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1st International Symposium on Building Pathology

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University of Porto

Conference Proceedings

Edited by:
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Preface

The ISBP conferences aim at attracting a balanced portion of delegates from academia, industry and research institutions; providing a binding platform for academics and industrialists to learn with the past and current building pathologies and encouraging the systematic application of that knowledge to the design, construction and management of buildings. Building pathology is the scientific study of the nature of building failure and its causes, processes, development and consequences. In order to provide an economic and effective remedy to building defects it is essential to identify properly the cause in order to address the problem.

This first International Conference will be held in cooperation with the CIB W086 Commission - Building Pathology supporting the discussion on Building Pathology - The Research and the Practice. The main objectives are to produce information which will assist in the effective management of service loss; to develop and evaluate methodologies for the assessment of defects and failures; to propose methodologies for the prevention and mitigation of building defects; to analyze costs associated with building pathology and to disseminate findings among all those involved in the production and management of buildings.

More than 170 abstracts were submitted which allowed the selection and publication of more than 80 papers. The demanding and rigorous review process represented a heavy obligation for the international Scientific Committee and, of course, for the authors. The editors wish to express to all people involved in the review process their deep and sincere thanks and acknowledgement of their keen efforts in completing this necessary task.

The ISBP2015 Proceedings are published in one electronic volume that contains papers focusing on the themes of Structural Pathologies, Hygrothermal Pathologies, Diagnosis Techniques, Building Pathology vs. Durability, Asset and Maintenance Management, Information Dissemination, Building Performance Simulation and several Case Studies.

The editors, the reviewers and the authors made a considerable effort to produce the proceedings without significant errors or omissions. However it should be conceded that in this volume containing approximately 750 pages it was not possible to completely capture all faults or inaccuracies. In this regard, the editors regret any oversights and express in advance their apologies for any errors that may subsequently be uncovered.

The ISBP2015 has received sponsorship from several Institutes and Companies. To our sponsors and to all other organizations involved in supporting the conference, without which this conference would not have been possible, we would like to express publicly our most sincere thanks.

The organization of an international conference of this breadth and scope depends strongly on the earnest work of a number of committed people namely: the papers' authors, the keynote speakers, the Scientific Committee and the Organizing Committee; a special thanks to all of them for their hard work. We are especially grateful to the staff of the Laboratory of Building Physics of the FEUP whose incomparable work and dedication to the organization of this conference has greatly contributed to this unique event.

Finally it is hoped that ISBP2015 conference can be considered to have provided a highly useful venue for exchange and dissemination of information for all those who participated in this event and that being in Porto and the Northern Region of Portugal, as a complement to the conference, has offered an opportunity to discover a country of more than 800 years of history, and one which has a great joy in welcoming visitors, and whose countryside, cultural patrimony and gastronomic diversity the Portuguese are immensely proud of.

The Editors,

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(FEUP – PORTUGAL)

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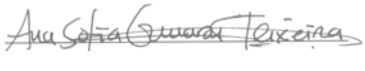

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1st International Symposium on Building Pathology

Recovery and enhancement of modern architectures: the case of Cinema Ariston in Potenza (Italy)

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ABSTRACT

The Architectural Heritage of the Modern is in addiction with the historical and cultural heritage that are the 'Beauty' of Italy. The starting point of this research is to reuse an area of the historic city center of Potenza and to recover an historical architecture abandoned: the Cinema Ariston.

It is built in the 50s of 900s and it is a significant example of modern concrete architecture in the town. The original function of cinema includes it in those buildings that have marked the history of the town and today can not be deleted from the memories of all citizen and it should be enhanced as a central element for the renovation. An accurate metric and materic survey and a diagnostic investigation (including pachometer, sonic and ultrasonic tests) have been carried out to define the project. The results obtained were used to implement an analytical model for the study of the seismic vulnerability and to define the conservation interventions and structural rehabilitation.

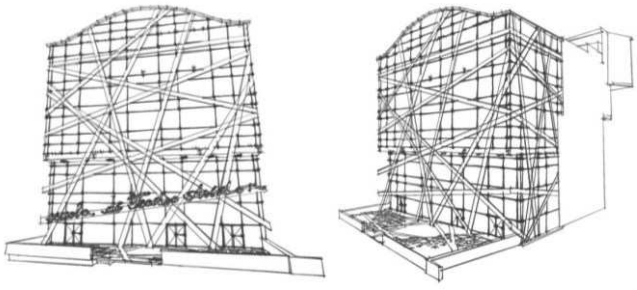

Fig. 1. Design Sketches

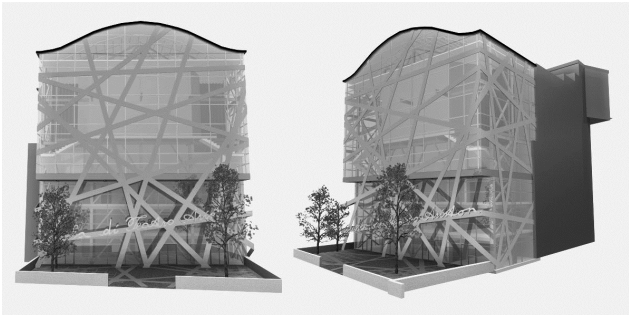

Fig. 2. 3D Models

The recovery project includes also a new construction and proposes the re-completion of the existing, partially demolished, through new elements and modern materials.

The policy adopted for conservation and the new intended use ensure a future for the Cinema Ariston and the urban space connected to it; the aim is to perpetuate social and historical memories of buildings that have no particular values for the preservation, but retain other important values to be transmit.

KEYWORDS: Diagnostic, Vulnerability, Recovery, Enhancement, Integration.

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1 INTRODUCTION

During the last years the need for the conservation of land and the rehabilitation of existing building have emphasized the role of the Recovery as the only solution for complex problems of Architectural Heritage.

The conservation with maintenance and preservation actions, as well as the improvement of energy and structural performance and indoor comfort of the existing buildings are the starting point of the recovery project. It interprets signs of history and makes possible to re-invent a space in relation to the existing but without deleting the original integrity and ensuring the architectural quality. It is essential to know the architecture, with an interdisciplinary approach, linked to metric, materials and constructive knowledge and using a method that allows the understanding of architecture's places to be recovered.

The future of historical architecture is possible with a flexible design that, through the knowledge of the historical layers of the building, proposes solutions based on the relation between analysis, design, project and construction. This is the aim to achieve with the recovery of the Cinema Ariston in Potenza, possible through an intense process of research, analysis and design.

2 URBAN PLANNING AND HISTORICAL CONTEXT

Cinema Ariston is located in the center of Potenza, borders on the Prefect's Palace and an aristocratic mansion near Pretoria street, the path on which has developed the urban core. It was built in the 50s and it is one of the first examples of modern architecture in reinforced concrete of the town, in which the testing of materials and techniques describe the uniqueness of shapes.

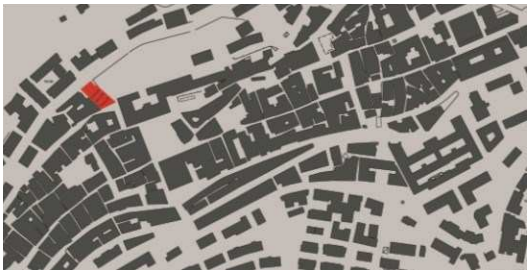

Figure 1. Site Plan.

The contrast between the new construction (in reinforced concrete) and the other buildings of the eighteenth-century and nineteenth-century, shows the historical transition from traditional to innovative construction techniques, that have changed the urban planning of the town. It was essential to define the cultural dynamics that characterized the evolution of the town to understand which was the role of the Cinema Ariston and what should be today. The Cinema Ariston was the first place used only to cinema activities, while the others cinema were created inside theaters or large areas used by cultural purposes. For these reasons the activity of Cinema Ariston was intense, but later it had a difficult story. After different steps of closing and reopening, it was abandoned in 1995 for security reasons. Today, because of the abandonment, the decay is so shown that who lives or sees every day the Cinema feels a kind of depressing "memento mori".

Figure 2. The North-West Facade.

3 THE CINEMA ARISTON: THE STATE OF CONSERVATION

The Cinema is located on a natural slope and has a rectangular planimetric shape as opposed to the profile facades, where there is co-penetration of volumes that define unique shape. The extension of the Cinema made possible to preserve the natural characters of the site, reflecting both in plan and section, the morphology of the place. The main facade is characterized by glass surfaces, now partly walled, and by the sign of yellow color that characterizes the original entrance.

Figure 3. The Main Facade.

The facade on the north-west, in Via Mazzini, is completely absent after the demolition carried out over the years because of the vulnerability of structural elements; on this side the Cinema is completely stripped and it allows to see what remains of its structures. The atrium structure has reinforced concrete pillars and beams and it is different from the structure of the stall area characterized by beams in longitudinal, transverse and oblique directions which identify a regular grid of pillars. From them, at the level of the stall area and the gallery, it can identify different reinforced concrete shelves on which they rest the reinforced concrete roofs, in order to derive the floor of the gallery realized with twice reinforced concrete vaults.

The survey was intended as a method to understand, through the historical-critical approach, the current appearance of the building highlighting anomalies and peculiarities.
The historical documentation, poor and incomplete, and information obtained in situ were allowed to complete the geometric, material, structural and pathological building knowledge, that are essential for an accurate recovery project.
From the pathological and decay point of view, the building has several alterations due to atmospheric, chemical and biological agents. There are stains, patinas and efflorescence on the

surfaces of the materials, the rubble and vegetation cover most of the walk areas, instead gaps and the demolitions were caused by human intervention. Therefore, the re-use will ensure the absence of these causes and the preservation of the building.

Figure 4. The Stall Area view.

Figure 5. The Gallery view.

4 DIAGNOSTIC SURVEY: A NON-DESTRUCTIVE METHODOLOGY AND THE SEISMIC VULNERABILITY

The knowledge step was conducted with particular care to diagnostics divided into pathological analysis of the building and a non-destructive survey on the structural elements. The main pathologies of decay were identified and it was possible to recognize the causes, in order to propose actions that should preserve the building.

4.1 The non-destructive diagnostic and the seismic vulnerability

The survey with non-destructive tests (pachometer, sonic and ultrasonic tests) made possible to estimate the mechanical properties of structural components using the method Son-Reb (SONic REBound).

The pachometer tests were used to verify the layout of the reinforcement in the pillars and their diameters, comparing this information with the structural project. These tests showed that the longitudinal reinforcement in the pillars are not enough to meet the current static and dynamic needs. Average values of the sonic (Ir) and ultrasonic (Vm) tests of each pillar are reported in the Table 1 and were used to calculate the compressive strength of concrete (Rc) with the method Son-Reb using the different formulae of several authors. Ultrasonic and sonic tests showed that the concrete is in a

bad condition; the difference of the values for the ultrasonic test can be attributed to the types of measurements (with the transducers placed on opposite or on the adjacent faces of the pillar) and the presence of moisture for the different exposed to weather conditions of some pillars than others. The different results of sonic tests , however, were attributed to the different shapes of the pillars and the difference of the plaster and composition of the surface layer of concrete, which is more damaged in some pillars.

The values estimated by the Son-Reb method show how the different expressions used in the six survey points provide almost comparable values; however it is clear that the concrete investigated is not homogeneous, as in the first and fifth pillars, the results of the concrete strength are lower than the other points investigated, as well as the second pillar is characterized by higher values. Therefore, it was decided to use a minimum, average and maximum value of strength of the concrete in the model of analysis of vulnerability and seismic risk, through a parametric analysis. The analysis of vulnerability and seismic risk of the building is carried out by the procedure VC (Vulnerabilità Cemento Armato Reinforced Concrete Vulnerability) [Dolce & Moroni 2005], which allows to optimize the information obtained from surveys considering the characteristics of the building designed with seismic criteria or designed for vertical loads only. The structural model identifies the collapse mechanisms with the definition of the shear and /or bending crisis of the pillars, making reference to the levels of damage required by Italian Regulations of the State Limit of Operation and State Limit of Collapse [Nuove norme tecniche per le costruzioni D.M. 14 gennaio 2008].

Table 1. Sonic values, Ultrasonic values, Rc values using Son-Reb method [Rilem NDT 4 1993], [Gasparik 1992], [Di Leo & Pascale 1994], [Del Monte 2004], [Giacchetti 2005].

Code	*Ir*	*Vm*	*Rc* [MPa]				
			Rilem	*Gasparik*	*Pascale*	*DelMonte*	*Giacchetti*
Pa_1	34.8	2190	6.45	10.14	7.58	10.60	5.35
Pg_2	49.5	3382	37.76	35.21	31.94	32.92	27.19
Pp_3	40.4	2948	17.24	21.20	18.41	20.76	14.31
Pg_4	39.4	3505	26.11	28.31	27.38	27.04	21.68
Pp_5	40.8	2290	9.05	13.43	10.01	13.68	7.51
Pp_6	36.3	3367	20.97	23.76	22.76	23.04	17.41

The simulation model was developed using parametric analysis and has identified collapse mechanisms of the structure for bending crisis of the pillars. The seismic action on the limit states considered (Operation and Collapse) has been evaluated in reference to the parameters of the seismic hazard of the site, and has been rated the seismic risk of the structure using risk indicators.

Figures 6-7-8. Pictures of non-destructive tests.

4.2 The reinforced concrete jacketing of existing structures

Before a recovery project, it was essential to design rehabilitation actions of the existing structure, and it was chosen the reinforced concrete jacketing, as the best method that meets the seismic structural and architectural building needs. The intervention was designed and analysis by the VC procedure was conducted; results have validated the efficiency of intervention, and so the building could allow to respond to the seismic.

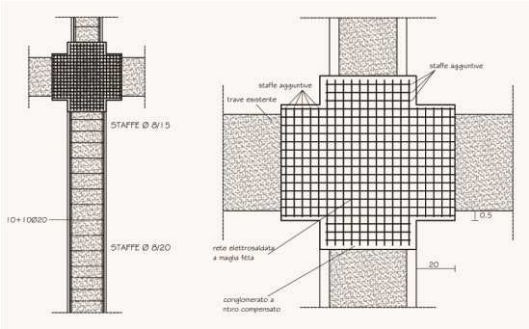

Figure 9. The reinforced concrete jacketing for pillars.

5 RECOVERY AND REHABILITATION PROJECT

The recovery project is the combination of several strategies that requires the achievement of technological solutions to define the transformation of the relationship "new-existent," and should meet the architectural functional and performance needs.

The current shape of the Cinema Ariston, its history and the role it has had in the town have directed the design choices to a recovery of its historical and cultural memory, preserving parts of existing structures and proposing the transformation of the building by introduction of compatible functions. In this way it was possible to preserve qualifying existing spaces as starting points for the project. The design process was conducted in two different ways, one oriented to the preservation and enhancement of the existing and the other to the technology design of the new construction. In the recovery project of the existing, materials and shapes were preserved to have continuity with past and to ensure the projections of the Cinema into the future, while lost or compromised elements have been restored. It was essential to provide conservative interventions, such as the removal of rubble and demolished materials, removal of coatings and efflorescence, and surface cleaning for the remaking of plasters. For these reasons the project has been balanced between conservation and innovation.
The recovery and enhancement project suggests a new function of the Cinema Ariston, which retrieves the primary activities of cinema, and increases its use with a “new-old” intended use which gives to the "architectural ruin" a new identity consists of the Cinema- Theatre and School of Theatre.
The strategy used is the architectonic integration that includes the completion and the improvement of the existing with new volumes retaking the old space lost in the years of abandonment, and at the same time improving the architectural configuration of Cinema.

The new building is approached to the existing creating a continuity of appearance; is designed using contemporary and innovative techniques, that are related to techniques of the Cinema Ariston. In this new building are located activities of the School of Theatre, where the analysis of architectural space was easy, because there are no significant structural constraints but at the same time, was complex because requiring a logical continuity with the existing one. The architectural language used for the "glass box" with a combination of steel and glass elements allows the relationship with the surrounding urban context through reflections, lights and colors, and it emphasizes the renovated image of the new building. A grid of steel elements on the front facade wants to re-create artificially

the integration of nature in architecture. This contemporary language, with materials, geometries and properties different from existing, but compatible and complementary, is the right architectural compromise.

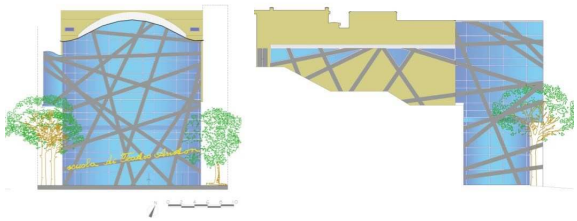

Figure 10. Facades of new building.

5.1 The technological project of the existing building

The technological actions proposed on the new and existing building want to improve the thermal, moisture performance and indoor quality. On the roof was designed a “tetto rovescio” with a waterproof membrane below the insulation and separated from it with a fabric layer, that is an excellent solution for cold winter and warm summer, typical of the town of Potenza. On facades the insulation was the only solution that could solve the penetration of rain water, the moisture on internal surface and heat loss, ensuring at the same time a correction of thermal bridging, as well as protection from decay generated from the weather.

5.2 The technological project of the new building

In the new building the roof is a “tetto-rovescio”, there is a glass facade panel, a floating floor to soundproof classrooms for the activities of the School of Theatre and the courtyard flooring is a garden in a dense urban center. This floor is similar to the facade and it is made with square blocks whose dimensions are gradually reduced to the advantage of the grass.

The study of the acoustic was conducted analyzing the primary and secondary structure and it was essential to introduce acoustic directional reflectors to ensure the comfort. The recovery project was complex and required a detailed study both in the knowledge phase that in design. Infact, conservation, structural rehabilitation, recovery and enhancement actions should not delete important historical, architectural and artistic traces, but join them in an innovative project.

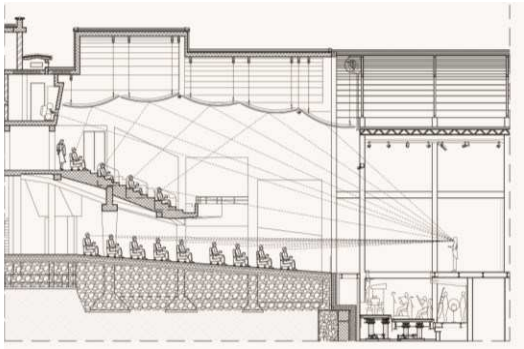

Figure 11. Acoustic scheme with acoustic reflectors**.**

6 CONCLUSIONS

The many topics discussed in this research have allowed the development of a complex and multidisciplinary approach that has permitted the formulation of important final remark. The Cinema Ariston, infact, despite being abandoned for years has revealed potential and interesting characters. The historical and cultural importance of the Cinema required an approach for a project that will meet the needs of the town and the community. The creativity of the design phase has shown the possibility to increase the functions of the Cinema, adequate to define a new identity projecting the Cinema Ariston in a future dimension. In addition, provide an important cultural and aggregation point in the historical center of Potenza, would give a restore of the town, now lacking in services and cultural place.

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