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TECTONICS AS A TARGET IN THE ARCHITECTURAL DESIGN STUDIO

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ABSTRACT

Contemporary architectural education is based on bridging the distance between different types of specialized knowledge, which support architecture. Although the main locus for this synthesis is the architectural design studio, the theory courses are also expected to prepare a basis for this synthesis.

“Tectonics” is a concept, which bridges the abys between building technology and art of architecture. Both technology and art can be simultaneously dominant within tectonics. One can follow the rules of optimization of technology, and still achieve aesthetics, or one can break these rules for aesthetical reasons, but still provide strength through some other unexpected, but reasinoble ways.

Tectonics can be achieved through building structures, building materials, construction techniques, and finishing details. These are the addresses of tectonics within the general notion of building technology. However, the addresses of tectonic design within art of architecture are not that clear. The objective of this research is to discuss the possibilities of bridging the abys between architectural design and building technology through the analysis of student projects, which were asked to be based on tectonics.

After taking a theory course of tectonics during the first term of the second year, the students took a design course, which is based on tectonics, during the following term. During this design course students’ artistic approaches to design were conceptualized as design concepts, such as anologous design, 3D model, rational design concepts, and ideals as concepts. Students were left free to have any approach to design and tectonics. Although they were informed by the types of design concepts, and types of tectonic approaches, they were not guided about the ways of achieving tectonics. They were asked to have drawings containing structural systems, and particularly elevations, which are based on 1/20 principal system details.

This paper presents the first step of an action research about the target of tectonics in architectural design education. It provides answers to some primary research questions about the relationship between design concepts, types of tectonics, and the ways of achieving tectonics through the analysis of these student projects. Answers to these research questions were provided through a critical phenomenographical investigation, which compares the judgements of students and teachers/mentors about the achievements of the each project.

TECTONICS AS A TARGET IN THE ARCHITECTURAL DESIGN STUDIO

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1. INTRODUCTION

At the beginning of the 2006-2007 Academic Year Spring Term, the second year second term architectural design studio (ARCH 202 – Architectural Design III) teachers of Eastern Mediterranean University, Faculty of Architecture, Department of Architecture, were asked by the administration of the department to reorganize the course in order to form a technological architectural design studio. We; the studio teachers made a research about the level of technology, which is being tought in other schools of architecture, and found out that the level expected from second year students is usually defined as the 'understanding level,' but not the 'competence level.' Since transforming a design studio into a construction or structure studio can only be meaningful in achieving competence level, and since this will not serve to a designerly purpose in any case, we diverted our target from technology into tectonics, which directly relates technology to design. This decission was also based on the existence of a course of tectonics (ARCH 235 - Introduction to Tectonics of Structural Systems), which was taken by the same students a term earlier than ARCH 202. Since ARCH 202 has always been based on architectural concept development, we decided to achieve tectonics parallel to architectural concept development.

There are various definitions of 'tectonics.' It generally refers to the use of technology for artistic purposes including its ancient meanings. (see Aristotle, 1988) The synonymous but more contemporary concept of 'architectonics' relates technology to aesthetics and romanticism. (Frampton, 2001: 1-27) Leatherbarrow, and Mostafavi (2005) prefered to use the concept of 'tectonics' in their book "Surface Architecture" in order to refer to the artistic uses of technology in architecture. In order to enlarge the meaning of the concept we also prefered to use the concept of 'tectonics' through this research and paper. On the other hand, tectonics is sometimes defined as the correct and artistic use of technology, such as in the book of Delanda (2004). Frampton (2001) and Leatherbarrow and Mostafavi (2005) also consider some artistic uses of technology as atectonic. However, there is no clear differentiation between tectonic and atectonic uses of technology, and many examples of tectonics, which are given in these books, can be criticized from the perspective of structures and construction. Thus, we prefered to be open in our studio for both the correct and 'other' uses of technology for the artistic architectural purposes. Here, the term 'other' indicates the 'non-optimal,' but safe and reasinoble uses of technology

Neither the design theory teachers, nor the technology teachers amongst the ARCH 202 studio teachers were experienced about mentoring tectonic design, which requires a critical approach both to design and to technology. Thus, we decided to transform our activity into an 'action research,' through which we can learn more about tectonic design education, and record our experiences. This paper is a presentation of the first step of this action research, which is done through studying with 22 students and two design teachers/mentors. At the end of the academic term, these students were asked to write a page about how the tectonics was achieved with the help of the design concept of their projects. The teachers were also asked to answer the same question for every student in their groups. By using this data a critical 'phenomenographical research' is made in order to answer four research questions, which are presented together with the literature review in this paper.

‘Phenomenography’ is a qualitative, interpretivist, and empirical approach to educational research. The aim of the method is to understand the level of knowledge, which is learnt by the students. (Wikipedia, n.d.) This is investigated by understading the conceptions of the students about the ‘material world.’ The evidence of learning is accepted as the subjective transformation of the basic concepts by the students. (Säljö, 1996) For this purpose, either the students are asked to talk amongst each other, and these talks are recorded in order to form data for the empirical research (Franz et al, n.d.), or in-depth interviews are made with them. (Marton, 1994) However, Säljö (1996) thinks that most of the ‘phenomeno-graphical’ researches are out of context, because they are too conceptual. Similarly, Marton (1994) says that the aim of phenomenography is to find out what is learnt by the students through their practices. According to him, what is meant by practice can vary a lot from case to case. One of the research targets of this paper is also to find out a way to understand what is learnt by the architectural design students from the teachers/mentors through their design practices. However, the critical issue is not about what is learnt, but it is about what is learnt from the teacher/mentor. For this purpose, we based this research on the basis of teacher’s understanding of the student’s design concept, and his/her strategy to achieve tectonics. Because, if this understanding does not exist, this means that there exists only misunderstandings between the student and the teacher, which can only lead towards confusion or difficulties of self-education. Thus, as Säljö (1996) and Uljens (1996) critically suggest we evaluated teachers’ concepts, rather than students’ concepts in order to understand what is learnt by the students.

The rest of this paper contains information about the studio process, literature review about design concepts and tectonics, presentation of four research questions, information about the method and results of the empirical research, and answers of the four research questions.

2. FURTHER INFORMATION ABOUT THE STUDIO PROCESS

The project was a ‘confectionary building’ of maximum 500 m^2. We gave students a detailed building program in order to avoid loss of time while dealing with functional research.

One of the very early and intuitive decissions was to lead the students towards further materiality, and for this purpose we took the following steps:

a. We chose a site, which contains a cliff, dramatic rock formations, tall eucalyptus trees, and a beautiful view of Mediterranean sea and Karpas peninsula of Cyprus. We asked students to think about the materiality of the context by highlighting topographical features of the site, and climatic factors. Materiality of the natural context was expected to lead the students one step closer to tectonics in architecture.
b. We asked students to show the functional relationhips; especially the required sequence of activities in the kitchen, by representing each activity with a little box, and connecting these boxes to each other according to the expected relationship between these activities. The results were 3D models, which were applied also to the site later. In order to initiate the students to the process of these 3D models, we first asked students to form a similar model by using their bodies and the studio space. Each student represented an activity, and they called the related activities besides themselves in order to hold hands, touch from the shoulder, etc. Finally, it became impossible and meaningles to continue without using tables, chairs, or stools. (Figure 1) Some of them sat under the tables, some of them sat on stools etc. We thought that this activity showed them the three dimensional spatiality of functions, and structural nature of the architectural space.
c. We also asked students to prepare ‘principal system details’ of 1/20 in order to use them as tools to give design decissions about elevations. Principal system details differ from application project system details by showing only the main design decissions and principal organization of materials with respect to each other. In addition to these, the application project system details contain further detailing, which are the backwards reflections of 1/5 and 1/1 finishing details. In order to lead students during the preparation of these principal system details, we asked them to prepare a file of examples, which show the materials they wish to use, the inspiring technological expressions, etc. These examples helped to bridge the gap between students’ tectonic imagination, and teachers’ understanding. Whilst this first gap was bridged, then it became possible to discuss the principal details, which are capable to realize those examples, and the appropriate drawing and expression techniques of them, between the teachers/mentors and students.


Figure 1. Students, while forming a 3D model of functional relationships.

We gave lectures about site considerations, design concept types, tectonics of contemporary structural systems, and tectonics of interior space. However, we did not say anything about the relationship between the design concepts and tectonics. We highlighted the importance of the context in tectonic design, potentials of the analogical design concepts, the determining effects of the selection of materials, and the structural systems. We also showed them a film about the design process.

Both midterm and final evaluation juries contained external jury members, who teach courses about architectural technology. Students knew that they were going to be evaluated on the basis of their design concepts, and their achievements in terms of tectonics from the very beginning on. Only the %20 of the final grades were given by the group teachers/mentors.

3. LITERATURE REVIEW AND CONCEPTUAL BASE

3.1. Types of Architectural Design Concepts

According to McGinty: (1979: 208) *"A simple definition of a concept suggests that concepts are ideas that integrate various elements into a whole. ...... these elements can be ideas, notions, thoughts, and observations. In architecture, a concept suggests a specific way that programmatic requirements, context, and beliefs can be brought together...."* Thus, all designs, which have a unity, can be understood and communicated in terms of design concepts.

There are various approaches to the types of 'design concepts' in architecture. According to White (1975: 10-28) design concepts can be developed during the various stages of the design process. There can be design concepts, which belong to urban design scale, preliminary design scale, or application project design scale. Concepts can also be categorized according to the way they are developped. For example, McGinty (1979: 208-237) categorizes design concepts as: a. Analogies, b. Metaphors and similes, c. Essences, d. Direct responses and problem solving, and e. Ideals. We think that McGinty's categories can be applied to all scales within the design process, which are highlighted by White.

In this paper, we accepted the above types of design concepts by making some changes in them. We categorized analogies, metaphors, and images together. Similarly, we categorized essences and problem solving together as the rational approaches. We made the category of ideals more explanatory by relating it also to ideologies and philosophies. In order not to exclude experience based design concepts, we added the category of 3D models to the above categories. Since we can explain these concept types only in short within the limits of this paper, one can refer to McGinty and White in order to find more explanatory definitions of them.

a. Analogies, Metaphors, Images

According to McGinty (1979: 223) *"analogies identify possible literal relationships between things."* Once the relationship is identified, it is articulated into its depths in order to provide a designerly tension between the social requirements and the autonomy of the designer. Thus, the relationship is not based on similarity of appearances, but similarity of poetic meanings. 'Metaphors' identify abstract and fictive relationships between the meaning of two or more things. (McGinty, 1979: 228) 'Images' (as design concepts) can be defined as responses to the order of the things within the context, or some other rememberences, which can be related to the immediate context. Both analogies, metaphors, and images can be explained with the general concept of 'mimesis,' which is any type of deep semblance between the two things.

There were nine projects in our architectural design studio, which can be represented by this type of design concepts. Seven of these were not well understood by the teachers, but two were very well understood. The understood ones are *'chevaliers' helmet,'* and *'cooperation between flower and bee.'* The other ones are *'millstone,' 'mushroom,' 'klaket of film makers,' 'social role of mıra coffee,' 'tree,' 'sea wave,'* and *'aquarium.'* Figure 2 contains a table showing the presedences of the project, which has a design concept of *'mushrooms.'*

Figure 2. Memduh Demirağ's project which is based on the concept of 'mushrooms.'

b. 3D Models

Analogies, metaphors and images refer to some other specific things, objects. They have a lot to do with literary and visual abilities of the designers. However, there can also be experience based design concepts, which refer to the various compositions of 'infinite' number of things; rememberences. Since these complex concepts cannot be expressed with the help of literal concepts, they can only be produced through making representative physical models. However, in order not to leave these concepts only at the physical level of the experience, they have to be explained consciously by using the related concepts of the verbal language.

There were only one student, who had a design concept, which is based on a 3D model. This project was very well understood by the group teacher, and found very successfull by the jury members. Figure 3 contains a table showing the presedences of this project.

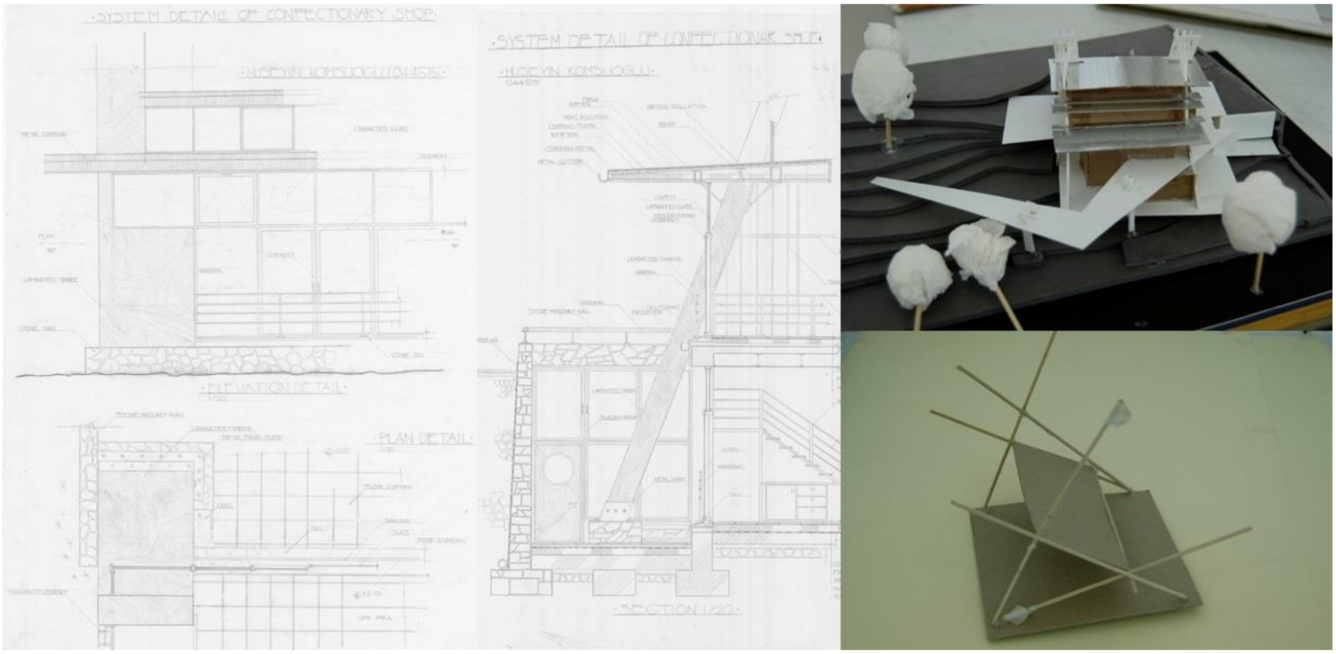

Figure 3. Hüseyin Komşuoğlu’s project, which is based on a 3D design concept.

c. Rational Approaches: Essences, and Problem Solving

We live in the era of rational production. This is the demand of the modern society from all professionals, who create and recreate the physical environment. Thus, it is a very responsible action not to ignore this rerquirement of the society, and to filter them through the critical autonomy and the strong will of the artist. This is the ‘artistic rationality’ (Adorno, 1998) which is able to relate bare rationality to social sensitivity. ‘Essences’ define the ultimate application of rationality into design. Designer defines what are needed, and then realizes them autonomously. On the other hand, ‘problem solving’ requires identification of some major problems, around which the artistic rationality can operate.

There were seven students, who had rational approaches to design. Four of the students, who were understood by their group teachers, were interested in problem solving. They articulated the problems of topography and climate to various degrees. Figure 4 shows a table, which shows an example of this type of projects, which is focused on the problems of wind and light control. One student, who were understood by his group teacher, studied the essence of circulation in his project. Figure 5 shows a table of this project, which is based on the essences of the problem. The other projects, which fall in this category were based on the articulation of topography and view.

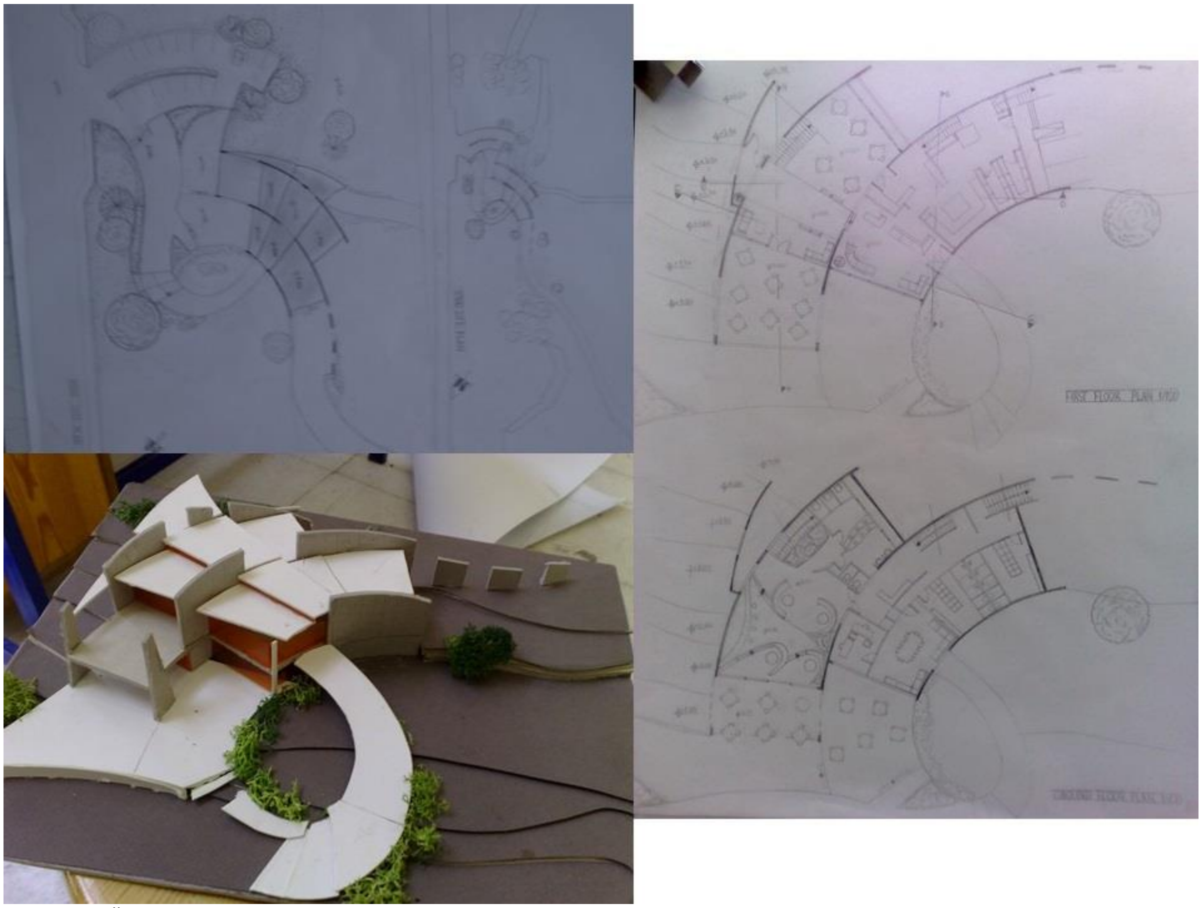

Figure 4. Ömer Tellioğlu’s project, which is based on wind and light control.

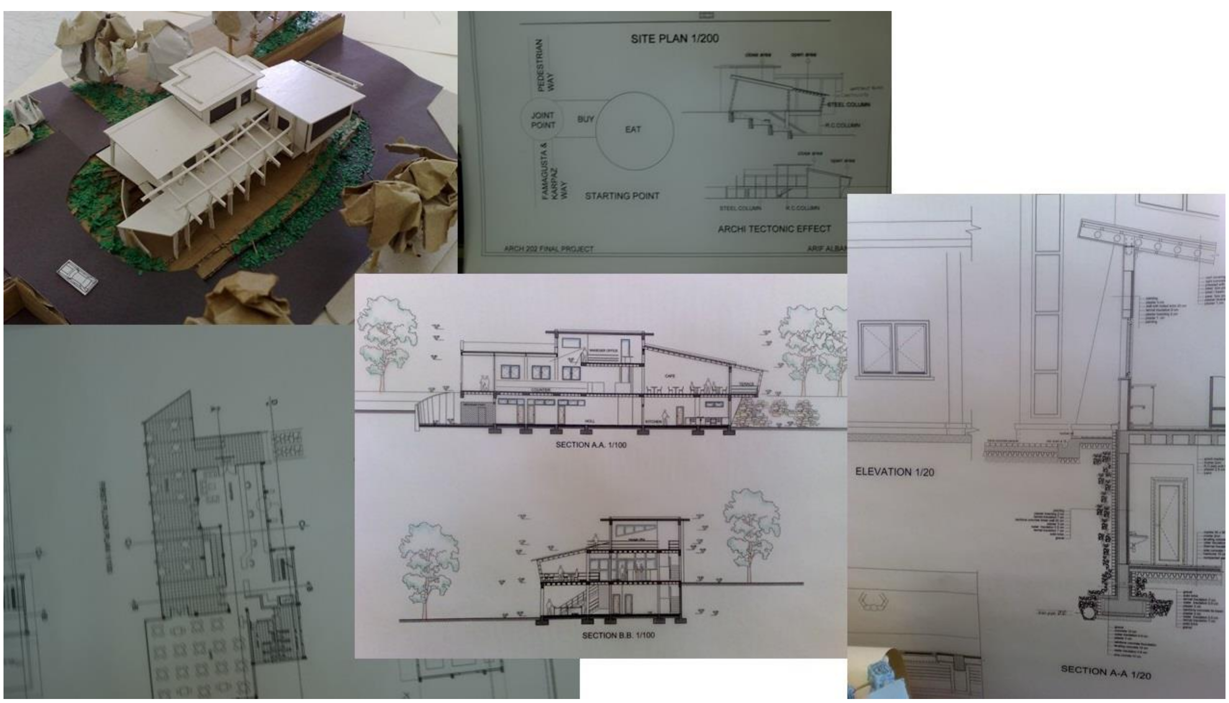

Figure 5. Arif Alban’s project, which is based on the essence of circulation.

d. Ideals, Ideologies, Philosophies

Design concepts can very generally be defined as designer's thinking in reference to some other thoughts, or products of thoughts. Thus, designers can also start designing directly with various types of thoughts as well. In this case, design is based on either to the form, or to the depths of these thoughts, which can be ideals, ideologies, or philosophies. There are similarities between rational design and this type of design. Here, not the rational production, but the ideals, ideologies, and philosophies represent the society. Still, the designer plays the role of critical and autonomous artist, who has a strong will.

There were three students, who responded to the design problem by thinking parallel to some ideals, and philosophies. However, one of them did not submit her thoughts about her project, which was based on 'minimalism in design.' The other two were based on 'cubism' and 'modernity.' The table, which can be seen in Figure 6, shows the presedences of the project, which is based on the 'cubist gaze,' which sees the interiors of all objects.

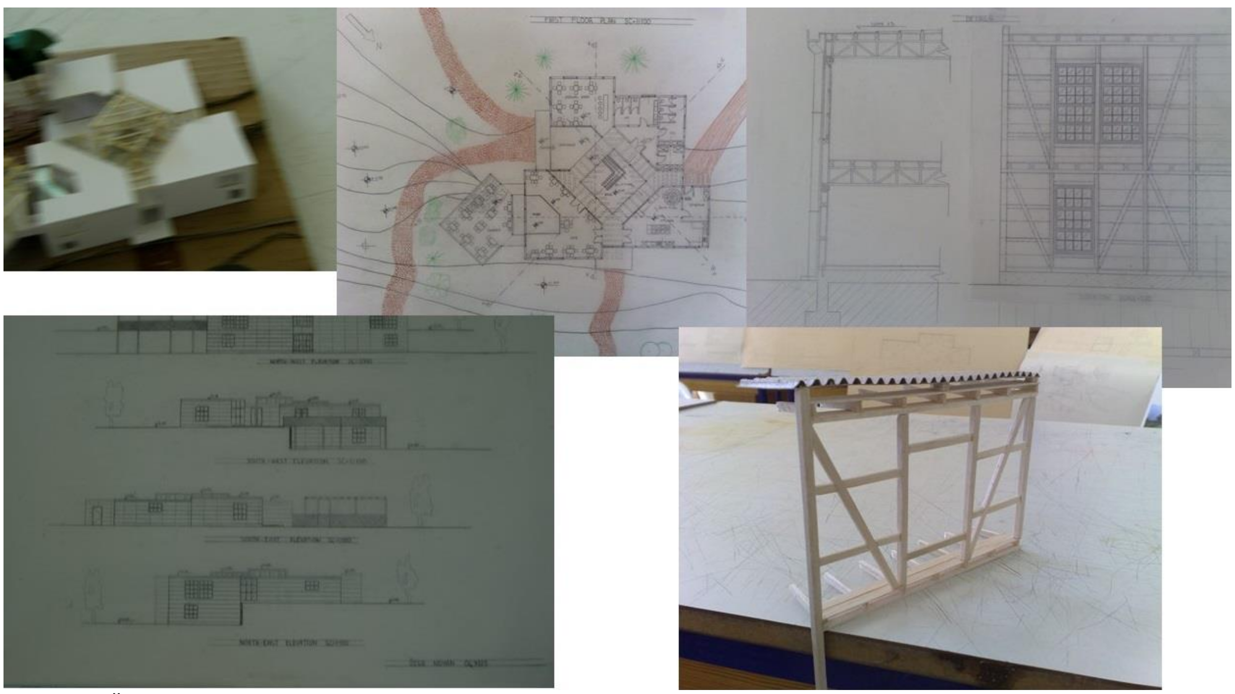

Figure 6. Özge Noyan's project, which is based on 'cubism.'

Now it is time to set our first 'research question' on the basis of the types of design concepts: ***Are some of these design concepts better than the others in achieving tectonics in architecture?***

3.2. Types of Tectonics

Frampton (2001: 3-27) classifies the types of tectonics in architecture as a historian of architecture. He accepts the material issues of the context as the basis of tectonics. According to him, topography, ethnography, and tradition form the base for tectonics. He considers the specific uses of technology, such as the art of construction, symbolic expressivity of construction, and innovative uses of technology as the basis of construction as well. He also highlights the uses of 'corporeal metaphor' as a source to achieve tectonics. However, since our target is to teach technology through tectonics, we accepted the materiality of the context only as an inspiring sourse on the way to tectonics. Thus, the types of tectonics, which are accepted in this paper, are directly related to the various types of uses of building technology for artistic purposes. These are as follows:

a. Tectonics, which originates from the preliminary design scale,
   - Tectonics based on form structure relationship,
   - Tectonics based on materials of surfaces,

  - Tectonics based on system articulation (materialized elevations on the basis of principal system details)

b. Tectonics, which originates from the construction design scale: tectonics, which are based on the production process, and finishing details.

This means that either the building structure, or the materials, or the technological nature of the elevations, or the production process, or the finishing details can be used for artistic, architectural purposes. Hüseyin Komşuoğlu's project, which is presented in Figure 3, is a good example, which combines all types of tectonics. There is a tectonic nature of structure in this project: 'The A frame.' Timber is selected to support this tectonic idea further, and the project achieved the constructive and poetic characteristics of 'attics.' (Bachelard, 1994: 3-38) Principal system detail of this project has spatial characteristics as well. The joint detail provided for the main members of the timber A frame also has tectonic characteristics.

We can now set our second 'research question': ***Is it possible to achieve all types of tectonics with all types of concepts? Or, is there any limitation?***

3.3. Types of Appearance of the Design Concept and Tectonics Relationship

The ways the realtionship between design concept and tectonics are formed was a mystery at the beginning of this action research, because there are not much in the literature about this subject. The strongest information exists about how this relationship occurs in Mies van der Rohe's architecture. According to Hartoonian (1994) Mies had a very strong desire for spritually abstract architecture, which leaded him towards a new architectural 'ideal.' Similar to all other aspects of architecture, especially technology served for the purposes of this ideal. Hartoonian explains the abstract role of the walls (non-functional, non-structural) in Mies's architecture. Leatherbarrow and Mostafavi (2005) explain how Mies put technology in the service of his artistic purposes, although his thoughts originated from rationality and modern technology. They explain the artistic reasons behind the reflections on the facades of Lake Shore Drive Appartments, and the discrimination between the horizontal and vertical elements of the same facade, in order to achive further verticality.

There can be two more 'research questions' about the relationship between the design concepts and tectonics: ***In how many different ways the relationship between design concept and tectonics can be formed?***

How can a design teacher consider these while mentoring his/her students?

4. RESULTS OF THE EMPIRICAL RESEARCH

In comparison to the two previous ARCH 202 projects, this academic term's projects, which were oriented towards tectonics, were better in respect of their technological achievements. Their structural systems were drawn, building materials were selected / presented appropriately, and principal system details were thought / drawn. These differences are clear and observable from the photographs of approximately 100 projects of the last three terms.

After having discussions about 'design concept' and 'tectonics' the whole term, at the end of the term, but before announcing the results of the jury assesment, we asked our students to write a page each, in order to describe what they achieved in terms of tectonics through their design concepts. The same question was previously shown as the base of the jury presentations of the students as well. Similtaneously, the design teachers/mentors (us) also wrote about their group students' design concepts, the type of tectonics, which were achieved by them, and how they were achieved. Later we prepared a table showing the differences between students' descriptions about their works and teachers' descriptions of them, and asked teachers to make interpretations about these differences. ***"What else can be done in order to achieve reciprocal understanding between teachers and students for the sake of a better mentorship?" Then we questioned the ways tectonics were achieved for the students, who were understood by the teachers. This was done in order to understand the role of design concept on the development of tectonics.*** We finally checked the relationship between the level of understanding between teacher and student and the success level of the student, which was based on the mathematical average of the grades given by the jury members.

The pages, which were written by two of 22 these students were not meaningful and identifiable. Thus, we ignored them, and the number of students who took part in this research dropped to 20. In order to be sure that we have not made any discrimination amongst the types of design concepts and the types of tectonics, we checked if there are well understood examples of all types of design concepts and and all types of tectonics. We found out that there are well understood and successfull examples of all types of design concepts and all types of tectonics within the projects of the ten of the twenty students. This means that the group teachers did not have any preconceptions about the types of design concepts and types of tectonics.

Then we started to answer the four research questions, which were initiated within the literature review, with the help of above data.

Research Question 1: Are some of the design concept types better than the others in achieving tectonics? This question was answered by considering the type of design concept used during the design process, the level of understanding between the teacher/mentor and the student, and the success level of the student. We found out that the projects, which were well understood by the teachers, are also the successfull projects. These are 10 projects which include an ideal ('cubism') as a design concept, two analogies ('chevalier's helmet,' and the 'flower and the bee'), one 3D model (see Figure 3), one structural problem solving ('the cantilever'), and five contextual problem solving ('topography and climate'). The relatively unsuccessfull and ununderstood ten projects also included an ideal ('modernism'), seven analogies ('millstone,' 'mushroom,' 'klaket,' 'mıra coffee,' 'tree,' 'wave,' and 'aquarium'), one contextual problem solwing ('topography and climate'), and one problem solving ('getting the best view'). These results show that all types of concepts can be successful in achieving tectonics, or not. There is not any type of design concept, which can be more or less successful in achieving tectonics.

Research Question 2: Is it possible to achieve all types of tectonics with all types of design concepts? This question was answered by considering which types of tectonics were achieved through which design concepts. We found out that all of the successful and well understood projects, which include all types of design concepts, achieved all types of tectonics at the preliminary design scale. These include form structure relationship, materials of surfaces, and tectonics based on detailed system articulation. This means that all types of preliminary design scale tectonics can be achieved through all types of design concepts. A few projects, such as the one in Figure 3, also contained tectonic details.

Research Question 3: In how many different ways the relationship between design concept and tectonics are formed? This question was answered by considering the design teachers' interpretations about how the tectonics was achieved in the student projects, which were fully understood by them. According to these interpretations the type and characteristics of design concept determine the way of achieving tectonics. These are as follows:

1. If the design concept has an initial potential to achieve tectonics, then the tectonics is achieved simultaneously with the design concept: a. If the design concept is related to structures, such as the analogy of *'chevaliers'helmet,'* (see Figure 7) and *'solving the problems of a cantilever;'* b. If the design concept can easily be related to material selection and system articulation, such as the ideal of *'cubism,'* which makes inside as well as the outside of the object (project) visible and understandable. (Figure 6)
2. If the design concept does not have any initial potential to achieve tectonics at the beginning, then during the later stages of the design process; while designing structures, selecting materials, and articulating the system details; the design concept should be remembered in order to answer all questions about the technology. These can be the analogies such as the *'wave,'* and *'the flower and the bee'* etc. (See Figure 8)
3. If the design concept does not have any potential to achieve tectonics, and if the design concept is rational (such as realizing essences, and problem solving), then the potentials of the physical project should lead to the further decissions about structures, materials, and system articulation. (See Figure 9)

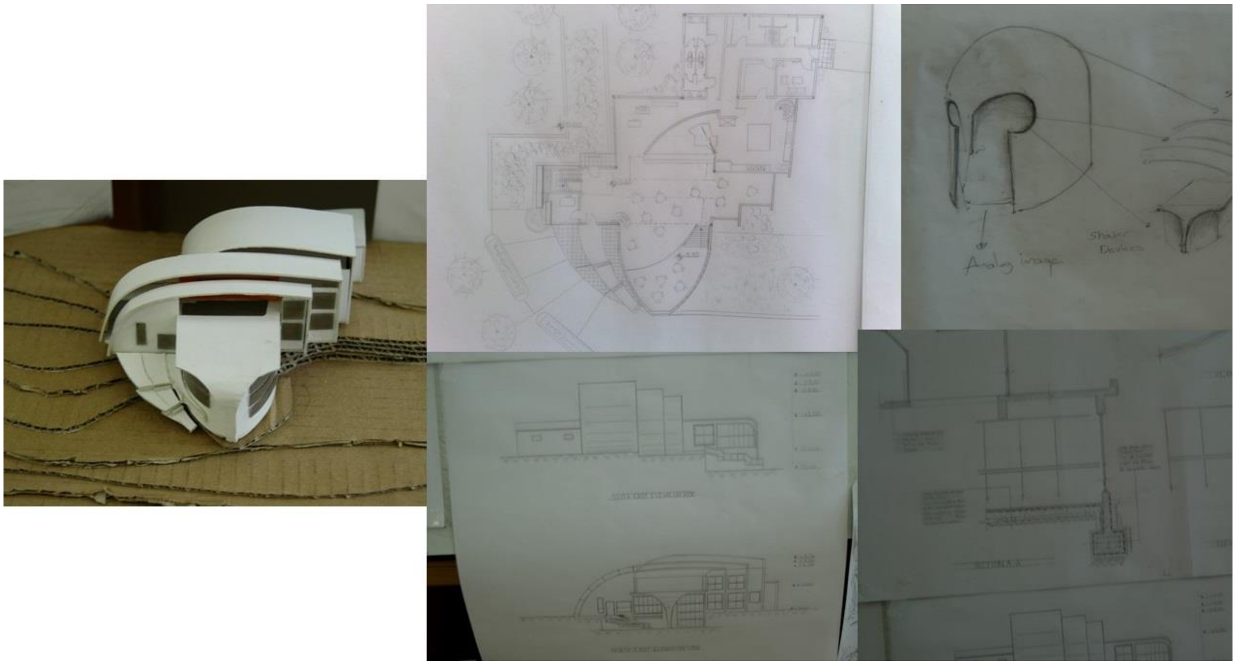

Figure 7. Taha Eren Gül's analogy of *'chevaliers'helmet,'* which is directly related to the building structure, and well understood by the group teacher.

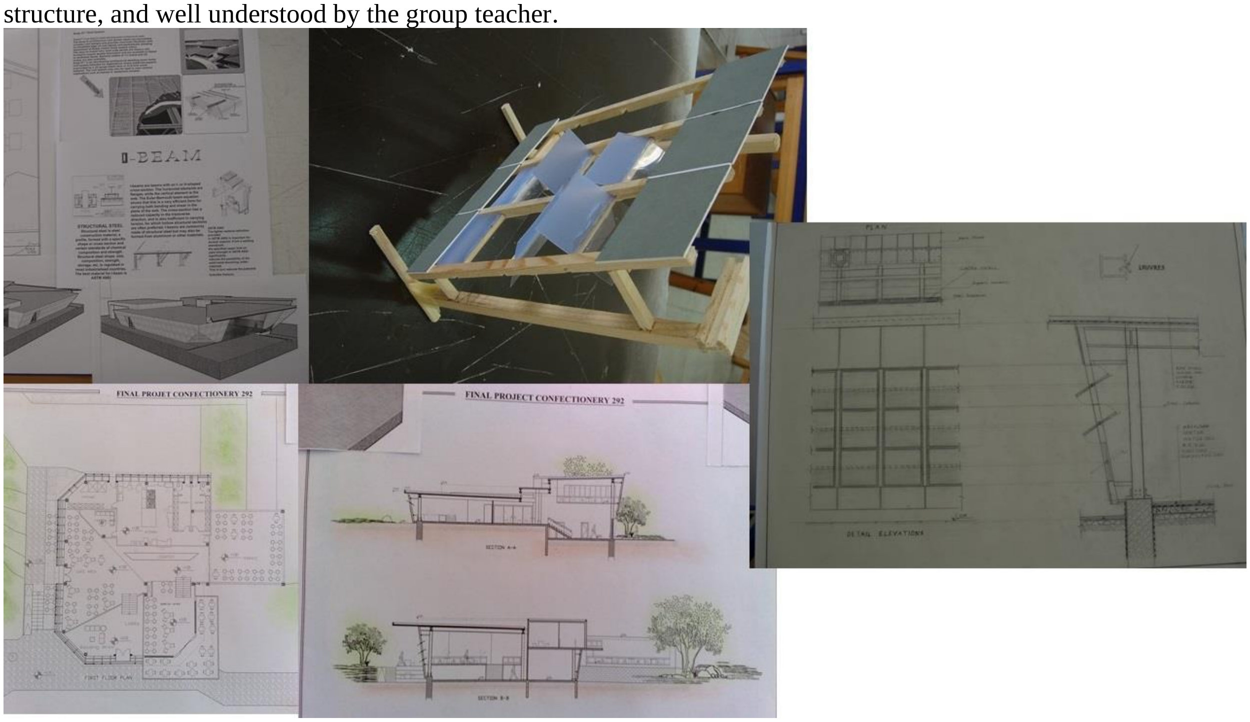

Figure 8. Murat Yaşar's analogy of *'cooperation between the flower and the bee,'* which does not provide a direct relationship with its tectonics.

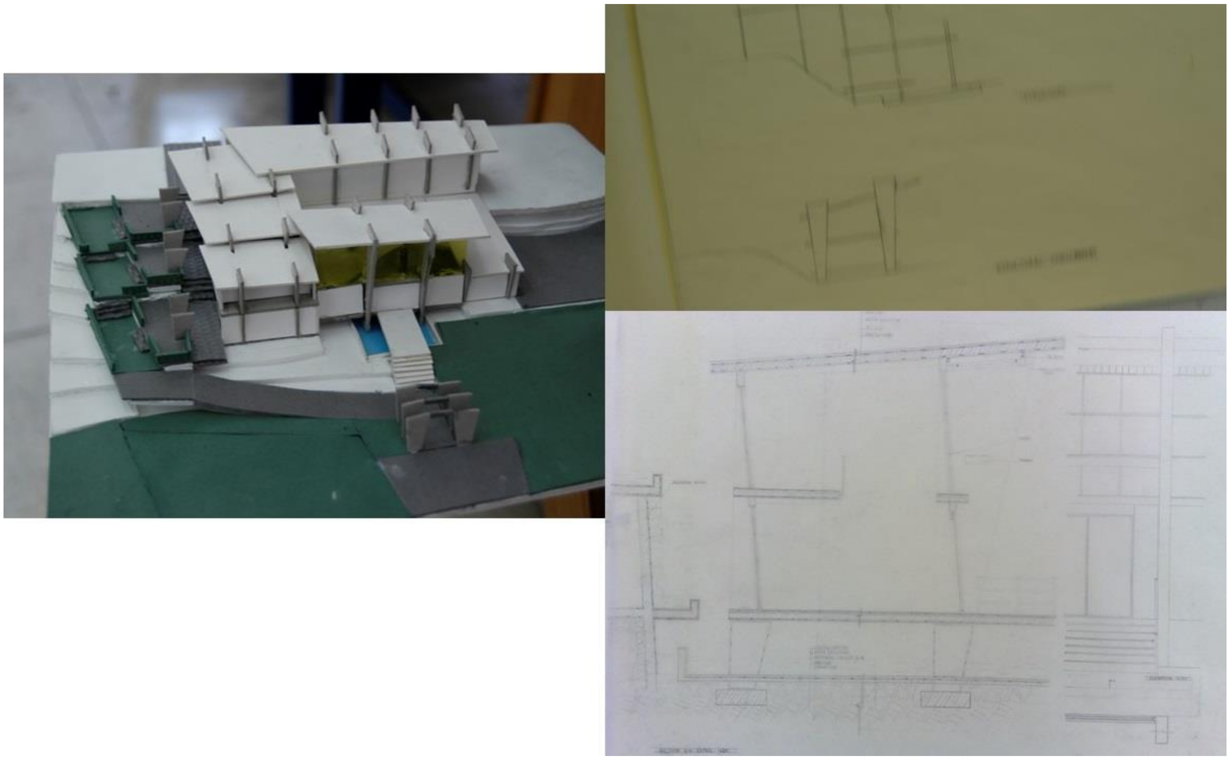

Figure 9. Faruk Zavalsız's climatic problem solving, which is not directly related to tectonics, but well understood by the group teacher.

Research Question 4: How can a design teacher consider the answer of 'research question 3' while mentoring his/her students? This question was answered by making a final interpretation about how tectonics can be achieved in relation to the different types of design concepts. According to this interpretation;

1. The teacher should question the design concepts at the beginning of the design process in order to find out which design concepts have initial tectonic potentials, which can be achieved through all types of design concepts. The whole design process is clear from the very beginning of design for the students, who have design concepts with initial tectonic potentials.
2. The teacher should remind the other students, who have design concepts, which do not have initial tectonic potentials, to continue to use (and to problematize) their design concepts at the later stages of design in order to answer the questions concerning both structures, materials, and system articulation. However, this might not be valid for some rational design concepts, which do not have initial tectonic potentials.
3. The teacher should tell the students, who have rational design concepts, which do not have tectonic potentials, to use the physical potentials of their projects at the later stages of design in order to give tectonic decissions about both structures, materials, and system articulation. This is the most ambiguous type of design process in achieving tectonics.

5. CONCLUSION

The objective of this research is to realize the first step of an action research, which is about how to include tectonics into architectural design education, which is based on design concept development at the preliminary design stage. The phenomenographical method, which is used for this stage of the research, is a critical phenomenography, which accepts teachers' understanding of students' design concepts and tectonic ideas, as evidences of students' consciousnes about their design projects. It is shown that accepting teachers' understanding as evidences of students' understanding (learning) gives meaningful results.

Results of this critical phenomenographical research, which was realized for 20 students, show that it is not necessary to limit the types of design concepts in order to achieve tectonics in design. It is shown that all types of design concepts can achieve all types of tectonics, which belong to the preliminary design stage. This means that all types of concepts can achieve tectonics both in structures, materials, and system articulation details.

Highlighting materiality of the context (topography, climate etc) helps to the students, who prefer rational types of design concepts (essences, and problem solving) by adding materiality to the abstract nature of the rational approach to design.

Another result of this research serves for a new categorization of the design concepts. This categorization is with respect to the way tectonics appear within the design process. According to this, architectural design concepts can be categorized as;

1. the design concepts, which have initial tectonic potentials,
2. the design concepts, which are not rational and which do not have any initial tectonic potentials,
3. some rational design concepts, which do not have initial tectonic potentials.

In order to achieve tectonics, the design process changes according to the above types of design concepts. The first type of design concept produces tectonic ideas at the very beginning, and it becomes possible for the teacher/mentor to talk about the whole design process from the very beginning on. The second type of design concept cannot produce tectonic ideas at the beginning. For the students, who have these type of design concepts, it is necessary to design the structure, select the materials, and make the system articulation according to the design concept whenever these decisions become necessary. This is another spritual process in order to re-interpret the design concept in terms of tectonics. Since the third type of concepts are not based on 'artistic rationality,' but based on 'instrumental rationality,' it is necessary for the owners of these design concepts to realize a secondary step, which is based on the intiutive reinterpretation of the physical product of the early design stage, in order to initiate ideas about structural design, material selection, and design details for system articulation.

These results can be useful for design teachers/mentors by helping them to differentiate the various types of design concepts with respect to the way tectonics appear within the design process.

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