

MECHANICAL ENGINEERING I PHYSICS I
PRESERVATION OF THE ARCHITECTURAL HERITAGE
I SPATIAL PLANNING AND URBAN DEVELOPMENT
I STRUCTURAL SEISMIC AND GEOTECHNICAL
ENGINEERING I TECHNOLOGY AND DESIGN FOR
ENVIRONMENT AND BUILDING I TERRITORIAL
DESIGN AND GOVERNMENT I URBAN PLANNING,
DESIGN AND POLICY I AEROSPACE ENGINEERING
I ARCHITECTURAL AND URBAN DESIGN I
ARCHITECTURAL COMPOSITION I ARCHITECTURE,
BUILT ENVIRONMENT AND CONSTRUCTION
ENGINEERING I ARCHITECTURE, URBAN DESIGN,
CONSERVATION OF HOUSING AND LANDSCAPE I
BIOENGINEERING I DESIGN I ELECTRICAL
ENGINEERING I ENERGY AND NUCLEAR SCIENCE
AND TECHNOLOGY I ENVIRONMENTAL
AND INFRASTRUCTURE ENGINEERING
I INDUSTRIAL CHEMISTRY AND CHEMICAL
ENGINEERING I INFORMATION TECHNOLOGY
I INTERIOR ARCHITECTURE AND DESIGN I
MANAGEMENT ENGINEERING I MATERIALS
ENGINEERING I MATHEMATICAL MODELS
AND METHODS IN ENGINEERING



Chair:
Prof. Carolina Di Biase

DOCTORAL PROGRAM IN PRESERVATION OF THE ARCHITECTURAL HERITAGE

The PhD programme in "Preservation of the Architectural Heritage", was first activated at the Politecnico di Milano back in 1983. In addition to the professors of architectural restoration, history of architecture and structural strengthening of the Politecnico di Milano, the Faculty Board includes representatives from other well-known universities and research institutes (Università IUAV, Venezia; Università di Genova; Università degli Studi di Bergamo; Istituto Superiore per il Restauro e la Conservazione ISCR; ICVBC-CNR, Milano); they collaborate actively in the teaching and research activities.

The ultimate purpose of the Faculty Board not only resides in broadening the experiences that the PhD candidates acquire over the first three years of the course, where they have the opportunity to interact with scholars from different backgrounds; it chiefly aims at providing the PhD candidates with a unique training experience in the Italian panorama, so far unparalleled also in domains other than the preservation and restoration of the cultural heritage. Such context investigates the synergies and responses to the modern themes of cultural heritage protection.

The PhD programme is meant as the place where theorization, methodology, investigation into the most significant chapters of the protection of historic architectural and cultural heritage are connected to complex, challenging operating research themes, on-site and lab experimentation of analytical and diagnostic stages.

The relationship with Italian Ministero per i beni e le attività culturali e il turismo - Mibact has been definitely fruitful, especially when we consider that many among the best PhDs in Preservation of Architectural Heritage have been hired as officers and executives to the above ministry.

Teaching aims

The Faculty Board organization allows to investigate and share extremely relevant, up-to-date topics that, architectural heritage being the high spot of research, describe the complex domain of preservation, a strategic field and, at the same time, one of the chief resources of the Italian economy and future.

Being a mix of differentiated research, experimentation and operating methods, the PhD programme provides the candidate with a rich and

very interesting experience. The on-going contact with the breakthroughs from studies and research carried out in Italian and international contexts and the will to promote joint projects are fostered through expanding the network of relations the university entertain with other universities and research centres in different geographic areas of the world.

In this regard, over the past 5 years the PhD programme in Preservation of the Architectural Heritage has been committed to promoting and coordinating inter-doctoral courses contributed by foreign professors from different European countries. In the last years: within the International UNESCO chair the Summer School of the PhD School "Architectural Preservation, Design and Planning in World Heritage Cities and Landscapes"; organized from the co-operation with other PhD programmes in the Politecnico di Milano, the Course of the PhD School "150th Anniversary of the Politecnico di Milano, 1863 - 2013 - *Tradition and Perspectives of Polytechnic Culture in Europe*".

Coursework

The PhD programme, lasting three years, calls for the acquisition of 180 credits overall. Thirty credits are offered by PhD courses.

The academic plan of the PhD programme revolves around 5 main research areas:

1. Preservation culture and practice; 2. Diagnostics of materials and structures and rehabilitation of historic buildings; 3. Methods and themes of historical research; 4. Construction history; 5. Historical territory and landscape.

Within this plan, different experiences are organized in order to get PhD candidates in touch with study and research developed in Italian and International context: lately the visit to important restoration site, such as the Rialto Bridge and the Palazzo Vendramin Calergi in Venice (Municipal Administration) and the Colosseo in Rome (ISCR, formerly Istituto Centrale del Restauro) or the Sanctuary of Vicoforte (with Politecnico di Torino); moreover the visit to the underwater archaeological site in Baia (Napoli) in relation to the ISCR project "Restoring Underwater". The remaining credits are aimed at personal study and research for the PhD thesis..

The activities undertaken during the second and

third year also include attendance of workshops, seminars, national and international conferences related to individual research, with great attention to conferences wherein PhD candidates present the results, even partial, of their research theses.

Research organization and topics

Educational activities are related to research either under way or at an early stage of development, some of which addresses major monumental structures and some of the most renowned sites of the world. This aspect increases the technical characteristics, and will make PhD immediately competitive at the European level.

To the aim of their thesis research, PhD candidates have the opportunity to rely on facilities and laboratories, both inside and outside the University, the breadth and width of which provides them with a crucial support to the aim of acquiring "competence for highly qualified research activities" in the domain of cultural heritage protection.

In this connection, the PhD programme deems to carry on the long - standing collaboration with the ICVBC-CNR (the Institute for the Preservation and Enhancement of Cultural Heritage).

As for the thesis research, candidates thus have the



1. The overview of Pengjia Zhai, old village in Hubei, China (Lu Huang, 2016)



2. Legnano in the 1915 (postcard, Franco Pagani and Dario Rondanini collection, Legnano).

opportunity to address and investigate in-depth the wide-ranging themes connected to heritage knowledge and preservation broadly meant, such as advanced methods of investigation; knowledge management applied to historic buildings, as the one related to the Pengjia Zhai village in the Hubei province (China), carried on analysing the construction techniques and life of families in the private and common spaces, in order to preserve buildings and settlement **fig. 1**; or to the twentieth-century heritage, as the thesis regarding the architecture built between 1900 and '30s in Legnano (carried on in co-supervision with the Municipality aimed to preserve and enhance the architectural heritage of the city) **fig. 2**; or to historical investigation on construction technology, as the reinforcing tie rods in the behaviour of the vaulted structures analysed in the case study of Santa Casa Lauretana, in Tresivio (Northern Italy) **fig. 3**. The multi-disciplinary nature of the doctoral courses, encouraged in the framework of the PhD programme since its establishment, equally values the fundamental contribution of historical research alongside its methods; at the same time it features innovative, pioneering themes: research about the energy response of buildings targeted to the reuse of existing technical systems and to reducing the impact of new systems which, since long, have been extensively addressed by the PhD programme and at the heart of an International exchange with European



3. Santa Casa Lauretana, Tresivio (Northern Italy). Tie-rods contrasting the thrusts of the masonry vaulted structure to be understood and preserved.

universities and research labs (see the thesis on Valle d'Aosta traditional buildings and the preservation and energy behavior improvement **fig. 4**); or the studies carried about the seismic vulnerability of buildings, which will be keyed to investigating the cognitive methods underlying the "Guidelines for the assessment and reduction of the seismic hazard the cultural heritage" (Ministerial Circular n.26 of 2nd October 2010, D.P.C.M. 9th February").



4. Preservation and energy performance improvement of historical traditional buildings in Valle d'Aosta.

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The Board of Professors comprises the following members:

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PRESERVATION AND ENERGY BEHAVIOR IMPROVEMENT OF VALLE D'AOSTA TRADITIONAL BUILDINGS

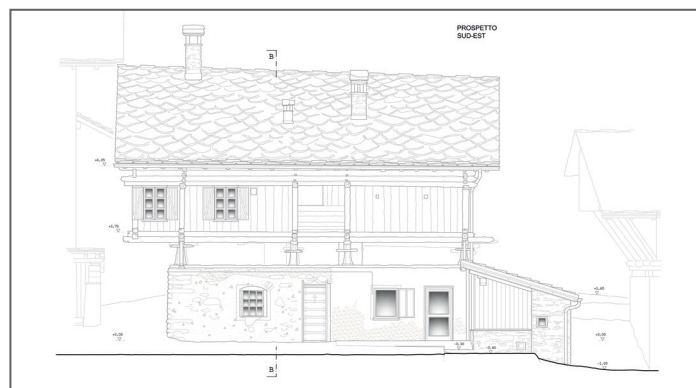
Bionaz Cléry – Supervisor: Prof. Stefano F. Musso

Co-supervisor: Prof. Lorenzo Appolonia

The Thesis defines the methodological and technical problems related to the design of solutions for the preservation and the energy performance improvement of historical traditional buildings. In particular, the subject of study are the preindustrial rural constructions of the mountain landscape of Valle d'Aosta Italian region. According to the contemporary cultural heritage safeguard principles, the Thesis first of all analyses the characteristics of those buildings, as the construction techniques, the materials, the traditional uses and the relations with landscape, in a way to define compatible and adequate solutions for their

preservation. Each lateral valley of the Region has edifices with local peculiarities, depending on resources, materials, morphology of the territory and cultural influences coming from abroad, that have reached the communities of Valle d'Aosta through the mountain passes, which were very important historical connections. In particular, the thesis has analyzed the so-called *greniers* and *raccards*, ancient wooden buildings, spread in the whole Region, used for the agricultural products conservation and the cereal processing. Refurbishment and re-use are perhaps the only way to save these fabrics from decay and abandonment, even

if some retrofitting and energy upgrading techniques commonly used risk to strongly and definitively alter their consistency. Nowadays it is necessary to consider energy behavior improvement when dealing with the reuse of existing buildings. Concerning historical heritage, this can be possible paying attention on preservation targets, above all, and carefully calibrating the re-use works. The method presented in the Thesis suggests to look for flexible, sustainable and tailored interventions, which moreover consider, propose and improve the original climatic properties of those traditional Alpine buildings. As a matter of fact, such constructions were built to let mountainous populations settle in tough environment, especially in winter season, finding the best orientation, according to solar irradiation and winds, and using specific materials, solutions and construction techniques to reduce thermal dissipation. The energy behavior analysis has been carried on a case-study building, through the development of a diagnostic project. That has dealt with the monitoring of climatic parameters, environmental temperature and relative humidity data of



1. Main front of the case-study building. Above the stone masonry basement there is the wooden structure, the *raccard*, laying on twelve “mushroom shaped” pillars.(Author’s elaboration).

four rooms, and the realization of thermography images. The climatic data have been acquired with a weather station, thanks to the collaboration with ARPA, the agency for the protection of the regional environment, and the local institutional bureau for the preservation of the cultural heritage, the Soprintendenza per i Beni e le Attività Culturali della Regione Autonoma Valle d'Aosta. The results have been discussed considering the landscape morphology, the analysis of the construction techniques, the traditional uses, the materials and the positioning of the case-study building. Since it is necessary to identify recovery interventions compatible with the characteristics of these traditional structures, the common energy retrofit interventions are not adequate. A comparative analysis carried on five apartments, situated in the same village, has shown that energy consumptions are affected

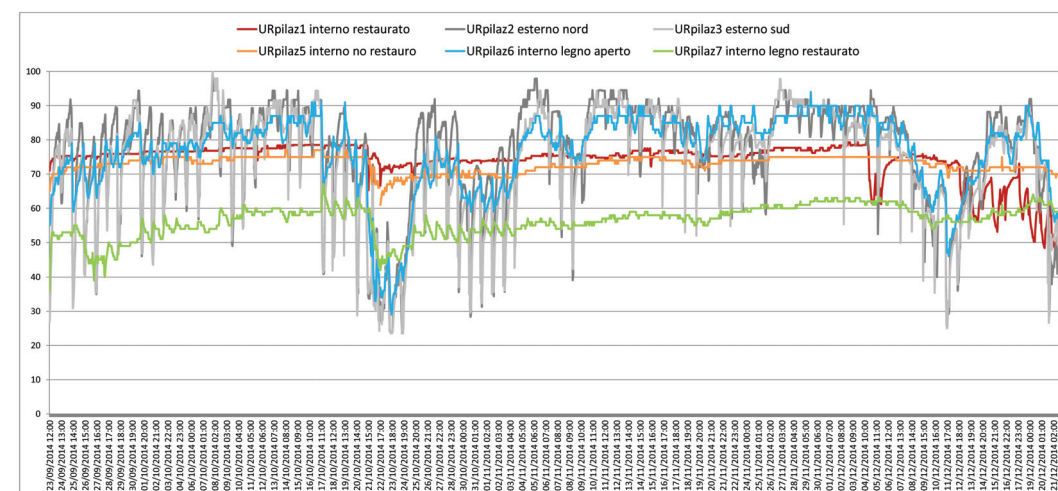


2. composition of many thermography images.

The front is the one facing the South in the case-study building. Only the part of the building on the right is heated. (Author’s elaboration).

not only by the building structure, but they are mostly determined by the use and the behavior of the inhabitants. Moreover, according to the results of this analysis, the energy behavior of the historic buildings resulted better than this of the new constructions. Finally, considering all the analysis carried on, punctual interventions and strategies for the recovery, reuse and preservation of such

delicate heritage have been suggested and explained for the main construction details. Adequate recovery techniques together with a correct use of the habitation and an aware behavior of the inhabitants lead to improve historic buildings energy behavior and preserve them from decay.



3. Graph reporting the relative humidity (UR%) recorded inside four rooms of the case-study building and outside. Six data loggers were positioned to understand the energy behavior of the building.

ARCHITECTURE AND WAYS TO BUILD BETWEEN 1900 AND '30S IN LEGNANO. A CENSUS TO THE PRESERVATION AND THE PROMOTION OF THE TWENTIETH CENTURY ARCHITECTURE

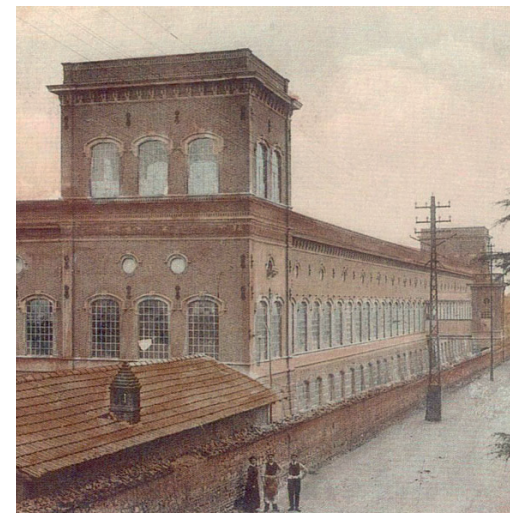
Dellavedova Patrizia – Supervisor: Prof. Alberto Grimoldi

The research, in co-supervision with the Municipality of Legnano, is aimed to preserve and enhance the architectural heritage of the city from 1900 to the '30s. The latter is the result of a constructive season promoted by several large industries, which guided the entire process of evolution of a modest farming village which became - in the twentieth century - one of the main Italian industrial centers. This rich and heterogeneous heritage is the material evidence of this history, but it risks being forgotten, because it is unknown and is subjected to continuous alterations, demolitions or mutilations, which are gradually leading the city to loss its identity. From this it's derived the need to create a first cognitive tool on this architecture and relative ways to build, stimulus for further studies. This is also aimed to sensitize administrators, technicians and citizens, as a first step to the creation of an 'Observatory for architecture of the twentieth century in Legnano', able to manage its changes in time, by forming the basis for any urban planning or cultural policy aimed to restore the sense of the city. This tool may also suggest further actions of preservation and promotion or processes of awareness and participation, essential for an heritage of such dimensions and characteristics.

The evolution of existing and

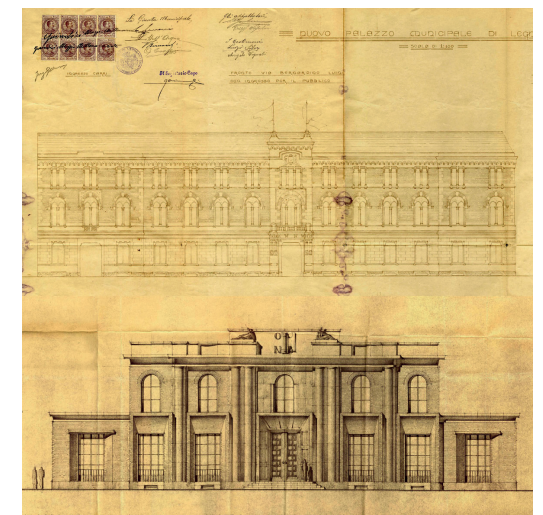
disappeared heritage was reconstructed, by analyzing its characteristics, materials and technologies used, the designers and builders, the technical and architectural culture, in relation to the context. In addition to this the selection and census of existing buildings were carried out, with a topographical inventory and sheets to multiple levels of detail with related documentation, accompanied by other tools such as comparison tables and thematic maps. This analysis has revealed an atypical case of 'factory town' which is unique and whose interest exceeds the local area to be extended nationwide. Here, the result of each construction is interrelated to political, socio-economic and cultural issues, and the inseparable link between industry and architecture is clearly evident. The local industry, in fact, in addition to allow the economic and productive growth of the city, has commissioned the main architectures and it was the engine of local technical and cultural development, which was led by an educated and innovative middle class in contact with the European experiences and polytechnic culture. The innovation research was initially powered by the updating of internal production processes, which pushed - at the beginning of the century - at use the best designers and builders and the latest techniques and materials, by experimenting them

first in its plants, and then in other building types. The industrial buildings were the first significant architectures in Legnano, designed in a functional way, in which appeared the first use of metal and reinforced concrete. This influenced the local diffusion of modern techniques in the common building, albeit more slowly, and their language - the neo-romanesque of Camillo Boito in 'bricks and iron' - spread to residential, religious or utilitarian buildings, favored by the close link between the town and the Middle Ages. At the same time the need to control and secure a skilled workforce pushed the industrials to take numerous parallel paternalistic initiatives, each of which autonomous, with its own identity and drawn by different designers. This created a still existing exposure of building types and architectural languages, with interesting distribution and new technical solutions: schools, working-class neighborhoods, dormitories, health and leisure facilities. The need for representation of the new industrial class further favored the role of modern and refined patrons, in collaboration with renowned designers, specially from Milan, called here to realize important public works, villas or funeral shrines. Most of these architectures were published in



1. The industrial architecture in 'bricks and iron': 'Manifattura di Legnano' (postcard, Franco Pagani collection, Legnano)

the major Italian architectural journals: they influenced the local architecture and led to generalized elevation of taste and of decorative art, with a high level of artistic craftsmanship expressed in stone or concrete decorations, wood furnishings, wrought iron or stained glass. Nevertheless there was a big gap between the main constructions and those due to a class of minor cultural level and realized by local technicians and builders, which often led to



2. The public buildings: from the neo-medieval to the fascist language. City hall 1908 - 'Casa del Balilla' 1933 (Historic Municipal Archive, Legnano)

mediocre results. The continuous industrial development of Legnano was also favored by local politics and urban planning, aimed to encourage the expansion of large industries in the city center and the establishment of new factories in the peripheral areas. The infrastructure of the territory was promoted, with new urban and suburban transports, public services, schools and distribution networks; roads and bridges were extended to improve

3. The industrial paternalism: 'De Angeli Frua neighborhood' (postcard, Franco Pagani and Dario Rondanini collection, Legnano)

internal and external links; the Olona river was regimented. These works were made by an updated municipal engineering department or directly by the industries, in association to the fascist ideology of the 'pickaxe wrecker', which led to demolish the old city center, by sacrificing the built heritage of the past. In addition, the Fascist Regime stimulated the initiatives for workers of each company to reach a 'total control' on the worker's life, and it included them in a state paternalism, which led to a boom of realisations. The industrial and public initiative was joined by the religious one, to complete the equipement of the city. Among these, the health and leisure architectures were the most interesting sperimentations, with new and innovative types of buildings which marked the transition to a different technical and architectural culture, which will reach its climax only after the war.

WAR DAMAGES, RECONSTRUCTIONS AND RESTORATIONS OF CHURCHES IN THE LAZIO REGION. THE ACTIVITY OF THE *PONTIFICIA COMMISSIONE CENTRALE PER L'ARTE SACRA IN ITALIA* AFTER WORLD WAR II

Fiorentino Giulia – Supervisor: Prof. Serena Pesenti

Co-supervisor: Prof. Elisabetta Pallottino

The research addresses the issue of the reconstruction of the churches after World War II, deepening the role of the Pontificia Commissione Centrale per l'Arte Sacra in Italia, through its mostly unpublished archive preserved in the Archivio Segreto Vaticano. The core competencies of the Pontificia Commissione, whose establishment in 1924 is linked to the debate on sacred art of the beginning of the century, concern the field of protection and preservation of ecclesiastical heritage and that of the construction of new churches. Since its establishment, the commission, formed by members both clerical and lay, which includes liturgists, archaeologists, art historians, architects, engineers, painters and sculptors, carries on policies that are cultural reference for the reconstruction after World War II. In particular, in the 1930s the Pontificia Commissione takes a stand on the question of the relationship between the new sacred art and modern art, taking sides on strong closing positions on the modern architectural design, with respect to which prevails the recall to the classical tradition. This principle is expressed in the publication of 1933 *Il Monito del Sommo Pontefice in materia d'arte sacra*, and it is

reiterated in the meetings entitled *Settimane di Arte Sacra per il Clero*, organized by the Pontificia Commissione from 1933 to 1939, with the aims to train the prelates on sacred art themes. In 1944, Pius XII entrusts to the Pontificia Commissione, presided over by Mons. Giovanni Costantini, the coordination of the reconstruction of the ecclesiastical buildings, task that the institute carries out through the survey of damages and the examination of the reconstruction projects. For these activities, the President calls upon to take part of the commission several intellectuals belonging to the roman academia and also by choosing among those members who hold senior positions at the Ministry of Public Works and the Ministry of Education. Mons. Giovanni Costantini also takes care of the relationship with the Italian State, particularly asking the Government to include the ecclesiastical buildings within the legislative framework of the funded reconstruction. Based on the statistical data presented by the commission, the examination of the reconstruction projects reaches its peak between 1948 and 1951, with 726 proposals examined in the three years for most architectural projects.

Because of this activities intensification, the Holy See decides to increase the number of commission members, so that in 1950 they account for three times more than those of 1945; corresponding members are appointed for Northern, Central and Southern Italy. Since 1944, Mons. Giovanni Costantini dedicates to give the widest possible dissemination of addresses that should guide the interventions on churches, both within the diocese, through the circular addressing technical and practical issues, and outside the ecclesiastical world, in particular through the publication edited with his brother Mons. Celso Costantini, entitled *Fede e Arte: Manuale per gli artisti*. In the chapter devoted to the reconstruction of the churches, the authors distinguish interventions into categories that take into account the level of damage and its historical interest. The churches more or less serious damaged have to be repaired or restored according to its primitive layout. For the restorations, the authors refer to the *Istruzioni per il restauro dei monumenti* (1938), revealing an orientation that, albeit schematic in its articulation, is in line with the opinion of inadequacy for those norms developed in the

postwar culture of restoration. However, specific orientation regarding the norms application supported by Costantini brothers about the postwar restoration is inherent in their opinion that sacred monuments are built for worship, not worship for monuments.

For the churches completely destroyed that have to be rebuilt, the authors confirm the ecclesiastical opposition to the modern architecture. The church is also recognized as an essential element of the environment, it is therefore recommended to use traditional architectural elements and local materials, but it also says that the church must have a monumental character that stands out between the nearby buildings. The reconstruction of religious buildings is subordinated to specific legislation since 1946, when the Italian state, even with the pressures by the Pontificia Commissione and by Mons. Giovanni Costantini, issues some laws. Between 1946 and 1947, the Italian State defrays the intervention on churches and admits the possibility that the reconstruction can be left to the ecclesiastical authorities both in the design and as regards the construction works.

For the Italian State, the Ministry of Public Works through his peripheral organs is directly responsible for the reconstruction of religious buildings, while it remains in the hands of the Ministry of Education the intervention on ecclesiastical heritage as established by the law of protection of 1939. Regarding Lazio region and the



1. S. Sepolcro Cathedral in Acquapendente, reconstruction project by Vincenzo Fasolo (G. Fiorentino, 2016)



2. S. Francesco Cathedral in Civitavecchia, reconstruction project by Plinio Marconi (G. Fiorentino, 2016)



3. Gesù Church in Tivoli, reconstruction project by Orseolo Fasolo and Mario Paniconi (G. Fiorentino, 2016)

ecclesiastical initiatives for the reconstruction, the research analyzes some examples of significant reconstruction projects, documented in the Pontificia Commissione archive and in the mostly unpublished archive of the Ministry of Public Works. The research covers a set of issues that have to do with the preservation of the architectural heritage and with the new religious architecture. In the reconstruction, the Pontificia Commissione appears generally favorable to the restoration of the architectural factory as evidenced by the projects that bring the churches back to their medieval facies; in restoration, the use of modern technologies and materials is always hidden from view. Regarding new constructions, the Pontificia Commissione appreciates the projects that work on the features of the local architecture, as long as the churches can be recognized as such in the landscape.

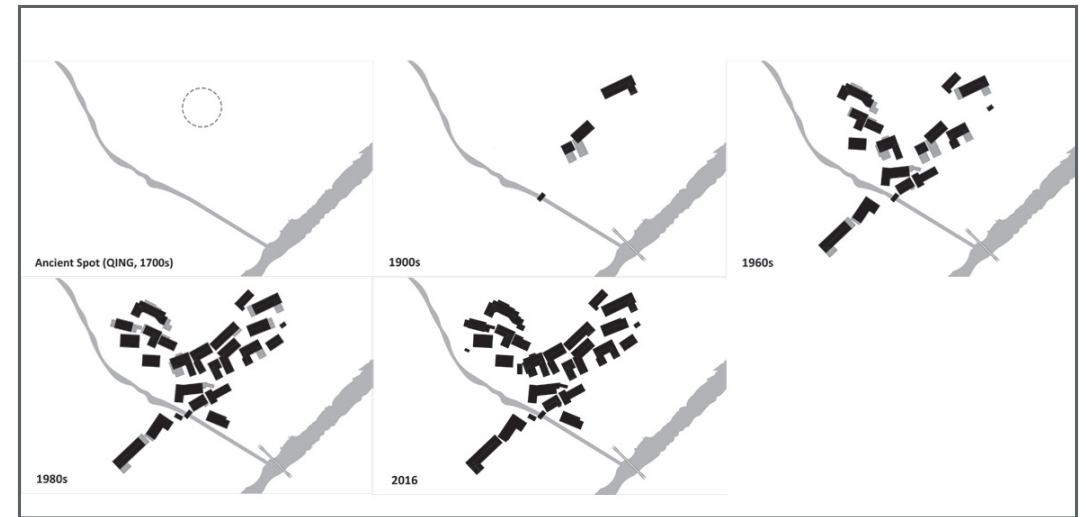
PRESERVATION OF CHINESE TRADITIONAL SETTLEMENT IN A MODERN CONTEXT - THE CASE OF PENGJIA IN WESTERN HUBEI

Huang Lu – Supervisor: Prof. Carolina Di Biase

Traditional village is a complex concept in Chinese context, its significant is far beyond ordinary village, no matter in spatial dimensions, historical evolution, rural pattern or architectural form. On the one hand, it carries a history and culture which formed by a dozens of generations in the village; on the other hand, in a continually updated modern civilization, it's attempting to explore its own value as well, and weather is the traditional culture or new civilization, both could be found with corresponding demonstration in the architecture of the traditional buildings. Therefore, in recent 20 years, as more and more Chinese scholars realized the importance of traditional village's preservation, the studies are gradually stereoscopic. And certainly, national government has played an essential role to promote the development of traditional village preservation. The case of the thesis is Pengjia Zhai which is a traditional settlement located in Hubei province, this settlement was established around 1870s, and the buildings inside of this settlement is a Chinese traditional architecture type-timber Diaojiao Lou. In 2012, it has been chosen into the first list of Chinese traditional villages, and under a national

protection level. Nevertheless, as a result of Pengjia Zhai's remote geographical location and some historical reasons, there are not much history records about this settlement in the past. Moreover, in the limited literature about this settlement, most of studies were concentrated in the overall landscape and architecture style and features, and some protection and development suggestions in the future from sociology; at mean time, some scholars have criticized that the intervention of modern elements have damaged the building patterns and also the landscape. However, the research about the evolution of history and settlement pattern were limited and unclear, and the analysis of Diaojiao Lou's structure, material and function from time line were missing. Through the analysis of Pengjia Zhai's history and current situation, it could be discovered that this settlement is in a continually evolution with construction quantity changes and renovation during hundred years. And there are two major factors working together lead to the evolution: an internal cause which is the family separation based on Chinese traditional culture, and an external cause which is the rural population mobility and the improvement of modernization

and civilization brought by Chines urbanization since the end of 20th century. Nonetheless, although Diaojiao Lou building has been changed due to these causes, those changes are only including the renovation of building materials and modification of interior functions. The structure of Diaojiao Lou and its material have never been renovated, and this is the most valuable and core part of Diaojiao Lou building in Pengjia Zhai. Hence, according to the building using status in Pengjia Zhai, the 22 private buildings have been divided into three catalogues, which are the abandoned buildings, the buildings with occasionally used and the ones are using everyday. It can be purposed that restore the oldest and abandoned building with its structure and material, recover it as same as the original and traditional Diaojiao Lou which could have a educational function to make people have a more specific and visual knowledge of Diaojiao Lou building in Pengjia Zhai; Besides, those buildings which have a intervention of modern materials, if necessary, need to be repaired or reconstructed to meet the requirement of pursuing to the quality of life or tourism needs in the future, it is feasible if under



1. The evolution map of building groups in pengjia zhai from the 1900 to 2016, the first peak construction period was around 1960s which about 60 years past from the ancient buildings for the reason of family separation and population increasing. draw by author according to the site investigation to the buildings age.



2. This building is on the reconstructing project. the old wall has been removed already, and the substitute material-holly bricks are prepared for building the new wall, and the framework of buildings are remaining still and haven't been changed anything. photo by author, 2014

a principle of maintaining its Diaojiao Lou's wooden structure. Because the settlement could never have been renovated, the life of residents should be improved in the case of keeping the original building formation, and this is the another point of view to preserve Pengjia Zhai's Diaojiao Lou buildings.

MODERNITY AND SCHOOL ARCHITECTURE (1870-1940). ORIGINS AND HISTORY OF PRIMARY SCHOOLS BUILT DURING THE THIRTIES IN PARIS'S SUBURBAN AREA

Iliou Romain – Supervisor: Prof. Ornella Selvafolta

Introduction and issues

Primary school, and education in general, is a political question in France. From the first parish schools till the last reforms of the educative programs, the reigning power always wanted to place inside the instruction, and later the education, what he held as essential for the subjects and today for the citizens. During the development of public instruction, an organic link formed itself between the school and its space, bringing inside it at each period the most relevant preoccupations: to constrain the social moral, to dominate the hygiene of the body, to forge the New man, to encourage the children's creativity, to welcome the incoming individual. In order to answer to these successive challenges, the school building gave itself courtyards, covered yards, black boards, furniture, large openings, installations of various types. A modern breath seems to be moving constantly the shape of this institution and also the box in which it is accommodated.

Today, at the dawn of the upcoming realization of the Grand Paris, which desires to make the capital of France a major metropolis of the 21st century, the Paris, which people may think, about is still this great metropolis

of the 19th century, contained first inside the walls and today inside the ring road so called "Boulevard périphérique". For a century, the suburbs spread and developed, urbanized and build themselves, providing a heritage, yet hardly recognized and now in danger. This constitutes the essential witness of what makes Paris a metropolis of the 20th century, even if the city did not extend administratively. From that point of view, several attempts have occurred especially during the interwar period, in which the Seine "département" and the suburban towns that composed it played a key role. The increase of the population corresponded also locally with a great effort in terms of public facilities. Among these, primary schools played a major character, especially those built in the 1930s.

By listing all the schoolhouses built during the 1930s and enquiring on their histories, architects who participated to their design, politicians, administrators but also destinies of these buildings, the thesis intends to highlight a relatively ignored heritage, showing also the constitution then of crossed experiences, an historical significance and today the existence of a monumental network organizing the suburb's framework.

An heritage peculiar to Paris' suburb

These schools, some of which were then for a long time considered as examples and remain today prominent inside the history of French modern architecture, were erected inside an architectural tradition inherited from the 19th century and heavily regulated. They nevertheless embody the first attempts to get out of a dogma - then driven by his own understanding of modernity - while retaining its essence. Indeed, a link is emerging between the different periods regarding school architecture, once manifested the desire to extend the instruction and education to the entire population: ensure good hygiene and a work area corresponding to the functional necessities of teaching methods, with the systematic use of materials and the latest technology, being regularly updated. However, the specific context of the interwar indicates that regarding school buildings, the intrusion of "purists" or "art-deco" formulas was not obvious.

Socialist and communist mayors of the Parisian suburbs led this renewal that succeed in placing themselves at the head of the vanguard of elementary public school architecture, creating the

conditions to materialize the encounter between modernity and new teaching practices, with quality results praised by critics, academic community, users and hygienists. Yet it was not easy for architects to move in a particularly restrictive and out-of-date regulatory environment, which sometimes can make these schools appear as "post Jules Ferry" models, adopting architectural contemporary modernity only as an aesthetic value and not conceptual. If modernity has been the key driver of the design of school architecture in the nineteenth century, it remains so during this period. The political and ideological struggles led on the ground by local officials definitely allowed the school design to know a revival, facing at first violent criticism from conservative circles, both political and artistic, before to establish itself as a model seeking to extend over the whole territory.

An influence and an originality vanished

These schools will have a great influence. Nevertheless, in France, the path toward a renewal of school architecture should oppose itself to reluctant academic and ministry administrations, and the regulations inherited from 1880, updated in their last version in 1887. If new regulations are adopted in august 1936, after the arrival of "Front populaire" coalition in parliament, their rewriting starts in January 1934 during Anatole de Monzie (other radical socialist, 1876-1947) period at the head of the Ministry.

He keeps a dubious look at the modern realizations in Seine-suburb. These doubts can still be found inside 1936 rules that keep 1887 frame but relatively introduce the possibility to use modern materials and modern architecture. Regionalism, since 1921 official doctrine for school architecture, is authorized only if cheaper than modern solutions. Today, these schools went through different histories but knew similar pathologies and necessities to be updated according to more recent pedagogic methods and comfort needs. Some may have lost their terrace roofs. Most of them lost their original window frames, furniture and inside finishing, taking away original intention of project design and meaning because of a modified perception. At the same time, a lack of illustrious paternity and a lack of communication between municipalities about their twentieth century heritage did not help also for their valorization. Memory and culture: toward a monumental network Governed by shared hygienic inspirations, an homogeneous political, architectural, urban and economic reality, these "groupes scolaires", risen inside developing zones, are moved by the same principles and the same understanding of the challenges of an architecture at the service of education that looks after the innovations of the modernity. A substantial connection appears then between all these buildings as much as in their chronology and in their spatial spread. The patrimonial character of

these schools, as members of a common and unifying movement, strengthens itself, surpassing a local story that would be otherwise absurdly limited to the borders of these eighty municipalities that fragment the Seine-suburb. This territorial network, patrimonial and monumental, highlights a common history whose reality is still contested by political and electoral competitions that durably marked the first half of the Twentieth century and still today exist. Inscribed inside a monothematic catalogue, these schools discuss with each other and allow a new reading of this history, characteristic of the Seine-suburb. So, if not contextualized, it is obvious that the patrimonial value of a school that haven't been confronted with its contemporaries and would only be considered as the emanation of a local and recent history (the local characteristic of such a realization is highly questionable when considered the political challenges and the development of the Seine-suburb that occurred during the thirties and that overpassed such boarders) would be at least suffocated if not silenced.

IRON TIE-RODS WITHIN MASONRY ARCHED STRUCTURES: REVISION OF A HISTORICAL REINFORCING TECHNIQUE FROM THE APPROACHES OF CONSERVATION AND STRUCTURAL EFFICIENCY

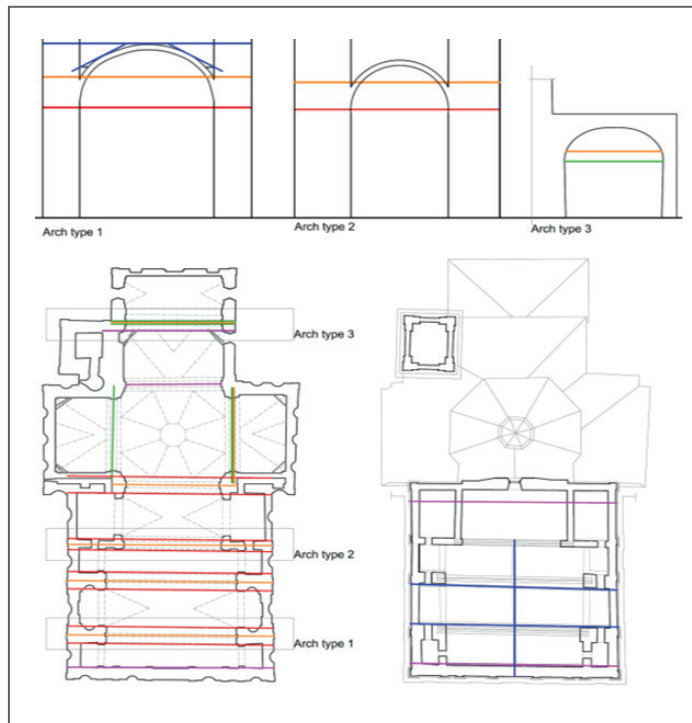
Mora Gómez Juan – Supervisor: Prof. Lorenzo Jurina

Historically, arched structures have long been considered by mechanics and constructively as their own enemies in a self-destructive structural behaviour, the very cause of their own collapse if the arch was not well designed, the only structural typology prone to fail under its own weight, a “strength made out of weaknesses”. Tie-rods were the immediate and pragmatic solution to solve the errors in design or construction that would otherwise have led to collapse, and to further develop even other statically improbable designs. From these reasons rise the importance of the tied arch as a particular structural unit, sometimes accidental, sometimes deliberately projected. As such, it must be understood as a tectonic ensemble on its own: their interaction with the masonry leads to a structural behaviour that must be distinguished from the one of the simple arch, as a primitive form of reinforced masonry where each element's work is defined by its material and form.

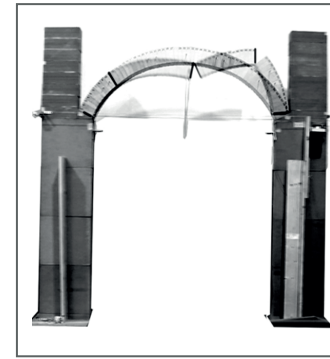
A well-known structural collaboration that, due to its material complexity, is not fully understood to our days though. This work has intended a deep comprehensive analysis of the type, going from its very

identification and the definition of the intrinsic values that lead to its conservation and influence on its conditions, through the characterization and the dissection of its defining features, which will allow us to understand their value within its context, but also to understand its structural contribution to the architectonical ensemble, and its behaviour under different hypotheses. Following the material, technical and constructive developments

through history, tie-rods have evolved in time, offering different solutions that diverge in a range of parameters linked to aesthetics, materials, constructive details and logics of use. This ensemble of concepts, put within their historical context, constitutes the identity values that ties can offer as important historical and architectonical signs within the overall reading of a historical building, being a constitutive part of its reading.

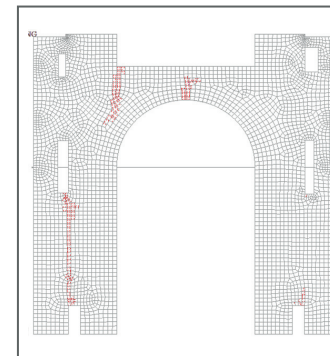


1. Historical superposition of tie-rods in the Santa Casa di Tresivio



2. Physical model for the study of structural behaviour or tie-arch unit.

These signs and traces should be preserved in the further strengthening interventions that the building might undergo, and to the possible extent, without altering their tectonic value. Predicting and assessing the modifications that the tie-rods introduce in the arch structural behaviour is essential for this task. The structural behaviour of masonry and the simulation of actions on them has not still been completely set for these complex cases. The modelling of historical



3. Study of structural performance and verification of historical hypotheses through FEM.

structures involves a series of uncertainties calling for physical assumptions and simplifications that must be interpreted consciously and with the proper knowledge. Coming to the arch-tie unit, a further complexity is added, given the juxtaposition of materials with very different properties, the difficulties in physically defining how each part of the structure affects the other, and the uncertainties of the tie mechanical properties. Due to the paradigmatic variety of both typologies of arches and tie-rods, the case study of Santa Casa Lauretana, in Tresivio (Northern Italy) has offered a leading thread to develop a whole research into the study and valuation of the different parameters that define this reinforcing technique. In this building, a series of tie-rods have been applied according to different historical constructive criteria, and with the different techniques that corresponded to the times. It has served, thus, for the compared study of the evolution of these elements. The methodology has been to establish the parallels among four different approaches applied to the case study: the historical research on the strengthening interventions in the building, the research in the historical technical and architectonical literature, an experimental parametrical campaign on a mock-up, and the use of FEM methodologies in detailed models. This leads to the possibility of valuating these elements as historical and constructive signs, and to a qualitative and quantitative description of the structural

behaviour of the tie-arch unit in its possible varieties. Also, it has permitted the confrontation among the historical and contemporary methodologies of structural analysis, and shown its complementarity. The overall result of this work has been a deep reflection on the many dimensions that compose the knowledge of these elements, and the discovery of warnings for their conservation in successive strengthening interventions. This includes the identification of the characteristic features of tie-rods, their contribution to the historical knowledge of a building and the reasons for their preservation. The simulations and structural prediction models have helped to understand their structural behaviour in many hypothetical scenarios, and thus, how they should contribute within the structure, even with the addition of further reinforcements. Tie-rods, within their dimension of traditional reinforcing systems, pose a statically full valid solution still nowadays, especially when complemented to either other traditional reinforcing techniques or to innovative technique that nonetheless respect the original tectonics of the structure. It must be also understood that new tie-rods are not the only possible strengthening solution, and many times not even the optimal, depending on the case. But their conservation will many times need the complementarity of other solutions, which must be studied in the research for the optimal structural behaviour and preparation for unexpected actions.