DESIGN CRITERIA FOR THE MIDDLE EAST

A Thesis submitted to the Faculty of Graduate Studies and Research in Partial Fulfillment of the Requirements for the Degree of Master of Architecture.

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ABSTRACT

In the twentieth century many of the architectural and urban planning works in the Middle East have undertaken without a thorough understanding of the climatic, traditional, religious and geographical factors that are unique to this area. This thesis discusses these and other factors which contribute to the unique character embodied in Middle Eastern cities and architecture. The design criteria form the main body of the thesis. The criteria are individually discussed and the discussion results in a set of guidelines and recommendations. Each criteria begins with a stated problem, proceeds with a detailed discussion, and concludes with a recommendation.

RESUME

Plusieurs projets architechiraux et urbanistiques réalisés au Moyen-Orient depuis près d'une centaine d'années témoignent d'une faible connaissance des composantes climatiques, culturelles, religieuses et physiques, spécifiques à cette partie du monde. Le présent mémoire offre une analyse détaillée de 24 critères de design, à la lumière des différents éléments propres au caractère distinct des villes et de l'architecture du Moyen-Orient.

Ces critères de design traitent soit de morphologie urbaine, soit de morphologie des bâtiments, et sont abordés un à un de la manière suivante: chaque concept est développé à partir d'un enoncé de base établissant, un enjeu ou un besoin existant, et conduit, après une réflexion soutenue, à un ensemble de principes et de recommandations.

ACKNOWLEDGEMENT

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I am thankful to my friends who were there with support when I needed them. A special thanks to my friend Tarek Hassan who assisted me with the graphics, to Danny Peart for his editing suggestions and to Klondy Guerra for typing my thesis.

My parents, Moushira and Omar Darwish, have supported and encouraged me throughout my life; my parents-in-law, Kamar and Farouk Mufti, have helped and inspired me through the difficult periods, and for this, I am deeply grateful. Finally, I would like to thank my wife Ghazal for her support and understanding and my son Muhannad for the many times he changes my serious frown to a smile.

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INTRODUCTION

INTRODUCTION

THE PROBLEM:

The beginning of the nineteenth century marked a radical change in the continuous development of the Middle Eastern countries. Western culture and the technological advances of the industrial revolution were introduced to the Middle East. However, the people did not have the necessary knowledge to cope with these influences and many problems were created. Western civilization began to influence the textures of Islamic values, the art, the family structure and the physical space.

The traditional Middle Eastern Islamic city was a living entity with an active pattern of spacial organization. In general and all over the world, the traditional city evolves in the process of fulfilling the social and physical needs of each one of its citizens. Therefore, each inhabitant has a genuine interest in the welfare of his/her city.

The pattern of mixed-land use in the traditional city expresses the integration of economical components into the fabric of the social life. As a result, it extends into each corner of the city filling the urban scene with life.

The physical form of the traditional city demonstrates a progression of urban space extending hierarchically from the public domain down to the smallest unit of the city. The mosque provides the focus of the activities involving the total population of the city, while the residential courtyard remains the smallest private domain. With the mosque being the top of the hierarchy, the next level is the division of the city by the principal "suq" streets extending from the mosque square; these streets are the widest and the busiest. Consequently, they are distinct from the major residential streets that provide access to residential quarters. The traditional Middle Eastern city is also

distinguished by its compactness and its low-rise developments. It is pedestrian in scale and constitutes an urban environment characterized by low energy demand and consumption.

Today the Middle Eastern city seems disjointed and out of place as if it was located in a different environmental setting. Rapid change has been seen and felt in the wide boulevards, the car oriented town layouts, and circulation patterns. The buildings are far from being responsive to the climatic factors and far from being human in scale. Consequently, the Middle Eastern city entered a process of modernization by copying models of alien urban forms. This happened at a time when western designers had realized the inadequacy of those same models and tried to develop new principles and patterns of urban forms. These new principles and patterns just happened to be similar to those found in the older Middle Eastern city. Middle Eastern architecture has many elements as valid today as they were decades ago. That is because these elements were created as a response for the climatic, religious, social, and geographic requirements of the Middle East. These elements in turn responded to the physical and emotional needs of the people. These needs have not changed dramatically even today. Although the form and the size of these elements may have to be altered due to changes in materials and socio-economical conditions.

ATTEMPTED SOLUTIONS:

In the last 15 to 20 years many attempts have been made by local and foreign architects and planners who tried to solve a difficult and complicated problem. In Middle Eastern cities there is conflict between the past and the present. Their task is to analyze and obtain inspiration from the patterns of the traditional past and adapt them to the modern techniques and materials, and to reconcile them with Islamic values and climatic factors.

Hassan Fathy is one of the earliest architects who took the initiative to solve

the problems that were stated. His ideas based on harmony between the climate, the original materials, the tradition and the physical forms. His understanding and concern are evident in his work on the "village of Gourna", and in the private houses, that he designed. His writing and teaching also offer many examples of his thinking in this area. Fathy has been able to influence a new generation of architects who share his concern and are trying to follow tradition and move it a few steps ahead. This is best understood through:

> "When the full power of human imagination is backed by the weight of a living tradition, the resulting work of art is much greater than any that an artist can achieve when he has no tradition to work in or when he willfully abandons his tradition."[1]

The Western group of "Skidmore, Owings and Merril" also attempted to understand the Middle Eastern culture. They issued a manual titled "Primer for Development" to be used by foreign designers in developing a suitable and acceptable Middle Eastern environment. This manual summarized the basic important points and outlines that the designer should understand and be familiar with before attempting to find acceptable solutions.

THE DESIGN CRITERIA

In this thesis I am trying to set guidelines or design criteria for architectural work for the Middle Eastern Countries I have been inspired by Christopher Alexander's book "A Pattern Language". This book presents the different issues of planning patterns that should be considered during the designing process. It applies equally to the design of houses, public buildings, neighbourhoods, streets, gardens and individual windows and seats.

The thesis presents the factors that should be looked at, considered, understood and carefully studied when designing or planning any kind of environment

or facility in the Middle East. I apply the pattern language format to the design criteria that are suitable for the Middle East area. Each criteria has the same form: A. first, there is the headline, in bold type, this headline states the problem in one or two sentences. B. the body of the problem follows the headline. The body of the text describes the cultural background the traditional values, and how they could be applied in the Middle East. C. the solution is then offered, in bold type. This is the heart of the criteria and it describes what I think we need to do.

In this thesis, I have attempted to organize the relevant thoughts of architects and planners when designing and planning any environment. Each criteria is designed to consider the special location, climate, religious and cultural factors that the Middle East countries share.

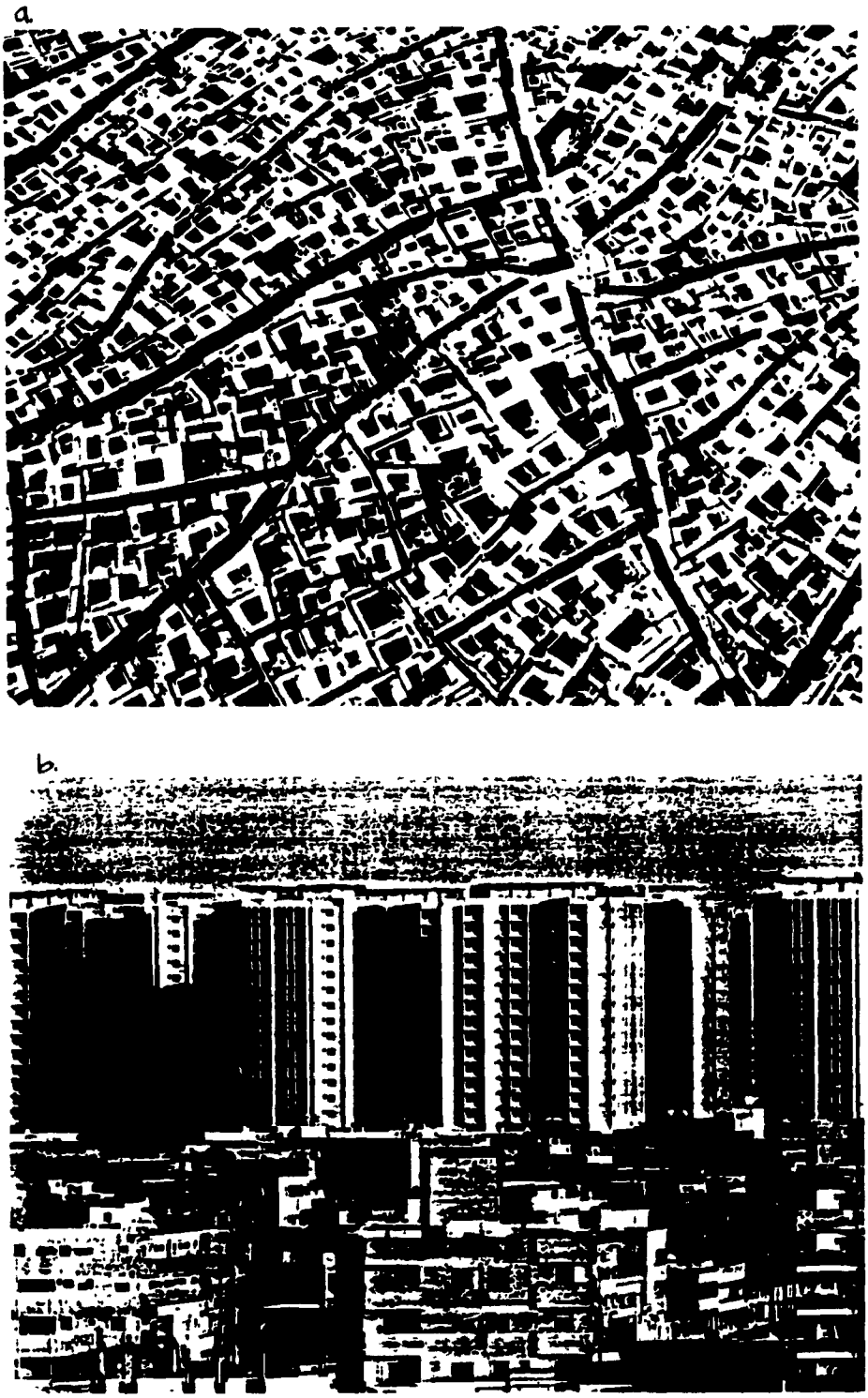


Fig. 1 (a) The Jeddah Rush Housing Project, contains eight units, each comprising four 15-story towers on a 2-story platform; (b) Typical Urban Settlement in the Middle East, Marrakesh, North Africa.

PART I: URBAN FORMS

CIRCULATION

1. CIRCULATION NETWORK

Pedestrians should be able to move safely and freely around their neighbourhood.

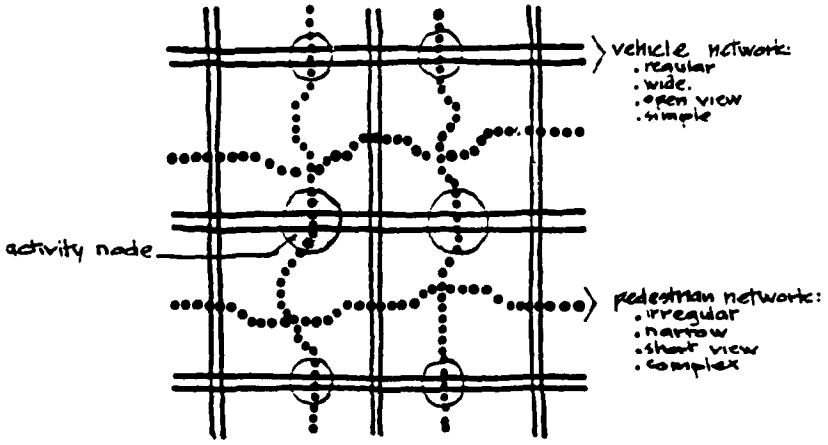
When designing any street, one should keep in mind the kind of activities that occur in certain streets. Physical environment does not determine behaviour, but it can be supportive or inhibiting. Pedestrian activities are slow. Pedestrians have a chance to see, feel, and sense a more complex and detailed environment. An environment that is somewhat natural, as nature is never straight but flexible and organic (Fig. 2). But the movement of motor vehicles is fast and mechanical. The environment is perceived as having flowing lines, long simple shapes, grand vistas, and single glance images.[2]

Since we have two different activities, one for pedestrians and another one for cars, we must have two different circulation networks, with a common meeting point where the activities occur. Each network should have its own level of complexity, where complexity is a product of the number of noticeable differences per unit time and hence to speed (Fig. 3). By doing this, we protect the needs of children and elderly people, and maintain the tranquillity of the pedestrian life.[3] Different studies have shown that children should not be required to cross any road other than the smallest local road or cul-de-sac, between home and school or bus stop.[4]

A complete separation between pedestrians and automobiles is only required in medium to high density areas. In high density like the downtown areas, traffic is controlled by traffic lights, signs, etc...which guarantee the safety of pedestrians. On the other hand, in low density residential areas where it is common to use loops and cul-de-sacs for peace and security, mixing cars and pedestrians considered safe and healthy. The mixing of cars and pedestrians add more life to the urban structure. Some highly popular areas, such as Piccadilly Circus, Times Square, and the Champs Elysees, are much more alive because they are located where pedestrians and cars

meet.[5] Special attention should be given when designing the points where the two systems meet.

The Middle East has a hot climate and it is necessary to provide shaded areas for pedestrians. Pedestrian streets should be narrow in order to provide enough shade for pedestrian comfort. This contradicts the requirements that are needed to create the car network. Streets that are used by cars should be larger than the ones used by pedestrians in order to accommodate the size and the speed of the moving vehicles.



In medium and medium high density areas, where ever it is dangerous to mix car and pedestrians, it is necessary to provide two separate circulation networks. One for cars and another for pedestrians. Each of the networks should be designed to adequately serve the size and speed of the users. In hot climates, shaded areas should be provided for pedestrians. Special attention should be given to points where the two networks meet, to provide safety and protection for pedestrian activities. Priority should be given to pedestrian paths to be short, where cars can drive around.

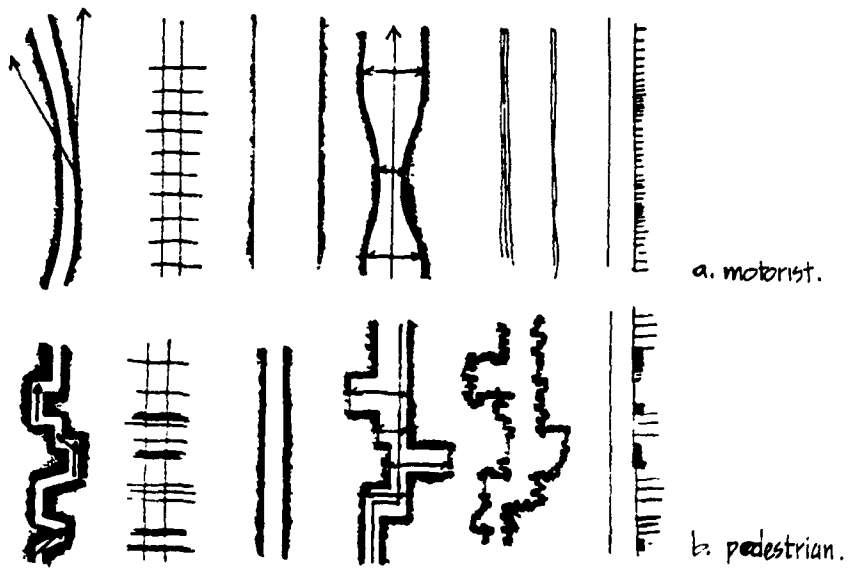


Fig. 2 Perceptual characteristics for: (a) Motorist, and (b) Pedestrian spaces.
After: Rapoport 1987, p. 89

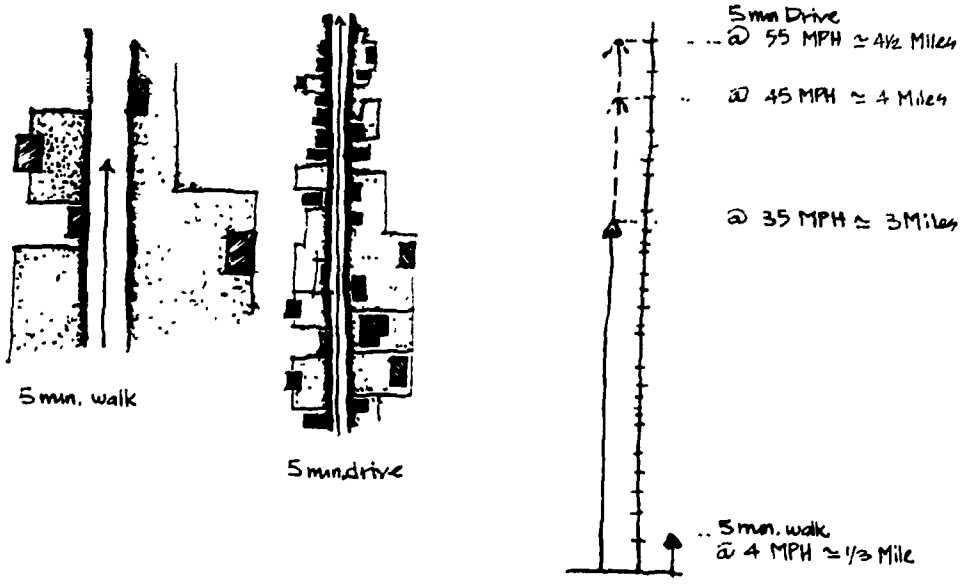


Fig. 3 Speed and noticeable differences.
After: Rapoport 1987, p. 87

2. HIERARCHY OF STREETS

One must be able to relate himself to specific places and streets in order not to lose one's character in the crowded, busy cities.

In a residential area people do not want a fast noisy through traffic running in front of their homes. On the other hand, people need a transition mode to take them from quiet area of their houses to the faster and busier roads. Hierarchy and harmony are a part of our daily existence. The eye will not function well if it is transferred to a bright too quickly, as it needs to adjust to the change. This is also true for the change in a circulation network. There are basically three types of streets: (a) Primary roads, for high speed traffic with limited access and no intersection, such as highways and express roads; (b) Secondary roads or streets, they are the main feeder and interior street, signals and signs are needed to control traffic, e.g. minor arterials and collect or streets; (c) Tertiary streets, local residential street and non conductive to through traffic, e.g. loops and cul-de-sacs. Where the tertiary lanes feed into secondary streets, which feed into primary express ways.[6]

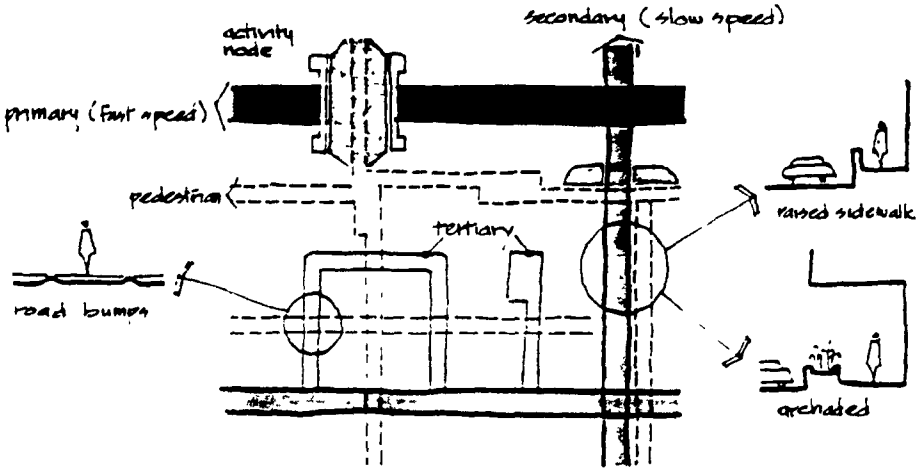
The hierarchy of streets should be based upon the speed and the type of vehicles that drive through the system. The faster the travelling speed, the less is the complexity of the street, and the more space (area) is needed per vehicle.

Another issue is the degree of privacy and social interaction of the street. As mentioned earlier, that where cars and people meet, they create a very special and livable urban life.[7] Therefore, all residential buildings should open to tertiary line, a loop or cul-de-sac, where high volume and high speed are discouraged. Alexander suggested that in order for the loop to be safe, it must not serve more than 50 cars. Tertiary line should limit accessibility and prevent short cut traffic.[8]

Primary streets and expressways, provide good solution for long trips and fast traffic, because they are free of traffic lights. Expressway passing through the urban fabric is often depressed, or elevated from the city street level. In both cases there are

some problems: The depressed road, the driver is denied any view, and they create a very strong physical separation in the urban fabric; the elevated road, increase the traffic noise and have dark, unusable space under the roadway.[9] Therefore the idea of the parkway, if possible, will help in solving this problem, where the driver will have a natural view, and the woodland park will act as a buffer zone against air pollution and noise. Likewise a highway right-of-way with a sloped embarkment covered by woodland will do the same effect (Fig. 4).[10]

Secondary streets, major arterials and collectors are the intermediate stage between primary and tertiary streets. These are the type of streets that people will be used for short trips with basically low speed traffic. In some of them the mixing of cars, pedestrians and other small low speed means of transportation is possible (Fig. 5).



City Streets must have degrees of hierarchy from private to public, for the various size and speed of cars, and for the activities that are carried on them. The following are the basic street hierarchy:

- **Tertiary, only for residential areas (loops and cul-de-sacs).**
- **Secondary, for low speed, short trips, and pedestrian at separate levels (collectors).**
- **Primary, only for vehicle use,high speed and long trips (expressways).**

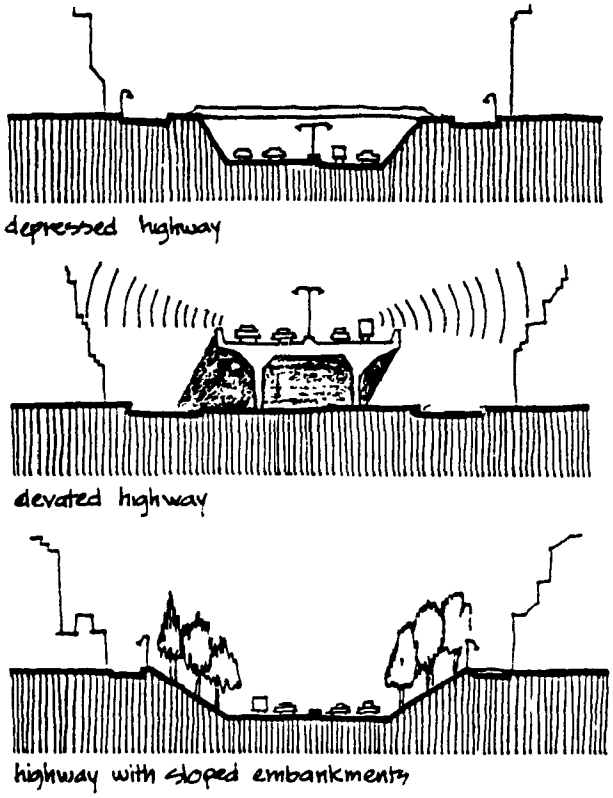


Fig. 4 Different types of expressways.

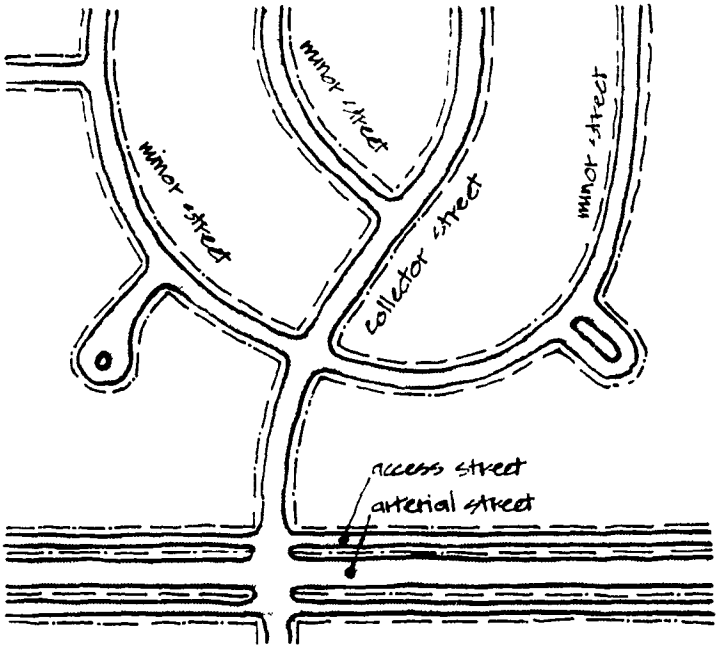


Fig. 5 Street Classification.

3. PEDESTRIAN STREET

When pedestrians are harassed by traffic and overheated by the hot sun, they abandon the streets. In return, they lose an important part of their social life.

Our modern urban environment discourage people from walking. An activity which has been unchanged since the origin of our species. Nowadays, we are rediscovering the importance of walking. It prevents a lot of our modern illnesses, and it is a sport that anyone at any time at any place can practice. Therefore, we should redesign our urban environment to meet the needs of the pedestrians.

Not only do we need a safe walking environment, but also a place where children can play with other children of their own age group. Research showed that in the first five years of the children's life, they must have contact with other children, or else they will have some kind of mental illness later in their lives. Therefore, a safe car free open space at the door step of each house is a must. Alexander recommended a group of at least 64 households to be connected with each other by a pedestrian network.[11]

For a pedestrian street to be used, it must be physically comfortable and it must have a suitable social structure to be attractive and alive. The following are some of the physical forms that make a pedestrian street comfortable: First, is the proportion of the street, where the most comfortable street is the one that have a square proportion of an even narrower where the height exceed the width (Fig. 6).[12] It does not only give a relaxed enclosure, but also produces a shaded street that is protected from the sun; Second, nature is never straight, the natural movement of human beings is a slow curve. While long and endless streets are proven mentally disturbing, and winding streets seem shorter than straight endless ones. Therefore, the use of close vistas is recommended (Fig. 7).[13]

The best view is not always the full view, where walking along the old street of Cairo develop an experience that we may call the unfolding mystery. Such heady

perspective suggests only and gives more chance to the mind to multiply the possibilities of perception; and thus expand the scope and richness of the suggested experience.

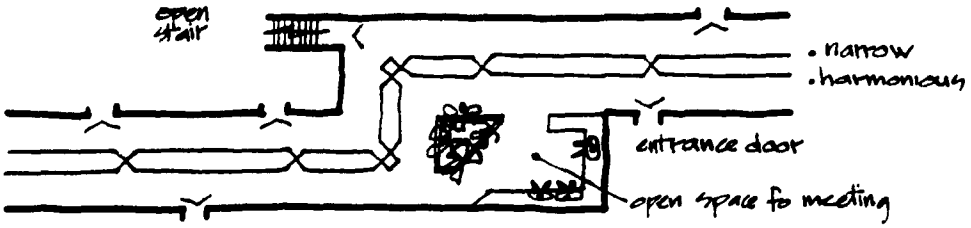
Finally, the pedestrian street should be designed as a single identity, where the emphasis is on the complete street perspective within the urban fabric and the whole urban design network, rather than the individual buildings. Due to the narrow spaces between buildings, and the unnoticeable gaps between facades, the pedestrians tend to perceive the street as one unified facade rather than a series of independent facades. On the other hand and due to the pedestrian's slow speed, if possible the emphasis could be given to a high level of complex and intricate details.[14]

This is best explained by looking at any typical old city in the Middle East. For example, El-Muizz street in Old Cairo, where inspite of the fact that buildings were built in different periods, scales, proportions and contained a wide variety or ornaments and mashrabiyas, the whole street perspective seemed to be of one order. A passerby will think that the whole street was built by one hand and was designed by one designer (Fig 8). This harmony was basically achieved through the following devices; using the same stone paving fabric throughout the street; the end and the beginning of the street were designed in such a manner that they justified each other; the buildings tended to have the same height which emphasized the horizontality of the street except where there were minarets and domes; and the close similarity between forms, building materials and colours.[15]

The above were the physical form of the pedestrian street that make it attractive to people. This by itself is not enough or sufficient to achieve a well designed pedestrian network. The street must be socially attractive to be alive. In other words, it must encourage people to stay in and not just to pass through. Otherwise, the street will be like a beautiful sculpture or monument that people admire but do not interact with. The following are some of the recommendations that enhance the street life:

First, as much as possible all buildings should have an independent entrance that open to the street. Even the rooms on the higher floor, that is to eliminate indoor

staircases. In other words, all vertical and horizontal circulation should be through the outdoor street.[16] Second, people should have places where they can sit and relax. This could be done by: a) Widening the street at certain points where seats and sometimes even a light roofing could be added; b) Creating outdoor places that people feel comfortable at by controlling the street width, street vista, and the street unity. The more privacy is needed in the residential areas, where it works as an extension to the house.[17]



Plan the pedestrian streets in the residential areas, so that it connects at least 64 households without any traffic crossing.

To create an attractive pedestrian street network, it must have the following:

- **Shaded areas by having an approximately square section.**
- **Slightly curved and not straight with endless end.**
- **Harmonious with a unified facade through the following:**
  - **using the same paving.**
  - **using the same building height.**
  - **the street end justifies the beginning.**
  - **similarity between building forms, materials and colours.**

And for the street to be alive, it must have the following:

- **An open circulation, meaning many entrances and open staircases,**
- **an open space with seats,**
- **to be treated as an outdoor public room, with the reqiured privacy level. All is achieved by controlling the street width, vista and unity.**

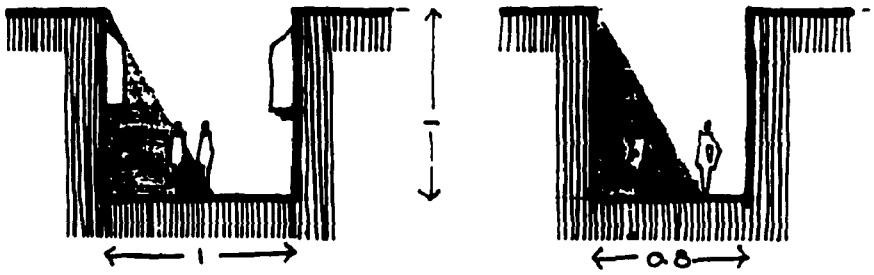


Fig. 6 Pedestrian street proportion.

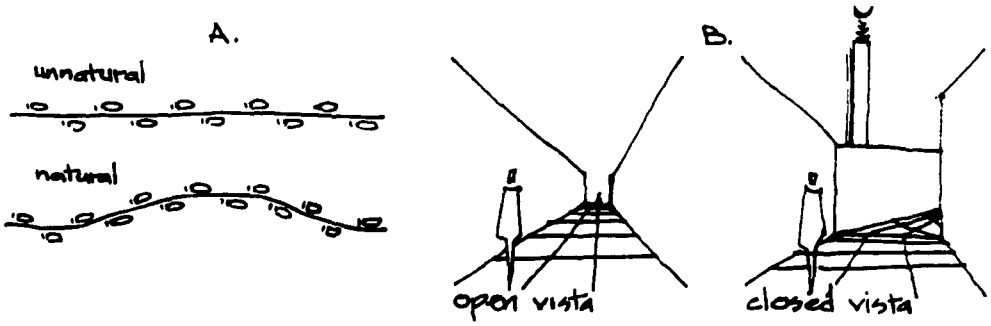


Fig. 7 (a) Pattern of human movement.
(b) Closed and open vista.

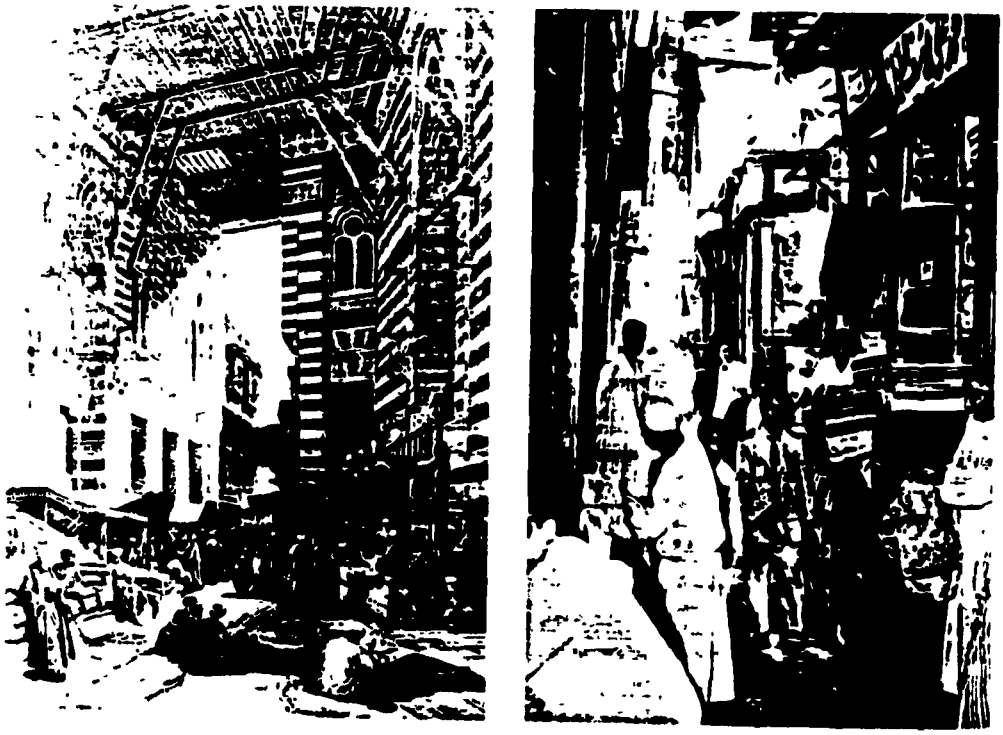


Fig. 8 El-Muizz street, Cairo, Egypt.

4. CAR PARKING

One of the biggest problems in our modern cities are cars, and where to store them without tearing up our environment.

To be able to understand how we are giving away our land to cars, one must consider if streets occupy 25% of the central area of a typical city, then 41% of the land will go to off street parking.[18] For example, in downtown Los Angeles, over 60% of the land is given over to the automobile.[19]

The physical environment is the medium for the people's social interaction. In an environment that is overwhelmed by cars, people lose their feeling of social communion to a hostile surrounding. To solve this problem, shall we get rid of the car? Of course not, it is very important in our daily life. Hence, the road network system must stay, leaving us with one option; to reduce the car parking area, or at least its effect as much as possible.

There are two types of parking: the street parking and the off street parking. The latter is of two types; the surface parking, which is the most damaging to the environment and the most land consuming, and the multistorey or underground parking. I will start by discussing the off street parking, since it is the one that creates the greatest harm.

The land occupied by the off street parking, especially surface parking, should be reduced to a minimum. Alexander in his empirical observations, concluded that for any environment to be fit for human use, land given to parking should not exceed 9% of the total land usage.[20] Those surveyed who experienced the 9% parking felt that any increase in the parking ratio would ruin the environment. Furthermore, for the 9% rule to be applied to a certain area, this would apply 12 cars per acre of surface parking. This number could be increased through the balanced use of surface parking and multi stories garages. Most important factor remains that the land assigned for parking uses should not exceed 9% in any given area.

Large parking lots are unpleasant, unsafe for children, bad for the overall landscape, depressing, and unhuman in scale. Therefore, small scattered parking lots are far better for the environment, even when their total area equals that of the large lot. The parking lot should be small enough so that pedestrians can walk through it without feeling they are in a car dominated territory. Alexander suggests that for any parking lot to have this character, it should not serve more than 5 to 7 cars.[21] Furthermore, in order to be able to control the heat re-radiation and glare, in the Middle Eastern hot climate, the use of small parking bays that are easily shaded, and that could be placed in the interior courtyards is recommended.[22]

After dividing parking land into small parking lots, it is still important to shield the car from the pedestrian view. The same concept should be applied to the multi-stories garages. This could be accomplished with plants, hills of grassy earth, walls, shops, houses, or any other kind of screens as long as the cars and the parking structures are not visible.[23]

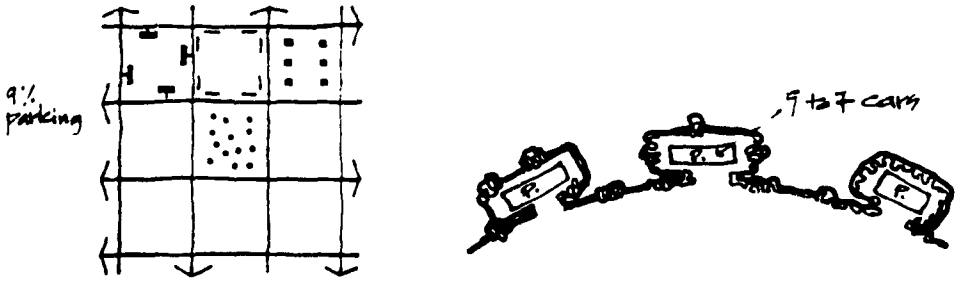
The other type of parking is "on street parking". Some people disagree with it claiming that it will result in poor traffic flow.[24] On the other hand, some people see it as an improvement to the sidewalk safety and comfort, and it is a transitional area between the driver and pedestrian zones. Furthermore, no-parking zones are inefficient since parking is mostly by-passed by drivers.[25] Thus we recommend the use of a street parking for some part of the secondary streets and all the tertiary streets, where the traffic flow is light, the total separation between cars and pedestrian is not needed, and where speed is controlled by traffic lights, signs, and other means.

The Dutch were successful in using the on street parking without damaging the environment, by the application of the "woonerf" concept. The "Woonerf" is a residential street where the pedestrian, rather than the traffic, has the dominant role. Furthermore, the "woonerf" has the following characteristics:[26]

- small, unconnected parking spaces
- children playgrounds
- no definite zone for car or pedestrian

- attractive landscape, such as; trees, various pavings, street furniture, bike rack...etc.
- Limitation of speed by the use of bumps, sharp bends, and narrow sections.

It is best explained by figure 9.



When designing a car parking area the following guidelines should be governing:

- **Keep land assigned for surface parking uses not more than the 9% of the total land use.**
- **Create a small parking bay, between 5 to 7 cars each.**
- **Shield it by building, landscape, or walls so it would be visible to pedestrians.**
- **As much as possible do not expose it to the sever sun.**
- **Use "on street parking" in secondary and tertiary streets, where the traffic is light and slow.**

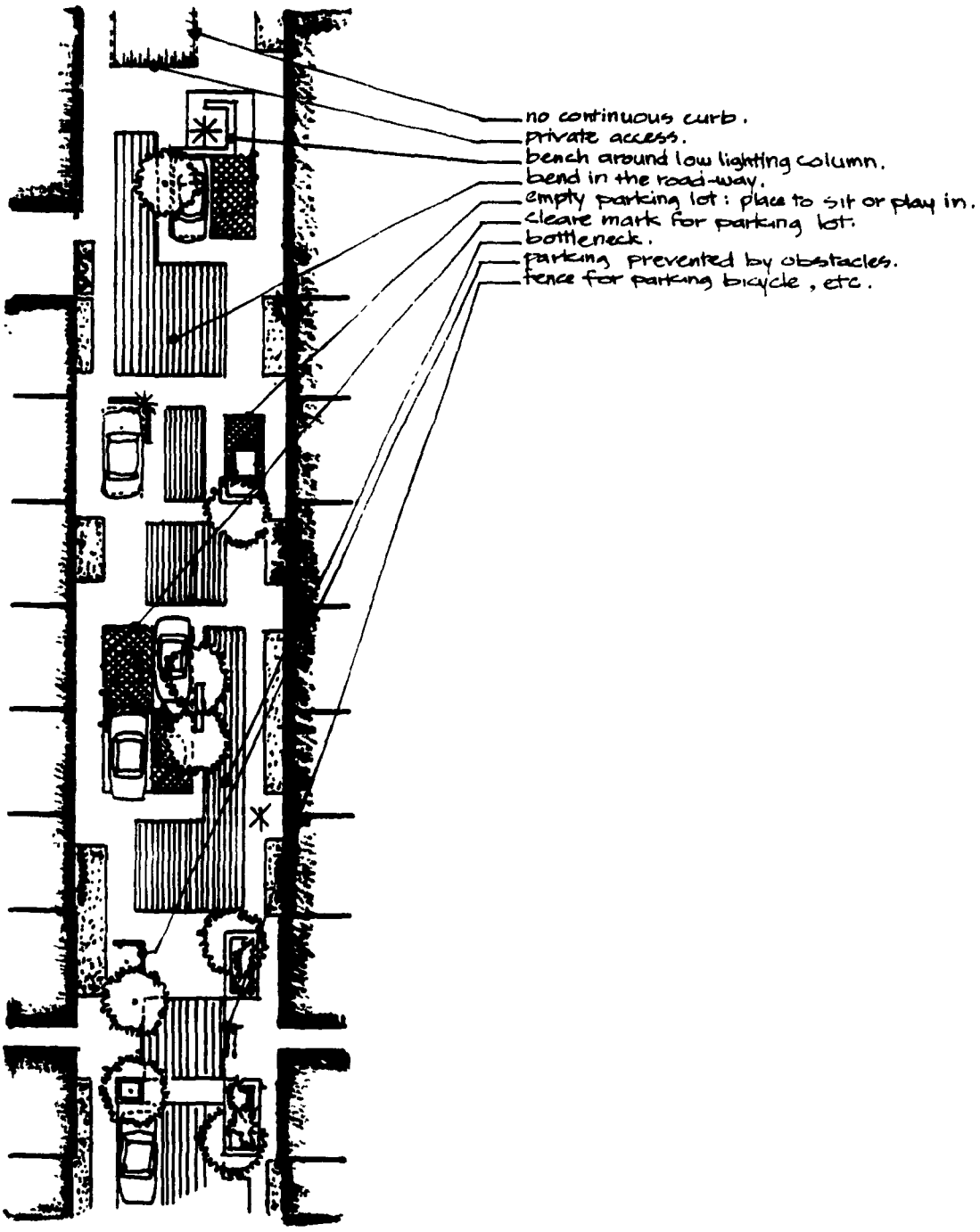


Fig. 9 The "Woonerf" street concept.

ACTIVITIES

5. LOCAL CENTER

In the Middle East people are used to get their shopping needs and to get to their gathering places on a daily basis.

People in the Middle East are used to buying their vegetables fresh every day. The same thing applies to meat, dairy products and all other types of food. Muslims must pray five times a day, and if possible at the mosque with the group. Therefore, the mosque is a very important part of the daily Muslims life, which make it a gathering place for an integrated community. Children should be able to walk, not to be driven, to their schools. All these factors will call for a local neighbourhood or quarter center, that could be accessible by the entire population of the quarter. A center of this sort encourage neighbourly social interaction and a sense of community.[27]

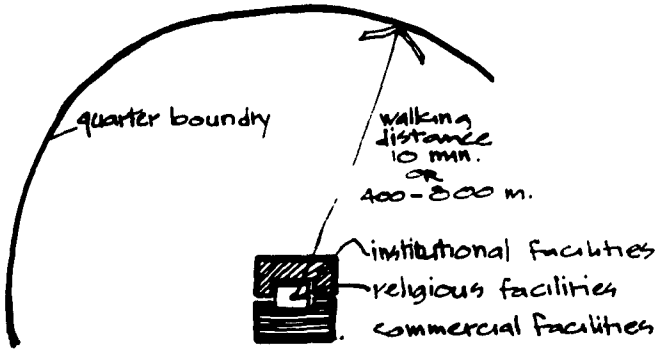
Traditionally in the Middle East, for security reasons each quarter was able to live independently when necessary, working as a small fortified self-sufficient neighbourhood. Each quarter contained its own mosque or church, school (madrasah), public bath (hammam), small local market (small suq or suweiqah), and work shops, particularly for weaving (Fig. 10).[28]

This urban setting helped the quarter to integrate itself and with the city as a whole. Such an arrangement was greeted as a healthy social, educational, and psychological environment.[29]

The size of the area served by the local center, should be determined by the walking distance, in order to provide accessibility to everyone in the community. What is a reasonable walking distance? It varies from one region to another, depending upon the different climate, culture, age and environment. In general, it has been agreed upon that 10 minutes or 400 meters (1/4 mile) is an acceptable walking distance, however, it should not exceed 800 meters (1/2 mile) range.[30]

The expression "local center"does not necessarily mean that all the components of the center should be located next to each other in one location. Spreading the

center components around the neighbourhood, will advocate a balanced distribution of activities around the neighbourhood, making it more livable, sociable, and inhabitable. Also, by going around the neighbourhood people get to know each other which will enhance security.[31]



Each residential quarter or neighbourhood must have. The following local central facilities that serve the daily needs of the local population:

- religious, mosque or a church
- commercial, food store, drug store, small coffee shops, (where people meet), and small sized workshops.
- institutional, schools, and nurseries.

These facilities should be within walking distance, 10 minutes or 400 to 800 meters, for all the residents.

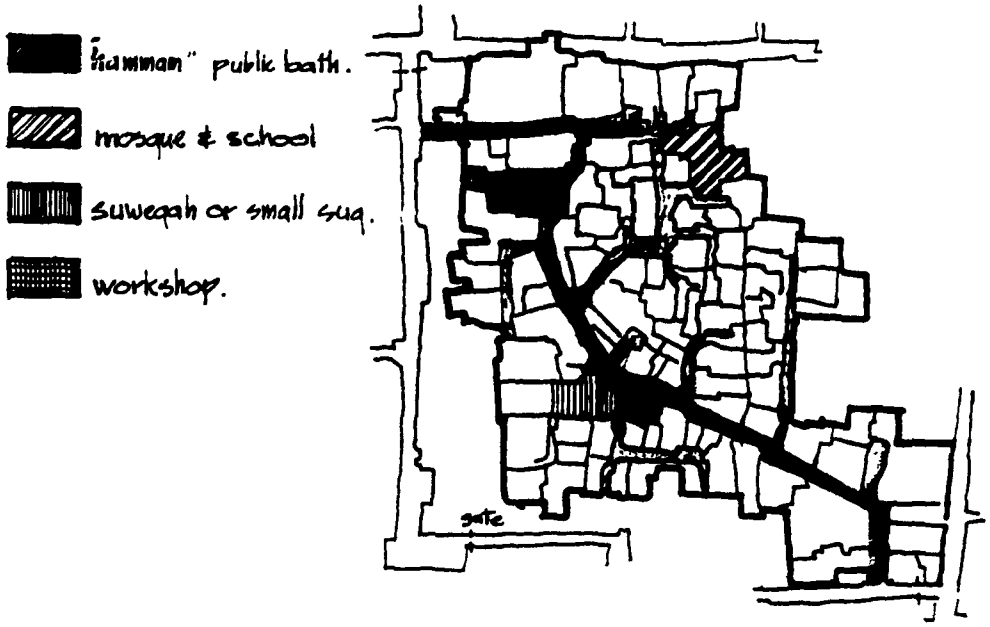


Fig. 10 Local services in a residential quarter, Damascus.

6. TOWN CENTER

The residential quarter by itself can not meet the people's needs to various products and activities.

As mentioned earlier the mosque has a very important and central part in the Muslim life, as they must pray 5 times a day. There is a hierarchical order in social and religious rules that the mosque plays in the society. Basically, there are three types of mosques: major city mosque (Jami), Khutba mosque (Jami), and local mosque (mesjed).[32] The local mosque is to be located at the local quarter center for the daily prayers, the Khutba mosque is to serve more than one quarter and it is used for the Friday prayer, which is obligatory for every male Muslim to perform in the mosque. The most important here is the major city mosque. The classical "jami" is to function as religious entity, an intellectual and educational center, a court of justice, and a political arena where people and leaders take important decisions. It is also a place for secular activities, such as eating, drinking, recreation, and if necessary for the homeless. Traditionally this religious and institutional complex "Kulliya" is the central focus of the town.[33]

In the modern Middle Eastern cities, the mosque can function as a multi purpose center. In Egypt, for example, with all the poverty and overcrowding that exists in Cairo, the major mosques of the city have started opening their own health clinics and schools. In other words, the mosques become community centers. Nowadays, in the realm of public services, the construction of multi-purpose buildings that utilize space efficiently through time-sharing have been advocated by architects and planners.[34]

In urban planning the idea of hierarchy has remained very persistent. With regard to city centers, hierarchy appears to be a logical way of organization, it makes activities accessible to large segment of the population, and helps them to organize complex territories in their mind. This "central place theory" come out of the work of August Losch in South Germany.[35] One should remember that in reality there is

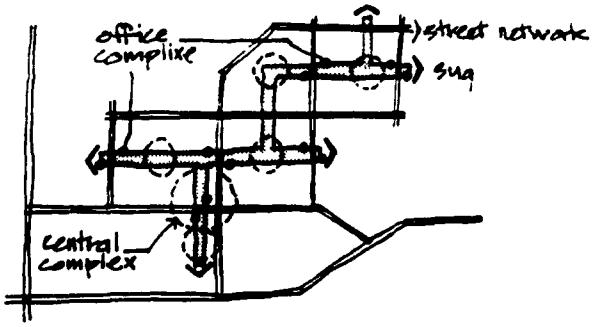
complete overlapping between all the service areas of the different centers, where people use various centers for different purposes. At this point it is clear how the traditional concept of the "Kulliya", and the hierarchy of the mosque size function, coinciding with the "central place theory". This means that we established a hierarchical network of institutional and religious centers, but where are the commercial centers?

In the traditional town, the commercial component was essentially the "bazaar" or "suq", which was not only a place of trade and commerce but also a place for intense social interaction.[36] The "suq" was the backbone of the city, forming a linear commercial and activity corridor that connect between the different centers or activity nodes. The famous Iranian architect Nader Ardalan in his book "The Sense of Unity", best explained the linear motion of the traditional city (Fig. 11.), saying:

> "Cities evolved from the concepts which maintained the city walls that defined the cities positive shapes in space and their correspondence to cosmic laws. They maintained the concept of a center but a center as a single point in space that moves in time and create the line, or the linear element of the bazaar. This orientation toward a moving point introduced a more vital planning concept which, even today, accept growth and change as a natural phenomenon of exitence. The paradoxes of constancy and change, of completeness within completeness, were here resolved much as in nature and her modes of operation. Cities and buildings, analogous to the forms of nature, appear complete and beautiful at every stage of their growth. As vital forms, they have within them the heritage of their past and the seeds of their potential future".[37]

This concept of a linear commercial corridor, can be usefully incorporated in designing the commercial space in the modern cities. Christopher Alexander in his book "A Pattern Language" advocated this idea, by calling for the gradual formation of a promenade at the heart of every community, that links the main activity nodes of the city. Linear centers allow for easy individual access, low cost, and flexibility in growth and change. Kevin Lynch proposes that the combination of local and linear centers would be a workable model for today's cities.[38] It does not follow that the use of a linear centre implies a linear city. Most of the traditional cities of the Middle East did not have a linear form.

The next question which arises is that of the office space locations. In our modern cities office complexes, with their concentration in the center, create an abundance of traffic problems. Small scale offices which relate to commercial and institutional activities, could be located and integrated in the "suq" area. While, large office complexes could be situated of the central area and within the central pattern network (Fig. 12). They are to be near the primary road network, in order to be accessible by vehicles as well as pedestrian.[39]



At the town scale a central place is needed to satisfy the residents' needs which can not be satisfied at their local center. Therefore, the town center should contain the following:

- Central Complex: contain the religious and institutional facilities. The size of the complex depend upon its function and the area it serves.
- Suq: the main commercial corridor connecting between the central complexes. It contains small offices, and is basically pedestrian with vehicular access for emergency and delivery purposes.
- Office Complex: the large office spaces, scattered around the town, connected to central complexes by the suq, and near the primary vehicular circulation.

The whole town center system is to be connected to the quarters by means of pedestrian paths.

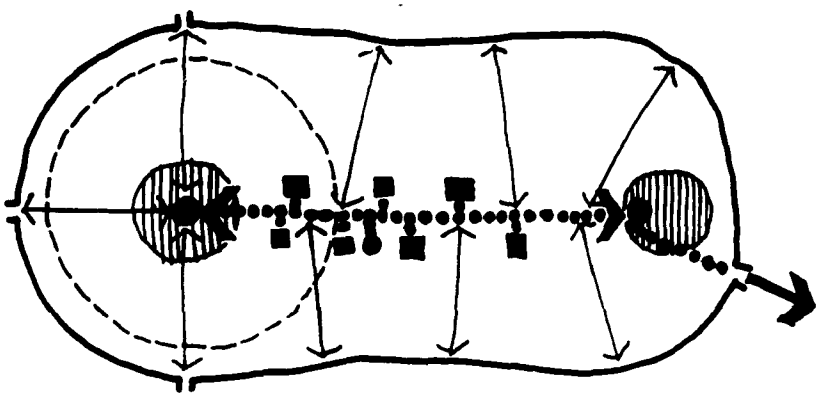


Fig. 11 The center as a single point in space, moves in time and creates the linear concept of the suq.
After: Ardalan, 1973, p. 89.

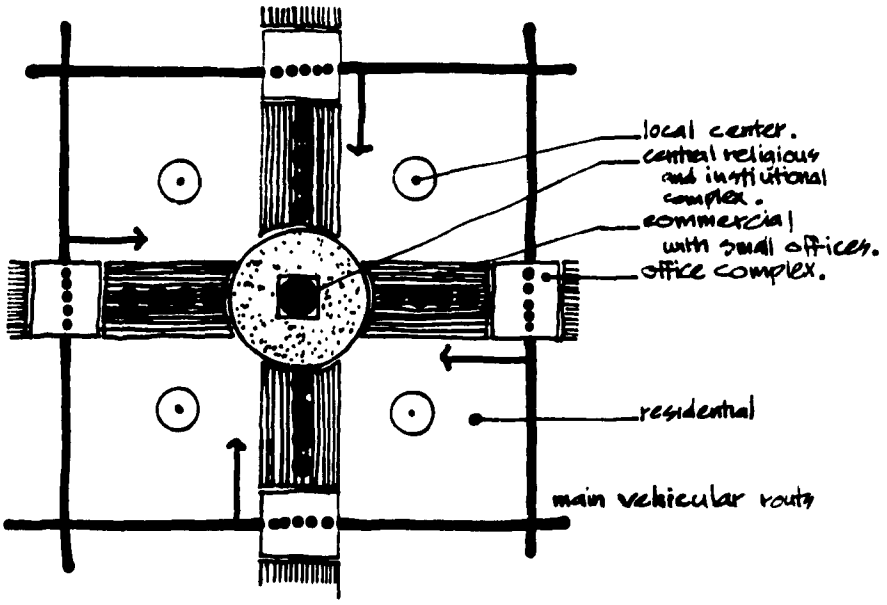


Fig. 12 Office space allocation.

7. SUQ:

The city's pedestrian network, will be an attractive gathering point, it is integrated with commercial, cultural, and social activities.

In order to attract people to use the pedestrian network, we should integrate the network with a series of alluring activities. What could be more appealing than shopping, which attracts people from all ages and groups. Nowadays, it is very evident how successful and attractive is the idea of shopping malls. On the other hand, shopping centres are cut off from the surrounding development by its ring of cars; this makes it a place for a community on wheels that lacks local, walk-ins, casual link.[40] The alternative could be attained in the concept of the old, traditional "suq" or "bazaar".

In the traditional Middle Eastern cities, the "suq" is the commercial component of the city, the area of urban economic life, and one of its prerequisites. The suq was usually to be found, in a linear pattern, parallel or on the side of the city thoroughfares, that run between major city gates and its core, providing good access to the city and its surroundings (Fig. 13).[41] Expressing how important and vital is the suq to the structure of the city, Nader Ardalan in his book "The Sense of Unity" said:

> "The bazaar traditionally begins at the palace precincts, which symbolize the spiritual head of the body, and grow cellularly in an apparent natural pattern in the direction of its symbolic head the Msjid -i-Jami - going on, then, to the opening of one of the city gates. As the bazaar grows, the vital backbone of the city evolves, and the pedestrian streets leading into the city's body proper insert themselves as ribs".[42]

Examining the urban market and commercial activities in the traditional city, it is possible to identify the following different forms of Suq types:[43]

i) The major suq area around the major city mosque in the central area. The whole area could be locked by minimum number of well located gates. The suq is usually covered.

ii) The spontaneously developed linear suq, which is spread all over the city, and some times it is covered with vaulting.

iii) The open square "Maydan" or "Batha", which is used for weekly or seasonal markets, therefore, it requires portable makeshift facilities. The open square is usually located in the city suburbs, a part of commercial activities. It is used for public meetings, political meetings, and entertainment activities.

iv) Local suq "Suwaiqa" or mini-suq, which is to serve the population of each quarter.

v) The architecturally designed "Kaysariyya",is a market that deals with specific goods, such as textiles, that is arranged around a courtyard, and could be locked. This form of building alter developed into "Khan", which was designed to accommodate travelling merchants on top floors, and their goods on the ground floor.

It is very interesting to watch how, in the traditional cities, they solved the contradiction of locating the mosque, as the spiritual center with its religious and institutional services; and the suq, as the material center. The suq arrangements, usually, follow such an order of hierarchy that places the noble trades and crafts close to the mosque. Those trades and crafts that have a potential for offensive noise, smells, or symbolic content, were located away from the mosque. In between the two categories lay trades and crafts that do not produce any physical offence and are symbolically neutral. The hierarchical order of the suq, is best illustrated by Besim Hakim's survey for the core of Tunis Madina Central (Fig. 14).[44]

As a by-product of the suq hierarchical order, with respect to the mosque location, it has a concentration of similar trade and craft types together in the same area next to each other. This arrangement was often enhanced by the need for different craftsmen to complete individual processes in the making of a final product. Furthermore, the modern idea of placing at least two stores selling the same merchandise next to each other, or the modern concept of "professional buildings" where people of the same profession are gathered in one building, are not too different from the system developed in the Middle Eastern suq. Moreover, nowadays one can see the rebellion against the large department store and the renaissance of the

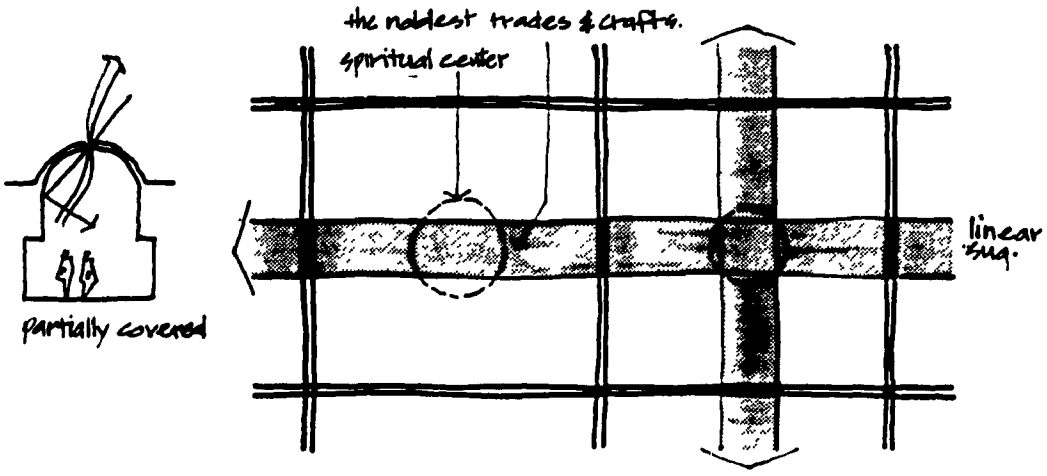
boutique or small specialty shops. At the same time, there has been a recognition that small shops, managed by their owners, offer a more personalized service than a large bureaucratically organized store.[45] From the above, one can very easily see the interesting lag between the Middle Eastern suq and the modern thoughts in urban planning, where many of the newest forms being developed are very similar to the principles found in the old suq.

If one were to look at the physical characteristics of the suq, he or she will find it very similar to the pedestrian streets from the visual and climatic point of view; where pedestrians should be protected from the harsh climate. Moreover, if one examines the street's pattern in the suq area, one will find that the method of traffic segregation was introduced to separate large packed animals from pedestrians. Therefore, a system of routes crossing the main thoroughfares was introduced to reduce the traffic conflict to a minimum, and to enable the large loads of goods to reach the premises of various merchants.[46] Comparing the above with what Christopher Alexander recommended, in his book "A Pattern Language", to build shopping centres in the form of pedestrian streets, at right angles to major roads, which confirms the validity of the suq concept.

Finally, the Middle Eastern suq with its narrow shaded streets, personalized business relationships and mixed land use pattern created a very dynamic place for all the people of the city. The shopping space was able to serve two purposes: a) to ease and to speed the shopping process for those in a hurry; and b) to amuse and entertain those who enjoy social interaction.

To add more life to the city, and to encourage the people to use their pedestrian network, integrate the commercial facilities with the urban fabric and make it:

- **distributed in a linear manner, all over the city according to its size and function.**
- **act as a link between the different city centres.**



- **hierarchical in order of it's nobility and distance to the city spiritual center.**
- **small scale trades and crafts that compliment each other and provide personal service to the customer.**
- **to a right angle with the major road, in order to provide sufficient accessibility.**
- **partially covered and protected from the harsh climate.**

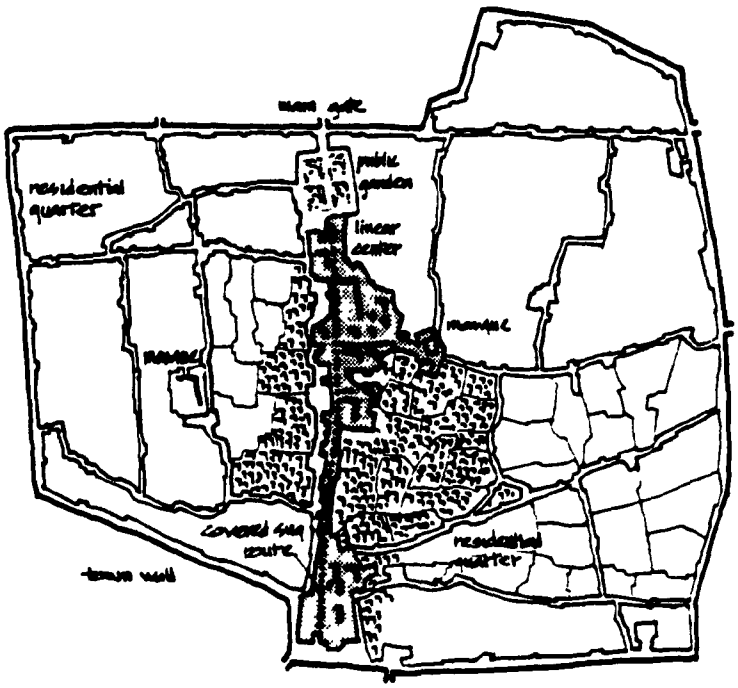


Fig. 13 Traditional city plan with the suq route indicated.

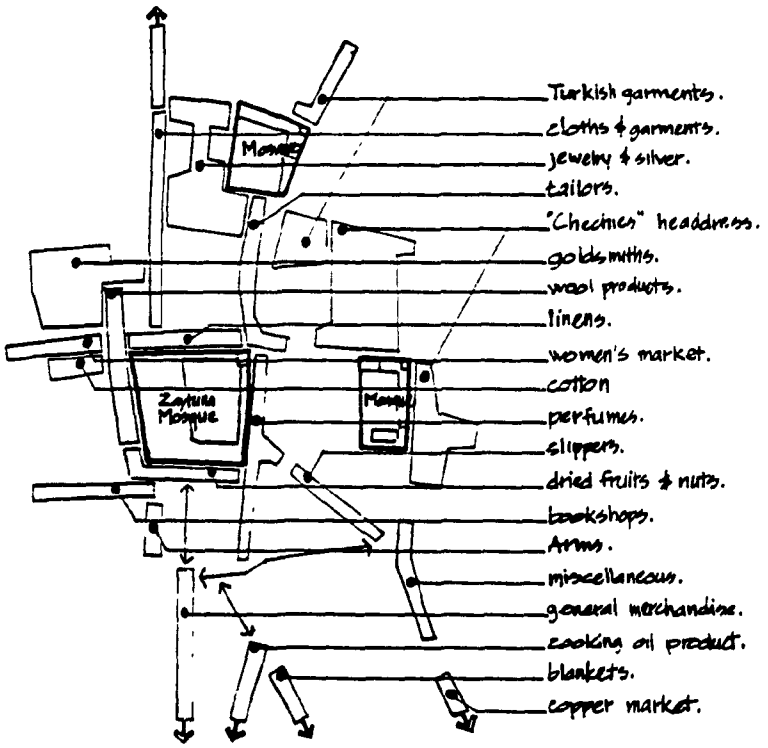


Fig. 14 Hierarchy Distributor of the major trades in the suq surrounding the Zaytuna mousque in Tunis.
After: Hakim, 1986, p. 85.

8. GATHERING PLACES

Social interaction is an integral part in the people's daily life. Since the house is considered to be a private place for family and women, people need adequate meeting place within the urban fabric.

The term "gathering places" could be applied to all locations of the urban setting where people socialise together, especially the public places that are outside the private and personal territorial domains of the citizens. In general, gathering places could be found in two basic types; outdoor places, and indoor social activities places.

In the traditional urban settlements, gathering places would include the public gardens or open spaces "Saha", residential pathways, streets, covered shopping streets "suqs", all sizes of mosques, and public baths "hammams".

Pedestrian streets are very interesting, because people have to use them everyday, especially the commercial part of the streets, such as suqs. In the suqs people will meet each other, either for business if they work there, or for socialisation if they are there for shopping. In general, the suq is a very active place, where things occur at a fast rhythm. Therefore, any social interaction will be fast and short. Furthermore, to encourage a more relaxed atmosphere in the suq, it should be provided with special sitting areas, benches, small open spaces, and coffee shops.

In most of the Middle East cities, coffee shops are a major component of the urban fabric and the people's life. It is a place where men meet each other, in a relaxed atmosphere, over a cup of coffee; and sometimes they play games, such as backgammon. They became like clubs, where people tend to return to their favourite and to the faces that became familiar. Coffee shops were popular in the Middle East, and are popular now, and are popular in most of the urban settlements around the world. In addition, the Islamic teaching, which has a great effect on Middle Eastern culture, discourages people from sitting in the street; in order not to bring any harm to the pedestrian life by staring or throwing words at pedestrians. Therefore, coffee

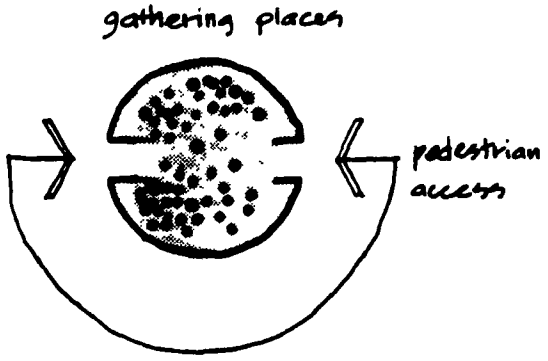
shops are popular in the area. At the same time, they are not street cafes, like the ones in Europe, where everything is oriented toward the street; they are more of an enclosed inward oriented place, which could be found in the middle of any residential area.

Another type of the "gathering places" is the public bath "hamman", which was a prominent element in the traditional city. The hammam was not only a hygienic institution, but was also used for social and recreational purposes, where the life of the whole quarter revolved around. Being a centre of social contacts between society members, it was a place for the exchange of house-keeping ideas among women.[47] In modern context, the hammam is a thing of the past, it is used by a very small segment of the population. Today we have another type of institution that could carry the same function, which is the health and social clubs, where people go to relax, socialise, and practice their favourite sports. These "health social clubs" could be spread over the city to serve the inhabitants' needs.

One thing that never changes in the Middle East and has a great impact on people's life is the Islamic religion. In Islam people must pray five times a day, if possible at the mosque, and they must pray the afternoon Friday prayer at the mosque, where it comes after the Friday "Khutba", a speech dealing with the people's daily life and problems. Therefore, the mosque was and still is one of the city's vibrant gathering places, where people meet and discuss the important issues in their life.

What about the outdoor gathering places? In the traditional cities there were the "Saha" or the open square which was used for commercial, social, and entertainment activities.[48] With the increasing urbanisation of the Middle East cities, a growing need for open squares and public green spaces has recently been sensed. Public green spaces are proven to have a great effect on microclimate conditions. If properly designed and disposed throughout the city, they serve as shaded channels for cooling local breezes.[49] Hence, the city should be provided with a series of open squares that are small enough to be shaded by the surrounding buildings and the available greenery.

The open public space should be small and compact, not only for climatic reasons, but also for psychological reasons. Findings by C. Alexander pointed out that at a distance of 21 meters people can just barely hear a loud voice, and can just recognize each other's faces. Thus, the width of a public square, in the short direction, should be no more than 14 to 18 meters across. Furthermore, Alexander suggested that in order for any open square to be alive, the ratio between the space and the number of people at any given time should be 14 to 28 sq.m. per person.[50]



Within the urban fabric, and connected to the pedestrian network, provide a well-distributed network of gathering places. There should be two types: one indoor such as coffee shops, mosques, and health-social clubs; and another outdoor one in the form of open square that should be small in order to be shaded, cooled by vegetation, no more than 14 to 18 m in width, and small enough to provide an area of 14 to 28 sq.m. per person at any time.

STRUCTURE

9. LOW-RISE, HIGH-DENSITY

High-rise buildings nowadays fail to provide people with suitable physical and social life.

All over the world, nowadays, high-rise buildings are being promoted as the solution toward achieving high-density development. At the same time high-density development is viewed as bad, troublesome, and slummy. On the other hand, low-rise buildings are associated with low-density, which congregate with luxury, richness, and goodness. The above assumption is only in the mind of people and because of bad design of the urban and architectural environment. The following argument will demonstrate the point that high-density could be achieved with low-rise or medium-rise, and without damaging the environment.

Traditionally in the Middle East, urban settlements were designed with high-density, where buildings mutually protect each other from the adverse condition of wind, dust and heat. These settlements were mainly two to three storeys high attached buildings, with rooms grouped around a private court yard. Most of the streets and open spaces were completely or partially shaded (Fig. 15).

In other words, the urban settlement was compact, where compactness is the ratio of exposed building surface to the enclosed living volume. Compactness was one of the goals in traditional settlement to minimize the building surface exposed to sun and the outdoor environment (Fig. 16).

The same concept of compactness, or high-density, is widely used in the hot climate region of the Middle East. Moreover, in the west, planning literature has generally criticized the spread-out city, for its consumption of land, expensive utilities, transporta-tion, and the social isolation it produces. Lionel March, in his book "Urban Space and Structure", pointed out that 4,000,000 acres of land is expected to be built on by the year 2000 to accommodate the whole expected population of England and Wales; on the other hand, he showed that the same populations with every household

having a house, a garden, and a car could live on 2,000,000 acres of urban land.[51] Thus, there is no need to waste nature and valuable land that could be used for other purposes. Kevin Lynch, in "A Theory of Good City Form", draws the attention to the poor accessibility of those who cannot drive or who are not allowed to do so, which is created by the low density suburbs. The low density increases people's dependence on the private automobile, therefore, limiting the mobility of the elderly, the handicapped, the teenager, and the poor. Adding to all the above, Victor Olgyay in his investigations of the effect of climatic influences on community layouts, suggested that in hot-arid regions the town structure should react against heat with a shaded and dense layout. It is interesting to realize that the social and psychological acceptance of dense settlements vary from one culture to another. For instance, in the United States there is a correlation between high-density and trouble, slums, and a high rate of crime. While in China and the Middle East, desert settlements are dense by choice, and there are no signs of biological stress among their inhabitants.[52]

The most common opinion in people's minds is that the method of obtaining high-density is by building high-rise buildings. The following argument is going to prove that high density could be achieved by building low to medium-rise, and that high-rise buildings cost more, have a bad impact on the surrounding environment, and that they have a harmful mental effect on people.

First, if a comparison is to be made between low-rise and high-rise, then variables used must be constant for each case, such as site area, block depth, width of interspace, floor height, etc. In most cases, it has been found that the same density that could be reached by high-rise could be reached by low-rise, at one third of the height, assuming that a balance is maintained between the plot, the building size that it can support, the street systems that serves this, the day-light needed, and the open space around the building. Leslie Martin, in "Urban Space and Structure", compared between two basic types of buildings, the tower form (pavilion pattern) and the perimeter development (court pattern), in terms of efficiency in utilizing the site. Martin applied this comparison on part of Manhattan Island, assuming that every block in that

part is occupied by a tower of 21 storeys high, it was found that by omitting some of the cross streets and using a wide courtyard pattern of buildings, the same amount of floor space could be accommodated in seven storeys. (Fig. 17).[53]

In the last few years the Saudi government, in an effort to meet the increasing demand for housing, built "The Rush Housing Project" in Jeddah. The project comprised of 32 towers, each has 15 storeys plus two storey platform, and contains a total of 1,936 apartments. A. Farahat and M. Cebeci discovered that the same project elements could be accommodated in 5 to 6 storey buildings plus basement, while maintaining the same minimum distance between buildings, for light and privacy, and the same floor area. This reduction in height was achieved through the use of the courtyard pattern, thus a more defined, ordered and human open space was created (Fig. 18).[54]

Second, another comparative study done by San Francisco architect, Herbert McLaughlin, comparing 10 to 18 storey housing projects with another of 3 to 4 storeys. All the projects selected were the work of intelligent and informed architects, who used their skills to humanize the scale of the buildings. The results showed that in both building types the same density was achieved, but with 30-40 percent reduction in the cost of a usable square foot of space in low-rise even if the land is quite expensive. McLaughlin did a table demonstrating the cost of low-rise with 80% site coverage and the cost of 10 and 20 storey high-rises with 50% site coverage, and their correlation with the land cost. He found that for the high-rise solution to produce occupied footage at the same cost as low-rise, the land cost had to reach 2 million dollars an acre (table 1).[55]

It seems that most literature agrees that if all costs are computed, including utilities, streets, and public facilities, the capital cost of new housing in the United States is close to minimum for row housing at high densities. It is slightly lower for dense 3 storey walk-up units, otherwise the cost will rise substantially as densities diverge from this low point in either direction: On one hand toward single-family housing, or on the other toward high-rise apartments.[56] Adding to all the above that

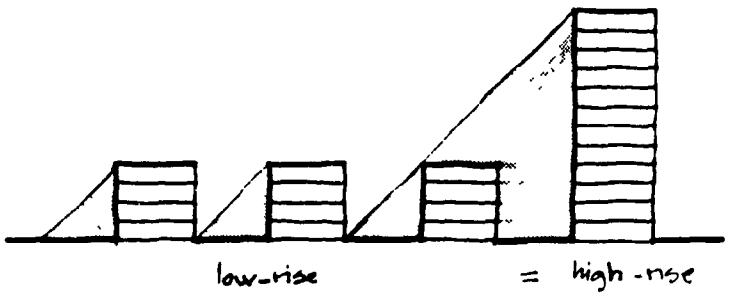
the technology of building high-rise costs much more in the Middle East, where cheap labour is widely available.

Third, there is abundant evidence showing the bad effect of high-rise on the mental and social well being of families. Christopher Alexander in "A Pattern Language", exhibits four strong pieces of evidence that support the above statement, which are shown in the following text. A study by D.M. Fanning, shows a strong relationship between cases of mental disorder and the height of people's apartments. Furthermore, the study suggests that the higher the people live off the ground, and the more time they spend in the highrise, the more frequently they suffer from mental illness. Another work by Dr. D. Copper about mental health and high-rise, suggested the following: that children are poorly socialized, tense, and irritable in high buildings; mothers are more anxious about their children playing outside, since they can't see them from a kitchen window; TV watching is extended in high-rises because of the physical barrier to the outdoor activities, such barriers as elevator, stairs, and corridors. A Danish study by J. Morville revealed that children of all ages, who live in high blocks, spend less time playing outdoors. They do this less frequently and at an older age than their counterparts on the lower blocks. And lastly, Oscar Newman, in "Defensive Spaces", compared two housing projects in New York, one high-rise, the other a collection of 3-storey walk-up buildings. The two projects share the same overall density, the same neighbourhood, and their inhabitants have roughly the same income. But Newman found that in high-rises the crime rate was roughly twice that of in walk-ups. It is clear by now the mental and social disorders that high-rise cause to people's lives.[57]

Finally, the high-rise buildings have a negative effect and a bad impact on their immediate and farther surroundings. The physical structure of the building affects the visual environment and the micro climate around it, such as shade and wind. The building contents may have an indirect effect on the surrounding land-use pattern, land value, traffic flows, parking, and the social structure.

building type	cost per occupied square foot	ratio of occupied square feet to square feet of land	cost per square foot with land at $300,000	$600,000	$1 million	$2 million
two-story	24.91	1.36	30.98	37.07	49.18	69.44
three-story	30.44	2.04	35.21	39.44	49.18	39.42
four-story	34.29	2.71	37.57	40.85	49.22	56.15
mid-rise, 10 stories	44.35	4.24	46.57	48.79	51.75	59.15
mid-rise, 20 stories	47.31	9.9	48.54	49.78	51.43	55.54

Table 1. The effect of land cost per acre and building height, on the building cost
After: McLaughlin, 1976, p. 97.



It is very important to have a compact urban form, through low-rise, high-density buildings that do not exceed four storeys high. Doing this will help in providing a favourable micro climate, buildings a healthy social environment, creating an integrated society, and bringing down the building cost.

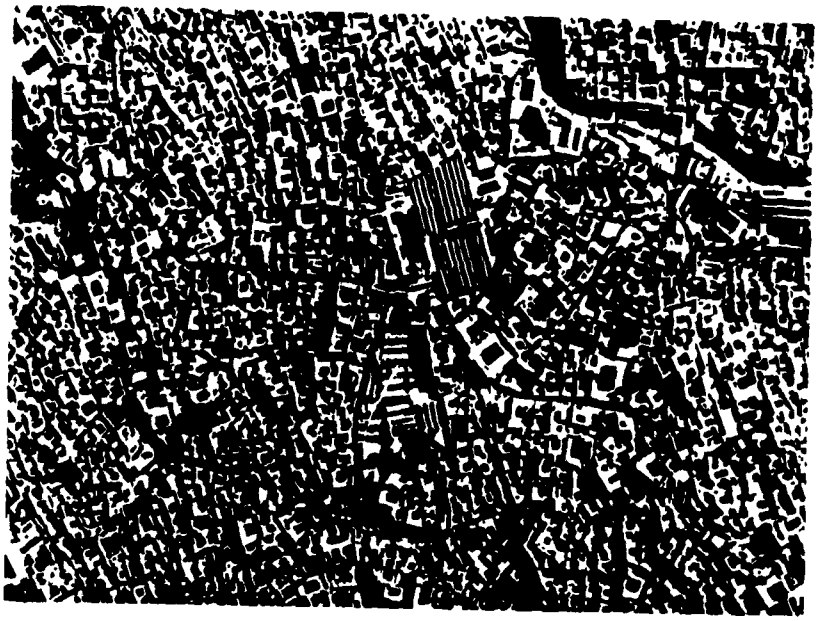


Fig. 15 Air view of the central area of Fez, in Morocco.

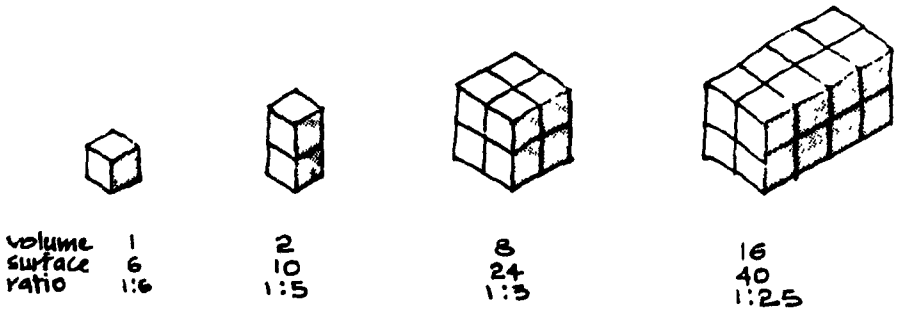


Fig. 16 When volume increases in relation to surface, heat exchange with the outside decreases.

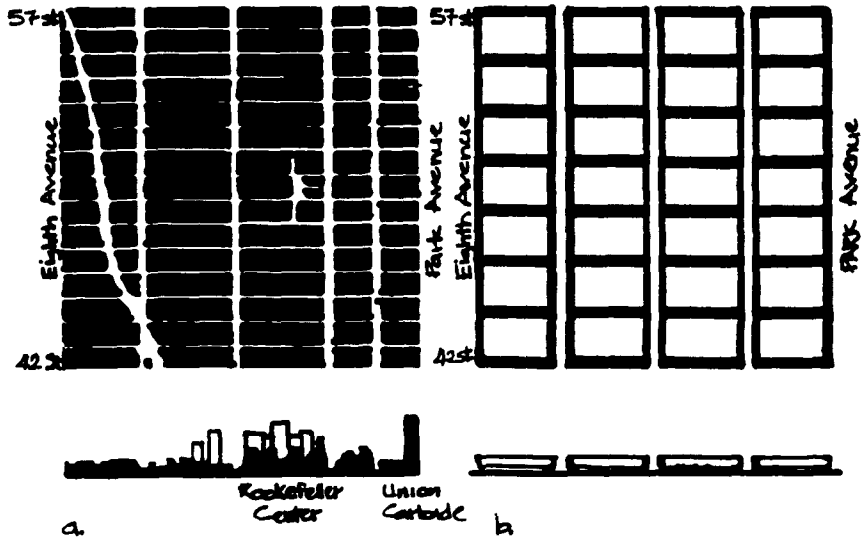


Fig. 17 Part of Manhattan: (a) existing, (b) proposed 8 storey high court forms.
After: Martin, 1972, p. 21.

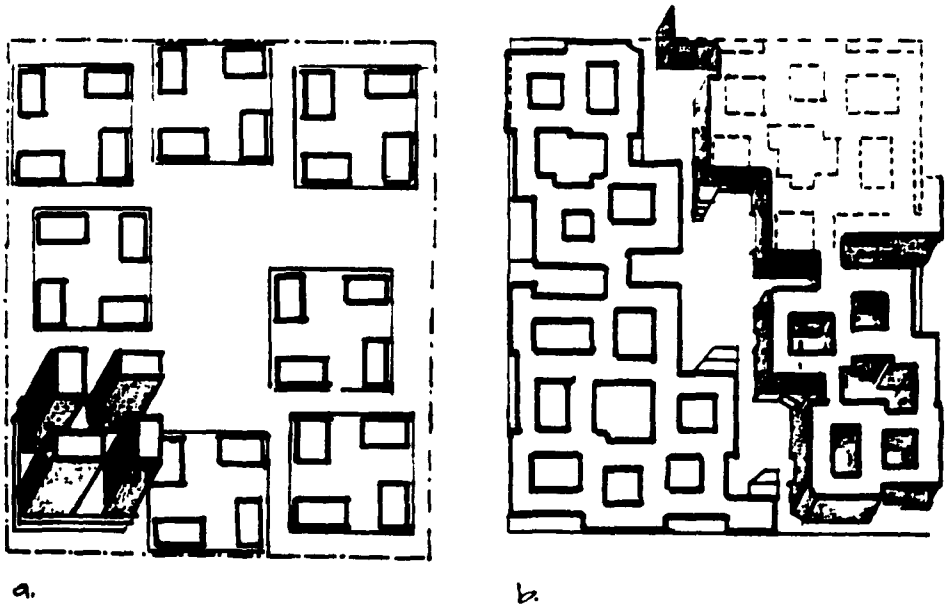


Fig. 18 Jeddah Rush Housing Project: (a) existing pavillion type, (b) proposed courtyard approach.
After: Farahat, 1982, p. 309.

10. RESIDENTIAL QUARTERS

Nowadays people are losing their identity, through the vast city and neighbourhoods. In other words, they are losing their sense of community.

Our modern cities are too huge and shapeless to grasp, which as a negative effect on the people who live in them. The homgeneity of the city kills all variety of life styles, and kills the social and political life of the inhabitants. First, from the social point of view when one lives in a large overwhelming society, one will not be able to identify oneself with a specific group of people that have the same values, morals, and culture. On the other hand, everyday we will meet someone with a slightly different background, who responds differently to our actions, even when the actions are the same. In a world like that, it is very hard to establish any sort of inner strength, and it creates a weak, and unfriendly society.[58] Second, from the political point of view, the size of the political community is very large and the individuals are separated from their leaders. At the same time the government body is physically invisible and located outside the realm of most citizens' daily lives.[59]

Therefore, the city should be a sum of distinct but fundamentally similar part, where each part strengthen and reinforce the values and beliefs of its own culture, and at the same time each part should be integrated in the whole structure of the city. These cellular parts are best exhibited by the neighbourhood concept or the quarter idea in the Islamic-Arabic cities. It's that part of the city where people are in face-to-face contact, and are on intimate terms with each other because they share the same values, culture, and background. Hence, a sense of community will develops, and people will support each other. This will be the basic unit for the city politics, in which the voice and interest of the community is well represented (Fig. 19)[60] In other words, the small dimension of the quarter unit makes it a two-way political channel of communicatin up to the high authorities and down to every individual.

Looking through the old Islamic cities, one can identify many small quarters, which even today still retain the same characteristics. Some good examples could be found in North Africa, Afghanistan, and India. Traditionally, the Arabs settles in the newly-founded cities by tribes, each having its own quarter. Later on, the solidarity of the quarter was based on the different ethnic, social, and religious identities. In most cases, each quarter was named after by the group of people who lived in it. In cases where the Arab-Muslim population were dominant, the unity of the quarter grew out of the association with the school or "madrasah" and under the elected leadership of the "sheikh" or Mukhtar", who also acts as representative of the quarter to the authorities. Some quarters were named after their market or carft. Furthermore, the solidarity of the quarter resulted in a self-policing society, that in insecure times, practised methods of communal defense.[61]

Another important aspect of the traditional quarter was the hierarchy and the degree of privacy of urban public spaces. Where there was a hierarchy from the most public, around the mosque and the market, to the most private space, the entrance hall of each house. This, of course, related to security and to the required maximum segregation between the sexes in Islam. Therefore, what is call "semi-private" space was created to provide a protected area outside the dwelling unit itself within which the kin-like responsibilities, and freedoms, govern (Fig. 20).[62]

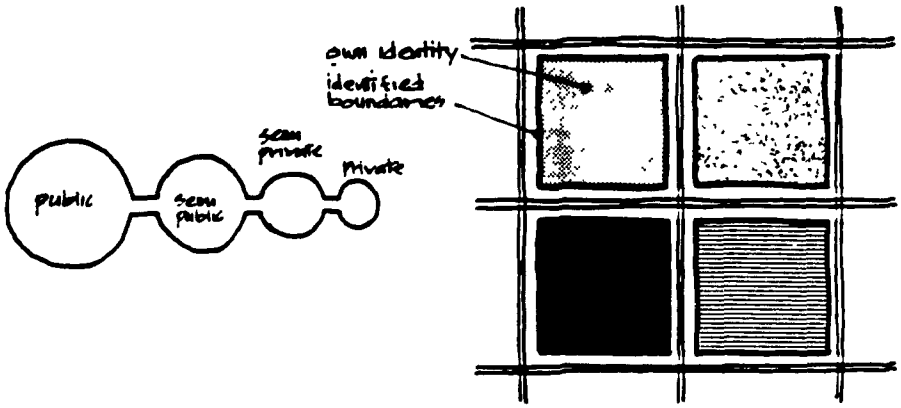
The above concept of the quarter has been advocated by many of the leaders in this feild such as Lewis Mumford, Christopher Alexander, and James Dahir. The question now is what is the size of the quarter or the neighbourhood? It is basically the size that make people live together in harmony with good relation with each other, and where they are able among themselves, to reach agreement on basic decisions about public services, community land, and so on. Anthropological evidence suggested that for a human group to be able to reach such decisions, it cannot exceed a population of 1500, and many researchers suggested a figure as low as 500.[63] In the traditional settlements, reasearchers found that the size of the quarter varies from a population of 500 to 1,200.[64] In the original neighbourhood theory by Perry, he suggested that

the population of a neighbourhood should be that which is necessary to support an elementary school, which is estimated at about 5,000 persons or less.[65] From the above we conclude that the proper size of any given quarter or neighbourhood should not exceed a populatoin of 1500. Otherwise, it should be divided into smaller units or parts. For example, in planning the city of Umm Said, of 100,000 people in Qatar, the designer based his plan on cells or superblocks. The populatoin within any one superblock is planned to approximatetly 5,000. The chosen figure was based on the number needed to support neighbourhood facilities. Each superblock was divided into four quarters of 1,250 people which is served by a people which is served by a local center, two minutes walk from the furthest point within that part (Fig. 21).[66]

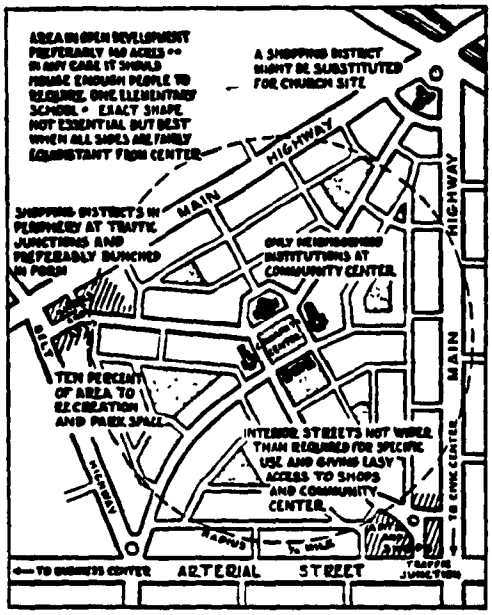
In order for the quarter idea to work as a close-knitcommunity, it needs to be physically separated in space. That is for two reasons; first, each quarter is required to have its own environment that meets the inhabitants needs; second, each quarter is required to be protected form being swallowed by other neighbouring subcultures. It has been found that the most distinctive areas in any city are surrounded by natural boundaries, such as wilderness, farmland, water or man-made boundaries, such as railroads, major roads, parks, and schools.[67] At the same time, when the quarter is big in size and divided into smaller parts, each part could have its own boundary. These smaller boundaries can be much more smaller and modest. It only has to limit the access into each part, which could be reached by fewer and winding streets, or by the use of symbolic gateways.

The neighbourhood idea has been criticized by many people as being a planning illusion. The criticism states that people don't live that way, and that their friends are scattered all around the city. They shop in one community, use the school of another, and go to work in a third. To plan a city as a series of neighbourhoods may support social segregation. The answers for all the above criticisms are: first, planning a city as a neighbourhood does not limit people mobility, so it is their own choice to use any services anywhere in the city; second, it will not create any social segregation since the people live in any neighbourhood by their own choice, and not

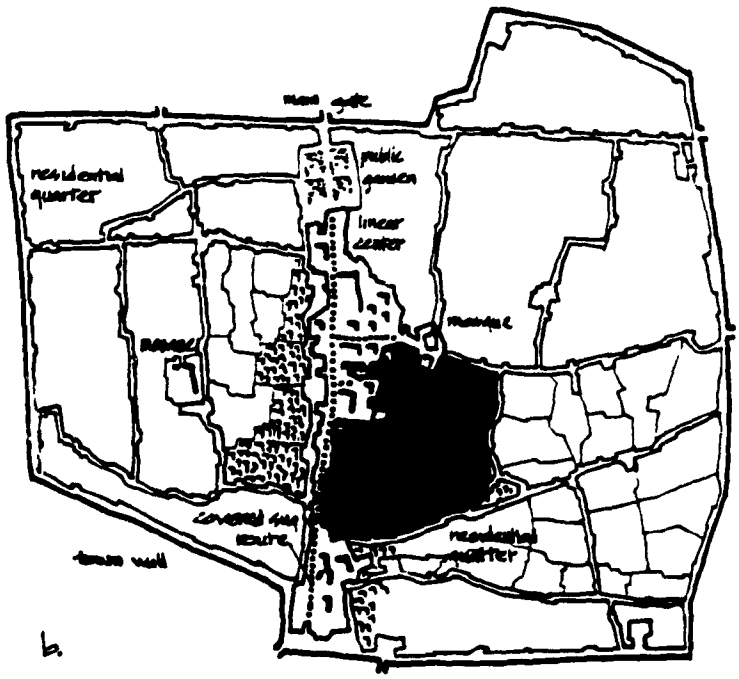
because they are forced to; and third, for security reasons it is better that people recognize their neighbours. Finally, it is a place where children play with each other in a safe environment, and where they grow up. Therefore, it is healthier for parents to be in social peace with each other.



The city could be divided into quarters according to their ethnic, religious, and social values. Each quarter should have its own identity and sense of privacy, which could be obtained by the hierarchy of spaces and streets. Each quarter should have identified boundaries and be physically separated from others. The size of the quarter should not exceed a population of 1,500. If it does, without losing its social and political unity, it should be divided into smaller parts.



a.



b.

Fig. 19 (a) The Neighbourhood Unit, Perry, 1929; (b) The traditional city - Quarters.

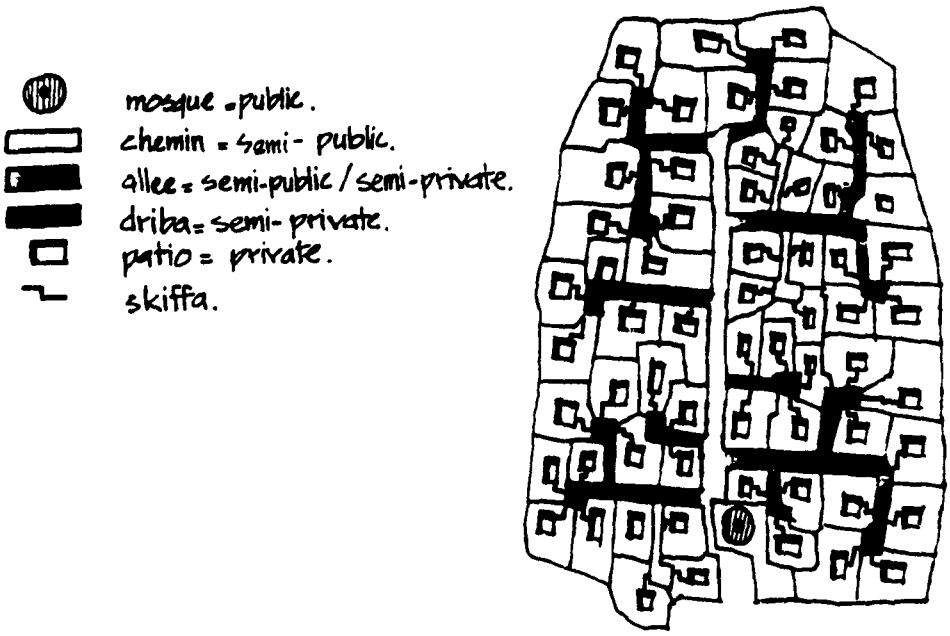


Fig. 20 The private/public space hierarchy in the traditional quarter.

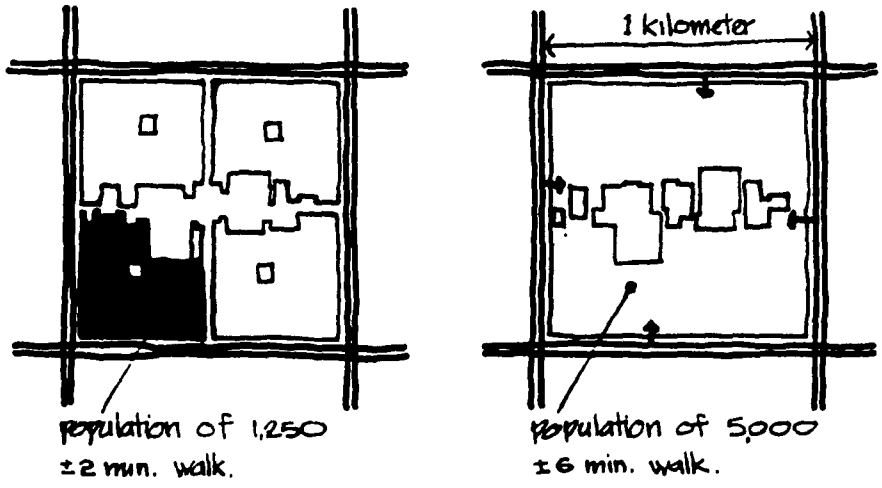


Fig. 21 Superblock and neighbourhood concept, Umm Said, Qatar. After: Hugh, 1979, p. 124.

11. MIXED USES AND LAND VALUE

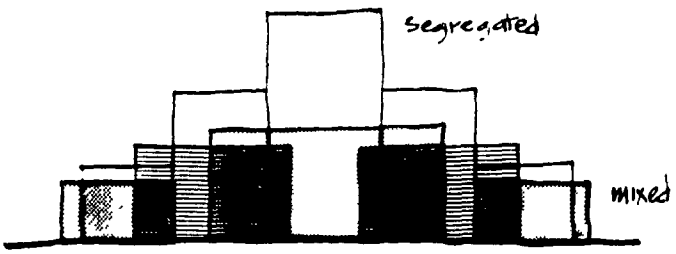
Modern development policies tend to segregate between residential and non-residential areas, which resulted in a dead central area with very high land value, communication, transportation, and security problems.

Conventional western planning methods stress the division of urban space along segregational functional criteria, which resulted in the loss of social context by insulating human activities. It also resulted in over dimensioned roads, highways, and transportation systems that reconnect what has been broken up by the zoning scheme. Not only this, but this pattern of segregation disturbs the land value. Urban services tend to cluster next to each other, in order to attract as many people as possible. Once a nucleus has been formed, it attracts more and more services, and keeps on growing. At one point, a downtown will become enormous, rich, vital and fascinating. Gradually land values rise so high driving the houses out of the center, while shops and office buildings fill in the empty spaces (Fig.22).Since shops and office buildings are basically occupied in the day time, at night time the central area turns into a ghost town, a fertile ground for crimes and illegal actions.

In contrast, the pattern of mixed land use in the traditional city powerfully expresses and facilitates the integration of an economical component into the fabric of social and physical relationships in the city. This is clear through the "suq" or "bazaar" concept, as the artery of economical life, that extends to each corner of the city filling the urban scene with life and vitality. Meanwhile, the center was occupied by the "Kulliya", as the city heart of religious and institutional buildings.[68] This concept in planning of the traditional city could be applied in our modern cities through the linear center. Of course, by putting the "Kulliya" in the center and distributing the office spaces over the city, the land value pattern will change. It will be more homogeneous, without drastic differences in the land value, making it possible to create a mixed land use between residential and non-residential activities (Fig. 23).

Much literature support the mixed land-use idea. Jane Jacobs in her book "The Death and Life of Great American Cities", stated that each district in the city must serve more than one primary function, and preferably more than two. Jacobs defined primary uses as those special places which in themselves attract people such as offices, factories, dwellings, school, etc. This mixing of primary uses will assure that: a. people are outside in the street at different times of the day; b. people are in the place for different purposes; and c. each of the many facilities services is used by a group of people.[69]

In other literature, Christopher Alexander in "A Pattern Language", argued that scattered small work places are better than a centralized large work place. The small work places are advantageous for the following reasons; a they respond much faster to changes in supplies and demands; b. they are more self-governed therefore they have better production and services; c. it is possible to produce complicated industrial goods and services through the combined efforts of hundreds of small firms; and d. they reinforce the home-work relationship. The same will apply to small shops that are scattered around the city, within the reach most of the population.[70]



Within the linear structure of the city center, integrate some residential uses through the non- residential areas (such as commercial, industrial, and institutional), and vice versa. This will help to bring life to the urban structure of our cities, through the reinforcement of the home-work relationship and the improvement of the working environment.

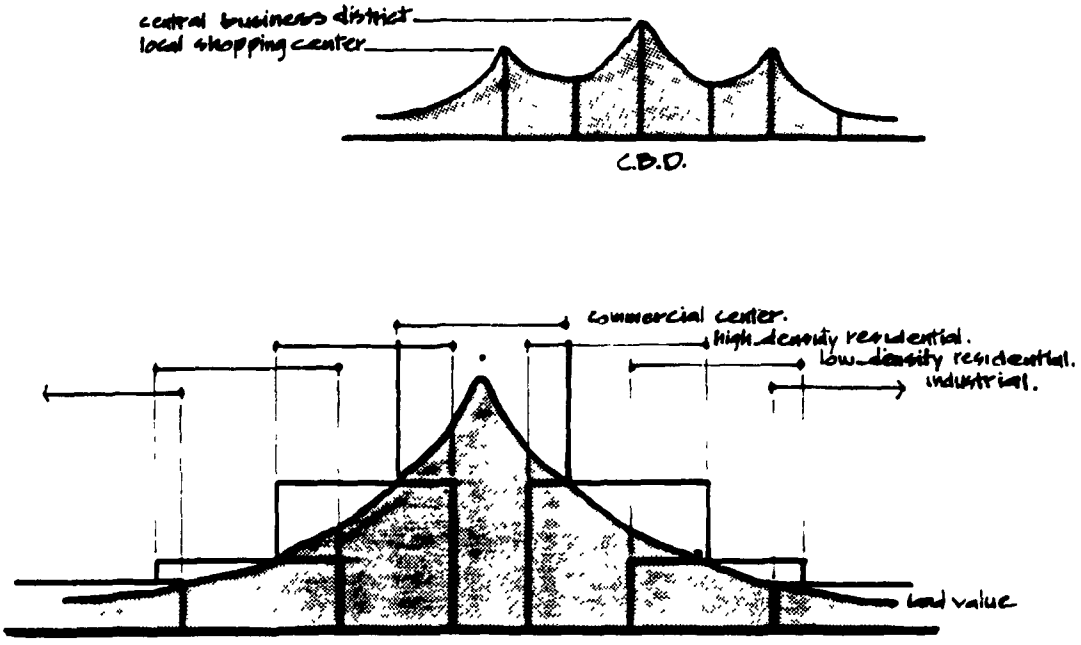


Fig. 22 Land value and land use in the conventional city.
After: Ansari, 1982, p. 275

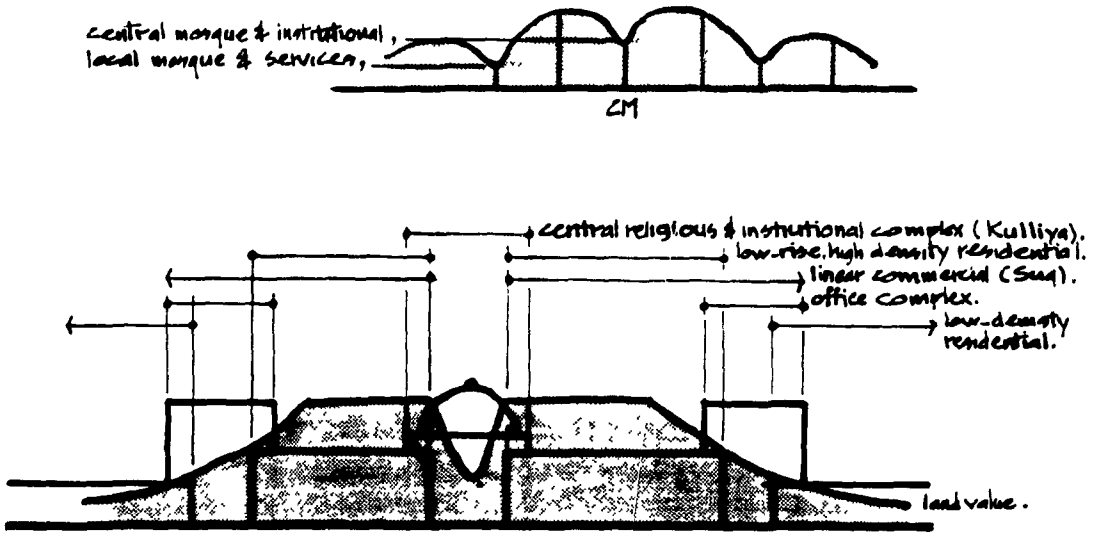


Fig. 23 Land value and land use in the traditional city.
After: Ansari, 1982, p. 275

CITYSCAPE

12. GATE WAY

If each residential area were to have it's own identity and a sense of self policing, then it is important to identify the point of transition at it's boundaries.

The boundary surrounding any important precinct, such as a neighbourhood or building complex, could be a real boundary or just in the people's mind. In both cases the boundaries will have no effect if the access points are not marked. In other works, the points where the path/road crosses the boundary should be visible. The best way to mark the crossing is always best by a gateway, which c eates the feeling of transition from one territory to the other.[71]

In traditional architecture, the process of apprehension of the hidden and the manifest aspect of a given place, is emphasized by the movement toward it and through it. Such movement is best shown by the use of gateways, that stands for the right of passage between the two aspects of life. At the scale of the city, the gateway cut through the city boundary serves as a symbol of entry and as an orientation tool and guidance for visitors and residents to the city's major corridors of movement. This theme is repeated at different levels, at the scale of the quarter, at the scale of cluster, and even at the scale of the individual dwelling unit (Fig. 24) [72]

Finally, the gateway expresses transition in the social and functional dimension as well as in spatial transition. The transition is usually done to evoke an expectation of something different, a new set of orders and principles. In one hand, the gateway could be a natural environment, as in a mountain pass, or an avenue of trees. On the other hand, it could be a man-made environment, as in a simple archway, a bridge,a passage between buildings, a bend in the path, or by a change in the texture of the ground surface.

Symbolic gateways should be provided at different levels and scales, (quarters, building clusters, and even individual dwellings), in order to define a

sense of entry and transition from one territory to the other. It defines what is hidden and what is manifest, it separates between private and public domains, and it facilitates orientation.

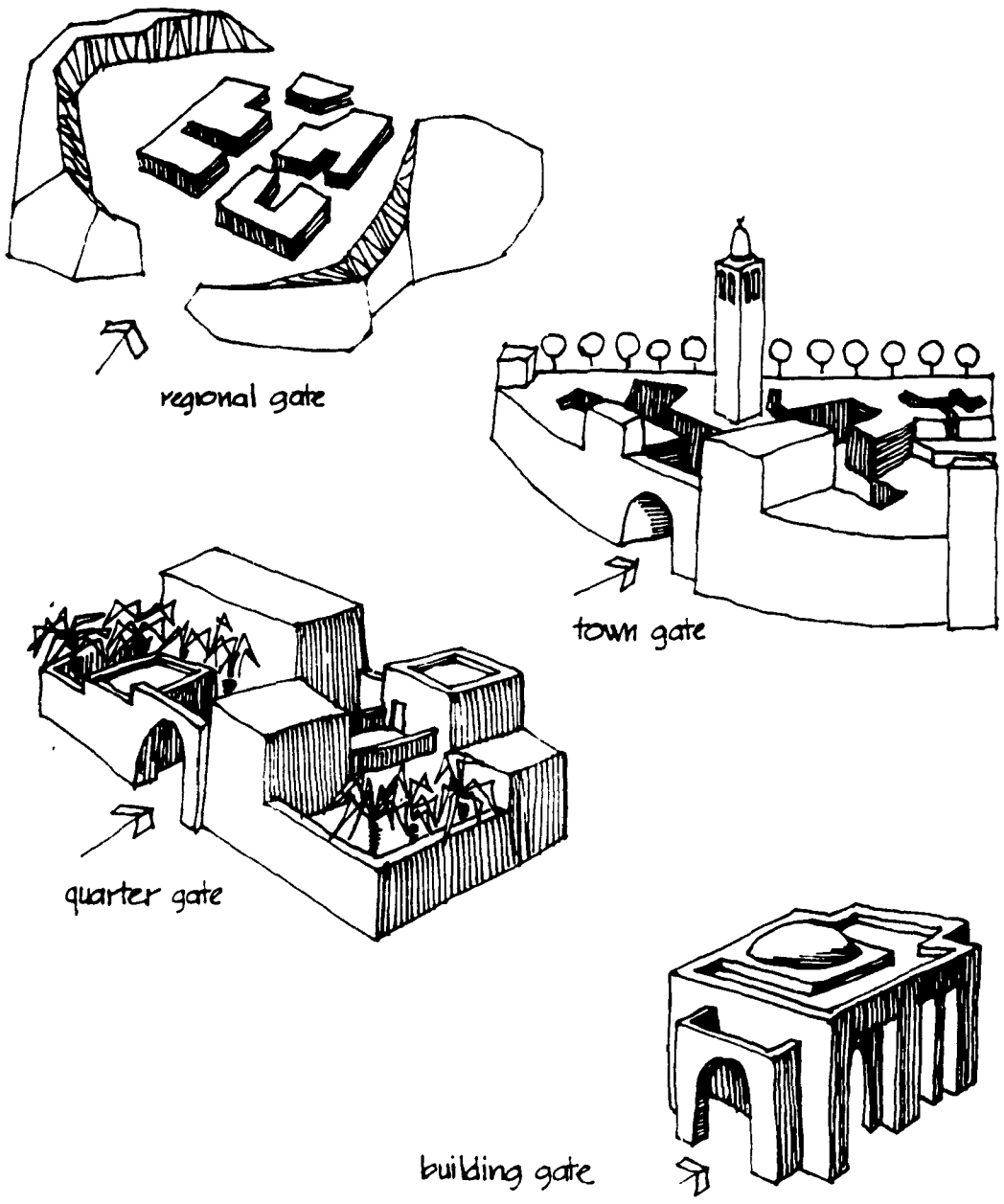


Fig. 24 Hierarchy of gateway scale.

13. LAND MARK:

The similarity and repetition that dominates our modern cities, makes it very difficult for people to find their ways through a city that lacks any symbolic contents.

Landmarks are the titles and headings of the city scope, and they are an amplification of the cultural identity of the city. Landmarks help people to read their cities and understand them without having to read signs. In other words, they are urban features that provide orientation, define places, and reveal functions at a distance. To understand landmarks more we have to study them in the symbolic and artistic content.

In the traditional architecture, buildings always have a symbolic meaning in the people's mind. Their symbolic meaning is more functional rather than an emotional or intellectual one. For instance, the mosque minaret has always a functional purpose where in the old days a person will go to the highest point of the minaret to call for praying. Nowadays, with the use of landspeakers the minaret functions as a visual landmark, that there is a mosque here and people can go and perform their praying. Therefore, the true uniqueness of the landmark lies not in the form it took but in the relationship it creates, and forces, for its users. It is important to understand that landmarks could be identified by other means than visual, such as sound, history, and mode of life.[73] Art was and still is playing an important role in identifying the environment in the Middle East. Landmark elements, such as minarets, domes, and roof edges, that are visible from a distance, are designed with special care often as real pieces of art. Even at a small scale environment the concept of art is used as a carefully designed feature on entrance doors, windows, lines between floors...etc. Such landmarks, make the environment personal and specific for the users. Finally, landmarks are as likely to be spontaneous as they are planned.[74]

Traditionally the Middle Eastern cities are famous for their landmarks, that give a special flavour to the city, and help orientation and place identification. Therefore, the use of landmarks in a symbolic and artistic way should be encouraged, through intentional planning, or by letting them grow naturally through the various modes of life.

PART II:
BUILDING FORMS

SOCIAL

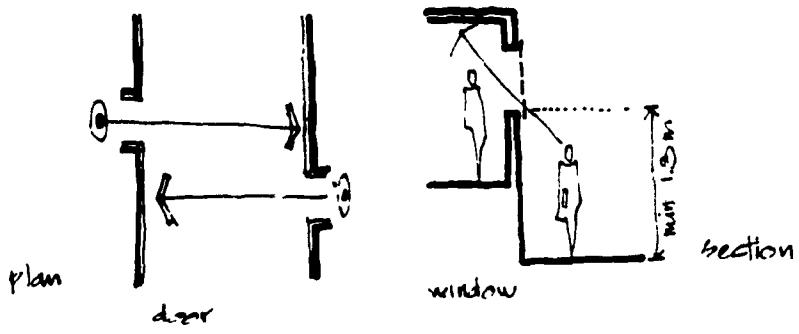
14. STREET OPENING:

A home is a home because of the privacy that one can have inside. On the street people are being watched, at home there is the right not to be observed by strangers walking on the street.

The concern for privacy in the Middle Eastern culture and religion is reflected into the physical forms in several ways. Among these forms are the placement of doors on the street, the architectural treatment of windows facing the street, and their position on the wall. The basic rule that govern street openings is to prevent harm and damage to the others privacy. This is a rule that has always been enforced by the Islamic law through the Qur'an and the prophet-teaching.[75]

History shows that some scholars did not allow the opening of a door in front of another, and some didn't allow it even near another. The reason given by one jurist was that everyone has the right not to intervene in the privacy of another dweller when they open their doorway. At the time, people would be able to bring their loads near their door, or use the front area for reception and entertainment without causing any harm to their neighbours. This concept has been widely used in many Middle Eastern cities. In a field survey out in the traditional residential quarters of Al-Aghawaht, in the Median city, in Saudi Arabia, it was found that only two doors face each other in a group of more than 200 houses (Fig. 25).[76]

Likewise, windows that open into the street should provide privacy for the inhabitant. Traditionally, the problem had been solved by two ways. First, the use of perforated wooden screens known as "Mashrabiya", that allows air circulation and light without intervening in the dwellers privacy. Second, window parapet was generally 1.8 meters high or over the eye level of the people walking in the street.



When the width of the road cannot be made wide enough to provide privacy for the inhabitant, then no external door should be located in front of another. Also, all windows that open into the street should be at least 1.8 m. high, and should be screened to prevent people walking in the street from looking in.

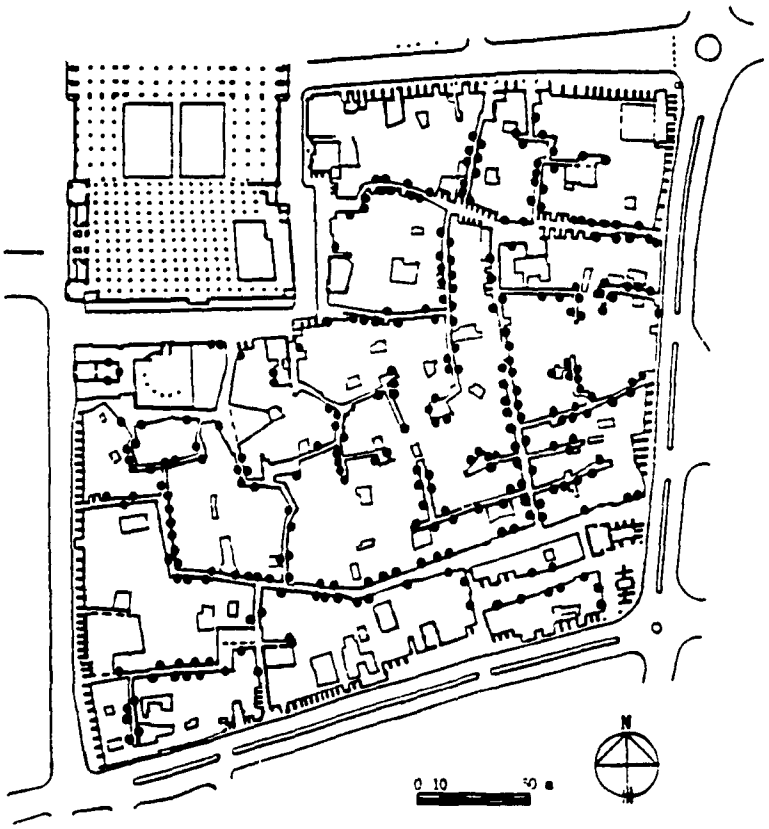


Fig. 25 Doors opening on the streets, Al-Aghawat quarter, Al-Medina city, Saudi Arabia.
After: Bahammam, 1987, p. 36.

15. HOUSE ZONING

Tradition and religion have a strong influence on people's daily social lives. There is a need for the social separation between men and women which can be best understood through the concept of "haramlik" and "salamlik".

The influence of religion upon all aspects of life and upon the attitude of the people is very strong, especially in the Middle East. In Islam the house is considered a social unit, that does not separate itself from the family life. The house in the Middle East is not attached to a certain place or time, but deals with various factors such as natural, social, and cultural environments that affect its function and appearance.

Let us discuss the socio-cultural forces affecting the design of houses in the area. The social interaction in the Islamic society is dominated by two interrelated factors; first, the role of women in society and their place in the household structure; and second, the nature of the socialization process among men. These two factors play important roles in the shaping of daily interactions and they influence very strongly the design criteria of the present houses. Women's activities were centred around the life of the family which was very private. Their interaction was basically with other women and with the extended family members. On the other hand, men have a larger social network, since they were free to socialize and interact with anybody out of their next of kin.[77]

The immediate result of such differences between the role of women and men, was the separation of the house into two distinct parts. The "harmalik", which was the private part for the women and the members of the family, has a limited access to outsiders. The "Salamlik", which was the male quarter, was provided with facilities for social gathering and entertainment. It is fair to say that these "Salamliks" were an extension to the public spaces of the city. Even today, when it is affordable to such Salamliks, it is normally an open reception for anyone to walk in. Therefore, this part of the house was not considered an integral part of the living quarters. In other words,

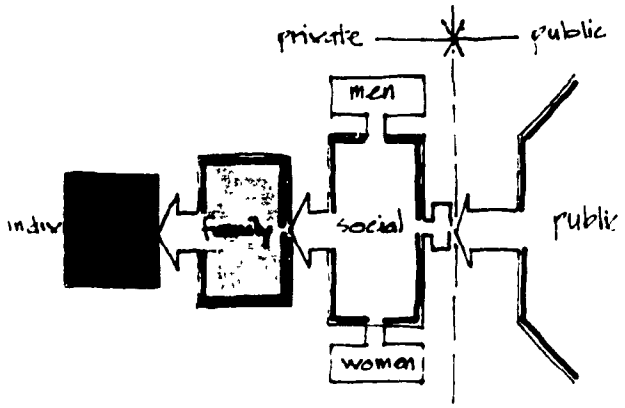
we can say that the "Salamlik" represents the public part of the house, and that the "Haramlik" represents the semi-public or the semi-private part of the house, where the most private part of the house being the sleeping quarters.

We must pay close attention that women were always separated but never isolated from the world of men. Women were allowed access to entertainment events, discussions, poetry readings and other recreational activities from behind a screened opening placed in their private quarters.

The issue of privacy seems to have been and still is a sensitive and important issue to the Middle Eastern residents. Their right to privacy was strongly emphasized and always guaranteed by the Islamic law, which is the same today as the day it was created. The traditional houses fulfilled, to a great extent, society's needs for privacy. It responded to the privacy requirements as much as to the climatic necessities of the region. In general one can consider three different levels of privacy: (a) privacy between neighbours' dwellings as well as between individual dwellings and the street; (b) privacy between sexes; and (c) privacy between the individuals within the family.[78]

It is not suggested that house design should return to principles that were utilized prior to the 20th century, because the social and economical conditions are not the same. There are many aspects of the traditional methods of design that seem to have been ignored. Nowadays, it is more fashionable to shift to Western oriented ideas that do not suit the Middle Eastern culture and values.

Christopher Alexander introduced the intimacy gradient pattern that calls for many different levels of privacy in each house. A sequence of the building spaces that start with the entrance and the most public part of the building, to the slightly more private area, and finally to the most private domains. He also indicated that the degree of privacy varies from one place to the other, depending on the culture and the religion of the people. In short, the privacy at home is an essential need for the human being anywhere.



Any house layout should have a spacial hierarchy from the most public to the most private. The house should have the following zones: (a) social zone, where visitors are allowed, and if possible divided into male and female areas; (b) family zone, restricted to family members only, and could be used for female reception; and (c) individual zone, for each member of the family.

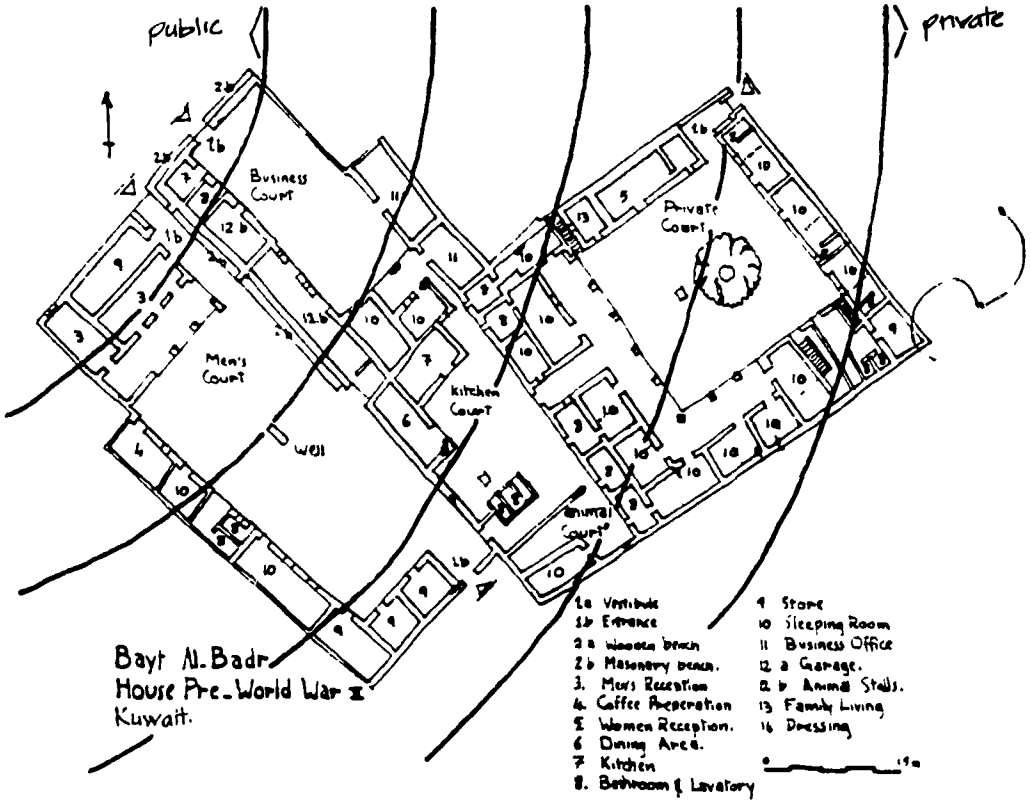


Fig. 26 Privacy zones hierarchy in a traditional house.

16. ENTRANCE

The house entrance is an important transition point, since it is the gateway to the individual private world.

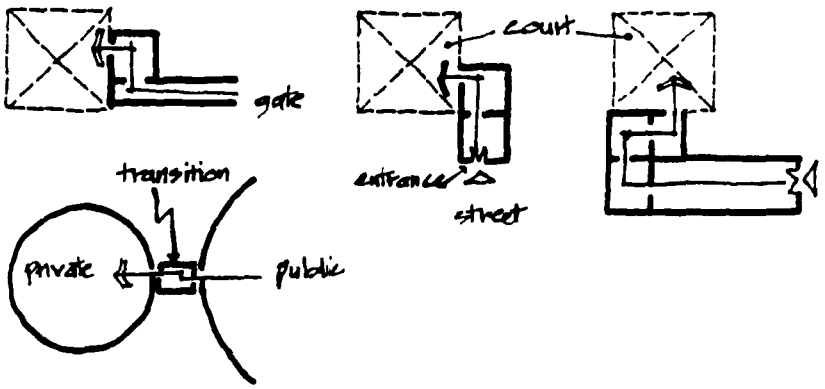
In order for buildings and especially houses to be tranquil and peaceful, they need to have a graceful transition between the street and the inside of the building. It is a transition between what is private and what is public. For this transition to be felt it should exist in the real sense. In other words, it should have an actual physical place between the outside and the inside. To create the psychological transition in the people's minds, the physical space could be accompanied by other changes in the environment. These changes could be of light, view, sound, direction, surface, level, or enclosure. Different research have stated that people passing through such space, go through changes in their behaviour, and people would prefer to have such transitions in their houses.[79]

This is a concept which is not new in the Middle Eastern architecture. Most of the traditional entrances where governed by the privacy consideration. The entrance was protected by a private wall, to inhibit a direct view from the street. Ultimately, it protects the intimacy of family life from the possible visual intrusion by neighbours and strangers.[80]

Another method, which has been used in the traditional courtyard houses, to ensure the privacy of the resident, is the tapestry of light and dark. The entrance room seems to be very dark in contrast to the very bright courtyard. The reason is that when visitors walk into the court from the dark entrance, they are blinded for a few seconds by the bright light, which allows the family member to move to the private section of the house without visitors invading their freedom.

In other cases the entrance door was usually setback to create a transitional space between the door and the street. This space allows people to sta d in front of the doorway without interrupting the street flow. At the same time it gives the resident

a chance to bring in the loads or shopping to their doorstep, without causing any inconveniences.



The entrance should act as a physical and psychological transition area, with its own spatial identiy, through the change of view, light, sound, direction, surface, level... etc.

17. OUTDOOR SPACE

An outdoor living space is very important in peoples lives, especially in areas where the weather permits this. Therefore, it should be properly utilized.

From time to time, people always try to find a place where they can meet friends, eat, drink, talk and relax in a formal way as if they were indoors, inside their own private home, but at the same time they are not indoors. It is a place where children can play safely under their mother's supervision while she continues on her daily chores. It is a place where people can sleep comfortably during a hot night with a cool breeze and clear sky. In short, people need an outdoor room that is an extension of the house property which has the beauty of the sun, wind, smell and all other natural elements.

In order for the outdoor space to be used by the people, it must have the feeling of a room without a ceiling. In other words, it must have a certain enclosure about it. For these outdoor rooms to work they ought to have access at the same level as some indoor rooms or a few steps higher or lower. This outdoor space could be in a form of terrace, roof top, balcony or courtyard but it must have the above characteristics.

The privacy of a given outdoor space depends on the various levels of social interaction and functions to be carried out within the space. At a more communal level, there is a space that supports the social interaction among men or those who are not of direct relation to the family. Separate and distinct space is dedicated to women only, or to the inner family.

From the above, the outdoor space must obtain privacy and enclosure, but at the same time, that doesn't mean it must be surrounded with solid walls. People don't sit staring at blank walls. On the contrary, they try to look out beyond the space they are in, towards a view of whatever there is in the distance that comes nearest into view, or toward any point of activity where they can satisfy both their need for individuality and communality.[81] At this point, to maintain the privacy, it is

recommended to use small and numerous openings, or large openings with proper protection, such as the use of the lattice screen "Mashrabiya".

What makes a house a home is its tranquility and peacefulness. If we are to consider the outdoor space as an extension to the house where people can feel at home, it must have this sense of tranquility, peace and beauty which can be obtained with a delicate touch of greenery, flowers and water, over the open space, evoking paradise. In doing so, the outdoor space will symbolize an oasis in the middle of a desert, sheltered from the oppressive climate by its tree enclosure.

Finally, an outdoor space adjacent to a building can remain relatively free of dust and sand. Throughout the day and because of its enclosure, the outdoor space is partially shaded, which is a very important factor to generate air circulation. In short, a good design of outdoor space creates a favored microclimate for the inhabitant.

When designing outdoor space whether it is a roof top, terrace or courtyard, there should be easy access from the inside. A certain enclosure should be created, whether by fence, trees, shrubs, columns, ...etc. But at the same time, a hole should be made through the enclosure so people can orient themselves to the outside world without losing their privacy. Adding a touch of nature to the space, such as greenery and water gives it a sense of tranquility.

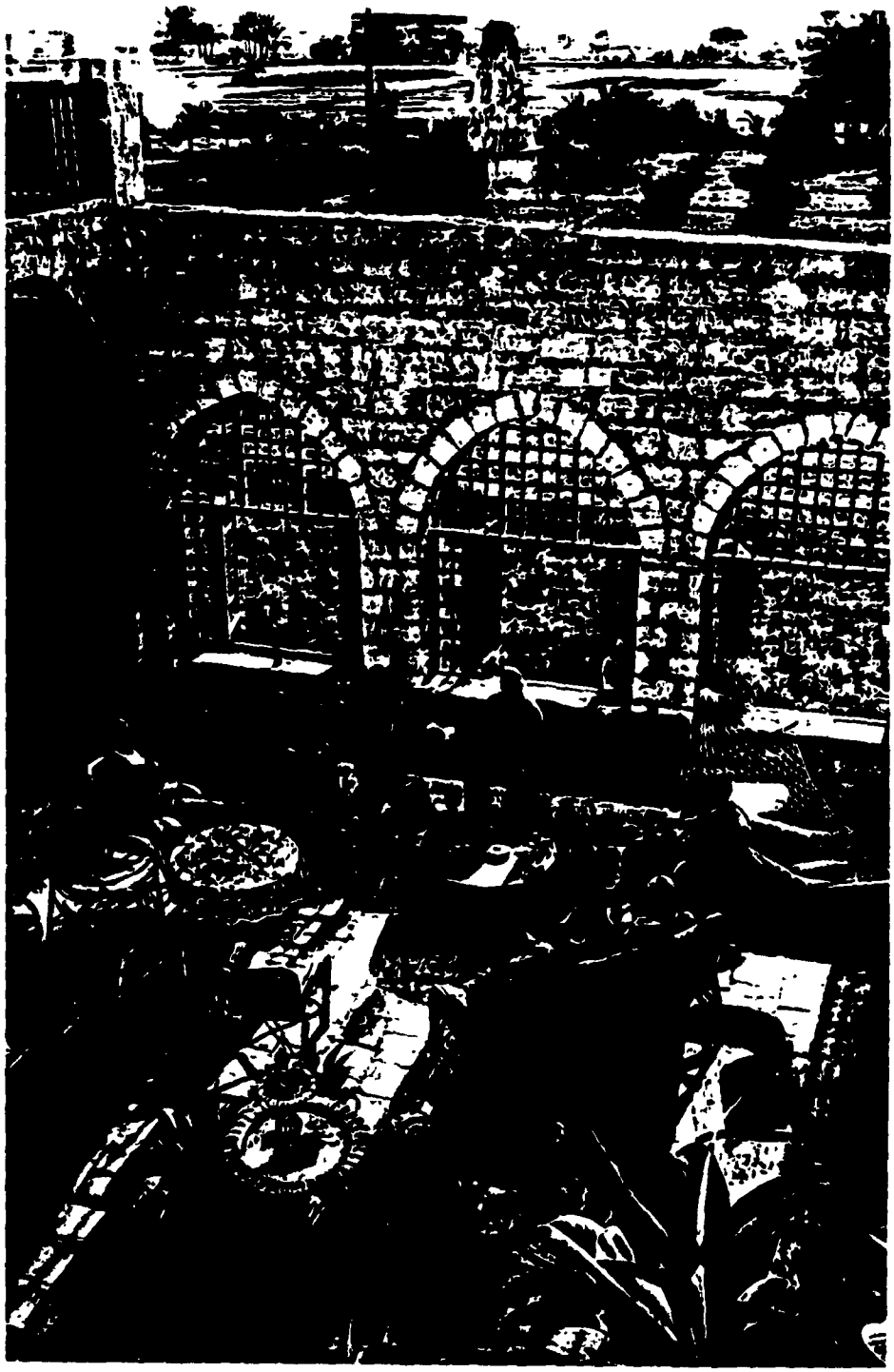


Fig. 27 Courtyard in the suburbs of Cairo, Eqypt.

CLIMATIC

18. AIR CIRCULATION

In hot arid climates air circulation is very important to reduce temperatures, but wrong patterns of air circulation could have a reversed effect.

Air circulation has a great effect on the temperature of our environment: Firstly, by convection cooling through the exchange of indoor air with outdoor air if the latter is a lower temperature than the indoor air. Secondly, by physiological cooling due to body heat loss through increased evaporation and convection heat loss. This explains why in Egypt it is very popular to have living quarters with northern exposure in order to catch cold breezes coming from the north. On the other hand, air circulation provides us with the fresh air that is important for our human comfort.

In hot dry areas, ventilation must be carefully planned, where ventilation should be eliminated during the hot hours of the day. Otherwise circulating the air, by introducing a large quantity of outdoor air which is hotter than the indoor air, will increase room temperature and reduce the advantage gained through the massive heavy-weight construction of the building. A series of tests done at Khartoum University shows that, when the room was ventilated throughout the day, the indoor air temperature followed closely the outdoor air temperature and remained high after the outdoor air temperature had dropped. When the same room was not ventilated during the hot period of the day the indoor air and surface temperature was 10-11^{0}C lower than the maximum of the outdoor air temperature. Later in the day when the ventilation was started, the indoor air temperature fell rapidly in accordance with the outdoor air temperature which was higher only by 1^{0}C (Fig. 28). In the Middle East, it is a common practice to close the windows as it starts to get warm at noon, and to open them again late in the afternoon and early evening, which can be improved by the use of well fitting and air-tight windows, and by the use of an outer louvred shutter to minimize heat transmission and infiltration (Fig. 29). In short, windows should be opened at night to cool down the structure and closed at daytime to keep in the cold

air and the coolness which is stored in the structure.[82]

To be able to design for beneficial air circula- tion, it requires a good understanding of the forces behind air movement. Thermal forces will rarely be sufficient to create appreciable air movement. As the wind blows against a structure, air piles-up on the windward side creating an area of high pressure with the air flowing around and above the building. An area of reduced pressure is created directly downwind of the structure. Thus, a pressure difference is created between the windward and the leeward side of the structure; With an adequate opening, the air will move through the structure from the high pressure side (pressure zone) to the low pressure side (suction zone) (Fig. 30).

To insure good air-circulation, care must be given in the designing of interior partitions and exterior openings, which in return, will affect the direction and the velocity of air movement. As for the velocity, it can be controlled by the size of the inlet and outlet. As the outlet is large a higher velocity is obtained. When the outlet is small, the air velocity will be less but the total rate of air flow (volume of air passing in unit time) (Fig. 31) will be higher. Direction of air flow into a space should be at a level and in a pattern that suits its function. Air flow could be controlled by: First, the level of the inlet where air flow tends to take the same level regardless of the outlet opening position (Fig. 32). Secondly, overhangs and sun shading devices can have a great influence on air-flow patterns. For example, a canopy over a window tends to direct air flow upwards, and a gap between it and the wall will ensure a downward pressure. (Fig. 33) shows some other example such as levers and sashes. Third, the built-up pressure in front of the solid area of the elevation, where a larger pressure built-up is created by larger solid surfaces around the opening tends to push the air flow in an opposite direction. Both in plan and section, whether it is one storey or more, the result is the same (Fig. 34).[83] The air changes direction and speed as it passes through a space that is divided by means of partition which in return can effect air circulation. Figure 35 shows some air-flow patters due to internal diviation.

In the hot arid region such as the Middle East, where the compact urban fabric is used in order to protect the environment from the hot sun and the hot dusty wind, it is difficult to obtain air circulation as explained above. Thus, traditionally people in these areas have developed many ingenious solutions to achieve air circulation. Some of which can be used and valid up to this moment, such as wind catchers, and air shafts. The air circulation system at this moment mainly consist of: input in the form of a wind catcher; an opening connected to a shaft and normally orientated to catch favorable breezes, above the roof level; and output in the form of a duct or opening at a high level within an elevated part of the roof such as a dome, or sometimes through the open courtyard (Fig. 36). The wind catcher motivated by the dynamic force of wind, where a high pressure area is generated when wind hits the wall of the shaft forcing the air to go down. On the other hand, the output of the system is motivated by the stuck effect caused by thermal forces, where the hot air with its lower density rises upto a higher level. Traditionally, wind catchers have been used all over the Middle East under different names such as 'Badgir' or 'Malkaf' in some cases they were uni-directional, in others they were multi-directional (Fig. 37). Wind catchers can be equiped with a special door which can be closed in winter or when the weather conditions are undesirable. It is preferable for the wind catcher shaft wall to be of an interior wall in order to stay cold.

In hot-dry climates, air circulation is not enough to provide comfort; humidification of the air may be necessary which can be provided by evaporative cooling methods. Evaportaive cooling is simply, when hot air passes over a water surface a significant amount of it's heat is absorbed by the water surface; resulting in cooler air and water evaporation which in turn increases air humidity. Traditionally, in some parts of the Middle East, evaporative cooling is done with the aid of a porous pottery jar filled with water, which can be placed in front of the window behind a wooden work (Fig. 38); or in some cases as in Egypt, it is placed inside the wind-catcher shaft where the water seeping through the jar drops into a charcoal placed on gratiny through which the air is being cooled down and filtered from dust. Hassan Fathey used the same concept

in his redevelopment project of Garna Village in Egypt where he claims a drop of 10^0C in the air temperature inside the room.[84]

In other parts of the world, such as India, an open weave matting of vegetable fibre (cascas grass) is often hung in front of the window and kept wet by throwing water against it from time to time. As the air passes through the mat curtain, it is both cooled and humidified. At the present time the same mat is used but it is often hung from a perforated pipe in order to keep it moist.[85]

As a general role, all windows and openings should be closed during the overheated period, and opened for ventilation at night time when the temperature drops. Air movement should be well planned through the utilizing the pressure difference between the windward and the leaward side of the building. The air flow through the space should be controlled by the proper design of: the outlet and inlet size, the inlet level, the position of sunshades and overhangs, and the proportion of solid areas around the inlet. In dense urban fabrics wind catchers should be used. Evaporation cooling methods, such as water filled porous jars, should be used to cool down the incoming air.

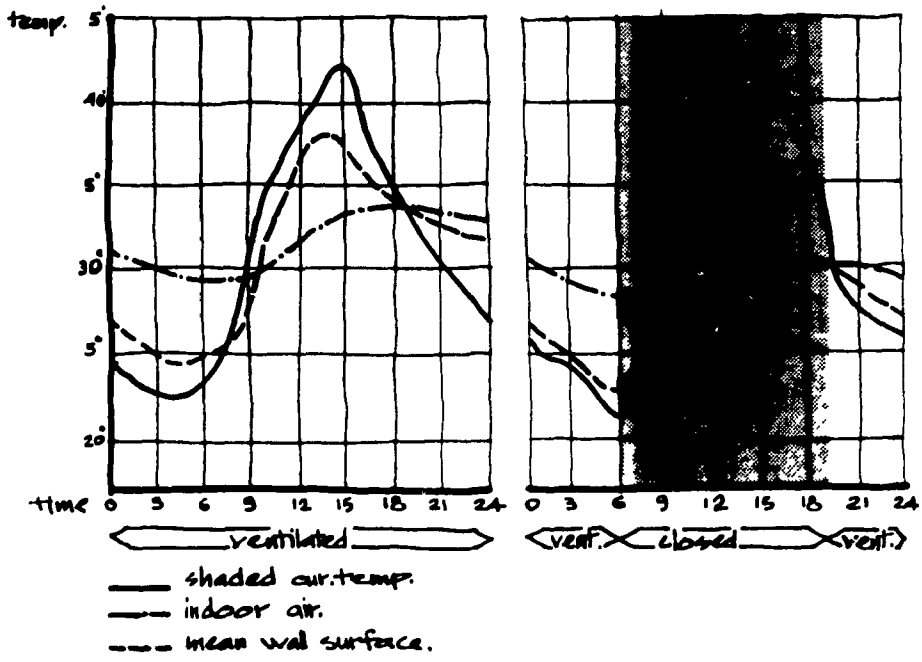


Fig. 28 Ventilation pattern throughout the day and indoor air temperature. After: Danby, 1973, p. 65.

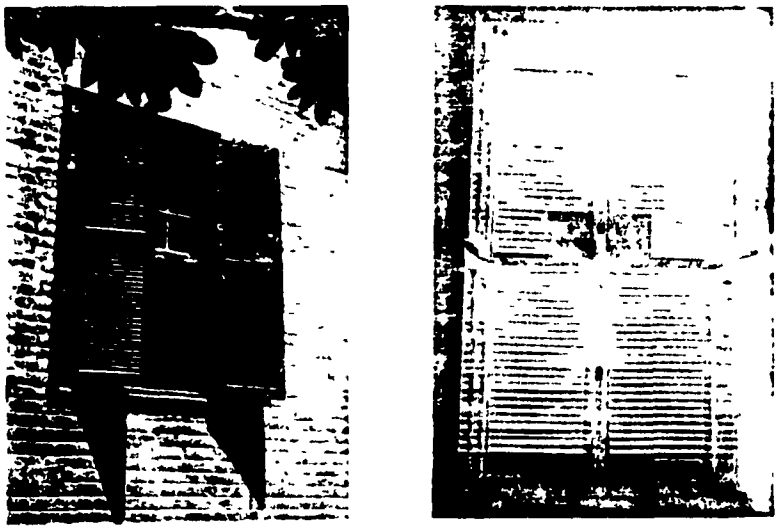


Fig. 29 A combination of outward opening louvered shutter and inward opening glazed window.

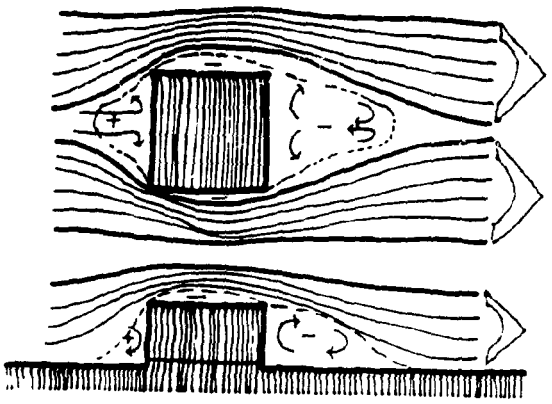


Fig. 30 Airflow around and over the building, showing pressure and suction zones.

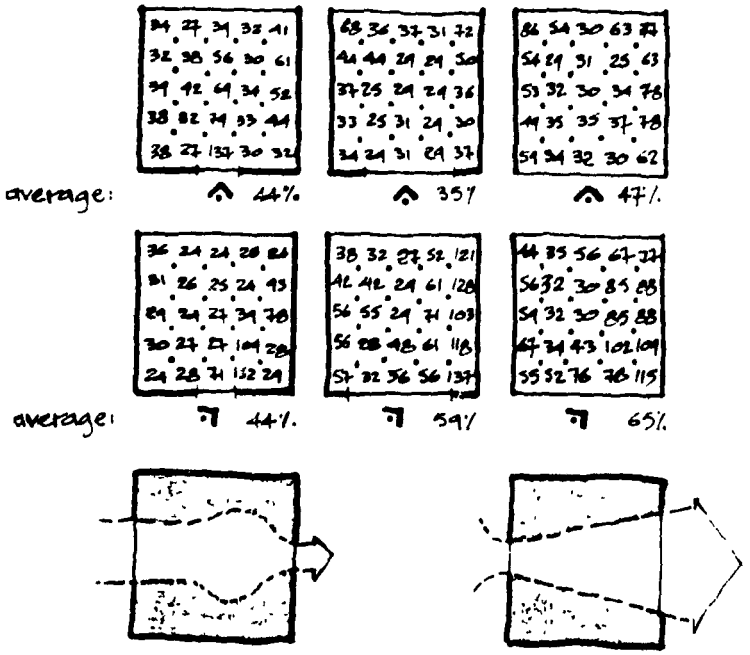


Fig. 31 Effect of wind direction and inlet opening size on air velocity distribution. After: Givoni, 1969.

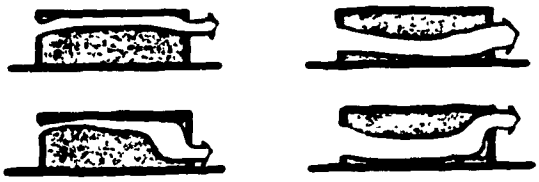


Fig. 32 Effect of opening positions on airflow.

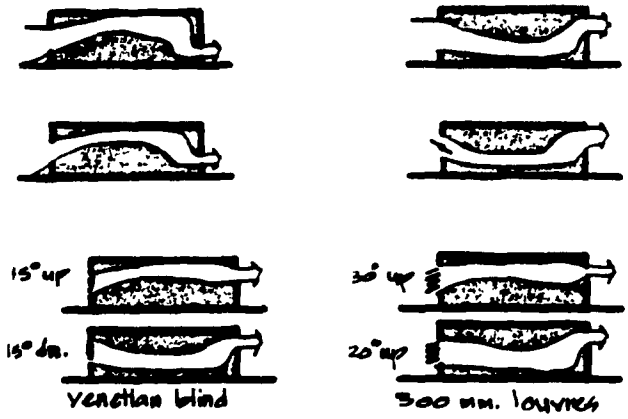


Fig. 33 Effect of canopies, sashes, and louvers on airflow.

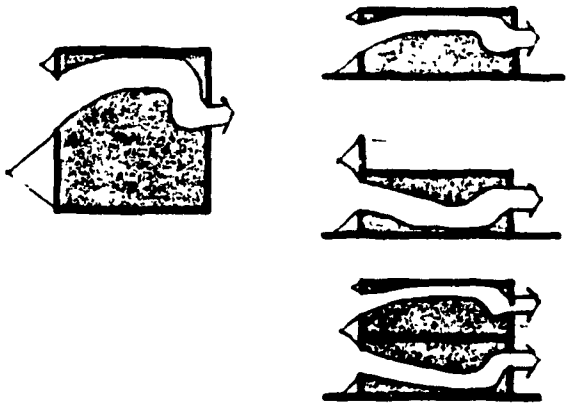


Fig. 34 Pressure built-up at inlets and airflow.

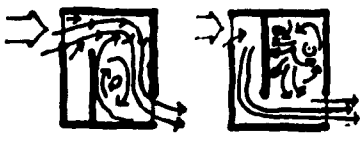


Fig. 35 Effect of internal partition on airflow.

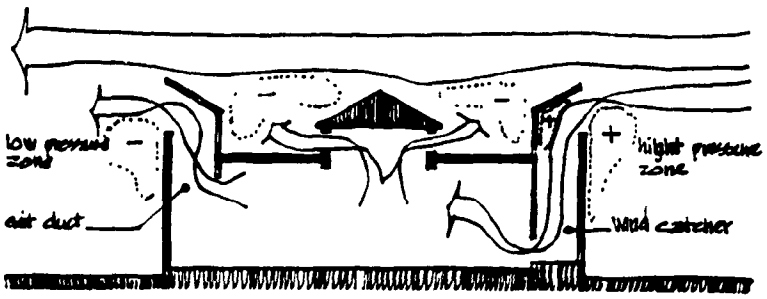


Fig. 36 The use of wind catcher and exit duct in assisting air circulation.

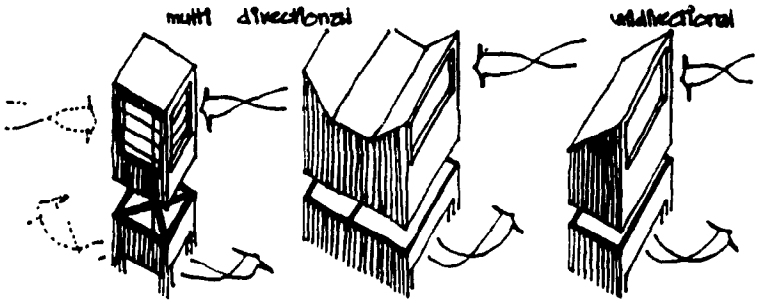


Fig. 37 The different types of wind catchers.

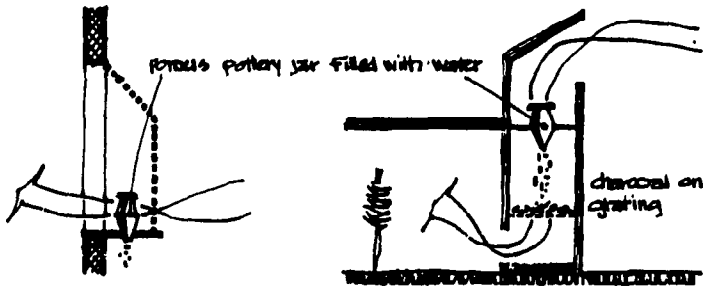


Fig. 38 The use of water filled porous jars for evaporation cooling.

19. WIND PROTECTION

In many of the hot arid areas, sand and dust blown up by wind are of the greatest discomfort to the inhabitants and can have a detrimental effect on building materials.

It is important to understand the difference between dust and sand particle, and their behavior in order to be able to protect the building from their damaging effects. Dust has a smaller grain size than sand, which in turn affects their rate of falling to the ground and their movement. Thus, in sand movement the particles are constantly making contact with the ground, so bounce back into the airstream and are carried farther downwind, in other words, sand drift along the ground. The smaller dust particles can be lifted to a considerable height and are carried for long distances before returning to the ground. That is why dust storms often rise to great heights, 1,500 m. or more, while the sand movement average height is about 1m. above the surface even in strong winds. As a general rule, the harder the surface, the greater is the bouncing motion of the grains, and the greater is their travelling distances down wind at higher levels.[86]

Designing a sand barrier, and because of its tendency to bounce along the ground, a relatively small barrier screen (about 1.7m height) can be very effective. An inner courtyard will obviously have great advantages (Fig. 39). In the case of dust protection, it is acceptable to assume that dust movement will follow the actual wind pattern; that is created by the contact of air streams with deflecting barriers as observed in wind tunnel experiments. Therefore, the barrier needs to be at least as high as the building and not more than 6 m. away from the facade. Consequently, good protection can be provided with different building shapes as shown at (Figure 40).[87]

Working in grouping buildings together, they can be laid out in order to protect each other from the wind blowing sand and dust, and act as wind barriers. Although

this kind of layout will prevent the entry of hot dusty and dry air, some ventilation and relatively cool dust-free air is necessary for hygienic and physical comfort reasons. Traditionally, people built high dense urban settlements where buildings are constructed very close to each other preventing sand and dust from getting inside (Fig. 41), at the same time wind catchers were used to enhance cool air circulation.

Artificial berms located on the windward side of developments, or even a single house, will divert wind up and over the site (Fig. 42). The berm must be large enough with a gentle slope to allow structures to be located within its effective zone of protection at the leeward side. A concentration of trees and shrubs at the crest of the berm will increase the barrier's ability to deflect wind, as well as filter noise and dust (Fig. 43). A well designed and landscaped berm will provide valuable open spaces and recreational areas.

Vegetation is commonly used in barriers for controlling wind patterns and filtering it from dust and sand. In the leeward side of a shelter belt, wind velocity may be reduced by as much as 50% for a distance of 10-20 times the height of the barriers. This effect can be improved depending on the barriers penetrability, width and height.[88]

The less penetrative is the shelter belt, the more the air is forced up and over the barrier, and the lower is the negative pressure zone behind the barrier, which will pull overhead air flow back down to its original path sooner. In general, the overall wind speed behind a partially penetrable barrier is not reduced quite as much as behind a denser barrier, and the zone of maximum protection moves farther away from the barrier than the first one (Fig. 44). The optimum density, including leaves, branches, and trunks combined is estimated to be between 50-60 percent. At this density, narrow belts are just as effective as wide belts with the same overall penetration.[89]

For sand protection, hard and artificial surfaces around the building should be reduced to a minimum; a barrier as low as 1.7 m. will be sufficient. As for dust protection, the following methods, which are generally designed to control

wind direction and speed, will be satisfactory; barriers as high as the building and not more than 6m. away from it. Green shelter belts of 50-60% density, artificial and natural berms with proper vegetation, and a high density urban fabric which will provide the perfect environment for dust protection.

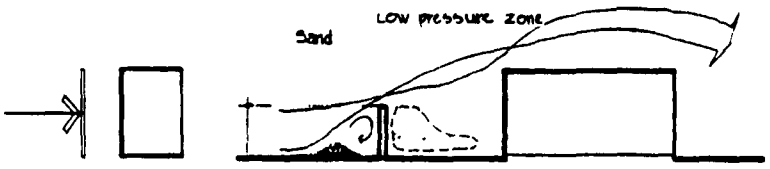


Fig. 39 Sand protection.

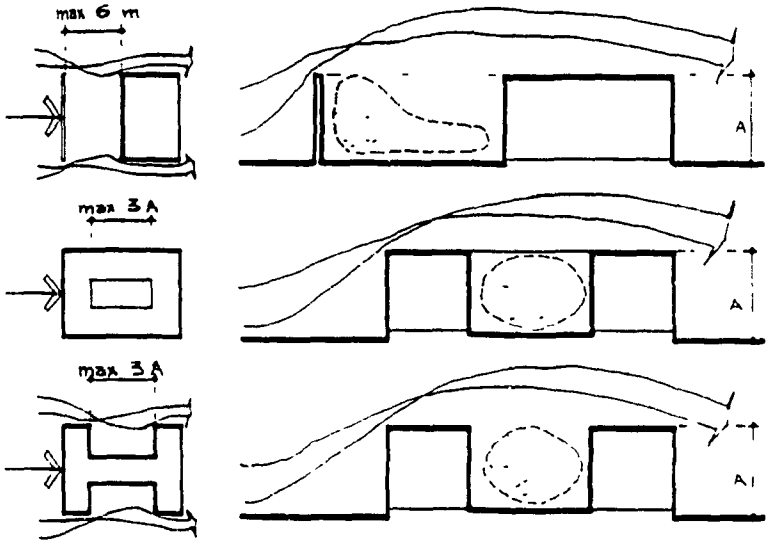


Fig. 40 Dust protection.

Fig. 41 Traditional urban fabric.

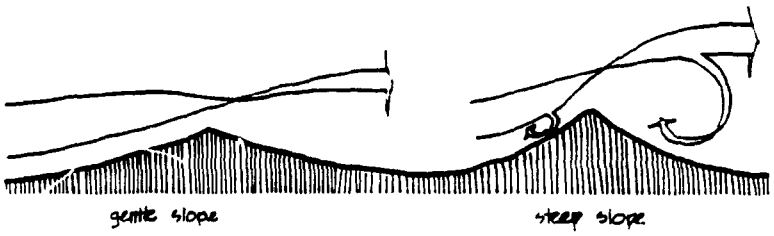


Fig. 42 The berm effect on wind movement.

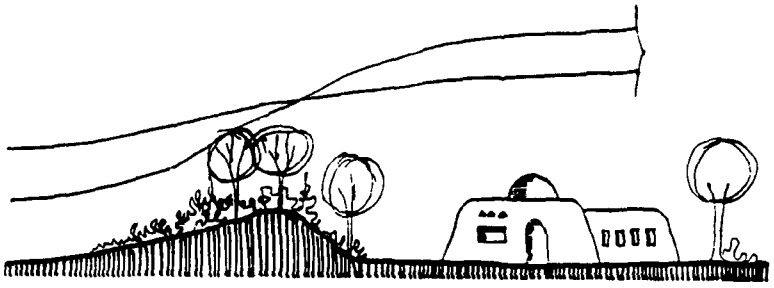


Fig. 43 Vegetation increase, the berm ability to deflect wind.

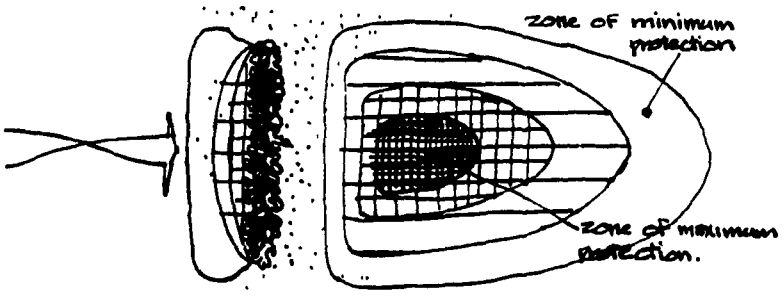


Fig. 44 Zones of protection around shelter-belts.

20. ORIENTATION

There are so many buildings that do not respond to the solar and wind orientation which resultes in a great heat built up during the summer or a great heat loss during winter.

The orientation of a building is a problem which is determined by many factors: site topography, pleasing view, noise reduction and climatic factors of wind and solar radiation. What will to be discussed here is mainly the climatic factors, where the rest depends very much on each individual case. No doubt that early mankind noted the importance of orientation to the thermal stress. The Egyptian and classical builders were, of course, keenly conscious of solar orientation, probably as much for reasons of health as of their sun-dominated religions.

In hot climate areas, protection from solar radiation is very important; especially in the afternoons with it's excessive heat, where a difference of as much as 3°C in air temperature can be found between the worst and the best orientation. Olgyay in his research for optimum 'Sol Air' orientation recognized three basic factors: air temperature, solar radiation and heat convection. They can be utilized to maintain a temperature level near the 'comfort zone'. An optimum orientation for a given site would give maximum radiation in the under heated period, while simultaneously reducing insolation to a minimum in the over heated period. Olgyay found out, by plotting the direction of maximum radiation gain for both the hot and cold periods for Phoenix, Arizona, that the desirable direction in the under heated period lies at 32° east of South; and the undesirable radiation in the overheated period lies at 22° south of west. Because the previous directions are not perpendicular to one another, adjustment weighing heat and cold stress is necessary. The adjustments were made with a 1/3 / 2/3 ratio in favor of the overheated period resulting in an 'optimum' orientation of 25° east of south (Fig. 45).[90]

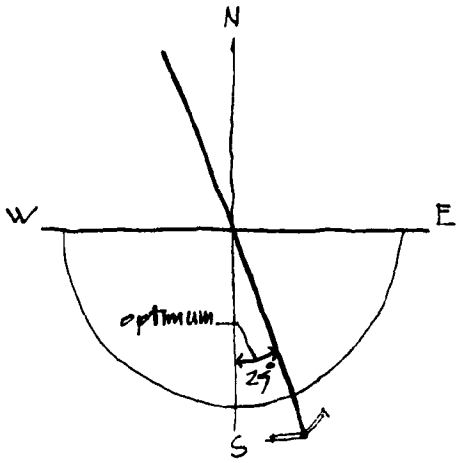
For wind orientation, three types of local wind data are necessary: Prevalence of wind in terms of percentage of time, velocity, and general characteristics such as cool and hot breezes. Once this data is obtained, it is easy to determine the favored wind orientations for a given area. Unfortunately, it is not always the case that solar orientation and suitable wind orientation coincide with each other. In such a case the best compromise must be reached based on the physiological advantage of each factor, which is also determined by the ambient air temperature and humidity levels. However, it has been found by Civoni that when the building is placed at 45° to the wind direction, the average indoor air velocity would increase and a better distribution of indoor air movement is reached (Fig. 46).[91] This finding may help the conflict between solar and wind orientation.

In Cairo and Northern Egypt, the direction of the prevailing wind has posed an interesting dilemma to home builders, where the wind constantly blows from the north-east, and shifting occasionally to a west-north direction. The most unpleasant wind comes from the south, in the spring time, carrying sand and hot air. On one hand, it is necessary to provide living quarters with northern exposure to catch the cold breeze to maximize bodily heat loss during the summer. On the other hand, it is encouraged to provide the same quarter with the low sun rays of the winter sun from the south. Therefore, many Egyptian architects and developers are placing the residential areas on a north-south orientation.

Applying the optimum orientation to a given building is not always an easy thing to do, unless the building is of a unilateral type. In case of other building shapes, some of which are illustrated (Fig. 47), each side must be assigned a proportionate importance, where a parallelogram of the forces should be drawn. The result will be an adjusted exposure for the important sides.

Finally, one should consider the individual user patterns of each space in the building and the most preferable time to let the sun into the space. Some spaces will be used only at day time such as school and office buildings, other spaces will be

used only at night time such as bedrooms. Therefore, a well designed floor plan will give us the maximum out of a given orientation.



The optimum orientation for buildings, in hot-arid climate, is 25^0 east of south. If this orientation does not meet the favorable wind orientation, then the best compromise should be reached. As much as possible east and west walls should be kept free of openings. The best orientation should be given to each individual space according to its use. Different shapes of building should be oriented according to the importance of each side.

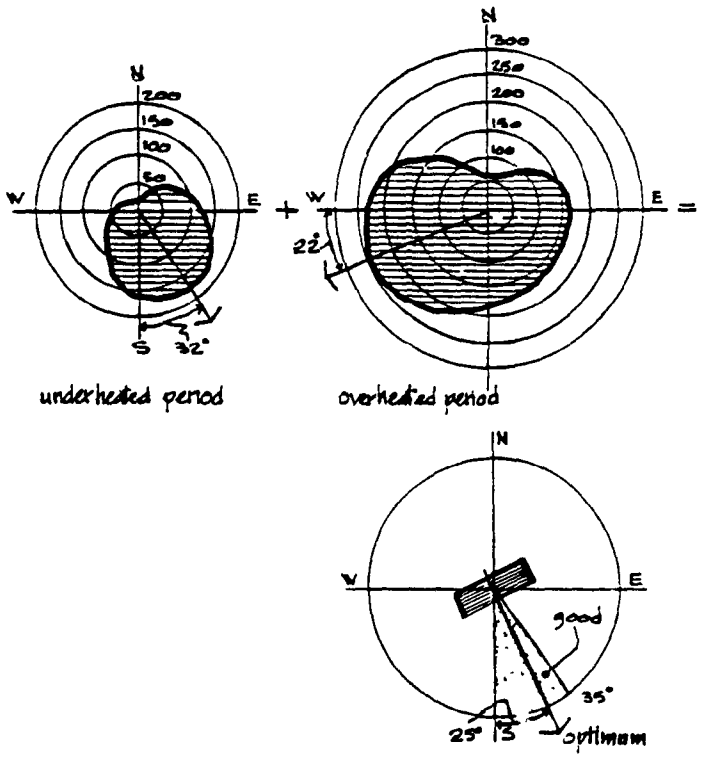


Fig. 45 Sol-air orientation for the hot arid region of Phoenix, Arizona. After: Olgyay, 1963, p. 58.

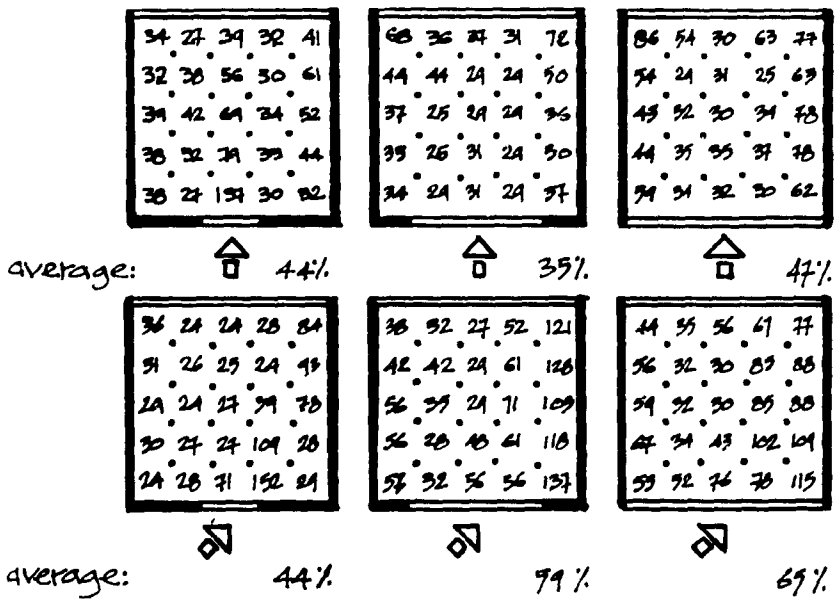


Fig. 46 Effect of wind direction on air velocity distribution. After: Givoni, 1969.

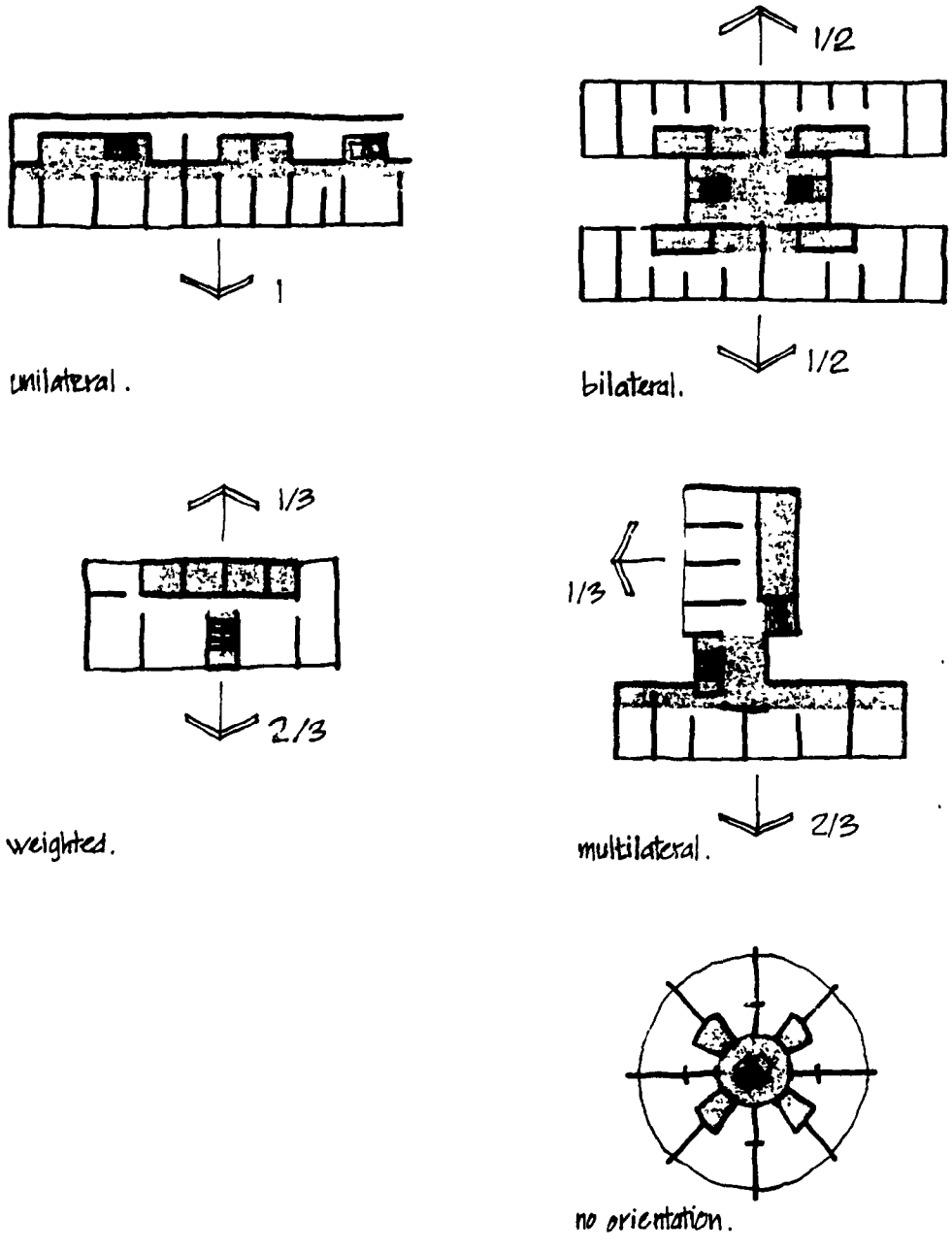


Fig. 47 Building shapes with directional orientation.

21. WATER AND VEGETATION

In the desert climate with extremely high temperature and abandons of water and vegetation, the living environment could be unbearable.

Water and vegetation has always been appreciated by traditional desert communities. They have been used as a main design element in both city planning and within the individual buildings in order to modify their microclimate. Water and vegetation have been used not only for their improvement of physical comfort conditions, but also for their contribution to the mental and visual delight. In the Middle East, water and vegetation have been used to create an image of paradise where the description of paradise includes a steam of water flowing beneath a prosperous garden.

The early generations obviously realized the value of water as a cooling medium, and modern science has confirmed their faith. The importance of water is undoubtable for two reasons: First, water improves physical comfort by the evaporation process; which increases the relative humidity and decreases the dry bulb temperature of the surrounding air, a process which is greatly assisted by air movement. Second, water brings pleasure to us, whether it is a visual pleasure, by just looking at a pool of water or spring of water; or the pleasure of hearing the sound of water falls, especially where water is considered to be a very precious thing.

The effect of water cooling depends to a great extent upon: the area of water in contact with the air; the relative velocity of the water and the air during the contact; and the difference between the initial water temperature and the air wet bulb temperature. From the above, the spray pond is more effective than a still pool of the same size, because it is exposed to a greater vertical cross section of air and is in constant movement and circulation (Fig. 48). However, the spray pond consumes more water than the still pond does. On the other hand, in order to achieve the same efficiency in still pond, a considerably large surface will be required (Fig. 49). Further

improvement could be obtained by careful design and location of water in accordance to the air direction. Traditionally in the Middle East, water was featured in pools, jets or series of tiers.

The use of vegetation is known not only to help the micro-climate of a building, but also to improve the environment as a whole. Researchers in the residential areas of Khartoum showed that, where there are well established gardens, mainly through irrigation from the Nile, the temperature was 2 to 3 degrees cooler than other areas where gardens are almost non-existent because of the absence of irrigation.[92] Therefore, it is not easy to achieve a good level of vegetation in areas where the water supply is perpetually insufficient; but in areas where water the supply is abundant, almost anything can be grown to achieve a satisfactory environment. That explains why in the traditional fabric, the garden, was limited to the individual scale of the courtyard where it is easy to control and maintain.

During the daytime, the highest temperature is found at the boundary between the ground and the air. In other words, temperature increases considerably as one approaches the ground. At night, the reverse is due to the heat loss by evaporation and outgoing radiation. Therefore, the closer one approaches the ground, the more extreme it becomes. Plant and grassy ground cover reduces temperature while city and man made surfaces tend to elevate temperature and reduce humidity. Paved surfaces store up a great deal more heat and remains at hotter temperatures longer than unpaved or grass surfaces (Fig. 50). Moreover, the vegetation helps in reducing the glare within the surrounding environment and reduce glare.[93]

Trees can have a great effect on shading and improving the environment in the arid zones. It is important to keep in mind that the possible effects of trees on foundations, either by the water required to nourish the tree or it's roots. Apart from that, two other arguments against the use of trees are: the time involved before they reach their effective shading height; and the associated high-costs. According to Tandy, the initial high cost of growing trees in hot dry land are due to: (a) the necessity to grow from seeds, (b) the cost of caring or transporting good soil, (c) the cost of

watering, and (d) the necessity to construct tree guards. On the other hand, once the tree is established to a height of 3.00 to 4.50 meters, it becomes a naturally efficient shading element completely free of maintenance costs.[94]

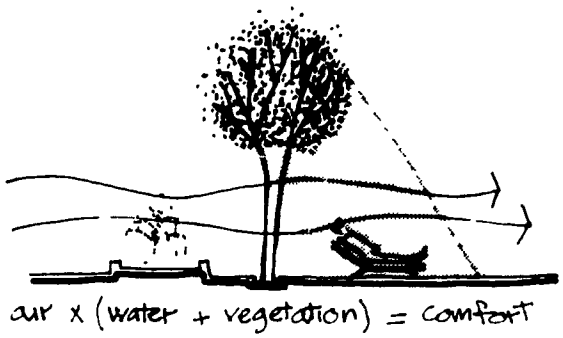
The quality of shade given by trees depends upon their shape, height and spread. Dense foliage, for instance, will provide solid shade, while open foliage will give dappled shade. About the effect of shade Kally and Ittner found that radiation was reduced by up to 63 percent under solid shade, and 55 percent under dappled shade. Furthermore, they found that the temperature of above ground was reduced by as much as 22.2^{O}C in five minutes after the arrival of the shadow line.[95] Climbing and ascending vines function as solar control devices where they reduce solar radiation and insulate the wall behind them. In order to improve the green insulated blanket, it is a good practice to set a trellis 10-20 cm away from the wall (Fig. 51).

The landscape surrounding the building can have a great effect on the temperature in and around that building, this can be seen clearly in (Fig. 52). By daytime, the air should enter the building through shaded areas without passing over or through heated surfaces, in this respect vegetation can play an important role (Fig. 53). On the other hand, the size and position of trees and shrubs around the building have a remarkable effect on air movement over and around low rise buildings (Fig. 54).[96]

The role of plants as nature's soil protector is obvious, they help stabilization and assist in reclamation of eroded areas without the rise in the temperature accompanied by using an artificial surface. In addition to the plants and trees great value in binding loose earth, they are of ample value in generally lowering the dust and sand particles in the habitable outdoor space. This is true particularly when carefully planted with the rest of the urban environment and not as later haphazard visual fill-ins.[97]

In summary, trees, shrubs, ground covers, vines, and turf have a great advantage in improving the micro climate and environment in hot arid zones. Such advantages are: (a) reducing direct and reflect radiation, (b) absorbing heat, (c)

helping to lower the surrounding temperature by evaporative cooling as a result of transpiration, (d) acting as a buffer agent to abrupt temperature changes, (e) reducing and filling dust; (f) helping to control the wind speed and air flow, and (g) reducing glare in the surrounding environment.



In all building design an oasis effect should be created through the combination of water and vegetation, in order to create favorable microclimate which is also a visual delight. In locating water and vegetation one should keep in mind the air flow direction and the building orientation.

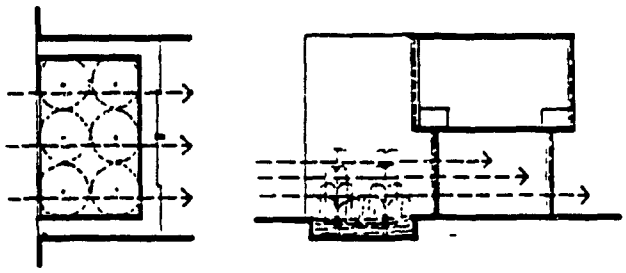


Fig. 48 Air passing over water sprays is cooled and cleaned before entering the building.

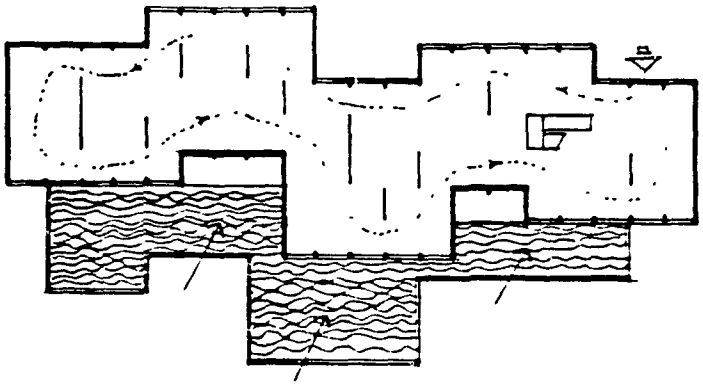


Fig. 49 Large pool of water along the facade on the prevailing windward. (Mohenjo-Daro Museum, Pakistan).

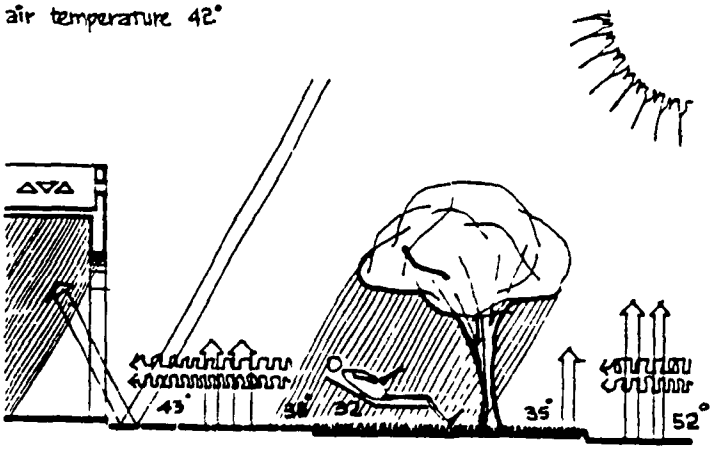


Fig. 50 Ground surfaces temperatures around the building. After: Konya, 1980, p. 35.

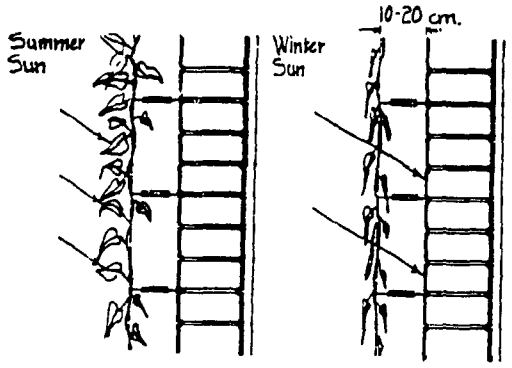


Fig. 51 Climbing and ascending vines reduce solar radition and serve as insulators.

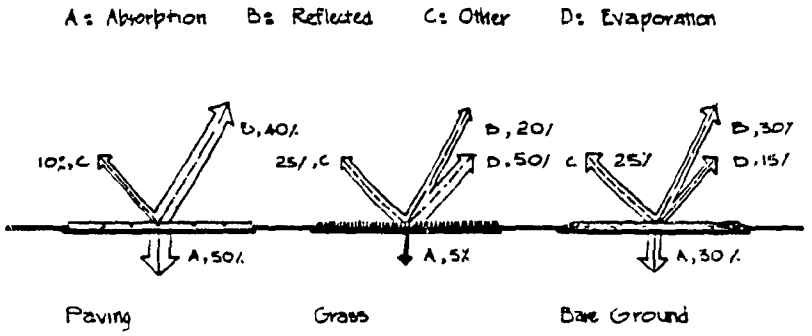


Fig. 52 Thermal behaviour of different surface material. After: Konya, 1980, p. 35.

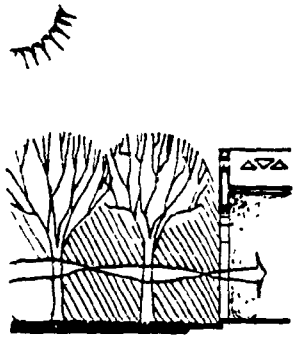


Fig. 53 Air is cooled by passing through shaded vegetation area.

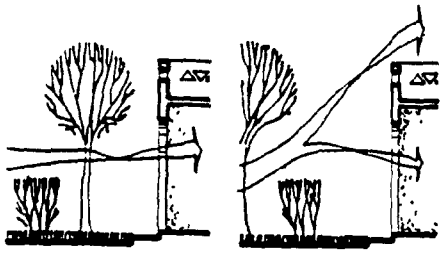


Fig. 54 Vegetation effect on airflow patterns.

22. OPENINGS:

To avoid causing any dicomfort to the inhabitant, building openings should be designed to meet their basic functions in the hot climate.

A well designed opening can have a great effect in the quality of the inner environment, the psychological and the physiological comfort of the occupants. The openings design depends to a great extent upon the function served and the climatic conditions. Mainly openings perform the following functions: (a) provision of daylight, (b) provision of view and visual contact with the outdoors; (c) provision of natural ventilation for physiological comfort and structural cooling; and (d) provision of protection against external climatic conditions.

In hot desert zones, windows tend to raise the indoor daytime temperature, the larger the window the greater is the heating effect. Since it is technically difficult which have openings with massive shutters that have a high thermal capacity to have the same effect as walls, it is recommended to use shutters with high thermal resistance such as heavy shutters made of wood. A traditional solution which responds to the previous statement is the use of 'Mashrabiya'. This is an oriel window covered with wooden lattice work, which is usually used in conjunction with a second window located immediately above it (Fig. 55). The second high window in the 'mashrabiya' works to prevent the unwanted sun ray to penetrate in the summer and at the same time allow the favorable winter sun. Another function for the use of the second window is to allow for air circulation by helping the hot air to escape at a higher level and be replaced by cooler air coming through the 'mashrabiya' especially if it is provided with devices such as a porous pot filled with drinking water, where the air and the jar are cooled by evaporation as the hot air touches the water seeping through the wall of the pot.

The combination use of wooden shutters, that have a high thermal resistance, with glazed windows can have a great effect. When both are closed during the over-

heated period of the day, they will minimize heat transmission. When the wooden shutter is closed and glass is opened during the moderate period of the day, the cool breeze will get in while the opening is protected against the sun; and at night both can be opened to allow for maximum cooling.

The fact that glazed area in summer permits the progressive build-up of long-wave energy inside a room, thus giving rise to what is known as the "greenhouse effect" makes it important to keep the glassed areas to a minimum. This requirement is compatible with adequate natural light requirements. A study by T.S. Rogers in his book "Thermal Design of Buildings", comparing the operation costs of cooling and heating in three identical buildings, but with different glass-to-wall ratios, concluded that the one with the least glass area would cost the least for heating and cooling plants and annual operation expenses. Glass has a low insulation value, which makes it very vulnerable to the flow of heat through it from one side to the other. This was illustrated by Olgyay (Fig. 56) that heat transmission through glazing where 30 times as much as lightly painted insulate timber framed walls when they were exposed to the western sun, and as much as 13 times in the shade facing the same direction. A glass area as low as one-sixteenth of the floor area of the room, as recommended by the Building Research Station in the UK, should be adequate for normal residential buildings. Glass specifications can be improved by incorporating certain iron compounds during the manufacturing process, which makes it absorb some of the short wave energy falling on it, reducing the incoming radiation intensity. On the other hand, this effect is limited because their own temperature is raised, which in turn causes an increase in the heat converted and re-radiated into the room (Fig. 57). Further improvement could be reached by the use of double glazing with the outer layer made of reflective heat-intercepting plate glass.[98]

Shading devices can be used to provide shading to the window. In general there are three main types of shading devices; vertical devices used when the sun is at one side of the elevation, such as eastern and western elevations; horizontal devices used when the sun is opposite to the building, such as southern elevations; egg-crate

devices which combines the horizontal and vertical elements and can be effective in any orientation (Fig. 58). The use of heavy material in building the shading devices can dramatically reduce their effectiveness. This painfully demonstrated in the capital complex building in Chandigarh, India, which stores up heat during the day, and after sunset steadily warms the cooler night air on its way into the interior of the building, giving it no opportunity to cool down (Fig. 59). Therefore, it is preferable to use shading devices made of thin light materials with white or light color.

In the hot climate another problem appears, how to prevent glare form the sky and surrounding environment without blocking the daylight. A traditional solution for this problem is to keep windows on the external elevation small and few in numbers, and to have large windows opening into the shaded internal courtyard. The use of wooden screens 'mashrabiya' were used to reduce the sharp contrast between the bright opening and the surrounding inside wall surface (Fig. 60). In general, it is encouraged to use small openings allowing indirect daylight to get in. Louis Khan's in his work in Angola, inspired by the local people, came to the conclusion that every window should have a free wall to face. This wall will modify glare and defuse light without blocking the view (Fig. 61).

In general the openings should be kept to the minimum, in order to be able to protect against heat radiation and glare, but not less than 1/16 of the floor area. Glazed openings should be provided with a high thermal resistance layer, such as wooden shutters, to improve their thermal behaviour. Shading devices should have a low thermal capacity and light color, in order not to heat the cold air that is flowing to the interior.

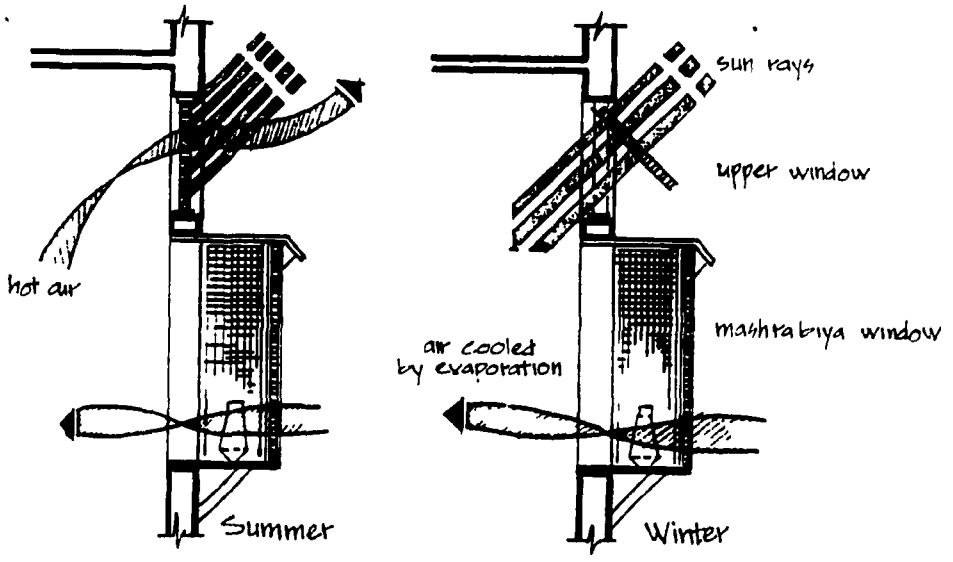


Fig. 55 The "Mashrabiya" and the upper window uses.

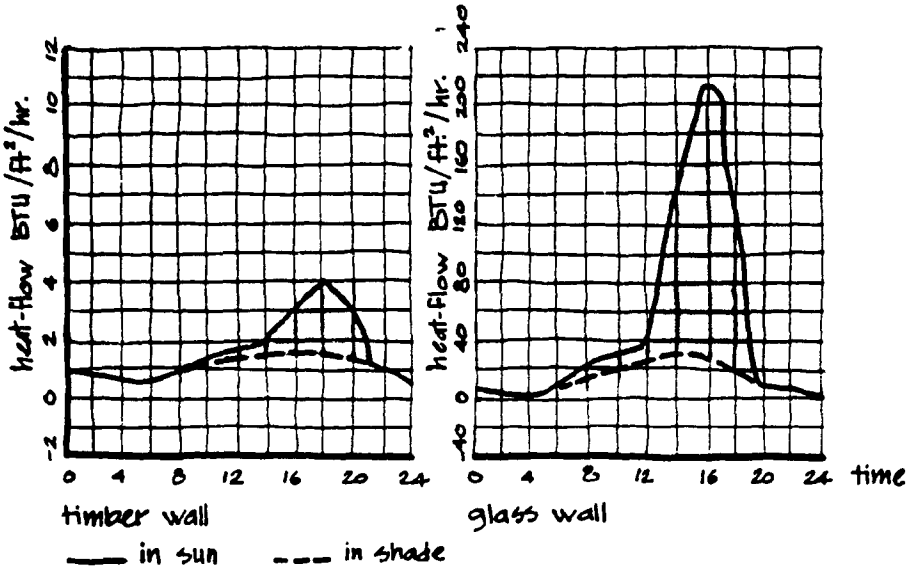
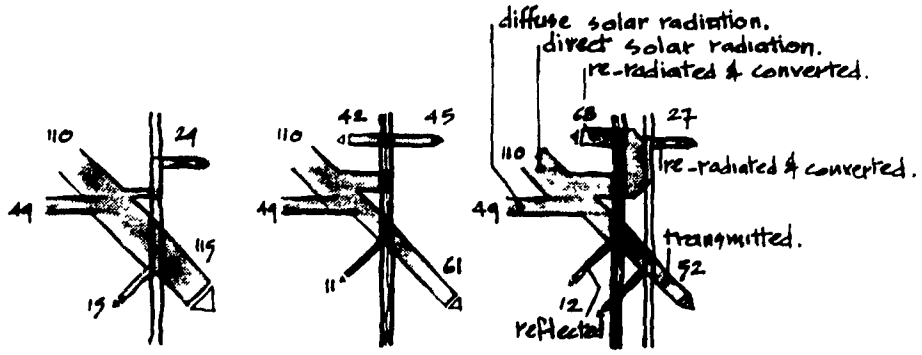


Fig. 56 Heat transmission through a light painted insulated timber wall and a glass pane.
After: Olgyay, 1963.



	regular glass	heat-intercepting glass	combination of both	
total admitted	144	106	79	BTU/ft²/hr.
total light transmitted	88%	70%	48%	

Fig. 57 Heat transfer through glass.
After: Saini, 1980, p. 45.

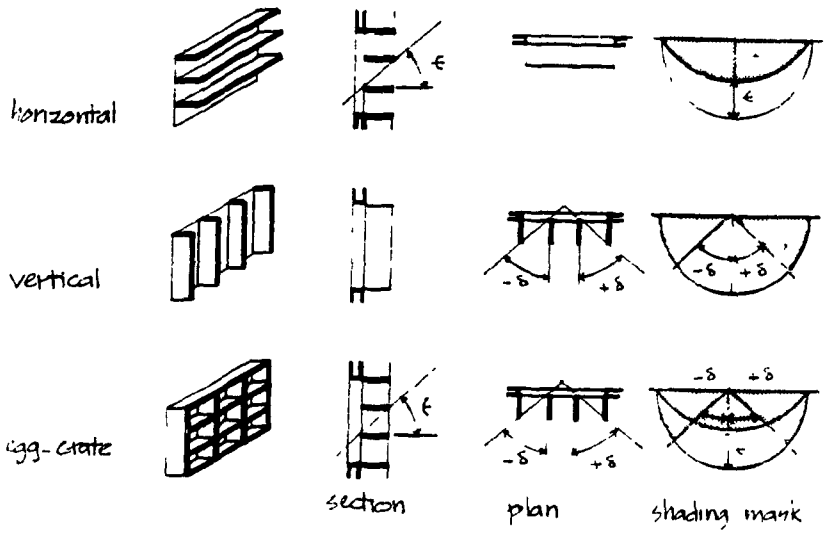


Fig. 58 Basic shading devices with their typical shading masks.

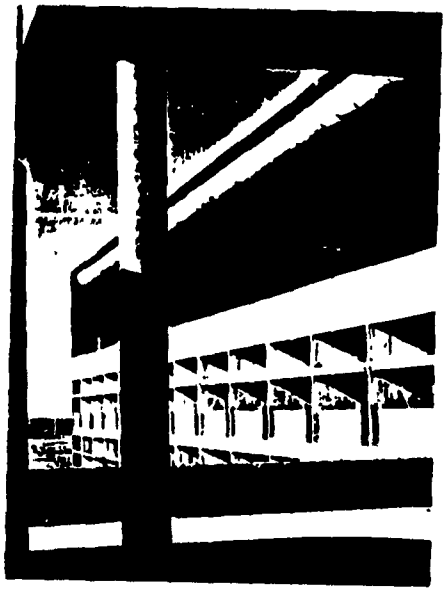


Fig. 59 The Capital complex building, Chandigarh, India.

Fig. 60 The "Mashrabiya" effect on reduction of glare in interior spaces.

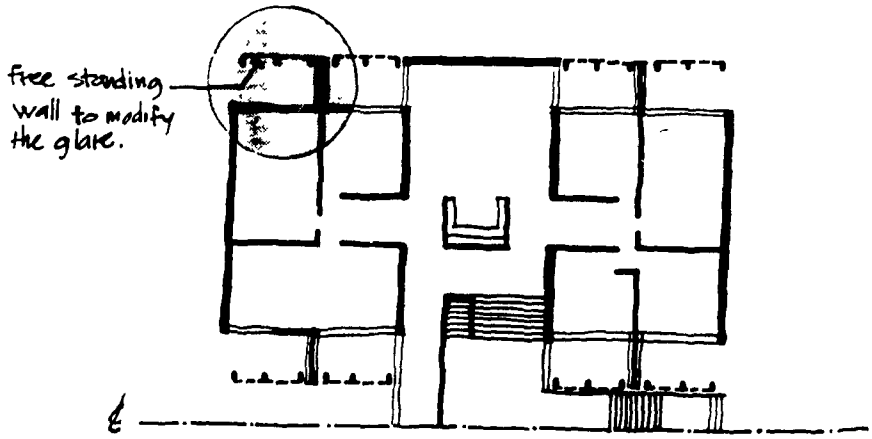


Fig. 61 Louis Khan solution for the glare problem, in Chancellery building for Luanda, Angola.

23. WALLS

In the hot arid regions, shaded areas are not enough to provide people with comfort and protection, especially on hot summer days.

Traditional buildings in the Middle Eastern arid climate are built of high-mass structures, which contain thick walls made of heavy and dense materials such as stone, brick, adobe, mud, etc. The heavy and thick walls are able to overcome the large external diurnal variation in temperature and stabilize the indoor temperature. This is due to the high thermal capacity and the insulation value of the heavy thick walls, which absorb much of the heat falling on it at day time during the overheated period. The wall re-radiated the heat at night during the underheated period and made the indoor warm during the cool desert nights. In other words, the wall should provide enough time-lag to make people comfortable inside and to stabilize the indoor temperature (Fig. 62).

The effect of insulation and thermal (heat-storage) capacity is best explained through the work of S.J. Richards in Pretoria, South Africa, where a series of measurements were taken for overall heat transmission co-efficients (U-value) and the time-lag for common building materials. His findings indicated that heavy and massive construction, generally offer fairly good U-values and a greater time-lag. Therefore, are able to absorb large quantities of heat without a marked rise in temperature; hence, their controlling influence on the indoor micro-climate is better (Table .2).[99] As a result, massive buildings can be relatively cool during the daytime. Van Stranten has graphically illustrated the performance of heavy-weight and light-weight structures in terms of indoor air temperature under typical warm weather conditions (Fig. 63).[100] Another test that had been made by Victor Olgyay compares the behavior of two structures, having the same U-value of 1.5W/m^{2o}C, a light-weight timber structure having 92-hour time-lag and 22.9 cm. brick structure with time-lag of 10 hours. The observation show that although the total heat transmission is the same for both, the

light-weight structure transmitted 475.3KJ through its wall surface from 7 am to 7 pm., while the heavy-weight structure transmitted only 349.6 KJ during the same period. (Fig. 64).[101]

The heavy-thick wall, has its disadvantages, especially in multi-story building where weight critically affects the design of the structure and the cost. Therefore, it is reasonable to look at the performance of a cavity-wall or the combination of insulation and heavy-weight material. In the case of composite walls, the high heat capacity materials should be enveloped by a layer of a high thermal resistant material. Such a combination can provide a much longer time-lag than if the insulation is placed on the inside of the massive layer. At night and because of the outer layer of insulation material, the heat flow from the heavy wall to the outdoor will be restricted; therefore, a good ventilation pattern is important at night in order not to make this structure much warmer at night than the simple solid wall one.[102]

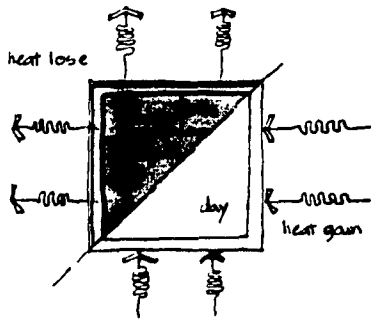
A comparison study, done by Kuba at the University of Khartoum, between two mud walls having the thickness of three half brick modules, one was solid, and the second had a cavity in the middle module. He found that the maximum inner surface temperature of the cavity wall is always higher by two or three degrees centigrade than that of the solid one. This was due to the high rate of heat exchange by radiation across the cavity. Hence, the advantage of the cavity wall over solid wall is it's light weight and fast cooling process at night.[103]

Experiments were also made with the ventilation of a cavity wall, results show that ventilationi will produce little or no improvement to the thermal performance of the cavity wall. Kuba came to the conclusion that theoretically an ideal external wall (Fig. 65) would involve a double leaf construction in which the outer leaf would have a low absorbtivity for solar and long wave radiation, and high resistance against inward flow of heat and low heat storage capacity. The inner leaf would have a rapid cooling ability and large heat storage capacity. A reflective membrane across the cavity would be suitable to reduce heat transfer from the hot outer leaf to the inner cold leaf. He

also suggested that the external surface of the wall should be a low absorption material such as white line wash coating.

Surface treatment and the selection of surface material will have a great impact on the thermal behavior of the building. Light colored or shiny external surfaces will reflect a large part of the incident solar radiation. Thus, much less heat will actually enter the building fabric. Experiments done by Kuba indicated that a surface having several coats of white line wash maintains a temperature lower than shaded air temperature, most of the day.

Apart from the thermal benefit of light colored buildings, they intensify the environmental glare. This problem can be solved by the careful design of some building elements and by the selective choice of colors for different parts of the buildings. A variety of elements can be projected from the building walls, and in order for these elements to reduce glare without adding to the thermal load of the building, it is recommended to have minimum contact with the building envelop and to use a light weight building material, such as wood. Such projection can have darker colors without a great increase in the heat load, thus reducing the glare significantly while casting shade on the walls behind them, which all together will improve the visual variety of the environment.[104]



All external walls should be built out of heavy and massive structures, that have high thermal capacity, in order to provide a long time-lag. At the same time it is preferable to have a light colored external surfaces. It is possible to reduce the walls thickness, without affecting its performance, by adding light weight insulation materials to the external side; consequently a good ventilation system at night time will be important.

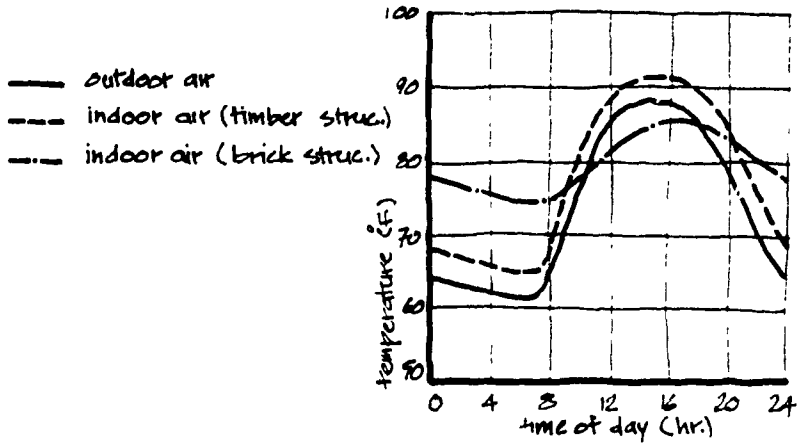


Fig. 62 Comparison of indoor air temperature of similar brick and timber structures.
After: Saini, 1980, p. 41

material	U-value (BTU/ft²·hr·°F)	U-value (W/m²·°C)	Time-lag (hours)
Stone, 12 in (30.9 cm) thick	0.55	3.1	7.0
Solid concrete, 6 in (15.2 cm) thick	0.74	4.2	3.8
Solid concrete, 12 in (30.5 cm) thick	0.54	3.0	7.8
Common brick, 4 in (10.2 cm) thick	0.60	3.4	2.3
Wood, 2 in (7.1 cm.) thick	0.30	1.7	1.5

Table 2. Overall heat transmission co-efficient and time-lag characteristic data for homogeneous walls
After: Saini, 1980, p. 41.

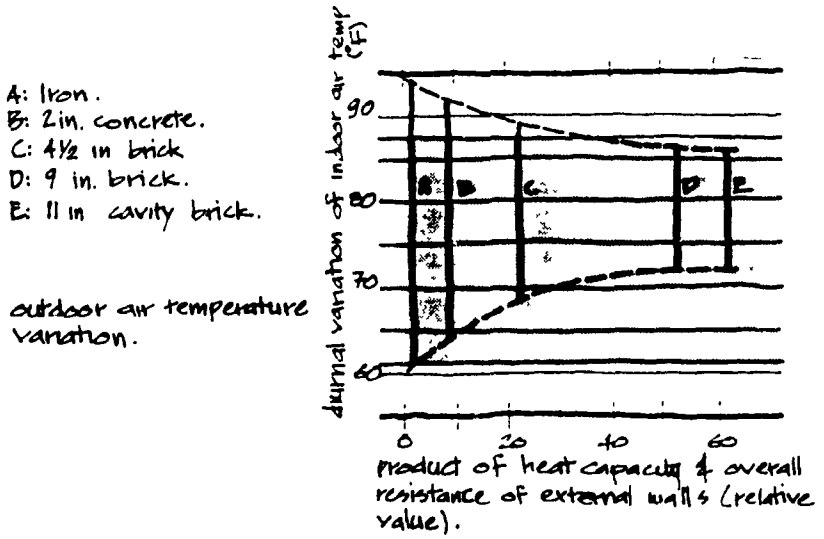


Fig. 63 Combined effect of heat capacity and resistance of external walls on indoor air temperature.
After: Saini, 1980, p. 41.

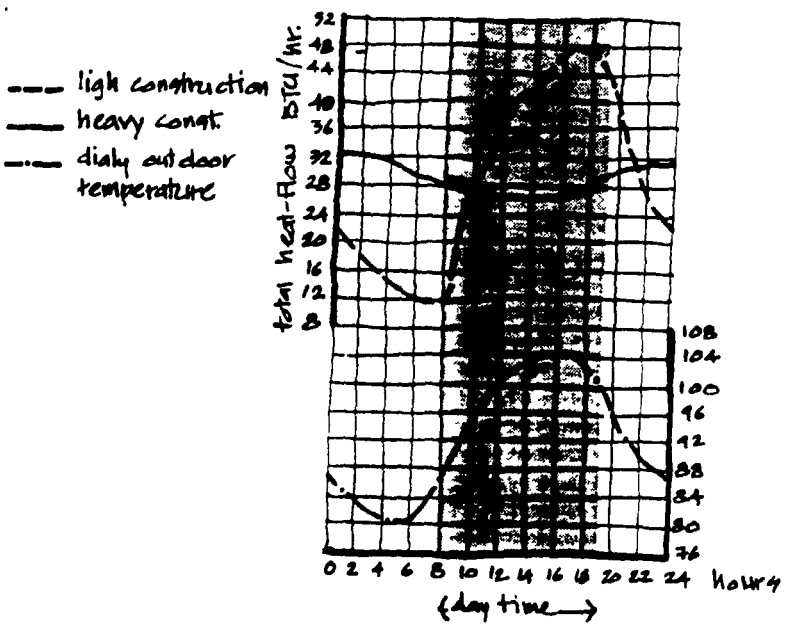


Fig. 64 Thermal behavior comparison of heavy and light construction, in Iraq during the month of July.
After: Olgyay, 1963.

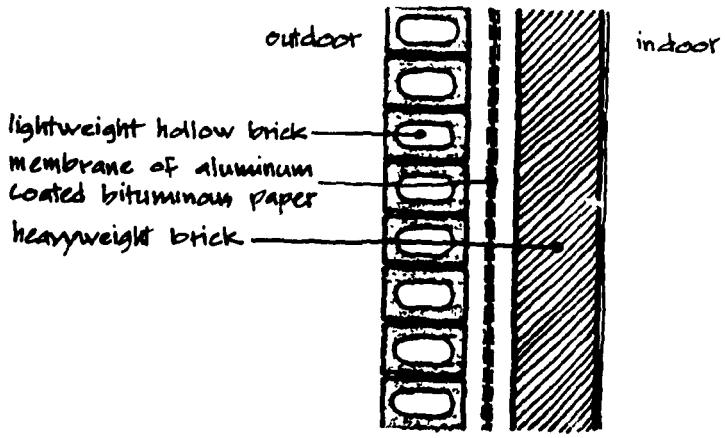


Fig. 65 Suggested external wall construction for naturally controlled indoor environment.
After: Danby, 1973, p. 63.

24. ROOF:

The fact that the largest amount of solar heat is received by the roof surface, makes it very important to give special attention and care to the roof of a given building.

An experiment done at the University of Khartoum showed that the amount of solar heat received by the flat roof is only 26 percent less than the total of all four elevations in the case of a cube.[105] The color and nature of the external roof surface determine the amount of short-wave solar radiation absorbed into the roof structure during the daytime, and the amount of long wave re-radiation emitted by the roof structure into the internal the space at night time. Which in return effects: the external and internal roof temperature; and the room air temperature. This is best explained by the diagram prepared by J.I. Yellott which shows the solar radiation absorbency and the thermal emissivity for various types of surfaces (Fig. 66).[106]

From the above observation one can see the advantage of the white colored surfaces, where they have a low solar radiation absorbency and high emissivity; which enables them to cool down at night far more rapidly than any shiny surface. An experiment done by B. Givoni on a light weight horizontal panel illustrates the effect of color on the external surface temperature (Fig. 67). It can be seen that the surface temperature of a dark grey exterior, was raised 52^{O} C above the maximum air temperature, while the surface temperature of a white washed exterior was raised only 1^{O}C above maximum air temperature.[107]

On the other hand, the white paints or light colored finishes, such as white washes, don't retain their properties, as determined in laboratory tests due to the dust and other climatic effect. Another disadvantage of light colors and shiny metals is the fact that they can create a glare problem in the vicinity.

An experimental research done on a full scale building by Givoni & Sholon showed that in houses with white wash roofs, the ceiling temperatures were lower

than those of the room upper air layer and the room's air during most of the day, implying a flow of heat from the room into the roof. In this instance, the roof acted as a cooling element for the building, and that is because the average external surface temperature of the whitewashed roof is lower than the outdoor air average.[108]

Massive and heavy weight roofs introduce a good time-lag and a diminution in the rate of heat transfer that is due to their high heat storage capacity and thermal resistance. The extent of the time-lag depends very much upon the thickness of the slab (Table 3). A traditional method which is commonly used in the Middle East is to cover the slab with a layer of earth, a material which has a considerable capacity for heat storage. It has been found that 10.2 cm mud when used over a 10.2 cm thick concrete slab can reduce the ceiling temperature by $10^{O}C$ (Fig. 68).[109]

Providing the roof with the extra layer of light-weight insulation material can have a great influence on increasing the time-lag of the roof. Even if it is applied to a normal light-weight roof, where a massive roof construction can be impractical and uneconomical. Most observers seem to agree that insulation material is far better when it is located above the roof structure, than when it is located below the roof structure to the ceiling. In other words, the ceiling temperature and the maximum heat flow to the interior are lower when insulation layer is external. On the other hand, the advantage of increased thickness of mass insulation becomes progressively small as the thickness increases.[110]

Shading the whole roof appears to be the most effective means to reduce the heat load. It is important in this case that the upper layer of the roof have a low heat storage capacity, otherwise the heat will be transferred by radiation. At the same time, researchers indicate that the natural ventilation of roof-ceiling space has no effect in the summer on temperatures indoors.[111]

Where water is available, evaporative cooling can be applied to the flat roof to prevent heating of the flat roof. This can be done either by the methods of ponds or jet sprays. The last is preferable because it saves in water and reduces the load, caused by the body of pools, on the roof. The same idea can be found in an old

Egyptian practice, which is still common until now, where they used to sprinkle water over the pavement resulting in evaporative cooling. A system patented by Harold Hay (the Skytherm Roof Pond) consists of water-filled polythene bags placed on the roof and a movable covering of 50 mm thick polyurethane insulating panels. In winter, these panels are left open during the day to allow solar radiation to be absorbed and re-radiated into the building; at night the panel is closed to conserve the heat. In summer the process is reversed with the panels being closed during the day to insulate the bags from solar radiation and allow heat to be drawn from inside; while at night they are left open to allow the water to radiate heat to the night sky (Fig. 69).[112]

In the traditional architecture of the Middle East, arched roofs, such as dome and vaults where commonly used. These shapes help to a great extent in reducing the amount of heat gain by the roof, since they create self shaded areas (Fig. 70) which means shorter exposure time to the heat radiation.

As a basic rule, roof should be built out of heavy weight materials, with a light colored surface in order for them to provide a good time-lag. Other ways to improve the roof thermal behavior are: the use of insulation materials, especially below the roof level; the use of water pond and jet spray for vaporation cooling; shading parts of the roof where they can also be used as seating areas; and finally the use of curved surfaces for their self-shaded areas.

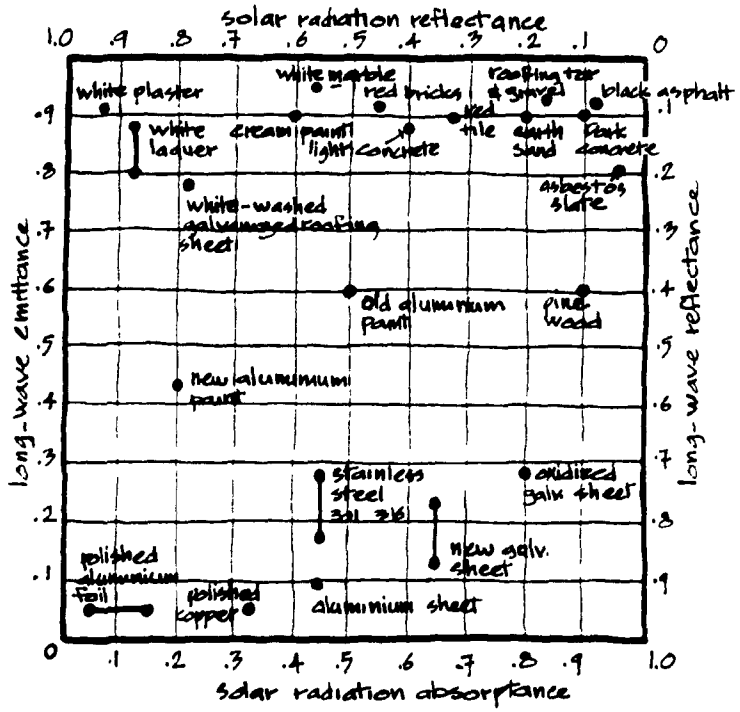


Fig. 66 Solar radition absorbency and long-wave emissivity for various types of surfaces.
After: Yellott, 1966.

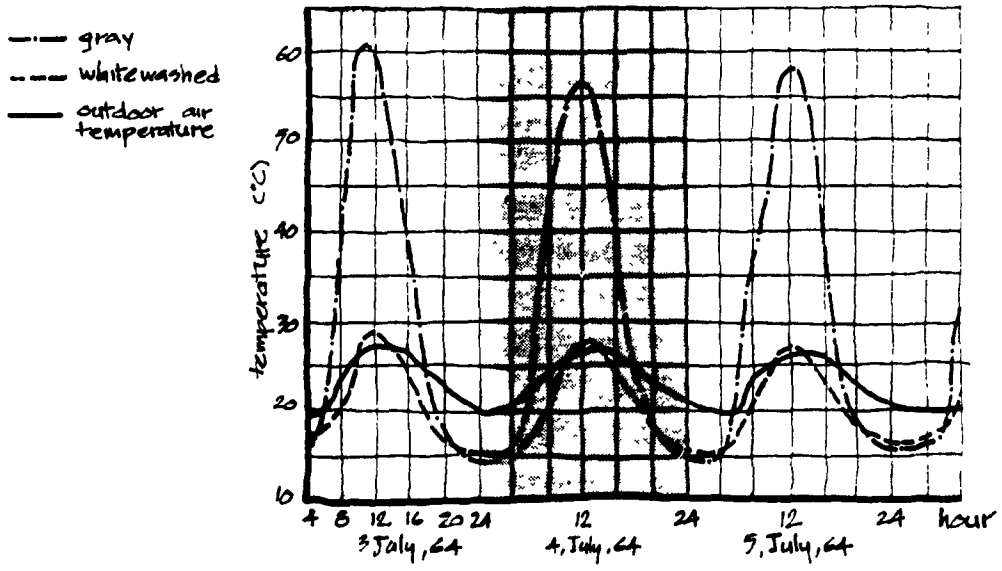


Fig. 67 External surface temperature for gray and white washed panels.
After: Civoni & Hoffman, 1973, p. 527.

	concrete thickness 2in 5.1 cm.		4in. 20.2 cm.		8in. 20.3 cm.		hollow tile* 8in 20.3 cm.	
	maximum temperature °F	°C	°F	°C	°F	°C	°F	°C
upper surface	121	44.4	104	40.0	101	38.3	99.5	37.5
lower surface	115	46.1	97.9	36.4	84	28.0	88	31.1
mean temp.	116	46.7	99.9	36.9	88	90.1	90	32.2
time lag	1 hr.	25 min.	2 hr.	30 min.	6 hr.	0 min.	5 hr.	0. min.

maximum shade temperature 80°F (26.7 °C)
* 4 3/4 in. (12.07 cm.) clay tile, with 3/4 in (3.26 cm.) concrete screen.

Table 3. Temperature attained by concrete roof slabs
After: Saini , 1980, p. 52.

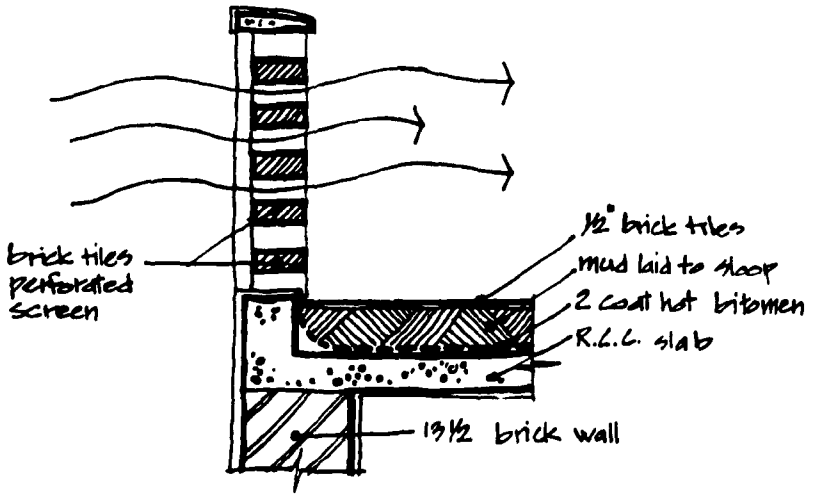


Fig. 68 Roof detail showing the use of mud layers.

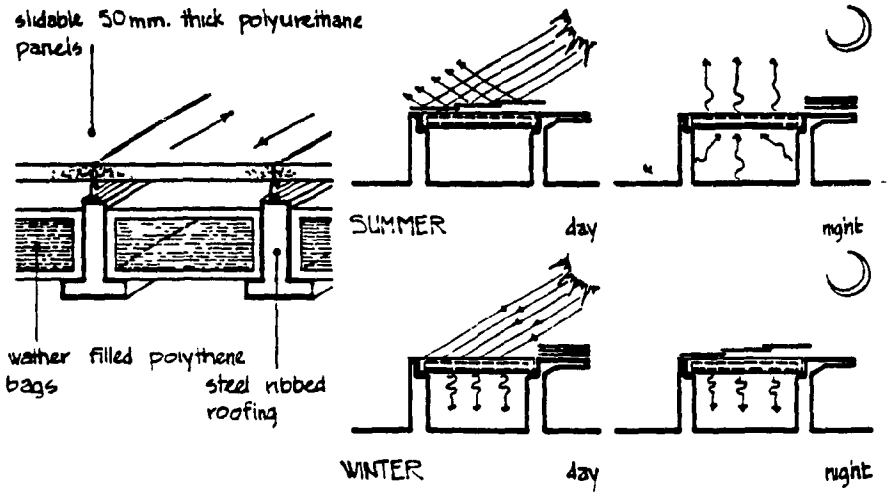


Fig. 69 Harold Hay's skytherm system.
After: Konya, 1980, p. 98.

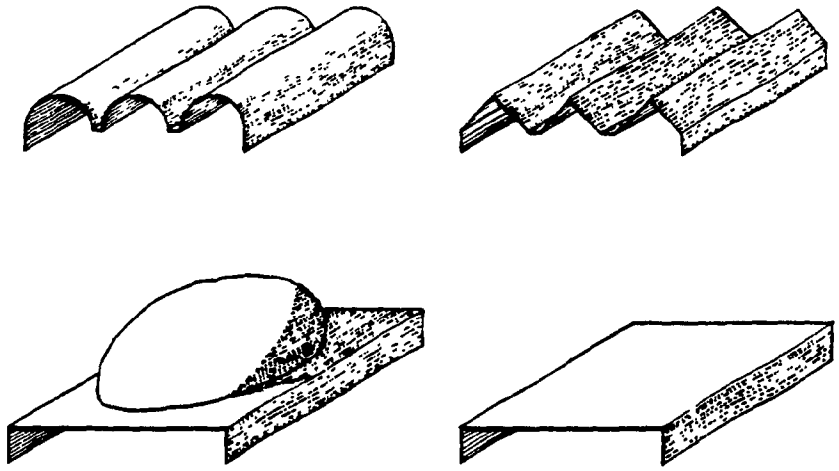


Fig. 70 The effect of the roof shape on the extent of shaded areas.

CONCLUSION

CONCLUSION

This thesis has presented a personal attempt to create design criteria for the Middle East. The criteria deal with issues that are specific to the Middle East area and which serve the special requirements and needs of its people. These criteria are intended to assist architects and urban planners who intend to design future projects for the Middle East.

The goal of the criteria is to set guidelines and recommendations that are important to consider in the designing process. Further studies will have to be done in order to create an ideal environment for the Middle East. An environment that recognizes the social and physical needs of the people who will dwell in it.

It is generally understood that the countries of the Middle East share similar traditions, social values, religious and climatic factors. Yet, in spite of the similarities, differences do exist. In Tunis, most of the inhabitants live in independent single family housing; while in Egypt only the rich live in single family housing while the majority of the population live in apartment buildings. In Saudi Arabia the society is more conservative than the other Middle Eastern countries; where women are not allowed to drive cars or socialize with men. The architect and the urban planner must recognize these obvious differences in their designs as well as many more subtle differences.

The twenty-four criteria that have been presented are general and are intended to be applied to all of the Middle East countries. Sub-criteria will have to be established to resolve specific differences that exist in each country, region and city.

Taken separately these criteria can lead the designer to the resolution of a particular situation. Together, they can generate a model city for the Middle East. This model city would be responsive to the various needs of Middle Eastern society. It can be accomplished by following the recommendations and guidelines that are stated in the body of this research.

We must keep in mind that many of the factors that have influenced the architecture and urban development of the past remain unchanged today. There is a place for modern thinking and technological advancement in the Middle East. But technology must be sensitive to the unique character of the region and be adapted to the values of the inhabitants. This architectural sensitivity will help the people to adopt a positive response to the changes that are certain to occur. They will know that their values have been protected and that their Middle Eastern character will be preserved, with respect for their past and careful thought for their future.

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