

# Architecture and Didactics: A New Cultural Centre for Matera, European Capital of Culture 2019

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## Abstract

The paper describes the students' works, which included posters and physical models, were the partial outcomes of the current 3rd year design studio, led by Prof Giuseppe Fallacara and taught with the support of Maurizio Barberio and Micaela Colella, both Ph.D. students at the Polytechnic of Bari. The goal was to simulate the activity of a large architecture practice, involved in the design of a public building, which generally requires the contribution of a large number of architects and designers. The students were given a brief for a new museum and multipurpose centre in Matera, Italy, which was recently nominated European Capital of Culture 2019. They had to deliver a design proposal, a rapid prototyped model and a short video.

## 1. Introduction

University studies establishes the basis of an essential education of the students. However, probably even more important is the way university programs influence future professionals in developing the skill required in team working and while sharing responsibilities, especially in the architecture schools where students will seldom perform their work in isolation. On this assumption, Giuseppe Fallacara, Associate Professor from the Department of Civil Engineering and Architecture, Polytechnic University of Bari, with the support of his assistants, Maurizio Barberio and Micaela Colella, has used an unusual teaching method in the current third year Design Studio. This student-centred approach has resulted in a series of cooperative lessons, in which both students and tutors worked on projects under conditions that ensured equality between them. In this way, it has been possible to provide the necessary intellectual and technical tools to respond a complex and vast issue as the one professors and students have chosen together during collaborative lectures and active participation, in order to have an immediate feedback about students understanding, that results in the equalization of competencies and skills.

## 2. Educational project and course planning

Since the academic year 2015-2016, the aim of the course analysed in this paper is to investigate a new way of teaching architectural design at University, basing all academic activities on key concepts such as Experiential Learning and Flipped Classroom. These two concepts arose at different times in the history of pedagogy and they inspired the organization of the course, which has gradually changed even according to the feedback received from the students. The aim is to create a learning process where students are actively engaged; they are required to participate to demonstrate a process, analyse an argument, or apply a concept to a

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real-world situation. Students are then deliberately forced to face uncertain situations, adapt and manage the stress. This allows students to develop their problem solving skills through creativity that is a key part of their job. The current state of the labour market, in fact, requires a considerable capacity to adapt to various changes; consequently, what it really matters is the ability to acquire new knowledge quickly and to use that knowledge to build new skills. The definition of Experiential Learning, by the US educational theorist David Kolb [1], was inspired, among others, by the work of John Dewey. In his book *Experience and Education*, written in 1938 [2], Dewey criticizes the traditional teaching methods since knowledge is transmitted exclusively through the books and students are not involved in the learning process. Therefore, the acquisition of knowledge or skill is achieved through repetitive practice. Besides these important concepts, the course also examined learning experiences and perceptions of the flipped classroom model [3]. With this method, the role of the teacher results radically changed: he guides the students in processing the project critically and actively, encouraging him to face and solve complex tasks. In order for this method to be effective and used in teaching a complex and heterogeneous discipline such as architectural design, a case study concerning an open competition is presented to simulate the dynamics that occurs in a great architectural office with a multi-discipline community of professionals. The simulation of an open competition is in fact one of the professional situations that involves a large number of designers and specialists. In particular, the above-mentioned competition focuses on the upcoming event that involves Matera, a city of the Southern Italy, as the 2019 European Capital of Culture. According to the guidelines that the official application document provided [4], together with students, possible architectural topics and their location have been identified. After the completion of group discussion, the project concerning a new multipurpose cultural centre

has been considered as the most appropriate to accomplish the teaching approach of the course.

### 3. The project

#### 3.1. Overview of current museum presence in Basilicata and further developments

Basilicata boasts a great number of museums that are located in different zones of the region, offering a fairly rich and varied panorama. From the analysis of the dislocation of the most important museums, such as National and Provincial museums, a large number of museums in the region results [5]. In addition to the museums in the two regional capitals, other five museums are situated in the area from Vulture to the Ionian coast through the Val d'Agri, together with a dense network of local museums, often specialized in specific topics and sometimes with considerable success. In many other cases, however, the museums of Basilicata, in particularly smaller ones, have considerable difficulties concerning quality, accessibility and development. The result is a complex and fragmented situation (Figure 1) that combines its positive side, the considerable geographical spread and the development of local resources, with the negative aspects comprising inadequate infrastructures and the lack of databases and common guidelines to ensure effective communication within the museum institutions and with the user.

A more detailed analysis may relate to the location of the main types of museums in the Basilicata Region (archaeological museum, art museum and demo-ethno-anthropological museums). The works and findings - showed in the most part of the exhibitions - have local and regional origin. This results evident considering their decentralized and diffuse nature, that is very attentive to history and local traditions but consequently they have a short-range diffusion. The types of findings,

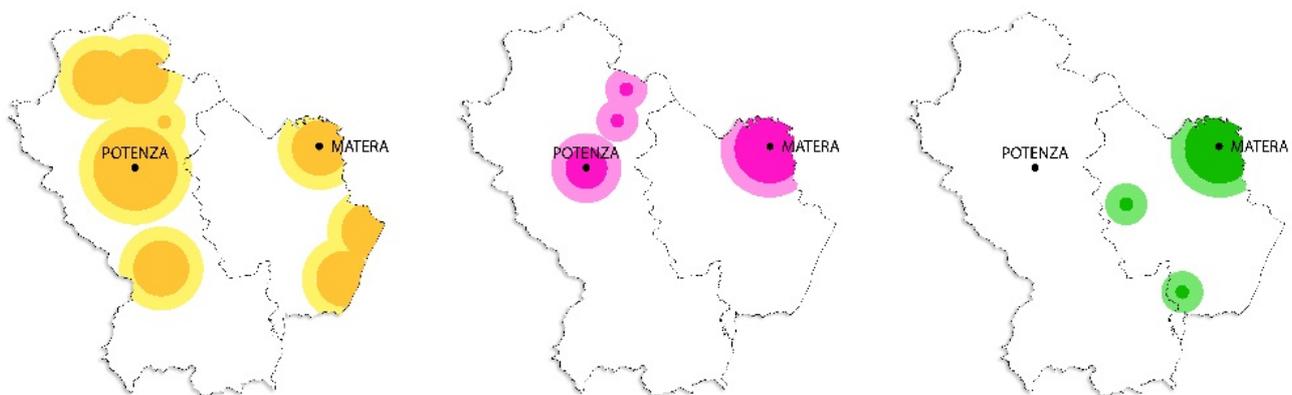


Figure 1. From left to right: quantity of archaeological, artistic and ethnographic museums

housed in seven of the eight national museums in the region, almost represent the evolution of civilization in Basilicata from the Palaeolithic to the Roman period. They are above all ceramic products; there are few sculptural and architectural products. Overall, the amount, as well as the quality, of the archaeological findings showed in the museums of Basilicata turns out to be very significant; of course, these findings must be added to the likely vast amounts of findings stored in warehouses, or that are inaccessible to the public. In general, the main archaeological museums are situated where important settlements were located in ancient times, such as Metaponto, Policoro or Grumentum, and they exhibit the findings collected in the surrounding areas. Similarly, although they cover a larger area, the museum of Matera and the museum of Melfi collect the findings belonging to their respective territories. The only archaeological museum that aims to represent a geographically larger history is the *Museo Archeologico Nazionale della Basilicata* in Potenza [6]. Art museums have less impact in the region: the remarkable collections these museums house are almost exclusively concerned with the sacred art of Basilicata in Medieval and Modern times. An exception is the MUSMA of Matera, dedicated to contemporary sculpture, with one of the most interesting exhibitions of the Italian art. Demo-ethno-anthropological museums have a very important place in the region [7]; in fact, they are widely disseminated in the territory and closely connected to the local identity. An accurate analysis of present situation of the museums in Basilicata is the indispensable starting-point for any argument concerning the inclusion of a new, ambitious museum in the region. These arguments must start taking into account both strengths and weaknesses, so that the new museum could exploit the strengths to face the weaknesses, without overlap or imitate the pre-existing museums. The chance for its realization should not be underestimated: the visibility that the event Matera

2019 ensures will be used to enhance the Basilicata and the southern Italy within the entire European context. These assumptions guide, therefore, the inclusion in Matera of a new museum complex dedicated to both archaeology and to the history of architecture of the region. The complex should offer to the European visitors in 2019 an exhaustive panorama that represents the region. Finally, the museum should be an opportunity to enhance the archaeological heritage that already exists but that is inaccessible or barely visible, to improve communication and the infrastructure of the existing museums and to create a network for the exchange of information based on a common database.

### 3.2. General description of the project and sustainability criteria

The application document of Matera 2019 [4] emphasizes the economic and social sustainability of the entire event, especially stating the desire of renovating the existing buildings, reactivating repopulation phenomena of the abandoned spaces of the historic centre. Whilst considering this statement sacrosanct, we believe that the redevelopment of a city should cover all the municipal area, especially the peripheral and marginal ones, where there are often phenomena of physical and social degradation, with negative effects on the whole urban area, or also provincial or regional for the most extreme cases. For these reasons, we decided to study the possibility of including the new Multipurpose Cultural Centre in a degraded area of the city. After a careful analysis, the chosen area has been identified in the northeast suburbs of the city, on the edge of the industrial area (Figure 2).

Its redevelopment would be strategic for because of the proximity to very interesting places such as the *Parco della Murgia Materana*, the *Santuario Santa Maria della*



Figure 2. Current condition of the project area



Figure 3. Panoramic view of Matera and its landscape

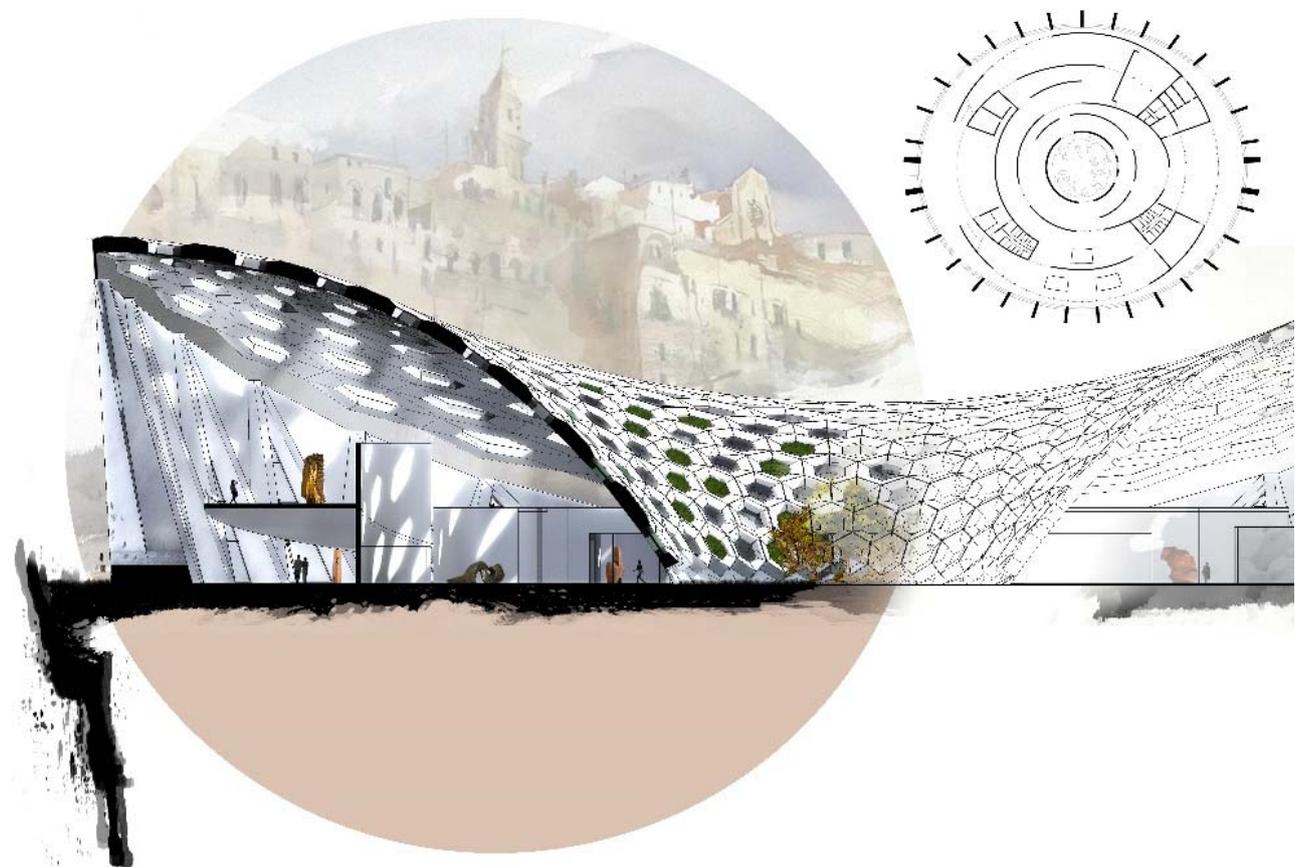


Figure 4. The section and the plan of the project

*Palomba*, the *Chiese rupestri* of Matera and the *Parco Scultura La Palomba*. However, the sustainability should concern all the aspects of planning, from financing to construction issues. Although the term sustainable is used extensively to indicate the technical requirements that provide information about energy-efficient buildings, it does not really give us any information about the indoor comfort nor the low impact of the building on the environment. Rather, sustainability should be interpreted as a general model for

approaching the design and construction of architecture. Thus, the concept of sustainability should also take account of the history of building techniques, the deep knowledge of the characteristics of the materials and the way they are used in architectural construction of a particular homogeneous area [8]. Following this perspective, the material used in the case study is the stone. The aim is to combine tradition and innovation in the designing of a complex roof made of load bearing cut-stone blocks reinforced with stainless

steel cables and bands. Therefore, the use of stone to build big roofs typical of complex buildings, is considered by the authors perfectly sustainable and coherent in the Mediterranean area, where this material is abundantly available and the high temperatures of the summer require the use of structures with high thermal inertia. In addition, the use of stone allows a better visual integration into the landscape of Matera, where the entire historic centre, protected by UNESCO, consists of stone houses (Figure 3).

The elliptical plan of the museum is divided into walls and partitions variously disposed on elliptical geometries, delimiting the various exhibition areas fluidly. Here there are all the functions of the museum, including the ticket office, a restaurant, a café, a garden in the inner courtyard and services. On top of these areas, on a wide low slope ramp the temporary exhibitions are arranged (Figure 4).

The idea proposed results from the work of a group of architecture students who are expert in archaeology, after accurate researches on the current situation of the museums in the region. It consists of a mutable museum: the collections owned by the museum will not be permanent, but will borrow findings from other museums or from their warehouses for temporary exhibitions. Consequently, the temporary exhibitions will allow to show those items that otherwise would have been impossible to see, involving significant and interesting repercussions from the museological point of view. Therefore, the museum will be divided into three main areas: a temporary exhibition, described above; an area dedicated to the history of Basilicata from prehistory to the present day; an underground archaeological museum, with an extremely versatile construction but arranged according to precise

geographical and chronological criteria. The museum is located under a large and funnel-shaped elliptical shell, a tribute both to the large annular traditional vaults, and to expressive and large roof forms in the contemporary architecture, used for buildings that accommodate considerably complex spaces and functions (Figure 5).

The updating of stereotomic stone vaults is a research line that the research group of the authors have studied for more than ten years [9]. In the past, stereotomy was regarded as the most appropriate in encouraging students to "build space" and stimulate creativity [10]. We wonder about the possibility of tying up again the broken thread of the research on stone-cutting construction following in the wake of the discontinued weave of the stereotomic culture, aiming at applying its innate creative momentum in contemporary architecture planning.

### 3.3. Topological vaulted space and parametric digital stereotomy

The vaulted space has always represented the ideal domain in which to operate the more sophisticated and complex reflections on the construction of architecture. This is particularly true for the stereotomic architecture. The intrinsic quality of the vaulted architecture resides in the immediate ability to define measurable areas, which can serve as the endpoint for the indeterminacy of the outer space. The idea of "potential flexibility" and "manipulation" of the vaulted lithic space is at the basis of the method – described below - that is linking topology with stereotomy. The method arises from a very simple consideration, that is the observation that most of the vaulted systems can be imagined as a discontinuous structure or masonry wall that has been



Figure 5. Exterior and interior views



Figure 6. The natural vault near the Sanctuary

folded and/or deformed to obtain its geometrical final conformation, with the due simplifications and specifications [11]. By using some tools (i.e.: 3D Studio Max®) for the spatial transformation and the volumetric deformation of the shape, a correspondence between a flat surface and a spatial one is realized. In so doing, the final object is attained in an indirect way, and not directly through the canonical modelling that, in the case of complex objects, would involve major difficulties for the three-dimensional modelling. At the beginning of the course, students have been encouraged to experience this new modelling technique. This exercise has been very important since students had to deal with different elements simultaneously: pre-figurative invariant, that is the subdivision capacity in appropriate sections of a vaulted system; technical/geometric invariant, that is the capacity of geometric, punctual definition of an architectural system and of ashlar and its realization (projective technique and cutting technique); static invariant, that is the capacity of providing static balance of the architectural system of drystone joint (graphic and mechanic static of rigid structures) [10, 11].

### 3.4. Acoustic shell

The whole project involves the presence of an additional structure, detached from the rest of the museum, an open-air theatre, which allows to deal with a complex

issue such as the acoustic monitoring in an outdoor space. The purpose of the project is to develop the design focusing primarily on an architectural element, an acoustic shell that functions as a stage wing for performances and, at the same time, as a mechanism for reflecting and amplifying the sound, so that a very good quality sound would travel towards the audience. The acoustic shell is a double-curved stone shell creating a cantilevered fan-shaped structure. The shell is modelled through a topological deformation, starting from the flat configuration of the whole shell and deforming until it assumes the final configuration. The shell is divided by hexagonal elements consisting of six prismatic blocks, pre-compressed between them thanks to a metal band. A big natural stone vault located near the sanctuary, in proximity of the former quarry now *Parco Scultura La Palomba*, has inspired the curved profile of the shell (Figure 6).

The hexagonal tiling was chosen because it is known that a hexagonal grid or honeycomb is the best way to divide a surface into regions of equal area with the least total perimeter (honeycomb conjecture), as the mathematician, Thomas C. Hales proved in 1999 [12]. Although the double curved surface chosen for the shell makes impossible the use of hexagons of the same size, this type of tessellation is still very useful, because it avoids triangular tessellation (which the hexagonal comes from), that is inadequate for stone constructions. A double steel cable system ensures the static stability.

The static principle at the basis is that the equilibrium of a shell under construction is obtained by introducing external forces that prevent the collapse of the structure. If the shell is conceptually divided into two, in order for there to be equilibrium between the parts, it is necessary to supply a counter-weight to the suspended keystone, which is exactly in the middle of the structure that is still missing. This force can be supplied by introducing a 'leash' into the extrados that through a traction system, blocks the keystone in the semi-arch, guaranteeing the compression of the blocks [13]. The interaction between stone and metal, in the Mediterranean area and Europe, has several illustrious predecessors in many stone architecture of the past, such as, the jack arches of the Louvre colonnade, or the portico of Sainte-Geneviève or, more recently, with the researches of Peter Rice [14]. Viollet-le-Duc, in his work "*Entretiens sur l'Architecture*" (1858-72), introduced a prototype that can be considered the first example of a reinforced arch ever recorded, generated by the thrust equilibrium of stone and the resistance of steel. The primary author of the paper has carried out several prototypes based on the interaction between stone and steel, as intended by Viollet-le-Duc; between these *Foglia* and Lithic Tree (Figure 7).

*Foglia* uses the technique of extradosal reinforcement; the prototype has been built in 2009 as part of a project about lithic shelters and, more generally, cantilevered roofs [13]. Lithic Tree, built in 2013, refers to a tree-like structure with a cantilevered lithic crown, made up of separated stone elements held together with a special steel reinforcement, favouring an optimal working

compression dynamic between the voussoirs [15]. In this particular case, however, since the shell has an anticlastic double curvature another cable system is necessary, in addition to the one of the extrados above mentioned. This system have to be arranged horizontally to the blocks that, by providing lateral compression action, to guarantee stability. In order to ensure the acoustic efficiency, circular wooden panels will be added to complete the shell structure. The panels will be made of diffusion material, whose convex shape improves the reflection of sound. These panels, fixed with articulated metallic structures, can be directed following infinite configurations, according to the acoustic requirements related to the type of show (Figure 8).

#### 4. Conclusions

This case study aimed at encouraging students to understand the potential and the limits of the tools they used according to the objective, in order to be able to choose the most appropriate tools for the development of their project. The multidisciplinary nature that characterizes the Design Courses creates the basis to deal simultaneously with several issues, from the composition to modelling, from geometry to construction technique, since they are all involved in architecture and design. In the light of the above-mentioned considerations, it is believed that stereotomy can still have a strong educational value, due to its ability to hold together all these topics. Finally, it is argued that University should not only be the place



Figure 7. On the left: *Foglia*. On the right: Lithic Tree (projects by Giuseppe Fallacara)



Figure 8. A view of the acoustic shell during a show

where specific professionals are educated, but where students could especially learn the ability to critically thinking, develop new ideas and be able to search for the theoretical and practical tools to achieve their intended goals

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