

# Examining Problem Solving Ability and Creativity of the Students in Design Studio

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## ABSTRACT

The willingness, the pre-college training, earned cultural and knowledge background of a student are important factors that have effect on student profiles. A 3-stage sketch problem examination which is aimed to evaluate their drawing, problem solving abilities and creativities was designed in a vertically organized design studio. It was observed that problem solving ability of the students considerably favorable than their creativity. With the purpose of developing the creativity of the students, a study method which is based on the formal and structural experimentation was suggested for the future studio studies regarding to current architectural trends.

**Key Words:** *Design Education; Student Profile; Willingness; Problem Solving; Creativity.*

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## 1. INTRODUCTION

The Group Studio 6, in Gazi University Department of Architecture has been pursued with the support of a profile defining study and the understanding of different talent of the students for renewing studio programme. Since debates on design circulate mainly around its creativity and problem-solving characteristics, we intended to evaluate these qualification of the students through a sketch exam.

Although there are many definitions of creativity and problem solving process and ability, an important issue in

the creativity literature centers on how creativity in individuals can be evaluated [1]. Although creativity assessment relies on human judgments [2], the answer ought to be searched in the definitions anew.

Scientific or artistic creativity requires that something original is produced, or at least added, something that has not been conceived or made before. An individual that finds an original solution for a certain problem, unaware of the fact that this solution has been found previously by somebody else, is still considered a valid example of

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creativity [3]. Creativity enables the talented designer to transcend conventional knowledge domain so as to investigate new ideas and concepts which may lead to innovative solutions [1].

According to Goel (1995), creativity is a key element in design problem-solving. A major reason is that design is a complex and ill-structured activity, where problems cannot be solved through the application of algorithms or operators. Cross, (1997), Hsiao & Chou, (2004) and Gero, (2000) state that in addition to the need for qualitative knowledge and experience, the exploration of unfamiliar and unconventional design solutions requires creative skills [1].

Unwin believes that architectural design is not 'problem solving'- architecture may involve solving many problems, but at its origin it is a matter of making propositions [4]. There are various different approaches that exemplify the fact that problem solving skills are applicable to architectural education based on the relationship between intuition and creativity or logic and the relationship between reason and result. The problem-solving-oriented design process anticipates the increasing complexity of technology and promises a more effective assimilation [5, 6]. Undoubtedly, in design education, intuition is needed, which is then turned into creativity with the help of knowledge and experience [7]. As Peich has mentioned, architecture is created via a combination of logic, emotions and intuitions [8].

As Liddament has mentioned, the ability to solve a problem is not only in algorithmic characteristics but in the general spectrum, creative thinking extends from algorithmic thoughts, towards comprehension, in terms of developing solutions for problems and various applications of critical thinking, to the methods used in solving algorithmic problems; moreover, logical systematic characteristics and in an odd and a deep contrast only to problematic, that is creativity in design [9].

The focus of creativity research has been on personal characteristics [10]. Gardner (1993) suggests a multilevel framework which includes neural, cognitive, emotional, social, and cultural perspectives, in order to examine this human behavior more thoroughly. Creativity has also been examined within a social-cultural framework. Csikszentmihalyi (1988, 1996), pays attention to the social-cultural level of creativity [11]. Yet many creative thinkers themselves have recognized the potential role of the environment to influence creativity [10].

Architectural educators expect architect candidates to have preliminary knowledge and idea of architecture before university. In this study, a proposal to identify a student profile will be introduced as a beginning step for teaching in architectural studios. A two-stage approach was considered appropriate for the main assessment.

The first part is related to the evaluation of the student's pre-college cultural and knowledge accumulation and the desire of the student to study architecture.

The second part is concerned with the effect of the student's prior experience on his/her architectural education. In order to determine the second part of the proposal, a sketch problem exam is taken into consideration. This exam takes place at the beginning of

the semester and determines the drawing, problem solving abilities and creativity level of the students.

## 2. THE PRIOR EFFECTS ON THE STUDENT PROFILE

Considering the general profile of the students, based on 18 years of experience in design studio, the basic parameters that influence design education can be summarized as below:

In terms of defining student profiles in architecture studios, in order to determine a student's earned cultural and knowledge background in pre-college training and the willingness of a student it is primarily needed to be defined.

### 2.1. Pre-college Experiences

While the students at the beginning of the other professional fields feel the support of the secondary education more powerfully, the multidisciplinary and holistic nature of architecture leads to a level of cognitive challenge that is unlikely to have been experienced during secondary education [12]. According to Wolffe, et al., selection, orientation, and guidance requirements are important for architectural education [13]. During design project work the student is invited to make propositions which are often speculative and exploratory in nature. The student's responses are likely to be unique and individualistic, and owe more to interpretation and intuition than to a logical or formulaic process [14]. Most students of architecture enter higher education with little experience of this form of learning, and therefore a large part of architectural education is concerned with the development of new abilities, values and conceptions, so that eventually they are able to think and do as architects. For new students in architecture, a move to a system where the answers are uncertain, and the route to that endpoint ambiguous [15] and not following any set methodology, may prove a frustrating and difficult challenge. As they progress, they will develop ways of countering these difficulties, which places a demand on schools of architecture to instill new ways of thinking and doing in their students from an early stage [16].

Garvin states that creativity is a response to the sum total of hereditary and environmental influences of the individual [17]. According to Eder and Hubka, during learning, some prior knowledge, abilities, skills, attitudes and values must be 'unlearned' in order to accommodate the new learning [18]. The deficient curricula of most Turkish secondary schools with regards to arts education makes it very difficult for students to gain a cultural background in this field. Only the students who graduate from vocational high school have experience on technical drawing.

### 2.2. Willingness and Admission to Architectural Education

The admissions of the students to the department of architecture in various countries associate with different conditions. Admission of first year students firstly depend on General Secondary Education Certificate. Applicants are expected to show a portfolio of recent work at interview and declare their intentions. In some universities, Preparatory Architectural Coursework is compulsory for candidate. Some department of architectures administer their own or regional entrance

exam to evaluate future students skills and knowledge on the field of architecture before accepting them to architectural education. It is clear that the students in all of these alternative methods have been made their application willingly and consciously.

Whereas, in Turkey students are accepted to universities by taking a national exam. The successes of future architecture students are evaluated through math and science questions along with other students competing in the engineering and health fields. After taking the university exam, candidates complete the “university preference list” which includes the list of universities and departments they wish to study. Due to such evaluations which are based on exam scores, a determined choice by students replaces real enthusiasm for the field of architecture.

The unwilling participation of a student to study architecture is a completely different situation from those

who start off with the totally appropriate personal talents. The average student tends to approach architecture as an important, useful and rewarding craft to be learned. The talented student seems to approach architecture as a challenge to his ingenuity and creativity [5].

### 3. CASE OF GAZI UNIVERSITY DEPARTMENT OF ARCHITECTURE

The system of studio training at Gazi University Department of Architecture may look like a cultivation process. In a vertical organization scheme, the five main studios are formed by different students from the 3rd, 4th 5th, 6th and 7th semesters. In such a vertically-organized studio structure, it is obvious that there is a difference between different students in terms of informative knowledge and their development levels. It is assumed that these differences would positively decrease when students communicate with each other.

Table 1. Student Enthusiasm.

Enthusiasm	4th Semester	5th Semester	6th Semester	7th Semester
Very much willingly	2	1	1	2
Willingly	4	4	3	3
Unwillingly	2	3	3	1
Total number of students	8	8	7	6

The effect of the “willingness” factor of the student to study architecture is determined by the performed inquiry to resolve the student profiles. Total 29 students in the studio group were asked the ranking of the profession of architecture in their preference lists. As indicated in Table 1, the students who preferred architecture on top of their preference list were included in the group “very much willingly”, those in whose lists architecture ranked 2<sup>nd</sup> to 5<sup>th</sup> were included in the group “willingly” and others in the group “unwillingly”.

### 4. SKETCH PROBLEM EXAM TO DEFINE THE STUDENTS’ DRAWING, PROBLEM SOLVING ABILITIES AND CREATIVITIES

A sketch problem examination that included a 3 stage was applied at the beginning of the semester, which attempts to define problem solving abilities and creativity skills. In order to define the level of expression in terms of time management, spatial perception and drawings (plan, section and perspective), a sequential 15 minutes is given to the student. After each problem, the student is asked to start with new sketch paper. This sketch problem exam, including 3 parameters is presented below as the following 3 questions:

**1<sup>st</sup> stage:** *The drawing of the study/sleep personal space of the student.* The students were asked to depict the dimensions, the forms and furnitures of the rooms. This question aims to define the ability of the student to use architectural delineation techniques and the level of his/her perception altitude for details. Drawing is the

language of expression of architecture. Therefore, it should follow the rules of technical drawing or properly reflect ideas through free hand drawing. Otherwise, even the best ideas will fail to flourish because of this shortcoming. Focus should be placed on improving drawing skills in case this is an issue among students.

**2<sup>nd</sup> stage:** *The re-designing of the student’s current study/sleep personal space to accommodate sharing the room with a sibling or a relative.* The 1<sup>st</sup> stage ensured evaluation of options which could be produced for the 2<sup>nd</sup> stage. This question aims to define the problem-solving skills of the student in the case of limitations.

**3<sup>rd</sup> stage:** *The designing of a study/sleep personal space without any limitations for themselves.* They were let free to reshape everything. This question aims to define the student’s creativity and his or her desire to be different.

#### 4.1. Evaluating the Sketch Exam

The evaluation of the results of the sketch exam is carried out in three stages. The first stage covers the evaluation of students’ individual designs (see Table 2). The second stage covers the evaluation during the semester and third stage covers the evaluation in between semesters as a whole.

##### 4.1.1. The evaluation of 4<sup>th</sup> semester student group

**1<sup>st</sup> interrogative evaluation:** 1 student presented completely free hand drawing, the rest of the students performed a study compatible with architectural delineation techniques (see Figure 1).

**2<sup>nd</sup> interrogative evaluation:** Adding one more bed or bunk has been tried out. Concerning about fitting in the room, the closet design is considered once again (see Figure 2).

**3<sup>rd</sup> interrogative evaluation:** 1 out of 8 students looked for a solution in except for uniform rectangular prism Table 2. 4<sup>th</sup> semester student evaluation sample.

(see Figure 3), 4 students found a way to increase comfort by the functional addition in rectangular prismatic space. It is observed that students are more likely to look for a new form and also 10% of the students survived the pressure of rectangular prismatic design.

Stages	minutes	Student name: Ferhan Aydın
1 <sup>st</sup>	0-30	Plan drawing completed.
	30-60	Perspective drawing completed.
Technical drawing is straight. Perspective drawing was performed as to technical rules.		
2 <sup>nd</sup>	60-90	Plan and perspective drawing completed.
Although he was slow in problem solving, she detected the solution in designing the equipments once again.		
3 <sup>rd</sup>	90-105	Plan drawing started. Curvilinear and flowing area structuring is picked.
	105-135	Plan drawing completed.
	135-165	Perspective drawing completed.
Although improving slowly, a design is presented. The design flows with the curvilinear surface and the equipments internally as opposed to the area used in daily life despite the fact that functional distinction can be observed.		

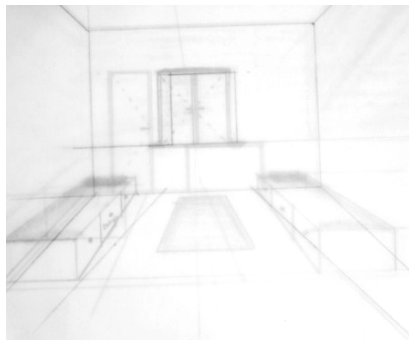


Figure 1. Esin Atabeyli  
4<sup>th</sup> semester.

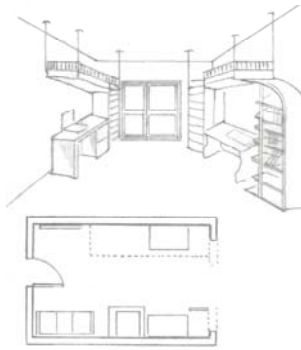


Figure 2. Ferhan Aydın  
4<sup>th</sup> semester.

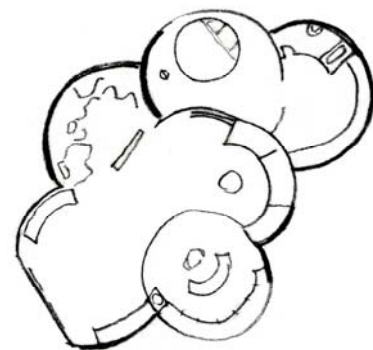


Figure 3. Ferhan Aydın  
4<sup>th</sup> semester.

Creativity is also characterized by concepts such as originality, the distance between a creative object and the prototypical representation, based on membership of the category of similar objects, is also by definition large, larger than the distance between the aesthetic appeal and the prototypical value [2]. The product originality assessment indicated that the most recognizable sample for experimenting on the external form of the space – rather than dividing the space into sub-spaces – has been done by 4<sup>th</sup> semester students. This is possibly because of the brainstorming skills that are attempted to be given to 4<sup>th</sup> semester students in their first year basic design course have not been assimilated by some other structural, stylistic and environmental behavioral rules yet.

#### 4.1.2. The evaluation of 5<sup>th</sup> semester student groups

**1<sup>st</sup> Interrogative evaluation:** 5 out of 8 students worked considering the technical design rules, 2 of them combined technical drawing rules with free hands drawing, and one of them mostly performed free hand drawing.

**2<sup>nd</sup> Interrogative evaluation:** Design of the closet and other furniture are taken into consideration once again (see Figure 4 and 5).

**3<sup>rd</sup> Interrogative evaluation:** 2 students have attempted to try forms to be added to the rectangular box. Increase in comfort level has been tried out by adding bathroom and hobby room, making the room larger. The space has been divided into sub-spaces (see Figure 6). 1 student designed his private area as a 2 storey for different tasks.

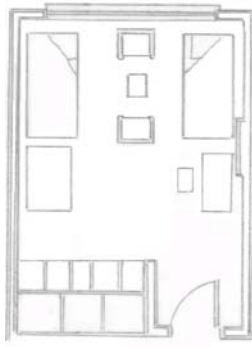


Figure 4. Buğra Uzun  
5<sup>th</sup> semester.

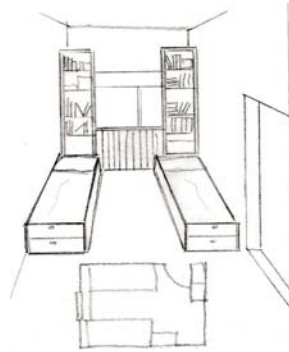


Figure 5. Selin Inceoğlu  
5<sup>th</sup> semester.

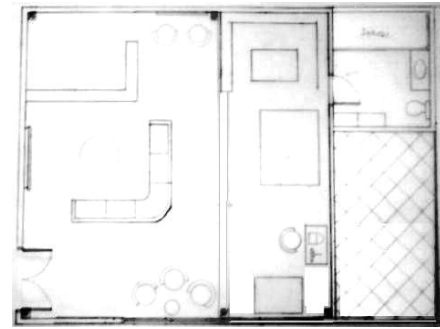


Figure 6. Buğra Uzun  
5<sup>th</sup> semester.

It is recognized that %75 of students are in search of difference by influence of rectangular prismatic space pressure and 25% of them by adding up to rectangular prism. It is also observed that students could not take an innovative attitude to describe themselves and to be different and also could not get away from their traditional rectangular form in their answers to questions.

#### 4.1.3. The evaluation of 6<sup>th</sup> semester students

**1<sup>st</sup> Interrogative evaluation:** Students performed a study coherent to technical drawing rules (see Figure 7).

**2<sup>nd</sup> Interrogative evaluation:** Solutions such as; adding extra bed or bunk have been tried in terms of room restrictions that are brought in. The design of the closets is taken into consideration concerning the size of the room.

**3<sup>rd</sup> Interrogative evaluation:** 4 students out of 7 assimilated uniform rectangular prism design, 2 students improved their design by adding small prism to main rectangular prism. One student has come up with an idea in terms of physical inspection. It is observed that the perspective design performed by rules in the other phase has been performed free hand drawing in that phase (see Figure 8-9). 5 students have increased the comfort level by effective additions such as locker room, bathroom, studying unit and a pool. It is observed that %70 students are in search for a solution in rectangular prismatic form and %30 has come up with alternative additions to the existing form. It is determined that being different, innovative and attached to traditional rectangular forms and increasing the comfort level of the area is adapted by the students.

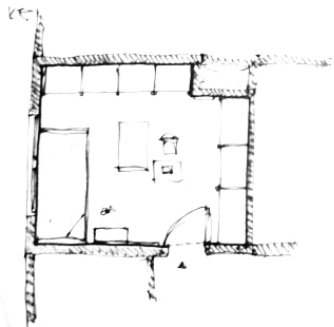


Figure 7. Ammar İbrahimgil  
5<sup>th</sup> semester.

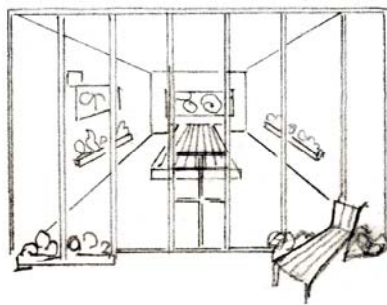


Figure 8. Esra Özpoiraz  
6<sup>th</sup> semester.

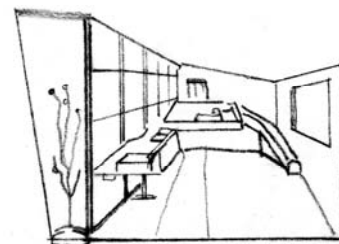


Figure 9. Ammar İbrahimgil  
5<sup>th</sup> semester.

In the 5<sup>th</sup> and 6<sup>th</sup> semesters, it is observed that students are likely to be concerned with the details related to the interior design at the plan level. Their qualification is on functional solution, beside their proposals of new functions for plan. Cross emphasized that creative design is related to product creativity, rather than process-creativity [19]. It is appeared that problem solving skills of these students are sufficient, although their final work exposed quite weak creativity. It would be better, if they could turn this skill to creative problem solving ability in product originality manner.

#### 4.1.4. The evaluation of 7<sup>th</sup> semester students

**1<sup>st</sup> Interrogative evaluation:** Students performed a study that's suitable for architectural delineation techniques in their plans and profiles. In perspective presentation, it is recognized that one student performed a free hands drawing.

**2<sup>nd</sup> Interrogative evaluation:** Adding extra bed or bunk have been tried in terms of room restrictions that are brought in, closet and student desk are taken care of together (see Figure 10-11).

**3<sup>rd</sup> Interrogative evaluation:** All of the students except one have performed free hand

drawing. 3 out of 6 students lean towards searching for new forms apart from the traditional rectangular ones (see Figure 12). One student preferred to express by drawing the section rather than perspectives and in this phase it is

observed that perspective design is performed with free hand drawings by everyone. 3 of the students came up with an idea in the frames of physical environment inspection, it is observed that the details such as selection of the materials and their application on the design are emphasized.

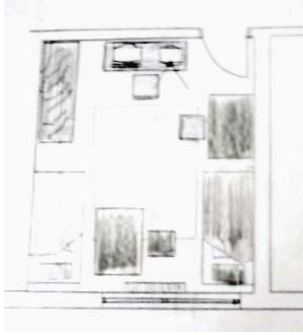


Figure 10. Açelya Barut  
7<sup>th</sup> semester.

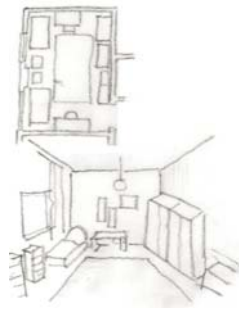


Figure 11. Sertaç Gökçek  
7<sup>th</sup> semester.

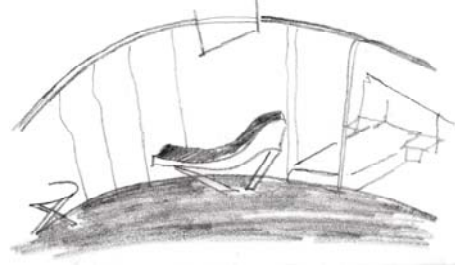


Figure 12. Sertaç Gökçek  
7<sup>th</sup> semester.

According to McCoy and Evans, the creative process is generally defined as four phases:

- (a) the accumulation of a knowledge base;
- (b) incubation of that knowledge;
- (c) recognition or vision of an innovative solution to a problem; and
- (d) the transformation of that vision into a useful, creative product [10].

It is a natural outcome that 7<sup>th</sup> semester students recognize the problem in a larger perspective, creating a common idea rather than the other semester student do, as a result of their education process Their situation in the process of architectural education correspond the phase

(a) and (b). It is also observed that 7<sup>th</sup> semester students

concerned the control of physical environment. This is a sign that students follow a deductive approach, however they give less emphasis to the details of interior design. By all means, the proposals in their design are useful and functional. These outcomes meet the phase (d). Considering the phase (c) they must encourage to be more innovative in formal expression.

## 5. CONCLUSIONS

Naturally, the students who participated to design studio, have been affected by socio-cultural accumulations and pre- college education experiences. Likewise, they ought to be getting prepared to the conditions that will have to deal with when they graduate.

Table 3. Evaluation of Groups.

Semester		4 <sup>th</sup>	5 <sup>th</sup>	6 <sup>th</sup>	7 <sup>th</sup>	Total	
Student number		8	8	7	6	29	
Stages	1 <sup>st</sup>	a. Free hand	1	1	-	-	2
		b. Technical drawing	7	5	7	5	24
		c. Combine a+b	-	2	-	1	3
	2 <sup>nd</sup>	Functionality and usefulness	8	8	6	7	29
	3 <sup>rd</sup>	Unique rectangular form	-	4	4	1	9
		Addition to rectangular form	4	2	3	2	11
		Substraction from rectangular form	-	1	-	-	1
		New formal composition	4	1	-	3	8
		Using of additional materials-equipment	4	3	3	2	12
		Freedom in functioning	3	4	5	3	15
		Sub-spaces	7	4	4	5	20
		Different stories	1	1	1	2	5
Considering surrounding environment	4	-	2	3	9		

The sketch exam tested the students' problem solving and creativity skills which are the main subject-matter in design. As a result, in addition to having small differences between groups when 4 different semester students are evaluated together, it can be asserted that 4<sup>th</sup> semester students approached the sketch exam problems in a more creative and intuitional way as formal expression; 5<sup>th</sup> and 6<sup>th</sup> semester students worked more technically and inductively adapted to the design; and 7<sup>th</sup> semester students took the problem as a whole, which is more compatible with a deductive approach.

As appeared in 2<sup>nd</sup> stage of the sketch problem examination, it is also observed that students have adequate memory capacities and skills in problem solving. Students who received a high score on the university entrance examination in math and science were more advantaged in terms of problem solving skills, approaching the problem with 'static patterns' and making a quick decision of what template should be used due to the education they earned in high school on logical or formulaic process. On the other hand, such students have never been involved in less scientific and more subtle design activities. This hold on the development of interpretation skills negatively affects the architectural education process.

The formal compositions the student used at the 3<sup>rd</sup> stage of the sketch exam indicated that they need to improve creativity. 4<sup>th</sup> semester students were seen as more creative in formal experiment than the other group students. Contrary to this, formal approach of 5<sup>th</sup> and 6<sup>th</sup> semester students to the question in this stage were the most conservative in whole group. The works of 7<sup>th</sup> semester student exposed that they made an effort to organize different effects as input to their design. Essentially, the idea during architectural education is to enable students to organize knowledge from different systems and become creative. Considering end product

originality, they must be orientated to searching new possibilities. In that regards, it is conceived that during the semester to encourage design students to make different formal experiments unlike from the ones that they perceive in their surrounding expands their design imagination.

Studying creative design is seen as problematic because there can be no guarantee that a creative 'event' will occur during a design process, and because of the difficulty of identifying a solution idea as 'creative'. However, in every design project creativity can be found—if not in the apparent form of a distinct creative event, then as the evolution of a unique solution possessing some degree of creativity [20].

Designers are expected to develop solutions that address the functional demands of their clients who have distinct needs, lifestyles, goals, and objectives to consider [21]. Considering the brand new aptitudes in architecture world, the topic that is supposed to be taken into consideration is to bring the students the creative thinking skills that would enable them to make a difference. The consumption community has demands based on identification, such as being unusual and original. This mentality in Postmodern culture has brought in demands to develop product quality and a 'different' image production based on formal peculiarity. This difference is the result of the attitude against the monotonous that is rationalized by a collective mind [22, 23, 24].

"Formal composition based on geometric structures" and "Variation on structural composition and using new materials and techniques" were accepted to be more useful exercises to improve design creativity since they are considered to be more demanding than merely trying to shove vertical and horizontal planes, spaces and thus buildings into a box. In this application, new hybrid forms could be obtained *by the deformation, addition and extraction of basic geometries*. Moreover, the students

may be guided to work with *abnormal structural systems by modeling*. In this way, it will be possible for them to obtain new structures by using altogether different structural systems and different geometric forms.

The success level of architect candidates who will undertake the task of producing objects for this environment will be affected by skills and qualities they will acquire during their education to meet these demands. Students should be encouraged to make good use of contemporary technologies, interpret structure and material in a way to positively contribute to spatial quality and, consequently, to create new formal compositions.

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