Intelligent Intervention: Toward a Definition for the process of Design in the Architecture of Design/Build

By

Mahmoud Poorzand

B.A. (Arch.), University of California, Berkeley, 1980

A thesis
Presented to the university of British Columbia
In Partial fulfillment of the
requirement for the degree of
Master of Advanced Studies in Architecture

In

Faculty of Graduate Studies

(School of Architecture)

We accept this thesis as conforming to the requirement of standard

University of British Columbia, Vancouver, Canada

2001

In presenting this thesis in partial fulfilment of the requirements for an advanced degree at the University of British Columbia, I agree that the Library shall make it freely available for reference and study. I further agree that permission for extensive copying of this thesis for scholarly purposes may be granted by the head of my department or by his or her representatives. It is understood that copying or publication of this thesis for financial gain shall not be allowed without my written permission.

Department of Architecture

The University of British Columbia
Vancouver, Canada

Date oct 5 /01

Abstract

The method of Design/Build is known for its practicality and skillful designers and builders. However, high quality buildings produced by this method suggest there is an intellectual wealth hidden beneath this technical practicality. To uncover this wealth, a definition for the processes of design used in this method must be constructed to clarify its intellectual aspects.

Such a definition begins with the assumption that design is an intelligent process through which people arrange their environment. To uphold the intelligence of design, the interaction between human (designer, tradesperson, client, or inhabitants) and architecture must be maintained throughout the process. The unique conditions in the method of Design/build allow the human intellect to freely interpret and intervene in the processes of architecture.

To fully exploit these conditions, a designer must develop a particular view, seeing architecture as combined processes rather than as an end-result. Via this view, it becomes evident that the arrangement of lines, forms, and structures of buildings is just a material manifestation of a deeper reality, i.e. the agreed values that an individual or society holds. These values are translated into two groups of design principles in architecture. The first group is geometrical and includes proportion, symmetry, order, and unity. The second group is relational and leads to consideration of adaptability, nature, need, tradition, and material. These principles define the relationships of architecture, humans, and the environment, expressing the role of intelligence in man-made settings.

In Design/Build, these principles can be incorporated into the processes of design far more than in any other method, because architecture is intimately connected to environment (social and natural), and there is a dynamic interaction between designing and building. This method sees architecture as a combination of processes, considering design not as rules and regulations, but as a process that is empowered and motivated by the events of everyday life. This method arrives at the rules and regulation of architecture only after recognizing this fact. Without the attendance of life in an architectural process, the geometrical and relational principles of design are dull and meaningless.

By establishing this view, this paper hopes to construct a definition for the design process of Design/Build, a definition that does not deal solely with the technicality and practicality of this method but rather with the intellectual aspects of the process.

Table of Contents

List of Figures

Note on Images:

The images in this paper are provided as a visual assistance to the text and although this work is meant to be cross-cultural, the reader will note the images are mostly from formal and vernacular Persian architecture. There are three reasons for this choice. First, the author's familiarity with the context and vocabularies of this architecture made the matching of concepts and images easier. Second, while the ideas that these images convey are timeless and cross-cultural, they lend an exotic flavor to the discussion. Third, the goal of this work is to illustrate the intellectual capability of the design process in Design/Build, therefore where the examples came from is not as important as what they convey.

Source of Inspiration

Introduction

The role of Life in Design

The role of Geometry in Design

Proportion in Design

Symmetry in design

Order In Design

Unity in design

Adaptability in design

Nature in Design

Tradition in Design

Need in Design

Material in design

Acknowledgments

The task of writing of this paper would have been almost impossible without the support and much-needed encouragement of my friends, classmates, instructors, and family.

I appreciate the advice of my professors, especially Ron Walkey, whose extensive knowledge of architecture is matched by his ability to guide me in formulating the fundamental concepts and help me to maintain focus throughout this work, and professor John Gaitanakis, who put much valuable time in reviewing this work.

I also would like to thank Duane Elverum, Michel McNamara and all the people who provided such a creative course in Design/Build on Hornby Island.

As I will explain in the beginning of this paper, my experience on Hornby Island was more than a technical course in Design/Build. It provided unprecedented knowledge about a sustained community that interprets architecture through their real needs. This experience thought me an appreciation for the events of everyday life and the ways it affects the processes of architecture. It made it clear that a creative process of architecture is always based on the agreed values of the whole community, and that architecture is not a few fixed design concepts that can be overruled by the reality of actual process.

And finally I thank Andrea Elvidge who helped me to be concise and clear in my writing, for which I am extremely grateful.

Dedication

To my father

Informing and inspiration

The Experience of Design/Build on Hornby Island

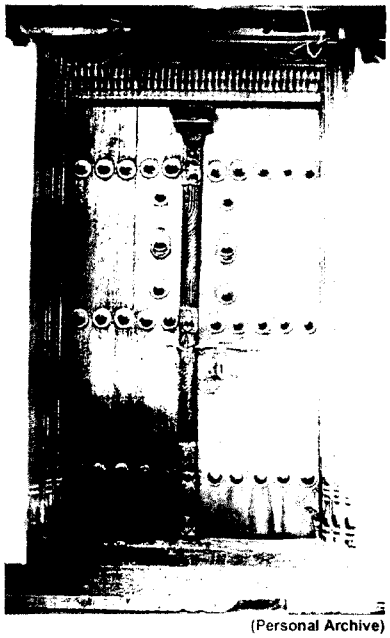
In the summer of 1999, I was part of a group of students from the University of British Columbia School of Architecture who took a summer course on Hornby Island. The purpose of this course was to design and build a small house for the Elder Housing Society of Hornby Island. This project was part of a larger plan and program initiated in 1996 that will be completed over several years. A few weeks before the course began, the students were asked to conduct research for a one-day seminar on Design/Build and the context in which the house would be constructed. The course started on site with the evaluation of a modest preexisting design scheme. Considering the complexity of documents needed for a similar project elsewhere in Canada, this modesty of design work came as a surprise to other students and me. Though simple, this preliminary work of design was the result of research that had been conducted by students of a design course offered in a previous term. The students who prepared this preliminary work were asked to summarize the essential design ingredients of a house in a schematic drawing for a small and affordable project. The whole design work consisted of a few sheets of 11"x17" papers including a plan, a section, and two elevations. Accepting this work as a point of departure over the first few weeks, our group examined the exact dimensions of architectural spaces, types of materials, use of architectural features, and specific construction details on site while construction on the house progressed. The preliminary drawings acted as a general guideline that controlled the evolution of our design concepts throughout the process. However, once the construction got under way, it was the result of work from earlier days and the order of every new day that ultimately drove the design and construction decisions. Even though we knew that there was a deadline for the Hornby course and an obligation on the part of the class to finish the house to a certain point, we never felt the pressure of time as a limitation. It seemed that time was at peace with architecture. The pace of work was determined by the quality of the work that we were producing, as well as by the quality of the life that we were experiencing. The profound effect of this experience on my understanding of architecture inspired my choice of Design/Build as the topic of my thesis.(Figure 1)

(Figure 1)

Images are Hornby Island project archives.The six images above show a visual calendar of Hornby Design/Build.

- The first image shows the conceptual site plan and general layout of houses.
- The second shows the development of the design phase by students on site.
- The third shows the construction phase, mostly done by students.
- The fourth shows clients visiting the construction site and providing their views on the designing and building processes.
- The fifth and six are images from the last day and goodbye party, held the final night on the site.

Introduction



(Personal Archive)

Introduction

General View

It is very unwise to judge any work of architecture by standardized criteria. Modern societies have developed many different methods of designing and building that fit their unique context and serve the required purposes and priorities. Judging these methods in isolation via universal criteria may demonstrate weaknesses in some areas and strength in others. True assessment of an architectural process is only possible when it is done in its own context, using the purpose and priorities that it has set for itself. In the final analysis, the purpose of each method and the preferences of a practitioner who favors or must employ a particular method will determine the actual criteria for judging the truthfulness of that method.

Corporate architecture, the architecture of style, architecture promoted by popular culture, office-centered architecture, and the architecture of Design/Build are some examples of methods that are being employed in modern societies. Each of these architectures makes use of a particular process that satisfies its purpose and answers the need of its initiator (either the client or the architect). Without bearing in mind the purpose and priorities that have been set for a work of architecture, it would be impossible to make any progress in either the design or construction process. The purpose and priorities of a process of architecture and the context in which this process takes place are the fundamental characteristics of any method. The method commonly known as Design/Build will be the focus of this essay. This paper will show how the method of Design/Build allows people to interpret and intervene in the processes of architecture, and how by handing over such authority to real users, this method enhances the living qualities of an architectural process.

A preliminary outline of the acts and attributes of Design in the method of Design/Build is provided first. In order to show the role of people (the designer, builder, client, and user) in the formation of this abstract outline, the study places some of its arguments in the context of a general historical trend. It is significant to note that this historical trend offers only a broad view to facilitate entry into the era of modern architecture. Based on this general view of history, the new division of labor in the modern practice of architecture is rejected, since it reduces the role of designers, builders, and craftsmen to mere assemblers of work. Considering that such a division did not occur in all societies simultaneously and in the same manner, the exact form and timing of such a division is not of great concern in this study. However, how it has affected the processes of designing and building in general is of great importance. Taking into account the consequences of this division, the study assumes that the modern division of labor is not beneficial to the architecture of Design/Build, and only improves the quantitative output of a building process. This division of labor is probably the

main reason why, since the advent of modern economy in developed countries, the system of production has not been able to accommodate the architecture of Design/Build.

This brief historical overview sets the stage for discussing the effect of the division between design and construction processes in a work of architecture. The production of architecture based on the quality of the living environment and the quality of the whole process of designing and building are emphasized. In other words, it is not just the end product of a process that should be valued, but also the whole experience of making the architecture. Producing architecture is not only making a building, but also rearranging the environment and recasting the players as architect, builder, or potential user. The view that a process of architecture is a full round of interaction between building, environment, and people will be echoed throughout this paper.

Laying Out the Format of this Thesis

While preparing the raw material for this paper, I found that the study of a complete process of Design/Build is outside the scope of a thesis. On the advice of my professor, I decided to confine my discussion to the first part of the subject, i.e. the Design. It seemed certain that making an artificial break in a unified process such as Design/Build would create ambiguity and misinterpretation. Designing and building are not only connected by their intimate relations, but also by the fact that in this type of architecture, the construction phase does not follow the design process in a simple sequential order. There is a dialectical interaction between these two phases throughout the process of architecture.

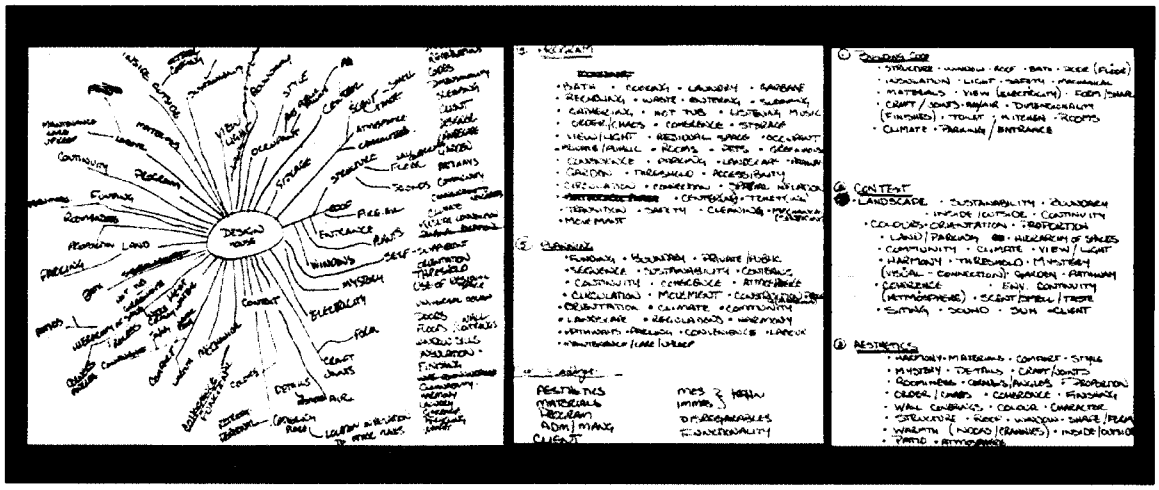
The story of design does not end at the beginning of the building process, because Design/Build as a creative process unfolds through a full cycle of interaction between people, building, and environment. Each act of construction is always being modified by a fresh design intervention, prompted by on-site intelligence. In this architecture, the meaning of design progressively evolves, as the act of designing takes place. Nevertheless, like any academic study my work must adopt some limitations in order to proceed.

To translate the raw ideas into a written work, the paper begins by defining the word Design, based on knowledge I gained through the experience of Design/Build on Hornby Island. The accuracy of this definition is largely defendable in the context of this experience. Of course, there are some general conclusions that can be drawn from this experience, but even those generalities must be applied to circumstances with a similar purpose and priorities. For example, in an architecture whose purpose is to satisfy only the aesthetic pleasure of an individual client or a privileged few, a definition of design that has been acquired from the experience of Design/Build is not entirely useful. In such a case, the main priority is given to the tastes of an individual or a group of people who constitute the sole

authority for assessing the work of architecture.

In the architecture of Design /Build, the main concern is to promote continual constructive interaction between people, building, and the environment. The level and extent of this interaction is the main criterion that should be used to assess a work of Design/Build, and basis for constructing a reliable definition of design.

After my practical experience on Hornby Island, I participated in two consecutive Design/Build seminars. The objectives of these courses were to prepare two design schemes, one for a theater and one for a small house on Hornby Island. Returning to regular classes, I incorporated debates and discussions on the theoretical aspects of the lessons that I learned from the Hornby housing project. The creative environment of both courses became a perfect place to investigate how a designer perceives a work of design. Discussion of each design proposal started with the essential makeup of the project, using vocabularies that referred to the architectural spaces, spatial arrangements, environmental elements, human factors, human relations, and finally the course of events that would lead to the formation of the building. These discussions revealed the endless ways available to perceive a work of architecture. Each student was asked to contribute words to this growing "design thesaurus" and I noticed that each word reflected the character of the person who proposed it. No matter how standardized a definition of design might be, in the final analysis it is the living experience of each individual that makes it real. Words and phrases are indicative of the ways we see architectural spaces through our experience of life. The order, the content and context of this thesaurus revealed the value of related architectural elements in a design scheme. (Figure 2)



(Figure 2)

This image shows the design tree for defining architectural components (concepts) of a house; this tree was made by the collective input of all the students in my class.
After creating the design tree, the class began to define how the words should be classified in accordance with the design stages and the fields of activity to which they belonged.

Even within a small group of students, the meaning and criteria of design were clearly not absolute or universal true. A definition becomes universal when it comes from a common experience, and is equally appreciated by everyone. This finding suggests that people's experience of life plays a significant role in both understanding and creating an agreed-upon definition of architecture. Therefore, this paper gives special attention to the role of people's life experiences in rendering the definition of design.

Later in the two design seminars, students developed some interesting schemes for both the theater and the house on Hornby Island. Despite a common design topic, each student's design scheme evolved in its own unique way, exhibiting the influences of each individual's view of the process of architecture. During the review sessions and final presentation of their work, the students performed a living scenario of their design proposal, conducting virtual tours through the designed spaces of the buildings. The performance of these scenarios brought to light the flow of human life within the imagined forms and structures of each design scheme. The movement of life acted as powerful "software", commanding the minds of the designers, and helping them to carve the forms and structures out of raw space. Observing the gestures and movements of my classmate as they narrated the events unfolding in their design schemes, I realized that there exists a well-defined geometry which regulates the flow of life into the knowledge of lines, forms, and structure of these design schemes. This geometry not only represents human life, but also helps designers to envision the interaction of the environment with architecture, and to discover the dimensions and forms that allow the buildings to be at peace with their surroundings. Relying on these skills, a designer designs and builds a livable architecture that is in tune with the environment. This geometry transforms life with all its complexity into the forms and structures of architecture. Making a desired architecture is not only knowing about the quality of life, but also about a dynamic geometry which can translate knowledge of life into a living place, and vice versa. In the architecture of Design/Build, the crucial role played by this geometry in defining the creative process of design is as important as the role of life itself. Geometry and life complement each other in both the design and the building processes while the intimacy between geometry and life liberates the view of geometry from inflexible, abstract concepts.

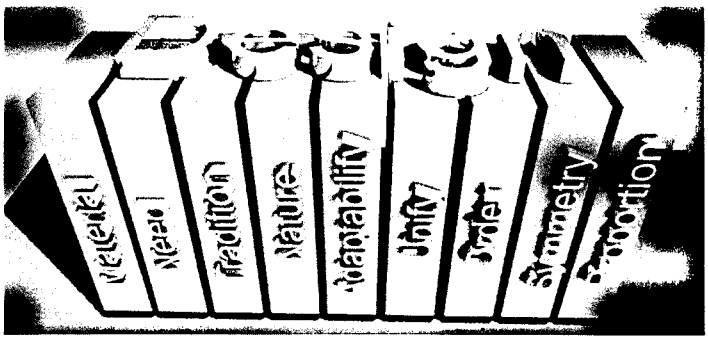
The Structure of this Thesis

Because this thesis will be presented in an academic realm, my thoughts and personal experiences had to be put into an academic context. Existing architectural dictionaries seemed the most logical place to search for a suitable framework for this purpose. Dictionaries are where many of the fundamental definitions of design have been constructed. In order to structure this thesis, I found it useful to borrow the structural format that was used

by Russell Sturgis in early 20th century to define the meaning of Design. After furnishing an abstract definition for the word, Sturgis expands the meaning of Design by linking it to nine principles; they are defined as consideration for proportion, symmetry, order, unity, adaptability, nature, tradition, need, and material. These principles are still vital to current architectural discourses. By making a connection between them and the definition of design, Sturgis transforms the original abstract outline into something more inclusive and tangible. The discussion of these principles amplifies and enlarges the capacity of the word beyond its abstract definition. (See Appendix A for more detail)

However, there are two difficulties in using this format. First, when the meaning of design is divided into smaller subdivisions, these principles are given a measure of autonomy. (Figure 3)This artificial autonomy can lead to a misperception where each principle is taken as an independent criterion for the evaluation of architecture. The second danger comes from fragmenting the meaning of architecture to a level where it becomes disintegrated, so divided that it fails to sustain any living quality. Such fatal fragmentation disassociates the meanings from the living environment that gave birth to them in the first place. To avoid these problems, each chapter in this paper will illustrate that in Design/Build, the flow of life and human intervention constantly affects the construction of those meanings. In short, the influence of life on and the intervention of humanity in the meaning of design and its principles never remain at the level of verbal definitions. Through their influence and intervention, processes of life and people reconstruct the physical structure of architecture, so that it truly corresponds to their ideas of design and its principles.

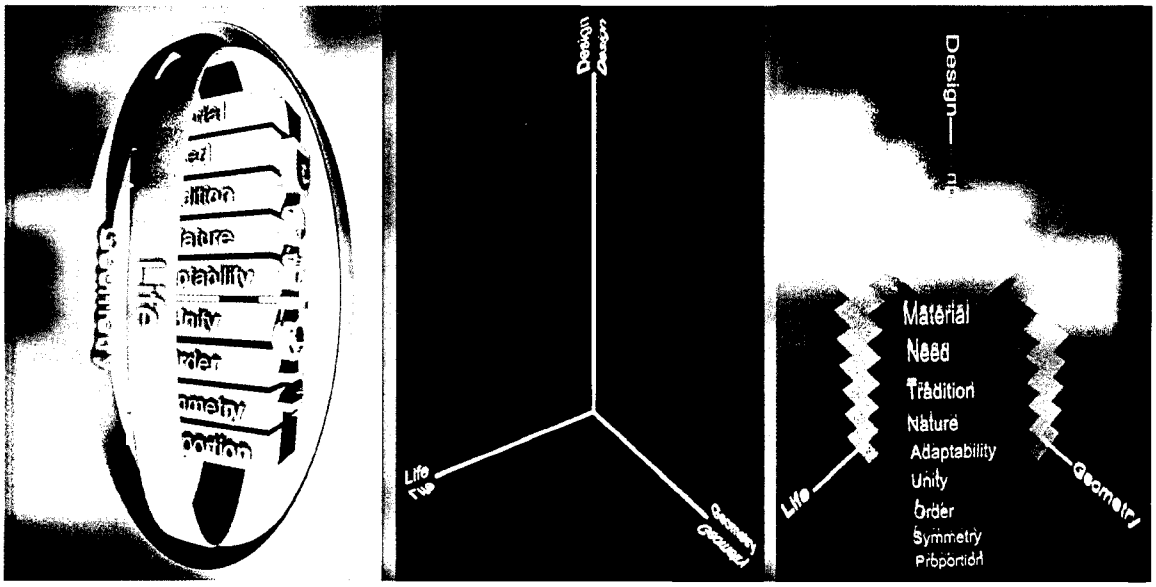
These principles act as new dimensions for design, extending the general outline far beyond its abstract limitation. They expose aspects of design not contained in an abstract view. The first category of principles includes proportion, unity, symmetry, and order, the geometrical attributes of design. Because of over-abstraction of these geometrical concepts, understanding of their real potential has been reduced to formulas and numbers. Through time they have evolved into geometrical attributes of lines and forms that represent cultural



(Figure 3)

This 3D-model is a visual representation of the conventional structure and components of design definition used by most dictionaries of architecture.

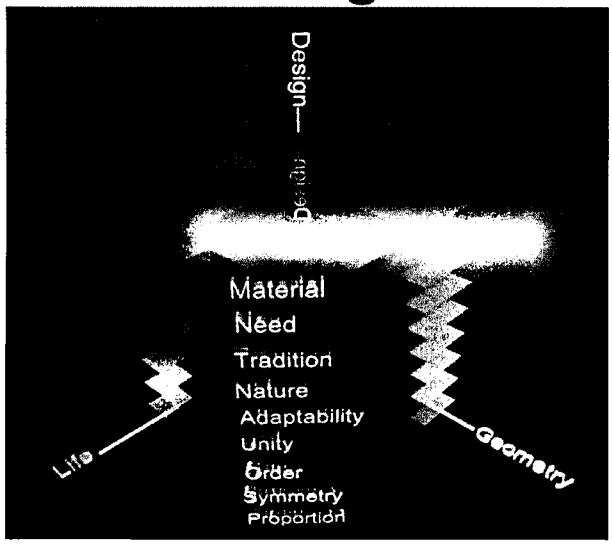
values. Most designers' look at them as lifeless means of composition, composed of abstract words and concepts. While the architecture of Design/Build gives attention to the abstract and mathematical concepts of these design attributes, it never confines itself to that level. In this study, the discussions and definitions of proportion, unity, symmetry, and order gradually depart from an abstract notion, focusing on the connection of these topics to life and the actual environment, and searching for the actual context within which these concepts are being generated by the daily experiences of life. Such a deliberate move toward the realm of life and the elements of environment seeks to reveal aspects of these attributes that are often lost through over-abstraction. Giving some weight to these aspects will advance two major ideas. First, design attributes are far more than a composition of words, lines, and forms. Their origin is rooted in the experiences and feelings of everyday life; they are a manifestation of cultural values in the structure of a man-made environment. Second, the purpose of design does not end in a self-reflexive and isolated object, but rather in a process that evolves through its own course of becoming. These ideas seem to be much easier to show in the second category of principles: which deals with consideration of adaptability, nature, tradition, need, and material - the relational values. Unlike the first category, these remaining five merge into the meaning of man-made environments and the life of the people who construct them. The task is then to reveal their geometry. (Figure 4)



(Figure 4)

The 3D-models are a graphic representation of design principles. The left one symbolizes the binding effect of life and geometry, and how these two processes integrate the fragmentation of design topics. The middle one shows the coordinates of design, and how geometry and life add new dimension to the linear concept of design. The last image shows how principles of design become integral components of a three dimensional reality of architecture. This reality comes to life in a new system of coordinates.

Design


Design
Material
Need
Tradition
Nature
Adaptability
Unity
Order
Symmetry
Proportion
Life
Geometry

The Definition of Design

In his seminal 1904 work, Russell Sturgis defines the word Design:

> The art and practice of so arranging forms and colors, or objects having forms and colors, that there are reached certain definite results intended to be agreeable to the eye and to embody some idea of the designer....
> By extension, the art of bringing to completion any visible and tangible work of human thought and skill; thus an engineer designs a locomotive, and his design for it is approved or disapproved. In a similar sense, an architect designs a building; that is, he plans it, imagines its exterior appearances, and the interiors of the halls and the larger room, and selects in advance the material for all its parts.
> The first object in designing a building is to so shape, connect, and arrange rooms and passages that they will best serve their purpose...
> These and such other general rules apply to the separate rooms or combinations of two or three rooms; but the design of the building involves the harmonizing of these spatial requirements with the more general ones of so arranging all rooms on the ground floor and those of the second floor ... that the arrangement of the windows as seen from without is harmonious, agreeable, and in strict accordance with the style of the exteriors...In practice, it is found impracticable to do this unless the architectural design is allowed a certain picturesqueness of treatment. It is impracticable in an inexpensive house to provide at once for convenience and for stately and symmetrical exterior design. So with the equally great necessity of architectural effect within the building - the much-desired stateliness is often wholly unobtainable in connection with perfect convenience; and a satisfactory result is only to be obtained when a certain freedom, as of picturesque and unexpected grouping of parts within, is allowed. The more expensive the building, the more easy it is, as a general thing, to
> obtain dignity both within and without in combination with fitness...
> (Sturgis, 770 & 771)

Sturgis's connects the definition of design with the geometrical and relational principles. The manifestation of these principles in the physical form of architecture represents the individual and social values that have given rise to the work of architecture, therefore their meanings and their role in the definition of design must go beyond abstract and intangible concepts. This is especially true in the architecture of Design/Build, as will be discussed in greater detail in the following chapters.

By defining design as a practice, Sturgis characterizes design as a verb, showing the occurrence of an action or a process. In the real world, a verb occurs as events with respect to time. From this perspective, human actions are not monotonous and repetitive patterns of events; rather they are fresh experiences of unfolding conditions. Each new experience is understood partly by the knowledge of past precedents and partly by a creative approach to each new condition. This perspective accommodates a unique approach to the process of design that is dynamic and often unpredictable, demanding creativity and the permanent presence of an intelligent element in the design and building processes.

In creating a new work, interaction between a designer and the elements of architecture are the bare minimum conditions that must be present in the process. Like any new experience, the process of making is not entirely predefined, since it inevitably will be affected by new social and environmental circumstances. A designer has no foreknowledge of the new conditions that may unfold during the design process. The ideas that a designer has gathered from previous precedents cannot be the sole basis of decision-making. New problems demand new solutions. It is vital that a designer intelligently and continuously intervene in the process. This intervention ensures that design will remain a creative course of action, capable of providing suitable answers for any new condition.

The capacity for rational thought is what separates active management of human intelligence from mute (passive) guidance of documents, drawings, or technical devices. A design process that develops into an "art of bringing to completion any visible and tangible work of human thought and skill" (Sturgis 770) must break through this passivity and blind obedience to the architectural process. Renowned physicist, David Bohm acknowledges the role of intelligence in the understanding of new problems, arguing that the answers for new conditions often cannot be found in existing knowledge.

> There is in this mechanical process no inherent reason why the thoughts that arise should be relevant or fitting to the actual situation that evokes them. The perception of whether or not any particular thoughts are relevant or fitting requires the operation of an energy that is not mechanical, energy that we shall call intelligence. This latter is able to perceive a new order or a new structure, that is not just a modification of what is already known or present in memory. For example, one may be working on a puzzling problem for a long time. Suddenly, in a flash of understanding, one may see the irrelevance of one's whole way of thinking about the problem, along with a different approach in which all the elements fit in a new order and in a new structure. Clearly, such a flash is essentially an act of perception, rather than a process of thought ... though later it may be expressed in thought. What is involved in this act is perception through the mind of abstract orders and relationships such as identity and difference, separation and connection, necessity and contingency, cause and effect, etc.
> (Bohm 51)

New ideas of design do not come from what the designer already knows, but from challenges to his intelligence in new environments. Bohm sees human intelligence as "able to perceive a new order or a new structure that is not just a modification of what is already known or present in memory." The value that the architecture of Design/Build gives to the actual attendance of a designer at the building site is based on this assumption. In this situation, the designer will be able to solve unfolding design problems interactively. No amount of drawings or technical documents can replace the creative presence of an intelligent being on the site, and the designer's presence is not an arbitrary choice. As opposed to office-centered architecture, the method of Design/Build has greatly increased the presence and intervention of the designer during the construction phase. The modesty of the design documents automatically provides ideal conditions for the intervention of the designer throughout the building process.

Sturgis' main objective in designing a building is to "so shape, connect, and arrange rooms and passages that they will best serve their purpose." Any work of design needs to have a definite purpose, and that purpose should control and shape the order of its forms and structure. When the order fully accommodates the purpose of a design idea, the result is an architecture that is fully adapted to the complexity of that purpose. This idea is a central theme in the architecture of Design/Build. [1]

Sturgis also deals with the designer's consideration for the unity or wholeness of architectural elements. He maintains that "the design of the building involves the harmonizing of these spatial requirements with the more general ones of so arranging all rooms on the ground floor and those of the second floor ... that the arrangement of the windows as seen from without is harmonious, agreeable, and in strict accordance with the style of the exteriors." The unity of architectural elements does not happen by accident, but rather as a result of the conscious implementation of order. Such order sets priorities for the use of the geometrical principles of proportion, scale, symmetry, and unity in the production of architectural forms and structures.

Not every part of a building influences the arrangement of architecture equally. The priority that order sets for a design idea determines which part of the building gets the most attention in this process. For example, some architectures emphasize "the style of the exteriors", while the others may prefer the "perfect convenience" . In Design/Build, the priority of architecture is not an issue that can be deliberately decided in isolation from other parameters. In this method, design is a process that evolves through interaction with every element of architecture. This is not to suggest that there is an absence of sequential order between designing and building, but rather that they are not seen as two separate processes. In this method, the dialogue between design sequence and the building process is constantly maintained. The idea of design does not die on the sheets of drawings, or on the documents of construction; it remains alive in the mind of the designer, an active force that motivates the on-site intervention of the architect. Consideration of all these essentials automatically ensures the unity of architectural elements, earning Design/Build the title of art, by " bringing to completion any visible and tangible work of human thought and skill."

Sturgis reveals another central issue, the conflict of good design and convenience: "So with the equally great necessity of architectural effect within the building - the much-desired stateliness is often wholly unobtainable in connection with perfect convenience; and a satisfactory result is only to be obtained when a certain freedom, as of picturesque and unexpected grouping of parts within, is allowed." Aesthetic value and exquisiteness of design (so called architectural effect) often contradicts the comfort and convenience of architecture. One important factor in this conflict is the perception of aesthetic values. Over-abstracting aesthetic ideals in architecture disconnects them from the actual processes that provoked

1- See the chapter of this thesis entitled "Adaptability in Design" where this theme developed fully.

them in the first place. Modern social and economic development has separated the practice of design from the process of building, isolating designer from builder, and both of them from the potential users of the architecture, i.e. the inhabitants. Furthermore, according to Hassan Fathy, all thee have been separated from the actual processes of production:

> Thousands of years of accumulated experience has led to the development of economic building methods using locally available materials, acclimatization using energy derived from local natural environment, and an arrangement of living and working spaces in consonance with their social requirements. This has been accomplished within the context of an architecture that has reached a very high degree of artistic expression.
> With the advent of the industrial revolution, the inherited techniques and perfected knowledge of creating, using handmade tools, were lost and now are forgotten. Energy-intensive mechanized tools have diminished man's personal, cellular contribution to the fabrication of objects, the building of structures, and the growing of food. The lesser the challenge for man to imprint his genius, the less artistic is the product.
> And however fast technology advances, however radically the economy changes, all changes must be related to the rate of change of man himself. The abstractions of the technologist and the economist must be continually pulled down to the Earth by the gravitational force of human nature. (Fathy, Natural...Vernacular Arch. P xix, xx, & xxi)

A designer who is alienated from the actual environment of the work will develop a fragmented concept of beauty. This fragmented concept replaces the art of the aesthetic with the "picturesque and unexpected grouping of parts" (Sturgis 770). These mirages of aesthetic values exhibit themselves in the form of the picturesque. They are photocopies of aesthetic ideas. The real aesthetic value is not an image separated from the context in which it is going to be placed and judged. An authentic architectural effect cannot be created in an isolated office environment but only when the designer, builder, user, and environment constantly and freely influence the formation of the architecture. The modern division of labor has mistaken the aesthetic values of architecture, leading modern works to suffer from a contradiction between convenience and architectural effect.

Two important questions have not been clearly addressed by Sturgis. First, what are the generative elements of architecture and how do they interact within the processes of design and building? And second, how does a designer obtain and develop concepts of design? That the processes of life are the principal inspiration of design ideas, and the knowledge of geometry translates these ideas into the physical structure of architecture are key assumptions in the current work. The role of life and geometry in the development of design and the production of a building are the main elements that distinguish this thesis from other works that have attempted to find a tangible meaning for the word "Design."

Life

(Personal Archive)

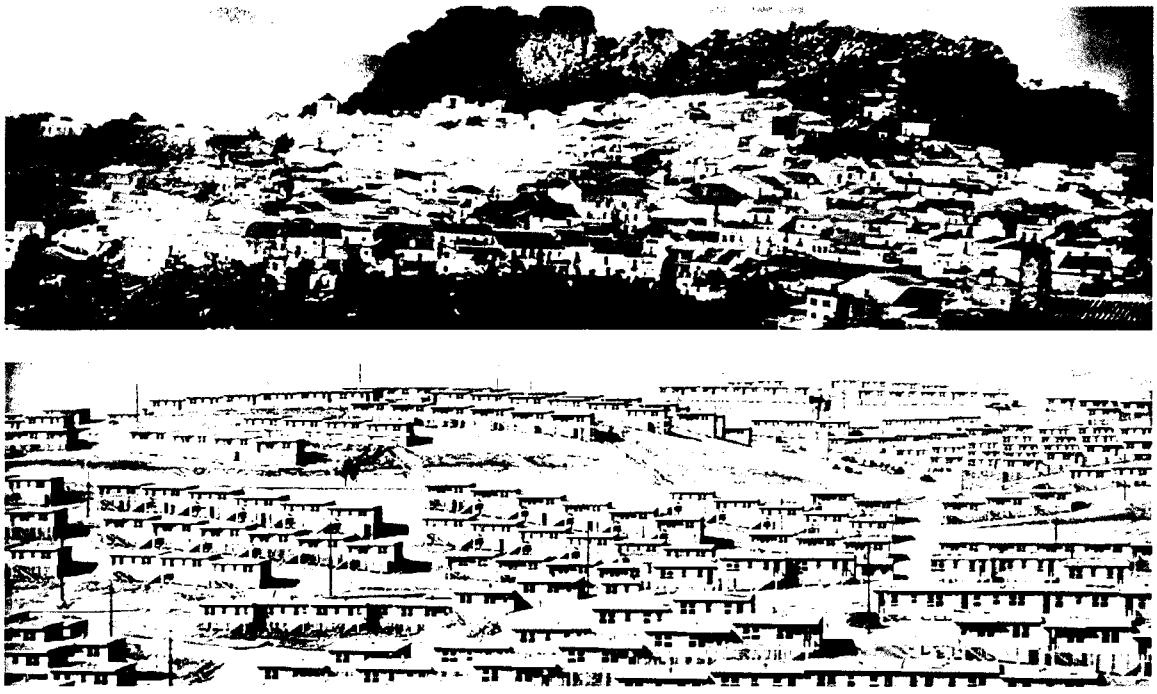
The Role of Life in Design

Life as authority in the development of design and the center of all architectural processes is the essential premise of this work. (Figure 5)

(Figure 5)

Bakhtiari folk dance: The richness of colors, simplicity of occasion and freedom of the dancers all signify the ongoing process of life. (RAINER/IRAN page 142)

Life is more than a biological entity, or an animated body. The science of biology sees life as "a quality that makes living animals and plants different from dead organisms and inorganic matter" (Encarta), something that can be externally viewed or measured. However, life as a process is made up of qualities that may not be seen or measured quantitatively. Feelings of happiness, sadness, or surprise, or the satisfaction of living in a well-ordered world cannot be defined by quantitative measures. The sense of belonging to a place cannot be evaluated scientifically. Life in architecture is more like an order of elements that distinguish lifeless buildings from the living environment. (Figure 6) The liveliness of an environment is an order that generates a genuine bond between people and architecture. It is an aspect of life that a designer learns only by going through the experiences of living. Science recognizes life in its functional aspects, its physical movements and manifestations. The life that concerns a designer resides in the quality of spaces and the feelings toward architecture that are manifested when people interact with the built environment.



(Figure 6)

Two images exemplify two different environments. Both have been constructed on similar terrain. The Banca Popolare in Verona is a successful example of vernacular architecture that illustrates the humanity, sense of community, and tranquility of a living architecture. Made by lay people with no intellectual preconception of architecture, it was designed to sustain the life of this community. The Chabot Terrace in Vallejo is a modern settlement located in the Bay area of northern California, and represents the work of modern architects and planners. There is little presence of life in this well ordered environment. (Mediterranean Vernacular page 169), (Bay Area Houses page 239).

Office-centered architecture relies heavily on building standards for the design of a living space. Overemphasizing the role of standards in architecture may optimize the physical comfort of the human body within a controlled and predefined environment, but it may fails to produce qualitative aspects of design. It defines and designs the elements of architecture based only on their functional performance. The aim of this design method is not separable from its definition of life as the "state of a material complex or individual characterized by the capacity to perform certain functional activities including metabolism, growth, reproduction, and some form of responsiveness or adaptability" (Webster's Third New International Dictionary). A design method that is based on this definition will produce a work that "function[s] at its best or [in] the most effective way." Though standards and scientific approach are necessary for any design process, they only address the functionality of architecture and the quantitative aspects of life. A clear example of this architecture is shown in Figure-6. In large mass-produced public housing projects, insufficient knowledge about the processes of life, and giving too much credit to functional aspects has produced one of the most unlivable architectures on earth.

Overemphasizing functionality narrows the perspective of a designer to what is needed for material use of the inhabitants or the functional use of an environment. But the process of life is more than the physical movements of the body. It is "the sequence of physical and mental experiences that makes up the existence of an individual: the totality of actions and occurrences constituting an individual experience" (Webster's Third New International Dictionary).

The architecture of Design/Build requires a more in-depth view of life. Life must be defined in connection with words like "living" and "alive." Design/Build not only deals with the processes of life, but also with each and every thing that affects the living environment. A regular dictionary may not contain an easily understood definition for the words like living or alive, because they refer to a wide range of processes and attributes. These words often acquire different meanings in different contexts. Linguists define these words in broad and general formats that do not serve the purpose of architects. Christopher Alexander provides a definition of the word "alive" that illustrates one of the most appealing attributes of life:

> There is a sense in which the distinction between something alive and something lifeless is much more general, and far more profound, than living things and nonliving things, or between life and death. Things, which are living, may be lifeless; nonliving things may be alive. A man who is walking and talking can be alive; or can be lifeless. Beethoven's last quartets are alive; so are the waves at the ocean shore; so is a candle flame; a tiger may be more alive, because more in tune with its own inner forces, than a man.
>
> A well-made fire is alive. There is a world of difference between a fire, which is a pile of burning logs, and a fire, which is made by someone who really understands a fire. He places each log exactly to make the air between the logs just right. He doesn't stir the logs with a poker, but while they are burning, grasps each one, and places it again, perhaps only an inch from where it was before. The logs are so exactly placed that they form channels for the draft. Waves of liquid yellow flame run up the logs when the draft blows. Each log glows with full intensity. The fire, watched, burns so intensely and so steadily, that when it dies, finally, it burns to nothing; when the last glow dies, there is nothing but a little dust left in the fire place.
>
> (Alexander, *The Timeless Way of Building* page 29 &30)

Alexander provides some interesting clues to the meaning of life in architecture. He suggests that life is not limited to the views held by science, so the criteria for assessing the aliveness of architecture may go far beyond the standards recognized by scientific studies. Those who have experienced the great works of architecture know that the qualities of life reside in these buildings. Man-made environments such as cities, streets, buildings, rooms or even the details of a structure may possess a living quality. This quality creates a connection between a work of architecture and the community that uses it. This profound quality of life sustains the biological life of inhabitants within man-made environments.

Alexander asserts that a work of architecture is alive when it is "more in tune with its own inner forces." Life can be maintained in an environment that is in complete balance

with all the acting forces of architecture, when architecture is sensitive to all things and thoughts that exert force on the processes of design. Bringing subtlety to a design process liberates design ideas from the captivity of abstract concepts and allows life to flourish. Abstract concepts, by their nature, move architecture away from the quality of life, because they intentionally ignore the fine details, variables, and complexities that are the essential characteristics of life. Even a simple structure is prone to many forces, generated by the complex and variable processes of life. Alexander analyzes the acting forces at the entrance of a house to prove this point:

> Start by walking around, looking at house entrances, paying attention to whether they feel right to you or not, whether they feel comfortable, alive...
> In the case of entrances, for instance, it turns out, in my experience, that all the good ones have an actual place, between the road and the front door, a place in which there is a change of surface; change of view; perhaps a change of level; perhaps you pass under a branch, or hanging rose, there is often a change of direction, and there is above all this actual place, halfway between the two, so that you pass first from street to this place, and then again from this place to the front door. Very often, in the best cases, this place has a glimpse of a distant view-of something, which you cannot see from the street, nor from the door, but see only for an instant in between the two. If we ask ourselves why entrance transitions are important, we recognize that they create some kind of "in-between," a bearing space between the outside and the inside-a place of perpetration, where a person can change his frame of mind, and adapt to the different conditions: from the loud, noisy, public, vulnerable, exposed feeling of street, to the private, quiet, intimate, protected feeling of indoors.
> If we try to formulate the forces governing this transition precisely, we see that they shed a great deal of light on the invariant which makes transition function.
> (Alexander, *The Timeless Way of Building*, Page 256)

Without an inclusive consideration for all these acting forces, designers cannot bring life to the design of architecture.

The other important point that Alexander makes is the essential difference between a random act of building and a conscious and creative work of design. Architecture is a knowledge-based discipline, and a designer cannot bring life to an environment without possessing that knowledge. Much of this knowledge can only be acquired by experiencing the actual processes of life: "There is a world of difference between a fire, which is a pile of burning logs, and a fire, which is made by someone who really understands a fire." Without fully experiencing the qualities of life, or understanding the meaning of life, a designer cannot hope to design a place that will sustain life.

In Alexander's view, all living things have a specific geometry that is unique to their structures. The same is true for living environments. A designer must gain knowledge of this geometry that brings life to the environment, and then place each element of design into its appropriate position. The impact of this geometry is clearly shown in the example of building a fire: "He places each log exactly to make the air between the logs just right...the logs are

so exactly placed that they form channels for the draft." This geometry not only defines the placement of each part, but also designates the spatial order that allows natural elements to freely interact with the components of structure. This geometry provides well-ordered channels for the currents of air without which the fire will die. The same is true for the geometry of architecture; it not only governs the placement of each part, but also takes into account its interaction with the elements of nature. Life does not flourish in an order less architecture but rather in a well-defined geometry. This geometry develops through the interaction of the design process with the elements of environment. (Figure 7)

(Figure 7)

The vaulted alley of Zavareh is roofed in a procession of domes. The domes are lit by openings in the center of each bay, creating a cool and ventilated space that is ideal for hot climates. Essentially the same geometry and architectural forms prevail in all the settlements at the edge of the desert region of Iran. This is a solution that comes from a creative interaction with the natural elements. Without shade and ventilation, the maintenance of life in this environment would be almost impossible. (Personal Archive)

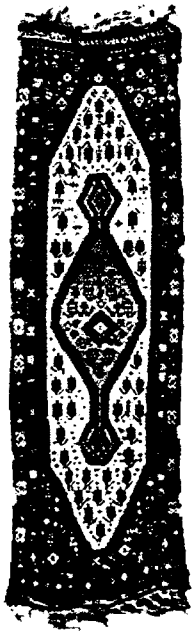
The difference between a living structure and a lifeless object is not its mortality, but rather the quality of its process of existence. A living structure has a high level of performance during its life through which it will fully exhaust itself: "Finally, it burns to nothing; when the last glow dies, there is nothing but a little dust left in fireplace." The level of performance that leads to exhaustion is an essential measure of liveliness. The fire is alive, because "it burns to nothing" in a perfect performance. When a thing that is alive dies, nature does not waste any mass or parts of it. In the case of fire, logs are transformed into heat. The same is true for architecture; a living environment does not waste any part of its structure, utilizing each and every element. Aliveness is an order through which architecture exhausts all its potential to accommodate the processes of life.

Emphasis on performance rather than function is an important characteristic that separates the architecture of Design/Build from other methods. The word performance is usually used for the processes of art, while function mostly refers to mechanical procedures. In art, the progression of actions that transforms an event into a perfect performance is

always being arbitrated by intelligent improvisation. A true process of art needs the constant intervention (fostering) of intelligent beings. The flow of life necessitates such arbitrations and intervention. These measures make the architecture of Design/Build a performance of art. On the other hand, function is always constructed on the basis of a predefined procedure.

Like mechanical procedures, functional design is based on preplanned actions. Any deviation from the predefined sequence of events will cause a breakdown in functionality. Life is the main generating force behind any design process, particularly in the method of Design/Build. Concern for life brings people, architecture, and environment to a peaceful coexistence. There are many qualities that a living work of architecture shares with biological life; recognizing those qualities allows the creation of an environment that sustains the processes of life. Life is reproducible through geometrical and relational principles that promote order, unity, symmetry, proportion, adaptability, nature, need, tradition and material. In the following sections the role of these principles in the maintenance of life in works of architecture will be discussed.

Geometry



The Role of Geometry in Design

The Oxford Encyclopedia defines geometry as following terms:

> A branch of mathematics traditionally concerned with the properties of points, lines, and surfaces, and with the way they related to each other. Thus geometry is concerned with the notions of length, angle, parallelism and perpendicularity, similarity and congruence, area and volume, ratio and proportion, but without the idea of measurement.(Oxford paperback Encyclopedia, page 566)

This common notion of geometry may satisfy the requirements of scientific encyclopedias and dictionaries, but it does not define the intrinsic roots of geometry.

Since Design/Build cultivates its design ideas on the processes of life and the elements of environment, it must find a more inclusive and less abstract meaning of geometry, a living geometry that creates a physical dimension for life and environmental processes. Persian tribes use this type of geometry in the art of kelim and rug weaving. Abstract images of birds, animals, trees, mountains, and rivers tell the tale of annual migrations. Lines, shapes, and colors are presented by an abstract geometry, yet the feelings that they transmit can be profound and concrete. The conveying power of this geometry matches the actual experience of the artist. It strongly reflects the tribal lifestyle and the environmental features of migration routes. (Figure 8)In order to penetrate deeply into the source of living geometry, the creative implications of: "the properties of points, lines, and surfaces ...[and] the notions of length, angle, parallelism and perpendicularity, similarity and congruence, area and volume, ratio and proportion" (Oxford Encyclopedia 566) must be considered. For architecture, these geometric principles are not simply abstract numeric values detached from the processes of life and the living environment. The difference between conceptual and tangible geometry provides clues for differentiating "sensible" and "intelligible" geometry:

> Know... that the study of sensible geometry leads to skill in all the practical arts while the study of intelligible geometry leads to skill in the intellectual arts, because this science is one of the gates through which we move to the knowledge of essence of the soul, and is the root of all knowledge, and the element of wisdom, and the principle of all practical and intellectual art."
> (The Sense of Unity, page 27/Ikhwan al-safa)

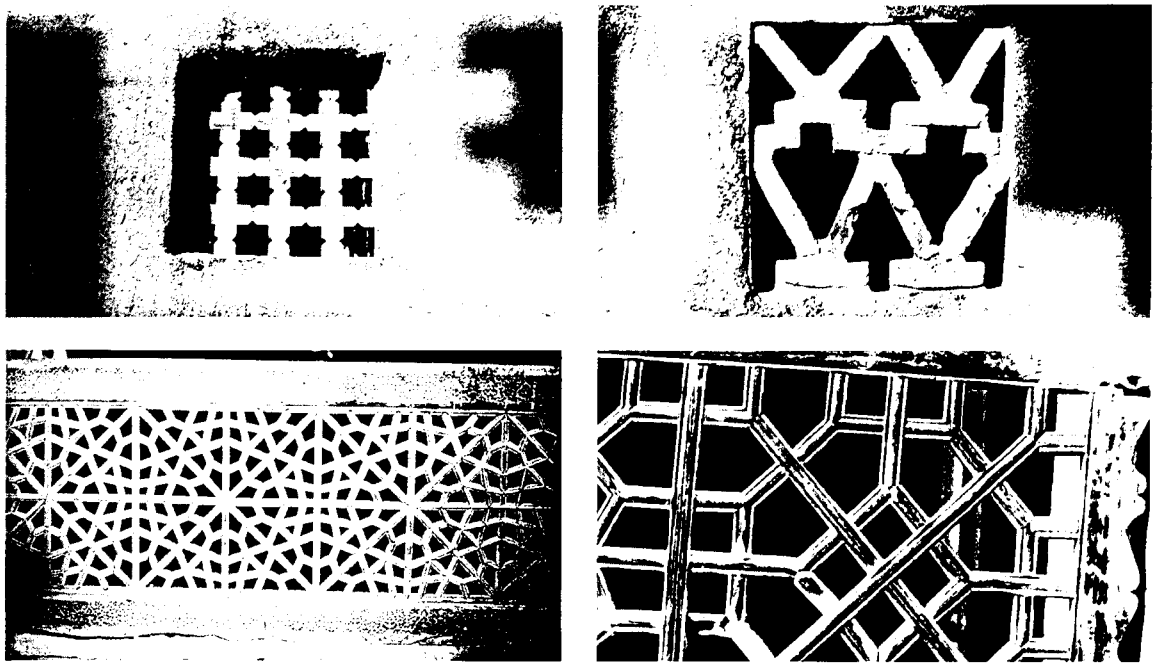
The very act of questioning the difference between a concept and a practical idea sets unique parameters on the architecture of Design/Build, distinguishing it from the methods of office-centered architecture. Questioning creates a sense of reality and purpose for the architect, a conscious process. The geometry of architecture becomes more than a conceptual arrangement of lines and forms. Axioms, properties, and rules become tools that reflect and complement the deeper geometry of life. Order, proportion, unity, and symmetry of design refer to the processes of life that occupy the space of architecture.

(Figure 8)

The Tribe Kelim illustrates migrating domestic birds and animals. Blue symbolizes the water and red is the color of earth. The abstract fish-like form that rings around the boundary of the kelim illustrate the recurrence of days and the annual rotation of the seasons. Though abstract and ambiguous to outsiders, this geometry is crystal clear to those who have experienced tribal life. Amazingly similar abstract patterns are found in the artifacts of tribes in Africa, Asia, and America, suggesting that similar lifestyles demand similar geometry. (Personal collections)

Assuming that architecture is an environment for the habitation of living beings, then "the properties of points, lines, and surfaces" of its geometry must enhance the processes of life. If architecture is an integral part of a larger ecosystem, then the way the features of its geometry are related to each other must support the natural balance of the environment. In this geometry the "notions of length, angle, parallelism and perpendicularity, similarity and congruence, area and volume, ratio and proportion" (Webster Third New International Dictionary, page 950) have their origins in the processes of life and the surrounding environment. Looking at this side of geometry enables the architecture of Design/Build to create a structure that is tangible and real.

In the architecture of Design/Build, all these geometrical principles are associated with the thoughts and actions of inhabitants and inspired by the order of environmental elements. They are the outward manifestations of the process of becoming, or of life itself, as they are a definite guideline for human behavior. Formation of this geometry is a natural response to all the existing forces in a living environment. When formed, the geometry itself becomes a lever that balances the relationship between the inhabitants, the architecture and the environmental forces. This type of geometry mostly deals with the fields and realms of living phenomena, rather than giving attention to abstract concepts of lines and shapes. (Figure 9)



(Figure 9)

The Geometric forms and patterns used in Iranian vernacular architecture are an example of this geometry that has evolved in response to the needs of everyday life. Despite its sophisticated geometrical patterns, most of the people who used this geometry did not have an academic background. The two openings in the wall are ventilation outlets; the lattices are made of wood or mud-brick. The design is a precise and direct response to human material and intellectual needs; no fixed preconception of geometry has ever influenced the process. The two wooden lattice railings have been built with detailed geometric design and experienced craftsmanship. Despite their complexity, these designs are for everyday use. (Personal Archive)

Design/Build assumes that the geometry of architecture is not independent from the processes of life. This assumption gives a specific value to the purpose of this method and sets a definite priority for its design and building practices. In Design/Build geometry is not a purposeless order of lines and masses, and it is not just an intellectual concept. Geometry goes far beyond the rules "that deal with the measurement, properties, and relationships of points, lines, angles, surfaces, and solids." It is a different level of knowledge that renders the processes of life. It generates lines, forms, and structures that capture living qualities:

> We realize then that it is just the patterns of events in space which are repeating in the building or the town... For what the patterns do is at the same time seize the outward physical geometry, and also seize what happens there... They account entirely for its geometrical structure. (Alexander, *The Timeless Way of Building,* 94)

To gain this knowledge of geometry is to understand the geometry of life itself, beginning by looking at the living events that regularly occupy architectural spaces.

The designer needs to give less credit to the physical geometry of the buildings, and understand that physical lines and forms are created by the patterns of the events

that happen in these environments. Knowing about these events, and discovering how they are related to lines and forms, provides entree to the wisdom of the tangible geometry of Design/Build:

> Those of us who concerned with buildings tend to forget too easily that all the life and soul of a place, all of our experience there, depends not simply on the physical environment, but on the patterns of events, which we experience there.
> (Alexander, *The Timeless Way of Building* 62)

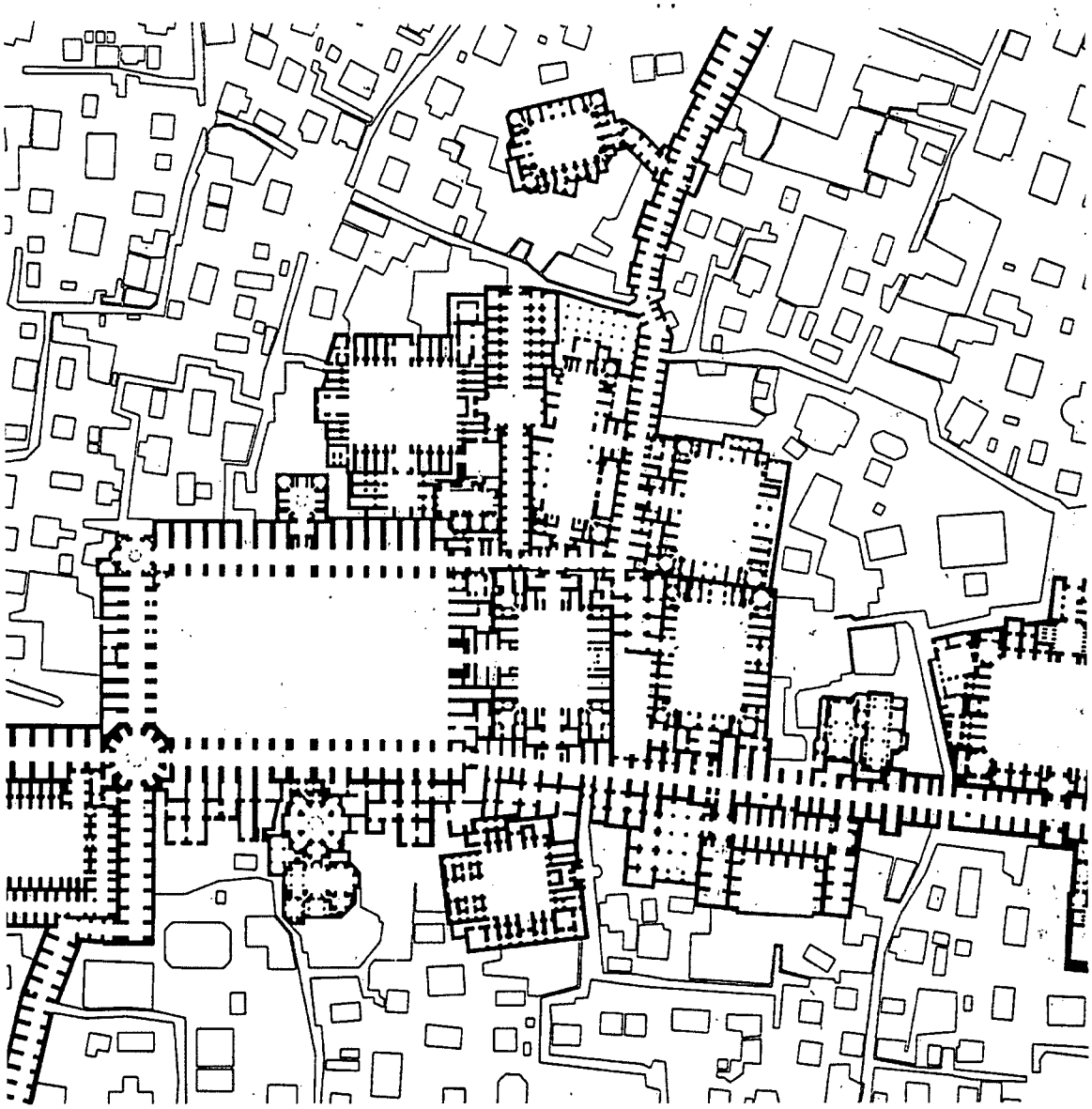
The next step is to identify how these patterns of events can be transformed into the physical structure of architecture. When the events of everyday life inspire geometry, the anatomy of architecture comes to life. Architecture that is produced by such geometry not only sustains the life of its inhabitants, but also brings life to its own physical structure. To produce such architecture, a designer needs to gain mastery in two areas: an inclusive wisdom of life, with all its sensitivities and its refined process, and a kind of geometry that allows that wisdom to be translated into the lines, forms, and structure of architecture. A designer must develop a concrete knowledge of the relationships between the progression of events and the geometry that defines their residing spaces. More than six hundred years ago, Ibn Khaldun observed the importance of this knowledge and its application:

> It requires either a general or a specialized knowledge of proportion and measurement, in order to bring the forms [of things] from potentiality into actuality in the proper manner, and for the knowledge of proportions one must have recourse to the geometrician. *(Architecture of The Islamic world* 132)

For convenience the patterns of events and their relevant geometry have been divided into two topics. In an actual process of architecture, events and geometry constantly overlap and influence one another. They are both parts of the unified entity called architecture. (Figure10)

The dialogue between geometry and actions occurring in space sets the scene for the evolution of architectural forms. Through this dialogue, the geometry acquires a concrete perception "of length, angle, parallelism and perpendicularity, similarity and congruence, area and volume, ratio and proportion." Geometry appreciates the anatomy of life. Every line and shape of architecture resonates with the rhythm of life. Every room, door, window, column, wall, tile, and brick manifests the qualities of a living environment. The knowledge of this geometry unifies the designer with the work, the people, and the surrounding environment, because these elements share the same order of life:

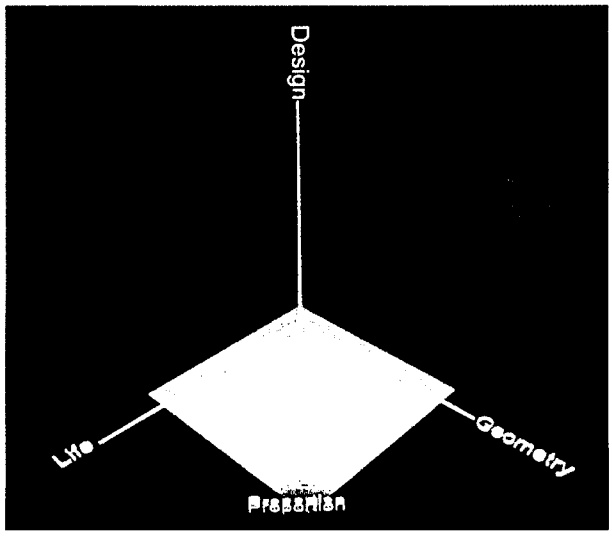
> For when a town or building lives, we can always recognize its life - not only in the obvious happiness, which happens there, not only in its freedom and relaxness - but in its purely physical appearance too. It always has a certain geometric character.
> (Alexander, *The Timeless Way of Building* 143)



(Figure10)

The formation of the urban fabric around the central Bazaar in Kerman is a clear example of the influences that geometry and patterns of events exert on one another. The urban structure began with the construction of the Bazaar, which exhibits a relatively clean-cut and ordered geometry. As time passed and the city grew, residential units were built around the center (or spine) of the Bazaar. The clean-cut geometry of the Bazaar is mixed with the random patterns of residential units. The result is a synthesis of ordered and organic geometry. Ordered geometry is introduced by the logical procedures of a public institution; organic geometry is brought about by the random events of everyday life. The new formation is created by the interaction of organic patterns of random events with the orderly intentions of the institution. Ordered geometry has set the stage for the occurrence of events, while the events occurring set the parameters for adaptation of ordered geometry. This is an ongoing process through which geometry and events overlap and reshape each other.
(Formal Structure In Islamic Architecture Of Iran And Turkistan, page37.)

Proportion



Proportion in Design

The definition of Proportion

Many of the fundamental concepts of Sturgis' definition of proportion are still applicable to modern architecture:

> That there is in the nature of things a series of agreeable relations generally applicable is a dogma, which has been almost unquestioned. But this perfect relation can only be in agreement of the object with all its conditions, as a perfect tree is differentiated into palm or oak according to latitude, and these, again, in their size and character so as to be in harmony with the several soils, ruling winds, and so on. Proportion in architecture is nothing but a relation of parts conditioned by utility, material, scale, and habit... Now a true proportion can only exist when there is a just relation between weights and supports, and if the materials or scale are changed this equilibrium is destroyed.
> (Sturgis page 775)

The kernel of Sturgis's definition of proportion lies in the concept that "there is in the nature of things a series of agreeable relations." These relations are inherited attributes and cannot be influenced by external factors. However, he warns the reader that this definition is only relevant within a presumed abstract perception of architecture: "this perfect relation can only be in agreement of the object with all its conditions." Such inherent relations are often disturbed by the many variables in the surrounding environment and exist only as abstract notions. The perfect relation is only obtainable in a fully controlled environment, or in a world of perception.

For centuries architects have tried to invent systems of proportion, which describe or formulate the inborn relations between the elements of architecture. The ratio of Golden Section[1] and the ratio of 1: v 2 been used by Islamic architects, the Fibonacci series, and many other modern systems of proportioning are examples of these efforts. Each of these systems has developed a distinct rule that is only applicable within its own mathematical dogma. Despite the originality of each of these systems, all of them have one characteristic in common: an abstract makeup that is often independent from the influence of environment. For example, the ratio of golden section has been applied in many different types of building regardless of the environment that they were designed for. This proportion has been in use since classical times, and is supposed to possess an inherent aesthetic value. The abstract makeup of this system diminishes its adaptability. Such systems are consistent within themselves because they are based on reason and not reality. Paradoxically, since their performance is not being tested against differing conditions, they have gained universal stature. An abstract system does not need to prove itself in practice, because it has been

1- For background see, The Old Way of Seeing

designed to work only at the conceptual level. When there is not an actual measure to judge the relevance of a system of proportion, then by default it is always relevant. This unquestioned relevancy gives abstract systems of proportion cross-ideological recognition.

The Systems of Proportion

One of the best-known rules of proportion is the norm of Golden Section, which has been based on a ratio of 1:618. This ratio has evolved over time and been modified from place to place. So far, the oldest known rectangular form that embodies Phi-based proportion is the King's Chamber of the Great Pyramid of Cheops, whose proportions are W=1, L=2, H=1.118, and base diagonal =2.236. A rectangular shape that represents this volume is known as a right-angled parallelepiped (RAP). In western culture the Greek letter Phi, that stands for Phideas the architect of the Parthenon, designates the rule of Golden Section.

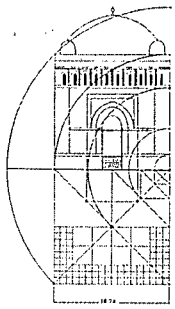
Architects have often used the ratio of whole numbers for the system of proportioning. This system uses a ratio such as 3 to 5 that is represented numerically by the Fibonacci series (1, 1, 2, 3, 5, 8, 13, 21, 34, 55, 89, 144, and so on). In the early twentieth century, Le Corbusier incorporated human scale and the Golden Section into a single system. The dimensions used in his system form two Fibonacci series in the human scale. The Red series starts at 72 inches, which is the ancient conventionalized height of a man. The Blue series starts at 89 inches, which is the height of a man with his arm raised. For larger sizes, 1.618 is used for multiplying these dimensions, and for smaller sizes 1.618 divides them. [1]

Another system of proportioning is the ratios that Frank Lloyd Wright used in his works. He preferred 1:2 ratios, where 1 and 2 are the width and length of a rectangle where the length of its diagonal is equal to 2.236. A similar system can be found Islamic Architecture. The proportion in this system is primarily based on arches drawn from the diagonals of squares[2], to drive the ratio of 1: v 2. (Figure 11) Islamic builders, artisans, and craftsmen followed this simple rule for many centuries to establish a common system of proportion throughout the buildings. This system had the advantage of deriving its ratios from the perfect square that is one of the most dominant forms in Islamic art.

Proportion in Design/Build

Three main features characterize all these systems of proportioning. First, their rules are independent of the process of architecture that they intend to inform. Second, their rules

1- For background see, http://www.geocities.com/Area51/Shadowlands/2944/cor.htm
2- For background see, The Architecture of Islamic World, page 132



Systems of proportion governing the elevation of a building, based on the tomb of the Sāmānids, Bukhara. Dimensions such as those of the dado, the door, the door-frame, and the row of upper windows are all governed by simple divisions of the basic grid. The walls form a perfect cube, while the height of the dome corresponds to the diagonal of the generating square (see pl. 17). (2)

(Figure 11)

The image shows the system of proportion governing the elevation of a building. Simple divisions of the basic grid govern all dimensions such as those of the dado[1] , the door, the doorframe, and the row of upper windows. The walls form a perfect cube, while the height of the dome corresponds to the diagonal of the generating square. (Architecture of The Islamic world, Page 132)

remain independent from the elements of environment in which the proportion of lines and forms resides. Third, they seem to be insensitive to the people who are experiencing the proportion of lines and forms. These rules have become the abstract relations that regulate dimensions of lines, forms, and structure of architecture. In this format they have lost their living expression.

Design/Build assumes the rules of proportion are the creation of human intellect and must express human needs and values. In the past, these numbers and ratios corresponded to the order of real things, the thoughts of people, and their perception of the natural world: "An egg, an apple blossom, a human face, a seashell - all embody Golden Section proportions" (Jonathan Hale, *The Old Way of Seeing*). Over-abstraction of the original ideas and rational metamorphosis of its method of implication has dissociated the rules of proportion from their tangible meaning. These rules stayed so much within the closed circle of intellectuals that they lost their human appeal. The building designed using this rule of proportion may have some semblance to the order of nature from which the rule was originally derived, but the outward manifestation cannot produce liveliness and tangibility of natural elements, as Jonathan Hale sees it:

> It is underlying pattern, not any literal representation that makes a building 'come alive.' Trees, which populate the landscape much as buildings do, are much more generally considered to be beautiful. But, as Frank Lloyd Wright said, a building should be like a tree, not look like a tree... Harmonious buildings that embody life forms refer to us they are about us. That is why we are so attracted to them.
> (Jonathan Hale, *The Old Way of Seeing*)

Reproduction of a living order is not duplicating a mechanical process, and cannot be defined by rules and sets of laws. The abstract rule of proportion cannot bring life to the

1- The lower part of an interior wall when specially decorated or faced.

environment that Design/Build intends to create. Design/Build produces architecture for living events, so abstract measures of proportion are ineffective for its use. This architecture needs a system of proportioning that recognizes the relations between people, buildings, and the environment, that imparts bring endurance, equilibrium, and harmony to these relations all at once.

> Clearly apparent, however, is the modern need for those very qualities, which the canon of proportion was supposed to impart to societies, which adopted it, qualities of endurance, equilibrium and harmony under natural law.
> (John Michelle *The Dimensions of Paradise*)

Design/Build looks for a system that can bring perfect order to "the object with all its conditions, as a perfect tree is differentiated into palm or oak according to latitude, and these, again, in their size and character so as to be in harmony with the several soils, ruling winds, and so on" (Sturgis 775). In such a system the rules are not independent from the processes of architecture, from the context within which architecture resides, or from the person who experiences the proportion. Architecture made by this system is not only proportionate within itself, but also with respect to the relevant environment. Like the leaves and branches of a tree, the lines, forms, and structure of a proportionate architecture must vary according to the social and natural environments that surround it. The proportions of lines and shapes are not divisible from the inspirations of everyday life, as Geoffrey Scott avers:

> Nothing, therefore, will serve the architect but the fullest power to imagine the space?value resulting from the complex conditions of each particular case; there are no liberties which he may not sometimes take, and no 'fixed ratios' which may not fail him. (Geoffrey Scott, *The Architecture of Humanism*, pages 230)

Design/Build considers the idea of proportion an inclusive concept that affects not only the architecture but also all aspects of human life. Proportion is a quality that is evident in all facets of life. According to Sturgis, the element of proportion is more than a simple numeric ratio. It is an architectural expression of human values. These values generate a desire for a proportional place for habitation. When the lifestyle of an individual or a society is not proportionate, the desire for proportional architecture is low. In architecture, proportion brings meaning and order to an arrangement of lines and forms but for its inhabitants, it is the confirmation of a chosen way of life. These two implications of proportion are not distinct from one another. The existence of proportion is essential for the maintenance of life in the environment, because it makes architecture meaningful and coherent: " Proportion is the nature of architecture... an innately understood grammar of shape. And that grammar, unlike speech, is expressed in all living things" (Jonathan Hale, *The Old Way of Seeing*, page 58). Like grammar, the proportion of architecture gives structure to the vocabularies of

design and makes them indicative of purpose and values. Though these qualities may not be physically tangible in and of themselves, they will manifest in architecture as qualified spaces. They make architecture a tangible and enhanced place that conveys such qualities. The process of everyday life inspires the rules of proportion, and in return the structures made by these rules maintain the ongoing process of life. In this sense, proportion of architecture and the process of everyday life complement each other.

Proportion in Tradition

Proportion is viewed as the relation between parts of a building, according to Hale:

> Proportion is the relation between two ratios: for example, a is to b as c is to d. In a building, a might be the width of a window, b its height, c the width of the wall in which the window is placed, and d the height of that wall. The window and the wall have the same proportions. (Jonathan Hale, *The Old Way of Seeing*)

However, such a limited idea of proportion does not perform optimally in the real world. Numbers and formulas cannot predefine the relation of a building to its environment, the relation of architectural parts to human behavior, the size and movement of inhabitants, and many other relations that exist in a living environment. This contradiction of reality and predefined concept affects the process of proportioning.

In traditional architecture there are a clear links between the rules of proportion, the processes of human life, and the surrounding environment. In traditional societies, laws that regulated the relationships of people with their environment were also proportional to the capacity of the natural environment. For example, the use of raw materials for a building project was proportionate to the available local natural resources. The dimension of lines, the size of structures, and the scale of buildings were all revealed through a balancing process that defined the boundaries of man within the environment.

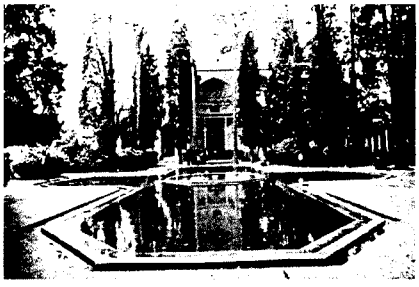
In a hot and arid climate, the scale of underground water-storage is proportionate to the duration of long periods of extreme drought. (A) The height and width of a wind-catch is proportional to the speed of prevailing winds. (B) The height of 'Eywan' and the surrounding wall of a courtyard are proportional to the length of the shadows they cast. (C) The surface area of a water-pool in a central courtyard is proportional to the aridness of climate, or maybe to the freedom of goldfishes. (D) Trees and vegetation in a courtyard are proportional to the humidity needs of the interior of the house during hot summer nights. (E) The size of a guestroom is proportional to the prosperity of the inhabitants. The number of openings and windows on the walls and the heights of ceilings in the rooms and corridors are all proportional to the need for interior ventilation. (Figure 12)

A - Naein, Iran: Underground water-storage: the water reservoir for each neighborhood is built by the collective effort of the community; the appropriate size of an underground water-storage has been derived from thousand years of experience of living in this environment. (Personal Archive)

B - Yazd, Iran, Dollatabad Garden: Wind-catches are constructed on the top of houses to provide cool air and ventilation for the inhabitants; their size is an indication of the hot and dry climate of the region. (Personal Archive)

C - Kashan, Shaded Porch and central courtyard: the image shows a typical vernacular Persian. The sunken center court is an open space surrounded by rooms and porches. Trees grow around a pool and tall walls shade the ground. The heights of the walls and the lengths of the shadows indicate the comfort this place provides on a hot and dry midsummer day. The proportion of the structure is determined by these factors, not by the prescribed calculations. (Formal Structure ... page 44)

D - Shahnemat-alah-vali Kerman: A water-pool gives a sense of repose and openness to the enclosed courtyard. The vast surface of the pool adjusts the aridness of the climate to a level of comfort. The surface area of the pool is proportional to the need of people for humidity and cool air. (Personal Archive)



E - A townhouse in Esfahan Iran has all the elements of an ideal microclimate. The trees and vegetation in the courtyard provide cool and humid air for the interior of the building. There is a delicate balance between the density of trees and vegetation and the square footage of the courtyard and interior.
Too much vegetation increases the humidity beyond the comfort level and makes the microclimate damp and soggy. Insufficient vegetation destabilizes the microclimate and inhibits the growth of trees and plants.
(Architecture The Of Islamic World page 184.)

(Figure 12)

Moreover, in traditional societies individuals in a community were bound by strong sets of moral and religious values. Individual self-expression in public was allowed, as long as it did not contradict the values held by the community. These cultural values shaped the merit of individuals with respect to their community. Obviously, merit did not have a quantitative measure; nevertheless, it provided a compelling criterion for architecture to adjust the scale of private and public space. The size of an individual's private space was proportional to the value that the community placed on that individual. Similarly the size of public spaces such as bathhouses, mosques, plazas and open theaters signified the importance of the community. (Figure 13) Generally, the dimensions of architecture were proportional to the material and intellectual needs of inhabitants. This view of proportion provided a clear understanding of relations between the components of architecture, which went far beyond the abstract and numeric ratios. It extended the idea of relations between lines and forms to the needs of those who were experiencing the architecture in their everyday life. The mathematics in this system of proportion were different from relational numbers and fixed ratios:

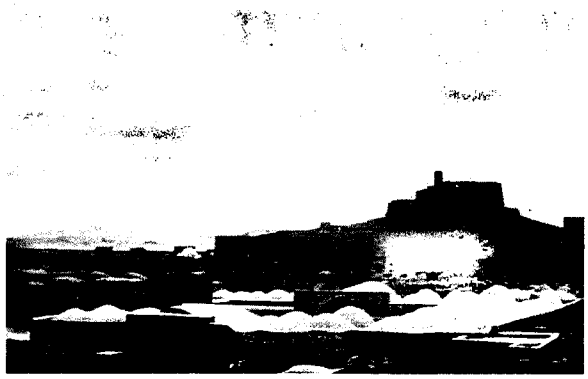
> The ancient Greeks are said to have had two kinds of mathematics. There was utilitarian arithmetic, the lower, less respected kind, which was for toting up their amphora; and then there were the number systems of harmony, the patterns of geometry and music. These belonged to the higher branch, the "better" branch of mathematics. (Jonathan Hale *The Old Way of Seeing*, page 58)

The geometry of this kind of proportion is clearly evident in the architecture of most traditional cities, where by setting an actual size for private and public realms, the system of proportion defines the freedom and restriction of individuals. The architecture becomes a guideline for human values and behavior. The scales of residential houses, commercial shops, civic buildings, and religious monuments are all proportional to prevailing social and cultural values. The size of an average house represents the status of an average citizen. The scale of commercial shops reflects the power of merchants and craftsmen, who generate economic wealth and prosperity for the community. The enormousness of a mosque or a government building is an indication of the absolute authority of religious and political institutions. (Figure 14)The status of an average citizen, the power of merchants and craftsmen, and the authority of political and religious institutions are all proportional to the overall social structure. The proportion of architecture symbolizes the positions that each of these groups occupy in the social hierarchy. Here, Proportion in architecture is more than "a relation of parts conditioned by utility, material, scale, and habit." Patterns of social life delineate the geometry of proportion in traditional architecture, as evidenced in the radial plans of the ancient concentric cities in Iran, where proximity to the center determines the status of the buildings.[1]

1- A more in-depth treatment of this subject is provided in 'The Sense Of Unity', pages 85 to 89.

(Figure 13)

The Tykeh at Zavareh: the Tykeh is a special place for religious ceremonies; the size of this type of structure is proportional to the depth and influence of religious beliefs in the society. People who live in the cities located on the edge of the central desert in Iran are famous for their religious devotion. Though Zavareh is a relatively small city, the number and size of its religious buildings is notable. The size of these public buildings is not determined with respect to other public or private structures, but rather by using the level of devotion as the measure of architectural proportion. (Personal Archive)

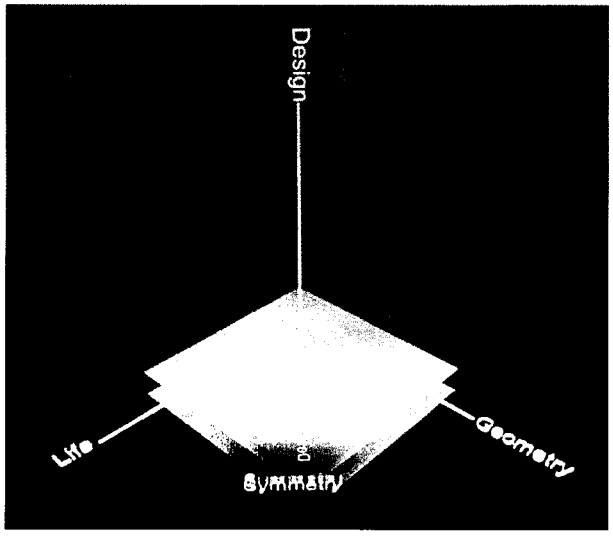


(Figure 14)

The scene shows the fortified city of Bam in southern Iran. The massive building in the upper right of picture looks even larger because it is on top of the hill, dominating the public buildings, houses, and streets of the city. When compared to the average structure in the city, this extreme proportion telegraphs the political power of its residents. The actual structures of proportion are hidden in the processes of life that occupy the structure of architecture. (Personal Archive.)

Because of its flexibility and intimate relation to society and environment, Design/ Build has the potential to incorporate the unique conditions of environment within the works of architecture. It is not enough to attend to the parameters that affect the proportion of the buildings; the designer must also choose a method of architecture that allows those parameters to be incorporated in the process of proportioning. The success of a system of proportion does not come only from the authenticity of ideas, the will of the designer and the tools of design, but also from the method that an architect selects.

Symmetry



Symmetry in Design

The Definition of Symmetries

The second element that Russell Sturgis associates with the process of design is symmetry. He shows how this well-known geometric property, seemingly conceptual at first glance, plays a role in the production of architectural spaces:

> An attempt has also been made to make a dogma of symmetry. There is (1) the symmetry in all directions, as a sphere; (2) the axial symmetry, as of a prism or a tree; (3) the symmetry to a plane, as of a man or a ship; (4) balance; (5) irregularity. What is usually meant by symmetry in architecture is symmetry on both sides of a vertical plane (3), and it is a great and arbitrary limitation of the field. There is, however, this much in symmetry: where the purpose of a building is all gathered up at a center there is likely to be an approximation to (2), or even, as far as possible, in some topes and tomb chambers, to (1). Where the purpose of a building develops as we enter it, as in an Egyptian temple, or where performers and audience have to be considered, a symmetry along the plane of action is certainly appropriate, just as the symmetry of an animal and a ship is to the planes of movements. Even where the purpose of a building is more complex, as in a house, it is probable that there should be always some attempt at balance of parts as expressive of thoughts and order; the extreme of irregularity, indeed is unthinkable." (Sturgis page 775)

Types of Symmetries in Architecture

Rotational symmetry signifies evenness around a point in the plane, or a center in the space. Rotational symmetry is caused by the revolution of a source-form around a center or a point. This type of symmetry symbolizes the idea of center in architecture.

Reflective symmetry signifies the evenness at both sides of an axis in a plane, or at both sides of an axial plane in space. In both cases reflective symmetry is caused by the balance of a source-form with respect to its mirrored image on the opposite side of the axis. This symmetry covers both number (2) and (3) in Sturgis' definition, and symbolizes the unity of opposites in architecture. From an abstract point of view, it fits the conventional definition of symmetry. Reflective symmetry is also a natural response to the plane of movements in space. (Figure15)

There is also another type of symmetry that is very close to the geometry of reflective symmetry, but has not been distinguished as a separate type by Sturgis. **Translation** symmetry occurs when a source-form moves along a horizontal axis, and generates an array of successive forms. This periodic and continuous repetition of one form along a defined path has mostly been used in the design of ornaments, row houses, and bazaars. This type of symmetry also embodies the idea of continuity in architecture. (Figure 16)

(Figure15)

Esfahan, the main Bazaar: the shops are on both sides of the path, and the movement of people along the path reveals the secrets of linear symmetry. The linear symmetry of the bazaar is the geometrical expression of the river of life that flows and interacts with architecture.
(Formal structure ...In Islamic Architecture page 30)

(Figure 16)

The ornament alongside the stairs in the palace of Perespolis is an example of this type of symmetry. The repetition of soldiers and servants who come to pay tribute to the king symbolizes the continuity and permanence of the king's reign. The appearance of these symbolic symmetries had a precise purpose and social implication in the architecture of ancient Persia. (Personal Archive)

Balance is a generic form of symmetry where there is an implicit presence of equilibrium and synchronization between the elements of architecture. Every part of the building is in harmony, acting as one to support the purpose of the architecture. All the elements of the architecture possess an equal value in their contribution to the formation of balance. This symmetry is evident in the design of Fein's Garden in Kashan. Despite its asymmetrical plan, the Garden of Fein enjoys a perfect balance of composition in its overall space. The rooms and galleries in the periphery, the row of trees around each patch, the continuity of water the in channels, the reflection of water pools, the springs and fountains, and the pattern of sidewalks have all been designed to bring tranquility and balance to the

architecture of the Garden. Balance represents qualities far beyond the simple concept of evenness. Unlike the other symmetries, equilibrium or balance is not made of two objects standing at both sides of the center. It is a state of order that maintains harmony between many lines and forms that are not necessarily identical in shape or equal in size. For this reason, it symbolizes the value of inclusiveness in architecture.(Figure 17)

(Figure 17)

In the Fein Garden at Kashan, total harmony between the elements produces balance. The lines and forms in this ambiguous and tranquil environment are overwhelmed by the enormous power of equilibrium. (Personal Archive)

Sturgis expresses a view of symmetry that is in contrast to the idea of movement: "Where the purpose of a building is more complex, as in a house, it is probable that there should be always some attempt at balance of parts as expressive of thoughts and order." Here, symmetry has been defined as an entity that brings balance to all the diverse and complex elements of the living environment. It anchors architecture to preconceived "thoughts and order." Symmetry frames all the various movements in an order of architecture, with the purpose of expressing stability and order. It balances the arrangement of forms and lines by pulling together the diverse and often opposing elements of an environment toward a single point. In this sense, the balance of symmetry symbolizes the idea of stability in architecture. This stability can be seen in vernacular settlements, where a large cluster of small houses arranged in a random pattern are pulled together by the gravitational force of a symmetrically ordered public building. The sheer mass and strong symmetry of the public building anchors the randomness of the surrounding fabric and brings stability to the whole arrangement. Another example is in the arrangement of a typical living room. Furniture, plants, paintings, sculpture and shadows cast by interior lights are placed randomly throughout the room. A beautiful rug with symmetrical patterns in the middle of the room rationalizes the chaos and randomness, and brings stability and order to the room.

Irregularity is a kind of order where the basic requirement for symmetry is not evident in the immediate surrounding of a building. This situation is also called broken symmetry or asymmetry. In this order the arrangement of lines and forms lacks symmetry, because the object is not an independent structure. It is part of a greater symmetrical order that is not visible at the local level. Broken symmetry embodies the idea of the larger whole in architecture, with the search for its source showing the way toward that larger whole.

Sometimes regularities are not observable at close range. For example, trees in the woods appear to grow in an irregular pattern, unlike the regularity of a plantation or orchards. However, an aerial view of a natural forest reveals a well-defined regularity in the growth pattern. This unfamiliar regularity has evolved from thousand years of interaction between trees and their natural environment. The position of the sun, the layers and chemistry of the soil, the direction of prevailing winds, and the slope of the land play an important role in defining the pattern of this unfamiliar regularity. The order of this arrangement does not come from a mathematical model, but from the balance of all the forces that act continually upon the trees and environment. A complete understanding of regularity involves a holistic perspective on the order of objects, and their interaction with the environment. (Figure 18)

(Figure 18)

Tunisia, ghorfas of Ksar: these granaries are long oblong rooms with a barrel-vaulted roof. The buildings cluster in fours around a central court, forming a fortified central market area called a Ksar. These structures are for commercial use only. The irregular arrangement of forms and open spaces indicates a relaxed and informal social life. The regularity of architecture is not visible in the arrangement of a few rooms or courtyards, but the overall structure suggests an ambiguous regularity that is not definable by simple geometry. Mediterranean Vernacular, page 70

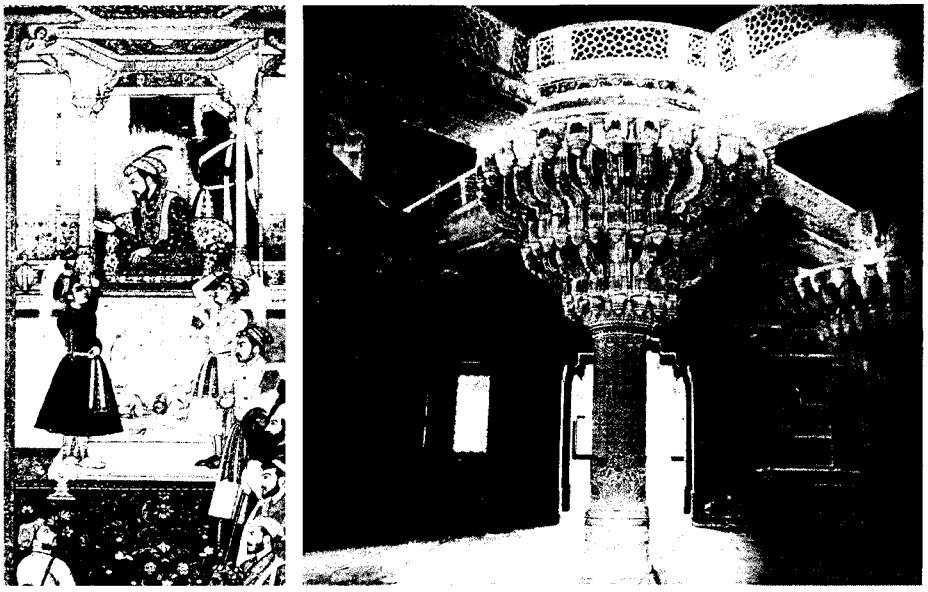
Broken symmetry is an imperfect symmetry occurring in small structures that serves the order of the larger arrangement. Often, the asymmetry of architecture at this level is in accordance with the balance (symmetry) of the forces that act on the higher structure. In *A Pattern Language* , Alexander introduces the idea of the Eccentric Nucleus, which is a

structure similar to the geometry of broken symmetry (150 - 155). He describes the geometry of a service center designed for a community of 7000. The local community is part of a larger urban structure that contains many smaller communities that congregate around a major urban center. Theoretically, the abstract concept of a service center resembles the geometry of a circle: the center is located at the core, symmetrical with respect to its surroundings. Alexander explains that the core of this community must be eccentric and structured asymmetrically, because the main urban center exerts a pull on the core of the surrounding centers. The pull exerted on the local centers is not evident in the local environment, but the geometry is there. The cause of its irregularity lies in the balance of the larger whole.[1]

Geometry of Symmetries

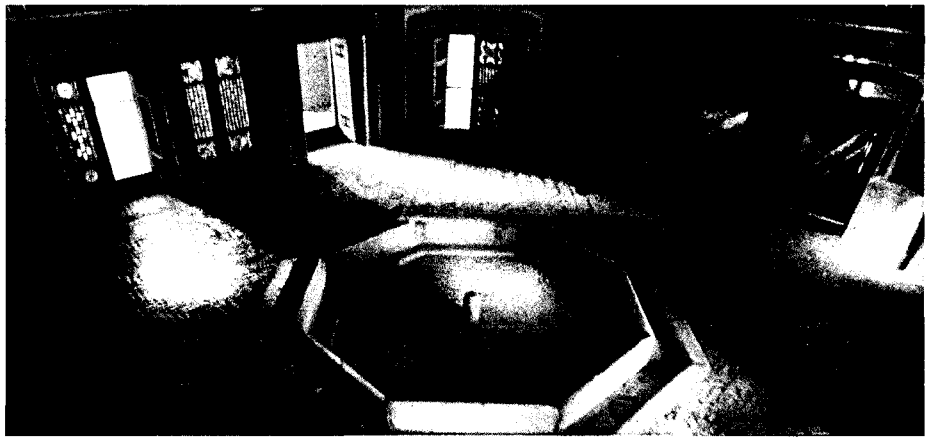
Every one of these symmetries stands for a specific geometrical order of architecture. They express the ideas of center, unity, continuity, inclusiveness, and wholeness. Symmetries represent individual and social values that have been transformed into orders of lines and forms. (Figure 19) The first step in understanding the geometry of symmetry is to define the basic constituent elements of symmetrical order. Reflective or transitional symmetry is composed of three basic elements: the axial line or plane that stands in the middle, and the two identical forms at both sides of the middle axis. Most of the time, it is the sameness of forms, which indicates the definition of symmetries. The BBC English Dictionary defines symmetry as: "the fact of both sides giving and receiving an equal amount" (BBC English Dictionary). This definition ignores an important element in the geometry of symmetry, however the axis plays a vital role in making and maintaining symmetry. In architecture all three basic elements of symmetry have an equal effect on the arrangement of space. In some cases, a center or an axis plays an even more important role than the other two elements. For example, a sculpture in an open space, a motif in the middle of an elevation, or a reflecting pool in the center of a courtyard all contribute more to the feeling of symmetry than their surrounding objects. In all these cases, an object that has been placed in the core of a space (i.e. the axis) overpowers the lines, forms and even size of its surrounding structures. The force of gravity that a central element generates imposes a balance on the overall environment far stronger than the evenness of the lines and masses in its surroundings. (Figure 20)Therefore, only a consideration of all the geometrical components of symmetry allow for its successful use in an architectural design by exploiting the full potential of each element according to its position in a symmetrical order.

1- See *A Pattern Language*, pages 150 to 155 Eccentric Nucleus



(Figure 19)

Akbar Shah was unique among the Islamic rulers of India in his vision of a universal state, drawing upon the best of all cultures and religions. His vision was manifested in this audience hall, in which the emperor's throne is placed upon a central pillar connected by bridges. Here visitors, philosophers and politicians met and argued. This building is one of the most interesting examples of symmetrical order in architecture. Akbar Shah was in search of a universal state, in which he played the central role. His relation to other cultures and religions was symmetrical, as was his place within the architectural space. The audience hall is the physical manifestation of this symmetry, with Akbar sitting equidistant to all. (Architecture of the Islamic world, Page 63)



(Figure 20)

Dollatabad Garden, Yazd: A reflecting pool and a fountain in the middle of a foyer. The movement and the sound of falling water draw all the attention. The gravity of the pool subordinates every element in the surrounding environment. The fountain becomes the focus of the symmetry, and the surrounding walls, lattice windows, door, and even the observer meld into its compositions. (Personal Archive)

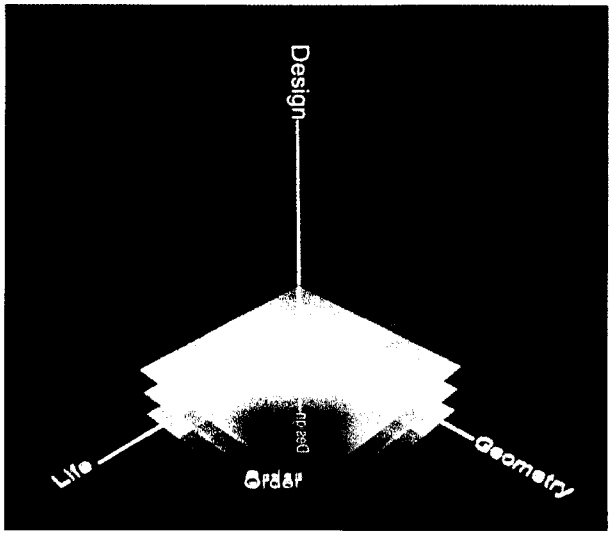
Symmetries and Their Connections to Life

Sturgis argues that the use of symmetry in architecture is usually confined to a few types of symmetries. In these types of symmetries, the scope of design is restricted to the achievement of a simple visual balance by using two identical equidistant forms "on both sides of a vertical plane." Sturgis maintains utilizing symmetries within this narrow point of view is "a great and arbitrary limitation of the field." However, bringing limitation to the field of architecture goes further than limiting choice. Viewing symmetry as an arbitrary concept limits the scope of design in architecture more than limiting the use of symmetry to a few types. Symmetries do not happen in architecture just because a designer desires them. The geometry of symmetry, and the choice of a designer to use it, is not the personal preference of a designer. In the architecture of Design/Build symmetries are formed when a designer pays attention to the particular purpose of a building: "where the purpose of a building is all gathered up at a center." If a designer follows the geometry of congregated events at the center, a natural form of symmetrical order will occur that satisfies the spatial needs of the building and its user. Such symmetries are not predetermined concepts of design; they are only revealed when a designer attends to the patterns of events in space. For Design/Build, the geometry of symmetries is not as important as the patterns of actual events that generate symmetries. Scientific study has shown that the structures of symmetries in nature are not only geometric arrangements in themselves, but also the material expressions of intrinsic laws that may not be physically tangible. To understand the geometry of these symmetries is to understand the laws that are acting upon those conditions:

> But, as time went on, it became clear that other types of symmetry occur in Nature, not related to the geometric arrangement of atoms in a molecule or in a crystal but rather to the dynamic laws of Nature.
> (Iachello Francesco, *The Search For Order In The Universe*, Page 8)

Symmetries of architecture are not simply related to the geometric arrangement of lines and forms, "but rather to the dynamic" processes of life that occupy the space. To understand the geometry of symmetries in architecture is to give attention to the rules and laws that govern the social and natural surroundings of man-made environments. Design/Build is an architectural process that can aid in the recognition and creation of symmetries. The active participation of a designer in the evolution of a design idea and full exposure to the social and natural environment are the major advantages of Design/Build. These advantages allow a designer to translate the cultural and social ideas of symmetry into the order of lines and forms, to create a tangible symmetry that accommodates people, architecture, and environment.

Order



Order in Design

The Definition of Order

Sturgis' definition of order is brief and generalized; the presence of order in architecture is the manifestation of principal human values in the lines and forms of a building. This view can be extrapolated to include every process of design and building:

> The general law in regard to these abstract considerations is desirability of order, which itself is based on convenience and on ideas derived from the harmony in nature's order. (Sturgis, page 776)

The law that governs the order of architecture is a natural outcome of people's need and desire for such an arrangement. Despite its abstract representation, the order of architecture is a precise expression of human needs. Furthermore, the idea of order in the human intellect has its source in the harmony of natural form. These two concepts are central to architecture.

Since the beginning of architectural practice, the evolution of human need has influenced the meaning and application of order in architecture. Each new school of thought has tailored the definition of order with respect to its own purpose and needs. These definitions are mostly abstract ideas that have lost their connection to everyday life. Often these abstract perceptions become the basis for ideas of order in architecture; polemics and hypothetical assumptions obscure the constructive aspects of order. Consequently, the knowledge of ordering has been reduced to abstract mathematical formulas. Order created by such design ideas is often insensitive to the needs of living environments and careless of the qualities of life in architecture, rendering the environments ordered by these design concepts incapable of sustaining the qualities of human life. The architecture of Design/Build defines the order of its work through interaction with people and the surrounding environment. There is no predefined formula for achieving order; each work of architecture establishes its order in accordance whit the needs of its users and the condition of its environment. The order of architecture does not supersede the order that is demanded by people and the prevailing lifestyle.

Christopher Alexander applies the definition of order to a wide range of activities in the process of architecture:

> Whatever we know about buildings is no more and no less than what we know about order. A building is a living order. Its life comes from its order. Its beauty comes from its order. We can make buildings well, to the extent that we understand order deeply. The building works, or does not work, according to the order which it has. In making a build-

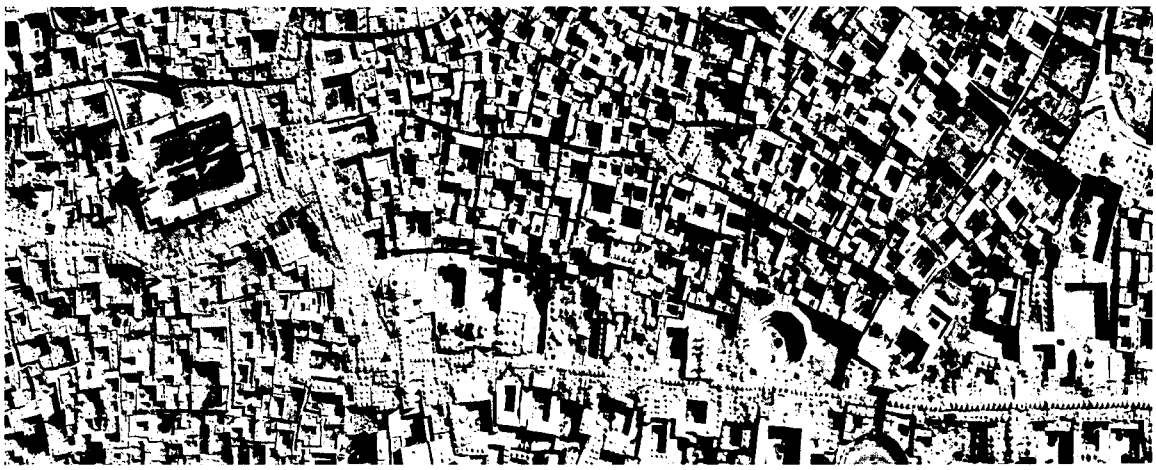
> ing, we are making order... Even a small building has an order of great complexity. In the course of laying-out and making the volume of the building, the filigree of structure, floors, windows, doors, and ornament - we face a dazzling task. How can we get the life to all this? What conception of order will create this life? (Alexander, *The Nature of Order*, Page 3 to 19)

In a conventional definition that sees order as a fixed arrangement in the elements and structure of buildings, many of Alexander view are not defensible.

To understand the significance of order and its undeniable relation to life is to conceive of architecture as a process that unfolds as it evolves. When seen as a process, each line and form that a designer adds to a work of architecture needs to be in accordance with the previous arrangement. A process is an unbroken chain of events that requires order to continue. In every process, new scenarios must follow the previous course of events, whether unexpected or preplanned. Objects are distinguished from processes by an orderly connection to the past. Architecture is based on the proper use of order. The answer to Alexander's question, "How can we get the life to all this? What conception of order will create this life?" lies in conceiving architecture as a process rather than as an object. Design/Build sees ordering of architecture as a process that evolves through the development of life and the elements of environment.

There are two major levels in defining the order of architecture. The first level defines order as an abstract concept. This definition is responsible for translating the concept of order to an applicable knowledge of design, or to a skill in the production of buildings. At this level, a mathematical model or an abstract concept often constructs the descriptions of order. These models provide a primitive logic that enables the tools of design and the machinery of building to produce the forms and structures of architecture. However, this level of defining order is unproductive unless a proper link between these models and the forces that generate order can be established. Designers tend to substitute these abstract models for a real knowledge of ordering.

The second level defines the links between the models (representations) of an order and the actual process that forms that order. (Figure 21) Defining these links lays the foundation for a comprehensive understanding of order that goes far beyond conceptual models. Unlike abstract models, this level of definition is not restricted by the rules and regulations of lines, shapes, and numbers. It's meaning expands as it comes into contact with each new environment because it defines the order of architecture not only intellectually, but also by sensitivity to the elements of its environment. Inspired by the complexity of environment, this level of definition provides endless ideas for new arrangements of architecture. It encourages architects to make use of order that is open to the requirements of society



(Figure 21)

This image is an aerial view of Kashan, showing houses, mosques, a bazaar, alleyways, and caravansaries that make up the fabric of an urban environment. In this urban landscape the order of buildings, streets, and open spaces is the result of a continuous process of evolution. This is a clear example of an order of architecture that has been generated by the processes of life. The preconception of an order does not create life in the community; it is the flow of ongoing life that creates this complex order of lines and forms. The architecture of this fabric is not in the body of buildings, but rather in the process of designing, building and inhabiting the living spaces. Without a clear understanding of the processes of life in this environment, geometrical reproduction of its arrangement does not reveal its real order. (RAINER/IRAN Page 219)

and environment.

Formal Order of Traditional Architecture

One tries to find in events old-fashioned divine governance--an order of things that rewards, punishes, educates, and betters... (Friedrich Nietzsche, *The Will to Power*)

In traditional societies, dominant religions and philosophical dogmas have shaped the order of formal architectures. The hierarchies of lines and forms in formal architecture symbolize the succession of authorities in the religious order. For many centuries, implementation of hierarchical order in buildings mirrored the stability of religious values. Examples of such order can be found in the ziggurats, pyramids, temples, and palaces of ancient civilization. Through a long process of evolution, formal architecture combined lines and forms to convey ideological messages through religious building.

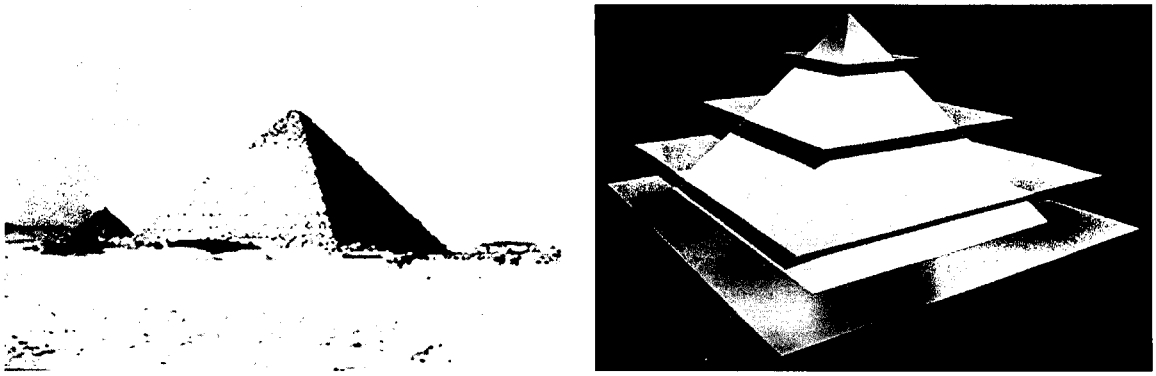
For architects of religious buildings it was important to safeguard the sacred codes of building from possible deviations. These codes were as important as the writings of sacred books; any alteration in their order would nullify the real effect of its message. Knowledge of ordering was a secret affair and had to be protected from the hands of the unworthy. Codes,

building designs, methods of construction and other related documents were concealed by the privileged class, and safeguarded as fiercely as rank. (Figure 22) Any change in the order of architecture would send a mixed message to the under-class. By possessing the knowledge of ordering, designers and builders could elevate themselves to the ranks of the upper class of priests, shamans, and royal clerics:

> Plans and other pertinent information about the design of temples were preserved in archives. The same was true for all official institutions, such as courts, public works of various kinds, and palaces. These written instructions, divinely inspired and contained on rolls of papyrus or leather, would have to be consulted by the state architect in remodeling extant buildings or replacing them with new ones. Senmut, the famous architect of Queen Hstshepsut, boasted of this privilege: "I had access to all the writings of the prophets; there was nothing which I did not know of that which had happened since the beginning." (Kostof, *The Architect.* Page 5 & 6)

The real motivation behind possessing this knowledge is not selfish nor is it an innocent desire to make an ordered environment, nor even to preserve the words of the holy books, but rather a need to accentuate (convey) the hierarchy of social classes and the prevailing worldview. Possessing knowledge of architectural order could elevate a person in the social hierarchy. The order of architecture and social order were both dictated by conditions of time and place. From this perspective, the order of formal architecture goes far beyond abstract perceptions of line and form, conveying a geometry that resembles the backbone of social and political life.

It is equally important to note that the order of architecture, based on religion or ideology, never reduces life to an abstract concept, as in the modern perception of order.



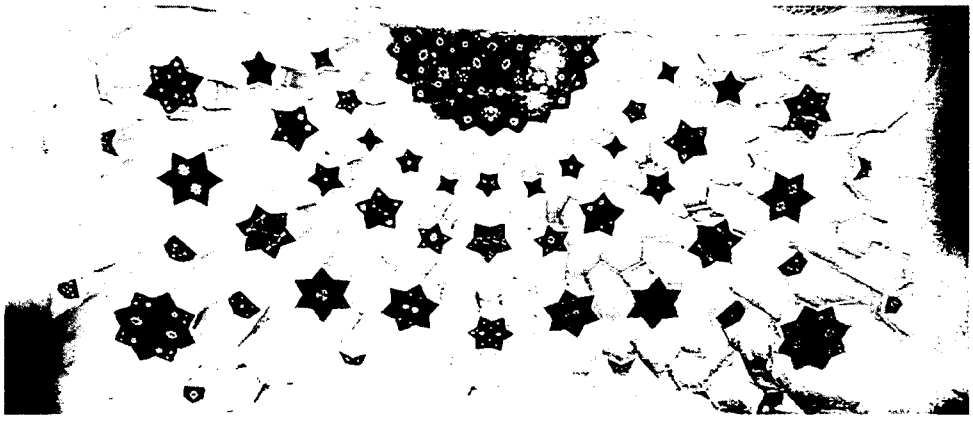
(Figure 22)

The image on the left shows the Pyramid of Menkaure in Egypt. This structure is emblematic of the religious and social order of ancient Egypt. The small pyramids in the background represent the lower rank of the ruling class. The larger one in front indicates where this Pharao was in the social order. (www.ancient-mysteries.com/index.html)The image on the right simulates the planes of social structure in the hierarchical order of the pyramid.

Traditional religion as a source of divine order has never dissociated itself from everyday life. Religion was not an isolated concept, but rather a blueprint for an active way of life. It was an ideological model for an ordered world within which people, man-made structures, and the environment coexisted harmoniously. This model evolved to its full level of subtlety through centuries of active interaction with the public and private life of people. Unlike modern ideological schools of thought, the old religious institutions had much stronger ties to the social and natural environments, a bond that linked religious ideas of order to a much wider social and natural setting (Figure 23).The ancient religious ideas of order were not the outcome of confined logical deduction, executed by intellectuals; they came from lessons learned from everyday social and natural events. As religious ideology and religious institutions grew into a powerful superstructure, they imposed order between people, and between people and their environment; the pattern of this superstructure became a familiar geometry in the order of architecture. R. D. Dripps characterizes this process:

> Architecture is derived as a consequence of the initiation of discourse enabled by the gathering. Here also, the nascent political body determines the structure of institutions that will endure each individual life and will ultimately shape the relationships among these people and between them and the earth.
> (Dripps R.D, *The First House*, page 21)

It was essential for traditional people to maintain this superstructure, since it anchored order. The order of religion gained credibility and became an inspiration for the patterns of desired



(Figure 23)

The Shrine of Shahnemat Valli: A decorative pattern in the ceiling of the southern entrance illustrates the order of stars and sun. The hierarchical order of each star to the sun, its distance, its rotation about the sun, and finally its position with respect to other stars symbolizes the relation of apprentice to master in the Sufi ideology. The rays of the sun are the enlightenment spread by the master's teaching. In this order, the distance from the master not only indicates the hierarchical position of each apprentice, but also specifies how much he may benefit from the teachings of the master. (Personal Archive)

forms in architecture.

The order of architecture goes far beyond the arrangement of lines and forms. The appearance of order in buildings is indicative of deeper elements in a process of architecture. Interaction with these elements develops Design/Build's concepts of design and the order of forms. Unlike office-centered architecture, Design/Build cannot rely on abstract concepts of order because it entertains no predefined design ideas. Ideas for design develop throughout the evolution of the building process, as does the concept of order.

Order of Vernacular Architecture

Here hills and vales, the woodland and the plain,
Here earth and water seem to strive again,
Not chaos-like together crush'd and bruis'd,
But, as the world, harmoniously confus'd:
Where order in variety we see,
And where, though all things differ, all agree. (Alexander Pope, *Windsor Forest*)

Notions of formal architecture inform collective memory. The works of Palladio and the writings of Vitruvius and Alberti are influential contributors to this perception, prompting architecture with a predetermined concept of order but the history of architecture also includes significant examples without well-defined predestined orders.
Since early civilization laymen have constructed the greater part of the habitable world, often without a preset design concept. Unlike formal architecture, most of these built structures could not survive the passage of time, but their process of design and the ways of construction are still in use throughout the non-industrial world. Designed as the architecture of habitat and daily use there was no intention to preserve them forever. These methods of architecture, mostly inspired by the order of the natural environment, are called vernacular. The key feature of this architecture is its profound and relaxed order. This order is able to administer the unpredictable course of design and building; it is well suited to a variety of lifestyles, materials, forms, and structures. The order of vernacular is also a reminder of the geometry that regulates the composition of natural elements.

In many respects the fluency and organic pattern of natural elements has acted as a blueprint for the order of lines and forms of vernacular architecture (Figure 24). In addition, the local customs and values of each community assist in the final formation of this order:

> Random order in rural Iran is most commonly found in the hot, humid region. There, due to the interaction of land ownership patterns, crop system, and bio-climatic conditions, men have built isolated units that are like single stars or nebulas in the sky but

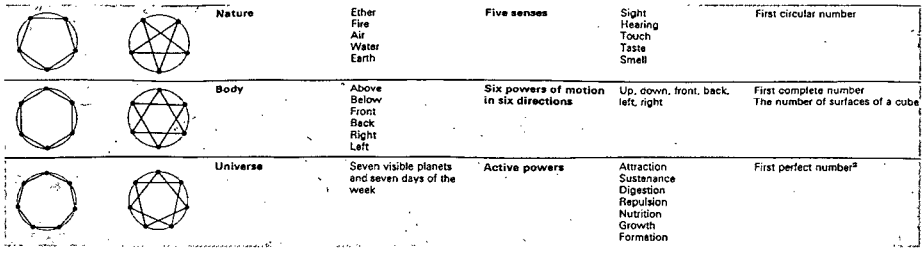
(Figure 24)

Straw-thatched wooden house, Taleschmahale, Iran: The roof is the main element, with an umbrella-like cover thatched in rings. The walls forfeit their usual role and the shade-giving roof loosely defines the balcony of the house. Space can flow easily, and its fluidity accounts for the pavilion-like arrangement (order), resulting in a spontaneous organic freedom. (RAINER/IRAN Page 41)

> that are connected by an overall pattern visible to one who has lived with the pattern for generations. (Ardalan Nader *The Sense of Unity,* page 81)

In contrast to formal architecture, the order of vernacular is less general (universal), and often specific to the social and environmental needs of each region. Unlike formal architecture, the rules and regulations of vernacular order are more democratic and less predetermined. This democracy has become the dominant feature of this order, and it provides flexibility for the adaptation of vernacular architecture to local conditions. Many of these principles remain in the architectural orders of contemporary vernacular buildings. For example, the patterns of natural elements are still the main inspiration for the geometry of vernacular architecture (Figure 25). These patterns of natural elements have inspired the order of buildings and constructed the environment of the Persian vernacular, just as they have in other parts of the world:

> Mountains, ravines, river beds, or contours of the land all serve as natural boundaries which man creates systems that show distinct random, linear, or cluster



Nature	Ether Fire Air Water Earth	Five senses	Sight Hearing Touch Taste Smell	First circular number
Body	Above Below Front Back Right Left	Six powers of motion in six directions	Up, down, front, back, left, right	First complete number The number of surfaces of a cube
Universe	Seven visible planets and seven days of the week	Active powers	Attraction Sustenance Digestion Repulsion Nutrition Growth Formation	First perfect number[2]

(Figure 25)

The geometrical interpretation of natural elements is the predominant pattern of Persian vernacular art and architecture. This pattern occurs in most decorative forms, the arrangement of architectural components, and the structural composition of domes and vaults.
(The Sense of Unity page 26)

> tendencies...The overall plan of arbitrary arrangements of individual dwellings has a uniform quality that forms a particular structure of unity that is infinitely extendable.
> (Nader Ardalan *The Sense of Unity,* page 81 & 82)

The orders of vernacular are also influenced by the values and thoughts of the people who erect these structures. Like nature, the values and thoughts of laymen have no limits because they are open to the endless possibilities of their surroundings. They are motivated by episodes of unfolding event, not blocked by the walls of concept. The uninterrupted and flexible relations that exist among vernacular communities, and between them and the natural surroundings, are explicitly echoed in the order of the lines, forms, and fabric of vernacular architecture. Hierarchical placement of forms and structure does not reflect any favored social hierarchy as it does in the order of formal architecture. Hierarchical order simply exists, because the roofs of lower dwellings provide an ideal place for the placement of upper buildings. Upper and lower is a matter of natural sequence of forms, as it has been in nature for millions of years. It is a natural response to the force of gravity. Like the geometry of mountains and hills, the layering of masses in architecture gives rise to the order of hierarchy (Figure 26).The order of vernacular does not necessarily signify any social hierarchy. Instead, it advocates a settled coexistence with the forces of gravity. The geometrical resemblance of formal and vernacular order echoes the similarity between the Pyramids of Egypt and Mount Sinai. The pyramid elevates the Pharaoh to the level of God, while Mount Sinai is the place where Moses was humbled and learned to obey the commands of God. The geometric resemblances of orders do not prove their functional similarities; it is the values and beliefs of people that give meaning to the order of structures.

In vernacular architecture, life has become synonymous with the geometry of order. Any arbitrary change to the geometrical order of vernacular will ultimately jeopardize the flow of life in the settlements. This is also true for all organic bodies in nature, where the order of elements have been deliberately designed to sustain the flow of life.

The order of vernacular buildings has some significant affinities to the architecture of Design/Build. First, this order grows out of a spontaneous response to the processes of

design and building; therefore it is flexible and democratic. Second, it is highly sensitive to the needs of inhabitants and the elements of the environment. Third, it is an order that is not made to last forever, but rather to be consumed by the people who use it. The study of order in vernacular proves that the implementation of order in architecture goes far beyond the pure arrangement of lines and masses of buildings. A designer must accommodate the

(Figure 26)

Terraced village, Fulladmahalle, Iran: Every permutation is used to build settlements on hills or southern slopes so that each house has a view of the scenery, and all the houses and courtyards, no matter how close they are to each other, can capture some of the southern sun. Over thousands of years of development, this factor has helped shape the order of this vernacular architecture, creating a hierarchical order of equal access to the sun. The same geometrical arrangement that reflects social hierarchy brings equal opportunity to the members of the community. The hierarchical order of this settlement is also an imitation of the geometry that has dominated the natural environment. (Rainer/ Iran page 59)

orders that are being generated by the force of unfolding events. Only through this dynamic and delicate process can the sustaining of life in the geometry of architecture be assured.

Changing the Old Order

The human understanding is of its nature prone to suppose the existence of more order and regularity in the world than it finds. (Francis Bacon, *Novum Organum*)

A process of architecture always goes beyond the perception of order that resides in the mind of its designer. Through this journey to new territories, a designer discovers new forms of order, overcoming the strangeness of the new. The wisdom of the new order

offers a new framework for thought and that framework becomes a shelter for new ideas. However, as time goes by, the new framework grows old and finally blocks the road to discoveries of a new order. The designer becomes conservative, settled and reconciled with the old order:

> There is nothing more perilous to take in hand, more perilous to conduct, or more uncertain in its success, than to take the lead in the introduction of a new order of things. (Niccolo Machiavelli, *The Prince*)

The old knowledge of order is not creative enough to give the designer guidance in the complexity of new the world, and thus becomes alienating. The light once meant to illuminate the road of discovery is now shadowing it. The old order must be rejected in order to create a new one. This story is the tale of any living process of entropy. Nothing remains untouched by the need for change. Every living process ultimately comes to a point where its extinction is necessary in order to give birth to a new generation. So, too does the old order of architecture.

The orders of environment never remain permanent because they are formed and inhabited by the processes of life. The inevitable decay and change that life brings into an environment will affect every essential structure of the old order. The quest to understand and answer the needs of the new environment is the main driving force behind the search for new order. Any knowledge gained from this process readjusts and reorganizes the relation of architecture to the new environment, so change in order is assisted by the accumulation of this knowledge. Thus, pushing an already established order beyond its limits, or pushing the elements of architecture beyond their ordering capacity is, in itself, an act of knowing. The knowledge of new conditions is essential for the adaptation of design to the new environment, and that adaptation is vital for maintaining life in the processes of architecture. As a general rule, any healthy process that aims to sustain life must reorder itself according to new conditions, and the processes of architecture are no exception. By rejecting the present order, a designer brings the architecture into new territory. The period of transition may seem like a state of anarchy or chaos because the foundations of the old order are at risk. Such unstable moments are not permanent. The fracturing of the old order provides the necessary conditions for the formation of a new order. Charles Jencks embraces the concept of the moment of creation being next door to chaos:

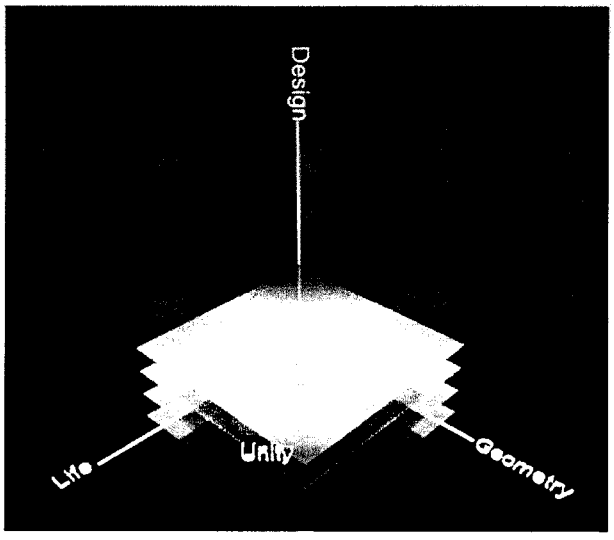
> Creativity is balanced on this knife-edge between predictability and randomness. A completely ordered or completely chaotic system is not very valuable because it cannot evolve very far; it cannot improve or progress. By contrast, a system pushed far-from-equilibrium to the boundary between order and chaos - to that crucial phase transition - is rich in possibilities...Imagine a growing sand pile, with sand being continuously funneled on top of its point until it grows to a certain critical height. We could say the pile is pushed far-from-equilibrium by the increase in sand - until it starts to col-

> lapse. At this stage it has reached 'self-organizing criticality' - the edge of chaos - and its emergent behavior is holistic, as I will explain shortly. Landslides, or avalanches, of all sizes then occur: a few big ones, more medium ones and lots of little ones...Similar conclusions have been drawn by those scientists who favor the anthropic principle, who see in the constants of nature a predisposition for development in certain favored directions. This idea of predisposition rather than predeterminism is compatible with the notion of the edge of chaos, because it features free will and choice as essential elements of an open system.
> (Charles Jencks, *The Architecture of the Jumping Universe*, page 85, 86 & 87)

As compared with the state of order, chaos is not self-reliant. It is a mode of transition that enables a designer to adjust the process of architecture to the new state of order. Chaos occurs at the moment when a designer break free of old perceptions and precedents, and searches for something new, something that fits the needs of the new environment. Chaos is a vehicle of change that delivers a designer to the next step, where the new state of order awaits. This process is ongoing for as long as people need the architecture. Changing the old order and adapting to new environments is one of the main objectives of Design/Build.

In the seemingly endless variations of order, each variant is capable of ordering the world according to its own circumstances. All the variants are equally able to bring order to the lines, forms, and structures of buildings. However, the type of order that they produce may not be the same, or always a matter of common agreement. Each and every interpretation of order is legitimate, as long as it is capable of fulfilling its fundamental promises. No interpretation should take credit for something it cannot accomplish. For example, an architecture that promises a single universal order cannot take credit for comprehensiveness, especially when it comes to the diversity of human environment. This variant may be capable of producing a universal order of architecture, but it is incapable of accommodating the subtle lines and forms that are required for the maintenance of a diversified life. The same is true for an architecture that tries to maintain cultural diversities; such a view of order is not capable of fabricating an abstract universal model of order. Any accomplishment of an order is naturally bound to the fundamental purpose of its cause, not to its visible geometries.

Unity



Unity in Design

The Definition of Unity

Another element that Sturgis associates with the process of design is unity in architecture. In his view, bringing unity to architecture is more than applying an inflexible rule of visual graphics to drawings and details of design. Unity comes from recognizing the role of a median between two extremes:

> A close study of examples of ancient art shows many minor adjustments of parts, such as the use of curved surfaces and inclined lines in Greek architecture. These refined modifications are often explained as if they were intended as optical corrections made for the purpose of making the square and the straight appear square and straight to the eye, which would otherwise misconceive them. The general principle is more certainly expressed in what a practical man would call "taking off the hardness," harmonizing the quantities by mixing them; for instance, if we look at a man or a tree we see that every part is "shaded" into the next. We may find approximations to geometrical solids in simple objects, but we are not likely to find a cube or prism forming a part of an organism. A Greek portico contains the rounded surfaces of the statues, the cylindrical shafts, the inclined pediment, and the vertical walls. The adjustment "sweetened" all these together. The ordinary theory fits only one point of view, and indeed is merely a front elevation (on paper) explanation. The "imperceptible correction" of the steps of the Parthenon, for instance, is a very obvious incorrectness, when the steps are seen from the end. The principle of "sweetening," on the other hand, is quite general, and the irregularities of Gothic work conduce to the same unity in the total result. In the simplest case it is desirable to have a mean between extremes, as for instance black, white, and gray, vertical, horizontal, and inclined; and three colors or tones, at least, are required to give color.
> (Sturgis Russell, page 776)

Sturgis introduces the technique of refined modification as a way of adjusting the parts of architecture. He also suggests the process of mixing as a way of harmonizing the quantities. In the end, he sees unity as a way of realizing the median that exists between the extremes.

Refined Modifications as a Way of Unification

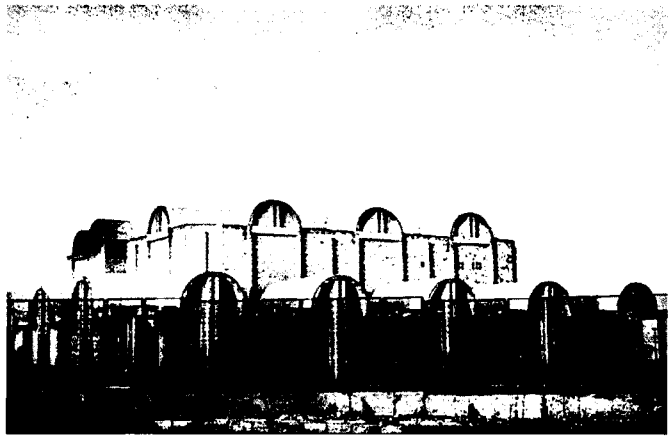
Sturgis believes the "refined modifications" that ancient designers utilized for the unification of building elements were actually optical corrections to make lines and forms identifiable to the human eye. This technique emphasizes the boundaries between the shapes and forms of buildings, where the "square and the straight appears square and straight to the eye." Human eye cannot recognize the complete geometry of an object, because they see "only one point of view." Under the best visual conditions, the human eye

can only see half of the exterior facades of an object, the one facing the viewer. Looking at a simple three-dimensional form such as a cube or a cylinder illustrates this phenomenon. From each vantage point, the viewer can only see half of the face of these objects. In order to sense the full geometry of a cube, the viewer's mind must virtually construct the other (half) of the face. To overcome this limitation an architect must provide enough visual clues so that a viewer can see visible faces in connection with the rest of the building. This is what Sturgis calls the adjustment of parts, or refined modifications. Having a complete sense of the geometry of a building is essential for experiencing the totality of architecture. The experience of unity begins by visualizing the whole geometry of the building at once. Sturgis' "adjustments and modifications" reveal the true geometry of the forms and lines. A major concern of Design/Build is to reveal the qualities of the architecture to the viewer. In the architecture of Design/Build, unity is not conceivable without providing the opportunity for the viewer to experience it.

Mixing the Quantities as a Means of Unification

Sturgis further defines unity as a process of mixing different quantities together. Unity is achieved by mixing large and small forms, long and short lines, dark and light elevations, or round and sharp edges, in short, any two opposite quantities that provide razor-sharp division in composing the elements: " the general principle is more certainly expressed in what a practical man would call 'taking off the hardness', harmonizing the quantities by mixing them...for instance, if we look at a man or a tree we see that every part is 'shaded' into the next." Unity must be seen in the context of environment; in Sturgis' example, all the lines and forms of architecture are affected by the influence of environmental elements. In the case of a man or a tree, the light source (perhaps the sun) casts shadows on the surfaces of every part. The geometry of forms in a real environment is not the same as the geometry of forms on a drawing board. In the real world "we may find approximations to geometrical solids" of but the complete realization of untainted geometry is almost impossible. In reality, the illuminated side of an object casts a shadow on the other parts and obscures the rest of the object. In more complex objects like buildings, light from a natural or artificial source casts the shadow of the upper forms on the external faces of the overlapped parts(Figure 27). This natural phenomenon consolidates the diverse geometries of the building parts into a seemingly unified and uninterrupted solid. This phenomenon has led to the use of a technique of unification in architecture that is commonly called "taking off the hardness." This technique harmonizes the quantities by mixing the geometry of the parts together. The shadows and light that make the whole a building visible override the real geometry of the forms. Knowing how the shading of one part affects the appearance of the others is the

most crucial factor in this unifying process. The architecture of Design/Build has a great advantage in this regard, because its knowledge of unification comes from the direct (hands on) experience of lines and forms within an actual environment.

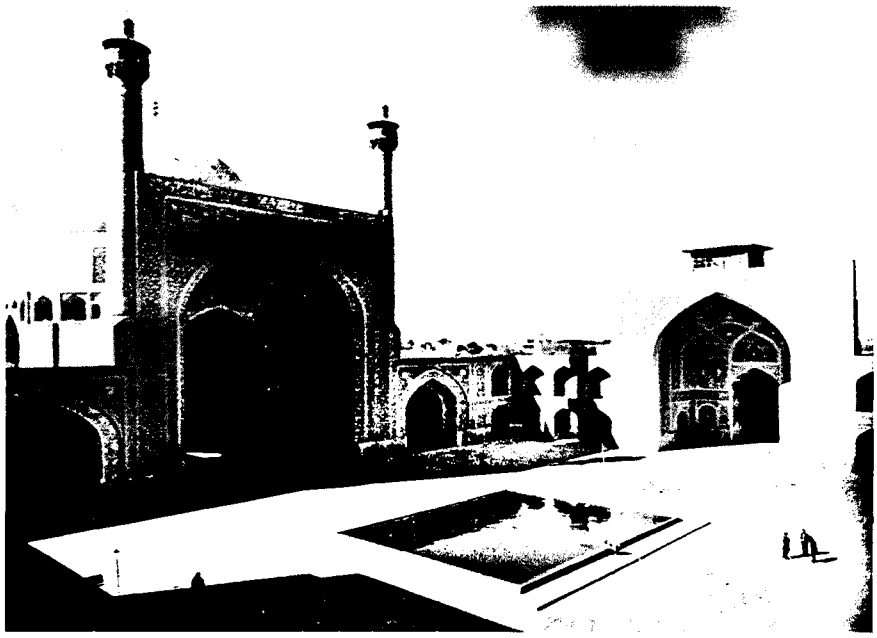


(Figure 27)

The image shows a view from the National Radio and Television, Semnan, Iran, where the over imposed decorative elements and architectural components are separate from the exterior wall, but the whole facade appear as one entity because of the effect of light and shade. The shadows casting on the wall join all the elements together. (Personal Archive)

Extending the Idea of Mixing

There is value in extending the idea of "casting shadows" to see if the same logic applies to other attributes of environment. The lines and forms of architecture continually affect one another under the influence of environmental elements. Sound and silence, variety and monotony, hot and cold, tall and short, private and public -- many attributes of architecture are subject to the same rules that govern light and shadow. Each building part constantly reflects the attributes of its surrounding environment to the adjacent parts. Such reflection transfers some of the features of each part onto the others, intensifying the bonds between adjacent lines and forms. For example, in the central courtyard of a mosque, when a soundwave hits an elevation it bounces back and hits other elevations. A person who stands in the middle of a courtyard and listens to the sounds that come from all directions feels the continuity and unity of the whole building. This effect is apparent in the Grand Mosque of Esfahan, especially in the early morning, when the call to prayer (Adzan) reverberates throughout the space. The rhythms of sound and silence, in the moments before dawn, echo from all directions, consolidating the fragmented images into one unified mass of architecture (Figure 28).



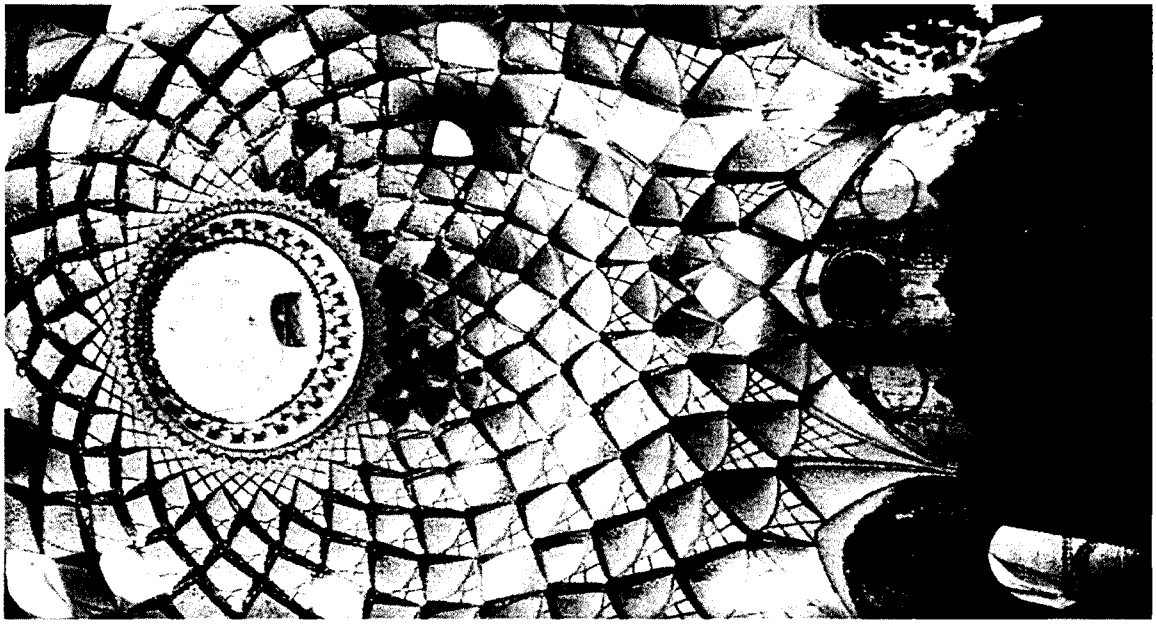
(Figure 28)

Esfahan, Shah's Mosque: the Image shows the main courtyard with 'Eywan' and recessed vaults on the periphery. The acoustic design of the mosque plays an important role in religious gatherings, where the slightest sound from any corner echoes throughout the space. Though this feature was designed functionally for communication, it plays an important role in the unification of the whole space. Echoes from all sides produce a unique sense of space that delineates the boundaries of architecture, providing a complete sense of space that enhances the experience of vision. (Ardalan Nader, *The Sense of Unity*, Page 54)

The general formula for unity comes from a proportional mix of two opposing attributes, without diminishing the original quality of each. Sturgis calls this method "sweetening." In his example of a Greek portico he notes how different geometries such as the "rounded surfaces of the statues, the cylindrical shafts, the inclined pediment, and the vertical walls" have all been merged and integrated into a single entrance structure. Taken individually, the roundness of the statue's surface, the cylindrical form of the shafts, the inclined lines of the pediment, and the verticality of the walls have little in common, not even sharing the same geometry. Their unity lies in Sturgis' " mean between extremes." Greek architects were able to find an attribute that could act as a median between opposites. This idea lays the foundation for the most fundamental rule of unity in architecture: taking advantage of opposing qualities which otherwise would contradict each other.

To avoid contradiction, designers tend to choose one of the opposing elements, which deprive their work of the advantages of the other element. Working with extreme ideas is also considered more acceptable in design, because excessive dissimilarity between two opposites makes the designer's choice easier; the lack of sufficient difference between two similar concepts makes it hard to select between them. By nature, human beings favor easy

decisions and simple ideas, but it is not the simplicity or the complexity of ideas that makes the unity of architecture profound and inclusive. The power of Sturgis' proposal lies in the concept of the mean. Unlike an extreme, the mean or median provides a wide range of possibilities for design; it reveals the endless potential solutions that exist between the two ends. It emphasizes the similarity of geometry, and the gradual transition from one end to the other. Working through the concept of mean not only unites the architecture, but also gives the designers more choice and variety (Figure 29).



(Figure 29)

Brogerdi house, Kashan: View into the dome of a living area. The ceiling patterns under the dome are designed for decoration, but they are also functional. The cap on top of the opening and the fractured surfaces on the ceiling are produced by a complex geometry. These geometric elements break the intensity and reflect the light of the exterior, creating a spectrum from light to dark. This ceiling design provides a mean that gradually reduces the intensity of the sunlight, and blends it with the dark interior space. The visibility of the light and the tranquility of the dark are both used efficiently through means of median. Furthermore, the geometrical pattern establishes a logical sequence of forms and lines that changes the height and diameter of the dome, reconciling the differences between large and small surfaces and volumes. (Personal Archive)

Unity in Practice

If unification in architecture goes beyond bringing together the lines and forms of buildings, there are other aspects of architecture that need to be united as well in order to achieve a genuine unity. Unity of architecture and inhabitants, or of building and environment, typify some of these aspects. To unify the parts within a building, a designer must fully exploit

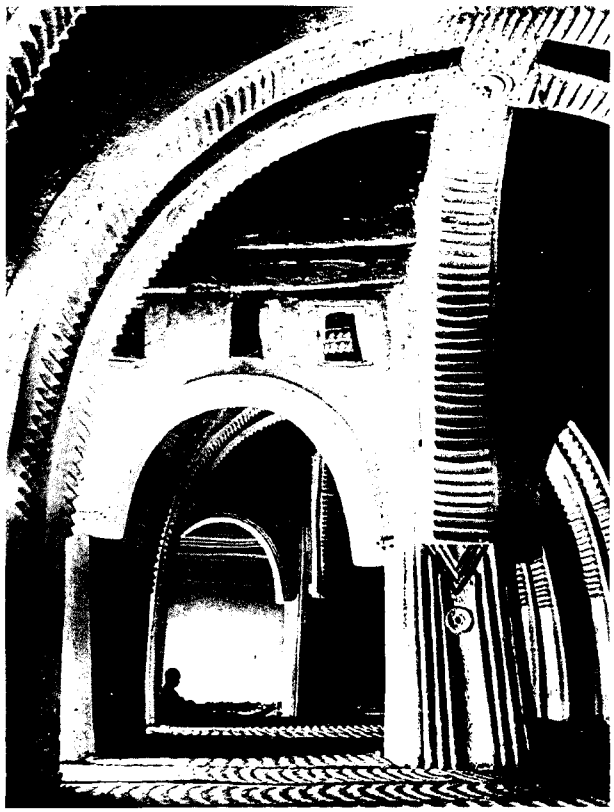
all of these aspects at once, making use of the hidden potential and the specific conditions that prevail in architecture. Frank Lloyd Wright provides advice for achieving comprehensive unity in a building:

> First - To reduce the number of necessary parts of the house and separate rooms to a minimum, and make all come together as enclosed space - so divided that light, air and vista permeate the whole with a sense of unity. Second - To associate the building as a whole with its site by extension and emphasis of the planes parallel to the ground.... Third - To eliminate the room as a box and the house as another by making all walls enclosing screens - the ceilings and floors and enclosing screens to flow into each other as one large enclosure of space...Make all house proportions more liberally human, with less wasted space in structure, and structure more appropriate to material, and so the whole more livable.... Fifth - To harmonize all necessary openings to outside or to inside with good human proportion and make them occur naturally - singly or as a series in the scheme of the whole building.... Sixth - To eliminate combinations of different materials in favor of mono-material so far as possible; to use no ornament that did not come out of the nature of materials to make the whole building clearer and more expressive as a place to live in.... Geometrical or straight lines were natural to the machinery at work in the building trades then, so the interiors took this character naturally. Seventh - To incorporate all heating, lighting, plumbing so that these systems become constituent parts of the building itself. These service features became architectural and in this attempt the ideal of an organic architecture was at work. Eight - To incorporate as organic Architecture - so far as possible - furnishings, making them all one with the building and designing them in simple terms for machine work.
> (Frank Lloyd Wright, *The Cardboard House*)

Some of Wright's eight suggestions are important clues to building a practical view of design. For example, by minimizing the number of unnecessary rooms in a house the designer consolidates the various functions into a unified space. As a result, light, air, and view will flow throughout the space and touch every corner of the building. The free movement of these natural elements intensifies the experience of unity in the house, grafting together the opposing realms of architecture (Figure 30).

A house can achieve unity if the inhabitants sense the open movement of natural elements. The relation of the house to its environment allows them to experience architecture in a larger context. Unity is not a self-contained quality. It manifests itself in the connecting force between diverse elements. The effect of this force is not confined to the attributes of the building. Unity is also the perception of a proper order that connects people, architecture, and environment; unity is realized when all these elements converge.

Architecture achieves unity when people develop a bond to their habitat and when that habitat is integrated to the environment, associating "the building as a whole with its site." Wright believes that designers are responsible for the introduction of any new object to the existing environment. Such responsibility extends the scope of unity. Architects must look for unity far beyond the buildings' own architecture, and unify buildings in the larger context of the environment.



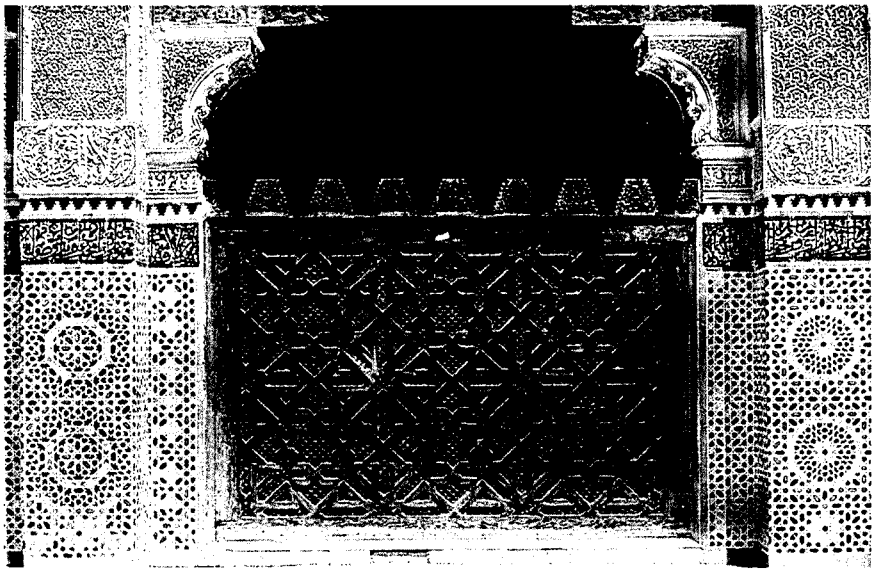
(Figure 30)

Zaria, northern Nigeria: the design of this mosque utilizes the indigenous Hausa vault of arched mud-plastered palm trunks to support the roof. The interior of the mosque clearly demonstrates the idea of a unified space. The movement of light, air, and view consolidates the various parts of the architecture into one realm. The stripes on the arches and on the fabric on the floor are borrowed from the ribbon pattern of the palm leaf. Repeating the same pattern in column, arches, and floor unifies the diverse elements of the interior architecture.
(*Architecture of Islamic World*, page 190)

Wright's caveat to make "all house proportions more liberally human" means the dimensions of a house must resonate on the human scale. A designer not only has to know about walls, windows, doors, rooms, and ceilings, but also how they relate to human dimensions and habitation. A designer needs to make a connection between the architectural information, the environmental factors, and the subtle movements of people in space. This connection lays out the true foundation for an architectural scale that incorporates all of these factors. Such a scale must be considered the key measure of architectural unity. Integrated knowledge of people's behavior and the geometry of unity in the end unify people and the dominion of architecture. In order to make the unity of architecture and people more profound, the designer must make the "whole more livable." People experience the wholeness of architecture through intimate relations with their living space; therefore it must be livable above all.

Wright suggests eliminating "combinations of different materials in favor of [what he calls] mono-material." He believes the use of a single material creates unity in the various parts of the structure. Mono-materiality becomes an axis of unity. However, the strength of a unified structure lies in its ability to bring together many diverse elements:

> Different textures and materials are unified by the geometric principles that govern their design. At the Bu-Inaniyya Madrasa, Fez, stucco, ceramic mosaic and wood of beam and screen share a common decorative conception.
> (*Architecture of the Islamic World* Page 148)

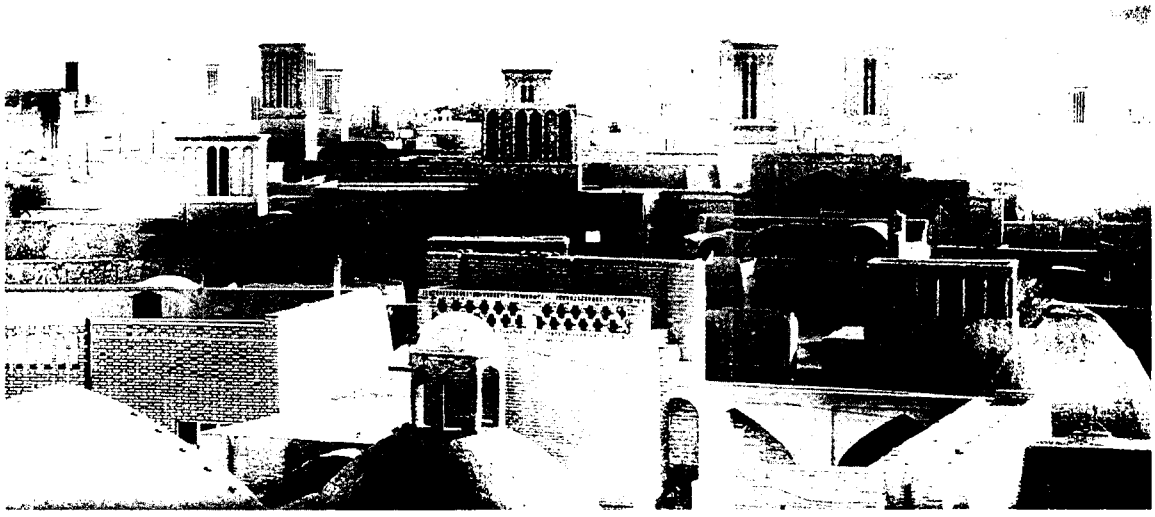


(Figure 31)

The Bu-Inaniyya Madrasa

To produce a rich architecture, designers must adopt an intelligent method that joins all the diverse qualities of materials into a unified whole. (Figure 32)

Wright also suggests that adjusting the geometry of building parts to the intrinsic qualities of the material produces a whole architecture. Each material has a natural quality uniquely its own. Based on this quality, a material has an affinity for a particular shape and geometry. The appearance of materials and the ways they can be formed are linked to their essence. Wright advises architects to "use no ornament that did not come out of the nature of materials." Architecture that fully exploits the inherent geometry of a material expresses the quality and increases the unity of the building parts. Unlike office-centered architects, the architects of Design/Build see, touch, and examine the building material on site. They are able to assess the compatibility of a material with the geometry of the form that they are designing. The flexible process of this type of design allows radical adjustments and modifications throughout the construction process. All these factors help the architect to tailor the geometry of building parts to the inherent qualities of the material (Figure 33).



(Figure 32)

The idea of diversity goes further than the use of mono or multi-materials in a building. It extends to larger structures such as the urban fabric where the diversity of building types and open spaces plays an important role in the maintenance of social life, as shown in the Roofscape of Yazd (a city in the central region of Iran). Earth and brick cover all the buildings' facades, yet the use of a few material does not override the diversity of architecture. Several characteristics of the city fabric emerge; each element of the cityscape stands as an independent structure while contributing to the totality of the fabric. Bazaar, mosque, public bathhouse, streets, houses, courtyards, 'Eywan', roof structures, and wind-catches are all woven together in a homogeneous urban pattern. The diversity of lines and forms are enhanced by the uniformity of appearance. The strength of this unity is not in the choice of mono-structure or mono-materiality, but in the intelligent composition of diversity, where the unique characteristics of each structure contribute to the richness and strength of the unified environment.(Formal Structure...page 41)

There are other issues that deal with the geometry of production and also concern the unity of architecture. Wright explains how these three parts affect an architectural process: "Geometrical or straight lines were natural to the machinery at work in the building trades then, so the interiors took this character naturally...making them all one with the building and designing them in simple terms for machine work." Unity for Wright occurs when the geometry of the parts resonates with the machine's patterns of movement. There are always certain lines and directions along which a given machine can operate more efficiently, and an operator (or designer or builder) must recognize that geometry. In architecture, the metaphorical perception that represents the mutual understanding of man and machines reveals itself in the union of lines and forms. The architecture of Design/Build's close connection to building and design processes provides an ideal opportunity for a designer to acquire a complete knowledge of the pros and cons of working tools, and to learn about the possibilities high performance tools provide for innovation.

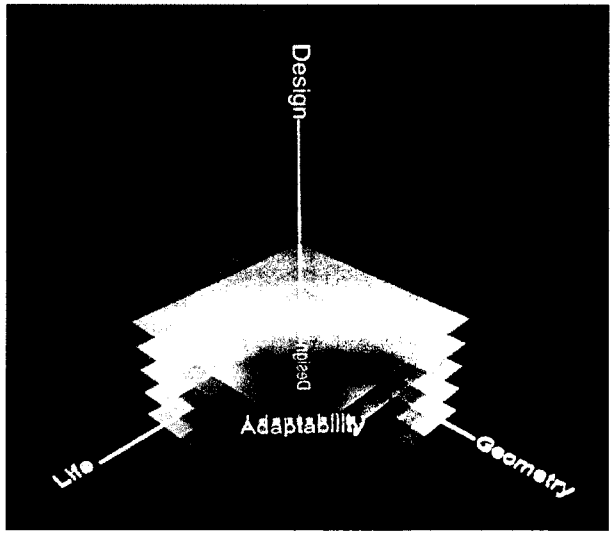
(Figure 33)

This image illustrates a creative technique of producing building parts in traditional Islamic architecture that is very similar to modern methods of Design/Build. Decisions are made through hands-on experience of the material. Obviously, a preliminary idea exists about the shape and form of each work that has been derived from past experiences but adjustments and modifications take place in the moment of making, when the person actually touches the material. This experience gives a first-hand knowledge about architecture and unifies the parts with the rest of structure, "make the whole building clearer and more expressive as a place to live in." (Frank Lloyd Wright)

A - Making a tracery window: the pattern is carved freehand on semi-dry gypsum, laid on a wooden board, and installed as a complete unit. The quick decisions required when working with volatile thin semi-dry gypsum slabs demand a great deal of knowledge about the inherent characteristics of plaster. Using plastic instead would not achieve the same effect.
(*Architecture Of The Islamic World* Page 115)

B- The another image shows the use of the same technique in making a grille for a ventilation opening. The skill needed to make this pattern on the spot comes from experience of the building material, and knowing what is the most appropriate geometry for that material.
(personal Archive)

Adaptability



Adaptability in Design

The Definition of Adaptability

Adaptability is a complex issue that encompasses subjective factors such as human needs and harmony with the elements of environment. These qualities are not measurable by universal standards, but there is one basic principle that applies to the adaptability of all architecture. The essential law of adaptability is that it proposes an exact solution to a particular problem, tailoring the general rules of design to the precise conditions of a given building.

Adaptability is another important issue Sturgis deals with; he argues that beside the general rules, which more or less lead architects toward an adaptable environment, all other issues are subjective measures:

> Essential character is another desideratum - every building and detail should be shaped so as best to express its typical character. A spire may be high; the glory of a dome is its expanse. Beyond these general rules, which we gather from a wide observation of past art - rules too negative and academically elegant for the practical builder - there are other great conditions which must ever form the positive groundwork of all progressive schools of buildings. (Sturgis Russell 777)

At first glance, this instruction does not seem a practical criterion for understanding adaptability. Adaptability must be investigated through the measures of adaptation of the architecture and its inhabitants. Then, the parameters that harmonize a work of architecture with the elements of environment must be established.

Adaptability has always been expressed through a tangible geometry that is specific to its concepts. The lines, shapes, and structure of such geometry produce particular feelings and meanings that convey the concepts of an adaptable environment. This geometry shapes the structure of the object according to the purpose that it should serve. There is a direct relation between this geometry and the intention of architecture. The meaningful order of this geometry provides a guideline for the desired behavior of the inhabitants of the building, creating architecture well matched to the performance of its users. The principles of proportion, symmetry, unity, and order of an adaptable architecture always answer the requirements of its particular context. The geometry of adaptability is always precise, and therefore the lines and forms of this architecture conform to movement and imagination. The lines, forms, and structure produced by this geometry provide an environment in which architecture can satisfy the greatest needs of its inhabitants(Figure 34).

The general rules of adaptability are not intellectual speculations, produced by individuals. They are a set of laws gathered through the careful observation of the past

precedents of architecture and setting limits for those discussions that arbitrarily ignore the traditions of architecture. Today's idea of an adaptable architecture needs to be derived from the study of tradition. Like any other architectural concept, adaptability has a past, a present, and a future:

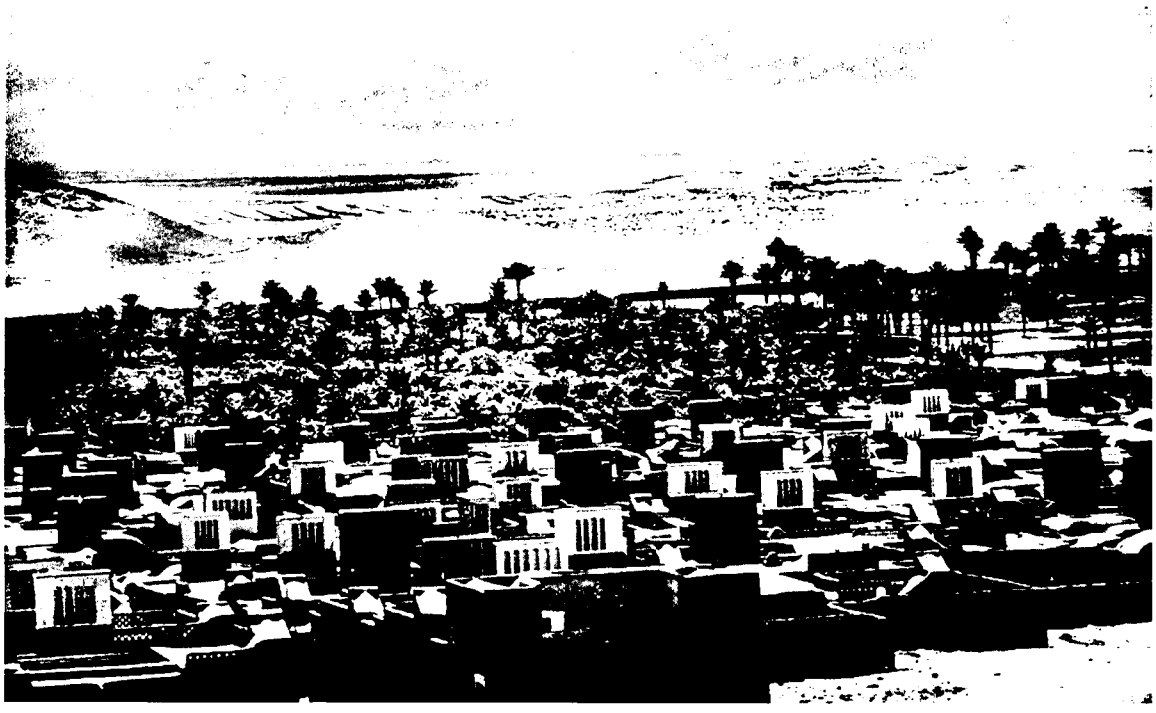
> There are traditions that go back to the beginning of human society, and yet they are still alive and will exist perhaps as long as human society does: for example, the tradition of bread making and that of brick making. Earth has been the most essential building material since the dawn of man. It has been used throughout centuries in rural housing as well as for larger and more prestigious monuments. In modern times, earth has frequently been condemned as poor, archaic and primitive, yet it has passed the test of time proving to be a versatile and viable building material, adaptable to the most diverse cultures, conditions and climate.
> (James Steele, *Hassan Fathy*, Page 7)

Adaptable architecture is a piecemeal process of trial and error through which designers find the best possible solutions for the requirements of a new environment. The process of adaptation in architecture is a continuous and unbroken course of modification that has no beginning and no end.

(Figure 34)

Abeyaneh, Iran: A raised platform by the entrance of a house provides a niche along the public alleyway where inhabitants sit and socialize with passersbys. The geometry of adaptation can be simple and inexpensive; yet its sophistication lies in detailed attention to the processes of life and environment. (Personal Archive)

Sturgis believes "rules [are] too negative and academically elegant for the practical builder," meaning they are intellectually right but lack practical appeal, because they are too general. The principle of adaptability customizes the general idea of design to the specific conditions of a given environment. Through this process, the designer adapts a work of architecture to its respective context (Figure 35).Limiting the procedure of adaptation by imposing general rules and theoretical concepts will ultimately render a design process fruitless and compulsory. A process of design becomes productive and voluntary when it utilizes the general rule of adaptability in conjunction with the needs and conditions of each individual work of architecture. This method bridges the gap between concepts of adaptation that have evolved in academia, and the actual measures needed for designing and building an adaptable environment.



(Figure 35)

Chupanan is a rural settlement in southern Iran. The architecture, arrangement, and orientation of the building have been adapted to the requirements of the natural environment. Trees and vegetation encircle the whole village; these green belts create a relatively large-scale system of air conditioning, creating a cool moist microclimate within a hot dry desert landscape. Wind-catches (Bad-gear) have been built on top of each house to face the prevailing wind. Each device has a shaft with an opening on the sides, extending down to allow the breeze to reach the interior of the house. The wind is filtered through the moist water-tank in the basement, generating cool, moist air and avoiding the problem of screening that results from the blocking of buildings in ordinary planning. Direct contact with the local environment makes the design of such an ingenious device possible.(RAINER/IRAN 159)

Sturgis notes, " there are other great conditions which must ever form the positive groundwork of all progressive school of buildings," implying that adaptability does not end with the contemporary theories and practices of architecture. These ideas must progress and evolve by taking advantage of every discovery about the new environment. A great portion of the knowledge that will assist in the design of a new adaptable architecture lies ahead, not behind:

> Looking to the future, we see that the situation at any given time largely determines the coming stage in development and change...[we must] try to bridge the existing gap in its development by analyzing the elements of change, applying modern techniques to modify the valid methods established by our ancestors, and then developing new solutions that satisfy modern needs.
> (Hassan Fathy, *Natural Energy and Vernacular Architecture*, page xxii & xxiii)

The new practical knowledge of adaptability that guide a design process, is not a concept frozen in time and place, nor is it rigidly framed in rules and regulation from the past. It is a progressive course of understanding that unfolds and feeds on each new experience and condition. The definition of adaptability is linked to the future, where architecture must reinvent its geometry in order to accommodate the requirements of new environments and the needs of new lifestyles.

Developing a Geometry for Adaptability

Each work of architecture serves a particular purpose and a group of buildings that serve a similar purpose often develop a common geometry.(Figure 36) For example, most industrial buildings share a geometry that makes them distinguishable from residential or commercial buildings. The dominance of this geometry is not the outcome of a subjective design decision made by an individual architect. This geometry has evolved along with industrial architecture. It is based on careful consideration of the production line, movement of the workforce, and so on. This geometry generates forms and structures that suit the industrial environment, adapting the working environment to the specific needs of industry. Without this geometry a factory cannot provide a healthy environment for its workers a proper circulation of raw material and produced commodities, or a place that is favorable for the performance of its machinery. Residential, commercial, or other types of building made to accommodate a specific type of event must develop a similar relationship between this geometry and its optimum level of performance.

As Sturgis notes, the idea of this geometry has been gathered "from a wide observation of past art" and will improve with the study of the new environments. Architecture must always provide freedom for the development of new geometry that might alter and

revolutionize existing concepts of adaptation. Such freedom paves the way for the design of forms and structures that are often more adaptable to new conditions.

The compatibility of architecture with the need of people, and the agreement of the lines, forms, and structure of architecture with elements of the surrounding environment are equally important for creating an adaptable architecture. Because of the dialectical approach to the design process used in Design/Build, this method synthesizes the feedback from social and natural environments with the essential principles of architecture. Through this process it creates an adaptable building. Unlike other methods of architecture, Design/Build is highly dependent on its immediate and working environment, and must coexist with its surroundings. The human desire for coexistence becomes visible in the work of architecture through a specific geometry of adaptability.

• Adobe architecture of New Mexico:
(http://www.santafeconnections.com)

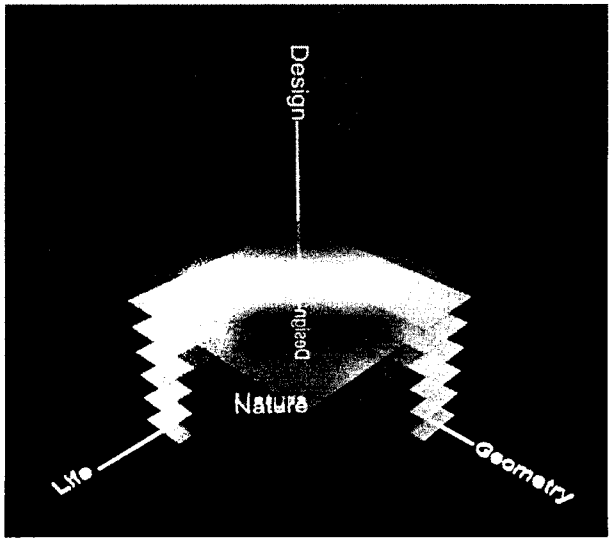
• Village of Neibandan, Iran:
(RAINER/IRAN Page 110)

• Moshe Safdie's Habitat project in Montreal:
(*Mediterranean Vernacular* Page 172)

The three images are examples of residential architecture from different parts of the world. Although each of these buildings evolved independently in a different social and natural environment, their common purpose creates a similar geometry. The primary needs of habitation and the environmental requirements of residential life have given rise to the geometry of residential architecture that is exclusive to this building type. This geometry will remain the dominant feature of this building type as long as the needs of habitation stay unchanged, but it would be wrong to consider this geometry the ultimate architectural composition for residential buildings. When the common lifestyle changes and the needs of the people and requirements of the environment alter, so does the geometry of adaptability. Moreover, when it comes to subtle functions of architecture, this overall commonness of geometry cannot accommodate the adaptability of lines and forms of a specific building type.

(Figure 36)

Nature



Nature in Design

The Definition of Nature

Nature is number six in the list of elements which Sturgis associates with the definition of design in architecture. He raises several issues in his writing on nature and its connection to life and geometry.

> Man's building work, when the product of healthy and stable conditions, is as much a part of nature as a bee's or a bird's. Harmony with the rest of nature is the great rule, and old building work is the crowning interest of landscape. "Architecture," says W. Morris, "means the molding and altering to human needs of the very face of the earth." While the influence of nature on architecture is largely in a spiritual or epical quality...nature will also furnish well-defined positive conditions which result in the differencing of local types where buildings are grown on the spot, and not 'designed' through the post office...All flourishing periods of art have been the result of a going back to nature, and naturalism has been one of the constant elements of style from prehistoric times to the present day. Now, it is with these constant elements of style that architecture as an idea is alone concerned... To get on practical designing terms with nature we must exchange the botanist's and painter's way of looking at the world for the observation of other facts of form and color - the plan and pattern of things; but the highest purpose ...is the gathering out of nature of those particular facts and expressions best fitted for a given purpose." (Sturgis, page 777)

Sturgis believes harmony with nature should be the first concern of architecture, and in this regard traditional architecture has achieved a high degree of peace with nature. But is harmony with nature a matter of intellectual expression, or a subjective issue for architecture? This question can only be answered in a living environment, where the impact of design on society and surroundings can be observed. For those environments that are not alive, the presence of nature has no practical purpose. Nature is a context within which life continues to exist. Outside this context, even the most sophisticated structures are not able to sustain life for an extended period of time. In this sense, harmony with nature is an objective necessity for architecture, not a subjective issue. No work of architecture is able to shelter the processes of life without reference to natural elements(Figure 37).

(Figure 37)

Khorasan, Iran: image showing a rural settlement in a harsh environment, where the land is dry and the climate unkind. At first glance, it is hard to believe that this large community has survived for so many years. Concrete knowledge of natural elements and the way these elements interact with the environment is the key to this survival. The inhabitants see themselves as components of a larger structure at peace with the elements. Dependency on nature remains the key characteristic of this architecture. (Personal Archive)

Another view in architecture promotes in the hegemony of man over nature. Architecture is seen as an independent object, detached from the larger natural context. The design of a building concerns itself with two completely different sets of issues: events that are happening inside the building envelope and events occurring outside its boundaries. Natural elements are considered external forces that must be controlled or eliminated through design solutions. The relation of architecture and nature is not seen as the relation of a component within its larger structure, but as a confrontation of an entity with destructive external forces. Total hegemony over nature is the ultimate goal of this architecture:

> The relationship of building to nature is first of all defensive. A building must be designed to resist the onslaughts of nature... with the intention of providing a safer and more comfortable environment than that found in nature."
> (William Blackball, *Geometry in Architecture*, page 4)

Humans need to modify natural environments to suits their need. Customizing the environ-

ment is the goal of all species, but only humankind has wrongly perceived this act as a defensive measure. Considering the relation of architecture and nature as confrontation, or as a struggle for hegemony is not originally an architectural view. This view has its roots in modern scientific philosophy. It is ingrained in the theory of human evolution, which measures the successful evolution of plants, animals, and humankind against their level of freedom from the forces of nature:

> All such adaptations speak of how, progressively down the millennia, animals and planets have evolved devices, which free them from the forces of nature. Man, the most recently evolved of the dominant planetary life forms, has taken this development of independence of the environment a step further.
> (Vivian Fuchs, *FORCES OF NATURE*, page 21)

In this view the evolution of the human race has been a progressive process of increasing independence from the natural environment. On the contrary, modern settlements indicate that human dependency on natural environments has grown. Without clean air, water, raw material, and the natural resources that nature provides, modern human settlements could hardly continue to survive. The human race has progressively evolved within the realm of nature, and during this evolution humanity has modified its old relations with the elements of nature. Seeing humans within nature and as part of it is the first step toward harmonizing architecture with its natural environment. Without a balanced relationship with nature, buildings would not be able to sustain and support the life of their inhabitants. A work of architecture must open itself to the elements of nature in order to sustain the processes of life. Modification of these elements for human use is not a defensive process.

If designing a building means molding and altering the face of the earth for human use, then architecture carries a great responsibility. Processes of architecture are not isolated activities happening in a void. Each line, form, or detail will affect the order of the existing environment. Building even a small structure adds to the overall configuration of the existing order. Architects must learn to harmonize their works with nature before imposing them on the environmentn(Figure 38).

Sturgis deals with the interactive relationship of architects and nature. He believes the effect of nature on architects enables them to create genuine works of architecture. The poetic and spiritual influence of nature on architecture is completely different from a utilitarian and functional effect. The influence of nature is in fact the origin of artistic inspiration for designers and builders. Artistic inspiration may not be physically tangible, but it is the most fundamental factor controlling the physical shape of man-made environments. Sometimes the "epical" and intellectual interference of architects is more effective than any other physical intervention. The first decides the strategic management of the living environment, and the second the tactical influence of architects on the current process. Without strategic views, tactical achievements have no effective direction (Figure 39).

(Figure 38)

Semnan, Iran: a view from the Cheshme-Ali resort facility in the north of Semnan. The resort provides recreation and entertainment to vacationers on weekends and during hot summer evenings. The casual yet efficient use of natural elements brings a feeling of tranquility and comfort to the environment. The design idea suggests an intelligent management of the elements, rather than an attempt to control them. (Personal Archive)

(Figure 39)

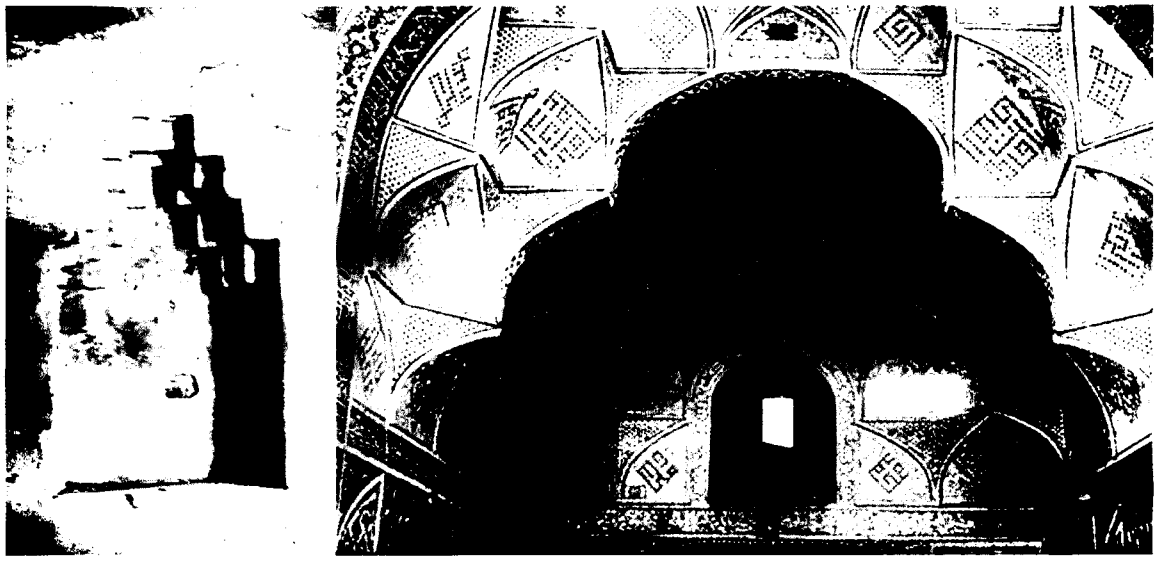
Yasoje, Iran: the gate to an orchard in a rural settlement; the poetic influence of nature on architecture is not necessarily a sophisticated and complex one. It can be simple and sincere. The human scale of the gate, the casual placing of stones, the diagonal bracing that offsets gravity, the unity of wood and stonewall, and the simplicity of approach is characteristic of nature's influence. This influence is evident throughout vernacular architecture, and sets its strategic development. (Personal Archive)

Another contribution of nature to architecture comes from the particular conditions that it often provides for the formation of indigenous architecture. Sturgis argues, "Nature will also furnish well-defined positive conditions which result in the differencing of local types where buildings are grown on the spot, and not 'designed' through the post office." Clearly, he reserves a special place for the spontaneous techniques of indigenous architecture. Within these techniques, design and building processes evolve through a direct interaction with the social and local environment. Every line, form, and detail of the building develops according to the particular needs of its immediate surroundings. As a result, architecture becomes a process that is well adapted to the natural context. This is what Sturgis calls harmony with nature. In many respects this method of architecture is the ancestral root of Design/Build. This is the way all the buildings of early societies were erected, when architecture evolved from a direct response to the untainted needs of people and the actual conditions of the environment. The age, simplicity, or even spontaneity of the process does not signify the core characteristic of this method. What makes this method unique and useful is that it is born of actual conditions and real need:

> The true basis for any serious study of the art of architecture still lies in those indigenous, more humble buildings everywhere that are to architecture what folklore is to literature...These many folk structures are of soil, natural. Though often slight, their virtue is intimately related to environment and to the heart-life of the people. Functions are usually truthfully conceived and rendered invariably with natural feeling. Results are often beautiful and always constructive.
> (Frank Lloyd Wright, *The Sovereignty of the Individual*)

Wright draws an interesting analogy between indigenous architecture and folklore. Folklore has never replaced classical literature, but it has been the source of great inspiration for classical writers. The same is true of indigenous architecture; it may never completely replace conventional architecture, but it can offer many creative concepts for its progress (Figure 40). Design/Build is the legitimate offspring of indigenous architecture that adapted to the conditions of modern society. This ancestral link allows Design/Build to translate the qualities of indigenous methods into the language of modern architecture. The flexible and adaptable processes of Design/Build provide an ideal opportunity to recognize folk culture in modern design concepts.

Sturgis discusses converting the poetic and spiritual influence of nature into the practical lessons of designing and building: "To get on practical designing terms with nature we must exchange the botanist's and painter's way of looking at the world for the observation of other facts of form and color - the plan and pattern of things; but the highest purpose ...is the gathering out of nature of those particular facts and expressions best fitted for a given purpose." He describes nature as a system of production. To make use of nature, the designer must find the original recipes for its productive process.



(Figure 40)

Kashan, Iran: Left image, a recess in a wall. The settled proportion, the gradual progression of width as the steps move away from the center, and the in-depth awareness of gravity are the characteristics of this simple recess on the wall, exemplifying a complete awareness of natural forces. Simple expressions of form and structure of folk buildings are the bedrock of formal architecture in Iran. The complex forms and structure of decorative 'Mogharnas', in the main 'Eywan' in the Grand Mosque of Esfahan clearly show this line of evolution. (Personal Archive)

Natural System of Production, Locality, Unpredictability, and Intelligence

A careful study of natural forms shows how nature diversifies the production of organic forms. Nature manufactures the forms to suit local conditions. It not only customizes the products for a particular environment, but also tailors each item to the unique sub-conditions. Usually, a natural environment consists of many small, diverse, and relatively independent microclimates. All of these microclimates are interlocking, and together create a larger macroclimate. The macroclimate operates as a unified field within which all microclimates are balanced. Though a natural object takes its overall structure from the general laws of nature, it is the microclimate that controls the formation of local forms and details. By being sensitive to each locality, nature manages to generate a large number of variations in type, while preserving the overall structure. In a given climate, one may see many types of trees, or many formations of trunk, branch, and leaf in a single species of tree. Each tree is slightly different from the next(Figure 41). Nature produces an enormous diversity of shapes, forms, and structures; this propensity to create extensive diversity may give some insight into the production process of natural forms.

(Figure 41)

Yasoje, Iran: a scene from a wilderness preserve in Yasoje. The oak trees are only a few meters apart, but the trunk formation, branch layout, and distribution of leaves have evolved differently, adapting to microclimate. (Personal Archive)

In the natural system of production, the context itself is an indivisible part of the means of production. Locality always controls the production process so that each sub-condition operates as a designer and builder of local patterns. For each living object, the combination of local conditions and the genetic code that makes that object gives detailed guidance to the process of production. The outcome of such a process is always an original, unique product. At the same time, the general conditions of the larger environment provide the framework for the course of evolution in a broader sense. The overseeing of the larger environment ensures the unity and compatibility of different local processes of production, while the influence of locality produces the diversity.

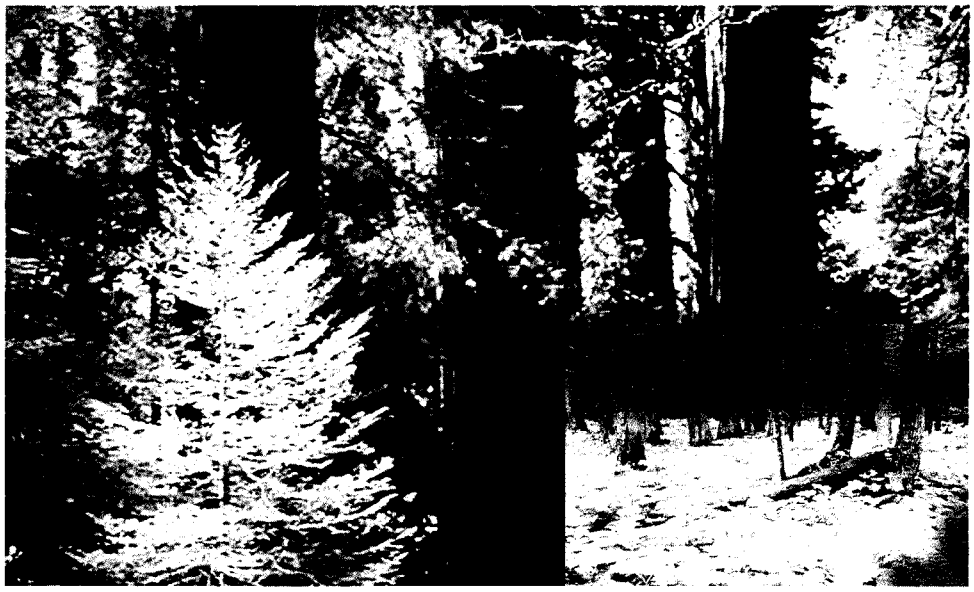
In nature, an active intelligence continuously governs the whole process of production. This immense body of knowledge, compiled through a long period of natural development, not only produces the natural forms but also constantly reproduces itself. The intelligence of nature consists of a fixed body of information and also a creative response that is crucial for solving the problems of each new condition. This system of intelligence records the information of any change that takes place within the environment. The new stored data upgrades the future process of production, with each system passing fresh information on to the next line of production. The intelligence of nature is continuous in place and time. The adaptation of species to new changes in environment and climate, central to natural evolution, is a manifestation of this intelligence.

Nature's processes of production do not cease at the end of the production line. The interaction between context and a produced object will occur as long as the object resides within the context. This interaction is in fact an elongated process of designing and building, through which the product becomes modified and acclimatized to the altered conditions. In that sense, the process of natural production goes far beyond the last stage of the assembly line. Production processes of nature are the ongoing courses of adaptation and modification. The context of the object acts as the active element of a production system that always creates new instructions for refinement and adaptation. The context is a line of assembly that extends boundlessly in time and place. In nature, production and maintenance of the produced structure emerge and evolve simultaneously. Each act of maintenance works as a process of repairing and refining through which a part is actually being reproduced in order to be useful under new conditions.

The next important step in understanding the natural system of production is to learn where nature finds its criteria for diversified design. Nature generates each new element or form to fill the void (need) within the present structure(Figure 42). These new objects will support the formation of the next elements (or forms) that will be placed into the next emerging voids. The eco-balance of the natural environment relies on filling these emerging voids continuously. The precise proportion and shape of each new object are revealed by the characteristics of the emerging void in the environment, and the measures are exact. The design and building of each type or form has an exact time and a precise place in the structure, because it must offset the negative impact of the void. Each object comes out of a particular condition and becomes distinctly different in design and construction with respect to the rest. The criterion that creates the process of production in nature is determined by the emerging voids (needs), and by the purpose that the new objects must serve.

The strength of a natural structure comes from the particularity of each of its parts, and how nature has been able to tailor each of these parts for a particular role. Diversity is what gives natural forms their strength. The conditions of production constantly change in the context of each process, purpose, and time of its occurrence. Any new product is in fact a response to a new need, created by context, purpose, and time. New needs necessitate diversity of type and form. Repetition and redundancy never dominate the natural system of production. Things in nature may be similar, but they will never be identical. Nature accepts similarity as a healthy sign of a union of diverse processes but rejects sameness because it indicates the production process has been disassociated from its local conditions.

The unique position of each form with respect to the previous form or the form that follows necessitates this diversity in all dimensions (Figure 43). Diversity is a structural necessity, with nature creating an original blueprint for each production process. This blueprint emulates past precedents while remaining sensitive to new conditions.



(Figure 42)

An example of this process can be found in natural forests. When a tree dies it falls on the ground, and the empty (void) space in the wood lets the sunlight in. The combination of sunlight and the fertilizer produced by the decomposition of the dead tree starts the assembly line for the production of new trees. The new trees fill the gap and stabilize the unbalanced conditions, produced by the emergence of void.(www.photo.net/photo/pcd1765/cedars)&(www.nhphoto.com/ and is photo #S-CA004)

(Figure 43)

Position of the branches in a tree: each new branch in a tree occupies a position relative to already-existing branches. The position and shape of the branch affects the growth of other branches, both new and old. Thus, each new branch is different from the others. (Personal Archive)

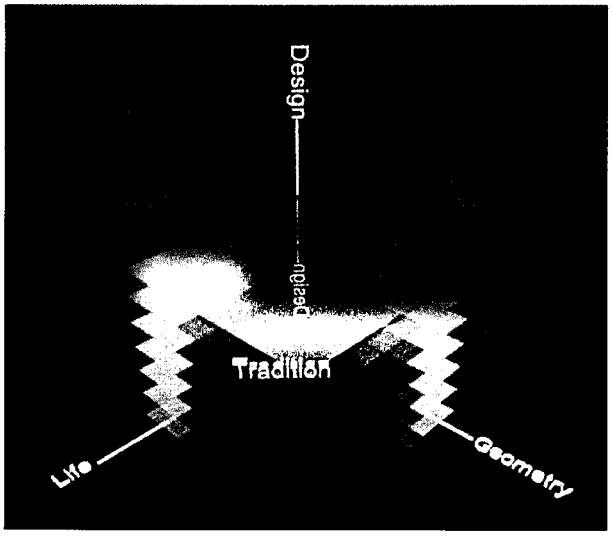
Nature never restricts its future to a predetermined set of words, lines, and forms. It is a system of mass customization, producing a new form exactly when it is needed. When it does not have enough clues to design something new, nature relies on intelligence and makes an educated guess. The choice of design does not come from statistical deduction, mathematical model, or financial calculations (Figure 44).

(Figure 44)

Lorestan, Iran: Cloud, lightning, thunder, rain, and earth are the perfect recipe for creating natural forms. The rain carves the earth like a sculpture, slicing the stone; each process is spontaneous, yet the similarity of forms created is astonishing. The key word for defining such elaborate and complex process is spontaneity. (Personal Archive)

Nature does not conceive new ideas in advance, but rather through a continuous process of trial and error. Nature shares this process with life. Life is an untold scenario that can be understood by following the events as they unfold, but trying to predict the course of events in advance creates complexities and ambiguities. Nature is able to sustain the processes of life because it unfolds as life does. The meaning of life becomes even more inaccessible when an attempt is made to encapsulate it in words and concepts. Nature does not encapsulate the meaning of life; therefore it can produce suitable shelters for all life forms. Natural things (or thoughts) are either being made to live, or made to sustain life; this is what the architecture of nature is all about. The method of Design/Build has many characteristics in common with the natural system of production. First, each project in designing or building is a new process of making. Second, it relies on past precedents of architecture as an unquestioned source of knowledge but it never underestimates the value of new advances. It embraces the diversity that allows growth and expansion beyond the local environment and relies on locality, because that is where Design/Built finds its strength. It cherishes life, because that is where Design/Build gets its ideas.

Tradition



Tradition in Design

The Definition of Tradition

Sturgis classifies tradition as the seventh determinant of a design process. He believes the study of tradition goes beyond the classification of old buildings. Tradition is a value and a way of life that reveals itself in the physical appearance of buildings:

> By this group of positive conditions I mean the great store of past experience, remote or recent. To make this properly available, our present methods of studying the monuments must be reversed; instead of studying them archeologically we must study them as essays in practical buildings, under certain conditions. We should put aside the curious and highly specialized, and look, on the contrary, for what was universal - the central stem of development of building. If we will thus concern ourselves less with styles, and regard these old facts from our proper standpoint, the whole body of this past experience is ours to profit by. We should observe what result were the direct outcome of the use of certain material ...We should look at the piecing of the stone together in the plain wall, the texture of the plastering, the color of the tiles, the durability of the cast. As builders we want the methods, not the results. But above all, we must use old art as an incentive and a witness to the fact that, of old, art had a message, and we must learn to read its final expressional result as a work of art...We must not study Greek as Greek, nor Gothic as Gothic; but see them only as phases of the one universal art. As we look into the mirror of history at the arts of men, we see that every phenomenon, every period, overlies and is interwoven with all the rest; all is movement, flux, and change, but all is one...The student of architecture should seek to estimate the value of this or that structural method for present-day materials and common needs, and try to read the expression of old art so that he may learn to express today's motives. (Sturgis, pages 777 & 778)

Sturgis believes it is not only the physical existence of old buildings that signify the meaning of tradition, but also the skills and expertise that have designed and built these remarkable architectures. From his perspective, the antiquity of tradition is not its main characteristic; even a recent experience of design may rise to the level of tradition. If ancientness is not the main feature of tradition, what makes tradition successful and timeless? How did tradition surpass the other skills and expertise of its own time?

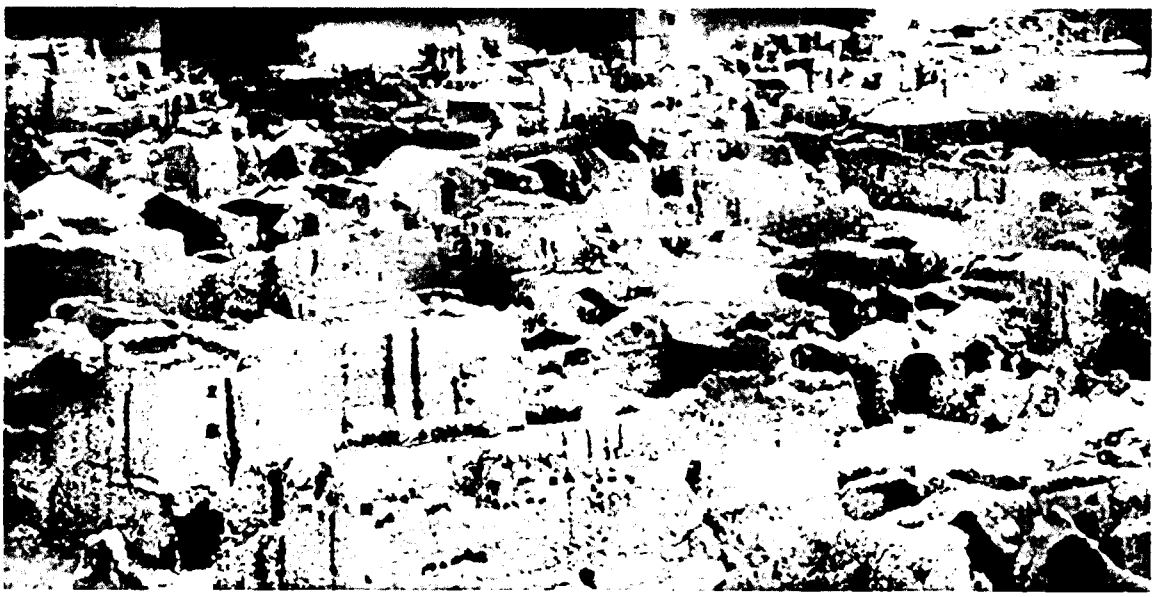
The Continued Existence of Tradition

Often, people pay attention to a particular architectural work because it perfectly suits their need:

> A place, built like a ploughshare, where every corner, every table, every shelf, each flower pot, each chair, each log, is placed according to the simplest necessity, and supports the person's life directly, plainly, with the harmony of nothing that is not needed, and everything that is. (Alexander, *A Pattern Language*)

The essence of tradition is the compatibility of architecture and human need, the fundamental characteristic of all those buildings that have survived the test of time. These buildings did not survive because they were durable or long lasting, but because people continued to find them useful, and therefore maintained and protected them (Figure 45). Constant maintenance sustains the physical structure of these buildings. Time and again, their inhabitants have renewed the well-preserved traditional architecture. In that sense the buildings are not physically old. Most parts of these buildings have been replaced many times. What has not changed is the intimate and ancient bond between the inhabitants and these buildings that signifies tradition:

> I once saw a simple fishpond in a Japanese village, which was perhaps eternal. A farmer made it for his farm. The pond was a simple rectangle, about 6 feet wide and 8 feet long: the opening of a little irrigation stream. At one end, a bush of flowers hung over the water. At the other end, under the water, was a circle of wood, its top perhaps 12 inches below the surface of the water. In the pond there were eight great ancient carp, each maybe 18 inches long, orange, gold, purple, and black: the oldest one had been there eighty years. The eight fish swam, slowly, slowly in circles - often within the wooden circle. The whole world was in that pond. Every day the farmer sat by it all afternoon. Even now, I cannot think of it without tears. Those ancient fish had been swimming, slowly, in that pond for eighty years. It was so true to the nature of the fish, and the flowers, and the water, and the farmers, that it had sustained itself for all that time, endlessly repeating, always different. There is no degree of wholeness or reality, which can be reached beyond that simple pond.
> (Alexander, *The Timeless Way of Building*, page 38)



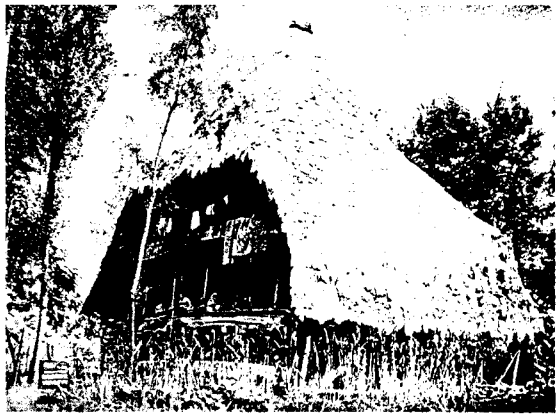
(Figure 45)

A view from the walled city of Bam in Iran: abandoned fifty years ago. Once a prosperous settlement, it is now deserted and lies in ruins. Without human care and maintenance, no architecture can survive on its own. (Personal Archive)

Traditional buildings that have survived are in tune with the elements of their environment. Traditional architecture does not resist the forces of nature, nor contradict the overall order of its environment, according to Hassan Fathy:

> For example, the proportion of window area to wall area becomes less as one moves toward the equator. In warm areas, people shun the glare and heat of the sun, as demonstrated by the decreasing size of the window. In subtropical and tropical zones, more distinctive changes in architectural form occur to meet the problem caused by excessive heat. In Egypt, Iraq, India, and Pakistan, deep loggia, projecting balconies, and overhangs casting long shadows on the wall of buildings are found...such arrangements characterize the architecture of the hot zone...
> (Fathy, *Natural Energy And Vernacular Architecture*)

Without close attention to the effects of natural elements, traditional architecture had little chance of surviving the test of time. Fathy's examples mostly concern human comfort, but traditional architecture also contains other characteristics that bring buildings closer to their natural settings. Its lines, forms, and structures are complementary to the elements of nature. In desert architecture, the exterior shapes of domes and vaults are round and smooth to deflect the eroding force of sandstorms (Figure 46). The roof structure of vernacular houses on the Caspian Sea protects the timber structure of the roof from continuous rainfall and the humid climate of the coast. Bundles of rice-straws used to thatch the roof keep the joists and beams dry. The permeability of the rice-straw on one hand, and the transparency of the interior space on the other, provides ideal ventilation for the roof. The architecture uses the most sustainable and self-reliant solution for the long-term maintenance of the roof, with the smallest amount of effort from the inhabitants(Figure 47) .



(Figure 46) & (Figure 47)

• Mahan, Iran: A rooftop view of Shazadeh's garden shows the round and smooth surfaces of a roof that mitigates the effects of wind. (Personal Archive)

• Taleschmahale, Iran: straw-thatched wooden house. (RAINER/IRAN page 43)

Alexander espouses yet another view that finds similarity between traditional architecture and nature. He suggests there is a connection between the geometry of traditional architecture and the basic structure of the world. This connection is not a random coincidence, but is made to serve a particular function in architecture. It unifies the architecture with its context:

> The forms of traditional societies - which are so much alike, in spite of radically different technologies, and different building materials, and different climates and societies - embody, above all, the deepest substance of what life is, both in functional terms, and also in much deeper terms. But these traditional forms also come from a much deeper source, which has to do with the geometry of space itself...In short, it turns out that the oneness of space, which occurs in these age-old artifacts, is not merely beautiful, not merely touching ... but ... it contains structures of fundamental importance to the way the world is made. (Alexander *The Linz Café*)

In traditional architecture the connection of the geometry with the context is an important reason for its continued existence. Because of this connection, the context does not reject the architecture.

Tradition in Architecture

Sturgis recognizes that the tradition of architecture is more than the physical appearance of buildings. He encourages architects to learn about the methods of traditional architecture because merely studying the physical appearance of a building restricts the imagination to lines and forms. Studying the methods of tradition allow designers to reproduce the quality without being limited by the boundaries of style. The general approach of tradition can then be adapted to the needs of each specific environment. The dynamic study of tradition allows dialogue between the general tendency and the particular solutions.

The ability of traditional architecture to adapt to each local condition has transformed the solidity of its structure into an intelligent geometry that responds to the slightest change in the social and natural environment. As a result, it is able to integrate into all levels of social life, and adapt to specific needs of people. Abdel Wahed El-Wakil describes these qualities in the adobe architecture of Egypt:

> In addition to the versatility of this architecture, it is its humanness that touches the chord in us. The spirit of place has been fully expressed in it, with subtle variations continuing to adapt to specific human needs and tradition.
> (James Steele, *Hassan Fathy*, page 8)

Design/Build is perhaps the only type of architecture that is able to learn from these issues, because it relies on the process rather than end result of tradition. For Design/Build, tradition describes the relation of the buildings, the people, and the elements of environment.

The Message of Tradition

Sturgis argues that traditional architecture is the art of making buildings. It is a process that creates a building, but is not only the building that signifies tradition. The process he describes is completely different from the technique of quantitative manufacturing. As art, tradition is concerned with the authenticity of its process, i.e. designing and building. The quality of a work of art comes from the processes that create it. This view conveys a graceful message that is central to all aspects of traditional architecture and reveals one of the most fundamental beliefs of the people who made these architectures. Traditional people believed habitation needs were qualitative as well as quantitative, encompassing livability and aesthetics of space. There was also concern about the ways these needs were to be fulfilled through the process of architecture. The pleasures of life come not just from the fulfillment of material needs, but also from intellectual satisfaction (Figure 48).

(Figure 48)

Mykonos, Greece: the message of tradition is clear in Mediterranean coastal-vernacular architecture. Vernacular architecture in Mykonos continues to be contemporary, while preserving its tie to the 'old art'. (*Mediterranean Vernacular* page 130)

Continuity of Traditional Architecture

Continuity of method and style, regardless of time and place, is a distinctive quality of traditional architecture. Each step in the sequence of development follows the previous one. Change in design and construction methods is motivated by a collective conscience, rather than by individual decisions. New solutions are not represented by a sudden break from the past, because control of the process is not in the hands of individuals. The idea of change is considered an overall process of development that benefits all the participants, who not only consume but also create the new ideas. The designer and builder share their ideas,

allowing all of the stakeholders to participate in the process of finding new ideas. This mass process of making architecture insures the continuity of the design and building process, both in place and time.

Any change in the method and style of traditional architecture was an attempt to enhance the existing processes of design and construction. Traditional "architects" never regarded the existing processes as disposable knowledge that could be replaced by something entirely new and surprising. An individual's artistic expression or contribution to the style of designs or the method of construction was seen as a (personal) desire to participate in the larger process of architecture, not as a wish to make a distinction between the contributor and the other participants. Each designer, builder, or craftsman recognizes that the process of architecture is not a one-man show. It needs the participation and cooperation of all who stand to profit from the process. Architecture was also considered a way of life, a process of evolution, continuous and holistic. Every period of traditional architecture is interwoven with the rest: "all is movement, flux, and change, but all is one." (Figure 49)

(Figure 49)

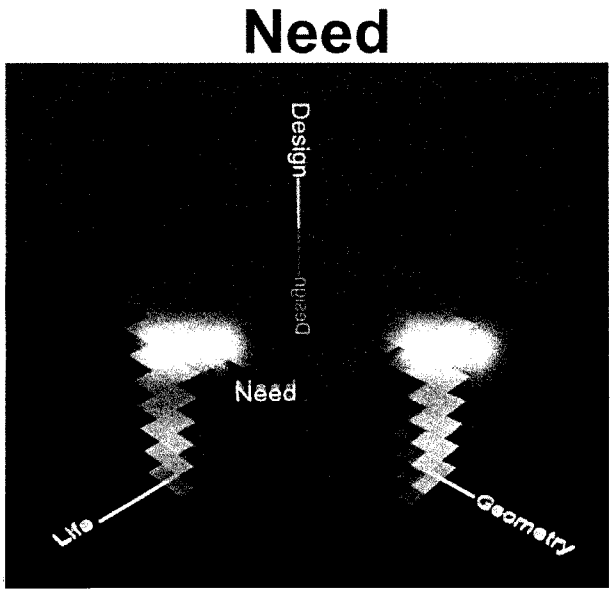
Qazvin, Iran: the Jameh Mosque of Qazvin is a clear example of continuity in architecture; the building is made up of many smaller sections incrementally added by new rulers over hundreds of years. Though each new section exhibits different styles of design and methods of building, the original continuity of form and function has been preserved. Parts of this architecture belong to the pre-Islamic age. Zoroastrians created the original building for religious rituals and worship; after the Moslems conquered the city, they preserved the function of the building, using similar styles and methods to enlarge the structure:

> As a result the sum total of the art and the material culture of the pre-Islamic world remained as such with functions, purpose, and associations it had before.
> (Oleg Grabar, *The Formation of Islamic Art*, page 41)

Traditional architecture grafts the current culture of architecture to the previous ones.
(Personal Archive)

How Tradition Should Be Used

Sturgis suggests that "the student of architecture should seek to estimate the value of this or that structural method for present-day materials and common needs, and try to read the expression of old art so that he may learn to express today's motives." Fascination with the beauty, simplicity, and craftsmanship of traditional architecture can lead designers into a state of nostalgia characterized by the desire to mimic the style and techniques of the past. The traditions of architecture offer more than the styles or methods that were used to design and construct the architecture. Knowing tradition from the standpoint of "what it is" is just the beginning. This level of understanding encourages superficial duplication and imitation, rather than reproducing it for contemporary use. To make tradition relevant, the designer must learn how it evolved and how it affected the lives of traditional people. This knowledge promotes an understanding of tradition as " what it will be." The architecture of Design/Build uses tradition as a vehicle for learning, not as an inflexible ideology inherited from the past. Design/Build is a process that deals with new conditions, creating new solutions all the time. Tradition as inflexible style does not jibe with the dynamic nature of this method. Design/Build needs to know how tradition adapted to new conditions, how it preserved its innate characteristics despite all these transformations. Throughout the design and construction phase, traditional architecture relied on intelligence to deal with new situations actively. Tradition perceived architecture as a process not as product; its desire for such a process did not cease at the end of design or construction, thereby preserving its originality and innovation.


Need
Design
Need
Life
Geometry

Need in Design

The Definition of Need

Need is Sturgis's eighth element in the definition of design. He draws a definitive line between the needs of people for architecture, and the demand of the market for buildings as an article of trade:

> A third cornerstone of a positive foundation for modern design is Utility. At first sight there seems little danger of this being forgotten, for supply and demand are very well adjusted. But need does not mean the same thing as demand, and a wise consideration of what are true needs would carry us far and give us nearly all we want. This lowest, firmest ground for art should at once - if we could only realize the things which we really require - give us a well-ordered country, clean towns, workmanlike buildings, bright colors, light in our rooms, and a shelter at our doors, and we should not for long lack an interested public - intelligent craftsmen and beauty would soon spring up by the way, for beauty is to art what happiness is to conduct. I do not think that it is possible for a work at the present moment not to recall some one phase of past art more than another; but these stigmata of the styles are measures of our weakness, not of our strength; and if it is impossible to get a 'design' together without Greek or Gothic, it would be possible, when it is once made, to hunt out every known trick of style, pilasters, eggs and tongues, pinnacles, gargoyles, and all the rest; and then to make a concentrated appeal to the imagination in some little panel of sculpture or piece of precious material.
> (Sturgis, Pages 778 & 779)

The Differences Between Need and Demand

The incompatibility of need and demand is the key to defining processes of architecture, according to Sturgis. Demand is a controller in the market economy that regulates the flow of commodities. The exchange between supply and demand empowers the production of a commodity, which is not one and the same with human need. The economic incentive behind this process of production, i.e. profitability, sets the purpose and priority of market-driven architecture. In this architecture, the quality and quantity of demand is formed by its exchange-values. Exchange-value often corresponds to the prevalent modes and fashions, rather than to actual needs.

The incentive that molds people's real need does not fit the values offered by a commodity. In office- centered architecture, the designer speculates on needs, guessing about how to fulfill the requirements of the end user. People's real need focuses on the use-value of architecture. A clear understanding of this use-value is central; the designer must have a detailed knowledge of those who are going to reside in the designed environment.

How people will occupy the various living spaces, how these spaces will fulfill their needs, and how they will reshape the spaces as their living requirements change are critical pieces of information. What the market expects of a work of architecture is its exchange-value, how much it is worth and how quickly it can be sold. Each of these two values will produce a particular kind of building. For the last few decades, architects have attempted to combine these two values in one method of designing and building. Though some of these attempts have had partial success, there are still many unresolved issues (Figure 50).

(Figure 50)

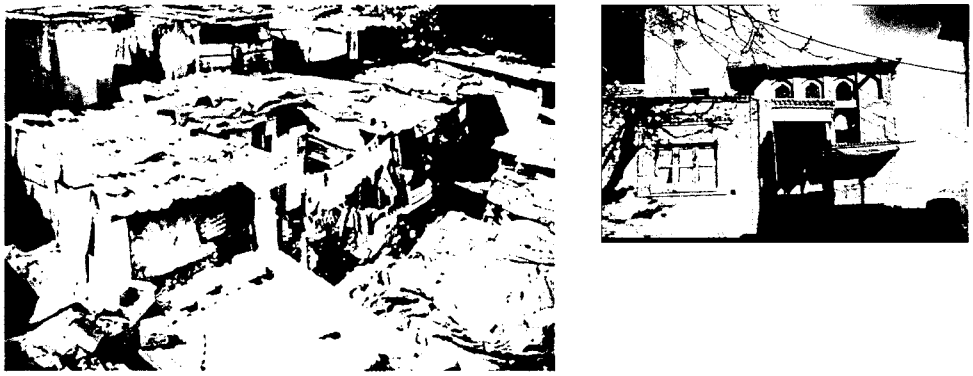
Bay Area, Vallejo: these public housing projects are an example of an architectural process where consideration of economic factors overrides the main principles of designing and building. Since the early twentieth century, social activists and radical architects have fought for decent housing to accommodate the lower and middle working classes. Many such efforts have failed to produce an architecturally qualified building, though from an economic point of view, they were successful. Good intentions do not automatically translate to qualified living spaces, because the modern system of production is not intelligent. It lacks the dynamic knowledge of geometry that can transform the values and needs of human life into the lines, forms, and structures of architecture.
(*Bay Area Houses* page 239)

A realistic and unbiased evaluation of human needs allows architects to far exceed the purpose of demand, but to be unbiased does not mean to have no opinion of essential human needs. Unbiased evaluation means that need in architecture should not be evaluated based only on economic concerns for the profitability of a design or building process. Such biases are evident in public or co-op hosing, where overemphasis on economic issues and total reliance on the mechanical system of production remove all other concerns from the design and building processes.

Unlike need, demand is always overshadowed by the supply in the marketplace. Demand reaches its peak when the supply of commodities is short. It plunges to its lowest level when commodities overload the market. These two market conditions determine the quantities and qualities of demand. The qualities of demand are often reduced to the basic requirement of exchange-values, rather than the basic necessities of human life. The economic feasibility of the market is not the same as the economic consideration of human needs. In the marketplace the basic requirement is only a package of necessary measures that sustain the ongoing transactions and profitability of a project. Any extra (often useful) feature is considered to be unnecessary or, in economic terms, profitless.(Figure 51) No matter how much the market economy increases the value of demand or modifies its contents, it will never match human needs. The flexible approach of Design/Build toward the development of design ideas provides an opportunity for answering real needs through the constant dialogue between designers, clients, and the local environment. (Figure 52)

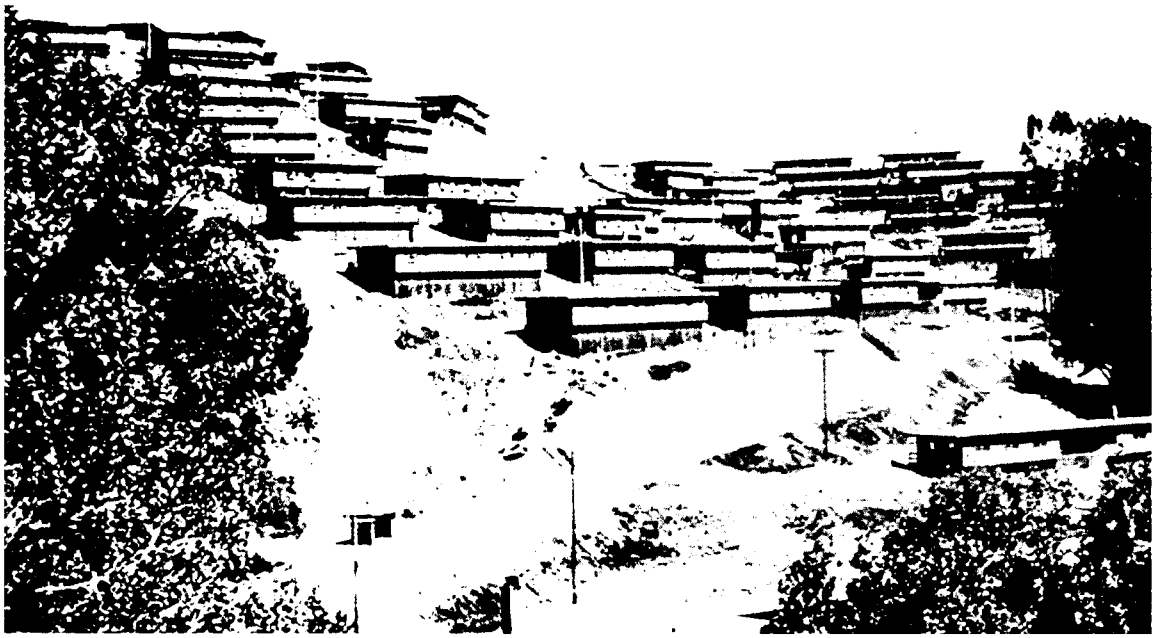
The Geometrical Characteristics of Need and Demand

In designing and building, need produces a geometry that is entirely different from the lines and shapes of demand. The geometry of need is more flexible; its lines, shapes, forms, and structures are adaptable to the unpredictability of human life. The elements of architecture in this geometry are capable of generating space for the unscheduled complex events of daily life. This geometry is an interactive system that allows inhabitants to reshape their living space according to conditions unfolding in their environment. (Figure 53) In this geometry the concepts of line, form, or structure are not readymade and fixed they evolve along with changes in the living environment.



(Figure 51)

The idea of basic necessity in modern societies is reflected in the development of shanty-towns in mega-urban areas. The people who live in these settlements are rural immigrants. A comparison of their previous living environment, usually a village, and their new settlement, at the edge of urban sprawl, clearly exhibits the differences between the economic view of basic necessities and the requirement of a basic quality of life. In this economy the value of a living place is determined by the amount of money that users can afford. (http://www.indigodev.com) A scene from Abeyaneh, Iran: the quantities and qualities of this living environment have sustained this community for hundreds of years. The economic feasibility of building projects in this community is decided by the qualities that the process of architecture can produce. (Personal Archive.)



(Figure 52)

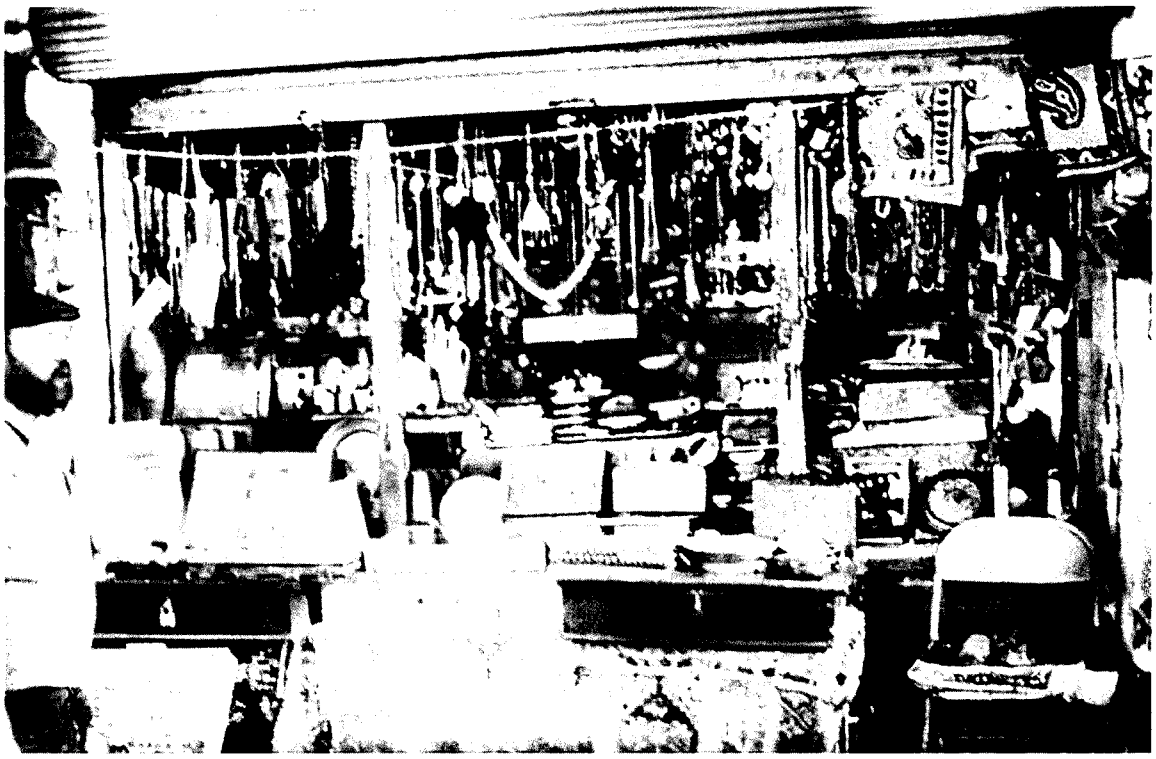
Bay Area, Marin City: The dull and lifeless geometry of these houses is not caused by limited economic resources but rather by eliminating the role of human intelligent in the process of designing and building. The financial resources of a vernacular settlement are much smaller than these modern housing projects, yet the quality of life is much greater. (*Bay Area House* page 241)

(Figure 53)

Shamirsad, Iran: the painted courtyard of a loam house has been arranged freely to meet the needs of its inhabitants. The entry to the house faces south, creating a warm and cozy place in the morning. The old piece of rug in front of the door provides an ideal working place where women prepare food for cooking. The sunny courtyard offers a place for growing flowers. Every line and form is made to support the processes of everyday life. This is the geometry of need, simple yet efficient. (RAINER/IRAN page 68)

Comparing the front elevation of a shop in a traditional bazaar with the showcase of a store in a modern shopping center clearly illustrate the differences between the two geometries of need and demand. In the front view of a traditional shop, displays of items do not have a predefined geometric pattern; new items will be added as needed to the seeming chaos. The overall pattern is random, yet the shopkeeper is able to locate a specific item with no difficulty, even when the item appears to have blended into the existing display. The incremental placement of new objects acts in accordance with the overall pattern of existing order. The flexible geometry of the display allows new needs to be fulfilled. Modification and addition do not disturb the essential order of the display. The geometry of need is at work here -- flexible, continuous, and tolerant (Figure 54).

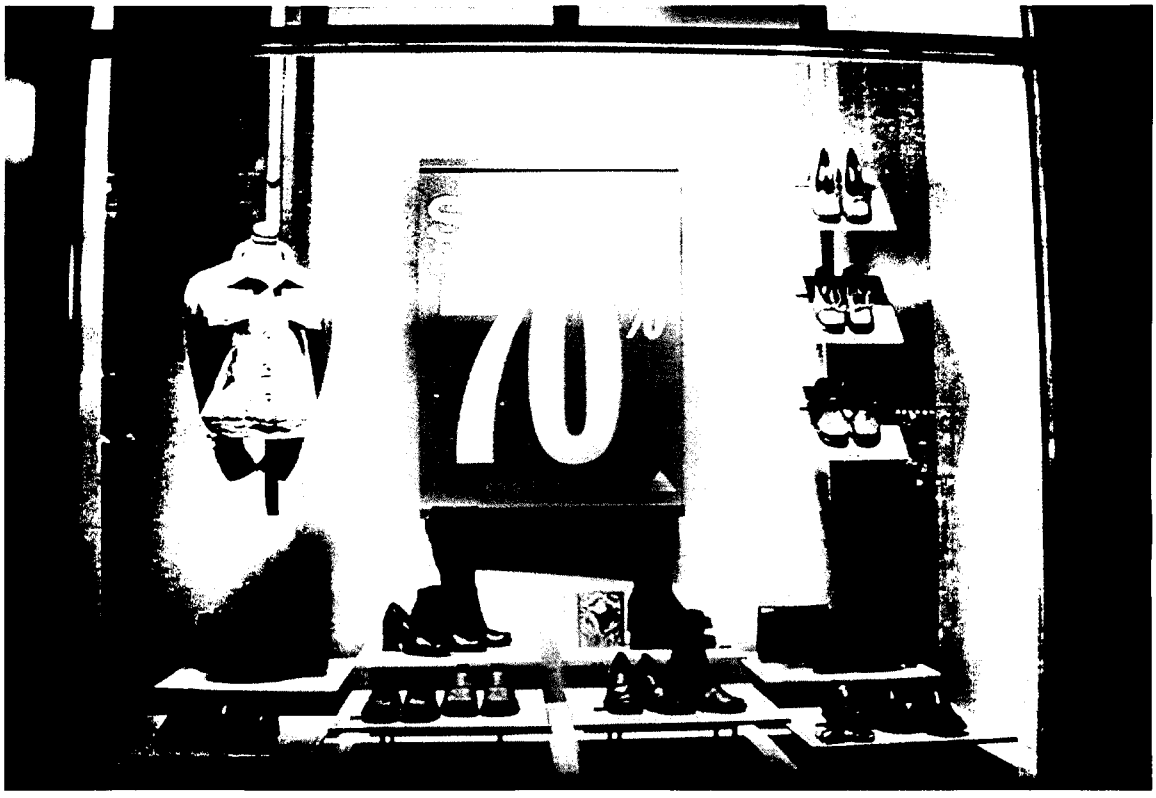
In contrast, the showcase of a store in a modern shopping center has a preset geometry; the position of each item has been arranged after careful consideration of marketing rules. Lights, colors, texture, signs, and viewing angles are all taken into account. The main purpose is to create artificial demand for the objects on display. Any change in the composition of the showcase will disrupt the existing order; therefore every few weeks a new design must replace the old arrangement. The successive new geometry arrives to create demand for the latest articles of trade in the market.



(Figure 54)

Esfahan, Iran: A traditional shop in the bazaar, the order of items in the front of the shop implies the randomness that is specific to the events of everyday life in a traditional culture. The geometry that outlines the arrangement of these items is not easily recognizable. The continuous flow of passersby, the old man pushing his handcart, the salesman loudly announcing the price of his wares -- a similar scenario occurs everyday. This daily experience is a prerequisite for recognizing the geometry of the display at a traditional shop. (Personal Archive)

Although the geometry of modern showcases is a new concept of design, it does not have enough room (tolerance) for modification and adjustment to change. Perhaps the sudden shift in the configuration of a new demand does not allow the lines and shapes of new items to blend into the geometry of the existing showcase. The geometry of the new demand does not evolve from a permanent source of need, which is why the lines and shapes of the new demand do not fit into the old geometry of showcase. New and old demands are not outcomes of a continuous way of life. Demand is triggered by sudden jumps from one extreme to another, by the impulsive trends of the modern market. In contrast, human needs follow an unbroken line of evolution that is inspired by the processes of life, continuous in content and form. The showcases of modern shops symbolize the geometry of demand -- rigid, fragmented, and intolerant (Figure 55).



(Figure 55)

The showcase of a modern shop in Vancouver exhibits the rigid geometry of demand.
(Photo by Martin Liew)

The processes of design and construction in the method of Design/Build do not mix well with marketing criteria for the production of buildings. Though the economic feasibility of projects in this method is important it does not override the other aspects of architecture. For Design/Build, economic issues are not limited by the idea of immediate profitability. The overall development of skilled worker, craftspeople, and sub-contractors are the other side of economic considerations. Skill, intellectual qualities and the intelligence of a workforce in any given process of architecture are considered the most valuable assets and economic gain.

The processes of architecture -- the experience of designing, building, and inhabiting the space -- are no less important than the end product, i.e. the building. In Design/Build, the full circle of interaction between people, architecture, and environment enriches the processes of designing and building. Such enrichment and enhancement is also part of the economic benefit of Design/Build projects, though it is not as tangible as the immediate profit that comes from selling the buildings. This benefit manifests itself in the long run, in the development of a sustainable architecture, addressing Sturgis' ideas of need.

Need as a Collective Idea

In a process of architecture there are many determinants for needs. The need for habitation not only involves the quantity of the buildings, but also the quality of the architecture. The assessment of this quality is a personal issue, because it fulfills individual needs for habitation. Many aspects of need are products of the individual's interaction with society and environment. From this perspective, any personal need is also a reflection of social and environmental needs. The agreement of individuals with the members of their society on the essential characteristics of need creates a set of common values, or a culture of need. This culture is a shared social value that also offers general guidelines for the fulfillment of personal needs. The influence of this common culture of need unifies the geometry of architecture. It brings together the architecture of buildings that have been designed and built by people with different needs. It creates an agreed-upon border between individual needs and social needs, and gives the architecture a unified appearance. It is also a reference point for people to share their real needs, helping to shape the lines and forms of collective architecture. Adolf Loos discusses the effect of this culture on designed objects:

> We have our culture, our ways of life and the commodities, which enable us to live this life. No man nor any association had to create our wardrobes, our cigarette boxes, and our jewelry. Time created them for us. They change from year to year, from day to day, from hour to hour. For we ourselves change from hour to hour, and with us our attitudes and habits. This is how our culture has changed...We do not sit in a particular way because a carpenter has made a chair in such and such a manner. A carpenter makes a chair in a particular manner because that is how we wish to sit... (Adolf Loos, *Cultural Degeneracy*)

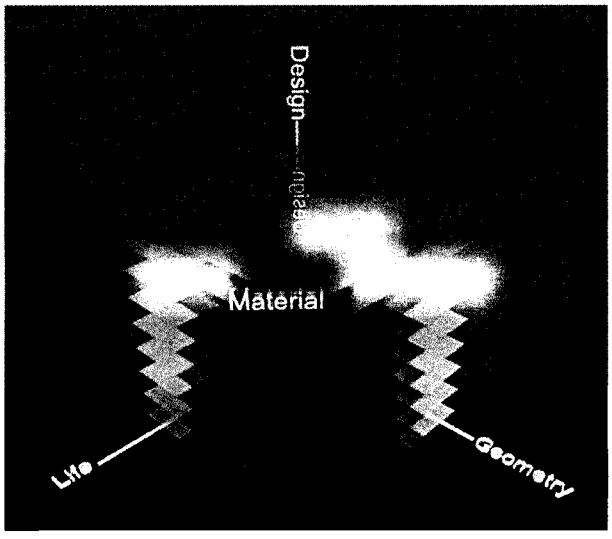
Loos zeroes in on the issues that establish authenticity of need in a design process. He suggests human need is not a timeless entity, and that it changes along with the wishes and aspirations of people. Need is the product of cultural preferences and changes according to alterations in cultural status. Designing an object does not change the way people use that object. Way of life (and the need which comes with it) determines the shapes and forms (geometry) of design. The shape and form (geometry) of a chair is revealed by the way the user sits in it, not by carpenter's idea of the chair. The configuration of a chair is decided by the collective notion of a chair.

Any object that is designed and made by a realistic culture of need is genuine and authentic. Such an object not only satisfies the need, but also enhances the living environment. When Sturgis claims that "If we could only realize the things which we really require - give us a well-ordered country, clean towns, workmanlike buildings, bright colors, light in our room, and a shelter at our doors, and we should not for long lack an interested public [and] intelligent craftsmen..." he is saying that there are many levels that the fulfillment

of human need influences. Sturgis argues two other important elements are also affected by the fulfillment of human need. They are the public that has become interested, and the craftsmen who have become intelligent by fulfilling human need. Both of these elements are crucial for the development of design and the execution of building projects, since they are the foundation of economic development. Unlike market-oriented architecture, the architecture of need does not target the immediate profitability of a design or building process, but instead seeks long-term economic development. The method of Design/Build is completely in sync with the architecture of need, because without intelligent craftspeople the method of Design/Build is tedious and unproductive and, without an interested public, Design/Build will lose its leverage in the competitive market.

Sturgis argues that in fulfilling human need architecture must be an original and authentic process. Human need is specific to place and a time, so response to that need must be local and timely, original and innovative: "...these stigmata of the styles are measures of our weakness, not of our strength; and if it is impossible to get a 'design' together without Greek or Gothic, it would be possible, when it is once made, to hunt out every known trick of style." The inflexible duplication of traditional works of architecture is not a real response to present need. The strength of architecture comes from originality. It is true that no work of architecture can be completely cut off from its precedents, but association with the past is different from blind imitation. Sturgis suggests it is possible to utilize knowledge of past architecture to respond to present needs. Only then can a design inspired by past precedents be considered original and authentic. Creative use of tradition begins with the assessment of current needs, followed by the search for the methods and skills of designing and building that properly answers those needs. Next, the task is to find out how to incorporate previous methods into present conditions. These processes may completely alter the fundamental characteristic of a previous method and create a new way of making architecture. The architecture of Design/Build is eminently capable in this respect, because its strength comes from creating spontaneous responses to new environments. This method is not compatible with ready-made ideas and prefabricated styles, because its goal is to fulfill the present needs of people -- a contemporary solution for a contemporary need. The design process in Design/Build evolves through interaction with the ever-changing factors of the environment, the attributes of material, the quality of the workforce, and the desire of the inhabitants.

Material



Material in Design

The Definition of Material

Material is another important subject that Sturgis associates with the definition of design. He is adamant about the significance of material in architecture:

> A fourth group of positive conditions, those given by the materials we use, is in many respects the most important of all. It is not by impossible return to some art Eden, a general agreement as a point of departure and a point of view, but by a common sense adaptation of means to ends by reasonable methods of workmanship, and by the simple expression of our delight in making things, that we shall form a school of art.
> Beyond the initial impossibility of our doing work like the old, because we are modern, there are farther impossibilities as to materials and labor. For instance, in the Middle Ages it was often cheaper to use timber in large bulk rather than to cut it down with great labor; and an Elizabethan author tells us how the carved braces in old timber-framed houses 'come husbandry in dealing with their materials' and what was before rejected as crooked 'doth now come in the fronts and best part of the work.'...Once, long ago, a Chinese potter found that a certain pigment fired on a certain body produced a heavenly blue. Another found that baking under certain conditions made the glaze crackle. A Persian found out lustring; and another liked running of colors we admire in Rhodian ware. What is true of these is true of building. Suppose a doorway is needed, or a font, or a capital; a man who knows how stone is obtained in convenient sizes, and who knows its pleasant qualities of surface when treated in a certain way, tries, by the smallest modification of the original masses, to get a suitable form for the jamb, or bowl, or weight bearer. This is the law of all stone design and the line of evolution of all fit moldings; the best figure sculptures, even, those in which the final work still retains the evidence of the log or block from whence they were hewn...All consideration of architectural results leads us back to material determining conditions, and there are infinite possibilities open for natural growth to that architecture which shall once again examine the groundwork...we shall find in these considerations of materials, needs, tradition, and nature, all that is required to build up a positive style of architecture. (Sturgis Pages 779, 780, and 781)

Sturgis opens up a progressive view of the role of material in architecture. Material and its way of consumption (utilization) must be modified and modernized, to keep up with the changes that take place in the way of life. Such modifications redefine the human relationship to its natural and social environment. Climatic changes, shifts in the natural balance, disruption in the ecological equilibrium of the environment and many other factors set the direction for such modifications. It is important to recognize these factors are not independent: change in one area will disturb the others.

Change and Modification of Material and Its Way of Consumption

Careless consumption of valuable materials can jeopardize the fragile balance of the living environment. Traditional architects and builders knew this and replaced the old material with new in order to keep pace with changes in their natural environment. Remarkably, adaptation to new environmental conditions time and again has ignited revolutions in the overall processes of architecture. Arthur Pope provides an illustrating example of this phenomenon:

> The VAULT, though of less spiritual importance, is absolutely vital to the development of Persia's great architectural achievements. From Sasanian or even the late Parthian times, the vault in its various forms was without doubt the most important element in Persian buildings. Its widespread adoption was necessitated by the lack of sufficient wood and timber to continue the Achaemenid habit of post and lintel construction.
> (A. Pope, *Persian Architecture*, page 103)

Persians knew the vault form long before it became one of the major elements in their architecture, but the revolutionary role of the vault in Persian architecture dates to when it was chosen to replace the wooden lintel. As opposed to wooden, or even long and solid stone lintel, the vault is made of smaller building modules (Figure 56). When vaults replaced wooden lintels, the significance of smaller building units (modules) in the design of complex forms became clear. This discovery revolutionized the architecture, creating a new geometry that could adjust to every twist and turn of new forms and structures. The design of the great bridges, mosques, and civic buildings of Esfahan has its roots in this radical modification of material and the use of dome and vault.

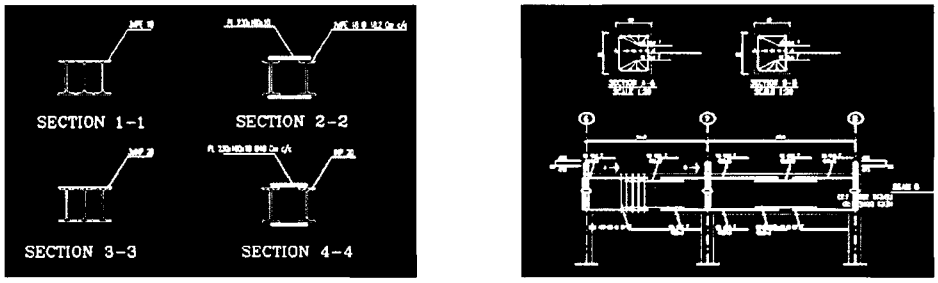
Scientific Discoveries

Modern science has discovered new ways to increase the efficiency of building a part without increasing its original mass. Based on these findings, architecture must change the pattern of material consumption because it cannot rely on an endless supply of building material. The full potential of every building material must be exploited by scientifically enhancing its performance in order to reduce material consumption. This goal can be achieved by radically reducing the total mass of material required per square meter, using what Sturgis calls "reasonable methods of workmanship." For example, the invention of 'I' or 'U' profiles in the design of beams and joists has greatly increased the bending strength of these structural elements without increasing their mass. Equal mass in a different cross-section (geometry) cannot resist the same amount of bending force, because in the newly designed cross-sections, most of the mass is shifted to the upper and lower flanges of the

profiles and material has been placed where it is most needed. The design of reinforced concrete beams and joists constitutes a "reasonable methods of workmanship." This design replaced steel with concrete in the upper sections of beam, conserving a valuable material. Concrete resists the force of compression in the top section of the beam, while steel bars in the lower sections work against the tensile force (Figure 57). On their own, these materials cannot provide adequate resistance to the respective force, therefore using only steel or concrete for beams and joists is not an efficient pattern of material consumption, as it may not be a first-class structural design for the buildings. In the architecture of Design/Build, understanding the materiality of building parts and how they can be designed effectively are the paramount tasks. Without this skill, Design/Build would be just an unpolished version of office-centered architecture.

(Figure 56)

The image on the right is from Perespolis, shows a stone lintel over a doorway. The dimension of stone module does not allow for flexible forms and structure. The left image is a building from the Pre-Islamic era illustrates the use of the arch structure, Semnan, Iran. The development of this new element stems from widespread use of a new material, i.e. mud brick. Note the flexibility of the mud brick arched-lintel versus the stone flat-lintel. (Personal Archive)



(Figure 57)

These drawings illustrate cross-sections of an 'I' beam and a concrete beam, as well as the efficient distribution of steel in the structure of the beams. (Personal Drawings)

Changing Social Environment

The changing social environment affects the use of material in architecture. Any social progress has an impact on the level of skills and abilities of the work force in building technology. Shifts in the organizational structure of the labor force influence the way materials are used in buildings. Old construction skills become extinct; those that survive may not be justifiable within the context of modern architectural practice. James Steele recounts how Hassan Fathy faced severe difficulties in incorporating traditional adobe architecture into the modern environment of the Dar Al-Islam project in New Mexico (Figure 58):

> This construction, however, was to take place under circumstances and conditions unique to America, totally unlike any of the village projects he had previously supervised in Egypt. For a start, the communities are composed of families with no tribal affiliation or single thread of past tradition, grafted together by a common spiritual bond. For another, labor and material costs, even adobe, are not as cheap in the United States as they are in Egypt, and without the traditional skills or past habits of cooperative building to fall back on, cost had to become an important factor in this new equation. As Abdullah Schleifer has explained, adobe, which initially seems very cheap because the earth it is made from is free, is in fact extremely labor intensive, and since adobe brick must be handled a minimum of seven times before it is put in place, the final cost of a wall is more expensive than poured-in-place concrete. Moreover, the American tolerance for extremes of heat and cold is not exactly comparable to Saidi or Fellahin of rural Egypt, making it necessary to augment the material or construction methods in some way to offset these social differences.
> (James Steele, *Hassan Fathy*, page 117)

Fathy's struggles in New Mexico encapsulate the issues that are important to architecture and the use of building material, and how it must be adapted to changing social conditions. This example is significant as an up-to-date account of the conflicts between the traditional way of using building materials and the expertise and skills of modern societies. Traditional materials and methods for making adobe buildings are still valid in rural Egypt because of its unique social conditions. In New Mexico, these conditions may never have existed, or perhaps ceased to exist long ago. A precise choice of material or method of application will not be successful without careful consideration of the natural and social circumstances of time and place. The architecture of Design/Build always relies on the elements of location and responds to the requirements of the present. In Design/Build, knowing the material and enhancing its method of use is not a one-time task. Every new day on site brings new experiences and provides opportunities for innovation. This fresh knowledge allows Design/Build to thrive in a changing environment. Information technology has provided immense possibilities for Design/Build to appreciate different localities and materials. The concept of local skills and familiarity with local material is becoming blurred; the global village is an excellent base for exchange of information about different materials and availability of local skills, a place Fathy doubtless would have made full use of had he had the opportunity.

(Figure 58)

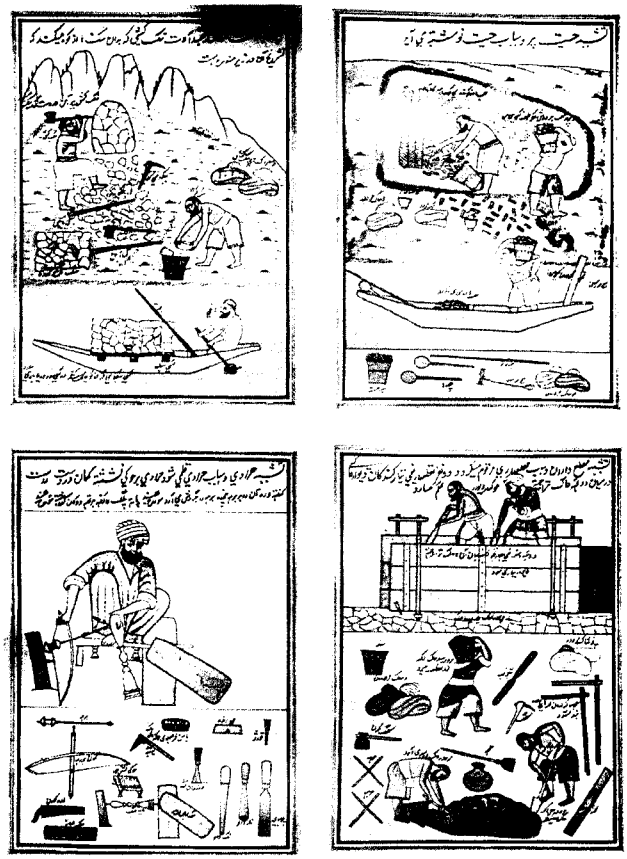
Dar Al-Islam project in New Mexico: the images show an overall view of buildings and environment somewhat similar to an Egyptian rural area. What cannot be seen is the social environment that was largely responsible for the difficulties that Hassan Fathy encountered.
(Steele, *Hassan Fathy*, page 115 &116)

Collective Knowledge of Material

What is viewed today as traditional knowledge of material is the result of the collective efforts of designers and builders from all over the world. Sturgis' example of Chinese and Persian potters illustrates that authentic innovation comes from the hands-on experience of material through constant examination of new ways and methods. Traditional use of material is not a monotonous, repetitive use of the materials in hand. Knowledge of material comes from a collective enthusiasm for new discoveries without which architecture would have little to offer. Material must not be limited to what is available at a given time, but rather to all the options uncovered by exploring new substances and methods. Experience of material is one of the key advantages of Design/Build over office-centered architecture. As Sturgis observes, "this is the reason that none but those who deal with materials at first hand can design anything really fresh and lasting."(Figure 59)

Sturgis is also indirectly conveying the idea of collective efforts. Present-day knowledge of building materials comes from China, Persia, Egypt, and Greece -- all over the world. Knowledge of building materials is a combination of expertise and skills, developed mostly by anonymous people who had a collective idea of progress. They were passionate about their findings, striving only to bring good qualities to the living environment. They could work

collectively because they focused on their work rather than on themselves. Each society had its own unique architecture but was never reluctant to learn and use the experiences of others. The history of Islamic architecture shows that early Islamic civilization borrowed many of its methods and materials from neighboring countries. Many great mosques are made of materials and techniques borrowed from the Romans and Persians. The quest to find a better building material is not a journey of one, but a cooperative attempt on the part of all designers and builders.



(Figure 59)

Documentation of building techniques, Kashmir, 1850s: the production of building materials includes the means of transportation, the tools of carpentry, and the formwork and techniques of material use. The connectivity in sequences of digging, transportation, production, and use of building materials is evident. This connectivity brings wholeness to the processes of architecture. The men who built the mosques, caravansaries, palaces, and baths were for the most part anonymous craftsmen using techniques that go back to the pre-Islamic era. Some of these techniques are still used today. The first image shows a hewing stone being loaded into a basket and taken away on a boat. The second image is a brick-kiln outside the city that requires river transport. The next one shows preparation of a rammed-earth wall. Two men remove the earth with spades at the bottom, place it between wooden shuttering and press down hard. The last image shows woodturning and the tools of the carpenter; the man operating the drill moves the bow backward and forward. A close and tangible experience of the materials, knowing how they are produced and how to use them, is secret to all great works of architecture. (*Architecture of The Islamic World* page 113)

The architecture of Design/Build makes the most of all materials and techniques discovered by other schools of architecture. Design/ Build believes the distinctive approach of each method creates a unique opportunity for new discoveries. Proving or disproving the method is not the point; rather it is making use of the achievements of all methods of architecture. For example, high-rise architecture has set precedents in the use of glass and steel. These experiences must be evaluated separately from assessing the impact of the buildings themselves, because the experiences of this architecture are part of a single heritage. The significance of this heritage overrides the authority of its origin. Schools of architecture collectively own this heritage, and they have an obligation to contribute to it.

Limits for Use of Material

Sturgis remarks on the boundless prospects of innovation in building material and the ways material is consumed: "there are infinite possibilities open for natural growth to that architecture which shall once again examine the groundwork." A practical approach to this issue cannot ignore the limitations that exist in the consumption of building materials. The need for a sustainable living environment imposes several significant limitations on the use of building materials.

There is always a correlation between the occurrence of a well-ordered architecture and the use of local materials. Successful works of architecture make intelligent use of local materials that are available and abundant. Often within a geographical zone, some materials are more abundant than others. If used properly, these materials can help to accommodate the architecture to the local conditions. Buildings made from these materials are far more adaptable than those made from non-local materials, because these materials have already passed the harsh test of local climatic pressures. The small displacement of raw material from its original location means the process of construction will not harm the ecological balance of the living environment. For example, vernacular builders often use white clay to whitewash walls and building façades. White clay is a local material, ready for use with little preparation. Its use has no effect on the natural balance of the living environment, as compared to white synthetic paints made from processed petroleum. Synthetic paint requires raw petroleum from hundreds of meters below the ground, and typically incurs costs to bring it thousands of kilometers to the work site. The huge displacement of raw material changes the chemical balance where the crude oil is extracted as well as the paint is actually used. Even an insignificant material like paint can have a great effect on the global environment. Asbestos, corrugated aluminum sheets and plastic are other examples of imported materials whose use can be very harmful to the ecological balance. In most cases there are durable and economical local materials that can be substituted for these materials.

Building materials produced with minimum alteration to their original state are more in tune with the natural environment, a key criterion for the assessment of a building material. The energy that is needed to produce a material is equal to the energy that is required to return it to nature. This simple formula is applicable to material productions. A good work of architecture does not come from the alteration of raw materials but from composing them in the proper order. Many local materials need little or no energy to be transformed into useful construction materials or building parts. The energy and technology required to transform these materials into useful parts is clean, simple, and abundant. Since local materials do not require complex processes for their manufacture, their residues are easily returned to nature. Plastic and aluminum are the worst examples of modern building materials that cannot be returned to their original state without recourse to an expensive process. On the other hand, they cannot be ignored, because their residue threatens the ecological balance of the environment.

Environmental limitations are necessary because they safeguard the well-ordered balance of nature, which is no longer self-regulating once unnatural materials are introduced. Fathy argues that preserving the balance of the environment is a professional obligation for all architects:

> The techniques and equipment available to the architect today free him from nearly all material constraints. He has the run of centuries of styles and can choose his plan from every continent on earth. But he must remember that he is not building in a vacuum and placing his houses in empty space, as mere plans on a blank sheet of paper. He is introducing a new element into an environment that has existed in equilibrium for a very long time. He has responsibilities to what surrounds the site, and, if he shirks this responsibility and does violence to the environment by building without reference to it, he is committing a crime against architecture and civilization.
> (Fathy, *Natural Energy and Vernacular Architecture*, page 5)

The adaptability of building material in the environment is a major concern in the architecture of Design/Build. This architecture develops its design concepts based on the parameters of the surrounding environment. An unbalanced environment is an unreliable ground for developing design concepts. Extreme climatic changes in recent decades have revealed the difficulties of establishing a permanent framework for architectural concepts. Every new twist in climatic conditions invalidates the existing assumption of a design concept, and requires radical adjustment. Such difficulties add uncertainty to the processes of design and building and impair the performance of any design process that relies on a familiar and certain environment. Office-centered architecture has no anxiety over environmental change, because it relies on codes and standards for the development of its design concepts.

The inhabitants must pay a price for anything which architecture takes from the environment. For example, industrial production of building material consumes oxygen and clean air, and careless expansion of polluting industries limits the vital elements that sustain

human life. The amenities that new materials bring are not free of charge. Environmental considerations provide a solid line of inquiry for future discoveries. Using environmentally friendly materials may take away some of the luxury of modern buildings, but it will preserve the natural environment. Design/Build promotes the advancement of living qualities in the process of architecture. It does not neglect the importance of the fundamental ingredients that are vital for maintenance of life. The lines, forms, and colors that constitute a creative work of architecture do not fit into a polluted and unbalanced environment. The smoggy and noisy environment of a modern urban center will destroy a beautiful whitewashed vernacular building in no time. This dependency of the architecture on its context drives Design/Build toward a sustainable architecture.

A good class of material must be ecologically sound, biodegradable, low in energy consumption, and not based on exhaustible resources. Stone and brick, widely used in the buildings of the past, meet most of these requirements, and the choice of this class of material was not a coincidence in traditional societies. It shows how deeply people understood the balance of nature and mastered the properties and applications of different materials. Alexander classifies the general criteria for the choice of the best building materials:

> The central problem of materials, then, is to find a collection of materials which are small in scale, easy to cut on site, easy to work on site without the aid of huge and expensive machinery, easy to vary and adapt, heavy enough to be solid, long-lasting or easy to maintain, and yet easy to build, not needing specialized labor, not expensive in labor, and universally obtainable and cheap.
> Furthermore, this class of good materials must be ecologically sound: biodegradable, low in energy consumption, and not based on depletable resources.
> (Alexander, *A Pattern Language*, page 956)

Today, the organization of the work force in the building industry exerts pressures on the selection of building material. Over-specialization and the emergence of trade organizations that physically separate work forces from one other and the processes of work itself pose difficulties to architecture. Office-centered architecture embraces this separation and assigns jobs to subcontractors according to phases of design and construction. The familiarity of each new contractor with the materials that have been used previously by other trades is minimal because they are physically separated by phases of construction and by site rules and regulations. In a work of architecture that needs to be integrated and whole, such artificial separation brings disunity and fragmentation in the appearance and performance of the building. In the architecture of Design/Build, the boundaries between different phases of construction, and therefore building trades, are not as sharply defined. Members of different trades can share their knowledge about materials that eases the transition from one construction phase to the next. Shared knowledge of materials provides coherence to the totality of the work (Figure60). This coherence provides unity and continuity in the

appearance and performance of architecture. The architecture of Design/Build gives much attention to this coherence, because it relies on the collective knowledge of material and enhancement of the working environment.

(Figure60)

A 15th-century miniature from the city of Heart shows the building of a portal. Scaffolding is being prepared, mortar is being made, and bricks are being shaped nearby while a mason cuts the stone and the master lays the bricks. The image shows the full circle of construction, where each craftsman and worker has a concrete understanding of all materials and the working process. (*Architecture of The Islamic World* page 114)

Ending

(Personal Archive)

Ending

People interpret and intervene in the process of architecture in many different ways. This diversity of experiencing architecture has led to the evolution of different methods of designing and building, each with their own strengths and weaknesses. The method of Design/Build allows people to freely interpret the process of architecture in their own way. It does not sharply divide the process of design from the process of building. This method lets people interact with and intervene in the process of architecture based on their own personal interpretation.

Attributes that qualify works of architecture are manifestations of the foremost values essential to the maintenance of life in built environments. Despite the seeming incompatibility of different approaches in architecture, there is an intellectual consensus on the fundamental qualities of architecture. For example, all schools of architecture acknowledge the significance of order in a work of architecture but their idea of what that order should be is different. They all believe that architecture must be a direct response to human need and that it must adapt itself to the social and natural environment, but their ideas of human needs or adaptations are not the same. Most methods of architecture have developed their own system of proportion, concept of order, or priority of need. All these attributes are developed to enhance the qualities of architecture. How much a method of architecture can incorporate these qualities in its works depends on its fundamental structure, which is shaped by its purpose and priorities, on how the architecture is able to interpret fundamental social and individual values. These three issues - values, consensus, and interpretation -- constantly influence and shape each other in the process of architecture.

Communication within academic circles requires an already established definition of design, to act as a framework for discussion and dialogue. In this paper, writings of Russell Sturgis have provided this framework. It is clear that Sturgis' ideas are complementary, even integral, to the experience of Design/Build. An author, who reflects the views of society in the early 1900s, turns out to be agreeing with a contemporary and radical method of architecture. Whatever has caused the convergence of these two views of architecture must be much more profound (primitive) than the architecture itself, something fundamental to the formation of any architectural method, regardless of its particular process of design.

The study of Sturgis' ideas points out that all people, regardless of their personal preferences, share values that are essential for the continuation of a healthy community life. Keeping these values alive is central to the life of each individual, and also to the life of society. In his writings, Sturgis symbolically expresses these values in an architectural language and classifies them into two major categories. The first category refers to consideration for geometrical attributes of design, such as proportion, symmetry, unity, and

order. The second category deals with the concepts that oversee the relation of humanity, architecture, and the environment. They include adaptability, nature, tradition, need, and material. Sturgis expounds on the influences of these attributes and concepts in the processes of design and building.

Despite their abstract appearance, the first set of attributes (geometrical) have very specific implications in understanding and building the structure of living environments. Order, proportion, unity, and symmetry evolve from the shared values of people. Over the centuries, social and individual values have found a special place in the process of defining and designing the geometry of living environments. Through these geometric compositions of architecture, people express themselves as intelligent living beings. These geometries reflect the intellectual preferences for the occurrence of events in architecture. The intelligent arrangement of space is the kernel of architecture. This process sets the preferences for performance of space and provides guidelines for human behavior. Based on this assumption, the geometry of a building illustrates the purpose of its architecture. Design/Build is interested in these geometrical attributes as they provide insight into the purpose of architecture and aid in expressing that purpose.

Sturgis' second set of principles, (relational) illustrate that a careful consideration of these topics is essential for the advancement of a healthy architecture. Concern for need, adaptability, nature, tradition, and material sets the process of architecture on a specific path which differs from the shortsighted and random act of assembling lines and forms. [1] This concern provides a particular view of and a responsible attitude toward the design of a livable environment. Fathy's discussion on material investigates the influence of these values in the process of design, and how they can make a designer sensitive to climatic factors and natural environment. Consideration of these values generates a type of geometry in design that is completely different from the geometry of a market-oriented architecture. Consideration for need, adaptability, nature, tradition, and material provide a set of principles that are essential for healthy continuation of life in the environment. They have become established concepts in the process of architecture, revealing the values for sustenance of life and preservation of its context, i.e. nature. For Design/Build these principles are important because they specify the characteristics of the environment within which design should evolve. They are also significant because they define the preferences of those who will use the work of architecture. All these principles help to clarify the process of design and lead to creative works of architecture.

Over thousands of years, these principles have become integral to architecture. Architects agree on the significance of these principles in the processes of designing and building, because as qualifiers of space they are vital to the maintenance of life in any environment. On the other hand, paying lip service to these principles does not guarantee

1- These differences have been illusterated on pages 17,97,99,100 in figures 6, 51,52,54,55.

they will flourish and grow in a work of architecture, as witnessed by the comparison of office-centered architecture and the architecture of Design/Build.Sturgis' writings might be applied equally to either method, except that the actual processes of each of these methods produce a different type of architecture, because they use different ways of designing and building with different goals. Each of these methods has developed a different interpretation of proportion, symmetry, unity, order, adaptability, nature, tradition, need, and material. Each allows a different level of intervention in the process of designing and building, producing works of architecture that are correspondingly unique.

Each method of architecture interacts differently with the attributes of design and absorbs a different level of the defined qualities. Design/Build is capable of incorporating more of the qualities of design into its process, because it allows people to freely interpret architecture in their own way. It relies more on the collective than the sectarian view. The most immediate effect of this approach reveals itself in the richness and unity of architecture. It generates a collectively agreed order in the arrangements of lines, forms, and structures. Design idea in Design/Build become democratic (symmetrical) because it stands in the middle of all opinions, providing equal access to all views. Design/Build does not sharply divide the process of design from the process of building, but instead allows intelligent thought/choice to override rigid rules and regulations that block the dynamic interaction of the designing and building process. Because of the interconnection of the designing and building process the designer is able to intervene in the course of building to modify and make last minute adjustments. Most important of all, the builders, craftspeople, and workers who labor in the building process acquire an overall understanding of the whole project. By allowing people to intervene in the process, Design/Build imparts a social dimension to architecture. By investing in the social development of architecture, it tries to establish a mass culture for architecture. This strategy encourages awareness of architectural issues at the individual and social level and reduces bureaucratic control of the design process. In contrast, office-centered architecture minimizes the intervention of people in the architectural process, viewing architecture as a market commodity wherein economic aspects are more important than its social dimension.

Design/build qualifies the architectural space by giving attention to qualities of life. This is possible because the process of architecture is guided by the intelligence of its creators. The compliance of Design/Build with the essential values of life is not an arbitrary choice by the designer or the builder; it is embedded in the basic processes. This compliance occurs because, in Design/Build, designing and building are not linear and fixed. Continuous interaction between these two sequences of events improves the design concepts. The method of Design/Build relies on an active client, an imaginative designer, a good craftsman, a dynamic builder, and a caring inhabitant. All of these elements are alive and intelligent, continually reshaping the process of architecture. Their inclusion in the process of designing

and building ensures living qualities will thrive in a built environment. This inherent attribute of Design/Build gives it a competitive edge in producing a living architecture. Design/Build incorporates qualities of life to architecture through geometrical and relational principles that promote the use of proportion, symmetry, unity, order, need, adaptability, nature, tradition, and material.

The attributes and concepts of architecture that signify key individual and social values are equally available to all methods of architecture. Whether a method can incorporate them into its line of work depends on the capacity of that method, the interpretation of these values by its designers and builders, and the methods that they use to incorporate these values in their work. Symmetry, proportion, unity, and order are subjective, in the sense that individual designers (or builders) must interpret them before they can be utilized in the work of architecture. Their presence in architecture is also the outcome of individual and social intervention in the process of architecture. The processes of interpreting and intervening are essential to the development of theses values in architecture. The sequence of work, the organization of the workforce, and the democratic participation of people at all levels of designing and building processes are essential steps toward a genuine incorporation of these values into a work of architecture.

Appendix - A

The Nine Principles of Design

In order to expand the definition of design, Sturgis associates it with the concepts of proportion, symmetry, unity, order, adaptability, need, nature, tradition, and material. To illustrate the relation of these concepts to design, he establishes them as a set of principles and guidelines for the practice and process of design. These principles are revealed in the four geometrical arrangements and five relational guidelines that are embedded in his discussion of proportion, symmetry, unity, order, adaptability, need, nature, tradition, and material.

1. In the discussion of proportion, considerations of utility, material, scale, and habit outline the first principle, proportion.

2. In symmetry, the significance of harmony and balance between people and the built environment establishes the second principle: " Where performers and audience have to be considered, a symmetry along the plane of action is certainly appropriate."

3. Order is the third principle: "the general law in regard to these abstract considerations is desirability of order..."

4. Sturgis describes the rule of unity as a consideration for "mean", advising; "in the simplest case it is desirable to have a mean between extremes..."

5. Adaptability has been defined as a principle that promotes concern for compatibility between the forms and purpose (or function) of architecture: "every building and detail should be shaped so as best to express its typical character."

6. The sixth principle is a concern for harmony with the natural surroundings: "Harmony with the rest of nature is the great rule.... Now, it is with these constant elements of style that architecture as an idea is alone concerned..."

7. Sturgis is particular in the way the principle of tradition can be used: "if we will thus concern ourselves less with styles, and these regard old facts from our proper standpoint, the whole body of this past experience is ours to profit by."

8. The eighth principle is defined, as a consideration for real needs: "a wise consideration of what are true needs would carry us far and give us nearly all we want."

9. Material is the final and perhaps most important principle of design according to Sturgis, and "All consideration of architectural results leads us back to material determining conditions..."

Sturgis sets definite guidelines and parameters for the purpose and processes of architecture through his discussion of these nine concepts or principles. He elevates each of them to a major principle of the design process through the consideration and codes of conduct that each represents.

Bibliography

Cited works

Articles

1. The Cardboard House, (1931) By Frank Lloyd Wright

2. Cultural Degeneracy, (1908) By Adolf Loos

Dictionaries & Encyclopedias

1. A Dictionary of Architecture & Building Vol. 1, (1904) By Russell Sturgis - New York The Macmillan Company

2. Encarta® World English Dictionary © 1999 Microsoft Corporation

3. Webster's Third New International Dictionary, 1963 G & C Merriam Company Publishers

4. Oxford paperback encyclopedia, page 566, Oxford University Press 1998

5. BBC English Dictionary, 1993

Books & Journals

1. A Pattern Language Towns Buildings Construction, (1977) By Christopher Alexander, Murray Silverstein, Sara Ishikawa, With, Max Jacobson, Ingrid King, Shlomo Angel - Oxford University Press. New York

2. Architecture of the Islamic World, (1978) Edited by George Michell – Thames & Hudson

3. Folk Architecture of the east Mediterranean, by Daniel Paulk Branch, 1966 New York & London.

4. Forces of Nature, (1977) Edited By Sir Vivian Fuchs - Thames & Hudson. London.

5. Formal Structure in Islamic Architecture of Iran and Turkistan, (1990) By Klaus Herdeg - Rizzoli Publication New York

6. Geometry in Architecture, (1984) By William Blackwell - John Wiley & Sons Publication. New York

7. Hassan Fathy Architectural Monographs, (1988) By James Steele - Academy Editions. London / ST. Martin's Press. New York

8. Mediterranean Vernacular, (1991) By V. I. Atroshenko & Milton Grundy - Anness Publishing Limited. London

9. Natural Energy and Vernacular Architecture, (1986) By Hassan Fathy - The University of Chicago Press. Chicago & London

10. Order of Things, (1998) by Barbara Ann Kipfer, Random House New York
11. Persian Architecture, (1969) By A. Pope, Soroush Press Tehran

12. Rainer / Iran, (1977) By Roland Rainer - Akademische Druk_u. Verlagsanstalt, Graz

13. The Architecture of Humanism, (1914) By Geoffrey Scott - The Architectural Press London

14. The Architect, (1977) Edited By Spiro Kostof - Oxford University Press. New York

15. The Architecture of the Jumping Universe (1997) By Charles Jencks - Academy Editions Publication

16. The First House, by R.D Dripps, (1999) The MIT Press Cambridge, Massachusetts. London.

17. The Formation of Islamic Art, (1987) By Oleg Grabar - Yale University Press London.

18. The Old Way of Seeing, (1994) By Jonathan Hale - Houghton Mifflin Company Boston New York

19. The Sense of Unity, (1973) By Nader Ardalan & Laleh Bakhtiar - The University of Chicago Press. Chicago & London

20. The Search For Order In The Universe, Symmetry in science VII, by Iachello Francesco - Plenum Press, New York 1993

21. The Timeless Way of Building, (1979) By Christopher Alexander - Oxford University Press. New York

22. Wholeness And The Implicate Order, (1980) By David Bohm - Ark Paperbacks. London, Boston, Melbourne & Henley

Draft & Thesis

1. The Nature of Order, (1988) An essay on the art of building and the nature of universe, by Christopher Alexander.

Consulted Works

Articles

1. A Chapter on the Design and Construction of Modern Furniture, (1897) By Henry Van de Velde
2. Artificial Life for Computer Animation By Demetri Tterzopoulos
3. Architecture, (1910) By Adolf Loos
4. A Chapter of Axioms, (1911) By C. R. Ashbee
5. An Ideal Suburban House, (1895) By M. H. Baillie Scott
6. Image/Speech Processing Adopting an Artistic Approach - Toward Integration of Art and Technology By Ryohi Nakatsu
7. In Search of the Right Abstraction: The Synergy Between Art, Science, and Information Technology in the Modeling of Natural Phenomena. By Przemyslaw Prusinkiewicz
8. Modern German Architecture and what we may learn from it, (1915) By W. R. Lethaby
9. Modern Furniture Decorated according to Nature, (1900) By Emile Galle
10. Palace Window and Folding Door, (1896) By Alfred Lichtwark
11. Potemkin's Town, (1898) By Adolf Loos
12. Ornament in Architecture, (1892) By Louis Sullivan
13. The Beauty of Form and Decorative Art, (1897-8) By August Endell
14. The Decorative Art and the Machine, (1895) By Rioux de Maillou
15. The Development of Modern Industrial Architecture, (1913) By Walter Gropius
16. The English House, (1904-5) By Hermann Muthesius
17. The Future of German Form, (1915) By Hermann Muthesius
18. The Modern Home, (1899) By Charles Plumet
19. The New Ornament, (1901) By Henry Van de Velde
20. The Role of the Engineer in Modern Architecture, (1901) By Henry Van de Velde
21. The Tall Office Building Artistically Considered, (1896) By Louis Sullivan
22. The Work-Programme of the Wiener Werkstatte, (1905) By Josef Hoffmann & Koloman Moser
23. Where are we going? (1897-8) By S. Bing

Dictionaries & Encyclopedias

1. A Dictionary of Architecture Vol. 1 & 2, (1877) By Thoms Richards - Architectural Publication Society
2. Dictionary of Architecture & Archaeology of Middle Ages, (1838) By Johan Britton
3. International Dictionary of Architects and Architecture
4. Visual Dictionary of Architecture
5. Concise Encyclopedia of Architecture, (1959) By Martin S. Briggs - New York E. P. Duton & co. Inc
6. Encyclopedia of Vernacular Architecture of the World, (1997) Edited by Paul Oliver - Cambridge University Press

Books & Journals

1. Architecture and The Spirit of Man, (1949) By Joseph Hudnut - Harvard University Press Cambridge
2. Broken Symmetries, (1999) Edited By L. Mathelisch & W. Plessas - Springer, Verlag Berlin Heidelberg New York
3. C. Escher, (1982) Edited By J. L. Locher - Harry N. Abrams, Inc. Publisher New York
4. Carlo Scarpa, (1985) a+u Extra Edition Tokyo Japan
5. Dynamic Symmetry, (1920) By Jay Hambidge - Yale University Press New York
6. Form Function & Design, (1960) By Paul Jacques Grillo - Dover Publication Inc. New York
7. Gaudi; On Discovering Gaudi's Architecture, (1967) Text by Le Corbusier & Photo by Gomis Prats
8. Manhattan Skyscrapers, (1999) By Eeic P. Nash & Photo by Norman McGrath -Princeton Architectural Press New York
9. Notes on the Synthesis of Form, (1964) By Christopher Alexander - Harvard University Press
10. New Urban Environments; British Architecture and its European Context, (1998) Edited by Peter Murray and Mary Anne Stevens Prestel Publication Munich & New York
11. Symmetry in Chaos, (1992) By Michael Field & Martin Golubitsky - Oxford University Press Oxford
12. Symmetries in Science VII, (1993) Edited By Bruno Gruber & Takaharu Otsuka -Plenum Press New York & London
13. Style in the Visual Arts, (1956) By Bruce Allsopp - London Sir Isaac Pitman and Sons, LTD
14. The Great Architecture of Japan, (1970) Described and Photographed by Drahomir LLLik - Hamlyn publication London New York
15. Traditional Japanese Houses, (1983) Edited and Photographed by Yukio Futagawa & Text by Teiji Itoh - Rizzoli Publication New York
16. The Linz Cafe, (1981) By Christopher Alexander - Oxford University Press New York
17. The Oregan Experiment, (1975) By Christopher Alexander, Murray Silverstein, Solomon Angel, Sara Ishikawa & Denny Abrams - Oxford University Press New York

18. The Production of Houses, (1985) By Christopher Alexander, Haward Davise, Julio Martinez & Donald Corner - Oxford University Press New York Oxford

19. The Theory of Proportion in Architecture, (1958) By P.H. Scholfield - Cambridge University Press Cambridge

Draft & Thesis

1. The Unified Building Process, Variables which produce a coherent structure of space (1986) - By Artemis Anninou