CMU PROJECT REPORT 76/77

PROJECT REPORT 76/77

399

Table of Contents

Studies CMU/INTERTECT Team Members have Participated

in during 1976 - 77

1. U.N. Disaster Relief Office Emergency Shelters Study - Policies

2. U.N. Disaster Relief Office Emergency Shelters Study - Case

   Studies on the impact of shelter and housing assistance

   A. Socio-Anthropological considerations
   B. High Aid Impact
   C. Intermediate Aid Impact
   D. Low Aid Impact

3. OAS Study of Post-Earthquake Reconstruction Issues in Guatemala

4. long term impact of emergency shelter

5. National Academy of Sciences Committee on International Disaster Assistance, Workshop on Emergency Shelter

6. USAID Disaster Preparedness Seminar 1976, 1977

7. Guatemalan NGO Self-Evaluation Workshops

Disaster Relief Operations that we have Particiapted in

1. Guatemala - Post-Earthquake Emergency and Reconstruction Programs
   OXFAM - AM. OXFAM - AM.

2. Guatemala - Post-Earthquake Reconstruction and IRDP - Save the Children Alliance

3. Indonesia - Post-Earthquake Emergency and Reconstruction Program-OXFAM

4. Lebanon - Post-Civil War Reconstruction Project - SCF/CDF

November 24, 1976

Mr. William Beller
Office of Science and Technology
Agency for International Development
Department of State
Washington, D.C. 20523

Dear Mr. Beller:

This letter is to inform you of the schedule of project-related activities which the CMU/INTERTECT team will be conducting over the next several months.

1) Completion of Phase I:--A member of INTERTECT will visit Bangladesh during December and January to follow up the activities initiated in Bangladesh under the feasibility study. A report will be prepared on the follow-up activities and submitted in mid-February 1977.

2) Survey of Proposed Test Sites: Before and after the visit to Bangladesh, a member of INTERTECT will visit various sites in Asia and Africa which could become possible test sites for the project. Travel to these sites will be under sponsorship of the U.N. Disaster Relief Office, not U.S.AID. During the trip, he will meet with various officials of the U.N., relief agencies and local governments to establish the linkages necessary to carry out the project. A report on the visits and the selection of test sites will be submitted in mid-February 1977.

3) Establishment of Linkages: IN December 1976, Volker Hartkopf of Carnegie-Mellon University will attend a low-cost housing conferance in Israel. En route, he will visit various VOLAGS working in the field of emergency shelter in the U.K., Belgium and Geneva. The purpose of the visit will be to establish linkages and exchange information with organizations conducting research in emergency shelter. Hartkopf may also visit several proposed test sites en route to Israel. Portions of this trip will be funded by the contract.

4) Soil Stabilizer: Work on the soil stabilizing agent is proceeding at CMU. While progress has been slow, it is felt that the first stabilizing agents will be ready for field tests at the W. Texas site in late spring of 1977.

5) Methodology: Significant progress has been made in developing the methodology and new directions have been indicated due to work with various other projects. These new directions are summarized in the attached letter concerning requested amendments to the project proposal.

Should you have any questions relating to the schedule of activities or to other matters pertaining to the project, please do not hesitate to call.

Yours truly,

Frederick C. Cuny

FCC:jwp

cc: Volker Hartkopf
Charles Goodspeed

November 24, 1976

Mr. William Beller
Office of Science and Technology
Agency for International Development
Department of State
Washington, D.C. 20523

Dear Mr. Beller:

This letter is to request that the prpposal, "Application of Approach, Development and Field Tests of Prototype Ultra Low Cost Shelters in Disaster-Prone Areas", submitted by Carnegie-Mellon University in March 1976 (proposal no. 08143), be amended in the following manner:

I. Requested Amendments:

A. Page ii (Abstract), second paragraph, #3): Amend to read "develop and test structures and methodologies for use in other relief and post-disaster situations".

B. Page 1, last paragraph: Delete the first and second sentences, and insert the following: "It is now proposed to expand the project so that the approaches can be implemented and tested in two other distinctly different relief environments. The team will develop approaches based on response to specific types of disasters, such as earthquake, flood and cyclonic storms, which deplete the housing supply and necessitate shelter, temporary housing, and/or rapid reconstruction of housing. Priority will be given to those disaster-prone countries where there is a high risk from exposure following a disaster. Activities will be centered in areas which have climatic environments and housing types distinctly different from those of Bangladesh.".

C. Page 2, second paragraph: Delete the fourth and fifth sentences and add the following: "The second entails the development and testing of the approach and prototype(s) for response to earthquakes. The third phase entails developing and testing the approach in flood-prone areas.".

D. Page 7, number 3): Delete ahe second and third sentences and add the following: "It is proposed that disaster-prone countries in the Mid-East, Southern Asia, and Latin America be selected. The program will be in three phases.".

II. Explanation of Changes:

These changes will allow the team greater flexibility in carrying out the intent of the proposal, that is, to further develop the most culturally acceptable and cost-effective approach to the rapid installation of shelters following a disaster. The changes allow the team to concentrate on developing responses appropriate to the type of disaster, rather than concentrating on oneegeographic region in each phase. Thus, the team will be able to provide a general approach applicable to all disasters of that specific type and to produce shelters based on the approach for a specific area. In the original proposal, the team would have selected one country for which to develop shelters, and the team could not be certain which lessons learned would be applicable to other areas. With these changes, instead of working from specific to general, the team will be working from general to specific.

III. Reasons for Changes:

The amendments requested in "I." above are a result of the following:

A. During the past year, members of the team have participated in several studies of emergency shelter needs. These studies include the United Nations Disaster Relief Office study on the provision of emergency shelter; the Overseas Development Ministry (U.K.) study on criteria for emergency shelter; research generated by an O.A.S. post-earthquake housing research team; and our own on-going research program. Theese studies are bringing to light new data on shelter needs and are outlining common patterns among specific types of disasters not generally noted before.

B. The consultants to the project, INTERTECT, have been deeply involved in the earthquake relief and reconstruction programs in Guatemala and Indonesia, and that experience has indicated that the new approach would be far more valuable.

C. As a result of the recent wave of earthquakes, large amounts of funds have been committed to research on earthquakes and the resulting disasters. By shifting the approach in the proposed manner, we will be able to better participate in and benefit from that related research.

The changes requested will not alter either the products of the project (the development of an approach and the various prototype shelters) nor the existing timetable for completion of the various phases of the project.

Respectfully submitted,

Frederick C. Cuny

FCC:jwp

cc: Volker Hartkopf
Charles Goodspeed

2. Methodologies

METHODOLOGY AND STRATEGIES

Activities

1. Review of strategies currently used by VOLAGS
2. Review of strategies currently used by governments, intergovernmental organizations
3. Participation in NAS CIDA Conference on Emergency Shelter
4. Review of the State-of-the-Art
5. Development of outline for methodology

Reports/Papers

1. "Post-Disaster Shelter/Housing: The State of the Art"
2. "Emergency Shelter: Issues," submitted to CIDA (to be published June 1977)
3. Paper, "Summary of Recommended Strategies and Policies for meeting post-disaster Shelter and Housing needs", by F.C. Cuny, INTERTECT
4. Resources & Needs for Post Disaster Shelter and Housing, Clare Goodspeed & U. Hartford

POST-DISASTER SHELTER/HOUSING: THE STATE OF THE ART

By

Fred C. Cuny
INTERTECT

and

Carolyn Weesner
Carnegie-Mellon University

This Report was made possible
through a Grant by the Agency
for International Development,
Office of Science and Technology,
Department of State, Washington, D.C.

June 1976

POST-DISASTER SHELTER/HOUSING: THE STATE OF THE ART

Background

During HABITAT, a series of workshops were held devoted to the topic of emergency shelter and post-disaster housing.

Three key meetings were:

1. The Workshop on Post-Disaster Housing, June 2, HABITAT Forum: The workshop, chaired by Jean-Paul Levy of UNDRO, consisted of a series of 20-minute presentations by persons working in the field. Discussions were limited to questions posed to each presenter.
2. The Carnegie-Mellon University/INTERTECT-sponsored forum on Emergency Shelter, June 6, Gage Residence, University of British Columbia: This meeting, limited to persons actually involved in emergency shelter work or research, was an open discussion of common issues and problems.
3. Ad hoc meeting of delegates, June 10, HABITAT Forum: This meeting was called by the Guatemalan and Bangladesh delegates to provide an open forum to discuss common issues and problems, to discuss information-sharing, and to learn more about the developing role of UNDRO.

This paper represents a review of the issues identified at these meetings and a brief statement on the State of the Art as derived from the issues presented.

Major Issues

Relief in the Development Context: Much of the discussion at both the official Conference and the forum dealt with the growing awareness that "relief" programs cannot be regarded as separate and distinct from "development"

programs. Various speakers underscored the interrelationship of the two and gave examples of how improperly run relief operations actually retarded the development process. As housing or emergency shelter programs are often the most costly -- and visible -- relief projects, they provide an excellent measure of the success or failure of various approaches and philosophies of relief. From the discussions at all the meetings, it became apparent that the vast majority of organizations, including some of the most advanced development groups, lose their perspective following a disaster and concentrate their energies on delivery of items such as emergency shelter rather than on developing or supporting social systems and helping these to deliver the necessary items. Once again, many field staff found comfort in the fact that they were not the only ones to have experienced a high degree of failure in top-down approaches.

What became apparent to all was the lack of professional assistance available to governments and voluntary agencies, especially at field level, following a disaster; the lack of hard data on approaches and projects in disaster relief; and the lack of a central co-ordinating agency or information clearinghouse on disaster-related data pertaining to the Third World.* There was special concern that much of the effort and funding in disaster work is concentrated at the upper levels of the international relief system; and it was universally felt that the upper levels are completely out of touch with the realities at the field level. It was felt by most non-governmental organizations that there needed to be an extensive re-examination of the traditional approaches to both disaster relief and post-disaster housing.

---

* In fact, several sources of disaster information exist, notably the INTERTECT information-sharing program. UNDRO is currently setting up an information clearinghouse; and Carnegie-Mellon University is setting up a resource network.

Defining Emergency Shelter and the Shelter Need: At each discussion on post-disaster housing, the question of whether or not emergency shelter should be provided after a natural disaster received extensive debate. Vidyadhar Chavda of India (who surprisingly enough was winner of the UNESCO Prize for designing an emergency shelter system) declared that there was no such thing as emergency shelter. He and others pointed out that in a housing-deficient society, all structures become permanent, and efforts should be devoted to providing rapidly-built low-cost housing, eliminating all efforts at providing emergency or temporary shelters. Frederick Krimgold of M.I.T. and UNDRO, however, offered perhaps the best framework for deciding on whether or not emergency shelter is required. He pointed out that the issue can usually be decided as a function of the time necessary to build a house under normal circumstances (which incidentally increases with the country's scale of development). For example, in Bangladesh where people can normally construct a structure in a day, it is useless to attempt to provide shelters post-disaster, as by the time they or the materials arrive, they are already unnecessary. In a more advanced society such as Greece, where the time required for construction of housing is much longer, some form of emergency shelter would be applicable.

The other situation in which emergency shelter is required is the refugee camp. If refugees have been evacuated from an area and cannot be absorbed by the local community or do not have formal access to normal housing resources, emergency shelter can be applicable.

Extensive debate focused on what form of assistance an emergency shelter program should take. While most agreed that use of indigenous materials was the only logical approach, there was considerable disagreement on how much technical assistance should be offered and how best to offer it. The Carnegie-Mellon design team pointed out that even in the high density refugee camps of

Bangladesh, cultural resistance to new forms of housing limits the effectiveness of the designer; and that even in the high exposure risk environments, a housing program -- as opposed to shelter -- must involve residents in the planning and execution of the project. Again, it was apparent from the NGO discussions that the normal development approaches cannot be discarded in emergencies. David Hopkins of Save the Children Federation/Community Development Foundation probably best summed up the discussions in his remark that NGO's and governments must stop viewing shelter as an item to be designed and built, and begin thinking of shelter as a process.

A peripheral issue to the question of technical assistance was: what is the proper role of colleges and universities in providing help in post-disaster situations? The Carnegie-Mellon team related how their program had undergone a change in approach from a design-oriented program to one of research on methodologies and strategies for response. Ian Davis, a consultant to UNDRO, related the failures of college- and competition-inspired emergency shelter designs, and the helpfulness of in-depth studies such the the University of Tennessee study on housing provision after the Nicaraguan earthquake. It was generally agreed that the best role for colleges and universities is to conduct research studies in such areas as housing policy, land reform and land tenure issues, and to conduct case studies of shelter programs. INTERTECT pointed out the difficulties in getting hard data on philosophies behind emergency shelter programs, stating that the majority of studies are analyses of structures, not programs.

Operational Issues

In all the various discussions at HABITAT, the following issues concerning post-disaster housing operations emerged:

Evacuation: The evacuation of areas in the aftermath of natural disasters was seen as a grave mistake by the majority of both delegates and NGO's. Numerous field workers discussed the difficulties of re-establishing development programs following an evacuation and the difficulty of getting the much-needed citizen participation going again. Many people who had worked in Managua after the 1972 earthquake pointed to the problems of rebuilding the city due to the dispersal program. Australia, in its excellent film on Darwin, cited the evacuation as the single biggest mistake in its relief program. The fear that disease can be spread by the bodies of the dead -- a fear that has often been used as a justification for evacuation -- was debunked as a real threat by representatives of several disaster relief organizations. INTERTECT cited its recent work in Guatemala, where some towns were evacuated and others began immediate reconstruction, as an example of the wisdom of the latter approach.

While all agreed that evacuation after a natural disaster should be avoided if possible, the official government delegations of many countries stopped short at condemning forced mass evacuations of slum and squatter settlements. India and Bangladesh, especially, defended their forced removal of squatters into Bustee camps. (Bangladesh even went so far as to laud their own policies in their official HABITAT film.) These policies were brought to the fore during HABITAT by the actions of India in the attempted clearance of Janata Colony, a 25-year old squatter settlement in Bombay, to build a park. The majority of NGO's condemned the action and called it a man-made disaster, while a number of delegations supported the action on the basis of the government's obligations to all the people to build a decent urban environment.

Refugee Camps: The main by-product of evacuation -- refugee camps -- was discussed at length. While all agreed that they should be prevented at all costs, the reality of having to deal with them was rarely discussed. The

Carnegie-Mellon team discussed its work on shelters for camps in Bangladesh; and INTERTECT touched briefly on its on-going study of refugee camps and camp planning techniques. It was agreed that camps are in fact very similar to squatter settlements, especially the Bustee camps, and work in the camps must utilize the same developmental approaches.

Infrastructure: Numerous field workers described the lack of adequate provision of and attention to infrastructure systems, especially water and sewage, in post-disaster housing programs. The case of housing being installed long before water and sewers were available was the rule, not the exception. In a presentation to the Self-Help and Low-Cost Housing Symposium, Mrs. Yasmeen Lari of Pakistan cited the success of planners when adequately reacting to the community priorities in the provision of sites and services in reconstruction of a sector of flood-stricken Karachi; while the failure to so react was cited in films by Mauritius and Greece as a prime reason for large-scale housing projects remaining vacant in the aftermath of their disasters.

Salvage and Rubble Clearance Following Disasters: Several challenges to the traditional response of governments in immediate clearance of rubble were offered at HABITAT. Carlos Santos, an engineer working in Managua following the earthquake, cited the need for governments to go slowly and give people time to salvage all their building materials. He noted that millions of dollars worth of valuable materials were bulldozed and dumped into the lake, thus depriving the very poor of critically-needed building resources. INTERTECT supported his arguments by noting that the reason that structures collapse is rarely because of failure of the materials, but rather because of the way in which they have been used. Santos stressed that most clearance should be done by hand to maximize the recapture of salvageable materials.

Community Disaster-Response Mechanisms: Various discussions centered on the ability of most societies to respond themselves to disasters. A. A. Sultan (an Egyptian currently with the Graduate School of Architecture, University of Tokyo) pointed out that most communities have both formal and informal mechanisms which respond to disasters. There is a great danger in not recognizing and building on these mechanisms, for not only can an opportunity to facilitate delivery be lost, but the mechanisms themselves can be destroyed by an outside-directed relief operation. It is necessary to solve the problem of how to relate outside help to the built-in mechanisms of a society; i.e., how can we encourage this collective response? It was agreed by all the NGO's that not enough data is currently available on these mechanisms and how they work.

Change: A number of discussions revolved around the question of how much change can be introduced following a disaster. While all agreed that a disaster presents an excellent time to introduce change in settlement patterns, construction techniques and structural improvements, the question of how much change can reasonably be expected and how to best effect this change evoked a wide range of responses. Many representatives of voluntary agencies and delegates felt that people should be provided with new, safe housing which would represent a substantial improvement over the previous unit. Many field workers challenged this approach, however, noting that for real change to occur, an atmosphere for change must be created first; changes are then introduced slowly, gradually building people's acceptance of change. Ron Sawyer of Save the Children Federation/Community Development Foundation related how this approach was used following the earthquake in Guatemala -- how people there were taught to rebuild their homes in an extensive training program where simple changes were introduced slowly, getting the people used to the changes, then expanding the program gradually to encompass larger and larger objectives,

the ultimate aim being a complete integrated rural development program tailored to the local community. The training is offered at all levels of the housing program but concentrated at the materials distribution activities. This evoked the comment by Frederick Krimgold that permanent changes in building techniques are dependent on the availability of the materials necessary to effect that change and the continued access of the people to those materials.

Land Reform and Tenure: The one issue which almost everyone avoided as much as possible was land reform. Delegates of Third World countries and many of the NGO representatives politely sidestepped the topic each time it came up. Privately, many voluntary agencies said that in relief operations they do not even address the subject in many countries because of fears that local governments will kick them out. Several speakers, however, pressed the point that unless these issues are properly addressed, little real change can be accomplished. INTERTECT related several cases where voluntary agencies, anxious to help rebuild housing for short-term safety goals, had in fact served to reinstitute problems that existed before and had set back the chances for land reform by destroying the groundwork of self-help programs which had existed before the disaster.

The problems associated with land tenure issues were also discussed, particularly at the Forum. It was felt that too little data on how disasters affect land tenure issues was available; there is also a lack of data on successful approaches to addressing tenure problems in post-disaster programs.

Pre-Disaster Planning: If there was one issue at HABITAT upon which everyone agreed, it was that if adequate resources were devoted to pre-disaster planning, the terrible tolls extracted each year could be substantially reduced. But the question of where to concentrate the pre-disaster planning effort --

at governmental level before a disaster or at the field level after a disaster -- was heavily debated. UNDRO and most of the official delegates felt that if more resources (money) are devoted to the preventative measures (not to be confused with preparedness), the disaster-prone countries could cut their losses. But a vocal minority of NGO's challenged this assumption. They noted that many of the factors most necessary to making pre-disaster planning effective are issues of development, such as land reform -- issues to which existing governments and institutions have consistently failed to respond, usually because of vested interests. They pointed out that even if a country wants to change, it usually doesn't have the funds, the legal framework or the human commitment until a disaster strikes. They argued that the emphasis should be placed on developing methods of building in disaster prevention during the reconstruction, i.e., take advantage of the impetus to change when it is at its highest peak. Those opposed to this approach countered by saying that things are too disorganized after a disaster to institute these changes. This statement was challenged in turn by noting that organizations and committees set up following disasters are often more effective than their pre-disaster counterparts, and that many organizations operate more effectively in providing goods and services on a crisis basis. Furthermore, the emergency powers granted to many disaster relief committees enable them to slash through red tape.

All agreed, however, that more emphasis should be placed on pre-disaster planning at all levels, and that measures of pre-disaster planning should be incorporated into all national development plans.

State of the Art: All the discussions and issues which were debated at HABITAT seem to prompt a brief discussion on the current state of the art in the newly-emerging "discipline" of post-disaster housing. Perhaps the best framework for explaining it is offered by a team of UNDRO consultants who are

preparing a study of emergency shelter provision.

They point out that a disaster can be defined as a temporary gap in the continuum of normal housing; but unlike other gaps, the actions conducted during the disaster affect what normal housing becomes when the gap is closed. In order to develop appropriate responses to close the gap (i.e. emergency shelter, temporary housing or rapid reconstruction of permanent housing), it is necessary to understand two things:

1. What strategies are available for closing the gap? There are three generally accepted strategies. First, the performance of normal housing can be extended, mainly through pre-disaster planning and disaster preparedness programs. Second, a variety of temporary solutions can be used to fill the gap, such as emergency shelters or temporary housing. And last, the gap can be filled by rapid reconstruction of normal or improved temporary housing.
2. What factors control the gap? Several of the factors are "repeaters" in each disaster, but each is unique in every situation. Factors include such things as uncertainty in the refugee population, availability of financing, market instability (inflation), cultural acceptance of new housing types or styles, availability of materials, etc.

In order to understand the strategies and factors, it is necessary to know what "normal" housing was before the disaster. A complete understanding of housing form, building sequences, financing, settlement patterns, and other issues must be gained in order to predict what degree of change can be reasonably expected when a return to normal is effected. The failure to comprehend this is the largest single cause of delivering an inappropriate response.

RESOURCES AND NEEDS FOR POST DISASTER SHELTER AND HOUSING

By

Charles H. Goodspeed

This Report was made possible
through a Grant by the Agency
for International Development,
Office of Science and Technology,
Department of State, Washington, D.C.

March 1977

INTRODUCTION

The United Nations 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.[1] 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 deficiencies of food, health, shelter, and education has become a seemingly unsurmountable task. To make matters worse, new groups fleeing from new conflicts feed the refugee total faster than earlier groups can be taken care of.

Haider, pointing to the interrelated problems of inadequate shelters, hampered human development, and lacking quality of life, sees potential improvement of the situation of 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.[3]

The Carnegie-Mellon Intertect Working Party concentrates its efforts primarily on areas two and three. In order to conceivably serve the large number of displaced persons, the shelters under development are ultra low cost ($5-10 per person).[4] 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 changing nature of catastrophies in and of themselves (cyclones, floods, earthquakes, wars, etc.) preclude the development of a single, universally acceptable shelter prototype. 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.[5]

The major objectives are:[6]

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 productions 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.[7]

Socio-Cultural Patterns as Resources

In the past, housing solutions have created many unforseen problems because of inherent incompatibility with existing socio-cultural structures and patterns. Unsuited 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 refugee situations, this seems imperative. While the emotional and physical status of refugee[5] varies greatly according to the nature of the disaster and the time the people have been refugees, certain generalizations can be made concerning behavioral aspects. In his study, Refugee Camps and Camp Planning,[8]

Frederick Cuny identifies the phases of personal adjustment that refugees undergo in refugee camps. The general improvement of emotional and 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 prompt 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 two ways. First, the unit had to lend itself as 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 requirement, 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 couldn't use their own limited tools, in all likelihood the structure wouldn't 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 effected 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 resources the indigenous socio-economic environment can provide.[9] 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.[10] 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.[11] In addition, the amount of the 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-pozzalan-sand blocks; improved lime manufacture; mortars to match the various masonry units; clay roof tile; and bamboo matting production.[12]

Other articles provide progress reports along similar lines.[13] Some techniques utilize traditional knowledge; others focus on the application of advanced engineering concepts.

Within a scenario of an overall energy shortage, it is imperative that in all building projects the use of nonrenewable 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.

Information-Sharing System

Relief personnel, responding to natural and man made disasters, receive little advance information concerning resource availability, skills and abilities of the people affected, as well as past approaches to relief operations under similar conditions. This is particularly true in respect to the provision of shelter. Unfortunately, the present system does not allow for a wide sharing of information relief workers have gained in the field. As

a result each catastrophe tends to be approached as a singular event and very little information is transferred from case to case, voluntary agency (VOLAG) to voluntary agency. No doubt this system is wasteful and leads to after the fact ad hoc problem solutions instead of disaster preparedness.

This inefficient information transfer among research centers, relief workers and voluntary agencies calls for an information sharing system. The system currently under development at Carnegie-Mellon University consists primarily of three components: a) Users; b) Information Exchange Centers; and c) Information Bank.

The Information Sharing System is designed to be of major assistance to field personnel in their day to day decision making addressing cultural, socio-economic, physical and environmental resources and constraints. In return the system's information bank is to be continuously enriched by reports from the field. Emphasis is on systematic approaches to recurring problems. An example for both kinds of reports to and from the field can be seen in the publication "Feasibility Test of an Approach and Prototype for Ultra Low Cost Housing."[14]

Information flowing from the field to the system will aid research centers in their research development efforts. To be most effective these centers must stay informed about actual conditions in relief situations, problems unresolved, and approaches taken. In addition the Information Sharing System is designed to facilitate exchange between research centers addressing predisaster planning and post disaster relief in developing countries. Through the linkages with the various types of users the center will stimulate more accurate reporting and exchange of ideas.

Users

The user category consists of field personnel, VOLAG headquarters, government, organization and research centers. Field personnel involves

all people in the field addressing the day to day problems of relief work. It is at this level of relief that cultures, local economies and physical environment are dealt with on a personnel basis. At the next level of management coordination is the VOLAG's etc..

The research centers on the other hand address specific problems becoming experts on the subject through laboratory and library research and limited field experience. For research centers to be most effective they must stay abreast of the state-of-the-art in the field through communication with other centers.

Information Exchange Center

The main function of the center is to establish channels of communication between the various users and available information. These channels will be multifunctional in that material will be transferred to the users upon request and from the users to the information center. Part of the duties of the center will be to review the information prior to storing it. Similarly, the center will play an active role in supplying recommendations in response to the user requests.

Information Bank

The library for storing reports, papers, abstracts and bibliographies pertinent to relief work is denoted as the Information Bank. It is proposed that most users will have their own source of reference material filed for their own retrieval.

The format in which the information is stored will vary from one location to another. The format can vary from a bookshelf of notes and reports to a sophisticated computer system to be implemented by the Information Exchange Center. Common to the variation of storage format is the key-word reference

system at the user interface. This will enable users to easily request material from the other libraries by subject area through the use of keywords.

To date, there is no common storage and retrieval system adopted by relief organizations, thus limiting the accessibility of information from one library to another. One of the first functions of the Information Bank will therefore be to establish a standard user/Information Bank interface adaptable to any information file. The proposed interface will consist of a set of user oriented key words. The keywords will reference the stored material in a hierarchial manner (i.e. the more specific the key word the more narrow the scope of the material and similarly the more broad the more general). Upon specification of a list of key words the information common to all key words will be referenced. Through these interfaces the IEC will handle reports, local and global linkages, abstracts, bibliographies and professional comments for immediate implementation.

Summary

The proposed Information Exchange Center (IEC) currently under development at Carnegie-Mellon University will facilitate communication by minimizing the number of channels to be traveled and by increasing the response time. Many times relief workers are not cognizant of local resources, do not have the time to trace down references and are not in touch with others experienced in relief work. The center will be set up to speak directly with any user via mail, telephone, telex and teletype. At the finger tips of the IEC is the Information Bank and a group of professionals with the most updated, reviewed information. Through this process the user need only communicate with the IEC for all needed reference information. The IEC will operate its own Information Bank via computer; this will have quick response time.

Conclusion

Over a period of more than three years the Carnegie-Mellon Intertect working party addressed predisaster planning and post disaster actions; particularly related to shelter provision in developing countries. The feasibility of the approaches has been tested in the field in both Bangladesh following the civil war and in Guatemala following the most recent earthquake.

The team currently builds an information sharing system to systematically collect and share information with individuals and organizations working on related problems.

NOTES

1. Floyd O. Slate, "Low-cost Housing for Developing Countries, "Engineering: Cornell Quarterly. IX (Autumn, 1974), p.13

2. Slate, p.13

3. Gulzar Haider, "Design Education and Housing in the Developing Nations," Industrialization Forum, VI (Number 2, 1975), p.37

4. Interdisciplinary Working Party, Carnegie-Mellon University, "Feasibility Test of an Approach and Prototype for Ultra Low-Cost Housing (Washington, November, 1975), p.3.

5. Interdisciplinary Working Party, p.2

6. Hassan Fathy, Architecture for the Poor (Chicago, 1973).
Victor Papaneck, Design for the Real World (New York, 1971)
E.F. Schumacher, Small is Beautiful (New York, 1973)
J.F.C. Turner and R. Fichter (editors), Freedom to Build (New York, 1972)

7. Margaret Mead, World Enough; Rethinking the Future Boston, 1975) p.56

8. Frederick C. Cuny & Associates, Refugee Camps and Camp Planning (Dallas, Texas, 1971)

9. Haider, p. 36

10. Hassan Fathy, Architecture for the Poor (Chicago, 1973).

11. Ian Davis, Emergency Shelter (paper at a symposium convened by the Disasters Emergency Committee, London, January 1976).

12. Albert C.H. Dietz and Hasan Poerbo, "Industrialized Housing in Indonesia, "Industrialization Forum, VI (Number 2, 1975) pp. 7-8

13. P.A. Campbell, "Some Developments in Tropical Timber Technology," Appropriate Technology, II (London, Number 3, November, 1975).
Monsanto Research Corporation, Development of Low-Cost Roofing from Indigenous Materials in Developing Countries (Washington, December, 1975)
B.S. Saint, "Durability of Bush Materials," Overseas Building Notes (Garston, England, Number 120, August, 1967).

REPORT ON THE ACTIVITIES OF THE CARNEGIE-MELLON/INTERTECT EMERGENCY SHELTER TEAM RELATED TO DEVELOPMENT OF AN APPROACH AND METHODOLOGY FOR EMERGENCY SHELTER

Introduction

In June, 1977, U.S. A.I.D. contracted Carnegie-Mellon University to continue its work in the development of prototype designs for emergency shelter units for disasters in developing countries. As a part of the contract, the team was asked to explore the possibilities of conducting research into the provision of emergency shelter following natural disasters. (Heretofore, the team had concentrated only on man-made disasters.) A major part of the study was to include a review of strategies and approaches to the provision of emergency shelter and post-disaster housing, and the contract called for the development of a framework in which foreign donors could examine the options and strategies which were available in the provision of emergency shelter.

At present, there are several studies which are currently being conducted on not only the question of the provision of emergency shelter but also other forms of disaster assistance, and the members of the Carnegie-Mellon/INTERTECT team were able to benefit from these studies as well as contributing their own findings to them. The most important of these studies are the United Nations Disaster Relief Office Emergency Shelter Study and the Committee on International Disaster Assistance of the National Academy of Science. (Appendix A lists the addresses of the aforementioned studies and lists the materials available as a result of those studies.)

The team felt that it was necessary to fully understand the various strategies and approaches employed in the provision of emergency shelter before developing an approach and strategy of its own. A review of the activities of the voluntary agencies and foreign governments in emergency shelter shows that few of these groups actually have adopted sophisticated strategies and approaches per se, but many, in fact, do conduct repetitive or similar activities each time a disaster strikes, and therefore, the similarities between the programs allow them to be classified as they are within this report. The classification of the programs as such provides a framework wherein the performance of the approach or strategy can be examined and also helps to identify problems or problem areas which can be expected to be encountered when selecting this approach or strategy. The team has worked to identify the weaknesses which are inherent within these areas as well as the major gaps in the shelter and housing response system. In the work for the next two years, the team will address these problem areas and attempt to fill the gaps.

I. Review of Strategies Employed by Intervenors

Following natural disasters, wherein a large number of the preexisting housing units have been destroyed or substantially damaged, relief agencies and other intervenors have usually chosen one or more of the following strategies to provide shelter and housing for the victims.

A. Emergency shelter.

Many agencies, especially those who consider themselves only relief agencies, adopt the strategy of providing an emergency shelter unit to provide housing to the victims until such time as they can rebuild normal housing. In cases where there is an expected environmental risk to the victims due to the climate or seasonal conditions, emergency shelter units often receive a fairly high priority on the part of the intervenors in purchasing and shipping these units. At this point, the emergency shelter is basically a humanitarian consideration; the long-term impact of the shelter units are not considered, and questions of cost-effectiveness normally do not come into play.

The record of the performance of emergency shelters and the role in which they play during the actual emergency period is currently being hotly debated. The evidence provided in the UNDRO study on the performance of donor provided emergency shelters shows:

1. They have little positive effect on alleviating conditions in the disaster area. The times when emergency shelters can be employed after a natural disaster with any effectiveness appear to be extremely limited.

2. The majority of foreign intervenors have concentrated on designing emergency shelter units which can be quickly erected and can be flown from the donor country to the disaster area in a short period of time and in large volume. The problem, however, does not lie in moving the units to the disaster area nor in getting them quickly erected, the main problem is distribution of the units within the disaster area.

3. The evidence indicates very few of the emergency shelter units serve the purpose for which they were intended, in other words, life support or protection from the elements. The uses of the shelter units by the victims have normally been a secondary use, such as storage of goods, household articles, or animals.

4. The vast majority of shelter following a disaster has been provided by the refugees themselves. Even in cases where the emergency shelter units have been erected, most have arrived and been erected long after the emergency period.

5. In the few cases where the shelter units have arrived during the actual emergency, they have usually been employed in the construction of refugee camps. The evidence indicates that

the creation of refugee camps following natural disasters has a negative impact and creates long-term problems. The employment of emergency shelter units from the outside forces relief officials to adopt hastily conceived plans for distributing and erecting this influx of units. If they arrive immediately following the disaster, shelter units will receive a low priority (as compared to medical and sanitation needs), and, therefore, a shelter program will not receive the full attention that it needs. This encourages wastefulness and poorly planned distribution programs.

There are times, of course, when emergency shelter units are needed, but the evidence is overwhelmingly in support of its provision by the local government. If agencies wish to conduct emergency shelter programs, the time to begin conducting them is before the disaster occurs. In other words, areas in which a high risk exists and areas in which the structures are vulnerable to disaster should be identified, and emergency shelter units appropriate to the climate and environment can be placed in the proximity and distribution plans worked out in advance. Several countries, notably Turkey, have already undertaken steps along these lines.

B. Temporary Housing.

The temporary housing strategy is one normally undertaken by governments because the cost of providing temporary housing is so immense. The difference between temporary housing and emergency shelter is that the unit provided is expected to be a house which will last for a period of several months to several years and is intended to be erected on the site of a victim's previous house. The philosophy behind a temporary housing strategy is that a low-cost, temporary unit can be provided at little or no cost to the disaster victim, and he will be able to live in it long enough to obtain the capital necessary to rebuild a normal permanent house. Temporary housing programs are normally used when damage covers very large areas and governments feel that it will take years to rebuild normal housing due to a shortage of capital and/or materials.

The main problem of the temporary housing strategy is the cost of the "temporary" units which are provided is often more than a permanent structure, especially when the disaster victims normally build their own houses from indigenous materials. In Guatemala, the government purchased large numbers of small, prefabricated structures at a cost of between $300 and $600 apiece. They, in turn, offered these to the public through the co-ops at half price($150-200). It was expected that the people would purchase the houses and live in them through the rainy season, and, six to nine months later, would rebuild permanent structures. The problem was, however, that a normal house only costs between $50 and $150 and provides upwards of three times the space of the temporary house. The people refused to buy the houses because they were too costly, and the government program of very long-term, low-interest payments still did not interest sufficient numbers of people in buying the units.

In those cases wherein temporary units are provided at a cost which is affordable or attractive to the disaster victims, the temporary houses may

receive a wider distribution. However, a review of those instances where such units have been provided show that the houses are rarely used only on a temporary basis, that, in fact, they become long-term structures. Units provided in Peru following the earthquake in 1971, for example, are still in use. Rather than encouraging rapid reconstruction, the units usually inhibit more permanent and more formal structures.

C. Accelerating Reconstruction of Permanent Housing

Following several recent disasters, a number of agencies have developed a new strategy. Instead of attempting to provide emergency shelter or temporary housing, they have concentrated their resources on trying to encourage rapid reconstruction of normal housing. This approach -- which only works following a "single event" disaster such as a flood, earthquake, hurricane, or the cessation of hostilities following a war -- assumes that people will look after their own emergency shelter or temporary housing needs and allows the agencies to put the emphasis on restoration of the normal housing process as soon as possible.

In this approach, houses may be rebuilt to the normal standard following a disaster in which the houses themselves did not fail, such as in a flood or in a war. Reconstruction to an improved standard would occur following a disaster in which the houses failed as a result of inherent weaknesses of the structures, for example, following an earthquake.

The rapid reconstruction approach requires that the people have access to the normal housing process and markets. They must be able to obtain the materials they need for reconstruction and the services which are normally available within the community. As the majority of reconstruction activities will be carried out in self-help housing programs, reconstruction to an improved standard must concentrate on introducing the techniques of improved construction at a technological level consistent with the community and at a price which they can afford.

The advantages of using this approach are as follows:

1. It enables limited resources to be concentrated where they will have a permanent effect, and is thereby extremely cost effective.
2. It reduces the time during which people are without a full, formal houses, and thereby facilitates the rapid return to normalcy.
3. As this strategy requires the use of a self-help housing approach, it keeps the houses at a price affordable by the local people and allows the decision-making to be kept at an individual level.
4. Because it requires the use of a self-help housing approach, costs to the individual family may be reduced.
5. This strategy uses and builds upon the existing housing process and the skills which exist in the community.

Generally, there are no major disadvantages to using this strategy, but it does require a willingness on the part of the government to assist by reducing the natural obstacles in the normal housing process and a long-term committment on the part of the intervenor. Assistance can be in the form

of price controls, low interest loans, etc. It also may require the local government to address some issues which it does not want to address, such as land reform. The approach should only be carried out where people are not living in vulnerable locations.

Of all the strategies available for reconstruction after a single-event disaster, this appears to be the best.

D. The ABC Strategy.

In the past, some agencies have undertaken an A,B,C strategy, i.e., they provide emergency shelter, temporary housing, then permanent housing. Some agencies have gone the shorter but still costly route of A,C or B,C. These are obviously wasteful unless the materials and skills contributed at the first stage contribute significantly to the final "C" stage.

II. Review of Approaches to Emergency Shelter and Post-Disaster Housing

Once an agency has adopted a particular strategy, it then selects a particular approach to carrying out that strategy. In terms of the structures that are eventually provided to disaster victims, one or more of the following approaches is usually carried out.

A. Tents.

Of all emergency shelter types, tents are the least damaging to interject on a disaster situation, but contribute the least to reconstruction and permanent development. The provision of tents has not been found to be completely disruptive, whether provided by local institutions or outside intervenors. Tents, however, rarely serve the needs of the refugee or disaster victim, and, in many cases are not appropriate to the climate to which they have been sent.

Among the major problems of tents are:

1. They fail to fulfill many shelter functions. They are especially poor for storage of salvaged goods and belongings.
2. They are too small and cannot be expanded.
3. They may be more expensive than a new house made of local materials.

Tents are often viewed by relief officials as being superior to more permanent units because they will deteriorate and, thus, not become instant slum houses. There are three things wrong with this argument. First, from the standpoint of the victims, the gradual disintegration is a continual source of misery. Second, the argument points out the lack of knowledge of the factors that create slums and slum housing. Slums are rarely created by the housing units themselves; they may be a contributing factor to the poor appearance of a neighborhood, but rarely are they the cause. Furthermore, disasters normally affect and deplete the housing supply in slums more than higher income neighborhoods within an urban area. The provision of an emergency shelter unit into this environment will hardly be a contributing factor to creating something which had already existed before the disaster. Third, the argument points to the fact that agencies have not adequately reviewed their past actions in the shelter and housing field. The evidence indicates that most

agencies that have provided tents have also provided housing assistance. In almost every case, the assistance is provided at the same location that the emergency shelter units were provided.

The major negative factor, however, relating to tents is the fact that they are not a contributor to long-term stability. Their distribution requires time and effort and commands resources which are already scarce following a disaster. It is a high price to pay for a commodity that does not assist permanent reconstruction.

B. Imported Designs and Units.

In the past ten years, there has been a general quest for a universally applicable emergency shelter unit which would meet the temporary shelter and housing needs of the victims in all areas of the developing countries. Members of the design profession, voluntary agencies, industry, and many university graduate programs have been active in this research. Hundreds of designs have been offered, many have gone into limited production, and a few have actually been shipped to disaster areas for use. The majority of these units have been designed to take advantage of simplified construction processes, for example, prefabrication, or to make use of new materials developed for use in the industrialized nations.

A survey of the success of these units has indicated that their use as emergency shelter units or as temporary housing has been extremely limited, and their performance and acceptability has been very poor. In examining the design criteria by the user agencies and governments which commission these designs, it is clear that the designer is responding to criteria developed by the relief agencies and intervenors, not by the victims themselves. While the agency may wish to have a low-cost unit that can be easily airlifted and rapidly installed, the refugee himself may wish to have a unit which is climatically suitable, easy to maintain, and provides storage for such things as his animals. Even in the cases where the housing unit itself may be culturally acceptable, mass production of hundreds of the same units may make it undesirable.

Another major problem is that often the agencies concentrate so much on developing a perfect housing unit that the obvious need for sites and services programs to accompany the housing units are neglected. A review of the major housing programs offered after disasters in the last ten years in which the houses go mainly unoccupied indicates that the housing units were set up without any consideration of the siting nor the services to accompany the housing units.

There are, of course, instances where industrialized-style housing has been both appropriate and quite popular. In fact, there seems to be a growing trend for low-income people in the developing countries to demand such housing, especially low-income persons dwelling within large metropolitan areas. This demand, as well as the rising expectations of the urban poor, must be taken into account when planning temporary housing or emergency shelter programs. In recent relief operations, a number of these units were introduced in limited quantities, but were quickly discontinued due to the lack of funds. Their presence in the community, however, increased the expectation of those who did not receive the units, and when other solutions to the housing problems were offered, which used indigenous materials, there was great resentment on the part of those not receiving the "better" units and much animosity toward

the government arose.

C. Designs Incorporating Indigenous Materials.

In recent years, there has been much interest in the development of designs for emergency shelter units which incorporate indigenous materials. In the last several years, a number of groups have attempted to design and build shelters incorporating bamboo, wood, palm, reeds, adobe, and other materials which are typically used in the construction of houses in the third world. The majority of the effort has centered on developing designs which incorporate these materials and to make better use of the materials structurally, thereby improving their performance in adverse climatic conditions. (This is the approach taken by the Carnegie-Mellon/INTERTECT refugee housing team in their initial efforts in Bangladesh.)

While there is little doubt that the structural performance of the units is greatly improved over traditional units incorporating the same materials, the majority of these programs have still been unacceptable to the local people or to the agencies which have funded the projects. There are two major problems. The first is that to incorporate structural improvements utilizing these materials often increases the amount of materials that are required, thus making the unit more costly(even though the units may be less costly than units that use industrialized materials). The second factor is that the units often have different shapes and forms than the structures which are found locally or which the victims aspire to. (This was a major factor in a cultural rejection of the Carnegie-Mellon units in Bangladesh.) Again, these problems represent a failure of the designer in adequately defining the problem from the viewpoint of the disaster victim. Experience has shown that to utilize this approach, the design process must include the disaster victims and the supporting or assisting agencies as well as the designer.

There are two additional problems which limit the agencies from utilizing this approach. First, very few relief agencies have qualified housing specialists which are familiar with the capabilities, potentialities, and problems of using indigenous materials. For example, if an agency decides to utilize bamboo, it must not only know how best to use the bamboo structurally but must know such things as the proper time to cut the bamboo, how to recognize whether or not it has been cured properly, how to treat the bamboo for different climatic conditions, and what materials to use with the bamboo so that damaging insects are not attracted to the structure. The use of indigenous materials is a sophisticated process and, because the agencies themselves are not familiar with the process, many program planners will avoid using the materials.

A second reason why many agencies have recently decided to avoid the use of indigenous materials is that they are afraid of depleting the raw materials within the country. With the growing concern for the environment and the environmental impact of large scale depletion of raw material resources, agencies have become concerned that without adequate information on the ecological impact of using these materials, they may cause long-term harm in order to obtain a short-term benefit. It is thus mandatory that agencies undertaking this type of program approach must be able to obtain accurate information on the potential impact of their program. Unfortunately, little such information is usually available within the developing countries.

D. Materials Distribution

Many agencies have felt that the design process itself is something that

can be omitted in the provision of emergency shelter and permanent housing. These agencies feel that the key to providing better housing is to provide adequate or improved construction materials. In some instances, the approach of simply providing construction materials is intended only to replace the same type of housing which has been destroyed by the disaster, but more recently, in relief operations in such countries as Guatemala, Honduras, and Nicaragua, lightweight roofing materials were introduced in hopes that this would make the structures less susceptible to earthquake damage. Many agencies consider this to be the best approach to self-help housing and remain aloof from the design process altogether. Other agencies, however, have not only provided the construction materials, but have undertaken extensive housing education efforts, concentrating on improvement of building skills within the community and improvement of the housing units' performance through structural improvement. Use of this educational approach has only occurred recently, and the results are not yet clear as to the relative success.

There appears to be only two major problems with the materials distribution approach. First, in those cases where the material being distributed is not a local material nor one that is maufactured within the country, large-scale distribution and introduction of the material into the building practice may create a demand which cannot be met after the relief and reconstruction operations cease. While the initial materials may have been provided free or at a low cost, the materials necessary to maintain the unit or repair it may not be available. Second, the introduction of the material may necessitate changes in the basic design of the unit, and while the unit may be strengthened in one area, unless proper attention is given to all the details, it may be weakened in others.

E. Core Housing.

A new approach which has been employed recently in Guatemala is the development of the core house concept. In this approach, a relief agency provides a simple, low-cost frame which can be used as an emergency shelter or temporary structure. The frame and the roof are designed to be permanent, and, over a period of years, the occupants can then infill the walls with whatever materials are available to make a more permanent and formal structure. This approach was utilized by CARE in Guatemala with varying degrees of success, depending upon the area in which the program was conducted and the extent to which accompanying education programs were utilized along with the construction of the core. It is too early to tell whether or not this approach will have long-term desired results.

III. Methodology

On the basis of a review of the strategies and approaches employed by intervenors, the Carnegie-Mellon/INTERTECT team has reached several conclusions relating to the development of the methodology called for in the contract.

A. The best way to affect better emergency shelter and post-disaster housing programs is to work with the disaster-prone country to develop strategies and approaches before the disaster occurs.

B. The only way an outside agency can be effective in the post-disaster period is to be familiar with, and, if possible, have been active in the housing process before the disaster

occurs.

C. The best policy for the government to undertake in the provision of shelter or housing after a disaster is to select an approach and make that approach mandatory for all intervenors.

The Carnegie-Mellon/INTERTECT team feels that the best strategy to employ following a housing-depleting natural disaster is that of encouraging rapid reconstruction of permanent housing and omitting, unless there is a real threat to life from environmental exposure, the emergency housing stage.

The Carnegie-Mellon/INTERTECT team feels that the best approach to be employed in the rapid reconstruction of permanent housing is one which utilizes both materials distribution and education. In this approach, an intervenor selects a disaster-prone area. It then conducts an evaluation of potential risks to a community for a disaster and analyzes the structures to determine whether or not they would be vulnerable to that type of disaster. If the structures appear to be vulnerable, an analysis of the structures is made to determine whether or not the existing type of structure could be stabilized or structurally improved, and if so, several model structures are developed with the participation of the residents. In the development of the model structures, the comments and criticisms of the potential occupants are incorporated into the design and into future models. It is the role of the intervenor to serve as structural analyst and make sure that the designs which are being prepared are structurally suitable as well as culturally and economically acceptable.

Following the development of the basic models which are intended to be used after a disaster, suitable educational materials, construction aids, and training materials are developed, and as soon as the training aids are ready, a number of model houses are built throughout the potential disaster area. During the construction of these model houses, the educational materials are employed and, thereby, receive a field shakedown, which, in turn, leads to their final form. Following the construction of the models, the training materials are produced in sufficient quantities and placed within the communities. (The intervenor may wish to incorporate the housing designs in normal housing programs and may actively promote the use of the model or design in the community before a disaster occurs. In any event, sufficient quantities should be available for retrieval after a disaster, even if the units are being promoted before a disaster occurs.)

IV. Case Study

During the coming year, the Carnegie-Mellon/INTERTECT team will conduct a case study utilizing the approach recommended above. This approach is currently being explored by the Peruvian government through its Ministry of Housing. In addition, several voluntary agencies have also expressed an interest in participating in the process of developing this approach and strategy. The CMU team is exploring the possibility of working with the Peruvians and the voluntary agencies in sharing ideas, materials, and information in the development of these strategies and approaches. Currently, the Ministry of Housing has already developed a design for a unit which they wish to test and have asked the team to assist in the preparation of the training materials and the development of strategies wherein a housing program can be instituted rapidly following a disaster. Appendix B provides an outline of a proposed work program for the coming year. The team views this as an

opportunity, not only to exchange information with counterparts in Peru, but also to analyze the validity of this strategy and approach and to identify some of the problems that will occur if it is employed in other countries. In particular, the team is interested in the following areas:

A. Developing approaches for reviewing the housing types and determining vulnerability.

B. Reviewing and identifying the key elements of the local housing process which must be considered in developing prototypes and models.

C. Identifying problems in the host country's ability to respond and seeing how once these problem areas are identified, how the host country approaches the elimination of these problems.

D. Assisting in the developing of the materiel requirements for conducting large-scale disaster housing programs and developing procedures wherein the impact of the rapid acquisition of this mass material can be evaluated.

E. Participation in the preparation of the initial training aids. The team has gathered much information during the last year on how to present information necessary to affect changes in construction and to improve construction skills and is interested in working with counterparts in Peru to determine if these techniques will be cross-culturally useful.

Upon the completion of the case study, the team will prepare a series of recommendations on how to carry out this strategy in other areas and outline the procedures by which missions can develop this approach in their assigned area. These recommendations and procedures will include an outline of the training requirements that are necessary at all levels of the relief system (mission level, voluntary agencies, host country, etc.).

APPENDIX A

CURRENT STUDIES ON THE TOPIC OF EMERGENCY SHELTER

I. Title: Development of an Approach and Prototype Emergency Shelters
Organizations: Carnegie-Mellon University, INTERTECT
Funded by: USAID
Project Director: Volker Hartkopf, CMU
Address: Advanced Building Studies
Carnegie Mellon University
Pittsburgh, Pa. 15213
Phone: (412) 621-2600, ext. 8889

Comments: Team working to develop improved strategies and approaches for governments and voluntary agencies in providing emergency shelter and post-disaster housing. Work also included development of model structures (prototypes) derived through the process and based on the use of local materials and technology consistent to the region.

Publications: "Post-Disaster Shelter/Housing: The State of the Art"
"Resources and Needs for Post-Disaster Shelter and Housing"
"Report: Feasability Test of an Approach and Prototype for Ultra Low-Cost Housing (Bangladesh, 1975)"
"Evaluation of the CMU/INTERTECT A-frame as Emergency Shelter in Bangladesh"
"Issues Related to the Provision of Emergency Shelter in Winter Conditions"
"Issues Related to the Provision of Emergency Shelter in Drought Relief Situations"

II. Title: Emergency Shelters Study, Phase I
Principal Consultants: Cuny, Frederick C., INTERTECT: Davis, Ian R., Oxford Polytechnic; Krimgold, Frederick, MIT
Funded by: United Nations Disaster Relief Office (Geneva)
Project Co-ordinator: Davis, Ian, Oxford Polytechnic
Address: Mr. Jean Paul Levy
UNDRO
Palais des Nations
CH-1211 Geneva 10,
Switzerland

Comments: Comprehensive review of the role of emergency shelters, performance of shelters in various types of relief situations, and examination of cost-benefit of shelters. Study looks at long term impact of shelter policies and has conducted case studies on the impact and success of shelter programs in relation to development in the affected country. Phase II will explore policies and roles for the UN, other intergovernmental organizations, as well as local governments.

Publications: There are nine volumes of supporting data, case studies, and reports which are available.

III. Title: Role of Emergency Shelter in Developing Countries
Organization: Royal College of Art (U.K.)
Funded by: Overseas Development Ministry, U.K.
Project Directors: Kenneth Agnew, Gillian Patterson, RCA
Address: Dept. of Design Research
Royal College of Art
Kensington Gore
London SW7 2EU

Comments: Study commissioned to examine current provision and future needs for emergency shelter. Team concentrated on developing design criteria for a universally applicable shelter made of fibreboard which could be made in the United Kingdom and shipped overseas. Project terminated at end of Phase I by ODM, April, 1977.

Publication: Current Provision and Future Needs for Disaster Emergency Shelter, Final Report for Phase I, March, 1977. (RCA Report 188.2)

IV. Title: Role of Technology in International Disaster Assistance
Organizations: Committee on International Disaster Assistance (CIDA)
Funded by: National Academy of Science, USAID
Executive Secretary: Charles Fritz, NAS (Emergency Shelter Working Group Chairman: Frederick Krimgold, MIT)
Address: 2101 Constitution Ave. N.W.
Washington, D.C. 20418
Telephone: (202) 389-6470

Comments: Committee formed by NAS at request of USAID to explore role and future directions of AID's Office of Foreign Disaster Assistance (OFDA), especially in relation to science and technology. A working group was created by CIDA to examine emergency shelters and their provision by OFDA.

Publications: Proceedings of the meetings will be published in June, 1977.
: A report by the emergency shelters working group will be published in June, 1977.
: A paper by Ian Davis of Oxford Polytechnic, submitted to CIDA on emergency shelters will be published at the completion of the project.

V. Title: Seminar on Emergency Housing and Shelter
Organizations: Disasters Emergency Committee (of British voluntary agencies)
Funded by: Disaster Unit, Ministry of Overseas Development
Seminar Chairman: Leslie Kirkley (D.E.C.)
Address: 9 Grosvenor Crescent
London SWIX 7EJ

Publications: Report of a Seminar on Emergency Housing and Shelter, Jan. 15, 1976

BANGLADESH FOLLOW-UP

Activities

1. Evaluation trip by Everett Ressler, INTERTECT
2. Collection of data from participating organizations (OXFAM, MCC, CONCERN)

Reports

"Evaluation of CMU/INTERTECT A-Frame As Emergency Shelter in Bangladesh, March 1977," by Everett Ressler, INTERTECT

EVALUATION OF CMU/INTERTECT A-FRAMES AS EMERGENCY SHELTER IN BANGLADESH

March 1977

Everett Ressler

This Report was made possible through a Grant by the Agency for International Development, Office of Science and Technology, Department of State, Washington, D.C.

Preface

From February 13 - 19, 1977, a visit to Bangladesh was undertaken for the purpose of evaluating the emergency shelter units designed and built under the direction of the Carnegie Mellon University/INTERTECT Refugee Housing Team.

I particularly wish to acknowledge the kindness and helpfulness of Ms. Carol Eggan, Canadian University Students Organization (CUSO); Mr. Shabir, one of the builders of the A-frames; Mr. Hugh Byrne, staff engineer of CONCERN-Ireland; Mr. Paul Meyers, Mr. Ralph Miller, and Mr. Ernie Kaethler of the Mennonite Central Committee (MCC); Dr. Winburn Thomas, Director of Agricultural Development Agency of Bangladesh (ADAB); Father Young, Director of CORR; Mr. Joe Sharpe, CARE; Mr. Bert Kurkland, U.S.A.I.D.; the many people who permitted me into their homes in Mirpur, Demra and Tongi; and the many other people who shared with me their ideas and observations.

Introduction

General Impressions

The status, or general condition, of the people living in the relief camps is difficult to describe or analyze. The first impression was very positive. The camps (Mirpur, Demra and Tongi) all had a feeling of life and vitality, best characterized by activity.

The camps appeared orderly and clean. The small, self-constructed minimal shelters, that characterized the camps initially, have almost entirely been replaced with housing units provided by international donors and the Government of Bangladesh.

There appeared to be an expanding number of shops and markets in each camp, producing and selling a wide variety of utilitarian items. This atmosphere may reflect the reportedly improved economic condition of Bangladesh.

Inpressions of the residents in the camps were also positive. The children appeared well cared for and happy. Many are attending school. The women were actively involved in activities, and many men reportedly were working in Dacca.

Status of Camps

The status of Mirpur, Section XVI, remains as uncertain as it has for the last several years, with frequent rumors that it is to be moved immediately. In general, however, the orientation of the Government seems to be the acceptance of bustee camps as permanent residential areas; and they are reported to have granted land holdings to some residents.

Since the 1974 repatriation by Pakistan, there has been no further major repatriation of the Bihari people. The stance of the Bangladesh Government towards the Bihari people appears to be changing with an increasing acceptance. There is reportedly a movement to give back houses to the Bihari people and to grant them land.

The camps are still generally administered by camp committees and relief agencies. The Mennonite Central Committee, who held responsibility for the Mirpur camp, has turned over all responsibility to the camp committee as of February 1, 1977. The camp committees appear, however, to be quite tenuous and very political.

Background

The first block of the CMU/INTERTECT houses was completed in May 1975, and from the date of completion the shelters have been completely occupied. It is from this perspective of time and nearly two years' use by the residents that information about these shelters is collected.

EVALUATION OF CMU/INTERTECT A-FRAMES AS EMERGENCY SHELTER IN BANGLADESH

March 1977

I. Observations of Use

A. Care of the Structures by Occupants:

A general inspection revealed the units to be in good condition. There is no evidence of abuse. The inside was, without exception, clean and well cared for.

The structural component which showed the most wear was the door. Doors were often patched and reinforced. These repairs are indicative of personal input into maintenance.

The ropes used as cross-braces were often very loose but were intact. There was no evidence of the cannibalization of any part of the structure.

B. Occupancy:

The occupancy rate appears to have remained about constant with three-to-five families per unit. There were several exceptions where units had been taken over largely by one family. There existed an obvious orientation for family units of the same family grouping to be living in the same shelter. This appeared to be positive.

C. Modifications:

No modifications to the main structure were noted, nor have there been any real alterations of entrance, windows, ventilation systems or storage areas. (The comment most often heard regarding any modifications was an affirmation of how poor the family was.)

The most significant changes are the additions being made to the A-frames. The common courtyard, designed for a garden, has in part been taken over by family enclosures built around the doors of the units. This addition, common to all types of structures in the camps, is a fence or barrier which is built to provide a small, protected area through which one must pass to reach the door. Within these enclosures, small bamboo structures are being erected and used as living quarters.

D. Problems:

The major disadvantage of the A-frames is the floor space lost because of the shape, which is significant in such a small living area. The problem with using this space for storage is that materials stored at ground level are more likely to be damaged by rats and rain.

E. Impact of Design:

No evidence was seen that would indicate any incorporation of the principles of triangulation used in the A-frames, or of the ventilation systems used, in any other structures built in the area. All structures in the vicinity of the A-frames -- even those adjacent which were damaged by the wind storm of November 1976 -- were rectangular and conventionally built. All additions built within the enclosures (as described in "C" above) were rectangular and conventional.

In Demra, the Mennonite Central Committee has been using an A-frame for a family planning clinic. When a second building was needed, a traditional bamboo building was constructed. Although the A-frame in use was defended as strong, useful and cool, the traditional type was built because "permanence was needed and the traditional type was cheaper". This conclusion was often heard.

The one example of carry-over of the design was seen in Demra where A-frames were built; but the original design of the CMU/INTERTECT team was significantly modified. The units were designed to be two-family units, and the doors were moved from the sides to the ends. Windows were eliminated. The roof was constructed of bamboo mats and plastic, and the amount of bamboo was reduced. The cost was much more comparable with that of conventional bamboo shelters. The design was changed because the CMU/INTERTECT structures were considered too complex, more costly, and they required much closer supervision during construction. The modified structures were quite dilapidated and had the following overt problems:

1. The November 1976 winds had torn off the ventilation flaps and some had not been replaced. In one, the peak had been rounded which prevents any ventilation.

2. The main structural poles had sheared off at ground level during the wind.

3. The shelters were hotter and darker.

In general, this use (or mis-use) of triangulation provided very poor shelters.

II. Acceptability

The acceptability of the structures is evidenced both through preferences verbalized by the occupants and through observations of use. As had been described, the shelters appear to be both occupied and cared for. From a cursory examination, there appears to be no negative social stigma associated with them. One indication of this is the fact that one of the administrators of a family planning unit lives with his family in one of the units. They have fenced in an enclosure, added a small separate building for sleeping, installed

electric lights, and have made it quite an exceptional place.

The comment most often heard from the residents is that they would prefer a house like the other commonly built structures within the camp. The reason for this indicated preference may, however, involve more than preference for a particular shape of house. Other variables may include the amount of usable floor space, privacy within the structure, and degree of autonomy from one's neighbors. Individual shelters are probably preferred over semi-detached and more certainly over multi-family units. There is no question, however, that the residents prefer a more conventional structure (brick is preferred). More study would be required to analyze this in detail.

III. Construction Detail

The shelters built as designed by the CMU/INTERTECT team appear to have been well constructed.

Frame: The frames appear in good shape with no splitting or undue sagging.

Bindings: Joints were checked and the bindings were found to be quite secure. In fact, no loose bindings were found.

Floor: The raised bamboo floor and the mud plinth floor both appeared to be in good shape with no obvious faults.

Roofing: The roofing is without question the most problematic component. In the houses where only bamboo shingles were used for roofing, there were complaints of leakage. The use of plastic between bamboo panels seems to have eliminated the leaks, but consequently has made the shelter much hotter, as it prevents air from circulating through the thatch.

Another problem evidenced with the use of plastic sandwiched between bamboo mats is that the plastic tended to slide down the roof. This was seen several times.

It was also interesting to note that bamboo was often slightly torn away from the part of the roof on either side of the entrance, near ground level. It was noticed only on the roofs made with bamboo and plastic.

Doors: The doors were certainly the most used components and consequently showed the most wear. Often the bamboo had come apart or the hinge arrangement broken. Some doors were reinforced and some replaced with cloth.

Windows or Ventilation Flaps: They appeared in good order.

Design for Wind Resistance: The A-frames were designed to be wind resistant. There is general acceptance that the design is an improvement over the typical bamboo structures, but field experience has provided little information of limits. The only significant encounter with the wind occurred in November, 1976. The wind strength was enough to damage large bamboo roof sections but did little other damage. No damage was sustained by the A-frames at that time.

IV. Evaluations by Voluntary Agencies

In assessing housing options for Demra, a more conventional structure was compared with the CMU/INTERTECT shelter and the following analysis was presented:

> It was eventually decided to use the conventional pitched-roof design since, cost being equal, usable floor space was much higher than that of the A-frame. A-frames were very difficult to ventilate cheaply and simply, resulting in their being stuffy and hot; while conventional shelters enabled an air stream to pass between the side walls and the roofs. It was conceded that the A-frames had a stronger structural form, but it was decided that the rarity of a storm sufficient to destroy a conventional shelter counter-balanced this. Also, the conventional type was far more popular with occupants and helped create a more normal Bangladesh environment.

This analysis typifies the response and feeling of voluntary agencies involved in housing in the camps. It differs only in cost analysis. The A-frames are more expensive than the conventionally built shelters with equal floor space, if they are constructed as designed. Administrators could not justify the added expense in benefit to the people.

V. Conclusions

There may have been many attempts to develop a better emergency shelter using canvas, cardboard, plastic, metal, domes, etc. These proposed solutions have all had advantages and disadvantages. It is a comparison of the two that serves to pass judgment on the viability of the proposed solution. The basis of the decision is usually cost and acceptability.

The structures as tested by CMU/INTERTECT have proven that local materials can be used to build a more wind-resistant shelter. The experience of nearly two years' use has indicated that shelter's ability.

The disadvantages of the units lie in the low risk probability of wind damage in Dacca. If frequent threat of wind damage existed and the A-frames compared with the conventionally built bamboo houses, then the A-frames may prove to have a distinct advantage.

If, however, the risk of wind damage is negated, then the conventionally built houses have advantages with lower cost, more usable floor space, more traditional style, and may be easier to construct.

The sociological acceptability of the A-frames probably rests largely in use. Complaints about the shape were not heard from those families who had been able to acquire more floor space around or within the A-frame. More analysis, however, would probably indicate a preference for conventional-type structures.

The cost factor of the A-frames is a major consideration at field level. If the cost of these units is compared with the cost of brick shelters, then the units are a bargain. But field workers do comparisons between the least expensive options, and in this case they are much more expensive than the conventional shelters preferred by the occupants.

ER:jwp

399

CMU/INTERTECT ULTRA LOW COST SHELTERS

IN

RELIEF SITUATIONS IN BANGLADESH

Review of Work Accomplished
under Feasibility Contract no. AID/ta-C-1174
and Present Contract no. AID/ta-C-1345

Interdisciplinary Working Party
Carnegie-Mellon University
Pittsburgh, Pa., 15213
May, 1977

CMU Co-Principal Investigators

Charles H. Goodspeed
Assoc. Professor, Department of
Civil Engineering, CMU

Volker H. Hartkopf
Assoc. Professor, Department of
Architecture, CMU
Director, Advanced Building
Studies, CMU

Consultant

Frederick C. Cuny
Partner-in-Charge
INTERTECT
Dallas, Texas

The two-year evaluation of the emergency shelter was conducted by Everett Ressler. This report was written with the assistance of Carolyn Weisner.

I. Introduction

The following is a report to the Agency for International Development on the two-year evaluation of the CMU/Intertect refugee shelter field test in Bangladesh. The test shelters were built during Spring, 1975, and revisited during Spring, 1977. For an account of the testing program, please refer to the Feasibility Test of an Approach and Prototype for Ultra Low Cost Housing, Final Report to the Agency for International Development, ARC:301.54, G655; TA/OST 75-26.

II. History of the Project

In 1973 an interdisciplinary team of architects, engineers, planners, and sociologists was formed at Carnegie-Mellon University in Pittsburgh, Pennsylvania, to develop shelters for emergency use in developing countries. The team consisted of professionals from Carnegie-Mellon and from Intertect in Dallas, Texas.

Beginning in Fall, 1973, several prototypical shelters were developed and tested in the Carnegie-Mellon laboratory and in the jungles in Guatemala. Materials used were bamboo, wood, juterope, grasses and palm leaves, and stabilized soil.

Simultaneously, interdisciplinary courses were conducted in Emergency Habitat. Students submitted two entries to the 1975 competition for the UNESCO Prize held in conjunction with the XII World Congress of the International Union of Architects, Madrid, Spain, and received the Prize of the Soviet Union.

During Spring, 1975, under contract from the Agency for International Development (A.I.D.), U.S. Department of State, (contract no. AID/ta-C-1174) tests of the A-frame were conducted under actual field conditions in Bangladesh. Several test sites and programs were chosen. They were:

--Rehabilitation of a section of Mirpur
--Prototype for construction for Demra
--Prototype for Tongi
--Village of Kunda, Comilla District

In June, 1975, Dr. Vijai Singh, a sociologist from the University of Pittsburgh, visited a number of the test sites to evaluate the cultural acceptability of the units in their various roles and to report on their status several months after occupancy. Details of the testing program and of this preliminary evaluation are provided in the Feasibility Test of an Approach and Prototype for Ultra Low Cost Housing cited above.

In June, 1976, A.I.D. granted a new contract to the CMU/Intertect team (contract no. AID/ta-C-1345). One phase provided funds for a two-year evaluation of the project in Bangladesh in Spring, 1977. The following sections discuss the findings of this evaluation.

III. Two-Year Evaluation of CMU/Intertect A-Frames as Emergency Shelter in Bangaldesh

General Impressions

The status, or general condition, of the people living in the relief camps is difficult to describe or analyze. The first impression was very positive. The camps (Mirpur, Demra and Tongi) all had a feeling of life and vitality, best characterized by activity.

The camps appeared orderly and clean. The small, self-constructed minimal shelters, that characterized the camps initially, have almost entirely been replaced with housing units provided by international donors and the Government of Bangladesh.

There appeared to be an expanding number of shops and markets in each camp, producing and selling a wide variety of utilitarian items. This atmosphere may reflect the reportedly improved economic condition of Bangladesh.

Impressions of the residents in the camps were also positive. The children appeared well cared for and happy. Many are attending school. The women were actively involved in activities, and many men reportedly were working in Dacca.

Status of Camps

The status of Mirpur, Section XVI, remains as uncertain as it has for the last several years, with frequent rumors that it is to be moved immediately. In general, however, the orientation of the Government seems to be the acceptance of bustee camps as permanent residential areas; and they are reported to have granted land holdings to some residents.

Since the 1974 repatriation by Pakistan, there has been no further major repatriation of the Bihari people. The stance of the Bangladesh Government towards the Bihari people appears to be changing with an increasing acceptance. There is reportedly a movement to give back houses to the Bihari people and to grant them land.

The camps are still generally administered by camp committees and relief agencies. The Mennonite Central Committee, who held responsibility for the Mirpur camp, has turned over all responsibility to the camp committee as of February 1, 1977. The camp committees appear, however, to be quite tenuous and very political.

Background

The first block of the CMU/INTERTECT houses were completed in May 1975, and from the date of completion the shelters have been completely occupied. It is from this perspective of time and nearly two years' use by the residents that information about these shelters is collected.

A. Observations of Use

1. Care of the Structures by Occupants:

A general inspection revealed the units to be in good condition. There is no evidence of abuse. The inside was, without exception, clean and well cared for.

The structural component which showed the most wear was the door. Doors were often patched and reinforced. These repairs are indicative of personal input into maintenance.

The ropes used as cross-braces were often very loose but were intact. There was no evidence of the cannibalization of any part of the structure.

2. Occupancy:

The occupancy rate appears to have remained about constant with three-to-five families per unit. There were several exceptions where units had been taken over largely by one family. There existed an obvious orientation for family units of the same family grouping to be living in the same shelter. This appeared to be positive.

3. Modifications:

No modifications to the main structure were noted, nor have there been any real alterations of entrance,, windows, ventilation systems or storage areas. (The comment most often heard regarding any modifications was an affirmation of how poor the family was.)

The most significant changes are the additions being made to the A-frames. The common courtyard, designed for a garden, has in part been taken over by family enclosures built around the doors of the units. This addition, common to all types of structures in the camps, is a fence or barrier which is built to provide a small, protected area through which one must pass to reach the door. Within these enclosures, small bamboo structures are being erected and used as living quarters.

4. Problems:

The major disadvantage of the A-frames is the floor space lost because of the shape, which is significant in such a small living area. The problem with using this space for storage is that materials stored at ground level are more likely to be damaged by rats and rain.

5, Impact of Design:

No evidence was seen that would indicate any incorporation of the principles of triangulation used in the A-frames, or of the venti-

lation systems used, in any other structures built in the area. All structures in the vicinity of the A-frames -- even those adjacent which were damaged by the wind storm of November 1976 -- were rectangular and conventionally built. All additions built within the enclosures (as described in "C" above) were rectangular and conventional.

In Demra, the Mennonite Central Committee has been using an A-frame for a family planning clinic. When a second building was needed, a traditional bamboo building was constructed. Although the A-frame in use was defended as strong, useful and cool, the traditional type was built because "permanence was needed and the traditional type was cheaper". This conclusion was often heard.

The one example of carry-over of the design was seen in Demra where A-frames were built; but the original design of the CMU/INTERTECT team was significantly modified. The units were designed to be two-family units, and the doors were moved from the sides to the ends. Windows were eliminated. The roof was constructed of bamboo mats and plastic, and the amount of bamboo was reduced. The cost was much more comparable with that of conventional bamboo shelters. The design was changed because the CMU/INTERTECT structures were considered too complex, more costly, and they required much closer supervision during construction. The modified structures were quite dilapidated and had the following overt problems. In the first place, the November 1976 winds had torn off the ventilation flaps and some had not been replaced. In one, the peak had been rounded which prevents any ventilation. Secondly, the main structural poles had sheared off at ground level during the wind. Finally the shelters were hotter and darker than those provided by the CMU/INTERTECT Refugee Housing Team. In general, this use (or mis-use) of triangulation provided very poor shelters.

B. Acceptability

The acceptability of the structures is evidenced both through preferences verbalized by the occupants and through observations of use. As had been described, the shelters appear to be both occupied and cared for. From a cursory examination, there appears to be no negative social stigma associated with them. One indication of this is the fact that one of the administrators of a family planning unit lives with his family in one of the units. They have fenced in an enclosure, added a small separate building for sleeping, installed electric lights, and have made it quite an exceptional place.

The comment most often heard from the residents is that they would prefer a house like the other commonly built structures within the camp. The reason for this indicated preference may, however, involve more than preference for a particular shape of house. Other variables may include the amount of usable floor space, privacy within the structure, and degree

of autonomy from one's neighbors. Individual shelters are probably preferred over semi-detached and more certainly over multi-family units. There is no question, however, that the residents prefer a more conventional structure (brick is preferred). More study would be required to analyze this in detail.

Construction Detail

The shelters built as designed by the CMU/INTERTECT team appear to have been well constructed.

Frame: The frames appear in good shape with no splitting or undue sagging.

Bindings: Joints were checked and the bindings were found to be quite secure. In fact, no loose bindings were found.

Floor: The raised bamboo floor and the mud plinth floor both appeared to be in good shape with no obvious faults.

Roofing: The roofing is without question the most problematic component. In the houses where only bamboo shingles were used for roofing, there were complaints of leakage. The use of plastic between bamboo panels seems to have eliminated the leaks, but consequently has made the shelter much hotter, as it prevents air from circulating through the thatch.

Another problem evidenced with the use of plastic sandwiched between bamboo mats is that the plastic tended to slide down the roof. This was seen several times.

It was also interesting to note that bamboo was often slightly torn away from the part of the roof on either side of the entrance, near ground level. It was noticed only on the roofs made with bamboo and plastic.

Doors: The doors were certainly the most used components and consequently showed the most wear. Often the bamboo had come apart or the hinge arrangement broken. Some doors were reinforced and some replaced with cloth.

Windows or Ventilation Flaps: They appeared in good order.

Design for Wind Resistance: The A-frames were designed to be wind resistant. There is general acceptance that the design is an improvement over the typical bamboo structures, but field experience has provided little information of limits. The only significant encounter with the wind occurred in November, 1976. The wind strength was enough to damage large bamboo roof sections but did little other damage. No damage was sustained by the A-frames at that time.

IV. Evaluations by Voluntary Agencies

In assessing housing options for Demra, a more conventional structure was compared with the CMU/INTERTECT shelter and the following analysis was presented:

> It was eventually decided to use the conventional pitched-roof design since, cost being equal, usable floor space was much higher than that of the A-frame. A-frames were very difficult to ventilate cheaply and simply, resulting in their being stuffy and hot; while conventional shelters enabled an air stream to pass between the side walls and the roofs. It was conceded that the A-frames had a stronger structural form, but it was decided that the rarity of a storm sufficient to destroy a conventional shelter counter-balanced this. Also, the conventional type was far more popular with occupants and helped create a more normal Bangladesh environment.

This analysis typifies the response and feeling of voluntary agencies involved in housing in the camps. It differs only in cost analysis. The A-frames are more expensive than the conventionally built shelters with equal floor space, if they are constructed as designed. Administrators could not justify the added expense in benefit to the people.

V. Conclusions

There may have been many attempts to develop a better emergency shelter using canvas, cardboard, plastic, metal, domes, etc. These proposed solutions have all had advantages and disadvantages. It is a comparison of the two that serves to pass judgment on the viability of the proposed solution. The basis of the decision is usually cost and acceptability.

The structures as tested by CMU/INTERTECT have proven that local materials can be used to build a more wind-resistant shelter. The experience of nearly two years' use has indicated that shelter's ability.

The disadvantages of the units lie in the low risk probability of wind damage in Dacca. If frequent threat of wind damage existed and the A-frames compared with the conventionally built bamboo houses, then the A-frames may prove to have a distinct advantage.

If, however, the risk of wind damage is negated, then the conventionally built houses have advantages with lower cost, more usable floor space, more traditional style, and may be easier to construct.

The sociological acceptability of the A-frames probably rests largely in use. Complaints about the shape were not heard from those families who had been able to acquire more floor space around or within the A-frame. More analysis, however, would probably indicate a preference for conventional-type structures.

The cost factor of the A-frames is a major consideration at field level. If the cost of these units is compared with the cost of brick shelters, then the units are a bargain. But field workers do comparisons between the least expensive options, and in this case they are much more expensive than the conventional shelters preferred by the occupants.

VI. Lessons Learned From Bangladesh Field Test

In conclusion, the following categories represent a summary of the lessons learned through the field test and the 2-year evaluation:

A. Context:

The field work in Bangladesh underscores the need for a specific response appropriate to each encountered situation, instead of universally fitting prototypes based on geographical and cultural considerations. Even within a single geographic and cultural region, conditions vary enough to cause significant design modifications from one relief situation to another. The original design was conceived to answer a situation like the one created by the massive influx of refugees into India during the 1971 War of Independence in East Pakistan.

Information the team obtained from relief organizations active in Bangladesh during 1972-75 indicated that the then prevailing situation, affecting large numbers of people, was virtually the same as the one encountered in India in 1971. As a result the team designed a structure to respond to those conditions. The field tests demonstrated, however, that conditions were in fact quite different in the encountered situations. Instead of being short term they were long term if not permanent. The major participants, the donors and the displacees, did not agree concerning the permanency of the camps. Relief organizations insisted the camps to be temporary, whereas the displacees have accommodated themselves for long term occupancy. As a result a structure was designed which was largely inappropriate. The relief agencies, not wanting to encourage permanency, considered the structures' strength and durability too permanent and costly. The occupants, on the other hand, knowing that the situation would be long term, complained about lack of space and privacy. This brings out three major points:

1. The design process must originate in the field.
2. Specific Designs cannot be transferred from situation to situation.
3. The original CMU/INTERTECT design concept and process remains untested.

B. Approach:

1. The design process must originate in the field. It is impossible for the designers to be completely aware of all the constraints unless they are on site and comprehend fully both the operational constraints and the local housing process.

Among the issues which the designers must take into consideration are how structures are built and what building skills are used locally, who participates in the building process, and how space is organized and allocated.

2. The process must involve from the outset all participants, including the victims and intervenors, which are donors and designers.

3. Critical constraints, particularly trade offs of desired performance and associated costs must be established jointly. Critical cost levels, below which the safety of the future occupants cannot be guaranteed must be understood.

4. The final selection of suitable materials, components and layouts among the developed alternatives must rest with the future inhabitants.

5. Before beginning full scale construction, it is desirable to conduct small scale demonstration projects wherein occupants are provided with a range of options in order to select the most applicable design.

C. Structures:

The most important factor in developing designs acceptable to future occupants is cultural acceptability. This, in turn, depends largely on two major points:

1. The amount of useable space allotted per family and

2. The degree of resemblance to traditional forms the designs achieve.

Therefore, the designer must begin with indigenous designs and/or forms and analyze their appropriateness for the situation at hand. Should the indigenous structures exhibit deficiences, modifications which improve performance (i.e. structural strength, suitability for mass construction, etc.) must be incorporated. To reiterate: the intervenor must begin with what already exists. Any modification must achieve utmost simplicity.

D. Sites and Services:

Sites and service considerations (layout, provisions of water, sanitation and services) are as important as the design of individual units. It can safely be argued that the quality of a camp environment is as dependent on sites and services provided as on the designs of individual units.

E. Construction Process:

Methods chosen to train the construction teams did not prove effective in transferring the technology. More information must be developed on how to teach, how to transfer technology and how to present the information. (The team is addressing this area under the present contract.)

F. Operational Needs:

The experience indicates that the majority of agencies conducting housing projects are not fully cognizant of the differences in constraints imposed in different relief situations. This points to the need to assist agencies in assessing needs and constraints for each specific situation.

G. Spread effect:

The project demonstrates the failure of the concept of simply delivering materials and training aids to the disaster area and attaining a "spread effect." As stated earlier, the design process must begin on site and experience shows that trained personnel must be present continuously to promote new concepts or designs.

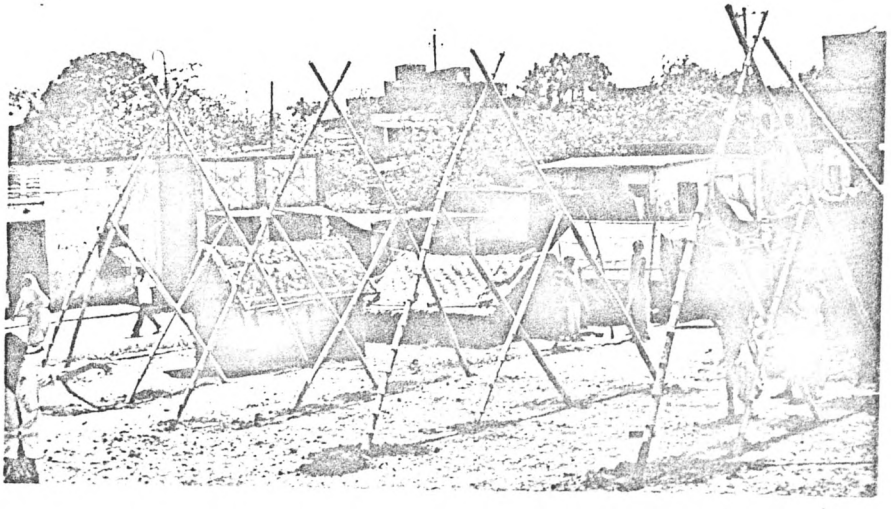
H. Timing:

The project underscored the importance of proper timing of construction. In most developing countires there is a "building season," in other words, a time when material, capital, and labor, combine to facilitate construction. Rarely, does a disaster alter this time frame. Unless the disaster occurs at a time when exposure risk is a major threat, housing construction will not tend to override other concerns. In the Bangladesh Field Test, the best time for construction proved to be the two months before the monsoon (March, April). The best time to evaluate performance was during and immediately after the monsoon, and the most logical time to initiate the second phase of construction was March, April, the following year. The team was unable to take advantage of these opportunities because of discontinuity in funding. In the future, to insure effectiveness, contracts must be structured to promote long-term continuity.

Rehabilitation of Section of Mirpur Camp, Spring, 1975

1. Conditions before rehabilition

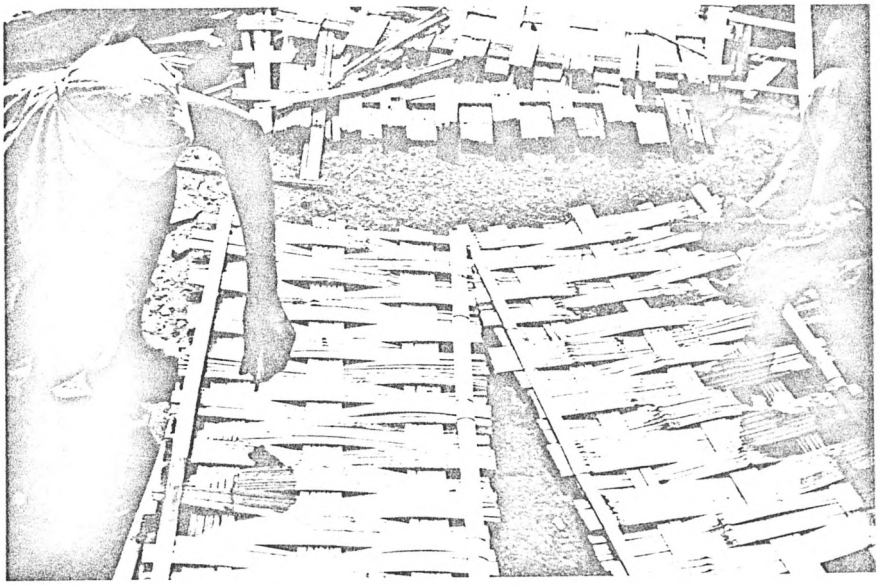
2. Work in progress- Levelling of land



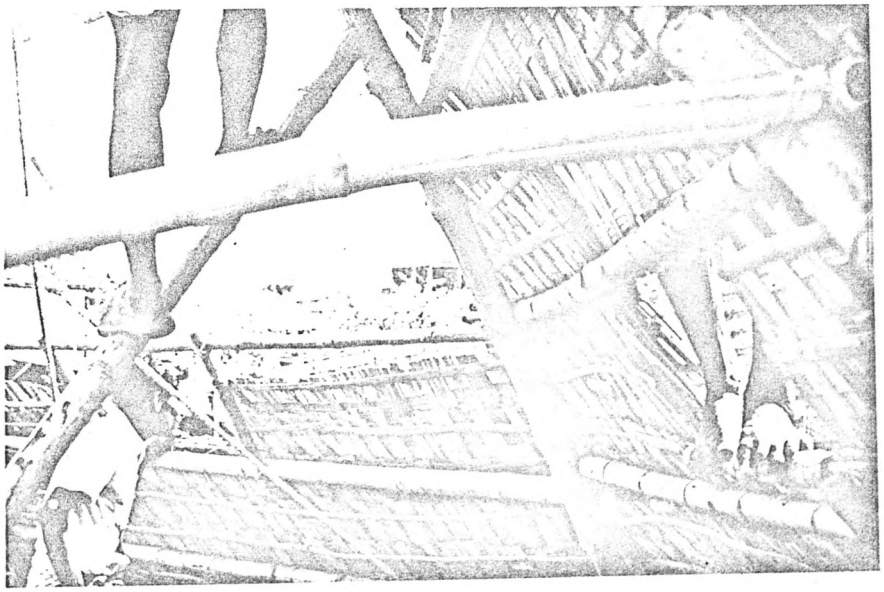
3. Erection of A-frames

Rehabilitation of Section of Mirpur Camp (cont'd)

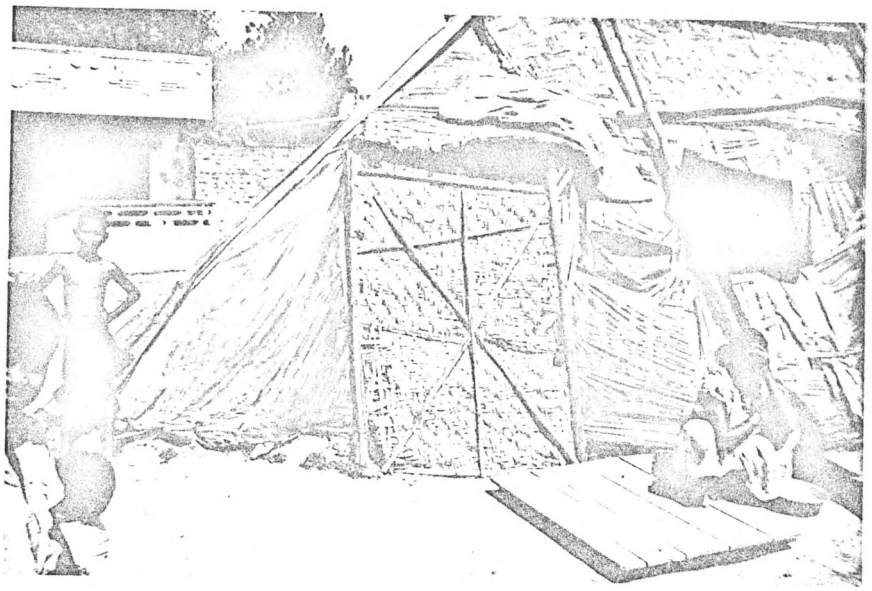
4. Cross-bracing and stringers attached



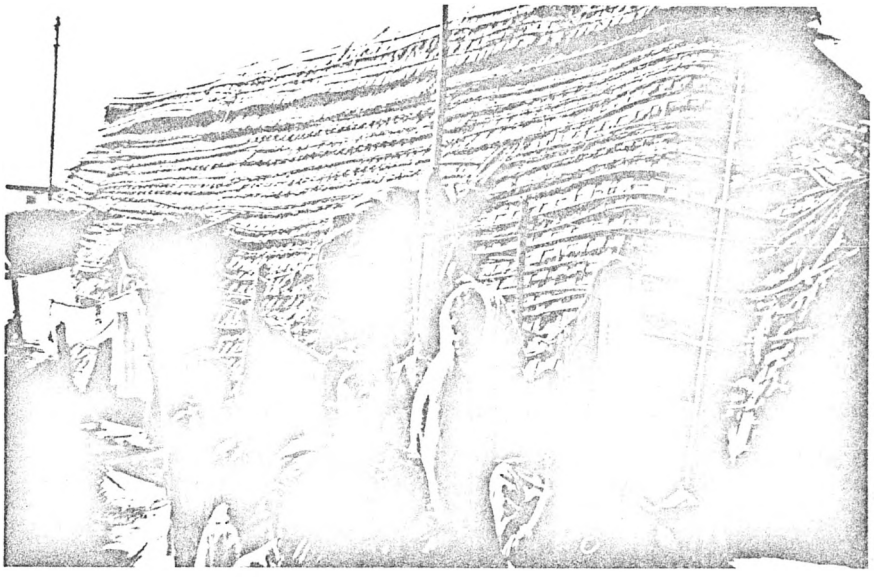
5. Making of bamboo shingles for roofing



6. Application of shingles



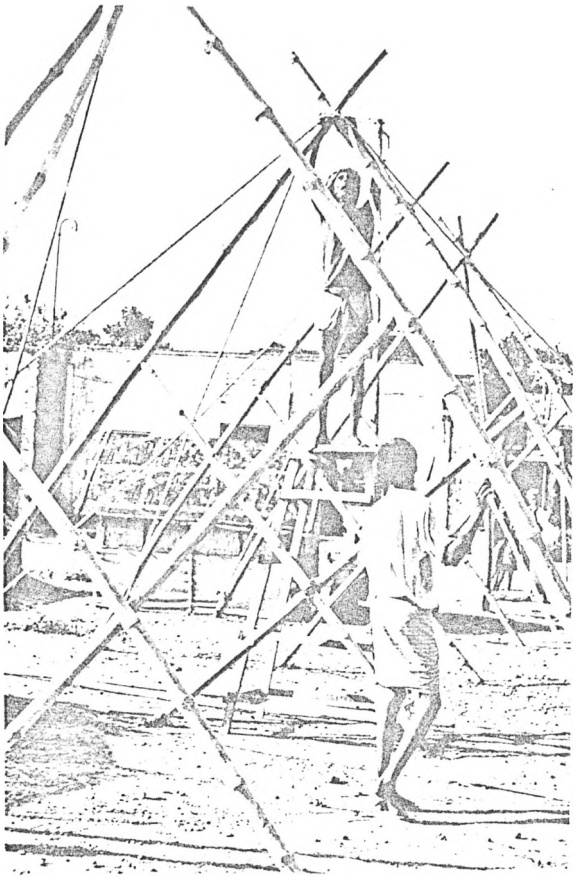
Signs of Use and Care of Entrances in Mirpur, Spring, 1977
7. Apex of triangular door repaired



8. Modification of triangular door to become rectangular

9. Chicken coop integrated into entrance

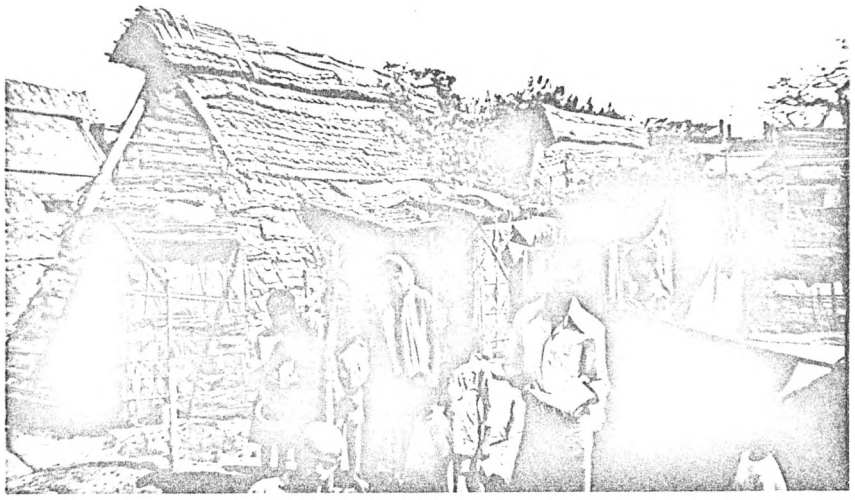
Danger of change to Structural Design



10. Cross-bracing of A-frames during construction

11. Interior view of Mirpur multi-family unit
It appears that some of the cross bracing has been removed to increase useable space. This shows a lack of structural understanding on the part of the residents.

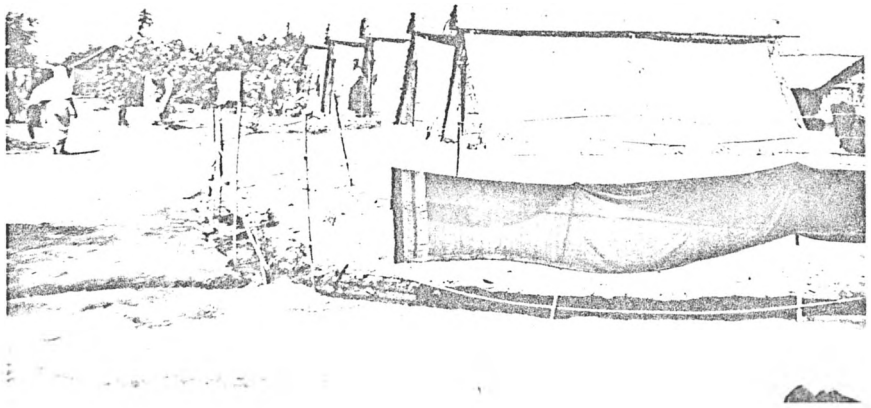
Use of Outdoor Space Between CMU/I Structures at Mirpur
The layout of the rehabilitated section of the camp facilitated the structuring of a sequence of public and private spaces.
12.



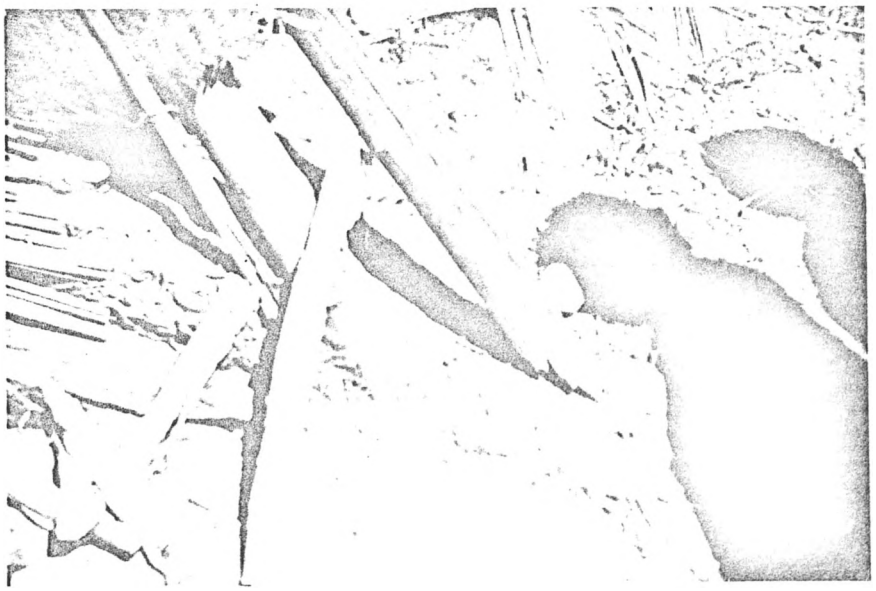
13.

14.

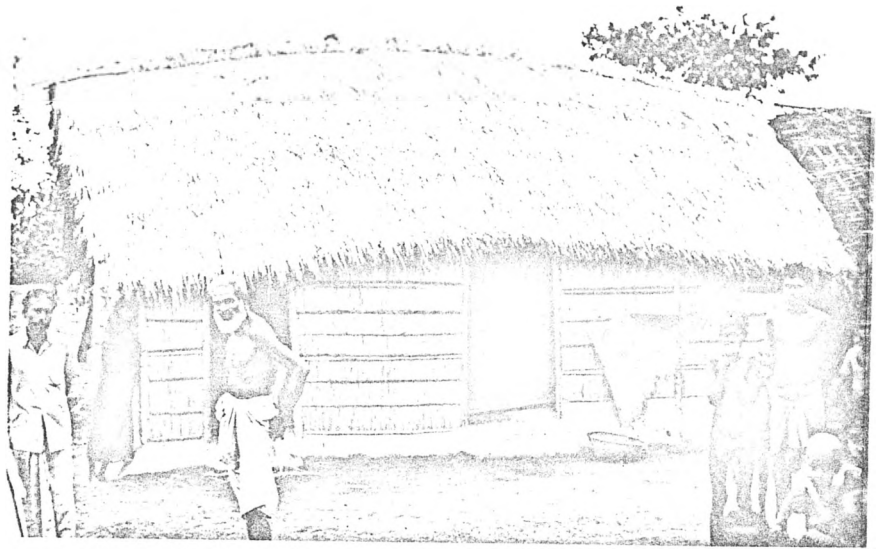
Rehabilitation of Demra
Using a Modified CMU/I
A-frame Structure
15. General view



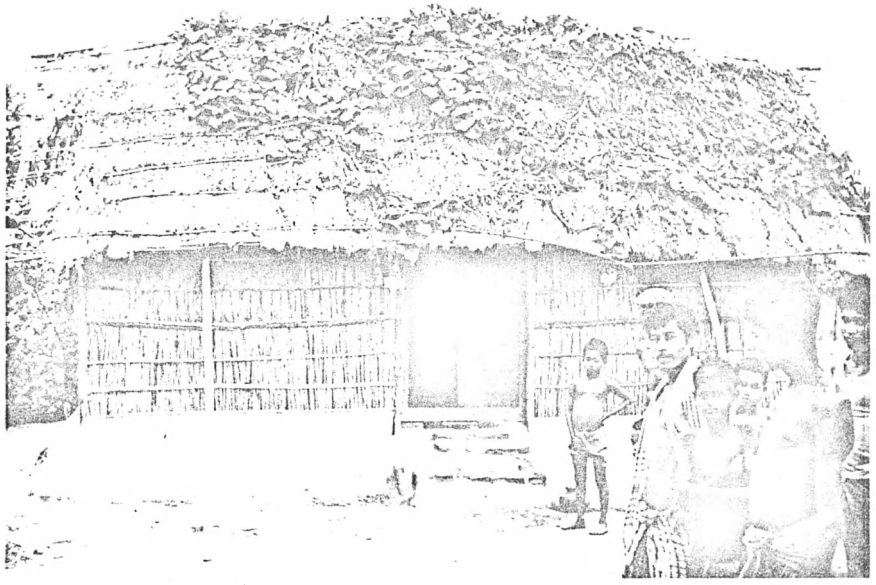
16. Entrance area



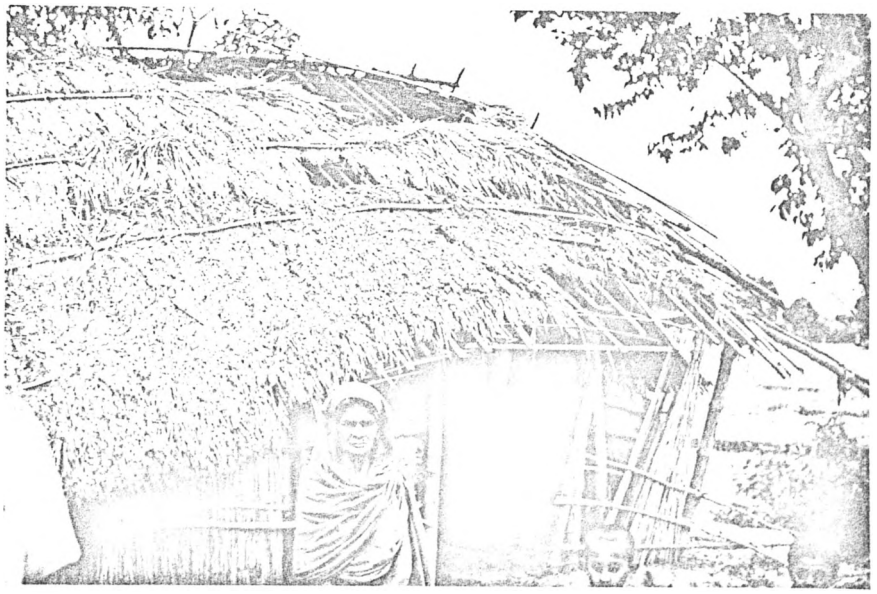
17. Untreated A-frame component sheared off in storm as a result of rot



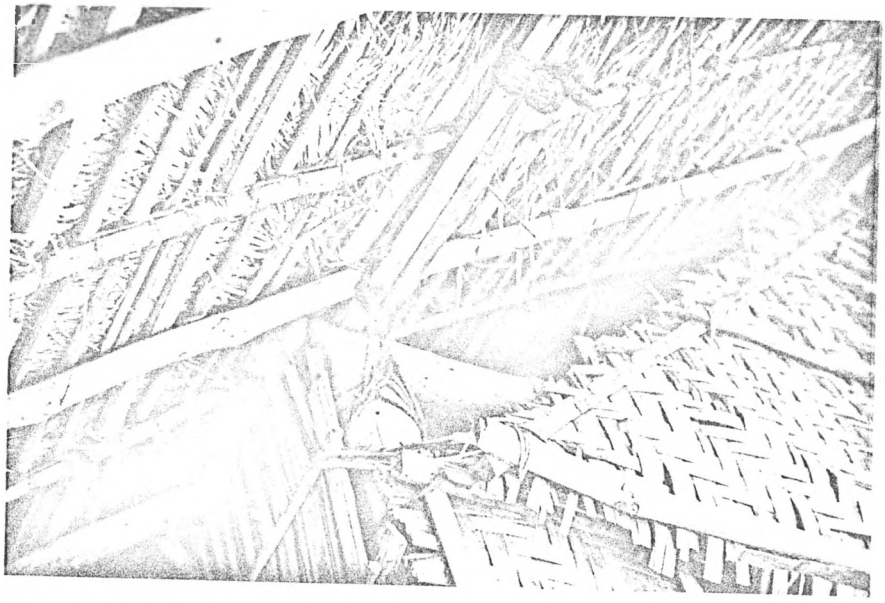
Indigenous Village Housing in Khunda in Bramanbaria Area
18. Well-maintained house



19. Reinforced house - note angled bamboo posts meant to prevent structure from leaning

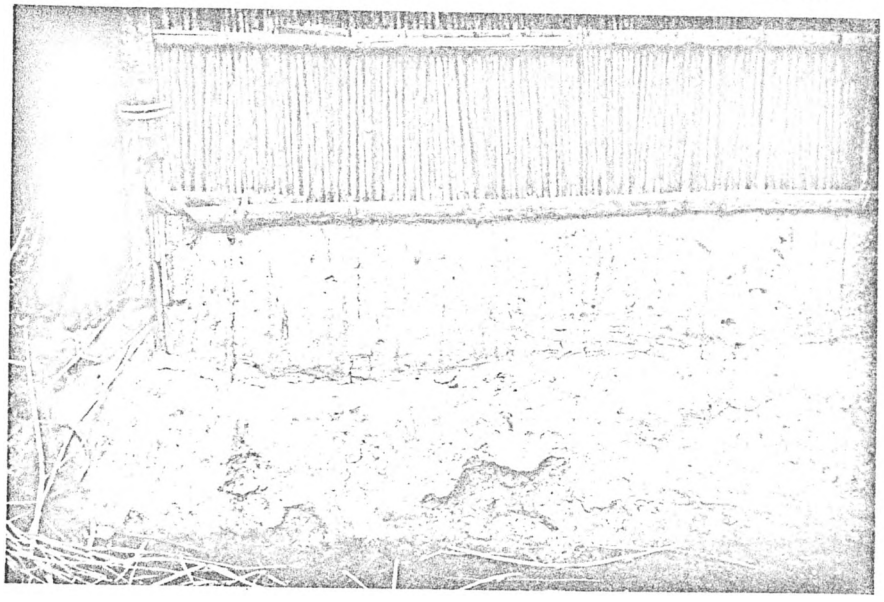


20. Structural as well as roof damage as a result of storm



Indigenous Village Housing Close to Khulna in Southern Bangladesh

21. Roof and wall connection, lack of triangulation



22. Joining of earthen plinth and wall

23. New house construction with earthen wall finished with cowdung plaster

AFRICA - MIDEAST EVALUATION TRIP

Activities

1. Turkey

   A. Evaluation of possibilities, establishment of linkages
   B. Evaluation of Turkish capabilities
   C. Identification of issues related to provision of emergency shelter in cold climates

2. CHAD

   A. Evaluation of situation as per AID request
   B. Identification of issues related to provision of emergency shelter in drought-relief situations

Reports/Papers

1. Report: "Issues Related to the Provision of Emergency Shelter in Winter Conditions" by Everett Ressler, INTERTECT
2. Paper: "Issues Related to the Provision of Emergency Shelter in Drought Relief Situations," by F.C. Cuny and Everett Ressler, INTERTECT (in preparation)

ISSUES RELATED TO THE PROVISION OF EMERGENCY SHELTER IN DROUGHT RELIEF CONDITIONS

I. Introduction

In the immediate past, as well as in the present, there have been several drought relief operations in Africa. These have been in the Sahel region, and more recently, in Ethiopia and Somalia. The major facet of a drought relief operation has been the provision of food and water to the victims of the drought. Several agencies, however, have also proposed emergency shelter and housing programs for the victims. This paper explores the issues related to the provision of emergency shelter under these conditions and the impact of such programs in a long-term context.

II. Refugee Profile

The people in the Sahel who were forced by the drought to migrate were both pastoralists and farmers living on marginally producing lands. For pastoralists, a drought-related migration may mean nothing more than extending their normal migration or moving to new zones. The movement of these peoples is already becoming more difficult each year, due to the increased development along river banks and other marginal lands by farmers and by firmer control of regions by the other pastorial groups. This restriction of movement has made them more vulnerable to drought. Movement, however limited, is still a tradition, however, and construction of lightweight shelters is a part of that tradition. Whether or not shelter would be needed in a drought is first related to whether or not the materials normally used are available. For example, in Chad, the normal building material is grass; in a drought, the grasses may not be available or suitable for use. In some cases, pastorals transport the building materials with them to the new locations, but in drought conditions, this has not always proved the same. People may arrive at the terminus of migration without any construction materials.

The farmer forced by a drought to migrate is more likely to move with few possessions. Shelter may be even more important to this group. Furthermore, these refugees may not have the skills to build lightweight, temporary structures as the pastoralists do.

III. Depletion of Housing Stocks

A drought in itself is not the type of disaster which depletes the housing stock. The concern for shelter stems not from the destruction of housing, as in an earthquake, but from the need for shelter by people who have left their homes and migrated in temporary search of food or water. An emergency shelter or housing program should not be undertaken, therefore, unless the victims of the drought leave their residences and move to a new location.

IV. Exposure Risk

In drought conditions, and in the subsequent environmental conditions caused by the drought (e.g. windstorms, etc.), there is not a sustained, long-term risk to individuals from the climate. Individuals may live for long, extended periods during the drought with only minimal need for shelter. In the short-term, food, clothing, and blankets are of a higher priority, especially during the actual migration.

Exposure risks of concern are primarily related to secondary infections stemming from a weakened physical condition. It is for this reason that cool nights, particularly in malarial areas, can result in pneumonia. Shelter may thus be needed for protection from the sun in the day, from the cool nights, or from rain. The need for such protection can be met in a number of ways (i.e., shade tree) and does not presuppose a formal structure. Often, the traditional structures made of local materials are well suited to meet the needs.

The most important function of shelter, however, may not be protection from the elements, but for establishing a point of reference for the displaced family. This point of reference may be defined as a gathering point for the family, a gathering point for the family's belongings and herds, and/or a location for the receipt of services.

The exposure risk varies greatly with geographic location, season, climate, and altitude. It also varies with the experience and resources of the affected peoples. The semi-nomadic pastoralists, accustomed to living with the hot days and cool nights, may be less affected than more sedentary farm families.

V. Shelter During Migration

Shelter requirements during the actual migration are minimal and can usually be met by the refugees themselves. As long as the refugees are moving, it is not feasible to attempt to provide shelter. Migrations caused by droughts are not of the type in which long columns of people move at the same time from point to point or form clearly defined refugee streams. When drought victims do migrate, it is in small groups which straggle from the drought zone towards the urban centers or to areas where they feel they can find better conditions. Certain routes will of course be more highly traveled than others, for example, main roads leading to large cities, passes or valleys through mountain regions, etc., but even so, large streams of people will not normally form. It may, in fact, be difficult to tell refugees from normal users of the route. Agencies that have attempted to set up wayside feeding stations have found it difficult to distinguish those who actually need the services from the non-affected population. Furthermore, the way stations rarely serve that function and instead become a terminus. In this case, the agency will find itself ill prepared for the large settlement that will develop overnight.

If at all possible, it is best to provide aid within the drought-stricken community itself rather than at centers outside the area. This will help prevent the migration in the first place. Attempting to provide services en route, along migration routes, or at the point where refugees are migrating will only increase the number of people leaving the drought zone.

Some agencies that have attempted to provide food and shelter in a drought have set up central feeding centers within the drought zone. This, too, has caused people to leave their lands and set up camp near the feeding center. Most agencies who participated in the Sahel operations and in Ethiopia concluded that feeding centers should not be set up but that aid and services should be provided in such a way that the drought victims could remain on their land or in their communities. (This can be accomplished by distributing aid through tribes, clans, or villages.) This will have the effect of reducing or even eliminating the shelter requirements from the relief agencies' point of view unless the traditional building materials are affected by the drought.

VI. Shelter at the Terminus of Migration

As noted earlier, most refugees do not require extensive shelter support while en route. However, once they have stopped moving, either temporarily or permanently, the situation may change. The terminus of migration may be in a new climatic region where shelter from the enviornment is at least more nominally required, and a static situation usually dictates that non-exposure risk considerations are enhanced, especially the need for having an enclosed space to retain the refugee family's goods and belongings.

There are four distinct situations which have been encountered by relief adnimistrators in droughts which required consideration of shelter or housing requirements. They are:

A. Shelter at feeding centers. As pointed out earlier, if food or water can be distributed to the affected people through a distribution system which reaches the people in their own communities, there will be little migration. If, however, food is distributed by setting up "central" feeding centers that require people to migrate in order to receive the aid, then temporary shelter may be needed.

Food distribution centers are usually located along a major road and often located on the edge of an urban center. Although there may be some assimilation of the migrating peoples into existing housing, the demand will unquestioningly outstrip the supply.

The ownership and suitability of available land is an important consideration in any housing. Feeding centers are often located on public land, such as schools, churches, or parks, or undeveloped municipal land holdings. Vacant land is sometimes chosen, but is almost always vacant because of the undesirability of the area. They are rarely served by utilities and other services.

The major shelter issue confronting the relief agencies is what level of shelter support should they provide at the feeding center. Most agencies feel that emergency shelter (such as tents) or temporary structures are the best approach. However, even temporary shelter can have very complex consequences, particularly when temporary can mean months or years. Some of the issues that must be faced include:

1. Does a temporary housing standard which exceeds the normal living standard discourage people from returning to their communities?
2. Does the temporary housing provided take into consideration family, tribal, and religious values of the people?
3. Does the temporary housing plan encourage self-direction or support dependency on the feeding center?

The need for temporary shelter is of course dependent on many variables such as magnitude of the drought, projected length of stay by the people who have migrated to the center, the climate, resources of the selected people, health of the people, etc. At some feeding centers, the relief agency assumes responsibility for the care of the widows, the ill, the handicapped,

and the aged. This almost always has become a long-term involvement. Once a family group has relinquished responsibility for that member, particularly in light of the hardships they themselves have faced, it may be difficult to re-integrate those who receive special support, especially if they are left behing. Thus, permanent housing will be needed for these special wards. It should be pointed out that most communities assume responsibility for such unfortunate members and assist with the housing.

B. Housing in major urban areas. Nearly all countries affected by the droughts of the 70's experienced massive influxes of people into the urban areas. Often, the people who migrated to the cities did so with an intent to remain there, and may have had family or friends there. In Addis Ababa, many of the migrants found shelter with family or friends. Even so, some people were without shelter. Unless these people were assisted in returning to their former communities, the housing needed would be more of a permanent housing. In Djamana, Chad in the drought of 1974, many people migrated to the edge of the capital to a riverbank area and lived in temporary shelters constructed of local materials. Temporary shelter usually becomes a permanent structure.

The number and percentage of persons remaining depend on a wide variety of factors, including the length of time they are refugees in the camp, their prospects for economic advancement if they stay or leave, the way in which they perceive the society in the towns, their age at the time they enter the camp and the time they leave, and the availability of jobs in the host community. In relation to the above, the availability of permanent shelter or housing plays a relatively minor part in decision-making as to whether to go or to stay.

If the refugees do elect to remain, the government is then faced with the problem of having to extend housing opportunities to the newcomers. This, however, is not an emergency shelter consideration; rather, it is a permanent, long-term housing consideration.

In the majority of cases, the government policy has been to encourage the refugees to return to their homelands as quickly as possible rather than remain in the towns. It was felt that if they remained, they would contribute to the urban problems that existed before the migration began.

Therefore, the strategy normally chosen by relief agencies and governments alike has been to provide minimal shelter to newcomers rather than long-term or permanent housing. Often the approach includes the creation of refugee camps.

C. Shelter in refugee camps. In order to more efficiently distribute relief supplies and also to ease the strain on local housing, refugee camps may be set up in or around cities. The administrating agencies are then faced with the problem of deciding whether or not to install temporary shelter at these camps. Although most refugees do not require extensive shelter

support while en route, once they have entered a camp, the situation may change. The camp may be in a new climatic region where shelter from the environment is at least nominally required, and the situation in the camp usually dictates that non-exposure risk considerations are enhanced, especailly the need for having an enclosed space to retain the refugee family's goods and belongings.

The major issue confronting the agency at this time is whether or not to provide shelters of a semi-permanent or permanent basis, or whether to provide minimal shelter in the form of tents or materials similar to those used in the local structures. In the majority of the cases, the government policy has been to encourage the refugees to return to their homeland or has attempted to resettle the victims in new locations.

Therefore, at the terminus of migration, the strategy normally chosen by relief agencies and governments alike has been to provide minimal shelter when required, rather than long-term or permanent housing in the camp area. The types of materials used for the shelters have depended on what was locally available, or could be brought from the capital, such as corrugated iron sheeting, duck cloth, etc. Other materials used have included thatching grass, dirt, wood, and a very few tents.

It should be emphasized that if the minimal housing approach is selected, the importance of adequate sites and services programs in the refugee camps is increased. Programs of sanitation and other environmental control measures becamse especially important.

D. Housing in resettlement areas. In some countries, the government has encouraged the refugees from a drought to resettle permanently in other areas. These resettlements constitute a need for permanent housing.

VII. Political Problems Related to Shelter Provision

When a government or agency begins to undertake a housing or shelter program at the terminus of migration, several key political issues are immediately raised. The first relates to the problem of permanence. Many agencies fear that if they establish decent temporary or permanent structures, they will be encouraging the refugees to remain on site. While this fact itself has not been shown to be a major variable in why refugees elect to remain in a community, it is perceived as such by the government and by residents in the host community. If local government authorities undertake such a program, they can usually expect severe criticism or opposition from the non-refugee population.

A second political problem which often arises is related to the provision of housing for refugees when many residents in the host community are not adequately housed. Governments especially draw heavy criticism from the residents for putting the needs of the "outsiders" over the needs of the existing population. Shelter and housing programs usually draw more criticism in this area than do feeding programs or the provision of other relief items and services.

S.S. America

SOUTH AMERICAN SITE SELECTION TRIP

Activities

1. Trip to Peru
   - A. Evaluation of site(s)
   - B. Establishment of linkages to local organization
     1. Government (PREVI)
     2. VOLAGS (OXFAM, World Neighbors)
   - C. Development of proposal, scope of work
   - D. Co-ordination with AID Mission
2. Research in support of proposed project
   - A. Contact with Thompsons and OAS
   - B. Review of training aids, training strategies, etc.
   - C. Development of alternative strategies

Documents

Letter stating scope of work with PREVI

INTERTECT BOX 10502 DALLAS, TEXAS 75207 USA (214) 521-8921

✓ Translation of letter to addressee on date below

April 11, 1977

Ing. Constantino Demitriades Boulanger
Director General
Ministerio de Vivienda y Construccion
Oficina de Investigacion y Normalizacion
Carretera Panamericana
Norte Km 16.900
Lima, Peru

Dear Ing. Demitriades:

During my visit to Peru in March, your associate, Ing. Urbano Tejada Schmidt, was very kind to meet with Miss Mary Walsh and me to tell us of PREVI's outstanding work. We were very impressed with the work done to date and find your proposed project to build model houses to be very exciting.

As I pointed out to Ing. Tejada, our organization is interested in having the opportunity to work with you and exchange ideas on the development of strategies concerning the dissemination of information to the rural areas before and after earthquakes. We recently completed a project in Guatemala which was very similar to the program you have proposed.

I also pointed out that the U.S. Agency for International Development is currently providing funds for our organization, in conjunction with Carnegie-Mellon University, which would allow us to work with you on this project. Our grant allows us to develop strategies for disseminating the information, to assist in preparing training and educational aids such as folletos, rotafolios, etc., and to assist in developing and evaluating a model house construction program.

In our discussion with Ing. Tejada, it was decided that the following would be a good way in which we could work together:

1. As soon as an area of the country has been designated for the initial part of the program, our group would send a small team of two or three persons to study the zone and identify the areas in which the housing is most vulnerable to earthquakes.

2. Once the most vulnerable areas had been identified, we would survey the area to determine the best ways to convey the information to the local people, based on such things as their comprehension of pictorial symbols. On this basis, we would make recommendations for the preparation of various visual aids.

3. While the aids were being developed, we would share with you our ideas for carrying out a pilot project using both model houses and a construction education program.

4. Once the project is underway, we would work with you to evaluate the approach, the model houses, and the training aids, and to make recommendations for any needed changes.

5. When the pilot project has been completed, we would work together with you to develop a plan for expanding the program to other areas and to develop a strategy for disseminating the information rapidly in the aftermath of an earthquake.

As I explained to Ing. Tejada, our group can be ready to begin as soon as an area is designated. The best time for us would be in mid-May or early June; but we can easily make our schedule fit your requirements.

Ing. Tejada has asked that we give you our ideas as to a possible choice for the pilot project. On my recent trip, I drove from Lima to Arequipa, to Puno, Cuzco, Abancay, Nazca, and back to Lima. We selected that area because, in our opinion, ORDEZA is fairly well-organized in the north and central part of Peru. In the southern region which we toured, the area 100 km. south and 100 km. west of Cuzco seems the most vulnerable due to:

1. The large number of two-story adobe houses;
2. The preponderance of tile roofs;
3. The large number of structures which are not balanced and whose walls are out of plumb;
4. The fact that recent tremors there indicate that it is currently more active than other regions.

Therefore, of the areas which we saw, this seems to be the best one in which to begin.

I sincerely hope that the proposals outlined in this letter will be in accord with the objectives of your program. If you concur that this is a good starting point, I shall contact the U.S. Agency for International Development to obtain their permission to begin work under our contract. If you would like to make some changes or additions to the proposals, please feel free to do so.

With kind regards,

Frederick C. Cuny

Frederick C. Cuny

cc: Ing. Urbano Tejada Schmidt
Mr. David Olinger, U.S.AID-Peru
Mr. James Claps, U.S.AID-Washington
Prof. Volker Hartkopf, Carnegie-Mellon University

INFORMATION SHARING PROGRAM

Activities

1. Identification of gaps in the information system
2. Preparation of system for storage, retrieval, dissemination
3. Survey of post disaster information needs
4. Survey of available information resources
5. Establishment of linkages

    A. SINDU
    B. UNDRO
    C. Data networks
    D. Research institutions
    E. Volags and other NGOS

Reports

1. "Post Disaster Technical Information Flow for the Reconstruction of Housing," by Everett Ressler, INTERTECT
2. Information Retrieval System, by Charles Goodspeed, CMU
3. "SINDU - An Information Exchange Network", by Charles Goodspeed, CMU

POST-DISASTER TECHNICAL INFORMATION FLOW

FOR THE RECONSTRUCTION OF HOUSING

By Everett Ressler

This Report was made possible
through a Grant by the Agency
for International Development,
Office of Science and Technology,
Department of State, Washington, D.C.

March 1977

POST-DISASTER TECHNICAL INFORMATION FLOW FOR THE RECONSTRUCTION OF HOUSING

By Everett Ressler

In the last few years, natural disasters in Haiti, Nicaragua, Turkey, Iran, Bangladesh, Peru and Guatemala destroyed housing to such an extent that massive reconstruction programs were needed. Following each disaster, the respective national government, other governments, international agencies, local communities and other groups responded by initiating housing programs.

The goal of this paper is to briefly investigate where such programs acquired the technical information needed to formulate and implement post-disaster housing programs, and to explore the need for and possible ways of improving this technical information flow.

Methodology

Guatemala was selected as a case study. Personal interview was the means of acquiring information about the flow of technical information. Interviews were conducted with personnel in housing programs of the Guatemalan Government, of official foreign aid, of voluntary agencies, and of religiously-affiliated groups. These discussions focused on a description of the housing programs; a review of what technical information sources had been used; the rationale for the technical decisions made; and what was felt to have been learned.

Findings

On February 4, 1976, a major earthquake in Guatemala destroyed over two hundred thousand houses. At least thirty agencies responded by setting up housing programs. Of the twenty-four major agencies, six were international charities, six were religiously-affiliated, six were representatives of other nations (three governmental and three private), and six were locally-based groups.[1]

There was great diversity between these housing programs, including major differences such as the basic approach to housing, structural design, materials and methods.[2] However, the purpose of this paper is not to evaluate these differences, but rather to investigate the basis on which such decisions were made.

There are many distinct facets to the need for, and use of, technical information in post-disaster housing programs. The findings of this study are grouped into the following categories: Information Users; Information Use; Information Flow; Information Type; and Information Sources.

---

[1] Charlotte Thompson and Paul Thompson, Reconstruction of Housing in Guatemala: A Survey of Programs Proposed After the Earthquakes of February, 1976.

[2] More specific details of these differences have been outlined in the study cited above.

I. Information Users (Program Personnel):

One of the most striking findings was that, generally, neither field nor administrative personnel working in the housing programs had technical backgrounds or experience in housing. The most obvious reason for this was that people with experience in administering post-disaster housing programs virtually did not exist, so concerned people from other professions altruistically assumed the responsibility. In other cases, the selection of non-technical people seemed to stem from a misconception of some agencies that post-disaster housing is merely shelter which can be constructed in any form by anyone.

With the broad diversity of professions represented in program personnel came obviously useful skills, and the diligence with which they worked is commendable. The lack of experience in housing, however, highlighted the significance and need for technical input.

Program personnel were quick to seek technical advisors, but often encountered difficulties in evaluating the highly contradictory technical opinions given (these will be discussed in further detail later). The need for such technical advisors arises out of the fact that housing is a specialized field. Housing programs in a post-disaster situation add many specifically different variables, and building in an earthquake-prone area demands still more very important considerations.

It should also be pointed out that only a very small percentage of the people interviewed had worked previously in a disaster situation or felt they might ever work in a disaster situation elsewhere. This indicates the lack of collective memory for building reconstruction programs on a base of past experience. It is also indicative of the problem of transfering what was learned in this disaster to people involved in other disaster situations.

II. Pattern of Information Use:

How technical information was used determined the pattern of when the information was needed.

A. Program Personnel:

Program administrators, congruent with the responsibility of assessing options and determining future programs, particularly sought information within the first three weeks after the disaster. This initial period was undoubtedly most significant for technical input. It was during this three-week period that damage was assessed, options for reconstruction programs considered, and in many cases initial program plans finalized and building materials ordered. Approximately 75% of the agencies interviewed maintained the program conceived during the first three weeks.

The technical information needed by program administrators in this conceptualization phase concerned options, and how such could be implemented. The administrator of a very large program suggested that, immediately post-disaster, model houses be built exemplifying all different building materials and techniques relevant to reconstruction programs, for the

purpose of providing program administrators with visual information upon which to base their decisions. Another form of this was the housing fair which was held in the capital city, consisting of the display of prototypes of manufactured houses. Although these houses were not considered appropriate or economical for rural reconstruction programs, the fair itself (and the former suggestion) was a response to the need expressed by program administrators for information about options.

It was during the initial three-week conceptual phase that the lessons learned and carried forward from past experience were most useful. The removal or burial, by large earth-moving equipment, of post-earthquake rubble in Nicaragua was several times mentioned as both destructive and wasteful of valuable resources. With at least one known agency, the information from the Nicaraguan experience was the deterrent to the use of large equipment in that way in Guatemala, thereby preventing a repeat of the same mistake.

Program administrators relied most heavily upon consultants and technical advisors also during this initial three-week period. Consultants and technical advisors, exploring options and alternatives for program planning, particularly sought information during the second and third weeks. Their greatest need was for information which was technical in nature. The U.S. Embassy, viewed as a primary source of information, reported that the greatest volume of requests were received within this initial period and came predominantly from Guatemalan professionals seeking information about a specific problem. Examples include requests for information about the stabilization of adobe and about building with ferrocement.

Field personnel directly involved in the building process viewed the need for technical information differently, from the perspective of functional problems. The technical information which they felt was needed was pragmatic, in a "how-to-build" form, and directly related to actual construction problems and difficulties encountered in carrying out the building program. In other words, they considered technical information as a functional resource needed for the duration of the program. Short-term technical consultations were very unacceptable. Field personnel felt the need was for a readily available technical resource person who would assist with the specific problems at hand, as they came up.

It should also be noted that the demands of the post-disaster situation were such that answers to technical questions were demanded almost as soon as the problem was recognized. Time delays were just not acceptable to personnel, administrative or field.

B. Technical Resource People (Consultants):

For both program administrators and field personnel, technical resource people were an important part of the technical information flow. They were generally architects and engineers, or students in those fields. They came from local technical firms, the university, from sponsoring agencies, from international consulting firms, as official aid representatives, and as independent individuals.

However, almost without exception, personnel at every level of the housing programs mentioned the confusion caused by differing technical recommendations. Consultants tended to work very autonomously. The only known, functional, interagency technical information sharing occurred during the first six weeks, through a weekly meeting of field level personnel which was sponsored by INTERTECT. The only interagency sharing of technical information at an administrative level occurred at the instigation of the National Reconstruction Committee, nine months after the disaster.

Although many of the consultants were respected professionals, very few had any experience in the mass production of housing in rural settings. Consultants often made recommendations based on their past experiences in large, urban areas or other cultural settings. Many examples were given of architectural designs for houses in western style, without consideration of culturally acceptable cooking facilities, or of siting and appearance preferences. The two most common problems were: the design of houses which were simply not within the economic range of the people, and consequently not appropriate; and the design of houses without regard to earthquake resistant building principles.

Whether the consultants were local engineers, architects, university professors or international consultants, both administrative and field personnel concluded that useful consultants must be "functional"; that is, that they not only provide information on a "how-to" level, but also provide information congruent with the social and cultural values of the community. It was this ability to interpolate purely technical information into the community setting which was felt to be most lacking and was most demanded of the consultant.

The system for selecting consultants was very informal. Program administrators preferred a consultant from within their organization, and they usually chose a consultant with whom they were personally acquainted. However, over ¼ of the agencies interviewed had changed consultants -- and basic elements of their housing programs -- within the first several months.

The most frequently received suggestion for ways to improve technical information delivery was the development of a roster of available consultants with experience in post-disaster housing, who can work effectively at a functional level. Experience was the most sought-after qualification.

III. Information Type and Sources (Printed):

The technical information most sought-after following the disaster was data concerning earthquakes; local building methods; how local building materials could be used in different ways; reports of experience in other areas, building with similar materials; and information about suitable and available options.

Within the first three weeks, the following materials are known to have been brought into Guatemala, reproduced, and distributed widely among agencies:

--- Design, Siting, and Construction of Low-Cost Housing and Community Buildings to Better Withstand Earthquakes and Windstorms was distributed by U.S.AID;

--- Small Buildings in Earthquake Areas was distributed by CARITAS and INTERTECT;

--- Manual for the Construction of Houses with Adobe (from Peru) was distributed by U.S. AID and the National Emergency Committee;

--- Tu Puedes Reparar Tu Vivienda (from Mexico) was distributed by the Mexican Embassy, the National Emergency Committee, and through the four national newspapers;

--- Earthquakes and Small Structures was distributed by CARITAS and OXFAM.

OXFAM was the only organization which began producing other printed materials for reconstruction within the first three weeks, the emergency phase. However, the following materials are known to have been developed within the first three months:

--- OXFAM, World Neighbors, and Save the Children Alliance produced over 100,000 copies of different construction manuals and teaching aids as supplements for training programs for builders;

--- CARITAS produced handouts on emergency shelter and the repair of damaged houses, and a manual for building with local materials;

--- CARE produced a manual on how to build an earthquake-resistant house;

--- The National Emergency Committee, with Educacion Basica Rural, produced a series of nine leaflets on how to demolish, salvage and repair houses;

--- CEMAT compiled a manual on the techniques of building with local materials in an earthquake zone;

--- An independent group of architects designed a small manual on building techniques;

--- Save the Children Alliance produced a series of leaflets on the repair and reinforcement of damaged houses.

Besides these general materials, each agency which designed a house produced materials describing that particular house. With the major exception of the materials developed by OXFAM, World Neighbors and Save the Children Alliance, much of the above listed materials were predominantly translations and adaptations of the five sets of materials brought in immediately after the disaster. This fact underlines the significance of the information which is distributed. The five original materials brought into Guatemala were general topic papers. Agency personnel needed to have the technical competence to extract, evaluate and interpolate this general information into specific recommendations for local materials and building practices.

The importance of the ability to analyze technical information was especially noted with the Manual for the Construction of Houses with Adobe. This was circulated widely; however, it was reportedly written by a non-technician and contains sketches of building techniques which structural engineers consider incorrect.

A. Technical Information:

In spite of the rather significant amount of printed materials produced, the personnel interviewed verbalized a lack of technical information. A common example was the confusion concerning the broadly differing opinions on the structural analysis of why adobe houses were destroyed. Was it because adobe is inherently weak? Or was it the way adobe was used as a building material? And should adobe be used in reconstruction? The decision of many groups to use a different building material such as concrete block, stemmed more from a lack of information about adobe and anti-seismic structures than from a sound comparison of the different materials. Similar confusion centered on how to add a porch to a house while retaining the seismic-resistant integrity of the house.

These examples illustrate that, although some printed information was available and consultants existed with every program, practically speaking, there was a lack of knowledge about some very basic considerations of the situation.

Other examples of necessary technical information included: wood preservative alternatives; building code information (relevant to the local situation); information on the repair of damaged adobe structures; design recommendations for footings, wall thickness and roofing materials; ferrocement; reinforcing for concrete; stabilization of adobe; and alternative building materials. At the time of the disaster, these information materials were not known to have existed in Guatemala.

B. Program Information:

Each program also had to determine an approach to housing, a method of construction, a technology of building, a speed for construction, siting considerations, building materials, cultural suitability, costs and distribution. Each of these categories in turn included many individual considerations such as whether the program should provide housing for the people or enable people to provide housing for themselves; whether to

build temporary or permanent structures; whether building materials should be salvaged from the ruins, local building materials and techniques used, or whether building materials should be imported. Should the houses be sold or given without cost? Should a pre-designed house be offered or individual preferences be permitted? And again, one of the most important considerations in such an earthquake-prone area was whether the houses being built were structurally sound.

All of these considerations demanded a technical input integrated with non-technical factors. Past experience from other reconstruction programs may have been very useful in the determination of each variable. However, both administrators and field personnel always qualified the need for information by saying that the need was not simply for the purely technical information. It was felt that technical information was closely linked with social and cultural factors and must be understood from the perspective of the specific field situation. Seldom, if ever, was there a need for technical information about how to build an earthquake-resistant house independent of such considerations as what the owner wanted the house to look like; what materials the owner wanted to use in building his house; what building materials were available; how the living space was to be used; whether the house would be enlarged; and how the house was to be paid for. Examples include the lack of occupancy of emergency shelters which were considered unsatisfactory, and the refusal to adopt the technique of building with buttresses because it did not conform with the desired house appearance.

Just as technical information cannot be divorced from sociological considerations in the local community, neither can technical information be effectively utilized without close involvement with the personnel implementing the program. Interviews with field personnel repeatedly revealed that coupled with any technical information came an equally great need for program information. This included planning, program design, training, logistics, personnel, and information for the many specific difficulties of the daily operations. Technical consultants were often heavily depended upon for combining technical data with program information.

Conclusions

Technical information must be recognized as a specific and unique component of reconstruction programs. The assumption that the technical information required is simple and readily available has not been proven true by experience, particularly if post-disaster housing is viewed from a developmental perspective.

Improvement in the post-disaster flow of technical information must begin with the understanding that the information-sharing systems which operate in normal times do not meet the need. Not only is the disaster situation atypical, but the people requesting the information, the way the information is used, the time constraints, and the specific information required are all unique.

Technical information from a program perspective must be understood in a fragmented way:

A. Program Conception: Personnel who initiate post-disaster housing programs have a distinct use of technical information, for which they depend on technical resource people. The information will be needed immediately following a disaster for a relatively short period of time. It must include data relevant to all the factors pertaining to program implementation, including past experience.

B. Technical Design: Technical resource people involved as consultants to any program will seek technical information in exploring options for specific problems. The people performing this function are the most likely to contact universities, international sources, etc.

C. Functional Problems: Technical resource people are specifically needed to relate to the program implementation process. The information required is typically not highly technical data per se, but topical materials describing the processes.

But the effectiveness of every program increases with the orientation of sharing experience and evaluating new options.

Recommendations

I. Coordination:

The broad coordination of disaster programs has almost become standard procedure; so must the coordination of technical information. Immediately post-disaster, a center for technical information should be set up, and the following goals included:

A. Its primary goal should be to work in response to the needs of participating agency personnel;

B. It should function as an interagency forum where ideas and lessons learned can be shared;

C. It should serve as a technical back-up by channeling requests to the resource people available;

D. It should serve as a data bank, drawing in pertinent information and disseminating it as requested;

E. It must be set up with the active involvement of all housing programs and resource people.

II. Pre-Disaster Planning:

The official governments, international agencies and local groups which exist in disaster-prone areas must begin with pre-disaster planning. This

must include not simply preparation for a response to the emergency phase, but also analysis and planning for positive programming in reconstruction. This preparation must focus on the variables, study the options, and collect information from what others have learned.

Pre-disaster planning begins with the objective evaluation of what has been learned in past experience; such evaluation should be a regularly scheduled part of every reconstruction program. This is especially important because of the short duration of reconstruction programs -- the people involved move on, and the lessons learned may be lost.

III. Data Bank:

There is an obvious need for an international data collection and dissemination center specifically oriented to technical information of use in post-disaster situations. The purpose must be to collect pertinent technical information and corresponding program information. Such a center must have the ability to furnish such information immediately in usable form.

The best use of such a data bank would include linkages to an in-country pre-disaster planning office or a post-disaster technical coordination unit. Suggestions for the provision of such a service have included the United Nations Disaster Relief Office, a university, or an independent technical resource service.

IV. Consultants:

Past experience in similar situations was one of the most common qualifications desired of consultants by agency personnel. It was recommended by several agencies that a roster of resource persons with experience and expertise be developed. With a better understanding of the needs, agencies may be able to provide better consultants.

V. Training:

The goal of every country is to be independent. Training indigenous personnel should be one of the key orientations for all consultants.

Post-disaster housing and the technical information provided must be oriented to providing houses from the perspective of community development rather than from that of temporary emergency response.

ER:jwp

INFORMATION RETRIEVAL SYSTEM

Developed at Carnegie-Mellon University under AID Contract,
Contract Number AID/TA-C-1345.

MARCH 23,1977

REQUEST FOR INFORMATION

REQUESTING ORGANIZATION

ADDRESS

INFORMATION REQUESTED:

Subject Area: (use keyword list to be as specific as possible)

Geographic Location: (by country or region, i.e. Middle East, Southern Africa.)

DESIRED FORM OF RESPONSE:

- BIBLIOGRAPHY ☐
- ANNOTATED BIBLIOGRAPHY ☐
- PAPERS OR REPORTS BY CMU/INTERTECT ☐
- LIST OF PEOPLE OR ORGANIZATIONS TO CONTACT ☐
- XEROXED ARTICLES ☐
- SLIDE SHOWS ☐
- USER MANUALS ☐
- OTHER (Specify) _____ ☐

_____

_____

INTRODUCTION

This manual explains the function and use of an information retrieval system. The implementation contains disaster relief information. The process is programmed, and runs on the Carnegie-Mellon University IBM 360 computer. It is interactive with the user to allow for maximum flexibility.

The present system is limited to :

25,000 keywords of 32 unique characters,
2,500 module names of 72 characters,
100,000 characters of module text.

The source code is in FORTRAN for portability to other systems and is expandable should need arise.

The program has 3 main tables: 'Keyword Table', 'Module Name Table', (e.g. Article Titles, Book Titles), and 'Module Summary Table' (e.g. text). There is a fourth table 'Module Name Pointer Table', but it is invisible to the user. See Appendix III for a sample.

FUNCTION COMMANDS

'ADD'

This command is used for the adding or updating of entries in the 'Module Name' table including the module names's 'Keywords' and 'Module Text'. After entering the 'ADD' command the system will prompt you for a 'Module Name'. Enter the name to be catalogued (stored). It may contain up to seventy-two characters. You will then be prompted for keywords. These may be up to thirty-two characters long. Each keyword is to be entered on a seperate line. (Hitting return will advance the line.) If redundant keywords are entered they will be ingored. When all keywords have been entered (or no keywords are to be entered) hit return twice. The system will then prompt for text. Text is entered in sequential lines of up to seventy-two (72) characters long. To end the text input: hit return twice. If you have more additions to do, print a '$' and you will be prompted for the next module name. If you are prompted for a module name and wish to stop 'ADDING' simply hit return. After leaving the 'ADD' state you will be prompted for another function.

'KEY'

This command is used for the quick retrieval of data previously stored.
After entering the 'KEY' command you will be prompted for a list of keywords. Each keyword should be on a seperate line, and may be up to thirty-two characters. After entering a list of keywords hit return twice. The system will search the list for module names which contain information common to all the keywords given (e.g. if 'Wood' and 'Bridges' are given as two keywords the system will respond with the appropriate information about wood bridges; it will not give information on other kinds of bridges, or uses of wood other than in bridges.) If the keywords are so general that too many articles are accessed it will prompt you for additional keywords. If the full list is desired, enter no addition keywords and simply hit return. A list of keywords can be found in the appendix to this manual. If no more searching is to be done, hit return after the prompt for keywords without entering any keywords. You will once again be prompted for a function.

'EXPLAIN'

The 'EXPLAIN' command is used to see the text associated with a module name. The 'KEY' command gives the module name and text, 'EXPLAIN' gives only the text, in response to a module name.
If the user knows the name of the module name but not the associated text, the 'EXPLAIN' command allows direct accesss to this information. After entering the 'EXPLAIN' command you will be prompted for a 'MODULE NAME'. Enter the one

desired. The system will give you its associated text. You will be prompted for another module name. If another is desired enter it, or just hit return to stop the 'EXPLAIN' process. You will again be prompted for a function, when you decide to end the 'EXPLAIN' process.

'DUMP'

The 'DUMP' command lists the contents of all the tables. It should not be used without sufficient reason as it will generally use large amounts of time and paper.
If a dump is needed, simply type in 'DUMP' after the prompt for a function. 'DUMP' does not destroy the information saved, it simply prints it.
The dumped list will be given by tables, with a title at the top of each new list. For the entries listed under 'KEYTAB': the first number is the position of the keyword in the keyword table (i.e. line number). The literal characters are the keyword. The final number is the pointer to the module name pointer list. For entries listed under 'MNP' (The module name pointer list): the first number is the position in the module name pointer list (i.e. line number); the second number in the list is the pointer to the position of the next module name pointer; the third number is the pointer to the module name. For entries listed under 'MNL' (The module name list) each entry is two lines long. On the first line: the number is the position of the module name in the module name list; the literal characters are the module name. On the second line: the first number is a pointer to the starting position in the module summary table of the associated text; the second number is the number of lines of associated text. For entries listed under 'MST' (module summary table): each entry is two lines. On the first line is the position of the text, in the module summary table. On the second line is the text. At the end of the dump are the length vectors. See the 'CHANGE' command for a description of their meaning.

'LIST'

The 'LIST' command is used for selective output of stored information. After issuing the 'LIST' command you will be prompted for a table name. Enter the appropriate table name (Valid entries are 'KEY', 'MNP', 'MNL', MST'). You will then be prompted for line numbers. These should be the starting and ending line numbers of the portion of the list to be printed. Both line numbers should be on the same line. The system will print the information requested and prompt for another table name. To exit from the LIST command hit return; to continue enter the appropriate table name. The system will tell the user if the line number exceeds the bounds of the list. The user will be prompted for new line number limits if this occurs.

'HASH'

The 'HASH' command allows the user to see the hash coded value of the keyword or module name. This is generally of little value to the user but is interesting and could be useful if a full dump is done. After issuing the 'HASH' command you will be prompted for a file name. Enter the file desired. You will then be prompted for a table name. Enter one ('KEY', 'MNL' are valid entries). You will then be prompted to supply either a keyword or module name depending upon the table name entered. Enter the appropriate response and the system will prompt for another keyword or module name. If you are through with the 'HASH' function simply hit return otherwise enter the appropriate response. Only keyword and module names are hash coded; thus only they may be used with the function 'HASH'.

'EXIT'

The 'EXIT' command is used to complete the running of the program. After 'EXIT' the program will return the user to the program's operating system.
To use the 'EXIT' command, type in 'EXIT' when prompted for a new function. This will cause the user to revert to the program's operating system where you will be prompted for a new system command. To completely stop the program; after receiving a prompt for a new function type:

```
EXIT
EXIT
LOGOFF
```

This sequence of commands will cause the terminal to be disconnected from the computer. This string of 3 commands should always be used when all work at the computer has been completed.

'END'

'END' has the same effect as 'EXIT' command. It is used in the same way, and is completely interchangable with 'EXIT'.

'CHANGE'

The 'CHANGE' command is used to change the length vector of a table entry. This allows the corrections of incorrect entries.
Type in 'CHANGE' when the system prompts for a function. You will then be prompted for a table name. Valid entries are 'KEY', 'MNP', 'MNL', 'MST', 'LENV', 'MAXL'. The latter two are the length vectors as follows:

LENVEC (1) - Initialized length of keyword table
LENVEC (2) - Number of entries used in the module name pointer list.
LENVEC (3) - Initialized length of the module name list
LENVEC (4) - Number of entries in the module text list
MAXLEN (1) - Number of entries in the keyword table
MAXLEN (2) - Dimensioned length of module name pointer list

MAXLEN (3) - Number of entries in the module name list
MAXLEN (4) - Dimensioned length of module text list.

It is not recommended that the Lenvec or Maxlen Values be changes as this may cause unpredictable results. When you are prompted for the particular item in the table, enter the one desired. You will be prompted for input. Retype the entry with the corrections (Note: 'Rubout' key can be used for correcting mistakes while tyyping the corrected text.) The user will be prompted for more changes. If none are to be made simply hit return, otherwise type in the appropriate values requested.

'FIND'

The 'FIND' command is used to locate the line number of a particular value found in some table. This is useful for changing, and listing of certain data.
Type in 'FIND' when the system prompts for a function. You will be prompted for a table name (Valid entries are 'KEY', 'MNP', 'MNL', 'MST'). You will then be prompted for the particular entry. The system will respond with the line number of the entry requested. You will then be prompted for another table name. If no more 'FINDS' are to be done: hit return, otherwise enter the appropriate table and continue as before.

'PAUSE'

The 'PAUSE' command temporarily stops execution of the program. This is used for connecting other programs with this one, but they have not yet been implemented. This command is of no value to the user and should not be used, it is for system programmers only.

SYSTEM COMMANDS

System commands are used for setting up files initially and for control of the program during execution. Commands at this level are called the program's operating system commands. They should be used sparingly and carefully. Much if not all work can be destroyed by the incorrect issuing of one of these commands.

'INITIALIZE'
This command is used for initializing files. It must appear once before any new file can be used. The system will prompt for all required values. Enter the appropriate data. This command is best not used unless one is familiar with the system.

'ABSFILE'
This command sets the system to use the Absfile which contains the disaster information. This file should be used for all work with this system. No other files are available at this time.

'EXIT'
This command returns the user to the computer's operating system (TSS) to allow the user to run any other program he or she has.
After issuing the 'EXIT' command the system will respond with '-'. The standard response should be 'LOGOFF'. Other responses should be used only by users familiar with TSS System Commands.

'END'
Performs the same function as 'EXIT', and can be used interchangably.

'STOP'
The 'STOP' command is used to change files, however since there is only one file available, this command should not be used, it is for system programmers only.

'PAUSE'
The 'PAUSE' command is used to allow connection to other programs not yet developed. this command will temporarily stop execution so its use is discouraged.

'GO'
The 'GO' command allows access to functions (such as 'DUMP',

'LIST', 'XHASH') during error recovery. The purpose of this is to assist the user in determining what caused the error and to recover from such errors without 'crashing' the program. It should be used only during error recovery.

'HALT'

The 'HALT' command is used to stop the execution of the program without rewriting any variables. It is used during error recovery as an alternative to 'GO'.

ACCESSING THE COMPUTER

In order to run the IRS Program (Information Retrieval System), the user must connect to the C-MU Computer System.

For remote terminals telephone numbers are:

110 Baud - 1-412-687-5708
300 Baud - 1-412-687-5724

After turning on the teletype (See Computer Center Documentation), the system will respond with a message and an '=' which is a prompt. Respond with 'TSS'; the system will respond with either a message or a '$' which is yet another prompt. If the message is '360 Paused - Please Stand By' or '360 Start Up in Progress', disconnect the terminal and try again in about 30 minutes. If the message reads 'Type H For Help?', respond with 'TSS' again. Respond to other messages as requested. If the '$' prompt appears or no prompt or message appears type in the logon command as follows:

```
LOGON CG17,,,C202
```

The system will respond with an 'Enter Password' request. Enter the password in the overstruck area. (The present password is 'GOOD'). The system will print some messages and then prompt with a '-'. Respond with 'CATLG' and the system will begin the IRS program and begin prompting at the system command level.

Be sure to logoff by issuing the 'LOGOFF' command before shutting off the terminal. A valid 'LOGOFF' command will cause the system to print a billing. This billing should not concern the user. However large bills should be avoided if possible by not leaving the terminal connected while not in use for long periods of time (5 or more minutes). The user may find it useful to organize his or her operations before 'LOGGING ON' to further reduce these bills. Billings should be kept for possible future reference.

A line is not entered until 'RETURN' has been used.
The 'EXIT' command must be given to transfer all entries into the permanent file.

MORE INFORMATION

For more information on the program and its operation contact:

Martin F. Rooney (Civil Engineer)
118 Q Porter Hall
Carnegie-Mellon University

Dr. Charles Goodspeed (Civil Engineer)
111 Porter Hall
Carnegie-Mellon University

APPENDIX I

COMMANDS

SYSTEM COMMANDS

Initialize
Absfile
Exit
End
Stop
Pause
Go
Halt

FUNCTION COMMANDS

Add
Key
Explain
Dump
List
Hash
Exit
End
Change
Find
Pause

APPENDIX II

KEYWORDS

ADMINISTRATION
DISASTER REPORTS
PERSONNEL
LIASON
OPERATIONS CENTER
COMMUNITY ORGANIZATION
COMMUNICATIONS
MONETARY CONTROL
ENVIRONMENTAL CONTROL
REFUGEE CAMPS & CAMP PLANNING
HUMAN WASTE DISPOSAL
WASTE DISPOSAL
DRAINAGE
WATER
ENERGY
ROADS & PATHS
FIRE PREVENTION
HEAVY EQUIPMENT
HOUSING
BUILDING MATERIALS
STANDARDIZED DESIGNS
HOUSING CONSTRUCTION MANUALS
IDIGENOUS HOUSING
BUILDING CODES
MEDICAL
MEDICAL FACILITIES
HEALTH PRIORITIES
PREVENTIVE MEDICINE
NUTRITION
MEDICAL MATERIAL
STORAGE & DISTRIBUTION
MATERIALS HANDLING
STORAGE FACILITIES
STORAGE AND HANDLING OF FOODS
STORAGE/HANDLING OF MEDICAL MATERIALS
RELIEF SUPPLIES DISTRIBUTION
MATERIALS HANDLING EQUIPMENT
TRANSPORTATION
GROUND TRANSPORT
AIR OPERATIONS
WATERBORNE OPERATIONS
DEVELOPMENT
AGRICULTURAL
ECONOMICAL
REGIONAL PLANNING
URBAN
DEVELOPMENT AID
REGIONAL STUDIES
LIST BY COUNTRIES

ECOLOGY
WATER
AIR
LAND
DEMOGRAPHY
APPROPRIATE TECHNOLOGY

APPENDIX III

SAMPLE

The following is a sample run of the IR program. Underlined words are responses that the user must type in. Each and every line must be terminated by hitting the RETURN Key.

```
CMU COMPUTATION CENTER - LINE=57 10:17:40 9/16/76
=TSS
TYPE 'H' FOR HELP.
=TSS


$
LOGON CG17,,C202
8.1 TSS AT CMU. TASKID=0047
PASSWORD:
XXXXXXXX
GOOD
WARNING: ACCOUNT IS LOW ON MONEY. INCREASE ALLOCATION SOON.
10:18 09/16/76 SDA=00E3
-CATLG
***** CATALOG SYSTEM VERSION 1.1 *****
***** LONG KEYWORD VERSION *****
SELECT DESIRED SYSTEM
?ABSFILE
UNIT1 OPEN
INPUT A FUNCTION
?ADD
INPUT MODULE NAME
ADAPTABLE ARCHITECTURE
INPUT KEYWORDS
ARCHITECTURE
LIGHT STRUCTURE
INPUT TEXT
A PUBLICATION OF...


INPUT MODULE NAME

INPUT A FUNCTION
?EXIT
UNIT1 CLOSED
SELECT DESIRED SYSTEM
?EXIT
TERMINATED STOP
-LOGOFF
```

GLOSSARY

360

An abbreviation for an International Bussiness Machines Computer, style 360 (The computer)

'ABSFILE'

A system level command

'ADD'

A function level command

IRS

Automatic Information Retrieval System, the name of the program

Character

Any letter of the alphabet, punctuation, numbers or other symbol found on a typewriter

CATLG

A command that starts the IR System

'CHANGE'

A function level command

C-MU

Carnegie-Mellon University

Crashing

An error that causes the program to terminate

'DUMP'

A function level command, without '' refers to a complete listing of all tables

'END'

A function or system level command; has the same effect as 'EXIT'

Error Recovery

A process done by the computer to overcome errors made by the computer during processsing

'EXIT'

A function or system level command used to stop that level of processing. A function level 'EXIT' causes all information to be stored for future use in the computer. A system level 'EXIT' stops the program.

'EXPLAIN'

A function level command

'FIND'

A function level command

'File Name'

For this system, file name is synonomous with Absfile. This is the previously stored information about disaster relief

FORTRAN

A high level programming language

Function

Any function level command

Function Level

This is the state of processing entered into after the Absfile has been loaded

'GO'

A system level command

'HALT'

A system level command

'HASH'

A function level command

Hash Code

A method of developing a number from a

sequence of alphabetic characters. It is used to determine the position in the keyword table where the particular keyword is to be stored. For a more detailed description see: The Art of Computer Programming ,Vol 1,D. Knuth.

'INITIALIZE'

A system level command

'KEY'

A function level command; also an abbreviation of Keyword

Keyword

A special word or phrase used to search for information

Keyword Table

One of 4 tables stored with in the computer which contains the keywords

Length Vectors

A series of values which tell the present size of the tables and the maximum size of the tables. See the 'CHANGE' command section of this manual for more specific information

'LENV'

An abbreviation for length vector

LENVEC

An abbreviation for length vector

Line Numbers

Number which represents the position of an item in a table or list

'LIST'

A function level command, without '' is a standard list or set of sequential lines of prose

Literal Characters

Numbers and letters as opposed to numbers

only

'LOGON'

The command used to connect a terminal to the computer

'MAXL'

An abbreviation for maximum length vector which is a subset of length vector

'MAXLEN'

An abbreviation for maximum length vector which is a subset of length vector

'MNL'

Module Name Table

'MNP'

Module Name Pointer Table

Module Name

A title of an article, book, or similar reference source which the system has catalogued

Module Name Pointer Table

One of 4 tables stored with in the computer which contains pointers from the keyword table to the module name table.

Module Name Table

One of 4 tables stored with in the computer which contains the module names

Module Summary Table

One of 4 tables stored with in the computer which contains the module texts

Module Text

A synopsis of an article, and/or information concerning its location and/or availability

'MST'

Module Summary Table

'PAUSE'

A function or system level command

Pointer

A pointer is a number stored in the computer which contains the position of a related piece of information in a specified table

Return

The 'RETURN' key on the teletype

Source Code

A listing of the actual program statements in some higher level programming language

'STOP'

A system level command

System Level

This is the program's error and supervisory level of processing

System Programmer

A person involved with writing the program as opposed to a user who is running the program

Table

A list of related objects in some set format which is stored in the computer

Table Name

Any one of 4 names used to designate tables stored in the computer. The 4 names are: 'KEY' for keyword table; 'MNP' for module name pointer table; 'MNL' for module name list (Table); 'MST' for module summary table

TSS

Time Sharing System

Valid Entries

Words or letter combinations given in response to a particular prompt which the computer can understand

SINDU - An Information Exchange Network

By Charles Goodspeed

Assistant Professor, Carnegie-Mellon University

The need for dissemination of information inter and intra all countries is paramount in this era of rapidly expanding technology and development. SINDU, Carnegie-Mellon University/Interect and others have addressed this problem within the area of the built environment developing information exchange systems. As a member of the inter-disciplinary working party at Carnegie-Mellon University, and in conjunction with the University's information exchange program (a segment of a contract of Ultra Low Cost Housing with the Agency for International Development), I participated in a mission sponsored by the Organization of American States to SINDU, located at the Universidad Nacional in Bogota, Columbia.

The group's prime goal in becoming involved in the mission was to evaluate the operation of the SINDU system and the possibility of extending linkages between the two information exchange systems. Placing these systems in a global perspective can provide the impetus for integrating many other such systems into a global network.

It is possible to assume that each system in such a network would have the capacity of staying at the State-of-the-Art in at least one discipline with the result that all systems represented in the network could remain at that level through information exchange.

The prime purpose of this report is to summarize the mission and to look at the future roles of SINDU and Carnegie-Mellon University as they pertain to information exchange. Both aspects of the SINDU system -- manual and automated -- are discussed. Goals and criteria are presented in terms of the short and long term feasibility of extended information networks initiated by SINDU.

SINDU's Information System

SINDU was established in 1972 to provide a continuing information service at the termination of CINVA, which was established in September 1951 by an agreement between the Pan American Union, the Government of Colombia, and as part of the program of technical cooperation in the OAS. Over the twenty-year existence of CINVA, extensive research and data collection efforts were conducted which formed the initial information bases for SINDU. One of the initial tasks of SINDU was to establish an information retrieval system to facilitate the dissemination of this information.

The design goals for the system were portability, simplicity, transferability, adaptability and flexibility:

Portability	ease of transporting a system between operating environments
Simplicity	pertaining to the ease of user accessibility, systems expandability and systems maintenance
Transferability	degree of acceptability to various storage and retrieval needs
Adaptability	ease of adapting the system to operating environments both manual and automated
Flexibility	capability of system to handle diverse input data.

The system SINDU finally accepted is very much like the GEODEX system used by many engineering libraries to provide a rapid retrieval system for students, faculty, etc. Over the past five years the SINDU staff has cataloged approximately 1000 entries in their system. The system and its usage are concisely explained in the SINDU manual 1 entitled "Sistems SINDU de Clasificacion y Precuperacion de Informacion." Each entry in the system is referenced by a numbering scheme and consists of standard bibliography information, a set of keywords and a short abstract. Other statistical data are maintained for each entry for monitoring the system. The numbering scheme links the entry in the

SINDU system and the physical location of the entry in the library. The implementation of the SINDU keyword version far exceeds acceptable levels specified in the design goals. As in any keyword reference scheme, SINDU does face the common problems of accuracy, adequacy and appropriateness of the keywords. In my limited review I determined that SINDU has established an excellent set of keywords. The quality of the abstracts is one of the most important aspects of any information exchange system. The Carnegie-Mellon University team feels that any information exchange effort, in order to remain at the state-of-the-art, must play a very active role in reviewing and writing abstracts. A means of accomplishing this is by utilizing a consortium of experts in a referee capacity.

Unfortunately, SINDU has not had this continued facility in writing their abstracts. A summary of their present entries is given in the publication "SINDU Resumenes 1." The full potential of SINDU may not be achieved unless it is updated to the state-of-the art.

Information Systems

There are many other systems and networks serving both in-house and commercial needs. In 1966 the New York Public Library began exploring an index system stored in a computer that would flash book references on display consoles or produce them in print upon coded request of the librarian. A similar system, IBM's Technical Information Retrieval Center, provides access access to over 150,000 documents with an additional 10,000 items inserted in the system per year.

In 1970 the United States Department of Commerce established the National Technical Information Service (NTIS) to fulfill its responsibility to transfer the results of its research and development activities to wider use in the private sector. Users may access summaries from the present NTIS Library of over 420,000 summaries, with an additional 60,000 being added yearly. Through

the interface between NTIS and the Smithsonian Science Information Exchange (SSIE) a user may address an additional 180,000 descriptions of ongoing research.

The Society for International Development supports a system similar to NTIS concerned with the State-of-the Art in economic and social issues relative to developing countries. There is no duplication of the Technical expertise and operational goals of these systems by the SINDU system. SINDU has a unique resource in housing material, in rural planning and development, and in the adaptability for decentralization not covered in any other system. SINDU should interface with these other systems as NTIS offers many services which the SINDU network could utilize in expanding its user base. As seen, SINDU is the only service for assistance in establishing information libraries in rapidly expanding cities, rural communities and colleges/universities in developing countries while sharing State-of-the-Art information assembled from world-wide organizations.

Automation of the SINDU system

SINDU has attempted to automate the manual system by a computer program written in COBAL (ANSI American Standard) on an IBM 360/44 computer using an OS operating system. The program consists of approximately 10,000 card images, requires 86K memory for compilation and execution and requires either a 9-track tape drive or a disk pack for execution. The COBOL (Common Business Oriented Language) was an excellent choice of language for SINDU as it is highly portable, it emphasizes the description and handling of data items, it easily handles tables and searching, it allows sequential or random access of files, it has intrinsics "SORT" and "REPORT WRITER", it handles all machine dependencies clustered in the "Environment Division," and it looks and reads much like ordinary business English.

The present program has the capability of adding, deleting and changing entries in the system. It has a full capacity for dumps including the ability to list by author, title, key wor and sequential entries. A prospective user enters the system by writing a logic statement of keywords expressing his area of interest. The system scans the entries for errors (it has a capacity of 26 error messages) and then performs a merg sort to establish the available material on the desired subject. The output from the program is a set of reference numbers from which SINDU personnel or its counterpart in other systems can retrieve the information from the library. At present this is the extent of the program. The following additional capabilities must be supplied to initiate the further development of the system as a truly interactive one.

1) Listing for the user the material selected by the keywords either by author, title, etc., for immediate review at the time of the request.
2) Expand the program to store and retrieve abstracts upon user request.
3) Make all JCL (To the maximum extent possible by using PROCDEF) invisible to the non-SINDU staff user.
4) Ensure that the final program is portable to the maximum extent possible.

At this time I am not sure these capabilities can be economically added to the present program. It would be unfair, given the little time I spent reviewing it, to criticize its potential capabilites once the program was expanded. I do have some reservations and feel the program characteristics should be examined more fully before any further changes or additions are implemented. There are tested programs that have all the capabilities of the present system plus the suggested additional ones which could be adopted at no additional cost, either in time or money, by SINDU. Carnegie-Mellon University, for example,has such a

fully tested system developed in and for the public domain.

Goals and Objectives

For SINDU to adequately and continuously meet its goals as outlined at its inception, the needs as repeatedly expressed by governments, relief personnel and planners at HABITAT FORUM must be addressed. To the trained eye the HABITAT FORUM exemplified the need for information exchange among commercial and research institutions through their exhibitions. In many cases, extensive human effort and money had been expended in developing new technologies with little or no knowledge of real applications nor the channels for implementing their work. SINDU can and must close these gaps through a continual information exchange program available to all levels of government agencies and institutions. Symposia, conferences, forums, etc. are most effective for the short run over a limited audience. The International Association of Housing Science sponsors international symposia which address only selected topics at each conference with an audience consisting of representatives of government agencies and research institutes from many countries. To continue the awareness of the topics and extend it to agencies working in rural areas of developing countries is the function of SINDU. The information must be abstracted and adapted to a format appropriate for the user in an acceptable time frame. To meet this need, expressed by many planning and developing agencies in developing countries and the need for collaboration between other agencies and institutions, SINDU must consider the following goals and criteria.

Goals

1) Establish and continuously assist in expanding an international information sharing network as a means of (a) staying at the State-of-the-Art, and (b) expanding to the State-of-the-Art in other application areas.
2) Collaborate with current research efforts and determine mutual inter-

national needs through the information sharing network as a means of concentrating available research resources on problem areas originating at the implementation level.

Objectives

1) The Network must become internationally recognized as the source of the most complete and relevant collection of available data in the areas specified by the intended users.
2) The system must remain an active system by searching for and reviewing all information to be catalogued.
3) The system must have easy access with almost immediate response time with material directly applicable to users' requests.
4) The system should establish users through communication oriented toward data collection. Users must recognize they have a problem and in turn desire a solution before they will actively and willingly accept assistance.
5) Extensive publication campaigns must be initiated both inhouse and through the press to educate and increase the awareness of prospective users to the system's applicability and track record in their areas of need.
6) A monitoring scheme must be utilized to ensure SINDU's relevance to the changing needs of its users.

SINDU can also assist in establishing communication channels between larger agencies such as the U.N., AID, OAS, research institutions, etc. through the information network. Such a program would greatly assist in the collaborative efforts amoung the institutions and also give them a direct access to field implementation, e.g., to a rural community with an inhouse information system. The critical issue is that through the acceptance of a standard interface such as the keyword structure of SINDU we can think of the network as an extension of the telephone in that each participant can directly access another through the

keywords. Within all the automated systems a participant could directly access any other computer public library section of storage and receive immediate response as if it were his own system.

Financing of SINDU and the Network

The Agency for International Development contracted a study associated with information exchange systems* which concluded by stating the need for information exchange. However, in the succeeding years no organization has supported such a system and, in all probability, none will. The very large commercial systems such as NTIS, SID and SSIE are self-supporting, through memberships and usage fees. Unfortunately, they meet only a portion of the world need. It is this remaining need that SINDU and the associated network must meet. Financing such a program can be evaluated on two levels - - the short term and the long run.

In the short term SINDU, with the aid of the Carnegie-Mellon University research project, must create awareness in agencies of developing countries, research institutions, and inter-government agencies (such as the U.N.) of information availability and information systems which they can adopt or with which they can interface through SINDU. To accomplish this SINDU must be given a budget and staff to upgrade its library to the State-of-the-Art, bring up an automated system and begin its newsletter publication. Carnegie-Mellon University will assist SINDU in the first two catagories under its own short term funding.

In the long run, the network (i.e., SINDU, all local systems in developing countries, and research institutions such as Carnegie-Mellon University) must be self-supporting. As previously stated, it is not feasible to expect support for a large central information exchange center capable of staying at the State-of-the-Art in many areas. Therefore, it will be necessary to decentralize the information areas to small inhouse systems, each at the State-of-the-Art in possibly only one area. There is presently an interest in the developing countries in

establishing such inhouse efforts to assist in the growth of their agencies, etc. It is up to SINDU to aid them in their development through information sharing and system planning such that they can be compatible with and actively join with the network. In this way SINDU need only support a limited staff to remain at the State-of-the-Art in a few disciplines and receive assistance for system development and system education programs from outside expertise. Payment for such assistance can be shared in part by the network members requesting such assistance. It will be imperative, however, to remain at the State-of-the-Art in operating systems and in educational programs. Computer technology is rapidly expanding in the area of telecommunications, which most likely will produce more economical communication channels and operating systems adaptable to the network. In today's computer market there are minicomputers in the range of $10,000 that could support a SINDU system plus all other inhouse computational needs in many developing countries. There are many programs that should be studied to establish a financial mechanism for information exchange. One in particular is the Civil Engineering Programming Application group which has an accounting system for monitoring the exchange of material among its members. Those members who receive more material than they share are charged a nominal fee which is then distributed among those members who share more than they receive. Keeping the information gathering, review, and distribution system in the environmental context associated with the information will help to ensure the relevance of the material.

Summary

I feel that SINDU is the best system available to meet the expressed needs. The developers of SINDU had the insight to set the pertinent design goals to enable the system to expand to a network. It has excellent facilities on the National University Campus consisting of office space, dark room and printing facilities, library stacks, meeting rooms, access to research space, and computer

facilities. Through the existence of CINVA and SINDU a good rapport with the Latin and South American Countries has evolved. An extensive world-wide mailing exchange clientele has been established there. In addition, it has an excellent start on cataloguing the available information on housing and rural planning and development. One of the most important aspects of SINDU is its strategic location in the midst of a laboratory (i.e. the developing countries) consistent with the content of its information bank. With these excellent assets it should only take a reaffirmation of support by those groups involved in research and information exchange to revitalize SINDU. However, it will take a concerted effort by all participants to collaborate through interfacing with SINDU in the creation of the desired viable information exchange network. Full support in the form of funding and assistance must be made available to re-establish SINDU at the level of proficiency needed to attract new systems into the Network. Anything less than maximum proficiency will not succeed.

*Population Information Program for information interchange on fertility control as publicized in A.I.D. Research, 1971-1973, by the Office of Research and Institutional Grants, Bureau for Technical Assistance, Agency for International Development.

SHELTER/COMPONENT DEVELOPMENT

Activities

1. Design Research
2. Component Research

    A. Stabilizer
    B. Columns and ring beams

Reports/Papers

1. Brief "Chemical Soil Stabilizers", by Karl Zipf

Chemical Soil Stabilization

Objectives

The objective of this work is to develop a dry, indefinitely stable chemical mixture, which, when added in small quantities to a native soil and water, will stabilize that soil for use as a material of construction.

This system should also be capable of safe application by unskilled, illiterate, indigenous labor with a minimum of training, and should stabilize soil at a reasonable cost and require quantities small enough to permit it to be shipped to the construction site economically.

Approach

The approach taken to date is the *in situ* polymerization of solid, water-soluble vinyl monomers. These monomers and an initiator system (all in the form of free-flowing powders) are mixed with mud. Once dissolved, the initiator system causes the monomers to polymerize to a gelled, three-dimensional polymer network which entraps the soil particles and stabilizes the mass.

Results

The following system has thus far been used to stabilize sand:

monomer solution:

10 parts acrylamide (monomer)
1 part N-methylenebisacrylamide (crosslinking monomer)
110 parts water

initiator system:

2.2 parts $(NH_4)_2S_2O_8$
1 part $NaHSO_3$
trace $FeSO_4 \cdot 7H_2O$

The ratios of monomers to sand and initiator system to monomers were varied. The properties of the stabilized soil depend on both, but the

former is the major determinant of cost, while the latter controls setting time. For example, when the initiator level was 30% of dry monomer weight, the gel time was about 30 seconds at room temperature, and the resulting dry compressive strength was 600 psi. An initiator level of 3% gave a gel time of 2-3 minutes and a compressive strength of 1000 psi. While these strengths are perfectly adequate for the intended purpose, a gel time at least an order of magnitude greater will be needed for practical applications. Cutting back on initiator can give that, but preliminary results indicate that it gives an incomplete polymerization, and strength suffers. This area needs further study.

Doubling the monomer/sand ratio did not double the strength. It appears that something on the order of 2-3% acrylamide by weight of sand is about optimum. On this basis, the cost of the stabilized sand is roughly comparable to that of poured concrete. Of course, this result would probably depend on the type of soil stabilized.

The newly gelled, stabilized sand is soft and easily abraded. The skin dries in about an hour however, hardening and protecting the interior. Maximum strength is developed when the mass has completely dried. If it is again immersed, it will gradually absorb water and return to the freshly-gelled state. Water absorption could be prevented by a brushed-on coating of a fatty quaternary amine, e.g., Aliquat® H226.

At this point, there is no question that an acrylamide-based system can successfully stabilize soil. Unfortunately, acrylamide is quite toxic until polymerized, and so a non-toxic substitute must be sought.

There is considerable evidence that metal salts of acrylic acid will polymerize in aqueous solution, and they should be of low toxicity. Considerable work has been expended attempting to get a commercial sample

of sodium acrylate to polymerize, without success, contrary to reports in the literature. The yellow color of this sample indicates a high impurity level, which may be the reason why it refuses to react. Work is currently being carried out to synthesize sodium acrylate from acrylic acid and sodium hydroxide to provide a purer, and hopefully polymerizable product.

Projected Work

The first order of business is to develop a non-toxic substitute for acrylamide. Once this is done, work will be carried out to define the effect of chemical composition on gel time and stabilized soil strength, the object being to approach a cost-performance optimum for stabilizing various soil types.

CHEMICAL SOIL STABILIZATION

An initial literature search was conducted in late 1976 and early 1977 to determine if there were any water soluable monomer systems that could be applied to soil stabilization. Of the ones found most were rejected because they were either toxic, expensive, or liquid. This left the metal salts of acrylic acid, of which sodium acrylate, and aluminum acrylate were the viable contenders, the sources stated that these were water soluable and they would polymerize, with aluminum acting as a crosslinking agent. To date the aluminum acrylate has not arrived and the calcium acrylate refuses to go into solution. The sodium acrylate does not polymerize with the common initiator systems, so more exotic techniques are being investigated.

Due to the obstinacy of the non-toxic acrylate system some time was dealt with a system of acrylamide, an ammonia salt of acrylic acid. Regretably acrylamide is extremely toxic until it is reacted. However, tests were run on it to see what kind of results that might be obtained from a chemically stabilized soil. The monomer mix consisted of 10 parts by weight of acrylamide, 1 part N-methylenebis-acrylamide, a crosslinking agent, and 110 parts of water. An initiator mix was $(NH_4)_2S_2O_8$ and $NaHSO_3$ with trace amounts of $FeSO_4 \cdot 7H_2O$. The initiator and monomer solution were mixed together and added to about 400 parts of sand, and allowed to react in situ. It was noted a reaction time of 30 seconds could be had when the initiator weight was 30% of the dry weight of the monomer. Resultant dry compressive strength was 600 psi. As the initiator concentration was reduced the set time was lengthened. Best results came from a 3% initiator level which gave a set time of 2-3 minutes and a compressive strength of 1000 psi. Any less initiator caused an incomplete reaction with a reduction in strength. It was also learned that increase in strength did not parallel the monomer concentration. Doubling the chemical did not double the strength. Therefore, it appears that a 2-3% of acrylamide by weight to sand gives the desired results. The costs per ton of acrylamide stabilized soil is about the same as poured concrete. Hopefully the acrylates will parallel this behavior.

Before it has reacted the monomer solution acts like ordinary water, but upon polymerization it forms a rubbery water insoluable gel. When sand is mixed with the monomer solution it acts like wet sand but once set it is a rigid non-moldable mass. Newly formed stabilized soil has a soft exterior that can easily be abraded. It will skin over in an hour's time which protects the surface. Drying time is 3-4mm per day and maximum strength occurs when it is completely dry. Should it get wet it will soften at the same rate it drys and will behave like a freshly reacted system. It will not dissolve.

Future efforts will be directed back to the acrylates trying to find a suitable initiator. Inhibitors may have to be formulated if the set time has to be lengthened. Another possibility is to see what affect there would be if Portland cement is mixed with the chemical system.

8. Linkages

LINKAGES

Activities

1. UNDRO Emergency Shelters Study
2. Committee on International Disaster Assistance, National Academy of Science, For OFDA/AID
3. OAS SINDU
4. CEMAT

Reports/Papers

1. Phase I Report to UNDRO Emergency Shelters Study, Vol. I-VI (Various parts submitted by CMU project) (not included).

THE CMU/INTERTECT APPROACH, WORK PRESENTED

AT THE FOLLOWING SEMINARS, FORUMS, ETC.

Lectures given at:

International Symposium on Housing Problems, Atlanta, Georgia, May 1976.

Habitat Forum, Vancouver, May/June, 1976.

IASS World Congress on Space Enclosures, Montreal, July, 1976.

University of Toronto, November 1976.

Katholiek University, Leuven, Belgium, December 1976.

Technische Hochschule, Aachen, Federal Republic of Germany, December 1976.

4th World Congress of Engineers and Architects in Israel, Tel Aviv, December 1976.

SID Conference, Unversity of Pittsburgh, March, 1977.

ORGANIZATIONS VISITED

During late November and the month of December a team member visited with the following institutions in Europe and Israel to establish and exchange information:

United Kingdom:

Oxford Polytechnic (Mr. Ian Davis)
Oxfam
London Technical Group
Intermediate Technology Group
Development Planning Unit (University College London)
Architectural Association
Building Research Station, Wafford

Belgium:

College of Europe, Bruge
Katholic University, Leuven
Fakulteit der Toegepaste Wetenschnappen

Federal Republic of Germany:

Lehrstuhl für Baukonstruktion
Technische Hochschule Aachen
Fachbereich 10, Bauwesen, Universität Essen
German Development Assistance Association for Social Housing, Köln
Lehrstuhl für Planung and Siedlungswesen, Universität Braunschweig
Low Cost Housing Group, Universität Kassel
Institut für Tropenbau, Starnberg

Israel:

4th World Congress of Architects and Engineers in Israel
Desert Research Institute, Ber Sheva

OTHER ACTIVITIES

1. Response to AID request to assist the Government of Turkey with Technical Information

2. Disaster Housing Seminar, Istanbul, Turkey, June 1977

December 4, 1976

MEMORANDUM

TO: Foreign Disaster Assistance Office,
Agency for International Development

FROM: Emergency Shelters Group,
Carengie-Mellon University

SUBJECT: Discussion of Proposed Role for CMU Team in Turkey

Last week, U.S. AID asked whether the CMU team would be available to assist Turkey in relief and reconstruction of housing in the earthquake-affected region near Caldiran. This memorandum is to advise U.S. AID that CMU is willing to send a qualified team with previous field experience to work with the Turkish Government in the area of self-help, earthquake resistant housing.

From our past discussions with members of the Turkish Ministry of Reconstruction, we realize that the Government has already made great strides in preparing for a disaster of this type; and we know from studying the past experiences in the Gediz and Lice earthquakes that one of their major responses has been the rapid installation of prefab houses. However, due to the extensiveness of the damage, as well as the economic, sultural and topographic limitations, many people may choose to rebuild their own homes. It is in this area that we feel our team can be of the most value.

During the last several years, our team members have been involved in a wide range of responses to housing disasters and have been particularly concerned with the problem of building low-cost, earthquake resistant houses out of locally available materials. During the past year, members of the team have developed materials and approaches for assisting local people in:

- how to inspect damaged structures and determine how and if they can be repaired;
- how and what to salvage from the debris;
- how to build temporary shelters which become the core for a long-term, permanent house that can be earthquake resistant;
- how to build permanent housing of local, indigenous materials using low-to-intermediate technology which is earthquake resistant;
- how to develop training aids for various groups of people with varying levels of education;

--- exploring housing options and determining economically viable approaches to housing reconstruction.

The team that is now available is especially concerned with getting the needed technical and program information to the appropriate level, but particularly to where it is most needed in the field. The team will come prepared with a wide range of printed materials, manuals and training aids, gleaned from the experiences of other countries in post-earthquake housing programs.

At the present time, we are prepared to send a two-man team for whatever time period which the Turkish Government deems appropriate. The team will include an information specialist and a civil engineer.

While members of the team have met Mr. Mete Gurer (Technical Advisor to the Minister of Reconstruction) and have studied the Turkish approach to relief and reconstruction, we are all anxious to have the opportunity to work with them first-hand and learn from their experiences things which we can, in turn, share with other disaster-affected countries.

Respectfully submitted,

Charles H. Goodspeed
Assistant Professor

CHG:jwp

cc: Frederick C. Cuny, INTERTECT
Everett Ressler, INTERTECT