTION





Level 2 | SIGNIFICANCE

Level 2 | USE / SATISFACTION



III Part

Materials and features of Modern architecture: identifying and analysing the state of repair and experimentation during restoration

"Tridente". Staircase leading to the canteen.
(Photo Giorgio Casali. Università Iuav di Venezia - Archivio Progetti, Archivio Giorgio Casali)

Fair-faced concrete

Conservation Science has, among its aims, a complete knowledge of materials which constitute the items objects of the conservation itself. This knowledge approach can be structured in function of different aims:

- identification of materials and products used in the artistic and building techniques;
- reconstruction of the "conservation history" with the task of individuate materials superimposed, over paintings, decay products;
- choice of the most appropriate methods and conservation treatments in the specific case.

This approach has been shared by Scientific Community since the second half of XX century and it was followed to a very wide set of artefacts (Lazzarini & Tabasso, 1976; Doehne &Clifford Price 2010); in the conservation of Architectural Heritage the used material are well known both in the case of natural stone and in the case of artificial ones such as mortars and ceramics. Nevertheless in the last decade several steps have been reached in the direction of deepening materials characterisation, thanks to innovative analytical tools: in fact these latter have been implemented in terms of sensitivity, accuracy and precision.

Moreover non destructive techniques can be used in order to get a preliminary data set, avoiding to sample materials.

In the field of mortar analysis some recent highlights are very interesting as for example, on the nature of hydraulic binders (Custance-Baker & Macdonald, 2014); on the contrary a real "classical" in the field of surveying handbook on the use of organic additives in mortars recipes is the text of Barbara Sickel (Sickel et Al, 1982).

This is the overview for what concern the architecture built in historical age with traditional materials; on the contrary the path should be still followed for what regards modern concrete.

These modern composite materials are still perceived as poor items without those technical and aesthetic components which make flourishing the compositional studies in other fields. Hence by this point of view a lot of research work should be still done in order to propose a change of perspective and to start to highlight concrete interests and complexity.

Scientific bibliography offers some examples as this kind of knowledge (Custance-Baker, Macdonald, 2014); anyway it is clear that this approach is not enough diffused and shared, with some fall-out problems when the quality of a conservation work should be evaluated.

Identification of the typologies of concrete and textures

An accurate analysis of the concrete has been therefore needed, to assess the quality of the concrete, quantify the thickness of the concrete cover and identify the level of damage (diffusion and gravity).

As a first step, an "Abacus" of the different typologies of concrete were realised, that takes into account colour, texture and surface treatments (some surfaces show the imprint of the formwork, others are bush hammered and the aggregates are exposed, others show a compact surface...).

The visual analysis has been conducted in parallel with the diagnostic activities performed by CNR, since the sampling points has been identified starting from the abacus, that were implemented by taking into account the results of the technical analysis.

In that analysis, also the repairs already performed over time have been considered.

In the 90's Giancarlo De Carlo developed a model for the repairs, witch are still recognizable on the "Colle". The concrete patches has regular shape, a surface hammered and in relief. There are no technical data on that repairs, except for a letter where the name of the producer (Thoro) is mentioned.

"Colle" service building. The repair patches designed by De Carlo.

That model has been reproduced in most of the subsequent works, although with different materials and a lower quality of execution.

"Colle" residences. Regular repairs patches.

"Serpentine". Regular repairs patches.

Recently, a solution inspired to the repairs developed by De Carlo has been used on large surfaces in the "Tridente", where a 2 layers commercial repair system were used. The finishing layer is very different from the original material and the regular shape of the patches, developed on a large surface, introduces a new design.

"Tridente".- Corrosion of the rebars and spalling of the concrete.

"Tridente". The repairs realized in 2016.

In addition, to adapt the structure to the anti-seismic regulations (in 2016, central Italy was hit by an earthquake that also involved Urbino) some of the pillars were reinforced by using fibre reinforced composite material, leading to an increase of the dimension of the structures.

"Tridente" service building. Reinforcement of the structure.

"Tridente" service building. Reinforcements and finishing layer.

"Tridente" service building. The exsternal surface after the seismic retrofit.

"Tridente" service building. The concrete structure, before and after the seismic retrofit.

In other parts of the complex the repairs were realised by using a "like for like" approach. In the Library of the "Aquilone", the façade at the 4th level has been completely renovated by reproducing the surface of the wooden formwork by applying a timber plank on the wet mortar. In the "Aquilone" and "Serpentine", new "cast in situ" elements were realised which are thicker than the existing.

"Serpentine" residences. Block CZ.

"Aquilone". Front of the library lev. 4.

Finally, some surfaces were painted with a colored acrylic paint.

If the design – and the quality - of the concrete has huge variations, the rebars as well changes: in the first construction - "Colle" – the steel rods are smooth, whilst in the other "Collegi" the grip is improved by using corrugated bars. Only in the residences of the "Tridente", a welded steel mesh replaces the rebars; thermal expansions and the poor quality of the material has led to detachment of the outer layer.

"*Colle*". *Smooth steel rebars.*

"*Nuovi Collegi*". *Improved adhrence rebars.*

"*Nuovi Collegi*". *Concrete reinforced with a welded steel mesh.*

Abacus of concrete materials

CONCRETE – COLLEGIO DEL COLLE - Type 1 (CC1)

Sampling: U1

Description: cement mix with aggregates of medium to large size, light color – pink.
Surface: the mold of the formwork is visible; the timber elements are almost everywhere horizontal.
Rebars: irons smooth armours.

Location: Collegio del Colle (exposed concrete structure)

CONCRETE – COLLEGIO DEL COLLE - Type 1 (CC1) + patches type A (CC1/ICa)

Sampling: -

Description: Small- medium size patches, with irregular shape. Concrete mix with small size aggregates, in different colours.

Location: Collegio del Colle

CONCRETE – COLLEGIO DEL COLLE - Type 1 (CC1) + patches type B (CC1/ICb)

Sampling: U2

Description: small- medium size patches, with regular shape (mainly recatungular).
Surface: probably compressed and bush hammered..

Location: Collegio del Colle – service building : concrete elements

CONCRETE – COLLEGIO DEL COLLE - Type 1 (CC1) + patches (CC1/ICc)

Sampling: -

Description: small- medium size patches, with regular shape (mainly rectangular) and slightly raised on the surface.
The shape of the patches recalls those defined by De Carlo but both the material and the surface texture are different.
Surface: smooth.

Location: Collegio del Colle – service building and residences.

CONCRETE – COLLEGIO DEL COLLE - Type 1 (CC1) + film (CC1/F)

Sampling: -

Description: an acrylic finishing has been applied to hide inscriptions and graffiti and to unify the colour.

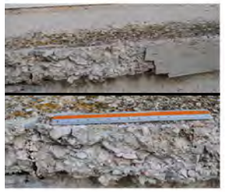
Location: Collegio del Colle – residences.

CONCRETE – COLLEGIO DEL COLLE - Type 2 (CC2a)

Sampling: U3

Description: cement mix with aggregates of medium to large size, light color – pink.
Surface: rough (bush hammered), the aggregates are brought to the surface.

Location: Collegio del Colle – service building (windowsills) and residences (concrete slabs above the door; concrete slabs located near the stairs).



CONCRETE – COLLEGIO DEL COLLE - Type 2 (CC2b)

Sampling: U3

Description: cement mix with aggregates of medium to large size, light color – pink.
Surface: smooth, aggregates of little dimension era visible on the outer layer.

Location: Collegio del Colle –residences (windowsills and concrete slabs).

CONCRETE – COLLEGIO DEL COLLE - Type 2 (CC2) + patches (CC2/ICa)

Sampling: -

Description: small- medium size patches, with irregular shape. Different types of concrete mix with small size aggregates, in different colours.
Surface: smooth

Location: Collegio del Colle – service building (windowsills), residences (concrete slabs above the doors, windowsills and concrete slabs).

CONCRETE – COLLEGIO DEL COLLE - Type 3 (CC3)

Sampling: U5

Description: cement mix of light color with aggregates of small size.
Surface: smooth, the mold of the formwork is visible; the timber elements are vertical.
Rebars: iron smooth armours.

Location: Collegio del Colle – service building (structure of the skylight on the terrace at Lev. 4).

CONCRETE – COLLEGIO DEL COLLE - Type 3 (CC3) + patches (CC3/ICa)

Sampling: -

Description: small- medium size patches, with irregular shape. Different types of concrete mix with small size aggregates, in different colours.

Location: Collegio del Colle – service building (structure of the skylight on the terrace at Lev. 4).

CONCRETE – NUOVI COLLEGI -Type 1 (CN1)

Sampling: -

Description: cement mix with aggregates of medium dimensions.
Surface: smooth, aggregates of little dimension era visible on the outer layer.
Rebars: improved adherence irons armours.

Location: Nuovi collegi - exposed concrete structure, façade of the residences (slabs under the windows).

CONCRETE – NUOVI COLLEGI -Type 2 (CN2)

Sampling: U15 – U17 – U19

Description: cement mix with aggregates of medium dimensions.
Surface: rought, the mold of the formwork is visible; the timber elements are almost everywhere horizontal. Plastic spacers.
Rebars: improved adherence irons armours.

Location: Nuovi collegi - exposed concrete structure, service buildings and residences.

CONCRETE – NUOVI COLLEGI -Type 2 (CN2) + patches (CN2/ICa)

Sampling: -

Description: Small- medium size patches, with irregular shape. Concrete mix with small size aggregates, in different colours.
Surface: smooth surface.

Location: Nuovi collegi - exposed concrete structure, service buildings and residences.

CONCRETE – NUOVI COLLEGI -Type 2 (CN2) + patches (CN2/ICb)

Sampling: -

Description: small- medium size patches, with regular shape (mainly rectangular) and slightly raised on the surface. The shape of the patches recalls those defined by De Carlo but both the material and the surface texture are different.
Surface: smooth.

Location: Nuovi collegi - exposed concrete structure, service buildings and residences.

CONCRETE – NUOVI COLLEGI -Type 2 (CN2) + patches (CN2/ICc)

Sampling: -

Description: the patches have been realised in 2016 with 2 different materials; below the surface the repair has been realised using a repair mortar whilst on the surface there is a layer of mortar that has a smooth appearance and a cool grey colour.
Surface: smooth

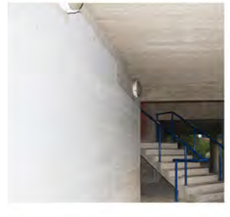
Location: Nuovi collegi - Tridente, service building, façade of the service building and conference rooms.

CONCRETE – NUOVI COLLEGI -Type 2 (CN2) + patches (CN2/ICd)

Sampling: -

Description: finishing layer applied on the surfaces of the pillars that have been reinforced using FRP (Fibre Reinforced Polymers). The surface layer has a smooth appearance and a cool grey colour. The seismic upgrading of structures have been realised in 2016.
Surface: smooth.

Location: Nuovi collegi - Tridente, service building, façade of the service building and conference rooms.



CONCRETE – NUOVI COLLEGI -Type 2 (CN2) + film (CN2/F)

Sampling: -

Description: an acrylic finishing has been applied to hide inscriptions and graffiti and to unify the colour.

Location: Nuovi collegi

CONCRETE – NUOVI COLLEGI – Type IG1

Sampling: -

Description: new concrete casts. The slabs are slightly thicker than the original.
Surface: The appearance of the existing surfaces have been restored by using a wooden element to recall the mold of the formworks.

Location: Nuovi collegi - Aquilone (residences) and Serpentine.

CONCRETE – NUOVI COLLEGI – Type IN1

Sampling: -

Description: new concrete surfaces. Realised with commercial repair mortars.
Surface: The appearance of the existing surfaces have been restored by using a wooden element to recall the mold of the f ormworks.

Location: Nuovi collegi - Aquilone (library, Lev. 4)

CONCRETE – COLLEGIO DEL COLLE - OUTDOOR PATHS (CP1)

Sampling: U9

Description: cement mix with aggregates of large size.
Surface: rought.

Location: Collegio del Colle – outdoor paths

CONCRETE – NUOVI COLLEGI - OUTDOOR PATHS (CP2)

Sampling: U18

Description: cement mix with aggregates of large size.
Surface: rought.

Location: Nuovi Collegi – outdoor paths

Characterisation of the materials

Material characterisation has been carried out by means of samples taken from the De Carlo Buildings following current standards (Norma UNI EN 16085:2012); the main task of the study regarded a possible classification of different concrete used by their compositional features and to investigate similarities and differences. Both concrete mixes and bricks have been sampled and analysed; moreover some decay products have been characterised (Table 1). Sampling points have been planned and chosen following preliminary indications provided during a first inspection carried out together with the other partners of the project (Milan Polytechnic, MTA Associates and Urbino University).

Samples have been observed by means of different microscopical techniques both optical (stereo-microscopy, polarised microscopy on thin sections) and electronic (Scanning Electron Microscopy SEM); instrumental analytical campaign was carried out by means of X Ray Diffraction, Ionic Chromatography, Fourier Transform Infrared Spectroscopy (FTIR) and Energy Dispersive Spectroscopy coupled with SEM (SEM-EDS); microstructure has been studied in depth with Mercury Intrusion Porosimeter (MIP). Instrumental details are reported in the Technical Report. As it is possible to see in Table 1 samples have been taken from several different buildings belonging to the architectural complex of De Carlo "Collegi", In the specific "Colle", "Serpentine", "Tridente", "Aquilone" and "Vela" have been studied. Samples have been mostly taken from surfaces in the outdoor environment, even if also some samples taken from interiors have been considered, such as flooring, plastering in stairway and halls. Each of the different concrete class (coming from a visual classification made by Milan Polytechnic) has been sampled and studied. They have been numbered from 1 to 8. Moreover mortar used in integration patches, applied during some early maintenance works performed by De Carlo himself, repointing and bedding mortars have been studied and classified.

Sample	Description	Location	Notes
U1	Concrete Type 1	"Colle" level 2; outdoor terrace parapet	Close to Reading Room
U2	Cement patch mortar	"Colle" level 2; outdoor terrace parapet	Close to Reading Room. Giancarlo de Carlo Patch mortar
U3	Concrete Type 2	"Colle"; corner window sill Reading Room level 2	
U4	Brick Type 1 with repointing mortar	"Colle"; close to the first step stair between terrace level 2 - level 3	Verify surface finishes presence
U5	Concrete Type 3	"Colle" level 3; skylight	
U6	Terrazzo flooring	"Colle"; interior in the reception room	Verify presence synthetic resin
U7	Interior plaster	"Colle"; corner close to furnishing in the inferior Room	
U8	Flooring Concrete	"Colle" stairway; step to level 1	
U9	Concrete Type 1	"Colle"; parapet close to exit (hallway to residences)	To be compared with U1
U10	Concrete Type 2	"Colle"; parapet close to hallway in between room 84 and 85	To be compared with U2
U11	Brick Type 2	"Serpentine"; close to rooms 190/197	
U12	Concrete Type 4	"Serpentine"; small rib vault close to a corner; rooms 190/197	To be compared with U1 - U5
U13	Concrete Type 5	"Tridente"; main hall; platform roof entrance	To be compared with U1 - U4
U14	Concretion	"Tridente" hemyicicle	
U15	Concrete Type 5	"Tridente"; parapet internal Terrace of the Rooms 201-208 block	To be compared with U13 - U17
U16	Salt Efflorescence	"Tridente"; stairway close to the entrance to rooms 201-208	
U17	Concrete Type 5	"Tridente"; external façade – Building 1. 5° block	To be compared with U13 - U15
U18	Concrete Type 6	"Aquilone"; stairway internal parapet. Entrance to the library (5° step)	
U19	Concrete Type 7	"Vela"; green containment wall; terrace 2° block	
U20	Concrete Type 8	"Colle"; background. Close to room 75; block 10	
U21	Mortar	"Aquilone"; background in Room Building B	Verify surface finishes presence
U22	Mortar	"Colle"; rib vaults; exterior surface respect to the rooms	Verify brick fragments presence
U23	Bedding Mortar and repointing mortar	"Colle"; Main hall entrance; left side t	Verify differences between the two kind of mortars

Table1. Samples taken from the Urbino University "Collegi" Buildings.

Results and discussion

The examined samples can be preliminarily classified in two groups in function of the colour of the cement paste background which can be white (Figure 1) or grey (Figure 2). Most of the studied samples belong to the first group; in the specific samples U3, U5, U6, U9, U12, U13, U15, U17, U18, U19, U1, U2, U7, U8 e U10; samples belong to the second group. It is worth noting that at higher magnification, the colour of the cement background paste could be spatially resolved as formed by several small dark particles: they could be of different colour even if both black and dark brown are prevailing (Figure 4b). Each of the white colour samples display a poor sorting, i.e. their aggregate is formed by particles sprayed in a wide range of size, with 5 mm of maximum dimension (Figure. 1). On the contrary the grey colour samples display a well sorted aggregate; this observation allow to suppose that the particles were sifted before the mix. In this latter case the maximum dimension of the aggregate is under 1 mm. The aggregate characteristics are still visible to a close observation at the naked eye. It is possible to observe in Figures 1 and 2, that the aggregate is formed by mixed colour particles with yellow, pink, white and grey as prevailing. It is possible to suppose that the aggregate should be mixed as to a specific design.

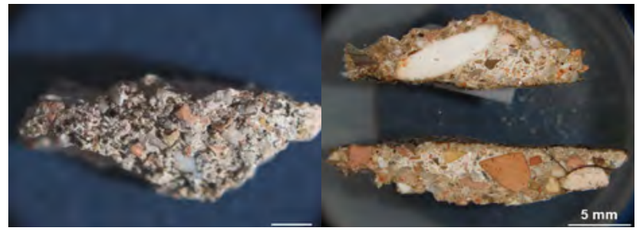


Figure 1. U13 comes from an external parapet in "Collegio del Colle"; Left: stereomicroscope microstructure observations. Right observation of the polished cross section.

Fig.2

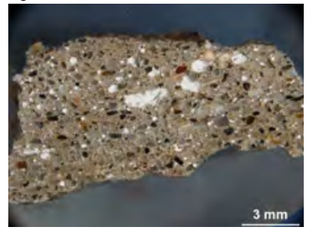


Figure 2. Sample U1: Polished Cross Section. Microscopic observation.

Fig.3

Figure 3. Sample U6: Polished Cross Section. Microscopic observation.

"Colle" service building. Flooring (Sample U6).

The aggregate compositional analyses results corroborated the classification in two groups; in fact two distinct groups are proposed in function of the presence of a calcite ($CaCO_3$) component in the group formed by U3, U5, U7, U8, U9, U12, U13, U18 e U19 samples. The calcite fragments are well visible in the thin section microscopic observations (Figure 5a).

This result allows to suppose that as to this group of samples a common calcareous sand was used in the mix design of the mortar; on the contrary in samples U1, U2, U10, a silicatic aggregate with a rounded shape, has been highlighted; in this second case we are allowed to suppose that a quartz sand was specifically selected (Figure 5b). The terrazzo mix constituting the flooring in the "Colle" reception hall is an exception (Sample U6). In fact in this case the aggregate is composed by marble fragments quite big in size (Figure 3).

(4a) (4b)

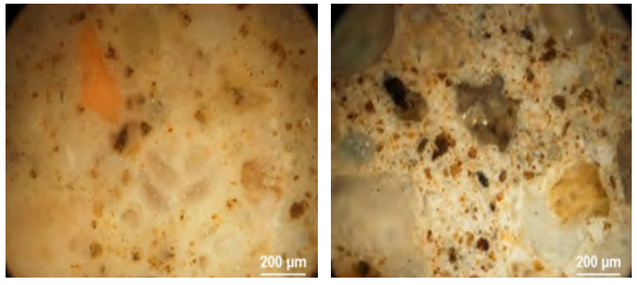


Figure 4a. Polished Cross Section Microscopic Observation of Sample U5. It comes from a skylight in the "Collegio del Colle". The background colour is white.

Figure 4b. Polished Cross Section Microscopic Observation of Sample U1. It comes from an outdoor terrace parapet in the "Collegio del Colle". The background colour is greyish.

(5a) (5b)

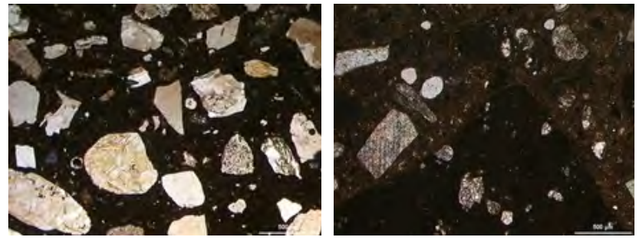


Figure 5a. Sample U1. Thin section observed at polarised light microscope (Nicol //): the aggregate is composed by quartz crystals and metamorphic rocks fragments with angular shape; the binder has a uniform microstructure with circular pores.

Figure 5b. Sample U3. Thin section observed at polarised light microscope (Nicol //): the aggregate is composed by limestone fragments with microfossils, with rounded shape (lower part) and by calcite crystals with angular shape; the binder is micro-crystalline with a not uniform structure and irregular pores.

Generally speaking, the examined samples do not present a layered surface.

Exceptions are given by samples U2, U5, U12 and U13; in all these cases it is possible to observe two layers and samples U7 which has a white finishes uneven by a thickness point of view in the range of some millimetres. It is made up by several applications, most probably given during subsequent maintenance works (Figure 6);. White finishes are composed by lime with titanium dioxide as a filler.

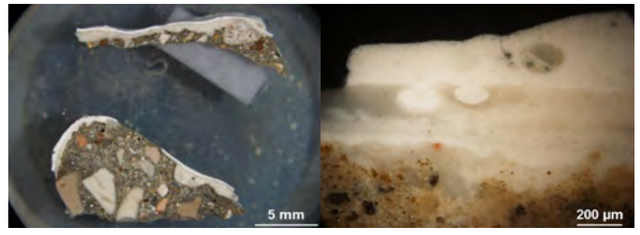


Figure 6. Two microscopic observation at different magnification showing microstructure of Sample U7 coming from a plaster in an interior in the "Collegio del Colle": to the right the sequence of several white finishes is showed.

Analyses carried out at scanning electron microscope with energy dispersive microprobe, confirm what has been observed in optical microscopy. In particular in each of the binder fraction examined, the characteristic ratio in between calcium and sili-

con peaks shows the presence of hydraulic properties (Figure 7). Moreover the observations at high magnifications allows to observe the presence of organic substances used in the mix, in the samples U2 and U7 (as regards the white finishes), U13 and U18. In this latter case the organic substance is concentrated close to the outer surface.

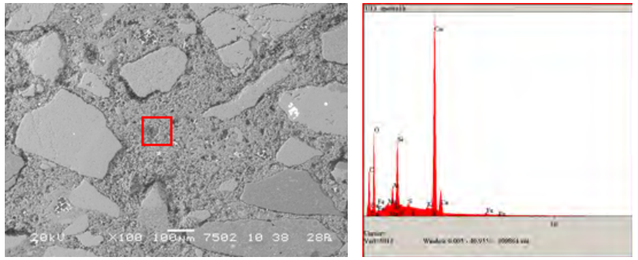


Fig. 7. SEM Observation in BSD mode in low vacuum (28 Pa) of the sample and EDS Spectra corresponding to red frame in the binder matrix. It is confirmed the hydraulic properties by the ratio Ca/Si.

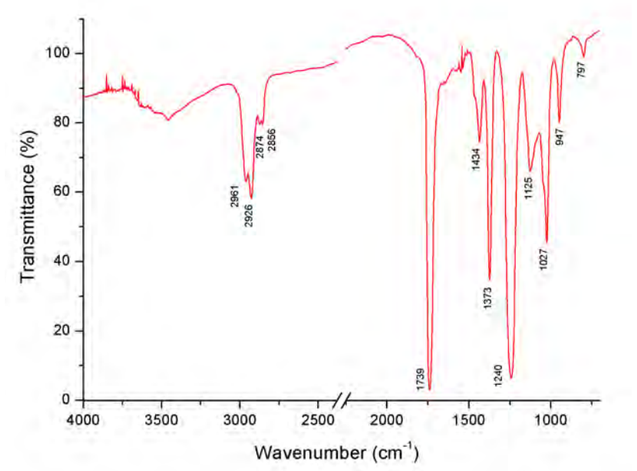


Figure 8. FTIR Spectra recorded in transmission of the sample U7. The spectrum has been obtained from a micro-particle coming from the near-surface region. Absorption peaks display the pattern of a co-polymer ethylene-vinyl acetate.

FTIR spectroscopy allowed to study in depth the composition of polymer based materials, when present; it is the case of Sample U7 in which the white finishes is bound with the aid of a synthetic resin. Observing the absorption pattern of the main peaks, it is possible to identify a copolymer ethylene vinyl-acetate (Figure 8). This class of resins is very common in paint industry, especially for building maintenance. In samples U9 and U17 also it was possible to identify resins classified in the group of epoxy, based on epichlorohydrin and bis-phenol A.

Studying porosity total amount, a distribution size by means of mercury intrusion porosimeter allowed to step forward in the classification and in the comparison among the studied samples (Table 2; Figure 9 and Figure 10).

Porosity ranges in between 8,22% (sample U1) and 25,50% (sample U13), with an average pore radius ranging from 0,01 (sample U9) and 0,30 (sample U7) (Table 2). The pores size distribution is unimodal, bimodal and trimodal (Figure 9).

Sample	P%	Average Radius (µm)	Distribution	Represented Classes (µm)
U1	8,22	0,22	unimodal	0,1-0,5
U2	10,75	0,05	uni - bimodal	0,025-0,05
U3	9,21	0,04	bimodal	0,01-0,025
U5	8,72	0,05	bimodal	0,1-0,25; 0,01-0,025
U7	14,52	0,30	bimodal	0,25-0,5; 0,01-0,025
U8	15,85	0,18	bimodal	0,1-0,5; 0,01-0,025
U9	11,75	0,01	unimodal	0,01-0,025
U12	24,69	0,24	trimodal	1-2,5; 0,1-0,5; 0,01-0,025
U13	25,50	0,12	trimodal	1-2,5; 0,1-0,5; 0,01-0,05
U15	24,28	0,11	trimodal	1-2,5; 0,1-0,5; 0,01-0,05
U17	21,23	0,04	bimodal	0,1-0,5; 0,01-0,05
U18	17,51	0,04	bimodal	0,1-0,5; 0,01-0,05
U19	17,08	0,07	trimodal	1-2,5; 0,1-0,5; 0,01-0,05
U20	8,92	0,06	bimodal	1-5; 0,01-0,05

Table 2. Porosimetric features of the samples examined by means of Mercury intrusion porosimeter.

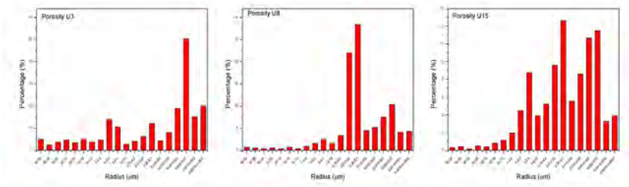


Figure 9. Some examples of different porosity distribution: bimodal in samples U3 and U8; trimodal in samples U15.

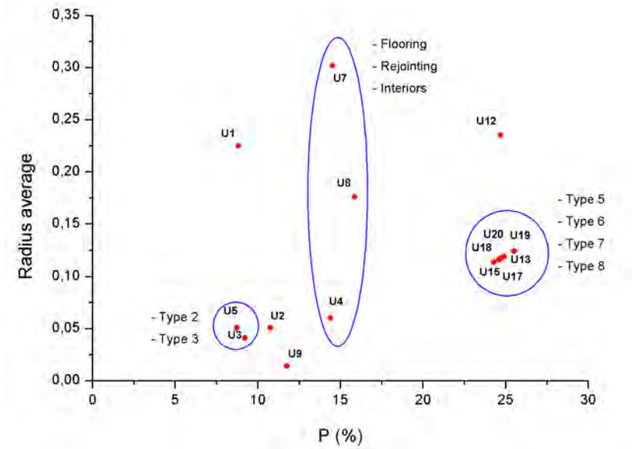


Figure 10. Classification of the samples studied in function of their porosimetric characteristics.

A comparison among porosimetric features, summarised in the diagram in Figure 10, allows to relate total pore amount (in percentage) with average pore radius. A further classification of the examined samples is then highlighted. This corroborate the classes already put in evidence with the other techniques. In fact is well evident that sample U1 is different from all the rest of the samples, while samples U13, U15, U17, U18, U19, U20 are characterised by very similar micro-structural features then constituting an homogeneous group. Another possible group is formed with U3 and U5 samples only.

For what concern the state of conservation see the paragraph C.1.2 (Survey of decay on the Building fronts) compiled by Politecnico Milan. To this survey it is possible to add that soluble salts examined in correspondence with efflorescences are mainly composed by sulphates, gypsum being largely prevailing (Table 3). On the contrary where small concretions are present, often in the form of stalactites some centimetre long, a calcitic composition has been revealed.

sample	Chloride	Nitrite	Nitrate	Phosphate	Sulphate	Oxalate
U14	0,466	0,011	0,377	0,000	0,179	0,047
U16	0,013	0,000	0,025	0,000	54,671	0,000

sample	Potassium	Sodium	Magnesium	Calcium
U14	0,329	0,369	0,022	2,989
U16	0,02	0,028	0,000	3,246

Table 3. Soluble salts Ion content determined by means of Ionic Chromatography in samples U14 e U16 (in %)

Conclusions

The main results obtained by the data analyses can be summarised as follows:

- 1. Samples have been grouped in function of the results obtained. The different analysed provided data which show a very good fitting;
- 2. Samples forming the most important group are U3, U5, U9, U12, U13, U18 and U19 showing important compositional similarities; in fact they are composed by a hydraulic binder and by a mixed aggregate, made up by both quartz and calcitic elements. For what concern U13 and U18 similarities could be extended to micro-structural features also;
- 3. Samples U1, U17 and U6 seems to be different from all the rest of the set. In particular sample U1 is different by each of the examined features, both compositional and micro-structural. On the contrary sample U17 is quite similar to the rest of the examined samples by porosity point of view.
- 4. In samples U2, U7, U13, U15, and U18 an organic component has been revealed; a better identification of the organic compounds was not possible due to their weak spectroscopic response. In sample U7 a vinyl base resin has been highlighted, while in sample U9 and U17 an epoxy resin is present.
- 5. A sequence of different layers have been individuated in sample U17, being the multilayer finishes made up of three applications; samples U2, U5, U12, U13 display two layers superimposed, while for all the rest of the examined samples only one layer has been detected.

For any further analytical detail, refer to Annex 3, where all the results have been collected in Technical Data Sheets classified as to the different Samples.

Annex 3. Concrete Diagnostic Data

Identifying the causes of deterioration and areas at risk

The external facades of the complex are characterised by bricks and concrete, both used without plaster or other coating.

Despite being a characteristic feature, the preservation of the fair-faced concrete slabs is an open issue, which requires it to be addressed promptly, to reduce the quantity of material to be replaced. Indeed, the extension of the concrete surface is quite impressive (between 2000 and 5000 m2 for each part of the complex, tot. over 16.000 m2) as well as the costs, also because most parts are difficult to access.

Concrete is a material which is fluid when it is applied; then it sets during its curing period. During this range of time calcium and silicon hydrated phases will be formed (Bertolini, 2009). At the ending of curing, this material reaches excellent mechanical features. Cement, aggregate, water and other additives are the raw materials used in concrete mix design. Concrete properties strongly depends by the used raw materials; especially additives will influence both working features such as fluidity and final features (Bertolini, 2009).

The process of decay the reinforced concrete is well-known: the corrosion of the reinforcement bars is the main problem, leading to cracks, to the delamination and spalling of the concrete cover (due to the increase in volume of the rebars, since the products of the corrosion have a larger volume, from the double to the sixfold), exposed rebars, rust stains, etc.

The process of carbonation of the concrete, caused by the reaction of carbon dioxide in the atmosphere with the alkaline components of the cement, involves a decrease of the pH of the material; when the pH is lower than 13 the condition of passivity is interrupted and, in wet conditions, the corrosion of the rebars starts. Two phases can be distinguished in that process: in the first stage (initiation period) the depth of the carbonation increases until it reaches the rebars, whilst in in the second phase (propagation period) the corrosion takes place and leads to the loss of the material. The duration of the first phase is directly proportional to the depth of the concrete cover that protect the rebars (the corrosion is faster when the cover is thin), but also depends on the moisture content of the material (the process is faster in a dry concrete but the corrosion requires damp conditions) and on the mix of the concrete (the carbonation decreases as the water/cement ratio decreases, and increases where the material is discontinuous, e.g. there are gravel nests). Finally, chlorides (even in small quantities) have a harmful effect, since they can increase the corrosion speed, even in dry conditions.

Therefore, different risks factors should be considered, such as the environmental conditions (position, exposure, orientation, exposure to sunlight), the different types of concrete mix, the dimension of the slabs and of the concrete cover, the construction techniques, the surface treatments (some elements have been bush-hammered and this resulted in an increased porosity and, consequently, an increased vulnerability) and finally the possible presence of protective elements, although these not always well-matches with the image of the buildings (flashing have been placed on the horizontal surfaces to reduce trickling, in the "Tridente" and in the "Serpentine"; in both cases the flashings have a remarkable visual impact, whether they are made of copper – as in the "Tridente"- or in white-painted metal).

"Serpentine". White-painted metal flashing.

"Tridente" service building. Copper flashing.

At the Collegi, the worst condition occurs, since the dimension of the concrete slabs does not guarantee an adequate level of protection (in some cases the thickness is less than 10 cm and the surface is exposed on both sides), the concrete cover is

very thin (about 1 cm) and, due to the growth of the vegetation and problems of infiltration and disposal of the meteoric waters, the surfaces are wet for most of the time. In the facades of the residences of the "Aquilone" building, the trickling of the water is located where the two windows of the block are juxtaposed.

"Aquilone" residences. The trickling of the water causing oxidation and spalling at the center of the concrete slab.

Consequently, the state of conservation can not be defined once and for all, but there are different levels of decay, ranging from a good state of repair (for the new elements and for those that have been realized with a better concrete mix as in the service building of the "Colle") to situations in which the corrosion of the reinforcement bars has already led to cracking, delamination, spalling, and to a significant loss of material.

Abacus of deterioration and damage

Understanding the processes of decay and the causes, intrinsic and extrinsic, which lead to failure, is an indispensable step for a proper assessment of the state of conservation.

In the "Collegi" different forms of decay can be identified (rif UNI EN 11182:2006; Di Biase (ed.), 2009 ; ICOMOS-ISCS. Ilustrated glossary on stone deterioration patters, 2008), that can be arranged into 3 main families:

Reinforced corrosion damage

- Detachment
  - Scaling (light, medium, severe)
  - Delamination
- Cracks (non structural and corrosion-related cracks)
  - Star crack
  - linear cracks
- Loss of material
  - Lack
  - Spalling
- Corrosion of the rebars
  - corrosion
- Stains
  - Rust staining
  - Copper oxides staining
- Critical points
  - Honeycombs
  - Cold-joint lines (at the stairs)

Biological decays

- Trickling and biological colonisation
- Biological growth/ patina
- Vegetation

Deposits and water - related phenomena

- Deposit of heterogeneous materials / soiling (adherent to the surface)
- Trickling
- Incrustation / stalactite

REINFORCED CORROSION DAMAGES

SCALING - Grade 1 (light)

Identification code: D1

Description: superficial loss of the surface mortar.

Localization: Collegio del Colle; Nuovi Collegi. Diffused (protected areas).

SCALING - Grade 2 (medium)

Identification code: D2

Description: diffuse loss of the surface mortar and aggregates, with exposure of the coarse aggregate.

Localization: Collegio del Colle; Nuovi Collegi. Diffused (upper parts of the facades, affected by leaching).

SCALING - Grade 3 (severe)

Identification code: D3

Description: substantial loss of material (mortar and aggregates) and exposure of the reinforcements.

Localization: Collegio del Colle; Nuovi Collegi. Diffused (parapets and slabs that are exposed on the two sides, affected by leaching).

DELAMINATION

Identification code: DC

Description: separation of fragments of material, parallel to the surface.

Localization: Collegio del Colle; Nuovi Collegi. Diffused (advanced state of corrosion of the rebars).

CRACKS (NON STRUCTURAL AND CORROSION-RELATED CRACKS)

STAR CRACKS

Identification code: F2

Description: fissure resulting from separation of one part from another, with a typycal form due to the rusting of iron elements.

Localization: Collegio del Colle (residences). Localised.

LINEAR CRACKS

Identification code: F3

Description: fissure resulting from separation of one part from another, due to the corrosion and subsequent expansion of the reinforcements near the edges.

Localization: Collegio del Colle; Nuovi Collegi. Diffused (exposed slabs, medium state of corrosion of the rebars).

LOSS OF MATERIAL

LACK

Identification code: MN

Description: loss of fragments of concrete of different dimensions, caused by the corrosion and expansion of the rebars.

Localization: Collegio del Colle; Nuovi Collegi. Localised (advanced state of corrosion of the rebars).

SPALLING

Identification code: MS

Description: disrupt and expulsion of the concrete covering bars located too close to the concrete surface, due to the corrosion and subsequent expansion of the reinforcements, that induce mechanical stress.

Localization: Collegio del Colle; Nuovi Collegi. Diffused (medium state of corrosion of the rebars).

CORROSION OF THE REBARS

CORROSION

Identification code: OX

Description: Decay of steel reinforcement directly in contact with the atmosphere creating rust.

Localization: Collegio del Colle; Nuovi Collegi. Diffused, with different levels of decay (exposed rebars).

STAINS

RUST STAINING

Identification code: M1

Description: staining of the adjacent concrete surfaces due to the presence of products of corrosion of the rebars.

Localization: Collegio del Colle; Nuovi Collegi. Localised (related to the corrosion of the rebars).

COPPER SALTS STAINING

Identification code: MS

Description: staining of the adjacent concrete surfaces due to the leak of water on the copper shelter of the skylight.

Localization: Collegio del Colle – service building (skylight on Lev. 4).

CRITICAL POINTS

HONEYCOMBS

Identification code: GB

Description: the surface shows localised spaces and cavities, where there is a segregation of the aggregates and cement mixture does not fill the voids between the aggregate.

Localization: Collegio del Colle; Nuovi Collegi. Localised.

COLD-JOINT LINES

Identification code: GR

Description: visible lines on the surface indicating a construction joint, where a layer of concrete had hardened before the subsequent was placed.

Localization: Collegio del Colle; Nuovi Collegi. Localised.

COLD-JOINT

Identification code: F4

Description: visible lines on the surface indicating a construction joint, in correspondence of the stairs.

Localization: Collegio del Colle; residences. Localised (stairs)

BIOLOGICAL DECAYS

TRICKLING + BIOLOGICAL COLONISATION

Identification code: BC

Description: biological growth on the surface of the concrete elements in correspondence of the water seepages.

Localization: Collegio del Colle; Nuovi Collegi. Diffused (rough or horizontal surfaces, areas that are sheltered by the trees or repaired form the sunlight).

BIOLOGICAL GROWTH/ PATINA

Identification code: BB

Description: growth of micro organisms, algae, bacteria and lichens (...) on the surface of the concrete elements

Localization: Collegio del Colle; Nuovi Collegi. Diffused (rough surfaces and repaired areas).

DEPOSITS AND WATER- RELATED PHENOMENA

DEPOSIT OF HETEROGENEOUS MATERIALS/ SOILING

Identification code: CC

Description: accumulation of exogenic materials adherent to the surface.

Localization: Collegio del Colle; Nuovi Collegi. Diffused.

TRICKLING

Identification code: CO

Description:
flow of the rainwater that wash some areas and remove the deposits, resulting in differences of colour and vertical marks.

Localization: Collegio del Colle; Nuovi Collegi. Diffused (surfaces interested by the water leakages).

INCRUSTATION/ STALACTITE

Identification code: CS
Sampling: U14

Description: accumulation of material (crust), apparently calcium carbonate, on the surface of the concrete, due to a process of water seepage and dissolution-reprecipitation of the concrete.

Localization: Collegio del Colle; Nuovi Collegi. Localized (under the concrete slabs, along seepage paths and cracks, e.g. covered pathways near the conference rooms in the service building of "the Tridente")

Checking the depth of carbonation and stability of reinforcements: diagnostic insights

To assess the state of conservation of the concrete elements, an in situ diagnostic campaign using no destructive and micro-destructive methods has been carried out.[1]

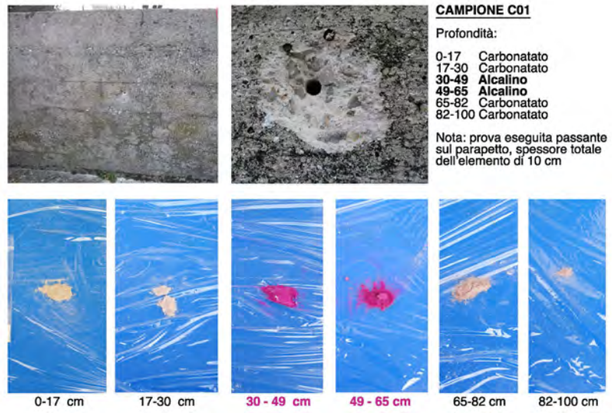
The campaign focused on the assessment of the carbonation depth and on the measure of the thickness of the concrete cover.

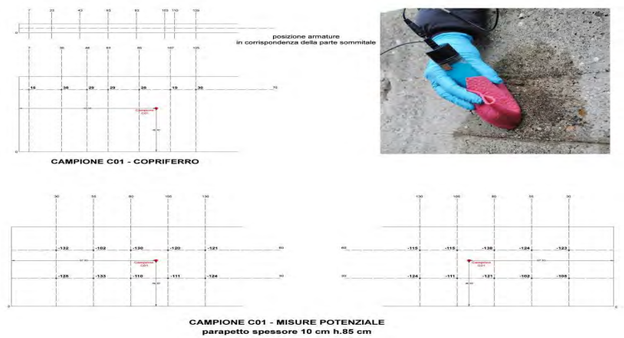
The 12 points of measure have been selected in different parts of the complex (4 in the "Colle" and "Tridente"; 2 in "Aquilone" and "Vela"), where different concrete materials and states of conservation were observed. In that 12 points, the carbonation depth have been measured by drilling holes and extracting powders at different depths and testing the samples using phenolphthalein (the powders were extracted and measured with a range of 1 cm). Besides, in 2 different parts, instrumental measurements have been made to assess the state of corrosion of the rebars and the thickness of the concrete cover.

The results of that analysis highlights the coexistence of very different situation, only in part conceivable through a macroscopic analysis: in the "Colle", where the quality of the material is better and the construction is more accurate, the surface is well preserved and the carbonation depth is very low (in some cases less that a cm); with the exception of some local damages, also the corrosion of the rebars is still limited, even in the parts that are exposed to the weather and even where the concrete elements are about 8-10 cm thick.

In the more recent construction ("Nuovi Collegi"), despite a general increase of the dimension fo the elements (12-14 cm), the poor quality of material and execution had led to a accelerated decay and the carbonation depth is about 5 cm. The "propagation period" has therefore already started and the corrosion of the rebars is widespread, leading to a diffused delamination and spalling of the outer layer.

[1] The campaign of measures have been planned and realised with ing. Elena Redaelli, Dipartimento di Chimica, Materiali ed Ingegneria Chimica "G. Natta" - Politecnico di Milano).





Mapping and score evaluation of the state of conservation

To identify the different materials and states of conservation within the complex, a complete mapping of the main facades has been completed. The analysis has been realised in two subsequent steps: in the first phase, a detailed mapping of the different forms of decay have been realised; then, a synthetic mapping of the state of conservation have been realised, to highlight the critical points and facilitate the comparison between different parts of the building.

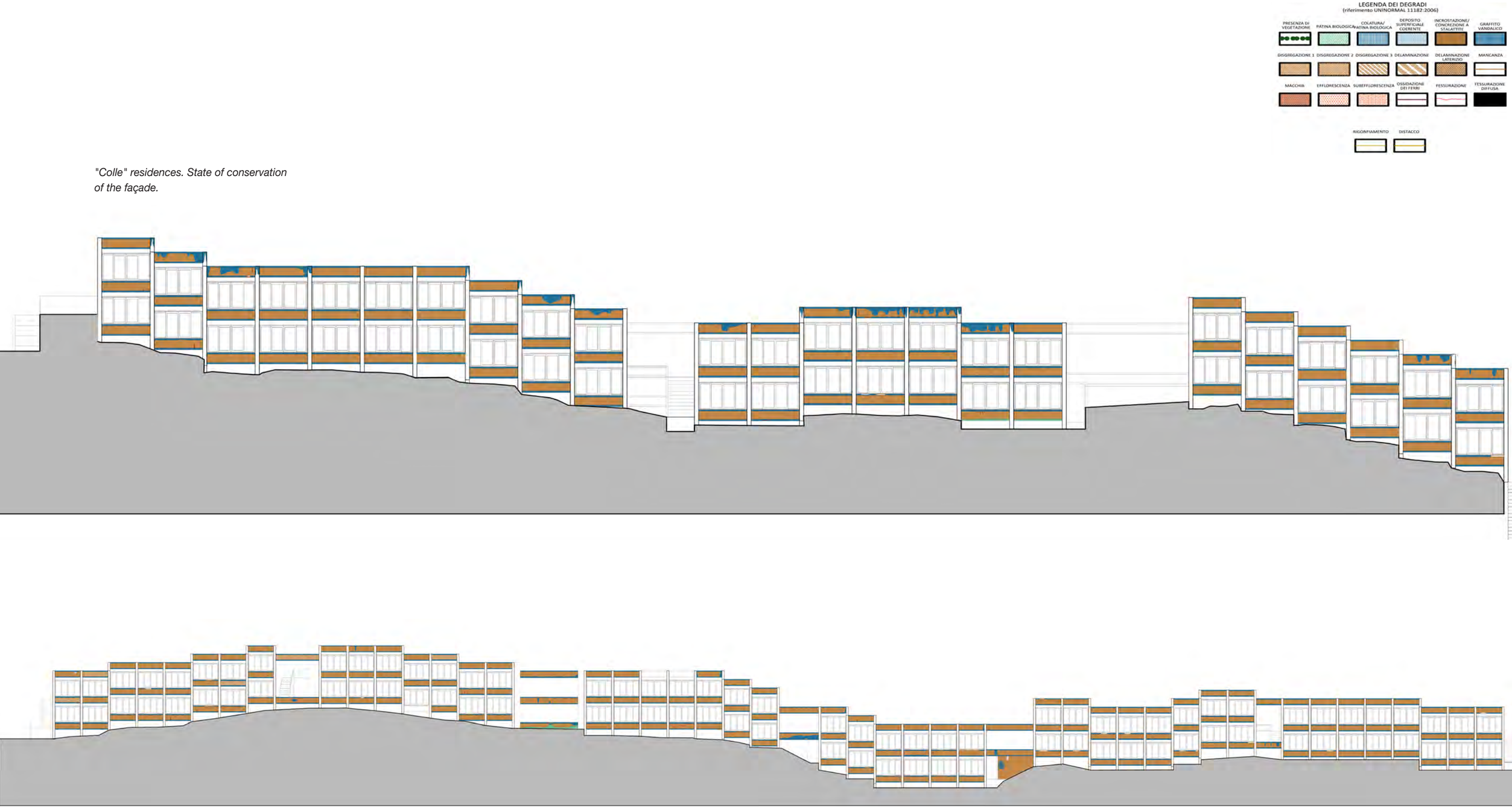
Than, the different forms of decay have been described and some typical situations have been identified and associated to a "score", ranging from 0 to 4.

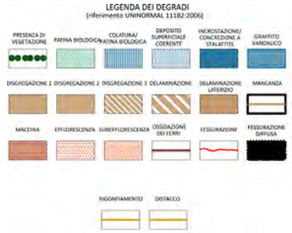
All the slabs have been identified on the plans with a "code" (eg. in the example below the codes refer to the outdoor covered walk-way of the residences of the "Colle"), in order to describe also the surface that in the prospects cannot be mapped because of the complex shape of the building; the final letter in the code refers to the position of the surface (interior, exterior, roof, ceiling...). All the surfaces have therefore been analysed and described, by linking some specific information to the code, as the type of material (as described in the abacus), the dimensions and the state of conservation (defined by the score). On the same plans, the main decays (exposed rebars, spalling etc.; in red) and the existing repairs (in blue) were also pinpointed to underline the more critical situations.

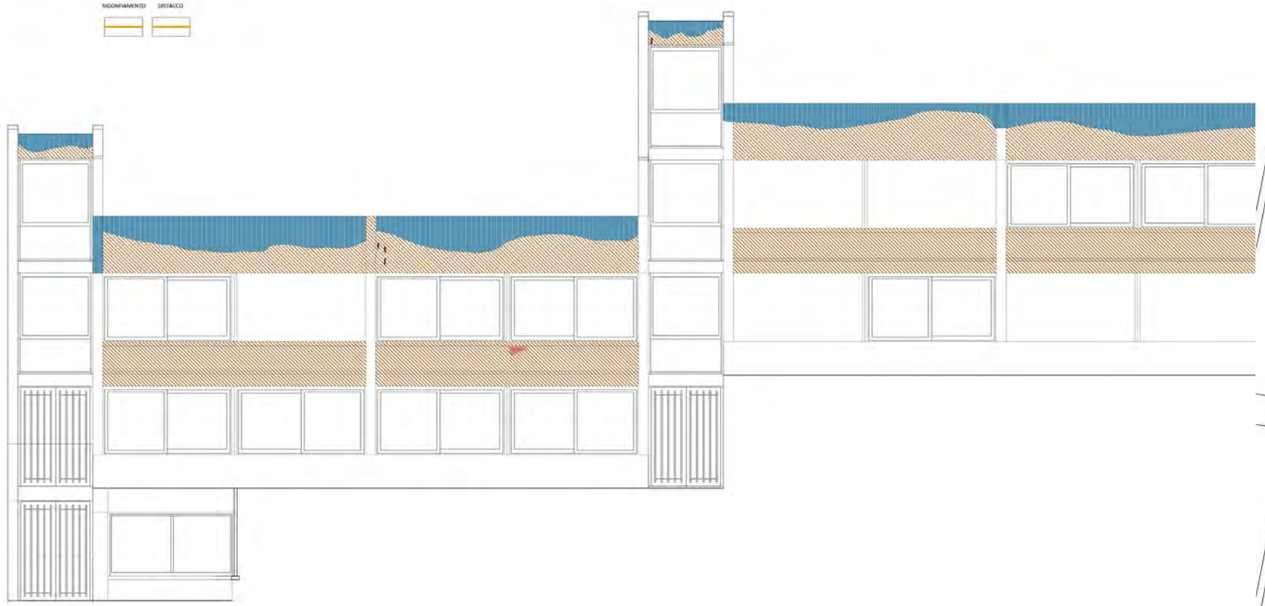
To document the state of conservation and make the consultation easier, a complete photographic record have been realised; for each part of the building, a series of images have been selected, organised and referred to the "code".

Finally, the data can be easily updated and downloaded from the DWG files: it is therefore easy to upload the files into the management database (see part IV), allowing a constant monitoring of the evolution of the decays. Besides, all the data can be easily managed to quantify the interventions, also extracting partial data.

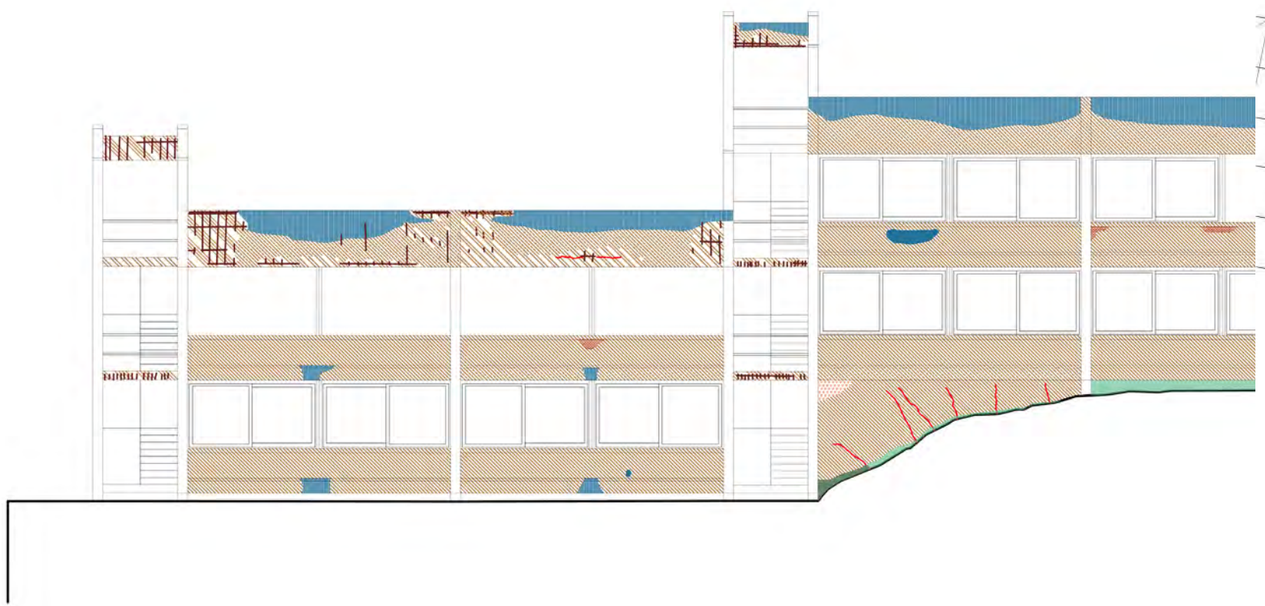
"Colle" residences. State of conservation of the façade.



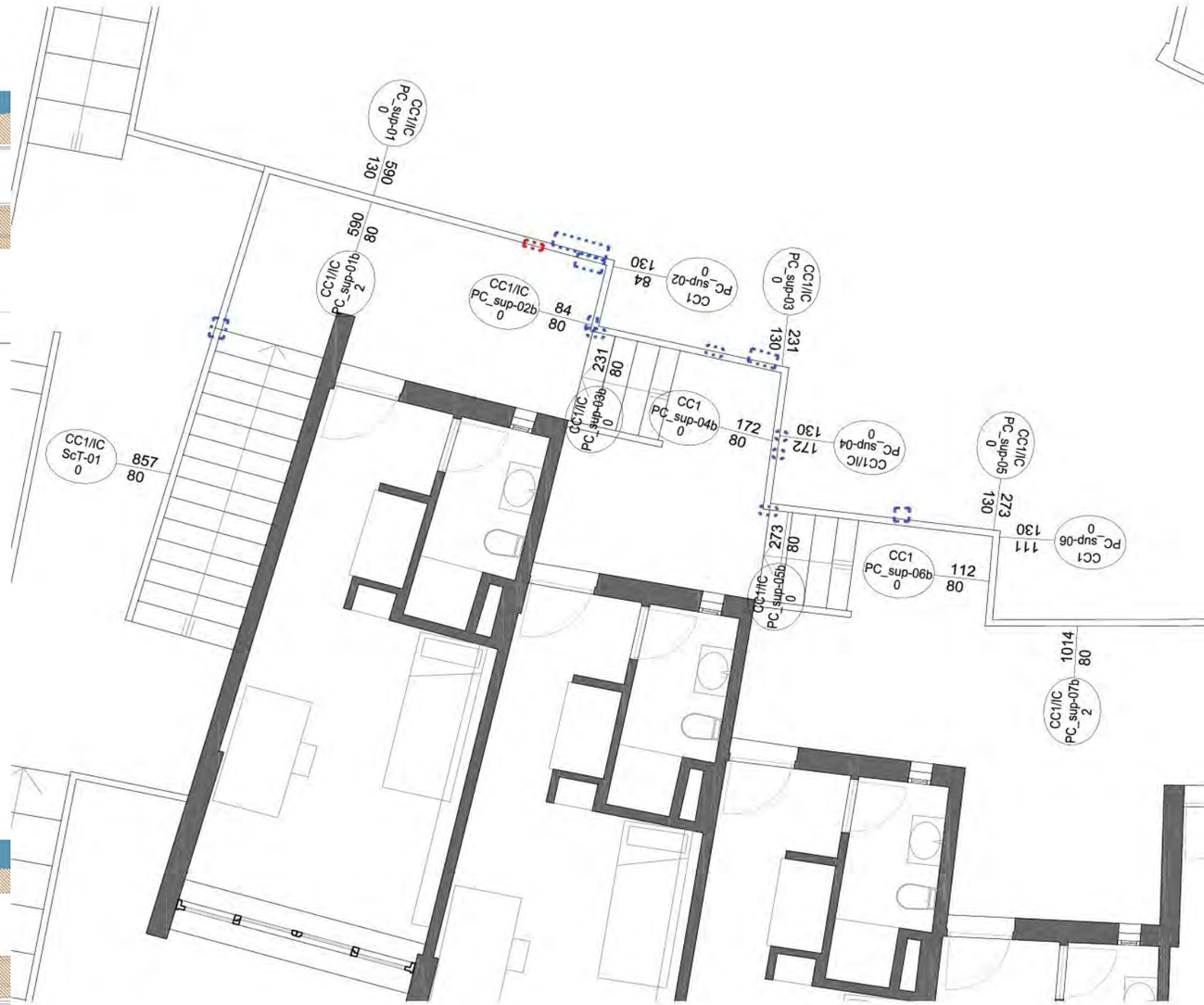




"Aquilone" residences. State of conservation of the façade.



The codes and the score evaluation. In red: decays (exposed rebars, spalling); in blue: existing repairs.



Annex 4. Concrete surfaces

The Pilot Sites

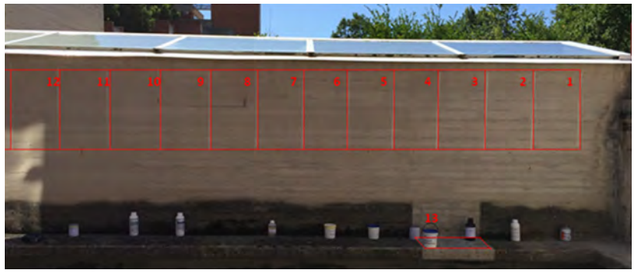
Starting from the field analysis presented above, 2 areas for the pilot sites have been identified that are representative of the typologies and of the state of conservation of the concrete. Besides, the areas were selected also to allow both, a good accessibility and the possibility to evaluate the results from a close distance and from afar.

In that areas, we have evaluated some promising conservation and repair techniques on the market have been evaluated through several on- site tests, namely:

- protective hydrophobic treatments and penetrating hydrophobic materials; to be applied on the concrete elements that are in a good state of conservation with preventive purposes, to reduce the humidity into the concrete.
- repair mortars; to repair the damages that has already occurred.

For the first test the selected areas should refer to a medium-good state of conservation, that means surfaces where the process of carbonation is still limited to the surface and where the damages due to the corrosion of the rebars are localised. Conversely, for the evaluation of the repairs, an area had to be identified where the state of decay quite severe and there were a significant loss of material.

In the roof theatre of the "Aquilone" building both conditions were verified, whilst in the "Colle" only the protective treatments were tested.



"Aquilone". The Pilot Site with the areas of the application of the products.

"Colle". Test areas.

That product have been evaluated by taking into account some guiding principles, that entail some operational recommendations, namely:

- **respect of the character of the building**
  - the "Collegi" are considered a worldwide masterpiece of brutalist architecture and exposed materials are undoubtedly a characteristic aspect to be retained; the "organic" appearance of the material (increased by patinas and lichens) gives an effective contribution to the integration between the building and the landscape.
  - the surfaces should be kept without plasters, paintings or other visible coatings that can hide the different textures, mixes of concrete and surface treatments.
  - commercial repair materials cannot be used on the surface, because of the different colour and texture.
  - the dimension of the elements should not be increased without altering the appearance of the structure. In some case reinforcement should be needed for to strengthen the structure and increase the résistance to the earthquakes.
  - different working phases must have results that are aesthetically homogeneous
- **minimum intervention**
  - prevent is more urgent than replace: the concrete slabs in the "Colle" could be treated with an hydrophobic treatment to protect the surface and reduce the humidity into the material.
  - as a general rule, the repair should be limited to the damaged concrete. In some cases more invasive interventions may be needed: eg. in the residences of the "Tridente" the corroded reinforcements must be replaced.
- **recognizability of the intervention**
  - a like-for like replacement is not needed (and is not technically feasible because of the dimension of the aggregates). Repairs should be differentiated from the original material; at the same time they should not introduce a new pattern on the surface.
  - Repairs must ensure maximum durability. For the most exposed elements (eg. the staircases of the Aquilone building) additional protections (as protective covers in mortar) should be evaluated.
- **control of the technical issues**
  - the additions must have the maximum chemical and physical compatibility.
  - the evaluation of the surface treatments should also take into account: permeability (the products that create a "film" on the surface are excluded); durability / need

for regular retreatment; non-homogeneous absorption in surfaces with different porosity; aging.
- the costs of interventions should be verified, also taking into account the durability of the different solutions
- electrochemical re-alkalinisation techniques does not entail the loss of the original material but are not applicable on the small elements since that technique requests the continuity of the reinforcing rods.
- migrating inhibitors should provide an additional protection, although there are no reliable data on the long-term durability.

- **Documentation of the intervention**

  - a thorough documentation of any interventions should be prepared and made available to evaluate the results over time. Photographic record of the areas before and after the treatment.
  - specific analysis are needed to verify the actual extent of the damage.

Evaluation of the protective treatment

Evaluation of the performances of a conservation product is carried out with the aid of shared protocols and standard methods. A laboratory phase is normally the starting point; a following evaluation on site is the second step. ICVBC CNR has a research activity in this field since many years: it is conducted through the preliminary application of the products on site on model samples, selecting the most performant; The selected products are then applied in the real case and evaluated through diagnostic on site.

Testing protocols provide steady tools for what concerns water-repellant treatments (UNI 10921, 2001); some research work should be still carried out for what concern surface consolidant and the other conservation treatments.

This is the background of the project for the so called pilot site at De Carlo "Collegi" in Urbino, with the aim to evaluate a set of products to be applied on concrete surfaces.

Hence two different areas have been selected with appropriate size and features: the first one is located at "Aquilone" Theatre and it also offers the possibility to get a visual evaluation of the products effects due to its wide surface (Figure 1); the second one on the contrary is a small area close to a parapet in the "Colle" "Collegi". The reason to select two different areas is given by the fact that the polymeric products could arrange microscopically in different ways depending by the substrate characteristics, giving

different performances. The comparison between the two selected ares provided a more complete evaluation of the tested products.

Materials and methods

In Table 1 are summarised some informations about the selected products; more details are reported in the technical sheets and in bibliography. Producst have been selcted on the base of the former experience of the working group, acquired both in laboratory tests and on site application. Moreover a general survey of the market has been carried out. Anyway the products set has been chosen in order to comprehend a whole variability of the different chemical classes; at this aim siloxanes, silanes, fluorinated resins, acrylic have been inserted in the set, both water and solvent based.

In this way the representiteveness of what is offered by the market in obtained.

Products have been evaluated on the basis of two main parameters:

1. the total colour difference induced by their presence on the surface; it was calculated following and measuring chromatic characteristics both before and after the application of the products (Raccomandazione NorMaL 43/93);

2. water absorption by capillarity measured before and after the application of the products by means of contact sponge method (Norma UNI EN 16085:2012).

Colour measurements has been carried out by means of a Minolta CR200 Reflectance Colorimeter using the CIE L*a*b* system. The instrument measures the three colour parameters of the CIE L*a*b* system (L*=Lightness ranging from 0 to 100; a*= red/green axis; b* = blue/yellow axis) in a spot of 8 mm diamater. After having measured we obtained the specific color variations induced by the presence of the treatments (ΔL*, Δa* and Δb*), and the total colour variation $\Delta E = [\Delta L^*)^2+(\Delta a^*)^2+(\Delta b^*)^2]^{0,5}$.

Water absorption has been measured by means of cellulosic alveolar sponges of 40 mm diamater. They have been soaked with a measured water amount and then applied over the surface of the testing area; they have been let in contact with the abosrbing surface for 60 seconds. The water uptake by the absorbing surface is given by the weight difference of the sponge after the 60 seconds. Weights have been measured with a precision scale (± 0.01g). Effectiveness of the specific products is given by the abatement of water absorption after the treatment.

Product	Brand	Function	Chemical Typology
1.Silo 111	CTS	Waterepellent in white spirit (10%)	oligomeric siloxanes
2.Fluoline PE	CTS	Waterepellent	Polieteri Fluorinated PoliEthers functionalised with phosphate groups
3.Protectosil BSM 400	Chem Spec	Waterepellent	Silanes
4.Antipluviol	Mapei	Waterepellent solvent based	Silanes and Siloxanes Mix
5.Colorite Beton	Mapei	Water based paint	Acrylic Resins
6.Marcosil	San Marco	Surface consolidant	Potassium silicate in organic Dispersion
7.Ferrogard 903	Sika	Additive Inhibiting corrosion	Amminic Alcohols
9.Evercem DPS	Tecnova Group	Consolidant	Soluble Silicates
10.Evercem Topseal	Tecnova Group	Waterepellent water based 5%	Potassium Metil-siliconates in water solution
11.Application sequence in 3 layers: siloxanes, acrylic and fluorinated		Multilayered Waterepellant	Siloxanes, Acrylic and Fluorinated resins
13.Mapecrem	Mapei	Hydrophobic Impregnation. To be used on horizontal surfaces	

Table 1. Applied products, function and chemical typology.

Fig. 1. "Teatro dell'Aquilone". The Pilot Site with the areas of the application of the products.

Results and discussion

Observing Figure 2 it is possible to see that chromatic variations induced by the application of the products ranges between 0.71 and 4.88 ΔE units. References indicate that a chromatic variation detectable at the naked eye has a threshold of about 2.0-3.0 ΔE units, depending by the type of substrate. Taking this threshold into account the product 2, 4, 7, 11 and 13 have produced a colour variation over the visual damage threshold.

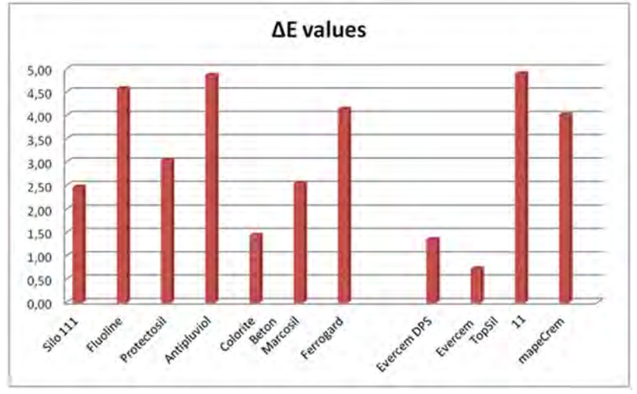


Fig. 2. Total Color Difference (ΔE) measured before and after treatments application.

For what concern data obtained with absorption sponge method and summarised in Figure 3 and Figure 4, it is possible to observe that most of the products are able to abate water absorption. in particular the most performant products are able to reduce water absorption of 99% (products 6, 11 and 13). Data are confirmed by the "Colle" parapet areas, even if the reduction of water absorption is slightly less in this latter case. Most probably the material of the substrate in the "Colle" parapet has a greater porosity and consequently products arrange on the concrete substrate in a differente way.

It is worth noting that the produt 8, does not induce water repellant properties; hence it does not abate water absorption consequentely (Table 1).

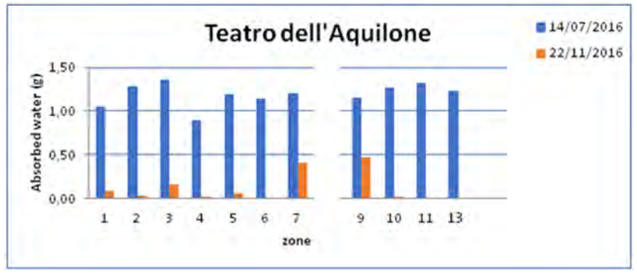


Fig. 3. "Teatro dell'Aquilone". Water absorption by capillarity with the contact sponge method. Difference between before and after the treatment.

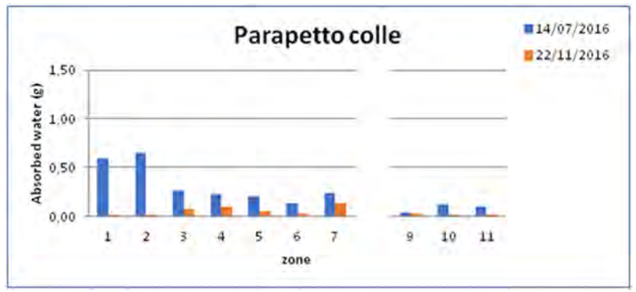


Fig. 4. "Parapetto del Colle". Water absorption by capillarity with the contact sponge method. Difference between before and after the treatment.

Conclusions

The data obtained allowed to affirm that the tested products providing the best performances, taking into account the best equilibrium in between Colour difference and water absorption, are Colorite Beton (5) and Evercem Topsil; in fact they associate a low value of ΔE, and a very good abatement in water absorption.

Repairs techniques

A second pilot site was organised, to test the repair techniques and prepare the guidelines.

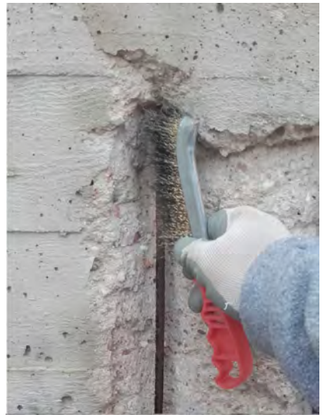
The sampling have been realised at the "Teatro" of the "Aquilone" Buiiliding, where a significant amount of repairs are needed.

As said before, in that evaluation there are some technical constraints to be taken into account, as the need to ensure maximum durability, to control the visual impact of the patches (that, in some cases, will have a large surface) and to ensure the continuity between successive steps of intervention, since the intervention will be unavoidably realised in different phases and, over time, further maintenances will be needed. Besides, since most part of the complex is not accessible by cars and the working conditions are very challenging, intervention techniques and materials that can be easily managed on site should be preferred.

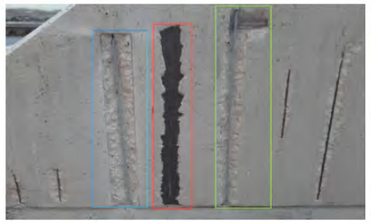
For that reason it has first been verified through a thorough market research if some commercial products (premixed repair mortars) can be "customized", by adding local aggregates or other changes. Unfortunately this hypothesis is found to be non-viable due to the limited modifiability of products on the market, to the need to limit possible disputes (any derogation from the indications that are envisaged in the technical sheet undermines the certification of the product and therefore undermines the responsibility of the producer in case of negative outcomes) and due to the technical impossibility to realise an industrial production ad hoc, also because of the variability of the textures within the "Collegi."

The pilot site has therefore directed to the identification of a repair mortar matching with the existing surfaces and to the development of a cycle of intervention that can be repeated with minor adjustments in different situations.

In the selected areas, the loose concrete has been completely removed, for about 1,5 around the rebars. Than the surface has been low-pressure washed and the rebars have been brushed to remove the corrosion and than treated with an anti-rust product, applied by brush, to protect the reinforcement.

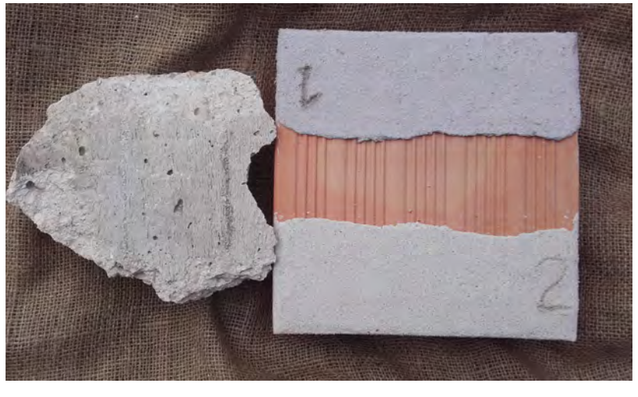


3 different tests have been realised, applying a site mix repair mortar on the whole part of material to be integrated, the same mortar with a 3% of acrilic resina (Acril33 di C.T.S.) and the same repair mortar as a finishing layer of about 1 cm, but using a commercial mortar for the deep repairs.



- rettangolo rosso: Mapegrout + finitura PR2
- rettangolo verde: PR2 + resina
- rettangolo blu: PR2

The repair mortar has been realised using a mix of white cement and local material (sand and gravel) with a binder/ aggregate ratio of 1:2 that match quite well with the surface (see the two tests in the image below). Nevertheless the different dimension of the aggregates and the texture of the surface makes the repairs immediately identifiable.



The identification of the repair mortar; two tests, compared to a sample of original material.[2]

[2] The site mix mortar have been prepared and applied by Cesare Portosa under the supervision of the Research Team.

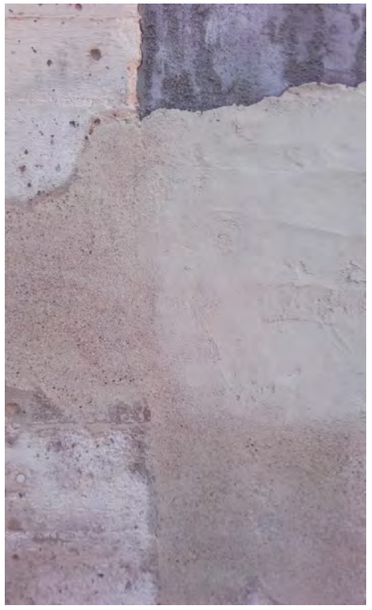
When the shape of the formworks is still visible on the surface, the horizontal course of the timber elements can be recalled on the surface, by drafting a "sign" with a point on the mortar before hardening, to integrate the patches with the existing surface. The "mold" of the formwork should not be reproduced, for technical limits (the thixotrophy of the repair mortar, the need to compress the mortar, to increase the surabilitu of the repair) and to avoid a replica of the surface.

Besides, different sampling have been prepared to test the shape of the repair, irregular or cutting the material to obtain a regular shape. After the application, the mortar has been buffered with a dump sponge to compact the material and avoid the shrinkage cracks; that treatment allows a better integration of the texture with the existing material.

The patches designed by De Carlo are in relief with respect to the surface. A sample has been realised in which the patch has regular shape and is raised on the surface; nevertheless, when a significant amount of repairs are needed (and in most cases, the extension of the surfaces to be treated prevails over the areas in good state of condition) hat solution cannot be replicate without the risk of altering the appearance of the surface and introducing a new pattern. Besides, to avoid stagnation and infiltration of water, the patches should be preferentially coplanar to the surface.

A mixed cycle of interventions that combines a commercial product and a site mix mortar has therefore been designed, to ensure reliability and ease of application and guarantee the greatest aesthetic compatibility with different kinds of concrete. Indeed, a repair mortar can be used for the deep repairs, to speed the interventions whilst obtaining the best results in terms of durability andand a specific mortar, used for the finishing layer (about 1 cm), can ensure the visual matching with the existing concrete. The site mix mortar proved to be less expensive than a commercial product and can be used as a unique layer when the depth of the repairs is limited.

The addition of an acrylic resin to the site mix mortar did not result in a substantial difference between the two samples and the benefits of that addition should be evaluated through specific diagnostic analysis.

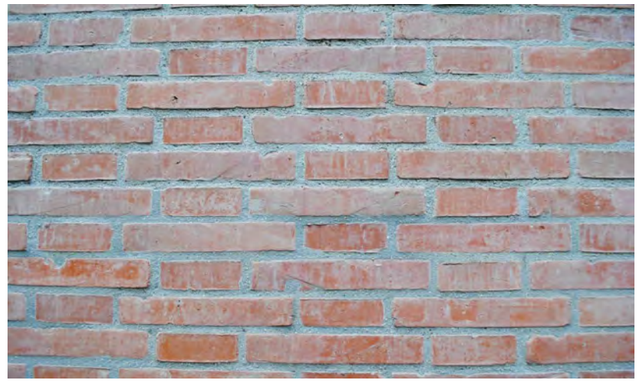


That cycle was developed by comparing some references, and in particular intervention realised at the Convent of La Tourette and in Paul Rudolph's Art and Architecture building in Yale where a "site mix" mortar have been formulated and used on the surface layer, whilst for the repair a commercial repair mortar was used, to ensure the maximum durability. In that cases, a new layer of concrete a paint wash composed by a mix of water and cement was applied both on the repair and on the original material, to unify the surface and hide the patches; in the Collegi, another solution was preferred, to find a good balance between the discernibility of the new material and the respect of the original texture and to recall the solution proposed by De Carlo. The geometric shape of the patches (that recalls the patches realised by De Carlo), the size of the aggregates and the line (which simplifies the trace of the formwork) identifies the new material without introducing excessive changes.

Exposed brick surfaces

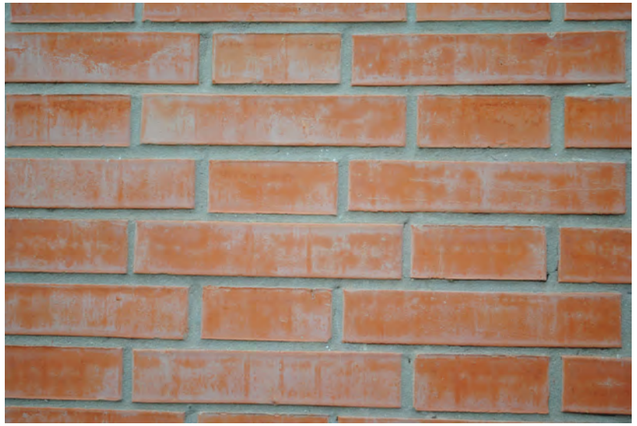
Typologies

The use of load-bearing masonries is amongst the characterising features of the "Collegi", and that choice undeniably recalls the traditional materials, used in the historic centre of Urbino.



"*Colle*".

"*Colle*" *(structure). Solid bricks (4 x 11,5 x 24,5 cm) and cement mortar (1 cm).*



"Nuovi collegi". (structure and cladding, coupled with a concrete structure: hole bricks and cement mortar,1 cm).

Forms of deterioration and damage

Bricks are generally in good state of conservation, except for some localized issues, as the detachment of the brick cladding from the concrete structures, cracks, due to structural problems (library and service building of the "Aquilone") and problems related to the drainage of water on the roof, that leads to infiltration between the concrete structure and the bricks, scaling and efflorescences.

"Vela". Detachment of the cladding from the concrete structure.

"Aquilone" residences. Stairwell, water infiltration from the skylight.

"Aquilone" residences. Stairwell, leaking of water from the roof.

"Tridente" service building. Leaking of water, construction joint.

"Tridente" service building. Leaking from the internal drainpipe.

"Aquilone" service building. Cracks.

Delamination.

Delamination and efflorescences.

Forms of decay:

- Deposits
  - Efflorescence
  - Sub efflorescence
- Detachments
  - Delamination
  - Detachment of the brick cladding
- Stains
  - Graffiti
- Cracks and displacements
  - Cracks

All the exterior surfaces were meant to be left without coating, as well as most of the interiors, both in the rooms and in the common spaces.

Nevertheless, some walls have been painted, to hide the graffiti (eg. in the "Colle" the external pathways on the blocks 9 and 10 have been completely painted) or have been sandblasted (as in the residential blocks of the "Tridente"), resulting in a significant increase in superficial porosity.

Window and door frames

All of the "Collegi"'s spaces have a direct relationship with the landscape. All the rooms, in particular, have a large sliding window overlooking the surrounding hills that introduces nature as a constant feature of the students' living environment. This strong presence of nature – its changing vegetation with the change of seasons – is perhaps the most distinctive aspect of living in the "Collegi". This premise underlines only how the relationships between the natural environment and student life are intertwined with the perception of the landscape. Every window can be defined as a picture where nature and artifice are the subject. The dark blue tents, which were the original protection from light and sunlight, open like a curtain on a natural scenery of incomparable beauty.

"Aquilone". View of the library windows frame.

The conditions of doors and windows and their conservation have been one of the critical issues of the "Collegi" since their completion. We discover that during the design different types of frames were evaluated, taking into consideration elements in steel and aluminum before arriving at the choice of wood.

"Tridente". The common room and the patio.

Analyzing the correspondence and personal testimonies[3], it seems that the reasons for this decision were varied: first, the presence of wooden windows in the "Colle", built a few years before; the desire to achieve harmony between the new windows and the materials and color of the existing ones and to consolidate the image of a network of thin white lines merged with the brick and concrete parts. Regarding the theme of color we should remember that at that time aluminum frames were mostly anodized and that paintwork carried no guarantees. Certainly the cost of different types also influenced choices, because of the scarcity of resources, generally coming from mortgages that the Free University of Urbino – and, in particular, Carlo Bo, the Dean – managed to obtain from the banks.

So in the end the choice to keep achieve continuity prevailed in the choice of materials and in the colors of the frames already made in the "Colle", supported by a need to reduce the costs and – I would add – the favor of wooden windows offered by the architect De Carlo. The craftsmanship of the production it its design has always been a constant as well as the project analysis in all its parts, including doors and windows frame.

Abacus of the typologies

A comprehensive registry of all the frames (doors, windows, rooflights) has been developed for a complete description; in the whole complex, over 4300 elements have been analysed and arranged in about 180 types.

The analysis shows different levels of significance and integrity.

In the first building ("Colle"), all the elements are custom-designed and almost all those in the common areas are unique pieces. The archive drawings shows the details and the careful design of each element.

In the "Nuovi Collegi" the study of the details is less accurate and a few typologies are repeated without significant changes.

In the study, also the replaced elements have been catalogued and evaluated, to understand the the ratio of replacement in each part and for each typology.

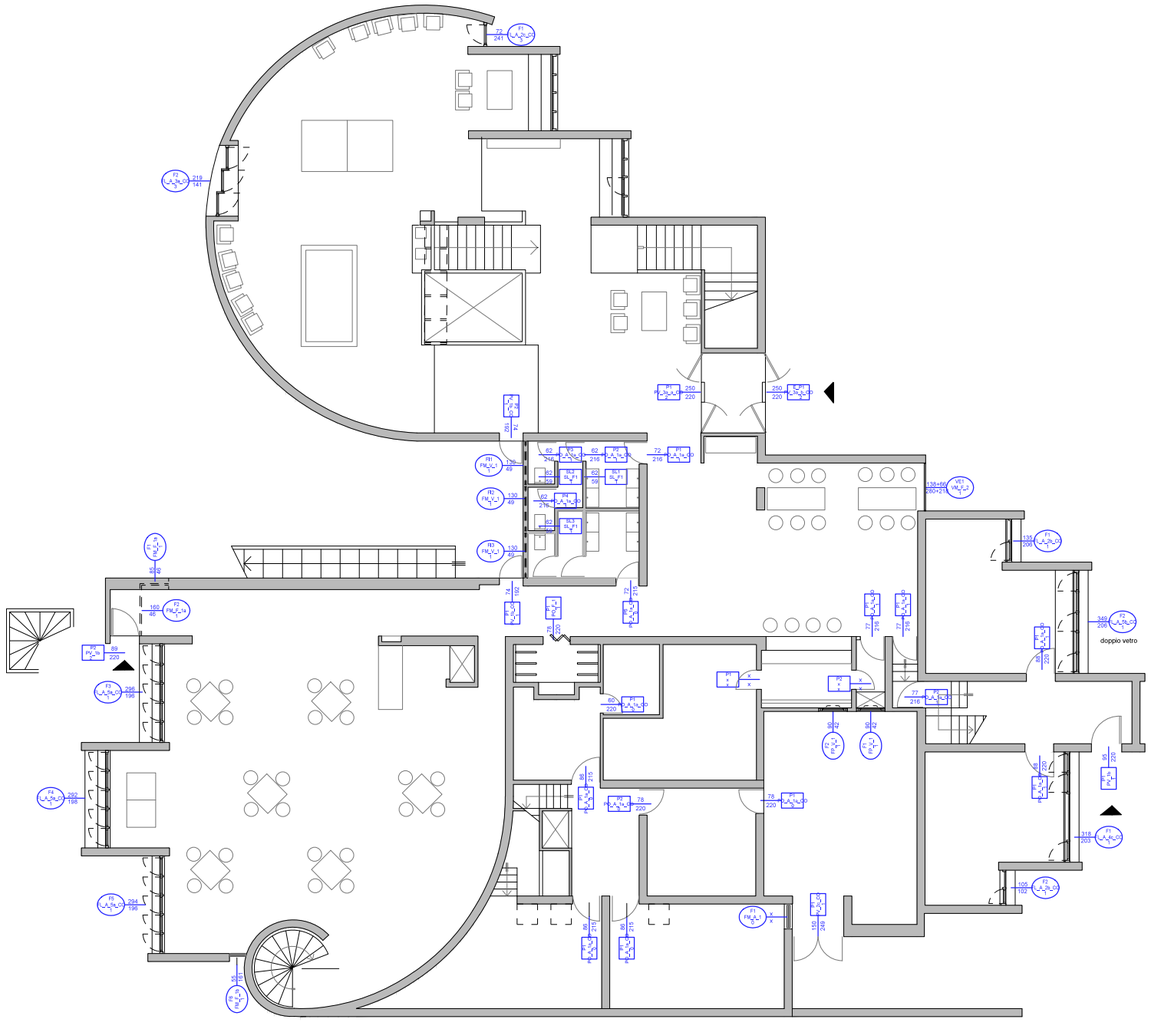
[3] The architect Antonio Vecchi participated as a collaborator of De Carlo to the project and the construction site and was one of the sources of this research.

The windows of the rooms required a special attention, since they are likely to be used more often those in the common areas, are not repaired from the weather and have a significant influence in determining the interior comfort conditions: for those a series of "synoptic cards" were created to compare the different situations: in the "Colle" only a few elements (6) has been changed, whilst in the "Vela" and in the "Tridente" the replacement is almost complete.

On the plans, each element has been identified with an alphanumeric code, classified and related to a state of conservation. Therefore, that analysis has led to a rather precise quantification of the elements and of the state of conservation of each of them.

A score, ranging from 0 to 4 defines the state of conservation of each element.

For each part of the building an abacus summarizes the typologies and the state of conservation.



"Colle" service building. Identification the door and the window frames.

COLLEGIO DEL COLLE - RESIDENZIALE

SERRAMENTO ORIGINALE

CODICE TIPOLOGIA: FL_S_4_CO
Riferimento al progetto:

Apertura: due scorrevoli, due fisse

Materiali:
Telaio - legno
Vetro - singolo

Quantità:
CO_ 144 (RE)
TR_ 0
AQ_ 0
SE_ 0
VE_ 0

SERRAMENTI SOSTITUITI

CODICE TIPOLOGIA: FA_S_2a

Sistema di apertura: Scorrevole, fisso

Materiali:
Telaio - alluminio
Vetro - doppio

Quantità:
CO_ 6 (RE)
TR_ 0
AQ_ 66
SE_ 111
VE_ 0

PERCENTUALI SOSTITUZIONE (150 elementi)

97,33 % ORIGINALI
2,67 % SOSTITUITI

STATO DI CONSERVAZIONE SERRAMENTI ORIGINALI (144 ELEMENTI)

COLLEGIO DEL TRIDENTE - RESIDENZIALE

SERRAMENTO ORIGINALE

CODICE TIPOLOGIA: FL_S_2b
Riferimento al progetto:

Apertura: una scorrevole, una fissa

Materiali:
Telaio - legno
Vetro - singolo

Quantità: 46 elementi

Altri collegi:
CO_ 0
AQ_ 0
SE_ 0
VE_ 0

SERRAMENTI SOSTITUITI

FA_S_2b Quantità: 207 elementi

FA_V_2 Quantità: 99 elementi

TIPOLOGIA: FA_S_2b e FA_V_2

Apertura: due ante scorrevoli
anta scorrevole + vasistas

Materiali:
Telaio - alluminio
Vetro - doppio

Quantità: 207 + 99 elementi

Altri collegi:
CO_ 0
TR_ 0
AQ_ 0
VE_ 0

PERCENTUALI SOSTITUZIONE (352 ELEMENTI)

13 % ORIGINALI
87 % SOSTITUITI

STATO DI CONSERVAZIONE SERRAMENTI ORIGINALI (46 ELEMENTI)

COLLEGIO DELL'AQUILONE - RESIDENZIALE

SERRAMENTO ORIGINALE

CODICE TIPOLOGIA: FL_S_2a
Riferimento al progetto:

Apertura: una scorrevole, una fissa

Materiali:
Telaio - legno
Vetro - singolo

Quantità: 68 elementi

Altri collegi:
CO_ 0
TR_ 0
AQ_ 3 (CC)
SE_ 41
VE_ 0

SERRAMENTI SOSTITUITI

CODICE TIPOLOGIA: FA_S_2a

Apertura: Scorrevole, fisso

Materiali:
Telaio - alluminio
Vetro - doppio

Quantità: 60 elementi

Altri collegi:
CO_ 6 (RE)
TR_ 0
AQ_ 6 (CC)
SE_ 111
VE_ 0

PERCENTUALI SOSTITUZIONE (128 ELEMENTI)

53 % ORIGINALI
47 % SOSTITUITI

STATO DI CONSERVAZIONE SERRAMENTI ORIGINALI (68 ELEMENTI)

COLLEGIO DELL'AQUILONE - CORPI SCALA RESIDENZIALE

CODICE TIPOLOGIA: VL_P_2F_AQ

Apertura: vetrata costituita da elementi fissi e a vasistas e porta di ingresso

Materiali:
Telaio - legno, vetro singolo

Quantità: 2 elementi
Stato di conservazione:
3 - 1 elemento 4 - 1 elemento

Altri collegi:
CO_ 0 SE_ 0
TR_ 0 VE_ 0

CODICE TIPOLOGIA: VA_P_2F_AQ

Apertura: vetrata costituita da elementi fissi e a vasistas e porta di ingresso

Materiali:
Telaio - alluminio, vetro singolo

Quantità: 2 elementi
Stato di conservazione:
0 - 2 elementi

Altri collegi:
CO_ 0 SE_ 0
TR_ 0 VE_ 0

COLLEGIO DELLA VELA- RESIDENZIALE

SERRAMENTO ORIGINALE

CODICE TIPOLOGIA: PF_L_2

Apertura: fissa, porta a battente e vasistas

Materiali:
Telaio - legno
Vetro - singolo

Quantità: 15 elementi

Altri collegi:
CO_ 0
TR_ 0
AQ_ 0
SE_ 0

SERRAMENTI SOSTITUITI

CODICE TIPOLOGIA: PF_A_2

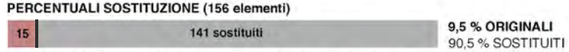
Apertura: vasistas, porta a battente

Materiali:
Telaio - alluminio
Vetro - doppio

Quantità: 141 elementi

Altri collegi:
CO_ 0
TR_ 0
AQ_ 0
SE_ 0

PERCENTUALI SOSTITUZIONE (156 elementi)



9,5 % ORIGINALI
90,5 % SOSTITUITI

STATO DI CONSERVAZIONE SERRAMENTI ORIGINALI (15 ELEMENTI)

COLLEGIO DELLE SERPENTINE - RESIDENZIALE

SERRAMENTO ORIGINALE

CODICE TIPOLOGIA: FL_S_2a
Riferimento al progetto:

Apertura: una scorrevole, una fissa

Materiali:
Telaio - legno
Vetro - singolo

Quantità: 41 elementi

Altri collegi:
CO_ 0
TR_ 0
AQ_ 71
VE_ 0

SERRAMENTI SOSTITUITI

CODICE TIPOLOGIA: FA_S_2a

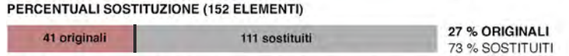
Apertura: una scorrevole, una fissa

Materiali:
Telaio - alluminio
Vetro - doppio

Quantità: 111 elementi

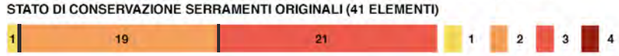
Altri collegi:
CO_ 5 (RE)
TR_ 0
AQ_ 66
VE_ 0

PERCENTUALI SOSTITUZIONE (152 ELEMENTI)



27 % ORIGINALI
73 % SOSTITUITI

STATO DI CONSERVAZIONE SERRAMENTI ORIGINALI (41 ELEMENTI)



FINESTRE IN LEGNO

CODICE TIPOLOGIA: FL_A_2a_CO

Apertura: un anta a battente

Materiali:
Telaio - legno
Vetro - singolo

Quantità: 1 elemento
Stati di conservazione:
1- 1 elemento
Altri collegi:
AQ _ 0 SE_ 0
VE_ 0 TR_ 0

CODICE TIPOLOGIA: FL_A_2b_CO
Riferimento al progetto: 44 (URB-1424)

Apertura: un'anta fissa, una a battente

Materiali:
Telaio - legno
Vetro - singolo

Quantità: 2 elementi
Stati di conservazione:
1 - 2 elementi
Altri collegi:
AQ _ 0 SE_ 0
VE_ 0 TR_ 0

CODICE TIPOLOGIA: FL_A_2c_CO
Riferimento al progetto: 31(URB-1418, URB-1419, URB-1420)

Apertura: Anta a battente, fisso

Materiali:
Telaio - legno Vetro - singolo

Quantità: 1 elemento
Stati di conservazione:
3 - 1 elemento
Altri collegi:
AQ _ 0 SE_ 0
VE _ 0 TR _ 0

FINESTRE IN LEGNO

CODICE TIPOLOGIA: FL_A_2d_CO
Riferimento al progetto: 13-14 (URB-1383)
Apertura: un'anta a battente, fissa
Materiali:
Telaio - legno Vetro - singolo

Quantità: 2 elementi
Stati di conservazione:
1- 2 elementi
Altri collegi:
AQ _ 0 SE_ 0
VE_ 0 TR_ 0

CODICE TIPOLOGIA: FL_A_2e_CO
Riferimento al progetto: 25(URB-1416)

Apertura: un'anta fissa, una a battente

Materiali:
Telaio - legno
Vetro - singolo

Quantità: 2 elementi
Stati di conservazione:
1 - 2 elementi
Altri collegi:
AQ _ 0 SE_ 0
VE_ 0 TR_ 0

CODICE TIPOLOGIA: FL_A_3a_CO
Riferimento al progetto: 28(URB-1417)

Apertura: Anta a battente, fisso

Materiali:
Telaio - legno Vetro - singolo

Quantità: 1 elemento
Stati di conservazione:
1 - 1 elemento
Altri collegi:
AQ _ 0 SE_ 0
VE _ 0 TR _ 0

LUCERNAI

CODICE TIPOLOGIA: LC_F_7
Riferimento al progetto: 35 (URB-1396)

Apertura: fisso

Materiali:
Telaio - lamiera Vetro - singolo

Quantità: 3 elementi
Stati di conservazione:
1 - 3 elementi
Altri collegi:
AQ _ 0 SE_ 0
VE_ 0 TR_ 0

CODICE TIPOLOGIA: LC_F_8
Riferimento al progetto: 37 (URB-1354)

Apertura: fisso

Materiali:
Telaio - rame Vetro - singolo

Quantità: 1 elemento
Stati di conservazione:
1 - 1 elemento
Altri collegi:
AQ _ 0 SE_ 0
VE_ 0 TR_ 0

CODICE TIPOLOGIA: LC_F-9
Riferimento al progetto: 46 (URB-846)
47 (URB-1452) 48 (URB-1453)
Apertura: fisso

Materiali:
Telaio - ferro zincato Vetro - singolo

Quantità: 2 elementi
Stati di conservazione:
0 - 2 elementi
Altri collegi:
AQ _ 0 SE_ 0
VE _ 0 TR _ 0

VETRATE

CODICE TIPOLOGIA: VL_V_6
Riferimento al progetto: 30 (URB-1418 URB-1419, URB-1429)
Apertura: fisso e vasistas

Materiali:
Telaio - legno Vetro - singolo

Quantità: 1 elemento
Stati di conservazione:
4 - 1 elemento (ora sostituito)
Altri collegi:
AQ _ 0 SE_ 0
VE_ 0 TR_ 0

CODICE TIPOLOGIA: VL_A_7
Riferimento al progetto: 29 (URB-1418, URB-1419, URB-1420)
Apertura: fisso e apribile

Materiali:
Telaio - legno Vetro - singolo

Quantità: 1 elemento
Stati di conservazione:
4 - 1 elemento (ora sostituito)
Altri collegi:
AQ _ 0 SE_ 0
VE_ 0 TR_ 0

CODICE TIPOLOGIA: LC_F-9
Riferimento al progetto: 22 (URB-1413)
Apertura: fisso

Materiali:
Telaio - metallo Vetro - singolo

Quantità: 1 elemento
Stati di conservazione:
1 - 1 elemento
Altri collegi:
AQ _ 0 SE_ 0
VE _ 0 TR _ 0

The current conditions

The Conservation Plan survey reveals the sad condition of all windows in their current state. The original window frames are almost all in a delicate condition and those that have been replaced are mostly in aluminium: 6 out of 156 at "Colle", 60 out of 128 at "Aquilone", 111 out of 152 at "Serpentine", 306 of 352 at "Tridente", 111 of 152 at "Vela", if we list only the bedroom windows. We are talking about 66% of replaced windows since the early nineties. The survey points out that the issue of window conservation is urgent and at the same time that original artifacts are now a minority. It should also be said that the replaced windows are not homogeneous. Changed at different times, the "new" windows are distinguished by significant differences in materials, in the size of profiles made by different manufacturers, in technical features. The visible result of all these changes is what is – for the most part – no longer a homogeneous facade, where windows are mixed by type, material, color and state of conservation.

The causes of this deterioration are different: exposure to the elements, technical characteristics, quality construction and, in particular, a lack of maintenance. As regards the first case, it is worth noting that the windows, in particular in the bedrooms are in general very exposed, aligned with the façades in buildings, which have flat roof and no projection. The second and third causes can be attributed to the choice of wood, the type of opening, the absence of double glazing. In the latter case, given the formation of condensation that, accumulated on the lower profile, has worsened its deterioration. Finally, the lack of maintenance of hinges and mechanical parts, a lack of periodic cleaning of profiles and regular repairs, have accelerated the deterioration.

Decay of Windows frames.

Analysis of the window frames and the knots in the woodwork

The variety and quantity of the window frames is a feature of the complex. In the cells' façade, facing the valley, windows characterize the architectural language. However, it is the core of common services, clearly differentiated by use and form from the living cells, which have the most varied and complex shapes of windows and door frames.

In this regard, let's take "Colle" by way of example. The whole facade overlooking the valley is characterized by window frames in relation to brick and far-faced concrete. The window covers the facade between two transverse squares and consists of four vertical parts, the central ones sliding sideways. The dimensions of the four parts of the window are set among far-faced concrete. The two central doors frames, sliding sideways inside the fixed partitions, have a larger dimension. The frame of the sliding central parts forms a square, centered in the rectangle of the window which has lighter profiles. It is a mark of the uniqueness of each cell and perhaps of its inhabitants, an element that is both functional and decorative. Also the design of wooden windows for the "Collegi" created after the "Colle" was certainly very precise.

Whereas, the formal solution of the "Aquilone" windows is different, its composition which aligns with the horizontal sequence of the opening band in the blocks of residences. In this case, a different sliding system (something completely new at the time) guaranteed air tightness. The "Aquilone" windows were a clear technical evolution compared to that of the older version, guaranteeing air-tightness and easy sliding despite its larger dimensions – an economic and evolutionary solution.

To deal with the problem and find a compatible solution with the original design, combined with the students need for practicality and comfort, we decided to choose three sample types for the purposes of a more detailed survey, concentrating our analysis of new replacement window frames for those that were beyond repair. For the samples we asked various companies to develop new solutions. The types we chose are as follows: sliding windows for the the "Colle" rooms; sliding windows for the "Aquilone" rooms; a library window at the "Aquilone" consisting of a fixed wing and a traditional opening. The choice of the sliding windows at the "Colle" and the "Aquilone" allowed us to check the large dimension frame sections starting from the original ones, larger in the "Aquilone", smaller but more complex in the "Colle" where there are four parts. The "Aquilone" library window has no particular features, and so it can be considered representative of many others windows.

Looking for a solutions

As we have said, the majority of the "Collegi" windows have been changed with types that bear no resemblance to the originals. In the selection of replacements, the only criterion applied was that cost and maintenance be kept to a minimum. The new windows generally have an aluminum frame, some PVC, of low quality and reflect the overwhelming need for replacements with scarce resources.

This situation does not exempt us from considering the value of the extraordinary variety of the windows designed by De Carlo and also to evaluate the recovery of any elements that can still be kept.

We therefore considered it indispensable to take a pragmatic approach, considering the following aspects:

- safeguard the value of the building in all its parts;
- consider different possibilities: recovery of the frame, substitution with a reproduction of the original frame type, or make a change of type, in relation to their current state and to the use of space;
- give priority to housing function and improve the comfort of the students;
- propose solutions that can be adopted immediately and compatible as far as possible with available resources;
- share goals and choices with the University.

In order to reach a correct solution to the problem, a selection was made involving companies that produc frames in different materials, asking them to develop a proposal starting from sample types.

We pointed out to the producers as priorities:

- respect the original dimensions and opening system;
- improve the insulation characteristics using double paint;
- achieve better efficiency of mechanical parts subjected to heavy wear and tear;
- produce an economic evaluation that matches the building features and the buyer's needs;
- ensure minimum maintenance.

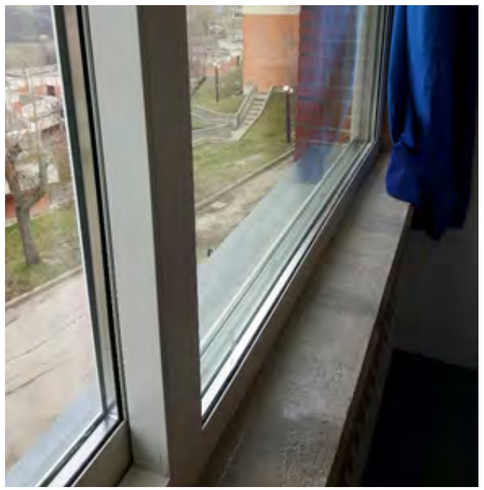
In particular we examined frames made of wood, wood and steel, wood and aluminum, aluminum, steel. We then considered the different proposals by selecting one that best matched the given criteria and chose a thermal break aluminum window frame.

This window was very similar in dimensions to the original wooden window frames. We should remember that the new large dimension wooden windows proposed and the weight of the double paint had profiles that were larger than the original ones. The aluminum frames require little maintenance and cost considerably less than steel windows or mixed solutions made of aluminum or steel and wood.

After this phase of selection, the technical details of the sliding window of the "Aquilone" were studied, in particular:

- the position of the frame in relation to the sill and the upper drip;
- the window sill flashings in titanium-zinc plates, which do not oxidate with a color that resembles the original;
- vertical flashings between the windows;
- matte and slightly embossed surface of frames and a pure white color;
- criteria for opening; handles and mechanical parts of sliding doors;
- glass type, particularly efficient as insulation and as a filter for solar radiation.

New windows in the pilot site.



Based on the building drawings, prototypes were realized in the pilot site.

To determine which window frames should be replaced, we applied the following criteria:

Replaces the windows in spaces that have a stable permanency of students and where there is a need for improved internal microclimatic conditions. Primarily, student rooms and study rooms.

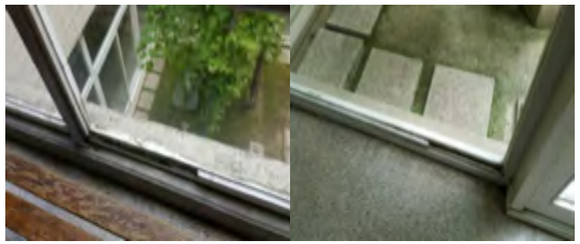
In the other spaces, those that are irreparable and show severe deterioration, are to be replaced.

Gradually replace all non-original window frames starting from the least recent.

Types of intervention

To determine when it is advisable to restore window frames we applied the following criteria:

- Replacement of the original window with identical sections and single glass when deterioration of the window frame exceeds 30%.
- On site repairs, including replacement of parts when deterioration of the window frame does not exceed 30%.
- Repair and upgrade parts that are no longer in working order, including part replacement when deterioration of the window frame does not exceed 30%.
- Fixed frame: on a case by case basis, cut the frame and replace any damaged base parts in contact with the threshold or window sill with a new double height frame, adding a metal protection of the same color. Keep single paint.



- Restore the original design of the open frame when replaced with a fixed one. Rearrange painting and apply double paint, depending on the use of the space without changing the existing frame.

- External Doors: apply double paint to the existing frame, and generally rearrange and replace any incongruous parts.
- External Doors: apply double paint where there are no vertical elements.
- External Doors: apply double paint and rebuild vertical elements where they have been removed.

Annex 5. Doors and windows frame

Annex 6. Survey of selected windows type, drawings and analysis of the new solution

"*Colle*". *Interior of a cell. (Photo Kunstgewerbeschule, Zurigo)*

The Interiors - survey and mapping of a private room's furniture

Introduction: analysing the furnishings within their environment

The indoor spaces of the Urbino "Collegi" are noteworthy for at least two reasons, i.e. that they are keeping the original functioning as it it was planned by De Carlo, and that they show a relevant intertwining between architecture and interior design, that should be studied deep. De Carlo designed the buildings in all their parts with a meticulousness that, when acknowledged, highlights the importance given to the details and witnesses the cultural background of the whole project.

There is a plenty of drawings, sketches and other documents about the project, collected in a large part by the Archivio Progetti IUAV in Venice. In fact, the research stems from this detailed documentation with the aim of developing a handbook for each item, useful to support the restoration process.

The team focused on single rooms, organized in blocks of 8 rooms each and common toilets and kitchen. Each room is equipped with a furnishings set functionally designed by the architect so that the whole environment proves suitable for the students' living habits. Both private and common spaces are provided with furnishings that are adjustable and customizable according to the different needs of each student. If spaces and objects are constantly changing and used in different ways, it's essential to provide a documentation that put in relation the furnishings' current state of conservation with their measures and loading gauge, their manufacturing and any change made over time. This kind of relational database is a fundamental step to plan the conservation actions and schedule the maintenance so that the space-object pair could work correctly as a whole.

The furnishings' state of conservation – in some cases dramatically influenced by severe damages – pushed us to test a methodology for the analysis and for the intervention plan based on the integration of different data visualization and managing approaches in the digital environment.

The overall examination of the 'system room' is based on the analysis of each piece of furniture present in the D6C room, "Aquilone". The investigation focused on this room's furnishings, yet never missing the spatial qualities provided by the interaction between architecture and objects.

The room's layout is based on a 18 square meters rectangle (6.00 x 3.00 meters), 2.50 meters high. It has a large window opening in the back wall. By entering the room the left-proper wall is constructed entirely of bricks that recall the external facades. The right-proper side is whitewashed with a sponge effect, as well as the ceiling. The lighting system is made by two lamps, one in the vestibule and the other at the center of the room. In the lobby, against the wall, a small cabinet is given the function of kitchen with a fridge and two hot plates, while on the opposite wall a door opens on the bathroom.

Within the room each item can be moved and arranged in different ways. De Carlo carefully selected and designed the furnishings in a way that prevents the end user from a routine and standardized application. Accordingly, the analysis of the furniture was drawn more on the technical features than on the aesthetic ones.

A first phase of basic research concerned a deep study of the original drawings kept by Archivio Progetti IUAV in Venice. By comparing the projects and the actual state of the furniture we identified what items have been substituted or removed from the room. According to this information and the consequent observations, we identified three categories of furnishings, i.e. functioning, substituted or new ones and decommissioned.

The second step involved the operational intervention in situ. Each item was disassembled and its parts measured and catalogued in descriptive tables. By understanding how the different parts have been assembled and are operating it was possible to identify all the building materials and the technical solutions the architect adopted.

In short, this analytical phase is organized in three steps: the historical investigation, the survey about measures and materials and the enquiry on the aesthetic shapes and the objects' use.

The review of historical documents

By studying deep the drawings found within the original boards we could identify the materials selected by the architect, some important details concerning the building techniques and, above all, the whole interior design project. Thanks to the evidences found on the original documents (drawings and even the documentation about the tendering procedure and the following testing phase) we managed to track back the company that produced the objects. There are also evidences concerning the selection of the materials and important information to understand the ratio behind the colour plan. Each space was conceived in detail, from the lighting system to the smaller furnishing.

Within the original documents the "Aquilone" is called "Collegio C'". The collected documents about the interior, are related to a span of time running from March 1978 to April 1980. Once concluded the operative phase, the testing one was carried out in 1982.

The objects' drawings are marked with a letter matched with sequential numbers in order to identify their position in the general layout of the building. Each board is signed Giancarlo De Carlo Architetto and carries the client's name, ie. Università degli Studi di Urbino. Furthermore, the board is identified by the project's name, i.e. furniture "Collegio C", UR 140. Next to each piece of furniture there is a number or a letter that matches it to the tender dossier and to a further document (dated May 1980) entitled: "Descrizione dei mobili e delle attrezzature del settore C da eseguire su disegno o da approvvigionare nella produzione corrente".

Following this approach, we provided each object with a digital 2D and 3D model in order to simulate the operational arrangements and make it visible projecting the furnishing in its spatial context.

The survey about shapes and materials

This part of the research was based on the organization of data and information in a structured dossier easy to navigate. We proceeded step by step, from the usual metric survey on each object to the examination of the parts' operational mechanisms.

First and foremost we collected all the information following a rigid methodology as a guideline for the whole analytical path. According to this approach we gathered the metric data of the objects on the basis of its size. At the same time for each object was reported any change in the structure, brought on by possible tampering or fixing interventions. Afterward through a CAD

model we got the perspective drawing and the layout of each object standing alone and/or placed in the space. Subsequently, we developed a 3D model for each object in order to analyze its assembling mechanisms and the functioning. Thanks to the possibility of virtually disassembling the object's parts we could identify the interlocking and connecting systems.

The survey focused on two categories of objects, i.e. active and functioning objects, identified by the letter A, and decommissioned ones, identified by the letter C. All the other furnishings currently in the room but not related to the original project – letter B – were excluded from the survey for they have been selected by the "Collegi" administration to substitute damaged objects without a connection to the architect's choices. Yet these objects have been provided with a dossier, composed by general and detailed photographies and a short description of their characteristics.

Once completed this phase we filled the tables with measures, drawn details and the description of each part. Through this abacus we easily defined the materials involved in the intervention and its priorities.

A second analytical phase was divide in two steps. A former tactile and visual approach led within the survey of the places involved, useful to make some hypothesis on the kind of materials used. And a second step characterized by the use of traditional scientific procedures to identify the specific materials. Nine samples was taken and analyzed through FT-IR methods, stereomicroscope photographs and optical microscopy.

By reading the results it was possible to confirm that the furnishings were produced through standard industrial manufacturing with common materials, yet of excellent quality at that time. The plastic laminate is composed by a melamin-urea-formaldheyde resin, a urea resin modified in order to obtain an hydrophobic coating, widespread in the domestic furniture during the Sixties. The laminate is glued to the wooden supports with a gummy adhesive, i.e. polyvinyl acetate. Where the plastic laminate is not covering the plywood a transparent thick coating was used, i.e. an alkyd resin. It can be supposed that this resin was laid out through rollers at the end of the manufacturing process. In fact some yellowed drops of that same resin are visible on the surface of the plastic laminate when in perpendicular position.

The steel components are coated with a blue varnish identified as a copolymer polyester terephtalic acid – probably pigmented through metallic oxides – applied by immersion. The object tied to a chain is immersed in a tub full of paint, then brought up and drain off. With this painting method it's possible to avoid the waste of materials and to obtain a thick and uniform coating on the whole surface. We found out that the glues for the plywood, such as stools and chairs, are urea-alkyd resins, typically used in the production of veneer.

The analysis and mapping of the degradation

In order to identify and map the different types of degradation relative to spaces and objects still used day to day it's necessary to focus first on the causes of their degradation or bad functioning. In this perspective the starting point we choose has been the comparison between the current conservative status and the original project. At this end we defined two kinds of degradation, i.e. a 'social' degradation and a 'physical' one.

The former followed an environmental mapping useful to identify the original objects and the non-original ones, used as substitutes. The causes of this kind of degradation are almost connected to the daily use of the room, to an incorrect maintenance that did not take in account the historical value of the "Collegi"s' furniture, and to the modified regulations concerning the use of public spaces. For instance, the ashtray originally provided in the rooms nowadays is no more there accordingly to the regulation that introduced a smoking ban in the building.

The second category describes the conservation state of each furnishing according to a traditional method for the classification of the decay pattern. Each object was disassembled and its parts were examined. Afterwards the degradations were mapped on the basis of the graphic models developed.

At the end of this phase we draw up a list of the main found, matching them with a descriptive photograph. The different typologies were analyzed starting from the causes and giving them a numeric value. This way we obtained a key for mapping the conservation state of the room.

As 'physical degradation' we classified 7 typologies of damages.

- ACT OF VANDALISM. Writings on the plastic laminate coating or even on the wooden support when the laminate is lacking. The black, red or blue marks are from pencils or felt-tip pens. There's a standing alone case of a white chemical substance, probably a whiteout.
- MISSING PARTS. In most cases the plastic laminate got unstuck, especially from the corners, due to a forcing performed by the users or caused by hitting. In the case of the table, the corners are lacking of the wooden support too. This might confirm the hypothesis that the damages were brought by a mechanical hitting. Actually the tabletop can be moved and could have been hurt as a result of continuos rearrangements. In the case of the cabinet there is a gap in the plastic laminate and another one in the support probably due to mechanical forcing on the surfaces.
- RESIDUAL OVERLAP SUBSTANCES. Residual adhesive substances probably due to colored stickers attached to the surfaces by students willing to customize the room. In most cases the residues are dark colored for they embedded the surrounding dust and dirt. In some other cases there are residues of scotch tape used to put up a poster or paper sheets to the furnishings' surface. The residues are light colored and it is no more sticky and it can be found on small non-uniform areas.
- OVERLAP SUBSTANCE. Stickers still attached to the surfaces or transparent, non identified material staining the laminate.
- > SURFACE DISCOLOURATION. By observing the objects closer some surface discolourations occur as spotted areas. It's possible that this kind of zoning affects the more superficial layer of the plastic laminate, altering its color without changing the tactile effect.
- MECHANICAL DAMAGES CAUSED BY USE. This is the type of damage easiest to be detected for it involves all the parts frequently running when using the objects. This parts should be kept by a scheduled maintenance, such as rusted screws and superficial layers detached by friction (as, for instance, in the case of the drawers).
- DETACHMENT. Degradation present where the plastic laminate doesn't adhere completely to the wooden support. This kind of degradation was detected on few parts of the furnishings.

In the end, the necessity to archive data – and make them readily available - led us to the development of a geodatabase, useful to insert the data in a clear and schematic way.

The system was built starting from a detailed floorplan of the "Aquilone", to provide a framework in which organising the geographic localisation data.

The project of the database was based on the following logical structure. Four sectors have been identified inside the Aquilone (AQ_body_AB, AQ_body_BC, AQ_biblio, AQ_teather). Each sector is organized by floor (ground_floor and 1st_floor). In turn each floor was distinguished in three layers: structure, infrastructure, furnishing. Each furnishing was matched with a descriptive table with general information.

By Interfacing a geographic information system (GIS) with the Conservation Digital Report (CDR) we introduced an important innovation. The CDR is an online platform recently created specifically for restorers. It is designed to register and organise all data concerning a restoration project.

While GIS system allows to archive information concerning the furniture - adding general description about quantity, authenticity, constitutive materials -, the CDR describes the objects (also with photos), defining their state of conservation, functionality and application.

In so doing it become possible to constantly update the information about furniture and give many professionals the opportunity to monitoring day by day the status of the "Collegi". The conservator – who should be in charge for the rooms' maintenance – would be able to access the CDR and update the conservative state. The manager – in charge for managing the whole complex– has the possibility to monitor the situation.

The final result is an combined system, easy to consult and browse, allowing a unique management of the many functional and conservative elements.

Annex 7. Survey and mapping of the state conservation's furniture and intervention

task A 2.1
PILOT SITE

COLLEGIO DELL'AQUILONE _ CORPO B BLOCCHI 1.3
STARTING JULY 2016

Enhancement of the building's envelope performances

Analyses of the envelope and of the indoor climate

The research performed by CECH includes an in-depth hygro-thermal analysis of a high-representative selection of rooms, an assessment of the energy retrofit proposals through a building-HVAC model and a test on a pilot site. Due to the architectural relevance of the buildings, procedures developed for the analysis and preventive conservations of cultural heritage buildings and objects have been used.

Authors have monitored surface temperatures, indoor air temperature and humidity for one year, since December 2015. This campaign of measurements consisted in a continuous monitoring of indoor and outdoor climatic conditions through data-loggers and seasonal thermographic and psychrometric mapping. This was to assess both the current hygrothermal comfort conditions, both the performances of the building envelope in different seasonal conditions.

Data have fed a building-HVAC model, which was used to design an appropriate strategy for retro-fitting and improving the energy efficiency of the complex. Some solutions were implemented on a pi-lot site in order to compare the building performances before and after the retrofitting.

Continuous monitoring was carried out in four bedrooms and in a common area of the "Aquilone" building. This building was selected among the five "Collegi" as it presents the most typical conditions. The surveys were then carried out on sample rooms and on common spaces within all the other build-ings of the complex. The map in Figure 1 shows the residential cells which were seasonally analyzed (red) and the residential cells which were continuously monitored via temperature and relative humidity sensors (blue).

Poster used outside the pilot site.

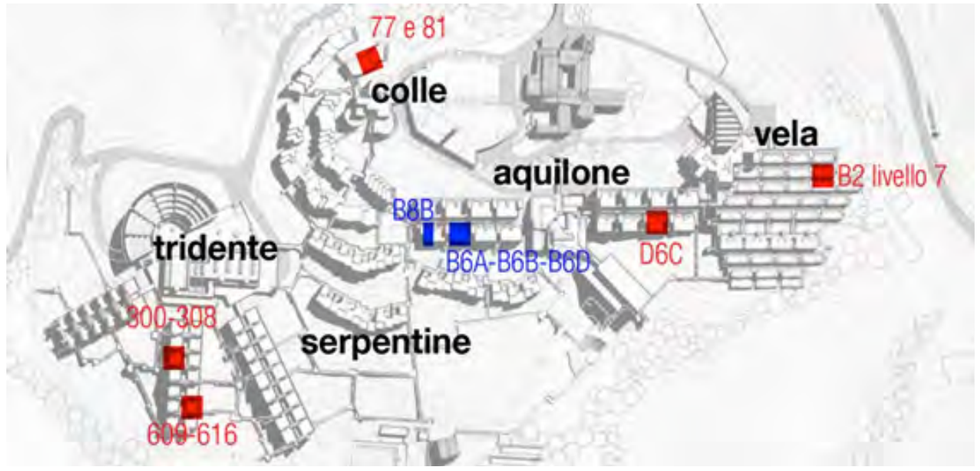


Figure 1. General plan of the "Collegi" with an indication of the analysed rooms.

Sensors (UNI, 2002) were installed in a couple of overlapping rooms on different floors (Room B6B and B6D) which is a re-curring configuration within the complex. They have then been compared with other rooms: Room B6A has a different position in the building layout and no external brickwalls. In Room B8B instead, the position is similar while the original window was substituted by a new one with an aluminum frame without ther-mal break. Sensors specifications follow the UNI EN 15758:2010 (UNI, 2010) and UNI EN 16242:2012 (UNI, 2012) standards. Their number, position and specific characteris-tics were determined via a preliminary analysis on-site.

Ten sensors for monitoring temperature (T [°C], accuracy: ±0,1°C at -25°C/+80°C) and relative humidi-ty (RH [%], ±2% at 0%/100%) were installed, four of which also measure the surface tempera-ture (Tsup [°C]). A total of twenty-two measuring points are thus radio-connected by wireless transmitters.

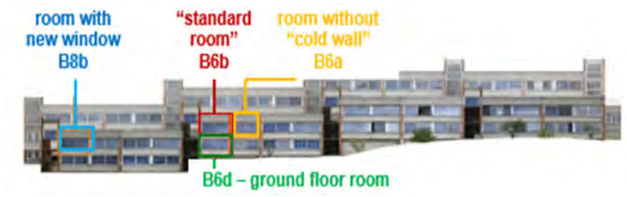


Figure 2. Position of the monitored rooms on the South-West façade of the building "Aquilone".

The sensors were temporarily removed from room B6A and B6B in October 28, 2016 due to the works on the pilot site. They have been re-installed in January 12, 2017 for monitoring the same rooms after the works.

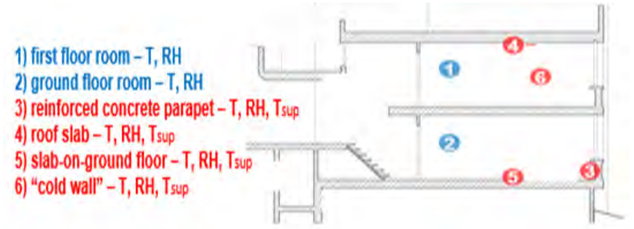


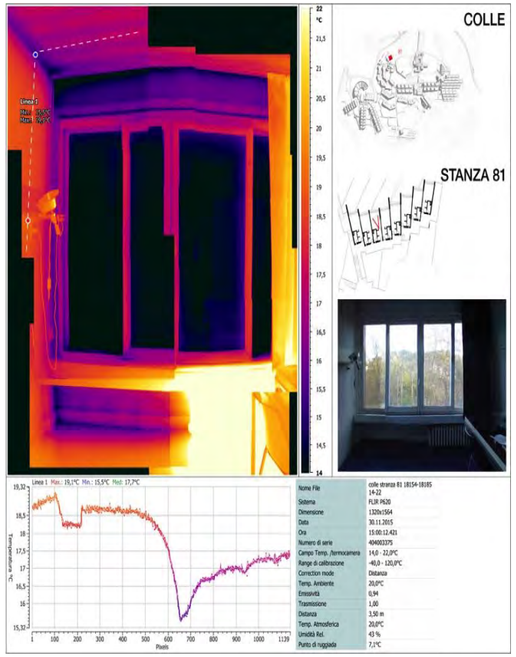
Figure 3. Position of the sensors along the cross-section of the building "Aquilone".

Thermal imaging has been used to detect heat losses, thermal bridges and heat gains due to the solar radiation. A FLIR P620 infrared camera (accuracy: ±2°C at -40°C/+500°C, resolution 640x480 pixels, thermal sensibility 40mK at 30°C) was coupled with an EXTECH MO297 (accuracy: ±0,1°C at -29°C/+77°C for air temperature, ±1% at 0%/100% for humidity) for a real-time cor-relation via Bluetooth between thermal image and air T and RH.

Temperature and humidity gradients were mapped through a digital psychrometer patented by the Department of Architecture and Urban Studies (DAStU) of Politecnico di Milano (Del Curto et al., 2016a,b). It is a customized version of TECNO.EL PsycroNet 600PW (accuracy 0.1°C, resolution 0,01°C) and it was used to measure on field T and RH following a virtual grid of around 1.5m. The values were then interpolated in order to obtain the gradients and the spatial distribution (in plan and/or section) of the main hygrothermal values (UNI 10829:99, UNI 10969:2002).

The U-value of one existing brick wall as been measured through a heat flux sensor.

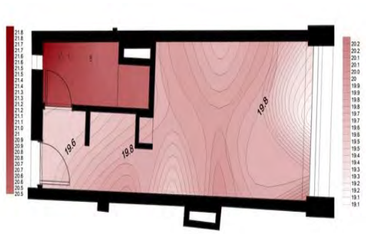
An overview of the results of the field-analyses are presented in the following sample images, while the complete results of the analyses can be found in the (Allex 8).

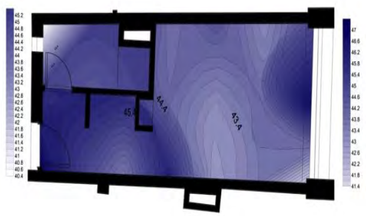


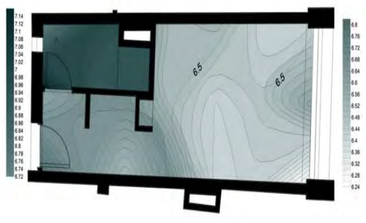
"Il Colle" room 81

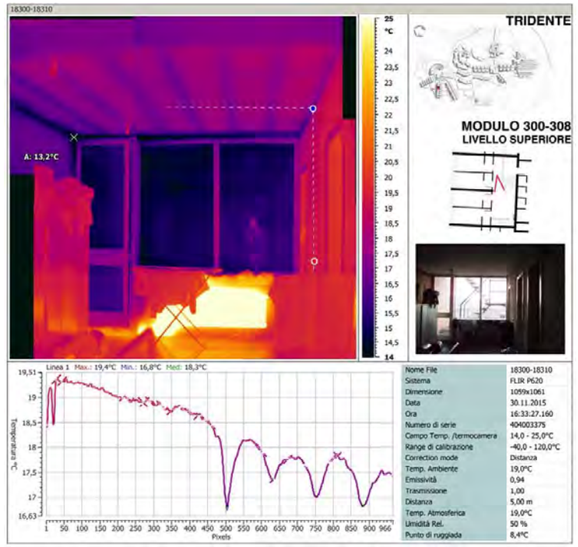
Thermographic survey and psychrometric mapping
red: T – blue: RH - green: SH

30.11.2015
outdoor conditions: T min 7°C - T max 12°C – RH min 43 UR% – RH max 71 UR%





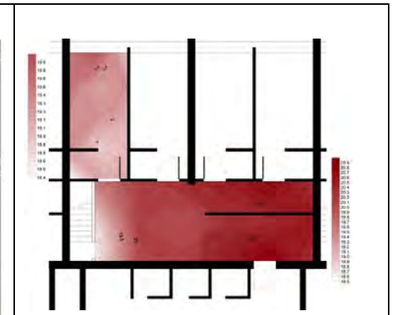


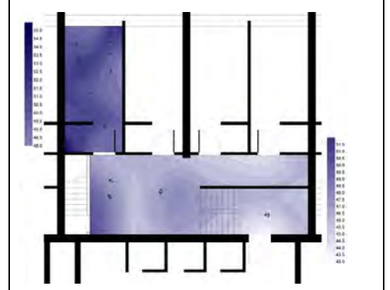


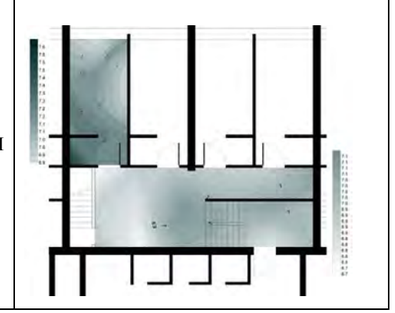
"Il Tridente" block 300-308

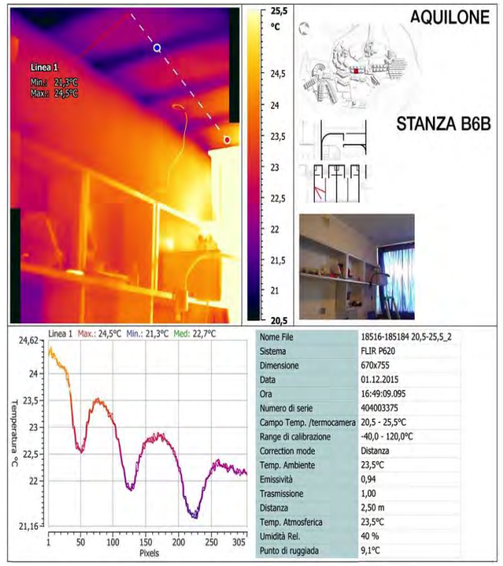
Thermographic survey and psychrometric mapping
red: T – blue: RH - green: SH

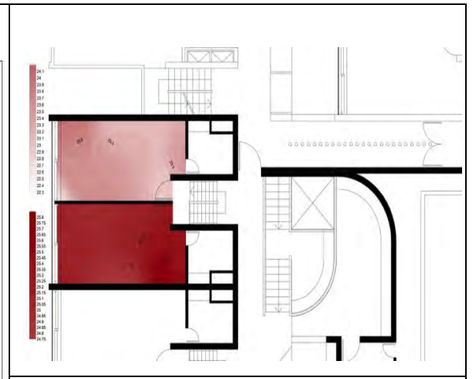
30.11.2015
outdoor conditions: T min 7°C - T max 12°C – RH min 43 UR% – RH max 71 UR%

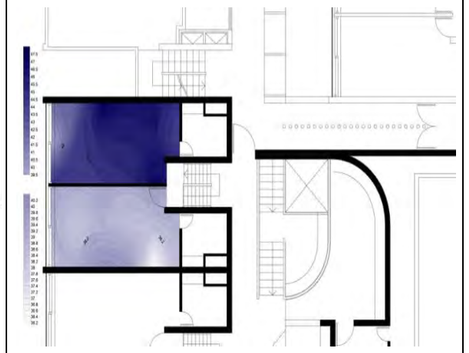


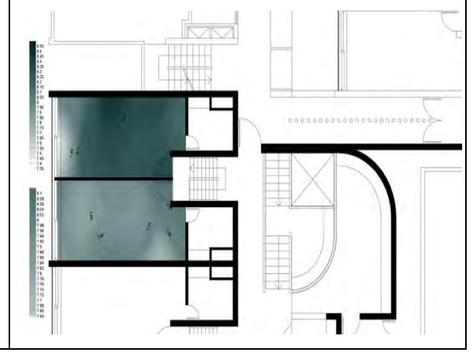








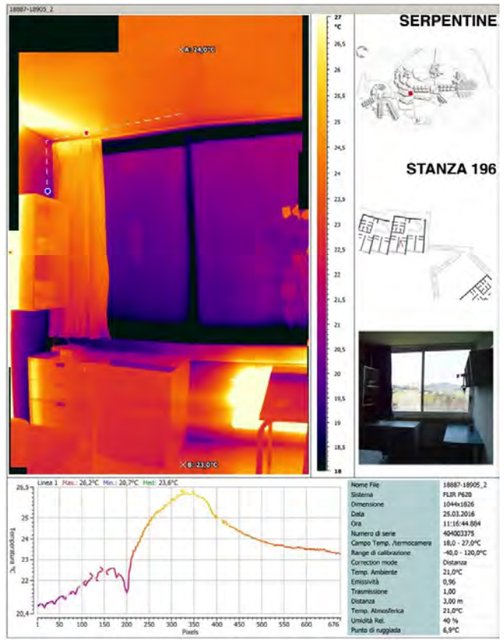


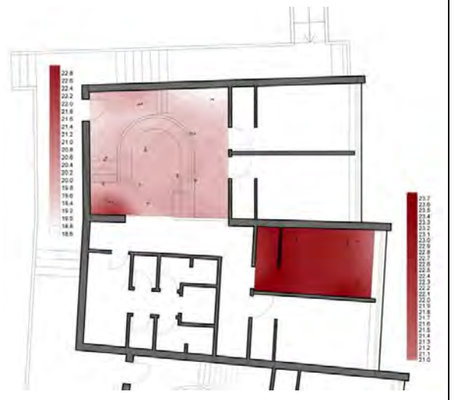


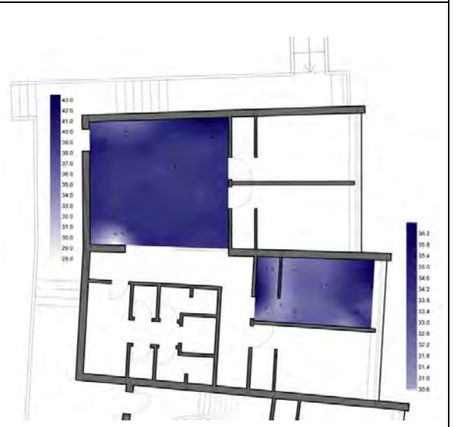
L'Aquilone: block B6

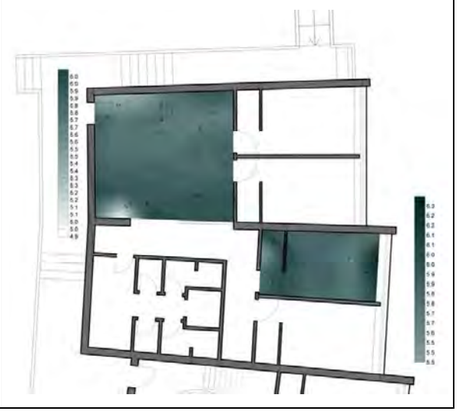
Thermographic survey and psychrometric mapping
red: T – blue: RH - green: SH

30.11.2015
outdoor conditions: T min 7°C - T max 12°C – RH min 43 UR% – RH max 71 UR%





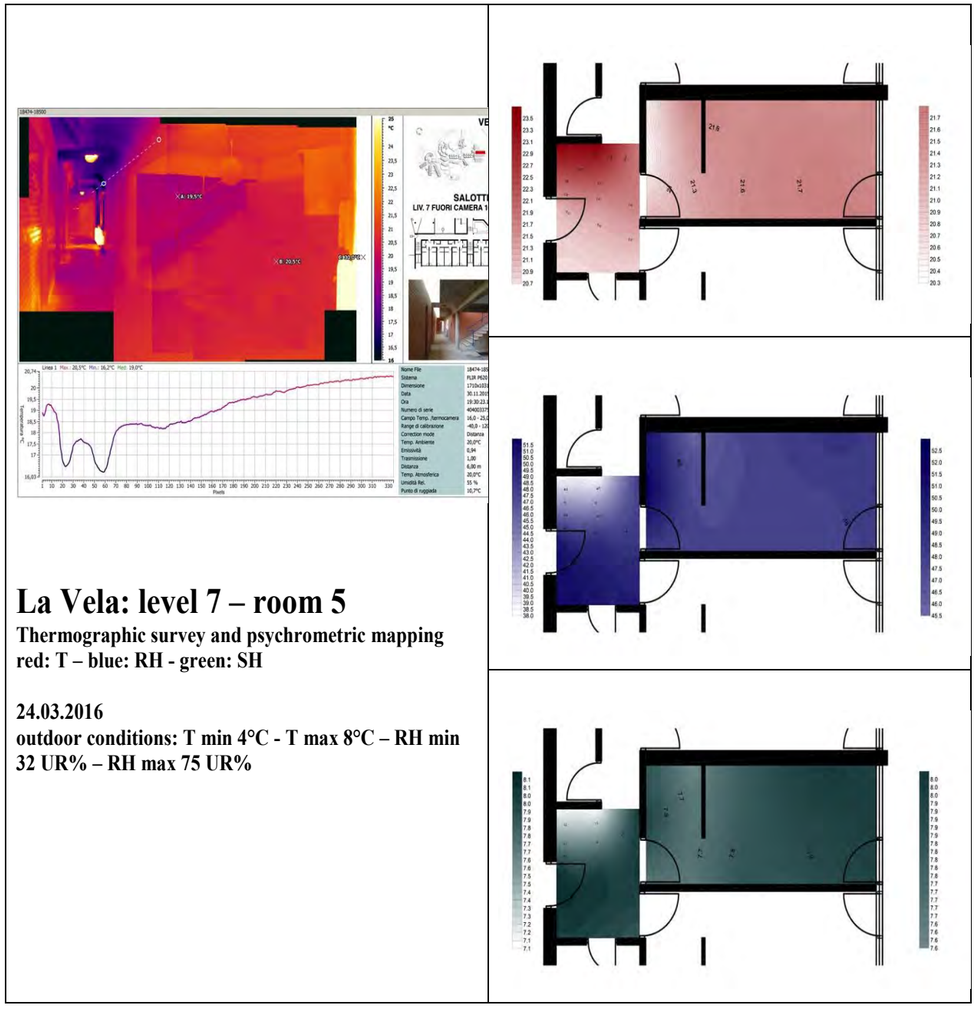




Le serpentine: block 196

Thermographic survey and psychrometric mapping
red: T – blue: RH - green: SH

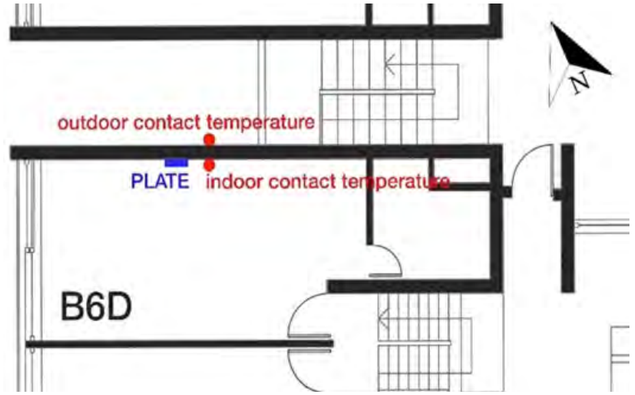
24.03.2016
outdoor conditions: T min 4°C - T max 8°C – RH min 32 UR% – RH max 75 UR%



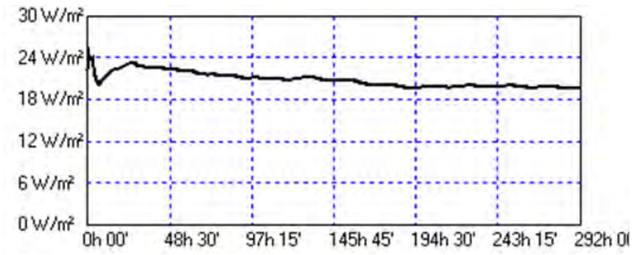
La Vela: level 7 – room 5

Thermographic survey and psychrometric mapping
red: T – blue: RH - green: SH

24.03.2016
outdoor conditions: T min 4°C - T max 8°C – RH min 32 UR% – RH max 75 UR%



"Aquilone", room B6D, thermal conductance survey Layout



Thermal Conductance average 2.10.2017 – 22.10.2017

Indoor climate assessment and building simulation

The indoor climate analyses and monitoring aimed at assessing the hygrothermal conditions and the effective compliance of the heating system with its set-points. The monitoring also allowed a verification of the correct operation of the system and of the thermal comfort conditions for different users of the building. Furthermore, it provide useful information to understand if these imbalances are due to the type of system, to problems of faulty installation or simply to a faulty control system.

Hygrothermal analysis

Data have been processed and results presented according to UNI 10829:1999 "Assets of historical and artistic interest - Environmental Storage - Measurement and analysis", in particular Appendix D "Modalities for the calculation of the environmental parameters" (UNI, 1999). For each measured parameter, the maximum, minimum, average, and standard deviation, the daily and annual temperature range, time profiles, the frequency distribution and the cumulative frequency were determined.

In order to extend to the whole complex the results obtained by monitoring few rooms, it was necessary to move from a detailed to a more synthetic observation, related to the frequency of acceptable ranges. During the winter monitoring period (01/12/2015 - 07/05/2016), a *Performance Index* was calculated, i.e. the percentage of time the microclimatic parameters fall within an acceptable range. Two Failure Indexes, were also calculated to better analyse the causes of the data deviations:

- *Cool Failure Index:* percentage of time in which the indoor temperature falls below the lower limit of acceptability;
- *Warm Failure Index:* percentage of time in which the indoor temperature falls above the upper limit of acceptability.

Temperature ranges have been defined on the basis of the set-point of the heating system, while relative humidity has been defined on the basis of the standards UNI EN ISO 7730: 2006 and ASHA-RAE 55:

- for average daily temperature: 19°C ≤ Taverage,day ≤ 21°C 18°C ≤ Taverage,day ≤ 22°C
- for average daily relative humidity: 40% ≤ RHaverage,day ≤ 60% 30% ≤ RHaverage,day ≤ 70%

A high percentage of Warm Failure Index can be seen in Fig.4. Room B6a, in the right-side graph, has not external and dispersing walls. High values in temperature are thus due not only to the possible over-heating but also to the solar gains. The relative humidity acceptability intervals of all the sensors are respected for the:

- 72% of the days, considering a 40% - 60% range
- 96% of the days, considering a 30% - 70% range

The acceptability thresholds defined in the regulations are given by the need to protect the health of the occupants, considering their physiological reactions, such as dry skin, irritation of the eyes and upper respiratory tract, and the need to prevent the proliferation of biological contaminants (UNI, 2015).

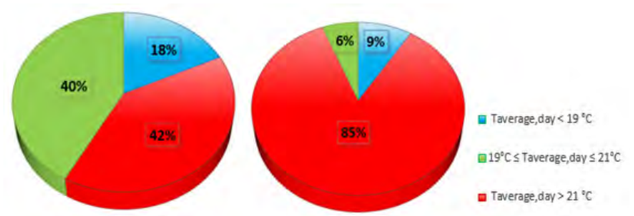


Figure 4 - Average daily temperature - Verification of thermal comfort range for all the selected rooms (left) and for room B6a (right).

The analysis of the average daily temperature has been compared also to the average tempera-ture calculated during the heating hours, in order to verify the compliance with the temperature set-point. An average of 20 °C in all the rooms can be observed in Fig.5. Different values have been measured by the sensors placed into the block of the common spaces and by the sensor placed close to the external wall. In 50% of cases, the temperature in the common areas remains below 20° C. Common areas are large spaces separating the rooms from the outdoor environment. They cannot benefit from free solar gains as the rooms, because they have not any large window facing South-West, nor they can benefit from thermal gains due to the presence of people, as they are usually underused. Common areas are just equipped with some radiators placed around their perimeter but, considering the huge volume to be heated, the lack of an insulated envelope and the lack of temperature control, they are not sufficient.

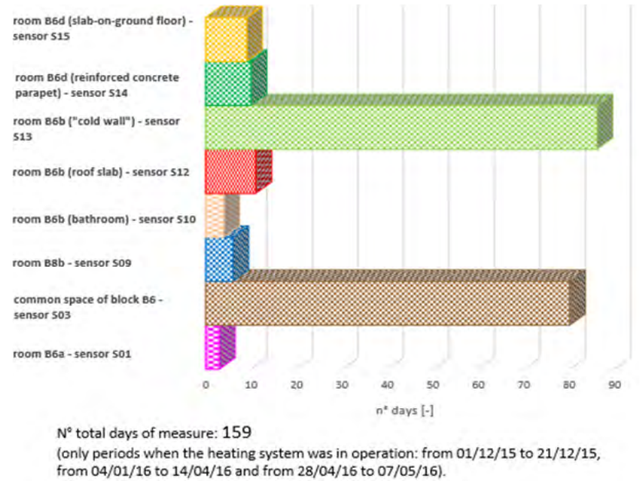


Figure 5. Number of days with indoor temperature < 20° C from 8 am to 10 pm.

Near the dispersant wall in room B6B, air temperature was < 20° C for the 54% of the days monitored, thus highlighting a possible local discomfort. For this reason, it was decided to consider also the air operating temperature and not just the ambient air (see par. 3.2). Anyway, data show how the indoor climate and the internal comfort of the "Collegi" are influenced both by the low thermal inertia of the not-insulated building, both by the high thermal transmittance of the windows.

The analysis then focused on comparing data from two weeks, with the heating system respectively switched on or off and characterized by bad weather days (due to rain, snow and/or fog) or clear sky. This distinction is to detect the magnitude of solar gains, especially through the windows, when the heating is off.

Since the building has no cooling system, the analysis of the summer monitoring period (08/05/2016 – 15/10/2016) requires, in accordance with the UNI EN 15251:2008 (UNI, 2008), a "thermal adaptive comfort model", which incorporates the definition of psychological well-being and considers the users' perception of the environment. The adaptive model consists in identifying a correlation between the thermal sensation and the main climatic variables. The acceptability interval Class II represents a normal level of expectation and should be used for new buildings and renovations. The acceptability interval Class III represents an acceptable, moderate level of expectation and may be used for existing buildings. They both have been verified. Fig.6 shows the trends of daily average temperatures for all the installed sensors and the acceptance bands of the adaptive method. The thick black line represents the comfort temperature under varying external conditions, calculated according to the adaptive method (ISO 15251). The dashed black lines represent the Class II comfort range. The black dotted lines represent the Class III comfort range. Fig.6 also shows that all rooms have excessive heating, especially room B6a (in magenta).

The summer period was analysed, with special regard to thermal excursions and to the influence of solar radiation, which increases the temperatures in the rooms in contact with the roof (12/07/2016), since these rooms disperse heat only towards neighbouring rooms and towards the roof slab and during summer the roof is the building component reaching the highest temperatures. Consequently, the measured indoor air temperatures are also very high, with a maximum of 41.3° C in B8b room (in blue), 39.6° C in B6a (in magenta) and 39.0° C in B6b (in red). Very high temperatures are also due to the incoming solar gains, since windows lack any kind of solar control. There is not any external screen to prevent overheating and indoor curtains made of cotton give the only protection. These rooms are thus very warm and dry (for example, in room B6a relative humidity is < 30% for the 66% of the days) negatively affecting the thermal comfort.

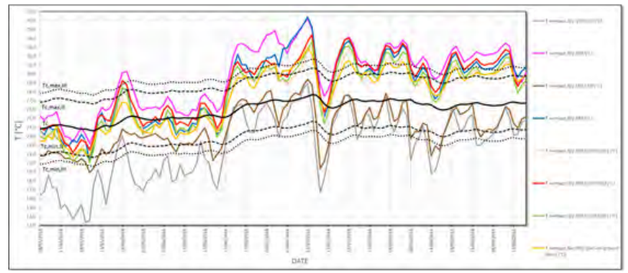


Figure 6. Daily average air temperatures with the acceptance bands according to the adaptive method.

Analysis of the hygrothermal comfort conditions

The hygrothermal comfort was analysed through the air operating temperature, which includes the linear average radiation temperature. An analysis considering only the air temperature would not be complete and may be misleading, since to determine the optimum comfort conditions the local thermal discomfort should also be considered. The measurement of the mean radiant temperature is obtained using five different points in the four monitored rooms, through the calculation of the view factors (ASHRAE, 2013). We have chosen to analyze the most critical situation in winter conditions. We considered the air temperatures registered by all the sensors installed during the coldest week, from 01/11/2016 to 24/01/2016. We made a distinction between the averages registered when the heating system was in operation (from 8 am to 10 pm) and those registered when the heating system was turned off (from 11 pm to 7 am).

Fig.7 shows that the air temperature in room B6B is 20.6°C while the linear radiating temperature next to the dispersant wall (point C) is 17.5°C, thus resulting in a 3.0°C difference. During the nights, when the heating system is not operating, the temperature falls to 16,3°C. Considering the average of the two, an operating temperature of 19.1° C is obtained, thus resulting in a discomfort of 1.5° C. The thermal discomfort was detected in particular close to the dispersing walls and to the windows with high thermal transmittances (5,522 W/(m K).

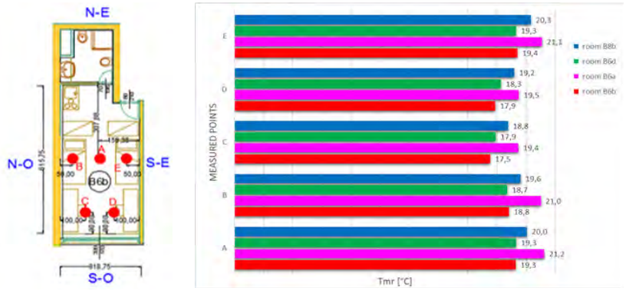


Figure 7. Room B6b with the position of five measurement points. Mean radiant temperature when the heating system is operating (right).

The local thermal comfort indices PMV (Predicted Mean Vote) and PPD (Predicted Percentage Dissatisfied) were calculated in the two most of critical points (Fanger, 1972). A software provided by AICARR based on UNI EN ISO 7730:2006 (UNI, 2006) was used. The values of the clothing thermal resistance were set equal to 1 clo (1 clo = 0.155 m2 · K / W), estimated by the table for standard winter home clothing's man. The metabolic rate is equal to 1.1 met (1 met = 58.2 W / m2), corresponding to the metabolic activity of a person sitting in an office (for the point C) and 0.8 met for a person sleeping (point B). Point C is the most uncomfortable when the heating system is on. Supposing a student sitting at a desk by the window during the day, the PMV is -0.99, outside the limits of acceptability of ± 0.5 according to UNI EN ISO 7730, and corresponds to the class C. The percentage of dissatisfied results in 25.6% expressing the feeling "very cold". Supposing a student lying down on the bed during the night (point B) we obtained an expected average score of -2.85, corresponding to a condition of absolute localized thermal discomfort and a feeling of very cold, with a 98.2% percentage of dissatisfied persons.

Thermographic survey and psychrometric mappings

To deepen the analysis of the building envelope performances and of the internal hygrothermal comfort, thermographs were made in some specific points of the walls in order to detect the thermal bridges, the moisture in the structures and the thermal losses of building's components. Thermographic surveys were also made to map the surface temperatures of the inner and outer walls. They were performed every three months in order to find out the behaviour of the building with different seasonal conditions. With the same frequency, a portable digital psychrometer was employed to map the temperature and humidity distribution in relation to the external conditions in different rooms and common areas of the five "Collegi".

Thermography has confirmed the thermal discomfort of the outer dispersant wall, which has been discussed in the previous paragraphs. The graph in Fig.8 shows the thermal gradient between the roof slab and the dispersant wall in the points highlighted by the dotted line in the thermal image. It is possible to notice a minimum of 16.2°C in correspondence of the connection between the wall and the ceiling, with high heat losses in this thermal bridge. We can also observe a difference in temperature between the slab which is 20.8°C and the wall that is 17.5°C. These local thermal discomfort were also detected in other "Collegi", especially at "Il Colle", where a surface temperature of 12°C was measured (room 83, 25 March at 10 a.m.). The psychrometric mapping on the left of Figure 8, confirms that the temperatures within the room with an outer dispersing wall are lower than those measured in an inner room. In room B6b the temperature is around 23.5°C while in room B6a is around 25.5°C. In the point of minimum air temperature, close to the "cold" wall, a maximum of specific humidity can be observed, probably caused by the evaporating effect of leaked water. The internal hygrothermal gradients are also strongly affected by the poor performance of the win-dows, which are a major issue for obtaining stable and suitable conditions.

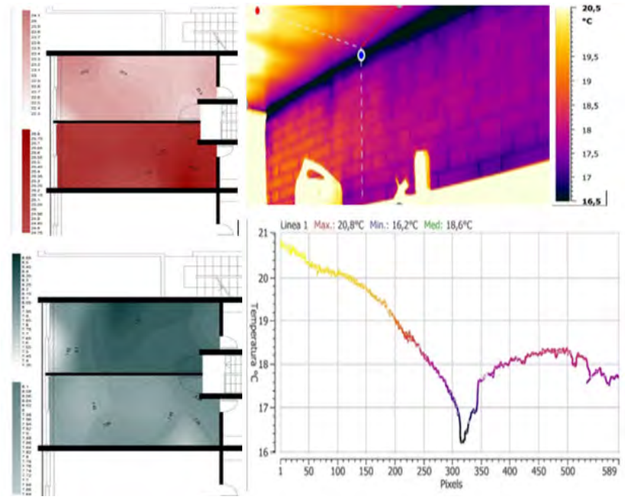


Figure 8. Distribution of temperature (top left) and specific humidity (bottom left) in B6b room (top) and B6a (bottom) of the building "Aquilone" – 31/11/2015. Thermal image of B6b room with the thermal bridge between the wall and the roof - 01/12/2015 (right).

In Fig.9, the same rooms were analysed during summer. On the left, the temperatures in rooms B6b and B6a are compared to those in the common space of block B6. The latter shows a temperature of around 24°C while the rooms are excessively warm, with a temperature of around 30°C. In the thermal image,

the ceiling's concrete joists are perfectly visible, just like all the non-insulated structures. The concrete structure of the ceiling is also visible in the thermal imaging of other buildings of the complex. The surface temperature of the inner side of the roof reaches 35°C, which is a very high value and confirm the data gathered by the sensors mentioned in the previous paragraphs.

Figure 9. Distribution of temperature (left) in B6b room (top) and B6a (bottom) compared with the common space (in the middle) of the building "Aquilone" – 14/07/2016. Thermal image of B6b room - 14/07/2016 (right).

Energy simulation and assessment of the retrofit proposals

After the analysis, the building-HVAC system was studied through an energy simulation software. Information on facilities and equipment has been collected by means of archival research and on-site inspections. The building-HVAC simulation was carried out with the "MasterClima MC 11300 PRO" by AERMEC. Two blocks of rooms of the "Collegio dell'Aquilone" were modeled, including bathrooms, connection spaces and common lounges (gross volumes of 14,143.70 m3, usable area of 3944.00 m2). "Aquilone" was chosen for the installation of the sensors and for the energy retrofitting pilot site in or-der to compare the situation before and after the retrofitting. The model was then validated through a comparison between the real consumption of methane and the temperatures measured by the installed sensors.

The simulation model applied to the original configuration allowed a calculation of the thermal load in the winter (585.85 kW) and summer conditions (377.66 kW). This initial analysis suggested the need to correct thermal bridges by means of insulating the opaque components, and to improve the performances of the windows, even considering their possible substitution. The roof slab has an influence of 12.3% of the total dispersion. It thus needs some improvement, also considering the recurring problems of water leaking from the roof.

Four different scenarios for the insulation of opaque components were combined with three different types of windows, obtaining twelve different "combinations". They were compared to define an appropriate intervention strategy which was later implemented in the pilot site. Any proposal of retrofitting the envelope had to cope with the historical and architectural value of the "Collegi". Insulating by external coating was thus considered unacceptable in a conservation perspective, even if it would contribute to solve many energy issues. Also filling the wall with insulating materials was not an option, since there is no cavity to fill. The only option for the outer walls was thus internal insulation.

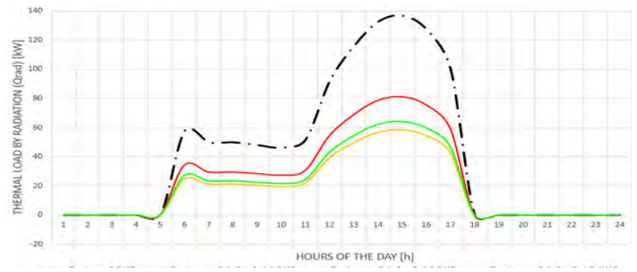
Three different proposals were simulated for the roof: an external insulation layer of 8 or 12cm was compared with a warm-roof configuration with the waterproofing layer below the insulating layer. The latter provides a better protection of the waterproofing layer from thermal shocks and avoids the risk of condensing vapour within the insulating layer. All the options (see Fig.10) were discussed among the different members of the project team, especially with those responsible of the retrofitting design and those in charge of the building maintenance and management. The goal was to find the best balance between conservation issues, energy efficiency and a realistic and effective intervention.

CASE 0	U [W/(m² K)]
ROOF SLAB: concrete hollow slab, not insulated	1,406
PARAPET: reinforced concrete, not insulated	2,369
"COLD WALL": exposed brick, not insulated	1,588
CASE a	U [W/(m² K)]
ROOF SLAB: external insulation layer of 8 cm in extruded polystyrene foam	0,289
PARAPET: internal insulation layer of 5 cm in mineral wool and gypsum	0,419
"COLD WALL": internal insulation layer of 5 cm in mineral wool and gypsum	0,358
CASE b	U [W/(m² K)]
ROOF SLAB: external insulation layer of 8 cm in extruded polystyrene foam	0,289
PARAPET: internal insulation layer of 5 cm in mineral wool and gypsum	0,419
"COLD WALL": not insulated	1,588
CASE c	U [W/(m² K)]
ROOF SLAB: external (8 cm) and internal (5 cm) insulation layer in mineral wool	0,222
PARAPET: internal insulation layer of 5 cm in mineral wool and gypsum	0,419
"COLD WALL": internal insulation layer of 5 cm in mineral wool and gypsum	0,358
CASE d	U [W/(m² K)]
ROOF SLAB: warm-roof with insulation layer of 12 cm in extruded polystyrene foam	0,215
PARAPET: internal insulation layer of 5 cm in mineral wool and gypsum	0,419
"COLD WALL": internal insulation layer of 5 cm in mineral wool and gypsum	0,358

Figure 10. Scenarios for the insulation of the opaque envelope.

The preservation of the windows proved to be more difficult. This confirms that the results already acquired concerning the conservation of historic windows (Ortelli et al., 2012) may be useful even when dealing with the windows of a wide XX century complex, e.g. the "Collegi". Fig.11 shows that, by replacing the transparent components with a solar control glass, it is possible to obtain a consistent decrease of the total summer thermal load, since

the thermal load by solar radiation is drastically reduced. This is clear when we observe the gap between the continuous colored lines (solar control glasses) and black dot-dashed line (existing glass). The reduction of the radiation heat output was evaluated considering the solar factor, the emissivity and the selectivity of three different types of solar controlled glass. Solution 1 (red curve) results in terms of thermal power by radiation, a lower reduction compared to the case 0 (black curve) because the low emissivity glass has a solar factor (g) greater than the other two cases. In addition, the low-emissivity glass of type 1 has a lower emissivity on the inner surface. This generally results in a significant reduction of magnitude if the room is air-conditioned in summer. The selective glass of type 2 (yellow curve) is the most powerful in terms of solar factor, of emissivity of the outer surface and especially in terms of selectivity. This window allows the greatest reduction of the heat load in summer conditions given that the high selectivity (1.9) allows an increased light transmittance. The solar factor is the ratio between the solar incident energy on the total glazed incoming surface. The energy expenditure of an air conditioned room can be controlled by keeping this factor as low as possible in the summer. In fact the second type has the lower solar factor (0.31).



TYPOLOGY OF GLASS TO SOLAR CONTROL: DOUBLE-GLAZED WINDOW WITH	g [-]	ε_{ext} [-]	ε_{ext} [-]	selectivity
CASE 1: STRATIFIED LOW- EMISSIVITY GLASS	0,43	0,04	0,29	1,56
CASE 2: STRATIFIED SELECTIVE GLASS	0,31	0,02	0,46	1,90
CASE 3: TEMPERED SELECTIVE GLASS	0,34	0,04	0,41	1,68

Figure 11. Thermal load by radiation in the existing windows and after the substitution of the window glass.

Following the DM 26/06/2016 (DM, 2016), for each of the twelve cases of intervention, the energy performance indices, the thermal and primary energy requirements and natural gas consumption were calculated, besides the variations of thermal loads in winter and summer conditions. The best intervention scenario was selected considering the combination of the winter and summer case. Results are in Fig.12.

Fig.13 shows a simulated comparison between the existing and upgraded performances in the thermal energy required for heating (in red) and for cooling (in blue) the rooms; a potential decrease up to 52.9% is expected for the former, up to 23.7% for the latter.

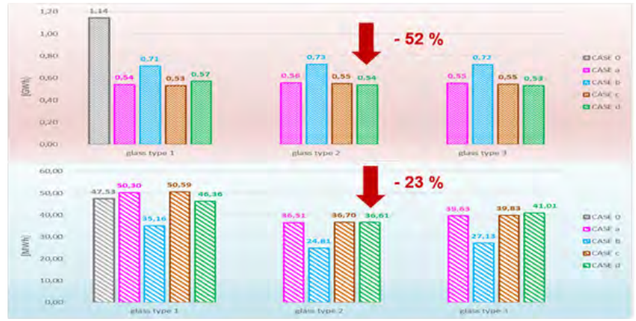


Figure 12. Thermal energy demand for heating (top) and for cooling (bottom) in the twelve intervention scenarios and in the existing situation.

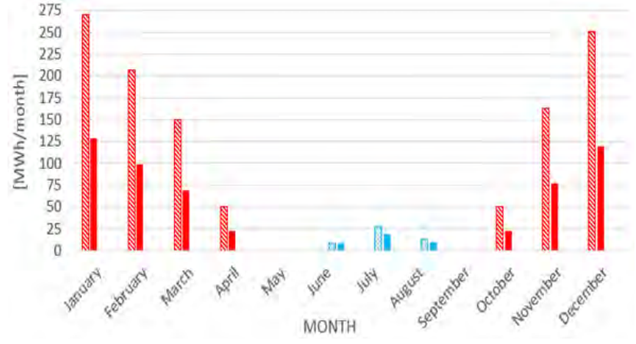


Figure 13. Comparison between the existing energy performances and the simulated ones with the chosen solution.

Annex 8. Results of the terminal analysis and of the building simulation

The Pilot site

The improvement of the envelope to obtain an energy sustainability of the "Collegi" complex was one of the objectives of the Plan and among its primary aims was the reduction of management costs and an improved interior comfort for the buildings in particular the students' rooms.

To find solutions to these problems it was necessary to improve our understanding of the characteristics of the envelope and to measure the climatic conditions. The buildings are of a very simple construction design: the majority of the residential blocks were made with bricks walls and reinforced concrete and hollow tile slabs. On the external walls there is no insulation and on the roof there are generally only a few centimeters of very low performance insulation. The window frames are of wood and single glass plate most of them replaced or, if originals, in a poor stare of repair.

The building envelope has been the subject of a dedicated research led by the Milano Politecnico CHEC Group and, based on the results of this discovery phase for possible solutions, an intervention was subsequently programmed for a small and select part of the complex that has since become the pilot site.

The choice of the pilot site

As part of the site analysis, laid out in the sustainability chapter, one part of sector B was identified, namely blocks B6 and B8 of the "Aquilone" residences. Our choice was influenced by their position, according to the orientation of the "Collegi" and their ease-of-access, so as to facilitate the on-site interventions of the pilot. Inside Block B6 we identified those rooms where we would check the microclimate conditions. They were identified according to the current numeration, as follows: B6A within other rooms on the second level; B6B with an external wall on the second level; B6D with an external wall on the first level. Block B8 was then chosen; B8B matches the homologous block B6 but with an aluminum window frame – not an original and recently installed.

In parallel, an analysis was elaborated with monitoring research and software modelling installations (MC 11300 PRO version 3.04 according to UNI TS 11300 and new climatic data according to UNI 10349) whose reliability was measured and verified. Before beginning interventions to the buildings, we were able to simulate the possible transformations, based on modelling, and to evaluate results in terms of internal comfort and energy-savings.

"Aquilone". The cells of the pilot site.

For the pilot site, in agreement with the Milano Politecnico CECH Group, we chose to intervene in rooms B6A and B6B of the block B6 of the "Aquilone" as representative samples for positions and according to an analysis of the worst climatic conditions: one of them with an outside wall and both on the second level suffered as a result of the poor performance of the terrace roof. Therefore, using the measurements before the interventions, the virtual model simulations and finally, the measurements following on-site repairs, we arrived at a proposed solution.

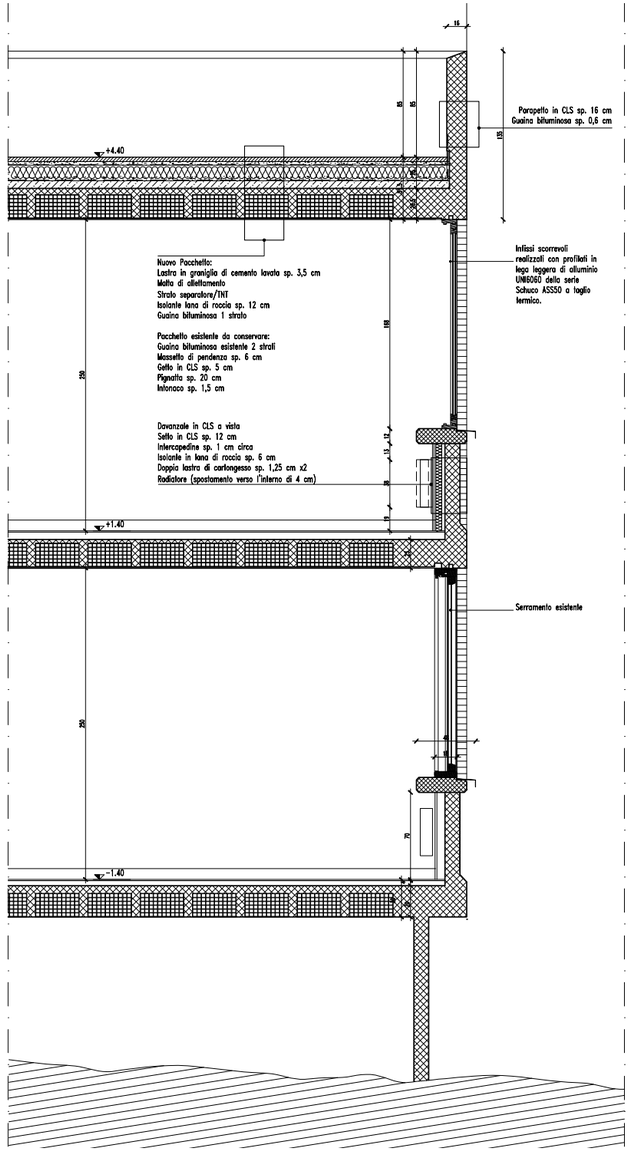
Intervention on the envelope
Insulation

As part of our search for a partner to develop the project, we conducted market research into insulation solutions currently in production. We contacted those companies offering a large range of insulation materials and which demonstrated a keen interest in the work. We finally selected Knauf Insulation which actively worked with us in supply the analyses and technical data relating to different solutions.

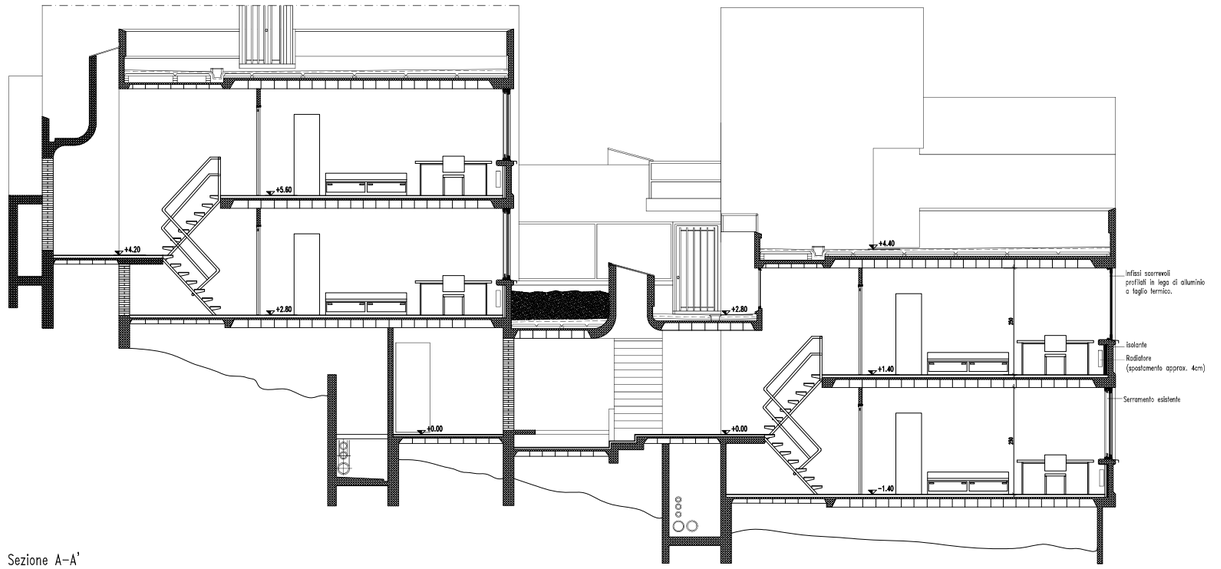
The envelope data, as part of the analyses, show the need for improvements in the roof, the external walls and parapets under windows, usually built with a far-faced concrete septum of minimum thickness. We had also conducted an on-site survey of materials and thickness of external walls and roof components to ascertain current state and check correspondence with the original project.

Obviously we could not and did not want to work from the outside: the far-facing concrete and bricks walls should be preserved, so interventions had to be concentrated on the roof and on the perimetrical portions where it was easy to apply insulation, but working only on the surface of inside walls.

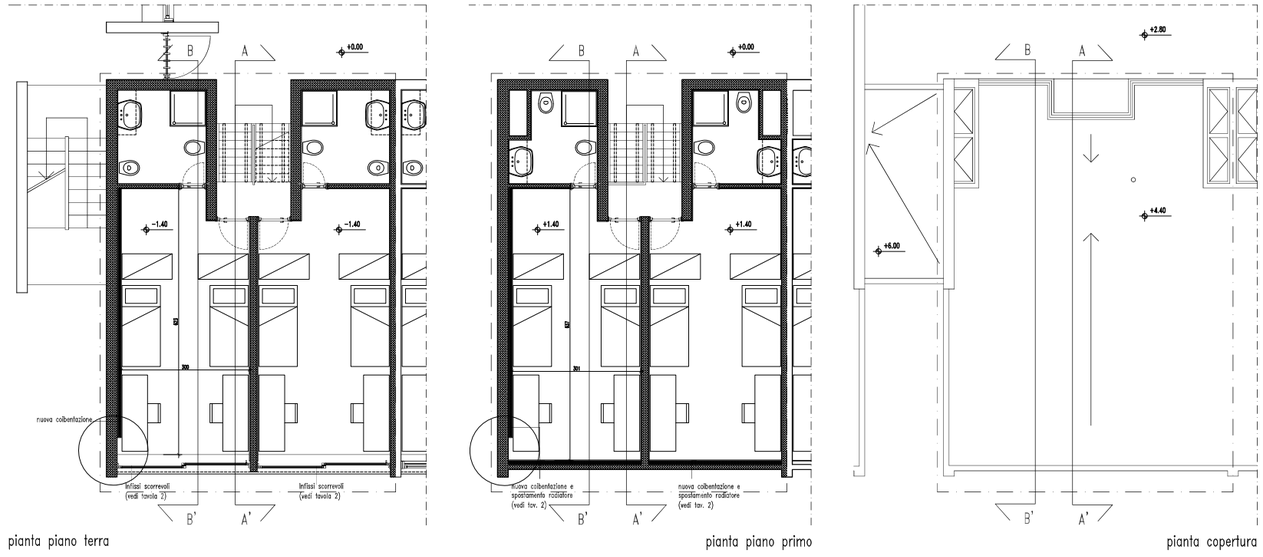
As regards the roofs slab, different combinations were simulated to increase insulation, with tests of different materials and thicknesses, with solutions that that took into consideration the modelling and measurement data but also the various problems caused by an increased thickness of the roof and in turn an reduced height of parapets; by water collection, and by interventions that compromise the functionality of the complex. See Fig.10-11-12-13 pp.247-249.



Pilot site. Drawing representing the interventions on the walls and on the terrace roof. Section.



Sezione A–A'



Pilot site. Drawing representing the interventions on the walls and on the terrace roof. Plan.

As a result, we defined a new insulation pack applied to the existing sheath that was not removed for convenience. The solution was generally defined as a "reverse roof" for the position of the insulation above the sheath. This solution provided the best results in the model testing and the insulation position provided a longer shelf life, less exposed to solar radiations. By removing

the concrete slabs and the lure mortar, two new layers of sheath and 12 cm thick polystyrene were laid. On these, flooring was then replaced.

The insulation of the external walls was contained at a minimum thickness to obtain acceptable transmittance values and similarly was applied to the concrete parapets. Rock wool insulation panels were installed on steel frames, covered by two layers of plasterboards panels. The last part of the masonry near the windows, with a width of about 30 cm, was not covered, to avoid changing the window frames dimensions and leaving the original inner brick wall intact. Of course it was impossible to eliminate all thermal bridges, but the solution was less invasive and the results of the simulations before, and subsequent measurements, gave us significant saving reduction values in terms of consumption and increased internal comfort.

Windows

The research on the above-mentioned window frames, allowed us to create the new windows in rooms B6A and B6B. In the development of building designs, the solutions were refined for the flashing of the window sill, made of light gray zinc-titanium, resembling the original color. The shape of the original flashing was reproduced and the insulation, not present in the original sill, was inserted.

The two installed windows, while made of aluminium, are identical to the original in terms of dimensions and sliding opening, similar in the frame thicknesses as visible from outside. The two prototypes installed have only a few differences: in the opening, they are simple and slide upwards and their finish is opaque or slightly embossed. These differences will allow us to verify wear and performance over time.

The glass was also carefully evaluated, choosing an extremely efficient solution both in terms of transmittance and solar filter, so as to overcome the problem of sunshine and indoor summer temperatures, highlighted as one of the most disconcerting issues during the summer months. The choice also considered glass transparency as a prominent factor to avoid the mirror effects.

The study on ventilation

The problem of condensation, owed to dampness caused by scarce ventilation, has always been prominent in the rooms of the "Collegi". One of the reasons for the deterioration of the wooden window frames is the accumulation of internal condensation at the base of the frame, due to an absence of double glazing and thermal break profiles. This problem is further aggravated by the use of the showers in bathrooms without proper ventilation. The data of the measurements gave us an objective confirmation of this problem. New window and door frames, made with double glazing and thermal break profiles, remove the infiltrations and therefore reduce the draughts and so the problem of condensation had to be solved with specific solutions.

In conclusion, the pilot site experience has shown how the solutions developed in the modeling phase as an improving of the insulation of the walls, roofs and windows required to be adapted to the site during the executive phase. In particular, the insulation of walls and roof slab has been slightly changed in thickness and/or extension. This may naturally involve local risks of superficial or interstitial condensation. For this reason, the issue of ventilation should be further investigated.

To make the envelope more efficient means avoiding a change of in the rooms by opening windows. This causes dispersions that drastically affect internal temperatures. It lowers them in winter and increases them in the summer, resulting in higher and wasteful energy consumption.

The solution we developed took into account these issues and above all the impossibility of operating with a system with a single air-handling unit and distribution made with large air ducts. We therefore thought to use small air-handling units with a heat exchanger, localized in the individual blocks servicing two to four rooms. This system does not require invasive interventions, is flexible in use, and is feasible by stages. The air-handling unit would be activated using detection probes for temperature, humidity and CO2. They can be programmed for a cycle of night-time free-cooling activities that allow lower temperatures by introducing fresh air from the outside during the summer.

Pilot site. The new insulation on the terrace roof.

Once the site and solutions were defined, the construction site was managed in three phases. The works was funded partly by the Plan, partly by the University in terms of materials and staff, and partly by private companies as sponsors.

The first phase was the realization of the insulation on the terrace roof. The paving in concrete slabs of the terrace roof were removed and set aside. Then the mortar on the existing sheath was removed. Two layers of bituminous sheath and insulation with extruded polystyrene sheets were laid, and finally the concrete slabs were re-fitted with a fresh layer of mortar. The new tread is higher than the previous 12 cm and this means the parapet will have to be raised.

In the second phase we intervened in the interiors by demolishing the small counterpart of the concrete parapet, putting in place steel frames, insulation and plasterboard plates. Finally, the windows were replaced. All interventions were carried out by university workers, and students were temporarily rehoused for a few days only during the work.

Annex 9. Interventions on the envelope in the "Collegi" and on the pilot site

The "Tridente" service building (Photo Giorgio Casali. Università Iuav di Venezia - Archivio Progetti, Archivio Giorgio Casali)

Setting of the conservation / maintenance program

Towards a preventive approach

One of the goals of the "Keeping It Modern" project has been to set a conservation/maintenance plan aimed at the conservation of the materials and architectural elements, that will suggest a program of periodic inspections, preventive actions, and interventions, consistent with the values of the building and with the general framework established in the "Conservation Plan".

That tool has been conceived starting from the "Preventive Conservation" approach, a methodology based on a very simple concept: a systematic practice of prevention makes it possible to control the causes of decay, allows timely intervention and limits the impact of future restorations, which means acting "as much as necessary, as little as possible", as stated in the Burra Charter (ICOMOS Australia, 1999).

Periodic maintenance can provide huge benefits (also in economic terms) and that gains can increase further when acting according to a well-defined plan.

Nevertheless, since maintenance (and maintenance plans) as conceived in the field of the new constructions may involve significant replacements, current approaches need a thorough rethinking to be transposed to heritage buildings.

In the last years, several studies have been realized to fill this gap, but there are still few experiences on recent heritage; besides, there are still few statistics on durability or reliable models that can help in predicting the actual behaviour of the modern materials and architectural elements over time.

This is one of the challenges we have faced in the project: understand if (and how) prevention can be part of the general management strategy of the complex and how the data that have been collected in the project can be used to set a specific strategy of care.

Data organisation and implementation of the information system.

The availability of exhaustive and updated data is essential to set an effective maintenance routine. For that reason, since the first step the data collection has been conceived and organised not just to support the development of the conservation plan itself, but also to set a "monitoring board" that will be used on the long run for the everyday management of the building.

As said before, each part of the complex (blocks, rooms, common spaces, internal and external paths, external spaces) has been identified through an alphanumeric code, reported on plans, which contains also the dimensions and the use of each room. For each room, it will therefore possible to insert the data on the state of conservation, to keep track of the maintenance works realised and of the costs and to control the use and the specific issues of each space.

The "Aquilone" residences- identification of the rooms.

Besides, also the architectural elements (doors, windows, skylight and concrete slabs) has been identified through an alphanumeric code, that refers to the room, to allow an easy localization.

Trough that code, the collected data has been organized into a unique information system (PlaNET Beni Architettonici, TeamSystem- STR), that have been especially conceived for the management of the historical buildings and that has been used for the first time on a modern construction.

Each code (related to a room or to a single element) refers to a specific "tab" on the information system, where other specific information can be inserted, typing a text or uploading a document: photos, texts, drawings, PDF and other documents - as the scans of the original drawings- are therefore organised and made accessible to all those who are involved in the management of the building. The database can be updated over time, by inserting new data and documents.

The information system allows different levels of detail, ranging from general (eg. by providing specific description) to specific information (e.g. in the research a complete mapping of the concrete elements and of the doors and windows frames have been realised, and for each element the state of conservation has been defined through the score evaluation).

PlaNET Beni Architettonici. Registry of the spaces and upload of the files.

For the "Collegi", the database has been arranged starting from the modular structure of the building, to simplify the information retrieval and the update procedure: since the organisations of the data reflect the structure of the building, the consultation of the database is very intuitive and user-friendly, despite the large quantity of materials.

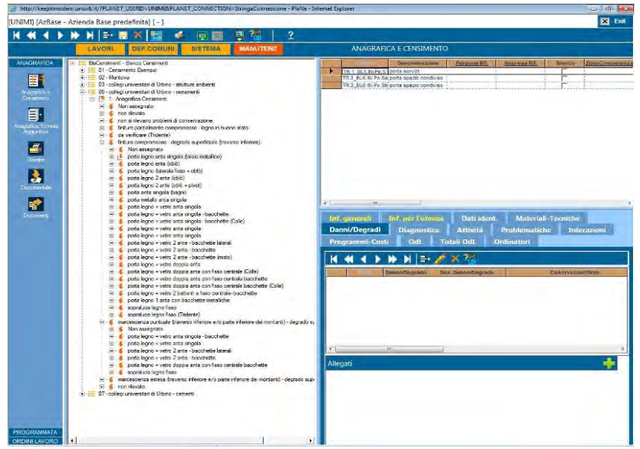
Besides, taking into account the size of the complex, to speed up the drafting of the plan specific support tools have been implemented such as word lists and abaci that can be selected through a drop-down menu to describe materials, decays and surface textures.

In addition, structured forms of data query have been set out to support daily management (eg. the architectural elements can be arranged by type and condition).

In such a way the professionals in charge of maintenance can easily identify the emergencies and plan the everyday activities.

The information system supports the management of a large amount of data and enables different stakeholders to share their data and programs. The system is web-based and can be accessed with different accounts and editing rights by different users, which can share their data in real time. Using a unique database, information opacity is reduced and the decision-making processes is more clear. A training day was organised in January 2016 to present the information system (dott. Elvio Benatti, TeamSystem- STR).

Finally, the database is thought of as a dynamic tool, always "in progress", since, filling the structure that have been established within the "Keeping It Modern" project, new data can be inserted over time, and consequently, procedures and solutions will be fine-tuned to ensure the maximum effectiveness to the conservation strategy.



PlaNET Beni Architettonici. Registry of the doors and windows frames.

IV Part

Guidelines for conservation and trasformation

"Colle". Common room interior. (Photo Giorgio Casali. Università Iuav di Venezia - Archivio Progetti, Archivio Giorgio Casali)

New uses and transformation

From the social research carried out in this project, some hints can be taken into considerations. The "Collegi" are close to the town centre, but necessarily different in terms of social composition and functions; what is more, social actions are not just located in the "Collegi", but they closely and strongly interact with De Carlo's architecture. As a matter of fact, the "Collegi" are a very special environment, capable of influencing the behaviors of individuals and of creating experiences that remain impressed in the life course of those who lived there.

The social analysis carried out highlights the pros and cons of this building complex, that should be taken into consideration in planning a conservation that does not turn the "Collegi" into a museum. Actually, the preservation of the high cultural value of the site must be combined with interventions aimed at rethinking some parts of it in order to meet the needs of current users.

From the point of view of changing uses and user satisfaction over time, a mixed picture, with many lights and shadows, emerges; attention is drawn to the need for a structural, organizational and social renewal to avoid the risk of obsolescence. On the one hand, the experience of the "Collegi" remains crucial in defining the characteristics of the students' educational paths in Urbino, providing opportunities (services, residencies, spaces for studying) that are not readily available at other locations. De Carlo's complex eases a social experience of spaces of freedom, as emerging in interviews, particularly by respondents who experienced living in other university residence halls or used other university facilities, where institutional controls and accessibility was felt to be much stricter. At the same time, the concentration on the residential function of the "Collegi" impoverishes the use of spaces and reduces the importance of the "Collegi" as a place where to live university life fully - including leisure and relations with different components of the university world and with the city inhabitants and its institutions. As a former student put it, without social relations - a key ingredient in De Carlo's architectural planning - the "Collegi"'s spaces themselves become very hard to live and there is a risk of starting to "see only cement". However, it would also be simplistic to attribute to organizational

changes in the use of spaces the responsibility of these profound transformations. The idea of sociability and of the use of original spaces should be actualized in itself in order to adapt to the changed arrangements of communal life, where the requirement of privacy, the need to easily switch between public and private environments, seem to prevail over the radically collective dimension - more "political", somehow - which pervaded the idea and use of "Collegi" over the past decades.

Considering how current users live the "Collegi" experience, some differences and also oppositions appear between the design idea and the actual use of spaces - both collective and private - that call into question the importance of structural adaptation of certain facilities. In the absence of a large scale intervention, the "open" character of the "Collegi" has allowed users, up to now, to introduce small, low scale interventions conducive to the adaptation of spaces to their needs. Many of them, in fact, show a certain appreciation for the structure and for the design idea that inspires the building complex, especially with regard to the possibility of customization and its modular structure. In this context, however, there are criticalities in the use of common spaces, while the blocks are configured as a central relationship environment. The need to solve structural issues emerges clearly, and at the same time a strong demand is growing for a better utilization of poorly used areas. In particular, there is a need for a better distribution of recreational services and a better organization of activities in spaces, as well as the necessity of a fundamental extraordinary maintenance intervention for different sites and facilities, both indoor and outdoor. Another emerging need is to find a solution to the question of preparing meals into the housing spaces. In fact, cooking inside blocks and bedrooms is a spread practice between Collegi's inhabitants despite this is not authorized by the regulation. A solution to this problem might be the organization of common kitchen that would complement the already amplified supply of meals provided by the canteen.

In considering an intervention that also contains elements of transformation, it is necessary to take into account the typological differences that exist between one residence hall and another, acquiring a deep sensibility to the different "forms of living" that each of them produce. Each residence hall seems to meet specific residential preferences that adapt to the different socio-cultural profiles of residents, as well as the specific stage a student lives going through her/his university career. This dimension is important as it is embedded within a wider context in which the experience of the "Collegi" can be interpreted as the time of the first separation from the family of origin: a transition to adult life represented by a "mediated" self-sufficiency that leaves its mark in the path of personal growth and identity building. The "Collegi" give students the chance of experiencing exchange and sharing – allowing them to give vent to their own preferences - without imposing them the necessity to face the burdens and problems of total housing independence.

In this respect, a key element is represented by a special social environment that allows residents to live and experience social relations. Compared to the past, however, sociability has undergone substantial changes, with centrality shifting from common spaces to blocks, partly as a result of changes affecting users' preferences, but also to a good extent because of new rules and stricter implementation of old ones, and due to the impossibility of securing some common spaces that were once the focus of many crowded social. Actually, it is quite clear a significant decline in the satisfaction of users, as far as their ability to use common spaces as places of aggregation. Such a decline is related to a sense of boredom and monotony which is felt by many current residents, due to the feeling that there is nothing to do. In turn, this perception strengthens the tendency to remain confined in the space of the bedroom, or at most of the block.

Think the structure of the "Collegi" today means also to answer questions about its role and function within a university city, Urbino, that experience the same problems and tendencies. Enjoying optimal conditions for students from many points of view – first of all the limited size of the town and University that make the dialogue and encounter between students and between them and the teaching staff easier[1], a relevant problem is related to the lack of cultural and leisure activities and spaces. However, in a city that describes itself as a City-campus, and where students play such a crucial role, cultural activities could be promoted by the students themselves, seen not only as recipients of activities organized "from above", but also as a creative resource. It is clear, however, that, in order to trigger this virtuous mechanism, investments should be made in promoting the availability of common spaces, which could act as incubators of sociability, study, planning... This vision is one of the cornerstones of the architectural system and urban planning studied and promoted by De Carlo, who built large common spaces at the center of the various buildings of the "Collegi" complex, in order to promote sociability and participation, and to make the student population more self-responsible. In order to reach this goal, a new start is needed, as over time its motivating force has almost vanished, due to the combined effect of stricter regulations and the impossibility, for financial reasons, to adapt and renew the structures. Such a proposal could be shared also by employees and contractors of the managing authorities, who identify the main problem of the "Collegi" in the lack of collective spaces in which to organize popular events such as parties and concerts; according to this view, the forms of regulation and their implementation are not a substantial problem. This perspective should be addressed

[1] Diamanti, I. & Maggioni, G. (eds.), (2013). Studiare a Urbino. Gli studenti, la città, l'Università. Napoli: Liguori.

together with the other main actors in the Urbino area, those who are more involved in the management of students in the University and in the City.

However, in taking such a course, attention must be paid to the different needs that emerge from female and male students, as there are important differences in how spaces are lived and perceived by gender.

In summary, the main difference seems to be based on the reproduction of a stereotyped gender roles division with reference to public / private dichotomy. In fact, the main relationships experienced by male students interviewed are those taking place in common spaces, which may be somehow connected to the public sphere. Relationships that develop within these spaces are characterized by numerous links which, however, are weak and superficial. Familiarity with this type of space and with this kind of relationship means that the need to appropriately capture space and block spaces and make them 'private' is not perceived by young men in such a strong way as by girls. Female students, in fact, tend to live in common spaces in a functional way and to take refuge in another dimension that they have created within the block and the room. These spaces are domesticated in an attempt to renegotiate their meaning and attribute them to the private and domestic spheres, in which respondents perceive greater security and control. The lack of perceived control in the public spaces manifests itself among the girls with a general perception of greater insecurity than that experienced by their male colleagues, which limits their well-being and the viability of the structure. In the same perspective, there is a need to better take into account the needs that emerge from the employees of the "Collegi", especially with regard to the structural adjustments that should be made to facilitate their duties (freight transport system, access to walkways, extraordinary and ordinary maintenance, etc.). Responding to these needs would mean raising the level of job satisfaction, possibly improving the quality of services offered and the perception of workplace safety.

These considerations might contain useful suggestions for adapting the spaces to the emerging needs, incrementing both the forms and the typologies of use. Rethinking some parts of the buildings and improving their services seems to be indispensable today in order to increase the sense of satisfaction of the students' experience. After all, transforming the original project on the basis of changes intervened over time has always been a concept at the center of De Carlo's thought.

Chart of transformation

The classification of spaces considers the features already listed and determines the level of transformability. It goes from the red to the Clear yellow (spaces that have already undergone severe tampering and can be further modified).

LEVELS OF TRANSFORMATION

Indoor Outdoor

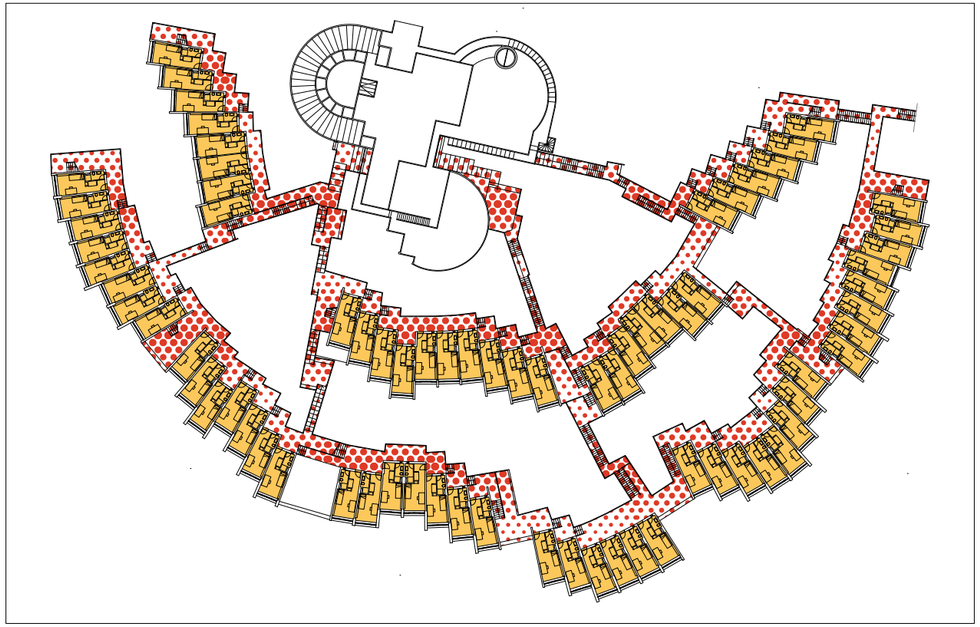
Non transformable
Spatial Spaces featuring parts of particular value for their implementation that have not been tampered with and are vital to the quality of life of students within the Complex.

Transformable according to a logic that establishes new consistencies in the interest of increasing use
Representative spatially recognized space spaces, which have not undergone transformations but need adjustments to be carefully studied.

Transformable
Spatial representations of recognized spatial value, which have undergone transformations or that no longer correspond to the current use in which transformations are accepted.

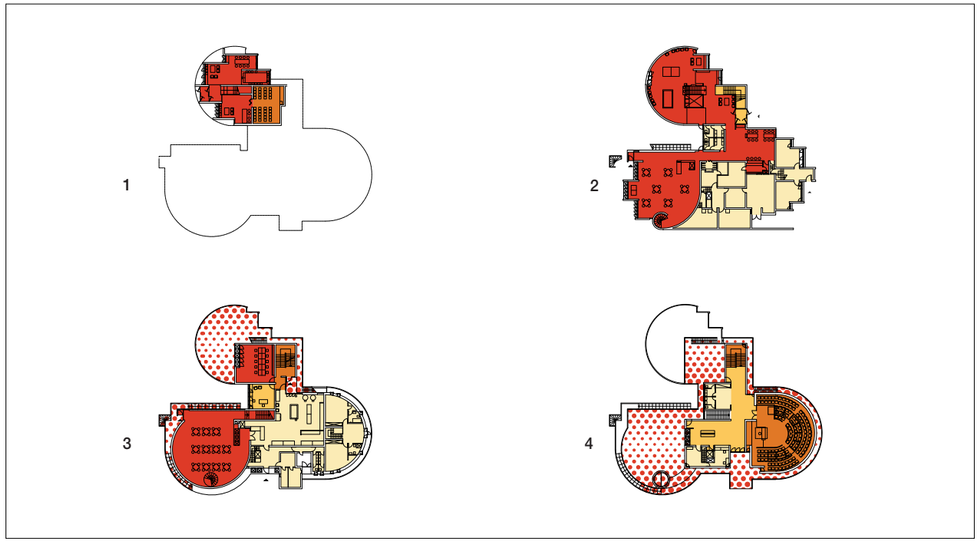
To be transformed
Spaces of great value too, which have undergone improper transformations, or who have never reached a condition of reasonable or even encouraged use of transformation.

The "Colle"

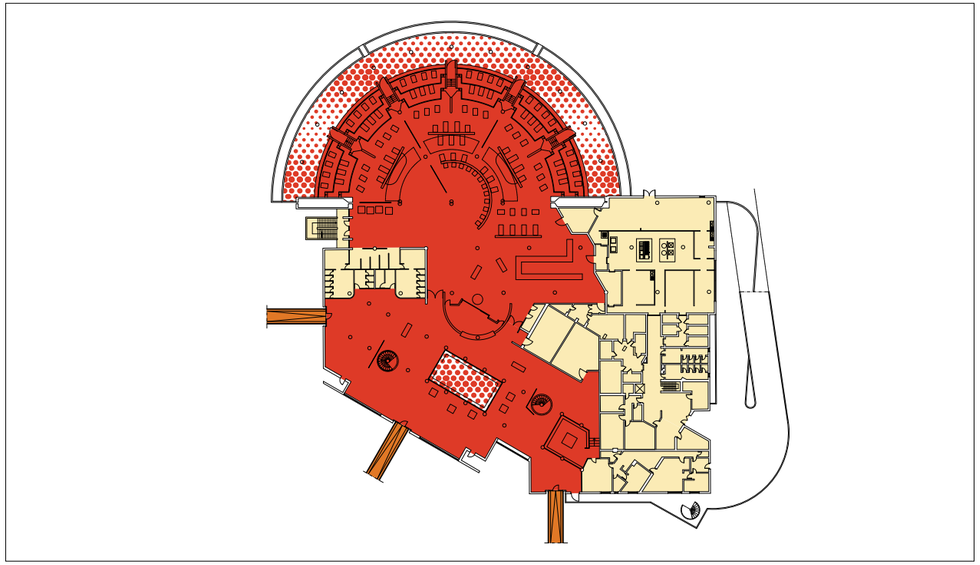


Level 1 | RESIDENCES

Level 1 / 2 / 3 / 4 | SERVICE BUILDING

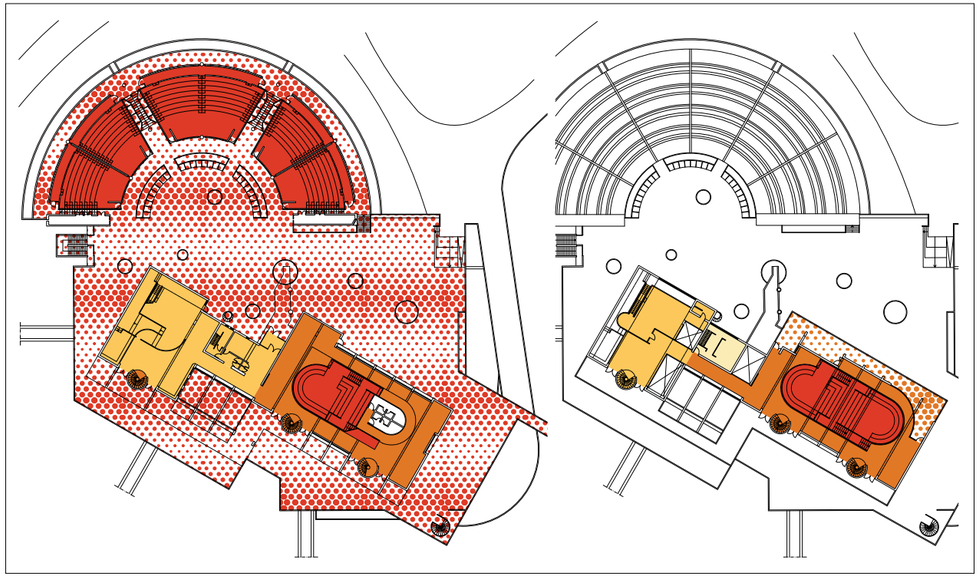


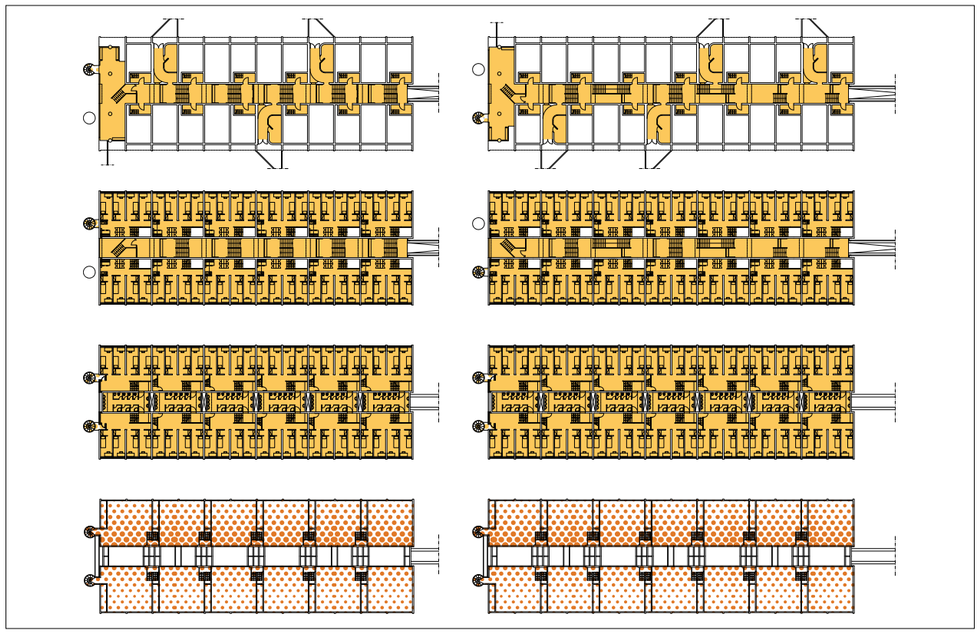
The "Tridente"



Level 2 | SERVICE BUILDING

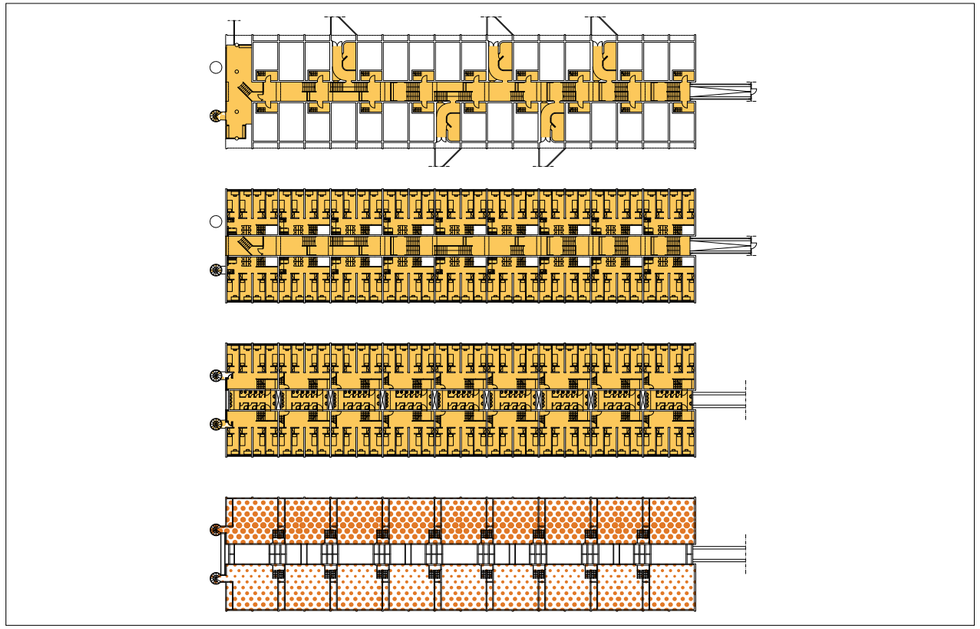
Levels 3 / 4 | SERVICE BUILDING



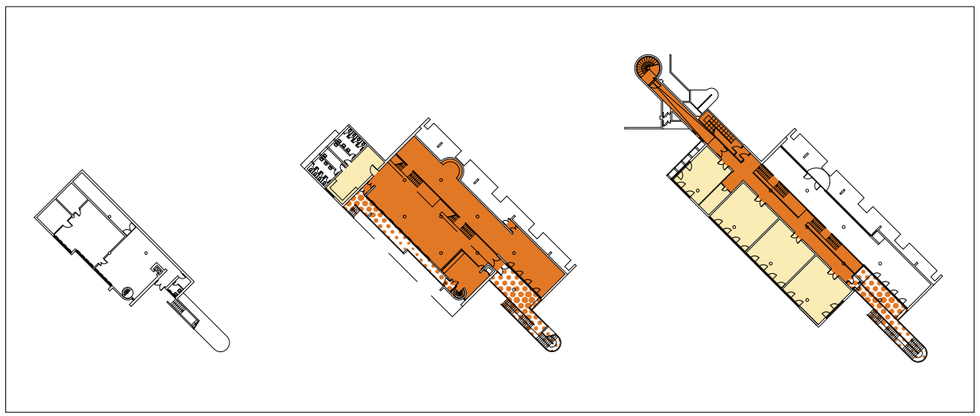


Levels 1 / 2 / 3 / 4 | RESIDENCES

Levels 1 / 2 / 3 / 4 | RESIDENCES

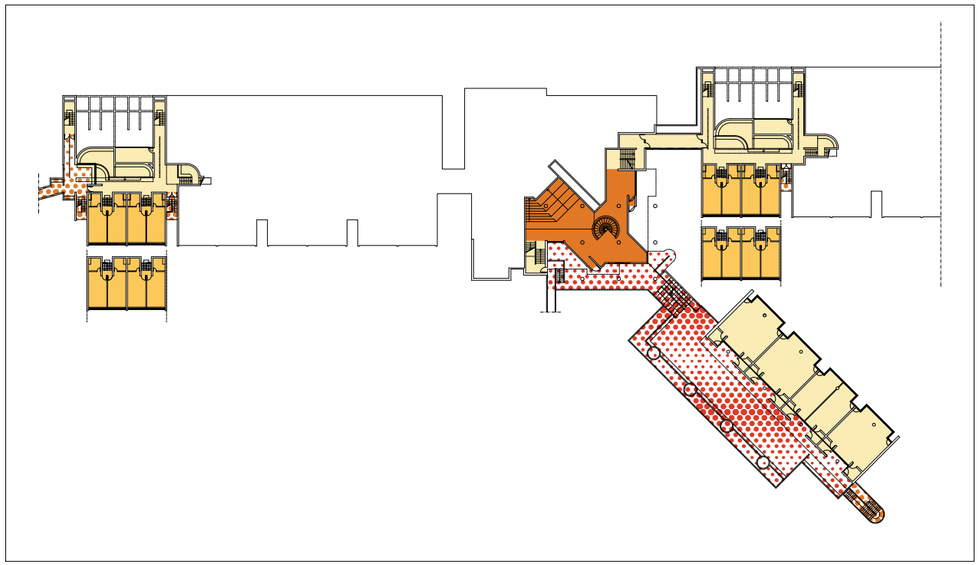


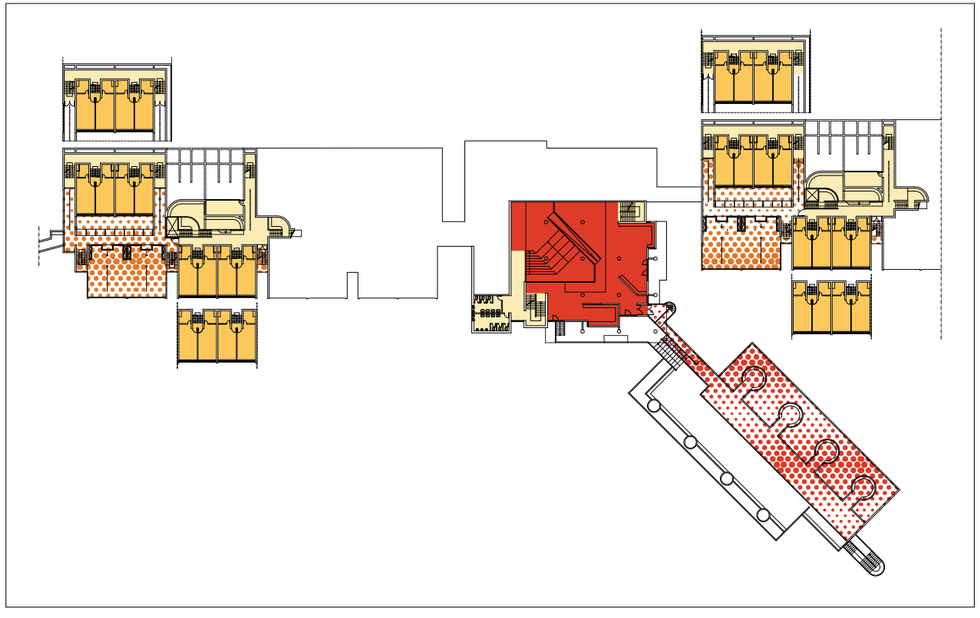
The "Aquilone"



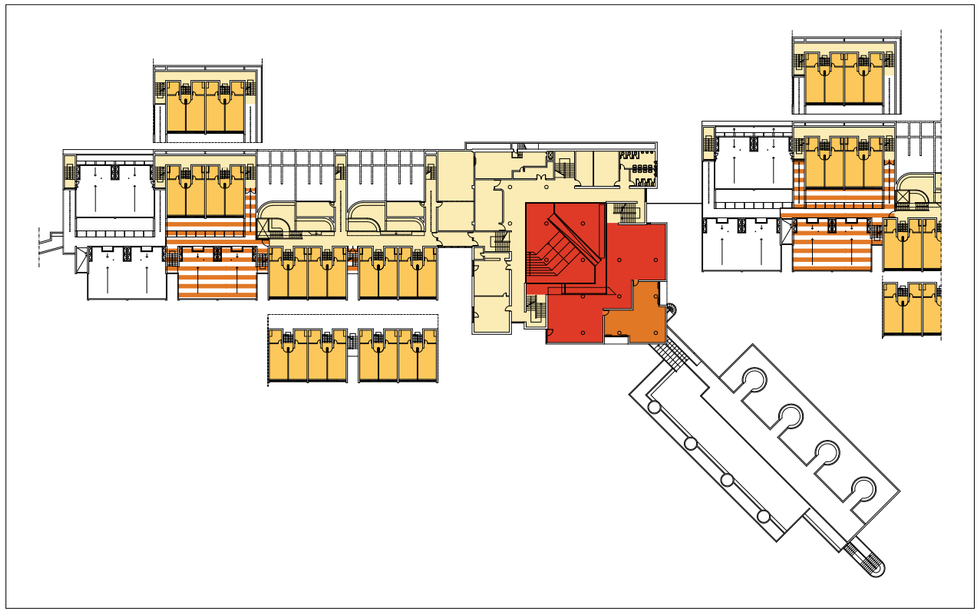
Levels 1 - 2 - 3 | LIBRARY

Levels 4 - 5 | RESIDENCES AND SERVICE BUILDING

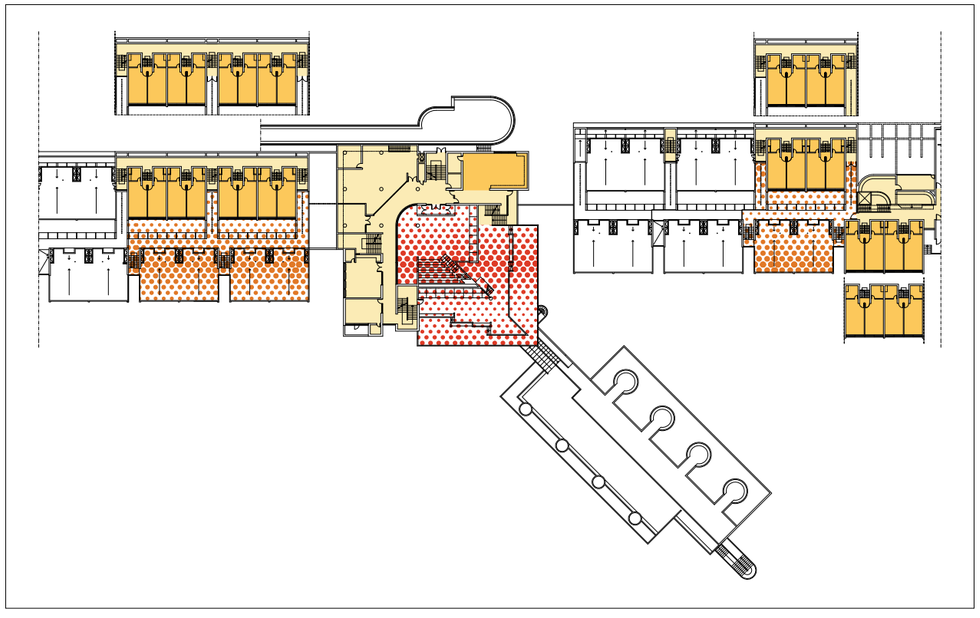




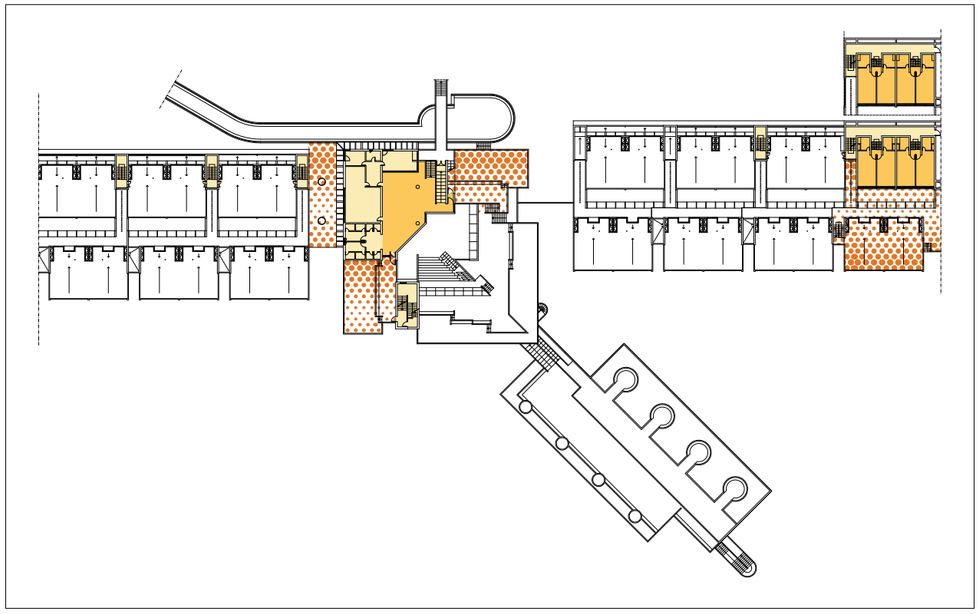
Level 6 | *RESIDENCES AND SERVICE BUILDING*



Level 7 | *RESIDENCES AND SERVICE BUILDING*

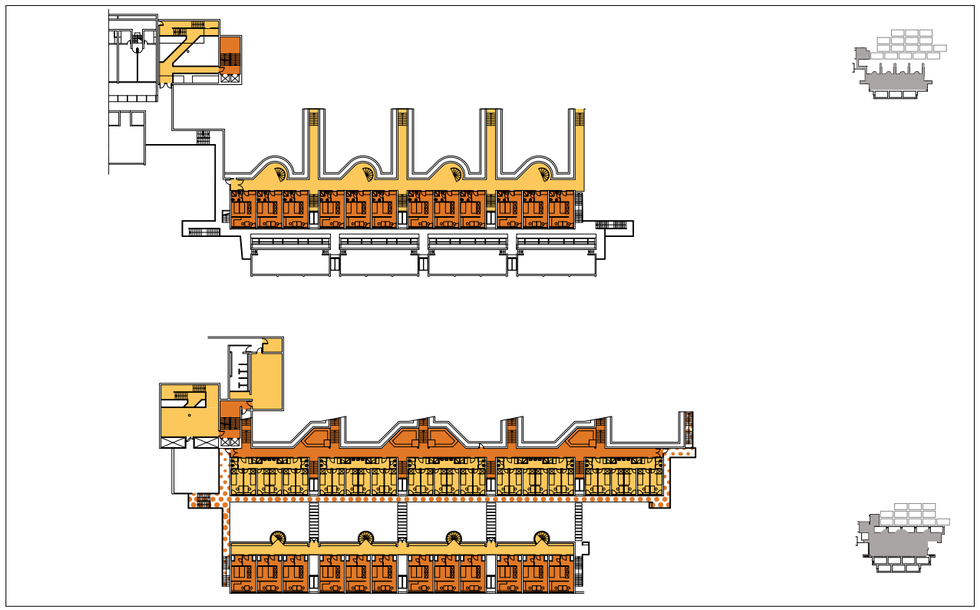


Level 8 | *RESIDENCES AND SERVICE BUILDING*



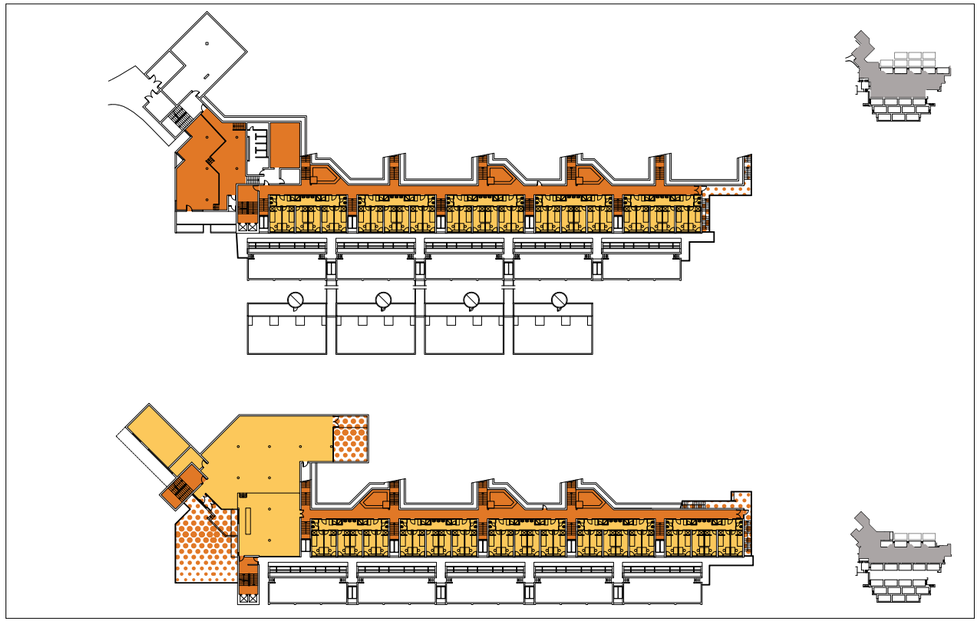
Level 9 | *RESIDENCES AND SERVICE BUILDING*

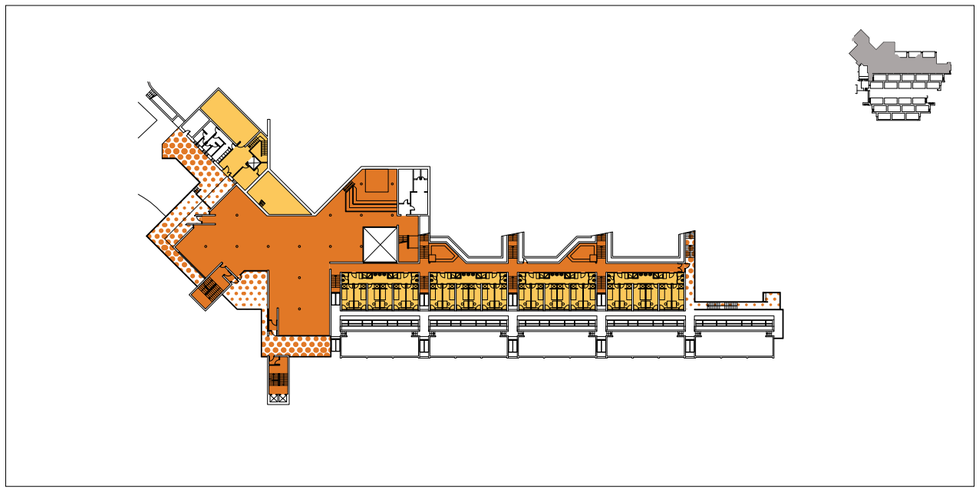
The "Vela"



Levels 3 / 4 | RESIDENCES AND SERVICE BUILDING

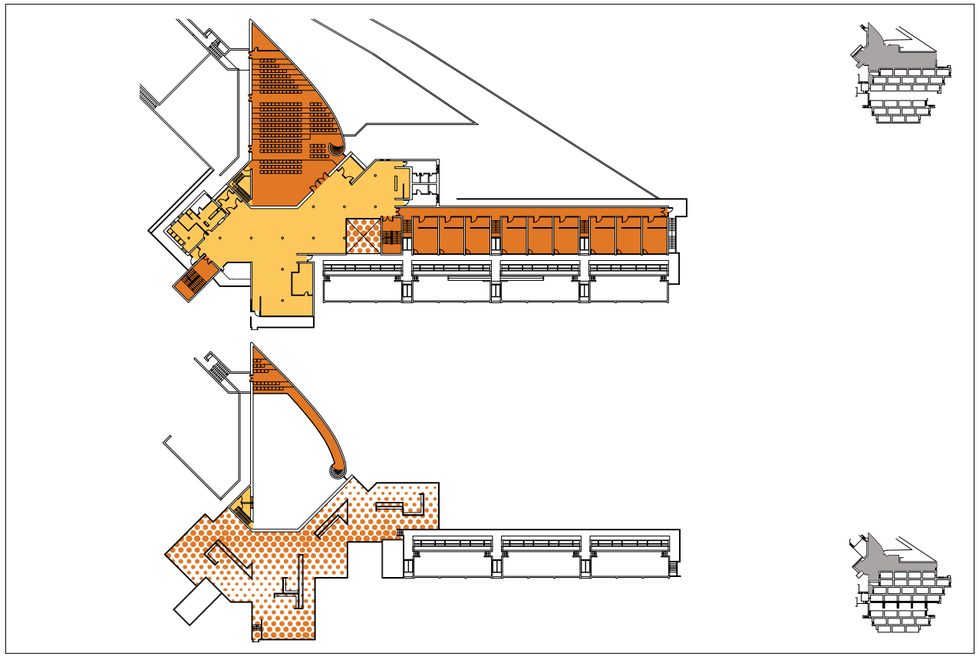
Levels 5 / 6 | RESIDENCES AND SERVICE BUILDING



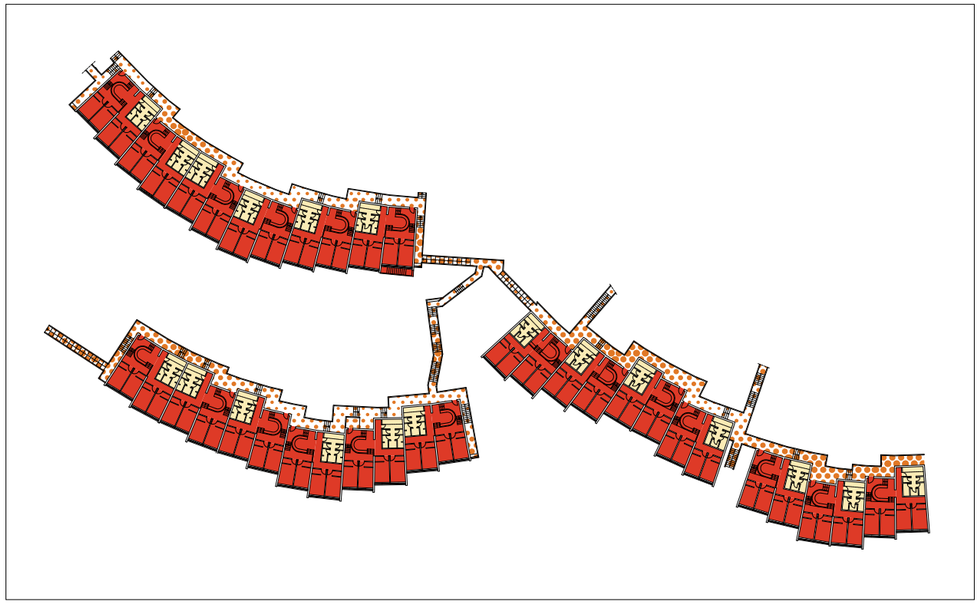


Level 7 | RESIDENCES AND SERVICE BUILDING

Levels 8 / 9 | RESIDENCES AND SERVICE BUILDING

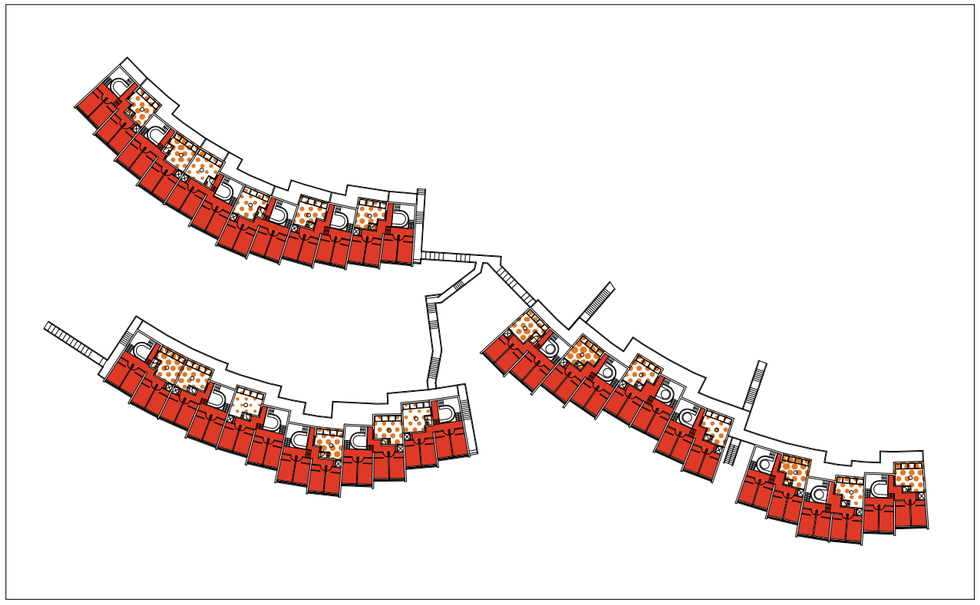


The "Serpentine"



Level 1 | RESIDENCES

Level 2 | RESIDENCES



Change Management Policies: Plan Objectives

The potential for change is conceived to increase the efficiency of the Complex and the continuity with the function assigned: providing support for University's activity in the most sustainable way, energetically, economically, socially and with a good level of internal comfort. There are currently parts of the complex that require regulatory adaptations and parts that are underutilized: among those dedicated to common use, some call for integration while others for modification of furniture, others for changing the use to meet needs which, at the time of their completion, did not exist. In general, the Conservation Plan (CMP) expresses the will to complete a process of realization that includes activities that have never been settled at the time of its realization, even by integrating and modifying the program. The experience with the UTSA University of Abroad Studies settled inside the "Aquilone" has proved that the possibility of doing teaching activities within "Collegi" have positive feedback on the common spaces, services and their use, such as the canteen. This experience suggests that all the transformations aimed at enhancing the teaching activity will be successful. In parallel the enhancement of the use of the outer space of the "Tridente" complex, extending it to urban activities such as occasional events, weekly market and small exhibitions is higtly recommended. This action could be fostered by the introduction of small café open to the public within the study halls open to the square or as an independent venue. Considering the presence of the classrooms, the theater,the canteen and the ease of access you can point to this space to improve the relationship with the city by completing the equipment. There are other spaces within the complex that offer students more opportunities of use such as the "Vela" Theater, the "Aquilone" Central Space and the Library. Special attention is recommended because they can represent valuable opportunities to trigger new processes of revitalization and integration. The parking plan, the continuation of Via "Giancarlo De Carlo" as the "new Gate" of the Complex, the Plan of sports facilities, the improvement of accessibility for maintenance, the perimeter of the complex, are the most important aspects to consider. Althought the plan does not aprovide solutions at this stage, it recommends further investigations in the next stages of the conservation program.

New buildings inside the area

To meet the needs of the University, the area of "Collegi" still offers possibilities for settlement, for creating new buildings offering new spaces for research and teaching; rooms for students and services in general. Therefore, it is necessary to identify the criteria that must guide the design. While the original buildings cannot be expanded, new developments are possible, given the need to deepen and adequately resolve the confrontation with the existing complex. The constraints relating to the distances and the control of the heights are to be furthered based on a proposal that must be examined and evaluated by a special commission. The goal is that the new buildings are confronted with the existing ones without unnecessary prejudice or unpreparedness in the

use of materials and shapes except those dictated by the quality of the proposal. Evaluation committee must be formed by the University of Urbino and include within it all the components that thoroughly know the estate to be protected and share the criteria expressed in the CMP. The general plan of the "Collegi" included areas where the planned services were not built: parking lots and sports facilities. The areas indicated will certainly be those where to place new activities. We do not want to point to other possible sites but rather principles that are able to guarantee appropriate interventions and to emphasize that those areas are not only available for new buildings.

"Collegio del Colle". Common pathways. (Photo Antonio Garbasso)

Internal modifications

Concerning internal modifications, when these complies to regulations or adaptation of use, they are always considered possible in the ways indicated in the "Guidelines for Transformations". The condition is that the reasons for the intervention are clearly stated and correspond to the general objectives of the Plan; That the transformation proposal demonstrates profound knowledge of the Complex and of this document and shares the criteria of intervention. To make changes of any kind, including the change of the furniture, you must follow the transformation paper categories and keep the proposal within the requirements contained therein.

"Aquilone". Roof terraces. (Photo Giorgio Casali. Università Iuav di Venezia - Archivio Progetti, Archivio Giorgio Casali)

"Tridente". Space for performances.

The evaluations made in the first phase have allowed identifying, for each part of the building, the significant and distinctive elements (to be retained) and the changes that can be introduced.

Service buildings

In the present state, the service buildings are the main weakness of the complex since they have failed to become "attractive poles".

The common spaces (without a specific function) and the outdoor spaces (terraces, green roofs) are essentially used only as corridors leading to the rooms (it is significant to note that, where is possible, alternative path are preferred) despite their high degree of architectural values, availability of common spaces and specific character.

It is crucial to enhance the specific character of each part of the building, not necessarily by reintroducing the functions planned in the 60s-70s (that, in most cases, have never been implemented and are now outdated) but by identifying new uses that can be compatible with the character of the spaces and that can be implemented without excessive changes.

Rooms

The rooms have different levels of quality and authenticity; Part of the buildings have already been (the "Tridente", the "Vela", the "Serpentine", the "Aquilone") changed (eg. most windows have been replaced) and mayor changes will be needed to introduce significant improvement.

The "Colle" is better preserved and should be used as guesthouse for external users.

External and internal pathways

The continuity of spaces and materials is a charateristic feature of the complex. The use of the same material (with different finishing) is a key-theme in the whole complex, emphasized using specific floor (concrete slabs, with exposed aggregates); that continuity must be retained without interrupting the spaces with partitions.

The use of material to characterize different functions must be maintained despite the need of introducing changes to assure the compliance with the regulation. For instance, implementation of smoke detection system can be used to avoid compartmentations.

The "Colle"

Is the first "district" realized and the most significant one because of the accurate design of any detail, the complexity of geometry and difficulty accessing the site.

Thanks to the quality of the construction and materials (eg. the concrete elements have been preserved considerably better than those of the subsequent constructions, despite the reduced dimension of the slabs).

Under-utilisation of common spaces is the main problem:

the current use of the living rooms (as study rooms)) is inappropriate, as these spaces do not have adequate facilities, privacy and comfortable furniture;

the terraces and the conference rooms are not used.

Since the "Colle" can provide an "authentic experience" for architecture enthusiasts, scholars and curious visitors, it should be decide:

to extend the possibility of booking a room as a guesthouse, today in fact can be used only by university students and faculty members;

to host in the main building meetings, conferences and others public activities;

to improve the use of the canteen and to extend the time which is right now restricted to breakfast time;

the apartment in the main building can host small groups of visitors or young families;

the service building could accommodate cultural and information services, and information panels.

The "Tridente"

The main building has huge common spaces open towards a terrace on one side and the square, on the other. That space, conceived as a theatre, has been used sporadically for student parties and it is now inaccessible for security reasons; it is accessible to the vehicles and open up towards a public area under-utilised despite its centrality, it can be proposed a change of function capable to increase the use: while maintaining the possibility to host performances why do not think to have an Internet cafè (to study, host cultural encounters, courses ...) with an outdoor sitting area? Today outdoor space is not equipped and it can be easily vertically connected to the kitchen and provide extra time for food and for staying.

A case study can be found in the "Idea store" in London: library (in this case bar) with courses, info points, services, availability of multimedia documents.

The residential units can be provided with small kitchens to reply to the need of self-cooking of the students. Tentatively they can be built on the roof of the central bathrooms body or using the small room around the canteen, without affecting the shape of the building.

The "Tridente" Square in front of class rooms and canteen, with easy vehicular access, proximity with bus stop, is the best place to share cultural activity with the Municipality, to host temporary exhibitions etc...

Internal patios cannot be used to insert vertical connections (elevators etc.)

“Tridente”. Space for performances.

The "Aquilone"

Library is under-utilized, it is only sporadically used by residents to read or study during the day.

Without affecting the continuity of the volume, which makes the space significant it could be equipped to host laboratories and highly specialized courses: in fact, the building is accessible on both sides and can be provided with an independent entrance. The study rooms can be relocated in the empty rooms of the main building conceived as a large common area, surrounded by study rooms differently seized for different needs (individual, groupworks, etc ...).

The living areas located along the inner streets, now neglected or used as services (for drying laundry etc) can be implemented by adding small kitchens and the technical space behind, can be used as a storeroom.

"Aquilone". Library, interior.

The "Vela"

According to the original design and since the large rooms are under-utilized, the main challenge is to introduce new functions to implement the accessibility of the 8th floor, the same level of the entrance of the theatre.

To meet the requests of the students it is possible have a common kitchen, at the sixth level, where a canteen was already planned and free up the space in the residential blocks; the service area has convenient service access from the street.

Accessibility can be improved by modifying the existing staircases, and working on the staircase A (the walkways should be reviewed).

Internal patios cannot be used to insert vertical connections (elevators etc.)

"Vela". Internal view of theatre.

Facing concrete

Starting from the mapping and score evaluation charters, the state of conservation of each element can be easily assessed.

Some typical situation can be and identified that correspond to 7 scenarios of intervention, namely:

0	Areas in a good state of repair	no action is required
PR-01	Additional protection – elements and surfaces in a good state of repair, that can be treated to prevent further damage	Corrosion inhibitor + coating (high performance hydrophobic protection)
PR-02	Additional protection - Horizontal surfaces	To protect the horizontal surfaces and avoid seepage: repair of the cracks, realization of a protective layer.
RP-01 RP-02 RP-03	Elements and surfaces already damaged: -a. Limited spalling/ cracks (5-10%) -b. Diffused spalling/ cracks (10-50%) -c. Large spalling/ cracks (> 50%)	Repair + corrosion inhibitor + coating
CC-01	Elements that are heavily damaged (exposed rebars, concrete affected by a widespread carbonation)	New concrete casting

Referring to points RP-01 / RP- 02 / RP-03 the different area of the surfaces to be repareired can be assessed by the score evaluation described in "Evaluation of the state of conservation".

"Tridente". Internal pathway.

Repair cycle

- Application of a broad spectrum biocide.
- Accurate cleaning of the surface (low pressure water cleaning and brushing. Pressure of the cleaning water should be chosen considering the state of conversation of the material, anyway avoiding to overcome 20 bars).
- Inspection of the surface.
- Removal of any loose material; the concrete within the reinforcements affected by corrosion should be removed.
- Application of a protective product on the rebars.

- Repair / concrete patches:

To ensure maximum durability and facilitate the work (most part of the complex is not accessible by cars) a premixed repair mortar can be used for the repair, leaving an outer "layer" of about 1 cm, that will be realised with a "site-specific" mortar.

Before applying the repair mortar, a product to provide better adhesion can be applied.

For each of the different concrete mixes, different "site-specific" mortars can be formulated in order to match the aspect and the texture of the existing concrete and evalueted on site.

The repair mortar will be relised using a mix of white cement and local aggregates; for technical reasons, the size of the aggregates will be smaller, making the repairs recogizable. It is recommended to treat with a wet sponge the mortar after the application, to bring out the aggregates.

The repairs (except for the smallest ones) will be realised with a geometric shape, as decided by De Carlo in the '90s, but at the same level of the surface, to avoid the damage that could result from stagnation of water and to have a reduced aesthetic impact.

Horizontal lines can suggest the formworks; It is not considered necessary to reproduce the grain of the wooden elements.

To provide overall protection a corrosion inhibitor and a coating should be applied on the surfaces.

Pilot sites. test of the repair mortar

Exposed brick surfaces

Guidelines:

- Accurate cleaning the surfaces.
- Removal of films and paintings.
- Replacement of degraded bricks.
- Treatment of the sandblasted surfaces.
- Anti-graffiti protection (in the covered paths).
- Evaluation of the connection of the brick cladding. Appropriate diagnostic tests should then be provided to verify the vertical structures having a brick cladding, especially where there are water leaks.

◀ *"Colle". Exsternal pathway. (Photo Kunstgewerbeschule, Zurigo)*

Doors and windows frame

- Replacement should be reserved to the frames that are exceptionally deteriorated and exposed to the weather (eg the staircase of the residences, in the Aquilone building).
- The dimension of the frames should be carefully evaluated;
- The size of the elements should not be changed.
- Openable windows should be maintained.

Service buildings and paths

- As a general rule, the wooden windows of the services building should be preserved and subject to periodic maintenance that can entail, if needed, some improvements (double glazing, reinforcements, flashings).
- The replacement with new elements, in wood or in different materials, must be evaluated case-by-case.
- The elements which may eventually be substituted will be changed with frames that has the same proportions and opening of the existing frames.

"Aquilone". Windows and roof terraces.

"Colle" service building. Decay of the window frame.

"Colle" service building. The window frames have been replaced with new elements, in wood that has the same dimension of the existing but different opening.

“Colle" service building. Detail of the new frames.

Residences

Different strategies are proposed, taking into account the different rate of substitution.

The "Colle"

It is the only college where almost all the windows are still original.

There are three possible scenarios of intervention:

- minimum intervention: replacement of rotting parts, replacement of the existing sliding mechanism;
- maintenance: replacement of the frames, to install a double glazing and replacement the sliding mechanisms;
- change: development of a prototype for a new window.

Without any doubt, minimum intervention is the more conservative and least expensive solution; nevertheless the need to change the sliding mechanism entails a significant ratio of replacement, without leading to significant benefits in terms of energy performances, internal comfort and maintenance.

The second scenario (maintenance) a like-for-like replacement, with a wooden window is proposed, with some improvement to increase durability, manoeuvrability and energy performances. That solution involves the loss of the original material but also an improvement of the energetic performances; nevertheless, realising 4 sliding frames in wood is very expensive and that solution does not solve the maintenance issue.

In the third solution (change) a new window can be developed; due to the significance of the "Colle", a wooden window can be evaluated, with metal protections specifically designed to ensure a greater durability.

Taking into account the evaluation of the state of repairs of each element the first scenario can be proposed for those frames that request limited intervention whilst the elements that cannot be conserved will be reframed according to the prototype.

"Colle". Decay of the room's windows.

The "Nuovi Collegi"

In that parts a functional evaluation prevails, also because most windows have already been replaced.

The prototype for a new window in aluminium, realised for the "Aquilone" building, can be revised to be applied to other colleges.

The original frames can be stored to document the first phase of construction.

"*Tridente*". *Wooden windows and 2 different types of new windows.*

Windows and doors decay."

"Serpentine". Common room interior.

Notes for a reasoned intervention

The restoration project for the furniture of the space called "room D6C", takes into consideration both theoretical and practical aspects. Operating on still working everyday-life objects underlines the importance of making purely conservatives choices mitigated by functional needs in order to keep perpetuating their use. It is not only about learning how to preserve the matter through processes that restore the original form, but it is also about maintaining and preserving that level of *empathy* that the user experiences with forms and lines of the original furniture integrated with the architecture.

The repurposing restorators find themselves before a complex topic, and, from a material point of view, before multiple elements designed to be repeated in a defined set, which is now discontinued. Sticking to the existing original project to entirely and accurately replicate these elements, might imply leaving behind industrial techniques, colour choices and the production type that G. De Carlo selected as the best one for the role he established. Therefore, it is necessary to deal with a veritable experimentation of modern living, taking into consideration changes in needs, materials and production techniques. Original objects cannot be replicated because of industrial production processes evolution, the use of materials, and because of different technical choices made during the production phase. This does not imply that the objects cannot be replaced or maintained, because "Collegi" cannot, by any chance, halt their productivity to become a museum of themselves. The main purpose of the intervention must be the functionality of the furniture in a preservation perspective.

During the drafting of the project, it is important to consider the space and its organisation as a system, that is the general utilitarian and aesthetic purpose of each room where the furniture is positioned. Since the project consists in trying to re-establish a chance to perceive private spaces as a completely personal experience, past life experiences must not prevent from creating new ones. Hence, it is necessary to allow every user to benefit from the object-room.

Even though the signs of a previous usage can be defined as a record, they are impossible to be preserved because they would limit the authentic use of the furniture. Hence, the writing of a paper mapping, by georeferenced photos, all the signs present on the furniture before the intervention is fundamental to create a catalogue collecting all past experiences. To conclude, it is possible to say that the restoration intervention should aim at re-establishing the structural and aesthetic unity of the entire room, allowing the student who lives in that space day-by-day to initiate a personal experience.

The intervention on Giancarlo De Carlo's furniture: a case of experimentation on contemporary furniture

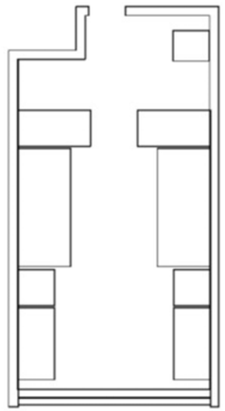


Fig.1 The room chosen for the restoration experiment at "Aquilone"

The furniture of room D6C has been restored in situ in order to work with the ensemble forming the space.

In a preliminary phase, every type of decay and its possible causes have been identified and mapped on a graphical database. The furniture deterioration was attested to be caused mainly by prolonged and often wrong usage; as a matter of fact, marker and pencil writings, various types of layered materials (adhesive labels, tape, etc.), compact deposits such as incrustations and oily/sticky residues have been found on the surfaces. Moreover, all the data concerning the real nature of all the materials were collected, and, together with their state of conservation, allowed the drafting of a sort of preliminary project that enabled the observation and understanding of the furniture complexity and entirety.

The aim of the intervention was to restore the original integrity state, both aesthetic and functional, through cleaning processes, potential replacement of not-functioning elements or parts, pasting, repairing facing gaps, polishing and reconditioning of abraded surfaces. The intervention project stated that in case of missing elements such as castors, locks, hinges, etc., the original ones were to be replaced by new, similar and compatible elements.

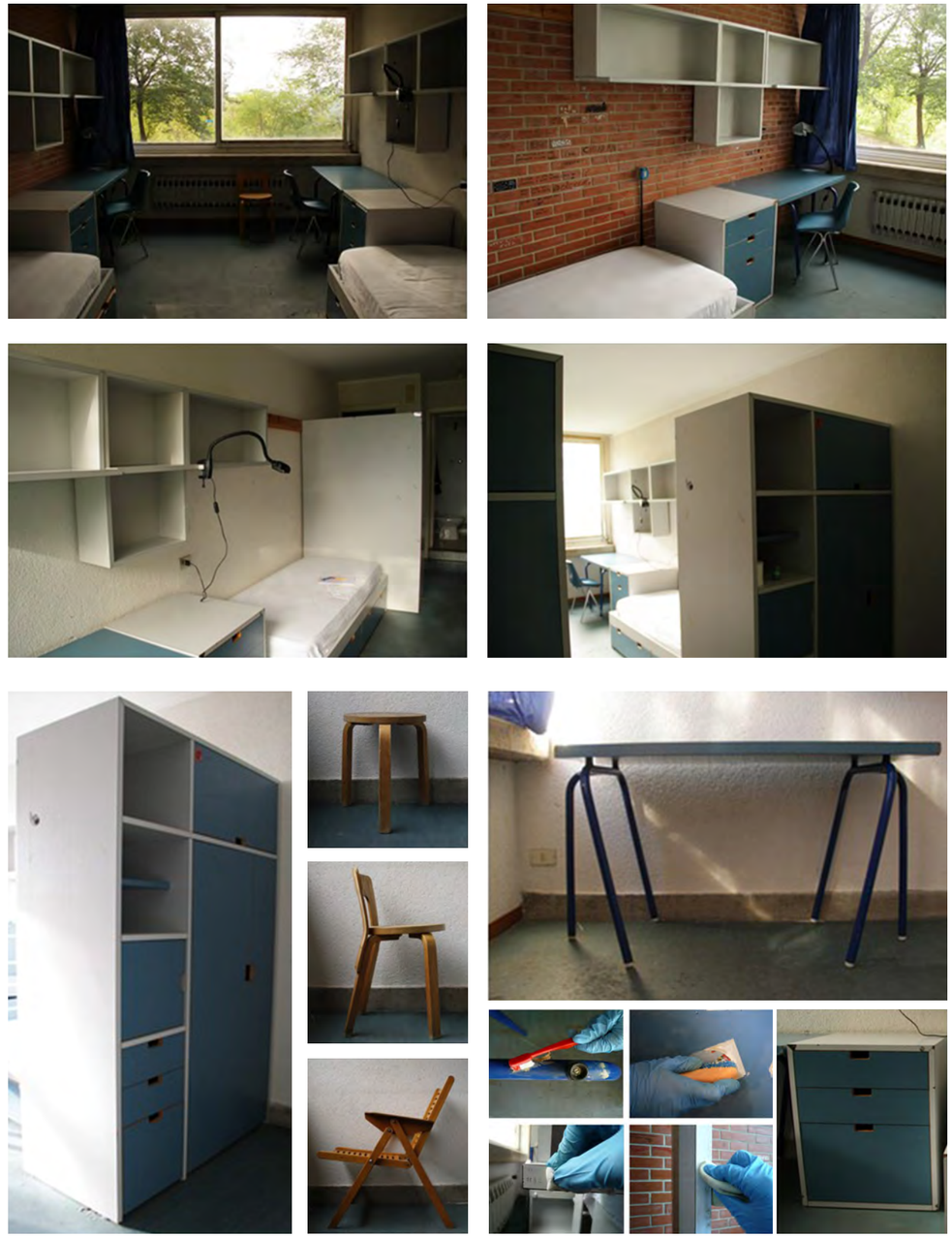


Fig.2 The room chosen for the restoration experiment at "Aquilone"

The intervention consists in five operative phases here briefly described:

Phase 1: PUNCTUAL CONTROL OF THE CONSERVATION STATE OF EACH COMPONENT OF EACH PIECE OF FURNITURE

Before carrying out further cleaning processes, it has been considered appropriate to assess that all the surfaces were intact to prevent them from being damaged during the mechanical removal of layered substances. Reinforcement operations have been carried out where needed.

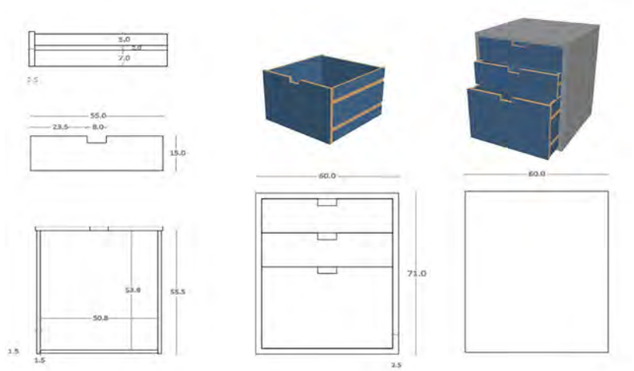
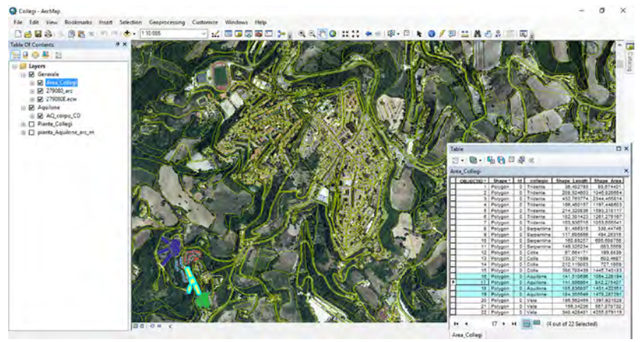


Fig.3 Step of survey and creation of the abacus of the elements



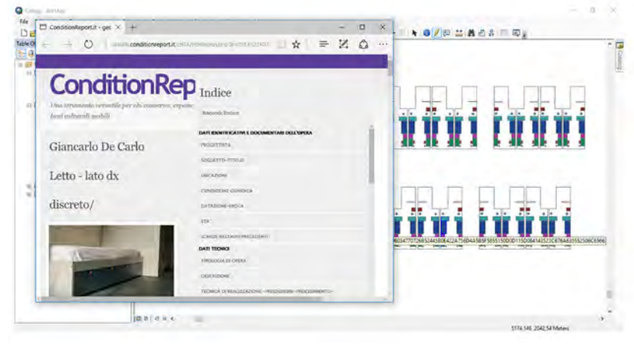


Fig.4 Example of the documentation file and management in interactive databse through GIS and C.D.R tools.

Phase 2: CLEANING PROCESS

The cleaning process involved all objects surfaces, paying close attention to those that were damaged by acts of vandalism and/or by various layered substances. Since the restoration area was set in a room of "Collegi", the choice to use non-toxic and non-polluting materials has been considered suitable, to avoid damaging the users inhabiting the building. After running some tests with different tools and procedures normally used for cleaning surfaces, the ones with the most satisfying results have been selected. The tools tested, selected and used were:

- BRUSHES (cotton patch, flat paintbrush, round paintbrush, toothbrush, white plastic putty knife, scalpel);
- RUBBERS (wishab, aka wipe white, eraser);

- SPONGES (magic sponge, make-up remover sponge, make-up sponge);
- CLOTH (microfibre, PVA, synthetic buckskin).

The first cleaning phase removed most of the foreign substances stuck on the surfaces. This type of mechanical action was the least invasive one and the most affordable one. When the results were not completely satisfying, a second cleaning phase was carried out by adding water, which is not by any means damaging for the surfaces, because of the hydrophobic nature of the materials that were being treated. In some cases, harsher substances had to be used, for example in the case of the wardrobe located in the right part of the room, which was covered in marker signs. The use of a magic rubber was not enough to clean the signs, so a solvent-based solution (80% isopropyl alcohol) was applied with a cotton swab and washed with demineralised water. The intervention method was developed basing on a prior decay analysis, thus systematically applying it following a case-by-case logic.

TYPE OF	TOOLS			
DETERIORATION	brushes	rubbers	sponges	cloth
act of vandalism - pencil		aka wipe, eraser		microfibre cloth, damp PVA cloth
act of vandalism - marker			magic sponge	
scotch / glue residue	toothbrush, plastic putty knife			
layered substance residue (unidentified)	scalpel, flat paintbrush			
adhesive labels	scalpel + toothbrush	eraser, wishab blue		

Phase 3: STRUCTURAL SECTIONS REINFORCEMENT

Where the multi-layered support lost cohesion – the various layers forming the support do not stick to each other anymore – a non-penetrating, colourless strengthening product, which is also stable to temperature and humidity level variations, is applied by injection.

Phase 4: FILLING OF STRUCTURAL AND/OR SUPERFICIAL GAPS

In this case, the intervention meant by filling of structural gaps consists in filling in some parts of structural elements as multilayer and honeycomb panels with stucco, if needed. In these cases, synthetic materials, light and stable enough and compatible with the support will be used to recreate a structural and aesthetic continuity. Superficial integration occurs when the decay concerns the covering material. The choice among the types of intervention

can vary in relation with the size of the damaged areas. For example, when there is a wide gap in the plastic laminate, it will be filled with new laminate especially shaped and colour compatible with the old one. As for little isolated gaps on furniture corners or edges, those will be filled with materials that are mouldable and compatible with the support.

Phase 5: REPLACING AND/OR INSERTING MISSING ELEMENTS

This phase is planned in case every missing or malfunctioning element should be replaced: castors, locks, hinges, feet. Those elements will be replaced with similar objects with the same functionality, dimension, colour and shape.

Phase 6: SUPERFICIAL PROTECTIVE COATING APPLICATION

The last phase consists in applying suitable and compatible protective coatings on the supports; the areas exposed to daily usage will be treated with special attention. A non-toxic, non-coloured and wear-resistant product has been selected for this phase.

The Workshops

During the elaboration of the Conservation Plan, two workshops were organized. The first took place in Urbino in September 2016, with the primary purpose to share ideas with the University and the community about the process that we were undertaking. The meetings lasted two days and took place in the Data, the former stable of Palazzo Ducale transformed by Giancarlo De Carlo in a "City center". The workshop was also an opportunity to share the process analysis with the Scientific Committee members and to verify and establish the first guidelines for the Complex Maintenance and Transformation Criteria. The first day we had a presentation of the work open to the city, while the second was a session restricted to the team.

In January 2017 a second workshop was organized in Rome hosted by the National Arts Museum of the XXI Century – MAXXI - with the participation of external guests invited to share their experiences and to comment the development and the challenges of the Plan. This final workshop focused mainly on two themes. The first concerned the constraints that this particularly complex site poses to a "proactive plan for the management and the conservation": the size, the articulated configuration and the presence of two institutional stakeholders - the University and ERSU - whose perspectives and long-term strategies must necessarily converge. The second addressed the challenges of transformation that should not affect the original identity of the complex.

Giancarlo De Carlo

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