Relationship of Air Movement to Wall Surface Temperature.

It will be remembered that the heat transfer experiments illustrated in Figs. 361 - 6 were carried out on houses which were in sheltered locations. Air movement across the wall surfaces was considered to be minimal in order to focus attention on heat transfer due to solar radiation, unobstructed by other conditions such as loss of heat due to air movement.

Many houses studied in the Sohar area were built on exposed sites where air movement is a factor to be considered when studying heat transfer through building materials.

Air movement across the surface of a wall or roof which is exposed to the heating effects of radiation, will tend to result in a lowering of the surface temperature.

If there is no air movement solar radiation hitting a wall's exterior surface will result in the maximum heating of the surface. A certain amount of heat will be lost to air molecules which will be heated up by 'conduction' when they come into contact with the surface of the wall. This phenomena is measured as "surface conductance" (W/M^2C^o).

Air movement causes turbulance on the surface of the wall, with this a greater number of air molecules come in contact with the wall's surface and more heat is transferred by conduction from the wall surface to the air, therefore the surface conductance will be higher as the wind velocity and surface turbulance increases. For a given velocity, turbulence will be greater over a rougn irregular surface than a smoother textured surface. 'Surface conductance' is therefore effected by not only the velocity of air movement across the surface but the texture of the surface.

A high surface conductance value will result in a somewhat lower surface temperature and therefore result in less heat being transferred through the wall into the interior.

Tests have been carried out on walls of barasti houses in both sheltered and exposed locations in order to discover the relationship between air movement and wall temperatures. Barasti has a relatively rough surface and the surface conductances are quite high. Fig 369 shows that in the case of barasti there is a direct relationship between the velocity of air movement across the wall surface and the external surface conductance.

From a comparison of graphs for the daily range of external wall surface temperatures in protected areas (Fig 370) it can clearly be seen that walls exposed to wind have lost wome of the heat generated by solar radiation. During the peak solar radiation period around 12 noon the wall exposed to a velocity of about 2 M/Sec is about a 6 ^{O}C cooler than the wall sheltered from air movement.

Fig 369

Graph showing the "external surface conductance" of barasti walls, relating to air movement

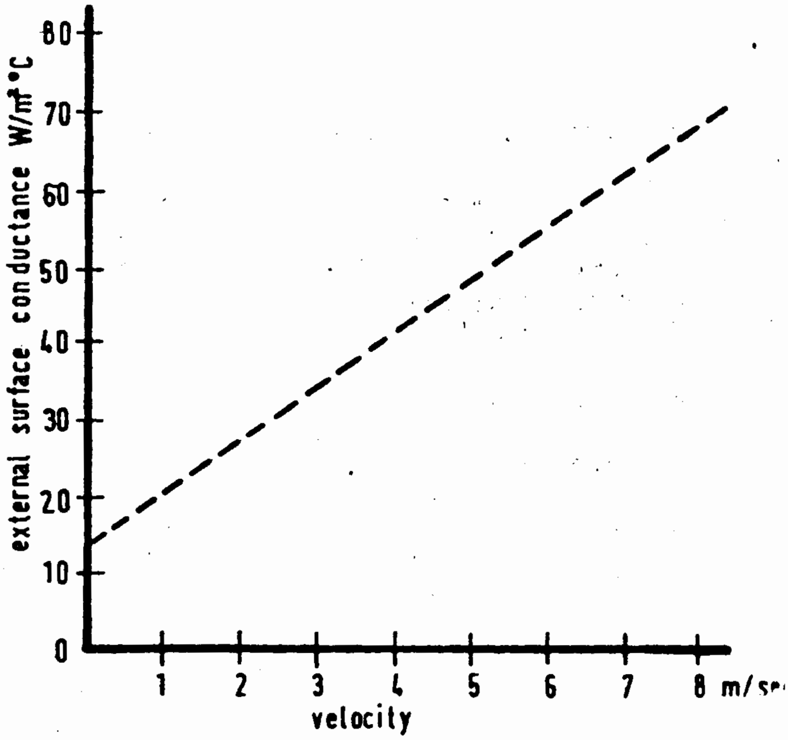


Fig 370

Daily range of external surface temperatures for a south-east facing barasti wall sheltered from wind

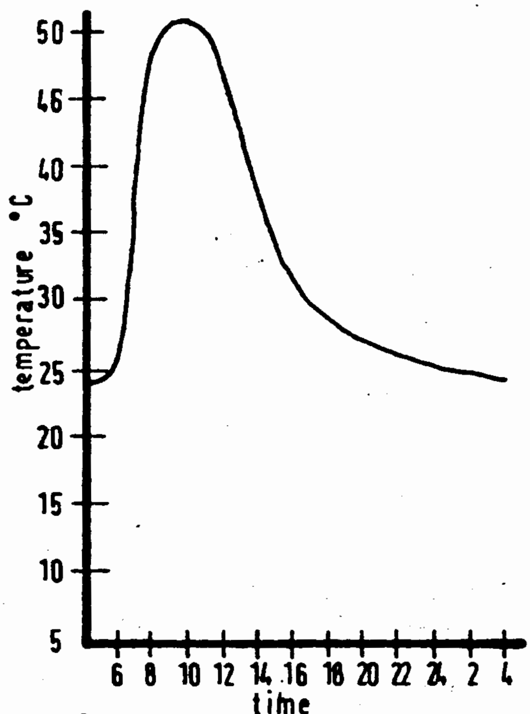
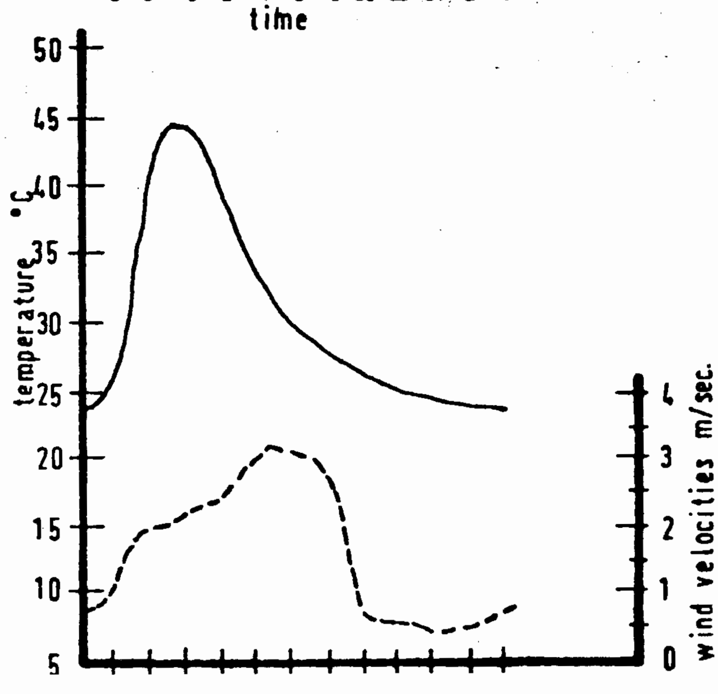


Fig 371

Daily range of external surface temperatures for a south-east facing barasti wall exposed to daily range of air movement

—— External wall surface temperatures

---- Wind velocities across wall surface



Lighting and Privacy

The value of screens made up using stems with no leaves on has been outlined in section 3.3.2 on air movement, where the screen allows a relatively unrestricted passage of air through it. The control and quality of light and the provision of privacy are equally valuable features of this type of screen, making use of the contrast between brightness and darkness. In conditions where the intensity and brightness of the sun are great, the surface that sunlight falls upon will frequently become unpleasant to look at, a condition known as 'discomfort glare', where extraneous objects are much brighter than the essential visual object, and to look at a bright exterior particularly from a subdued interior causes psychological and physical discomfort. It is for this reason that in many hot climates the sky is a more comfortable visual object than the ground, since the sky is often darker than the ground. Under these conditions a large window opening presenting an unobstructed view of the exterior would be in such contrast to the shaded interior that it would be a strain to look out of it. The Barasti screen provides a baffle between the interior and the exterior, so that the brightness outside is broken up by the individual stems, which provide an area of darkness and compensate for extreme conditions in the direct open sunlight, achieving a comfortable average. With the increase of exterior brightness the contrast between dark and light areas also increases and the human eye, in compensating for the discomfort of the bright exterior, will focus increasingly on the surface of the screen. At the other end of the scale, when the exterior is not very bright the contrast will be reduced and the eye is increasingly able to focus on objects beyond the screen, ignoring on account of the diminished contrast the visual barrier it previously afforded. It can be seen from this that at times when exterior conditions are visually unpleasant, the screen protects the eye from them, but with comfortable exterior light,it effectively dissappears.

It is not sufficient to simply balance light areas with dark areas, since too sharp a contrast between the two extremes will also cause discomfort. The transition between light and dark must be softened so that the eye can move gradually from one to the other without violent changes. The Barasti stem naturally overcomes this by virtue of the sectional shape of the stem, which is basically circular and therefore presents a surface where there is a smooth transition from a dark to a light area, as the curve of the stem comes round into the light, visually creating an alternating harmonious flow from dark to light areas.

As well as the visual qualities for those inside looking out, the occupants will be in complete visual privacy. When looking towards the screen from the outside, the stems will be bright, and in contrast the gaps in between will be dark, so that no view of the interior is possible, its subdued light appearing in relationship to the outside as an area of complete darkness.

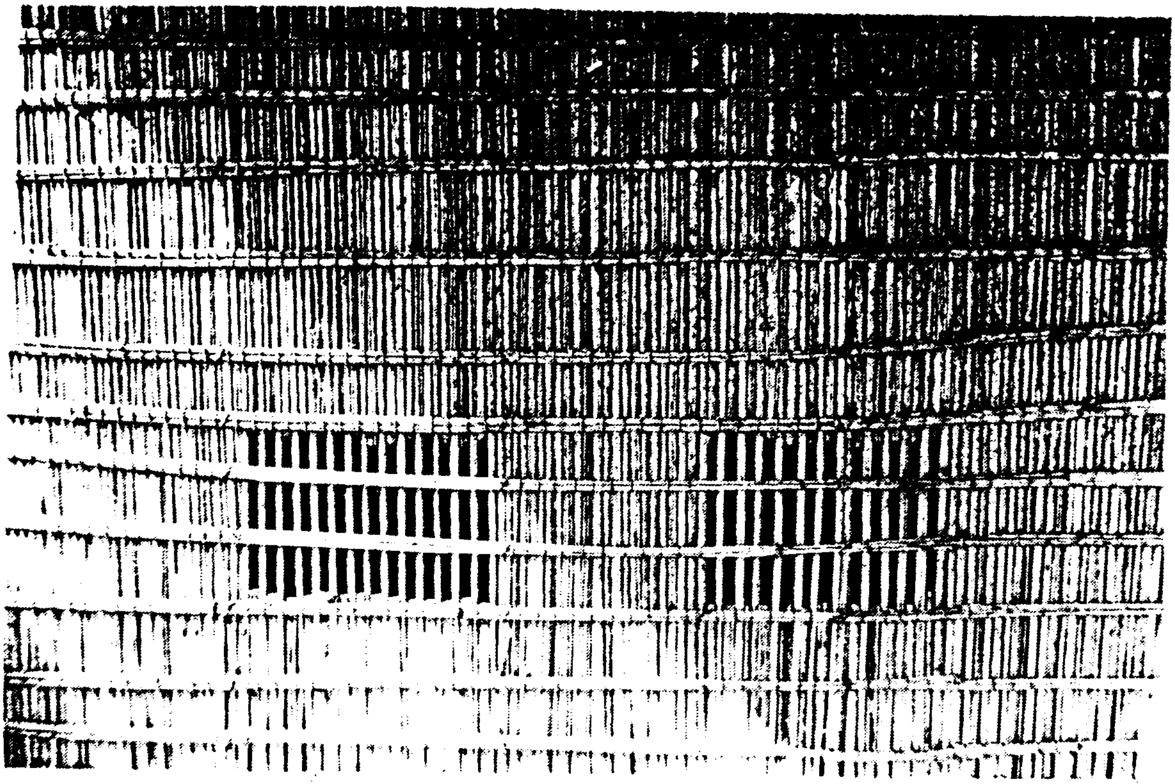


Fig 372 Exterior view of Barasti screen Note dark areas intensified

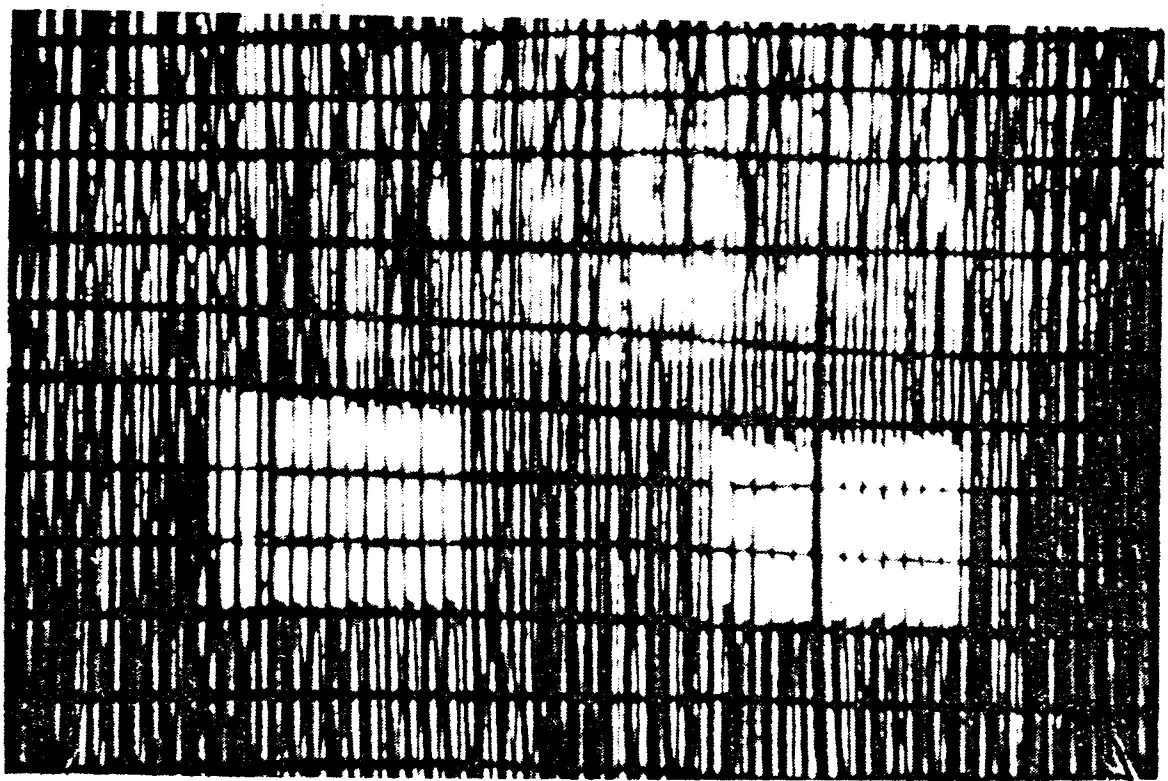


Fig 373. Interior view of Barasti screen

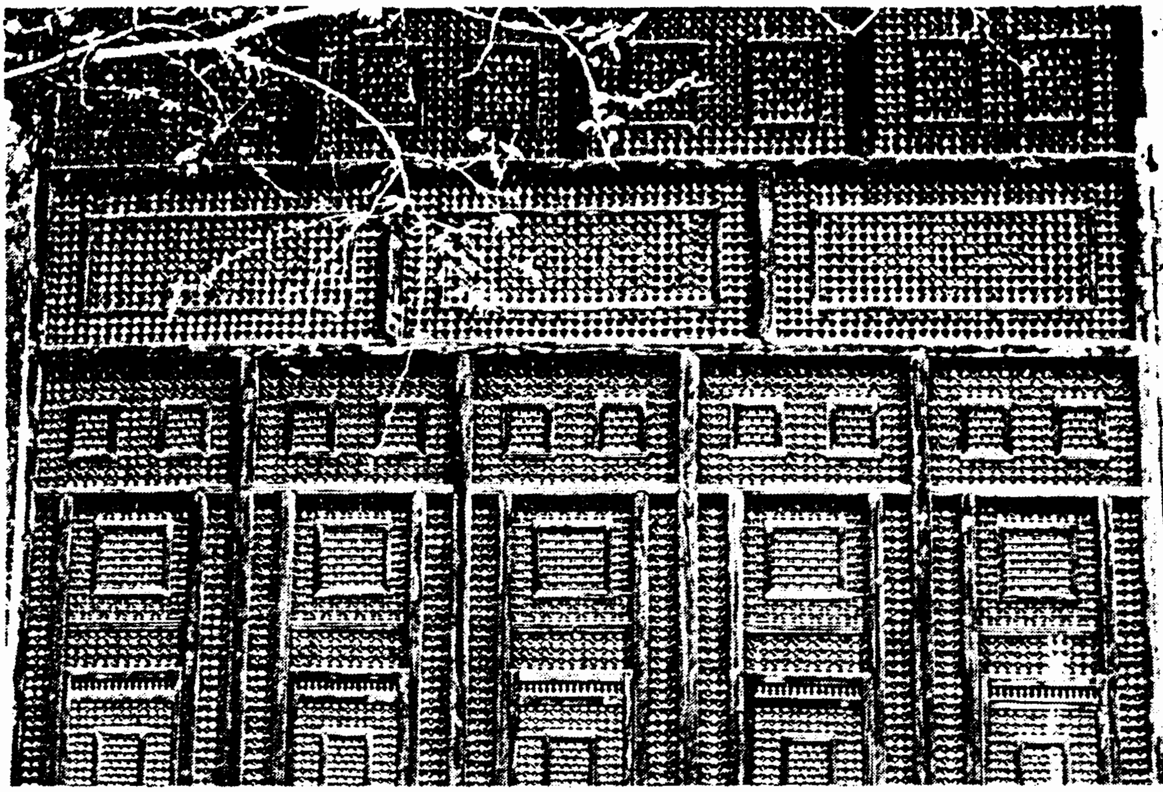


Fig 374. Exterior view of Mushrabeya screen (Cairo).

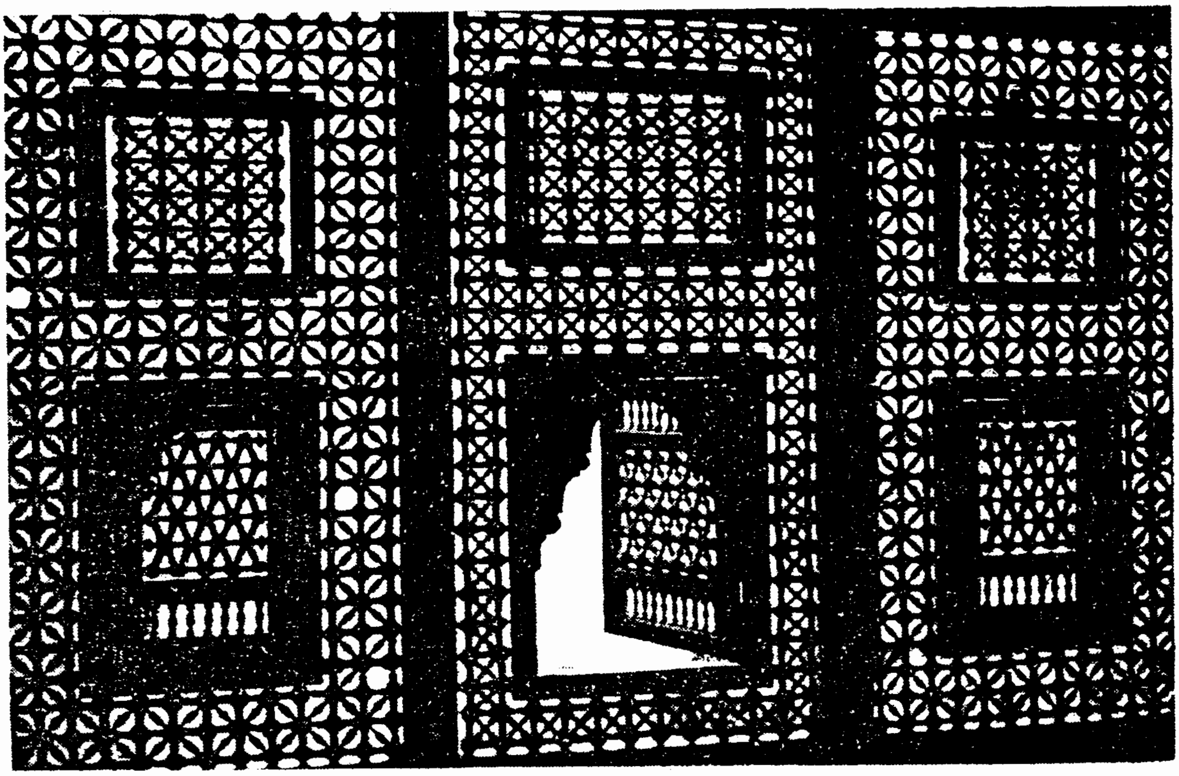


Fig 375 Interior view of Mushrabeya screen

* Omar El Farouk Ernaam is writing a thesis on the Mashrabeya at London University

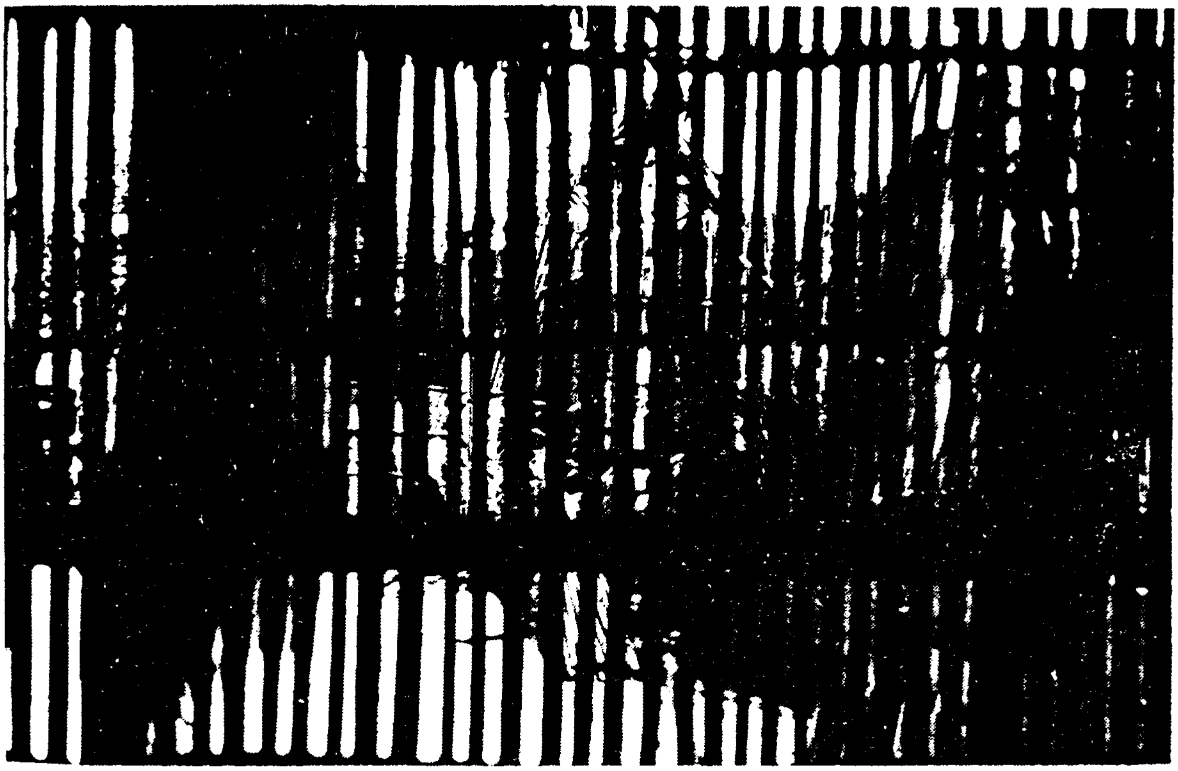


Fig 376 Baras· screen ~ showing ability to focus on objects beyond the screen when contrast is reduced

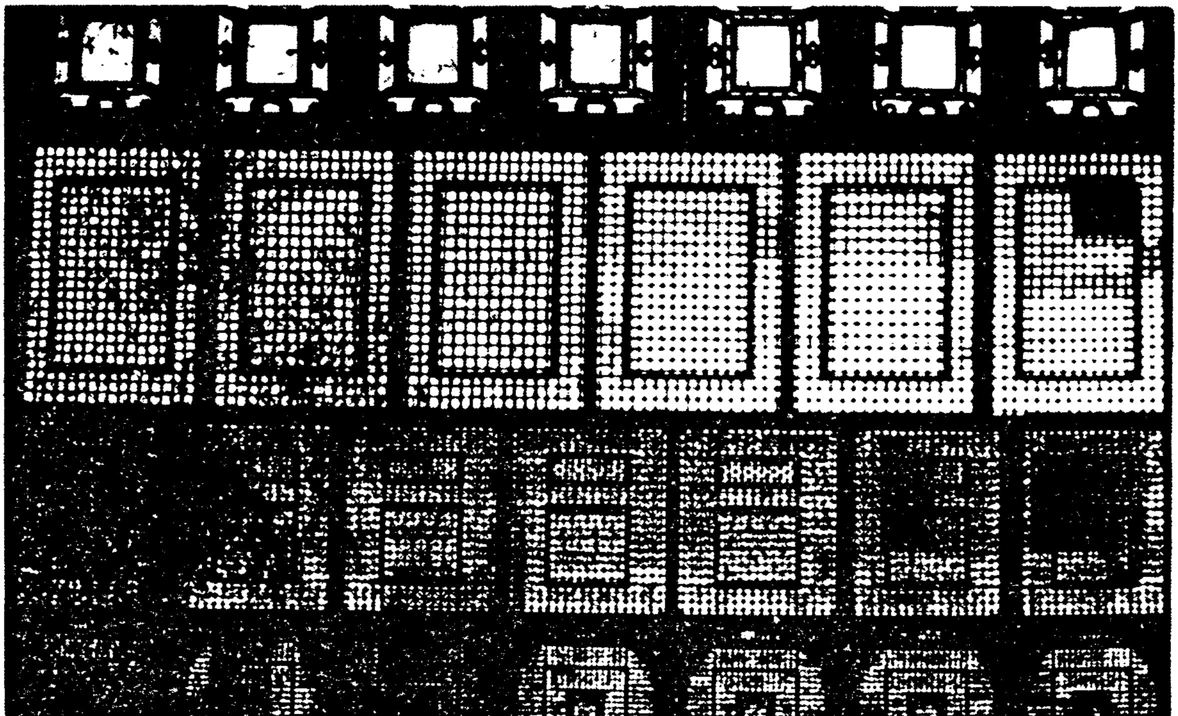


Fig 377 Mushrabeya screen

A smooth transition between light and dark areas achieved by the curved section of the material

Fig 378
Barash screen

Fig 379
Mushrabeya screen

The lighting levels of rooms using this type of panel are not reduced by the effect of the screen, since it comprises an entire wall, and the amount of light it lets in compares favourably with that let in by the much smaller windows set into a solid wa-l. Because of the lack of insulation provided by this type of screen, winter rooms using thicker panels with leaves on will be much darker. However, it must be remembered that during cooler periods of the year maximum use will be made of the sunshine, and much of the daytime will be spent out of doors, minimising the drawbacks of poorly lit winter rooms which are used mainly at night time. A comparison is made here with the timber lattice work screens used in traditional houses in Cairo. Other examples of this type can be drawn from many similar parts of the world. These screens (Mushrabeya) function in the same way as described above, and have been developed specifically for these purposes. Visual evidence bears out how well the barasti screen compares with the highly sophisticated mushrabeya of Cairo. Figs. 372 and 373 show respectively a view of a barasti screen from the outside and the inside; in the examples shown the panel has had two wider spaced areas incorporated, both to take further advantage of air movement and to allow more light, as the stems in this case have been quite tightly spaced. Figs. 374 and 375 show the interior and exterior view of a mushrabeya. Figs. 376 - 9 continue the comparison between the two types of screens.

vi. Costs

The price of various elements of the Barasti house vary from area to area. A da'am costs more in Mutrah than it does in a Batinah town or village, where the owner-builder will often provide his own palm frond stems (Zohor).

The figures given below for each element were obtained from various builders along the coast, and indicate the general price for the materials used. (Autumn 1973).

Item	Cost
Da'am of single thickness with leaves on	2.000 R.O.
Da'am without leaves on	2.500 R.O.
Da'am for roofing	3.000 R.O.
Da'am boudn from owner-provided stems (requiring three men)	0.600 R.O.
2 metre x 5 metre wall: to bind	1.000 R.O.
½ palm tree trunk 6 metre long	2.000 R.O.
Ridge pole 5 metres	2.000 R.O.
Kandelah 8 cm diameter 5 metres long post	2.500 R.O.
Pitched Roof room (Kaargeen)	50.000 R.O.
Flat roof room (Agreesh)	20.000 R.O.
Corner posts, each one including positioning	2.000 R.O.

One Omani Rial equals approximately £1.20.

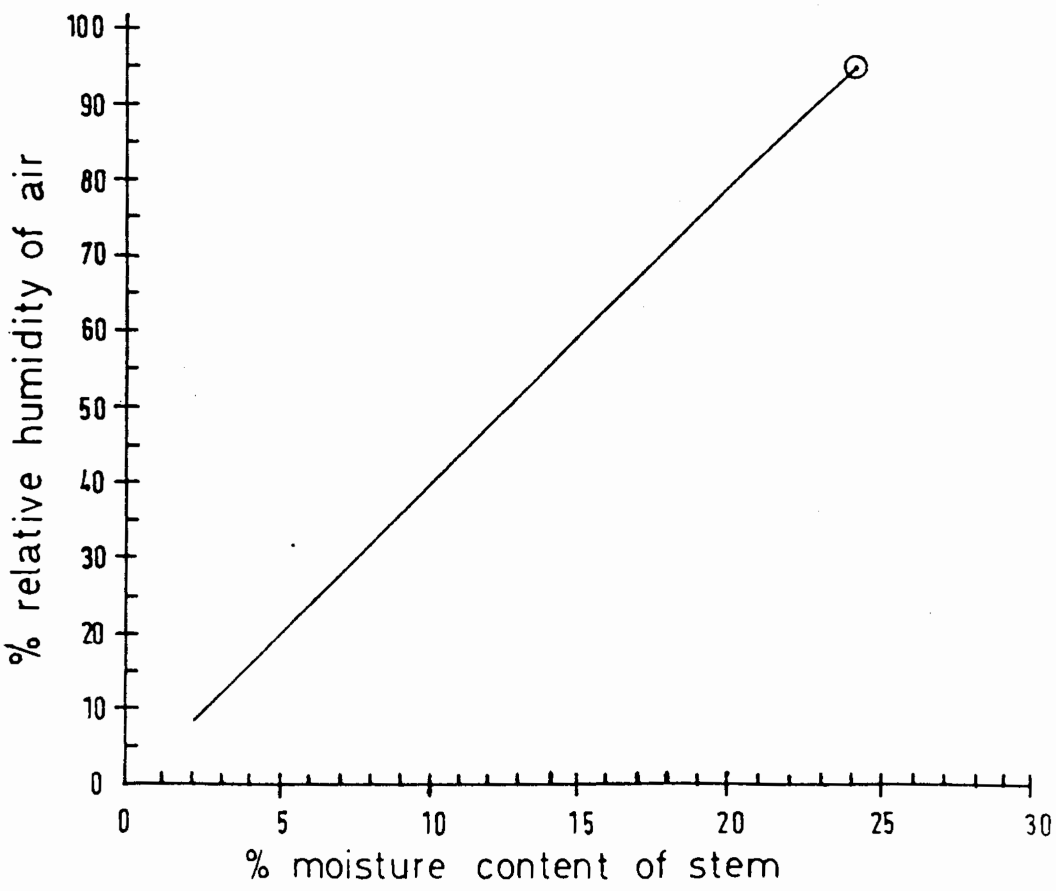
Hydroscopic Properties of Barasti

It has been suggested that palm stems themselves being of organic cellular material will absorb moisture from the saturated air, hence reducing the relative humidity of the air. It is known that when temperatures are high a reduction in the relative humidity of the air allows the body to more readily cool itself by moisture evaporation from the skin.

It is argued that, as moist air passes through the stems of a barasti screen wall, a drop in the air's relative humidity will occur; at the same time the palm stem's moisture content increases.

Field experiments were undertaken to test the above proposition. Relative humidities were measured (using a whirling hygrometer) both outside and within, barasti dwellings. A series of tests showed no measurable difference in relative humidity between the inside and outside of a dwelling; therefore the moisture content of the air after passing through the matting of palm stems was the same as before. It seems that once stems become totally saturated they are unable to absorb more moisture. Since relative humidities fluctuate very little between day and night in most coastal areas of Oman, stems will have little chance to dry out. On the other hand solar radiation falling on barasti panels during the daytime should dry the panels to some extent.

Laboratory experiments (See Appendix I) were carried out in London consequently in order to discover barasti's true hygroscopic nature. Sample stems were dryed by heating them to a temperature of 105^{o}C so that all water would evaporate. The dry stems were then weighed. Stems were placed into a temperature and humidity controlled chamber where they were subject to a range of air humidity conditions, moisture content being measured by noting the increased weight of the stems. Temperature was kept constant at 35^{o}C throughout the experiment. Results are shown in the accompanying graph.



Further tests were carried out in order to determine the means by which palm stems absorb moisture. Cut stems of about 1 meter length were submerged in water for a period of 4 hours and then split along their length to allow observation of water penetration into the interior of the stem. Little water penetration was observed through the skin of the stem. On the otherhand water had been clearly conducted up the length of the stem from the exposed cut ends. Water seems to have been conducted particularly, in the direction from the thicker end toward the tapered end, which would correspond to the direction of moisture flow in the living plant (ie. from the roots toward the extremities of the plant).

The palm tree being a tropical plant is particularly adapted to water conservation. In fact date palms are among the most efficient plants when one considers water consumed to food crop produced. The surfaces of palm stems and leaves help to contain moisture in the living plant and tend to inhibit moisture transmission in the barasti building material.

vii 1 Detection and prevention of Deterioration in Barasti

One of the principal criticisms of Barasti as far as the user in concerned is its short life span. The number of years that a da'am lasts varies according to location and use; Barasti used in houses on the beach front, and specifically when it is in direct contact with the ground, lasts as little as two years, which may include cutting down in size after the first year. In principle the further from the beach the greater the life span can be, but actual use in the building plays an important part in this.

Barasti under ideal conditions can last up to 20 years, quite conceivably more. When exposed to the direct sun it suffers from the redrying process and its life is often reduced to 10 years or less in the case of flat roofs, although there is no proof that this in not also due to termite activity. Palm tree beams last 2 years when in contact with the ground, longer when clear of the ground. Kandelah likewise lasts only months when in contact with the ground but can last 40 years when used in other parts of the building.

Methods of increasing the lifespan of the barasti stem will greatly increase its usefulness, removing one of the only local objections to its use.

The main cause of deterioration in Barasti, and all other timber members within the building, is through termite activity. There are two types of termites to be considered - subterranean termite and drywood termite.

Subterranean Termites (Rumma)

The most severe source of deterioration in Barasti is the result of subterranean termite attack. These termites live in the soil and find their way into buildings in their search for food, living on wood and dried vegetation.

An understanding of their habits will give some guide to their detection, eradication and prevention. Dwelling areas for subterranean termites vary, but in the case of Oman, subterranean termites appear to establish underground colonies, as opposed to the mound structures established by many other groups. Mounds may occur, but this will only ease the problem of early detection. These termites have fixed nests, from which the workers move out in search of food, and to which they return with their findings. Distances of up to 100 metres can be travelled by these workers. Each community can easily number many thousands of individuals consisting of soldiers, workers and nymphs, and the king and queen who meet the reproductive needs of the community. Because of their potential vast numbers, their attack on a building can be extremely rapid. (Fig 380).

Detection.

Typical of subterranean termite infestation is the presence of soil, or a mixture of sand and chewed wood in the excavated stem or tree trunk, (Fig. 381) while earthen tubes and covered ways are constructed over impenetrable foundations and walls to provide lines of contact between the food source and the nest. When the material to be attacked is in direct

Fig 381 Post destroyed by termites

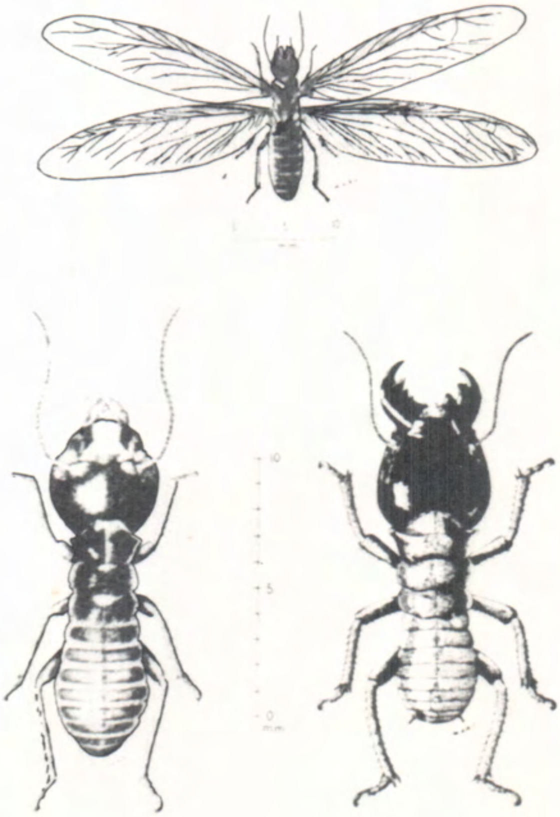


Fig 380 Termites

Fig 382 Subterranean termite attack on barasti stem with mud packing

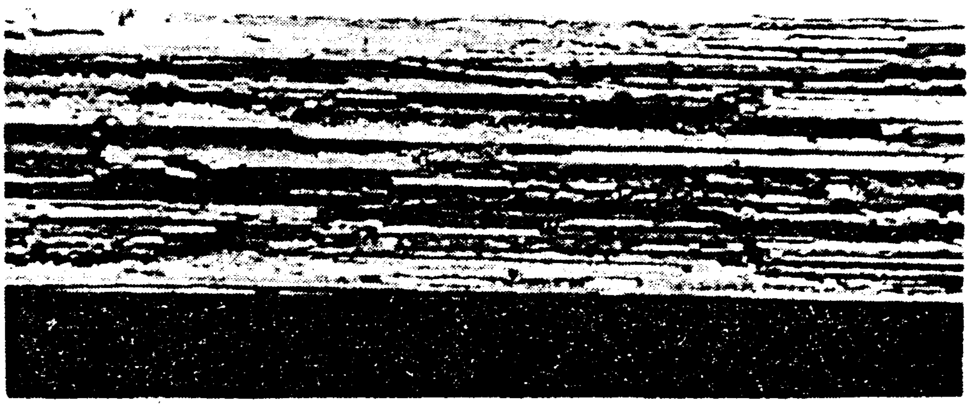


Fig 383 Dry wood termite attack on barasti

contact with the ground, termites approach it from below through tunnels in the soil, and there are no outward signs of attack. The core of the material is removed, leaving the outer skin untouched. The sand and chewed wood mixture is used to pack the hollowed out spaces and in this way maintain enough strength in the material that the attack may continue without structural failure. (Fig. 382) The soil packing also provides the important soil link to the nest without which the subterranean termite cannot live. Except during the period of swarming these termites avoid the light and dessicating air currents, and the tunnels and covered ways that they build are important in preserving their own micro-climate,

Subterranean termites remove a large area of the inside of the stem under attack, hollowing out chambers which are subsequently filled with packing material. Their great numbers in conjunction with this method combine to cause severe damage on a large scale. They are most numerous in warm moist soil, and this accounts for the increased destruction from termite attack nearer to the sea shore. They can be found in all regions with roughly the right conditions, and areas of cultivation are equally subject to attack.

Access to timber or Barasti through mud brick is possible in that mud provides a direct soil link. For methods to overcome this see the end of this section.

Dry Wood Termites (Sous)

Dry wood termites spread in small swarms of flying termites which appear at intervals during damper periods of the year. Stems become infested wherever end grains are exposed, or through splits and crevices in the surface which allow a pair of winged termites to get a foothold. Once this has happened, the wings are shed, and a small colony is developed. Colonies usually consist of 100 or so termites, and since the colony develops quite slowly, it can take quite a long time for the attack to become severe.

Initially, the only evidence of dry wood termite attack is seen by the small ejected pellets which can be found accumulating at the base of the stem. Workers make small holes in the exterior skin through which they eject these pellets of accumulated waste matter. These holes are the only major sign that attack is in progress. Slight blisters on the surface can occur where activity is very close to the outer skin. If these signs are ignored, the presence of dry wood termites can continue until physical disturbance of the material subjects the stem to strain, which will cause a fracture in the already weakened material.

Within the Barasti stem the dry wood termites travel along the grain lines, hollowing out long thin tunnels (Fig. 383), unlike the subterranean termites, which create galleries. Barasti is made up of tough fibres running along the length of the stem, with softer core material in between these fibres, which make ready channels for the termites to travel along. Partly for this reason, which allows some of the strength of the stem to be preserved, and because the dry wood termites, although extensive in occurrence, are few in numbers for each colony, it takes quite a long period of time for the damage to become critical. In comparison to subterranean termite attack, they are not as serious. Their prevention and eradication is, however, much more difficult and potentially expensive. Dry wood termites occur mostly near the coast, inland areas being largely free from infestation.

Prevention and Eradication

Subterranean Termites (Rumma)

Materials can be protected from subterranean termite attack by physical and chemical methods. Chemicals can be introduced into the material and sprayed onto the ground to create a barrier in the soil. There are various chemicals which are potentially suitable but their effectiveness varies depending upon the soil type, the chemical used, the exact termite in question, and the skill with which the chemical is applied. Impregnation of the material must often be done using a vacuum pressure process, and this plainly makes it unsuitable for widespread general use. The two preservatives most widely used are croesote and copper-chrome-arsenic mixtures.

Drawbacks of chemical treatment are that they are more often than not toxic to humans, especially children - and considering the freedom to wander that children have in most households, this can well prove to be lethal. Chemicals are also expensive both to buy and apply, relative to a villager's income. Their use brings varied results and before attempting to adopt the use of certain preservatives, extensive tests should be made under the conditions and areas of its proposed use. The United Nations have compiled data on the chemical preservatives used on bamboo. This list is included at the end of the section and may be of use in further work on Barasti.

The more suitable approach to combatting termite attack is through physical means. Where a new building is being constructed or material replaced, design features should be incorporated which can almost entirely overcome subterranean termite attack if used with care, and if in combination with these features regular checks are carried out to ensure that no termite activity has developed - for instance cutting off the soil covered ways, so that the termites lose their link with the ground and die - the Barasti stem or any other timber that may be used in the house can have a greatly increased lifespan.

The first principle to follow is to ensure that no susceptible material comes in contact with the ground, either directly or by means of a link through a termite proof material such as concrete, which can easily be bypassed by the termite. Where any fabric liable to attack is in any way linked to the ground, a termite shield, such as a metal cap, should be used, or a suitably designed base. Caps should be made out of a suitable metal that does not corrode easidy, and can be shaped to suit the situation - however any metal will be an improvement on none at all. Interior walls are equally important. No opportunity must be given for the termite to gain access to timber or Barasti. Where timber and barasti floors are used, these should be isolated from the ground, with as great a gap below as possible, since termites will build mounds up to reach timber joists and flooring, and from there into the rest of the structure. If the floor must rest on the ground, great care is required to provide shields between the floor and the ground. In the use of concrete or brickwork for bases to houses, cracks must be avoided, since they form a ready passage for termite attack. (Fig 384).

Where structural posts are set in the ground, they should be placed within metal containers or some other protective material, and these should have sides rising up above the ground level, so that there is no earth contact with the post. As an added precaution salt can be placed in the container, which will further deter termites. Salt impregnation of the material will also help, but the mixture must be quite concentrated (far more so than sea water). Furthermore, if the impregnated material is in contact with a damp surface, the salt will leak out of the treated area and the effect will be lost.

Dry Wood Termites.

Dry wood termites are far more difficult to combat. Infestation occurs by airborne termites getting into cracks, crevices and end grains. The only real answer to the problem is to treat the stem with a suitable preservative before using it in a building. Once damage is noticed, it is almost certain that it will be widespread.

Fumigation will destroy the termites already present in the material, but this will in no way deter reinfestation shortly afterwards. Impregnation will deter infestation in the first place. Both methods are expensive, can be toxic to children, and to a lesser extent, adults, and are complicated to carry out. On a more practical level, painting, especially with creosote, will help to prevent attack, especially as creosote protects the surface from splitting.

Dry wood termite attack is not as serious as subterranean termite attack, and because of the cost and difficulty of preventing their attack, it is often overlooked or ignored. It is however worthwhile taking all possible precautions to preserve the building materials, and if practical dry wood termite should be dealt with. Unfortunately it is unlikely that many of the solutions possible for dealing with dry wood termite will be within the financial range of most house builders.

General

Houses built of materials other than those liable to termite attack are not necessarily termite proof. Furniture and possessions will be equally in danger unless the same precautions are taken as for timber buildings. A fairly large number of crops, especially fruit trees, is subject to termite attack, and where reports are made of crop damage and failure, it is worth investigating whether termites are responsible, and taking suitable precautions. Other forms of deterioration to timber were noted. Soft rot is the term used for decomposition of a material by micro-fungi, when the stem or trunk becomes soft and cheesey. This occurs most when the stem is in contact with damp ground, and is primarily a surface attack. Precautions taken to prevent subterranean termite attack should cope with this problem at the same time.

FIRE TESTS

Tests have been carried out onBarasti single stems and panels in order to ascertain the performance of the material in a natural state to fire, and to compare these reaults with those when the stem or stems were protected with fire retardant paint or mud plaster. These tests were carried out using a gas fired blow lamp, held at a constant distance of 20 cms from the panel or stem surface.

The following results show three readings for each test, firstly the time that it takes for the surface to ignite, secondly, the time it takes for the flame to reach the back of the panel, and thirdly, the period of time after which failure or collapse will occur. Where single stems were tested, the time taken for the stem to collapse is given only.

PANEL TYPE	TIME TO IGNITE	FLAME REACHES BACK	MATERIAL COLLAPSE
Single thickness panel with leaves on. 2.5 cms thick	5 secs	10secs	1¼ mins
Panel as above covered with flame retardant paint	20secs*	40secs*	4mins*
	*Ignition stops when flame source removed		
Single thickness panel with mud plaster finish	5mins	15mins	18mins
Double thickness panel with leaves on. 6cms thick.	5 secs	4 mins	8 mins
	FAILURE TIME		
Single stem unprotected	2.5 mins		
Single stem protected with fire retardant paint	4.0mins		

It can be seen from this chart that unprotected stems are a severe fire risk, but that there are methods available for reducing this. Fire retardant paint, whilst allowing a panel to ignite in the area which is subjected to fire, both limits the spread of fire and extinguishesthe fire once the source of fire has been removed. In both cases the physical problem of stopping the fire is greatly reduced, and correspondingly, the overal fire risk. Mud plaster on a barasti panel provides an even greater protection against fire, but its use must be seen in relationship to the other advantages gained by the use of barasti, for instance, its ventilation and light control potentials.

Fire retardant paints used on the tests were Albi Flame Retardant paints, Rentokil Ltd, Sussex, and were applied according to the manufacturers specification.

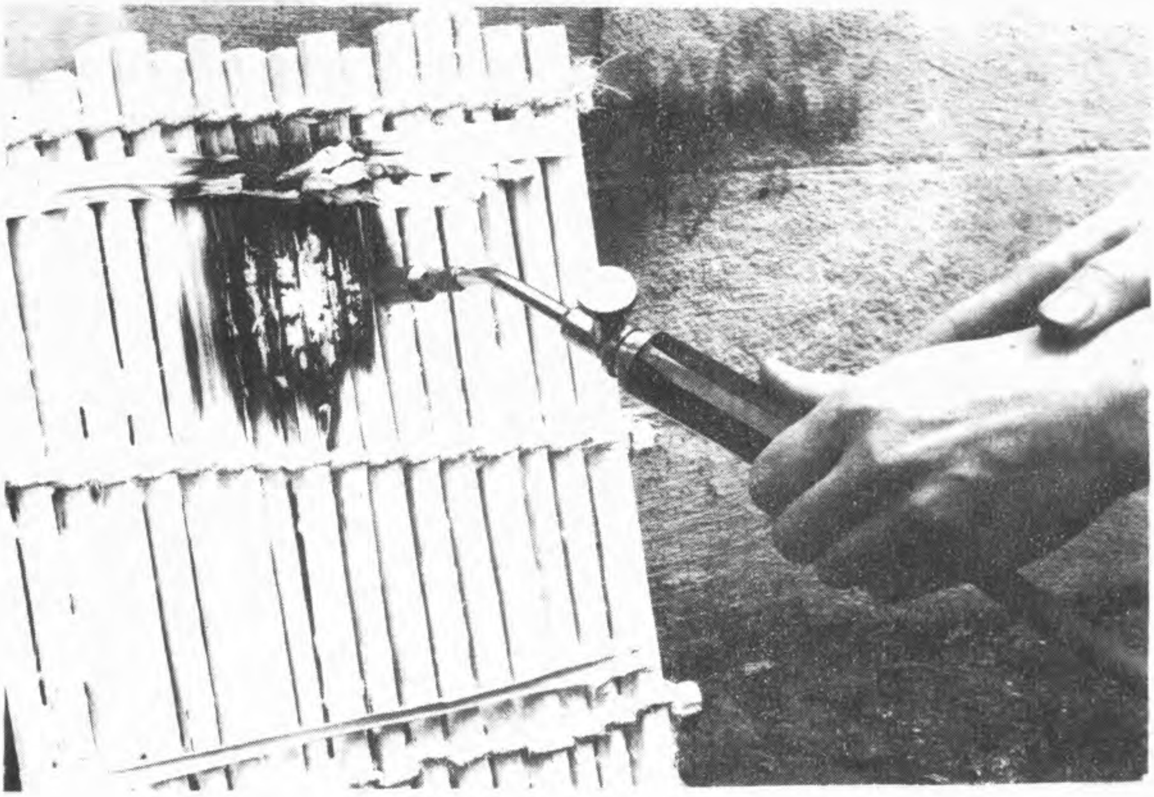


Fig 384 Fire test on barasti panel protected by fire retardant paint.

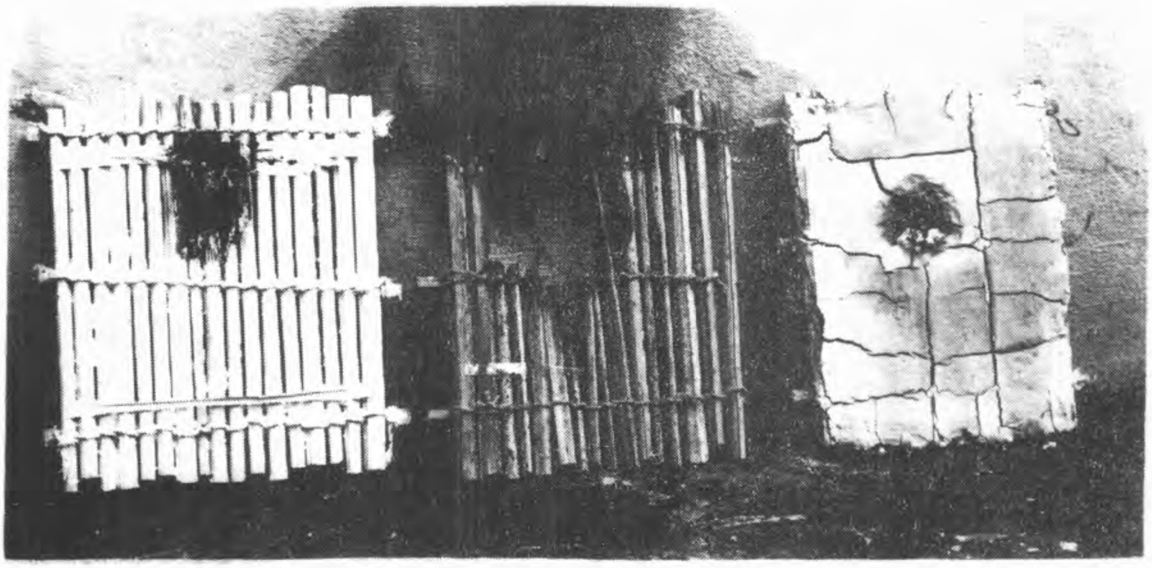


Fig 385 Panels after fire test:

protected by fire retardant paint.	unprotected	protected by mud plaster
Time taken for panel to disintegrate		
4 mins	1¼ mins	18 mins

Mud Brick

Mud brick is dealt with in detail in Section 4.4.1 (Northern Uplands) covering an area where its use is more extensive, and consequently constructional methods are not covered here. The thermal properties of mud brick in relationship to the Batinah Coast climate have been included in the thermal comparison with Barasti.

There are certain features in the use of mud brick which apply particularly to the Batinah Coast more than anywhere else in the North (The use of mud plaster with coconut barasti is covered in Section 832 on Salala). These features can be covered by the broad heading of the use of mud brick with barasti in house design. Inland of the cultivated belt, where the mud brick is mostly nsed, many of the rooms with mud brick walls have pitched roofs made in the same way as the pitched roof barasti house (3.3.3. iii). The barasti eaves often overhang the walls to protect them from the direct rays of the sun at the hottest time of day and reduce the potential heat transfer to the interior (Fig 319). Also common in this same area are houses built on a passage way form as described in Section 3.3.2A where all the walls except for that which faces the prevailing wind are built of mud brick, the remaining wall being an open barasti screen allowing the free passage of air as described in the section mentioned above.

A third feature occurs where houses are divided up into seasonal rooms, in which case a mud brick winter use room may butt onto a barasti summer room, which can in this case have two of its walls, usually the gable ends, built of mud brick. There is considerable evidence that in the past, mud brick was used more extensively immediately on the coast, but most mud brick houses that remain on the beach are now in ruins. Tests are being carried out in Cairo University on the mud brick used in this area, but at present the results are not available. It can be suggested that with the use of additives in the mud, bricks could easily be made, capable of providing a good building material, proof against the increased moisture in the air immediately adjacent to the sea.

The thermal performance of mud brick in this area is covered in Section 3.3.3 v. Fig 385 shows the restricted air movement of a winter village mud brick house.

Summary of materials performance

There is increasing use of concrete block in all areas of the Batinah Coast, but more especially near towns and the new asphalt road.

The degree to which concrete block is used in each house varies considerably and likewise its usefulness in the house. The advantages and disadvantages of the use of concrete block must be carefully considered since for too often the blind acceptance that concrete block is the answer to the housing problem leads to poor housing, performing badly climatically and costing far more than is necessary. It has been said earlier that its use as a building material is often prompted by a desire for enhanced prestige, being to many people a material synonymous with development. We would like to emphasise here that every building material has its own value in its proper context, but its misguided use can have unfortunate (undesirable) results, and with this in mind, the pros and cons of each material's use must be analysed to optimise the positive qualities of each material and minimise its use in areas where there are drawbacks.

The potentials of barasti as a building material have been given earlier in this section. It is worth quoting the Whitehead Report, stating "that housing should provide protection against extremes of weather as well as privacy and faculties for a healthy way of life. This is certainly not provided by barasti and mud houses, and to impose such standards here would be quite unrealsitic". The quote goes on to say that standards should be set up for housing, including ventilation and lighting.

This quote therefore puts forward four areas where the material is important in achieving specific features.

The performance of the various materials readily available can be compared against these four criteria. Firstly extremes of weather should be divided up into more specific areas. It has been shown in section 3.3.3.v. (Response to Climate) that mud brick as it is used in the area is a far superior insulator to concrete or barasti, (as used in their existing state), against both heat and cold and that if the thickness of barasti walls were to be increased, its insulation properties would improve considerably over concrete, while still costing less. It was also seen that during periods of both high temperature and relative humidity, heat transfer through materials plays a small part since the temperature does not fall enough to balance the hottest times of day. Under these conditions ventilation is of major importance. Section 3.3.2.b. describes the various methods employed for encouraging air movement, and emphasises that even the most basic barasti house will have a more comfortable climate than either a concrete or mud brick house during the periods of highest temperatures and relative humidity. Indigenous methods for introducing air movement into the house are also discussed (Badgir Fig. 333 and 334) and in conjunction with this, the micro climate comparison (Section 3.1.2) shows that air movement lowers the effective temperature into the comfort zone along the beach, and will do the same for the areas inland of the beach where the air movement can be encouraged (for example Figs. 325-7).

Quite plainly a solid wall will provide total visual privacy, although not necessarily accoustic privacy. In the light of the need for air movement shown above, a solid wall has drawbacks and in this context, the provision of privacy while still allowing a free passage of air is important. Section 3.3.3.v. (Response to Climate) also deals with lighting, and privacy and shows how the occupants of a barasti house will have visual privacy in exactly the same way as the sophisticated Mushrabeya of Cairo provide privacy. The section also emphasises the value of barasti as a lighting screen, providing the solution to a problem that in many other areas of the world requires considerable craftsmanship. In this context the claustre work windows found on the Batinah Coast (Fig 386) usually made of gypsum plaster also fulfill the same function, but on a far more limited and restricted scale and consequently not so effectively. Accoustic privacy in the rural context is not a great problem at the present as houses are spaced well apart from each other and great consideration is paid by an individual to his neighbours.

To achieve a healthy environment requires that the occupants of houses are both climatically comfortable and in hygenic surroundings. Much of the pre-ceeding section has dealt with the ways in which the climate is maintained within or as near as possible to the comfort zone. The subject of hygiene has scarcely been touched upon and will be covered in Section 9 (Proposals) where it concerns sewage disposal and other hygiene matters. One area of hygiene that relates directly to the materials used in building is dealt with here. Most materials except for those with completely impenetrable surfaces will harbour insects of one sort or another. Concrete block as used on the Batinah Coast has as many cavities within each block as does mud brick, if not more, given the granular formation of the former compared to the latter. Both of these materials should be rendered using a gypsum or lime based plaster which will properly seal the surfaces. It does not seem to be a major problem, in that small insects that may be harboured in any material are relatively harmless, compared to the greater problems of rats, flies and mosquitoes which are more a product of the local environments hygiene condition. Suffice it to say at this stage that rats were noted in some of the most recently erected Government Buildings, through no fault of the occupants.

We have recommended the use of concrete ground beams in the prevention of termite attack, (Section 3.3.3.vii.) and furthermore, that in conjunction with these ground beams, concrete floor slabs could be used to completely isolate the structure of the house from the ground. Greater care than is at present taken in the quality of the concrete will be required. Concrete supporting columns could well be made greater use of, although there is evidence that this is becoming quite popular already. (Fig. 387).

Underlying the use of the various materials available in Oman, and placing considerable emphasis on the climatic performance of each one, is the comparative costs of each material. A cost analysis of barasti has already been provided (Section 3.3.3.vi.). Mud brick as a material is almost equally as cheap. In a direct comparison between a pitched roof barasti room and a flat roof concrete block room, both 6 x 4 metres, the barasti room will cost roughly 50 R.O. as against 400 R.O. for the concrete one. The lifespan of the barasti room can be increased considerably by taking the suggested measures against termites, removing the main local complaint against its use. Where the annual income of most rural Omanis is low, the cost consid-eration in acquiring a house of their own is of prime importance, and over and above the climatic comfort element where as shown the indigenous materials perform extremely well, the relative prices of one material against another both capable of performing the same function should be kept in mind, both for the good of the people and the country as a whole.