

# A Theoretical Contribution To Improve The Formation In The Historical Lisbon School Of Architecture - The Forgotten Dimension of the Technological Perspective.

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**Abstract.** This article approaches the problem of the absence of the technology in the didactics of the Architecture's Design, in the course of School of Architecture of Lisbon, as the subtitle of the article suggests - the forgotten dimension of the technological perspective. Despite of the course contemplates a relevant technological component, however, does not reflect, much less exponent the creative act of the Project. This is first of all a result of the organization, didactics and contents of the Project classes, and not so much, a lack of knowledge provided to the student in the technological disciplines, which are present in quantity in the curricular structure. The situation, analyzed in this article, is a consequence of a blocking of the Project classes to the technology ones, which do not promote, nor allow, the necessary transdisciplinary articulation and integration between the act of designing and the application of technological knowledge, which is fundamental and intrinsic to the act of thinking and conceiving Architecture. The CAD / CAE / CAM digital tools have not only highlighted the fragility of this didactic process in the didactic context of the current teaching, but, in view of the potential of its operative process, impose the future reformulation of the Project's cognitive practice, integrating the component technology in the Design Methodology of the architect's teaching and praxis.

Keywords — Project Methodology, Creativity, Tectonics, Application of Digital Tools to Architecture, CAD/CAE/CAM

## 1. Introduction

The architect graduated from the Faculty of Architecture reveals in his professional activity as designer and creator a metaphorical and poetic discourse, this way of communication is preponderant and decisive in his professional practice, result of his formation, programmatic contents and didactics adopted and implemented in the Project classes, which is focused on excellence of the formal creation, but forgetting of the other dimensions that occur in the construction - the project is reduced to drawing and is formal signification.

This creative but restricted context of Project classes, has a beaux-arts origin, which are the origin of the Architecture course of the Faculty of Architecture, taught until the early 1990s at the former Superior School of Fine Arts of Lisbon. This formative posture and consequently the generated discourse, is not understand process by the other players of. Architecture and Real Estate, but, above all, incomprehensible by the average citizen (the ultimate recipient of the architectural object - the primacy citizen's democracy).

As Alberti said: The Architect is above all a good citizen [1]. The elaborated, abstract and poetic metaphors used by architects to explain his creation, are examples of the absence of technological valence, and are sometimes interpreted as insecurity by the average citizen. This communication could be exemplified by the theories like (of full / empty; the energy of the void, or the power of the mass, etc.), that remove the architect from his ancillary rule, its importance as a technician, this behaviour hurts the tacit social contract established between Architect and Community. The architect is above all

a technician; Architecture has a function, so it goes beyond the narrow field of art [2]. The metaphorical discourse, should be complemented with tectonic objectivity, in order to support the conceptual decisions made in the creative act of the Project. Similarly, a conceptual process centered on formal aspects of design, where technological and economic realities are not present becomes abstract.

The abstract exercise of drawing, reduced to the poetic/artistic dimension, has a great disadvantage because forget and not consider the technological aspects, forgetting the material reality naturally increase problems and limits the success of the work. The issue is not the drawing; it is the vehicle, not the problem. In the formal/compositional approach, the mental process of creation does not reach the tectonic aspects, which is necessarily present in all the shape manifestation - producing implies materializing. The absence of this dimension hurts the ethics of aesthetics present in a solid conceptual process – form by form do not reach proficiency [3].

The issue of ineffectiveness is a result of the Project Methodology adopted by the architect, acquired in Project classes, which is also reflected in his work and the way he creates their Project.

The architect produces space to be habited, built with an ethic based on the values of economic, constructive, social and environmental sustainability, which must be present in architecture, which is often ignored.

## **2. Proced Curriculum Status Of The School Of Architecture**

The lack of constructive and structural knowledge express in the projects is not a result of the student formation, in the school of Architecture, this course has a large range and a strong component of technological disciplines (structures, constructions and materials). In particular, the architecture course of the school of Architecture has 23 technology subjects, out of a total of 36 subjects. Technology subjects represents 64% of the total course (structures, buildings, environment and materials). Being more precise, the course has 4 structural disciplines: Statics, Structures I, Structures II and Structural and Constructive Systems; It has 9 construction disciplines: Edification I, Edification II, Edification III, Edification IV, Materials, Building Physics, Technological Innovation and New Materials, Project Support Seminar and Recovery and Conservation Technologies; has 2 subjects in Thermal and Acoustics: Environmental Comfort and Energy Efficiency and Environment; It has 2 disciplines infrastructures communication: Urban Infrastructures and Routes of Communication and Transport; It also has a Mathematics subject, 2 Descriptive Geometry and 3 Computing subjects.

The science and technology component in the architecture course is quite high and cannot be considered inferior to engineering courses. It is a myth to think that the engineer holds more technological knowledge than the architect. The distinction between architecture and civil engineering courses is based only on the calculation expertise: the design of reinforced concrete or metal construction is not taught in the architecture course.

## **3. The Problematic**

The issue mentioned in the introduction concerning low technology training, it is above all a result of the pedagogical and didactic context used in Project classes, which are the main core of the course, giving it its identity and nature. these subjects have biggest workload, and therefore highest of the final average grade, for these facts absorb the student's attention and focus. There are 10 Projects subjects in the architecture course (including the final Master Project in the last semester); one Project class in each of the 10 semesters of the course. In this Project classes is absent the syllabus and didactics, related to the material, in particular, structural and constructive issues. This absence deeply marks the student's cultural attitude and practice as an architect. As Project subjects are not dealt with the subjects related to the structural and constructive domains, and the teachers of technical subjects are not even present in the Project classes, the student relativizes the importance of these subjects and does not integrate them in their mental process of creation, which is fundamentally achieved in Project design, is in these subjects that student develops and creates his own methodological mental process - his cognitive design process. This is the fundamental problem in the formation of the architect at the Faculty of Architecture, resulting of the vacancy of technological knowledge in the mental and cultural training of the student.

The learning and mental training for the Project is done through simulations, which aim to provide to the student a methodological praxis capable of addressing the complexity and demand of different functional programs. The training and learning exercise in the Project classes create the conceptual process and the cognitive mechanism to design Architecture, consequently, shaping the architect's individual methodology and Design culture. In the Project classes, the school shapes student's spirit and builds its praxis, it is with the achieved operative axioms they will operate its creativity as a future architect. Its Project culture is acquired and shaped by the values carried by the Project subjects. That shapes their spiritual beliefs and aesthetic principles. The number of classes and the prominence of Project develops his mental process and the creative act of designing architecture. For the student of Lisbon School of Architecture, it is in Project classes where he finds the space of expression, he believing in the proficiency of the methods of creation and theoretical values learned in these disciplines. Such, it would be true, if these Project classes were capable of framing in their pedagogical methodology a holistic view and treatment of the architectural phenomenon, where necessarily the tectonic question would have to be present, since this premise is fundamental to pass from the notion of formal project for Architecture. As Mahfuz says: the concept of architectural design is validated by the passage from the full concept to the full constructed [4].

The Beaux Arts model, in which it is believed that the important thing is to stimulate the student's creativity, not opposing barriers to his imagination, does not include the tectonic question, forgets that design is first of all an integrated and globalized synthesis, where everything converges and inform the creation of architectural artifact [5], [6].

Creativity is essentially exponentiated by the existence of vast, systematized and organized knowledge. Creativity and the mental process of projecting are not born in the cradle, do not stem from a family genetic heritage, nor result from magic or divine inspiration. It is the result of the individual work of systematization and organization of the acquired knowledge, and the ability to extrapolate it (as more knowledge the student acquires, as creative will be). Boosting creativity require lot of work: it is necessary to collect information, learn and exercise; it involves organizing and systematizing of the collected knowledge. Creative work feeds on the quantity and quality of acquired knowledge [7].

it is possible to conclude; it is not a lack of transmission and acquisition of technological knowledge presented in the theoretical disciplines of technologies. As mentioned, the question is another and, it emerges of the fact of these knowledge these subjects are not integrated and treated in the Project classes (global systematization and organization in the context of the project), where the student trains and develops his mental process of creation - his Project Methodology. The question is the absence of incorporation of technological knowledge in the development of the Project's idea the projectual thought - shape thickness [8].

In the school of Architecture, the Project Methodology acquired and developed in Project classes does not contain unfortunately the structural and constructive dimension, so when the architect is designing builds his project without the gravitational component, but gravity is determinant to ensure the material existence of the idea. It conditions the existence and definition of the form designed and desired by the creator of the architectonic artifact.

The drawing or modulation with graphic digital software does not contemplate gravity or reflect the material *beauvoir*. Designing and constructing a space implies the definition of material and tectonic dimension of the architectural piece, that is, how to materialize the idea - the thickness of the form?

The form itself does not imply material. Geometry does not allow its self to move from the immaterial dimension, defined by surfaces (planes and lines) to the material dimension intrinsic to Form, which inevitably presupposes the existence of thickness [9]. To materialize a geometry is to give it thickness. This is the expression of the physical manifestation of form, which carry and determines its structural and constructive functioning. The shape defines the structural functioning, determines the plasticity and the performance of the architectural artifact during its useful life. Don't consider the thickness - the material, it's a methodological error often associated and practiced in Project Methodology acquired in the schools of beaux-arts tradition.

The student's Methodological Process and future architect must extrapolate Drawing as a graphic expression of the architect's intangible thought. A material definition becomes indispensable, which drags the attribution of a thickness and its consequent gravitational effect. This mental and cognitive

process implies the transition from a process of graphic composition, which only contemplates spatial organization, to a Compositional-Tectonic process, where drawing is informed and developed considering the constructive and structural implications carried by the generated shape. All form necessarily has a thickness, so it reiterates the gravitational character of form, that is, not to assume this earthly structural reality is completely unreal, and reveals a total ignorance of the phenomenon of gravity and, consequently, of what is the genesis of architecture [10].

#### **4. The Proposal Education Solution**

Objectively, the Project classes in the last two years of the course should be extended broader, integrating in their pedagogical and didactic process the subjects related to the design of structures and constructive elements, with the natural teacher participation of these technological subjects, monitoring and evaluation of the student. This is the great failure of the architecture's course in Lisbon school of Architecture, the absence of the technological dimension in the development of student conceptual thought - its own Project Methodology.

In the Project classes, with the pedagogical approach based on a formal composition, lacks the synthesis and conceptual integration of technology, this Project Methodology does not respond to the Vitruvian triad, forgetting the structural and constructive systems, real, they are always present in the act building [6].

As mentioned above, the didactics of the Project classes neglects the constructive process in the student's cultural awareness, because in this pedagogically praxis student separates creative process of the technological needs, therefore he does not assimilate the interdependence and requirement of integration when architecture hits the constructive level (formal and conceptual design and physical elements for materialization of form), thence student's creativity, trained in the Project classes, is restricted to formalism, relegating and forgetting the constructive aspects of the architectural artifact to build. The student is not trained to constructively express his idea, thus weakening his project and the way he communicates it.

The drawing culture reveals as one of the main characteristics of the given training, it is a vehicle for the student express his thought, the draw should be informed with knowledge acquired in the technology subjects, unfortunately this is not the common practice, and it results of the pedagogical and didactic inadequacy used in the Project, and also because of cultural rigidity of a few teachers of these disciplines. Any exercise of spatial composition finds a structural response in a restricted set of basic structural typologies, capable of enabling the respective architectural form. The structural system emerges from this compositional process. To conceive space is to conceive of form, that is a material manifestation of geometry, therefore it has thickness. Form defines the structural system that makes the trilogy: space - form - material [11]. Therefore, the design of the structural system is so embryonic as the act of ideation of the space, it stems from an interactive and iterative process between space and form. This dialectic approach is called Integrated Design, carried out simultaneously in the methodological and cognitive plan. This methodology is crucial for the architect's structural efficiency and plastic expression, despite its purely qualitative approach, The Integrated Design improve the approach to form as structure - the structural form is the result of a formal manipulation that aims not only the structural optimization, but also bestow ethics to the aesthetics which result from the generation process.

This reality could be observed in the structural system designed in the Project classes for their exercises, although the student has acquired a vast knowledge about this subject in the structural disciplines, he does not consider it, in the materialization or concepts developed in the Project. this theme is consistently ignored in the conceptual process of these disciplines. The technological aspects (structures, constructions and economics) is not incorporated by Project teachers, this way the student does not enhance and develop the structural in his design language or plastic expression of his architectural artifact, idealized and projected in Project disciplines.

This is the great pedagogical gap in the architect's education, only be overcome with the reformulation of the teaching didactics of the 4th and 5th years, that involve the presence of the Structural and Construction Teacher in Project classes, bringing the technology dimension to the training and development of the student's Project Methodology. It is especially important for the student to understand the structural phenomenology intrinsic to the conceived form and to know how to manipulate

it according to its design purposes, but with the current pedagogy and didactics this goal is not achievable.

### **5. Building's Economic Dimension**

Other situations in the architecture course, which reveals lack of objectivity, is also the lack of awareness in the student's training that the architect whenever he designs and builds is producing heritage, creating value and wealth. That is something he usually does not care, but should be part of the conceptual strategies of the architect when he elaborates when he starts his Project, as an author. It is the cultural rigidity followed in the Design classes is the major obstacle to the consideration of economic and financial aspects in the mental and cultural formation of the architect. It is urgent to make the student aware of the patrimonial dimension of the building - the real estate value of the building.

### **6. The Future Of Digital In The Integrated Project**

The actual development of digital technology has replaced the interdependence and articulation of the different moments of architecture design: shape modulation, tectonics and fabrication (CAD / CAE / CAM) [12]. Nowadays, the digital tool already makes it possible to overcome the limitation of mathematical calculation, but nevertheless, the knowledge of structural phenomenology remains essential and fundamental to the creation of form. Every built form necessarily has a structure - the structural shape [11]. To conceive a form, even in the strict ambit of the formal design, the architect must understand the catalog of typologies of basic structural forms at his disposal, in order to be able to materialize his projected work. It is important to accentuate this is not about calculus, we are considering and expressing another concept: typologies of basic structural shapes. It is a new doctrine in the structural field specific to the formation of the architect. A new formative space to consider in the formation of the student, and future architect.

The drawing act by itself is not enough, for the full development the conception the architect, the architect who creates the form needs to know and master the catalog of typologies of basic structural forms, their characteristics - the form cannot be any one. It is a gravitational reality still ignored in the conceptual plane by the Theory of Architecture.

The use of the BIM digital tool, in the process of developing the space design, it joins simultaneously the volumetric/shape and structural design, its calculation's plug-in, allows the establishment of a bridge between architecture and structural calculus [13].

The absence of aspects technological issues in the Project classes are naturally resolved with digital tools, increasing dialogue and integration between conceptual and scientific aspects; increasing the quality, plastic and diversity of the architectural object and consequently of the architectural space.

CAD/CAE/CAM digital tools generate a profound change in the architect's cognitive and conceptual processes, thus open new formal and plastic fields for architecture. The conception process is no longer sequential, but rather simultaneous, interactive and interdependent process, in this integrated approach the different cycles of the project participate simultaneously in the synthesis process [14].

This requires in the formation of the student, and in the Project classes, not only new syllabus, as well as new methodologies and didactics capable of approaching knowledge and conception in an integrated, interactive and interdependent way, developing in the architect's mind a new process, of project thinking - the Integrated Project [15], [8].

In the present architecture course of Lisbon School of Architecture, the aggregation in Project of structure and constructive elements is still absent, the future innovation of the course's pedagogy and didactics due to the evolution of the life outside the school itself will inevitably determine the course of the future of the course, leading to the integration of the Formal Project with the Design of Structural and Construction Systems - the Holy Grail of the Integrated Project. It may take time, but it will be inexorable in future to be taken over by universities. Future architecture courses will necessarily evolve, preparing students and their professional context for the reality and potential arising from the application of digital tools to architecture.

## 7. Conclusion

The role of the University in society as a critical a cultural space, able to anticipate some of the answers that the community needs, but same times even do not release, and therefore not posed; that is the role of research and experimentation which the University must develop. In parallel of teaching, the University must also produce knowledge through research of teacher and students.

The instrumental frame formed by the digital tools (CAD/CAE/CAM) [16] highlights the need for evolution of the beaux-arts methodological models. In view of this reality, which is already present today in the product industry (automotive, aeronautics, naval) [17] makes it imperative that University within provides the condition to create a new operative paradigm able to response to digital reality.

This compel the inclusion of the technological dimension in the moment of conception, it is the tectonics and the analysis of the architectural artifact, that validate of the idea and the development of architectural concept. This practice breaks with the sequential logic of projecting that process tends to ignore the material, performance, and technological a of aspects of architecture.

It is urgent to find new methodological concepts, a new operative paradigm that form the new generations of architects. The reality that will support its practice requires a cognitive paradigm, capable of producing a conceptual synthesis, contemplate shape, future performance, production and construction of the architectural object. This implies that technology informs and participates in the act of conception since the first moment.

Future architecture courses will necessarily evolve and integrate this emerging reality - integrated design, preparing students and their professional context for the reality and potential arising from the application of digital tools to architecture.

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