MATERIAL;
MEANS OF ARCHITECTURAL EVENT

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One of the significant notions of the contemporary era is the idea of “connectivity”. Direct perception, as a result of participation in duration, can result in a more effective connection between the designer, the built, and the user. This thesis explores common architectural material – specifically concrete block- as means of creating an event. The event is seen in two levels; first, at the level of form, where a fusion of surface and space can define a volumetric event and second in a process of making where the participation of the designer in making a piece suggests an instant connectivity with the built form. The material used in mold making was emphasized to manifest the importance of the characteristic of the material - in this case its level of viscosity - in developing forms in which events happen not just at a level of surface, but in a volumetric whole. Blurring the boundary of surface and space as well as integrating environmental phenomena in formal explorations results in an architectural event which achieves a better interaction with the user. Combining the advantages of digital fabrication (precision and limitlessness in formal design) and hand making is emphasized in this thesis.
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CHAPTER I
INTRODUCTION

One of the challenges that today’s world is facing is the growing notion of connectivity throughout the world. Architecture, like other professions, needs to respond to these new changes by creating more interactive designs which considers the user and the relationships with the environment.

How can architecture interact with users through design? Many people do not seem to think as highly of buildings as the design professions do themselves. Design involves many people in the production of buildings. There are gaps between the variety of opinions and approaches towards buildings. Many organizations make decisions about the building; at the bottom pile of these people would be “the user”. On the other hand, users will react to architectural works in various ways. To address these issues in architectural interactions with people, David Canter says that designers need to consider psychological aspects users while designing. (Terence, 1976)

Among the psychological aspects that relate users and architecture is visual perception. James Gibson (1986) introduced a new notion of perception and what there is to be perceived. His definition of perceptual systems eliminates the separation of “organs”, “senses” and the action of each sensual organ. This new notion of perceptual systems in psychology can be related to architectural elements of surface and space. This thesis explores how architecture can respond to this new notion of perceptual systems by redefining “surface” and “space” and their relationships. This redefinition can lead to effective interaction with users.

Another aspect of Gibson’s theory in relation to architecture is “what is perceived”. Gibson asserts places, attached objects, detached objects, persisting substance and events as what is to be perceived. (Gibson, 1986)

This thesis will explore how architecture creates, arranges and organizes the “perceived” to capture the attention of the observers by means of material. The study also involves how the new notion of perceptual systems eliminates the boundary between seeing and understanding.

A successful interaction is considered one which is able to capture the user’s attention and can achieve an aesthetical pleasure response. For this case, how vision and perception are related would be explored through
research by neurologist Semir Zeki. The relationships of visual perception and aesthetic perception are also considered by addressing notions of harmony and unpredictability.

Another issue that this research will address is the “means” by which architects and designers use to create stronger connections with the audience. Contemporary solutions apply more electrical devices in forms of installations rather than architectural material’s own potentials.

In short, the research is about addressing three issues: first, a stronger architectural interaction through visual perception; second, using surface patterns as context of architectural connection with the user; and third emphasizing the application of architectural material by investigating its potentials for a more influential connectivity with the designer, in the process of making and with the user, by its definition of surface and space in the resulting form.

The first chapter describes new notions of perception and scientific aesthetics. The second chapter fuses the psychological information of perception and precepted in architecture. It is an interpretation of how architecture can reflect the notion of “event” to connect with user. The thesis suggests that blurring the boundary of space and surface and considering construction as a conscious duration makes materials a means of creating perceptible events.
There are two main approaches to perception, both influential theoretical ideas of 20th century. The idea of indirect perception favored by Constructivism indicates that “…the organism engages in a sort of ‘perceptual thought’…” (Yantis, 2001, p.81) Gibson on the other hand criticizes Constructivism, mentioning that perception is an active act. (Yantis, 2001)

Recent scientific research by Semir Zeki, shows seeing is an active performance, which includes engagement of the observer in what there is to be perceived. The research designates the contribution of vision in the act of perception. (Zeki, 1999) This declaration of the notion that seeing is perception is mostly in agreement with what Gibson illustrates as Perception.

Gibson believes that perception is a continuous act, which blurs the division of past and present. He emphasizes that what we see now, the present experience, is the sensory basis of our perception of the environment and what we have seen up to now past experience is added to it. (Gibson, 1986)

Perception doesn’t become a memory. It is a progressive duration which is experienced by individuals. This experience involves the whole person. Gibson considers perceiving as a “psychosomatic” act which does not separate the mind and body of the observer. (Gibson, 1986)

In his book “Inner Vision”, Zeki mentions that Vision is an active process requiring the brain to discount the continual changes and extract from them only that which is necessary for it to categorize objects. The visual system selects from the everlasting information, compares them with its stored past visual information and thus identify and categorizes an object or a scene. “…the information… is never constant; it is instead in a continual state of flux…” (Zeki, 1999, p.5)

Zeki’s view of how visual perception occurs engages the observer completely and does not consider brain as the only aspect of the observer’s comprehension. His idea of an “observer” is similar to Gibson who believes that the observer sees the identity of objects with the events in which they participate. (Gibson, 1986)
Zeki describes how the visual system works and that it is not separated from perception; He states that objects are defined by different “cues” like motion, color, etc. the visual system integrates information from different cues. As a result an object with more than one cue has more perceptual benefits than an object with one cue. In other words, if an object has both color and is in motion, it is more perceptible than when motion is not present and the object is in a stationary state.

Cells of the visual brain can only be stimulated by visual stimuli. Each cell has a receptive field in the shape of square or rectangle. Zeki further describes the visual process; each specialized processing system of the visual brain consists of more than one station, at each signals are processed at a certain level of complexity, For example, the color pathway consists of specialized cells in V1, V2, and V4. Motion’s pathway includes specialized cells which are located in V1 and V5. The visual system selects from the information, compares them with its stored past visual information and thus identify and categorizes an object or a scene. (Zeki, 1999)

Gibson defines inputs as sensory impulses and that perceiving is the process of inputs, but information is not processed, so he rejects the cognitive science in this area. Gibson believes that the knowledge of the world does not already exists rather it develops as perception develops, it extends as the observer travels gets finer and all. (Gibson, 1986)

For Zeki, seeing and understanding are not separate because there are many visual areas in the brain, each looks at different attribute of the visual scene, such as form, color and motion. (Zeki, 1999)

Zeki mentions that functional specialization of compartments has parallel processing. Processing different attributes of a visual scene is done separately and in parallel. There is no single area to which all specialized areas are uniquely connected. (Zeki, 1999)

He has also found the interesting idea that three attributes of motion, form and color are not processed at the same time and consequently they are perceived at different times, in fact there is a temporal hierarchy in vision; color, then form and lastly motion is processed and perceived. (Zeki, 1999)

Processing systems are also perceptual systems and as a result, in the brain there is a parallel processing-perceptual system. Since perception is a conscious event, separate perceptual systems means separate
consciousnesses exist. Micro-consciousnesses generated by the activity of the different processing-perceptual systems that have to combine to give us a unified percept. (Zeki, 1999)

Zeki eliminates the separation of seeing and understanding based on the scientific evidence of many visual areas present in the brain, with specialized duty. What separates the idea of Gibson and Zeki is the visual information.

Gibson states that information is a specification of the observer’s environment. It is qualities of an object. Picking up information is not communication. Words, pictures convey information and they communicate, but information is not conveyed and exists in a sea of energy around us. He says that perceiving is the process of inputs but information is not processed, so he rejects the cognitive science in this area. Gibson believes that the knowledge of the world does not already exists rather it develops as perception develops, it extends as the observer travels gets finer. Zeki however does not separate words and images from information as Gibson mentions. The “conveying” of information in words and two dimensional images is seen as an indirect approach to perception by Gibson, but Zeki includes the conveyed information in the active process of seeing, since he is taking a scientific approach. They both however, agree on the concept of visual perception as a direct experience. (Gibson, 1986)

Another matter that the two do not agree on is storage of images and memory. Gibson says that there is no division line between memories and perceiving is a continuous act, it goes on and does not become a memory. He rejects the idea that past ceases to exist unless it is “preserved” in memory and that memory is a bridge between past and present. He emphasizes that what we see now, present experience, and is the sensory basis of our perception of the environment and what we have seen up to now past experience is added to it. (Gibson, 1986)

These disagreements can be related to Gibson’s phenomenological approach to perception, and Zeki’s scientific approach. The interesting fact however, is that they both reach the same conclusion from different points of view. A shared concept in both approaches is the idea of “motion”. Gibson includes this idea in what he defines as “event”. Gibson believes that event is a change in environment. (Gibson, 1986) Zeki involves the idea of “motion” as an individual component in visual brain. He takes motion both as an abstract and concrete aspect.

In conclusion, event can be seen as a presence of duration. Duration both involves a “change” contributing to Gibson’s definition and also involves the abstract and concrete notion of “motion” which Zeki considers.
A scientific Approach to Aesthetics

In his book Inner Vision, Semir Zeki indicates that “No theory of aesthetics that is not substantially based on the activity of the brain is likely to be complete, let alone profound” (Zeki, 1999, P.1). He further states that visual arts are expressed through the brain and they follow the rules of the brain. (Zeki, 1999) However this statement doesn’t mean that the brain functions individually in understanding visual arts. Perception is an active act in which the observer completely participates.

The scientific approach to aesthetics began with work of Wundt and Fechner who suggested a unified variety in objects brings joy in people and this unification is the fundamental principle of aesthetics. (smith, 2003)

In his research of the scientific function of the visual brain and aesthetics of visual arts, Zeki talks about the specialization of aesthetics:

Many might consider aesthetics to be a unified and singular attribute, a higher mental activity, no doubt empowered by the brain but not especially or uniquely related to any specific part of it. The notion of fractionating art and localizing aesthetics neurologically… might surprise or even shock them (Zeki, 1999, p.8)

Zeki states that the view of vision as an essentially active search for essentials has only been discovered in last twenty five years; as a result, they were not available at the time early neurologists speculated about the functioning of the visual brain. It is there for not surprising to find they have played no role in many theories of art or aesthetics. (Zeki, 1999)

Another aspect of aesthetics is introduced by Zeki, in studying the diagnosis of his patients who had visual problems, Zeki states that the pathology of aesthetics reveals its modularity. In his research, a patient who could not recognize colors, and was color blind, could not distinguish colors, yet he could still comprehend formal characteristics. And although color is intimately linked to form and for an artist “every inflection of form is accompanied by a modification of color...” (Zeki, 1999, p.82) the form vision of such a patient is not disturbed.( Zeki, 1999) The color blindness evidently had serious aesthetic consequences for him but the drawings made by the patient in which he could depict banana, tomato, leaves from memory, showed that he could realize other aspects of aesthetics which do not necessarily include color. According to Zeki:

The aesthetic quality of the works of art changes for such a patient… Impressionist art becomes meaningless to him … but portrait paintings find new meanings...the loss of the appreciation of one attribute does not necessarily entail a loss of the appreciation of all attribute(Zeki,1999, P.83-84)
Here Zeki indicates that Impressionist art and portrait drawings are in fact applying two different aspects of aesthetics which could exist individually and with the same aesthetical value. The first emphasizes color and the latter focuses on forms. Since there are independent parts in visual brain which recognize each of these attributes, the loss of one—such as color blindness—does not eliminate aesthetical appeal.

He further continues that neurologically there is not one visual aesthetic sense, but many, each one tied to the activity of a functionally specialized visual processing system. The loss of one processing system entails a loss in the capacity to appreciate the aesthetic effect produced by the attribute for which that system is specialized while aesthetic effects produced by other attributes remain intact. (Zeki, 1999)

In Echo-Objects, Barbara Maria Stafford explains this idea of Zeki:

In fact he is empowering the areas that include a processing system with more than seeing a particular attribute of visual scene. He is empowering them not only with understanding but of contributing directly to the aesthetic effects produced by the attribute for which they are specialized though without supposing that they are solely responsible for producing such effects (Stafford, 2007, 198)

Relating this concept to architecture, specialization of aesthetics indicates that each aspect of aesthetic can be applied in architectural designs individually and yet has the same aesthetical value. However, Zeki mentions later that more visual attributes result in a more effective perception. In other words, a stronger quality of aesthetics needs involvement of several features such as color and form, but each aesthetical aspect is still valid and parallel.

Zeki believes that there should be a functional specialization in aesthetics which:

Should not come as a surprise to anyone… It should instead be somehow obvious from the language that we use, even if the relationship with the functional organization of the brain has not been made before. We speak of aesthetics of color, or of the aesthetics of portrait painting, or of the aesthetics of landscape art, and so one, implying that there are separate categories of aesthetics (Zeki, 1999, p.88)

He does not reject a hierarchy in aesthetics, but believes that individual aesthetics are legitimate.

This is not to say that there isn’t a higher sense of aesthetics to which the individual aesthetics contribute, but how they might contribute to that neurologically imaginary higher aesthetics is not known and indeed a question has never been addressed before” (Zeki, 1999, p.88)

Relating this argument to what previously was said about events and the cooperation of motion and audience interaction, the presence of the idea of movement in events to create aesthetic appeal can be identified in two characteristics; unpredictability and harmony. The fist relates to how event as a change takes place to draw the observer’s attention, and the latter refers to motional characteristic present in events with the same results.
Aesthetic features

Unpredictability

According to psychologist Grace De Laguna, what we understand is shaped by how we are rewarded in seeing. (Lym, 1980) Consequently, architectural events need to “reward” the participant. This reward lies in the arrangement of the events and sometimes by the nature of the event. For instance, “acute spaces” (Lym, 1980) contain unique events. In the arrangement of events some of the strategies with more effective results are the ones that are at the same time aesthetic qualities. These include unpredictability and harmony.

In his article defining ugliness, Charles Harker shows through an example of a Japanese tea house master, how the notion of unpredictability and surprise plays an important role in capturing the user’s attention and creating an aesthetical response. He shows how architecture can cause aesthetic response in the observer by eventually revealing elements of design through a series of events which are designed with perfection. The difference of perfection and beauty is that perfection is observable and there are certain scales that can identify perfection, but beauty is relative, so experiencing a beautiful object can be relative. (Harker)

The relativity of beauty can also be resulted from Zeki’s scientific research on the function of visual brain. The specialization of aesthetics, in fact relates to the notion of beauty’s relativity in that it considers individual aspects of aesthetic characteristics with equivalent values.

When something is beautiful, it contains perfection. In other words, the event would contain factors of perfection, some of which are proportion and rhythm. In the example of the tea house, the observed beauty of the tea house and its perfect craft were the two elements which were able to create the strong communication with the observers and users of architectural design.

The idea of unpredictability can be incorporated in a broader concept of “harmony”. This idea was suggested by Peter Smith who believes that aesthetic reward is achieved after a degree of effort. In other words, he suggests that a beauty is not immediately seen in a pattern and is not predictable. (Smith, 2003)
Harmony

Peter F. Smith (2003) sees the concept of harmony as "the heart of the idea of beauty" (Smith, 2003) and that "it originates in music" (Smith, 2003). In his article "The Third Skin", Charles Harker also talks about one of the classic metaphoric models which is "architecture is frozen music" (Harker). He states that this metaphoric model generates questions having to do with qualities of architectural form and space. "Is it heavy or somber? Are the rhythms quick, allegro or slow and pensive...?" (Harker)

The analogy between architecture and music was not new. Goethe and Schelling for example were amongst many writers who had previously drawn the same parallel. However, Peter Smith mentions that the concept of harmony was wrongly comprehended previously. "...It seems that there has been a misunderstanding in using the notion of harmony..." (Smith, 2003). According to Peter Smith, for decades after the last world war, the planners have used the word to mean "conformity or even uniformity" (Smith, 2003), the result of which is the creation of "tedious Portland stone-faced reconstructed streets in Plymouth or Sheffield and the clinical austerity of early Milton Keynes". According to him, the definition of harmony goes back to Greek’s belief that "the essence of beauty lies in the clash between complexity and order." He states that when the mind recognizes a pattern out of randomness, we receive "aesthetic pleasure". (Smith, 2003)

He relates the meaning of harmony to musical terms, connects harmony to "consonance and dissonance". (Smith, 2003) He mentions that in a harmonious music, "order succeeds in overweighing complexity" (Smith, 2003). His definition of harmony is in other words, finding order in a complex set.

This idea goes back to medieval scholar Boethius who defined harmony as "a unified concordance of sounds dissimilar in themselves." (Smith, 2003) According to Kevin Nute, Gottfried Semper, sees the ancient forms with a woven nature, in which culture is woven as poetry (Nute, 2000). Thus for Semper, as for Sullivan and Wright architecture was closer to dance and music than to painting and sculpture. (Nute, 2000)

In the architectural sphere, Frank Lloyd Wright was among the architects that saw architecture as music. He justified this analogy on precisely the same grounds as Fenollosa did- that music and architecture were both
essentially non-representational arts- and that beyond their purely formal idea they ought not to be experienced “to tell a story”. For Fenollosa, then, after Kant and Hegel, the art idea was essentially a formal one, and to this effect he declared that the idea in art does not visualize subjects but rather, their expressions. (Nute, 2000)

This formalist approach was taken by Aesthetic Movement. Generally, Wright expressed a similar view to Fenollosa’s when he declared “ideas exist for us by virtue alone of form the form can never be detached from the idea…“ (Nute, 2000)

Relating this definition of harmony to Zeki’s quest of how visual brain functions it could be noted that since the task of visual brain is extracting essentials from a state of flux, it is in fact searching for harmony in the environment. This statement can be taken further, by saying that the visual brain is searching for harmonies events in the surroundings.

Peter Smith further explains the event in which harmony is produced in music as “the vibrato effect”. The uncertainty as a result of too much complexity, introduced by the element of “dissonance” repels the mind (Smith, 2003). This “uncertainty” which mind is repelling according to Smith, is explained in other terms by Zeki in how the brain functions during a visual perception. He states that the brain seeks for the “essentials”; consequently visual perception is an act during which the brain selects the constants from a state of flux, or uncertainty of the environment that surrounds us. (Zeki, 1999)

Referring to aesthetical aspects of music, Smith defines ugliness as music with no tonality, where randomness is created with no chance of perception. (Smith, 2003)

In short appealing events to the observer, needs to be harmonious, which means they should avoid uncertainty and mere complexity. What mind rejects, becomes ugly.

He also rejects “a strict symmetrical pattern” (Smith, 2003) which would also fail to create an aesthetical response since it lacks the critical minimum of unpredictability or complexity to be solved.

In an experiment which was carried out with his students in the studio class, Professor Harker attempted to define beauty by describing what ugliness was. Students were to photograph the ugliest building they could find after careful exploration; the result of the experiment was that there were various judgments about what qualities would make a building ugly. However, in his example of tea house, Harker refers to the element of “unpredictability” as a
quality that can be found in beauty. “The view” which was the aesthetical element in the tea house design, eventually revealed, through a series of unpredictable events created by the architect.

Sliding back screen after screen until finally the three walls facing outward toward the sea were completely open. The view was absolutely stunning (Harker).

In the third skin, Charles Harker introduces two experimental projects that address these two notions (unpredictability and harmony) as well as how perception and education are related. He exemplifies two projects which explore the relation of education and perception in a series of events created through architectural design.

In the first project “Earth House”, the users where involved in the process of construction by sharing their opinions about the project. The engagement of people during the process of construction can be considered an event through which an architectural work evolves.

The characteristics of this house indicated that “education alters the experience through understanding”. In this house the forms are derived from non-cultural references- eliminating the presence of memory of individuals-, which were unfamiliar for observers, but were understood by them when explained, in other words the perception occurred by education.

Forms were to express in an organic way, the nature of the materials and the building processes that derived from the materials (Harker).

As a conclusion in relation to Zeki’s findings is that since each cell in the visual brain has a receptive field which is square or rectangular, the pure Platonic forms are easier for perception and organic forms inspired by organic forms, require education.

In his second example, “Bloom House”, Harker shows how memorial images can eliminate the need for education for perception. In other words, if the user can relate visual elements to past experience, he does not need education for perception. Referring to Gibson’s idea of past experience and memory, the example of Bloom House can lead us to a new conclusion.

The conclusion from Gibson’s concept of developing perception is, since the concepts applied in the Bloom House are based on a developing perception, understanding the forms do not require education. In other words, if architectural events are shaped in accordance to developing perception, they are understood without instructors.
Interpreting from research on scientific aesthetics, as well as considering educational factor, engaging all users in duration with no need of education, needs simplicity of forms and involvement of natural phenomena which have strong images in any observer's memory. Next Chapter relates the following conclusions to architectural design and construction;

- Perception is the same as seeing. It is also a direct experience, in which body and brain have the same participation. In other words, body and brain are not separated in a direct experience.

- An event, as what there is to be perceived, is a presence of duration which contains change and an abstract or concrete motion

- Engaging natural phenomena refers to a non-educational perception, as well as a strong contribution to observer’s memory.
CHAPTER III
ELEMENTS OF ARCHITECTURAL INTERACTION

Architectural Event

Whether architecture interacts through space or surface, there is one similar factor present in both aspects of architectural design that results in a successful connectivity between architecture and its audience. This factor is introducing a three dimensionality in which the user can contribute.

By observing designs which strongly communicate to the user, we can see a masterful application of a notion Gibson names “event” from a psychological point of view. Interpreting of theoretical references discussed in the previous chapter, an event, as what is to be perceived, can be considered a presence of duration which contains change and an abstract or concrete motion.

We can extend this notion to architecture by saying that architectural designs, through their design, create events, or in other words they reveal a “change” taking place in the environment. Florentine Sack describes “change” in the book Open House as follows:

In far-eastern philosophy change is the only constant element in nature. We experience this in our own inescapable life process and in our environment. If architecture is flexibly designed and creates a relationship to the changes of nature in its structure, it can make a transcendent experience possible for us (Sack, 2006, p.74)

How can the idea of event be applied to result in successful architecture? Direct experience of the event by the participant can be one of the answers. This means the participant engages entirely in the event by mind and body. When considering the participant as “extension of the environment” (Gibson, 1986), there is no border between mind and body. Zeki relates the idea of direct experience to visual perception and mentions that visual perception is an active performance. In other words, observer is not a passive participator, but who engages in the event. Zeki, 1999)

In short, successful architectural interactions, engage the users in a process of change in the built environment. This engagement both involves the designer and the user. For the user, this involvement is by successfully creating an architectural event, in which environmental features are combined with form, and consider the
built form with a combination of volumetric characteristics in mind. For the designer, this calls for bringing designer closer to maker. By this, the designer participates in duration of making, which results in a direct experience. Considering the place of designer in the duration of making, introduces different levels of perception. When the designer is the maker, it is a direct connection. This was mostly how projects were carried out in the past. Currently, with the new manufacturing processes and digital fabrication approaches, the machine intervenes. Consequently, the level of intervention in design process, defines the level of connectivity of architect to what is built. The more the architect is involved in the process of making, the more interaction is achieved with future users.

The key characteristic of an event forming its connectivity is “motion”. The effectiveness of the presence of motion in an event is scientifically proved by Zeki. He has found during his research of visual brain function that when the element of motion is present in visual attributes of an event, the event can create stronger connections with the audience by drawing their attention. The concept of motion is present in “change”. Consequently, it does not necessarily refer to physical motion. In fact, an event is a movement from one state to another.

Seeing architecture as creating events, the question is how is material, as means of creating an event, can be considered in architectural design and construction? The second query is how surface and space can create an event?

In the following sections, architectural material will be seen as tools of creating an event. it could also be an event by itself. Further, it will be shown how surface/ space relations are effective in the occurrence of an architectural event.

Material

This section shows how material has been applied to create an architectural event. Depending on quality, properties, and the method of its application in construction, architectural material can be seen as a means to create an event. Materials such as glass are able to define new boundaries in surface and space relations, because of their transparency. In some cases, for instance, concrete, the material can be an event in itself, since their becoming, is duration in which a designer participates.
Historically, economic, cultural and political concerns, determined the use of specific materials. According to Christian Schittich (2001), functional and commercial demands after the industrial revolution resulted in more openness in city facades. Since the traditional massive external walls proved to be uneconomical, the most common material used in facades was glass. Consequently Architects were occupied with the notion of transparency and were designing the “skin” to mainly achieve this notion. For this, they majorly experimented with glass. (Schittich, 2001)

With the increasing focus on the surface, the nature of the materials becomes the central focus of the architectural inquiry: material as such emerges as a concept. The issue is not only the truthfulness that Modernism dictated, but also the desired appearance of material, aesthetic and tactile qualities, the effect of color and texture (Schittich, 2001, p.18)

In contemporary era, as society is increasingly characterized by its adaptability to new lifestyles and technologies, architecture must respond to new demands for effective interaction. Schittich mentions that in a time of permanent sensory overload through images and media, the architect has to create something new, or even spectacular to draw attention (Schittich, 2001, p.19)

The computer has changed our aesthetic perception and our design options. New manufacturing processes and techniques for construction address surface treatments as well as ways of production of the material. Some materials like concrete masonry have applied these new technologies in surface treatments’ which neglect the volumetric quality of surface. The significant developments in surface treatments can be seen in the context of glass coatings, screen printing, liquid crystal films or holographic elements which open up limitless possibilities of transmitting information or simple decoration.

Traditional building materials such as stone, brick and wood are rediscovered and applied in new contexts. Industrial building products such as plywood, fiber cement, plastic panels, expanded metal mesh are more considered in representational and public building skins and are as Schittich puts it “moving to limelight of visual perception.”(Schittich, 2001, P.22)

Concrete has also been emphasized for surface treatments; most recently concrete is featured in the full range of its visual potentials; tinted, manipulated with special additives, with channeled granulated or elaborately polished surface finishes.
Some new experiments have resulted in exploring the volumetric qualities of concrete surfaces. For example, Literacon which is a translucent concrete, has brought new opportunities of concrete surface for interacting with light and creating new architectural events. This interaction takes concrete surface beyond texture and color potentials.

Even when the material is the main concept behind a design, the idea of surface without volumetric characteristics leads architects to apply new developments only as treatments: However the material use isn’t always successfully integrated into the overall concept. Too often, what results is mere decoration of skins that are separated from the building (Schittich, 2001, P.22)

Material surface and volumetric quality have been treated by architects in different ways. The following examples include material applications that formulate events.

**Tadao Ando**

Ando sees materials with their individual characteristics. He applies them in architectural works with revealing their own nature, without using other additives to modify the material. However, he, himself, mentions that he sees material as a means of creating space, rather than emphasizing its nature. He attends spatial potentials of materials rather than their surface qualities. Here, material becomes secondary to the event of architectural space, which is a present duration and the architectural event. In other words, Ando applies material to reveal a presence that does not exist necessarily with the material, but the material helps in revealing it. This approach manifests material with the idea of surface as a two dimensional skin, and seeing materials as merely offering surface possibilities. He uses materials such as untreated wood, or raw fair-faced concrete. Schittich indicates that Ando is less interested in expressing the nature of material; instead he applies the materials to create architectural space. He mostly experiments with formal potential of surfaces rather than two dimensional treatments:

Many of his buildings feature surfaces that are not entirely plane or level, but slightly curved or undulating within the individual formwork panels which produces a sophisticated liveliness in the surfaces through the play of light and shadow on these subtle gradations (Schittich, 2001, P.18)
Concrete surfaces, manifest a process of production. True drill holes in the pattern of formwork panels reveal traces of how they had become.

_Eero Saarinen_

Saarinen is mostly interested in non-volumetric possibilities of surface of materials. He attempted to create architectural interaction with people through formal potentials. Lym writes that Saarinen wanted to express the character of his clients through formal devices. (Lym, 1980)

For the John Deere Company Headquarters building in Moline, Illinois, Saarinen wanted a rugged steel building in character with the farm machinery made by Deere so his office pioneered in the use of an exposed rust-protected brown structure steel. Saarinen commented

Farm machinery is not slick, shiny metal but forged iron and steel in big, forceful, functional shapes the proper character for its headquarters’ architecture should likewise not be a slick, precise, glittering glass and spindly metal building but a building which is bold and direct, using metal in a strong basic way (Lym, 1980)

Lym believes that Saarinen’s designs did not penetrate into the nature of his client-users;
He designed for the largely tangential, surface characteristics of those users. And so he wanted an exposed steel, forceful office building for the maker of large iron farm equipment (Lym, 1980)

_Alvar Aalto_

What Alvar Alto manifests as “events” in his architecture are the process of deterioration and weathering as visual experience. The event here happens at the level of material also. Through these events, his architecture is integrated with the surroundings. The materials he used in “Villa Maria” are chosen to make their aging process easily understood. Alto also manifests the event of human occupation by whitewashing the wall, oiling the wood and weeding the garden. These events show the existence of human beings in the house’s life process.
Peter Zumthor

Zumthor is one the architects who mostly focuses on materials as the major theme. He uses them to reveal their true nature in a poetic way. Material in his work becomes the event as well as creating an event. Schittich believes that Zumthor’s buildings derive their impressive strength from the deliberate use of few, untreated materials: stone, timber or concrete. Unlike Ando, he aims to bare the “true nature of these materials, beyond cultural connotations” and allows “materials to sing and glow in architecture”. This “singing and glowing” is in fact a presence of duration or the event. (Schittich, 2001, P.19)

Considering the spatial and surface potentials of materials, Zumthor tends to integrate these two aspects in his projects. For example in Kunsthuis in Bregenz, by “wrapping” glass around a monolithic concrete core, he manifests the glass surface with spatial capabilities. Visual appeal is created by aesthetical themes such contradiction by using two contrast materials of glass and concrete. Schittich describes this project as follows:

The nature and contrast of two different materials- concrete and glass- becomes an impressive theme in Peter Zumthor’s Kunsthuis in Bregenz. The monolithic core, where poured concrete on walls and floors is polished without coating and hence powerfully present in its materiality, is wrapped in a scaly cloak or etched glass. This wrap is structurally independent of the building and assumes all essential functions of the external skin-from weather protection to daylight regulation (Schittich, 2001, P.19)

Although the border of volume and surface is fading, the above example manifests that in contemporary architecture glass continues to be one of the major materials as themes of the building skin. Consequently, glass is the main material used in experiments that rely on the contemporary idea of translucent/transparent capabilities. This can be achieved by overlapping glass louvers or perforated metal sheet in front of glass, by printing, etching or coating the glass surfaces. All of these options and designs transform glass in to a building material that seems more suited than any other to represent the complexity of modern society. Since the idea of transparency is the closest notion to a creation of duration in form by blurring the boundary of surface and space, glass can be seen as the most common material to create an architectural event.
However, recently there have been attempts to use concrete for the concept of transparency. A firm has created concrete blocks out of Litracon, which introduce new approaches in treating concrete as an architectural material. Litracon’s translucent characteristics manifest unique potentials for creating architectural events through integration with environmental features like light.

In conclusion, the use of material as means of creating an architectural event, is normally manifested in glass. This is related to the transparent, translucent quality of the material of glass, which blurs the boundary of surface and space, creating duration in form.

Although concrete is explored to relate to the idea of transparency, it can also be seen as a process as Adrian Forthy suggests. In this case material becomes an event itself, since it goes through a process of becoming by the designer.

Form

Space

Architectural interaction with people is commonly through spatial consideration. As Louis Kahn says “architecture is thoughtful making of space”. Glenn Lym translates these interactions as our “romance with space” (Lym, 1980) which happens in everyday life. Architecture is thinking spatially and designing space. The most significant characteristic of space is that it contains duration and holds everyday life happenings or events. What distinguishes space from a surface is its quality to contain more dimensions than two and enabling the observer to engage in events occurring in more than a two dimensional world. Surface on the other hand has mostly been considered as a medium which has limited dimensions of two or less.

To see how architectural space can be interpreted in relation of the idea of an event, definitions of three types of space, with different qualities by Glenn Lym was studied.

The following pages are a summary of how these types of spaces are related to creating an event and their relation to perception.
Glenn Lym defines three types of space in his book; a psychology of building: neutral space, acute space and chronic space. Below is a description of each space and its characteristics according to Lym.

In a neutral space, life and its physical environment are separated. In neutral space we consider it best that the environment not impinge on life. We feel that environment have little to do with the real substances of our lives (Lym, 1980, P.2)

The separation between life and physical environment can be seen as excluding events from their contexts. Such events can occur, but they would lose their connectivity. They would be single expressions or results of some causes that are not able to interact with the environment. Consequently, connective events are part of their contexts.

Referring to what Gibson suggests as observers being an extension of their environments, the separation considered in neutral space, makes it unable as a medium of interaction. Lym explains this idea by introducing a second type of space in which spatial interactions can occur:

But spatial interactions which reveals itself in “acute, vivid, albeit brief interludes” proves that we do not live in a neutral space, rather “here our lives have a spatial feel. The boundaries between us and our spatial context dissolve (Lym, 1980, P.2)

According to Gibson, motion is one of the characteristics that can be present in an event although he states that the motion of a detached object is not the prototype of an event that we have been led to think it was (Gibson, 1986). Clearly Gibson is talking about physical movement; however the idea of motion in its broad sense is present in any kind of duration. In other words, any duration includes some type of motion. Every motion includes some kind of change.

Lym states that an acute space also includes the element of movement. This suggests that Ideal interaction with space takes place when the element of motion is present. He describes a student’s experience of “a union of himself and space” by means of the element of movement:

“I was impressed by the feeling of unlimited movement. The horizon seemed very distant, as did the ground below... I also experienced a sensation of infallibility- complete control without possible error in movement.” (Lym, 1980, P.2)
Other characteristics of acute space are its limited duration and aesthetical appeal. In other words, events happening in acute space are short, but stunning:

These acute space encounters have a framed quality to them. They have finite duration. We know while in them that we are not in ordinary, neutral space. This quality stems partly from the vividness of the acute space. We see spatial details clearly and freshly, also we see those details within the overall order of the moment (Lym, 1980, P.3)

According to Lynn, perceiving acute space is unique and rare. Each person experiences this space individually. This suggests that events in such a space are not perceived similarly by all observers. The context in which these events take place is substantially different from a common context, which enables the events to catch the attention of people, and create a memorable experience:

“Acute space is invisible. It is experienced by its beholders. It cannot necessarily be seen by others looking at the same physical environment” (Lym, 1980, P.5)

The individuality of perception is also brought up by Florentine Sack in Open House. The author mentions that comparing architectural experiences is limited since spatial perception is a unique experience. In experiencing architecture, experiences cannot be compared since; people react differently to each element of architecture. (Sack, 2006, p.74)

Our leanings, through culture or education significantly influence our perception of space. As Lym explains later, cultural origins influence ideas of acute and neutral space. He notes that in ancient times, acute space was a sacred context in which the environment and one’s actions were unified. (Lym, 1980)

This attitude that we are fundamentally different from cultures in which space and life merge in the course of everyday life has been given its definitive statement by Mircea Eliade Western man and woman live by and large in neutral space…..here the space is homogenous it is mapped and delineated yet all parts are considered qualitatively alike, for archaic man and woman space is not homogenous…some parts are sacred…in which the world is alive and may invade and live through us…Eliade pointed out the alienation of modern man and woman from the experience of sacred space (Lym, 1980, P.7)

Lym rejects the separation of spatial environment and daily activities, however, it is not acute space that we spend most of our lives in, rather it is chronic space. There is no division between space and action here, however, unlike acute space which is rare and unique, it is common and ordinary.

Relating his statements in terms of events, his comments put forward that the quality of events in chronic space is ordinary and common,
The fact remains that even in our daily lives, we are not separated or detached from our spatial environments... we merge our daily lives with space. Because we are looking at our own culture rather than an interesting foreign culture, we cannot see how understanding of everyday life is an understanding of everyday space. We cannot see that on a daily basis we spend a lot of time in chronic space (Lym, 1980, P.8)

Lym further explains what a chronic space is:

Chronic space is not an extraordinary space in the way that acute space is. Chronic space is the ordinary space of ordinary moments. One way to observe chronic space is to examine how we are annoyed or dissatisfied with aspects of our daily environment (Lym, 1980, P.8)

Lym also talks about the differences of acute and chronic space:

In both chronic space and acute space, the issues are fused to space. The experience of space becomes an experience of the issues in one’s life... both spaces are invisible to anyone other than the beholder. However, unlike acute space, chronic space has an unframed quality it recurs over and over. It does not have an explicit, finite duration chronic space does not seem especially vivid or dramatic to us we slip back and forth between it and the neutral space without being aware of any shift in the quality our space experience. Chronic space feels normal. It takes careful reflection, observation and outside help before we can see that chronic space is substantially different from neutral space (Lym, 1980, P.9)

Lym’s ideas about types of space, suggests how a system of events can be arranged through architectural designing for creating a variety of interactions with people. Seeing space with acute, or chronic qualities and not neutral characteristics, results in establishing stronger connectivity with architectural audience. Education and culture influence connectivity indirectly by defining how we see space.

The events in our lives happen in a spatial context; consequently, the brain comprehends those events spatially. Gibson believes that perception is identified by action and that to perceive the environment is also to perceive oneself moving in or through it...In other words he believes that perception is direct and needs the participation of the person in the event. “The observer sees the continuing identity of things along with the events in which they participate” (Lym, 1980, P.9)

This simply means that we are part of the events which have a spatial context. We perceive the events spatially. Visual perception is therefore spatial and since it involves the person it is also a conscious act. According to Gibson perception is not merely an act of the mind or body, but an act of a living thing perception is continuous and need a co perceiving of self. Gibson suggests that perception is a conscious act. Zeki discusses this consciousness of perception in relation to visual stimuli and suggests that vision and perception are in fact the same, indicating that seeing is a conscious act as well. There for, seeing involves engaging of the observer not only with his or her mind, but as a whole. Zeki also agrees with this idea and involves consciousness in the organization of visual brain:

“A vision is consisted of many micro-conscious events each tied to the activity of a given station in the processing system” (Stafford, 2007 P.147)
He rejects the ideas of Kant about the separation of seeing and understanding and how the mind functions visually.

In his ponderous way, Kant had put forward the view that the mind could be divided into two Faculties, the passive one of Sensibility, concerned with the collection of raw sense data, and the active one of Understanding, which made sense of the raw data (Zeki, 1999)

The integration of seeing and perception is brought up by Lym from the architectural realm. He addresses how perception of our surrounding- "spatial experience"- shapes the visions of designing the built environment. Another notion his emphasis is the presence of education in seeing the surrounding:

Space experience is the basis by which we evolve visions of how physical environment must be built We are trained to see space in subtle ways… psychologists have studied how we are trained by our everyday activities to see neutral space (Lym, 1980)

In fact Lym is suggesting that ordinary events teach us to precept space as a neutral space. The process of how common events guide us to a neutral comprehension of space is further explained by Lym.

In the 1920’s psychologist Grace de Laguna argued that what we see is shaped by how we are rewarded in seeing. In her analysis, an infant learns to discriminate the orchestration of open and closed doors, hallway paths, and cupboard locations as they relate to reward- cookies in a jar, for instance. These are secondary objects that the child learns in the process of obtaining rewarding “primary objects” the learning of secondary objects constitutes learning neutral space (Lym, 1980, P.16)

Beside ordinary events, he holds the context of events in a Western environment responsible for seeing space as neutral. He emphasizes the importance of the role of context of events in educating our perception.

Zeki explains the neutral perception of space from a scientific approach in relation to psychology. He mentions how art has reacted to this neutrality He says in Inner Vision that:

“The canonical view of an object is the one that we are best acquainted with, because we see it more commonly…But Cubism aimed to eliminate the point of view” ( Zeki, 1999)

Association between education and perception is put from neurological point of view by Zeki (1999) who points out that the way reality looks depends on its training of disconnected aspects of the world. However, unlike Gibson who suggests that perception is subject to maturation and learning, and that there is no border between past and present, Zeki’s implication of “neural Platonism” involves a prior image in mind shaped from our past experiences:

In a sort of neural Platonism, what we see is determined by prior nature of our internal representations, by our previous neural connections and perceptions from the fleeting sensations of transient events in the environment the brain-relying on personal and ancestral past experiences goes on to construct a viewer-center representation (Stafford,2007,167)
In his comparison between Impressionism and Cubism, he mentions that Impressionists did not go beyond the information that was available at a given instant—painting, but Cubism’s mind was not content with merely the visual data, it rather preferred to “penetrate to the essence of an object by representing it not as we saw it in a given day” a given instance’ but the way it was found finally constituted in memory" (Zeki, 1999)

What these two intellectuals see differently, is the relation of memory and perception. Gibson believes that a memory is in fact a process, a duration, which has not come to an end, and it cannot be referred to because it is not something stored as a past experience, but that a memory is a developing process which extends constantly because of new experiences. But Zeki mentions ‘prior images” stored in memory from past experiences, which can be reminded and referred to. The idea of memory influences the perceptual concept that each scholar presents. On the other hand, the difference between Gibson and Zeki’s attitude is the idea of how visual information is picked up. Gibson says that information is a specification of the observer’s environment and that it is a quality of an object. According to him picking up information is not communication, because information in the environment is not conveyed. It exists in a “sea of energy around us”. He suggests that words and pictures are means of communication since they convey “frozen optical information” according to him knowledge of the world does not already exists it rather develops as perception develops, extends as one travels and in other words it “matures”.

Zeki on the other hand points out that the brain can only have a Platonic ideal of a form that it has actually seen. If it goes through some “pathological condition”, it will not be able to recognize or combine many forms into one. This pre existing ideal is thus the stored visual record of a brain that has been exposed to many forms which it then extracts abstracts “what pre-exists within us” However he doesn’t suggest that brain works independently in the act of perception, it integrates with the events, observers and the environment.

Another factor influencing the perception is the role of other observers in what is declared by Lym as social interactions. Lym argues that the social events we engage in, influences our spatial perception. These events are also instructors of our comprehensions.

“Moment to moment we engage in social situations shaped by subliminal rules. In learning these rules we learn to experience space socially” (Lym, 1980, p.18)

He also connects the social events with past experiences:

We are trained to associate particular social nuances with particular impressions of space in childhood, our homes and schools subtly train us to distinguish places in which our activities are well structured versus improvisational.
Familiar and more structured social situations are likely to occur around a dining table or up front in a classroom. Less structured situations are likely in the home entry or in the school stairways (Lym, 1980, p.18)

According to Lym there is a variety of training in shaping the acute space. He further explains psychologically how our movements are controlled by the education of our perception:

“Our movements are controlled by sub-cultural rules of social situations in all social situations… the concern is how to establish appropriate communication channels among people involved by controlling spatial movement ”(Lym, 1980, p.19)

But Lym also brings up another idea concerning the education of perception. This concept is the notion of “thinking” which is included in the education of perception and turns comprehension into an active act. Without thinking, perception is superficial.

Comparing what Lym says to that of Zeki’s, it could be concluded that visual perception of Cubist works involves the presence of “thought” in these works, while in Impressionism, since they merely rely on instant visual data, they ignore the element of thinking.

Lym further emphasizes the role of “pure imagination” in creation of new perceptions. This idea rejects the concept of Gibson’s developing perception. It also disagrees with Zeki’s opinion of perception, since he mentions the existence of prior visual images from past experiences. When the spatial perception “captures material in the unconscious”, the experience turns into a “symbol”. However the symbol formation in acute and chronic space is different in that the chronic space does not have the unique qualities of acute space. The perception of chronic space is unconsciously done while acute space experience is a conscious one.

**Surface**

Architectural surfaces play an important role in interaction with people, especially when considering the visual perception in relation to architecture. These elements have the potential to draw more attention than any other building components. Similar to types of space that Lym describes, surfaces can have “acute” or “chronic” qualities as well.

In this comparison, it could be concluded that acute surfaces are able to draw people’s attention and result in a stronger interaction with the observers.
The perception of building surface has changed during time. As the building skin became separated from the load-bearing structure, it became a curtain, a pure skin. To begin with this was expressed in the smooth curtain walls, which defined our environments for so long. Most recently, however, the surface- and hence its material- has become the central focus of investigation. But emphasize on surface goes hand in hand with the risk of superficiality. Drawing attention to surface in architectural designs has sometimes gone as far as becoming as Christian Schittich puts it “no more than attention-seeking packaging” (Schittich, 2001, p.9). He describes the change in the perception of surface in the contemporary era:

In the fast-paced information age, our perception has also changed, marked by a flood of flickering, colorful images. It is fascinating to observe how vastly different the reactions of individual architects are to this particular aspect. Some adapt to these new perceptions and react with equally colorful, serigraphic images on brittle glass or with flickering media facades and illuminated screens. Others however, look back the quality of ancient building materials-massive natural stone or exposed concrete, untreated timber and brick masonry, to demonstrate the solid physical presence of a building in an increasing virtual world (Schittich, 2001, p.9).

In this section, a brief history of how surface has been seen over the time is described.

Architectural surfaces were seen as what draws the line around a man’s property, creating his own private sphere. Gottfried Semper stated that the animal pen, a fence woven form branches and twinges, was the origin of wall. In his work “the style” he refers to the common origin of cladding and spatial art. He divides architecture into load-bearing structure and cladding, which influenced Modernism.

These surfaces had specific functions, especially in relation to climatic and environmental considerations. However, people began to decorate these surfaces as they did their clothes. The decoration of surface is seen in monuments of different cultures; frescoed Greek, Chinese temples or Islamic palaces and mosques.

The application of ornamentation to monumental surfaces can be seen as analogous to what Lym describes as “acute space”. In other words, the “acute” relating to surface was demonstrated in ornamentation and “acute surface” was a decorated surface. It’s “unique’ experience was a result of its application in what was considered as “significant” buildings. From a visual aspect, Surfaces were a means of representation. Schittich writes:

“The European antiquity transformed the façade into a unique showcase with which public buildings presented themselves to urban space’ (Schittich, 2001, p.11).

The distinction of significant and ordinary surface, increased during the Renaissance, and borrowing Lym’s terms, “acute” and “chronic” surface was realized. These “types” of surfaces were more emphasized by replacing the
significant surface from ordinary architectural structures of "homes" to important structures of "church". Christian Schittich implies that this separation was to fulfill aesthetic purpose of drawing attention of the observer:

In the renaissance, especially, facades began to separate from the house; that is they are placed in front of an old church or palace as a new cloak they fulfill a primarily aesthetic purpose: attractive packaging the design of facades in the classic sense, their proportion, fenestration, division by means of architraves, columns and rusticated ashlar stones, has been the main focus of architecture for many centuries in addition to interior design (Schittich, 2001, p.10).

With the industrial revolution and introduction of new materials and methods of production, the perception of surface changed. New materials resulted in a new insight toward building skin. According to Christian Schittich, dematerialization of surface, is directly related to the increasing separation of load bearing functions:

In the 19th century, the industrial revolution changed the world. New materials and production methods opened up new opportunities- iron and glass conquered architecture ...the process of dissolving the building skin-Its dematerialization- is directly linked to the progressive independence from its load bearing function (Schittich, 2001, p.11).

The new materials also had an important role in the change of opinion towards ornamentation. Since the new materials of glass and iron were introduced by "engineers", they were applied in constructions with pure functional qualities and ornamentation was eliminated, since it was an engineer production. Ornamentation at this point was seen as an element of no use, because it was not responding to new methods of production and the new materials. Architects, instead of searching ways of integrating ornamentation with progressive technological developments, continued to merely apply ornamentation as means of “visual packaging” of surfaces. Christian Schittich indicates:

The pioneers of glass and iron architecture like, Joseph Paxton designed their structures with purely functional aspects. Ornamentation, a common feature in the architecture of their time, was entirely absent in these structures. Many of the visionary designs were created by engineers and non-architects, while the architects themselves seemed content with decorating facades and entrance structures with traditional styles, ignoring the changes that had overtaken them (Schittich, 2001, p.12).

However, ornamentation was not seen the same by all architects. Sullivan was among the architects who wanted to bring ornamentation to a new level and prevent the outlook that was shaping toward ornament:

In Schlesinger and Mayer store designed by Louis Sullivan, the architect created an impressive effect by clean divisions made by horizontal lines, which make the construction of the load-bearing structure visible on the façade. Here, Sullivan demonstrates his leitmotif, namely that the exterior of a building must be an expression of its internal structure and function, that is, there must be a correspondence between content and external form. Yet Sullivan is equally convinced of the necessity of ornamentation, he is intent on enriching the building in its details, adding to the strength of its expression but in doing so, his ornamentation is never superficial it is always an integral component of the whole (Schittich, 2001, p.14).
Unlike his contemporary Adolf Loos, for whom the invention of ornament was an anathema, Frank Lloyd Wright attempted to derive an authentic ornament from the process of fabrication irrespective of whether this entailed the mechanized manufacture of basic building blocks or the systematic assembly of prefabricated modular elements thus while Semper despaired of overcoming the new found capacity of the machine to dissimulate or rather to simulate rich material effects in their absence, Wright regarded the machine as "a phoenix that was destined to arise from the ashes of its current kitsch reproduction to yield a future democratic culture…"

It is worth of mention that the idea of ornamentation did not consider a division between skin and volumetric qualities of surface. This can be seen in the examples of interior roof ornamentations of Islamic mosques or churches, where surface is seen as a three dimensional element.

Considering surface with both aspects resulted in the notion of architectural elements such as “porch”, “bay window” and “niche”.

Fig.1-Khayyam Tomb (left) Retrieved From: www.payvand.com/news/09/may/1030.html
Fig.2- Sheikh Lotf Allah Mosque(middle) retrieved from: http://www.essential-architecture.com/STYLE/STY-Muslim-Persian.htm
Fig.3- A traditional pigeon house in Meybod, Yazd, Iran. (Right) Retrieved from: http://www.essential-architecture.com/STYLE/STY-Muslim-Persian.htm
The disconnection of surface and volume is conveyed in Modernist ideas, although they mentioned the idea of integration of inside volume and outside skin by initiating that “the external appearance of a building should reflect its internal life. There should be harmony between form and function, inside and outside” (Schittich, 2001, p.9).

In the concepts presented by Modernism, border lines exist; between inside and outside, building skin and space, surface and volume. The growing independence of external skin from its structural function leads to its complete separation from the load-bearing structure. This separation also caused disconnection of surface and volume.

The relation of window to wall- of open to closed surface is one of the major themes of the external skin. Earlier, the openings were small. The metaphor of mystery and darkness was one of the reasons for small openings in surfaces limitation in construction methods, and nature of available materials had a significant effect on the relationship of open and closed surfaces. According to Christian Schittich “Small opening in walls were not only as a result of the idea of “dark” and “mystic” but also the consequence of construction methods. In many traditional buildings it is difficult to puncture the wall with large window openings in a massive stone” (Schittich, 2001, p.10). Another reason for small opening was for protection and safety.

Sacral buildings in Gothic era demonstrate the first attempts to create generous openings in the stone-faced shells. The ideas that lead to larger openings were opening architectural spaces towards light. It should be noted that glass was a rarity and the idea of larger openings were considered by keeping the principle material stone.

Since there was not considered a distinction of surface and volume, the opening in the surface, was also seen volumetrically. Schittich writes:

The traditional window is rarely a plain hole in the wall. It is nearly always one component in a spatially layered transitional zone. Curtains, blinds, folding shutters, window sills and flower boxes each fulfill a different task and create a gentle threshold from the outside to interior (Schittich, 2001, p.11).

Considering both two and three dimensional aspects of surface opening developed architectural elements such as bay window, in which removal of surface/space consideration engages the observers in interesting architectural events.

One of the successful architects to have applied the idea of eliminating surface and space in designing surface openings is Louis Kahn. In his projects the integration of surface and space, especially in considering the
openings, has resulted in places where wonderful experience of events occurs, for example the reading areas in Exeter library.

Fig.4- Spatial Event

Note. From *Louis I. Kahn: light and space* (P .130), by Urs Büttiker, 1994, New York, Watson-Guptill
Copyright 1994 by Birkhauser

What should architecture that reflects the electronic age look like? Architects have mostly answered to this question by applying electronic media on surfaces. One of the architects that explore this challenge is Toyo Ito. Schittich mentions the use of electronic media in his Media Center in Japan:

In his Media Center in Sundai, Japan, the building skin hardly reflects the internal structure of the building. But it does represent its use as a site for electronic media, and by extension, the Computer age, the virtual world. Toyo Ito experiments with varying degrees of transparency, which he achieves by printing different grids onto the glass surfaces, using figured glass and overlapping glazing panels in different layers. The multi-layered spatial impressions that result, the mirroring effects and reflections, contributes towards translating virtual reality in to real architecture (Schittich, 2001, p.19).

The boundary between surface and volume is decreasing in this era. Architects are mainly achieving this by using themes such as layering and wrapping, like Ito’s Media Center or Zumthor’s Kunsthau.

Another major theme in the electronic age that contributes to the idea of connectivity and interaction is transparency, and architects mostly choose “glass” for exploring this theme. Schittich mentions that translucent plastics are also applied for this purpose.

In the Expo in Hanover where skin materials were presented, the pure nature of materials was emphasized, and was transformed into ornamentation by its structure. Transparency and translucency were the major theme. In the courtyard of the Finnish Pavilion, the shadows of real trees cast onto the glass panes printed with plant motifs result in fascinating effects. In the Dutch pavilion a variety of fabrics are used as filters. Water runs across the fabrics in some areas and its movement creates a constant shifting between transparency and translucency in this case the liquid is the structuring veil (Schittich, 2001, p.21).
Looking at architectural elements in relation to psychological definition of perception, successful architectural works with strong interaction with people were studied.

These case studies include the Exeter Library by Louis Kahn. He emphasizes “space” and uses a poetical spatial approach to perception. Using the psychological analyze which Lym carried out for this project, perceptual qualities that architecture can create through the element of space is studied.

Another case study is John Deere Company by Eero Saarinen; in this example we will be looking at a surface event. The last case study in this section is Kunsthau in Bregenz by Peter Zumthor, who brings out the volumetric surface characteristic through considering “material” as the main theme of his designs. The purpose of case studies in this part is to manifest the role of surface and space in the relationship of architecture and psychology and also suggesting that a different look at surface connects architecture to the current definition of perception. Considering volumetric qualities of surface, blurs the distance between space and surface, making surface more capable of creating architectural events.

*Lym believes that Saarinen's designs “…did not acknowledge the acute and chronic space experience of his buildings users…” (Lym, 1980, p.70) but that he “…designed for the largely tangential, surface characteristics of those users…” (Lym, 1980, p.70)*

Although Lym considers architectural meaning only through spatial experience, architectural surface, when it is seen with its volumetric characteristics, can also produce architectural significance. In fact, Saarinen uses materials to “express the “character” of his clients” this surface event accentuates architectural interaction with the users of the building. Lym describes how Saarinen explains about the way materials were used for this project:
Farm machinery is not slick, shiny metal but forged iron and steel in big, forceful, functional shapes. The proper character for its headquarters’ architecture should likewise not be a slick, precise, glittering glass and spindly metal building, but a building which is bold and direct, using metal in a strong, basic way (Lym, 1980, p.70)

Fig.5- Surface Event

One of the elements that characterize the work of Eero Saarinen, both in architecture and industrial design, is the originality, diverseness, and uniqueness of every single creation. John Deere Company, is the first project to use weathering steel. Saarinen created a surface event in which the architectural material integrates with the environment.

Weathering is the surface event which is incorporated in materials in John Deer Company. By engaging with the element of time, it gives architectural materials an important role of manifesting duration, consequently an event. However, by focusing more on skin of surface, the event is happening more at a level of “substance”. Volumetric surface events manifest a stronger role of architectural creation.
Exeter library; Louis Kahn

Lym describes Kahn’s approach to architectural design as Kahn searching for the “beginning”:

For a commission in the 1960s to design the Indian institute of Management in Ahmadabad, India, Kahn sought the beginnings of “school”. He wanted to know the archetypal nature of “school” what its energy and spirit were. To design this school meant to create a spatial order for the Institute, yet one firmly rooted in the original intentions of school (Lym, 1980, p.77)

Kahn tried to anticipate the users own experience of space, and what he concluded about the experience of a library space, was “the individual inspired by a book” a reader would be inspired by reading a book, so he decided that he would “bring a book from a dark protective shelf into sunlight. This sunlight celebrated the reader’s illumination by the book (Lym, 1980, p.77)

A man with a book goes to the light. A library begins that way. The carrel is the niche which could be the beginning of the space order and its structure the reading room is impersonal it is the meeting in silence of the readers and their books (Lym, 1980, p.70)
Kahn’s approach to creating a spatial event is by considering spatial experience with eliminating the border of present and past. In fact, “… the archetypal nature of ‘school’, what its energy and spirit were…” (Lym, 1980) refers to what Gibson sees as a continuous experience where no past and present exists. The nature of the event is created based on an ongoing experience which has always existed, although it was developed through time. The only factor that Kahn may not have emphasized strongly is the individuality of this experience which is the result of its development. Lynn later describes how the individual experiences of library users are different, but the main concept of the library which is “inspiration”, is captured by Kahn and presented through creation of a masterfully spatial event.

Lym mentions in his book that by questioning the library’s teenaged users he found that the users’ experience had little to do with the Kahn’s spatial order.” I found no user who spoke of the reading areas as places in which to take a book to sunlight. …’He further states that the reason why the library was not experienced the same way as Kahn wanted to, was because of how the users understanding of library books, differed from what Kahn’s.

For these users, library books were, by and large, not a part of an inspiration ritual...Books were to be read quickly, digested and analyzed, and selected. For the Exeter student, books were “on reserve”, “in the catalogue” or “due back in two hours” ...the carrels were places for hard work and studying they were not usually places for solitary inspiration by reading I asked the users if they felt invited when they saw the presence of books all around the central court; only a few said yes many were indifferent others found the place distinctly distasteful (Lym, 1980, p.88)

Lym concludes that the spatial experience in Exeter, for the users, who are mostly students, is not an experience of a space for solitary inspiration with a book; rather it is an experience where students sought each other for communal inspiration. Although there is a student center near the Exeter Library, the social center of the campus had moved to the library. The students mentioned how they came to the library for social interaction.

Students use this library a lot to come and meet friends. There is a lounge on the third floor which people use to study in, but there’s always a lot of people and friends and stuff...It’s not at all like a library A library has to have books. But I think it also has to be a place where you can get together and run bull sessions without disturbing the people who are attempting to work You can work together here, instead of by yourself. You can arrange to meet a friend from any part of the campus. It is a very useful place (Lym, 1980, p.90)

The library’s central area, rather than having the invitation of books, had the invitation of meeting. Although a few students browsed the open books on shelves overlooking the central area, more students stood there to look down into the court to see if they knew anyone coming into the library.

My friends and I have this special whistle. Whenever any of us enters the building, we whistle up from the court, and if we get a replying whistle from some place up above, we know we’re here. We get together The other day, someone
took a pillow off the third floor lounge and threw it all the way down the main floor through the court—weird stuff here (Lym, 1980, p.90)

As Lym concludes from his research about the spatial experience of the Exeter library, Kahn has not failed to create spatial experience.

To Kahn, a library was inspiration by books. So he saw individuals reading books comfortably, illuminated in sunlight at the exterior periphery of the building. To the users, library was inspiration by being with friends. They took their friends out to the naturally lit periphery to be with them in plush chairs. These users were responding to Kahn’s more basic spatial order of ‘inspiration’ (Lym, 1980, p.93)

Fig.8- Spatial Event (left)
Note. From Louis I. Kahn: light and space (P 129), by Urs Büttiker, 1994, New York, Watson-Guptill
Copyright 1994 by Birkhauser

Fig.9- Spatial Event (right)
Note. From Louis I. Kahn: light and space (P 128), by Urs Büttiker, 1994, New York, Watson-Guptill
Copyright 1994 by Birkhauser

Kunsthaus; Peter Zumthor

Zumthor’s use of material, integrates elements of surface and space with aesthetical qualities. In Kunsthaus, a light, transparent surface is created by applying etched glass shingles in façade. This façade wrapped around the main body of the building with concrete core. Steel framework supports the glass shingles. This arrangement reveals the
volumetric character of surface in the wrap. The quality and construction of etched glass, causes a refraction of light before it enters the interior. This integration with natural phenomenon of light, introduces an aesthetical event to the users as well as performing as an insulation layer against cold and heat. Combining light furthers with leaving a 90cm wide light pit that makes it possible to direct daylight to the first subterranean level. The choice of glass for the wrap, and concrete for the core, manifest the common application of “glass” for blending surface and space. Concrete is seen commonly as a solid volume. The diffusion of surface and space is created by the concept of “wrapping”, not merely by the transparent quality of glass. Florentine Sack notes that Zumthor “…achieves ‘surface diffusion’ in his buildings by natural condition of material, without an additional treatment of surface…” (Sack, 2006, p.149) This fusing of surface and space is according to Sack, “withdrawal of architectural restrictions” (Sack, 2006, 151)

Fig.10-Kunsthaus (left) Note. Retrieved from http://www.kunsthaus-bregenz.at/e/html/ewelcome00.htm
Fig.11- Kunsthaus (right) Note. Retrieved from http://www.kunsthaus-bregenz.at/e/html/ewelcome00.htm

Yayoi Kusama

Yayoi is a Japanese artist who works with ideas such as repetition, accumulation and pattern. She has successfully represented the relationship of surface and space, in an installation called “Video Room” in 2004. In this work, she has integrated pattern and objects- as what Gibson defines as “substance” and “detached objects “in relation to what there is to be perceived-and created an interactive narration room in which the communication with the audience happens through the playful patterns on walls, transferring in to real objects of “seats” in form of pillows spread on floor .in other words, by transforming the same abstract patterns on walls into physical, usable
Objects. Consequently, she manifests the idea of “event”, in form of a transformation, and as a result, a conscious visual perception is achieved.

Fig. 12- Yayoi Kusama

*Note. From* *Patterns in Design, art and architecture* by Petra Schmidt, 2005, Basel [Switzerland]; Boston [Mass.] Birkhauser, Copyright 1994 by Birkhauser

*Fabio Novembr*

One of the other examples in which the idea of event is again manifested in form of a transformation of pattern into a object. This transformation eliminates surface/space separation like the previous example. The design appears in the interior designing of UNA Hotel by Fabio Novembr, in Florence. A dynamic change of floral patterns on the floor, in to the element of entrance, once more performs as means to a visually active interaction with audience and users, by defining the opening to the space. Here again an abstraction pattern, becomes a real means of architecture that leads to an awareness in visual understanding of the users understanding. The patterns are in wood and glass.
Construction process

Construction Methods

Textile Block Houses (Frank Lloyd Wright)

The textile blocks designed by frank Lloyd Wright is examined from two aspects; First, the innovative construction system; second, the characteristics of surfaces of textile blocks.

Textile construction system

In California, Wright used an innovative building process in 1923 and 1924, which he called the textile block system. The buildings were constructed with precast concrete blocks with a patterned, squared exterior surface. (Gebhard, 1988) The surface patterns expressed concrete through indirect historical associations to their regions. All
four textile block houses (Alice Millar House, Storer House, Freeman House, Ennis House) present what David Gebhard calls “symbolic romantic ruins” (Gebhard, 1988). Wright describes the textile system in 1927:

“A simple mechanical means to produce a complete cladding that looks the way the machine made it, as much at least as any fabric need look” (Maccarter, 2005, p.181)

The textile block system, as means of constructing walls was composed of two parts units. It was tied horizontally and vertically into a structurally stable configuration by a web of steel rods (Alofsin, 1993). The reinforcing rods were placed in cast grooves and anchored with mortar (Gebhard, 1988). The walls stability was achieved by wired ties which were placed perpendicular to the blocks. Connecting the rods and the two parts system produced a cavity which could provide insulation. (Gebhard, 1988)

Wright believed that this system had economic and tectonic advantaged since there was no need for skillful labor and also there were two exterior surfaces with texture potentials. However, this system was not successful in a long term (Gebhard, 1988). The color and texture of blocks failed to reflect the surrounding site despite Wright’s desire. This was due to impurities in concrete which could not be washed, and the blocks were not stable over a time (Gebhard, 1988). Wright wanted the buildings to “grow right out of the soil wherever sand and gravel abound”(Gebhard, 1988). But the transformation of surrounding landscape in to a jungle prevented this idea (Gebhard, 1988). The Millard House was the most romantic one of the blocks (Gebhard, 1988). Gebhard describes the features of this house:

“The walls of thin concrete block, with an air space in between, occur both externally and internally thus tie the interior closely to the outside” (Gebhard, 1988, p.19)

The Millard House (1923) peeks forth from its “jungle” pool and thicken vegetation. With its patterned perforated glass-filled apertures. La Miniatura already embodied the essential syntax of the textile block system that was employed, with the subtle variations, in each of the subsequent block houses. (Gebhard, 1988)

**Textile Blocks-Surface**

This section looks at the textile blocks in relation to what they created as architectural events and how the surfaces of these blocks were considered for this purpose. Therefore surface patterns as well as Wright’s philosophy in designing the surfaces is investigated.
Wright's philosophy of design is derived from philosophers like Semper as well as eastern architecture of Japan beside vast personal experiences he gained through his travels to Europe and other places. Two of the major philosophers that have influenced Wright's work are Gottfried Semper and Fenollosa. According to Robert Maccarter, two aspects of Semper's influence are seen in Wright's projects; First, the textile production as the archetypical origin of all built form; second, the relation of the art of building to aboriginal applied arts for its motifs (Maccarter, 2005). Fenollosa’s influence on Wright is in accordance to Japanese art (Nute, 1993). Fenollosa believed that the quality of mutual interdependence of parts or wholeness was essential to the purely formal idea in art. Wright applied this as a central theme in Composition where he applied this concept in relation to simple arrangement of lines in surface patterns of the textile blocks. (Nute, 1993)

Figure 14. Millard House

Note. From Romanza, California architecture of Frank Lloyd Wright, by David Gebhard, 1988, Sanfransisco Chronicle books, Copyright 1988 by David Gebhard

Nute further mentions that as well as interlocking plan forms, it seems that line-ideas may also have inspired a number of Wright's decorative designs as for example the patterns used on the Storer and Millard block houses both of which appear to have derived from a combination of two line-ideas. (Nute, 1993)

Anthony Alofsin believes that the Japanese architectural material influenced the textile blocks. He describes how Oya Stone inspired Wright in designing the textile block and its influence on the construction system (Alofsin, 1993). As a conclusion to this part it should be mentioned that what the above investigation reveals in relation to architectural event and the idea of surface with both skin and spatial characteristics, is that Wright treated surface as a medium of creating
an event, and for creating this event he considered both skin and volumetric qualities of textile blocks. The architectural events that are created by textile blocks are a narration of history. With these blocks, aesthetical appeal is created through events which narrate history, and needs perceptual education. This perceptual education is explained in Open House:

The human body is a creation of great subtlety...The subtlety of Japanese house is revealed in the delicate structure of surfaces as well as the permeability of the multi-layered building skin. But this kind of design principle is also evident in the work of Frank Lloyd Wright, as for example in the ornamental walls of Charles Ennis House which gained special transparency through engraved openings (Sack, 2006, p.145)

**Digital Fabrication (MIT research)**

This case explores new solutions for formal issues as a result of limited conventional methods of fabrication. MIT research group are developing non-conventional techniques to produce double-curved walls built out of unique masonry units. They mention that “curved forms” mostly remain as “rendered images” since fabrication and assembly of these forms are difficult.

In “computing and materializing non-uniform shapes” a new approach to digital fabrication is presented by Kenfield Griffith and Larry Sass. The system produces information for physical construction:

“This program generates information for physical construction as architectural models of double-curved walls built from unique masonry units. We present a series of computer programs and physical models as examples of straight and curved walls generated from an evolutionary system built for design...” (Griffith and Sass, 2005)

Another issue brought up by the authors is the “scale” of physical models used for detail study of space, light and formal qualities. Large scale modeling is a hindrance due to hours of manufacturing components and labor work for assembly.

“The vision is to explore design systems for constructing physically large curved surface representations with rapid prototyping...” (Griffith and Sass, 2005)

Although architects like Bernard cache and Frank Gehry have attempted to overcome the problem of non uniform construction of curved shapes with digital technology, their solutions are mostly applied using metal and glass.
“Form and shape investigation built by architect Eladio Dieste demonstrated the complexity of using masonry units as the elements of construction” (Griffith and Sass, 2005)

The system they introduce uses the method of dividing curved forms to sub-unite with embedded assemblies. By this, the separation of “rendered images” and actual construction disappears. The designer is engaged in a process were his/her drawings are actually tested for real world challenges. It is in fact, engaging in an event of creation were the designer plays a more significant role. The other problem addressed by sub dividing is large scale modeling. The authors mention that Wang and Duarte’s approach in fabrication which uses a Stratasys FDM 3D printer does not fit architectural needs since it produces solid objects as small physical models.(4” square”)

“Design evaluation is by physical testing of tolerance, structure, and assembly and aesthetics” (Griffith and Sass, 2005)

The fabrication process begins with a curved surface transformed into unique component models. These components are also managed for strength and assembly tolerance. Models, that are larger than the typical 3d printing machines should be divided to individual components. Embedded assembly puts the architect designer more in control of the constructed walls:

“Traditional masonry wall construction is composed of a standard manufactured unit assembled in a variety of ways to build one wall. Variation is not in the masonry unit, but the skill and experience of the mason” (Griffith and Sass, 2005)

The image below illustrates how the architect designer is more in control with new digital fabrication

Fig15-New Construction, Retreived From ddf.mit.edu/papers/08_griffith_sass_caadria_2006.pdf
The following images show three programs for fabricating masonry units which was carried out by the MIT researchers. The first program produces uniform blocks with tab and slot for assembly. The starting shape for the program is a rectangular surface.

Fig.16-Newconstruction,RetreivedFrom ddf.mit.edu/papers/08_griffith_sass_caadria_2006.pdf

The second image illustrates the fabrication of non-standard units which use a four sided non-orthogonal shape as input. The novelty of this approach is that the tabs and slots are angled based on the shape of the block.

Fig.17-Newconstruction,RetreivedFrom ddf.mit.edu/papers/08_griffith_sass_caadria_2006.pdf

The third process, which is more complex than the previous two, subdivides curved wall forms into non-uniform components. This approach does not start with a surface, but two curved lines. The program evaluates and
Levels of Connectivity (Scale, Decisions)

Direct Connection (Mike Kandler)

In this part of the case studies, levels of connectivity of designer and built will be studies. Since making is duration in its self, it is considered a process. Here, the levels of connectivity of designer and the design will be explored.

The first case is two projects by an architect, who is the designer and the maker. The characteristics of this case are small scale of the project, decisions made during the process, and direct experiencing of the becoming of a built form. The two projects done by “Max-Power Concrete” architect Mike Kindler will be presented. Both projects are within human scale, and the architect has complete control over the production process. Decisions and modifications are easily made throughout the manufacturing of both projects. These two projects include a “sink” and a “fire place” Photos of the construction process were provided by Kandler, in an effort to manifest an event in which the architect is subdivides the lines and offsets the shape for unit thickness. Then solid shape is subdivided into smaller units. Subdivision size is specified by user.
engaged in evolving a client’s request. In both cases he has complete control over any pre made decisions and necessary changes during the production.

The first case study is about a monolithic sink, custom designed for a client in Upper Arlington by Mike Kandler. The process of making involves a selection of materials which influences the pouring process and also the resulting form. The scale of the project enables the designer to have modifications throughout the production and have control over instant decision makings.

The above image shows the formwork for the sink, which were provided by the designer. The main material used for the form was a ¾” melamine board, caulked to make smooth shapes as the designer mentions in his notes. A variety of trim pieces were used to create the design edging effect. For sculpting of the sink block out, the material used was polystyrene. Kandler used plastic wrap to achieve a smooth finish and eliminate the “lines” caused by the Styrofoam joint. The process of sink block out is described by the designer as follows:

“Styrofoam sink block out was sculpted to sink shape then wrapped in plastic wrap for a smooth shape without any lines caused by the Styrofoam joints” (Kandler, 2009)

The 1/8” tile board was also caulked to create a slope. As the designer mentions in the upper part it was caulked ½” thick the tile board sits on shims to create “fall”. Since earlier images of form work making were not available, Mike describes the reinforcement selection through notes:
“The reinforcement was created by using rebar grid, more commonly referred to as #2 or pencil rod and carbon fiber mesh(c-grid). The inside form made for structural purpose make the walls 1 ¾” thick “ (Kandler, 2009)

![Fig. 20- Sink, Retrieved from Mike Kandler photos, 2009](image)

This next case study is about the process of construction of a fire place. The designer has provided photos of the construction process as well as notes about the decisions made during the process. The project begins with inspiration from a drawing and a reference magazine photo provided by client. The first series of photos manifest the fireplace base preparation and pour. The base for the fireplace was a cast-in-place. Mike describes the base pouring process as follows:

2x4 lumber was planed down to sizes needed, which is 1” thick. Existing slab for sub base was cleaned and coated with a bonding agent. 6x6x610 wwf was used as reinforcement. The concrete was a 5000 psi bag mix, mixed in a mixer and 5 gal bucket, transport to pour area. Concrete was screened, floated edged and towed using standard concrete finish tools and techniques. No curing or sealing compounds were to be added at this time. This slab will undergo the same treatment as the other 3 pieces in our shop they will be polished using diamond polishing tools and an acid stain will be used. At the end of the procedure, the concrete will be very naturally shinny after it has gone under the polishing process through 3000 grit (Kandler, 2009)

All lumber was purchased locally at a lumber yard. Thoro bond was applied for sub base coat with a paint brush. Screeding and floating were done by applying the following tools; 15” wooden hand float, an 18” magnesium hand float, an 18” steel trowel and a steel edger with a 1/4” radius - in that order. Using pre-mixed concrete instead of concrete ingredients was due to limitation of storage area in workshop. The polishing of concrete was used by applying diamond polishing process. Mike Kandler describes the polishing process and tools as follows:

used a 4-1/2” variable speed electric grinder with diamond pad attachments to grind/polish the base and the surround pieces…The surround pieces were polished to a high shine - the process started with a 100 grit diamond pad
and continue to a 3000 grit pad. The base stopped at a 200 grit pad, this was due to a design decision from the owner.

The second row of images reveals the fireplace formwork assembly. Here, #2 rebar grids were used and assembled with zip ties. Wire suspending rebar in the middle of concrete piece formwork were used for vertical support the picture also shows a Styrofoam detail carbon fiber grid was used for fireplace formwork. The choice of rebar and designing reinforcement is described by Kandler:

The reinforcement was designed specifically for this piece, using bars and C grid, that I am familiar with using. These pieces exceed what will be needed to provide support to the surround. I can rest easy knowing I used superior materials in my work (Kandler, 2009)

The rebar is assembled by hand, working adjacent to the formwork; so that we ensure that the rebar grid will be imbedded in the center of the concrete. Before placement of the concrete, the rebar structure is "suspended" in the formwork or "mold". Once the concrete is placed and sufficiently vibrated to eliminate air voids, the wires that are "suspending" the rebar in place are cut, and the rebar will remain in place and provide tensile and flexural strength to the pieces (Kandler, 2009)

The third row of the images shows pouring of the surround pieces. The surrounded pieces were not a case of “cast-in-place” as the base for fireplace. These pieces were made in the workshop and transported to the project site.

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1 Ibid
The pictures in this page show the finished surrounded pieces in the workshop. Mike, how the assembly of fireplace surround pieces would look like from both sides.

The details of joining each two pieces together are also shown in the following pictures. "...The individual pieces of surround stack together in "post and beam" fashion. They are fastened together and to the underlying wood frame and adjacent wall using silicone caulking, this is sufficient to hold the pieces in place forever. Additionally, this surround could be disassembled and moved if so desired (Kandler, 2009)
Intervene (Loom Studio)

The next example is concrete block designs by Loom Studio. The role of machine as mediate is significant in their process of construction. They have mostly focused on the potentials of machine production. This example is in contrast with previous example, in which a direct participation of the designer, and consequently a direct perception is not achieved. The designer is not necessarily the maker. In this section, the manufacturing process, according to the designers will be explored. Their design, is a search for innovation in the manufacturing process, with focusing on what design potentials can machine production achieve. They have worked on the traditional mechanical production of a CMU unite, and created innovative block forms by modifying the traditional manufacturing process

Loom Studio’s investigation of “12 blocks” is based on concrete as a standardized building component, which is based on economy and utility in the new construction. The team mentions that utilizing these building components increases efficiency by “reducing the number of unknowns and consequently, the necessity for highly skilled labor...” (Design Loom, 2009) they aimed at improving the performance and character of concrete block through their research. The investigation focuses on the possibilities of surface articulation within concrete block systems; it also relies on maintaining the structural and economic advantages inherent in the system. The investigation started by researching the manufacturing and construction process. The affordability of CMU is based in its production and installation, since cost of production relies on manufacturing process, they chose to work within the constraints inherent in this process, the writer describes mechanical production of concrete block.

Manufacturing a typical concrete block takes place within a single machine that supplies concrete, forms the blocks and moves the blocks onto a conveyer belt. In the first step of the process, a steel plate is supplied to the bottom of a bin within the machine. The bin is then filled with zero slump concrete. A device called the plunger, which is the formwork of each block, comes from above the bin and plunges... into the concrete. The block is formed and the plunger pushes the steel plate down along with the newly formed block onto a conveyer belt underneath the bin. The block then moves down the conveyor to be cured. Each cycle of this process produces two, three, or four blocks depending on the type of machine. Because the process depends on dropping the blocks out of the plunger, the block form needs to provide draft in the upward direction. This means that all projections and/or voids need to move from the outside toward the inside of the block as they move upward (Loom Studio, 2007)

Loom Studio considered three variables in machine manufacturing; formwork, size and bonding. Formwork is considered as what produces the overall shape of a single block. They believe that blocks are formed by machine components. Machine parts are what make the “face molds”, “block cores” and “shoes”.


The shape of a block is formed by the components contained within the plunger. These include the face molds which create the exterior of the block, the core formwork which creates the block cores and the shoes, which finish the top of the block (Loom Studio, 2007).

The rigidity, precision and mechanical characteristics of machine parts build the formwork. Loom also takes into account the financial aspects of formwork:

The face molds are regularly replaced due to wear and are relatively inexpensive. Because of their short lifespan and affordability, we focused our investigation on creating blocks that exploit possibilities dependent on these components (Loom Studio, 2007).

An interesting fact considered by Loom Studio is the relationship of block size and labor efforts, both from skill and economical views. They also emphasize that size “develop the visual and tactile qualities of a wall…”

Concrete blocks are available in a range of sizes. While there are clear advantages to using blocks of varying size to develop the visual and tactile qualities of a wall, the size and weight of blocks also impacts the cost of labor during installation. In order to maintain the economic advantages of typical block construction we limited our investigation to blocks of the most typical size, 8"x8"x16"…” (Loom Studio, 2007).

Structural quality is achieved by the block’s arrangement in a system. The group took standard bonding patterns as the main factor for structural purpose.

The structural integrity of a concrete block wall is dependent on its bonding pattern. Creation of a structurally monolithic block wall depends on establishing a bonding pattern with interlocking cores that can be reinforced and filled with grout. This works best with a running bond. Therefore, we limited our investigation to configurations of block within a running bond pattern (Loom Studio, 2007).

Fig. 23-Egg Block, Retrieved from www.loomstudio.com, Copyright 2007 LOOM.
Combination (Amphorae)

Amphorae are the name of the prototype made by this group. The work is worth mentioning here, because they combine the controllable scale of designing, which results in hand craft, with the precision of machine manufacturing by using liquid forms in producing concrete blocks. Here, the control element is achieved through “re-configurability” of individual block units:

“ The re-configurability of the block enables design changes through life of the project not at just initiation of the design considering the long term issues which may arise as well” (Break, Keelle, Mercie, Anzalone, 2009)

The unit block is flexible both at the level of the unit itself, with six different configurations possible ranging from 33-73% porosity and as a material system, where the units can be combined in different ways to provide adaptation to site conditions. The result is a dynamic material system with flexible individual units. A significant advantage of the Brie Block is its formwork. Since it is a changeable form, complex forms can be achieved by configuration of a single formwork, eliminating the need of making unique individual formwork. Beside economical benefits, its adaptation quality makes Brie Block an ideal element to produce dynamic walls with a variety of options.

CNC milling has brought variety in mass production process; however an issue of construction waste needs to be addressed when applying this method. In the manufacturing process, a waste management strategy was applied by the designers through considering geometrical characteristics of the mold.

While CNC milling has allowed architects to create different modules at the same rate as mass produces modules, it has also creates exponential amounts of waste. Placing all of the effort onto the geometry itself allows a single mold typology to be 3 axis CNC milled which can be reused countless times allowing for minimal startup costs and waste of material (Break, Keelle, Mercie, Anzalone, 2009)

The designers also mention that the choice of material has significant effect on the results.

The Brie Block relies very heavily on the properties of concrete to make its achievements. No other material could be cast with such great strength and at such a low cost. Its ability to be cast is also extremely important given concretes ability to take almost any form based on its formwork (Break, Keelle, Mercie, Anzalone, 2009)

Considering scale and handling, the block weighs only 36 pounds and spans a total of 42a inches (32 inch bond) with a height of 18 inches. The blocks can easily be hand lifted and installed with only alignment pins and grout.
As another economical consideration, the design team replaces the structural steel by polypropylene blended synthetic macro-fibers as reinforcement, and saved cross-sectional material by reducing the amount of cover needed for steel reinforcement and producing a multidirectional system of tensional reinforcement.

“The block can be fabricated with sections as thin as 1.5 inch at a material cost of only 5$” (Break, Keelle, Mercie, Anzalone, 2009)

Fig.24-Amphorae, Retrieved from http://amphorae.wordpress.com/brise-block/
CHAPTER V

CMU AS MEANS OF ARCHITECTURAL EVENT

Material: why CMU?

In this section of the research, the reasons for choosing concrete masonry unit will be discussed. These motivations are related to concrete as material, concrete blocks as a system of material and the relation of these two to architectural event and its perceptual aspects.

Surface issues

Currently, according to Moravansky, there are two debates regarding masonry; its surface as a medium for meaning and a boundary and its mass as a product of manual work. New technologies in surface treatments have been applied to deal with the first issue. However, looking at projects addressing the surface treatments, it seems that surface is still considered a two dimensional skin. Most “treatments” deal with color and texturing of the surface. For example stone soup concrete mixes mica-based pigments into concrete to give it a metal look. Concrete sinks made of this concrete are bronze and look like metal. Creating architectural events through surface requires the elimination of surface/space boundaries and considering the volumetric potentials of surface. Some other new technologies address the environmental issues that are dealt at surface level. For example, stain proof concrete has been developed by Sonoma Cast Stone. Although this is an appropriate design approach, the poetic qualities of surface need to be addressed as well by engaging environmental factors.

Some of the concrete products that address these poetical issues are Litracon, which uses glass in the ingredients to achieve translucent concrete, or the concretes that use fiber-optic strands to produce light and effect of starts.
Most of the approaches to push the limits of concrete are at the level of mixing ingredients, and are related to how the concrete as a process is created. These advances deal with the second issue which is concrete’s lack of identity.

**Lack of identity**

In an article, Adrian forty argues about the architectural use of concrete. The bothering question is “why, when other materials had developed their own distinctive aesthetics, had concrete not?” (Forty, 2006, p.34)

He suggests that “…the uncertainty that is such a feature of the aesthetics of concrete undoubtedly has something to do with its common, but mistaken, designation as material. Concrete, let us be clear, is not a material, it is a process.” A process does exist for natural materials… but the difference between concrete and other natural materials is a matter of degree:

"With concrete the human labor element is more visible and more immediately apparent in the finish result“ (Forty, 2006, p.34)

“…what, if anything is "brought forth" in concrete is human invention and skill…” (Forty, 2006, p.34)

By setting architectural use of concrete by architects such as Mario Passanti and Giovanni Michelucci as successful examples, he suggests that a more successful method of concrete construction would be one that mixes the traditional ways of constructions- whether monolithic, arch, or shell-instead of sticking to one of them. Consequently, Adrian Forty is suggesting that to show the concrete as a process, and not as a material, architects have to mix different methods of construction in an architectural work He states that "bringing forth" the "immanent properties" of concrete is not possible, like what Heidegger expects to do with other natural materials in a work of architecture. His interpretation of human interaction in the process of making concrete is their skills and innovations. In other words, concrete engages the audience because it is resulted from people’s efforts.

Gathering from arguments on identity of concrete, it can be suggested the identity of concrete is its crafting which carries the trace of human hands. This identity can also be addressed as it engages the human innovations through new production techniques, which is manifested in formal innovations of concrete blocks.
Methodology

Issues and concepts that were researched in case studies inspired the design ideas and generated a system of approaches to work with these ideas. These concepts include:

-The notion of blurring surface/space separation in creating events by exploring formal characteristics of a single block and block arrangements in a system and integrating environmental affordances.

-The ideas of mass-customization and designer's control with managing scale were explored by converting CMU to bricks and developing a method of construction for CMU in which both computers crafted and hand crafted are brought together. For this purpose prototypes generated by computer designs, were applied in a hand craft process of constructing CMU formwork. The formworks were then used to make concrete blocks. Each stage of design/build process is described below:

-Integrating environmental phenomena (wind, light, water): This part of the research is a study of how the border of surface and space can be eliminated through design concepts. It also looks at how volumetric qualities of surface can be integrated in design process. The abolishing of surface/space is explored at the level of individual blocks. The resulting system of blocks would have the same quality.

-Blending Surface and space: Formal attributes can blend surface and space in two approaches, first by taking form as a solid, and processing from a 3dimensional quality to a two dimensional skin feature and second by taking a reverse approach and moving from two dimensional to volumetric value.
Fig. 25 - Conceptual designs
Phenomena: water flow
Blurring surface/space: shifting from volume to skin

Fig. 26 - Conceptual designs
Phenomena: light patterns
Blurring surface/space: shifting from volume to skin

Fig. 27 - Conceptual designs
Phenomena: light patterns
Blurring surface and space: shifting from volume to skin

Fig. 28 - Conceptual designs
Phenomena: light pattern
Blurring surface and space: shifting from volume to skin
Design experiments presented in this part, apply concepts where form is seen as a spatial solid, the relationship between space and surface starts from space and moves to surface. In other words it is a search for potentials of volumetric qualities of surface in relation to plane patterns. The pattern designed to engage environmental features in creating architectural events. Aesthetical considerations are revealed in harmony and unpredictability of flows and their motion in and on surfaces.

Fig. 29-Form as Solid

Fig.30- Form as Solid

Form as a surface enclosure

This part is a reverse approach in accordance to the last part. It is an exploration of spatial qualities of skins, and how volumetric characteristics can be used as design concepts to eliminate the idea of surface as a two dimensional element. Both approaches that try to eradicate surface/space boundaries are an attempt to relate to the new concepts of perception an active experiment which engages the audience visually in a direct approach.
Fig. 31 - Surface as enclosure, origami
Fig. 32 - Surface as enclosure, origami
Fig. 33 - Surface as enclosure, folding
Construction

Method of construction

A new construction method was developed for producing concrete block in which both levels of connectivity were blended. The mold making process and mixing and pouring concrete were by crafting while, the digital fabrication of prototypes and design were by the “intervene”. Based on the arrangement capabilities two projects were suggested in construction process. One, block with a single arrangement, meaning that there is only one way of connecting the blocks. The other is in a multi arrangement. Both are designed with embedded assembly.

Block arrangement in assembly

A block is designed with assembly that makes it capable of producing various arrangements. Different assemblies planted in each block were inspired by wood joints. The arrangements produced, can be set as landscape furniture along a trail path, were the walkers, engage in a play of shadow and light.

Fig. 34 - single Arrangement
Fig. 35-Multi-arrangement
Making a mold: The act of making as architectural event

Silicon Rubber

Fig. 36- Constructing a mold box

37 - Constructing a mold box

Fig. 38- Sealing Prototype

Fig. 39- Sealing Prototype
Fig. 40 - Applying release agent

Fig. 41 - Applying release agent

Fig. 42 - Applying release agent

Fig. 43 - Applying release agent

Fig. 44 - Mixing silicon rubber

Fig. 45 - Mixing silicon rubber
Fig. 46 - Pouring silicon rubber
Fig. 47 - Pouring silicon rubber
Fig. 48 - Pouring silicon rubber
Fig. 49 - Pouring silicon rubber
Fig. 50 - De-molding
Fig. 51 - De-molding
There were some issues that revealed themselves at the time of de-molding. The overall shape of the mold, specifically at the edges was affected by type of the sealing and the amount of crafting. Using hot melt glue did not result in clean edges, while modeling clay prevented rubber from escaping more successfully. Using clay needed more spending time over edges. The second challenge was how the sequence of each wall of the mold box affected quality and simplicity of working over the prototype. In this experiment, three sides of the box were made prior to sealing the prototype to the base. This gave better control over the less significant surfaces.
The third matter of importance was the placement of the prototype. In proper placement caused the rubber to lock with the prototype and when de-molding, either the prototype had to be broken, or the mold cut. Since silicon rubber is easily cut with Ex-Acto knife, the second option was chosen.

The forth problem was the bubbles seen in the mold result. This was due to rapid pouring and/or improper distance of pouring the rubber.

The last problem, which was predictable, was the amount of liquid rubber used. Since the amount was less than enough, a brush was used to cover the whole prototype. Since the layer of rubber was not thick enough, it tore in vulnerable edges. Silicon Rubber is easy to cut after it is cured and does not stick to most surfaces, but its tensile strength is not enough to hold concrete in it. Maybe a thicker dimension would eliminate this issue, but its tear potential remains.

_Urethane rubber_

![Fig.55-Laying clay on base for seal](image)

![Fig.56-Laying clay on base for seal](image)
Fig. 57 - Sealing prototype to base

Fig. 58 - Sealing prototype to base

Fig. 59 - Applying release agent

Fig. 60 - Applying release agent

Fig. 61 - Mixing Urethane rubber

Fig. 62 - Mixing Urethane rubber
Since this project used clay as the main material for sealing, the level of crafting the clay affected the result shape of the mold. The precision of the prototype however would still provide an opportunity for the final block to be precise.
One of the issues with urethane rubber is the safety issues at the mixing level. Proper mask and other precautions need to be considered to avoid health problems. The problems faced in the previous project were avoided. Bedding the base with clay resulted in a better sealing and consequently a proper finish in the edges.

Although bubbles were tried to be avoided, still small bubbles appeared in the bottom of the mold. This could be because of the distance of pouring. Urethane Rubber is not easy to cut after it is cured. It is adhesive and therefore a careful applying of release agent is needed. The best advantage of urethane rubber is its flexibility at the level making, which makes a great variety of shapes possible.

*Pouring concrete*

![Fig.72- Mixing](image1)

![Fig.73- Pouring](image2)

![Fig.74- Placing concrete in mold](image3)

![Fig.75- Screeding](image4)
The next level after experimenting with two types of rubber for mold making was pouring concrete to see how the final block results. Since the thesis questioned duration of involving the designer, specifically in mold making phase, pre-mixed concrete was used. At this level, duration of curing played an important role on the quality of the final block.

It is interesting to try other joint designs to interlock concrete blocks without applying mortar. This procedure is time saving and needs less labor skills.
CHAPTER VI
CONCLUSION

This thesis is an initiative to a research process, in which methods of construction, fabrication techniques and individual materials for molds would be investigated. Considering material as means of creating an event, this architectural feature is investigated for its various formal potentials, and in a system of arrangements.

In this thesis, a process of construction for concrete blocks is suggested in which more participation of the designer in design and build process is considered. Uniqueness and variety which digital fabrication brings, offers a significant potential for mass customization.

The viscosity of material for mold eliminates the limits of form for blocks. Although fabric formwork was the inspiration for mold making phase in this thesis, the consistency of rubber mold, made it more suitable for the final choice.

In conceptual design phase, computer-aided designs were developed through innovative methods of design, reflecting on digital fabrication process. Since concrete block is commonly seen as a solid, filled block, new potentials of formal arrangements can be explored for each single block.

The precision and capturing of details with digital fabrication opens up opportunities for designing blocks with embedded assembly in form of locks. In this thesis wood joints were studies as interlocking two wooden pieces, and were used as inspiration to design connections of concrete blocks.

Pouring concrete is a possible further research by itself. Choice of ingredients of mixture to obtain qualities of translucency, lightness, texture and color options, eliminates the idea of solidity and concrete block as a “filled” piece. It will also offer potentials for the idea of blending surface and space.


