CMU/Intertect Emergency Shelter Team

Reports

The 1977 International Disaster Preparedness Seminar

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

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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.

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* 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,

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.

Approach
Methodology

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

APPENDIX B

ACTIVITIES (For Peruvian Project)

Phase I	Role		Estimated Time (Man-weeks)	Total Actual Time
1. Site selection and analysis.				
A. Risk analysis.	EUP	CMU, INTERTECT, Krimgold	4	4
B. Vulnerability analysis--structural and components.	EUP	CMU, Krimgold	4	
C. Site selection.	MOH	All	1	
D. Comprehension analysis.	PREVI	INTERTECT	2	
E. Socio-economic/cultural analysis.	PREVI	INTERTECT	2	4
F. Building process analysis.	PREVI	CMU/INTERTECT	2	
2. Training aids development				
A. Visual aids.	PREVI	INTERTECT	8	
B. Development of presentation techniques.	PREVI	INTERTECT	4	
C. Development of teaching aids for instructors, extensionists, promotors.	PREVI	INTERTECT	8	8
3. Development of pilot project				
A. Training/education of workers.	AgU,PREVI	INTERTECT	4	8
B. Construction of first models.	PREVI,Co-ops	CMU, INTERTECT	4	
4. Evaluation				
A. Aids.	PREVI	INTERTECT	1	
B. Model house.	PREVI	CMU, INTERTECT	1	2
C. Process.	PREVI	CMU, INTERTECT	1	
5. Revision of training aids	PREVI	INTERTECT	4	4
6. Development of dissemination strategies				
A. Pre-Disaster.	CD,NEC,PREVI	CMU, INTERTECT	2	
B. Post-Disaster	CD,NEC,PREVI	CMU, INTERTECT	2	4

Phase II

(Development of models for other regions, PREVI especially interested in 2-story house for Altiplano regions.

EUP=Engineering Univ. of Peru MOH=Ministry of Housing PREVI=Peruvian Housing Research Institute
CD=Civil Defense Agency NEC=National Emergency Committee

CMU/I Shelter
Bangladesh

CMU/INTERTECT ULTRA LOW COST SHELTERS
IN
RELIEF SITUATIONS IN BANGLADESH

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

CMU Co-Principal Investigators

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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:

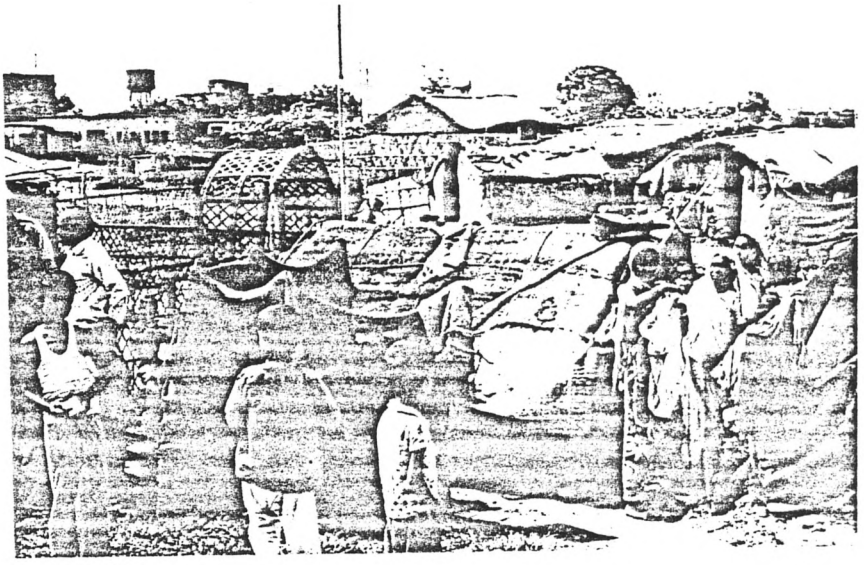
The experience indicates that the majority of agencies conducting housing projects are not fully cognizant of the differences in constraints imposed in different relief situations. This points to the need to assist agencies in assessing needs and constraints for each specific situation.

G. Spread effect:

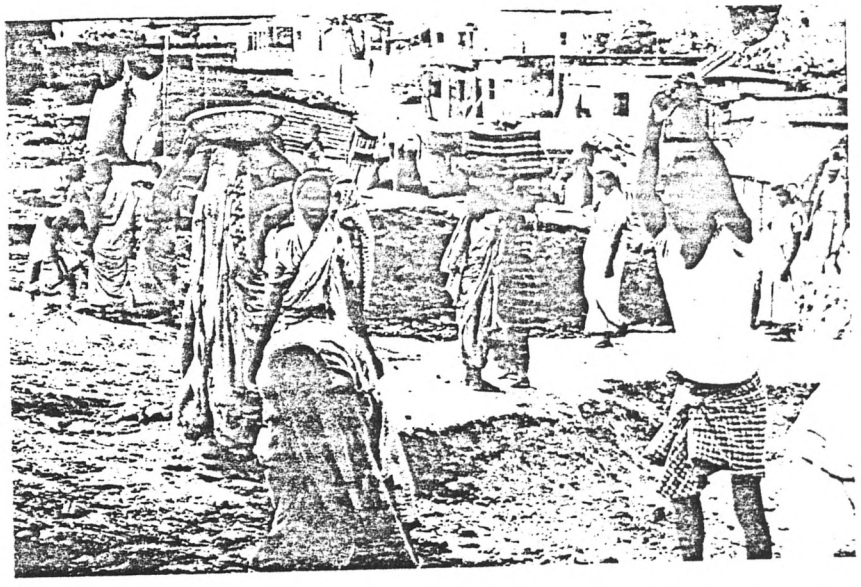
The project demonstrates the failure of the concept of simply delivering materials and training aids to the disaster area and attaining a "spread effect." As stated earlier, the design process must begin on site and experience shows that trained personnel must be present continuously to promote new concepts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

H. Timing:

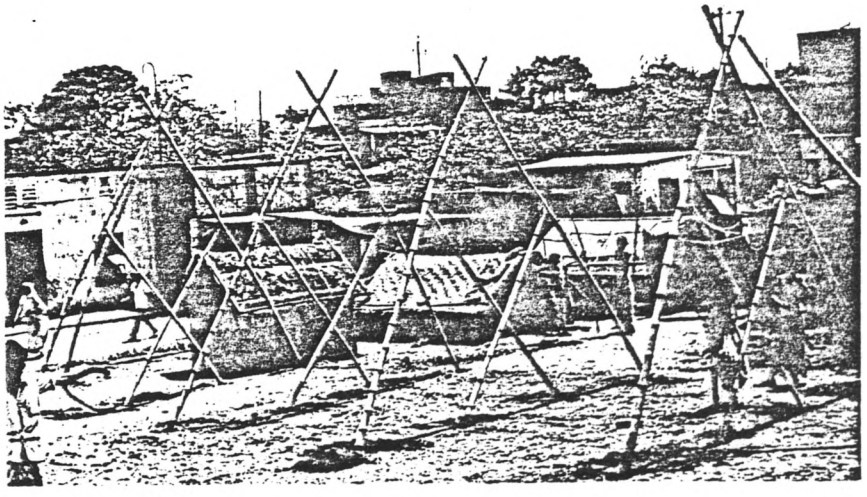
The project underscored the importance of proper timing of construction. In most developing countires there is a "building season," in other words, a time when material, capital, and labor, combine to facilitate construction. Rarely, does a disaster alter this time frame. Unless the disaster occurs at 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



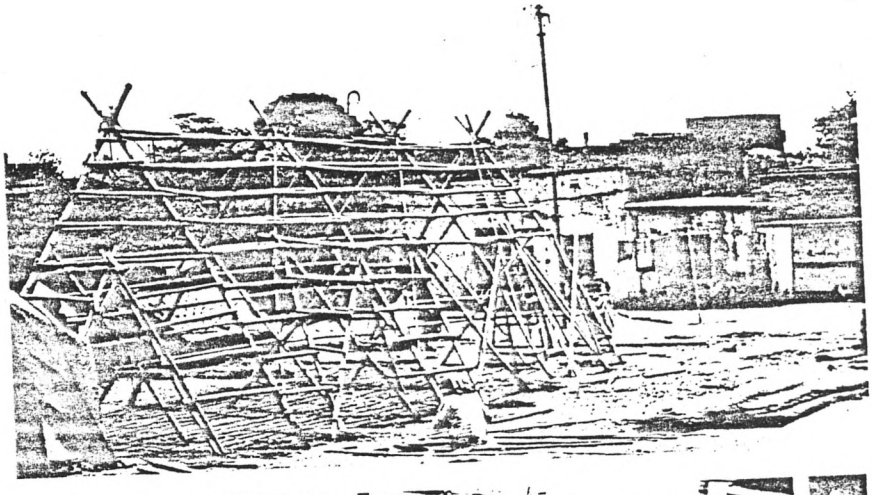
2. Work in progress- Levelling of land

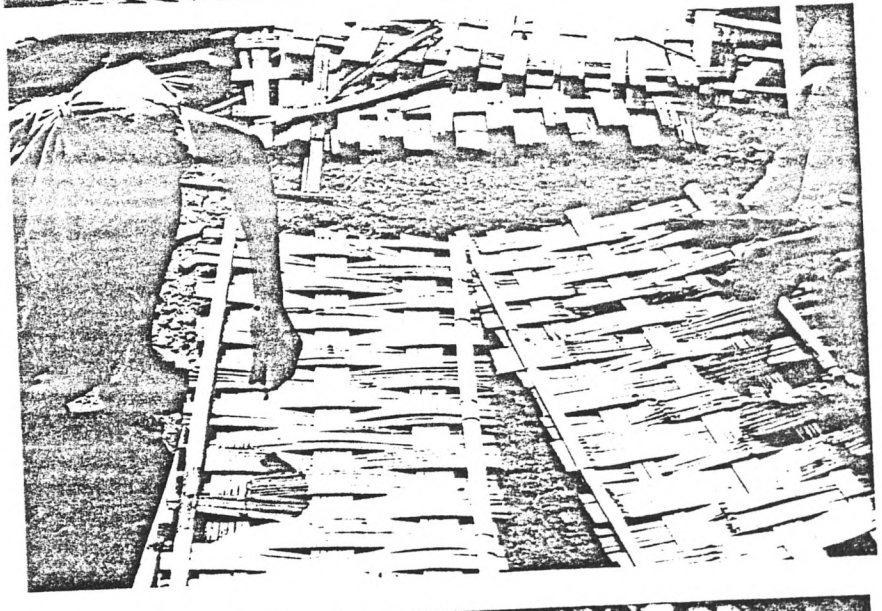


3. Erection of A-frames

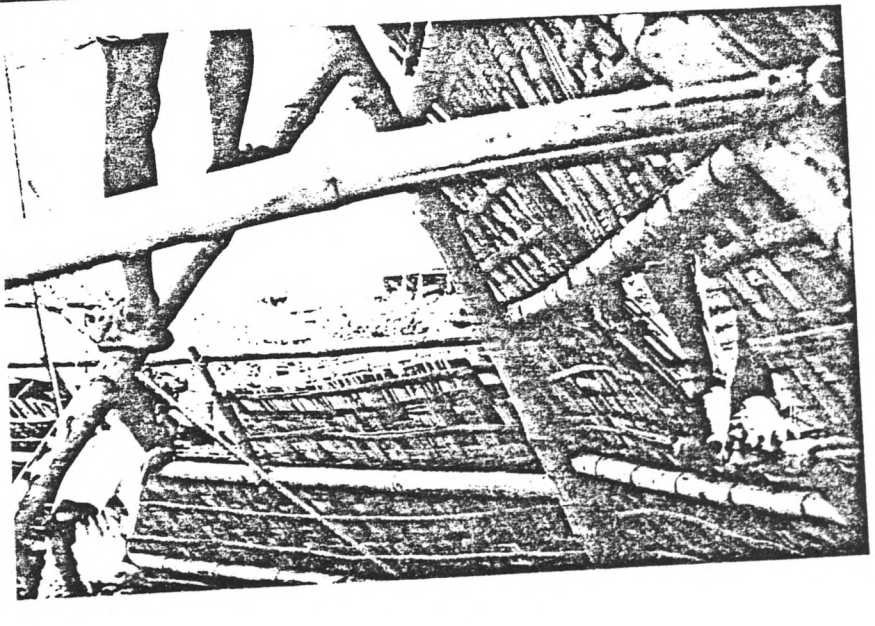
Rehabilitation of Section of Mirpur Camp (cont'd)

4. Cross-bracing and stringers attached

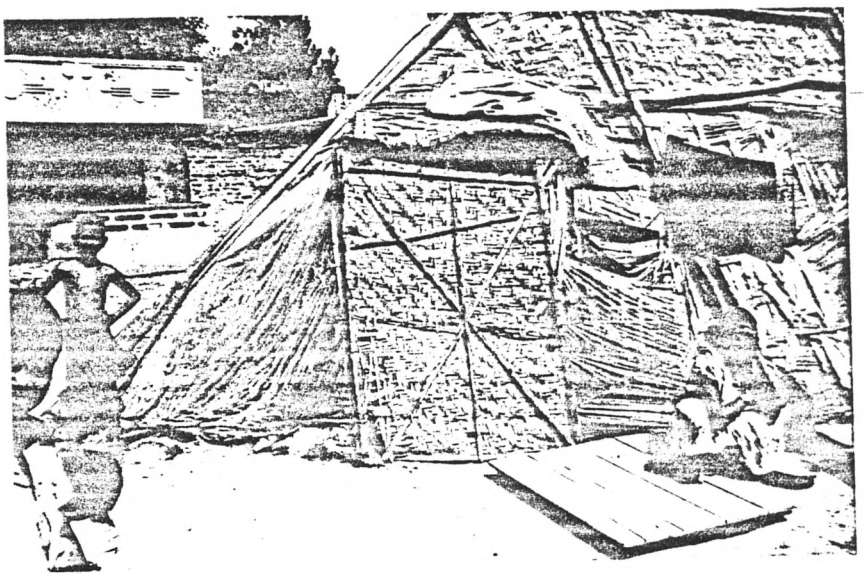




5. Making of bamboo shingles for roofing

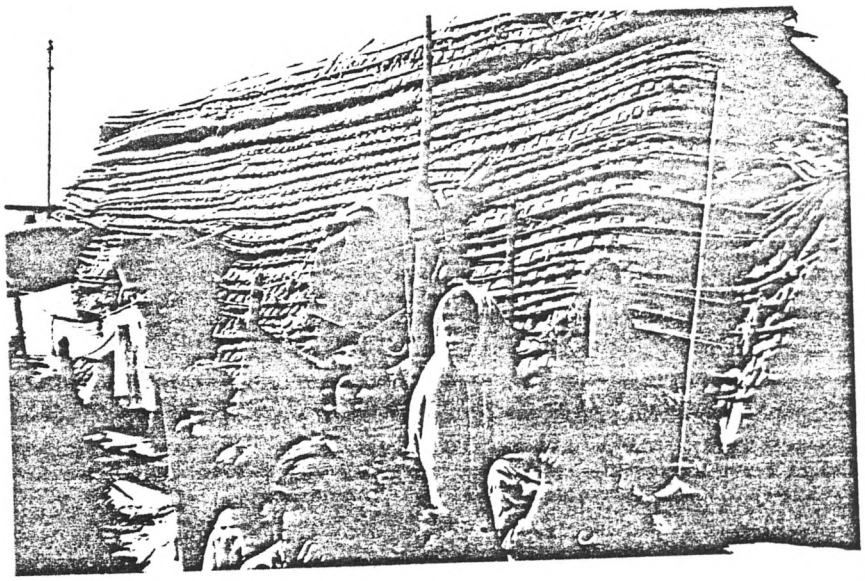


6. Application of shingles



Signs of Use and Care of Entrances in Mirpur, Spring, 1977

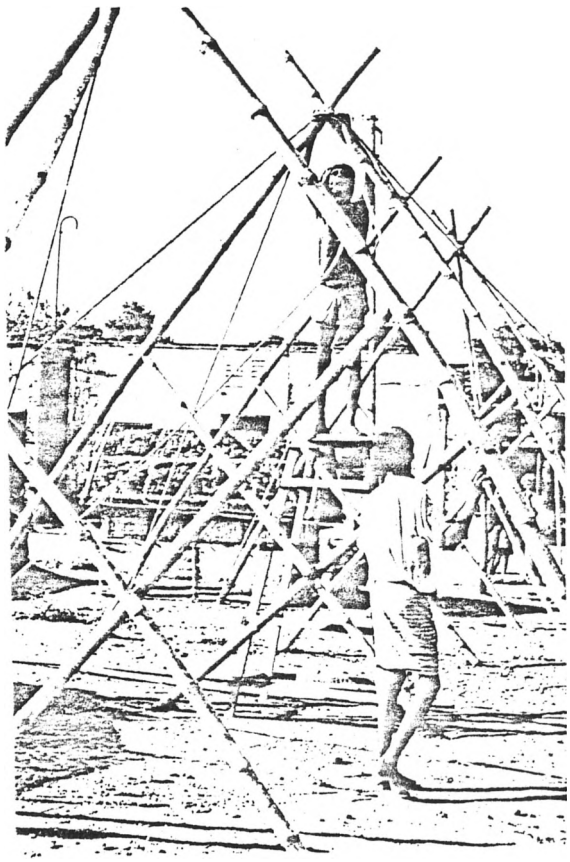
7. Apex of triangular door repaired



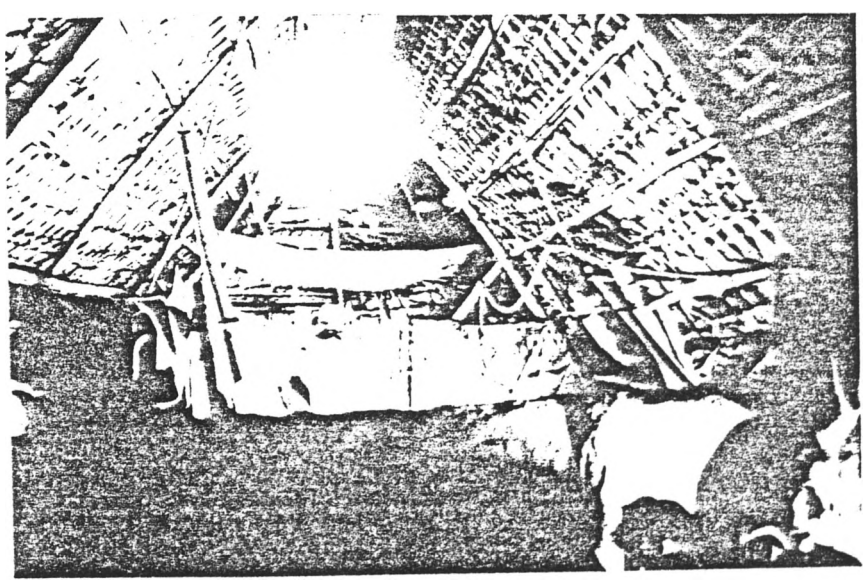
8. Modification of triangular door to become rectangular

9. Chicken coop integrated into entrance

Danger of change to Structural Design

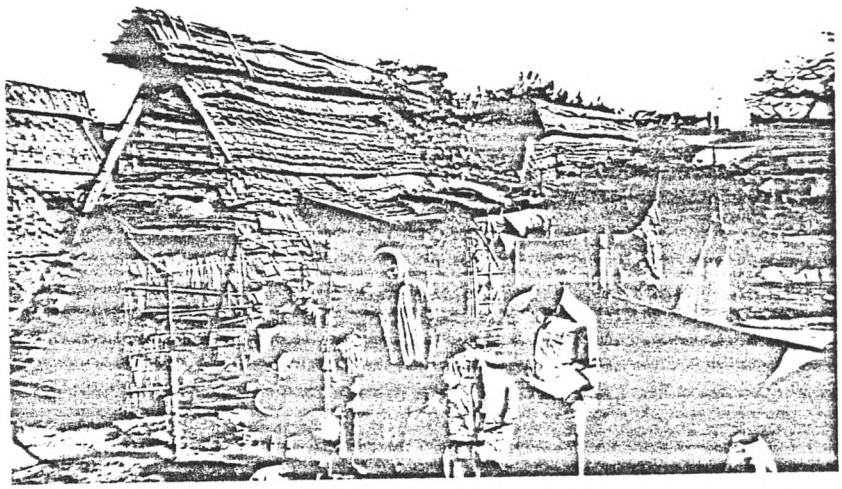


10. Cross-bracing of A-frames during construction

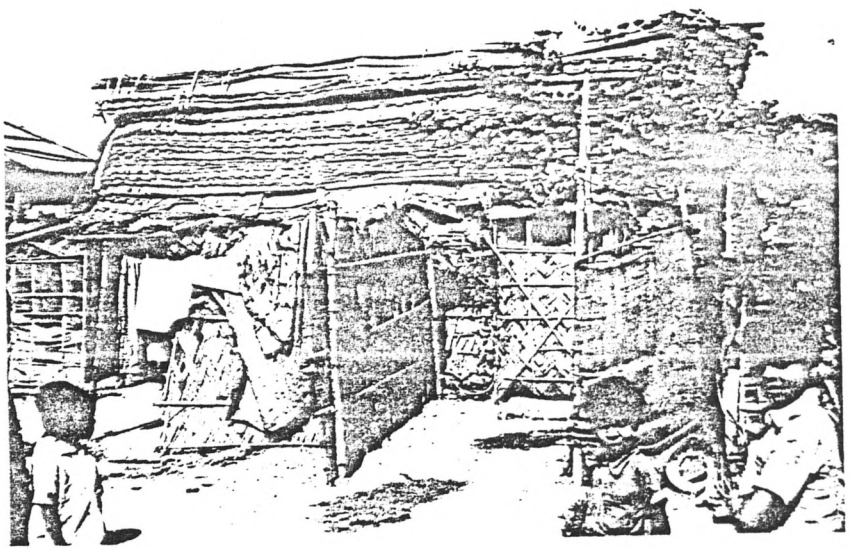


11. Interior view of Mirpur multi-family unit It appears that some of the cross bracing has been removed to increase useable space. This shows a lack of structural understanding on the part of the residents.

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.

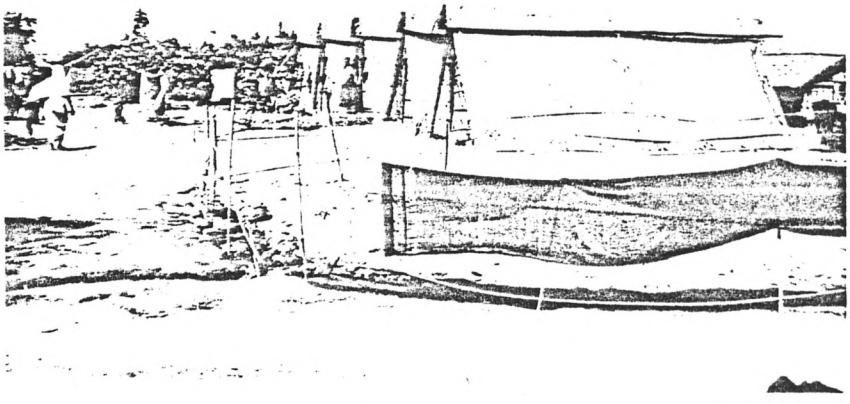


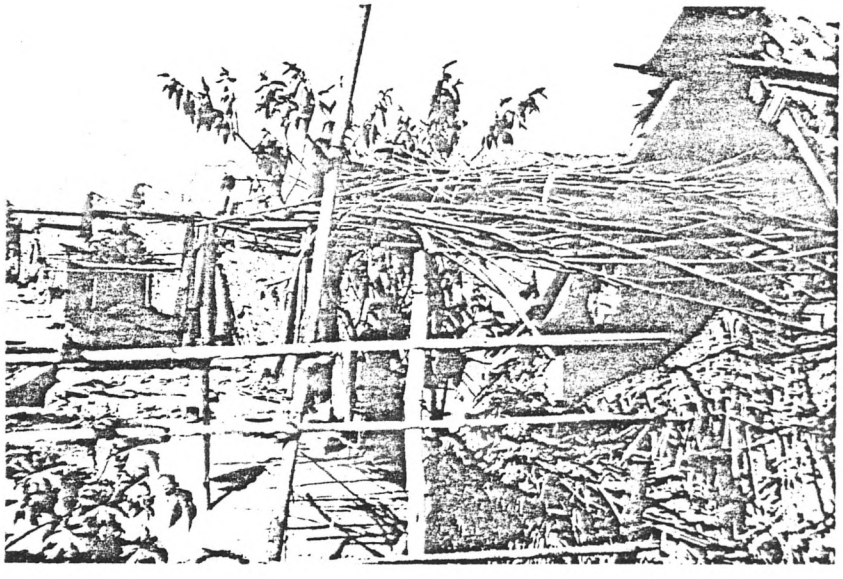
13.



14.

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





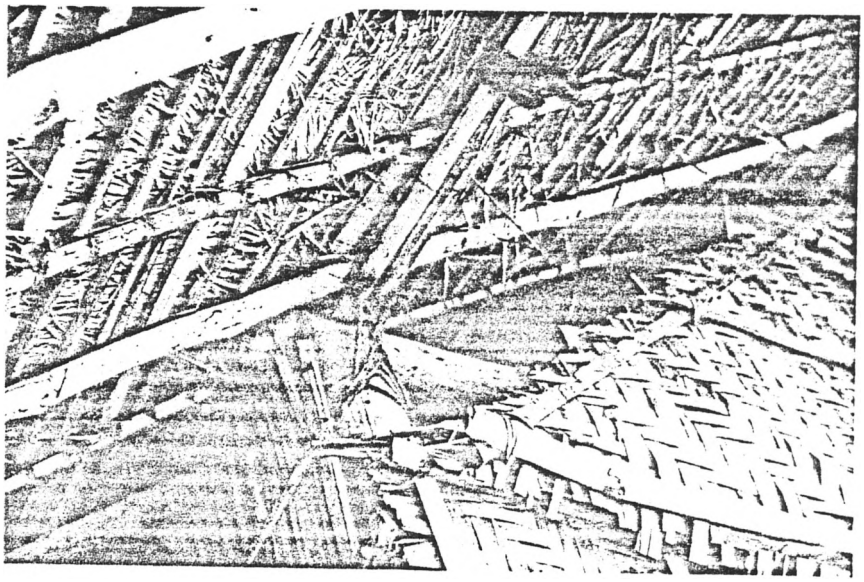
16. Entrance area

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

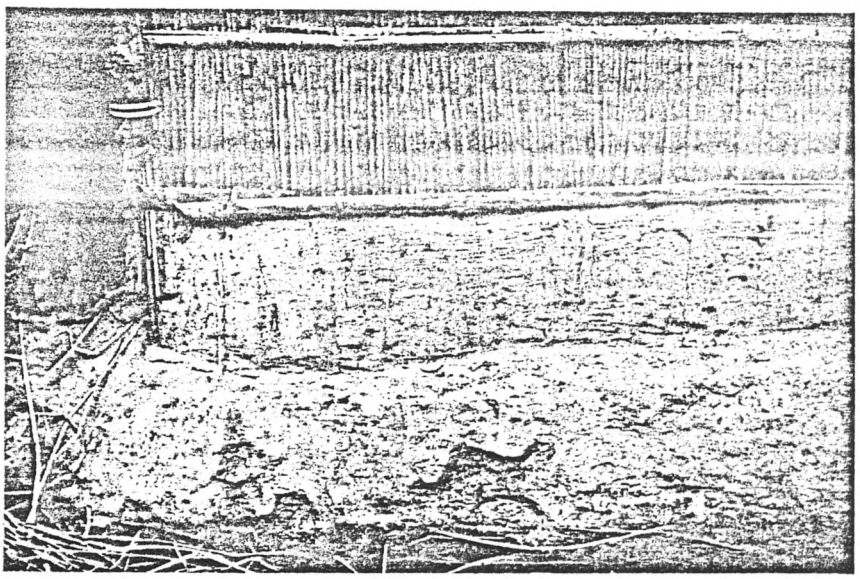
Indigenous Village Housing in Khunda in Bramanbaria Area
18. Well-maintained house

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

Information Flow

POST-DISASTER TECHNICAL INFORMATION FLOW

FOR THE RECONSTRUCTION OF HOUSING

By Everett Ressler

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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.

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[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

THE CMU/INTERTECT INFORMATION SHARING SYSTEM

Relief and development personnel, responding to natural and man-made disasters, receive little advance information concerning resource availability, skills and abilities of the people affected, and past approaches to relief/reconstruction programs under similar conditions. As a result, each situation tends to be approached as a singular event, and very little information is transferred from case to case.

Carnegie-Mellon University, in conjunction with INTERTECT, is developing an Information Sharing System to facilitate the dissemination of information on pre-disaster planning and preparedness, disaster relief and reconstruction, and post-disaster technology. As a result of the expansion of disaster relief work and low-cost housing research and development, the need is vital for a systematic collection, storage and classification of materials produced. At present, there is no common storage and retrieval system in use, thus limiting the accessibility of information.

The main goal of the Information Sharing System is to aid field operations. To effectively accomplish this, there must be adequate feedback from field personnel. Communications from the field will not only enrich the system, but will also provide raw material for further research in response to field operation needs. To be most effective, research centers/individuals must stay informed about actual conditions in relief/reconstruction situations, problems unresolved, and approaches taken. In addition, the system is designed to facilitate exchange between research centers. Through these communication linkages, the system will stimulate more accurate reporting and exchange of ideas.

Field reports will be collected continuously to help the user evaluate the effectiveness of relief/reconstruction programs and in order to upgrade the quality of research. The library will contain not only material on the organization and administration of relief/reconstruction efforts, but also information concerning indigenous materials and cultures, local economies, and physical environments that relate to the daily problems of field work in developing countries.

Information will be stored in the form of books, articles, case studies, bibliographies, tapes and slide presentations, which will be cross-referenced by subject matter according to a list of key words which fall into twelve basic categories. The staff, aided by a group of professionals, will play an active role in evaluating the validity and relevance of the information received and disseminated. The information will be reviewed prior to storage, and responses will be actively tailored to try to meet the specific needs of the user.

The CMU/INTERTECT Information Sharing System is currently undergoing an internal testing process, and a key word list is being developed which can be adapted to any information file. By building a system that is easily accessible and actively evaluated, we hope to provide a common storage and retrieval system for the use of field personnel, government and voluntary agencies, and research centers, which will handle local and international requests for information quickly and efficiently.

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THE CMU/INTERTECT INFORMATION SHARING SYSTEM

General Classification of Subject Matter

01	Bibliographies
50	Pre-Disaster Planning
60	Disaster Preparedness
100	Administration
200	Environmental Control
300	Housing
400	Medical Care
500	Storage and Distribution
600	Transportation
700	Development
800	Regional Data
900	Ecology
1000	Demography
1100	Appropriate Technology
1200	General Reference