HEALTHY BUILDINGS: INNOVATION, DESIGN & TECHNOLOGY

ICAT 2016

ANTONIO GALIANO GARRIGÓS
TAHAR KOUIDER

CONFERENCE PROCEEDINGS OF THE 6TH INTERNATIONAL CONGRESS OF ARCHITECTURAL TECHNOLOGY
UNIVERSITY OF ALICANTE 12-14 MAY 2016

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DETAILING FOR A RESEARCH CENTRE IN ANTARCTICA

An experiment to force students to be creative ınstead of copyıng standard solutıons

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Abstract. In order to equip architecture students with ambitious detail designing ability, related courses of the architecture programs should deal with subjects which are rather rare and unusual for real life practices in order to prevent students copying standard details. In 2015 an innovative project brief has been given to architecture students of Istanbul Technical University. The scenario given in the brief is to design a research station for the first group of Turkish scientist, to be built in one of the coldest and most arid regions on earth; the Antarctica. The performance requirements given in the brief were determined to prevent the students from copying details from any kind of resources as the total number of details generated in real life for those conditions are very limited and specific. The method used has demonstrated a great success and creative detail solutions were generated by the students. In the paper, the innovative coursework brief for bettering the detail design ability of architecture students is explained and the output of the studio is presented.

1. Introduction

The ease of reaching to knowledge in the contemporary world has effected the education of architecture students both in positive and negative ways. Learning from the precedents is easier than any time before. By the help of google virtual tours in almost any important architectural place is just some finger tips away for the students. That equips the students with lots of images and concepts of buildings and building sites which may better their conceptual design abilities. But for detail designing ability this ease of reaching to knowledge may make students use generic details without thinking about the integration and performance. The reasons of these are firstly; from computer screen understanding the relations of the materials, components, and elements of the buildings is rather difficult. And secondly, detail design activity is dealing with more stringent factors, in other words physical properties, of the buildings and just directly using a detail pattern found from some resources without carefully evaluating it is a risky method to be taught for the architecture students. Architects should be equipped with enough construction knowledge, to be able to make their design idea applicable to construction (Emmitt, 2002). Architecture students have to gain a multi-dimensional perspective by understanding different activities both in design and construction processes. (Nicol and Pilling, 1987:13), (Yazıcıoğlu, 2010) (Howieson, 2000) Mostly "service courses" in the field of "architectural technology" are equipping architectural students with construction knowledge related to materials, structure, construction, management etc. In the architectural technology education different methods, such as "learning by seeing", "learning by hearing", "learning by doing" etc. are used to transfer knowledge (Atli, 2009). The effectiveness of each method is depending on the educational environment. In the paper the "learning by doing" method is introduced and evaluated for the "Building Element Design" course at the Istanbul Technical University, Department of Architecture.

2. Detail Design at Istanbul Technical University

At the Department of Architecture in Istanbul Technical University, architectural technology related courses are given in five main areas. Those areas are; "building materials", "environmental control", "building structure", "building construction management" and "building elements". Courses in the "building elements" area is dealing with the design process and the construction process of "physical" building sub-systems namely; external walls, roofs, floors, stairs, ramps, internal walls, windows and doors. Subjects in the "building elements" area are given in three mandatory and seven elective courses. The three mandatory courses are constructed as a series with a pedagogic approach that roots to the learning process theory indicating that learning occurs in three steps; awareness of the knowledge, understanding it and using it. The objective of the first course in the series, called "Introduction to Building Construction", is to generate awareness on building elements in general. The objective of the second course, called "Building Construction Methods", is to make students understand the "structure" and construction concept of building elements. The objective of the third course in the series, called "Building Element Design", is to encourage students to use knowledge obtained from the previous two courses in the design process. (Altun, 2006) These three mandatory courses, which are given in the second semester, third semester and fourth semester, are supported by elective courses, specialized on certain building elements and processes, like "Roof Systems", "Vertical Circulation Systems", "Building Construction Techniques" or "Design Principles of Building Elements". These ten courses are given by five professors and four teaching-research assistants. A total number of nearly two hundred students are attending each of the mandatory courses and each elective course has ten to thirty students.

3. An Innovative Project Brief for Building Element Design Course

The course "Introduction to Building Construction" is generating awareness on "building elements" with the methods of "learning by seeing" and "learning by hearing" through lectures and assignments. The course "Building Construction Methods" is dealing mainly with the construction process of building elements besides of the "structure" of building elements. The course "Building Element Design" is constructed for creating the opportunity to use obtained knowledge with the method of "learning by doing" through studio work, supported again by lectures and assignments.

3.1. THE SCENARIO OF THE BRIEF

In order to make students get more interested in the course a scenario has been adapted to the course work brief. The scenario is as follows:

Turkish government has commissioned you to design a research station for the first group of Turkish scientist, to be built in one of the coldest and most arid regions on earth; the Antarctica. The research station will be first used by 7 scientists in summer and in time the number will be increased to 25 in summer and 13 in winter. The research station should be designed to be moved as any type of in situ construction is very difficult in the region. As the region is dramatically important for the sake of the world the station should minimise the production and use of electric, water, heat, etc. Also the government wants the station to be designed with a sustainable approach to be a model for the other nation's stations. The government's long term intention is to have a minimum, zero energy and carbon neutral station. The station will comprise of a living room, dining, kitchen, bedrooms, bathrooms, technical spaces and 3 laboratories.

3.2. PERFORMANCE REQUIREMENTS

It is expected from the students to understand the importance and methods which may be used for detail design activity. Mainly performance based approach for detail design activity is used throughout the term and in order to prevent the students from using generic details they have found from books, magazines, web sites, manufacturers' booklets, etc. stringent performance requirements were demanded from the building elements that have been designed by the students. The stringent performance requirements are as follows:

The government wants the station to be manufactured in a special area designated for the project in the TUBITAK Gebze Campus and must be built here first to be able to assess the performance of the station beforehand. The building parts will be transferred to Antarctica by a ship from the Port of Kocaeli. Thus the station should be designed to be capable of assembly and disassembly for at least 2 times. There are some stringent performance criteria that need to be met, or bettered:

Green energy production methods should be implemented to the stations.

The station will be constructed in Istanbul and moved to Antarctica thus, the assembly and disassembly should be easy and repeatable.

In order to cope with the harsh climatic environment of Antarctica the envelope of the stations should be highly insulated with U-Values for opaque parts to be 0.05W/m2K; and for transparent parts to be 0.1W/m2K.

3.3. STRUCTURE OF THE STUDIO

One of the most important aspects of the studio is its being a group study. At the first day of the term after the description of the project brief, students are made to generate self-selecting groups consisting of 4 students. There are two important reasons for making group studies. Firstly, architecture is a profession which is realized as a collaborative study in real life. Similarly, group studies make it possible for the students to work on the project collaboratively. Secondly, complex and highly detailed output is expected from the students at the end of the term which will be an overload for a single student to comprehend.

Each day every group makes a presentation to the tutor about the studies they have realized. The tutor analyses these studies and a discussion related with the strong and weak properties of their studies. And the session is finished with the tutor’s explanation of the studies needed to be finished until the next week.

The programme of the term and weekly subjects are as follows:

TABLE 1. Weekly programme of the term

Week	Subject
1	General information about the term and the brief.
2	Open group presentations related with the subject, mainly related with Antarctica.
3	Energy, and clean water production and storage methods, first ideas about the concepts.
4	Evaluation of the conceptual ideas and structural system design.
5	Physical model of the structural system and conceptual design of the floor systems.
6	Physical model of the floor/roof systems and conceptual design of the external walls.
7	Physical model of the external walls and conceptual integration of the floors/roofs with external wall systems.
8	Physical model of the floors/roofs – external wall integration and conceptual design of the window systems.
9	Physical model of the window systems and conceptual integration of the external walls with windows.
10	Physical model of the floor/roof – external wall – window integration and conceptual design of the internal walls.
11	Physical model of the floor/roof – external wall – window – internal wall and conceptual design of the stair systems.
12	Physical model of the whole building system.
13	Physical model of the whole building system.
14	Physical model of the whole building system.

As it is seen from the weekly programme the structure is based on physical models. Each week a building element is conceptually designed and the next week a physical model of it is made and integrated with the physical model of the previous week. Physical models are great tools for detail design education as they give the possibility for the students to see 3 dimensionally if their detail is really working and if it is possible to integrate it with other details.

4. Analysis of the Student Works

When the final submissions of the groups are analysed it is seen that creative and working conceptual and detail designs were generated.

4.1. CONCEPTUAL DESIGN

The first thing realized by the groups in the term was developing a concept design. While deciding about the concept of their buildings some common criteria were used.

Since Antarctica has a very low average temperature, the buildings should protect the users from the cold and conserve its heat energy. It was obvious that thick walls with very good insulation were needed, however, the shape of the building is also an important factor that could help with reducing heat loss.

Heat is lost in three ways, conduction, convection and radiation. The biggest amount of heat is lost through conduction, which is when objects are directly touching each other. To reduce the amount of heat lost through conduction, the surface area of the objects touching each other must be reduced. This can be achieved by reducing the size of the building, thus usually spherical shapes were used. Circle has the lowest perimeter/area ratio and a sphere has the lowest surface area/volume ratio.

To reduce the conduction effect further, we raised the building off the ground on to steel stilts. Touching the air is much more advantageous and thermally efficient compared to touching the ground. Our final building form was beginning to take shape

Another important factor is the wind speed. Antarctica has high average wind speed and katabolic winds. In order to transform the buildings into more aerodynamic shapes the top and bottom edges were usually tapered.

At figure 1 the preliminary conceptual sketch showing the firs ideas may be seen.

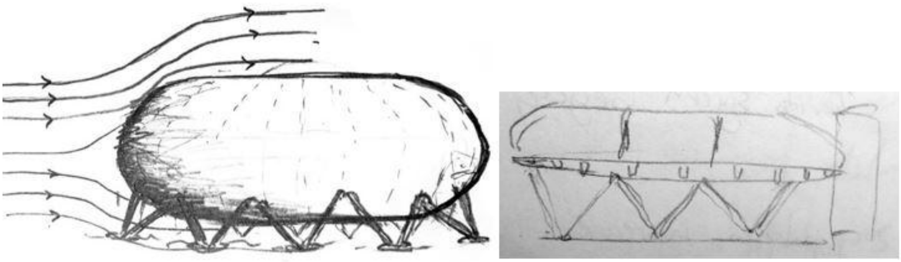

Figure 1. Conceptual design sketch of one of the groups

4.2. STRUCTURAL SYSTEM

The second thing realized by the groups was generating the structural system of the research stations.

For the structural system, the main criterion is ease of assembly and disassembly. As it is not possible or easy to produce concrete and also not possible to use welding techniques due to the climatic limitations usually timber, especially laminated timber, was used as the structural system material. For connections steel supports were used for mechanically connecting pieces to each other. Being light weight, easy to use, ease of production and low thermal conduction properties are some specialities that made timber the most popular choice. In Figure 2 the structural grid system with diagonals may be seen.

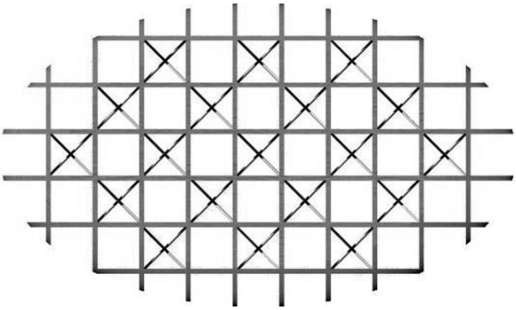

Figure 2. Structural grid system of one of the groups

The second thing that should be overcome by the students was lifting the building above the ground level to reduce the permafrost effect. While lifting the buildings should also be connected strongly to the ground to cope with the harsh winds of Antarctica. For this usually bolted steel structures were used.

In Figure 3 one of the solutions generated for connecting the buildings to ground may be seen. In this alternative steel tubular columns are holding the building above the ground, resting on precast concrete blocks. The tubular steel columns are connected to large concrete blocks which are buried under the ice sheet. The concrete blocks are connected to each other like LEGO blocks. Their purpose is to distribute the weight of the building, and also as a dead weight so that the building isn't affected by wind.

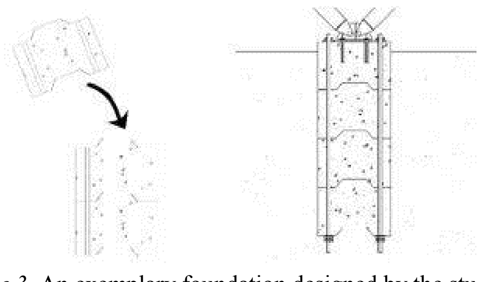

Figure 3. An exemplary foundation designed by the students

4.3. BUILDING ENVELOPE

The building envelopes opaque parts' U-values are expected to be lower than 0.05W/m2K which is really struggling for the students. High-end thermal insulation materials, like aerogels, vacuum insulated panels, etc. were analysed by all of the groups. Most of the groups made it possible to satisfy the value in reasonable wall thicknesses. Figure 4 represents one of the building envelopes designed with a resulting U-value of 0.047W/m2K.

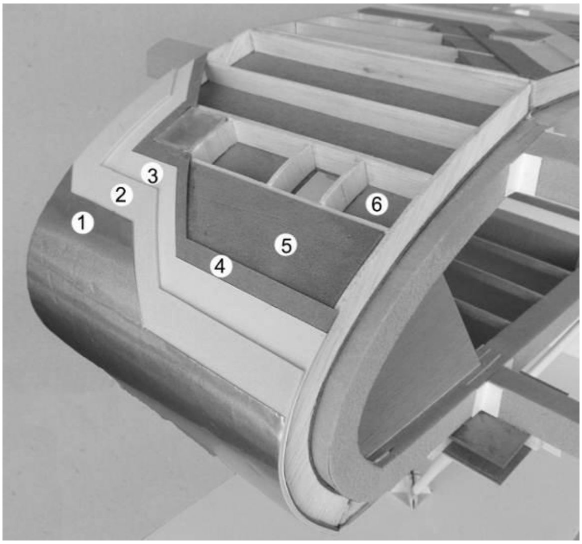

Figure 4. Physical model of the building envelope of one of the groups
1-Stainless Steel (1.5mm), 2-Foam with Closed Cells (3mm), 3-EPDM Silicone Sealant (3mm), 4-Laminated Wood (74mm), 5-Spaceloft Subsea Aerogel Blanket (240mm), 6-Laminated Wood (42mm), 7-Kraft Paper, 8-Aluminium Vapour Barrier, 9-Woollen Felt

5. Conclusion

"Building Element Design" is a "service course" at Istanbul Technical University, Department of Architecture. It deals mainly with architectural technology related subjects regarding detail design of building elements. The course is based on "learning by doing" approach which expects the students to use the information about the detail design activity which have been acquired in the prequel courses "Introduction to Building Construction" and "Building Construction Methods". In the paper the innovative subject given to the students of the Building Element Design is presented. The subject is to design a research station in the Antarctica. The aim of the subject is preventing the students from copying generic details and instead designing innovative details. The harsh conditions of Antarctica really accomplished the aim of the subject. The results presented above, show that student works satisfy the stringent performance requirements. The evaluation of the course stated that the method of "learning by doing" together with an innovative subject and stringent performance requirements is successful in many aspects. Students understand;

- the importance of detail design activity,
- the importance of collaboration for bettering the architectural design,
- relations between components of a building element,
- relations between different building elements,
- the logic of assembling,
- sequence of construction,
- environmental conditions affecting the construction process,
- up-to-date construction technologies,
- up-to-date construction materials,
- importance of integration, easily by the "learning by observing" method.

References

ALTUN, C., EDIS, E., GOCER, C., 2006. Approach change in building technology education; From "typical" details to performance based design, *Proceedings of Architectural Education Forum 3*, Istanbul

ATLI, D., 2008. *Learning styles in construction teams*, I.T.U. Press (in Turkish)

EMMITT, S., 2002. *Architectural technology*, Blackwell Science

HOWIESON, S., 2000. Integrated architectural design: issues and models, *Changing architectural education edited by David Nicol and Simon Pilling*, Spon Press

NICOL D. AND PILLING, S., 2000. *Changing architectural education*, Spon Press

YAZICIOGLU, F., 2010, Process Observation in "Building Construction Methods" Education, A Case Study, *Proceedings of 2nd International Conference on Design Education,* 28 June - 1 July 2010, 42