

Structural Themes: an Integrative Model for Design and History Courses in Architectural Education

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Abstract: *The universal feature of undergraduate architectural education is the central importance of the design courses, which are given in every semester. Architectural design is a very complex process nurtured by the knowledge and skills acquired through various courses. Structural system is an integral component of architectural design. The student should have comprehensive knowledge on different structural alternatives compatible with the design problem. Since these alternatives are produced through history, architectural history courses provide the essential basis for the knowledge of structural systems. However, courses of design and history are not integrated in general. This paper proposes an integrative model for design and history courses in architectural education by focusing on structural themes as guidelines for the design context.*

Keywords: *architecture, structure, design, history, education.*

1. Introduction

Architecture is a very old and universal profession. The interventions of mankind on earth has always been the issue of architecture because architecture aims to shelter human needs. One of the first and most known theoretical reflections on architecture has been formulated by the Roman architect Vitruvius (c. 80 – 15 B.C.) who has formulated the three basic standards for the evaluation of architecture: commodity, firmness and delight [1]. These standards, which touch upon the disciplinary complexity of the profession, are still recognized.

In terms of commodity, architecture should fulfil the functional requirements of the user in a successful way. In order to satisfy this requirement the architect should understand the social context. This standard establishes the link between architecture and social sciences. In terms of firmness, architecture should provide a stable structural system resistant to the physical forces emanating from gravity, dead and live loads and lateral loads such as winds and earthquake forces. This standard establishes the link between architecture and engineering. Finally, in terms of delight, architecture, which manages to be functional and firm, should also have a beautiful composition. This standard links architecture with art. As a result a successful architect should be furnished with the knowledge and skills of a social scientist, engineer and artist. That is why architectural profession and education are so complex and difficult. Architecture is neither science nor art because it is at the intersection of the two.

Due to these historical reasons, the undergraduate curriculum of architecture consists of courses related with a variety of issues ranging from art, design, theory, history and other social sciences, structural systems, engineering etc. The objective of this multidimensional approach is to furnish the architects of the future with knowledge and skills of this complex profession. This paper focuses on the teaching of structural systems during the undergraduate education of architecture and proposes an integrative model of courses which produces an efficient learning process. In order to reach this goal, firstly the course curriculum is analysed for deriving the problems and then an alternative model is synthesized as an educational solution.

2. Analysis: Architectural Curriculums and Structural Systems

Although there are minor differences concerning the numbers and contents of the courses and particular missions and visions of the architectural schools in different geographical contexts, the expected qualifications of the B.Arch (Bachelor of Architecture) program graduates are almost universal. Especially initiatives such as Bologna Process around Europe try to define the “program qualifications” of the departments of architecture according to universal standards and local needs [2]. Program qualifications stand for those skills which are mandatory for a student to be able to graduate and become a professional architect.

2.1. Architectural Design Courses

It can be observed that these qualifications, which are related with various fields are mostly acquired through the successful completion of the architectural design courses. The design courses are offered every semester and as the student passes to the following semesters the courses require the student to deal with more complex problems.

The list of program qualifications given below belong to the Department of Architecture at the Akdeniz University Faculty of Fine Arts (Antalya, Turkey) [3]. These qualifications also illustrate the objectives and learning outcomes of the design courses:

The graduates of the B.Arch program are expected to interpret contemporary cultural and technical (material and structural) developments in design process, conceive and interpret significant aspects of architectural history and cultural heritage from the viewpoint of the historical basis of architectural design and their effects on architectural applications. In this process the graduates have to learn the dimensions, proportions and features of the architectural elements related with human scale, acquire basic information on the effects of the constructed environments on the natural environment and comprehend the role of graphic communication and language skills in architectural presentations. The graduate should also acquire the capacity of three-dimensional conception in order to design in the light of architectural design inputs and site parameters and reflect their thoughts through architectural representation techniques, conceive an architectural program by dividing it into its constituents, collect necessary data concerning program content (analysis), compose them (synthesis), interpret them and develop design in the light of these experiences, actively use freehand drawing as well as computer technology as an architectural design tool, and actively use representation techniques during the processes of learning, collecting data (analysis) and problem solving (synthesis). In order to do so, they are obliged to acquire the capacity to organize spatial requirements as a consistent whole within site parameters and environmental circumstances.

In order to be pass the architectural design courses, the students have to use appropriate methods and techniques for the development of the abilities for critical, abstract and creative thinking, proposing alternative solutions and problem solving, conceive the continuities between natural, urban and architectural scales, acquire the ability to use architectural design as a feature which increase the social life quality and develop projects and activities in order to increase the quality of the built environment. This point highlights the interdisciplinary nature of the design process and its social and ethical roles. Those students who are awarded by graduation have to recognize and obey the codes of conduct which define the professional missions, rights and responsibilities, act according to universal principles of professional ethics, democracy, human rights, social / scientific / cultural values. They have to take responsibilities as individuals or interdisciplinary team members in order to solve unpredictable problems during architectural applications. To summarize, they have to learn how to learn, learn the methods for approaching knowledge, and continuously develop professional knowledge and experience.

In this respect, architectural design is central to architectural education. It can be argued that the knowledge of structural systems are integral to the architectural design process.

2.2. Architectural History Courses

In Turkey, as in many countries, the academic structure of the architectural education programs in bachelor and graduate levels consist of four main subfields. These subfields are design, history, building science and restoration. In the B.Arch program, through various required and elective courses, these subfields have differing roles on the formation of a graduate. Whereas graduate students may choose one of these specific subfields for his / her future studies.

Architectural history is one of the subfields of a B.Arch program and, in Turkey, this subfield is represented generally by three obligatory courses of general architectural history placed in the 3rd, 4th and 5th semesters of the 4-year education. After the acquisition of basic knowledge concerning the definition and content of the profession, the second year student is expected to learn significant phases of architectural design through the analysis of the representative architectural works of certain historical periods. The conventional method used by the instructors of the undergraduate architectural history courses draws its references from the ideas of “Zeitgeist” and typological progression [4]. “Zeitgeist”, namely the “spirit of the age”, is the Hegelian argument for the existence of formal patterns for diagnosing the representative architecture of a certain historical period. According to this view, the “spirit”, namely the underlying mentality of a certain historical period shapes all cultural spheres including architecture. Art historians such as Riegl has coined the term “Kunstwollen,” namely the “artistic will of the age” in order to translate the idea of “Zeitgeist” to the world of art [5]. According to this viewpoint every period has created a characteristic will engendering a certain artistic and architectural form and these forms representing historical periods are consecutive steps of a consistent historical progression.

Therefore architectural design courses present the visual knowledge of a selection of important buildings in history. These buildings represent the characteristic social, cultural and technological conditions of a certain age. Therefore the selected buildings are milestones in terms of technological and material advance in architectural history. For instance, the stone masonry systems of the great fortifications in the of the Bronze Age, the skeletal cross-vault systems of the Gothic cathedrals and the steel and reinforced concrete frame systems of the contemporary age are all steps of an evolution. In this framework architectural history is a potential ground where the types and progression of structural systems can be analyzed and interpreted.

2.3. The Problems of the Established Model in terms of Teaching Structural Systems

As it has already been stated, the architectural design courses constitute the core of the educational curriculum and all other courses, such as architectural history, should be designed for supporting the rbles sequired knowledge for design. Each course has a certain impact on the formation of the program qualifications which set up the professional capacities of the architect.

However, general experience in architectural education indicates that design and history courses, which are potential testing grounds for the architecture students’ knowledge and abilities in structural design, cannot be integrated. In terms of their integration concerning especially the structural knowledge, two major problems of the design and history courses may be identified:

A significant mistake experienced in the design courses is that the students tend to underestimate the integrated nature of space and structure. It is observed that the students try to design space according to functional requirements and the structural system which is the principal requisite for spatial enclosure is seen as the final step of the design process. This attitude is totally at odds with the historical experience of architecture, where structure has been an integral form-giving component of the design process. This erroneous conception of the design process leads to serious discrepancies between architectural space and structural system and violates the historical integrity between commodity, firmness and delight raised by Vitruvius.

Likewise, an erroneous conception of the learning process is experienced in the architectural history courses when these courses are regarded by the student solely as a theoretical course. As long as the knowledge of architectural history cannot be integrated with the practical activities of the design process, the program qualifications of the architectural education cannot be set up in an efficient manner. An important result of this drawback is related with education regarding the structural systems. When the potentials of history courses for learning the historical experience of the structural systems cannot be realized, historical buildings cannot be understood as integral wholes fulfilling the standard requirements of commodity, firmness and delight. In this framework the most frequent mistake is the conception of the historical buildings as works of art analyzed solely in terms of aesthetic standards. However each architectural work is a complex entity one of the components of which is the structural system.

3. Synthesis: Structural Themes and an Integrative Model

3.1. Proposal for Structural Themes

In the light of the analysis given above, this study proposes “structural themes” for bridging the design and history courses from a structural viewpoint. Through this proposal the above mentioned problems may be solved.

Architectural history covers an enormous temporal and geographical space and various building practices [6]. In the course of history construction materials such as timber, mud-brick, brick, stone, iron, steel and reinforced concrete become the most basic constituents of architecture, and these materials are found within various structural configurations. Current knowledge in architectural history, which goes back till the Neolithic age, provides a wide range of comparable examples. Even a quick glance at the structural features of seemingly unrelated periods suggests a profound continuity between building practices [7]. This contingency can be analysed through key structural configurations [8].

The most characteristic component of material evidence is the structural configurations composing materials in prescribed orders. Thus some contemporary architectural approaches regard the structural unit as the “irreducible essence of architectural form” [9]. The focal point of the structural unit is the “joint,” which is the interface of load transfer and material differentiation within a structural configuration. The material differentiation can be realized through alternating materials or through variations of the same material in terms of size and quality [10]. This paper focuses on the former and explores the characteristic, typified and patterned alternations of construction materials in various historical examples.

Therefore architectural history can be regarded as a repository of material evidence, which involve common and recurring structural patterns. These patterns can be grouped around certain themes indicating characteristic structural behaviour. This approach may uncover similar approaches to the treatment and allocation of materials in coping with ever existing structural problems. While assessing the structural problems and solutions, this paper refers to two basic structural themes: “the frame”, and “the compressive mass,” as Frampton has put forward by referring to Gottfried Semper [9]. The structural theme of “the frame” is associated with materials such as timber and steel by implicating lightweight frame configurations. The structural theme of “the compressive mass,” is associated with stone, mud-brick and brick by implicating the repetitious stacking of heavy-weight masonry units. The fundamental contrast set by these two structural themes defines an interpretive framework against which historical examples might be assessed, related and classified.

3.2. Integrative Model for Design and History Courses

By using the above-mentioned structural themes as the organizing guidelines of an architectural history course, otherwise unmarked affinities between different historical construction systems can be identified. In this way the architecture student will be able to conceive the historical examples of architecture as comparable solutions for the problem of spatial enclosure. This fresh insight into the historical basis of architecture can lead to creative insights during the production of alternative solutions to design problems.

The main two structural themes proposed here as “tectonic” and “stereotomic” systems help us to organize the complex corpus of architectural history around a coherent interpretive framework based upon timeless structural principles. The identification of the different recurrences and variations of these structural themes in different examples will display common principles traceable and comparable across different architectural cultures and traditions. It will be understood more easily that the same structural principles underlie infinite historical constructions.

Then how can an integrative model for design and history courses be developed? This model can be possible by bridging these two seemingly separate courses through the above-mentioned structural themes. In other words, the theoretical content of the practice-oriented architectural design course should be increased, while the practical content of the theory-oriented architectural history course should also be increased. The design problems assigned to the students of architecture during the design courses should arise a consciousness for the analysis and adaptation of historical structural themes and variations. Meanwhile the selection of historical buildings organized around the framework of the structural themes should be used for exhibiting the live continuities between this historical-theoretical knowledge with the contemporary practice.

It is possible to illustrate the proposed integrative model by referring to the following examples of design and history assignments:

The architectural design courses should set up grounds of discussion for interpreting historical knowledge of architecture. In this way lively continuities between the past, the present and the future can be established. The most appropriate way to realize this goal in the design courses is to assign design problems in historical contexts. The preservation and interpretation of cultural heritage is a universal problem in our contemporary world and architects are important actors in this field. Therefore if design problems are formulated for the sites close to cultural heritage contexts, architecture students can have the opportunity to make in-situ analyses of the historical examples of architecture and therefore they can understand the structural systems in a much more comprehensive manner. Designs developed for such kind of sites will have to analyse and interpret historical structures and variations of the universal structural themes can be produced through the adaptation of contemporary construction materials, techniques and systems to the historical context without violating the character of these sites. The theoretical basis of the design process can be sustained by this historical way of thought based upon the structural themes.

The architectural history courses can be designed in an unconventional way and structural themes may set up the guidelines for this new composition. The historical examples analysed during the history courses can be analysed in terms of their position with respect to the structural themes. In this vein, the following questions can be posed: Does the selected example conform to one of the structural themes? Does it represent a variation of a structural theme? How does it produce a variation? What are the reasons for its positive or negative structural performance in its historical context? Does it have any potentials for contemporary applications? If yes, how can it be adapted to contemporary problems? In this way the historical examples can be reviewed as lively compositions of materials which are always meaningful for the spheres of design and practice. For instance, Neolithic architecture in sites such as Çatalhöyük can be analysed as a variation of the structural theme of “stereotomics” since the building fabric is made up of the piling of mud-brick units on top of each other (Fig.1). Then the historical and contemporary performance of the structural system in central Anatolia may be questioned. As another example, the Gothic cathedrals of the 13th century in France can be analysed with respect to its “tectonic” character and the logic of the constructional frame may be discussed (Fig.2). In this way the continuities between a Gothic cathedral and a contemporary steel frame structure can be revealed.

The bridging of these seemingly unrelated examples can be very important for the student to develop general architectural culture embracing many different examples. Therefore the names of the lectures constituting the architectural history course can be “Neolithic Stereotomics” or “Gothic Tectonics,” instead of “Neolithic Age” or “Gothic Period”. In the same way the name of the design problem for one semester can be “Re-designing the Stereotomics of Central Anatolia”. Examples can well be multiplied. In this way the student will conceive these periods as meaningful repositories of ever-existent structural themes rather than histories of bygone and outmoded cultures.

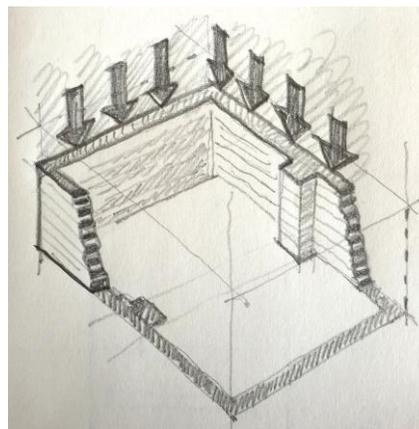


Fig. 1: Sketch indicating the load transfer of the “stereotomic mass” (a Neolithic structure of mud-brick masonry)

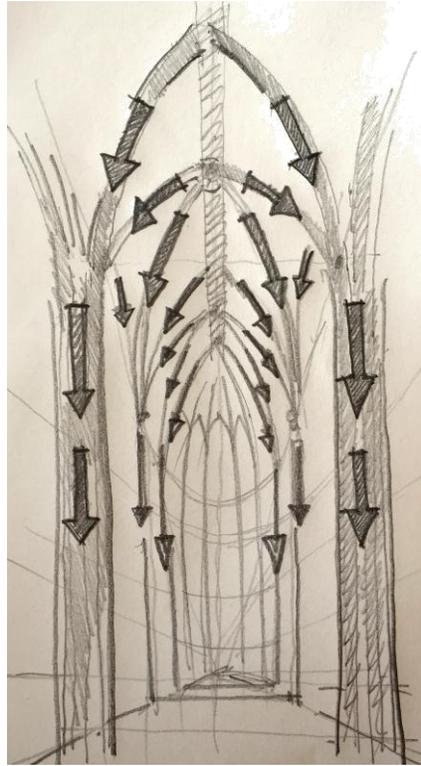


Fig. 2: Sketch indicating the load transfer of the “tectonic frame” (the scheme of a Gothic cathedral)

4. Conclusion

This study has demonstrated that the field of structural design is a potential bridge between architectural design and architectural history. If this potential can be used in an efficient manner the architecture students will be able to analyze the built environment in its multidimensional nature. An indispensable component of this multidimensional architectural environment is the structural system. Architectural history indicates that humankind has devised various structural systems to make the spatial enclosures possible and consistent structure is the prerequisite for the design of space. By adapting the proposed integrative model based upon the two major structural themes and their variations in different historical contexts, it will be possible for the architecture students to comprehend the built environment in a much more comprehensive way.

In many parts of the world contemporary urban sites and construction activities share the same geography with historical sites of cultural heritage. If architectural education follows the proposed path then architects of the future will be able to develop a historical-critical way of thinking which will enable them to interrelate the past, the present and the future. Therefore, they will learn how to analyse the design problem existing in the present, how to derive patterns through a critical analysis of the past and how to adopt these principles into the architecture of the future. In addition, this educational model which is devised for the departments of architecture can also be adapted into the departments of civil engineering since these professions always work together and engineers should possess the similar historical sensibility towards the built environment.

5. References

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