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SPACE ENCLOSURES FOR EMERGENCIES IN DEVELOPING COUNTRIES*

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INTRODUCTION

The UN Center for Housing, Building, and Planning assesses that the world needs for construction of all kinds will exceed the total amount of building accomplished throughout all of human history (Slate, 1974). Particularly for people displaced by natural disasters (earthquakes, floods, typhoons and hurricanes), wars, fires, political upheavals and slum clearance decisions, there is a pressing need for action. In developing countries, however, because of inadequate construction on many levels, displacees moving in masses in destitute or nearly destitute conditions from traditional sites to new areas, receive low priorities. Generally they have no employment and very few possessions; they are truly at the bottom of the economic ladder. The provision of even minimal shelter for millions of displacees before a backdrop of widespread deficiences of food, health, shelter and education has become a seemingly insurmountable task. To make matters worse, new groups fleeing from new conflicts feed the refugee total faster than earlier groups can be taken care of (Slate, 1974).

Haider (1975), pointing to the interrelated problems of inadequate shelters, hampered human development and lacking quality of life, sees potential improvement of the situation by research and development in the following three areas:

1. systems approach to housing policy, planning, programming and management;

2. culturally sensitive architectural planning and design of housing;

3. technological and economic improvements in the materials and methods of housing.

The Carnegie-Mellon Intertect Working Party concentrates its efforts primarily on areas two and three. In order realistically to be able to serve the large number of displaced persons, the shelters under development are ultra low cost ($5-10 per person). Inter disciplinary Working Party (1975). Relief to displaced persons initially is often seen as short term, but experience indicates that it usually is longer term than first intended. Providing inexpensive, culturally acceptable, upgradable shelter from local materials and labor can obviously be of great importance. It is the 'bottom-up' approach, assisting the poorest, which the Carnegie-Mellon team is using to find answers to the pressing problem of shelter for the people of developing countries.

The interdisciplinary working party recognizes that varying local conditions in disaster-prone areas (i.e. variations in culture, population density, economic development, climate, topography, availability, cost and use of building materials; and the differing nature of catastrophes in and of themselves (cyclones, floods, earthquakes, wars, etc.)) preclude the development of a single, universally acceptable shelter prototype.

Thus, the interdisciplinary working party decided to concentrate its initial efforts in three areas: first, the development of a building process and methodology which can be applied to a wide variety of situations; second, the development of a prototype housing unit which could be built throughout large areas of the world with whatever materials were on hand locally; and third, the introduction of technological processes to improve indigenous building techniques and construction practices. All were incorporated into a design program to produce an evolutionary shelter, a unit which provides immediate shelter for refugees and, with modifications, can be turned into a long-term house. By concentrating efforts on developing shelter for refugees, who are traditionally the people on the lowest rung of the housing ladder, the resulting technologies could be applied to the problem of providing housing for the ultra low income urban and rural populations in the Third World (Fathy, 1973).

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The major objectives are:

(a) to maximize utility with minimal means;

(b) to maximize material utilization with minimal effect on the environment;

(c) to enable almost immediate response to emergency situations;

(d) to maximize amenity to the users with minimal means.

APPROACH TO A SOLUTION

"Only some orderly resolution of the three modes of designing that exist today – designing at a distance in indifference or contempt, designing by the outsider who respects and knows the people for whom he or she is designing, and designing by one of those for whom the thing designed is to be used – can possibly restore a world of 4,000,000,000 people, in which mass production in many cases is cheaper and wiser, to some semblance of meaningful relationship between themselves and the tools and houses and clothes and utensils that they use. And this resolution must be achieved soon, for the building begins each day" (Mead, 1975).

In Table 1 major resources for the design and provision of shelter for emergencies in developing countries are listed. Resources are grouped into physical, socio-economic, and socio-cultural categories. Attempts are made to delineate what presently appears to be the most appropriate use of the various resources listed (Fathy, 1973; Papaneck, 1971; Schumacher, 1973; Turner and Fichter, 1972). Many relationships are self-explanatory. For instance, it is obvious that in the construction of shelters, the use of materials foreign to an area should be minimized, whereas the use of materials, renewable energy and labor indigenous to that area should be maximized. Other relationships are less well understood or accepted; some are more problematic.

Socio-cultural patterns as resources

In the past, housing solutions have created many unforeseen problems because of inherent incompatibilities with existing socio-cultural structures and patterns. Unsuitable materials, material assemblies, building shapes and layouts not only brought about habitats with uncomfortable internal climatic conditions for instance, but often were in effect destructive to the cultural identity of whole regions. Generally, the aim should be to achieve high degrees of similarity and familiarity to existing political, social, and labor patterns in the solution approaches to shelter designs and construction implementation. Particularly in dealing with refugees this seems imperative. While the emotional and physical status of refugees varies greatly according to the nature of the disaster and how long the people have been refugees, certain generalizations can be made concerning behavioral aspects. In his study, Refugee Camps and Camp Planning, Cuny (1974) identifies the phases of personal adjustment that refugees undergo in refugee camps. The general improvement of emotional and

Table 1. Use of resources

Foreign		Resources	Indigenous	
maximum	minimum	Degrees of use	minimum	maximum
		Socio-cultural resources		
	x	Political		x
	x	Social customs		x
	x	Value system		x
	x	Labor-skills		x
		Educational system		x
		Socio-economic resources		
	x	Capital	x	
	x	Labor, employment		x
x		Scientific and technical concepts		x
x		Administrative, managerial concepts		x
		Physical resources		
	x	Materials		x
x		Materials improvement		x
	x	Renewable energy		x
	x	Nonrenewable energy	x	
	NA	Land	x	

behavioral aspects is seen to be a function of stability, organization, involvement and improvement of the physical environment. The Working Party addressed these functions in the design program for the prototype. First, the various behavioral aspects of refugees were outlined as design constraints. The constraints were then grouped under the functions outlined above. The results were as follows.

1. *Stability.* In order to encourage stability, the structure must be of a design similar to existing housing types or familiar to the region. Thus, the constraints identified which would promote stability were familiarity and similarity.

2. *Organization.* In order to be successful as relief housing, the structure must facilitate refugee organization. This requirement had to be met in 2 ways. First, the unit had to lend itself to encouraging administration by design. In other words, the structure had to be designed from the viewpoint of a refugee camp administrator. Second, the structure itself had to be designed to be part of an organizational effort, i.e. it had to lend itself to mass production by the refugees themselves. To meet this requirements, the prototype had to be easy to understand, simple to build, and able to utilize pre-fabrication techniques.

3. *Involvement.* To be able to involve the refugees, the prime constraint was to design a structure that could be built with those tools, materials, and building techniques with which rural people in the developing countries would be familiar. If the refugees could not use their own limited tools, in all likelihood the structure would not be built.

Refugee situations often come about because of great imbalances in the political and social structure of a country. Aid for the poor affects, and is affected by, existing political and social structures. On one hand, if attempted solutions disregard political realities and social preferences, they cannot be implemented; on the other, if the assistance is strictly confined to adhere to what may be a grossly imbalanced social structure, the benefit to the people in need is often negligible. This dichotomy is at the heart of many problems in foreign assistance. Therefore, the Working Party develops concepts which can be implemented directly by the population in need.

Socio-economic resources

Housing goals must become compatible with the resources the indigenous socio-economic environment can provide. (Haider, 1975). Spiralling, unrealistic expectations make housing for large segments of populations in developing countries unattainable. Construction techniques generally should be local labor but not capital intensive. Suitable scientific and technical concepts, such as optimization techniques and engineering analysis, should be employed to improve the materials, their production, utilization and joining. Hassan Fathy's work provides meaningful illustrations for this point (Fathy, 1973). Instead of importing synthetic foreign materials, preference should be given to the use of advanced administrative and managerial know-how (i.e. mass production techniques, task scheduling, land management, etc.).

Physical resources

The use of indigenous building materials, particularly in emergencies, is to be preferred, since transportation can be minimized, unnecessary outflow of capital prevented, and similarity to existing housing designs more easily achieved than by using foreign material (Davis, 1976). In addition, the amount of time needed to respond to disasters can be minimized.

Local, mostly natural, materials such as bamboo, wood, thatch, etc., are subject to various pests. Their life span is often unacceptably short because of fungi, vermin, fire and general deterioration. Structural and other characteristics, however, can be dramatically improved by appropriate material treatments, joining and overall design. The literature is especially rich in this sector. The East-West Center, for instance, reports on many advances achieved in the treatment of wood against decay and termites; utilization of wood waste; utilization of now little-used species of timber; simple industrially-produced components; stabilized-earth blocks; lime-pozzolan-sand blocks; improved lime manufacturing; mortars to match the various masonry units; clay roof tile; and bamboo matting production (Dietz and Poerbo, 1975).

Other articles provide progress reports along similar lines (Campbell, 1975; Monsanto Research Corporation, 1975; Saini, 1967). Some techniques utilize traditional knowledge; others focus on the application of advanced engineering concepts.

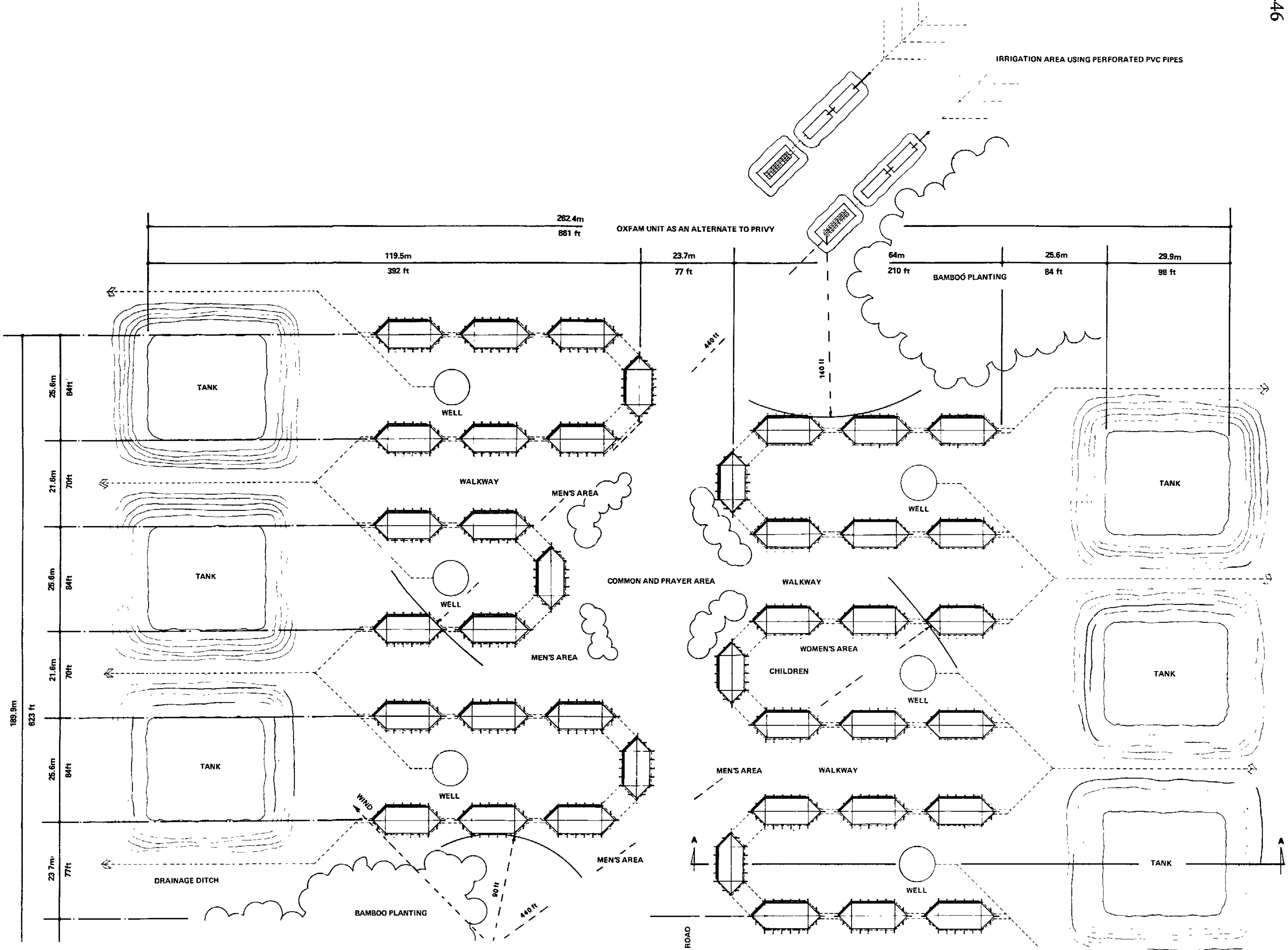
Given an overall energy shortage, it is imperative that in all building projects the use of non-renewable energy be minimized, both in initial construction and long-term operations. The employment of renewable sources of energy, coupled with useful environmental impact studies, should be encouraged.

Habitable land must be treated as a scarce resource, particularly in countries such as Bangladesh, where an exploding population has already destroyed the delicate balance between land for habitation, agriculture, and transportation.

THE CARNEGIE-MELLON INTERTECT CAMP PLAN, SHELTER PROTOTYPE DEVELOPMENT AND IMPLEMENTATION FOR BANGLADESH

Camp plan

The camp layout shown in Fig. 1 is based upon the socio-cultural, socio-economic, and physical characteristics illustrated in Fig. 2. The camp is designed to hold 1,600 refugees close to Khulna, southern Bangladesh. The area is subject to


IRRIGATION AREA USING PERFORATED PVC PIPES
OXFAM UNIT AS AN ALTERNATE TO PRIVY
262.4m
861 ft
119.5m
392 ft
23.7m
77 ft
64m
210 ft
25.6m
84 ft
29.9m
98 ft
BAMBOO PLANTING
440 ft
140 ft
TANK
WELL
WALKWAY
MEN'S AREA
COMMON AND PRAYER AREA
WOMEN'S AREA
CHILDREN
WIND
DRAINAGE DITCH
BAMBOO PLANTING
90 ft
440 ft
ROAD
189.9m
623 ft
25.6m
84ft
21.6m
70ft
23.7m
77ft
A

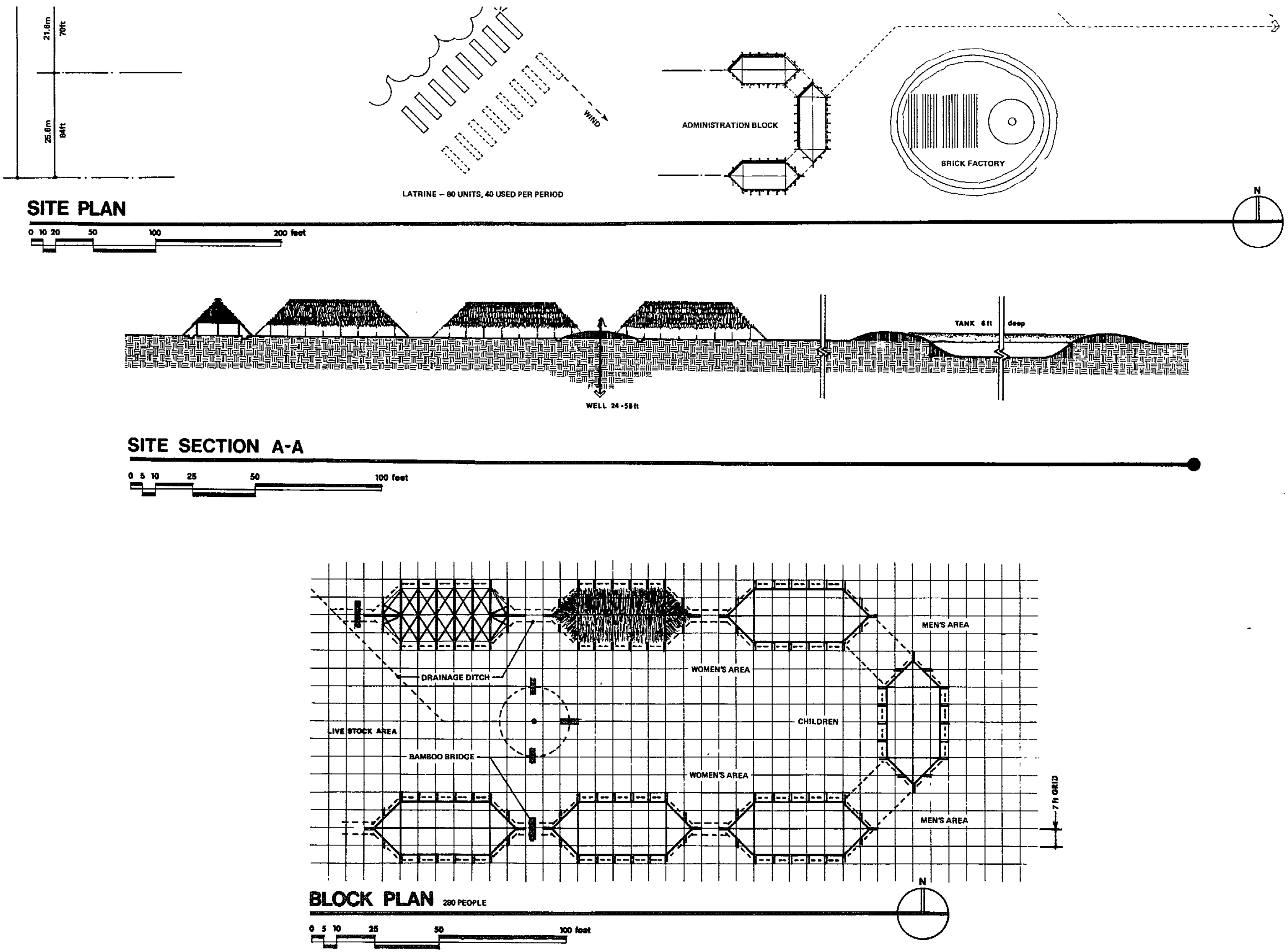
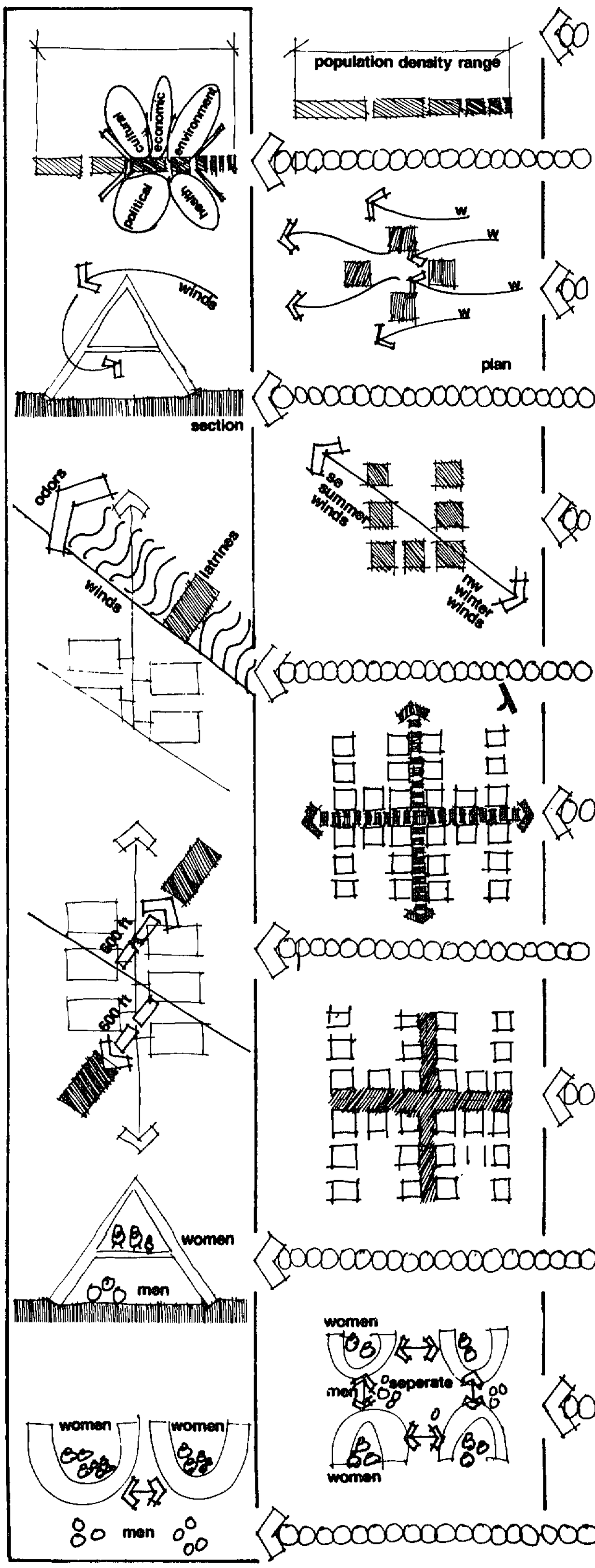

21.6m
70ft
25.6m
84ft
LATRINE – 80 UNITS, 40 USED PER PERIOD
WIND
ADMINISTRATION BLOCK
BRICK FACTORY
N
SITE PLAN
0 10 20 50 100 200 feet
TANK 6ft deep
WELL 24-58ft
SITE SECTION A-A
0 5 10 25 50 100 feet
MEN'S AREA
DRAINAGE DITCH
WOMEN'S AREA
CHILDREN
LIVE STOCK AREA
BAMBOO BRIDGE
WOMEN'S AREA
MEN'S AREA
7ft GRID
N
BLOCK PLAN 280 PEOPLE
0 5 10 25 50 100 feet

Fig. 1.



LAND USE MUST BE OPTIMAL AND THE INESCAPABLE CONSTRAINT OF MODERATE TO HIGH POP. DENSITY CONTRIBUTES TO THE DEVELOPMENT OF A CAMP PLAN.

RESOLUTION OF THE CAMP SIZE IS A COMBINATION OF MANY CONSTRAINTS, EACH ONE OF WHICH HAS AN OPTIMAL SOLUTION WHICH SOMEWHAT IMPINGES ON ALL OTHER AREAS OF CONCERN. THE OPTIMAL CAMP PLAN IS THE SOLUTION WHICH LEAST DISTORTS THE BEST OF ALL CONDITIONS.

STAGGERED ORDERING OF HOUSING UNITS BEGIN TO UTILIZE CROSS VENTILATION AND DIRECT WIND FLOW INTO OTHERWISE DEAD AIR SPACES.

"A"-FRAME CONSTRUCTION OF THE STRUCTURE PROVIDES FOR INCREASE OF SECONDARY WIND MOVEMENTS WITHIN THE BLOCK OR COMMUNITY SPACES.

GOVERNING WIND DIRECTION FOR THE KHULNA DISTRICT OF BANGLEDESH IS FROM THE S.E. IN SUMMER AND N.W. IN WINTER. ORIENTATION OF THE BLOCK TO USE THE COOLING EFFECT OF THE SUMMER WIND IS A PARAMOUNT CONSIDERATION.

PROPER ORIENTATION DUE TO ODOR DRIFT CAUSED BY WIND IS A MAJOR CONCERN FOR PLACEMENT OF THE LATRINES. DOWNWIND SOLUTIONS ARE UNREASONABLE IN AREAS WHERE SEASONAL SHIFTS IN WIND DIRECTION OCCUR.

COUPLED WITH THE NEED TO MOVE WITHIN THE CAMP, THE ORGANIZATION OF BLOCKS AROUND A TRANSPORTATION ARTERY OF BLOCKS BEGINS TO FORM A PATTERN WHICH DEFINES EACH BLOCK AS A LIVING UNIT WHILE REMAINING A PART OF THE WHOLE CAMP.

BESIDES ORIENTATION DUE TO WIND FACTORS THE DISTANCES TO WALK TO LATRINES MUST BE REASONABLE. A DISTANCE OF 600 FEET IS NOT UNREASONABLE AND PEOPLE OF THIS AREA HAVE BEEN KNOWN TO WALK CONSIDERABLY MORE TO USE LATRINE FACILITIES.

IN OUR PARTICULAR CASE THE CULTURAL CONSTRAINTS IMPOSED A SEPARATION OF SPACES INTO AREAS USED EXCLUSIVELY BY MEMBERS OF A SINGLE SEX.

THE SO CALLED "WARD" SYSTEM OF ORGANIZATION IN WHICH SUBGROUPS OF REFUGEES RESIDE AS A GROUP LIVING WITHIN A SINGLE BLOCK BEGIN TO APPROACH A NORMAL BENGALI LIFESTYLE AND DECIDEDLY LESSEN THE BARRIER TO EFFICIENT CAMP ADMINISTRATION OFTEN ENCOUNTERED IN A CLOSE ORDERED CAMP.

RESOLUTION OF CULTURAL PATTERNS MUST OCCUR AT EVERY LEVEL OF THE CAMP DEVELOPMENT. THE "A"-FRAME STRUCTURE PROVIDES FOR SEPARATE SLEEP AREAS USED BY THE DIFFERENT SEXES AS IS THE CUSTOMARY RULE OF BENGALI SOCIETY.

SEPARATION OF "WARDS" AND DEFINITION OF SPECIAL AREAS FOR USE BY MEN AND WOMEN IS ACHIEVED IN THE PROPOSED CAMP PLAN. A PRAYER AREA USED BY MALES FITS NICELY INTO THE PLAN AND BEGINS TO UNITE THE CAMP INTO A UNIT.

SMALL "WARDS" ARE ALSO A PART OF THE BENGALI CULTURE WHERE KINSHIP OR SOCIAL TIES BEGIN TO UNITE INDIVIDUALS OF THE BLOCK INTO A DEFINED UNIT OF SOCIETY. NORMAL BENGALI LIVING PATTERNS TEND TO THESE SMALL CLUSTERS SEPARATED BY RICE FIELDS AND ARRANGED LINEARLY ALONG RIVER BEDS.

DESIGN DEVELOPMENT

Fig. 2.

floods in the rainy season; the climate is tropic, and displacees, primarily of Moslem religion, have little or no income.

The diagrams were part of the submission to the International Union of Architects (UIA) Emergency Housing Competition, 1975, Madrid, Spain. The Carnegie-Mellon team received the prize of the Soviet Union.

General characteristics. The camp plan represents an attempt to optimize land use by avoiding overcrowding, which would lead to unacceptable sanitary conditions. Seven wards accommodating approximately 1,500-1,700 people with common spaces, latrines and an administrative and storage center comprise the designed camp. Each ward consists of 7 large shelters, which are used to house up to 6 families, 1 water well and 1 tank (for bathing).

The site is assumed to be linear, along a shallow river embankment, with fields located in the area adjacent to the camp. A road bisects the camp and provides transportation across the length of the village. The arrangement of the housing units into parallel wards allows communities to form according to cultural or religious preferences. Easy access to every family unit is provided. The arrangement of structures perpendicular to the road reduces the total length of walkways required, without loss of unit isolation from adjacent structure or other wards.

The plan for the camp was shaped by considering socio-cultural, socio-economic, and physical factors. Its layout also reflects the concern for phased construction, thereby avoiding managerial problems (generated mainly by having too many refugees on site before adequate shelter can be provided). Phased construction also allows the advantageous employment of the skills and labor potential of the displaced people.

Phasing. In the wake of disaster, and after the general extent of damage has been established and reasonable solutions formulated, sites for camps are selected, According to the plan, 250-300 refugees are permitted to enter the respective sites where they are registered and sheltered in tents, if the climatic conditions require such action. Among those 300 people, it is estimated, 50 refugees can be asked to perform the various building tasks. Construction materials are brought to the site, while work parties are assembled and skills and techniques are taught. The drainage system, water well and the 7 shelters for the first ward are built, as well as the 3 structures for the administrative center and portions of the latrines.

After ward 1 is completed and occupied, the future inhabitants of ward 2 are permitted to enter the site and are sheltered in the tents previously occupied by members of ward 1. Members of ward 1 and 2 now work together to establish ward 2 and 3. When completed, ward 2 members move in, the tents are taken down, and members of ward 3 are registered and moved into their ward structures. The final phase of the basic construction of the camp now takes place, with working parties of wards 1, 2 and 3 building wards 4, 5 and 6. With all wards constructed, 800-900 additional refugees can be accommodated in the camp, bringing it to its capacity.

Once all shelters have been completed and occupied, the inhabitants will be supplied with material to produce separation walls in the form of matts, the added-to kitchens, earthen stoves, etc.

From each ward, large labor groups will be recruited at this stage to dig the tanks for bathing. The excavated earth will be used to raise the ground floors of all structures, as well as to build up berms around the tanks. Upon completion of all major components, a teaching program is initiated. People are taught to produce building materials, such as bricks made by stabilizing soil as well as burning clay, shingles for roofs, matts, etc.

Block plan. As a result of the development described above, the block plan represents an attempt to provide living space for an identifiable social grouping within the camp and to eliminate impersonal monotony while it enables relief administrators to efficiently oversee the camp. The arrangement of shelters provides an enclosed work and garden space for Bengali women and protected playing areas for children outside the shelter. Each block contains 1 water well and tank, thus including 2 vital facilities in the everyday life of Bengali families. Areas between blocks are mainly used by men for their work (repair work, tailoring, haircutting, etc.) and socializing. The physical separation thereby supports the traditional need to physically separate activities performed by the different sexes. This would encourage the feeling of security compatible with the cultural experience of the people, and therefore aid in the normalization of life in the camp.

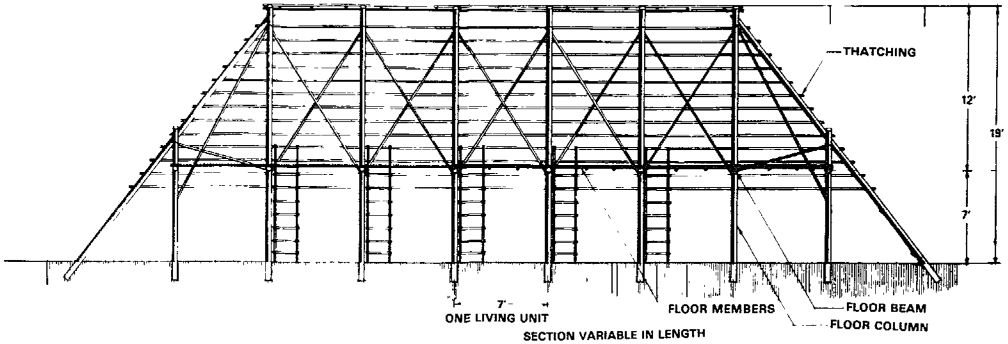
Shelter design

Prototypical shelters were designed, developed, and tested at Carnegie-Mellon University (1973-1974), the jungle of Guatemala (1974), and finally under actual field conditions at various camp sites in Bangladesh (1975).

Shelter design factors. The cost of shelter per person was not to exceed $10; materials indigenous to tropical areas were to be primarily considered; local labor and building skills were to be employed in the construction exclusively; the structure was to be flood and storm resistant; administrative personnel were to be able to check easily for illness and death within all shelters erected; and in order to stabilize otherwise further deteriorating relief situations, the shelter was to lend itself to an organized mass production, encouraging involvement and self-help of refugees. The designs were to be as similar to existing housing as possible.

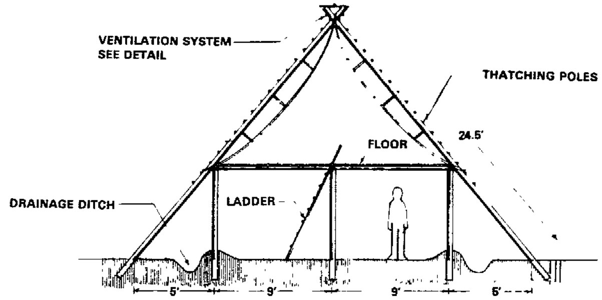
Shelter description. The shelter consists of three independent components: The main framing; the flooring; and the roof framing and covering. (See Fig. 3, Unit Design.)

The main framing consists of an A-frame, diagonal bracings, and a ridge pole and associated connections. An A-frame



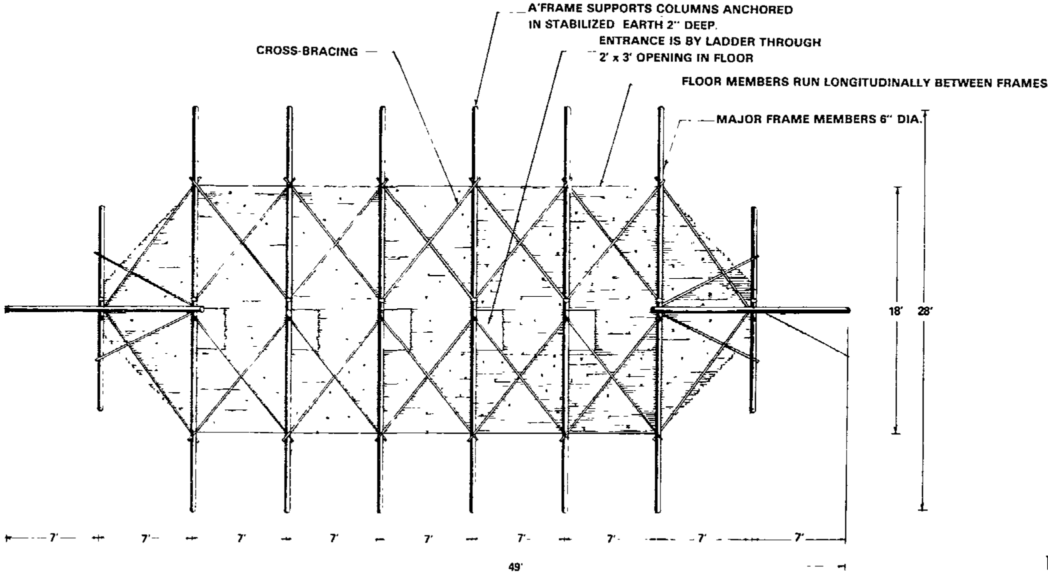
LONGITUDINAL SECTION

0 5 10 15 feet



TRANSVERSE SECTION

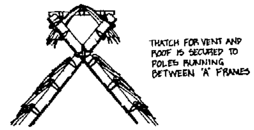
0 5 10 15 feet

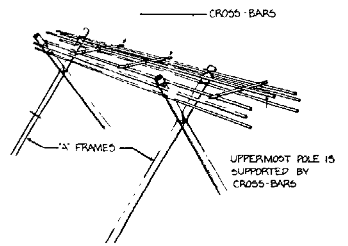


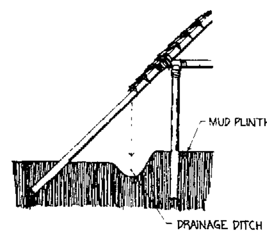
NOTE THATCH, THATCHING POLES; VENTILATION SYSTEM ARE NOT SHOWN

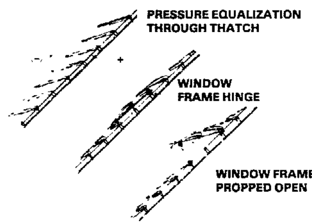
FLOOR PLAN

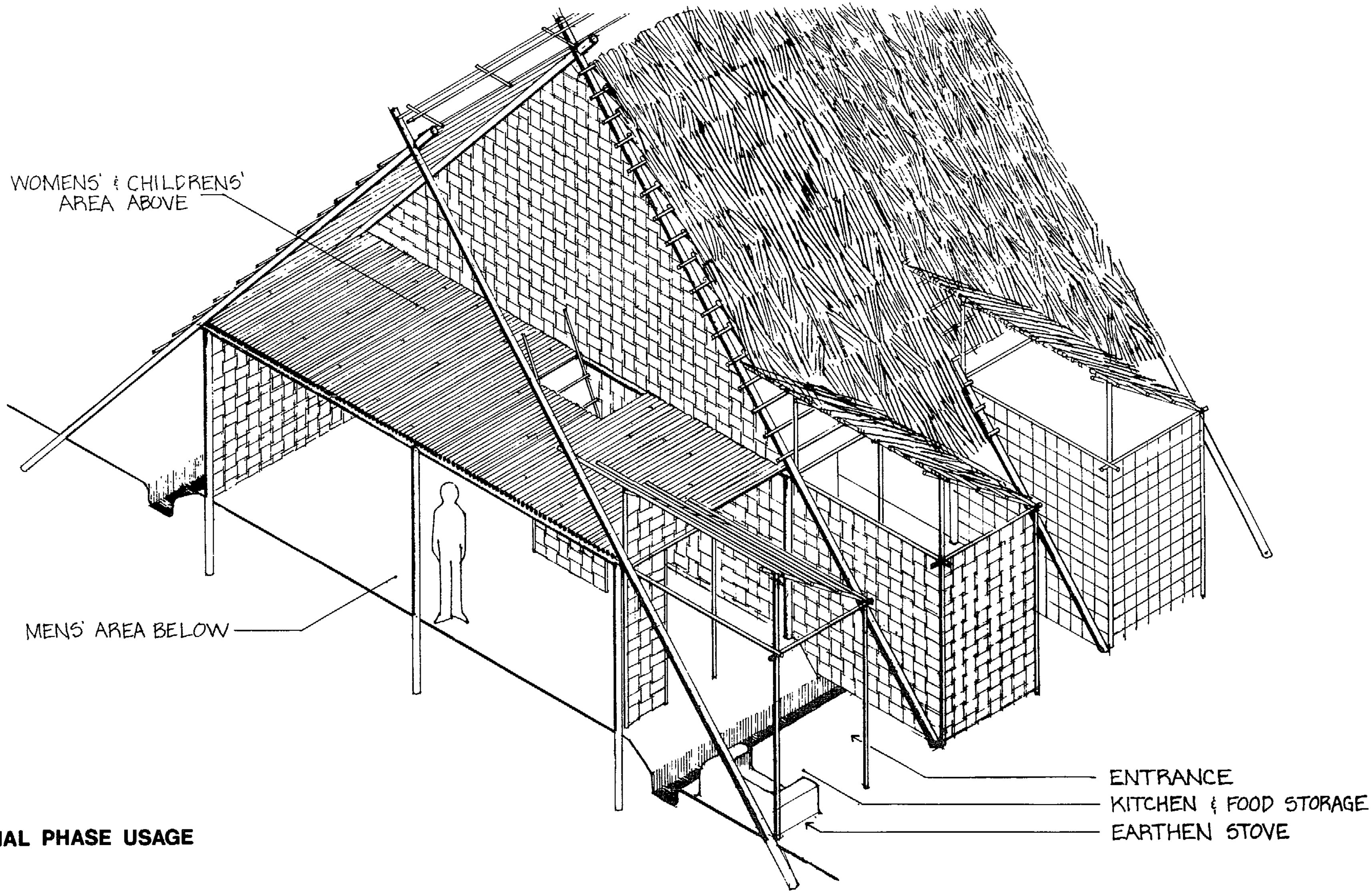
0 5 10 15 feet











FINAL PHASE USAGE

Fig. 3.

consists of two large wooden members notched and bound at the top to form a durable joint. The height and spacing of the frames can be modified as required by the structural strength of the members and induced forces. The diagonal bracing between the A-frames is assembled separately from the roofing components. The connection details for the diagonal bracing resist either compressive or tensile forces, depending on the direction of wind loading.

The flooring system consists of the floor, supporting beams and columns. The flooring configuration remains fixed with the construction details varying slightly, depending on the material properties. The beam-column connections for the flooring system do not change, but the spacing for the beams and columns vary with material properties. The column height and anchoring system is dependent on the expected local flooding conditions.

The design of roof framing and covering components depends on the properties of the covering material used. A means of venting was devised for the vertex of thatched roofs.

Shelter adaptations. The shelter can be modified to accommodate many material, environmental, administrative, cultural, and technical concerns. While it closely resembles housing unfound throughout the tropical areas, the unit improves on indigenous shelter by: maximizing the utility of each component by minimizing the amount of material necessary for construction; relying almost exclusively on locally-found materials; and providing refuge from the most severe natural forces occurring in a tropical environment.

The structure can be built entirely on site, or major components may be prefabricated by refugee work teams, speeding up the construction process. Depending on the need and the number of workers available, hundreds of units can be built per week.

After providing shelter, the units can incorporate added functions, such as separation of families or cooking of meals. The isometric view shows the added kitchens and dividing walls. (These are not meant to withstand severe winds, nor floods. Securing such additions would require considerable extra costs without reasonable benefits in exchange.)

The unit design supports the cultural traditions of the people it intends to serve by providing the possibility for the separation of sexes and age groups (lower floor for men, upper floor for women and children), enabling individual entrances for each family unit, and separating public from private spaces.

The structure, while providing shelter and privacy for its users, enables administrators easy access to check for sick and undernourished people.

Field tests in actual relief situations

A number of structures were built in actual relief situations following the prototype construction program in Bangladesh during March, April and May 1975. After careful selection, sites were chosen in each of the major relief camps in the Dacca area, and structures were erected under the supervision of one of the team members. A brief description of each project follows.

1. *Mirpur Bihari Camp, CMU (N. Dacca).* In a project funded by the Oxford Committee for Famine Relief, U.K. (OXFAM), the CMU-Intertect team initiated a construction program which involved the provision of up to 80 family units in 23 structures as part of a joint program (OXFAM–Mennonite Central Committee-UNICEF-CMU) to rehabilitate a 100-yard square section of the Bihari Camp. The team developed a basic site plan for the development of the area, supervised the site preparation, trained a team of Bihari residents to build the structures, and supervised the construction of the first unit. Remaining units will be built by the Biharis under the supervision of the Mennonite Central Committee field representative and a local Bengali architect who was trained to take over the project. The structures are of a variety of sizes, from small, 2-family units to 1 large 7-family unit. Some have 2 floors, but most have only a mud plinth. All are constructed with bamboo frames, bamboo mats, and jute rope cross-braces. These structures are designed to be long-term replacement housing in a refugee camp environment (see Fig. 4).

2. *Demra Bustee Camp (10 miles south of Dacca).* The Bangladesh Red Cross funded the construction of 1 2-family unit at the Demra Camp. The object of this test was to determine the costs (Tk 500 per family) and the stability of the unit under high wind conditions and in a refugee camp environment. The structure is made of bamboo frames with a sungrass covering. The staff sited the structure, trained a team to construct it and provided occasional supervision to the construction team. This project was also supported by the League of Red Cross Societies (see photos).

3. *Tongi Bustee Camp (20 miles north of Dacca).* One demonstration unit (2-family) was funded by the Presbyterian Mission representative at Tongi following the devastation of the camp by high winds and rain. The team provided supervision of initial construction. The majority of the work was carried out by a contractor of the Mission. The unit was constructed of bamboo frames with bamboo mats and has a 3 ft above ground bamboo floor (see photos). Support for the project and continuing interest has been provided by HEED and the Bangladesh Red Cross, as well as the camp's engineer. Originally designed for 2 families, 4 now camp. The government of Bangladesh has announced its intention to build larger units in the low-lying, flood-prone areas of the camp, though to date no funds have been appropriated. The purpose of this test is to determine the unit's application as short-term, interim housing in a flood-prone refugee camp environment (Interdisciplinary Working Party, 1975).

Existing conditions
Mirpur camp, DACCA,
Bangladesh – spring 1975

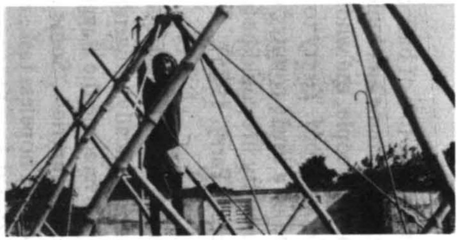


Construction sequence

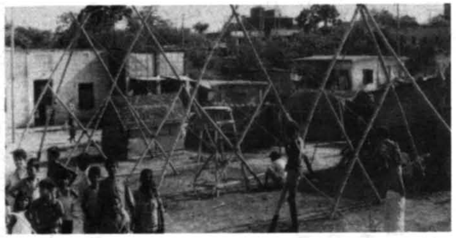
1. Level site
2 Erect A-frames
3. Tie cross bracing

1

2

3


4. Overall view
5. Mount stringers
6. Prepare shingles

4

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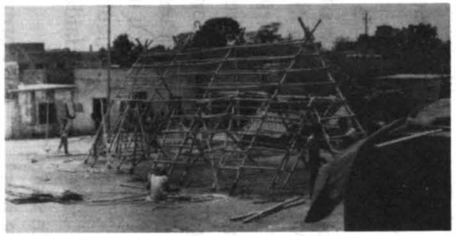
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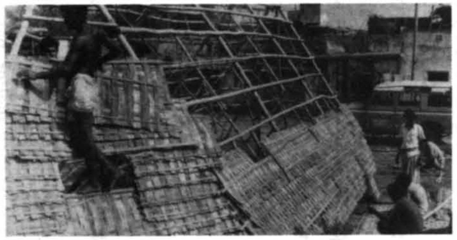
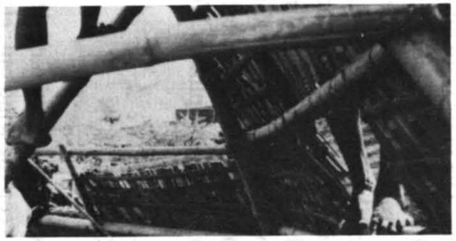
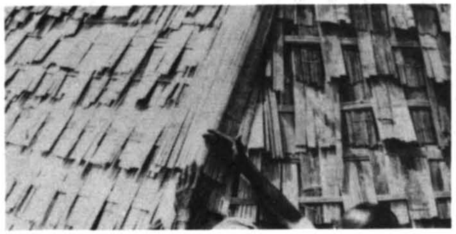
7. Mount shingles
8. Interior view
9. Partially complete

7

8

9


10 Corner detail
11 Inhabited structure
12 Completed ward

10

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12


Fig. 4

Village or rural housing

Two units were constructed in a project funded by the Community Development Foundation/Save the Children Fund at the village of Kinda in the Comilla District. The sites were selected by the CDF local representatives, as were the families who were to receive the structures. The purpose of the project was to test the structure as a long-term replacement unit for structures destroyed in natural disasters in rural areas and to test acceptability by local residents. The site selected was one which was repeatedly struck by floods and cyclones; thus the environmental suitability is also observable.

The staff provided a trained Bengali team and also trained several local people in the construction procedure. One team member supervised the construction of the frames but left the finishing to the local people. The units were built of bamboo frames and sungrass thatching. The CDF will monitor the structures over the next 2 years and will provide the CMU team with their appraisal of the unit in this role.

In addition to these units, UNICEF contacted the team about constructing several large-size structures in the Mymensingh area for use as schools and auxiliary buildings. The Bengali architect trained by the staff will undertake this construction in the near future (Interdisciplinary Working Party, 1975).

CONCLUSION

"There is no universal solution to building design. In some places it is desirable to keep the wind out; elsewhere it is desirable to let it in; similarly with sunlight. In some places people may want roofs to be flat, providing a high place to sleep during hot nights or an area to dry food-stuffs; elsewhere the roof must be steeply sloped and strong to prevent damage from snowfall. Some cultures have small family units of 4 or 5 people for 2 generations; others expect all living family generations and close relatives to live together in households of 20 or 30. In Borneo, where some people dwell in simple lean-to's of bark and leaves, other tribes go to the opposite extreme and build huge long-houses where several hundred people, the whole population of a village, all live under one roof. To try to standardize the building systems even of a single country could tamper with cultures. Community life could be altered with unknown consequences" (Parry, 1975).

Neither using imported construction systems and materials nor emulating romantically indigenous building traditions will enable us to overcome the staggering shortage of shelter in the developing countries. "Some may conclude that housing the world's poor is a hopeless task, and others may have serious doubts that the problem can be solved to any significant degree. Many of us, however, believe that attempts must be made, and that solutions far better than those that have been tried can be found" (Slate, 1974).

"The ultimate morality is to do more of the desirable with less of the undesirable. This ideal serves as the criterion that can distinguish between elegant solutions and extravagant solutions; it is the true essence of optimality. Holistic optimality implies a criterion function that encompasses all concerns relevant to that problem. Thus lowest cost, highest durability, maximum privacy, lowest density, etc., each in themselves are incomplete criteria, and their singular pursuit will yield holistically sub-optimal solutions" (Haider, 1975).

Formulating and following an holistic approach to the design and implementation of ultra low cost shelter for emergency use in developing countries, the Carnegie-Mellon University Intertect work has proven successful under actual field conditions in Bangladesh. Encouraged by the results, the team is presently expanding its activities to include the development of prototypes—utilizing the already tested aporoaches—for arid and semi-arid and earthquake-prone regions in Africa and Latin America.

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