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The Art of Building Construction in Al-Alkhalaf Village, Saudi Arabia

Tawfiq M. **Abu-Ghazzeh**

Assistant Professor, College of Architecture and Planning,

King Saud University, Riyadh, Saudi Arabia

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Abstract. This paper illustrates the "Art of Building" in Al-Alkhalaf settlement in **Asir** region, Saudi Arabia. Here, people's efforts over the past history of traditional building and village development have produced structures with notable technical, functional and environmental qualities. Social norms and cultural values of people in this village along with the inherited traditions of building have produced "A Pattern Language" with its related components and systems of arrangement visible through Al-Alkhalaf built form.

The paper concludes that with respect to modem standards of scale, amenity, safety and permanence, the accomplishments of vernacular architecture can mainly serve to merit our study for its principles, not its froms. A basic re-orientation of the architectural curricula of schools of architecture in Saudi Arabia is necessary in order to introduce architectural students to the inherent viability of preindustrial theory and practice. Reconciling the past with the challenges of the present is necessary within which contemporary architecture of Saudi Arabia can be created.

Introduction

Recent economic growth of Saudi Arabia has led to the loss of major works of architecture and archaeological remains, which have been submerged under an overwhelming wave of modernization. Entire quarters of ancient towns have been wiped out and many buildings of historical significance have been destroyed or largely transformed. In parallel, a number of modern building materials, forms, and construction techniques have been imported and used in the construction of newly-built projects of various types and uses. Many of such materials are used thoughtlessly, without due

attention to their characteristics. Contrary to the conscious use of building materials in vernacular (traditional)* [1] buildings of this country, both modern builders and designers did not fully understand characteristics and the appropriate use of modern building materials and imported building techniques.

Ozkan, *et al.* [2] observes that while the merits of vernacular architecture may provide as inspiration for some professionally successful practice, lessons that man can learn from varnacular architecture are numerous. They include, among other things: human-nature dialogue, in terms of built environment as a language and means; response to environmental factors; limitations of materials; culture and technology as a tool in construction; building activity with respect to social relations. Since the term "Vernacular Architecture" refers to both living and non-living environments in specific cultural and environmental conditions of existence, it broadens the scope of architecture beyond function and aesthetics. As a result, analyses of vernacular architectural examples serve to raise questions pertaining to the contemporary practice of building. It leads to concerns of what needs to be done to promote building activity which is responsive to human and societal needs. Eventually this functions not only to create theory, but to combine theoretical knowledge with practice [2].

Vernacular (traditional) architecture is an aspect of culture which mediates between man and his environment. It therefore has an ecological as well as a social and a cultural distinction [3, p. 1]. Faced with the limited choice of natural building materials and techniques, builders of vernacular architecture in many societies had, for hundreds of years, to rely on given strategems in building activities to fulfill human needs, and to maximize the comfort of the internal environment. Functional, environmental, and technical qualities of indigenous buildings have long served users' basic requirements. The performance of many traditional buildings, still functioning today, is satisfactory even when judged in the light of modern technology [4, pp. 215-32].

Several researchers concerned with the study of vernacular buildings have introduced various methods, definitions, and interpretations to explain vernacular architecture [5]. Anthropologists, social scientists, architects, and others in related fields have long used the techniques of architectural representation of dwellings, based on the documentation of structural and morphological details, for the description of traditional buildings as significant elements of traditional culture [6-9]. Architects, archaeologists and folklorists, including Brunskill [10] and Glassi [11]

* For the purposes of this paper the term "traditional" is used synonymously with "vernacular" to refer to building entirely through the use of local indigenous methods and materials. For a clarifying discussion of this interpretation see Meta Turan (ed.) [1].

have used the morphological approach to investigate the geometrical and compositional rules, building materials, and construction techniques that can be attributed to the organization of vernacular buildings' physical components. While this approach may include anthropological information, it serves to explain mathematical and constructional data. However, as Hokings [12] observes, "vernacular solutions are seen not so much as objective solutions to universal structural and constructional problems as they are examples of local building technology in tune with the immediate environment".

Resisting both an obsession with optimized technology and a nostalgic historicism, a recent approach known as "critical regionalism" has suggested a design strategy for housing that will include a paraphrasing of traditions, meaning free rendering and amplification of architectural motifs such that the essence of an original source is maintained while the vocabulary and expression are new, with particular emphasis on the characteristics of places [13]. Kenneth Frampton [14, pp. 16-29] has spelled this attitude as "an architecture which distances itself quite equally from the enlightenment myth of progress and from a reactionary, unrealistic impulse to return to the architectonic forms of the pre-industrial past".

Rudofsky [15] argues that there is much to learn from traditional architecture, before building has become an expert's art. While the beauty of vernacular architecture has long been dismissed as accidental, investigation of the art of building in many settings, including our own, reveals that indigenous architecture is the result of rare good sense in the handling of practical problems. Rudofsky [15, p. 4] continues to explain: "above all, it is the 'humaneness' of this architecture that ought to bring forth some response in us". In vernacular societies, man's effort to perfect the making of artifacts has demonstrated a remarkable human ingenuity. Franz Boas [16, p. 101] has pointed out that "when the technical treatment has attained a certain standard of excellence, when the control of processes involved is such that certain (similar) forms are produced, we call the process an art". Human concern to investigate vernacular architecture in a specific setting, in this context, can be a quest for survival of building arts. Modern man, for all his impressive knowledge and technological apparatus, often builds comparably less well than did his primitive predecessors. A central reason for his failure lies in his buildings, and consistent overestimation of his own technological capacities [17, pp. 261-70].

We are not advocating to eliminate the role of contemporary professionals in the construction practice, but to raise the educational standards of the profession so that architects and builders alike will appreciate the underlying principles of building in harmony with nature, society and individual user or client. Bozkurt Guvene [18, pp. 296-297] observes that "by rediscovering, learning and teaching the vernacular principles, architects may vernacularize their prized services, and thus, have a greater impact on the vernacular itself". She continues to explain that among world popula-

tions, the Japanese have been the pioneers in demonstrating man's wisdom to use the vernacular/-modern tradition. According to Roberts [19], what is known of Japanees architecture - modern or vernacular - is a continuation of the building tradition known to the Japanese as the "shoin-Zukuri". This tradition includes the principles of using natural materials, harmonizing with nature, and being a part of townscape, continuing tradition, familiarizing, that is, evolving instead of revolutionizing, scaling to human proportions, diversifying by using a uniform set of elements and "Kiwari", or proportioning elements to spaces spanned by them. The most significant aspect of Japanese architecture, with or without architects, subscribe to these outlines and principles of construction [19].

Traditional Architecture and the Built Environment in Saudi Arabia

While vernacular buildings of Saudi Arabia reveal careful adaptation of suitable building techniques and technology to the climate and cultural requirements of Saudi society, recent introduction of internationally accepted images of architecture has rendered obsolete much of the folk experience inherited in traditional buildings of the Saudi built environment. Traditional building practices, associated forms and configurations and traditional materials such as adobe were soon viewed by most people as substandard, and the new building technologies as superstandard. A rejection of tradition has resulted with little consideration as to how new technology, building materials and patterns of land use might be adjusted and molded to suit established conventions rooted in the religious principles and social values of Saudi society [20]. This perilous undervaluation of the vernacular architecture has been accompanied by a grossly inflated estimate of the efficiency and economy of industrialized, "hightech" architecture of the developed countries. In discussing the role of Hassan Fathy in the re-interpretation of the traditional enivronment, James Steele [21, p. 36] observes that "one of Hassan Fathy's most important contributions is that he has been one of the first in the Arab world to identify technology as a mixed blessing that can harm a society as well as help it. The basic misunderstanding about him is that far from rejecting technology, he feels that it must be used judiciously in a way that is balanced by human needs [21].

Investigation of the art of building in traditional settlements in our society deems to be necessary to seek ways of understanding the past without accepting a simplistic return to earlier traditions. Roderick Lawrence [22] has pointed out that "in architecture the relationship between space and time is a dialectical process between building form and social factors, between continuity and change, between permanence and tradition". An effort, therefore, is needed to redefine and reaffirm the regional identity of buildings in Saudi traditional human settlements for the purpose of exploring contemporary alternatives to tradition.

In the harsh climate of Arabia, man's struggle for survival has resulted in various forms of traditional architecture. Climatic variations, topography, availability of

building materials, and economic conditions are the main reasons [23]. A notable house form is observed in Al-Alkhalaf human settlement. Built around the mid 17 th century, people in this settlement have found building materials in nature. This along with transportation limitation has determined the type of structures built by the available materials. Environmental conditions, the range and the level of activity of individuals, along with principal life hazards, including the presence of tribal raids [24] required the adaptation of structures to provide inhabitants with necessary protection. Defensive considerations have been influential in the development of this village architecture. Building typology, materials, construction techniques and related decision-making processes, are among issues that have influenced the emergent pattern of built form in Al-Alkhalaf settlement. The quality of the traditional built environment observed in Al-Alkhalaf village is a result of the inherited principles and practices of production that ensured what Alexander [25, p. 19] describes as "a quality without a name" in the built environment. This quality is due, in part, to the nature of traditional settlement development, whereby environments had grown incrementally, over relatively adequate periods of time.

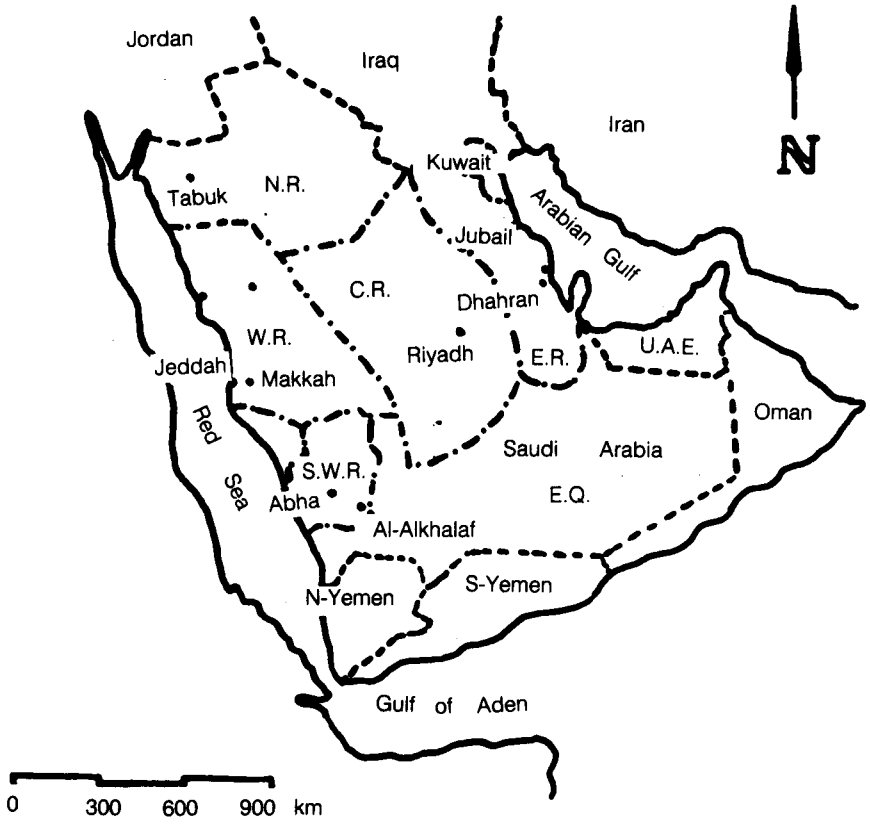
This study aims to investigate the act and the process of traditional building construction in Al-Alkhalaf human settlement. Characteristics of buildings in this village include, among other things, consideration of climate, site, height of building and properties of building materials. The respect of traditional builders for these issues of concern in building practice is worthy of study, since these accept environmental and natural conditions as allies rather than enemies.

Physical Context and Climate

Al-Alkhalaf is located at 2100 m. altitude in Asir (the southwestern region of Saudi Arabia). The later is divided into four zones that are distinguished with various land forms, topography, and different climatic conditions. Extending from the Red Sea coast at the west towards the east direction, these zones are:

The coastal Tihamah, the mountain Tihamah, the Sarat mountains and the mountainous transitional zone leading into the central Arabian platuae, respectively. Al-Alkhalaf settlement is located in the third zone (Fig. 1).

The geological structure of this zone comprises granite basement rocks with a cover of sandstone or basaltie layers. Mountains of this area are often characterized with a tabular form because the sediment structure occur in stratified, almost horizontal, layers over the basement rocks [26, p. 31]. The geological structure of this area has provided inhabitants with natural building materials with adobe and stone being dominant. The standing of Al-Alkhalaf village, three kilometers to the east of the Sarat mountain rift (running north south), is characterized by summer rain storms providing the opportunity for intensive agricultural practices. Mean annual temperature is 18°C with the heighest in July (22°C) and the lowest in January (4°C). Annual



key

N.R. (Northern region)

W.R. (Western region)

C.R. (Central region)

S.W.R. (Southwestern region). Asir

E.R. (Eastern region)

E.Q. (Empty quarter)

Fig. 1. (A) Geographical location of the Al-Alkhalaf human settlement in Saudi Arabia
Source: After *The Kingdom of Saudi Arabia*, 7th Edition, Stacey International, London, 1986.
(All photographs and drawings included in this paper are by the author).

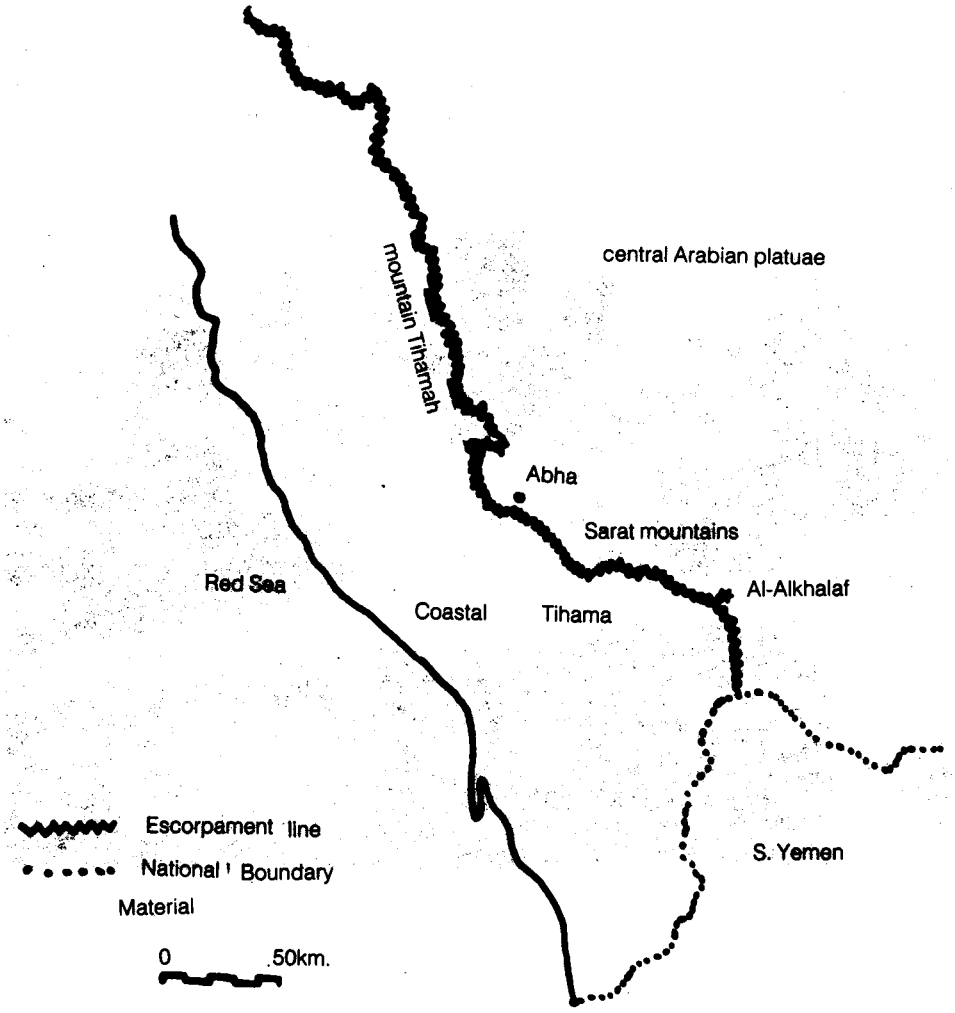


Fig. 1. (B) Position of Al-Alkhalaf human settlement within the context of Asir.

rainfall is 300 mm Summer winds blow from the north, and the main winter winds flow from the south-westerly and westerly directions.

Surrounded with flat and terraced agricultural fields, the village is built on a bedrock site that gently slopes from the southeast to the northwest. Thus, topography and climate have played an important role in the physical formation of both settlements and individual building architecture (Fig. 2).

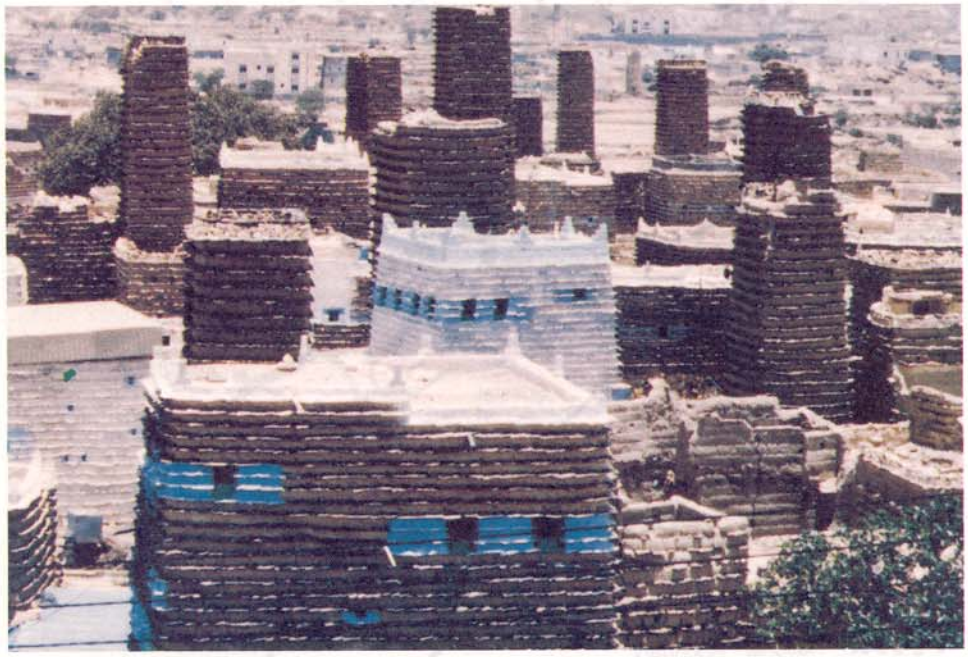


Fig. 2. View of Al-Alkhalaf Village from the South. All photographs included in this paper are by the author.

Climatic Considerations

Human activities, behaviour and feelings are influenced by climate. Comfortable living conditions may result from the combination of temperature, humidity, air movement and air cleanliness. It is also related to man's rate of metabolism and heat production, its rate of transfer to the environment, the resulting physiological adjustments, and clothing. The rate of heat transfer is influenced by environmental factors of air temperature, thermal radiation, air movement and humidity, and by the personal factors of activity and clothing [27, p. 55]. In traditional architecture, climate is an important aspect of the building form generation. This is to be expected under

conditions of poor technology and limited environmental control systems, where man cannot dominate nature but must adapt to it [28].

The Process of Dwelling Unit Planning and Design

Once the building owner hires a builder to construct the structure, the former explains to the later the design requirements by using the local design language which incorporates locally-used traditional elements. They must both agree upon the various aspects of building design and construction. This includes the spatial requirements, the construction details and ornamental features.

Accroding to Suzanne Blier [29, p. 350] "the strength of humans is based on their ability to come together to make decisions and take action for the benefit of the group as a whole". Decisions that relate to the residential building planning and design in Al-Alkhalaf village are often made as a result of debate and consensus between family members, relatives, neighbors and especially elders. These opinions are often passed to the master builder. Arguments about dwelling arrangement between the patron and the builder may continue at this stage; a visit to another building site may deem to be necessary to explain a specific idea. Nevertheless, house design may not end at this stage, since dwelling unit construction may grow simultaneously with the family, and later, with the extended family. The master builder is aware of this fact and structural elements are built accordingly.

Building design along with room areas are determined according to a number of considerations. These include the social and economic status of the patron, the importance of the structure, span of the roof and, of course, the skill of the master builder. Before starting the construction process, the master builder often layout the plan on the building site. He develops an image about the horizontal as well as the vertical arrangement of the dwelling unit. The staircase location is considered of a major structural and functional concern, since the stair shaft works as a hollow column to support building structural stability [30, p. 88].

It is the responsibility of both the owner and the builder to discuss the likely impact of the building layout and its openings on neighbouring structures. Protection of neighbours' privacy as well as that of the building residents is of prime concern. Design of window and door openings is expected to pay due respect to the privacy of surrounding buildings. No entrance doors are observed standing across each other in Al-Alkhalaf settlement. Direct visual corridors into private domains of neighbouring buildings are avoided.

In Al-Alkhalaf settlement, the construction and use of the built environment is emphatically a matter of cultural prescriptions and consensus guided by Islamic rules. The household is not undifferentiated in its use of domestic space. Members may contest withg each other for the use of areas; they may negotiate, argue or seek delinea-

tion of land use priority from the village Sheikh (ruler). Traditional building practice was always controlled by guidelines familiar to inhabitants. These guidelines were also based on Islamic principles which define people's rights and responsibilities. These include, among other things: respect of privacy, public rights of way, support of the welfare of the community, avoidance of harming others, and respect of the right of precedence or earlier usage [31, p. 23]. In brief, correct and acceptable decisions in building practice are known and respected by community members.

Residential building design may consist of the ground floor level that shelters animal stalls. Majles (males reception room) is located at the first floor along with one or two more rooms to serve the Majles. Living rooms and bedrooms are sheltered in upper floors. The upper most level in the building customery houses the kitchen, a sitting area and a roof terrace. The latter functions as the basic outdoor living space.

This outlined process of dwelling unit planning and design falls within the realm of the unselfconcious sector of the total culture in Al-Alkhalaf human settlement. Paul Oliver [32, p. 56] observes that in traditional architecture the "fixity and persistence in plan, the sanction and legitimacy of precedent in design, the formalization of techniques and processes in construction, and the use of spaces in accordance with the dictates of custom, typify traditions in buildings which operate as a coordinated system." The commitment to the established building methods is accepted uncritically. Eventually it became a matter of habit and of established value. In this settlement not only traditions and building practices are handed down, but also dwellings. In this indigenous environment dwelling coincides with living. Ivan Illich [33, pp. 119-20] mentions that "to dwell means to live in the traces that past living has left".

The Art of Mensuration

The art of mensuration in the traditional buildings of Al-Alkhalaf was based on the architectural scale of the master builder. Lengths and heights of building elements were related to the human body. The fact that males are of different heights did not bother the builder nor his patron. Absolute measures in themselves were never critical in the practice of the traditional builder. The human foot was used as the basic unit of mensuration for short lengths on horizontal planes. Thus, measurements of rooms, walls, and other related elements were simply determined according to a certain number of the master builder steps. Exact dimensions or standarized ones are not critical in this practice. Length of building perimeter, window openings, lintels and other related components above floor level are decided based on the cubit measure. Palm of the hand is used with the cubits for accurate measurements. The stride is used for deciding dimensions of long distances, (i.e., fencing a plot, dividing up a piece of land, etc).

Levels at the vertical plane are determined in reference to human body height. While the knee level is used to determine built-in furniture elements, window sills are

decided according to human waist height. Interior door heights are decided in reference to human neck height; security requirements and social norms are the main reasons. According to village elders, bending one's head while entering or exiting a space will give women in other rooms a warning to wear a head cover and also probably to hide away. The room heights and the level of the main entrance door lintel along with other related elements are related to the human height with or without a stretched arm.

Widths of public thoroughfares, pathways and alleyways are related to human activities. Quite often, the minimum width needed to allow a back paced donkey to pass freely is all the space required. Width of main entrance door of many residential buildings is decided based on the same criteria. The height of this door opening may be decided in relation to the requirements of a woman with head luggage to pass through. Walls that surround fina (dwelling unit out-door space) which exists within the homestead domain are high enough to secure the privacy of users. These are often crenelated with Al-Awshaz (Cicuta maculata) tree branches to secure against predators and intruders.

Building Materials and construction Techniques

Building construction involves two distinct phases: preparation of building materials; and the construction activity.

construction materials

Natural building materials are used in construction activities in Al-Alkhalaf village. Stone, wood and mud are the basic materials, presently available in sufficient supply on sites that are easily accessible to these village inhabitants. Iron, not a local material, is used as a secondary material in manufacturing door and window fittings. Perhaps more emphatically than any other forms of expression, constructed space reaffirms the connection with the land. The nature of the shelters (materials, construction, form, etc.) can give some indication of the permanence of habitation at the site [34, p. 339]. In Al-Alkhalaf settlement, stone or other permanent materials are only used in dwellings built on land belonging to the tribe or subgroup of which the individual in question is a member. In other cases, less durable materials are used. In bedouin societies, this indicates the relation of individuals to the group [35]. Consistent use of durable building materials, stone and adobe, in this setlement's residential buildings is a result of inhabitants belonging to one tribal affiliation: Qahtan.

Stone: Rubble stone blocks are often transported by animals from stone quarries near Al-Alkhalaf village to the building site. Since very large stone blocks were rare and difficult to handle, small stones were used in the construction of the exterior ground floor walls. The professional builder instructs his assistants to cut stone into shapes and sizes that are needed. Later, stone blocks are skillfully laid to give a fine finish; no mortar is used, interstices between the stones are filled with small pieces of

stone. This includes foundation walls starting often from a level about one meter below ground level and rising to about 2-2.5m above ground level (Figs. 3,4). Load bearing walls on the interior along with buttresses and the central newel are stone structures. Use of stone walls at the ground floor level are deemed to be necessary to withstand, in addition to vertical loads, horizontal pressure of floodwater during fierce summer rain. While walls built of small stones are able to stand up water floods, such walls may easily collapse as a result of bedouin attackers prying out a few stones. This, along with structural necessities had resulted in the construction of these walls about 80 cm thick.

Adobe: Defence requirements against tribal raids along with limited property area has inspired people to construct vertical residential buildings. Khulb (adobe material mixed with straw) is used as the main building material in wall construction. Adobe is characterized with light weight as compared with stone and, therefore, allows multi-level structures with minimum use of human and material resources. Khulb mixture is prepared on a place near the building site. It is mixed in a soil mix pit before one or two oxen spend 10-12 hr circulating around and continue to mix both earth and straw together. The mixture is then left 24-48 hr to mature before it is ready to be passed in egg-shape forms to the master builder. Khulb mixture ingredients are mixed in certain quantities decided by the master builder. Excessive percentage of these materials may cause mud mixture to disintegrate during drying.

The adobe mixture is layed in courses without the use of shuttering, with each being built an average 40-60 cm. width and 30-50 cm. in height. This is left for one or two days to dry, depending on weather conditions. A number of window openings are braced with Raqaf (slate) stone slabs, or with rough timber reinforcing built into the thickness of the clay courses. The walls better slightly inward as they rise. Thus, buildings are shaped conically towards the roof (Fig. 5). Vertical exterior walls are topped with Al-Hayawa (stone course) that is used to withstand rainfall and protect mud courses underneath (Fig. 6).

Thick mud walls of high thermal capacity are used for walls and roof construction, providing interior spaces with a comfortable air temperature during summer and winter seasons. During the night, the natural time lag of mud material with respect to the air temperature allows heat transfer of warm days to counteract the cool winter nights [36], although some artificial heat must be added during this season.

Inner walls are built of Khulb material except the load bearing walls inside the building; these are constructed of stone at the ground floor level, whereas the upper levels are built of mud and stone. Mud wall partitions are used at various house levels

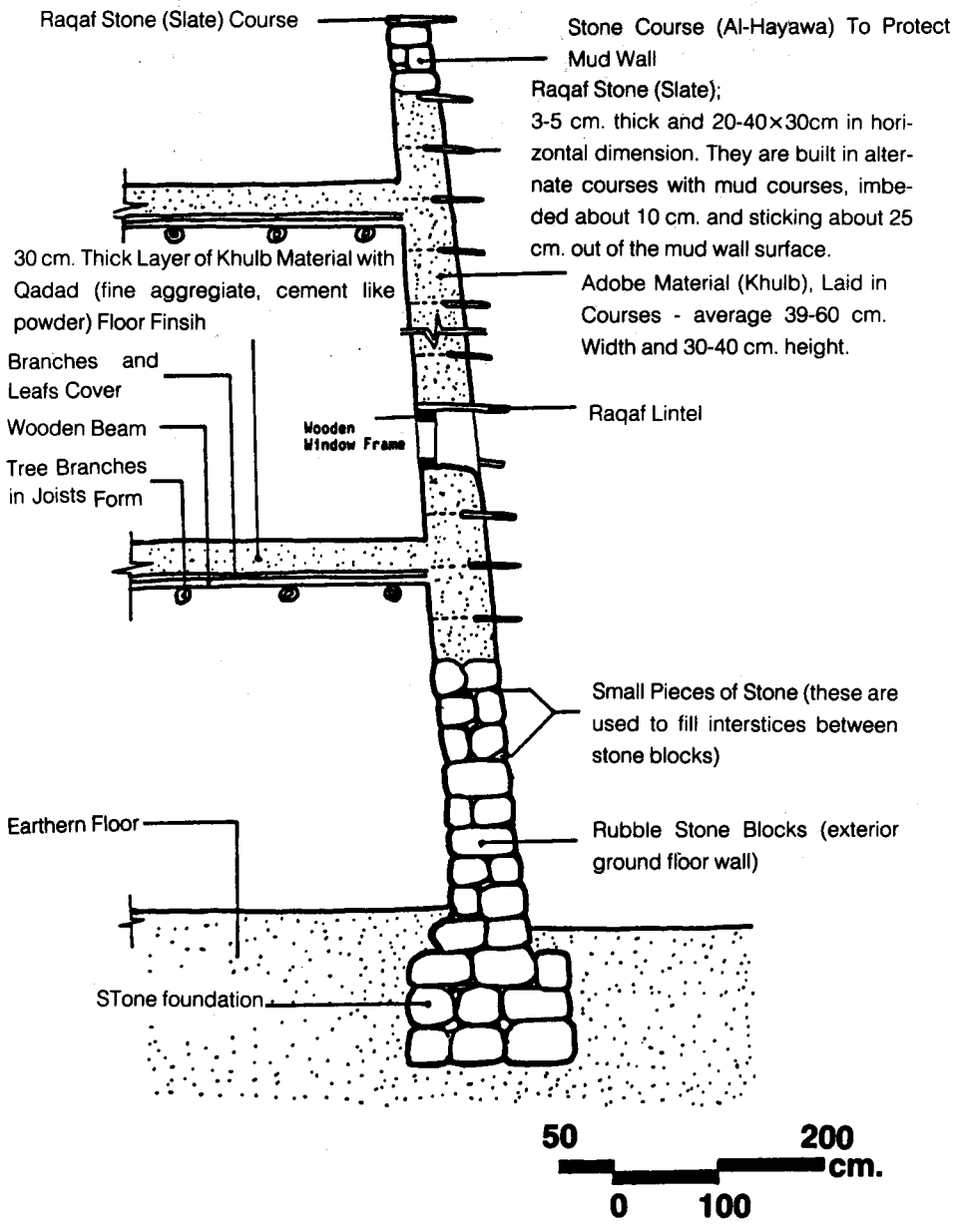


Fig. 3. Cross section showing materials and the construction system of the exterior wall, floors and roof of a typical multi-story residential building.
Drawing by the author.

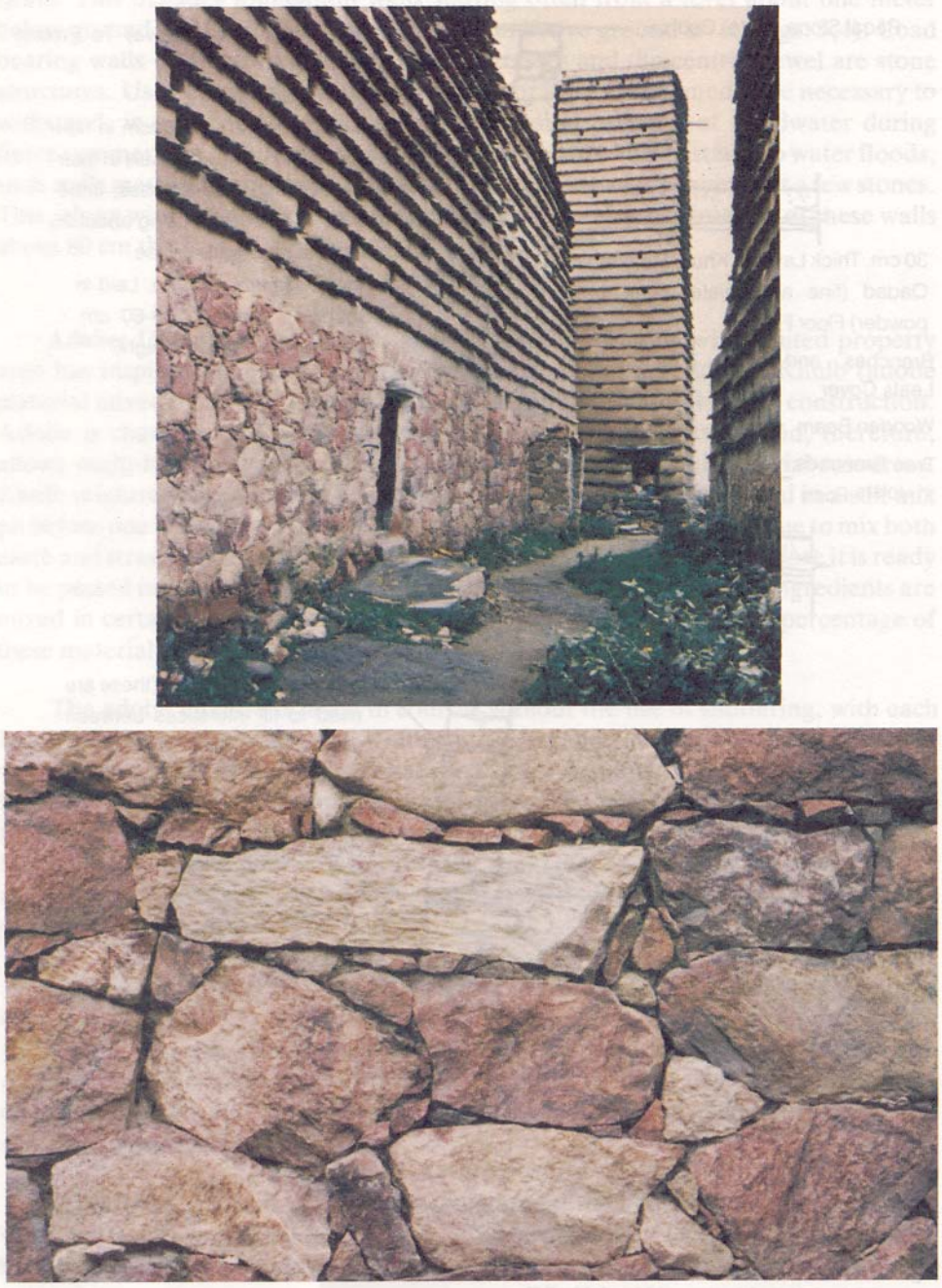


Fig. 4. Foundation walls are stone built starting often from a level about one meter below grade level and rising about 2-2.5 m. above ground level.

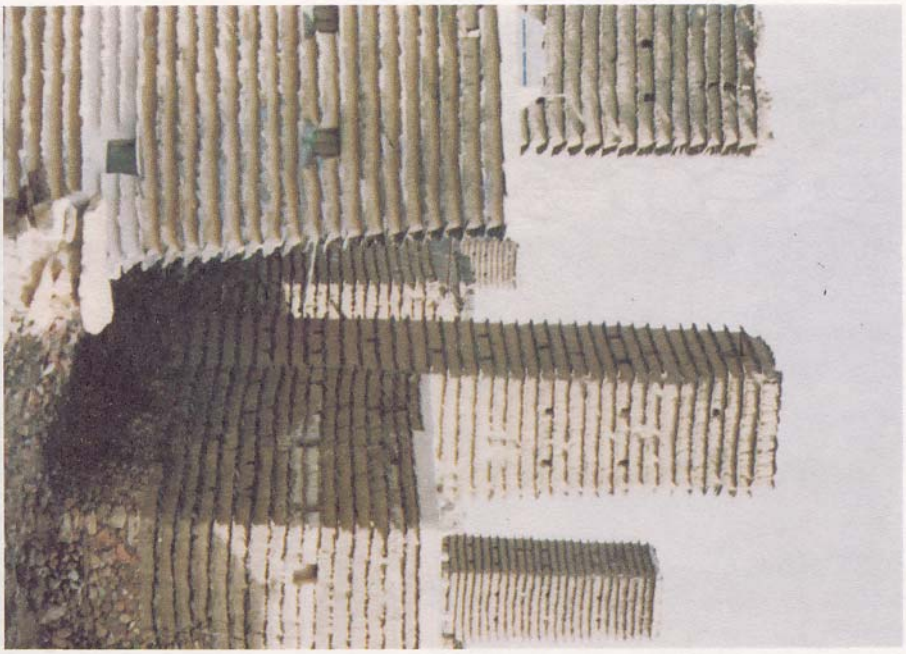


Fig. 5. Raqaf (slate) stone courses are built in alternate courses with mud courses. Buildings are shaped conically towards the roof for structural purposes.

Fig. 6. Vertical exterior walls are topped with al-hayawa (stone course) that is used to withstand rain fall and protect mud courses.

to create spaces for a number of functions (i.e., small animal pens at the ground floor level, and Al-Mekhwal (food storage room) at upper floor levels.

Raqaf: Raqaf stone (slate) building material is used to protect mud walls from being washed away by rain. These stone flacks are often 3-5cm thick and 20-40 × 30cm in the horizontal dimension. They are built in alternate courses with mud courses, imbeded about 10cm and sticking about 25cm out of the mud wall surface. These are laid horizontally in towes with their tips overlapping. They present a slight outward slope to facilitate rain water discharge away from the mud material (Fig. 7). Consequently, maintenance work to the later is minimized. Raqaf material is acquired from metamorphic stone sites present in nearby mountains. This stone material is characterized with dark grey to almost black color, it is impervious and dimensionlly stable. The technique of using Raqaf (slate) courses in building construction throughout the village has a powerful presence in the close-up visual of the settlement (Fig. 8).

Raqaf employment, as an integral part of exterior wall surfaces construction, is also used to underline architectural details as well as to suggest the merger of natural and man-made elements. For example, window lintels of many openings consist of Raqaf sheets (Fig. 7).

Although the nature of each of the two basic construction materials, adobe and stone, may suggest a different method of detailing, both are brought together harmoniously. Yet, each material is treated notably. Thus the ground floor levels, which are stone built, express the language of this particular material and the upper mud built floors demonstrate the nature of this material.

Wood: Wood material is used in the construction process for structural and non-structural purposes. Wooden beams are used to support both roof structures and stairflights (Fig. 9). Wooden columns are observed in few traditional buildings of Al-Alkhalaf (e.g., Mosque structures). Wood is used in door and window production; "Talh, Seder and Ar'ar" wood trees are used for this purpose.

While variability in climatic conditions joint with the dominant use of natural building materials has affected traditional buildings of Al-Alkhalaf, this settlement architecture has a uniformity in form, character and techniques far beyond what these environmental conditions might suggest. The thesis here is made that the influence of sociocultural and religious factors far outweighs that of climate and availability of building materials. The people of Al-Alkhalaf have showed a detailed knowledge of the forms, materials, and micro-climate of the area. They know the thermal characteristics of local building materials for maximum comfort and their resistance to rain. The accurate knowledge of such builders of local micro-climate is shown by the care with which they study the design of building envelopes.

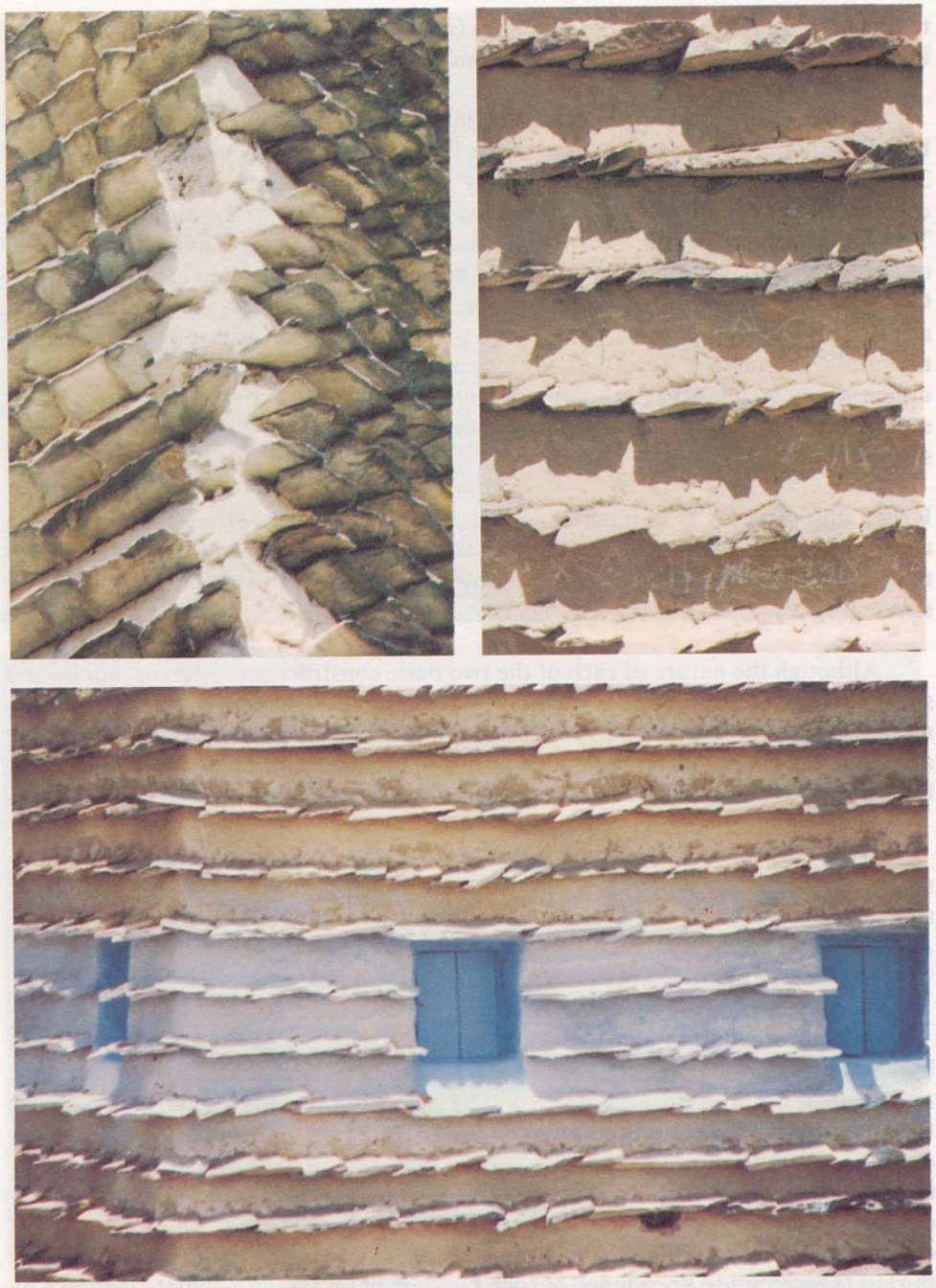


Fig. 7. Raqaf courses details.

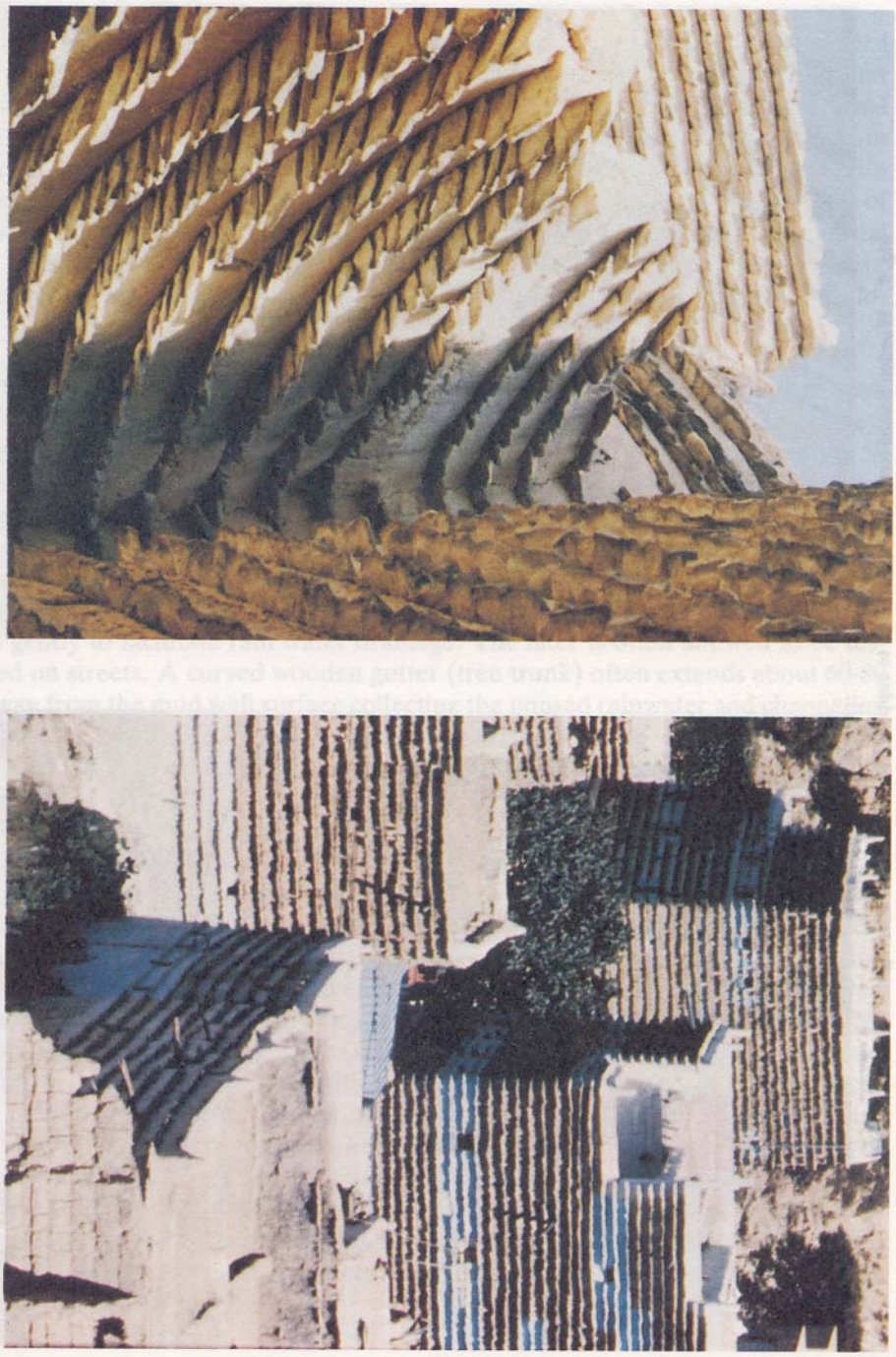


Fig. 8. View of residential buildings, notice the unity and harmony that is created among structures as a result of using raqaf and mud building materials.

Fig. 9. Wooden beams (tree trunks) are used to support floors, roofs and stairflights. (See also Fig. 14)

Floors and Roofs Construction

Since Al-Alkhalaf area is not blessed with forests, long wooden beams needed to support floor and roof construction are rare. Therefore, the span of dwelling unit spaces cannot be very long, averaging 3 to 3.5m. The wooden beams are always laid lengthwise, approximately one meter apart. These are spanned with tree branches in joist form, laid without any direct fastening to each other; the later are covered with branches, leafs and a layer of Khulb material 30 cm. thick that forms the top layer of floor and roof construction (Fig. 10). Since the beams are first laid into the material of the wall below, these always stand out as ribs on the ceiling, even after they have been covered with mud coating on all sides; this was observed in a number of buildings.

Once the span increases, or in case no spanning elements long enough to span the space are available, internal supports are introduced. Al-Battarah, a buttress attached to one of the enclosing walls and projects inside the room which averages 50 cm. wide and approximately 130 cm. long is built to support Alasaleh (basic spanning element) (Fig. 11). When the space to be spanned is not more than two meters, wooden joists are laid horizontally side by side or sometimes dispersed, a layer of sorghum stems being laid on top of this structure and Khulb (Mud) material then piled averaging a 30 cm. thickness to make the ceiling (Fig. 12). The top roof level often slopes gently to facilitate rain water drainage. The later is often allowed to be discharged on streets. A curved wooden gutter (tree trunk) often extends about 60-80 cm. away from the mud wall surface collecting the unused rainwater and channeling it outside the roof area (Fig. 12a). A hole may exist under the main entrance sill to drainout rainwater collected in the Fina (dwelling unit private open space) (Fig. 13.b).

Construction Vs. Design

The vertical dimension of a building translates space area into volume by its projection above the earth; it expresses the very process of building [37, p. 65]. Vertical load-carrying elements of traditional buildings in Al-Alkhalaf consist of bearing walls, which are both structural and enclosure. The amount of area which is covered by this wall construction, both in plan and in section (Fig. 3), is limited by the requirements to provide usable living space (see Fig. 3). The decision to use these load bearing walls seems to depend on tradition, available natural materials (largely those strong in compression-stone, adobe, and timber) and climate. These walls are built based on simple structural concepts, limited by the walls tendency to buckle. This, of course, restricts the height for any given thickness. Consequently, wall construction is massive at the base (averaging a one-meter thickness) with buildings tapering conically towards the top. Thus, wall thickness is reduced upward. In addition, mud material is reinforced with straw fibers which enhance the building material quality and hence their stability.

Fig. 10. a. Interior view towards the ceiling.
b. Cross section in partially collapsed building showing roofing system details.

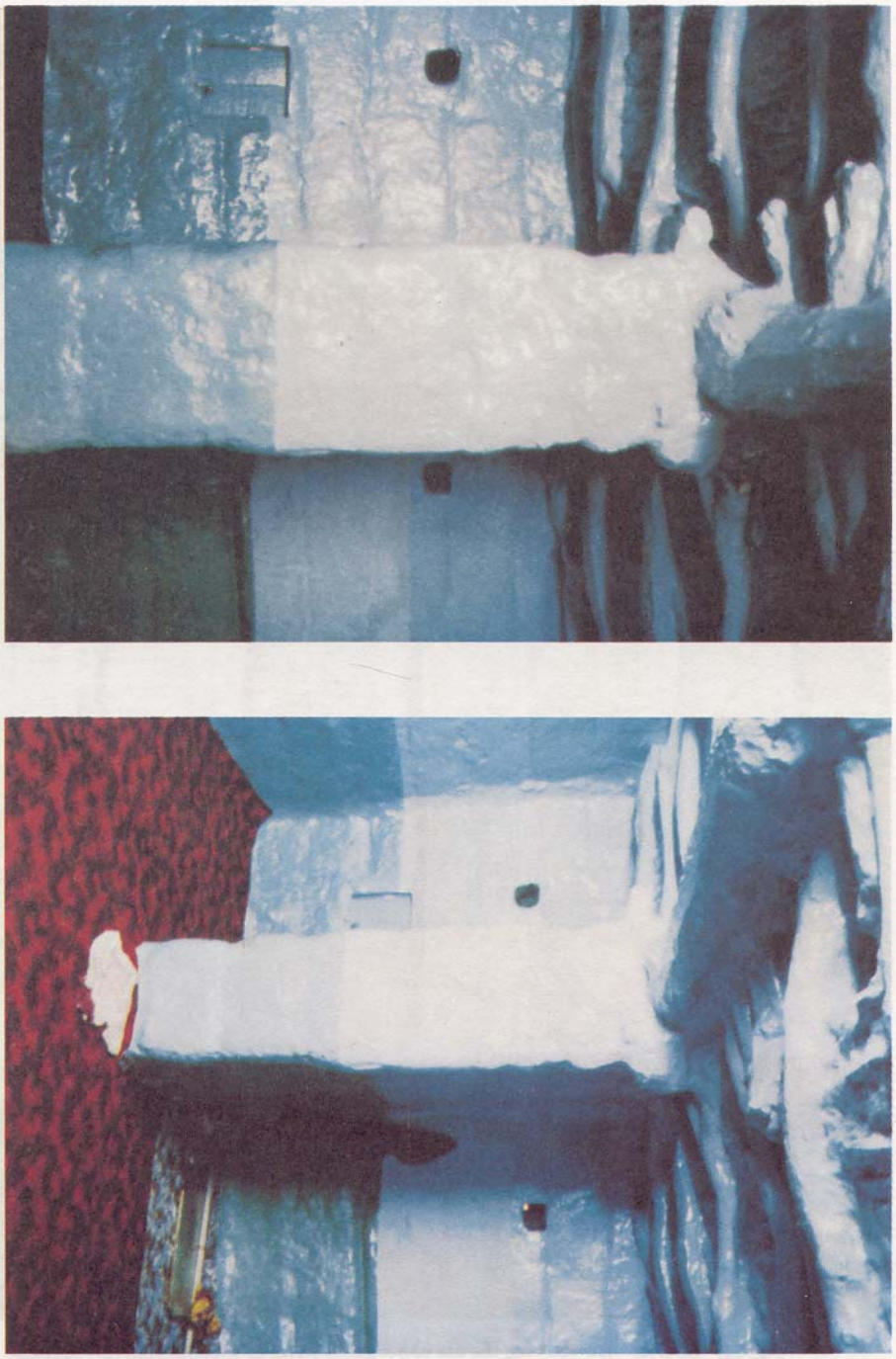


Fig. 11. Al-battarah vertical support element is used to support alasalah (Basic spanning element) in case no spanning elements long enough to span the space are available.

Fig. 12. Interior view showing the use of Sorghum stems in spanning narrow spaces.

b.

a.

Fig. 13. a. Wooden gutters are used to facilitate rain water drainage.
b. A Hall is built under the main entrance sill to drainout rain water collected in the fina (Yard) space.

In each residential building, from the entrance hall space, one is able to ascend mud steps, supported on wooden beams, that wind around a central pier to reach the upper level (Fig. 14). This circulation system is enclosed through the building height in thick mud walls. Structurally, the stair shaft acts to strengthen stability of the building as it works as a hollow column.

Fig. 14. Stair Construction Details. The staircase usually continues up unbroken from the bottom to the top of the house, a solid construction of adobe with a massive central stone and adobe pier, acting as a kind of structural spine to strengthen the whole building. The steps and the landing are of adobe built on top of wooden strucutural trimers and joists, and have steep goings.

Both wall construction and interior space design requirements affect the plan form and lead to a simple square or rectangular plan form. The building surface has shadows cast upon it as a result of Raqaf (slate) material sticking out of the building envelope in alternate courses. This has become the prime characteristic of the art of building in Al-Alkhalaf human settlement. The result of the careful integration of natural building materials, to create traditional building forms in this village, join with defensive, environmental and cultural factors to produce an architecture that is unique in time and place.

Builders: Construction is often entrusted to specialized builders. They are basically construction experts on the building site. The custom of cooperative building invites people, family members, neighbors, and friends, to work side by side with tradesmen. The use of cooperative techniques in Al-Alkhalaf society has enabled group members to effectively coordinate their efforts, either by pulling together or by dividing the labor so that each person does that task for which his abilities best suit him. This not only helps complete construction tasks, but also has social implications. While the host normally provides food for the construction gorup, those who can not afford to do so are exempted allowing other lineage members to supply meals.

Traditional buildings in Al-Alkhalaf are simple, clear and construction methods are well developed and well-known to the traditional builder. He has a detailed knowledge of the building rules. Decisions regarding size, layout, relation to site, and other related variables, are decided by discussion, with no written contracts used. The aesthetic quality is not especially created for each building; it is traditional and handed down through the generations. This approach works because there is a shared image of life, an accepted model of building, a small number of building types, and finally an accepted hierarchy, and hence, an accepted settlement pattern.

In short, the traditional socio-cultural norms that are shared among people in Al-Alkhalaf human settlement have permitted the accepted image of house construction along with the inherited building operation, to operate.

Finishing Materials and Techniques

Finishing, as opposed to architectural decoration, is an essential technical aspect of interior wall surface finish of habitable rooms in Al-Alkhalaf settlement. Al-Kharaf finishing material is a mixture of mud and animal dung that is used in plastering work of traditional buildings in Al-Alkhalaf. It is mixed and left 8-10hr to mature before it is mixed again with water and used in plaster work of surfaces of interior spaces. Characteristics of this finishing material include durability and water resistance.

As soon as the builder completes building the structure of the dwelling unit, plastering of interior walls surface begins. This task is resumed by women. At this stage niches and shelves are finished. Plastering work is completed mostly with bare hands. Rooms of different floors receive various floor treatments according to space use. Floor of stables, for instance, and storage rooms that are located at the ground level, are left with an earthern floor. Other dwelling unit floors and floor of the roof terrace are surfaced with Qadhadh (fine aggregate, cement-like powder) produced from crushed fired stones and mixed with water. This mixture is water-resistant.

The third stage in the dwelling unit construction includes the manufacturing and installation of doors and windows. Wood is the dominant material used for these ele-

ments. A specialized carpenter completes this work. The house owner provides the necessary wooden materials.

Construction Activity and The Season

Construction practice is often resumed during the dry season (September-December); this is because of agricultural activity requirements and economic reasons. Mild average temperature of about 20°C during this period will facilitate the process of mud-drying while preventing the development of serious drying cracks. Structural characteristics of mud, the main building material, encourages people not to build during rainfall periods. Construction of foundation walls may take place during the rainy season (March-May), while mud walls will be built during dry periods of time.

People often try to complete external construction work at the beginning of January, which is when rainfall begins to increase. However, internal construction involving built-in furniture, storage niches and shelves, plastering work and indoor decorative activities occupy the spare time of villagers during the rainy season. This begins in January-February and intensifies in March-May. The later period is the hardest time of the year for the master builder and his assistants, since weather conditions make it difficult to prepare basic building materials and practice construction activities. Consequently, they may participate in secondary occupations such as trade, agriculture, etc. during this period.

An Alternative Approach

This paper has illustrated the process and the system of residential buildings construction in the Al-Alkhalaf human settlement. Structures reflects the technical and environmental skills utilized by the builders. The method of the dwelling unit plan, design, and construction presents the house as the product of the individual as well as the society. Master builders in Al-Alkhalaf village have demonstrated a detailed and precise knowledge of the behaviour and characteristics of available natural building materials. This is obvious as a result of the straightforward solutions to the problems posed by climate and construction requirements.

Contrary to traditional construction and design requirements observed in Al-Alkhalaf settlement, essential contemporary standards of size, amenity, safety and permanence pose a challenge to Saudi architects, builders, and decision-makers in the construction field to introduce innovative approaches to dwelling unit design and construction. Such methods of building supply are expected to pay tribute to the wisdom of design principles implicated in the traditional building operation, which we often ignore at a great cost, in order to respond to health, hygiene and functional requirements of modern building practice.

It would, of course, be a mistake to romanticise the accomplishments of the vernacular architecture builder. With respect to modern standards of scale, amenity, safety and permanence, many buildings of vernacular architecture are less than adequate to satisfy contemporary living conditions. Neither would there be any profit in attempting the literal imitation of handicraft techniques or in the artificial limitation of building materials to those locally available. Vernacular architecture merits our study for its principles, not its forms. These have deep relevance to our populous and ill-housed contemporary society.

Since the contemporary professional practice of building is described as a purposive action materialized with practical rationality [38, p. 9], the practical aspects of scientific building based on man's professional training to build require an accumulation of knowledge of content and form related to construction activity, both in the process of its conception, design and execution, and the final product.

Architects in Saudi society today bear a major responsibility in directing the course of professional practice. Yet, the central issues of architectural practice need to be incorporated into the curricula of the architectural programs. In Saudi society, these curricula are identical to those of the developed countries (i.e., Western societies) not only in their subject matter, but even more significantly, because it is taken as given that the highest degree of technical competence occurs only under conditions of the masive application of mechanical energy to the construction process. Thus, these curricula emphasize the importance of "Labor-saving" methodologies and use of energy- intensive structural and mechanical systems. All of this suggests that students of architecture in Saudi Arabia are being set upon an intellectual course which, in the long run, cannot be successful.

This is not to imply that modern technology should be eliminated from the scene of Saudi architecture, but architectural ideas need not come only from foreign origins. Imported building techniques can be adopted only when they are found to be useful and adaptable to the development of an appropriate technology that is culturally and economically specific, but imported models and the imported way of life remains alien to Saudi inhabitants. For the modern Saudi architect, we are advocating authentic analysis of the traditional architecture and the utilization of those elements and concepts that are expected to enhance the current practice of building in a meaningful way.

Conclusion

Vernacular architecture, as evidenced by the Al-Alkhalaf settlement today, presents a challenge in terms of building technology. It shows a conscious use of materials along with a sensitive and skilled use of detailing. The system of owner-user participation in the building operation has allowed for building information to be per-

Fig. 15. Crowded houses arrangement provides shading and reduces the areas exposed to the Sun.

fected and developed based upon the builder judgement and the evaluation and appreciation of the user-owner.

Construction work was under constant scrutiny; the known traditional building system was, as a result, pushed to its limits to make the principles of design, geometry, and the use of building materials achieve quality and harmony in the accomplished architecture. People in Al-Alkhalaf have aimed to reach a state of balance with nature. Traditional buildings reveal a strong sensitivity to daily and seasonal temperature variations and to considerations of building form, materials and topography, that relate directly to the climate and microclimate [Fig. 15].

An understanding of folkloristic experience is of more than academic interest today because, with the rapid urbanization of many Third World countries, including our own, coupled with the employment of imported Western design models, there is a growing tendency to minimize or ignore the importance and complexity of the natrual environment. Evidently. The construction method employed in Al-Alkhalaf demonstrates a significant experience with climate and geographic cause-and-effect. In comparison, the modern architect, persuaded with the potentials of modern building technology, has been removed from the direct practical knowledge of such environmental and locational considerations; he is also quite convinced that they do not matter any more. Yet the poor performance of most modern buildings is an impressive evidence to the contrary. Most recent buildings, widely admired for their appearance, actually function quite poorly.

Building as a process, versus building as a product, requires man's understanding of the underlying principles of the science of designing and constructing buildings. Al-Alkhalaf vernacular architecture, as an outcome of intellect, with experience and skills operating in structural relations, is a practical rationality that involves insight, circumspection and innovation that seems to coin the human knowledge and intutive reason to apply to the human action with reference to the built form.

Reconciling the past, with the challenges of the present is necessary, and as such a framework, within which contemporary architecture of Saudi Arabia can be created. The sooner Saudi architects recognize this central fact of our existence, the closer they will be to achieving original independence, aesthetic, as well as economy. For it is people obsessed with imported life styles which, more than anything else, chains societies in developing countries to foreign economic and socio-cultural systems.

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فن البناء في قرية آل الخلف في المملكة العربية السعودية

توفيق محمود أبو غـزة

أستاذ مساعد، كلية العمارة والتخطيط، قسم العمارة وعلوم البناء، جامعة الملك سعود، الرياض، المملكة العربية السعودية

ملخص البحث. توضح هذه الورقة طريقة البناء في قرية آل الخلف في منطقة عسير ـ المملكة العربية السعودية.

لقد استطاع سكان هذه القرية، عبر التاريخ الماضي، من خلال جهودهم في ممارسة أعمال البناء باستعمال أنظمة وأساليب البناء التقليدية إنشاء مباني متميزة من الناحية التقنية، الوظيفية، والبيئية. لقد أسهمت عادات وتقاليد الناس في هذه القرية بالإضافة إلى استعمال طرق البناء التقليدية المتوارثة في إنتاج «لغة نمطية» بمكوناتها وأنظمتها التصميمية المرئية عبر التشكيل الفراغي لقرية آل الخلف.

تخلص الـورقـة إلى أنه مع الأخذ بعين الاعتبار للمتطلبات العصرية لمقياس المباني والفراغات، والنواحي المتعلقة بطريقة الاستعمال المعاصر للمباني من الناحية الوظيفية ومتطلبات المتانة والسلامة، فإن الإنجازات المرئية في العمارة التقليدية تسهم في إغناء هذه الدراسة بالمبادىء والأسس التي قامت عليها وليس في مظهرها الشكلي.