

Full Length Research Paper

Line as a means of conceptual expression in design education

Nilgün Kuloğlu

Department of Architecture, KTU Faculty of Architecture, Trabzon, 61080 Turkey. E-mail: melek@ktu.edu.tr, nkuloglu@hotmail.com. Tel: +90 462 3772679. +90 5324864003. Fax: +90 462 3775588.

Accepted 24 September, 2010

In this paper, the role of line as a means of reflecting mental processes of the designer in architecture will be discussed based on repeated research. Its significance will be underlined as an element of composition. The hypothesis of this paper is that line is a tool for expressing and developing thought in design education. Thus, in this paper the ways it is interpreted by the students will be discussed in order to posit the affects it is embedded with. Choosing examples, the use of line in the expression of concepts, the sub-concepts used in the expression of concepts, and the degree to which the expression has been supported will be dealt with and demonstrated.

Key words: Conceptual design, design education, design tools, perception, creativity.

INTRODUCTION

This article discusses the relationship between creativity and use of the line. Basic principles concerning expression of design are graphical and technical illustrations, drawings of the orthographic set, scale models and other media similar to those cited here. Besides teaching basic principles of design, an important goal of design education is to improve students' skills to perceive, interpret and communicate the world and facts. In this process it is very important that they use the means for expressing themselves in the most efficient way. The basic design course that has been taught in many schools of architecture since the Bauhaus is an important milieu to improve their expressing skills.

Lawson says, "Design is a highly complex and sophisticated skill. It is not a mystical ability given only to those with recondite powers but a skill which, for many must be learnt and practiced, rather like the playing of a sport or a musical instrument", (Lawson, 1991: 11).

Skill, ability and creativity are important components of design activity. Therefore, in pursuit of developing creativity, many researchers are working on building up of reliable theories. For example Durling focuses on links between personality traits and creativity, (Durling, 2003). Durling and his colleagues assert that:

"creativity is central to designers' thinking, though their methods of working and their attitudes toward the solving

of problems may be very different from other professionals; designers' creativity seems to be linked strongly to intuition, (Durling et al., 1996).

Design activity and creativity operate in tandem and can not be considered separately. There are various ways to improve creativity. One of them is concept development approach where concepts are deemed to trigger and improve creativity. Moore states that "drawings are thought to record not only visual impressions, but also to be a means of measuring the visual skill of the child, when it comes to the conceptual sketch, the relationship between drawing and visual thinking is thought to be even more straightforward", (Moore, 2003). Goldschmidt, who has studied on "visual design thinking", professes that conceptual sketching "is not a mere reflection of visual thinking, in fact it is visual thinking", (Goldschmidt, 1994).

"Concepts are part of our everyday life and they are used in many ways; presents our understanding of the world, governs our thoughts-communication with the world and used as metaphors or analogies in order to understand. The way we think, the way we experience, and what we do is much a matter of our conceptual understanding of the world around us. Concepts are, therefore, intellectual constructs and a form of ideational structure. According to diverse theories, they can be innate, formed from

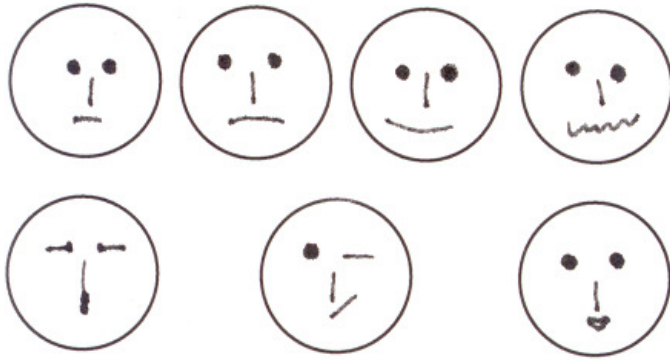


Figure 1. Human faces, (Şenyapılı, 1996).

experience, or formed from other concepts”, (Oxman, 2006, 69).

Likewise line is a tool of thinking and drawing. It is a vehicle for drawing technical illustrations; plans, sections, and façades on the one hand, and it is a tool for expressing ideas, abstract or/and concrete concepts etc., on the other. Line is an important tool especially for developing the design thinking. Tversky and her colleagues emphasize the role of lines with respect to rendering of diagrams, sketch diagrams and graphs: “Diagrams, which are derived from the lines, are often composed of schematic figures that serve as graphical primitives. In sketch maps, blobs, straight lines, curved lines, and crosses are used systematically to convey information about geographical features. In graphs, bars indicate discrete comparisons while lines indicate trends. In mechanical diagrams, arrows signify order of functional operation.

Diagrams seem especially suited to conveying a broad array of concepts and conceptual relations. They use characteristics of elements and the spatial arrays among them to convey meanings, concrete and abstract. Abstract meanings are metaphorically based on the concrete ones. Just as spatial language has been adopted to express abstractions, so space and the elements in it readily express abstractions. One reason that diagrams are useful is that they provide cognitively appealing ways of mapping elements and relations that are not inherently visual or spatial. Yet another reason that diagrams are useful is that they capitalize on the efficient methods people have for processing spatial and visual information”, (Tversky, Zacks, Lee and Heiser, 2000, 229).

Another study conducted by Tversky is about the sketches and design relationships. They argue that “cognitive science has provided two messages for designers: sketches benefit design, design benefits sketches”, (Tversky and others, 2003). While drawing and other representation techniques mainly focus on delivering architectural projects and design products in architectural language, basic design course focuses on

design elements and design principles that combine them. Thus the function of line can be expounded upon at two different levels; line as a tool for representation, and line as a tool of expression.

Line as a tool of expression

Line is one of the most important means of expression in arts and architecture. Tversky says;

“Design without drawing seems inconceivable. One view of the role of sketching in design is an iterative, cyclical, dialectic view where sketches serve to instantiate design ideas as well as to stimulate new ones”, (Tversky, 2002: 2).

In visual arts and architecture congruent with the meaning of use, line can serve different purposes. Modes of expression may differ contingent with the purpose. Throughout history, line has been a means of self-expression for the human being. Therefore the conceptual content of line must inevitably be analyzed when it is employed to convey thoughts and emotions. It is a well known fact that in pre-historic times lines were used on cave-walls and dolmens.

It is also known that abstract art was first formed in the Old Stone Age employing lines in schematic descriptions and has developed since then, (Turani, 1992). This period, which started in the pre-historic times, has turned out to be a way of self-expression in modern times. Man has created various figures and symbols (that is, hieroglyphs) using lines and the first written forms of language which were interpreted from drawings, (Lassau, 1989). From then on, line, apart from being an object supporting designing and visual arts, was deemed to be the easiest way of expressing feelings and thoughts, and describing events. For example, different types of faces could easily be described by using lines and dots (Figure 1).

Researchers concur that lines are made up of dots distanced at different intervals. Ching also argues that line can be defined with direction, position and length. Gürer claims that line is perceived as a one-dimensional element; has got a length but not depth. But for a line to be perceived, it must have some thickness, nevertheless, (Ching, 1979; Gürer, 1990; Bell, 1996). Line is used to combine visual elements with each other, to support them, to surround and intersect them, to describe and shape corners and join flat surfaces together, (Ching, 1979). Researchers categorize lines in different ways; Şenyapılı (1996) divides them into two groups; horizontal and vertical. Brett (1995) posits that lines can be grouped into four as they appear on a paper surface; horizontal, vertical, oblique and curved. Bell (1996) distinguishes between two different line character; soft-fluid lines and sharp-edged solid lines. It is possible to increase the number of such groupings. Geometric figures, such as



Figure 2. Cartoon, Ferruh Dogan, (Şenyapılı, 1996).

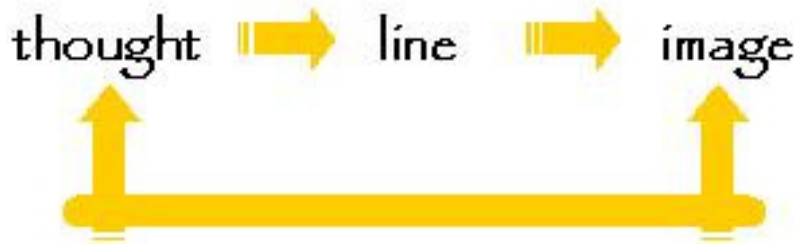


Figure 3. The process of perception and conception

planes are composed of lines. Basic geometric figures (square, circle, and triangle) and their derivatives (rectangle, polygon, trapezium, and parallelogram) are made up of lines. It can be said that all figures whether solid or organic, and all other visual images expressing one's feelings and thoughts (including scripts of languages) are made up various types and impressions of lines, (Kuloğlu, 2000). As mentioned above line is a means used in all visual arts and architecture. It may have different meanings with respect to the field in which it is used. It may serve various purposes in graphic arts while it expresses different concrete or abstract situations in the arts of cartoon and drawing (Figure 2). A machine designer, an architect or a cartographer can use lines as a technical language.

Natural and man-made surroundings can be described through lines. One can describe a building, a flower, and joy or sorrow using lines, all the same. In architecture, lines are more often used for technical descriptions as mentioned above. However, they can also be used as a means of improving creativity in architecture. The basic design course in architectural education serves this purpose. The main thesis of this article is that basic design course and especially first year design studio should improve perception, conception and the ability of

visual thinking of students of architecture, by exercising line affects in concept formulations.

Conceptual thinking

Arnheim argues that perception and conception lead as a whole to visual thinking, (Arnheim, 1974). Perception includes mental activities such as obtaining, storing and processing information while sensitive perception is defined as the action of remembering, thinking and learning. The relationship between perception and the conception when associated with line can be defined systematically, (Kuloğlu, 2000). To clarify further, thought involves perception and conception, and line is used as a means of expression to comply with the mental image, and the mental concept is created, interpreted and reproduced as a vision on paper. To sum up, the process starts with thinking and leads to concept formulation and expressing of the concept by means of line. Perception and conception are two important processes to underscore and elaborate architectural education. To improve the ability to perceive and conceive, it is necessary to improve the capacity of conceptual thinking and the other way around. Creative thinking is enhanced through

improvements in conceptual thinking. In discussing free-hand sketching A. McGown, G. Green and P. A. Rodgers state that;

“freehand sketching is prevalent in the conceptual phase of design and that the sketching activity has peaks and troughs over time, with its highest peak near the beginning of the design process”, (McGown, Green, Rodgers, 1998).

Menezes (2006) examines, “how novice and advanced design students perceive different things from conceptual sketches” in his work. He concludes that “emergence refers to new thoughts and ideas that could not be anticipated or planned before sketching” and he suggests that “the way the students describe and the way they use formal and symbolic verbal references might reflect the way they think and the way new thoughts might emerge during the interaction with sketches”. Particularly important is his statement that “it is likely that these effects could be found during the conceptual phases of design when precedent is being interpreted through sketching and new ideas are being reflected upon”, (Menezes, 2006, 584).

On the other hand, researchers such as Bilda, Gero and Purcell in 2006 have questioned whether sketching is essential for conceptual designing or not, in their “think-aloud experiments” with expert architects and their results show that there is no significant difference between sketching and not sketching based on three assessments: design outcome, cognitive activity and idea links. This case study shows that sketching is not an essential activity for expert architects in the early phases of designing. Put it differently, they have demonstrated that externalizing a design may not be the only way to design for practicing architects. This finding reinstates the relativity of novice and advanced distinction posed by Menezes’s team. In other words after years of experience dealing with visio-spatial concepts on paper may decrease. But this does not necessarily mean that developing visio-spatial concepts in mind decreases (Gehry, 1994; Himmelblau, 1993) and many other works with three dimensional rendering of pre-design concepts. To sum up, sketches and in general, externalizations are claimed to be central to design teaching for many educators and practicing architects in innumerable publications and lectures. As for concepts, “the essence of a work of architecture is an organic link between concept and form” says Holl, (1997). According to Ungers (1997); “designing with conceptual images makes it possible to move from pragmatic to creative thought, from the metric space of number to the visionary space of coherent systems”. Heylighen et al. (1999) foreground that “the practice of the design studio does play a role in the development of concept generation within architectural design. Simple as this conclusion may seem to outsiders, its consequences for hundreds of design students may not be underestimated. For it means that, rather than a

mystical ability exclusively reserved for elite of extremely talented designers, concept generation can be developed within every design student”.

In conclusion, concepts as guiding ideas contribute highly to design processes and design exercises in turn, feedback into the concept development. Practicing with concepts enhance and entail creative thinking. However exercising with concepts requires experience with controlled use of lines. The method of illustration explains how visio-conceptual thinking of students in a design course are meant to be improved through different kind of exercises. And the improvement is demonstrated based on the superiority of design outcomes in following years.

Method of Illustration

This study will introduce and explore the methods employed in one term of architectural education and discuss its limits. The logic of the approach taken into the studio is based upon the assumption that creative thinking can be improved during education. The most important point in this study is to guide students in exercising with certain design subjects during which professors could eventually help them think intuitively and express their thoughts creatively as images through lines. In this process the problems are in the form of concepts and transformed into sub-concepts and the solutions are expected as two and three dimensional drawings to express these concepts.

Theories of learning, as Gür argues, can be divided into four groups, and concept production is one of these. It can be said that students of architecture may not need to produce philosophical concepts but need to have the ability to learn perceptually and intuitively through concepts. Percepts are not projections shaped in the mind but a collection of ideas and knowledge stemming from various experiences. Affects are not feelings or senses but some internal tools of sensation which can be defined and transformed into visual qualities individually, (Gür, 2000). Concepts which students were asked to express two dimensionally have been interpreted to be the patterns of percepts and images shaped in their minds which they express with the help of lines. It is possible to claim that the character of the selected line plays a crucial role in transferring thoughts into images. Because as tools of affects, lines which go upwards represent life activity and existence and those which go downwards represent death inactivity and demise, (Şenyapılı, 1996). Of architectural elements, columns, stone monuments and towers can be viewed as vertical lines. Building rows can be considered as straight linear lines, (Ching, 1979). But the most important imperative of this study was that during these exercises students shouldn’t have been directed or conditioned. On the contrary, they should be encouraged to think creatively and they should feel free in expressing their opinions through lines, (Gür, 2000). It is because of this that the

impressions and the characters of lines (affects) had not been thought to the students beforehand.

METHODS OF THE STUDY AND STUDIO PRACTICE1

Studio practice has been observed, interpreted and evaluated according to the two different interpretations of line/use relationships, (Kuloğlu, 2000).

1. The use of line as a means of representation; the use of line for the purpose of strengthening the bond between the eye and the hand and improving the dexterity by relaying of various architectural elements and environmental observations on paper plane.

2. The use of line as a means of expressing thoughts; by way of thinking and transforming the thoughts into certain images; in other words, analyzing the concepts and the sub-concepts and representing them in drawing, where the use of line is essential. Within the scope of this essay, the use of line as a means of expressing the thought is to be elaborated.

In the first exercise students were expected to transfer five concepts identifying the “universe” on paper. The study was carried out in the studio and opened to discussion by way of participation of the students. The students were asked to cite the reasons for choosing the concept to expound the universe and to explain the sub-concepts they used in their renderings. The compositions rendered by students were assessed on the basis of Foucault's variables and in terms of appropriateness of the line character for the concept it stands for (percept/affect interrelationships). According to Foucault (1994) the relation between the signifier (lines-words) and the signified (expression-meaning) are identified through three variables. In this study the composition made up of lines were considered the signifier rather than words;

1. The basis of relation; may be natural as mirror reflection, or it may be based on social agreement among a group of people,
2. The type of relation; the relation may be based on a whole body of signs and symbols (an accumulation of wisdom) as the red cheek symbolizes the good health, or the relation adversely may be based on differences from a whole set of comprehensive symbols such as the nature of Islamic geometry bearing an obvious otherness to the grand traditions of the west,
3. The certainty of relation; the relation is defined as the faithful signs of a situation, or a phenomenon, that is, breathing as the sign of life.

RESULTS AND FINDINGS

In the scope of this study, the concepts found to be successful in identifying the universe are assessed in terms of the suitability of the line character and the degree of appropriateness for the concept. Examples from students' works are presented and discussed in terms of signified/signifier relationship and the nature of the relation are examined respectively through Foucault's definition of relation types, as mentioned in this study, Table 1.

DISCUSSIONS AND INTERPRETATIONS

The examples here were chosen from student's works.

There were approximately 60 students in the studio. All examples were evaluated according to the Foucault's variables and appropriateness of the line character as mentioned above. Presented compositions in this article were selected among the successful examples. The concepts which are used in this article are; infinity, breaking, universe and spreading, dispute, movement, concentricity, balance-contrast, life and war. The other concepts, which were chosen by the whole students about the “universe” were; love, life, life and death, melting, time, tree, music, disarrangement, freedom, water, amorphous, infinity, etc. Some concepts were repeated by different students and the most repeated concept was infinity.

The basic assumptions of this article were multifold:

1. A line is omni-potent and is a strong tool of expression,
2. Character of line transfers a concept into a communicable image.
3. If students of design are familiarized with exercises of the sort introduced here they gain a specific aptitude in extrapolating their ideas and concepts into spatial concepts and configurations.
4. Also, it is possible for designers to find a guiding idea in design problems in the following years if they gain competence in thinking through concepts.

This study clearly and inarguably demonstrates that:

1. Line avails itself to a rich variety of properties,
2. Students of architecture may think via concepts and transform them into a composition by using meaning laden lines.
3. Design students can be developed in terms of thinking through concepts.

Conclusions

The bearings of these assumptions on architectural education are that when they are raised as such they will design better projects during education and in professional life. There is no way to prove that these students will make great architects in the future but their advanced works in education are also presented in this paper to corroborate the fact that they made successful use of their acquisitions in this morphology-emphasize 3rd and 7th semester studios 2 (Table 2). This studio experience and such works are aimed to create creative individuals in the architectural education. The experimentation of this studio can be seen as a way to develop creativity. The results obtained from the following design studios confirm this hypothesis. Naturally there may be found and there are other devices to elicit creativity in architectural education but, in order to develop creativity one has to achieve freedom of thought in the first place and has to be able to reveal the ideas in mind and

Table 1. The examples of students' works

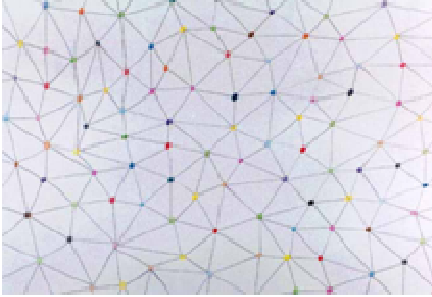
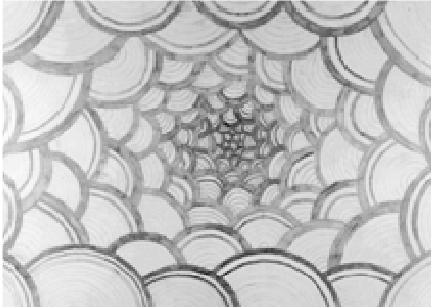
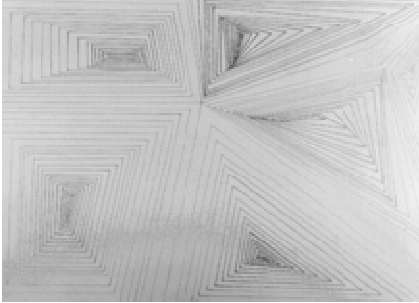
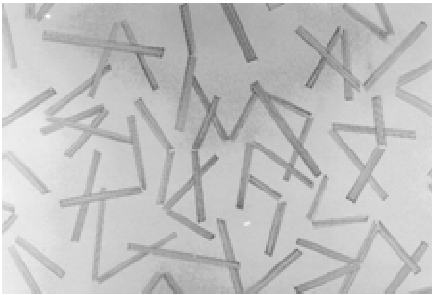
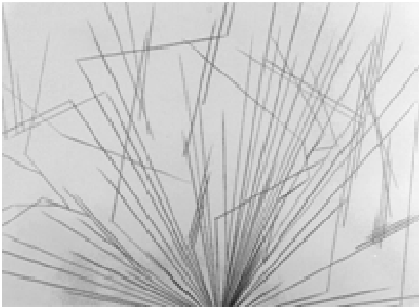
concept	composition	comment
Infinity by Adem Acar		In this example, the theme of infinity is considered as a state of incompleteness and unlimitedness. These sub-concepts have been supported by undefined borders of composition and have also been strengthened by mixed use of stable line character and points. It displays some sort of mirror reflections reminding the universe may be; involves some similarities as that of a culture; continuity of relations is taken as the faithful sign of infinity by the "author".
Infinity by Banu Öksüz		The theme of infinity is explained by the sub-concept of "depth". The expression of depth has been treated by the circular line character and emphasized by the difference in the line thickness. The basis of the relation is natural. The type of the relation, on the other hand, belongs to a cultural cognitive presupposition that "deep is that which is bottomless". Certainty derives from this rationale.
Infinity by İlhan Yazıcı		The theme of infinity is treated with the concept of "depth". It coincides with the concept of universe. Line seems to get thicker but vaguer as it recedes from the viewer. This emphasizes the idea of depth. The basis of the relation is natural and the type of relation is wisdom-based and therefore the certainty is taken for granted.
Breaking by Şükrü Kara		The concept of breaking is directly referred. The smooth and broken lines fit closely the affect of the concept. The selected objects are virtually broken lines. The basis of the relation is natural. The type of it belongs to a whole body of signs. The certainty of relation is self-testifying that the thought is correct.
universe and spreading by Umut Sevinç		In identifying the universe, the development and the spreading of humanity on the universe is expressed. The beginning of the composition symbolizes the humanity and the smooth lines symbolize the distribution of mankind on the world. The basis of relation depends on the agreement and the type and certainty to a family of scientific and, historical knowledge.

Table 1. Contd.

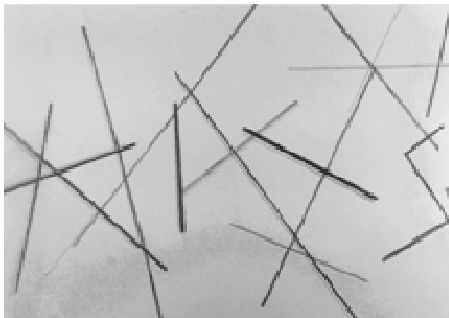
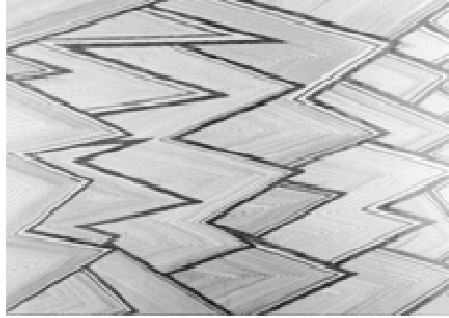
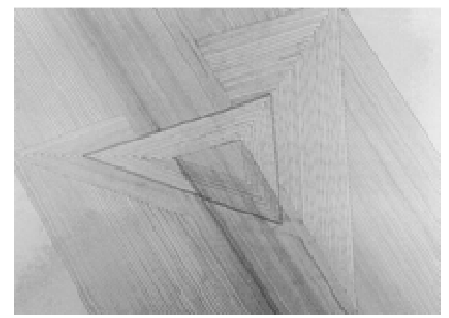
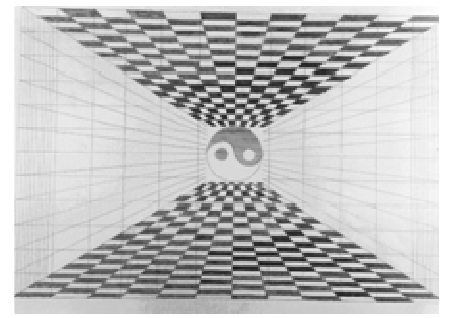
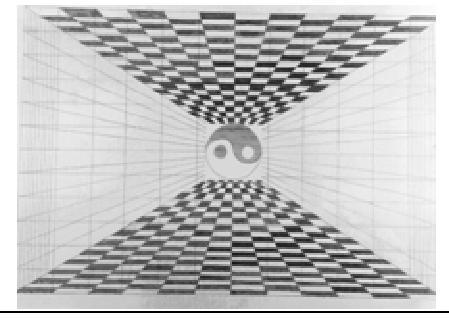
dispute		<p>The concept of dispute can be treated on different levels. It is expressed by the smooth and broken lines in this study. Thick lines stand for "dominance". The layout of the lines point to the concept directly. The basis of the relation depends on agreement. Its type is based on a whole body of learned signs and symbols and it certainly betrays the concept, the author believes.</p>
by Nurgül Küçük		
movement		<p>Movement is a concept which always exists in the universe: The line character in this study becomes meaningful with the sub-concepts such as "certainty" and "continuity". Zigzags and endlessness strengthens the concept. The basis of relation depends on social and scientific agreement. The type of relation belongs to a whole body of signs related to movement.</p>
by Banu Öksüz		
concentricity		<p>Concentricity is one of the original concepts that symbolizes universe. The composition is made up of straight lines and shapes are made up of straight lines. The origin of relation is natural. Certainty of relationship is direct and concrete.</p>
by Bilge Şahin		
balanced and contrast		<p>Balance and contrast are concepts defining the universe also. For the expression of balance a common element has been chosen. The expressing of contrast, on the other hand, is conveyed through smooth competing surfaces. The basis of the relation depends on a harmony. The type of the relation is a unique difference acquired from the common body of signs and symbols indicating harmonious difference.</p>
by Çağrı Zengin		
balanced and contrast		<p>Balance and contrast are concepts defining the universe also. For the expression of balance a common element has been chosen. The expressing of contrast, on the other hand, is conveyed through smooth competing surfaces. The basis of the relation depends on a harmony. The type of the relation is a unique difference acquired from the common body of signs and symbols indicating harmonious difference.</p>
by Çağrı Zengin		

Table 1. Contd.

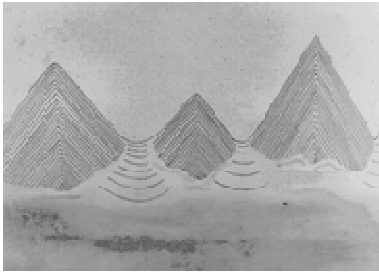

<p>life</p> <p>by Beyza Evrigen</p>		<p>Life is an organic concept which also describes the universe. The ups and downs of life, stability and movement are referred concretely. At times with zigzags and at other times with soft sinusoidal lines. The use of paper space also supports this. The basis of the relation depends on social agreement. The type of the relation is otherness which is modeled on variability and flexibility.</p>
<p>war</p> <p>by Gökhan Öker</p>		<p>In this study the destructive face of war is referred. Circular forms symbolize the effect of bombs. The expansion of the effect is represented by straight lines while the destructive influence is symbolized by zigzags. The origin of relation resides in social conventions and signs.</p>

Table 2. The examples of 3rd and 7th semester students' works.

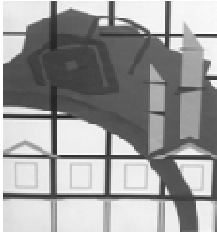
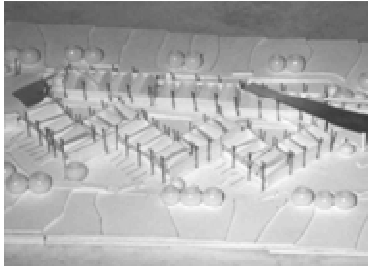
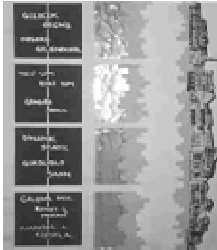
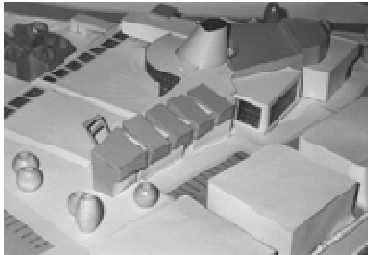
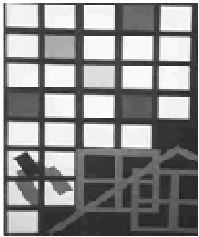

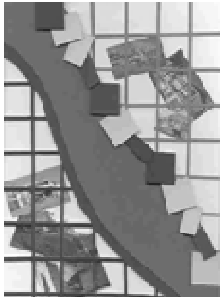

concept module	composition/final project	comment
	 <p>by Selcuk Coskuner 7th semester</p>	<p>The flow of the time from past to future versus the flow of Yesilirmak that passes through many residences. The expression of the flow from past to the future has been associated with the houses extended along the river. The theme of flow in houses has been emphasized in the way of roof formation.</p>
<p>dichotomy</p> 	 <p>by Derya Elmalı 7th semester</p>	<p>The city is composed of dichotomies. Traditional-Modern, Dynamism-Stability. Cultural center was put behind and the dichotomy theme was handed over in plan organization as was in the mass affect. The foyer area is in center and linked to corridors on the opposite. Thus, the traditional centrality idea is contrasted with distributedness.</p>
<p>intersection</p> 	 <p>by Demet Yilmaz 3rd semester</p>	<p>That the house is a corner building is a factor in dealing with intersection concept. But the meaning of this concept also included the unity of cultures and cultural continuity. In this context the house that has been formed from a simple geometric form has been taken back and covered with main gate (tac kapi: in Seljuk and Ottoman Arch.) isolation and in parts pierced walls.</p>

Table 2. Contd.

<p>Fluidity</p> 		<p>The flow of the time from past to future versus the flow of Yesilirmak that passes through many residences. The expression of the flow from past to the future has been associated with the houses extended along the river. The theme of flow in houses has been emphasized in the way of roof formation.</p>
<p>by Gulsah Atal 3rd semester</p>		

explain them by appropriate tools, (Kuloğlu, 2000).

End note

¹ The study has been realized with the KTU Department of Architecture's first semester students in Trabzon-Turkey. This studio work is conducted by; Prof. Dr. Ş. Ö. Gür, Assist. Prof. Dr. A. Asasoğlu, Assist. Prof. Dr. A. Usta, Assist. Prof. Dr. N. Kuloğlu, Dr. Y. Turcan, Dr. A. Ustaömeroğlu

² The study has been realized with the KTU Department of Architecture's 3rd and 7th semester students and the participation of the students from ITU Faculty of Architecture in Amasya-Turkey. This studio work is conducted by; Prof. Dr. H. Turgut (ITU), Assist. Prof. Dr. A. Asasoğlu (KTU), Assist. Prof. Dr. N. Kuloğlu (KTU), Instructor Dr. A. M. Öksüz (KTU), Research Assistant Ö. Cordan (KTU).

REFERENCES

- Arnheim R (1974). *Art and Visual Perception, The New Vision*. Berkeley CA: University of California Press.
- Bell S (1996). *Elements of Visual Design in the Landscape*, E&FN SPON London.
- Brett D (1995). *Drawing and Ideology of Industrialization*, Doordan P. D. (Ed.) Design History and Anthology, The MIT Press, London.
- Bilda Z, Gero JS, Purcell T (2006). 'To sketch or not to sketch? That is the question', *Design Stud.*, 27(587-613): 587, 609-610.
- Ching DKF (1979). *Architecture: Form, Space and Order*, Von Nostrand Reinhold, New York.
- Durling D (2003). 'Horse or cart? Designer creativity and personality', *Design self understanding. The aesthetic of technology*, European Academy of Design Conference, Barcelona, pp. 1-11.
- Durling D, Cross N, Johnson J (1996). 'Personality and learning preferences of students in design and design-related disciplines', Edge Ltd. and The Open University, IDATER 96 Loughborough University.
- Foucault M (1994). *Words and Things*. Kılıçbay MA (Trans.). Imge Publishing, Ankara.
- Gehry F (1994). Keynote Address, In: *Critical Architecture and Contemporary Culture*, William J. Lillyman, Marilyn F. Moriarty and David J. Neuman, eds., Oxford: Oxford U. Press, pp. 165-185.
- Goldschmidt G (1994). 'On visual design thinking: the vis kids of architecture', *Design Stud.*, 15-2: 122-240.
- Gür ŞÖ (2000). 'Mimarlıkta Temel Eğitim Dersi Uygulaması: A Practice of Basic Design Studio in Architecture', *Mimarlık: Architecture*, 293: 25-34.
- Gürer L (1990) *Temel Tasarım: Basic Design*, İTÜ Yayını, İstanbul.
- Heylighen A, Neuckermans H, Bouwen JE (1999). 'Walking on a thin line-between passive knowledge and active knowing of components and concepts in architectural design', *Design Stud.*, 20-2, 211-235, p. 233.
- Himmelblau C (1993). 'The End of Architecture', In: Peter Noever, ed., *The End of Architecture: Documents and Manifestos*, Munich: Prestel-Verlag and Vienna: The MAK-Austrian Museum of Applied Arts, pp. 17-25.
- Holl S (1997). 'The comment is taken from "Theories and Manifestoes of Contemporary Architecture"', C. Jencks and K. Kropf, *Academy Editions*, John Wiley & Sons.
- Kuloglu N (2000) 'A Practice of Basic Design Education and Experiences', *Architecture*, 293: 44-49.
- Lassau P (1989). *Graphic Thinking for Architects and Designers*, Von Nostrand Reinhold. New York.
- Lawson B (1997). *How Designers Think: The Design Process Demystified*, Architectural Press, p. 11.
- McGown A, Green G, Rodgers PA (1998). 'Visible ideas: information patterns of conceptual sketch activity', *Design Stud.*, 19-4, 431-453, p. 452.
- Menezes A (2006). 'How designers perceive sketches', *Design Studies* 27, 571-585, pp. 571-572, 583-584.
- Moore K (2003). 'Between the Lines: drawing, creativity and design', Tracey (contemporary issues in drawing), Loughborough University, Available online: View Article. ISSN 1742 2570, the full paper is published in the journal "Environments by Design" Kingston University.
- Oxman R (2006). 'Think-maps: Teaching Design Thinking in Design Education', *Design Stud.*, 25(69): 63-91.
- Şenyapılı Ö (1996). *Visual Arts and Communications*, Sanatyapım Publishing, Ankara.
- Turani A (1992). *Dünya Sanat Tarihi: World History of Art*, Remzi Kitapevi, İstanbul.
- Tversky B, Zacks J, Lee P, Heiser J (2000). 'Lines, Blobs, Crosses, and Arrows: Diagrammatic Communication with Schematic Figures', M. Anderson P, Cheng initial, Haarslev V (Eds.): *Diagrams*, 229: 221-230.
- Tversky B, Tversky B, Suwa M, Agrawala M, Heiser J, Stolte C, HanrahanP, PhanD, Klingner J, Daniel MP, Lee P, Haymaker J (2003). 'Sketches for Design and Design of Sketches', 79-86: 85, <http://www.stanford.edu/~klingner/publications/Tversky2003.pdf>
- Tversky B (2002). 'What Does Drawing Reveal about Thinking?', p. 2 http://www-psych.stanford.edu/~bt/diagrams/papers/Drawing_reveal_about_think_i.pdf
- Unger OM (1997). 'The comment is taken from "Theories and Manifestoes of Contemporary Architecture"', Jencks C, Kropf K, Academy Editions, John Wiley & Sons.