An Experience in Learning: Design of a Multi-Disciplinary University at Timbuktu, Mali.

by

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Abstract

Timbuktu is a city in Mali, North Africa. It has been a real and legendary city, and the Islamic center of North Africa. The program proposes a major international, multi-disciplinary University which will focus the world's attention to the problems prevalent in that area and address them.

If Islamic is not an adjective defining a religious quality, should it be understood as a word that identifies a special kind of Architecture, that of a civilization reflecting or determined by special qualities inherent in Islam as a cultural phenomenon?

The design is an attempt in discussing the spatial elements in Islamic architecture which appear to be typical and an attempt is made to explain those elements as expressions of culture created by Islam. The design solution is an expression of the place incorporating those elements of Islamic architecture which are still prevalent and which address the ecological, cultural, and social issues endemic to Timbuktu.
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Table of Contents

Introduction ..................................... 1
The Context ..................................... 2
  Timbuktu
  Urban Structure
  The Dwelling
Islamic Identity ................................ 5
  The Courtyard:
    Courtyard as a climatic moderator
  Street Patterns
The Design ..................................... 9
  The Site
  The Walls
  The Roof
  Student Housing
Post Script ................................... 21
Bibliography ................................... 26
Vita ............................................. 27
Introduction

Every Continent has its own great spirit of place. Every people is polarized in some particular locality, which is home, the homeland. Different places on the face of the earth have different vital effluence different vibrations, different chemical exhalation, different polarity with different stars: call it what you like. But the spirit of place is a great reality - D. H. Lawrence

Architecture is never a literal translation of whatever we mean by society, nor do partial analogies justify assuming a common significance for buildings belonging to different historical contexts - it reflects the attitude towards physical spaces and its transformations and interpretations thus subject to all climatic, technological or political accidents that affect a population. It is a context of human development and is constantly expressing that environment's cultural values. It's a fundamental form of cultural communication, revealing the way people live, their basic priorities as an individual, and society. It is therefore very important to understand the cultural and religious factors that governs people's lifestyles in a particular environment.

The thesis project was a competition sponsored by the National Institute for Architectural Education. It was a design for a University in Timbuktu. The program dictated a need for a multi-disciplinary university which would address the problems endemic to Timbuktu and the surrounding areas.

It was evident that Timbuktu was different from its counterparts in the western world. The difference was not as much in the functional elements, but rather in the unique spatial structure and organization. The design concept therefore involved a process of going through the physical manifestations of the spaces experienced in the Islamic world, and identifying a few of its key elements. These elements were then incorporated in the design of the University to create a place which would be culturally and ecologically endemic to Timbuktu.
The Context

Timbuktu

A Legendary city. A center of learning, a crossroads, a trade center, and a place intermingling of many peoples. It was the foremost religious center of the south of the Sahara, famed throughout the Muslim world, and is a place dictated by Islamic Doctrines. Timbuktu was founded in about 1100 AD and reached its zenith under the Songhois in early 1500s. Islam came to Africa in about 9th Century, and it was not until the rise of the Black Kingdom of Mali, in the 13th Century, that Islam spread to the Savana region, and Djenne and Timbuktu became the center of Islamic influence. In 1500s it was a city of more than 100,000 people and greeted and serviced caravans of upto 60 thousand people and 4,000 camels. Salt, Metals, ivory shells and gold were traded as people from the north and south, from the desert and the river, interacted. It was a University city, a center of learning, attracting scholars from throughout the known world.

Today this region is in the midst of a severe drought extending from Senegal to Ethiopia, the advancing Sahara, the loss of cropland, the ensuing famine and migration of peoples all have combined in continuing destruction of what was once a free powerful and balanced system. It has a very low urbanization rate, and hence beyond the planning capacities, reveals a clear deteriorating in living conditions of the poorest urban groups.

The Program Proposes a major new international and multidisciplinary University in Timbuktu. It will focus on world’s attention for the problems of the area and would at the same time, address those problems. Various world agencies will have offices in the complex and the students from the world over will meet, learn, and work on problems endemic to the area, but universal to all. Humanists, geologists, agriculturists, sociologists, civil hydraulic Engineers and Architects will be part of a multinational faculty working together.
Geographically, Timbuktu is located in the great Sahara desert but on the edge of the Niger river artery, in the country of Mali in North Africa. Its geographic location is 14° 3' N latitude and therefore has a hot arid type of climate. The greatest amount of radiation is felt in this region and it is augmented by the radiation reflected from the barren, light colored terrain. Timbuktu has basically two seasons; a hot summer, where the temperature is about 102 ° and a somewhat cooler period where the temperature averages to 75 °. In addition it experiences a diurnal change in temperature where the maximum day temperature is around 45-50° C and the temperature drops to 30-20° C in the night. The humidity is low and not of any serious concern in these areas. Rainfall is about 4 to 10 inches at the end of summer and are of short duration, but torrential in nature.

The main climatic elements seen in hot arid zones are:

- High intensity of direct Solar radiation plus radiation reflected from the ground.
- High diurnal and annual temperature ranges
- Low humidity and low precipitation
- Sandy environment and dusty storms.
Urban Structure

The dense urban structure in Timbuktu and the surrounding areas can be understood as a series of spaces of different degrees of sociability and highly structured class organization - city, neighborhoods, courts, dwellings, corresponding to their levels of increasing privacy. The narrow streets serve as transition between fully public spaces as seen in urban centers and mosques to the familial space of a dwelling. The layout also reflects ecological constraints, for the buildings shade one another from the bright sun, and covered passages provide protection from the wind and the sun. This kind of urban pattern, a sequence through spaces of varying degrees of privacy, is an element experienced very frequently in Islamic cities.

The Dwelling

A typical house in Timbuktu is a rectangle building, oriented, according to the cardinal points and entered usually from the south or the north. Traditionally, the house has 12 to 9 doors and built entirely of clay (banco) or Adobe except for the pilasters and the doors. However, from Egypt and the middle East came the influence of houses with monumental facades with terraces and multi-storeyed construction. These new approaches are seen in the later elevations of mosques in Djenne and Timbuktu.

The houses of Timbuktu are renowned for their monumental facades. About 7 meters high, these facades center on a door at least 2 meters high set between two pilasters. A narrow corridor leads to the interior courtyard and to the staircase. The interior courtyard in the center of domestic activity and the focal point or nucleus of any dwelling. Surrounding the main courtyard are the rooms which are usually paired: the servant rooms with the store rooms and the woman’s rooms with the pantry. These rooms are arranged to afford some privacy, and are lit solely by the doorway.

From the documentation of building types in Timbuktu, it is evident that Timbuktu has still retained its Islamic identity.
Islamic Identity

The sum of human institutions at any given moment in history is civilization—or, a particular civilization—founded upon a revealed doctrine which informs every aspect of it; of no civilization is this more true than it is of Islam. Walk through any traditional Islamic city in any part of the world from say Indonesia to Maghreb, whatever the difference of natural environment or climate, what is immediately apparent is its Islamic identity. And this immediately recognizable and tangible identity depends not upon uniformity of design or materials but upon the fundamental unity of the civilization and its traditional institutions and principles.

What tangible elements of the past for inspiration exists? and what general methods can we use to integrate their spirit and message to our modern environment? We are aware that there is an Islamic Architecture which is still alive in Timbuktu, not only with its great monuments, but with the structure of cities, lesser settlements, simple dwellings and tradition of the crafts. The approach for the design of the university called for a place endemic to that area, its climate, culture, and social conditions. It seemed appropriate to make use of the examples of the past and present and revive the same heritage. Timbuktu being the Islamic center of North Africa, has maintained a lot of the Islamic characteristics seen in other parts of the world. Since the Islamic religion is widespread one sees a lot of similarity in the basic design and concepts of buildings all over the world.

The source of Architecture and planning in the Islamic world does not follow any theory or philosophy or methodology, nor does it follow any system of proportion, shape or form of building. It is not an expression of any past or present technology, neither is it a particular kind of door or window, arch, dome or minaret. It is the architecture created by man’s concern for the Divine law (Shariah) and his behavior according to it within the Islamic society. It is the architecture concerned with unity. Islam is based on unity and is the means towards the integration of human life, and infact all multiplicity into unity. There was a need to adapt local materials and local images to respond to local climate and at the same time to hold onto the thread of the basic principles of Islam. Significance of Islamic architecture has never been in quantitative proportion but in the overall inherent quality of spaces Geometry is the link in the architecture of Islam, it is the principle behind the planning of cities, buildings, within the city and the windows, walls, grills, and screens.

Most of the Traditional Islamic Architecture reflects this unity and takes one through a sequence of spaces— a space which
evokes spirituality of the environment, a feeling of peace, harmony and humbleness of the spectator. The main elements which were the basis for determining the spatial quality were:

- The Courtyard: a space demarcated as a private space, a microworld of its evolution- the nucleus of any dwelling or living environment. A single unit. (A negative space).

- A combination of Units:
  God created the human body with its multiplicity of cells. The cell is the part and the body is the whole. In the same way the human body as a person is individual, he is part of the whole world and the concept of the whole is based on the geometrical principles. (A combination of positive and negative spaces).

- The Link: A network of covered walkways; feeders to help the entire complex to breathe as a whole. It links the two spaces giving the effect of unity. (an intermediate space the tarna)

**The Courtyard:**

A Paradise that has the space of heaven and earth - Quran (3:133)

Architectural space in the Islamic world is original. It was born with Islam and developed from religious, social, and political and geographical factors. Out of religion the open courtyard emerged.

Sahan (courtyard) is an open space surrounded by a building. This principle planning gives the building sufficient illumination; the requisite ventilation; acts as a sieve to purify air from dust particles; and cuts noise down from adjoining roads. Packed with information, it throws itself open to the four winds. The space responds to the ecological environment of the town by intense social and cultural forces. Traps warmth in winter and lowers the temperature of intense heat in the summer. This presents the first concept of unity of space. A concept where the boundaries give the place coherence, unity and continuity; a boundary that holds the place together. It provides privacy, intimacy and self awareness and secure territorial existence. The Islamic environment focuses on open spaces rather than on built masses, by deriving its coherence and unity from the main generating element- the courtyard. The Architecture totally depends on the negative spaces - the voids. It is a space which tames a limitless sky and pins it down as its ceiling has on the other hand a very limited ground- a very earthy space. Around the space, porticoes and porches make holes in the walls, opening into rooms. In the building itself the empty space pushes the walls back rather than allowing itself to be shut in. Inward orientation of buildings is the most important physical manifestations of social life in the Islamic city. Inward oriented houses were among the most unique elements that of the Islamic city in the sense that they did not have an equivalent in the Medieval cities of the West.
Courtyard as a climatic moderator

The courtyard acts as a light well as well as an air shaft, bringing both daylight and air movement to the rooms around it. The relatively static cooling system used in a courtyard house can provide the basis for understanding modifications that can generate air movement by convection. Warm air is less dense than cool air and therefore will rise in an environment of cool air. This movement is called convection. As the warm air rises, it must be replaced by cool air from the surroundings. If a heat source exists below the initial pocket of warm air, the cooler air replacing it will also be warmed and will rise. In hot dry regions, the courtyard functions in three regular cycles taking advantage of the diurnal range of temperature during summer.

First Cycle:
Cool night air descends into the courtyard and fills the surrounding rooms. Walls, floors, column roofs, ceilings, and furniture are cooled at night and remain so until the late afternoon. The courtyard loses heat by irradiation to the sky, and may be used for sleeping during the summer.

Second Cycle:
Around noon, the sun directly strikes the courtyard floor. Some of the cool air begins to rise and also leaks out of the surrounding rooms. This action sets up convection currents in the rooms which may afford further comfort. The courtyard now acts as a chimney. At this hour, the ambient temperature is very high outside. Thick walls do not permit the external heat to penetrate to the inside of the house. The adobe walls are excellent insulators with a time lag of 12 hours.

Third Cycle:
The courtyard floor and the inside of the house get warmer and further convection currents are setup by late afternoon. Most of the cool air trapped within the room spills out by sunset. During the late afternoon, the courtyards and the building are further protected by shadows. As the sun sets, the air temperature falls rapidly, the courtyard begins to irradiate the clear blue sky, and the cooler air begins to flow and dissolve into the courtyard.

Courtyard buildings grouped together create an environmentally consistent solution as a whole. The sun is able to penetrate only when it is directly overhead (around noon). To enhance thermal comfort, this phenomenon has been used in the architectural design of the houses exploring the courtyard concept.

Essentially horizontal in character, the courtyard concept represents perhaps the simplest and easiest form of shelter for people who are closely associated with rural desert traditions. This form of planning, whether individual or collective, retains some of the important elements of the life desert communities.
Street Patterns

Original Islamic cities were pedestrian cities. Dense development in the hot arid and composite climate zones is linked with narrow, winding streets which continuously change direction. The streets are curved and angular and sometimes culminate in dead ends or open into public spaces. The streets are like a continuous labyrinthine occasionally crossed by an overpass or terminating in dead ends. A visitor might lose his direction in alleyways. However a person in that development all these becomes point of references that are easily comprehended. The narrow streets are comforting to pedestrians and they provide an essential sense of togetherness. Streets do not reveal its end and so lures you into exploring some more and moving a bit further ahead. Occasionally the streets stop to rest. It widens out a bit, loses some of its dynamism, breathes a little, then resumes its path on a slightly shifted axis. Places where street relax leads one to community spaces. Narrow winding streets with a closed vista has the same function as the courtyard in a house. These streets are like arteries they feed each cell and help them to survive, co-exist along with the other cells in unified harmony.

Therefore the main concept in the design was to create an environment which was Place-related. A place which inherited the spatial quality of the Islamic tradition and at the same time responded favorably to Timbuktu’s climate and culture.
The program evolved a design of a University which was very culture dominant. This means that there was a need of an indigenous blend of the city’s vernacular architecture, cultural tradition and modern technology and scientific approach. The design, which had to remain faithful to simple building materials and technologies, and employed the elements forces of nature such as light and wind as architectural elements.

The Site

The site is located halfway between Timbuktu and its port Kabara. It occupies an area of 30,000,000 square feet and straddles the paved road between the cities.
The planning was based upon using the geometric discipline used in most Islamic cities. The design was derived from a special composition with geometry, differential space expressed in pathways, courtyards and intermediate spaces. The covered walkways and courtyards were the basic elements in the design. Each cell was square in form which contained a courtyard. The courtyard as mentioned earlier was the essence of any form of planning in the Islamic world. Surrounding the court were colonnades and rooms were arranged to open onto the porches encircling the courtyard. In the courtyard was the presence of water which is a strong element of Islamic architecture and ecologically useful since it increases the humidity to a level of human comfort.

We made every living thing from Water. - Quran (Al Anbia 21:30)

According to the Islamic tradition in design, water is like a magnet which polarizes space. In all open spaces in Muslim urban structure water is the focal point.

The square which was the basic form adopted, is a product of four equal paths which represents unity. It symbolizes the earth according to the Islamic tradition. Each of these units were connected to one another by covered walkways. These walkways acted as link to all parts of the complex and also provided a solution to the climatic problem. The organic character was further enriched through surprise plazas at every corner of the walkways or every bend of the street; a characteristic which can be identified today as a part of Islamic heritage in human settlement. These plazas served as open air theatres, and exhibition spaces for the University. The resultant compact and continuous layout of buildings reduced the land waste and provided a network of cool alleyways and squares and created agreeable microclimatic conditions. The courtyard buildings were grouped together to create an environmentally consistent solution as a whole as opposed to the concept of the detached machines for living.

The complex combined all the facilities together and this arrangement was flexible and provided for future expansion. The main idea was to create an oasis which would be a place where the micro-climatic conditions was favorable for human comfort.

Each module was 25'x25' and a combination of these modules side by side gave rise to laboratories and lecture halls. The entire planning was flexible and the module worked well for classrooms, laboratories, or offices. The various faculties housed in the university were:

- Classroom building
- Elementary Engineering
- Laboratories
- Experimental Water resources Laboratories
- Agricultural Engineering Facilities
- Studio
Detailed Elevation - Showing Entrance to the Academic Facilities

Detailed Elevation - Showing the Water Resources and Agriculture
The Walls

The wall needed to be sufficiently thermal resistant and this dictated the use of thick Adobe walls. Adobe or Banco is freely available in Timbuktu and the walls were constructed 16" thick. The load of the roof which was constructed of RCC, was spanned over columns 25' apart. Thus no load was carried by the walls. The openings to the outside was kept to a minimum and had wooden shutters. The classrooms had clerestorey lighting which opened onto the courtyard.

The Roof

A double roof system was incorporated in the design of the complex. The reflectivity of the outer surface or the sun roof, and the thermal resistivity of its materials were of primary importance. Shade can be achieved using a sun roof with an air gap in between. Since the outdoor temperature is higher than the indoor temperature, the outer surface is exposed to the sun gets heated as it absorbs radiation, and also as being in contact with the outside hot air through conduction. The roof then transmits the heat to the inner surface and raises the temperature of the air. The double roof acts as a parasol as it receives and throws off a high proportion of sun’s radiant heat and at the same time any heat which has been retained, escapes through the air gap. Vaulted roofs are effective as it is capable of reflecting off the heat because of its geometry, since a part of the roof is always shaded except in noon when the sun is directly overhead. Vaulted roof also increases the speed of air flowing over their curved surface due to Bernoulli effect.

The outer roof employed in the design is built of ferroconcrete, and the inner roof is a flat R.C.C. roof.
The need to provide each student with his or her own private dwelling created the need to find a spatial expression basic to the form of the Islamic house. This led to the design of each cluster following the basic elementary form of an Islamic dwelling. This concept also coincided with the same geometric discipline employed in the academic complex. The entire university complex combines the academics and the housing to form a single coherent composition. This kind of planning is often seen in Islamic cities where there is no marked differentiation between the main place of work and the place of living. The division of Muslim houses are defined by social accessibility. This is seen in the housing scheme where one experiences a sequence of spaces from the most private spaces to the public spaces.

Each room is provided with an open terrace which can be used during the night when the temperature drops and the internal walls are dissipating the heat they retained during the day. The terrace - a private world of each occupant, presents a space of the highest degree of privacy. The function of the room and the terrace is non-specific and hence provides a very flexible arrangement. As seen in the layout of the classrooms, ten rooms are clustered together around an open courtyard - a semi public space; a place of interaction between students living in that cluster. A number of these units are connected together through covered walkways and these lead into a huge open public space. In the case of the housing, the courtyard borders on the cluster, providing a protected area contiguous with the dwelling units as against a traditional house where each house has a private courtyard of its own. The symbolic entrance in the traditional Islamic houses is the vulnerable threshold between the household and the public and is often emphasized by the construction of a monumental doorway. The main gateway of the house usually does not give immediate access to the domestic quarters but leads into a vestibule or a passage with right angled turn so that the court is not seen from the main street. In the student housing the street opens into the court giving it a lesser degree of privacy. The entrance to the court is not directly accessible from the street but the concealment of content is not that exaggerated as a Islamic house. The entire housing area is two storeys high. A person who walks through the housing area will move through a sequence of open spaces of varying degrees of privacy. The material and the type of construction employed is the same as that of the classroom building.
The traditional house versus the Student housing

Student Housing - Typical plan of a single unit
Roof plan of the housing cluster
Student Housing - Elevation of a typical unit

Student Housing - Section through a typical unit

Vaulted Sun Roof
Street
Court
Terrace
Post Script

The result of the human environment interaction constitutes culture and has led to the development of multitude of cultures by people in different environments. Vernacular architecture is one of the most concrete manifestations of this interaction. The pivotal issue in this thesis is the employment of a traditional architectural method and form, in this case the courtyard, in today's fast changing world, and importantly, in a location where the method and form has had a long history. The use of courtyards in the Islamic world provides within acceptable tolerances the environmental (thermal, luminous, haptic, sonic, atmospheric), and the more intangible (social, behavioral) effects. In this effort, I realized that the solution provided by generations of traditional society, and the need to recall certain historic traditions led to the use of some of the spatial elements. The general problem in design in environments undergoing massive change has been a disregard for all forms of vernacular wisdom and their replacement by twentieth century methods. The result has been an impose of sterile and meaningless western statements upon cultures accustomed to certain endemic settings and values. It is therefore important not to ignore the basis of lifestyles for centuries and replace it with new values or forms which is not place related.

There is no claim by the designer that the result developed by the use of courtyards in the campus will be without problems, and ineffectiveness. The claim is however that a certain degree of those quantitative effects and a certain historic link to the past would be achieved.
Bibliography

Housing, Climate & Comfort; Evans Martin, Architectural press, London

Shelter in Saudi Arabia, Talib Kaizer, St. Martin Press, New York


Natural energy and Vernacular Architecture; Fathy Hassan, University of Chicago Press, Chicago, London.

Buildings in Hot dry Climates; Saini Balwant; John Wiley & Sons.


Reading the Contemporary African City, Proceedings of the seminar- Transformations in the Islamic world, Aga Khan award for Architecture, Dakkar, Senegal, 1982.


Architecture and the Community, Buildings in the Islamic world today, Aga Khan award for Architecture.


Personal Notes, Butke Walter J., November 1987
The vita has been removed from the scanned document