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DISASTER ASSISTANCE MANUAL

VOLUME I:

TRANSITION HOUSING

FOR VICTIMS OF DISASTERS

APRIL 1981

OFFICE OF HOUSING
OFFICE OF U.S. FOREIGN DISASTER ASSISTANCE
AGENCY FOR INTERNATIONAL DEVELOPMENT

DISASTER ASSISTANCE MANUAL

FOR

TRANSITION HOUSING

April 1981

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This manual was developed between October 1980 and March 1981 by Planning and Development Collaborative International (PADCO) under the auspices of the Office of U.S. Foreign Disaster Assistance (OFDA) of the Agency for International Development in collaboration with the Office of Housing.

Previous experience in financing and technical assistance after disaster in the less developed countries of the world has revealed the need for a publication to guide the formulation of policy in shelter and housing programming post disaster and having a particular reference to transition housing. That is, post-disaster housing planned, designed and constructed to provide for the immediate shelter needs of the disaster victims, as well as for the orderly and progressive transition of such projects to permanent improved communities.

The manual was prepared by David Oakley, Vice President of PADCO, Inc. of Washington, D.C. under contract no. AID/otr-C-1829. It incorporates major contributions by Paul Thompson of Thompson Architects, Madison, Wisconsin; Fred Cuny of INTERTECT, Dallas, Texas; and Joseph Arington, Vice President/Operations, PADCO, Inc. Illustrations were prepared by James Viets of INTERTECT, Dallas. Dr. Ian Davis, Advisor to the United Nations Disaster Relief Organization (UNDRO) and Director of the Disaster and Settlements Unit, Oxford Polytechnic, U.K., read much of the initial draft, made valuable comments and provided material.

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INTRODUCTION

Following a disaster, AID is often called upon to assist in reconstruction activities by helping to provide new, replacement housing for some low income disaster victims. Such victims will not only have suffered the loss of a building, but may also have lost their land, or access to it, as a result of the disaster or from circumstances arising from the disaster. Thus AID may be asked to assist these victims by helping to provide safe sites that meet transitional needs and provide a base for permanent reconstruction housing.

This manual has its origins in the felt need within AID to organize the initial AID response to such requests.

The offer of assistance with site and service or low income family housing projects is not the only type of request that AID receives after disaster. After many disasters the greater proportion of a population is able to rebuild on pre-disaster sites (or has to for lack of any option). Where this is the case, then assistance may take the form of supporting a number of interlocking strategies that will enable the victims to help themselves. Possible strategies include:

(1) Technical assistance on how to upgrade houses of traditional design and construction so as to be less vulnerable in disaster.

(2) Providing employment generation assistance.

(3) Assisting in improving local skills.

(4) Restoring of economic base to damaged area.

(5) Development of the marketing system.

(6) Supplying building materials at cost or subsidized.

Where the decision is taken to assist with contractor-built low income housing projects, an initial focus has to be on the finding of appropriate sites.

A. LAND FOR HOUSING RECONSTRUCTION

It is not possible to help someone with his housing unless he can be helped to acquire land or already owns land. Housing reconstruction programs for landless victims require the early development of land acquisition strategies by host government agencies as part of reconstruction planning. This land can then be used to service and relieve the transition situation that lasts past the immediate emergency to the time when permanent housing is constructed. Strategies include:

(1) Acquisition of large sites for mass housing construction.

(2) Acquisition of smaller, scattered sites for group housing construction.

(3) Assisting individual families to acquire individual sites.

B. ORIENTATION OF THIS MANUAL

This manual focuses on the planning that follows from the policy choice to implement contractor-built housing projects after a disaster that will meet the transitional housing need as well as the requirements of a permanent community. It appraises the relevance of the conventional type, middle and low income contractor-built project, to the post-disaster situation. It discusses the need for a revision in project approach to permit fast track implementation.

(1) The traditional or conventional contractor-built housing project is recognized as being only one of the many options; and only an option when amended to handle transition housing for low income families. Emphasis on this project type in the manual is not intended to suggest that this is the preferred type of AID post-disaster assistance.

(2) Contractor-built housing projects can by their very nature serve only a very limited proportion of the people of LDC's and meet only a small proportion of overall post-disaster needs (i.e. a proportion of the small proportion that cannot rebuild on pre-disaster sites.

(3) A decision to undertake a fast track contractor-built housing project such as is described in the manual should not preclude the consideration of planned assistance to other sectors of the population post-disaster.

(4) The fast track approach to contractor-built housing projects after a disaster should ideally include a plan for the staged occupation of the site by intended beneficiary households and any subsequent movement or relocation on the site which is fully integrated with the projected staging for the provision of basic infrastructure and services.

C. ORGANIZATION OF THE MANUAL

The manual is organized in three parts. Chapters I and II review the character of the project situation post-disaster. How and why people built the way they did prior to the disaster is seen as a starting point in project design equal in importance to the facts of the disaster and the avoidance of future disasters.

Chapters III through VIII review the technical issues set by disaster hazard and by the need to house people through a transition period prior to permanent site occupancy.

Chapters IX and X put forward a concept for fast site planning and development programming that embraces the transition need and early permanent occupancy. Implementation and construction programming issues are reviewed.

D. USERS OF THE MANUAL

This manual is designed as a guide for program and project decision taking for AID officials and host country officials who have responsibility in disaster assistance programs. It is hoped that it will also be of use to other national, voluntary and international agencies concerned with the issues of disaster reconstruction. While stating technical issues it does not take up technical matters in depth. Where technical

decisions or inputs are required, they are noted. In particular situations and countries, technical questions will need to be answered by those who are technically qualified. This manual cannot be considered as a substitute for the work of trained professionals. The manual does not cover many aspects of policy which would be important in helping a particular AID Mission to formulate its transition and permanent housing reconstruction assistance program. It assumes that a basic understanding of post-disaster shelter and housing issues will eventually be provided in a companion volume.

AID and companion organizations have had extensive experience in the implementation of contractor-built housing projects for low income families in LDCs. An AID Mission should not hesitate to seek the advice of those who have experience and expertise in this type of program. Sources with the U.S. government include:

- AID Office of Housing
- AID Office of U.S. Foreign Disaster Assistance
- AID Office of Engineering
- Office of International Affairs, U.S. Department of Housing and Urban Development

PREVIEW -- SHELTER: A POST-DISASTER SCENARIO

SURVEY

1. Survey impact of disaster on shelter.

2. Appraise impact on specific income groups by region, city, rural area, neighborhood.

   - middle class
   - moderate income
   - low income
   - very low income

3. Appraise impact of disaster on dwellings of different construction located at points of differing exposure.

   - near coast
   - on hillsides
   - in high density areas

4. Establish need by income groups and make preliminary identification of possible ways of meeting the need.

   - immediate
   - transition
   - permanent

     exploring relevance of:

     - upgrading of traditional designs
     - new designs
     - providing employment to homeless
     - providing training in scarce skills
     - restoration of economic activity
     - development of marketing system anew
     - supplying building materials (gift; at cost; subsidized)
     - development of new building sites
     - core house development
     - contractor-built projects
     - site and service projects

PROBLEM RECOGNITION

5. Relate ways and means to specific income groups and develop a generalized policy approach and then match this with host government policy search.

6. Discuss with concerned parties including representatives of victims and host government agencies: either bilaterally or in setting of United Nations chaired committee of international assistance.

7. Agree which income group(s), regions, areas, house types, etc. for which USAID is to be given a measure of responsibility.

POLICY FORMULATION

8. Determine how to execute the responsibility within the framework of current funding and funding that might be expected and relate to immediate, transition and permanent needs.

9. Prepare policy for USAID supported part of host government program. Give due attention to transition stage in shelter and housing.

PROGRAM DEVELOPMENT AND PROJECT PREPARATION

10. For that section of policy and program that relates to the provision of contractor-built housing projects.

- appraise sites on offer in relation to perceived risks
- appraise possible delays in obtaining access or acquisition
- determine to use fast track approach in site planning exploiting hectare or other unit approach to grid development sites
- determine on fast track approach to implementation generally:
  - in initial planning split up large project sites into five or six construction areas
  - integrate identification of these areas with land parcels in land acquisition program and with hectare grid
  - establish site planning standards
  - prepare site layout plan
  - plan a program of site development tied into construction phasing and site access
  - let construction contracts at the appropriate time in accord with phasing plan
- determine phasing of occupancy by low income families
- plan to let families occupy plots as each phase of site development is completed to stage one of the agreed standard
- where core houses or roof shelters are to be constructed on behalf of occupiers or with their self-help contribution, let work be planned to start on this after initial access road is put on-site
- argue that phase of occupancy will allow administrations to cope more readily with the number of peoples involved, create a more even flow of work for small contractors who will finish or expand dwellings and also even out the demand for materials

11. Study impact of proposed financing method on the way of life of the families to be helped.

SHELTER DESIGN

12. Determine design intention.

- resistant to what forces and to what extent and at what cost
- set design standards
- issue design instructions
- appraise submitted designs
  - life style of occupiers

- social
- cultural
- structural stability
- material use
- cost estimates
- required supervision
- if core house: (a) means of expansion (b) effect of expansion on safety of the whole

13. Aided self-helf.

    - appraise history of this in the area or region
    - involve local people/victims in the conceptic n (this means at earlier design stage)
    - help community leaders to lead
    - train teams if required

IMPLEMENTATION

14. Prepare contract documents or approve those of host country.

15. Within agreed staging, let contracts for project site(s).

16. Rough grade roads for main circulation.

    - bring in water supply
    - install first stage latrines
    - permit transition stage occupancy

17. Continue with plan of staged development, staged contracts and staged family occupancy of zones of site.

18. Launch and manage aided self-help program or ensure management is established by agency or appointed voluntary body.

EVALUATION

19. Evaluate the entire project.

20. Amend program/project in light of the evaluation.

DEFINITIONS

Core Housing. In disasters, this refers to the approach of providing a basic superstructure of a building which provides a minimum amount of strength for a disaster resistant house. Instead of providing a complete structure, an agency provides a foundation, frame, supports and roof structure that is designed and reinforced so that the homeowner can in-fill the walls with whatever material he desires without substantially reducing the margin of safety of the structure.

Critical Facilities. Critical facilities are those structures which are crucial to the operation of the government and the key installations of the economic sector. Examples of critical facilities are telephone exchanges, hydroelectrical facilities, fuel storage depots, central data processing centers, central banks, etc.

DAST. DAST is an acronym for Disaster Area Survey Teams. DAST units are provided by the United States Army to assist in the initial disaster assessment.

Disaster Assessment. Disaster assessment refers to the survey activities carried out to determine the effects of a disaster on a community and a society. Disaster assessment has three sub-activities: needs assessment, damage assessment and stoppage assessment.

- Access Survey is the identification of disaster-caused bottlenecks which will prevent or hamper search and rescue operations or delay other response activities. Stoppage assessment would include the identification of landslides closing roads, the inspection of bridges to ensure that they can be crossed following an earthquake or a flood, etc.

- Needs Assessment is the determination of the needs of the victim. This is usually divided into immediate needs and long-term needs.

- Damage Assessment is the determination of the extent of physical damage to buildings and manmade structures. Two types of damage assessment are normally carried out. The first is to determine the gross damage to a community so that reconstruction planning can have the necessary statistics for determining the aid levels required. The second is a detailed structural analysis of typical buildings to determine the causes of failure and methods for modifying the structures so that during reconstruction, suitable steps can be taken to make the building safer.

Disaster Mitigation. Disaster mitigation is the taking of actions which reduce the harmful effects of a disaster. Mitigation accepts the occurrence of extreme natural phenomena, but attempts to limit both human suffering and property loss.

Disaster Preparedness. Disaster preparedness are those actions which attempt to limit the impact of a disaster by structuring the response and affecting a quick and orderly reaction to the disaster. Preparedness is unique among all pre-disaster planning activities in that it addresses actions in both the pre-disaster phase (for example, warning and evacuation) as well as the post-disaster phases.

Disaster Prevention. Disaster prevention encompasses those activities which are taken to prevent a natural phenomena or a potential hazard from having harmful effects on either persons or property. Disaster prevention includes such activities as cloud seeding to control meteorological patterns, the construction of dams or dykes to prevent flooding

and attempts to reduce techtonic tension by such measures as pumping water into earthquake faults.

Disaster-Resistant Construction. The term disaster resistant is used to denote the degree to which a structure can be made more resistant (or safe) to certain natural phenomena. The term recognizes that no building can be considered totally safe, but that certain steps can be taken to improve performance or survivability.

Disaster Response. Disaster response refers to those activities which occur in the aftermath of a disaster to assist disaster victims and to rehabilitate or reconstruct the physical structures of the society.

Evaluation. Evaluation is the term used in disasters to determine the effectiveness of the program after significant portions of the program have been completed.

Filling the Gap. Filling the gap is a term used to denote the provision of intermediate aid in the housing sector (i.e. the provision of buiding material or shelter units) to serve until people can rebuild a formal house.

Hazard Mapping. Hazard mapping is the process of establishing geographically where certain phenomena are likely to pose a threat to human settlements. Typically, hazard maps identify areas which are subject to natural phenomena such as earthquakes, hurricanes, tornados, etc. and areas which could be threatened by manmade disasters (for example, areas surrounding nuclear power plants, chemical disposal sites or areas subject to threat from explosion or fire from such refineries).

High Wind Study. The High Wind Study is an oft-cited reference for the design criteria of lowrise buildings. The study, conducted by the National Bureau of Standards with support from the National Science Foundation and USAID, studies the performance of lowrise buildings in high wind areas. The title of the study obscures the fact that much valuable information was also developed about earthquakes and seismic design criteria for lowrise buildings. It is considered the key reference for housing in vulnerable areas in developing countries.

Housing Education Programs. This is the term normally used by voluntary agencies to denote a program offering vocational training to homeowners or builders in how to build a safer or more disaster-resistant house.

Housing Modification. This term refers to the process of altering the design of a structure before it is built to make it more disaster-resistant.

Intervenor. An intervenor is a term used to denote any agency who provides assistance before or after a disaster in order to alter or improve the post-disaster situation.

Lifelines. Lifelines are those facilities which are crucial to life support and which should receive high priority for protection or restoration following disaster. Lifelines include water systems, electrical systems, hospitals, etc.

Microzonation. Microzonation is risk mapping at a very small scale. Within any particular area, there are numerous geological variations which make certain areas safer or more hazardous than others. Microzonation delineates each of these areas so that communities can select the safest possible sites for development or the location of critical facilities.

Monitoring. Monitoring is the term used in disasters to denote surveys of ongoing activities to determine their progress and effectiveness.

Pre-disaster Normal. The term pre-disaster normal refers to a society and the processes within a society before a disaster strikes. It is used as both a goal of relief and reconstruction programs and as a measure for determining when a relief or reconstruction program should terminate.

Pre-disaster Planning. Pre-disaster planning is the process of planning actions which will prevent, mitigate or prepare for a disaster. Pre-disaster planning includes the tasks of disaster prevention, disaster mitigation and disaster preparedness.

Retrofitting. This term refers to the process of installing additional supports or altering the construction of a building already built in order to make it more disaster-resistant.

Risk. Risk is the relative degree of probability that a hazardous event will occur. An active fault zone, for example, could be an area of high risk.

Risk Mapping. Risk mapping is the process of identifying high risk areas. This is done by correlating a hazard, such as an earthquake, to the terrain and to the probability that such an event will occur. The results of these analyses are usually presented in the form of risk maps which show the type and degree of hazard represented by a particular natural phenomena at a given geographic location. Risk mapping is usually the first step in vulnerability reduction.

The ABC Approach. This refers to the process of first providing an emergency shelter, then a temporary shelter and finally, a permanent house for the disaster victims. The ABC Approach is generally considered to be a costly approach which delays recovery.

Vulnerability. Vulnerability is a condition wherein human settlements or buildings are exposed to a disaster by virtue of their proximity, terrain or their buildings. Communities in low-lying coastal areas subject to hurricanes or communities wherein a large proportion of the structures cannot withstand the effects of an earthquake would be considered vulnerable communities.

PART I

HABITAT AND DISASTER

CHAPTER I
THE POST-DISASTER PROJECT

A. ORIENTATION
1. Operational Responsibility
2. Beneficiaries
3. Location of Projects
4. Timing

B. KEY ISSUES
1. Preconditions for a Program
2. Urgency and Speed
3. Land Issues
4. Balance of Income Groups

C. KEY CONCEPTS
1. Parallels to Normal Housing Projects
2. Integrated Land Use
3. Integrated Income Groups
4. Maximizing Opportunity for the Victims
5. Importance of Sites and Services
6. Disaster Assessment

D. PEOPLE AND ORGANIZATIONS
1. Project Holders
2. Technicians

E. POTENTIAL ROLES FOR AID
1. Assistance in Site Selection
2. Assistance in Site Acquisition
3. Assistance in Project Planning
4. Assistance in Project Execution
5. Assistance in Project Financing
6. Provision of Assistance to Disaster Victims before and after Occupation of the Site
7. Stimulating Rapid Action

F. LESSONS LEARNED

G. REFERENCES

CHAPTER I

THE POST-DISASTER PROJECT

A. ORIENTATION

A conventional middle or low income housing reconstruction project is defined as a complete program of land acquisition, site planning, site development and housing construction. Conventional projects can be divided into two types according to the method by which housing is provided. They are:

(1) Simple projects wherein the reconstruction agency uses only one approach to provide the housing (normally contractor-built structures).

(2) Integrated projects wherein the reconstruction agency utilizes two or more approaches for providing housing (i.e. some core units or aided self-help components).

A post-disaster housing project can be seen as a conventional housing project conducted at an accelerated rate, taking into account considerations imposed by the disaster and/or a disaster threat. These will include the need to house people caught in the transition stage after the emergency relief period when permanent shelter is not yet available to meet their immediate needs.

1. Operational Responsibility

Conventional housing programs are normally conducted under the activity of a governmental or semi-public body. Because land acquisition is an integral part of the program, because the degree of sophistication required is high and because this type of project requires extensive financing and readily available cash, other types of relief agencies such as voluntary agencies are normally not project agents. However, other types of agencies may become involved in project execution, especially in the integrated project model.

2. Beneficiaries

The designated beneficiaries of such a housing project are usually people who are both homeless and landless as a result of the disaster and the project should be planned to meet the needs of these people on a priority basis. Examples of eligible persons are families who were tenants prior to the disaster, persons who have been evacuated from vulnerable sites and persons who have lost their land as a result of the effects of a disaster (for example, landslides, erosion, flooding or the diversion of streams).

3. Location of Projects

Conventional housing programs are normally conducted in urban fringe areas on lands adjacent to or nearby an existing settlement. In some cases, entire new towns have been developed in response to a persistent disaster threat; however, projects of this magnitude are beyond the scope of this manual.

4. Timing

Contractor-built housing projects may be initiated during any disaster phase but, because land acquisition is involved, project execution and the actual construction and occupation of housing will not take place until well into the reconstruction period. Thus, contractor-built projects are not a solution to emergency needs although suitably modified they can play a role in meeting transitional housing needs (Chapter IX).

B. KEY ISSUES

There are a number of issues to be addressed when planning a contractor-built housing project. They are:

1. Preconditions for a Program

Those factors which determine whether or not a built project should be undertaken:

(a) When the number of victims who have lost land or access to land represents a significant portion of the total in one particular area.

(b) When it can be determined that delays in reconstruction will mean that a significant number of tenants will not have access to other housing resources.

(c) When alternative approaches for providing land, such as scattered site acquisition, are not feasible due to costs or political/administrative obstacles.

2. Urgency and Speed

Even with the adoption of a fast track approach to project design and implementation, contractor-built housing projects are not an answer to the meeting of immediate and urgent needs post-disaster. Land once acquired has to be planned and developed. Material resources have to be gathered. Order books may be full of post-disaster orders and the project will have to wait its turn. The length of the delivery pipe line once the material required is available may be months long, especially where haulage involves a long journey, a sea voyage, then another land journey.

3. Land Issues

Land acquisition and subsequent land sales or tenure arrangements always become central issues in housing projects. As land is usually one of the more sensitive issues within the LDC's, AID program managers should proceed with caution in assisting local land purchase operations.

4. Balance of Income Groups

A common debate in planning conventional housing projects is the target population and income group to occupy the project. Usually, such projects are intended to provide housing to the poor and there often is resistance to allowing other income groups to acquire project housing or land. In practice, due to the resale provisions, requirements for loans, etc., the people qualifying as beneficiaries tend to be an upwardly mobile segment of the low income population, as well as portions of middle income groups. For large projects, this can prove to be an advantage, as it means that portions of the land can be sold at a higher price to subsidize other portions of the site, thereby lowering costs for lower income families.

C. KEY CONCEPTS

1. Parallels to Normal Housing Projects

A key concept is that a contractor-built housing project proposed for after a disaster is essentially a normal housing project carried out on an accelerated basis and giving special attention to transition housing needs. Many such post-disaster housing projects have failed because the reconstruction agency failed to manage the project in the same detailed manner as it would do under more normal conditions using the same review techniques. Acceleration of decision taking is feasible due to the pressures created by the disaster but all the social and economic issues need due attention (Chapter II).

The additional factors added by a disaster are:

(a) Pressures for rapid site acquisition and development caused by a need to house disaster victims through a transition stage as well as permanently.

(b) An immediate and identifiable clientele.

(c) Concern over the relative safety of the site.

(d) Concern over the relative safety of the house.

(e) Concern over access to places of employment, amplified if the beneficiaries are evacuees.

Disasters often represent opportunity loss. In other words, persons who would normally be eligible for loans or those who would have excess capital to invest in new housing may no longer have these resources due to losses in the disaster. Therefore, reduced ability to participate financially must be taken into account.

2. Integrated Land Use

Conventional housing projects often fail because they are viewed simply as a housing scheme, rather than as a balanced community. It is especially important in larger projects that land be provided for commercial and semi-public use and that the site be developed as a community, not simply as a mass of housing (Chapter II).

3. Integrated Income Groups

In large projects, it is important that the community be planned for a variety of different income groups. From a social perspective this balance is especially desirable because it reduces the impact of having one large, low income subdivision, which might deteriorate into a blighted area. By mixing the land uses in the initial plan, land prices can to some degree be stabilized during the early stages of the project (Chapter IX).

4. Maximizing Opportunity for the Victims

A key objective of any reconstruction activity is to promote the full recovery of the disaster victims. Housing reconstruction programs provide many opportunities for involving disaster victims and stimulating both economic and emotional recovery. It is important that reconstruction activities be planned to provide jobs and opportunities for disaster victims. It is especially important that contractors be encouraged to utilize disaster victims in site development activities and in housing construction (Annex 1).

5. Importance of Sites and Services

In a post-disaster situation, housing is often seen as a primary need and the end result of a program. Planners should be careful not to develop a fixation on housing and should give equal attention to choice of sites and installation of adequate utility services in the project scheme. Experience has shown that while housing is a primary concern of disaster victims in the immediate aftermath of a disaster over a long period of time, the development of the site and services provided is a more long-term concern (Chapter IV).

6. Disaster Assessment

The key to successful project planning and execution is a thorough and accurate disaster assessment. For the planner of a conventional housing project, information to be obtained prior to project planning includes:

Data concerning the beneficiaries of the housing project including:

- Ability to participate in the program financially.
- Numbers of people eligible for the program at the transition stage and long-term.
- Demand for this type of project (i.e. the number of persons who are landless or permanent evacuees).
- The suitability and availability of safe sites.
- The availability of the resources necessary to carry out the project in the post-disaster environment (i.e. will the materials be available? will the technicians necessary to plan and execute the programs be available when needed? etc.).

D. PEOPLE AND ORGANIZATIONS

1. Project Holders

The project holder of a conventional housing project must be an organization which can legally own or hold land and which has the administrative capability of implementing the project. The organization must be willing to undertake a long-term commitment in the project area. Implementing agencies are normally:

(a) Housing ministries of the national government.

(b) Housing banks.

(c) Municipalities.

(d) Specially-created disaster reconstruction agencies of the government.

(e) Regional intergovernmental organizations (OAS, UNDP, etc.).

Voluntary agencies may also be project holders in certain circumstances, but foreign voluntary organizations without a permanent in-country staff should not be considered. Foreign voluntary agencies, however, can be a useful technical resource and can be affiliated for the purposes of implementing portions of the project.

2. Technicians

The planning and execution of a conventional project requires inputs from a number of technical and professional people. Among those normally involved and their roles are:

(a) Planners — site layout.

(b) Architects — housing design, including disaster-resistant construction details and technical assistance in housing education components.

(c) Engineers — earthquake or wind-resistant structural engineering, sites and services planning and layout, soils analysis.

(d) Geologists — hazard and risk analysis of the site.

(e) Contractors — installation of sites and services, construction of housing, construction of community facilities.

E. POTENTIAL ROLES FOR AID

Appropriate roles for AID to play in a post -disaster housing project, depending on available resources, are:

1. Assistance in Site Selection

Activities relating to site selection include technical assistance in hazard and vulnerability analysis, planning analysis of access and suitability of the location and technical assistance in soils testing.

2. Assistance in Site Acquisition

Providing technical assistance to find alternative ways in which land can be acquired or occupied under tenure relationships.

3. Assistance in Project Planning

As transition housing projects require complex planning, AID can often assist by providing technical assistance to project holders.

4. Assistance in Project Execution

Project execution often requires a high degree of sophistication. AID can provide technical assistance, administrative guidance and help in sequencing activities. AID can often serve in a coordination role to help arrange input from other organizations and encourage partnerships in project execution.

5. Assistance in Project Financing

A problem that delays housing projects can be lack of immediate access to funds at critical times. AID may offer use of its own financial resources to stimulate rapid actions by providing funds, credit, loan guarantees or direct loans to project holders.

6. Provision of Assistance to Disaster Victims Before and After Occupation of the Site

Because contractor-built projects take time to execute, the emergency housing and shelter needs of the victims cannot be met immediately. AID can assist the designated beneficiaries during the interim period by providing alternative shelter until the project site is ready for phased occupation.

7. Stimulating Rapid Action

Project holders often are not familiar with methods by which housing projects can be accelerated. The Mission can provide technical assistance to project holders and should encourage and stimulate administrative shortcuts wherever possible.

F. LESSONS LEARNED

Considerable knowledge about contractor-built low income housing programs in both normal and post-disaster situations has been gained by AID and other organizations.

Among the lessons learned were:

(1) Land acquisition is the key step. For the project planner, this means that adequate time and resources must be devoted to land acquisition at the earliest possible stage of the project.

(2) Despite post-disaster program intentions, the occupants of a conventional housing project have not always been disaster victims. If a project takes years to execute, it becomes less and less likely that the disaster victims for whom the project was originally intended will eventually occupy the site. They will have settled elsewhere meantime. For the project planner, there are two implications if the project is to meet the declared purposes: (a) special attention must be given to ways of meeting the transitional housing and shelter needs of the target population and keeping them in the project "pipeline" and (b) priorities should be given to activities which will allow the primary recipient group early access to the site (Chapter IV).

The fact that many of the ultimate occupants of the site will not be the originally intended group may not be considered as a major problem, as long as adequate measures are taken to ensure participation by a significant portion of the designated beneficiaries. Planners may even allocate a portion of the site at the transition stage to be designated for non-primary group occupancy as a means of developing a balanced community.

(3) Post-disaster housing projects have not always proven successful in redevelopment areas. In many cases, the damage caused by the disaster is so severe that all the buildings on a site are demolished and large tracts of land are cleared. Some of these sites may be offered for use in a contractor-built housing project. Experience has shown, however, that these sites should be avoided due to problems of land ownership and other factors which serve to delay acquisition and increase the costs. (Redevelopment of these sites should be accomplished through other housing reconstruction approaches — i.e. offering of finance on favorable terms to original owners or to consortiums of original owners who consolidate the land for redevelopment.)

(4) Because housing projects take time to plan and execute, land costs will rise during the project. This has two potential complications: (a) first, unless rapid acquisition is possible, land acquisition costs will increase; (b) as land costs increase, it will be necessary to develop land cost write-down mechanisms so that occupants will be able to purchase the land at a reasonable price. This means that the agency must either be prepared to sell the land at a loss or plan the project so that more expensive sites can be sold at a price which subsidizes the sale of the remaining land.

(5) The provision of land can be used as an incentive for both safe construction and phased site development if suitable controls are used and it is understood by the beneficiaries that this will be a condition for receiving

clear title to the land. Program planners often fail to use this incentive and thereby lose an opportunity to effect safer and more appealing environments.

(6) Adequate sanitation is both the most important utility to be provided and a key to overall success of the project. Without an on-site sanitation system for each family, the desirability of the project and the overall environmental impact of the project will be substantially affected.

(7) Without clear title to the land, people will be unlikely to participate in self-help activities or to upgrade their housing.

(8) Many projects are over-designed. In other words, in an attempt to provide the highest possible quality of housing and the best site arrangement, programs enter into such detail that they inevitably cause delays and increased costs. Program planners should fast track approaches so that rapid implementation is facilitated and the transition as well as the permanent housing problem is met.

(9) The size and shape of individual plots can affect the ultimate safety of the evolving house. For example, plots are often too narrow to permit the necessary separation between buildings required in earthquake zones. Therefore, when the building is abutted next to the house on the adjoining lot, a vulnerable situation is created. Row or barracks housing cannot be recommended for earthquake areas.

The shape and size of a lot often determine the evolution of a house. By providing an inadequate site, additions to the primary structure are likely to increase the vulnerability of the house (Figure 4.8, p. 55).

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CHAPTER II
COMMUNITY HABITAT

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CHAPTER II

COMMUNITY HABITAT

A. ORIENTATION

This chapter focuses on the community habitat and residential needs of the disaster victims over the long term. These will structure the physical design of the conventional housing project to the same degree as the aftermath of the disaster itself and the need to devise an accelerated programming technique. This chapter thus gives the underlying structure to the project approach developed in Chapters IV, V and IX.

During the early stages of project preparation, local administrators and disaster victims will be overshadowed by immediate food supply, shelter and health issues. Quite quickly, however, as normality returns, this emergency attitude passes. Projects prepared within the emergency and relief framework of thought may then appear inadequate; even before construction. AID participation in project programming and design should ensure this does not happen with those projects that it is to support.

To ensure that this is the case, it is necessary to recognize the human and social concerns that shape effective neighborhood planning. It is also necessary to develop an appreciation of the parameters that shape layout and building form. This enables project planning teams to organize and interpret contributions and responses from victims and to ask relevant questions when assembling design briefs (Chapters IV and IX).

A disaster is an interruption in the normal pattern of habitat that defines a location, a community and its dwellings. Recovery and reconstruction will inevitably contain elements of upgrading and in part be new. But continuity is also important to the sense of community identification that families in new dwellings and on new sites desire so badly. If continuity is to be offered, then those who assist in transitional and permanent reconstruction programs need an awareness of what has constituted the traditional habitat. The key concerns which will structure both transitional and permanent housing are outlined below.

B. KEY ISSUES

1. Influences on Habitat and Building Form

For ease of recognition and for use in site layout, house planning and project preparation, it is useful to relate design criteria to three themes, all of which contribute to building form:

(a) Building fabric. Building materials, building structure and structural stability in the face of natural hazards (Chapters V, VI, VII, VIII).

(b) Activity and environment. Geography and place, climate, tenure, activity (i.e. domestic life in and around the dwelling and in community), services and utilities, water, sanitation, cooking and lighting (Chapter IV).

(c) Society and culture. Psychology, including attitudes to hazards, family mores, social order and community life, beliefs, signs and symbols.

There is a tendency in long-established, slow-developing societies for these themes to form a pattern or interweave. House form and settlement patterns become not only utilitarian but are expressive of a cultural unity and a whole way of life. The building process and its customary ways form an integral part of this pattern. Changing or adapting to this so that transitional housing forms a first stage towards permanent housing will be an important part of the revised approach to the design of a conventional housing project.

2. Changes in the Pattern of Built Habitat

The foregoing is thus of direct relevance to project preparation after disaster. The introduction of change into any part of a long-held pattern has reverberations throughout the whole. These will be experienced by most people as being unsettling, however "good" or "bad" external observers may view matters.

It can readily be accepted that a disaster disturbs a long-held pattern. A new site to live on with new neighbors is a further disturbance. New materials that lead to new forms is a further disturbance. New conceptual knowledge that makes disaster-avoiding layouts possible and disaster-resistant structures possible, offer further disturbances to long-held building practices. Unless all this change is strongly held in a comprehensible program and victims are led into its acceptance, chaos is seen to replace former patterns. Program planners will need to work with community leaders of the transition housing areas in order to ensure that the permanent solutions are relevant (Chapter IX).

To direct change, processes must be understood. Much has been learned about the nature of change but much remains to be learned. Change can exhibit a number of characteristic forms — all demand a specific response:

(a) Sudden (i.e. physical disaster).

(b) Fits and starts (i.e. flood and hurricane, boom and slump economics, onset of monsoon rains).

(c) Evolution (of institutions, forms, ideas, techniques).

(d) Diffusion of ideas, techniques, etc., leading to changes of perception with reference to the long-established pattern (i.e. perception that hazards can be mitigated).

(e) Spread of urban life; can be seen as a special case of (d).

(f) Original ideas.

A conventional housing project is likely to encompass many of these kinds of change. Unless people affected by disaster participate in the project formulation and are kept informed of administrative progress, particularly in the early stages, reactions are likely to group around the hostile end of the spectrum and be expressive of resistance, withdrawal and reluctant acceptance; rather than group about the accepting end of welcome and participation.

C. KEY FORMATIVE ISSUES IN HOUSING DESIGN

1. Building Fabric

a. The Local Building Process

The building process is among the many processes that are formative to housing and shelter. The same recognizable elements are always found whatever the different form they take in different contexts.

- Initiation — someone sets in motion the notion of meeting the need.
- A design is selected or a design specially commissioned.
- Preparation is made for construction — funds are organized, orders are placed, specifications are prepared.
- The construction sequence is organized.
- The building work is executed.

A little to one side of this process but integral to its success are the building material manufacturers and suppliers.

The patterning that this process takes is dependent upon the character of the developmental environment and the post-disaster situation. Characteristic differences can generally be recognized between practices in central urban areas, in middle income residential suburbs, in urbanizing rural regions, in squatter and freestyle housing settlements and in rural regions.

This underlines the importance in project preparation of seeing post-disaster transition housing as:

- The meeting point of numerous processes.
  — building
  — administrative
  — financial, etc.
- As a built product.
  — economic life
  — need for maintenance
  — adaptable to change and expansion
- As a tangible realization of an image.
  — what is long known
  — the newness that is aspired to
- As the modifier of human experience.
  — a base for family life

— in the "wrong" place
— just what is wanted

Even after disaster, when the emphasis on meeting fundamental human needs seems so obviously dominant, housing that is provided on sites far from employment, of socially unacceptable materials and which fails to meet in plan some cultural requirement, may well be rejected in subtle or even in a very obvious way — it may not be occupied (Chapter IV).

b. Material Use

Building materials in most developing countries have been developed for use in everyday conditions. Only in a few countries have disasters been both widespread and frequent enough (e.g. Turkey and Peru) to influence material selection and manner of use. (See Annexes I and II for recommended uses.)

c. Structural Stability

This in most countries has been determined in relation to everyday use assuming dead loads of material and live loads of people, furniture and weather factors such as rain, snow and sustained wind. It is essential in disaster prone areas that an understanding develop of the forces that lead to disasters, the reasons buildings fail and how economically they can be redesigned (Chapters V, VI, VII, VIII).

d. Permanency

Permanency can be related to the normal condition or to withstanding the typical disaster. Permanency of rural and middle income urban housing in most LDC's has usually been related to the normal everyday condition. This had led to a pattern of building forms and structural systems in many countries that are ill-suited to resist disaster forces (Figure 2.1).

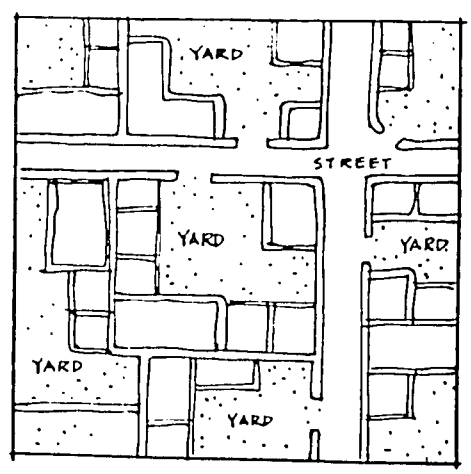

FIGURE 2.1
Comfort conditions in hot dry climates are obtained through seeking shade and freedom from the glare of brightly lit ground and walls. The traditional urban quarter of tightly packed courtyard houses, reached by footpaths, offers a satisfactory solution to the climatic problem. However, the abutting of walls and flat roofs in this way in earthquake prone areas offers very difficult design problems to the designer trying to achieve earthquake resistance. (c.f. Fig. 2.2)

e. Degree of Risk

The project preparation team will need to determine the nature of the disaster risks run on the selected development site and the extent to which material use, structural systems, the notion of permanency and construction techniques can be changed (and afforded) to achieve a new specification of performance in face of earthquake, cyclone and flood. Appraisal of such risks is a task for technical expertise and AID Missions may wish to recruit technical assistance personnel to ensure this is undertaken well.

f. Conceptualized Knowledge of How Buildings May Be Made Resistant

This knowledge is still evolving worldwide. It is yet to be effective in relation to low income family housing that is owner-organized and which uses traditional timber or block construction.

Disaster-resistant knowledge has evolved:

- From analogy, based on an examination of what types of dwellings fail and why.
- From the application of structural design theory originally developed to obtain resistance to disaster forces in industrialized countries where the materials used and construction relate to different technical standards, construction and supervisory capabilities.

Joining these forms of knowledge to that of the customary building processes of the disaster-hit community has its difficulties. The local processes have evolved under different circumstances and are often held intuitively by craftsmen, in a sequential, mythical way. This way of knowing is severely disturbed by the attempt to intrude knowledge that is different in kind. Recognition of this difficulty is important to the successful construction management of contractor-built elements of a site development project. It is highly significant to the success of the owner-managed stage of house completion or extension.

g. Continuity and Change in Construction Practices

A theme in project preparation and design will be the focus upon providing initially what disaster victim households could not provide, or very readily provide, for themselves. In relation to dwellings, this usually means land, water supply, sanitation and the technical supervision of a disaster-resistant, structurally-sound core or shell. Information-spreading and educational programs for key craftsmen and owners will be required as a component of any self-help program for the completion of core houses if they are not to be structurally weakened by additions made later.

h. Completion and Extension Through Time

Because of the complexity, administrative and technical costs of trying to manage and inspect the self-help completion of core houses, it is probably best not attempted. Alternative routes of achieving the same end should be explored. These will include consideration of the establishment of a technical advice center on the development site, linked to a materials distribution point if possible; the use of roving building completion demonstrators; the use of models of completed houses (sometimes a

failure in the past because of lack of local social/cultural knowledge by their designers); and use of training programs.

i. Innovations

The desire by project programmers to achieve rapid occupancy by victims of the development site has led in the past to consideration of innovative technical solutions. Experience shows that innovation in project administration, layout and phasing of contractor-built elements of the project and in phasing of occupancy of the site can contribute more to early settlement than attempts to innovate in construction. On the technical side, the introduction of disaster-resistant knowledge into traditional and conventional building processes is innovation enough. The importation of prefabricated structures can be expected to be expensive relative to improved conventional design. Such imports are often difficult to expand. A high proportion of what has to be done remains as an on-site process (i.e. foundation and "tie-in" work). This leads, when added to other factors, to a high unit cost for totally prefabricated solutions. (See also Chapters V and X).

2. Environment and Activity

The realities of the post-disaster situation will normally impose many constraints on the ability of the housing planner to respond fully to all of the underlying needs imposed by climate, site location and the social-cultural environment. It is important, however, that responsible officials make every attempt to recognize such factors to the fullest possible extent within their transition housing solutions. Among some of the most important are:

a. Climate

Climate is of interest to the housing designer at transition and permanent stages at four levels:

- Regional — the annual pattern plus the hazard region of rains and floods plus the expectancy of recurrent cyclonic storms.
- Local — the interaction of physical setting, land forms and settlement with climate.
- The climate close to the ground around buildings (i.e. induced breezes, shading through trees).
- Climate within buildings — influence of roof and wall thickness, position of openings, etc. on human comfort conditions.

The more the designer can exploit knowledge of the first two to modify the third so the more one can finally reduce the design effort and costs.

b. Place

Place or site location is of interest to the housing designer at four levels also:

- Regional — located on a gentle slope, in a flood plain, at the foot of mountains, near the sea. Every location will say something about safety relative to other regions in the face of rains and floods and the possibility of earthquakes and land slides in a prone region.

- Local — the density, spatial and visual pattern that existing buildings make will influence people's expectations of what new building work should be like.

- Ground conditions, soil bearing capacity, site drainage will influence use of the site.

- The layout and building placed on the site will change it from what it was before either positively extending its previous qualities or undermining them (i.e. either more or less pleasant to be on, more or less safe from the point of view of hazards than previously, better or worse drainage at the time of floods).

The more the designer can exploit knowledge of the first three, in order to act sensitively on the fourth, the more effective and more economical the result (Chapters III, IV and VIII).

c. Activity

Residential activity, together with the activities that it supports and support it, is of interest to the housing designer at four levels:

- Beyond the neighborhood or development site (i.e. work, marketing, cultural sites, transport).

- Within the neighborhood or development site (i.e. work, marketing, transport, water, sanitation).

- Between households in localized areas, groupings of lots and buildings, use of local communal open space.

- Within households or lots, clustering of buildings on lot, use of outdoor space, methods of cooking, place for sleeping, journeys for and storage of water, sanitation and culture.

Site development planning poses the incorporation of these factors into a total design in the context of climate and environment (Chapter IV). While these are all prime factors, local political, legal and administrative mores and standards will have a secondary but still significant influence on design decisions.

3. Social and Cultural

Activities can be seen and even measured, but the social and cultural environment, taken as a whole, provides the designer with an atmosphere more difficult to appraise than that of the physical atmosphere. The reasons why people behave the way they do, react to disaster in the way they do will be deep in the corporate mind of a people. This shared attitude, which is likely to underpin many personal and family variants, will also mold a people's view of change.

From the interaction of long-made appraisal of region, available materials, social patterns and beliefs have sprung such manifestations as:

- The grouping or clustering of rooms around a yard to form a home (Figure 2.1).
- Single isolated dwellings widely spread (Figure 2.2).
- Row houses alongside narrow paths up mountainsides.

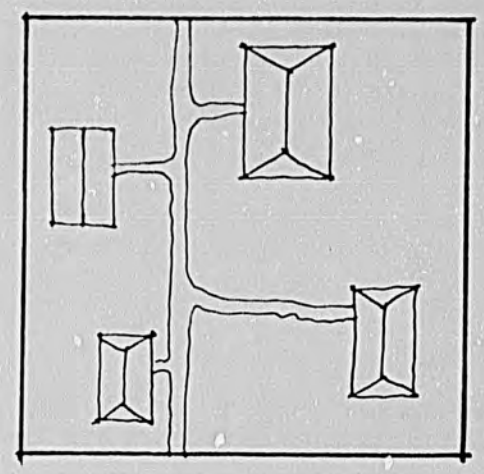

FIGURE 2.2
Comfort conditions in warm humid climates are obtained by inducing breezes under shaded roof areas so as to remove perspiration from the surface of the skin. The spread out pattern of houses that can result aligns well with the intention to achieve earthquake or cyclone resistant dwellings.

These patterns also reflect long held systems of land tenure and tenancy. Appraisal of such formative influences leads one to expect that house forms are signs and symbols as well as artifacts. Appreciation of this assists in understanding the reluctance of disaster victims to accept new forms unless they were moving toward their acceptance prior to disaster; as is sometimes the case with rural people newly settled in peri-urban areas.

4. Regional Characteristics

Regional "building" character is recognizable. It stems from building processes, settlement patterns and social and cultural mores interacting in a similar way throughout one large living space. It will change in parts of a region or throughout a region as change is embraced in any of the region's formative forces.

Traditional buildings and layouts of certain regions exhibit recognizable forms which offer clues to satisfactory solutions for day-to-day living. They may mislead as to the relevance to disaster situations, however. Where the period of recurrence of an earthquake, volcanic eruption or cyclone is long, then its threat may not be seen as

something to build against. It may even be categorized as "the will of the gods." Regional traditional design may therefore not be suited to disaster resistance without changes in disposition of dwellings one to another or in structural design and architectural detailing.

Recognizable regions from the point of view of a housing planner and designer are reviewed in Chapter IV.

5. Site Development Terms of Reference After Disaster

When the foregoing pointers are used to direct the design of Terms of Reference for a physical planning team, then some structuring parameters emerge:

a. Building Fabric

(i) Building materials. Needs to relate choice to past traditional usage, the possibility of upgrading material quality to ensure potential in disaster resistant construction, availability in time and on the scale required, availability of craft skill.

(ii) Building structure. Need to relate choice to pre-disaster usage, possibility of upgrading structural systems to perform in disaster situations, cost of doing so as against importing of new structural concepts (and so possibly new materials, techniques and contracting procedures).

(iii) Structural stability in the face of hazard. Achieving this results from a number of interacting factors:

- Choice of site and degree of risk or site.
- Avoidance of the usage of high risk areas on site.
  — avoiding poor bearing soil
  — avoiding earthquake faults
  — avoiding sections subject to land slide or below land slide areas
  — avoiding flood risk areas
  — exploiting natural assets such as slopes
- Separation of buildings and in earthquake prone areas of structural units within buildings.
- Appropriate structural and architectural design.
- Well-supervised quality construction.
- Well-guided house completion and extension under self-help program (i.e. poor extensions can weaken initial strong structure).

b. Activity and Environment

(i) The layout plan is to be seen as a means through which normal life can be recovered (not an emergency plan which modifies the emergency situation for decades to come).

(ii) Exploit geometrical clarity against or with the natural topography to create a sense of "place."

(iii) Exploiting man-made features such as long established footpaths to key in development into adjacent sites.

(iv) Develop layout ideas expressive of closeness (i.e. in hot dry regions) and to build to obtain mutual shade or apartness (i.e. in warm, humid regions) to encourage through breeze.

(v) Develop the layout three dimensionally through the juxtaposition of open and closed areas and clumped vegetation.

(vi) Forge an alliance between these positive themes and the necessity to use standardized lot sizes, land block sizes to facilitate quick and easy land surveying and simple and short utility lines.

(vii) Relate lot size and proportion to life style and house growth pattern of income groups and disaster hit families.

(viii) In house planning reflect the customary space usage of domestic life in and around dwellings and on the roof.

(ix) Consider the character of house extension and so locate a core unit that is safe and socially useful extensions are possible.

c. Society and Culture

(i) From contact with disaster victims absorb an appreciation of local family life.

(ii) Absorb an appreciation of social life — the interaction of persons and households.

(iii) The cultural pattern.

(iv) House image.

- traditional
- aspired to after the disaster and affordable

(v) Develop geometrical layouts that reflect or permit social and cultural patterns to prosper.

(vi) Arrange dwellings within land development blocks in groups around courts or precincts planned for communal use (Figure 4.11). The buildings then form walls to outdoor rooms in which community play and work may prosper. Place making this possible on what

would otherwise be flat area (with endless rows of single storey units).

(vii) Consider symbolism in the positioning of community buildings and in the relationship between lots (i.e. small lots located in the less desirable locations imply something about status of occupiers). Alternatively, all lots in locations that have some merit, or an advantage in access or size, says something about equality.

These shaping parameters are listed above in approximate order from the solid and material through the abstract to the spiritual. In design work decisions, all are drawn on at one and the same time. A cultural attitude can influence building orientation or the choice of walling material. A structural choice for a core house may determine whether or not a family can safely extend using traditional materials they have readily on hand (Figure 2.3.)

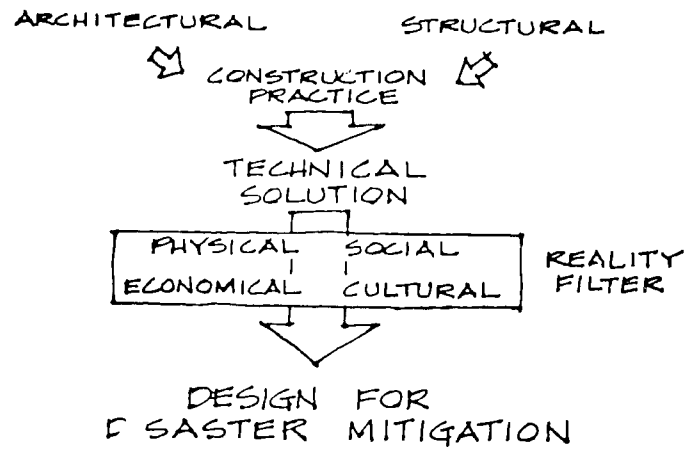

FIGURE 2.3
The context of technical decision. Technical decisions can lead to appropriate post-disaster solutions when they are integrated into the wider setting of human aspiration. Social and economic reality offers a restraint on technical ingenuity.

D. PEOPLE AND ORGANIZATIONS

In disaster relief emergency housing, there is little time to think of anything but basic cover from rain and hot sun. However, at the transition stage in a project that is to serve for generations to come, long-term issues of liveability are of concern.

1. Sources of Information: Local Housing Practices

The normal habitat and settlement patterns of most of the people is not a much studied subject in any country. The designer's need is not for prime sources but for secondary and for distilled knowledge to which he can reach. Most countries have one or

two academics or professionals who have privately assembled data, drawings and sketches of traditional buildings and/or methods of strengthening them or developing a new design approach in the face of newly perceived regional needs. Such rare individuals can be tracked down through telephone calls to University Departments of Architecture, Social Studies, Geography and to national professional institutes of architects or engineers.

Government executive departments in rural development may offer useful contacts or lead to the name of a particular field officer with an understanding beyond the confines of his daily job. Government departments of housing and urban development ought to be able to offer leads although the education of their administrative officers and technical staff overseas, or under the influence of overseas programs, has frequently cut such people off from the local formative roots of the building process.

E. POTENTIAL ROLES FOR AID

1. Assembly of Knowledge

Pre-disaster work ensures that the OFDA Country Profile is extended to include knowledge of the building process, settlement environment and social, cultural factors that influence dwelling form.

2. Assist in Basic Studies

Where a region is short of knowledge on traditional/customary housing, AID could commission studies of materials, origins and points of change.

3. Assistance in Project Preparation

Specifically to advocate the use of a three-sided knowledge base for project preparation:

- Analysis of disaster and post-disaster needs.
- Customary ways and processes.
- Accelerated program techniques.

4. Information Sharing

Publish findings locally in forms useful to designers and owner-builders.

F. LESSONS LEARNED

1. Preparedness Studies

The more prepared the Mission is with basic data that relates to the mass of the people at risk in disaster the more relevant the post-disaster projects can be.

2. Pace of Change

Change is not normally welcomed unless the benefits it is claimed it will bring are clearly an improvement over past practice and experience. Change is accepted or rejected by individuals in community. This is an important realization.

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PART II

TECHNICAL ISSUES

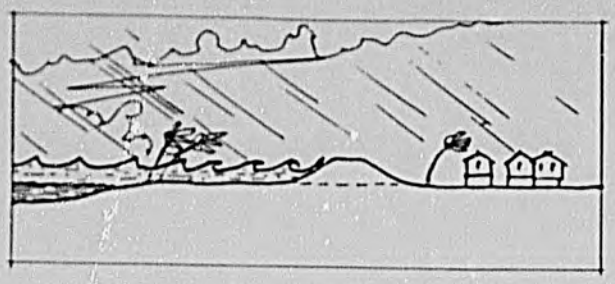

FIGURE 6.2: Embankment to protect project area from cyclone storm surge and wave uprush. Rocks placed on the seaward side of the embankment help break wave strength.

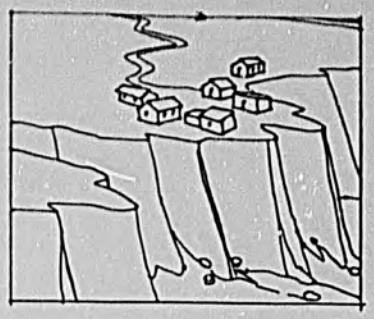

FIGURE 3.1: Locations to avoid: (i) the tops of cliffs for earthquake and landslip risks can be high.

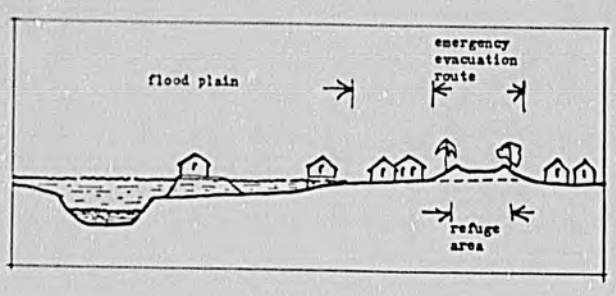

FIGURE 3.2: Locations to avoid: (ii) the bottom of cliffs and mountain slopes for earthquake and landslip risks can be high.

CHAPTER III
LAND SELECTION AND ACQUISITION

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CHAPTER III

LAND SELECTION AND ACQUISITION

A. ORIENTATION

Land acquisition is one of the most crucial aspects of a reconstruction program.

Typically, disasters increase land problems and certain types of disasters and their related effects reduce the amount of developed land available for housing. In these cases, new, safer sites will need to be developed to resettle disaster victims.

Risks for the future occupants of low income family shelter can be reduced in earthquake, cyclone and flood prone areas by recognizing and avoiding locations that are most exposed to risk.

Within project sites, and particularly on the larger developments, some areas will be less at risk than others and some will cost less to develop than others. Where these two categories overlap indicates possibilities for the locale of the first stages of site development and so the first stage of phased occupancy by victim families.

Experience has shown that the three key post-disaster land issues are:

- Land ownership or long-term tenure.
- Safety and location.
- Access to replacement sites.

1. Land Ownership

Land ownership or long-term tenure affects reconstruction plans in two ways. First, without tenure, people will be hesitant to contribute time or money to reconstruction efforts and will expect the reconstruction agency to provide all sites, services and a complete replacement house. Second, the provision of new land or opportunities for people to purchase land can be an effective stimulant to reconstruction, thereby reducing the time of recovery and providing leverage by which safer housing can be ensured.

2. Safety

The issue of safety is a prime consideration in reconstruction planning. Even if people own the land, they may be reluctant to rebuild if a continuing threat is perceived. It is therefore important that before land is acquired, the sites be analyzed to determine their vulnerability and suitability for habitation.

3. Location and Access

The location of the site and its proximity to the occupants workplace is another important consideration. Many resettlement schemes have failed because people did not

have easy access to their places of employment or because services to the sites could not be quickly and economically provided.

B. KEY ISSUES

1. Sites

In acquiring sites for a conventional housing project, there are three main objectives: the selection of safe sites, sites having developable topography, and selection of sites relatively close to places of employment. The following points are to be considered in making a preliminary reconnaissance of a site option:

- Access to water, including water for the construction stage.
- Access to services.
- Access to communication links (i.e. affordable truck, bus and rail fares).
- Access to and integration with adjacent neighborhoods.
- Participation in the generalized pattern of settlement cultural and religious sites, district hospitals, recreation lands.

The general social acceptability of sites will contribute greatly to their long-term success as components of the overall settlement pattern. Unless supported by service at locally-acceptable levels, then even if offered immediately after a disaster, they may well flounder, as the reconstruction period turns into the developmental one and the developmental into the normal.

At the national government level, acceptability has to be found for sites within the governmental administration. This may not be readily forthcoming if it is now proposed to give title to low income families who pre-disaster were not owners of land.

The AID Mission can assist national and local government agencies in the effectiveness of their site selection activity by advising on importance of keeping wider developmental issues in mind in order to enable project success in the long- as well as short-term. More specific advice to officials on how to avoid selecting sites of high risk can also be offered in accord with the following guidelines.

C. SELECTION OF SITES

Points to note with reference to particular risks include:

1. Earthquake

(a) Use as information brief all available data on disposition of faulting and of spread of poor bearing soils and unrestrained sands.

(b) Prefer relatively flat sites but avoid narrow ridges, steep slopes, narrow valleys and sites near cliffs or large gullies, i.e. within 150 meters (Figures 3.1 and 3.2).

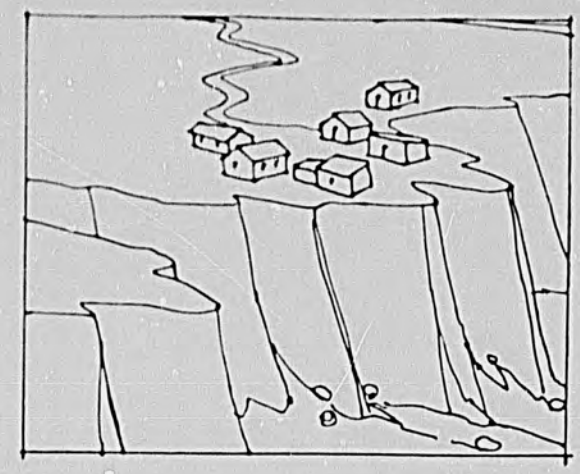

FIGURE 3.1
Locations to avoid. Earthquake and landslip risks can be high on cliff-top location.

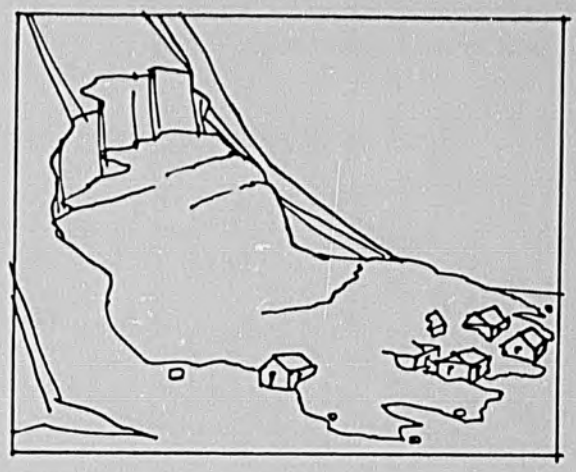

FIGURE 3.2
Locations to avoid. The bottom of cliffs and mountain slopes for earthquake and landslip risks can be high.

(c) Prefer sites with hard bedrock at or near the surface.

(d) Prefer sites where landslips are unknown in immediate area.

(e) Prefer sites where there is no sign of active faulting and avoid offset rock layers, rows of ponds or swamps and deep or long cracks in ground (Figure 3.3).

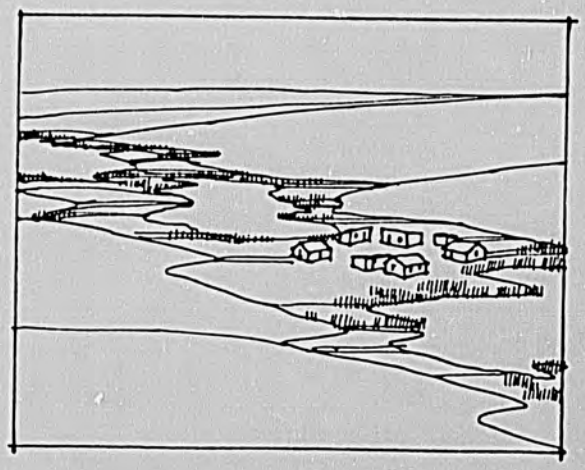

FIGURE 3.3
Locations to avoid. The faulted areas in earthquake prone areas that are often indicated by rows of ponds in marshy ground between buildable sloping or plateau land.

2. Volcanos

On the assumption that a volcano will blow through its top vent, it is possible to plot or map expected routes of lava and mud flows. However, this preparedness may be overtaken by the surprise of an eruption out of the side of the core.

3. Cyclones, Hurricanes, Typhoons

(a) Cyclones, hurricanes, and typhoons are often accompanied or followed by heavy rains. Prefer land away from seacoast, flood plains and lakesides.

(b) Establish expected flood or surge sea heights.

(c) Analyze interaction between the existing or proposed built-up urban area, natural land form and the new proposed site development.

(d) Flooding risks to be avoided:

- Low elevation relative to the sea, lagoon, river or surrounding land.
- Lack of sufficient natural outlet to discharge the volume of water or manmade blockages or restrictions at the outlet.
- Underdesign of capacity of surface water drainage systems.
- Increased planned and unplanned development which causes existing drainage systems to become overloaded.
- Watch for conditions outside design areas:
  - upstream development such as irrigation or deforestation that may generate the delivery of more surface water into project area
  - diversion of upstream drainage into downstream catchment areas causing overloading of drainage channels adjacent to project site
  - new building at the foot of slopes receiving direct surface run-off which will spill either side and cause erosion

(e) Wind risks:

- Degree of exposure and orientation of buildings related to construction quality.
- Location of type, age and stability of major tree growth in relation to buildings and important access roads.

4. Tsunami

These seawaves induced by undersea earthquakes are a danger to certain seaboard communities. Low income families are particularly vulnerable if living close to the beach and their residential areas are best located well away from the invasion paths of the tsunami waves. These can be mapped by analysis of past damage plotted upon contoured maps. The preparation of such risk maps is a preparedness activity prior to disaster.

5. Landslip

Use as briefing all available data on disposition of risk areas. Landslips can be associated with heavy rains or earthquakes but local geographical conditions indicate severity of the risk (Figure 3.2).

(a) Map if not already undertaken landslip risks in the area of your concern.

(b) Plot and compare against known fault lines if in earthquake area.

(c) Look for areas subject to slip and at the foot of steep slopes where slips and rockfalls are a possible danger.

(d) Appraise earthquake effects or effects after rains pertinent to last disaster.

(e) Accept that landslip warning maps will differ before and after a disaster and will need updating. Streams may be dammed, roads swept away, sites at one time free from risk may now have debris of landslips poised to fall at the next heavy rains or tremor.

6. Soil Heave

Avoid expansive clays particularly black cotton soil. The heave can cause dramatic cracking in light single storey structures and sometimes does not take place for two or three years after initial construction.

7. Flood

(a) Avoid low lying coastal areas, wetlands and sandbars at lagoon mouths.

(b) Avoid edges of inland lakes.

(c) Avoid floodplains and particularly the floodway.

(d) Avoid tight settlements in narrow defiles upriver.

(e) Avoid downstream banks and floodways below dams and particularly in earthquake areas.

(f) Avoid high water table areas.

(g) Accept that if such areas have to be used then protective measures such as channelization, ponding areas, floodwalls, etc. will be required to reduce the level of risk. At the lowest of prevention levels it will be necessary to prepare escape routes at high level and well above early water heights. The cost of undertaking these measures is likely to rule out the use of a particular site for low income family occupancy.

In addition, the following can prove important:

(a) Land parcel assembly. Consider the use of sites smaller than usually considered. Where larger sites are to be acquired, coordinate the phasing of development with acquisition of land parcels so that construction can start before all parcels are obtained. Strive to obtain access to the most developable areas first.

(b) Construction forward programming.

- Site selection:
  - consider ease of access for trucks, plant, workers
  - consider closeness of water for construction purposes
  - consider favorably sites with little or no off-site infrastructure needs
  - consider favorably sites with high proportion of usable building land

Post-disaster redevelopment of urban areas is a highly debated issue. Some cities have bulldozed large sections of a community and attempted to rebuild in a completely new fashion. While there have been some successes, such attempts have usually failed. Problems of land ownership make condemnation necessary to acquire the land, usually delaying the program to a point where full implementation becomes almost impossible. Thus, in a post-disaster environment where rapid construction of replacement housing is desirable, planning to acquire and develop land obtained through clearance activities should be avoided.

D. LAND COSTS FOLLOWING DISASTERS

Each type of natural disaster has its own particular effect on land values and this in turn affects acquisition timing and cost.

1. Earthquakes

After an earthquake there is a tendency for land values to rise not only in urban and marginal areas but also in the agricultural areas. This is probably due to a combination of scarcity factors, appraisal of the degree of risk on an earthquake happening again in the same place and desire of those with funds to exploit the unusual land market to find new locations.

2. Volcanos

Land values generally decline following the eruption of a volcano. Agricultural land will lose more value on average than urban land, especially if ash fallout is extensive.

3. Cyclonic Storms

Cyclonic storms have two associated damage-causing phenomena -- high winds and flooding. Both can destroy buildings and other manmade structures, as well as crops, but it is the flooding that alters the land and changes its value.

Land values following cyclones vary depending on the type and extent of damage. If a storm surge has struck, the value of the land inundated usually declines, more so if salt deposits remain. Beachfront property also declines in value in both urban and rural areas. Sites which proved safe (i.e. above the flood level) or which were protected from high winds by hills or manmade structures will usually increase in value. Overall, however, land values generally decline.

4. Floods

Floods caused by heavy rainfall can destroy crops and damage human settlements and housing, but in most cases the effects are only temporary. Agricultural land subject to flooding is often the best for agriculture, as flooding is a means of replenishing the nutrients in the soil. Thus, in rural areas, the flooding may have little effect on land value.

In urban areas, flood plains are usually considered undesirable for housing and other types of development. Therefore, the land will have less value than other sites. If embankments or other flood control measures are taken, urban sites previously subject to flooding will increase in value. If the areas are situated near navigable streams, control of flooding will often alter development patterns along the banks as access would make areas more suitable for commercial or industrial development. Thus, land prices could rise beyond levels acceptable for housing projects.

E. LAND DEVELOPMENT TRENDS FOLLOWING DISASTERS

Disasters can dramatically affect human settlement patterns. Typically, they increase land problems. Following a disaster, it is usually obvious that the persons disproportionately affected are those living on poor sites and political action will soon mount to provide suitable sites for those made homeless and landless by the disasters, as well as for those still living in areas vulnerable to secondary disasters. Signs of the pressures for action are land invasions, political demonstrations and increased land acquisition activities by humanitarian organizations.

In rural areas, economic hardships caused by a disaster often so adversely affect marginal farmers and small commercial enterprises that these activities are forced to cease. When this occurs, many families choose to move to urban areas to seek employment. This can add a sudden new wave of migration to already overcrowded and expanding urban centers.

If the disaster has affected the urban areas, commercial and industrial reconstruction demands may prompt a further increase in migration to the urban area. Increased salaries and job opportunities will attract many newcomers to the city from smaller, outlying towns, as well as from the rural areas.

For the planner of a conventional housing project, this trend in migration has implications for the land acquisition program in that the newcomers will compete for sites and services and land values will undoubtedly increase.

F. SITE STRATEGIES

Following a disaster, a site strategy must be developed by the program planner to ensure that the land acquired can be obtained rapidly and that disaster victims, the intended recipients, are sheltered until the project is ready for occupancy.

In general, there are three situations for which strategies should be developed.

1. Temporary Residence Off-Site

If sites are not immediately available, some actions must be taken to provide temporary shelter for those people who will be moving to the site. Normally, shelter can be provided by the immediate family, the extended family or friends. However, a small portion may have to be housed temporarily on public or semi-public sites. Examples of temporary locations are churches, schools, warehouses and temporary camps.

As a general rule, temporary camps should not be set up except in the following situations:

- Volcanic eruptions.
- During standing floods.
- During other types of natural disasters where land cannot be reoccupied due to a continuing threat.

If it is decided that a temporary camp must be established, it is important to develop the temporary site in a manner which will not prevent its becoming permanent. Sites chosen may be land on or adjacent to governmental facilities, land which is clearly not suitable for development of housing, such as industrial sites, parks or plots of land where the density created would make permanent settlement unattractive. (These criteria should not insinuate that a temporary camp should be designed and built as an unpleasant place to live, only that it should be designed to discourage permanence.)

2. Temporary On-Site Occupancy

Once a site has been selected, it may be desirable to begin relocation of disaster victims to the site or to portions of the site as quickly as possible, even if land acquisition is not complete. In a post-disaster situation, occupancy prior to complete land acquisition may be permitted or arranged under the following circumstances.

a. Provision of Legal Tenure to the Occupants

In many societies, land may be occupied under special tenure relationships pending the sale of land. For example, in certain Latin American societies, land tenure may be granted under a legal agreement which allows a homeowner to build on the land and occupy the site, but restrict the resale of the property to the original owner until such time as the land has been purchased from the owner by the occupant.

b. Lease Purchase Arrangements

In those countries where land sales may take an excessive amount of time, it may be possible to draw up an agreement allowing the site to be occupied on a lease purchase basis. The occupant would lease the land from the landowner until the land was sold. Payments made as part of the lease agreement would contribute towards the final purchase price.

c. Certificate of Occupancy

This arrangement may be used where the landowner has agreed to sell and a price has been arranged but the actual sale is delayed by legal procedures. Under this arrangement, a separate legal agreement is drawn up between the project holder and the landowner in which the terms of the sale are agreed upon and become binding. Under the agreement, the landowner agrees to allow immediate occupation of the site and to issue a certificate of occupancy to each prospective landowner, which allows the family to occupy the site and begin construction.

d. Commitment to Binding Arbitration

In cases where a landowner has consented to sell the land for the project, but there is a failure of all parties to agree on the purchase price, it may be possible to formalize an agreement that will allow occupation while negotiations are being concluded. To do this, all the parties enter into an agreement wherein the land will be sold at a price determined by binding third party arbitration. The agreement permits early occupation and separates occupancy from the actual land purchase.

3. Rapid Land Acquisition Strategies

The following strategies should be considered in order to acquire land rapidly for housing reconstruction programs.

a. Seek Public or Government Held Lands

Often, the fastest means of obtaining land is to have the government cede public lands to the project implementing agency. Strategies such as land swaps between government agencies can also be useful.

b. Avoid Condemnation Proceedings

As a general strategy, project agencies should be encouraged to purchase land outright rather than use land condemnation proceedings. Land sales are usually much quicker than condemnation, especially if more than one landowner is involved.

c. Early Acquisition

Land acquisition proceedings should be initiated as soon as the sites have been identified. Following a disaster, urban land values can be expected to increase dramatically. The earlier that land acquisition proceedings are initiated and concluded, the cheaper the price, and the less time the proceedings will normally take.

d. Land Swaps

In many cases, landowners may be reluctant to dispose of their property for fear of losing a valuable asset or an opportunity. If the landowner wishes to continue to own an equivalent portion of land, land swaps may be arranged. In a land swap, the person giving up the land will normally be provided an equivalent amount or an increased amount of land in another location in return for the site desired.

e. Use of Bonds

In many cases, land acquisition is delayed due to inavailability of immediate funds. In these cases, it is often possible to provide the land holder with an alternative form of payment until such time that the money is appropriated. The usual manner chosen is by providing interest-bearing government bonds to the landowner to hold until such time as the final payment is effected. During the period he holds the bond, any interest accrued is given to the landowner.

G. PEOPLE AND ORGANIZATIONS

1. Site Selection

This will generally be the responsibility of national or local government officials and professionals from such bodies as:

- Ministry of Lands.
- Department of Lands.
- Department of Irrigation.
- Ministry of Housing.
- Specific housing agencies.

Various pressures arise between administrators, engineers and surveyors when appraising land for its suitability for housing use, safety during disaster, etc.

2. Site Acquisition

Once selected technically, there can often be lengthy delays as questions of timing of purchase (or timing of transfer of use from one government department to another) are debated. Where agricultural land is being purchased at the urban perimeters, delays can arise over matters of:

- Failure to agree on price and the going to arbitration on a fair price.
- Compensation appraisals and rates where the farmer seller requires this on current and the coming year crop.
- Differences of view over planning low and formally adopted urban district plans.
- Allowing time (such as three months) set out under compulsary purchase land low or in planning acts for objectors to put forward their views.

Concerned agencies include such as:

- Ministry of Finance.
- Ministry of Economic Development.
- Ministry of Housing.
- Ministry of Local Government.
- Specific housing agencies.

H. POTENTIAL ROLES FOR AID

1. Technical Assistance

Facilitating site selection by assisting in hazard analysis through technical assistance if necessary and in soil tests and possibly in land surveying.

2. Administrative and Financial Assistance

Assistance may be required in legal matters, title search, title insurance and in developing opportunities offered in a general way by investment banks.

I. LESSONS LEARNED

(1) The longer land acquisition takes the greater the eventual cost of purchase and so the less likely that low income potential beneficiaries can participate.

(2) The longer acquisition takes the more likely the victims will find other solutions to their problem.

(3) The development of a project concept using "early occupancy" locks in the beneficiaries to the project; even perhaps prior to being able to offer clear title.

(4) Someone else always has an alternative plan for your selected site.

(5) Land registration and offer of title to lot purchasers is a key to success and possibly of early completion of core houses.

(6) May be necessary to write down the cost of land or cross-subsidy through middle income elements assisting the very poor if project access for very poor is to be made possible.

(7) In physical terms a well-timed water supply/sanitation provision is a key to community success on new urban land.

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CHAPTER IV
SITE DEVELOPMENT

A. ORIENTATION

B. KEY ISSUES
1. People and Places
2. Obtaining Access to Selected Site
3. Survey of Plan
4. Temporary Occupancy and Impacts on Development Strategy
5. Need for Rapid Development Approach that Unites Temporary Occupancy and Early Permanent Occupancy of Site
6. Need to Lay Down Parameters of Fast Track Approach

C. KEY CONCEPTS
1. Unified Approach
2. Integrated Project
3. Standards
4. Lot Size
5. Siting
7. The Layout Plan
8. Utilities and Services
9. Characteristic Regional Variations
10. Phasing of Construction and Planning to Implement Occupancy Stage 1 of Physical Standards Evolutionary Program
11. Phasing of Occupancy
12. Implementation of Infrastructure Generally

D. PEOPLE AND ORGANIZATIONS

E. POTENTIAL ROLES FOR AID
1. Information Sharing
2. Technical Assistance
3. Equipment Supply
4. Training

F. LESSONS LEARNED

G. REFERENCES

CHAPTER IV

SITE DEVELOPMENT

A. ORIENTATION

The conventional low income housing project presents a lengthy programming and planning sequence even after land acquisition (or access to land to development) is completed. Undertaking the needed work under post-disaster conditions is both simplified and complicated. Simplified because it is often posssible to get quick decision taking in emergency situations. Complicated because there is a need to allow families to settle on site at the earliest possible stage. This means in practice prior to the completion of road, utility and house construction. Achieving this early occupancy without excessive administrative complexity, too great increase in building contractor costs, and too much inconvenience to disaster victims is the challenge and purpose of accelerated site development. This leads to a revised or fast track version of the conventional housing project.

B. KEY ISSUES

As stressed in Chapter II, these remain the same as in more normal times despite and because of the impact of the disaster on households.

1. People and Place

a. Impact of Victims Needs

- Immediate shelter needs.
- Medium term (i.e. health and safety).
- Long term (i.e. appropriate for way of life).

b. Recognition of Local and Regional Characteristics

- Climate.
- Human response:
  - ways of living
  - forms of shelter
- Disaster types:
  - frequency
  - degree of risk to specific settlements

2. Obtaining Access to Selected Site

However accelerated the site acquisition process, it will be necessary to gain access for survey work, cross checking of aerial photos prior to finalization. Agreement to this should form part of early stage of acquisition process. It is essential if use of the site is to be made in part for transition housing (Figure 9.4).

3. Survey and Plan

Initial work should be to establish rapidly the location and areas of the most early developable and safe parcels of land within the boundaries of the selected site. From this initial planning of layouts, feeder or artery roads can commence (Figure 9.4).

4. Temporary Occupancy and Impacts on Development Strategy

A conventional site development on new lands takes too long to prepare and implement even when accelerated on a fast track administrative and technical process for it to form a large part of transition shelter program after a disaster. However, there are good reasons why the land upon which the permanent community is to be housed should be used at least in part for transition shelter of some of those families who will later be eligible for entry to the permanent scheme.

(a) It focuses people on the particular site as being the location from which they are to reorder their work, commercial and educational lives.

(b) It ensures that disaster victims are retained as project beneficiaries.

(c) Where it is possible to let site clearance operations, ditch digging, rock aggregate collection to day labor it means that future residents of the permanent community are offered work and income.

5. Need for Rapid Development Approach that Unites Temporary Occupancy and Early Permanent Occupancy of Site

The need for rapidity leads to the choice of a "rough cut" method of planning that allows for correction and realignment retrospectively while working on-site. Acceptance of such a way of working entails the acceptance of higher final costs of physical development but does mean earlier use of acquired land and earlier repayments from beneficiaries. It also makes it possible to meet the transitional occupancy need for early permanent occupancy.

6. Need to Lay Down Parameters of Fast Track Approach

(a) Early agreement on standards of development has to be achieved (Table 4.1).

(b) Need to conceptualize layout task is a threefold one:

- Grouping of lots.
- Arrangement of groups in blocks.

- Disposition of the blocks over the developable areas of the site to form a neighborhood pattern, once combined with access roads, paths and community facilities.

(c) Need to combine the physical planning work with the conceptualizing of the stages of construction, construction management capabilities, and a phased occupancy program that sees early occupancy of the most readily developable and safe areas of the site.

(d) Within this context, temporary camp occupancy (transitional use) within the site should be directed to future open space areas (mainly areas difficult to develop) or to areas later to be used for commercial development.

C. KEY CONCEPTS

1. Unified Approach

This is the key concept in which the main design tasks are brought into one unified approach to site development (see also Chapter IX). This being conceived as a process that incorporates temporary or transitional occupation, early occupancy on permanent lots and a staged evolution towards stated standards. The key issues (Section B above) form the design brief for the needed site development strategy; the forming of which will be an early task of the project site development committee. (See also Chapter X.)

2. Integrated Project

This term is used here to imply that there will be more than one target income group among the disaster victims. There will, therefore, be more than one entry point in the housing project, a typical range being:

(a) Middle Class. Capable of purchasing a lot with all service connections together with a completed house or a privately-built house.

(b) Moderate Income. Capable of purchasing a lot with all service connections and a core (or shell unit) with one or two rooms.

(c) Low Income. Capable of purchasing site, all service connections and a serviced core. House to be completed with self-help and/or the traditional building process.

(d) Very Low Income. Capable of purchasing site with service connections. House to be built with self-help and/or traditional building process.

3. Standards

Some standards will probably be embodied in national or agency regulations. Some standards will have their origin in the requirements of previous lending organizations; and some be set by AID. Such standards may relate to choice of sanitation, permanency of materials or road widths. Other standards will come from the assessment of disaster risks or the necessity to provide emergency routes (see Table 4.1).

Bringing these standards together to provide a unified set, as a basis for planner and designer, will be an early task of any site development committee. If this can be done for a program then this is more effective. If it can be done in company with a sub-committee of a National Reconstruction Committee, then more effective still. Uniformity of applied standards for particular income groups is a strong element in popular program acceptance.

The agreeing of standards in committee is difficult. Some members will seek to maintain basic minimum health and family security. Others will argue for the highest international standards. Others will seek middle ways in order to reach an affordable compromise.

Reconciliation comes through the general acceptance that standards have to be seen in an evolutionary light. The main standard is to see that nothing is done initially that will stop the highest standards being reached eventually that any community can afford.

4. Lot Size

This is a key element in urban and peri-urban schemes. If the families traditionally expect to grow food on their urban plots then this will influence planning provision. If this is not the custom then smaller plots may suffice providing that they are not that small that it is impossible to extend the house in traditional ways. In regions where it is traditional to build up to plot boundaries so that one building becomes contiguous with another then smaller plots will suffice possibly than where houses are traditionally placed centrally on a plot. The practice of building so that one dwelling abuts another, however, is not recommended for earthquake prone regions (see, however, Figure 4.8).

Terrace, row or barracks housing is still built in some countries where cyclones are expected. This practice cannot be recommended where there are to be occupier made additions to the row units. In theory and in optimism, it is possible to postulate a post-disaster world in which the whole population understands the need not to damage an existing structure when adding on and not to add on a non-disaster resistant structure to an original proofed unit. In practice, however, non-disaster proof additions have regretably to be expected. When added on to a row house, they become a danger not only to that house but to the adjacent ones also.

Except where construction is engineered and engineer supervised, it is not possible to assume that it will be safe for households to expand houses vertically above one storey in earthquake and cyclone areas. Ground storey construction will be made unsafe trying to carry the weight of a perhaps poorly connected second floor during high wind loadings or ground movement.

5. Siting of Core Houses

Experience indicates that the core approach is most usefully related to square type lots. In warm humid climates, the square lot gives room for a free standing house which is both climatically desirable and socially often preferred in such areas. Because duplex or semi-detached division walls are avoided, the risk of fire spread or the collapse of one house during an earthquake leading to the collapse of another is also avoided. In hot dry climates, the square type lot lends itself to the development of courtyard type dwellings and layouts which have social, cultural advantages (see Figure 2.1). Traditional approaches to courtyard layouts need some modification in earthquake prone areas (Figure 4.8).

The placing or siting of the services core unit on the serviced lot is of significance. Side or back locations are often preferable to the front position (although the front position may appear to offer economies in service lengths if services come from alongside the road reservation). The rear and side positions offer most adaptability for house expansion. Single utility core units or semi-detached units are to be preferred on house expansion grounds over the grouping of four sanitary cores at the lot boundary meeting point. Although to do the latter may be initially cheaper, it reduces considerably the adaptability of the lot to the requirements of the household. The overriding criteria being within the cost framework adopted, maximum opportunity should be offered the disaster hit family.

6. Building Completion and Further Extension

The core approach is well-established as being one of the possible approaches to bringing improved housing to low income groups in developing countries. It retains its advantages, socially and culturally, in disaster prone areas, but does introduce problems of structural risk which need AID project attention. Both earthquake and cyclone resistance depend upon wholeness of building action in which the building acts as one unit and not as a loose assembly of pieces. The continuity and rigidity of construction that is so required is difficult to ensure when the completion of core structures and their physical expansion over a larger plan area is undertaken without technical supervision. Suggestions for advising home expanders on what to do are given in Figures 4.1 to 4.8 and Figure 7.3.

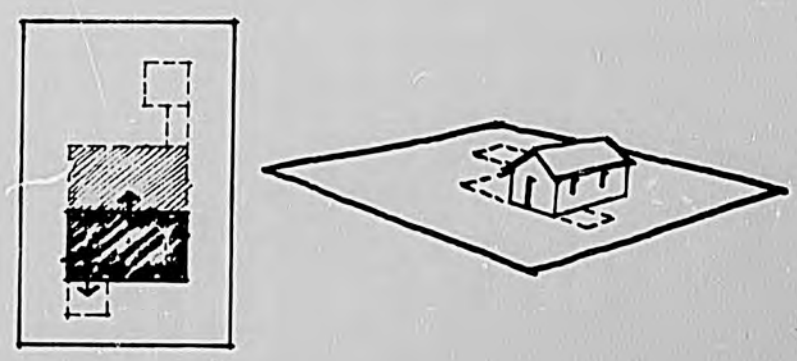


FIGURE 4.1
Cyclone prone areas: discipline for safe development of rectangular lot. This permits free flow of air for cooling in the normally humid atmosphere and avoids building up to adjacent dwellings. In this approach, extension and original core house are united structurally to act as one.

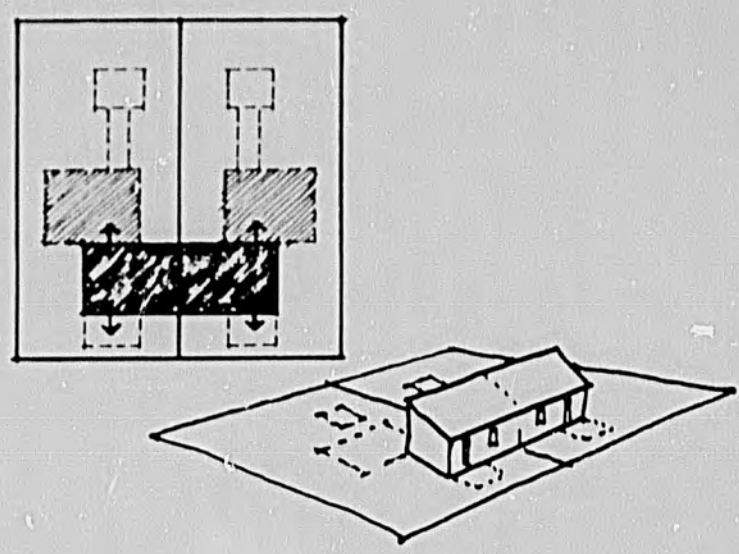


FIGURE 4.2
Cyclone prone areas: semi-detached (duplex) core houses, discipline for safe development of rectangular lots. The original semi-detached pair are designed as one structural unit. Expansion units are designed to be structurally integral with original or deliberately made structurally separate and sound.

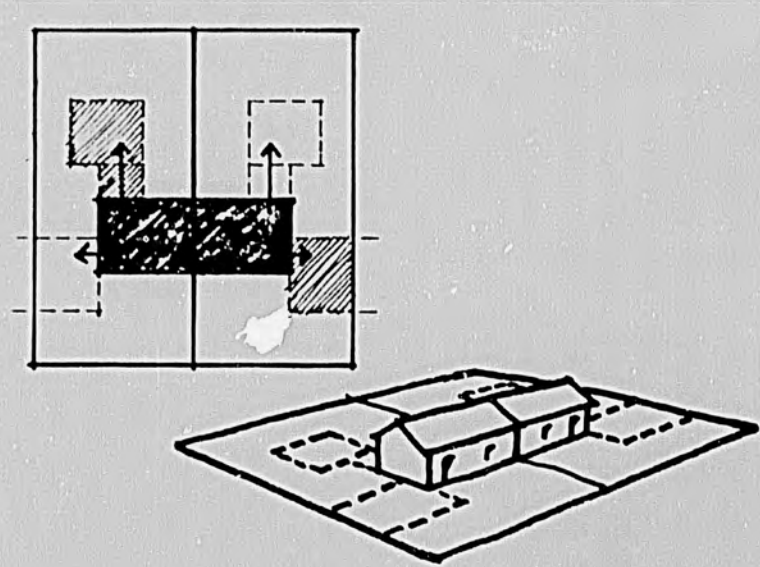


FIGURE 4.3
Cyclone prone areas: semi-detached core houses, discipline for safe development into row housing. Extension units to rear of lots may be structurally integral to original or structurally separate. Expansion areas to side lot boundaries should be structurally separated from the abutting neighbor.

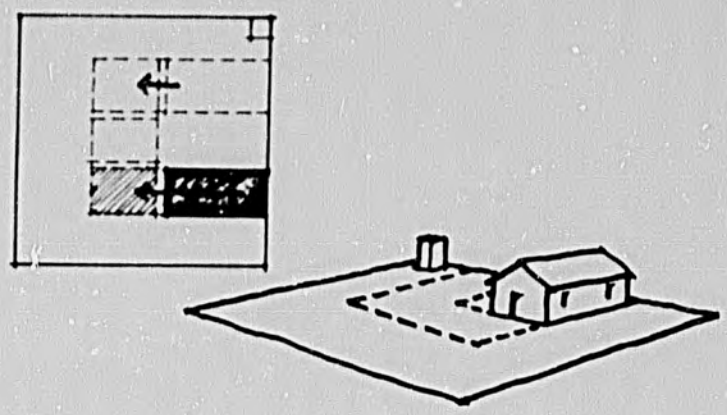


FIGURE 4.4
Earthquake prone areas: disciplines for the safe development of square lots.Occupiers are only permitted to build up to one yard wall which in any particular layout block (i.e. square hectare) must be to the same side of every lot so as to achieve separation of building clusters when house expansion is complete. Note "crush" sections between units. Realization would be through owner education and community social control.

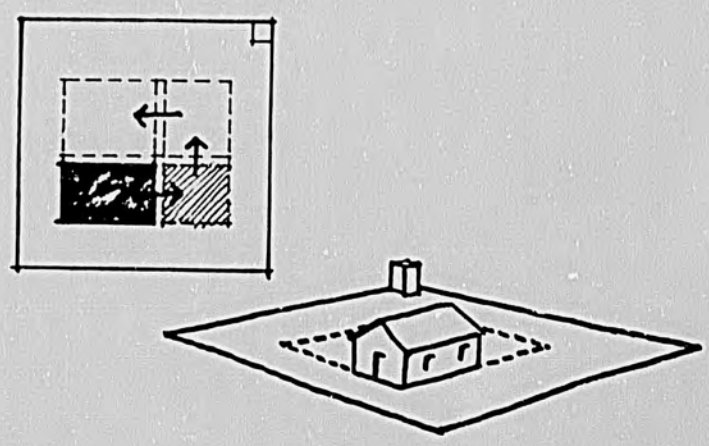


FIGURE 4.5
Earthquake prone areas: disciplines for the safe development of square lots. Occupiers are not permitted to build up to any boundary. Note "crush" section between units.

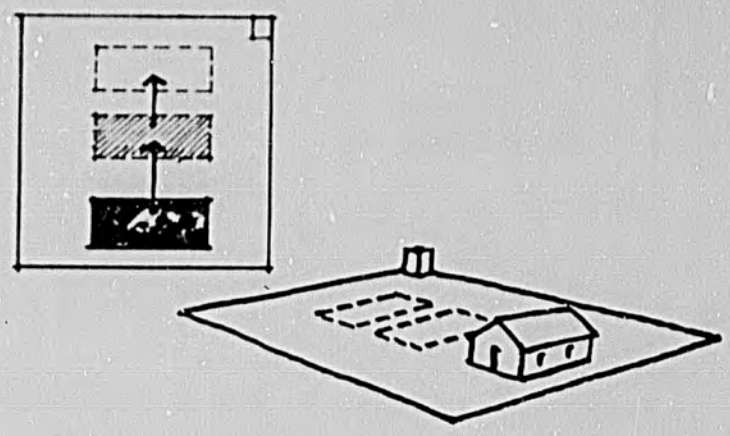


FIGURE 4.6
Earthquake prone areas: disciplines for the safe development of a square lot. Occupiers are encouraged to extend house area through repeating the original core unit. This approach may be suited to areas where the quality of building material is low. Covered ways formed from corrugated sheets can link the separate units.

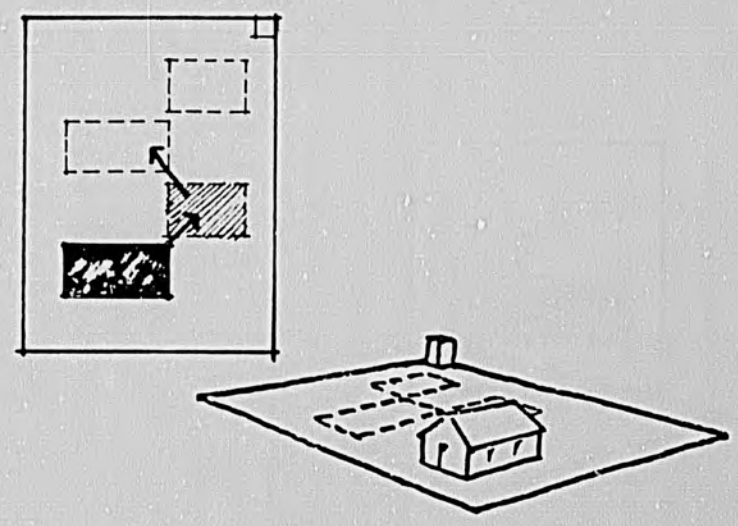


FIGURE 4.7
Earthquake prone areas: discipline for the safe development of a rectangular lot. The separated units of house expansion define outdoor living areas for male and female groupings and for cooking.

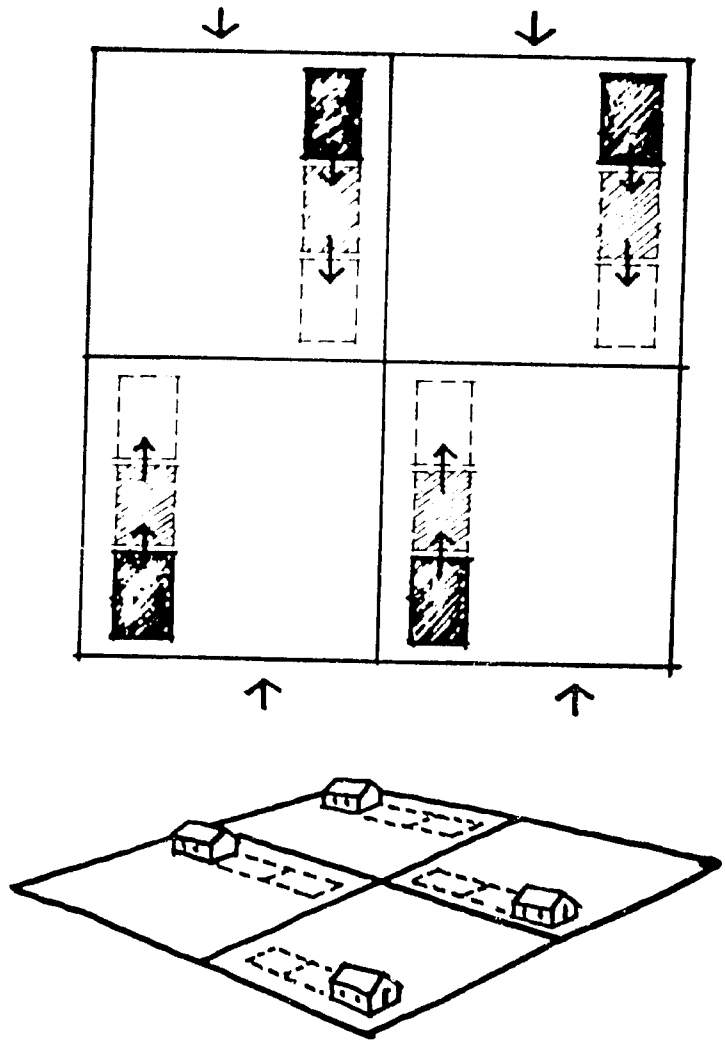


FIGURE 4.8
Courtyard type housing in earthquake prone areas: the need for the separation of structural units. If core houses are located as shown and house expansion is guided and limited as indicated, then this version of yard housing may be permitted in earthquake prone areas. There should be a "crush" section between each unit of house expansion.

7. The Layout Plan

The layout plan is precipitated by disaster but will form the long-term living environment long after the memory of the disaster has faded. The layout planner has therefore to consider all aspects that bear upon community neighborhood planning while following the thrust of rapid site development. Four themes can be said to orchestrate early work in site layout:

a. Site Topography

The probability is that knowledge of this will be far from complete and even inaccurate as layout work commences. This suggests a need for adaptability in relation to alignment, block disposition and of lots within blocks, as survey knowledge and results of soil tests become available and is plotted against disaster risks (i.e. flood points, sink holes, expansive clays, poor bearing soils. Identify the most costly and unsafe areas to develop and avoid these for early stage residential occupancy. Relate unsafe land and costly land to school playground use, wilderness recreation or pathways.

b. The Main Routes

Circulation by road and path within the development will be shaped by the need of the target groups as disposed over the site area commercial and cultural factors. When major artery is aligned, commission a survey profile on ground.

c. Lot Relationships

Assuming here size already established then:

- Rows of lots.
- Lot clusters of 2, 4, 8 etc.
- Lot precincts of 18, 24, 36 etc. reached by footpaths.

d. Modular Block Planning

Fast track planning uses one hectare, three acre or similar land planning module to dispose initial arrangement of lots on development site. Play these large geometrical blocks against the natural features of the site avoiding large depressions, hilltops and danger points of cyclone and of earthquake areas. Where gulleys or rocks are encountered within a hectare unit miss out affected lots from grid and devote to open space, extended gardens of selected house plots, or some communal use (Figures 4.9 and 4.10).

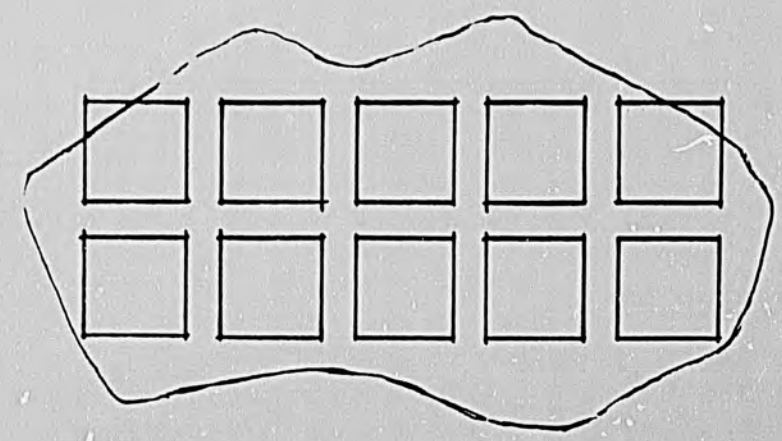


FIGURE 4.9
Site layout using a block size planning grid. The grid is used to order the basic layout of lots. Those blocks which contain the most easily developable land form the first construction and occupancy stages of the project. Land not contained by grids is laid out for housing on contour planning principles as detailed site survey information becomes available. Alternatively, it is reserved for community facilities.

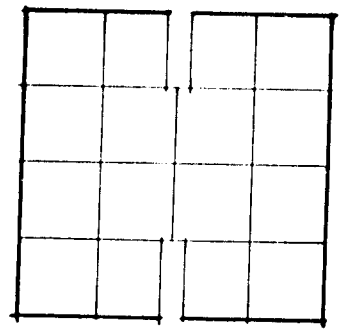


FIGURE 4.10
Housing development block showing square lots planned two deep back from access paths or road reservations. This pattern can only be used in earthquake prone areas if the principle of house expansion shown in Figure 4.8 is followed.

8. Utilities and Services

Site engineering design, its concern with drainage, arrangement of access roads and paths, provision of water supply and utilities is a parallel activity to that of planning the site layout. Although some first steps can be taken in either one of these activities neither can proceed very far without reference to the other. There is a constant stimulation between the two design activities and a series of checks and balances are encountered and made. Engineering is a service activity. Sanitation is a service. It is difficult for families to rebuild a community in a sanitary lanes environment. The sanitation is required but so are path and dwelling arrangements that offer families the chance to create homes in ways that define place and community within their cultural conception of "what these need to be".

Figure 4.11 shows in diagrammatic form how a site can be progressively occupied with a continuous upgrading of services proceeding in company with the householders ability to pay. Such an evolutionary strategy can also be followed in the construction of footpaths and access roads. At the initial stage only the main access road perhaps is constructed within the layout; as the emergency moves through the transitional stage into that of permanent reconstruction so as the years pass more and more of the access paths and roads are completed, many perhaps using local donated labor.

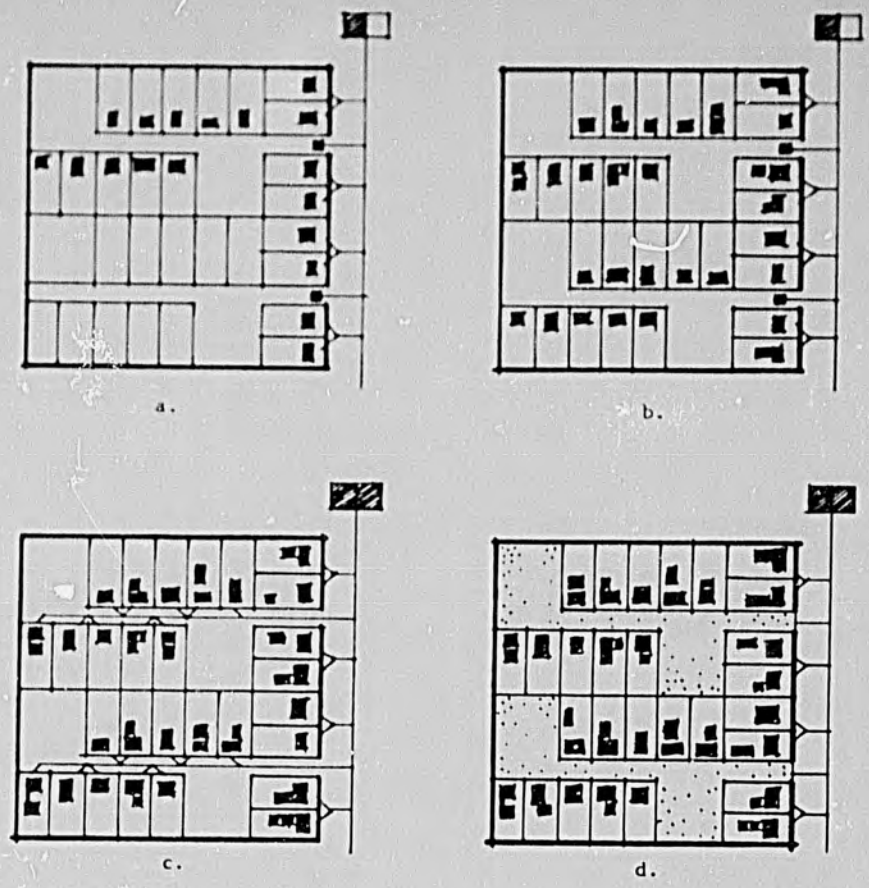


FIGURE 4.11
Planned evolution of environmental standards. In this diagram layout, water and sanitation are served from one side of the block and are progressively upgraded to provide service to individual lots concurrent with improving access.

a. The first lots are taken up and core house construction under self-help commences. Streets and paths are graded and after temporary camp stage truck water supply and sewer lines are laid. Initial communal latrines are replaced by communal w.c. Community help is organized to dig surface water drains.

b. As house construction proceeds and funds are assembled to upgrade the environment, community discussion takes place.

c. Water and sewerage laterals serving house lots are now connected. Community labor is used for excavation, rock crushing, etc.

d. Storm water drains are improved by community action and community labor contributes to paving of roads and paths.

9. Characteristic Regional Variations

Traditional layout patterns can be related to particular people, beliefs and climates despite the infinite variety of modification of the archetypes due to local circumstance of site, orientation or exposure, availability of building material and mode of water distribution and sanitation. These regional types only seldom reflect any design concern with disaster impact.

Appreciation of charactristic types can be gained by relating layouts to three climatic extremes:

(a) Hot, dry desert-like climate.

(b) Warm, humid climate.

(c) Cool upland/mountains.

a. Hot/Dry

In hot dry regions housing has often been placed in rows and clusters to form with walls and courtyards (Figure 2.1, p. 18) contiguous blocks of low level building. The whole acts as a self shade and helps establish a microclimate at the level of living to the mutual advantage of all. This is still good practice to follow from the climate modification standpoint but will require structural separation detailing between building units and between building units and courtyard walls if progressive collapse is to be avoided over the site as a whole.

b. Warm/Humid

In warm humid areas shade is required but it is not quite the comfort dominant requirement that it is in hot dry. In site planning, the most effective way of obtaining comfort conditions for dwellings is to spread them as loosely as possible over the development site and plant shady vegetation but not close to dwellings. Such a layout permits the needed air movement to pass over the site and through the vegetation and dwellings to pass over the skin of occupants. Removal of moisture from the surface of the skin being a prime requirement for human comfort in the humid climate (Figure 2.2, p. 22).

c. Cool Upland/Mountainous

In cool upland areas, there is a short swing between seasonal temperatures and day and night temperatures. Design is often influenced mostly by that extreme which lasts the longest in the year. Human adaptation to the other circumstances is then by living around, rather than in, the dwelling and by adding extra clothes and blankets to the bed.

At the intimate level of siting groups of dwellings, many communities will have unwritten rules governing the location of dwellings in orientation and relative to each other. These rules are sometimes embedded in custom but frequently reflect also deeply held spiritual views. Failure to take notice of such patterns of belief can lead to programs failing. (Since they were not asked, the victims have been too embarrassed or too polite to mention what was really very important to them.) So core houses stand unfinished. Plots are not taken up.

10. Phasing of Construction and Planning to Implement Occupancy Stage 1 of Physical Standards Evolutionary Program

(a) In initial site planning split up large sites into five or six construction areas.

(b) Integrate identification of these areas with land parcels in land acquisition program and with hectare grid.

(c) Plan a program of development and construction tied into phasing of acquisition and site access.

(d) Let construction contracts for land parcels/development areas in accord.

11. Phasing of Occupancy

(a) Plan to let families occupy plots as each phase of the site development is completed to Stage 1 of the Evolutionary Standards Program.

(b) Where core houses or roof shelters are to be constructed on behalf of occupiers or with their self-help contribution, let work start on this after the initial access road is put into site.

(c) Phasing of occupancy allows administrations to cope more easily with the numbers of peoples involved, creates a more even flow of work for small contractors and labor who will work on house completion and fence construction and evens out demand for materials.

12. Implementation of Infrastructure Generally

Consider letting what would normally be one stage contracts in two stages. The first stage would be to produce the minimum specification that would allow occupancy and house construction and aided self-help completion. At a later time, Stage 2 would be carried out and surface water drains lines (for example) and stone and gravel roads surfaced. It should be noted that between these stages it would be necessary to organize a community based drain clearance and road maintenance project or Stage 1 work will quickly deteriorate. (Stage 2 is envisaged here as being carried out within 2-3 years of Stage 1.)

D. PEOPLE AND ORGANIZATIONS

Site development may be the responsibility of development agencies at national, regional or local level and include:

- National housing agencies
- Regional development corporations
- City or municipal housing corporations and development authorities.

E. POTENTIAL ROLES FOR AID

1. Information Sharing

Techniques of rapid land survey and preliminary road profiling, techniques of economic site development for audience of architects, surveyors and engineers.

2. Technical Assistance

Support to surveying teams (combined with training). Assistance with interpretation of aerial photographs. Land planning technical assistance.

3. Equipment Supply

Mapping equipment for enlarging site plans from geographical maps. Equipment for the interpretation of aerial photography.

4. Training

In use of fast track land planning techniques.

F. LESSONS LEARNED

(1) Land planning teams, site layout planners and utility designers play a much more site-orientated, as opposed to drawing office oriented, role when the fast track method is followed. Further, they are needed over longer periods of time to prepare infill development drawings so as not to hold up site construction.

(2) The effective management of the implementation of the rapid site development is all important to its success.

G. REFERENCES

Caminos, H. and Goethart, R. Urbanization Primer for the Design of Sites and Services Projects. Massachusetts Institute of Technology, 1976.

Grundley, W. and Merrill, R. Sites and Services: The Experience and Potential. World Bank Urban Projects Department, Washington, D.C., 1973.

World Bank Paper. Sites and Services Projects. Washington, D.C., 1974.

TABLE 4.1

CHECKLIST OF TOPICS FOR SITE DEVELOPMENT STANDARDS AFTER DISASTER

1. Land and its use in the community setting.

2. Community planning standards:
   - commercial requirements
   - bus routes
   - lorry parks
   - marketing
   - education facilities
   - cultural
   - religious

3. Residential planning standards:
   - plot sizes and shap
   - plot frontages
   - access paths and road widths

4. Dwelling standards:
   - room sizes
   - ceiling heights
   - insulation
   - patterns of extension

5. Building design standards:
   - structural stability in face of disaster
   - design for safe collapse
   - structural safety after addition and extension

6. Standard, guidance and control of owner initiated house building and expansion:
   - limited regulations
   - guidance on site
   - technical handbooks
   - demonstration houses
   - training of supervisors
   - training of craftsmen

7. Water supply and distribution:
   - level of initial service
   - provision for progressive upgrading

8. Sanitation and drainage:
   - level of initial service in staged site development
   - provision for upgrading

9. Emergency lanes:
   - flood
   - cyclone
   - landslip
   - earthquake

10. Economy of the whole in relation to government's intention and the donor's intention in the face of the scale of the national need.

11. Economy of the whole in relation to needs as felt by affected households.

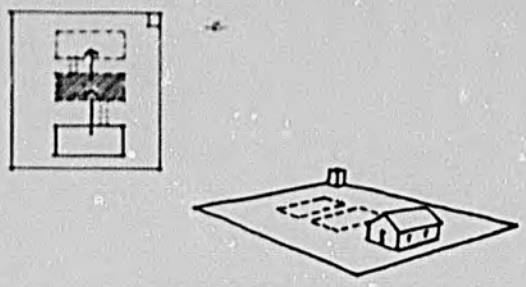
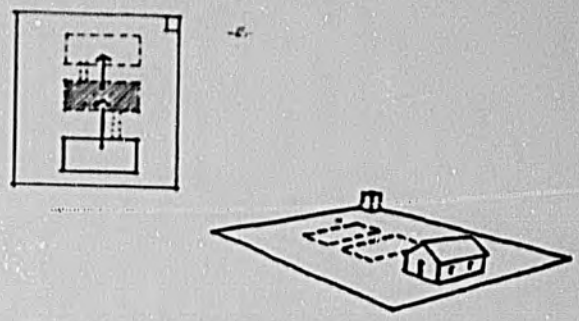


FIGURE 4.6: Earthquake prone areas: disciplines for the safe development of a square lot. (iii) Occupiers are encouraged to extend house area through repeating the original core unit. This approach may be suited to areas where the quality of building material is low. Covered ways formed from corrugated sheets can link the separate units.



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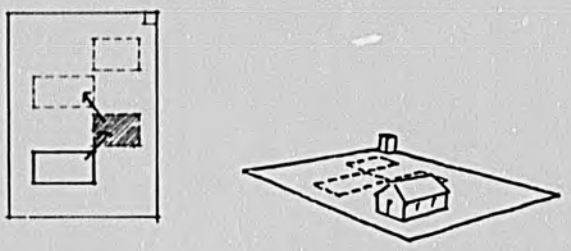

FIGURE 4.7: Earthquake prone areas: discipline for the safe development of a rectangular lot. The separated units of house expansion define outdoor living areas for male and female groupings and for cooking.

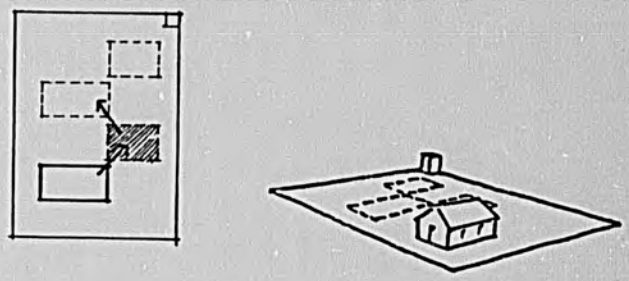

FIGURE 4.7: Earthquake prone areas: discipline for the safe development of a rectangular lot. The separated units of house expansion define outdoor living areas for male and female groupings and for cooking.

CHAPTER V
SAFE HOUSING PROGRAM COMPONENTS

A. ORIENTATION

B. KEY ISSUES

C. KEY CONCEPTS
1. Conventional Housing Projects
2. Prefabrication of Housing
3. Materials Distribution
4. Housing Education Programs
5. In-House Shelters
6. Core Houses
7. Housing Programs

D. LESSONS LEARNED
Lot Usage

E. REFERENCES

CHAPTER V

SAFE HOUSING PROGRAM COMPONENTS

A. ORIENTATION

The variety of approaches to organizing improved housing on designated project sites after disaster is reduced here to six main components or options. These are not options necessarily in conflict one with another for many combinations are possible in one project or integrated into a number of related sub-projects.

The programming options can be reviewed for particular locations in particular nations or regions as the social and economic design problem post-disaster for a particular place has been defined. The criteria of definition are extended by the determinants of earthquake and cyclone resistant design and planning for flood damage reduction.

Disaster risks are reduced greatly by the selection of relatively risk-free sites and by pursuing layout patterns which also reduce the risk. Once these two requirements are satisfied, attention focuses upon the achievement of safe housing structures. This is the theme of this chapter.

B. KEY ISSUES

The key issues bearing on safe structure are interrelated through a chainlike sequence.

(1) Select a site avoiding known risks.

(2) Plan site to avoid aggravation of risk on site of:

- Flood.
- Earth movement.
- Exposure to cyclone.
- Exposure to earthquake.

(3) Design structural system to withstand together with its foundation the design stress associated with the disaster (Figure 5.1).

(4) If a core structure, provide methods of fixing of exterior walls, or panel walls that will result in a stronger not a weakened structure.

(5) If a core house, devise methods of expanding the house that will not weaken the structure or structures on adjacent lots (i.e. through physical contact at lot boundaries).

(6) Advise self-help owners on how to complete and expand dwellings at no loss of disaster resistance.

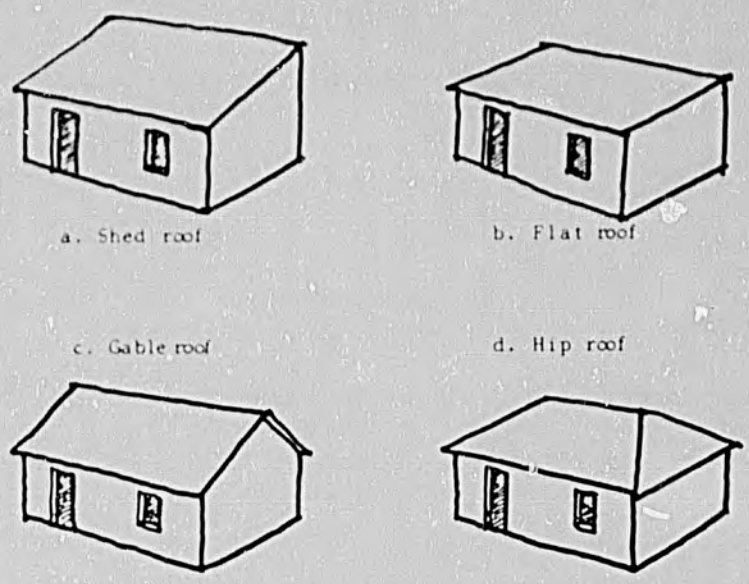

FIGURE 5.1
Building configuration. Achieving simplicity of form is a necessary first step towards achieving disaster resistance. However, not all these simple forms perform equally well under stress.

a. Shed roof: can be appropriate to earthquake prone areas and to cyclone when used as a core unit roof, to which it is intended that the owner add a down-sloping roof over an expansion unit abutting the high back wall.

b. Flat roof: not suited to earthquake or cyclone prone areas. In former all too frequently is constructed of heavy material which is further loaded by goods storage on roof. This is then very unsafe under ground shaking. In latter, wind uplift forces in cyclones are high on a flat roof.

c. Gable roof: can only be used in earthquake and cyclone prone areas if gable is well-reinforced and tied back into main structure. Earthquakes tend to bring gables down to ground and cyclones lift purlins out of gable fixings.

d. Hip roof: the most structurally stable form and recommended for earthquake and cyclone areas. A disadvantage is that expansion of the original unit means dismantling part of the roof. If this is done, rebuilding to achieve structural continuity between old and new work is important. A preferable alternative is to build a second complete unit in the compound yard (Figure 4.6).

C. KEY CONCEPTS

The program planner's range of choice is related here to six options or program components:

(1) Conventional housing projects.

(2) Prefabrication of housing.

(3) Materials distribution.

(4) Housing education programs.

(5) In-house shelters.

(6) Core housing.

1. Conventional Housing Projects

In a conventional housing project, land is acquired, a site plan is prepared, utilities are installed and housing is built, usually by a contractor, according to plans developed by an agency.

Conventional housing projects offer the best means of ensuring that the homeowner receives a safe, well-engineered disaster-resistant house. An architect and/or engineer designs the house, which is then produced by a construction team under suprvision using trained craftsmen. Only when the structure and finishing is complete is the building turned over to the occupant.

Advantages of this scheme are:

(a) Complete control can be maintained over the quality of the building.

(b) As long as quality control is continued in building maintenance, safety can be ensured.

Disadvantages generally are:

(a) Cost. This option is the most expensive in unit costs. Thus the number of people it can serve is relatively small.

(b) Time. Conventional projects take a relatively long period of time to plan (up to 18 months) and to execute (2-3 years).

(c) Low owner involvement. Because of the nature of the design process, owner/occupant input is usually fairly low. Due to the cost of preparing a design, variations are relatively few.

(d) Sites. This type of program does not lend itself easily to construction on scattered sites. Therefore, conventional housing projects are normally on large area sites. This tends to lengthen the task of land acquisition.

Because the conventional project (unless a fast track approach is adopted) takes time to plan and execute, it offers, unless amended, nothing to the homeless during the transition period. If the housing project option is chosen, it becomes necessary to develop a transition shelter program on or off the project site until the housing project is completed. This can form part of the project design for a post-disaster version of a conventional project (see Chapter IX).

2. Prefabrication of Housing

Housing can be prefabricated outside of a national territory and imported or prefabricated within a country for road or river transport to project site. Variations include various modes of part-prefabrication combined with on-site construction.

In retrospect, the weakness of the prefabrication after disaster approach has been that it focuses on walls and roof of what turns out to be a core house. Because of the factory mode of manufacture the totally prefabricated structure is often difficult to add to; and very difficult to expand safely.

During the 1960's and early 1970's, a number of reconstruction programs chose to develop and provide prefabricated housing units to disaster victims. In most cases, the prefab units were of panel construction with corregated metal or cement roofing sheets. The success of the programs varied considerably, depending on the sophistication of the design, dwelling size and its suitability to the particular community and environment. In most cases, the housing units were not popular. Occupants considered the houses to be only a temporary or intermediate measure. Researchers have pointed out that the advantages, which included speed of construction, reduced cost and speed of delivery, were advantages seen from the viewpoint of the agency providing the houses and not the disaster victim. When surveyed, disaster victims noted the following disadvantages:*

(a) Prefabricated houses represented only a small margin of economy compared to more desirable forms of houses.

(b) Prefabricated houses were more expensive than traditional houses.

(c) Prefabricated houses built in mass had the disadvantage of being uniform architecture.

(d) The resale market was very restricted. (This resulted in a high number of abandoned houses.)

(e) Prefabricated housing projects located in rural provinces turned out to have very high completion costs because of the difficulty and high cost of transportation.

(f) Because the units were designed for mass production, individual homeowners complained that they had no input into the overall design and, therefore, were often unhappy with the plan configuration.

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* Tarja Cranberg, "Social Factors Which Influence the Advance of Housing Technology," in Design, Siting and Construction of Low Cost Housing and Community Building to Better Withstand Earthquakes and Wind Storms, National Bureau of Standards, BSS 48, 1974.

Clear thinking after disaster concerning the use of prefabrication is made difficult because of the offers, both in gift and commercial form, that promote particular prefabricated solutions.

The things that can be used from the prefabrication market are:

(a) The management approach of standardization of dimensions, tolerances and erection procedures.

(b) The application locally of the idea of prefabrication to that part of the structure where quality control is difficult and trained labor scarce (i.e. main structural elements such as foundation beams, columns and ring beams and roof members).

It should be noted that the handling of precast concrete off-site manufactured elements is a skilled task. They will often receive a greater stress in being mishandled than when in final position and integrated into the structural system.

3. Materials Distribution

Materials distribution programs can be a method by which a degree of safer construction can be effected. For example, in those earthquake regions where heavy tile roofs contribute to the mode of failure in traditional housing, lightweight roof sheeting, such as corregated metal or fiber-reinforced cement, can be provided as an alternative to tiles. In areas where roofing is particularly vulnerable to uplift during high winds, fasteners and anchors can be provided. Other disaster resistant components which could be considered include:

(a) Concrete posts for disaster resistant frames.

(b) Braces or reinforcing material.

(c) Wood preservatives.

(d) Reinforcing bars for cement reconstruction.

(e) Stabilizing materials for earthen construction.

(f) Nails, screws or other fasteners to improve joints in the buildings.

The advantages of materials distribution programs are:

(a) A large number of people can be affected at a relatively low cost.

(b) Distribution is relatively easier than distributing complete prefabricated units.

(c) Materials can be delivered faster than (say) a prefabricated unit.

(d) The program places the burden of decision-making regarding design, size, etc. on the homeowner.

Disadvantages include:

(a) Without guidance or technical assistance, there is no assurance that the materials being distributed will be used in the manner intended or in a safe way.

(b) In those cases where the material being distributed is not indigenous or available in normal periods, the introduction of the material may create a demand which cannot be satisfied after the reconstruction activities cease. Furthermore, the introduction of the material may require changes in the basic design of traditional housing which, unless proper technical assistance is provided, may prove to be an unsafe adaptation.

Many relief agencies are finding that materials distribution programs are an attractive program option following widespread disasters, as it enables a large number of people to receive at least some degree of benefit. An additional advantage is that materials distribution schemes can be initiated during the emergency period and certain materials, such as roofing sheets and other components, can be used first as an emergency shelter and later be reincorporated into a more permanent dwelling.

Materials distribution programs can also form a component of a follow up program to a conventional housing project and help to ensure good materials are used in house construction and expansion stages.

4. Housing Education Programs

The term "housing education" refers to the provision of technical assistance to homeowners and buiding tradesmen on ways to improve traditional housing to make it more disaster resistant. Housing education may be a teaching and education effort alone or may be a component of one of the options mentioned herein. Most housing education is offered in conjunction with materials distribution programs and self-help programs.

Housing education programs are difficult to initiate and conduct as the training staff must be familiar with not only the technical aspects of construction, but with the means of conveying the information to different groups of people. Attention must be given to development of appropriate media for presenting the information and the structuring of appropriate sessions where craftsmen or owner-builders can receive practical as well as theoretical training.

As difficult as housing education programs are, without some post-disaster program in this field, long-term acceptance of disaster-resistant construction methods is not likely to take place.

The advantages of a housing education program are:

(a) Long-term change in construction techniques can be effected.

(b) If properly designed, large numbers of people can receive benefits at relatively low cost. (Initial costs may be rather high in terms of the development of the training aids, exploration of training methods and the training of the initial staff. However, longer term operational costs are relatively minor.)

(e) Housing education programs place the burden of decision-making about the style, shape and materials of the house on the homebuilder and occupant, thus ensuring a high degree of citizen participation and involvement in the program.

Disadvantages include:

(a) Housing education programs take considerable time to initate.

(b) Impact may be negligible in areas where tradition or resistance to change is strong.

(c) The ability to change housing according to the techniques being taught often depends upon the availability of materials or components needed for the change.

(d) Housing education programs often require many years of program inputs before the methods being taught "catch on" and become incorporated into vernacular housing. Thus, an agency initiating a housing education program must plan to stay on-site for a number of years, or until reconstruction is well under way.

With proper advance planning, housing education programs can be initiated immediately following a disaster. When conducted in conjunction with materials distribution programs, they can provide a resource for emergency shelter while at the same time laying the groundwork for reconstruction activities. Where self-help is a feature of house completion of a conventional housing project, education programs will be important to ensure the continued safety of the contractor-built cores.

5. In-House Shelters

The establishment of an in-house shelter is a method used in industrialized nations which has great potential as a safety measure in developing countries where housing costs are relatively high. There are two approaches. The first is to install a disaster-resistant shelter in a house. This could be a closet, or a small area of the building which can be reinforced and made safe from collapse. During a disaster threat, the occupants would move into the shelter for safety.

The second approach is to design or strengthen one room of the house so that it is disaster resistant. Normally, this would be the room in which all the occupants or a large portion spend the majority of their time during the day or night, such as bedroom or kitchen. Again, during a disaster threat, occupants would seek safety in this room.

Normally, in-house shelters are designed for use in cyclone prone areas because the occupants would have time to move into the shelter on receiving the warning. The second alternative (i.e. the strengthening of one room) could be used in earthquake areas, though in all probability, the only room which would justify extensive modification would be a bedroom. This follows the logic that if an earthquake took place in the day some evasive action is possible but if in bed asleep one is totally vulnerable unless in a strengthened room

No examples of the use of in-house shelters reconstruction programs are known, though the method has been adopted in traditional housing in various disaster-prone areas. The projected advantages for a reconstruction program are:

(a) Costs of disaster-resistant construction would be reduced.

(b) Extensive modification of traditional designs would not be necessary.

The primary disadvantage is that in-house shelters have little overall effect on reducing the overall vulnerability of the houses.

6. Core Houses

There is some fairly free use of the terms "core" and "shell" in relation to housing. Core is sometimes used as a short version of the term "serviced sanitary core of at least a water closet and sink." To this is often added the concept of the shell or core of the dwelling area. The shell is used to describe a large area enclosed but not subdivided. The core implies no particular construction or stage of completion (i.e. it may be a post and frame carrying roofing sheets). In USAID usage, core tends to mean the basic element of a house (i.e. one room as a minimum).

The shell approach has the advantage that a larger floor area is provided initially than is usual in the core approach. However, for earthquake and cyclone prone areas it has the disadvantage that large spaces are difficult and costly to render earthquake resistant. Further, any resistance that was achieved would be severely weakened if the shell structure was broken into to connect room dividing walls. The shell approach on the whole does not appear advisable in disaster prone areas because of the difficulty of safe completion and expansion.

The objective of core housing is to allow poor households who could not otherwise enter the housing market or start to occupy a lot to do both by providing minimum utility service and initial shelter, both at low cost. Finishing is by stages and is by the occupiers or their agents as and when they can afford the time and the cost. Service or utility upgrading to the neighborhood as a whole is by a staged upgrading process roughly linked to the rise in incomes of the area.

The option of providing a one or two-room core house has increasingly been adopted by reconstruction agencies. An agency provides a roof, structural frame which can be used as an emergency shelter or temporary structure. The frame and roof are designed to be disaster-resistant and permanent. The plan is for the occupants to fill the walls with whatever materials are available and to progressively upgrade the structure. Initially, the walls may be filled in with material salvaged from the rubble, then later replaced with more suitable or aesthetic materials as the structures evolve into more formal houses.

The advantages of core housing schemes are:

(a) The programs are relatively low cost and allow the agency to provide incremental assistance. The frame and roof can be provided during the emergency, for example, with materials for the wall and interior at a later date.

(b) Because the frame is designed to be disaster resistant, a degree of control over the end product is established.

(c) The provision of the components necessary to build the frame and roof can be provided rather quickly and relatively faster than a complete housing unit.

(d) This approach can be used immediately following a disaster to provide emergency shelter, thus maximizing impact of expenditures.

(e) The program can work on a scattered site basis.

(f) The homeowner makes a significant input into the final product and is given a degree of choice as to what materials will be used and how the final house will be finished.

(g) The core approach can be combined with the site and service mode and play a part in the initial upgrading of family health.

The advantage of reaching low income families who otherwise could not be helped by the formal housing system of urban areas is clear. The approach is often of value in rural housing also. A disadvantage is that people may not have the time or money to complete. If incomes are assured then loans can be offered to assist completion. Time for personal self-help is more difficult. In urban areas the breadwinner may work long hours and be physically tired. In rural areas the priority has to be given to the crop season. House construction is traditionally restricted to those periods of the year when no agricultural work is to be done. The time of the agricultural year when a disaster hits and when people occupy a project site will effect their experience of the disaster and the way they respond initially to "the opportunity to build their own house." An opportunity perceived more by others than perhaps by themselves.

Other disadvantages are:

(a) Without continuing technical assistance or a housing education component, people may infill the walls in an unsafe manner.

(b) The program will only work where people own the land or have long-term tenure.

7. Housing Programs

Each of the aforementioned safe housing options can be coupled with a particular land strategy to form the basis for a housing reconstruction program. In a widespread disaster, normally more than one approach will be taken. For example, a materials distribution scheme may be initiated as part of an emergency shelter strategy for all groups. Next, a core housing program could be started for people in urban areas; while in the rural areas the materials distribution scheme could be expanded and followed with a housing education program. For landless victims in the urban areas, large sites would be acquired for conventional housing projects with a range of housing types and styles; while in smaller outlying towns smaller conventional housing projects of 30-40 houses would be developed on smaller sites.

A similar approach can be taken in relation to a large one-site urban project in which a number of income groups are to be housed: all would get a lot and the potential of services connections.

(a) Middle Class. Issued materials at assisted prices or completed houses for purchase.

(b) Moderate Income. Offered service connections plus a core room or rooms.

(c) Low Income. Offered a core room(s).

(d) Very Low Income. Offered materials as a gift or at low cost.

D. LESSONS LEARNED

Lot Usage

(a) Positioning of the core on the lot is most significant. Poorly sited cores restrict use of lot (Figures 4.1-4.8).

(b) Partial prefabrication close to construction site of precast columns, foundation beams and bases and timber trusses, etc. is an effective use of resources after disaster.

(c) Education programs running concurrent with issue of materials for house completion most important to success of house completion programs.

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CHAPTER VI
CYCLONE RESISTANT DESIGN

A. ORIENTATION

B. KEY ISSUES
1. The Nature of the Cyclone
2. Coastline and Surge
3. Landform and Wind

C. KEY CONCEPTS
1. Behavior of Building in High Winds
2. Patterns of Failure in the Cyclone Wind
3. Principles of Cyclone Resistant Construction

D. PEOPLE AND ORGANIZATIONS
1. Programs
2. Technical Assistance
3. Training Aids

E. POTENTIAL ROLES FOR AID
1. Information Sharing
2. Technical Assistance

F. LESSONS LEARNED

G. REFERENCES

CHAPTER VI

CYCLONE RESISTANT DESIGN

A. ORIENTATION

The development of building policies in the face of cyclone risks cannot be undertaken independently of site selection and development policies and the overall thrust of developmental policy. The social and economic context of specific regions at risk and the extent that their traditional buildings are vulnerable will be strong determining factors in policy formulation.

Within the policy framework, the selection of technical approaches will be determined by numerous factors including:

(1) An understanding of the nature of the stresses to be designed against.

(2) The character of the building process, the severity of the risk at the macro scale.

(3) The severity of the risk posed by exposed seashores with sandbars and lagoons and uplands near the coast.

(4) The ability of governments, donors, and those who have suffered in disaster to pay for the specialized approach to construction.

(5) The extent of the coincidence of the achievement of cyclone resistance has as a policy with other policies such as encouraging self-reliance and community self development.

B. KEY ISSUES

The design of safe houses starts with the understanding of the nature of the hazard that has to be resisted.

1. The Nature of the Cyclone

The effect of a cyclone (hurricane) upon sea, landforms and buildings cannot be appreciated without a broad understanding of the forces at work in the storm winds and driven waters.

Cyclones have seven main characteristics:

a. Wind Velocity

Typical wind speeds range from 20-30 mph (32-48 kph) near the periphery, increasing to 70-100 mph (113-161 kph) near the center. Occasionally wind gusts of 120-150 mph (193-241 kph) are experienced near the center. At the eye itself the air flow is rising and at the surface the winds are generally light to calm. The area of the cyclone with wind speeds over 74 mph (118 kph) is generally about 30-40 miles (48-64 km) in diameter.

b. Dimensions

A mature cyclone would be 200 miles (323 km) in diameter but the area of influence could be 300-400 miles (483-644 km) in diameter with the outer peripheral areas experiencing heavy rainfall and squally winds.

c. Atmospheric Pressure

At the eye itself atmospheric pressure is very low, sometimes dropping 50-80 millibars below standard atmospheric pressure of 1,015 millibars. The drop in pressure raises sea levels under the eye which in turn contributes to storm surges on shorelines.

d. Rainfall

The cooled moisture falls as heavy and intense rainfall which may amount to 20 inches (0.51 m) or more in a single day. Peak rainfall intensity would usually be of the order of four inches to six inches (0.10 m to 0.15 m) per hour.

e. Wind Changes and Reversal

The air mass rotating in an anti-clockwise direction gives rise to changing wind directions as it moves along. The wind makes a full reversal of direction after the eye passes.

f. Passage Time and Path

The time of passage of the cyclone is normally not longer than 24-36 hours with winds of cyclone force blowing for between six and ten hours over any one location. The cyclone center may move on a straight line or broken path at between 10 and 15 mph (16-24 kph) and normally tends to veer away from high ground.

g. Wind Stress and Surge

Cyclones have major effects on water surfaces, especially near shorelines and on larger lakes, lagoons and water tanks. High winds stress the surface of the water causing it to move forward. If the return flow is resisted by shallow sea or lake beds the water tends to pile up on the shoreline. Additionally, water levels may also rise due to several other factors:

- Low atmospheric pressure.
- The shape and orientation of the shoreline or bay to the wind direction may accentuate resistance to return flow.
- The shape and orientation of the shoreline or bay to the wind directin may accentuate resistance to bottom return flow.

The effect of these factors on water levels acting together with the wind are referred to as the storm surge and is a feature of every cyclone.

2. Coastline and Surge

Coastlines facing the approaching cyclone are the most vulnerable to effects of surge as are coastlines over which the cyclone departs. Coastlines can be divided into three zones:

(a) Surge zones which will be flooded.

(b) Wave uprush zones which will be flooded by breaking waves.

(c) Estuary zones which include both surge and wave uprush zones. They need to be the subject of special study.

Within the cyclone prone area and subject to detailed work on coastal topographic survey work, the zones vulnerable to attack by surge can be identified on maps by contour line study.

3. Landform and Wind

The degree of exposure of land and buildings will affect the velocity of the cyclone wind at ground level and just above. Four main categories of surface roughness, each indicative of increasing levels of wind resistance, are normally recognized in building design literature and standards.

(a) Open country, seashore areas and rolling plains.

(b) Flat or undulating country, scattered windbreaks, scattered or isolated structures up to 33 feet (10 m) high.

(c) Clustered urban and other obstructions up to 33 feet (10 m) high; industrial and wooded areas.

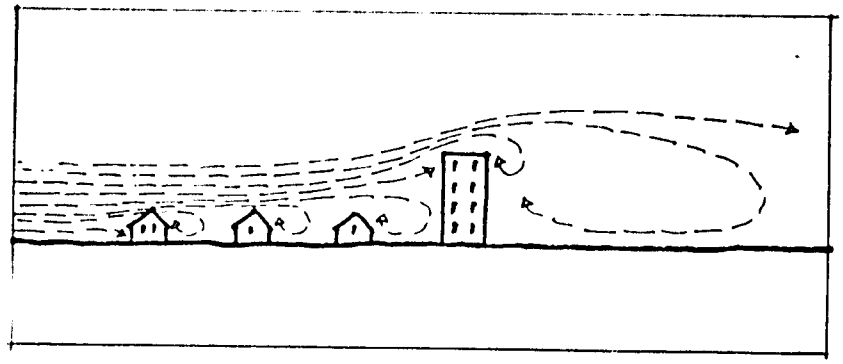
(d) City centers with closely spaced high buildings and trees (Figure 6.1).

C. KEY CONCEPTS

The achievement of safe conditions in and around dwellings in a cyclone prone area results from acceptance of a design brief that determines:

(1) Buildings are as far as possible sited away from coastlines and river floodways and exposed areas generally (Figures 6.2 and 6.3).

(2) The design criteria or design brief for wind resistance and flood reduction.



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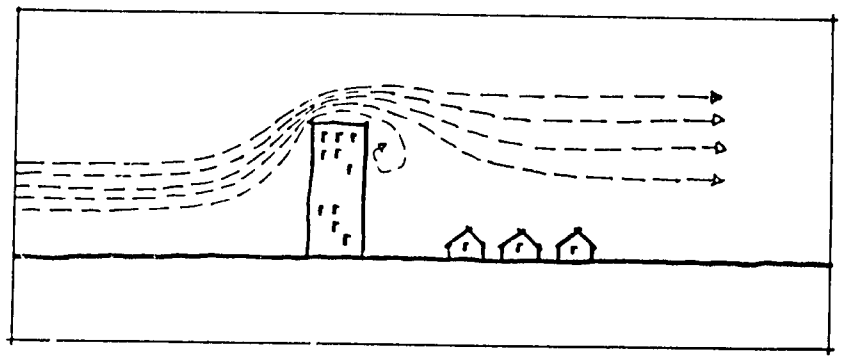


b.

FIGURE 6.1
Tall buildings offer some protection to lower buildings in a cyclone wind. However, they can also be the cause of wind eddies, reverse local winds, gusts and wind shadow suction areas. In mixed height developments, extra attention may have to be given to the anchoring down of roof structures and particularly eaves sections. Roof coverings may require extra fixings at eaves, ridge and gable ends.

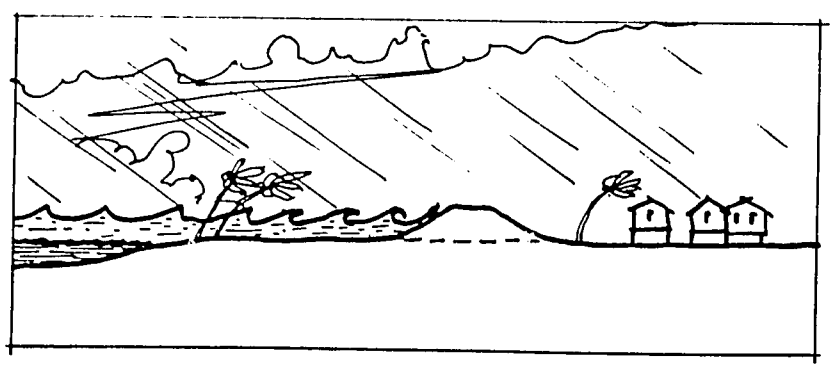


FIGURE 6.2
Embankment to protect project area from cyclone storm surge and wave uprush. Rocks placed on the seaward side of the embankment help break wave strength.

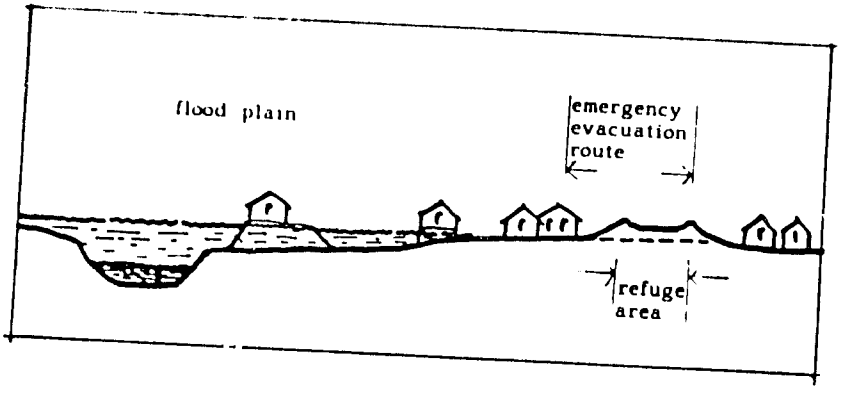


FIGURE 6.3
Embankment to protect project area from riverine flood.

(3) The wind brief will lead to achieving wind shelter and ground roughness for this will break the force of the wind (Figure 6.4f).

(4) The flood reduction brief will lead to consideration of off- and on-site works such as flood channels, ponding overflow areas, on-site drainage, flood protection walls.

(5) To the extent that reduction to exposure has not been achieved through site selection and site landscaping and site works, so the building design brief must ensure that the forces described in the criteria of "the design cyclone" are met in the design of prototype structures. These forces then form the basis for the development of standard specifications.

1. Behavior of Buildings in High Wind

High winds add extra live loads suddenly to a building. Normal live loads of trees, furniture and people are overwhelmed by new forces which, unless specifically strengthened to do so, the structure and dead weight of a house is unable to resist.

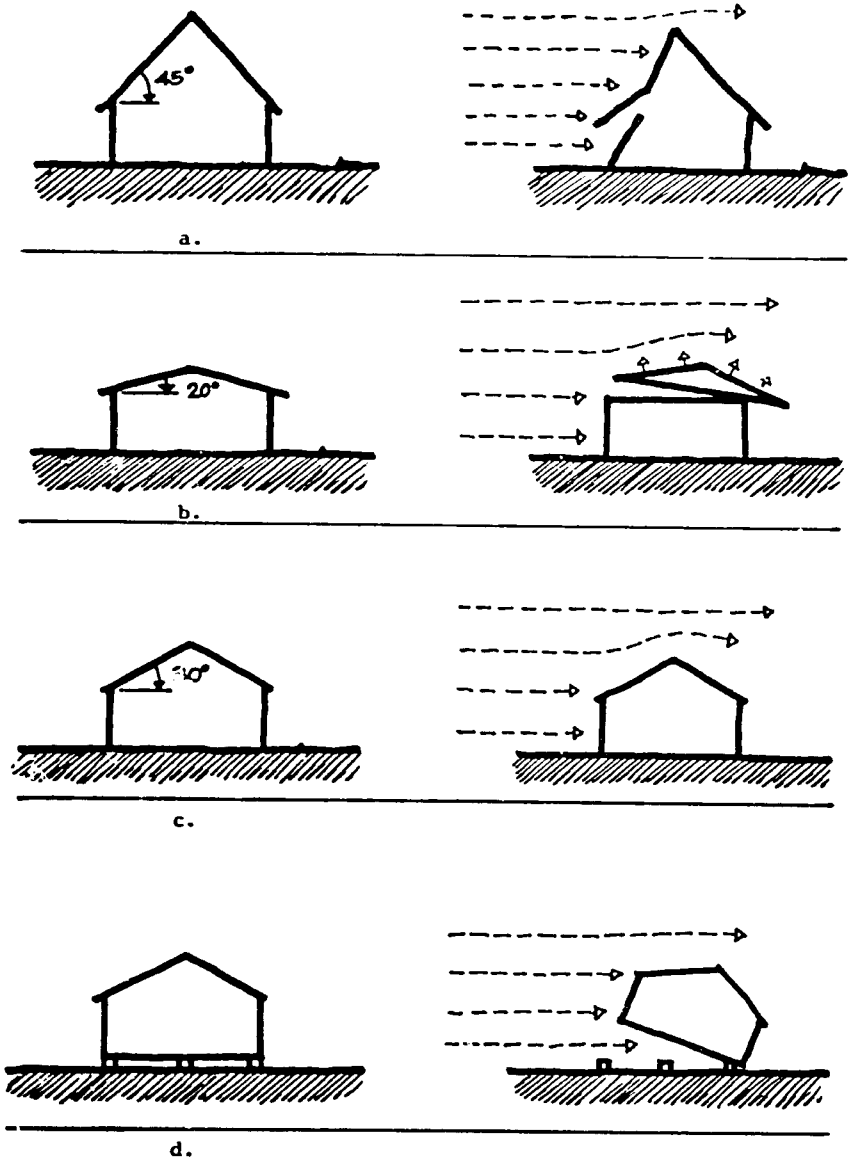
(a) Lateral forces act on all faces of the building tending to turn it over and shear it off at the base.

(b) Suction pressures occur on the side walls and walls opposite the wind direction tending to pull the walls outward (i.e. "explode" them).

(c) Suction pressures on the roof tend to lift it off (Figure 6.4b).

(d) Internal pressures build up inside the building. These may be bursting or suction pressure which may act with or against the external pressures of the building.

(e) Loads of different magnitudes and directions occur over short periods of time causing fluttering forces in the structure.



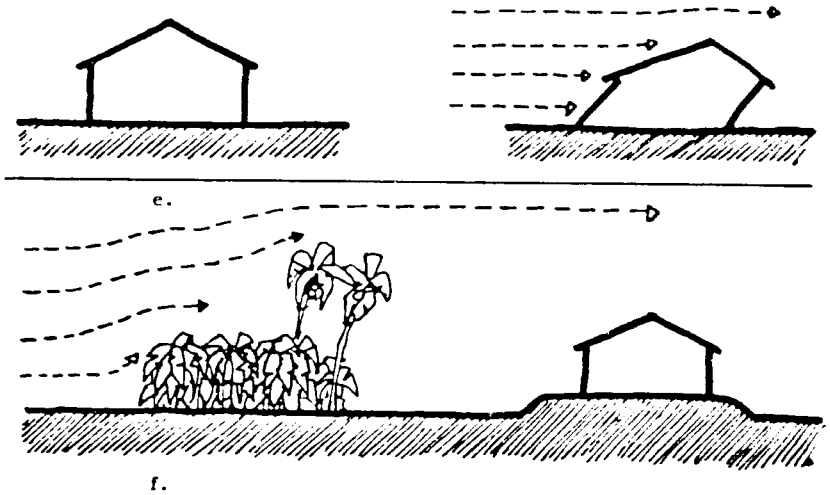


FIGURE 6.4
Behavior of small buildings in high wind. The form of building, the degree of exposure, the quality of construction and the degree of structural integrity of the basic design all influence the behavior of a building under high wind stress.

a. A steeply pitched roof will receive a high wind loading and may blow in.

b. A low pitched roof receives a high suction and may blow off.

c. A 30-degree pitched roof receives the least wind stress.

d. Well-constructed buildings which are not well-anchored down to their foundations may overturn.

e. Buildings without well-connected stiffened joints may distort.

f. A building shielded by vegetation placed at a distance equal to the tallest windbreak tree at full growth and built upon a raised plinth is well-protected against wind and flood providing it is appropriately designed and sufficiently well-constructed.

The intensity, character and distribution of wind induced stress is affected by:

(a) The form of the building (low, high, flat roof, pitched roof) (Figure 6.4).

(b) The degree of exposure (sheltered site, away from coast, away from other buildings). (Figure 6.4f).

(c) Structural type (open bays, closed in cellular construction, discontinuous or continuous structure, i.e. separate elements placed together or one continuous structural system acting as a whole). (Figures 6.5 and 6.6).

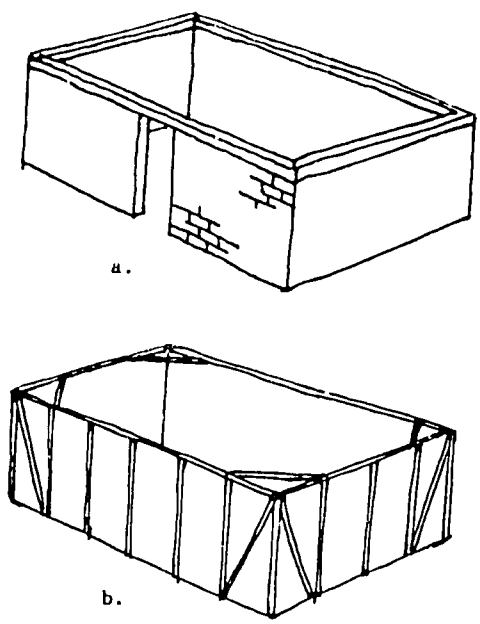
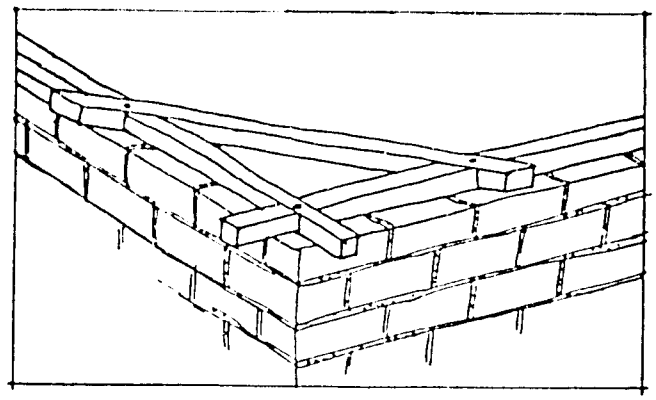


FIGURE 6.5
Stiffened walls formed into an integral box-like structure form an important link in the achieving of the chain of strength to resist cyclone winds. This chain must stretch from foundations, up through the walls to the fixing of the roof structure and coverings. Increased resistance is given if cross walls form an integral part of the original core house construction. Care must be taken by occupiers that when expanding a core house that its chain of strength is not broken into when building an extension.



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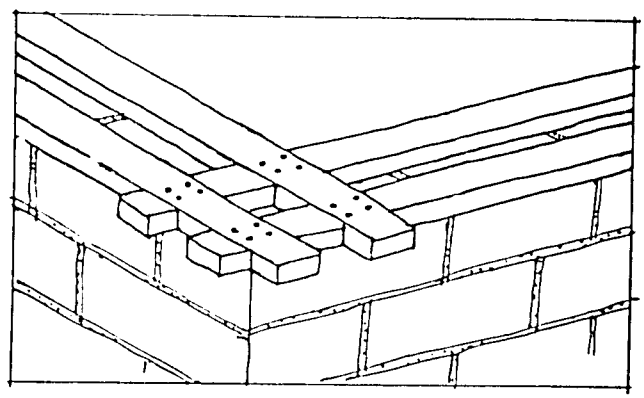

b.

FIGURE 6.6
Achieving the chain of strength against cyclone winds (and earthquakes) requires considerable attention to constructional detail.

a. Shows a timber ring beam at the top of a single block adobe wall. This is stiffened by a diagonal corner brace in the "ceiling" plane and is well-anchored down at frequent intervals into the adobe with deep hook bolts which should preferably tie into a band of horizontal reinforcement.

b. Horizontal reinforcement of adobe walls can be achieved by bamboo, steel or mesh reinforcement of joints. An alternative is to use timber ring beams at intervals up to the height of the walls.

2. Patterns of Failure in the Cyclone Wind

Building failure in a cyclone can seldom be attributed to one cause. Rather, failure stems from an interlace of causes including:

(a) A failure to perceive the need to design against cyclone wind forces.

(b) A lack of thoroughness in design. The design must incorporate inherent strength, continuity in structural design, cross or diagonal bracing and adequate connections.

(c) Poor materials of their kind and poor combinations of materials.

(d) Poor workmanship.

(e) Lack of supervision of building work.

(f) Lack of maintenance.

Well constructed buildings that are well-maintained can be expected to survive the storm with only minor damage. Failure of a building of which others of the same type survive the storm may be due to local wind gusts, an exposed open site (particularly if near coast), missile impact (branches, sheets of iron, etc.), or poor construction and supervision.

Some very specific failures are due to nearby trees falling on a structure giving rise to a high local "point load" which creates a breaking stress.

3. Principles of Cyclone Resistant Construction

High winds in a cyclone storm can come from any direction and they will seek to lift the building. So it must be constructed to stay down as well as stand up.

(a) It must be tied to its foundations.

(b) Every element in the structure must be tied together: walls to wall framing, posts, beams, rafters, columns, purlins, battens and roof tiles and sheets in order to develop a chain of strength against uplift that is well-anchored into the ground.

(c) The fixings between elements must be good enough and frequent enough to stop the structure from breaking up into separate and vulnerable elements.

Resistance to the wind is given by forcing the building to resist as a whole — not as an assembly of bits and pieces. The building is helped in this by being diagonally braced. Bracing in the inclined planes of the roof and in the ceiling plane is important. Large open verandas and part open areas will require diagonal bracing not only in the roof, but in the planes of the wall posts.

Appendix II gives sample specifications for core houses resistant to high wind in block construction, brick construction and timber frame.

D. PEOPLE AND ORGANIZATIONS

1. Programs

The following usually are able to develop capability in cyclone resistant building design:

(a) Executive departments of local housing ministries.

(b) Voluntary organizations.

(c) Intergovernmental agencies.

2. Technical Assistance

The following can be used as agents of technical assistance to owner-builders:

(a) Government building departments.

(b) Government or municipal social aid agencies through building development officers.

(c) Voluntary agencies.

(d) University departments (especially schools of architecture and engineering).

(e) Technical schools.

3. Training Aids

These may be produced by or for the agencies mentioned above to cover principles of construction of core houses, principles of completion and principles of expansion.

E. POTENTIAL ROLES FOR AID

1. Information Sharing

(a) U.S. technical publications for structural engineers and architects.

(b) More generalized technical information for officers of voluntary agencies have house construction responsibilities.

2. Technical Assistance

(a) Principles of site development and cyclone resistant building design for professional audiences.

(b) Design assistance with development and testing of prototype designs and specifications.

(c) Construction inspection and quality control.

3. Materials Purchase and Supply

(a) In-country.

(b) Third countries.

(c) From U.S.A. Obtaining agreement on standard sizes to be supplied.

4. Training

(a) Administrative and program officers in government departments and voluntary agencies.

(b) Technical officers in principles of design.

(c) Training of trainers in building demonstration work.

5. Preparedness Planning

(a) Assistance with the selection of low risk sites.

(b) Introduction of cyclone resistant design approaches in University level courses of architects and engineers.

(c) Introduction of cyclone resistant detailing in technical draftsmen training.

(d) Training courses in building inspection and appraisal of risk in face of disaster.

(e) Assistance to committees appointed to draft planning and building regulations.

(f) Assistance in the design of low cost prototype dwellings and core houses.

(g) Improved warning systems.

F. LESSONS LEARNED

(1) In cyclone resistant design, the overriding importance of the A,B, C of anchorage, bracing and continuity. The anchorage of all parts of core structure to one another and of infilling and additions to each other and to the core. The bracing of all wall and roof plans with strengthening, holding and diagonally stiffening members. The achievement of continuity to ensure structural unity and integrity.

(2) The equal importance of the implementation of the design in construction through the use of good quality materials, correctly positioned and fixed in accordance with specifications.

(3) The importance of managing house expansion through:

(a) Demonstration.

(b) Education programs.

(c) Training of key craftsmen.

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CHAPTER VII
EARTHQUAKE RESISTANT HOUSING

A. ORIENTATION

B. KEY ISSUES
1. Nature of the Hazard
2. Earthquake Risks
3. Earthquake Hazard Maps
4. Earthquake Effects

C. KEY CONCEPTS
1. Classification of Building in Accord with Risk
2. Earthquakes and Soil Conditions
3. Why Buildings Fail in an Earthquake
4. Types of Building Failure
5. Reducing the Risks from Earthquakes
6. Principles of Earthquake Resistant Building Design
7. Supervision

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E. POTENTIAL ROLES FOR AID
1. Information Sharing
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CHAPTER VII

EARTHQUAKE RESISTANT HOUSES

A. ORIENTATION

The design of earthquake resisting dwellings starts with identification of the nature of the effects of earthquake shock waves. It is extended by having an appreciation of the theory of mitigation through location and design.

The development of building policies in the face of earthquake risks cannot be undertaken independently of site development policies. The social and economic context of specific regions at risk and the extent that their traditional buildings are vulnerable will be strongly determing factors in policy formulation.

The selection of technical approaches will be determined by numerous factors including: an understanding of the nature of the shocks to be designed against, the character of the building process in rural and urban areas, the severity of the risk at the macro scale, the severity of the risk posed by particular ground conditions such as uncontained silts and sands, the ability of governments, donors and those who have suffered in disaster to pay for the specialized approach to construction, the extent the coincidence of the achievement of earthquake resistance has, as a policy, with other policies such as encouraging self-reliance and community self development.

B. KEY ISSUES

1. Nature of the Hazard

Seismic hazards exist anywhere that the crust of the earth can become stressed beyond its strength. When overstressing takes place, the bedrock ruptures and violent energy movements result. The hazard is a natural phenomenon and is related to identifiable geographic areas.

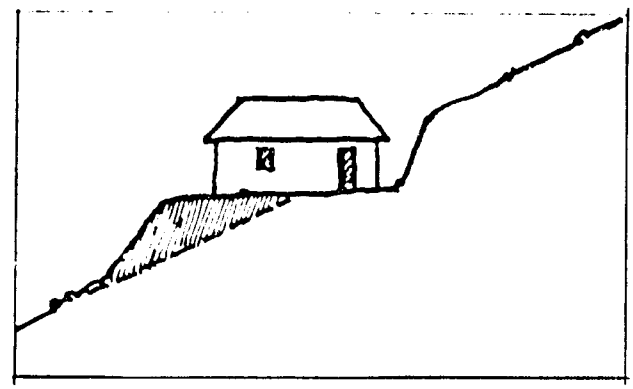
2. Earthquake Risks

Seismic risk is a humanity related phenomenon. It exists only when something having human value is exposed to the natural hazard of earthquakes (Figure 7.1).

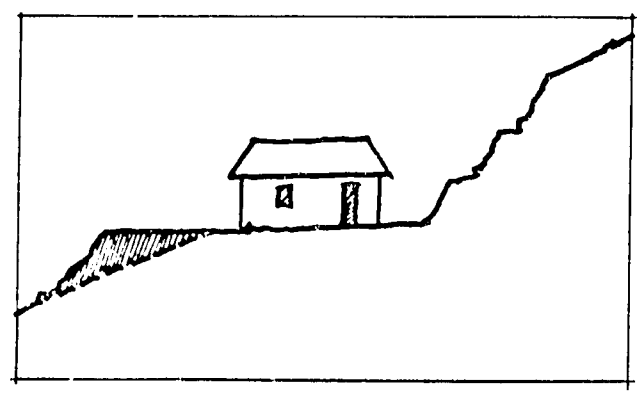
3. Earthquake Hazard Maps

Maps can be prepared showing degree and nature of hazard for continental, sub-regional or local region scales. Particular areas can be zoned for degree of risk in accord with the history of seismic activity. The preparation of such maps is often expensive but a necessary investment where there is a high concentration of population. In one such case in Manila, Philippines, UNDRO assisted in the development of such maps. A simple scale will run:

Zone 1 — no damage recorded
Zone 2 — minor damage
Zone 3 — moderate damage
Zone 4 — major damage



a. No



b. Yes

FIGURE 7.1
Building on steep slopes. Such slopes are best avoided where there is the risk of earthquake or landslip. However, where there is no choice but hillside, do not build on fill (a) or close to steeply cut hillside. Prefer solution (b) and leave a 1-meter minimum distance from house wall to tailored slope.

When such scales are encountered in the literature, it can be assumed that they relate to buildings designed and built of well-specified materials and structures. An area classified as being in Zone 2 and so subject to minor damage may, as far as its poor population is concerned, be in a major damage zone for their traditional buildings may not withstand ground movement of any severity.

Preparing maps of severity of shock to be expected is an important preparedness activity. Recognizing the hazard of an area is the first step towards achieving human and building safety. It is probably a task for technical assistance.

Risk is related to loss of life, damage to the economy and damage to buildings and other structures. In professional practice, it is possible to appraise the risk level of a

particular geographic location in direct proportion to population density and investment in buildings.

Investment in building needs to be measured along two scales: relative and absolute. For a peasant family in a less developed region, the loss of a stone built house may be devastating yet its absolute value in world terms may be very little. Loss of life in earthquakes is highly related to buiding failures.

4. Earthquake Effects

These can be grouped in four broad categories:

(a) Surface faulting.

(b) Ground failure.

(c) Tsunamis and seiches.

(d) Ground shaking.

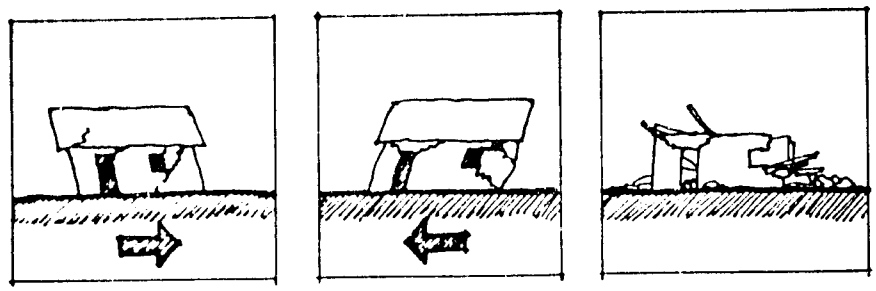
Surface faulting or displacement may give horizontal and vertical displacements of considerable magnitude. Although the resulting damage can be spectacular, losses may be slight compared to those caused by ground shaking.

Ground failure is due to landslips and liquefaction. Liquefaction is associated with waterladen silts and sands. Landslips can be severe in mountain areas or river valleys (Figure 3.2). Ground lifting and subsidence accompanies some earthquakes.

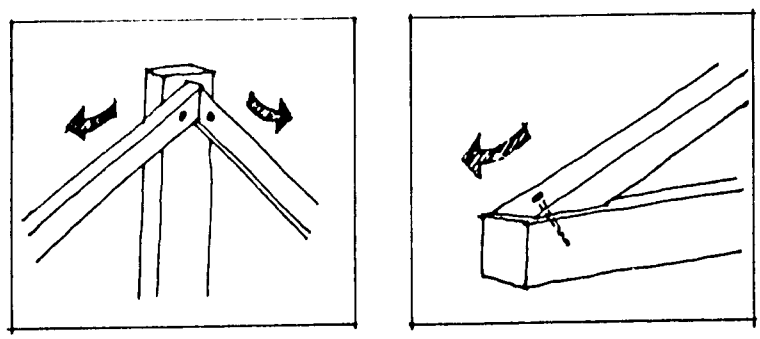
A tsunami is an earthquake tidal wave generated by a sudden faulting in the ocean floor. In the open ocean the amplitude of the water wave is only a few centimeters deep but the wave piles high as it enters shallow waters and can obtain heights of tens of meters to produce a wall of water that can cause severe damage to islands and coastal regions in its path.

Seiches are free oscillations of lakes and reservoirs which are produced by earthquake waves. Such can be caused well away from the center of earthquakes and embody waves several meters in height that can damage shorelines and adjacent properties.

Most damage in earthquakes is caused by ground shaking (Figure 7.2).



a.



b.

FIGURE 7.2
Building failure in earthquakes. Buildings respond to shocks received from ground shaking a' a whole (a) and at points of detail (b). If they are to resist then they must be sufficiently reinforced to provide a box-like resistance as a whole and sufficiently strengthened at every point of detail.

C. KEY CONCEPTS

Buildings respond to a given earthquake in a variety of ways dependent upon the strength and nature of the shock, the nature of the underlying subsoils and rocks, the character of the building (form, height, width), manner of construction and quality of maintenance.

The achievement of safe conditions in and around dwellings in an earthquake prone area results from:

(1) Avoidance of poor ground conditions, faulted ground or locations at the foot of potential landslip (Chapter III, Figs. 3.1 and 3.2).

(2) Acceptance of design criteria that leads to small buildings being designed for stiffness in all dimensions and for structural integrity (i.e. wholeness of responding action).

1. Classification of Buildings in Accord with Risk

In order to classify descriptions of failure damage inspectors have developed four categories each based upon major structural systems within conventional and non-conventional building practice:

(a) Steel frame.

(b) Concrete frame and reinforced (i.e. framed internally) masonry.

(c)
- Discontinuous concrete (i.e. precast systems without stiff joints and poured-in-place concrete without steel reinforcement.
- Unreinforced masonry, unreinforced adobe.

(d) Wood frame with pinned stiff joints.

In general categories (a) and (d) suffer the least damage while category (c) has experienced the greatest. The degree of damage within a particular category is dependent ultimately on the appropriateness of the structural design in relation to earthquake forces (as defined for engineering and architectural design). And, most importantly, the degree to which those designs were carried out in construction.

A chain runs from the identification of degree of risk, mathematical expression for engineering design, architectural response in form and arrangement, crafted construction, excellence of supervision to degree of maintenance. Intervention into a traditional building process to make a traditional type of construction earthquake resilient is a major intrusion not only technically but socially and culturally. The weakest link in the earthquake resisting chain is ruthlessly exposed by the next earthquake and is often readily identifiable in the reports of damage assessors.

2. Earthquakes and Soil Conditions

The more effective a soil is for static foundation loads the better it can be expected to perform in carrying a structure during an earthquake. A firm soil transmits less violent movements than a weak soil. Firm soils amplify ground vibrations less than soft soils. Working from such generalizations a soil grading can be made ranking soils in relation to seismic shocks in descending order from rock, firm soil, to weak soil, sands and silt. Since soils can "overlap", be thick or thin in layering, the generalization needs interpretation for any specific proposed site. The considered view of a geotechnical engineer is required for major projects.

Fine sands and silts, such as are found in river beds and some hillsides, offer a particular risk to structures since they may be subject to liquefaction due to ground

shaking during an earthquake. The vibrations cause the fine soils and sands to temporarily lose their strength in shear. Water bearing soils can become soft to depths of fifty feet leading to the characteristic failure under this condition: the building that has tipped over like a listing boat. If such soils have a free edge, such as a river channel or hill slope, then the risk is aggravated since the possibility of an avalanche-like flow becomes real.

3. Why Buildings Fail in an Earthquake

Poor location in the face of the hazard and poor construction of whatever kind are the two main causes of failure. Well-constructed buildings of whatever materials perform better than those badly constructed.

Knowledge of the dynamic response of a structure experiencing ground shaking is central to the development of a sound earthquake resistant design procedure. It is within the design capability of those engineers and architects who specialize in resistant construction (Figure 7.3).

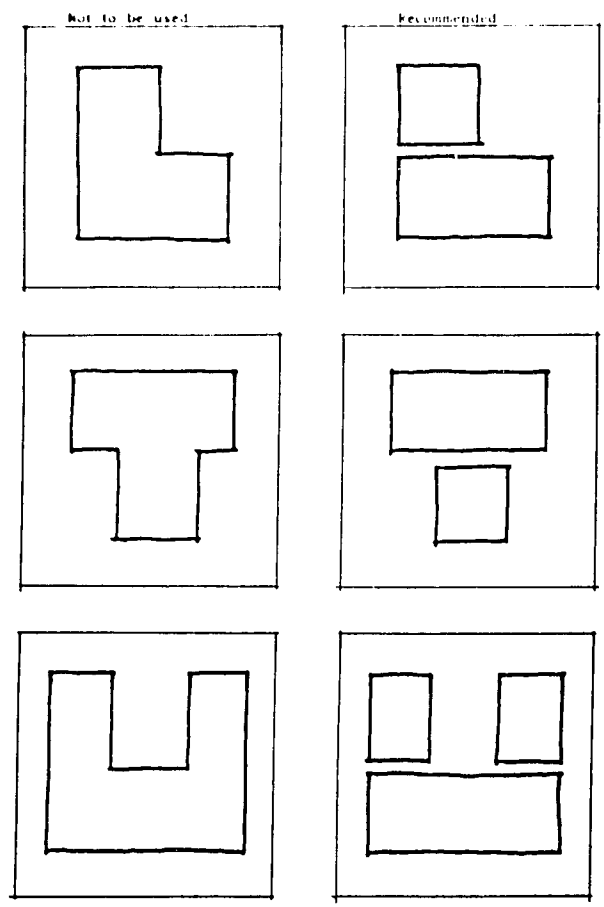


FIGURE 7.3
Achieving earthquake resistance. Simple forms and simple plans are recommended. "L" shaped plans are very vulnerable to cracking in ground shaking. Where a plan has to be built up using a number of units then "crumble" non-structural sections are recommended between the units.

4. Types of Building Failure

Failures due to ground shaking have a characteristic form. Poorly built structures of poor or uncemented materials crumble under the vibrations. Reinforced structures may distort or crack but remain upright.

(a) Wood frame buildings that have good joints and diagonal bracing generally perform well but attached brick or block chimneys are a danger. They adopt a different response and may topple.

(b) Unreinforced mud or adobe walls generally topple.

(c) Brick or stone walls depend for their effectiveness largely on the mortar once the design is correct. Earth or lime mortars lead to failure; cement sand or cement less so. Reinforced brick or block incorporated in a sound design is less likely to topple.

(d) Unreinforced piers of brick or masonry are likely to topple.

(e) In framed construction, panel walls are likely to become detached from the framing unless very well tied in. This has proved a weakness of a number of innovatory "earthquake resistant" single storey designs.

(f) Good foundations are important and in severe earthquake zones they should be continuously reinforced. Rigid building structures perform better on hard ground than on silt or filled ground. The latter should be avoided.

(g) Projections and parapet walls, unless very well tied into the main structure can be expected to fall away.

(h) Untied walls (i.e. walls that are free at one end) and gable ends, will topple unless well-tied into the main structure.

(i) Light roofed structures are more resistant than the heavy roofed.

(j) Arches are a point of weakness.

5. Reducing the Risks from Earthquakes

Recognizing and measuring the risks are the first steps. After that a number of policy responses are identifiable:

(a) Make existing but unresistant structures stronger (Figure 7.4).

(b) Prepare an earthquake resistant design brief for buildings of different kinds.

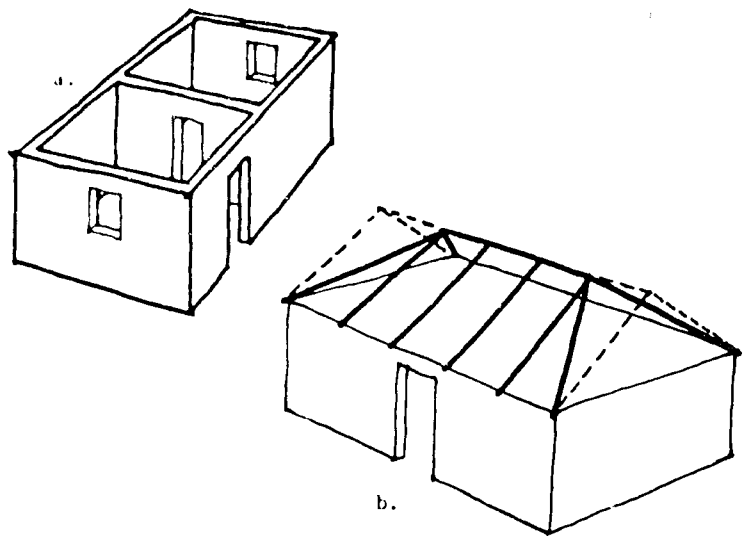


FIGURE 7.4
Achieving earthquake resistance. Buildings are reinforced through the walls at corners and around openings. Walls are capped by continuous ring beams as in (a) and stand on horizontally reinforced foundation beams (b). Hipped roofs are preferred.

(c) Use land planning to avoid geologically identifiable hazards and weak soils.

(d) Spread the risks through insurance.

6. Principals of Earthquake Resistant Building Design

The theoretical design of buildings to resist earthquake induced stresses is a technical matter. However, in practice the present levels of knowledge of the degree of risk, the periodicity of the risk and social, cultural and economic matters greatly affect technical decsions. Economy and significance of buildings either socially or in respect to utility after a disaster combine to make different approaches opt towards buildings of differing functions or belonging to different income groups. Where it desired to set an example (i.e. in simple traditional dwelling improvements), replicability by local craftsmen and affordability by local families will criteria of equal importance to passing on technical "know-how."

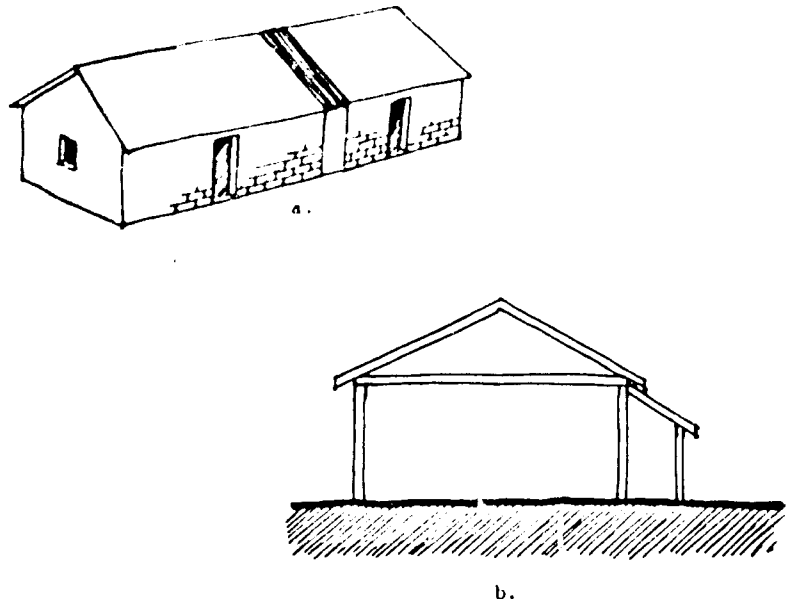


FIGURE 7.5
Achieving earthquake resistance. If initial resistance is to be maintained, additions have to be made with care.

a. Shows a new extension separated from the original core house by a lightweight crumble zone.

b. Shows a verandah structurally separate from the main roof and able to fall in an earthquake (or blow away in a cyclone) without endangering the structural integrity of the basic house.

The degree of "proofness" has to be established initially. Working from available data as to the degree and nature of the risk at particular locations, it has to be decided that design will be for:

(a) Earthquake proofness — nearly impossible to obtain in practice.

(b) Earthquake resistance up to a specified zonal force or building grading.

(c) Designed for structural durability but expectancy of cracking and distortion.

(d) Designed for safe collapse and recovery of material for rebuilding.

In practice small dwellings cannot be economically designed to resist earth faults of landslip. The main design parameter is seen as resistance to ground shaking. For this, a wholeness of building response to the shock waves is required. Reinforcement of walls, roofs and foundations to achieve a box-like structure is a major practice that reflects this principle. Specifications for simple core houses in brick and block appear in Appendix II.

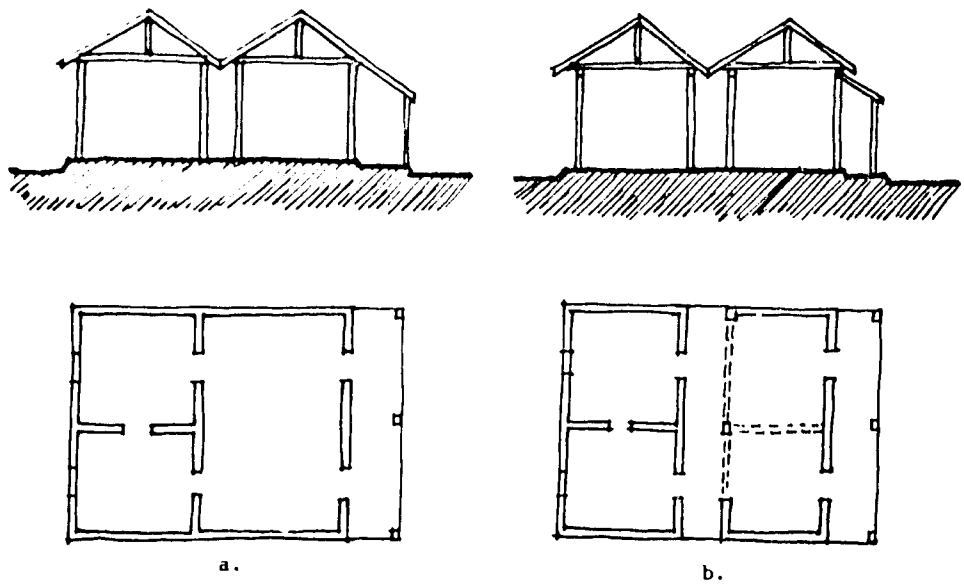


FIGURE 7.6
Achieving earthquake (and cyclone resistance). Where scale of need and costs of materials inhibit the mass production of earthquake resistant houses then traditional type houses can often be revised in design to offer a greater degree of safety in disaster (i.e. give time to escape before complete collapse).

a. Shows a double hipped roof house of a type found in Southeast Asia.

b. Shows the upgrading by dividing the plan and section into two structurally separate units with a crumble zone between and the detachment of the verandah from the main roof structure.

7. Building Supervision

Work done on an improved design is wasted if quality of construction is poor, materials are ill-used or not used. The experienced leading mason who regards reinforcing of blockwork as "wasteful" is a familiar figure. The rods he leaves out cause someone's death (Figure 7.7).

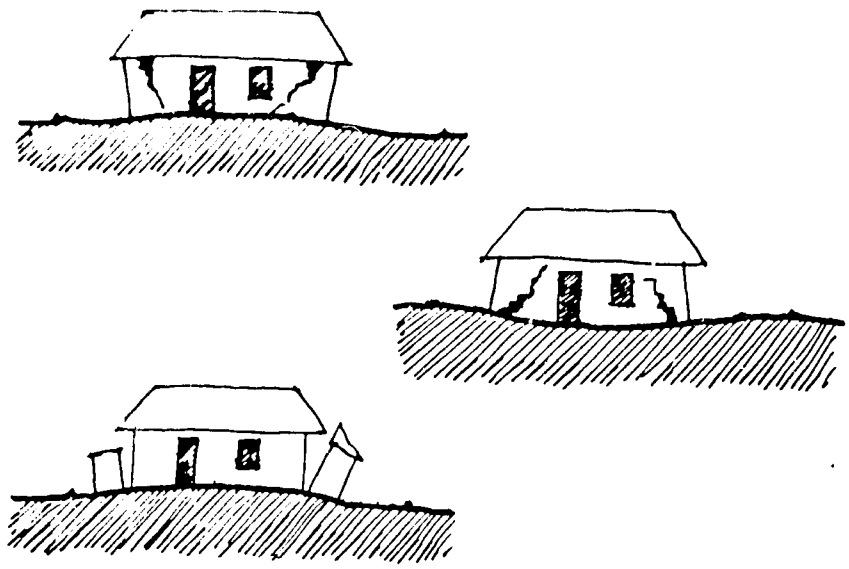


FIGURE 7.7
Characteristic cracking patterns in unreinforced walls under ground shaking.

The best supervision is self-supervision that stems from the craftsmen really understanding why they are doing what they are supposed to be doing. Demonstrations, slide talks, simple diagrams all help and posting pictures of good practices in village shops, lumber yards and at brickworks and concrete block yards all help.

There is a tendency for a small building under ground shaking to develop intersecting cracks at about 45 degrees to the horizontal. These cracks often start from the tops and bottoms of windows and other openings. Weak joints in blockwork or adobe means there is less resistance available. It is thus important to ensure that both vertical and horizontal joints are full of mortar and in brick and block construction that wall reinforcement is placed around openings.

D. PEOPLE AND ORGANIZATIONS

1. Programs

The following usually are able to develop capability in earthquake resistant building design:

(a) Executive departments of local housing ministries.

(b) Voluntary organizations.

(c) Intergovernmental agencies.

2. Technical Assistance

The following can be used as agents of technical assistance to owner-builders:

(a) Government building departments.

(b) Government or municipal social aid agencies through building development officers.

(c) Voluntary agencies.

(d) University departments (especially schools of architecture and engineering).

(e) Technical schools.

3. Training Aids

These may be produced by or for the agencies mentioned above to cover principles of construction of core houses, principles of house completion and principles of expansion.

E. POTENTIAL ROLES FOR AID

1. Information Sharing

(a) U.S. technical publications for structural engineers and architects.

(b) More generalized technical information for officers of voluntary agencies have house construction responsibilities.

2. Technical Assistance

(a) Principles of site development and earthquake resistant building design for professional audiences.

(b) Design assistance with development and testing of prototype designs and specifications.

(c) Construction inspection and quality control.

3. Materials Purchase and Supply

(a) In-country.

(b) Third countries.

(c) From U.S.A. obtaining agreement on standard sizes to be supplied.

4. Training

(a) Having administrative and program officers in government departments and voluntary agencies.

(b) Technical officers in principles of design.

(c) Training of trainers in building demonstration work.

(d) Training of key craftsmen.

5. Preparedness Planning

(a) Assistance with the selection of risk free sites.

(b) Introduction of earthquake resistant design approaches in university level courses of architects and engineers.

(c) Introduction of earthquake resistant structural and architectural detailing in draftsmen training.

(d) Training courses in building inspection and appraisal of risk by zone, soil condition and building structure.

(e) Assistance to committees appointed to draft planning and building regulations.

(f) Assistance in the design of low cost prototype dwellings and core houses.

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CHAPTER VIII
FLOOD DAMAGE REDUCTION

A. ORIENTATION

B. KEY ISSUES
The Hazard

C. KEY CONCEPTS
1. Strategies for Flood Damage Reduction
2. Channel Control
3. Land Use Planning and Management
4. Relocation
5. Floodproofing of Dwelling
6. Forecasting, Warnings and Preparedness
7. The Design Flood
8. Flood Resistant Dwelling Design
9. Building Design and Zoning

D. PEOPLE AND ORGANIZATIONS
1. Programs
2. Technical Assistance

E. POTENTIAL ROLES FOR AID
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D. REFERENCES

CHAPTER VIII

FLOOD DAMAGE REDUCTION

A. ORIENTATION

Knowledge of how to site and design dwellings to resist damage through flood is well advanced. It is generally an administrative or financial limitation, or lack of local civil engineering expertise and constructional capacity that leads to continued exposure to the hazard. It follows that poor peoples living in poor countries are those most at risk.

B. KEY ISSUES

In some LDC's, Bangladesh being a dramatic example, urban land free of flood risk is hardly to be found. Projects often have to be on less than desirable land.

Technically, the flood problem poses issues at the community level rather than at that of the individual dwelling. The design of flood-free settlements starts with understanding the regime of the flood system of local concern; either riverine or coastal, or combination. National development programming may involve river canalization and irrigation schemes. These may offer the opportunity to reduce the flood risks adjacent and downstream. Such opportunities need to be taken.

Communal protection of coastal areas will relate frequently to the need to achieve protection from surge seas associated with tropical cyclones (Chapter VI, Fig. 6.2).

The technical literature on flood protection assumes a professional command of the problem analysis and project planning process that is seldom available in less developed countries. The literature is seldom directly applicable for it assumes a legal background, a political will and construction capability that is not often to be found.

1. The Hazard

Floods occur in nature as a component part of the system of water circulation throughout atmosphere. Their intensity locally can be magnified if manmade development blocks the natural water passage. When the natural phenomenon is combined with the human disposition to live at the water's edge, disaster may ensue.

Flooding comes about when the surface flow of water is greater than the normal carrying capacity of a stream, or where coastal waters exceed normal high tide. Rivers flood when waters overflow their channel. Coastal floods generally result from the high waters associated with surges accompanying tropical cyclones or the seismic sea waves known as tsunamis. Coastal lowlands flooded by the angry sea can also receive secondary flooding as the waters from the mountains behind the coast send down the heavy run off that is often associated with the rainstorms that accompany or follow a tropical cyclone. Such floods can be particularly severe for the waters arrive in flooded channels and floodplains in areas whose vegetation, wetlands and lagoons are already inundated.

There are many everyday advantages to living in river valleys, around lakes and near wetlands so it can be assumed that settlement in such locations will continue. If

disasters are to be avoided the most exposed locations will need to be evacuated, either permanently or at times of risk. Escape routes may be devised (Figure 6.3), land and water resources managed (Figure 8.1) and individual buildings sited to lower the risk (Figure 8.3) and be proofed for protection where this can be afforded.

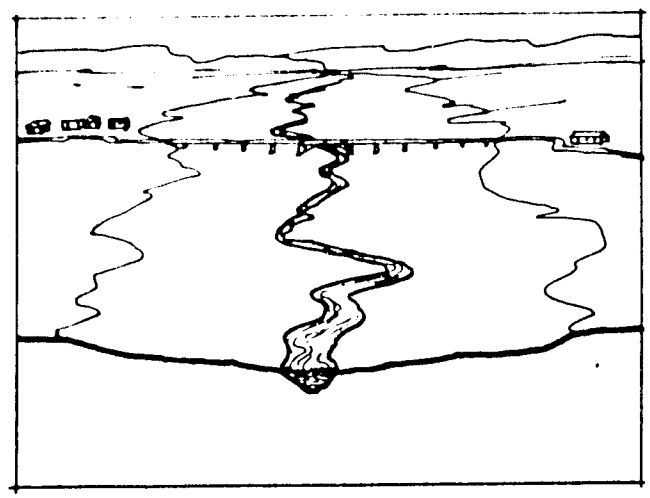


FIGURE 8.1
Land use planning and management can remove many from the flood risk areas. These areas, however, are often very desirable in other ways.

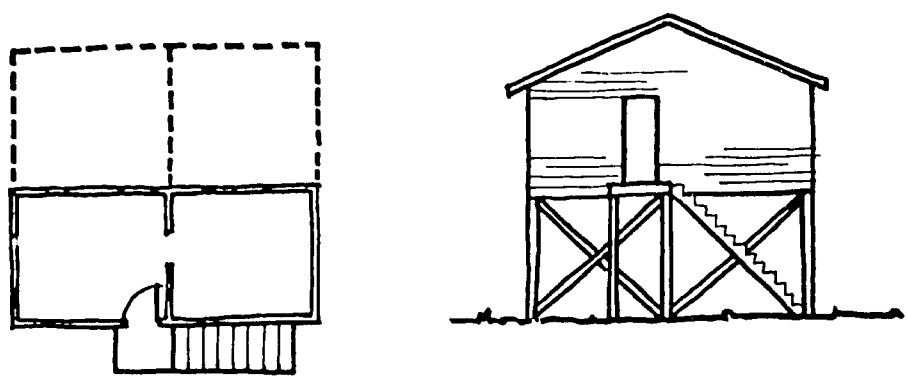
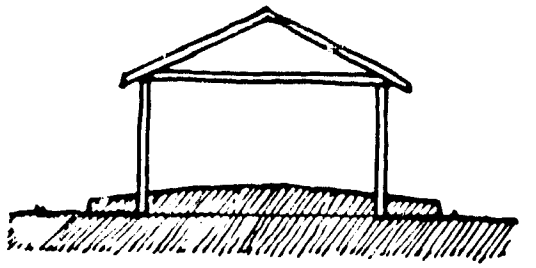
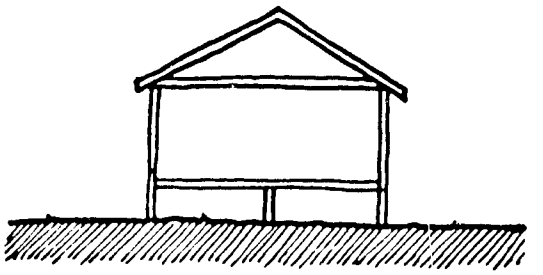


FIGURE 8.2
Raising of the level of living above the design flood. Building on stilts.



a.



b.

FIGURE 8.3
Raising the level of living above the design flood.

a. Use of earth mound.

b. Use of raised floor.

C. KEY CONCEPTS

Few countries do not show some interest in flood protection at national, sub-regional, community or individual household level. Dikes, levees, evacuation at time of flood risk and the raising of houses on stilts are common reactions. Coordinated area policies and programs are rather less common.

1. Strategies for Flood Damage Reduction

Since the contributary causes of floods are manifold and partly man-created, it is to be expected that appropriate policies and programs to combat the effects will exhibit a mix of strategies that relate to a greater or lesser extent to specific riverine and coastal situations.

(a) Channel control through banking and rerouting.

(b) Control and guidance of urban development.

(c) Land use plans and land management.

(d) Relocation.

(e) Floodproofing of buildings.

(f) Safety refuges in buildings.

(g) Forecasting, warnings and preparedness.

(h) Relief and recovery operations.

2. Channel Control

This is often too costly an operation for it to have general application but it will be appropriate to certain central areas and haboursides where there is high economic and social value. In poor urban communities and in small towns where community labor can be organized, it may be more worthwhile for the community to work together to deepen a channel or raise the banks than it would be for individual house owners to raise their properties on stilts. The frequency of the flood of high severity will contribute to the visible cost benefit of making the large scale response to the risk. If there is no cost benefit, such works are not likely to be carried through.

3. Land Use Planning and Management

In theory, this is an economical and non-structural way of ensuring that the risks are not made worse by further ill-placed development in the floodways or floodplain (Figure 8.1). However, since the social tendency is to settle in floodplains, land planning guidance and controls are not readily welcomed.

A combination of demonstration, guidance and inducement (i.e. through loans being linked to low risk sites) may be more effective in lowering community risks. A post-disaster situation may offer an opportunity to zone new land for urban use in areas of less risk. Within site boundaries, these areas least at risk would receive priority development under the fast track approach.

4. Relocation

Where neighborhoods along estuaries and sandbars are frequently at risk, the question of relocation of the inhabitants of highly explosed areas has to be considered, preferably in the context of a wider land use plan. For poorer people, the loss of access to their traditional sources of income will be a crucial matter. This, and the payment of compensation for loss of lands, offers major obstacles to the carrying through of relocation in a fair manner. The need to work with a community over the matter of its own relocation makes it a protracted exercise. A median policy is to make relocation lots available to a community at risk. This would reduce density in danger areas and permit upgrading of flood precautions, channels and sidewalks.

5. Floodproofing of Dwellings

This is more easily done for the rich than the poor. Floodproofing of individual dwellings is possible but is highly interrelated to the social and economic level of occupiers and their access to the urban type building process.

If the saving of life is taken as the policy focus rather than the proofing of buildings, then raising houses on individual mounds so that their roof spaces are above the design flood level is a sound practice. The mound should not be of loams and silts and the roof or roof choice should be made, if possible, to offer a 24-hour refuge (Figure 8.3).

6. Forecasting, Warnings and Preparedness

These topics extend beyond the province of the shelter adviser but do precipitate concern for rescue services which would be needed if a house refuge design program were to be credible. Preparedness includes the provision of some high level roads through the floodplain and residential areas of cities so that escape routes are available. These high level roads can also be designed as levees or alternatively have plenty of conduits so that drainage is not impeded (Figures 6.2 and 6.3).

7. The Design Flood

It is not possible to either land plan or construct defenses that will guard against every possible flood that threatens a development site. In order to proceed, a vulnerability analysis has to be undertaken in which hazards, risks and settlement situations are appraised and a theoretical design flood established. It is against this design flood that precautionary measures are then taken. This flood will be defined in terms of its location and levels and frequency of return: 10, 50 or 100 years.

To establish the design flood hazard data is assembled and folk reports appraised. Hydrologic data is studied from past records where these are available and flood hazard boundaries for differing degrees of flooding are established so that channel, floodways and floodfringes are defined; exposed coast areas, wetlands and shallows. The flood hazard boundaries when mapped then become significant in terms of action for they define the nature of risks at particular locations. Such definitions will need periodic revision for the addition of development (for example) anywhere in a floodplain will alter the nature of risks downstream. The filling in of wells or the draining of lagoons will also effect the severity of a flood for natural drainage will have been reduced in capacity.

The design flood becomes a designers brief. It should present for various locations flood depth, water velocity and duration of flood. Duration is a function of the rise in waters and fall which is related to run off capacity and absorbent capacity of adjoining ground and wetlands. Duration of flood will affect the saturation of soils, earthplatforms and bunds, saturation of building materials, seepage and the length of time that services may be out of operation. Frequency will be a function of the design flood and will highlight the need for high level escape lanes out of residential areas. High ground water levels are often a feature of riverine and coastal situations. This condition leads in flood to uplift pressures on foundations being experienced that much earlier during the flood.

Within the general overall setting the specific location of drainage channels, wetlands, erosion patterns and of high and low areas will affect flood risks and patterns within the site boundary. The character of soils and the slope of sites will affect general building stability and the vulnerability of buildings at particular locations to movement and damage during the flood period.

8. Flood Resistant Dwelling Design

It will be plain by this point that good practice in flood resistant building design starts with siting to avoid the risk, the construction of site defenses if site is in highly exposed position, site planning to achieve good drainage and escape lanes, building on the best bearing soil and highest land on the defined site.

Individual buildings can be protected by having minimum width openings which are then designed to be blocked during the flood by sealed panels or by sandbags. Traditionally, many buildings in flood locations have been raised on stilts (Figure 8.2). This does, however, raise the risk of being damaged seriously in a cyclone since exposure is increased dramatically. Another tradition is to build a dwelling on its own individual mound (Figure 8.3).

Buildings composed of wattle and daub or having infill earthen walls are very vulnerable in flood. Where the design flood level reaches only a few feet such buildings should have the lower parts of their walls built of blockwork or brick to this level.

9. Building Design and Zoning

For specific parts of towns it becomes a policy matter, and one best decided upon pre-disaster, whether or not an area is to be evacuated, be defended by a flood barrier or designed with individual protection (i.e. mounds, tanked bottom walls or stilts). The important thing is to have a policy and make it public so that the populations of particular areas know under what "system" they are to live.

D. PEOPLE AND ORGANIZATIONS

1. Programs

Capability in flood control works can be developed in executive departments of Ministries of Public Works, Irrigation and Coastal Protection.

2. Technical Assistance

Where capability in planning flood reduction schemes is missing, then direct technical assistance to post-disaster project preparation teams may be required.

Technical assistance may also be useful for those towns who have decided to unite public expenditure and town labor to achieve improved canalization or river banks.

E. POTENTIAL ROLES FOR AID

1. Information Sharing

U.S. technical publications on flood control measures for coastal, agricultural, irrigation and civil engineers.

2. Technical Assistance

(a) Interpretation of U.S. techniques for application in LDC's.

(b) Specific assistance with engineering of particular projects.

(c) Organization of community labor in water control works and the achievement of quality control.

3. Training

(a) In coastal and riverine protection work.

(b) In siting and building houses for flood protection.

4. Preparedness Planning

(a) Mapping of locations exposed to flood from river or sea and designating degree of exposure to risk.

(b) Vulnerability mapping to be introduced into physical planning and executive decision.

(c) Design of flood warning systems.

(d) Maintenance of flood escape routes.

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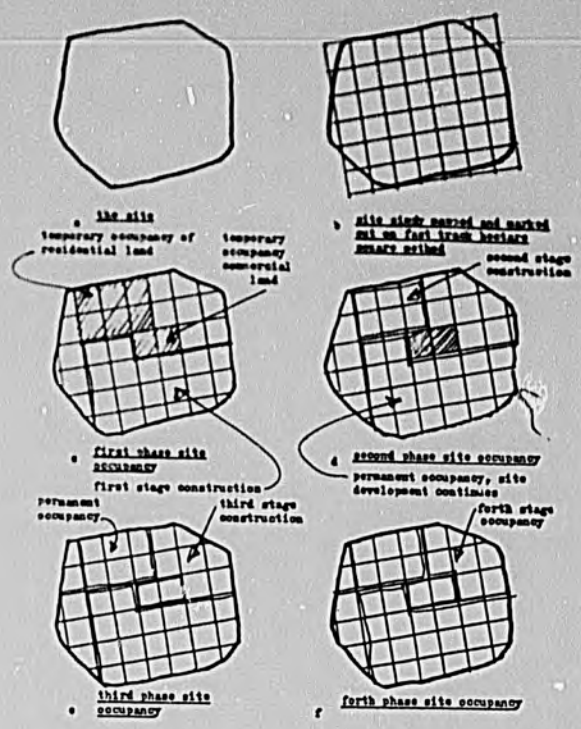
PART III

PROJECT PREPARATION AND IMPLEMENTATION



CHAPTER IX
PROGRAM AND PROJECT PREPARATION

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CHAPTER IX

PROGRAM AND PROJECT PREPARATION

A. DETERMINING PROJECT FEASIBILITY

There are two main steps by which project feasibility is determined.

1. Need Determination

The post-disaster shelter assessment should be structured to provide program planners with information on the different groups of disaster victims and their requirements for rehousing. Information to be gathered includes:

(a) The number of homeless and landless families. The percentage of this group as a total of all victim families.

(b) Characteristics of the groups, including income levels, percentage of loss, economic viability, estimated numbers and percent with post-disaster jobs and an estimation of their financial ability to participate in a program.

A rapid survey is required and Mission staff should attempt to gather rough estimates rather than precise numbers.

Once family needs have been identified, the Mission should determine what actions other agencies are taking to meet those needs. Other relief organizations will also provide aid. Their plans should be taken into account before the Mission decides which activities to undertake in a particular area and with which groups of the population. The transition housing problem is identified at this stage.

2. Establishing that Conditions Exist for a Project

When the victims' needs have been ascertained, it can be determined whether or not conditions exist for a particular type of project. In terms of an accelerated conventional housing project, the Mission will determine not only that the social need exists, but also that mechanisms exist which will allow implementation. Important concerns are:

(a) That land acquisition can be accomplished without undue restraint or delays.

(b) That financial mechanisms exist whereby funds can be transferred (perhaps from USAID) for the purpose of land acquisition and house construction.

(c) That organizations which can serve as project holders are established, available and experienced.

(d) That the economic environment of the post-disaster situation will permit loan programs.

B. SELECTING A PROJECT HOLDER OR IMPLEMENTER

Normally, a project holder will be a branch of the national government, a semi-public organization, an intergovernmental organization or a private non-government organization located in the host country. The Mission will determine whether the project holder is capable of conducting the project and seeing it through. Among the qualifications which should be considered are:

(1) Previous experience and responsibility in the type of program proposed.

(2) Previous experience in housing programs.

(3) Previous experience with loan programs.

(4) Technical capabilities.

(5) Managerial capabilities.

(6) Long-term commitment to the project (assuming here that there will be owner participation in house completion and expansion).

(7) Capacity to mobilize and coordinate the variety of relevant public and private entities whose effective participation is necessary.

C. INITIAL ACTIONS

Once an agency has decided on a certain course of action in collaboration with the Mission, the next step is to define precisely what the project hopes to achieve and to establish a framework for guiding later decisions. To do this, an agency will need to set its policies, establish goals and objectives, select the strategy and approaches by which the objectives will be attained and gather necessary information.

1. Policy Setting

Policies are the tool used to shape the response to the disaster and the identified need. Policies provide a standard by which choices are measured. Setting policies is one of the key program planning steps. Yet it is often neglected. Ideally, the Mission will have set its policies as part of its preparedness activities and thus when a disaster occurs those in the Mission involved in the initial program development will have some guidance to structure their decision making. If policies are not set as part of preparedness, it should be the initial post-disaster program planning activity. This will also apply to the host country housing agencies.

2. Objectives

Each objective should be put in a narrative form, and should describe what the Mission hopes to accomplish by each set of actions. The establishment of objectives is the time to discuss how programs in different sectors can be tied together to attain broader results. The Mission should strive for overall balance between programs.

3. Goal Setting

Goal setting is the quantification of the objectives. The purpose is to determine how much assistance is going to be provided and how many beneficiaries will receive aid. It is at this point that the Mission will balance its desire to help the victims against a realistic assessment of the capabilities of the project holder. The relationship of project components that deal with transition conditions to these components that deal with permanent occupancy are identified at this point.

4. Determination of Strategies and Approaches

A strategy is a plan for attaining a goal, while an approach is the method used. Among the strategies which need to be considered and developed for a conventional housing project are:

(a) Rapid land acquisition mechanisms.

(b) Strategies by which the site can be occupied by disaster-hit families at an early date: transition and permanent early occupancy.

(c) Strategies for phasing the occupancy of the site.

(d) Strategies for counteracting increases in land prices.

(e) Strategies for holding the project open and available for intended beneficiaries (i.e. ensuring land invasions do not occur).

5. Information Acquisition

Information needs may be divided into three categories:

(a) General information about the society, the people, their customs, traditions, housing, etc.

(b) Technical information about reconstruction and methods for rebuilding safe structures.

(c) Program information, the information upon which program planning decisions can be made, including:

- Identification of potential sites.
- Procedural and legal data relating to land acquisition.
- Economic information concerning the feasibility of proposed loan schemes.
- Statistical information concerning the disaster victims and their capabilities in the post-disaster situation.

D. PROGRAM ORGANIZATION

This entails allocating resources, developing the management component and initiating the project.

1. Resource Allocation

It is important to balance the allocation of resources, especially money, and to develop an appropriate mix of project responses. There are a number of ways in which funds can be stretched. They are:

a. Linkage to Other Programs

The methods usually considered are cost sharing, pooling of resources or contributing matching funds.

b. Recoverable Funding

In recoverable funding, all or a portion of the funds distributed are returned to the program, usually for reinvestment in the project activities. The most common examples are:

- Revolving loans.
- Sales.
- Subsidy schemes.

Recoverable funding increases the number of people who can be served, and extends the service of the cash originally committed.

c. Maximization of Buying Power

This refers to the practice of using the program money in such a way that either the programs or the beneficiaries financial power is extended. For example, if a loan program is going to be used in conjunction with the housing project, the agency may be able to find other institutions to make the loans and use its own funds to guarantee the loans. In this manner, an amount of, say, $100,000 could be used to guarantee up to $1,000,000 or more in loans, thus increasing ten-fold the purchasing power of the money that the Mission has on hand.

d. Multiple Objective Planning

In multiple objective planning, expenditures are targeted so that more than one objective is reached with each disbursement. For example, on the site for the conventional housing project, a work project is established to install utilities and build roads. The beneficiaries of the housing project are hired to help with construction. The people are paid in cash, credits or in coupons which are redeemable in nearby, adjacent markets. the specific objectives to be reached are the improvement of the site, income to the victims and stimulation of nearby markets. Overall, objectives are progressing, economic recovery of victims and stimulation of the markets.

2. Program Management Planning

Activities include establishment of a table of organization, developing a budget (see Annex III), establishing the program sequence and hiring of staff and consultants to support the work of the project holder.

a. Establishing a Table of Organization

Tables of organization have a subtle effect on the way in which programs are executed. The table of organization establishes lines of authority, responsibility and lines of communication. Care must be taken that the flow of information is not inhibited in any direction.

The table of organization should ensure that there are channels which allow those at lower echelons of a program to have access to the persons in authority. This may be achieved by establishing joint committees of project workers and program beneficiaries.

3. Staffing

There are two tendencies. One is to use volunteers to reduce costs. The second is to use professional sub-contractors to increase the speed. Both have their advantages and drawbacks. Volunteers normally will only work for a short period of time and, therefore, cannot be relied on during later stages of project execution. Volunteers may, however, be usefully recruited specifically for the house completion and expansion stages where these are to be self-help activities. Professional sub-contractors can increase speed of project preparation but project recipients or other disaster victims may feel that they should be given a larger share of the planning work.

4. Budgeting

Due to the nature of post-disaster funding, reconstruction agencies rarely know precisely how much money they will have. This, coupled with inflation and uncertainties in the post-disaster environment make it difficult to allocate financial resources and to properly budget.

A budget needs to be adaptable and allow for inflation. The initial document, formulated immediately after a disaster, should be regarded only as a planning tool and not the final document or instrument of financial control. A large portion of the preliminary budget should be left uncommitted so that the project staff can adapt to changing situations that are recognized at a later date.

A suggested format for estimating initial budgets for a conventional housing project is shown in Annex IV.

E. PROJECT MANAGEMENT SYSTEMS

Because managing a conventional housing project is a complex activity, a method for managing and monitoring activities and progress has to be agreed upon. Flow charts can be used in two ways.

(1) To plan and sequence a program where the resources and events and objectives are known in advance.

(2) To illustrate a plan for responding to a situation which is not yet fully known.

Through adopting the flow charting process, the implementing agency is forced to formulate a plan for the entire project. The flow chart can thus become an instrument for project management.

F. MONITORING

Throughout the course of a program, it is important to analyze actions and events. Incoming information is used to determine the performance and progress towards objectives. It is important to determine:

(1) Whether or not the program is proceeding according to schedule.

(2) Cash flow.

(3) Overall performance of staff.

(4) The overall performance of the program.

(5) Identification of bottlenecks and obstacles which cause delays or which require reassessing.

Monitoring is a continuous process and provides a basis for making adjustments while the post-disaster project is in progress.

G. SEQUENCING OF ACTIVITIES

A chart outlines activities related to a conventional housing project and the particular phase in which it is appropriate that be conducted (Chapter X, Fig. 10.1).

H. PROJECT IDENTIFICATION AND DESIGN CONCEPT

There is need to give early attention to the conceptualization of a project. This concept should allow a response to be made that bridges victims needs within weeks of the disaster, during the first year post-disaster and continuing on into a developmental situation over the years to come.

A main theme in project conceptualization is that of planning to achieve rapid site development and early stage occupancy by victims. It is recognized that the victims sited to a land development project are those who lost the house sites in the disaster

through landslip, earthquake or flood waters and those whose tenancy was insecure prior to disaster and after was non-existent.

The disaster situation has precipitated the emergency project planning situation. But those who come to occupy the site will be eventually part of a permanent community that has to function long after the disaster is forgotten.

The project concept is to be thought of as being the organizing idea that is brought to the site and to the post-disaster situation in order to speedily shape up a project. The concept includes:

(1) The disposition of physical planning elements.

(2) A means of rapidly structuring decisions on location.

(3) Temporary occupancy and early permanent occupancy for victims.

(4) Staged construction (Chapter X).

(5) Provision for different income groups.

(6) Provision for a range of starting points for lot occupancy related to affordability.

1. The Large Scale Project

The prototype considered is large in scale. The term "large" is relative to the size and character of the adjacent urban setting, but generally the size of the site and number of families housed will constitute a significant, identifiable new sector of the city. The project development range is from 1,000 to 25,000 families.

The alternative type of project considered is small-scale. Again, size is relative, but the principles of this project development would be applicable from 50 to approximately 500 families.

The following project conceptualization process assumes certain actions have already been taken:

(a) A needs assessment has identified the number of families that qualify for and would predictably occupy the project and has defined the income levels of those families.

(b) The site selection and acquisition process has been completed. The size of the site (or sites in a split-site project) is a function of the standard for lot size per family plus areas for circulation, public and commercial spaces.

(c) Site development consideration and analysis have been completed and have already determined the project's feasibility.

Planning the implementation of the project needs to be seen as part of the project concept stage. It begins with establishing at what points in time the site will be ready for occupancy for each income level. With that determined, a strategy for the

temporary housing of victims and the staging of their movement to the new site can then be developed.

For the purpose of characterizing the various income levels, the following definitions are used:

2. Income Level Groups: Disaster Households

(a) Middle Class. Capable of purchasing a lot with all service connections together with a completed house or a privately-built house.

(b) Moderate Income. Capable of purchasing a lot with all service connections and a core (or shell unit) with one or two rooms.

(c) Low Income. Capable of purchasing site, all service connections and a serviced core. House to be completed with self-help and or the traditional building process.

(d) Very Low Income. Capable of purchasing site with service connections. House to be built with self-help and/or traditional building process.

Using the needs assessment data, the first step is to determine the number of families eligible for the project, the percentage of those eligible likely to move onto the project site and the number of families within each income band that are to be provided for.

I. STRATEGIES FOR TEMPORARY ACCOMMODATION OF VICTIMS

The intended users of the AID-supported post-disaster site development project are likely to be the landless and untenured victims. The provision of shelter to this segment of the disaster population is often difficult because of:

(1) Logistical questions of where to locate them.

(2) Political questions of how to support a population with an inherently weak power base.

(3) The economic reason that providing a solution for this group is likely to cost more per victim family for donors than a program that helps people to rebuild on their previously occupied lots.

The new project site approach directly addresses the issues within (1) and (2) above. But the project planner will still need to devise a strategy on how to provide shelter for the victims until they are able to move onto their new site.

The options available to the planner will vary widely, depending upon the circumstances after the disaster.

(1) The ideal solution is to house the victims in pre-existing permanent public structures such as schools, until they can move to their new site. This solution, however, may be only feasible for a limited time if the sanitary

facilities are too over-extended or if building owner's set an early date by which they have to leave.

(2) The victims may be housed in temporary structures that are located on temporary sites. As with option (1), it will be necessary to make it obvious to all that the intended future residents of the project are living in clearly recognizable temporary conditions and that the conversion of them to permanent status would not be tolerable socially or politically.

The temporary structures could, of course, be tents. Preferable, though, would be a structure of materials that can be re-used at the permanent site, such as corrugated iron roofing and wood framing.

More crucial is the selection of the sites. They need to be carefully selected to be sites the public will not accept as being converted permanently to housing. Examples are public parks, within rights-of-way of streets, or land whose commercial value precludes housing.

(3) If it is not possible to provide shelter off-site for the victims until the site is ready, it may be necessary to provide temporary shelter on-site for the victims. It may be necessary to provide temporary shelter on-site as part of the project design. There are two ways to do this:

(a) Construct temporary shelters on the lots dedicated to commercial or public use. They should be built and sited so as not to interfere with the work on the residential sites. The cost of these temporary shelters will form part of the total project cost. It is, therefore, very important that the shelters be built of entirely re-usable materials as a means of maximizing the impact of the funds available to the project as a whole.

(b) In some cases there may be insufficient land to locate the victims on commercial or public sites. This may require the temporary location of shelters on a portion of the project site destined for housing during the time of the construction of the rest of the project. Upon the completion of construction of the permanent sites, the victims would be relocated to them and the construction would proceed on the sites vacated by the victims. If this is followed, the total number of moves by a family is kept to a minimum.

The following diagram suggests one scenario for site development concurrent with temporary site occupancy. It makes the assumption, illustrated graphically, that the temporary shelter is three times as dense as the permanent density (Figure 9.1). A standard specification for a temporary camp is given in Table 5.1.

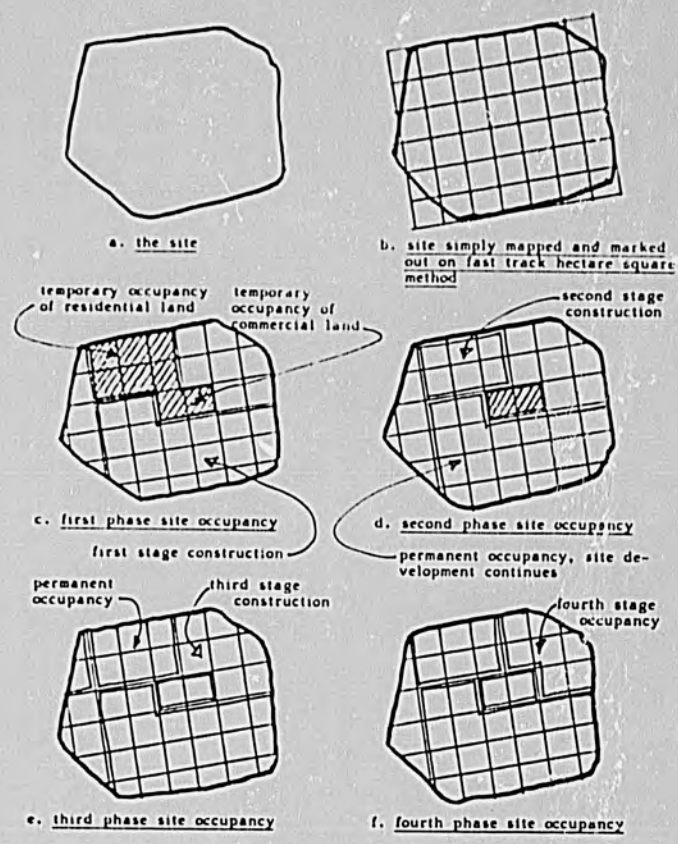

FIGURE 9.1
Conceptual sequence: phasing of site occupancy using commercial sites for temporary housing use.

J. PHASING DEVELOPMENT

The project conceptualization does not presuppose a specific or ultimate level of development for any of the income levels. Instead, it suggests a strategy for continuous development and assumes the need to rapidly develop the site to prepare it for occupancy as quickly as possible. The following are important to the achievement of this.

(1) The initial scope of development of roads, water supply, drainage, sewage and other urban services (as per evolutionary standards approach of Chapter IV).

(2) The approach to evolutionary standards of site development and house completion (i.e. rapid site development and occupancy) assumes some families moving onto the site at the earliest possible time. The host country may have standards for "sites and services" projects during normal

times. These standards would likely take more than a year to meet should they include such items as curb and gutter, water faucet on each site, lateral hook-up to sewer, street lighting, electricity to the site and fences built on property lines. Following through the evolutionary standard for a very low income site could start with a graded roadway, community water tank supplied by a truck, single- or multi-family latrines and staked-out sites. At this point, low and very low income victims could move onto the site. The incremental improvements in the services can be continued as the years pass, albeit with some decrease in efficiency (and increase in costs) due to the presence of the families on-site.

(3) The standards for disaster avoiding site selection and construction techniques (see Chapter III).

(4) The follow-up sequence of development, such as upgrading or extending services. Plan the development to ensure that work accomplished during the initial stages does not conflict with later development (e.g. plan for laying of water and sewer lines in the road right-of-way before the road is paved or clearly separate the reservations if uitlities are to follow late). Do not build permanent fences at the back of a lot if it is later to be a utility right-of-way. Plan for temporary connections if needed for early occupied areas.

(5) The determination of policy on the order of occupancy of the site, by income level and the relative proportion of each income level. For example, it is probable that the largest number of victims are among the poorest. Their urgency to move out of temporary accommodation is probably the greatest. However, the very low income sites are the most easily and quickly urbanized. Allow these victims to move onto their sites as soon as they are ready, while work continues on the development of the middle-through-low income sites.

The next largest and most in need of resettlement may be the low income group. As soon as the core or shell is complete, they could occupy their sites. A similar occupancy procedure would follow for the moderate income group.

(6) The phasing considered above relates both to the scheme as a whole and specifically to each development hectare. A bar chart showing the timing of each hectare for construction and occupancy would be a needed implementation tool (Figure 10.1).

K. SITE PLANNING WITH MODULE/GRID

The need for rapid site development requires a speedy method of site planning. While not overlooking any of the concerns of site analysis, a method of site planning must be used that achieves a finished plan within a very abbreviated time span.

The following example is of a specific technique that facilitates rapid analysis and rapid planning:

A grid system is delineated with the basic module being 100 meters by 100 meters (32 feet by 32 feet). These modules are bounded by elements of the site circulation

system of roads and paths and further subdivided into individual lots. The size of the lots may vary and be selected in accord with target group needs, cultural acceptability and cost effectiveness. (Examples are shown in Figure 9.2.)

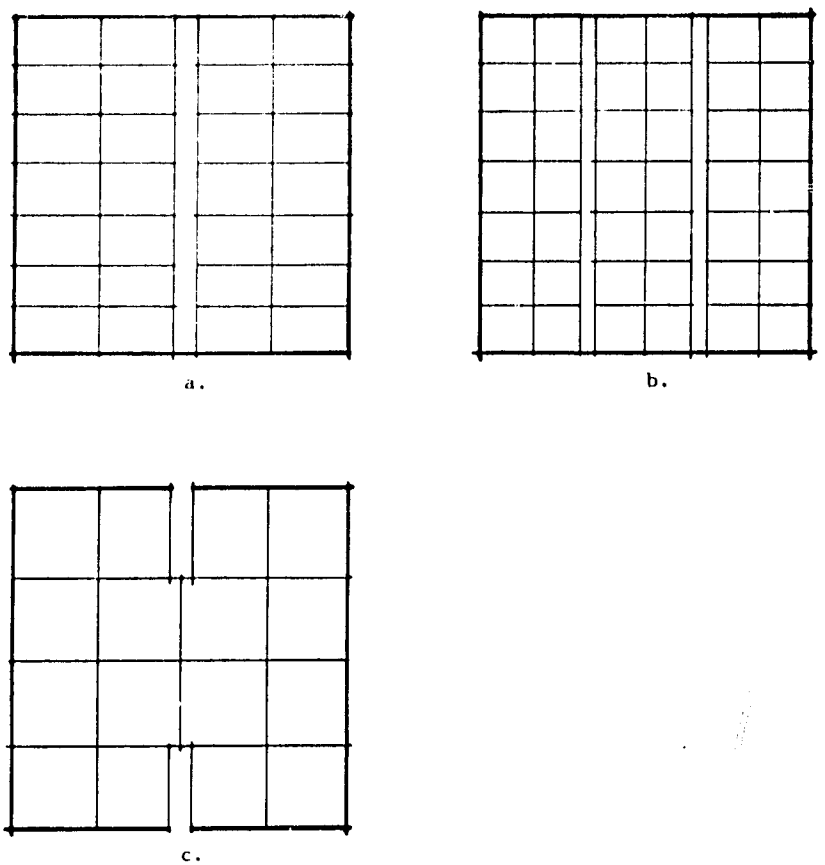

FIGURE 9.2
Schematic divisions of lots in one hectare planning grids. Choice of lot size, proportion and access is a function of local analysis.

These 100 x 100 modules are aggregated together to form groupings of 8, 10, or 12 modules, thereby forming sub-neighborhood sections (Figure 9.3).

To prepare the site plan:

(1) Draw up a base map of the project site at a scale such as 1:1000. Locate boundaries and all physical features giving attention to those that may increase disaster risks (Chapter IV). The base map can be prepared from a survey, blown up from other maps already available, or taken from aerial photographs.

(2) On transluscent paper, draw up (at the same scale as the base map) a grid pattern of the 100 x 100 modules. This drawing should cover a larger area than just the project site.

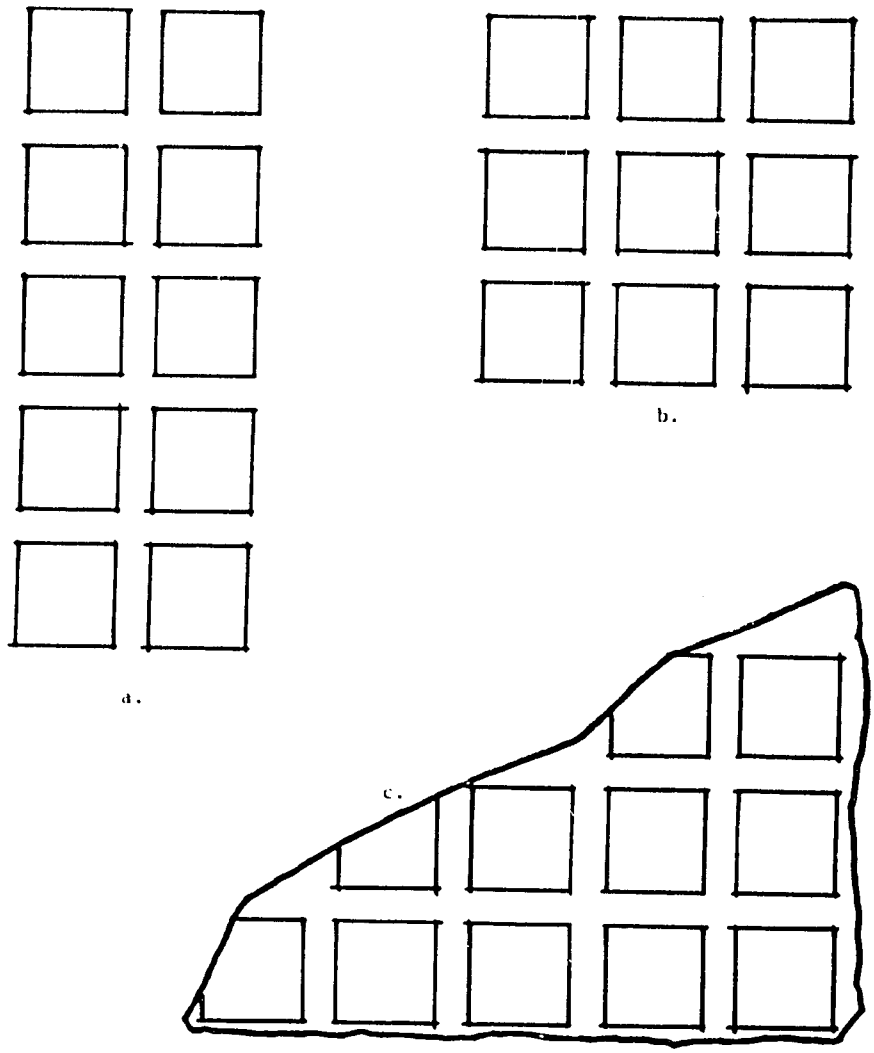

FIGURE 9.3
The hectare grid as planning tool. The grid method is adopted as a service to rapid development. It should not be allowed to dominate and lead the planner into foolish decisions. It should be allowed to direct the plan but not control it.

(3) Overlay the grid pattern over the base map. Reposition the grid overlay several times to seek out an optimum relationship between grid and site that would achieve the following objectives:

(a) The most compatible relationship between road system and topography (roads not too steep).

(b) The optimum circulation system and linkage to off-site system.

(c) Minimizing the conflict with the site's natural features (e.g. a principal road should cross a drainage channel as few times as possible).

(d) Land without the hectare units and within that is not suited for building is allocated for community open space or other uses.

Review Chapter IV for other site planning considerations that may be relevant.

(4) Select the optimum grid pattern and draw it on the base map.

(5) Visit site with land surveyor and check utility of proposals in light of site conditions. Revise or appropriate to lower development costs.

(6) Prepare a land use plan according to the following:

(a) On large sites develop with a diverse mix of income groups. There are several distinct advantages for this:

- Social. There exists the opportunity for an exchange at the community/public level of positive complementary qualities. The lower income levels bring popular leadership and help define the agenda for community development. The middle income groups bring technical skills and services.

- Economic. The lower income group may secure employment in the construction of the houses of the middle income groups. After completion of construction, the middle income groups may offer employment to their lower income neighbors for domestic or other work.

(b) It is assumed that for most societies where an AID project will be built that includes an income mix, the income levels will be separated physically from each other. The acceptability of the project may in fact require such separation. Therefore, identify the lots with the highest market value as the middle income level sites. The number of sites would, of course, agree with the planned number of middle income project participants. These sites would likely be on a major street on the edge of the project, buffered from the rest of the project through landscaping or other physical means, and in general be as desirable as competitive housing normally available.

(c) The moderate income sites would be those bearing the second highest market value and could be planned to define the spine or "main street" of the project. Their value derives from being on a major neighborhood street, from their potential to house small shops and perhaps from their larger area than the lower income sites.

(d) The low income and very low income sites comprise the remaining residential sites. An important social argument can be made for bringing together and mixing modules of these two groups. However, the different degree and timing of the supply of services may necessitate that the two groupings are kept in distinct sectors.

(e) The remainder of the project site is devoted to open spaces, commercial and institutional uses. While not located on prime housing land, these functions are not simply assigned "leftover" sites, but rather are carefully placed to maximize their utility, convenience to the population and their market value. Cross-subsidies may form a component in the project concept. (See Figure 9.4 for a schematic site plan.)

(7) Stake out roads and lots at the project site making adjustments within hectares to accord with ground conditions.

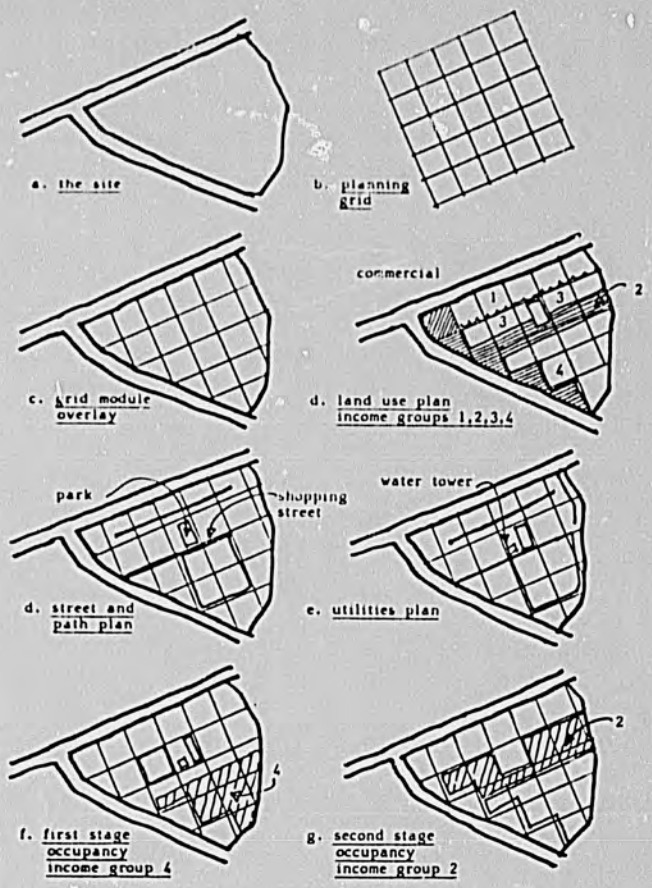

FIGURE 9.4
Sequence in fast track physical planning and development.

The project should now be ready to let out the first stage of construction development. The starting point for Stage 1 construction will be on those residential hectares where development costs are low and physical difficulties slight. Stage 1 is also likely to include site drainage and the construction of site residential artery roads.

8. Small Site Projects

The process of site selection, planning and development is essentially the same for either the large or small project. The small project differs from the large in the following ways.

(a) It is likely limited to a single income group or to two groups.

(b) For small sites that are located within the basic fabric of a city, connecting to the existing urban infrastructure may be a relatively minor matter of extending this infrastructure. Consequently, it may be possible to bypass some of the temporary installation of services.

(c) For small sites that are located substantially apart from an urbanized center, it may never be feasible to connect the new sites' services to the existing services. Consequently, a longer range view of the initial temporary services may be necessary.

(d) When the victims are living in temporary accommodation away from the site it may be possible to develop the entire site in one construction stage.

9. Issues in Project Financing

The large scale project with its multi-level income mixture is conceptualized as adhering to customary AID finance policies. The middle income portion would tend to serve the maximum income qualified for support while the low income portion would serve the minimum level.

However, if the very low income victims fall below the minimum qualifications, the overall project should include alternative means of helping them. For example, AID might require that the site actually acquired be large enough for the very low income and be subsequently planned to include lots for them. Although AID may only be able to support the financing of middle, moderate and low income, creative site planning can bring roads and minimal services to the sites for the very low income. Financing may be through a cross subsidy or by a non-USAID supported agency.

A fundamental objective in post-disaster reconstruction is to utilize the very limited available financial resources in a way to maximize their impact. In the context of the recommended rapid site development, there are various ways to achieve this (i.e. the sale of the middle income sites at an above cost price can be used to finance the second phase of the site development of the low income sites).

A neglected aspect of finance is the impact that any particular financing method has on the lives of the borrowers. Some major considerations are reviewed in Annex III, "Financing Systems: The Experience of the Assisted."

L. POTENTIAL ROLES FOR AID

(1) When the assessment of needs reveals there is a significant number of victim families who have no land on which to rebuild, AID could advocate the rapid site development approach to the national government.

(2) Provide technical assistance to the implementing agency for:

(a) Suggestions on rapid site acquisition.

(b) Site surveying.

(c) Site planning.

(d) Recommendations on financing systems.

(e) Recommendations on strategies for temporary victim shelter, phasing of site development to achieve as early site occupancy as possible, staging of movement of victims to their sites.

M. LESSONS LEARNED

(1) Without some fast tracking devices in project design and in particular in physical planning, the conventional housing project will take too long to prepare to have much relevance to a post-disaster program.

(2) Because occupancy of site by households parallels construction, the problems of site management and human organization are not dissimilar to those encountered on neighborhood upgrading projects.

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Morataya, J.; Ing, J.C. Sanitation in Emergency Camps, Regional School of Sanitary Engineering, University of San Carlos, Guatemala (November 1976).

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SATA. Manual for Rural Water Supply, Swiss Association for Technical Assistance (1975).

CHECKLIST OF REQUIREMENTS FOR TEMPORARY CAMP LAYOUTS

Think of residential grouping rather than "military" rows.

Areas:

1. Three to four hectares per 1,000 persons (30-40 sq. meters/p).
2. Minimum distance between unit and road — 2 m.
3. Minimum distance between units — 8 m.
4. Minimum floor area of unit (tent) per person — 3 sq. meters.

Water:

1. Points of distribution, maximum distance — 100 m.
2. If source is a tank, capacity 1/2-1 day supply depending on delivery.
3. Source should not drip and get area muddy.
4. 15-20 liters per person per day (4-5 U.S. gal.).

Sewage:

1. One latrine per 20 people.
2. Distance from living units — 30-50 m.
3. Dimensions of latrines:
   a. Shallow trench: width 30 cm, depth 90-150 cm, length 3.0-3.5 m per 100 persons.
   b. Deep trench: width 75-90 cm, depth 1.8-2.4 m, length 3.0-3.5 m per 100 persons.
   c. Bore hole: diameter 40 cm, depth 5-6 m, 1 per 20 persons.

Refuse:

1. One container per 25-50 persons or 4-8 units.
2. Collection daily.
3. Capacity of container — 50-100 liters.
4. Tight lid.

Washing:

Total of 35 liters of water per person per day.

Hands: By latrines, 3 meters long, 3 outlets per 5 latrines.

Bodies:

a. 1 shower per 50 persons in temperate climates.
b. 1 shower per 30 persons in hot climates.
c. Individual stalls, separate for each sex.

Clothes: 1 tub and work area per 20 units.

Dishes: Depends on cooking arrangements.

Drainage
Cooking
Lighting
Health
Recreation

Storage
Fire
Paths/Roads
Administration

CHAPTER X
IMPLEMENTATION MANAGEMENT

A. ORIENTATION
   1. Construction Methods
   2. Review of the Possibilities for Contracting Construction Work

B. KEY ISSUES
   1. Mass Produced Housing and Industrialized Processes
   2. Organization of Component Production through Popular Participartion or Direct Labor Processes
   3 Self-Help and Combined Self-Help/Component Production System's

C. CONSTRUCTION MATERIALS
   1. Project Location
   2. Safety/Permanency
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   6. Cultural Acceptability

D. KEY CONCEPTS and Inspection
   1. The Fast Track Process
   2. The Initial Development Brief
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E. PEOPLE AND ORGANIZATIONS
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F. POTENTIAL ROLES FOR AID
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   2. Technical Assistance
   3. Training
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G. REFERENCES

CHAPTER X

IMPLEMENTATION MANAGEMENT

A. ORIENTATION

1. Construction Methods

No "one" construction approach can be automatically considered most appropriate after a disaster. Rather, the full range of options — from modified traditional techniques to highly sophisticated prefabricated systems — should receive consideration. Some of the factors which may influence the final decision on construction methods include:

(a) Size, capability and capacity of the construction industry after the disaster.

(b) Level and use of industrialized components and "on" and "off-site" industrialized methods.

(c) Type and capability of craft skills which are available.

(d) Design and construction capability for permanent and safe construction.

The availability of materials, the need for rapid construction and the desire for effective participation of project beneficiaries in the building process all are issues which also need to be addressed by the project planner in making a decision.

2. Review of the Possibilities for Contracting Construction Work

Consideration should be given to the possibility of contracting or sub-contracting required construction work to private builders. The elimination of the worries associated with the direct organization of the building process is one of the advantages of contracting. It also increases the possibility of good technical supervision of the various stages of construction which is particularly required for the development of disaster resistant core housing on the site. However, since the tendering process frequently requires more preparation time plus bidding time, delays might result in the commencement of construction. The appointment of a specific contractor for the first stage or the utilization of direct labor contracting could eliminate this particular disadvantage.

The decision as to what form of contract to use will be shaped by the post-disaster situation. However, there are some general observations that can be made:

(1) Use of direct labor contracts. The materials purchasing being undertaken by a host country agency (helped in certain instances perhaps by USAID). This is a somewhat informal method and throws a considerable management task upon the executing agency staff. An advantage is that the same agency can, through its labor selection, give work to the otherwise

unemployed and give preference to those who will later be offered sites on the project. Since there is no profit element to be added to the cost estimates, there is a potential to achieve a low first cost. In practice, this is often not realized due to high costs of labor supervision — necessary in order to achieve disaster-resistant standards of construction.

(2) Competitive bidding. This can be with local or international contractors or with a mixture of both. The disadvantage of this normal method is that the technical preliminaries that have to be undertaken to achieve true competitive bidding take a lot of tme (design, drawing, specification, bills of quantity) and the process of bidding and appraisal itself takes time. For these reasons this method is more appropriate to later stages of a multi-phase contract after disaster.

(3) Appointment of nominated contractor. This has the great advantage that the contractor is known from a very early stage and his technical representatives can be drawn into the planning and design process with the commissioners of the project. The great difficulty is getting a fair nomination process implemented. Who is to nominate? Who is to accept that the nomination is reasonable in the circumstances? The politics of such a nomination are eased somewhat when there is a requirement for three or four nominations to be made for a similar number of equally sized projects. Here the local Chamber of Commerce can be asked to nominate seven or eight names to a joint Government/USAID/other international agency committee who will agree what names to include in a sequence of nominations after making suitable business investigations. In certain circumstances, USAID may prefer to stay outside of such a committee but retain rights of acceptance or rejection of any particular nomination. The appraisal of the most sensible course of action will be part of local consular art on the part of the Mission.

(4) Turnkey contract in which design and planning proposals are prepared by the bidders. This is unsuited to the first stage of a project since determination of what is required depends upon much local discussion. The method may have application to the later construction stages by which tme full Terms of Reference will be preparable based on early stage experience. A weakness of the turnkey approach is the difficulty of incorporating cooperative work with the victims and later occupiers of the scheme.

B. KEY ISSUES

1. Mass Produced Housing and Industrialized Processes

The decision to use industrialized processes in the reconstruction project may be based on one of two conditions: (1) that industrialized processes were already being used prior to the disaster and therefore the development of some areas and levels of industrial processes is possible; or (2) that industrial processes were not used previously and the disaster is seen as an opportunity to introduce and develop some areas. Perhaps, the size of the required construction program has led to a perception of the necessity for them.

The systemization of products, the specialization of labor and the concentration and mechanization of production are some of the basic elements of the industrialized approach to mass housing. These offer the potential advantages of increased production speed, economy of site operations and greater quality control of materials and of the final product. However, they must be carefully evaluated in terms of:

(a) Time. A complex operation will take time to set up.

(b) Investment. The effective continuous utilization of the industrialized operation after the post-disaster crisis is often required in order to justify the investment made.

(c) High Overhead Costs.

(d) Cultural Appropriateness.

(See Chapter II)

Most post-disaster housing efforts will include at least some mass production of simple components such as window frames and doors. This is prefabrication of a kind (i.e. of components, not building systems).

A distinction must be made between the manufacture of specific products as opposed to the industrialization of or rationalization of the building process/structure.

2. Organization of Component Production through Popular Participation or Direct Labor Processes

The decision to utilize direct-hire labor and/or popular participation in the building process can be greatly facilitated by the systematized production of many of the required components. In order to take full advantage of this potential, a careful analysis of the processes required to produce such components is necessary.

a. The Process Required to Produce Components

Once the housing design has been completed, the organization of the mass production of the components of a dwelling unit should take place. In this process, the following steps are considered important.*

(1) Examine and review the design and choice of materials:

- Review the design of the structure and the process of erection of the unit. Determine the proper sequence of operations and which components, if any, can be made off-site or pre-fabricated on-site.

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* Cuny, F. Relief Operation Guidebook, Intertect, Dallas, Texas, 1976.

- Determine what skills are necessary to build the unit.

- Determine the type of transport necessary to deliver materials or components to the site and its availability.

- Develop a construction plan sequencing delivery of materials or components, the construction steps and production of components.

- Determine the number of laborers necessary for each portion of the construction plan and organize them into teams.

(2) Review the labor force. Determinations must be made concerning the capabilities of the labor force and the persons who will supervise the various operations. If the work is to be performed by labor-only contract and by directly contracted labor, the workers should be reviewed in order to:

- Determine the skills available. This includes skills with traditional tools, available building equipment, measuring, mixing and/or skills necessary to build the unit to disaster resistant specifications.

- Locate building team leaders. If possible, try to locate persons with prior construction experience or familiarity with the components and materials to be used. However, the main requirements for team leaders should be that they are leaders and that they understand their tasks.

(3) Train the teams. Whether direct-hire labor or contracted labor, each team should receive thorough instruction in how to build the structure. Emphasis should be on each team's role and the right and wrong ways to construct the unit. In the training process:

- Demonstrate the unit. Pictures, models and drawings can be used to show the teams what they are expected to build.

- Build a unit. Explain each step and demonstrate the proper way to construct it.

- Review the process with each building team leader. Make certain that everyone understands their part and the proper techniques.

- Where skills are in short supply (i.e. block layers able to build square and level walls), then employ the skilled on corners, openings, etc. leaving the less skilled to do the straight runs in between.

(4) Establish a construction program. As soon as the training is completed, begin construction. As the initial teams become familiar with their jobs, review the teams and select new leaders to form other teams. Over a period of weeks, a pyramiding organization should be evolving. As it evolves, the staff should review the entire procedure to determine if any steps could be instigated to speed up the process.

b. The Organization of On-Site Assembly

The production of the components of a dwelling unit will require a complementary system to assemble or erect them on the site. This process can become quite complicated to ensure disaster-resistant construction and requires careful organization. Labor may be usefully divided into various skill and process areas. One team may prepare the site, while another pours footings or erects wall panels. A third or fourth team may be responsible for the erection of the roof structure, etc. Experience has proven that such on-site efforts are much more socially and economically desirable than the shipping of prepackaged assemblies to the site. However, in each case, an individual determination must be made. The most important considerations are: (1) design flexibility; (2) adaptability to climate and site conditions; and (3) the potential contribution to local economic development.

3. Self-Help and Combined Self-Help/Component Production Systems

Methods of construction should be directly related to the skills available for construction. The effective utilization of the existing capacities and skills of the victims of disasters in the reconstruction process frequently achieves priority social and economic goals whose impact transcends the crisis situation. The major considerations in making a determination of strategies include:

(a) The total demand for construction work and the capacity of local contractors to respond rapidly and effectively to needs.

(b) The needs and potential for employment generation among the affected population.

(c) The potential for the reconstruction effort to provide an effective vehicle for cultural and community integration and participation thereby improving acceptability of the solutions provided.

The disadvantages of self-help approaches must also be fully recognized. Frequently, the quality of construction is lower and skills development is time-consuming and sometimes difficult. A substantial effort is required to organize and maintain such programs and the motivation of the participants throughout the construction stage. Some negative trade-offs may have to be accepted in terms of the speed of construction.

The integration of self-help efforts and component production techniques should be considered as a viable option which can maximize the potential advantages of each approach while providing:

(a) Flexibility of design/development.

(b) Construction participation and follow-on community development.

(c) Customized programs and projects.

(d) Incorporation of minimum/resistant construction methods.

(e) Training and education to ensure safe construction.

C. CONSTRUCTION MATERIALS

Clearly the choice of construction materials is directly related to the construction techniques which are utilized. In determining the materials to be utilized, the following considerations are important:

1. Project Location

The availability of materials and their appropriate utilization will depend on site, climate and the attitude to achieving safety and permanency of structure. Post-disaster normal availability may be severely disrupted. Disaster-hit islands may be at the end of a many month supply line. Countries on a mainland may be able to get emergency imports overland from adjacent countries.

2. Safety/Permanency

Economy/safety issues will normally be predominant considerations in the selection of reconstruction materials. Traditional materials which are often both economic and readily available. In the absence of inexpensive alternative materials, methods of their safe use must be developed as part of reconstruction efforts.

3. Future Availability

Materials utilized for housing construction should be readily available to beneficiaries in order that they may modify and add to their house in future without undue hardship. (Where core houses are used, the means of completion and extension should be part of training programs.)

4. Household's Resources of Materials

Materials salvaged from the disaster as well as traditional materials frequently constitute an important resource for victims of disasters and should be effectively utilized whenever possible in reconstruction efforts.

5. Available Technology

The choice of materials will also depend on the availability of technology to produce such materials on the scale required in a timely fashion.

6. Cultural Acceptability

(See Chapter II for development of this theme.)

D. KEY CONCEPTS

1. The Fast Track Process

A "fast track process" suggested in earlier chapters of this manual can be specifically designed to accelerate the construction of houses on a newly acquired site after a disaster in order to overcome the usual constraints and to speed up policy and administrative decisions while allowing better coordination and organization of the construction site. The process is designed to improve site construction performance through early contractor involvement, negotiated contract procedures, strong guidance to contractors in organizing and scheduling work on-site, forward ordering of building materials directly by the responsible agency.

The key management principles recommended for executing the "fast track process" are as follows:

(a) Maximum use of standard size, land use modules, using standard drawings for road designs and drainage.

(b) Precise programming of the critical sequence of development actions.

- Recognition that obtaining access to the site is of the highest priority.
- The allocation of available land to immediate construction based on the minimization of site problems. All prime land, without undue development problems is reserved for housing with minimal open space within the reserved land (thereby placing open space facilities on more difficult areas for later design and development).
- Programming a precise construction program establishing the number and kinds of contractors, the allocation of numbers of houses to each contractor based on the standard area modules, and timing the sequence of development actions (potentially with several contractors operating on different parts of the site).
- Programming all the forward ordering of building materials to insure timely arrival on site. Delivery times may be lengthy. Post-disaster, it may be wise to order some material even prior to house design. Even if it cannot be used on the project for which originally intended it can be resold on the local market.
- Programming a high proportion of infrastructure works such as roads (other than main access roads), footpaths, drainage

works (other than temporary drainage), water supply and sanitation systems to follow on after house construction is completed. This allows additional time for design engineering without holding up house construction. It separates the housing contractors from the infrastructure contractors on a given module, thus increasing the efficiency of both.

(c) Increased management discipline. The imposition of management discipline at all times requires a quick and comprehensive policy decision to be taken by the responsible agency on the Initial Development Brief (see discussion below). Once taken, the approved Initial Development Brief must be kept intact as the management plan for the project without further revision. In turn, the project manager must be given wide powers to implement the Initial Development Brief in the field.

The main advantage to the "fast track process" in the post-disaster situation is that it focuses squarely on the production of the maximum number of housing units as rapidly as possible. The disadvantages of the "fast track process" should always be held in mind: they are within the range of acceptable risk.

The main disadvantages are:

(a) The risk that proceeding with first stage construction in the absence of overall plans and engineering drawings will result in substantial problems and perhaps additional costs at later stages of the project. This risk, while real, is minimized in that the area of a site selected for immediate "fast track development" is selected on the basis of minimum site problems.

(b) The risk that public facilities and open space will not ultimately be located in the theoretically optimal position with regard to service areas of the housing.

(c) The risk that reliance on the standard land modules will result in monotony in overall design. While the use of standard size land area modules clearly limits the design solution, other more interesting designs would only be possible by increasing the costs of urban development and slowing up the construction process. The development of house expansions by beneficiary households will provide variety. In addition, the areas within the site not selected for "fast track development" will allow opportunity later for alternative physical layouts.

2. The Initial Development Brief

The essential document which guides the "fast track process" is the Initial Development Brief. It is the basic checklist of activities involving early decisions which are vital to achieving accelerated house construction on a particular site.

The Initial Development Brief should be prepared for each site as soon as land acquisition has reached a nearly completed status. The Initial Development Brief draws upon all of the work prepared during the program planning process for a particular

affected area and in fact represents the transfer of that material plus site specific material to the design and engineering team. As such it should be prepared by the Project Manager to be assigned to the site and a designer, civil engineer, and cost engineer working as a team. The total time involved in preparing the Initial Development Brief will vary between two weeks and a month for a totally new site.

The audience of the Initial Development Brief is initially the policy-making body responsible for the project and AID, but after approval it should be given to all the participating staff with responsibilities in the development process.

The outline of the coverage of the Initial Development Brief is as follows:

a. Inputs to Development Brief

(1) Site boundary and topographical information at whatever best detail is available from maps, photos and field survey (visual or instrument).

(2) Appraisal to establish major site constraints, access, risk of flooding, poor bearing soils, existing structures, external and internal factors (e.g. local physical planning requirements).

(3) Land use distributions.

(4) Standard house types, plots and mix, reflecting local requirements; including material availability.

b. Outputs Constituting Development Brief Documents

(1) Site constraints: Based on inputs (1) and (2).

- Site areas to be developed within first six months.
- Site areas to be excluded from initial development but to be developed at a later stage (i.e. later access to be ensured).
- Site areas to be permanently excluded from development; indicate reasons.
- Access for contractors plant, materials and other access points for use after development.
- Major grading works to be commenced immediately.
- Major drainage works required immediately.
- Drainage configuration of site, run-off, exit points for surface water; identify off-site works required.
- Soil conditions — indicate constraints upon sewage collection and disposal; identify form of sewage system; on plot or underground piped system; implications for foundation design.

(2) Land use distributions (concept plan as in Chapter 9): Based on site constraints identified at point a. Rough sketch of land use distributions incorporating inputs (3) and (4); appoximate areas calculated; major elements to be indicated:

- Residential areas.
- Commercial facilities/community facilities, P.O.S..
- Reserves for sewage disposal, rubbish removal, water pumping points.
- Location of site management office (if required).

(3) Residential mix: based on input (4):

- Indicate proportional mix of house types and approximate total out-turn based on site constraints and land use distributions.
- Indicate plot size distribution.

(4) Materials and structural system: based on input (4):

- Select materials/structural system; early output to cost planner/contract management/materials purchase.
- Identify special design requirements arising from local materials availability, soil condition, local government regulations, etc.

(5) Civil engineering and services: based on inputs (1), (2) and site constraints, land use distributions:

- Indicate major permanent road alignments and probable phasing of construction in relation to house development phases; 0-3 months, 3-6 months, etc.
- Indicate necessary temporary road alignments and phasing to speed house development.
- Indicate critical engineering works associated with contractor access to first and subsequent phases of house construction (e.g. bridges, culverts).
- Indicate major elements of surface drainage system to be constructed with priority access roads.
- Identify location of water supply: (i) permanent, and (ii) temporary; and necessary land reservations for these works.

- Identify access points for electricity supply and land reservations for overhead lines and sub-stations if known.

(6) Documentation requirements: project manual:

- Description of contract documents including identification of special contracts to be let immediately for: (i) access works, bridges, culverts; (ii) major grading works; (iii) major drainage works; (iv) other works — site office, etc.; (v) field/photo surveys; (vi) special soil surveys.

- Working drawings to be produced, indicating: (i) content, element by element; (ii) form, style and scale; (iii) standard plans and details.

- Specifications associated with (i) and (ii) above.

(7) Cost plan, indicating:

- Rough cost plan based on progressive release of design information, standard plans, assumed PC sums for forward engineering elements and backend services (water, electricity).

- Major unknown cost factors requiring initial authorization by policy-makers before design proceeds (see Appendix IV for typical budget estimate form).

(8) Time frame: based on standard time allowances to be determined by the project agency and AID and adjusted to each project. Project start dates:

- Pre-site works.

- Critical access works.

- Major grading works.

- Major drainage works.

- Design site layout.

- Modify house types.

- Contract negotiations.

- Site civil works, roads.

- Etc.

(9) Participants training seminars and discussion groups.

- Orientation by host country agencies and USAID of beneficiaries views.

- Orientation of beneficiaries of purposes and limits of project, its timing and possibilities for self-help.

(10) Maps and plans required as output of development brief:

- Plan I.

  (i) Developable area
    - immediate
    - later but requiring access
    - not developable

  (ii) Access for development
    - key points to be improved
    - location of site office

  (iii) Major drainage works
    - canals
    - culverts
    - ponds

  (iv) Major grading works
    - with rough sections/quantity

- Plan II.

  (i) Land use distributions
    - rough sketch structure using module approach

  (ii) Phasing of contract
    - houses only

  (iii) Major road configuration
    - rough sketch layout indicating permanent/temporary roads with phasing of each section

  (iv) Principle directions of surface drainage
    - initial works
    - completed system (rough)

  (v) ROW/Land reserves for water, electricity

- Plan III.

  (i) Critical works on land outside main site including
  - access
  - drainage
  - requirements arising from "real" local government plans

3. Final Development Brief

While the Initial Development Brief guides the "fast track construction" on-site, there will be time available for the design and engineering staff to prepare the final development brief. The final development brief will incorporate all of the material of the Initial Development Brief and incorporate all of the remaining land areas and development issues not covered previously. The result will be a complete operational plan for the overall construction of the particular project site.

4. Staged Construction Contracts

In the conventional housing project a civil contractor is given the opportunity and flexibility to schedule construction in a manner to maximize his own efficiency, convenience and profit. The limits on the construction process are essentially mechanical and those of manpower. Not until all of the various pieces of the project are complete is the site opened up to the public for occupancy.

During a post-disaster crisis, the above scenario is too leisurely. The conventional objectives of maximizing relevance, efficiency, convenience and profit are replaced by the objectives of relevance plus fastest possible occupancy of the site. In other words, as soon as the sites are developed to the "crisis period" agreed minimum standards, they will be occupied.

The essential elements of the project's development was presented earlier in this chapter. A hypothetical phasing chart is shown in Figure 10.1. It is important to note here that this program of rapid site development and occupation is achieved at a cost. In total time, it will take the contractor(s) longer and present many additional steps and complications. For example, once the project is partially occupied, all of the construction materials on-site will have to be not only guarded 24 hours a day, but probably also enclosed in some sort of warehouse or fence. Another example would be the construction of a sanitation system. Normally, the construction would be the usual installation of sewer mains, laterals, man holes and residential hookups. In staged development, with phased occupancy, the construction will not only include some version of this but be preceded with the installation of temporary latrines, the servicing of them and the removal of them upon the eventual completion of the permanent system.

The project planner must accept the increased costs and complications as a trade-off from the benefits of relieving the crisis living conditions of the disaster victim.

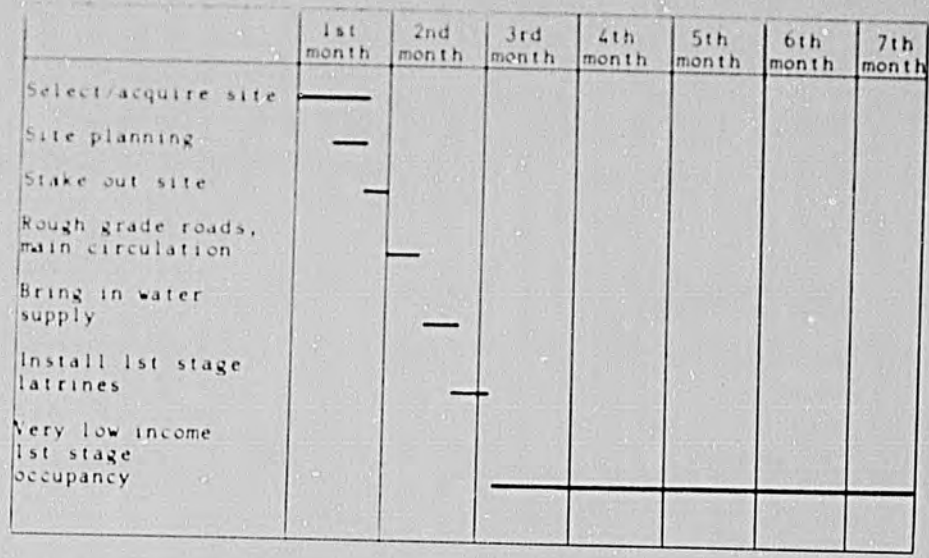

FIGURE 10.1
Hypothetical time line up to Phase 1 occupancy (varies with specific conditions of each site).

5. Control and Inspection

The ordering, purchasing, control, warehousing, issuing and guarding on-site of building materials after disaster is an onerous task. It is a time of limited supply and also of high demand. The search for sources of supply that will provide to an agreed standard, at an appropriate price and at the time required, may have to rove more widely than in more normal times. Storage routines and guardianship of the materials once delivered may have to be to a more intensive program. The establishing of procedures of purchasing and warehousing management will be important.

a. Building Materials Management

(1) Material supply planning. The purpose of material supply planning is to establish guidelines and methods for the initiation of purchase requisitions, delivery schedules and bills of materials. A specific individual within the responsible agency should be responsible for the initiation of a materials supply plan complete with the necessary support documents to support the ensuing years construction program. Initial preparation procedures should include:

- Use the construction phasing schedule as a guide to set the sequence of construction priorities.
- Construct a horizontal bar time chart, plotting the priorities against time in months. Refer to the project's critical path schedule and use it as activity guide.

- Compile a "first-cut" estimate of projected materials and quantities for the top priority projects.

- Compile a long lead time item list. Use the survey checklist.

- If not available compile bill of material quantities for the project.

- Compile a procurement schedule showing critical time areas and appropriate supply source data.

- Complete purchase requisitions and prepare procurement schedule.

- Check status of long lead time items.

- Progressively submit completed requisitions for procurement.

- Advise construction progress schedulers of any anticipated material delivery delays.

(2) Purchasing procedures. The complete purchasing cycle (Fig. 10.2 here) consists of the following steps:

- Receipt and analysis of the purchase requisition.

- Selection of potential sources of supply.

- Issuance of request for quotations.

- Receipt and analysis of quotations.

- Selection of the right source.

- Determination of the right price.

- Issuance of the purchase order.

- Receipt of order acceptance from supplier.

- Follow-up to insure scheduled delivery.

- Analysis of receiving and inspection reports.

- Analysis and approval of supplier's invoice for payment.

Some of the steps may in practice have to be bypassed because of the post-disaster emergency and in the light of past experience. For example, when purchasing a standard item from an old and established source, it is often assumed that the price and terms of purchase are right and the purchase order will be placed upon receipt of the purchase

requisition. However, periodic review of such terms and prices is often warranted and may result in substantial savings in the cost of purchased materials.

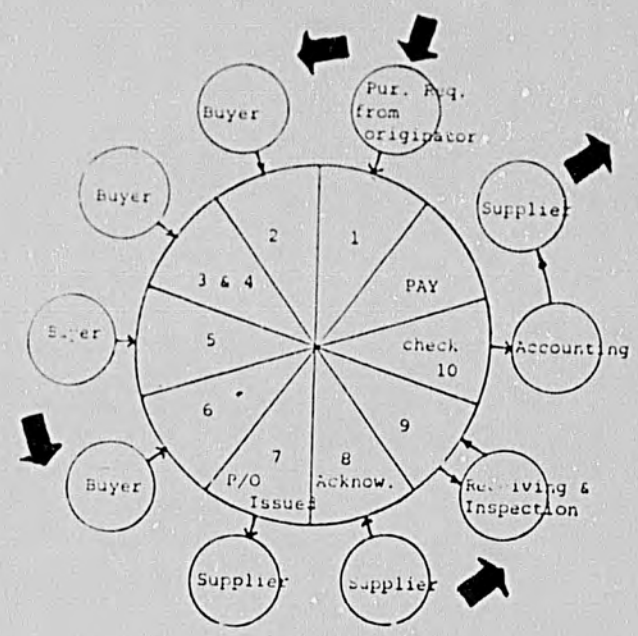

FIGURE 10.2
The purchasing cycle.

b. Inspection

(1) The purpose of inspection. The primary purposes of construction inspection are:

- To ensure compliance by suppliers and contractors with the standards of materials, specifications and contractual provisions for the project.

- To collect information regarding the conformance of material and the end product with established standards such that improvements are built into the design, procurement and quality control processes at subsequent stages.

Inspection does not create quality but it helps to control it. Because of the many variables that enter into construction, especially in a post-disaster situation, inspection should be considered as a never-ending function.

The importance of quality varies from supplier to supplier and from project to project. This fact has a direct bearing on the inspection problem. Inspection at any stage is a technical problem of where, when, how much and how to inspect. Inspection should be remedial as well as negative.

The inspector fulfills four primary responsibilities:

- Checks the quality of incoming materials.
- Checks on all finished work to insure that only acceptable items reach the customer.
- Aids in maintaining process control and attempts to locate the problems in manufacturing that would cause subsequent difficulties.
- Serves in an advisory capacity in attempting to correct or prevent quality control problems.

Inspection planning is the activity of designating the task location at which inspection should take place and of providing inspectors with the facilities needed for knowing what to do and the tools for doing it.

(2) Techniques. One of the important phases of any inspection program is the determination of the frequency of inspection and of the percentage of items to inspect. There is no formula which will give the answer as to what is reasonable inspection. The importance of inspection is in proportion to the importance of the quality. Table 10.3 suggests the amounts of inspection required for construction materials and the construction process.

(3) Methods of inspection. To control the quality of materials and construction process, one of the following three methods of inspection are usually adopted in housing projects using mass produced components:

- Screening, or 100% inspection. Each and every item is individually inspected. The aim is to detect all the defective items. One hundred (100%) percent inspection is necessary for (i) components important to the structural functioning of the unit; and (ii) finished products where accuracy is important (i.e. precast and timber members where face-to-face contact must be of high order.
- Batch-by-batch. Also known as sampling inspection. This method eliminates the high cost and time of screening inspection.
- Process. This method detects defective items where and when they occur on the construction site so that immediate corrective action can be taken.

(4) Classes of inspection. Inspection can be classified as either preventive or remedial.

- Preventive inspection as its name indicates is concerned with discovering defects, finding out what caused the defect and helping with removal of such causes. Its purpose is to prevent such defect from occuring in the future (application on-site processes).

- Remedial inspection is concerned with sorting good parts from bad parts. Its primary purpose is to discover defective parts that have already been produced and prevent their use in the final product (application suitable only for products, materials and p : processed pre-cut and pre-fab items).

While both types of inspection are important, emphasis should be mainly on preventive inspection.

(5) Inspection standards. Standards are an essential element of the construction management control process and are based on the requirements of procurement and technical specifications. Performance can only be measured against standards.

- Standards for materials. They are based on procurement specifications relating to:

  (i) physical condition or properties of materials.

  (ii) size and shape.

  (iii) degrees of finish. Check for roughness, matt, gloss or dull, shade, tint, etc.

  (iv) required physical, mechanical or chemical tests.

  (v) functional or performance. Check pumps, motors, lock sets, etc.

- Standards for works in process. Based on technical specifications:

  (i) buildings: related to structural stability; related to structural permanence, life cycle.

  (ii) civil works: related to integrity of permanent installations; related to durability.

- Standards for completed works:

  (i) buildings. The standards for completed buildings allow: for condition of satisfactory habitation such as cleanliness, hygiene, safety; for the satisfactory functioning of all items concerned with motion such as door locks, doors, window louvers, light switches, waste drainpipes.

(ii) civil works: the standards require satisfactory performance of roads, drains, water and sewer systems after subjection to required tests.

(6) Materials supply and protection. Materials are supplied to the project site from supply sources by two parties — the responsible host country agency and government contractors. The receiving, inspection and warehousing of government materials is the responsibility of staff members of the agency (Fig. 10.3). The acceptance for use and approval of protective measures of contractor supplied materials should also be the inspection responsibility of the project implementing agency.

100%	Variable %
Small quantities having high degree of accuracy, eg. pumps, motors, meters. Samples - check for compliance with specifications. Process - field test of a selection of water supply piping. Buildings - Final acceptance functional tests.	Small quantities, with wide variation of quality being permissable; occasional. Brand name items usually from a certified supplier occasional inspection only, casual. Grades - products procured on this basis must be checked, each batch or consignment for compliance with the grade specified. Products bought on a Specification basis usually require close checking. Large quantities of items, eg., bricks, floor tiles, inspected by acceptance sampling methods

FIGURE 10.3
Amount of inspection for construction materials and processes.

E. PEOPLE AND ORGANIZATIONS

1. Selection of Contract Methods

The basic decisions concerning the contracting methods to be utilized will depend on policy and program criteria established by national and local government agencies and participating donor agencies concerning the responsibilities of the public and private sector and the degree of coordination and integration of the affected communities which is desired. Officials and professionals from the following bodies will generally be involved:

(a) Disaster Reconstruction Committee.

(b) Ministry of Public Works.

(c) Ministry of Housing.

(c) Ministry of Finance.

(d) International and local voluntary agencies.

(d) Professional associations of architects and engineers.

See also first paragraph this chapter.

2. Quality of Materials and Components

Particular attention should be given to the quality of materials and of the various components of the building process which are utilized in reconstruction efforts. Specific technical assistance and participation in this decision-making and building process should generally be solicited from:

(a) National specification agencies.

(b) USAID accepted specification agencies.

(c) Local testing laboratories.

(d) Ministry of Public Works.

3. Protection of Materials On-Site

The effectiveness of supply and protection of the required building materials will normally involve:

(a) Construction project manager.

(b) Contractors (if appointed).

(c) Inspection teams.

(d) The community and private voluntary organizations.

F. POTENTIAL ROLES FOR AID

1. Information Sharing

(a) U.S. technical publications of fast tracking construction, tendering, material procurement and supply and inspections and mixed industrialized component/self-help systems for housing planners, architects and engineers.

(b) More generalized technical information for participating private voluntary organizations concerning the above — particularly self-help systems and on-the-job training and education programs and processes.

2. Technical Assistance

(a) Principles of fast tracking conventional housing development projects.

(b) Building materials procurement, supply and warehousing.

(c) Construction inspection and quality control.

3. Training

(a) Training of program officers in government departments and private voluntary agencies in the organization of component production and the self-help building processes.

(b) Training of technical officers in fast tracking construction, procurement and supply and inspection and control.

4. Preparedness Planning

(a) Prepare list of local construction contractors, skills and capacity.

(b) Assist in development of pre-cut timber processing plants and/or precast concrete, blockmaking plants.

(c) Assist in quality control of building materials through support of laboratory testing facilities.

G. REFERENCES

Lock, D. Project Management, Gower Press, London, U.K. (2nd Edition, 1977).

ANNEXES

ANNEX I: CORE HOUSING AND PROGRESSIVE UPGRADING

ANNEX II: BUILDING GUIDES FOR AID-ASSISTED HOUSING RECONSTRUCTION PROGRAMS

ANNEX III: FINANCING SYSTEMS: THE EXPERIENCE OF THE ASSISTED

ANNEX IV: CONVENTIONAL HOUSING PROJECT BUDGET ESTIMATION FORM

ANNEX V: ORGANIZATIONAL RESOURCES AND SOURCES OF INFORMATION

ANNEX I

CORE HOUSING AND PROGRESSIVE UPGRADING

A. ORIENTATION

Core housing is increasingly used by post-disaster agencies. During the emergency or rehabilitation phase, a relief or reconstruction agency provides a simple, low-cost frame which can be used initially as an emergency shelter. The frame and roof are designed to be disaster-resistant and permanent. The plan is that occupants to infill the walls with whatever materials are available and progressively upgrade the structure. Initially, the walls may be filled in with materials salvaged from the rubble. Later they are replaced with more suitable materials as they evolve from being shelters into more formal houses.

There are three key program elements in core housing:

(1) The provision of the materials necessary to produce a disaster-resistant frame.

(2) The organization of contract labor or mutual, self-help schemes to enable the frames to be erected.

(3) The provision of adequate technical assistance to the homeowners to enable them to safely complete the houses.

Core housing schemes depending on self-help can be more successful in those communities where the majority of the houses are non-engineered and where people normally play a role in constructing their own housing. Completion is generally of indigenous materials or materials which are available in virtually unlimited supplies at relatively low cost.

B. KEY ISSUES

There are five key issues:

1. Selection of the Type and Design

In every community there will be number of basic housing types made from a variety of materials. The disaster-resistant frame should be designed taking the most prevalent type of structure into account. The final product should be seen by the owners as an improvement over what they had before. The design will stem in part from an objective assessment of what materials are likely to be available following a disaster and what their costs will be. Houses in any one area may be made of a form of wattle and daub, adobe or cement block. A project planner would probably determine that concrete block housing would be the preferred type. Yet following a disaster, adobe or wattle and daub may be much more readily available, and affordable, by the disaster victims.

The decision on the basic design of the house and/or the variations which can be produced using the frame should be considered in committee with representatives of the disaster victims who are to be housed.

2. Determining Which Components to Provide

With choice of housing type and design made, the project planner must then decide on which components to provide as part of the core or frame of the house. In some instances, the agency may wish to provide only the foundation and supporting columns. In other areas, it may provide a complete frame and roof. The number of victims in proportion to AID funds will in part determine this.

3. Determining Homeowner's Inputs

Project planners must decide early on how much of the work will be left to the homeowner to complete without supervision. If particular components or fixing details are expected to cause problems during completion work, technical supervision provided through technical assistance may be wise. Demonstration houses, the training of key craftsmen, etc. would reduce the supervision task.

4. Timing

Starting too early or too late can affect the overall outcome of a program.

5. Determining Sites and Services Options

Sites and services are usefully integrated with core housing to form part of the overall project.

C. KEY CONCEPTS

(1) Core housing schemes require a thorough understanding of the failure modes of the traditional housing of a region. It is only by understanding how the houses fail that the components and constructional systems necessary to produce a disaster-resistant frame can be determined.

(2) A decision to undertake a core house project with a progressive upgrading scheme implies a high degree of decision-making. (The choices about what materials to provide, the form of the core unit — i.e. individual dwelling, duplex or row — the development of the necessary resources and planning the rapid delivery of the proper components to produce a disaster-resistant frame during the emergency are best made long before a disaster strikes.*)

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* If decisions relating to the frame have been made pre-disaster, efforts should be undertaken to introduce any building components into the building vernacular which are not currently a part. The more components which can be introduced in normal periods, the higher the likely degree of acceptance following a disaster (i.e. concrete posts for building frames, the use of certain types of reinforcing or tie-down straps for roofs, the use of chemical stabilizers for earth housing).

(3) Core housing programs require that local technical assistance resources be placed directly into each of the communities where the programs are being undertaken. Technical advice will be needed throughout the progressive upgrading phase. Normally, this means that building housing education will have to be provided to local small builders and craftsmen on how to upgrade houses in a safe manner, using the local mix of materials available to the owner-builder. In particular, advice will be required as to how to add on to the initial safe structure.

D. PEOPLE AND ORGANIZATIONS

1. Programs

The following types of organizations normally have the capability of conducting core housing and progressive upgrading programs. They are:

(a) Local housing ministries.

(b) Voluntary organizations.

(c) Intergovernmental organizations.

2. Technical Assistance

The following organizations can provide technical assistance at the community level and often help to supervise in the progressive upgrading phase. They are:

(a) Voluntary organizaitons.

(b) Universities (especially schools of architecture or engineering).

(c) Technical schools.

3. Training Aids

Materials such as pamphlets or other training aids to help homeowners progressively upgrade their houses in a safe manner can often be developed by:

(a) Voluntary organizations.

(b) Rural training institutes of the host government.

(c) Appropriate technology groups and institutes.

(d) Urban social work institutes.

E. POTENTIAL ROLES FOR AID

1. Pre-Disaster Roles

Appropriate pre-disaster roles and activities which AID can play center around helping the local government to determine whether or not a core housing approach would be appropriate as a post-disaster shelter and housing strategy. If this approach is seen to be a viable option, the Mission can encourage the study of vernacular housing to determine appropriate methods for improving each house type and identify those measures necessary to make housing safe and which could be incorporated into a core house approach.

Other assistance would include:

(a) The development of plans and mechanisms for developing post-disaster programs.

(b) Identification of material needs and requirements.

(c) Identification of material and technical assistance resources.

(d) Development of the infrastructure for a post-disaster program.

2. Post-Disaster Roles

In a post-disaster situation, AID can support core housing schemes by providing material assistance, technical assistance and training aids. Programs can be supported by funds and newly arriving voluntary agencies can often be steered into cooperating with the local government or other agencies utilizing this approach.

F. LESSONS LEARNED

The core housing approach has had varying degrees of success, depending upon the area in which it was used and the extent to which building education programs accompanied the erection of the core frame.

(1) The approach is only successful if people have immediate and continued access to the materials necessary to upgrade the program.

(2) Progressive upgrading will only continue as long as the houses which result are seen to be desirable to the disaster victims. This means that they must either be considered a "step up" or similar to what they had before. Radically different housing types or styles or houses which are much smaller than previous houses are unlikely to be acceptable.

(3) For the houses to be upgraded in a safe manner, the construction techniques and construction sequence must be easily understood by local craftsmen or those building the houses. It is especially important that the bracing system be understood as well as the specified manner by which all components are fitted together and securely fastened. For cyclone-

resistant housing, it is especially important that anchorage and fastening be properly understood. For earthquake-resistant housing, it is especially important that the manner of securing the wall infill to the frame be understood.

(4) The progressive upgrading component of a core housing program can only be successful where people own the land or have a degree of tenure. Without land or tenure, it is highly doubtful whether the home occupant will invest in continued upgrading.

(5) Unless a thorough education component is included, many of the safety features of the frame may be dismantled during expansion of the house.

ANNEX II

BUILDING GUIDES FOR AID-ASSISTED HOUSING RECONSTRUCTION PROGRAMS

A. INTRODUCTION

The purpose of the following building guides is to provide the housing staff of USAID missions a guide to the key construction details and components required to produce disaster-resistant safe housing. These guides are intended to be used as the basis for:

(1) Developing building standards to guide post-disaster reconstruction programs.

(2) Developing specific design criteria for use by AID-supported contractors.

(3) Developing training aids and manuals for instructional materials to be used in aided self-help housing reconstruction programs.

(4) Developing specifications for AID housing reconstruction programs.

(5) Assessing proposals to AID for assistance in building disaster-resistant housing.

These building guides were developed for residential, low rise buildings built on individual plots of land. Houses which are attached to one another, those which are higher than one story, or those which are designed for more than two-family occupancy, must be treated as special engineering cases and designed on an individual basis. These building guides also do not apply to commercial structures, industrial buildings, churches, schools or buildings used for large gatherings.

It should be noted that the purpose of these guides is to define a simple structure which is disaster-resistant. Disaster-resistant does not mean that the house is disaster-proof. It means that the house should suffer only limited damage when struck by a disaster agent.

An earthquake-resistant house is further defined as a building which permits the occupants adequate time to evacuate safely in an earthquake.

A wind-resistant house is further defined as a structure which provides a basic margin of safety in high winds. (In hurricane areas, it should be noted that safety is only provided against winds, not against flooding or storm surges.)

For reference, this section is divided into specifications that relate to cyclone and earthquake resistance. (Other types of disasters that affect houses represent a siting, not a structural problem.) Users of the manual will note that there is often great similarity between recommended measures taken to improve performance of a particular type of house, against both earthquakes and high winds. It should thus be remembered that for those regions where both types of disasters are prevalent, actions taken to improve resistance of the structure against one type of disaster usually have beneficial results in improving its performance against the other type. In those cases where new housing is being designed to withstand both disasters and there is a conflict between

recommendations for earthquake or high-wind resistant construciton, the most prevalent type of threat should be the deciding factor.

B. BUILDING GUIDE FOR AID-ASSISTED HOUSING RECONSTRUCTION PROGRAMS: CYCLONE RESISTANT BLOCK HOUSING

1. Siting

(a) In locating a house, take advantage of natural windbreaks such as stands of trees, small hills or hedges.

(b) Be especially careful of sites on or near tall hills. These can increase wind speeds by as much as 50 percent.

(c) Valleys funnel winds; they can create abnormally high wind speeds.

(d) Buildings placed near one another can affect wind speeds. Intense suction can develop on the gable ends of pitched roofs. If the building is in the wake of another, expect turbulence and some high local loading on small elements such as cladding.

(e) When building a windbreak or shield (such as a row of trees or a wall) include small gaps to stabilize the flow on the lee side.

2. Configuration

(a) The best shape of a house to resist high winds is circular. In those areas where circular houses are used traditionally, reconstruction programs should encourage continued use of this configuration.

(b) A rectangular configuration may be used provided that the length to width ratio does not exceed 2.5 to 1.

(c) The parallel walls of all structures must be of equal length and of equal height.

(d) An "L" shape configuration should be avoided.

(e) The following configurations are especially prone to major damage in high wind (Figure B.1).

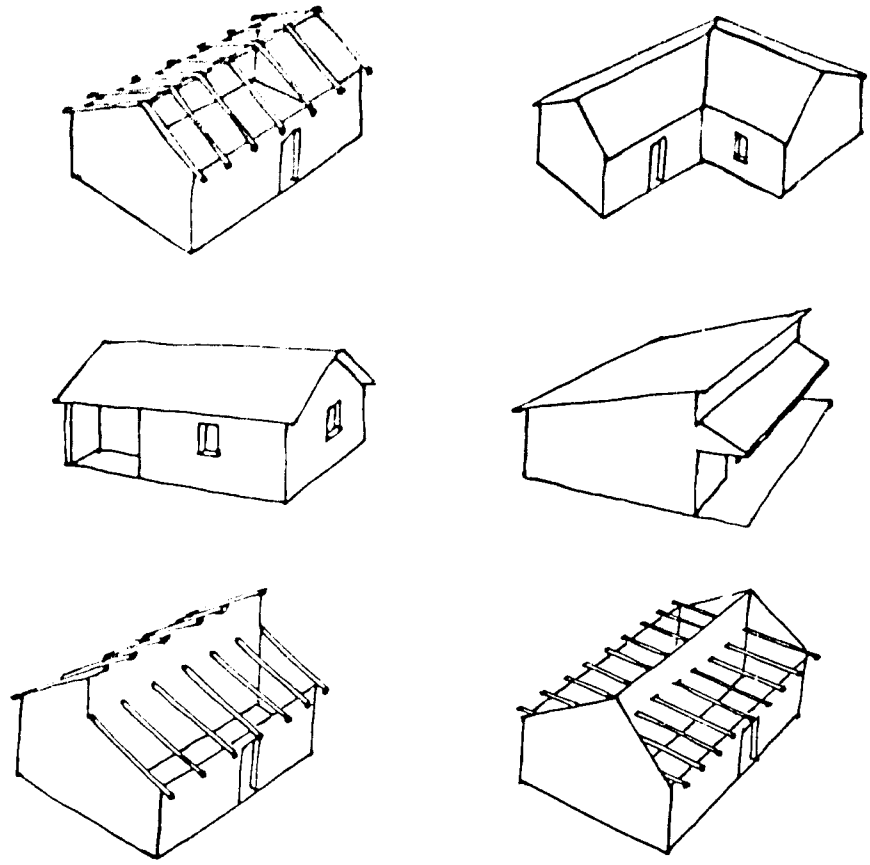

FIGURE B.1
WHAT NOT TO DO

3. Roof Design

(a) Pitched roofs

(1) If a pitched roof is specified, a hip roof configuration is recommended. This reduces the overall forces lifting on the roof. A gable roof may be used as long as adequate diagonal bracing is used between the roof trusses to provide lateral resisting strength for the roof, and when the gables are adequately reinforced so that they will not topple into the house.

(2) A roof pitch should be approximately 30 degrees, or about 1 meter in 3. (Wind loads are severe when roofs are pitched around 5-10 degrees.)

(3) Avoid outside overhangs of more than half a meter, even if supported at the edge by columns. If this is unavoidable, consider using vents or louvers along the roof edge to relieve the upward pressure.

Houses using a pitched roof should use roofing materials which are strong, shatter-resistant, and of medium weight. Recommended are:

- Heavy-gauge metal roofing sheets
- Medium-weight, fiber-reinforced cement roofing sheets (non-brittle)
- Wood sheets
- Wood tiles
- Concrete panels (those which can be fastened to the roof frame)

Clay tile may also be used, provided that a suitable substructure is built which will prevent individual tiles from falling inward and striking occupants should the roof be hit by missiles propelled by the wind, and provided that they can be securely fastened to the roof structure. Not recommended are:

- Thin guage metal roofing sheets
- Lightweight fiber-reinforced cement roofing sheets
- Lightweight composite tiles and roofing sheets
- Thin plywood sheets
- Asphalt-impregnated cardboard sheets

(b) Flat roofs

(1) A flat roof may be used as long as the roofing material is monolithic and is firmly attached.

(2) A parapet should be used around the edge of a flat roof to help reduce high suction along roof edges. (This will have little effect, however, on overall roof uplift.) If a flat roof is desired, the following materials are recommended:

- Reinforced concrete
- Ferrocement

Flat roofs made of other materials such as metal or wood roofing sheets are not recommended.

4. Wind Resistant Design Features

The forces applied to a building by high winds are:

- Upwards
- Sideways or lateral
- Twisting or racking

To build a structure which can resist these forces, there are three basic specifications that must be met.

(a) Anchorage. The first specification is to hold the roof on. This entails tying the roof down to the ground or foundation by an adequate and continuous chain of strength. Traditional construction is directed toward holding the roof up. In wind-resistant construction, the purpose is to hold the roof down.

(b) Bracing. The second specification is to brace the structure to withstand the lateral wind loadings and the racking effect. The methods used to brace traditional buildings are inadequate for the much larger forces existing in high wind conditions. Strength must be added not only at the corners of the building, but also at key locations throughout each wall.

(c) Continuity. The third specification is to provide the structure with integrity (i.e. to ensure all components are properly connected so that they can satisfactorily perform their function). Because the forces are often much larger and in the opposite direction of those occuring normally, far more attention must be given to providing adequate connections between members and components of a building.

There are many design features which can significantly reduce the effect of the forces of high winds on a structure. Most of the building features which are dangerous are designed to provide comfort under normal conditions. For example, many of the areas where high winds occur encompass sub-tropical and tropical regions. Houses in these zones generally feature lightweight materials, with large overhanging eaves for shade, elevated openings around the base of the roof and in the gables to facilitate ventilation and large window areas for through ventilation. Each of these features is contrary to ideal requirements for a wind-resistant house, so compromises in the design will have to be made. For the designer, there are several rules of thumb:

(a) Do not build any opening which cannot be closed off during a wind storm.

(b) Do not build openings which cannot be reached to be sealed off. (For example, an opening high on the wall under a gable may be difficult to reach and close prior to the onset of a storm.)

(c) Leave openings in suitable locations where pressure can escape (for example, at the ridge of the roof).

(d) Design the roof to reduce suction and break up lifting patterns.

(e) Design corners to reduce the pressures by allowing wind to slip around the corners. (This can be done often by rounding or beveling the corners of a building.)

(f) Avoid creating areas where wind can be trapped and excessive pressure can build up. (For example, sealing off the eave of a house at an angle parallel to or inclined towards the ground can significantly reduce the uplifing pressures at that point.)

(g) Avoid creating courtyards or patios which will increase circular or turbulent winds.

(h) All doors and windows should be a minimum of 1 meter from the end of a wall.

(i) All doors and windows should be a minimum of 1 meter from each other.

5. Structural Specifications

All houses built of cement block must meet the following structural specifications (Fig. B2):

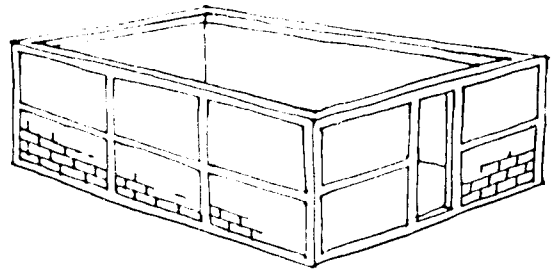

FIGURE B.2

(a) Block walls should be built on a continuous concrete footing in a trench. Avoid placing blocks directly on the ground, as this will cause the building to settle unevenly, causing wall cracks and openings for wind to penetrate.

(b) The houses should have vertical columns made of reinforced concrete in each corner and spaced at appropriate intervals throughout each wall. (Generally, columns should be spaced so that with the foundation and upper ring beam they form a square.)

(c) All windows and doors should have vertical columns on each side of the openings.

(d) Blocks should be solidly anchored to the foundation using dowels, reinforcing bars or tie rods. Imbed the anchors at least 25 centimeters into the footing.

(e) Walls should be anchored to the foundation with 15-millimeter rods spaced not more than two meters apart.

(f) Blocks should be laid according to a running bond rather than a stack bond method.

(g) To control cracking, blocks should be reinforced internally, using metal rods imbedded in grout. Be sure to maintain a tight bond between reinforcement and the surrounding material.

(h) To reduce costs, split cane, bamboo or other suitable tie material may also be used.

(i) Corner columns or posts should be securely tied to adjacent walls, using tie bars and/or horizontal reinforcement.

(j) Intersecting walls should be made continuous by means of tie bars and/or horizontal reinforcement that extends into neighboring walls and partitions.

(k) The houses should have a minimum of one horizontal ring beam placed close to the center of the wall.

(l) The houses should have ring beams at the top of the wall.

(m) Gables must be reinforced with vertical columns and surrounded by poured concrete on all sides.

(n) Interior walls should be jointed to exterior walls at a vertical column.

(o) Positive connections should be made between door and window sills, posts and lentels, and the walls in which they are placed and between all timber members (Fig. B.3).

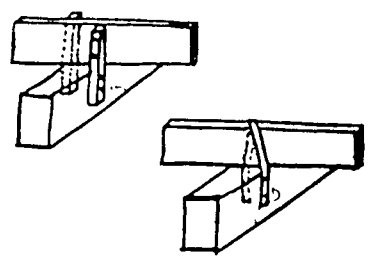

FIGURE B.3

(p) When connecting a timber roof frame to a block wall, special care must be taken to attach the roof frame securely to the structure of the building. One method is to have joists ready prior to the pouring of the upper ring beam. As the upper ring beam is poured, the roof joist is put in place. A fastener strap should be placed over and around the roof joist, then nailed to the joist. Then the ends of the fastener should be imbedded in the concrete to a dept of 25 centimeters. Fasteners may be made by cutting strips of galvanized sheet metal to dimensions of 30 millimeters by 50 centimeters. Galvanized sheets should be 20 gauge or thicker.

(q) Corregated roofing material, such as metal roofing sheets, asbestos cement roofing sheets, or composite materials should be secured at every corregation along the bottom purlin (at the eaves), at every corregation along the top purlin (at the ridge), at every corregation on the end sheets (at the gable end), and at every third corregation over the rest of the roof. To secure the roof sheets to purlins, it is recommended that self-drilling drive screws be used if possible. Metal sheets should be fixed with screws of the same metal. Nails are permissible, as long as the nail is long enough to penetrate deep into the purlin. When either screws or nails are used, a washer of at least 20 millimeters in diameter (approximately 3/4 of an inch) should also be used. (Note: Special roofing nails with a wide, flat head are often supplied with roofing sheets. The quality and length of these nails vary, and before they are used in high wind areas, it should be determined whether these are suitable or likely to lift out.)

(r) Corregated roofing should be fastened to purlins through the top of the corregations (Figs. B.4 and B.5).

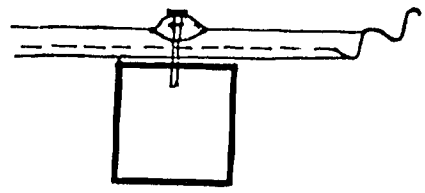

FIGURE B.4

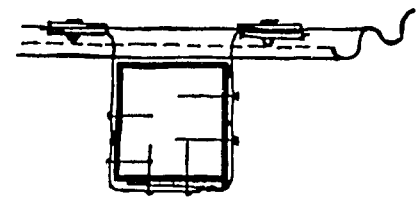

FIGURE B.5

(s) All wood joints and splices should be securely fastened and reinforced (Fig. B.6).

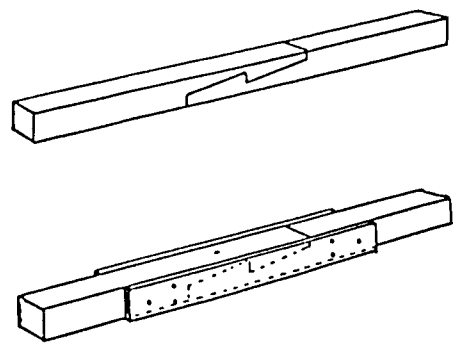

FIGURE B.6

6. Materials

Blocks chosen for use should be of high quality and strength and should be properly and sufficiently cured.

(a) Strength — Blocks chosen for use in cyclone-resistant housing should have a compressive strength of 800 psi after normal curing.

(b) Blocks may be fabricated from any ratio of sand to cement that provides the above compression strength.

(c) The use of pumice sand as a filler is permissible provided the sand does not contain, or is mixed with, any clay soils.

(d) Sea sand must be very well worked before use.

7. Safety Measures

(a) Doors and windows should be designed so that storm shutters can be placed over them during wind storms.

(b) Windows should be designed so that glass panes are relatively small and the window frame is supported by a wooden superstructure.

(c) Window frames should be designed so that if screens are used on the outside, they can be removed before a storm period and attached to the inside to provide protection against flying glass or other debris. All louvered windows must have outside storm shutters and be designed to lock into a closed position.

(d) In large buildings, or those which have numerous rooms, one specific area should be designed to be especially strong so it can be used as an in-house shelter during wind storms. This area may be a closet, a work room, an area beneath the main floor of the house (if flooding is not a threat) or any small room of the house which can be strengthened without undue additional cost.

C. BUILDING GUIDE FOR AID-ASSISTED HOUSING RECONSTRUCTION PROGRAMS: CYCLONE-RESISTANT BRICK HOUSING

1. Siting

(a) In locating a house, take advantage of natural windbreaks such as stands of trees, small hills or hedges.

(b) Be especially careful of sites on or near tall hills. These can increase wind speeds by as much as 50 percent.

(c) Valleys funnel winds; they can create abnormally high wind speeds.

(d) Buildings placed near one another can affect wind speeds. Intense suction can develop on the gable ends of pitched roofs. If the building is in the wake of another, expect turbulence and some high local loading on small elements such as cladding.

(e) When building a windbreak or shield, such as a row of trees or a wall, include small gaps to stabilize the flow on the lee side.

2. Configuration

(a) The best shape for a brick house to resist high winds is square or rectangular.

(b) The length to width ratio should not exceed 2.5 to 1.

(c) The parallel walls of all structures must be of equal length and of equal height.

(d) An "L" shaped configuration should be avoided. (These buildings have a high percentage of failure due to racking in high winds.)

(e) The following configurations are especially prone to major damage in high winds (Fig. C.1).

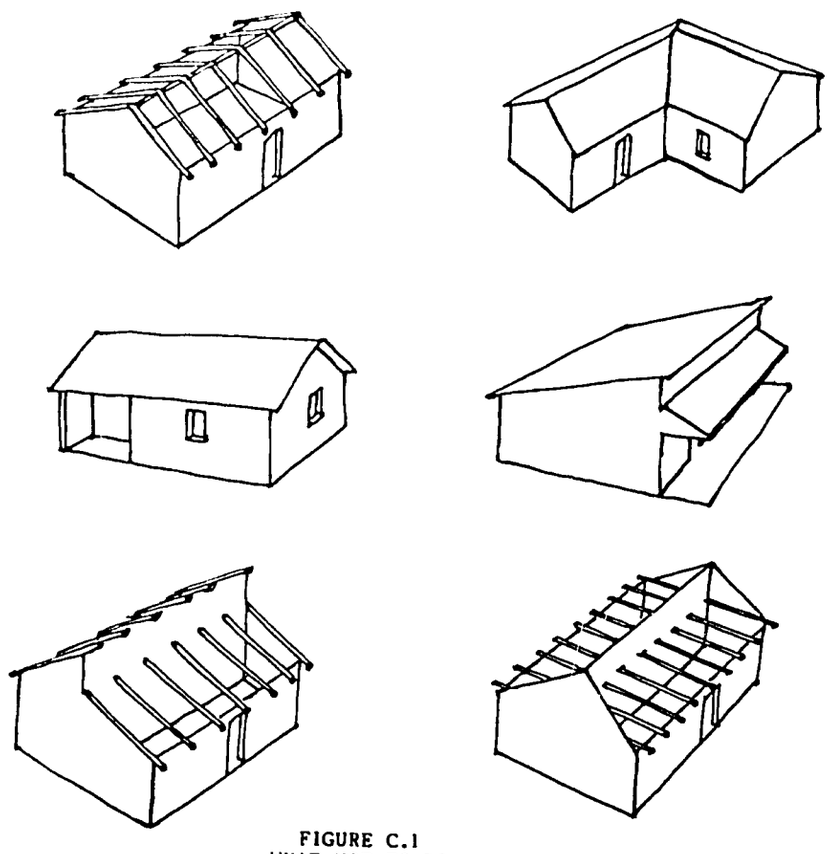

FIGURE C.1
WHAT NOT TO DO

3. Roof Design

(a) Pitched roofs

(1) If a pitched roof is specified, a hip roof configuration is recommended. This reduces the overall forces lifting on the roof. A gable roof may be used as long as adequate diagonal bracing is used between the roof trusses to provide lateral resisting strength for the roof (Fig. C.2), and when the gables are adequately reinforced so that they will not topple into the house.

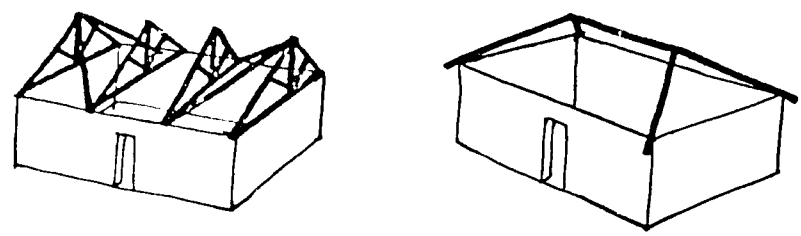

FIGURE C.2
GOOD PRACTICE

(2) A roof pitch should be approximately 30 degrees, or about 1 meter in 3. (Wind loads are severe when roofs are pitched around 5-10 degrees.)

(3) Avoid outside overhangs of more than half a meter, even if supported at the edge by columns. If this is unavoidable, consider using vents or louvers along the roof edge to relieve the upward pressure.

Houses using a pitched roof should use roofing materials which are strong, shatter-resistant and of medium weight. Recommended are:

- heavy-gauge, metal roofing sheets
- medium-weight, fiber-reinforced cement roofing sheets (non-brittle)
- wood sheets
- wood tiles
- concrete panels (those which can be fastened to the roof frame)

Clay tile may also be used, provided that a suitable sub-structure is built which will prevent individual tiles from falling inward and striking occupants should the roof be hit by missiles propelled by the wind and provided that they can be

securely fastened to the roof structure. Not recommended are:

- thin gauge, metal roofing sheets
- light-weight, fiber-reinforced cement roofing sheets
- light-weight, composite tiles and roofing sheets
- thin plywood sheets
- asphalt-impregnated cardboard sheets

(b) Flat roofs

(1) A flat roof may be used as long as the roofing material is monolithic and is firmly attached.

(2) A parapet should be used around the edge of a flat roof to help reduce high suction along roof edges. (This will have little effect, however, on overall roof uplift.) If a flat roof is specified, the following materials are recommended:

- reinforced concrete
- ferrocement

Flat roofs made of other materials such as metal or wood roofing sheets are not recommended.

4. Wind-Resistant Design Features

The forces applied to a building by high winds are:

- Upwards
- Sideways or lateral
- Twisting or racking

To build a structure which can resist these forces, there are three basic specifications that must be met.

(a) Anchorage. The first specification is to hold the roof on. This entails tying the roof down to the ground or foundation by an adequate and continuous chain of strength. Traditional construction is directed toward holding the roof up. In wind-resistant construction, the purpose is to hold the roof down.

(b) Bracing. The second specification is to brace the structure to withstand the lateral wind loadings and the racking effect. The methods used to brace traditional buildings are inadequate for the much larger forces existing in high wind conditions. Strength must be added not only at the corners of the building, but also at key locations throughout each wall.

(c) Continuity. The third specification is to provide the structure with integrity (i.e. to ensure all components are properly connected so

that they can satisfactorily perform their function). Because the forces are often much larger and in the opposite direction of those occurring normally, far more attention must be given to providing adequate connections between members and components of a building.

There are many design features which can significantly reduce the effect of the forces of high winds on a structure. Most of the building features which are dangerous are designed to provide comfort under normal conditions. For example, many of the areas where high winds occur encompass sub-tropical and tropical regions. Houses in these zones generally feature lightweight materials, with large overhanging eaves for shade, elevated openings around the base of the roof and in the gables to facilitate ventilation and large window areas for through ventilation. Each of these features is contrary to ideal requirements for a wind-resistant house, so compromises in the design will have to be made. For the designer, there are several rules of thumb.

(a) Do not build any opening which cannot be closed off during a wind storm.

(b) Do not build openings which cannot be reached to be sealed off. (For example, an opening high on the wall under a gable may be difficult to reach and close prior to the onset of a storm.)

(c) Leave openings in suitable locations where pressure can escape. (For example, at the ridge of the roof.)

(d) Design the roof to reduce suction and break up lifting patterns.

(e) Design corners to reduce the pressures by allowing wind to slip around the corners. (This can be done often by rounding or beveling the corners of a building.)

(f) Avoid creating areas where wind can be trapped and excessive pressure can build up. (For example, sealing off the eave of a house at an angle parallel to or inclined towards the ground can significantly reduce the uplifing pressures at that point.)

(g) Avoid creating courtyards or patios which will increase circular or turbulent winds.

(h) All doors and windows should be a minimum of 1 meter from the end of a wall.

(i) All doors and windows should be a minimum of 1 meter from each other.

5. Structural Specifications

All houses built of brick must meet the following structural specifications (Fig. C.3):

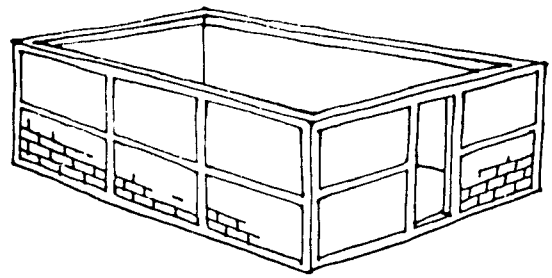

FIGURE C.3

(a) Brick walls should be built on a continuous concrete footing in a trench. Avoid placing bricks directly on the ground, as this will cause the building to settle unevenly, causing wall cracks and openings for wind to penetrate.

(b) The houses should have vertical columns made of reinforced concrete in each corner and spaced at appropriate intervals throughout each wall. (Generally, columns should be spaced so that with the foundation and upper ring beam they form a square.)

(c) All windows and doors should have vertical columns on each side of the openings.

(d) Bricks should be laid according to a running bond rather than a stack bond method.

(e) Corner columns or posts should be securely tied to adjacent walls, using tie bars and/or horizontal reinforcement.

(f) Intersecting walls should be made continuous by means of tie bars and/or horizontal reinforcement that extends into neighboring walls and partitions.

(g) The houses should have a minimum of one horizontal ring beam placed close to the center of the wall.

(h) The houses should have ring beams at the top of the wall.

(i) Gables must be reinforced with vertical columns and surrounded by poured concrete on all sides.

(j) Interior walls should be jointed to exterior walls at a vertical column.

(k) Positive connections should be made between door and window sills, posts and lentels and the walls in which they are placed and between all timber members (Fig. C.4).

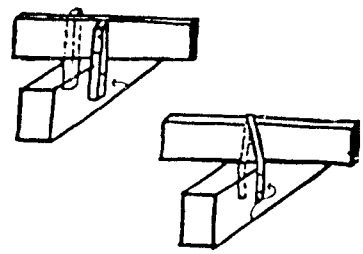

FIGURE C.4

(l) When connecting a timber roof frame to a brick wall, special care must be taken to attach the roof frame securely to the frame of the building. One method is to have roof joists ready prior to the pouring of the upper ring beam. As the upper ring beam is poured, the roof joist is put in place. A fastener strap should be placed over and around the roof joist, then nailed to the joist. Then the ends of the fastener should be imbedded in the concrete to a depth of 25 centimeters. (Fasterners may be made by cutting strips of galvanized sheet metal to dimensions of 30 millimeters by 50 centimeters. Galvanized sheets should be 20 gauge or thicker.)

(m) Corregated roofing material, such as metal roofing sheets, asbestos cement roofing sheets or composite materials should be secured at every corregation along the bottom purlin (at the eaves), at every corregation along the top purlin (at the ridge), at every corregation on the end sheets (at the gable end) and at every third corregation over the rest of the roof. To secure the roof sheets, it is recommended that self-drilling drive screws be used if possible. Metal sheets should be fixed with screws of the same metal. Nails are permissible, as long as the nail is long enough to penetrate deep into the purlin. When either screws or nails are used, a washer of at least 20 millimeters in diameter (approximately 3/4 of an inch) should also be used. (Note: Special roofing nails with a wide, flat head are often supplied with roofing sheets. The quality and length of these nails vary, and before they are used in high wind areas, it should be determined whether these are suitable.)

(n) Corregated roofing should be fastened to purlins through the top of the corregations (Figs. C.5 and C.6).

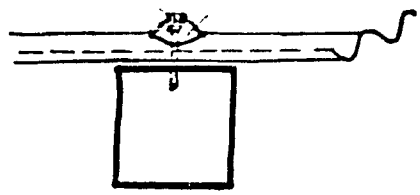

FIGURE C.5

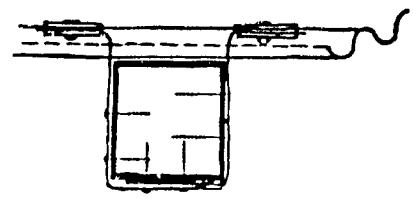

FIGURE C.6

(o) All wood joints and splices should be securely fastened and reinforced (Fig. C.7).

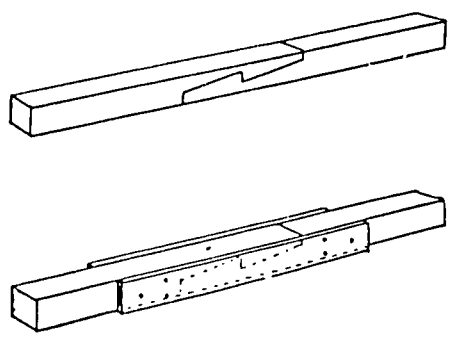

FIGURE C.7

6. Materials

Bricks chosen for use should be of high quality and strength and should be properly fired.

7. Safety Measures

(a) Doors and windows should be designed so that storm shutters can be placed over them during wind storms.

(b) Windows should be designed so that glass panes are relatively small and the window frame is supported by a wooden superstructure.

(c) Window frames should be designed so that if screens are used on the outside, they can be removed before a storm period and attached to the inside to provide protection against flying glass or other debris. All louvered windows must have outside storm shutters and be designed to lock into a closed position.

(d) In large buildings or those which have numerous rooms, one specific area should be designed to be especially strong so it can be used as an in-house shelter during wind storms. This area may be a closet, a work room, an area beneath the main floor of the house (if flooding is not a threat) or any small room of the house which can be strengthened without undue additional cost.

D. BUILDING GUIDE FOR AID-ASSISTED HOUSING RECONSTRUCTION PROGRAMS: CYCLONE-RESISTANT WOOD FRAME HOUSING

1. Siting

(a) In locating a house, take advantage of natural windbreaks such as stands of trees, small hills or hedges.

(b) Be especially careful of sites on or near tall hills. These can increase wind speeds by as much as 50 percent.

(c) Valleys funnel winds, they can create abnormally high wind speeds.

(d) Buildings placed near one another can affect wind speeds. Intense suction can develop on the gable ends of pitched roofs. If the building is in the wake of another, expect turbulence and some high local loading on small elements such as cladding.

(e) When building a windbreak or shield, such as a row of trees or a wall, include small gaps to stabilize the flow on the lee side.

2. Configuration

(a) The best shape of wood frame house to resist high winds is square or rectangular. A rectangular configuration should have a length to width ratio of 2.5 to 1.

(b) The parallel walls of all structures must be of equal length and of equal height.

(c) "L" shaped houses should be avoided as they have demonstrated poor performance in high winds.

(d) The following configurations can be expected to receive a high proportion of damage due to wind entrapment (Figure D.1).

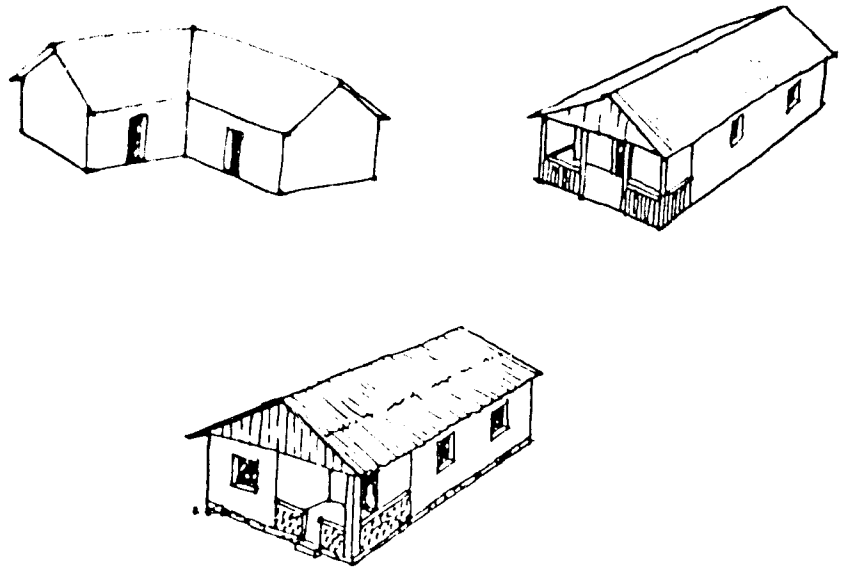

FIGURE D.1

3. Roof Design

(a) Pitched roofs

(1) If a pitched roof is desired, a hip roof configuration is recommended. This reduces the overall forces lifting on the roof. A gable roof may be used with a wood frame house, but care should be taken to reinforce the roof at the connection between the roof ridge and the gable.

(2) The roof pitch should be approximately 30 degrees or about 1 meter in 3. (Wind loads are severe when roofs are pitched around 5-10 degrees.)

(3) Avoid outside overhangs of more than half a meter, even if supported at the edge by columns. If this is unavoidable, consider using vents or louvers along the roof edge to relieve the upward pressure.

Houses using a pitched roof should use roofing materials which are strong, shatter-resistant and of medium weight. Recommended area:

- heavy-gauge metal roofing sheets
- medium-weight, fiber-reinforced cement roofing sheets (non-brittle)
- wood sheets
- wood tiles

Not recommended are:

- thin gauge, metal roofing sheets (30-gauge or less)
- lightweight, fiber-reinforced cement roofing sheets
- lightweight, composite tiles and roofing sheets
- thin plywood sheets

- asphalt-impregnated cardboard sheets

(b) Flat roofs

Flat roofs are not recommended.

4. Wind Resistant Design Features

The forces applied to a building by high winds are:

- Upwards
- Sideways or lateral
- Twisting or racking

To build a structure which can resist these forces, there are three basic specifications that must be met.

(a) Anchorage. The first specification is to hold the roof on. This entails tying the roof down to the ground or foundation by an adequate and continuous chain of strength. Traditional construction is directed toward holding the roof up. In wind-resistant construction, the purpose is to hold the roof down (Fig. D.2).

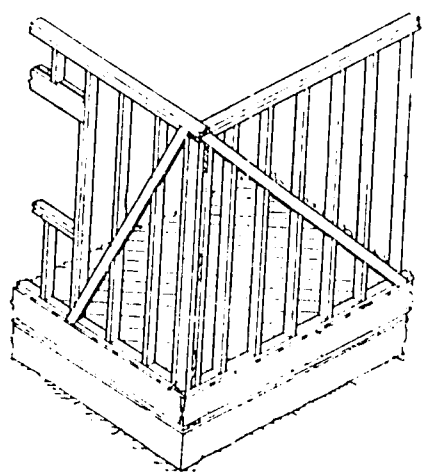

FIGURE D.2

(b) Bracing. The second specification is to brace the structure to withstand the lateral wind loadings and the racking effect. The methods used to brace traditional buildings are inadequate for the much larger forces existing in high wind conditions. Strength must be added not only at the corners of the building, but also at key locations throughout each wall.

(c) Continuity. The third specification is to provide the structure with integrity (i.e. to ensure all components are properly connected so that they can satisfactorily perform their function). Because the

forces are often much larger and in the opposite direction of those occurring normally, far more attention must be given to providing adequate connections between members and components of a building.

There are many design features which can significantly reduce the effect of the forces of high winds on a structure. Most of the building features which are dangerous are designed to provide comfort during normal periods of time. For example, many of the areas where high winds occur encompass sub-tropical and tropical regions. Houses in these zones generally feature lightweight materials, with large overhanging eaves for shade, elevated openings around the base of the roof and in the gables to facilitate ventilation and large window areas for through ventilation. Each of these features is contrary to ideal requirements for a wind-resistant house, so compromises in the design will have to be made. For the designer, there are several rules of thumb.

(a) Do not build any opening which cannot be closed off during a wind storm.

(b) Do not build openings which cannot be reached to be sealed off. (For example, an opening high on the wall under a gable may be difficult to reach and close prior to the onset of a storm.)

(c) Leave openings in suitable locations where pressure can escape. (For example, at the ridge of the roof.)

(d) Design the roof to reduce suction and break up lifting patterns.

(e) Design corners to reduce the pressures by allowing wind to slip around the corners. (This can be done often by rounding or beveling the corners of a building.)

(f) Avoid creating areas where wind can be trapped and excessive pressure can build up. (For example, sealing off the eave of a house at an angle parallel to or inclined towards the ground can significantly reduce the uplifting pressures at that point.)

(g) Avoid creating courtyards or patios which will increase circular or turbulent winds.

(h) All doors and windows should be a minimum of 1 meter from the end of a wall.

(i) All doors and windows should be a minimum of 1 meter from each other.

5. Structural Specifications

All wood frame houses must meet the following structural specifications (Fig. D.3):

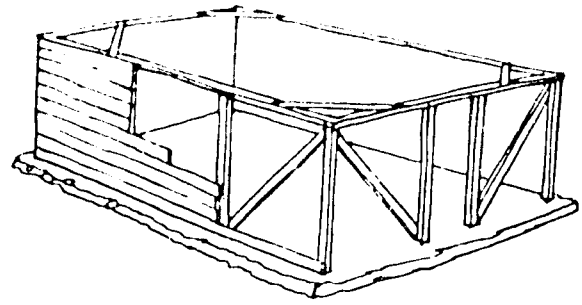

FIGURE D.3

(a) Walls should be built on concrete footings securely anchored to the ground. Avoid placing wood directly in or on the ground as this will cause rapid deterioration and a subsequent loss of internal and vertical resistance. Posts should be solidly anchored to the footings. Imbed the posts at least 40 centimeters into the footing (Fig. D.4).

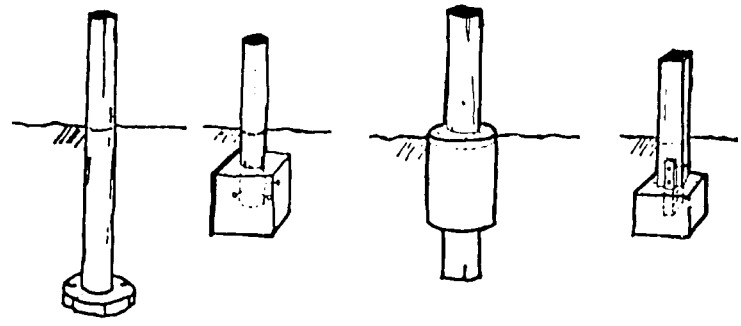

FIGURE D.4

(b) The houses should have wood posts in each corner and spaced at appropriate intervals throughout each wall. (Generally, posts should be spaced so that with the floor joists and upper ring beam, they form a square (Fig. D.5).

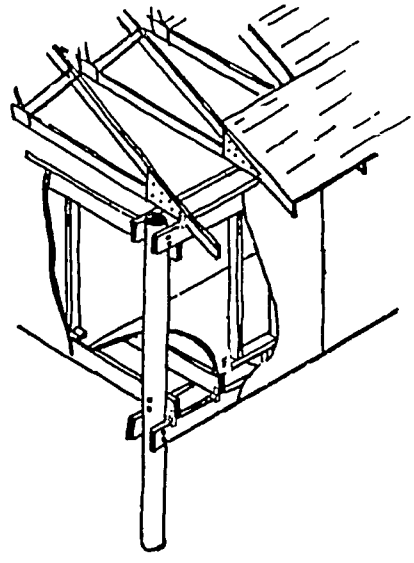

FIGURE D.5

(c) Vertical posts should be reinforced diagonally with wood bracing (Figs. D.3 and D.6).

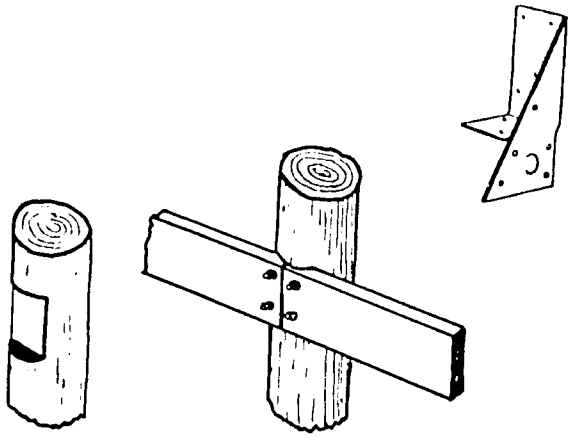

FIGURE D.6

(d) Wood siding should be securely nailed to each post.

(e) The houses should have a ring beam at the top of the wall formed by the upper part of the frame. Diagonal braces should be added at each corner.

(f) Gables must be reinforced where they join the main wall. Preferably a single post running from the gable to the foundation can be used.

(g) Interior walls should be fastened to exterior walls securely and a diagonal brace should be attached at the ring beam.

(h) Positive connections should be made between door and window frames and the walls in which they are placed.

(i) When connecting the roof frame to the wall, special care must be taken to attach the roof frame securely to the frame of the building. In addition to nailing the roof joist to the frame, a fastener strap or angle iron should be nailed to the joist. Then the ends of the fastener should be attached to the ring beam or post. (Figs. D.6 and D.7).

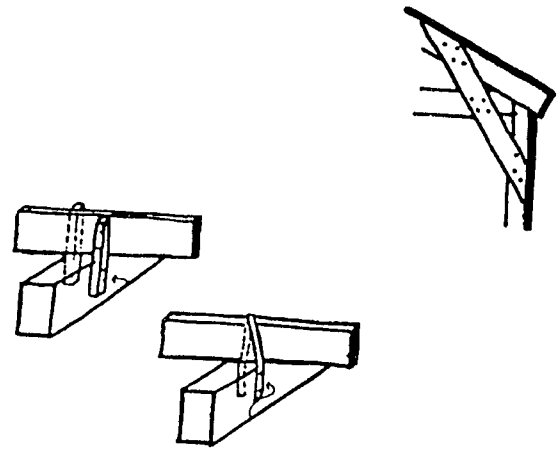

FIGURE D.7

(j) Corregated roofing material, such as metal roofing sheets, asbestos cement roofing sheets, or composite materials should be secured at every corregation along the bottom purlin (at the eaves), at every corregation along the top purlin (at the ridge), at every corregation on the end sheets (at the gable end), and at every third corregation over the rest of the roof. To secure the roof sheets to purlins, it is recommended that self-drilling drive screws to used if possible. Metal sheets should be fixed with screws of the same metal. Nails are permissible, as long as the nail is long enough to penetrate deep into the purlin. When either screws or nails are used, a washer of at least 20 millimeters in diameter (approximately 3/4 of an inch) should also be used. (Note: Special roofing nails with a wide, flat head are often supplied with roofing sheets. The quality and length of these nails vary, and before they are used in high wind areas, it should be determined whether these are suitable.

(k) Corregated roofing should be fastened to purlins through the top of the corregations (Figs. D.8 and D.9).

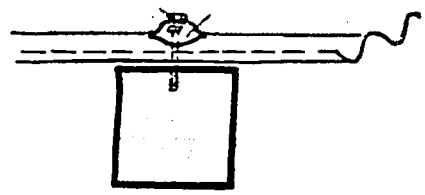

FIGURE D.8

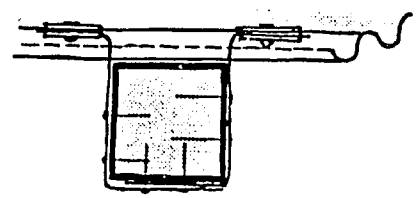

FIGURE D.9

(l) All wood joints and splices should be securely fastened and reinforced. Suggested fastenings are shown on the last page of this section (Fig. D.10).

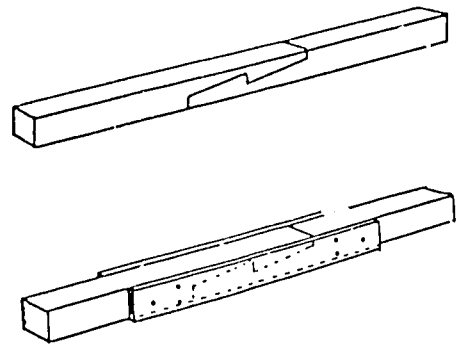

FIGURE D.10

6. Materials

Wood chosen for use should be of high quality and strength and should be properly and sufficiently seasoned and treated with an approved preservative. All load bearing timbers must be treated by a pressure treatment method. Wood siding may be treated by immersion or brush application methods. All exterior wood should be painted with a water resistant paint.

7. Safety Measures

(a) Doors and windows should be designed so that storm shutters can be placed over them during wind storms.

(b) Windows should be designed so that glass panes are relatively small and the window frame is supported by a wooden superstructure.

(c) Window frames should be designed so that if screens are used on the outside, they can be removed before a storm period and attached to the inside to provide protection against flying glass or other debris. All louvered windows must have outside storm shutters and be designed to lock into a closed position.

(d) One specific area should be designed to be especially strong so it can be used as an in-house shelter during wind storms. This area may be a closet, or any small room of the house which can be strengthened.

E. BUILDING GUIDE FOR AID-ASSISTED HOUSING RECONSTRUCTION PROGRAMS: EARTHQUAKE RESISTANT ADOBE HOUSING

1. Siting

(a) No house should be loc[illegible] closer than 1 meter to another structure or to a boundary divid[illegible] wall.

(b) No house should be located closer than 10 meters to a steep slope.

(c) No house should be built on a landfill or on the edge of a slope known to have been leveled by bulldozing.

2. Configuration of the Structure

(a) No house shall be built in the shape of an "L" unless a crush wall section made of lightweight material separates the two structural parts of the house by a minimum distance of 1 meter. The roof may be continuous as long as it is lightweight and also has a crush section.

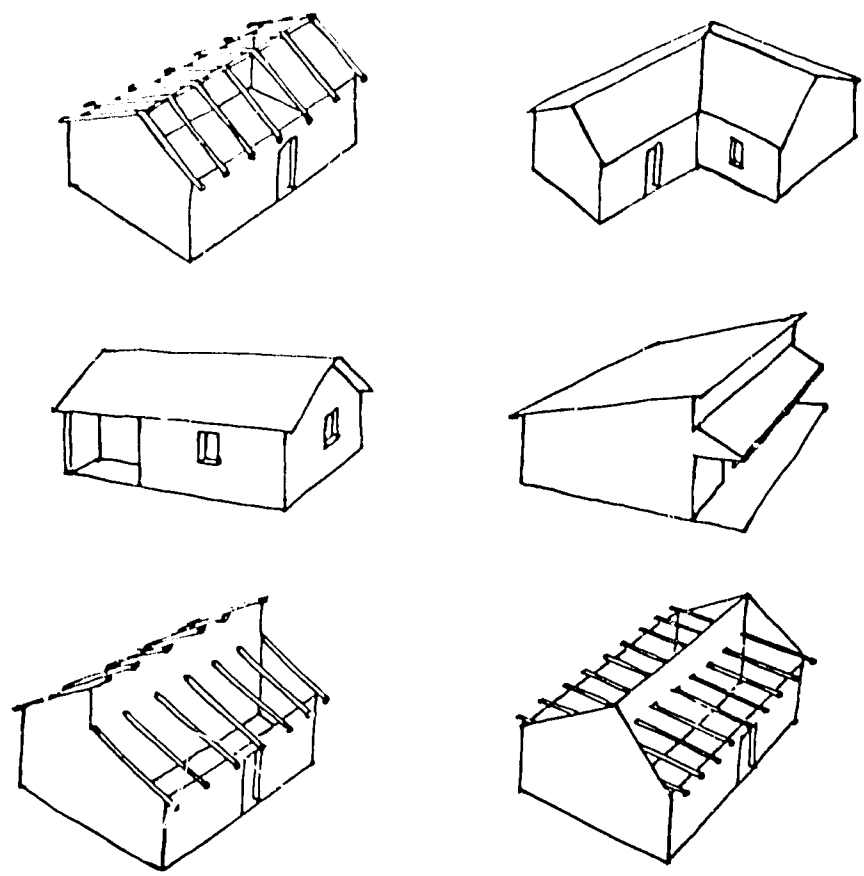

FIGURE E.1
WHAT NOT TO DO

(b) No house shall have an exterior wall which is more than 2.5 times longer than the shortest exterior wall.

(c) The parallel walls of all structures must be of equal length.

(d) The houses should not be more than one story.

3. Roof Design

(a) Pitched roofs

(1) If a pitched roof is specified, a hip roof (4-faced) configuration is recommended. A gable roof (2-faced) may be used as long as the roof is supported by end trusses, not by the gable walls.

(2) All trusses must rest on and be structurally secured to the upper ring beam of the wall and not be built into the walling itself.

(3) The following roof support configurations should not be used:

(4) All houses using a pitched roof must use lightweight roofing materials. Recommended are:

— metal roofing sheets
— lightweight fiber-reinforced cement roofing sheets
— lightweight composite tiles and roofing sheets

Not recommended are:

— wood sheets
— wood tiles

Not to be used are:

— clay tiles
— concrete panels

(b) Flat roofs

(1) If a flat roof is specified, a ferrocement (close mesh reinforcement) roof is recommended. Reinforced concrete roofs are not to be permitted unless continuous reinforced concrete columns and ring beams are used as the primary structural system.

(2) Roofs made of wood sheets supported by wooden timbers are permissible as long as the timbers rest on and are secured to a ring beam and not the wall itself. In addition, the timbers should extend a minimum of 1/2 meter beyond the ring beam. Timbers should not be spliced. Long well-nailed gusset plates should be used where needed to ensure structural continuity.

(3) Roofs made of earth and supported by a wood and timber frame are not approved.

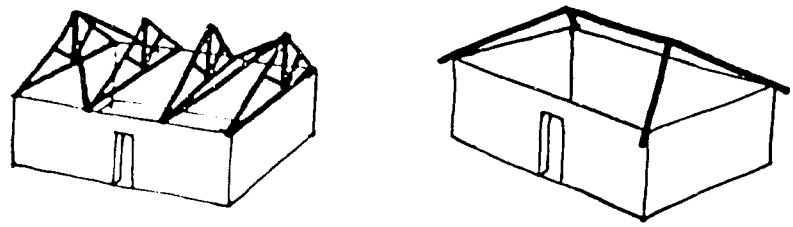

FIGURE E.2
GOOD PRACTICE

4. Earthquake-Resistant Design Features

All adobe houses should be built according to the following design principles:

(a) Exterior walls should be balanced by having doors and windows opposite each other in the parallel walls.

(b) All doors and windows should be a minimum of 1 meter from the end of a wall.

(c) All doors and windows should be centered or a minimumof 1 meter from each other.

(d) All doors in interior walls should be centered or a minimum of 1 meter from the end of the wall.

(e) The highest wall of houses with shed (1-face) roofs should be no higher than 1/2 meter above the opposite wall.

(f) All doors inside the house should open in the direction of the nearest door leading to the outside of the house.

(g) Mortar should not be more than 4 centimeters thick.

5. Structural Specifications

All adobe houses built with USAID assistance in earthquake areas must use some method of wall reinforcement. There are four systems which have been shown to be effective. They are:

- Frame and infill construction
- Post-frame and infill construction (also known as X-brace construction)
- Adobe de canto

- Modern (notched) adobe

Other methods are currently being developed, including use of epoxies and other bonding materials, which program planners may wish to consider; however, each method should be carefully reviewed by an earthquake engineer prior to selection.

(a) Specifications for concrete frame and infill construction. In this method of reinforcing, a continuous, running frame is constructed of reinforced concrete columns and beams. The adobes are used as a non-load-bearing, non-structural infill. Columns and ring beams are fabricated in-situ as the building is erected using the walling sections in part as permanent shuttering (Fig. E.3).

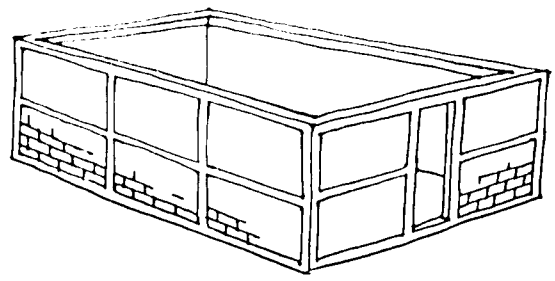

FIGURE E.3

Specifications are:

(1) The houses should be build on strong, level foundations with a moisture barrier.

(2) The houses should have vertical columns made of reinforced concrete in each corner and spaced at appropriate intervals throughout each wall. (Generally, columns should be spaced so that with the foundation and upper ring beam, they form a square.) All columns should be firmly implanted in the foundation at least two thirds of a meter.

(3) The houses should have reinforced concrete ring beams at the top of the wall.

(4) The houses should have a minimum of one horizontal ring beam placed close to the center of the height of the wall or under window sill height.

(5) All windows and doors should have vertical columns on each side of the openings.

(6) Gables must be reinforced with vertical columns and their edge surrounded by poured concrete.

(7) Interior walls should be joined to exterior walls at a vertical column.

(8) Corner columns or posts should be securely tied to adjacent walls, using tie bars and/or horizontal reinforcement laterally through the columns.

(9) Intersecting walls should be made continuous by means of tie bars and/or horizontal reinforcement that extends into neighboring walls and partitions. (To reduce reinforcing costs, split cane, bamboo, barbed wire, or other suitable tie material may also be used.)

(b) Specifications for post-frame and infill adobe construction. This method of reinforcing is accomplished by placing posts and beams in the walls and corners and cross-bracing them to provide a frame. The posts may be made of treated wood or reinforced concrete. Cross braces are made of wood, iron, cable or tensioned wire (Fig. E.4).

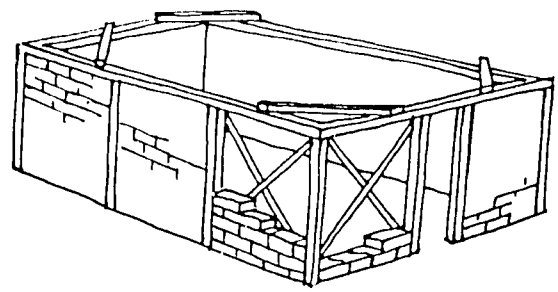

FIGURE E.4

Specifications are:

(1) The houses should be built on strong, level foundations with a moisture barrier.

(2) Adobe walls should have strong corner posts in each wall, buried at least 1 meter and fixed solidly in the foundation.

(3) All wood posts should be treated with a recommended wood treatment.

(4) All windows and doors should have vertical posts on each side of the openings.

(5) Long walls without openings should have posts in the wall, spaced so that with the foundation and upper ring beam they form a square.

(6) Each third layer of adobe should have a strand of barbed wire laid between it and attached to the posts to serve as additional reinforcement.

(7) Posts should be cross braced. Wood, wire or cable may be used with wooden posts, cable or iron rods should be used with concrete posts.

(8) A continuous ring beam should be placed along the top of each wall. This should be wood, not a reinforced concrete member or a beam cast in-situ.

(9) A diagonal brace should be placed across each corner of the ring beam in the plane of the "ceiling."

(10) Interior walls should be attached to posts in the exterior wall as well as by diagonal braces attached to the ring beam.

(11) Corner columns or posts should be securely tied to adjacent walls, using tie bars and/or horizontal reinforcement.

(12) Intersecting walls should be made continuous by means of tie bars and/or horizontal reinforcement that extends into neighboring walls and partitions. (To reduce costs, split cane, bamboo, barbed wire or other suitable tie material may also be used.)

(c) Specifications for adobe de canto construction. In this form of construction, adobe blocks are turned up on their sides and wedged into a wood frame (sometimes reinforced with wire). This method divides each wall into a number of small, relatively lightweight segments that are easy to reinforce. (Note: Only a hip roof configuration should be used with adobe de canto construction (Fig. E.5.)

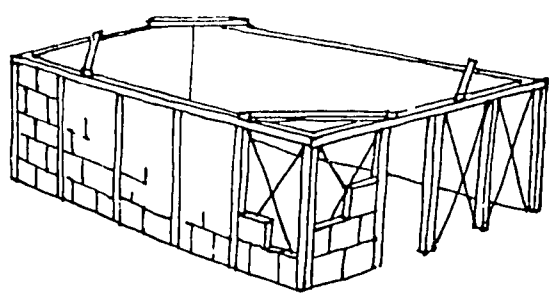

FIGURE E.5

Specifications are:

(1) The houses should be built on strong, level foundations with a moisture barrier.

(2) Adobe walls should have strong corner posts in each wall, buried at least 1 meter and fixed solidly in the foundation.

(3) All wood posts should be treated with a recommended wood treatment.

(4) All windows and doors should have vertical posts on each side of the openings.

(5) Long walls without openings should have posts in the wall spaced, so that with the foundation and upper ring beam they form a square.

(6) Adobe de canto houses should have wooden ring beams every two layers of adobe block. These beams must be attached to the vertical posts.

(7) A strand of wire should be placed on both sides of each layer of adobe de canto and tied securely to the posts.

(8) Posts should be cross-braced. Wood, tensioned wire or cable may be used with wooden posts; cable or iron rods should be used with concrete posts.

(9) A continuous ring beam should be placed along the top of each wall. This should be wood, not a reinforced concrete member or a beam cast in-situ.

(10) A diagonal brace should be placed across each corner of the ring beam.

(11) Interior walls should be attached to posts in the exterior wall as well as use diagonal braces attached to the ring beam.

(12) A stucco should be applied to both sides of the walls.

(c) Modern adobe construction. Modern adobe is a term used to designate adobe blocks that are notched at each end. This permits reinforcing rods to be placed vertically in the wall to strengthen lateral resistance. Pilasters or buttresses are built to add strength in the walls and the corners. (Note: A hip roof should be used with this type of construction (Figs. E.6 and E.6a.)

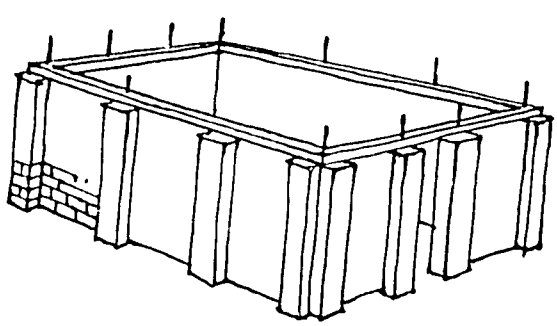

FIGURE E.6

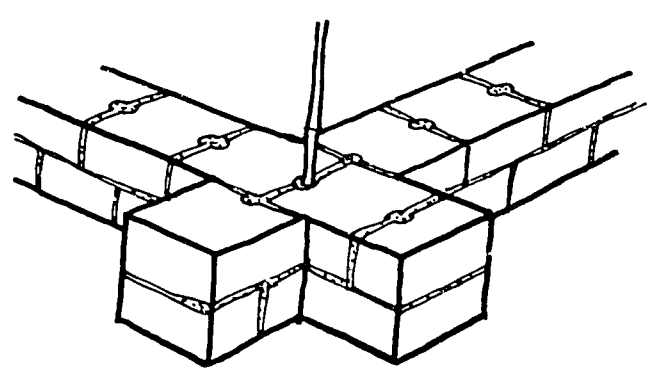

FIGURE E.6a

Specifications are:

(1) Houses should be built on strong level foundations with a moisture barrier.

(2) Vertical reinforcing materials should be placed at each corner, at each pilaster and at a point corresponding to the sides of each door and windowframe. Vertical reinforcing may be made of iron reinforcing bars, or split bamboo or cane suitably treated to resist moisture and insect infestation (Fig. E.6a).

(3) On each third course of adobe, horizontal reinforcing should be placed between the adobes. This is done by laying reinforcing rods or split bamboo in parallel lines slong the lengths of the course.

(4) The houses should have ring beams at the top of each wall (the ring beams are anchored to the wall by tying the wire to the reinforcing rods used as vertical reinforcement, three or four courses before the final, upper course of adobe is laid. The wire is run along the course to another reinforcing rod. It is then passed up through each additional layer along with the reinforcing rod so that the free end can be used to tie down the ring beam to the wall.)

(5) Interior walls should be joined to exterior walls at a pilaster.

(d) Roof specifications. When connecting a timber roof frame to an adobe wall, special care must be taken to attache the roof frame securely to the structure of the building.

When using the concrete frame and infill method, one method of fixing is to have the joists ready prior to the pouring of the upper ring beam. As the upper ring beam is poured, the roof joist is put in place. A fastener should be placed over and around the roof joist. Then the ends of the fastener should be imbedded in the ring beam. Fasteners may be made from iron reinforcing bars or other suitable materials.

For post and infill and adobe de canto construction, the roof trusses should be nailed securely to the timber upper ring beam. Diagonal braces should be fastened at the end of the truss system to add rigidity to the roof frame.

6. Materials

Adobes chosen for use should be of high quality and strength and should be properly and sufficiently cured.

(a) Strength. Adobes chosen for use in earthquake-resistant housing should have a compressive strength of 1,000 psi after normal curing.

(b) Adobes may be fabricated fom any mix of soil that provides the above compressive strength. If soils with a high plasticity (i.e. a wide range of swelling and contraction between moist and dry) are used, an agent such as lime or road asphalt should be added to the mix. It is advisable to get a soils laboratory to advise on the mix.

7. Safety Standards

(a) All houses should have doors which open outward, or the doorways should be designed so they will not fail or jam in an earthquake.

(b) All doors inside the house should open in the direction of the nearest exit to the outside.

(c) Avoid chimneys, cornices or any ornamental structure on the roof or elsewhere which could fall into the building or obstruct a door or window.

F. BUILDING GUIDE FOR AID-ASSISTED HOUSING RECONSTRUCTION PROGRAMS: EARTHQUAKE-RESISTANT BLOCK HOUSING

1. Siting

(a) No house should be located closer than 1 meter to another structure or to a dividing wall.

(b) No house should be located closer than 10 meters to a steep slope.

(c) No house should be built on a landfill or on the edge of a slope known to have been leveled by bulldozing.

2. Configuration of the Structure

(a) No house shall be built in the shape of an "L" unless a crush section made of lightweight material separates the two parts of the house by a minimum distance of 1 meter. The roof may be continuous as long as it is lightweight and also has a crush section.

(b) No house shall have an exterior wall which is more than 2.5 times longer than the shortest exterior wall.

(c) The parallel walls of all structures must be of equal length.

3. Roof Design

(a) Pitched roofs:

(1) If a pitched roof is specified, a hip roof (4-faced) configuration is recommended. A gable roof (2-faced) may be

used as long as the roof is supported by end trusses, not the gable walls.

(2) All trusses must rest on and be secured to the upper ring beam of the wall and not be built into the walling itself.

(3) All houses using a pitched roof must use lightweight roofing materials. Recommended are:

— metal roofing sheets
— lightweight fiber-reinforced cement roofing sheets
— lightweight composite tiles and roofing sheets

Not recommended are:

— wood sheets
— wood tiles

Not to be used are:

— clay tiles
— concrete panels

(b) Flat roofs:

(1) If a flat roof is specified, a reinforced concrete roof is recommended. Ferrocement is also permissible.

(2) Roofs made of wood sheets supported by wooden timbers are permissible as long as the timbers rest on and are secured to a ring beam and not the wall itself. In addition, the timbers should extend a minimum of 1/2 meter through the outside of each wall. Timbers should not be spliced. Long well-nailed gusset plates should be used where needed to ensure structural continuity.

(3) Roofs made of earth supported by a wood and timber frame are not approved.

4. Earthquake-Resistant Design Features

All block houses should be built according to the following design principles:

(a) Exterior walls should be balanced by having doors and windows opposite each other in the parallel walls.

(b) All doors and windows should be a minimum of 1 meter from the end of a wall.

(c) All doors and windows should be a minimum of 1 meter from each other.

(d) All doors in interior walls should be centered or a minimum of 1 meter from the end of the wall.

(e) The highest wall of houses with shed (1 face) roofs should be no higher than 1/2 meter above the opposite wall.

(f) Mortar should not be more than 1 inch thick.

5. Structural Specifications

All houses built of cement block must meet the following structural requirements (Fig. F.1):

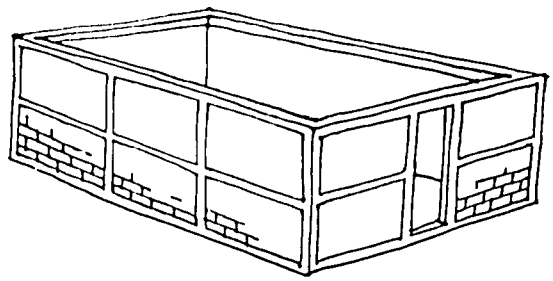

FIGURE F.1

(a) Block walls should be built on a continuous concrete footing with a moisture barrier. Avoid placing blocks directly on the ground, as this will cause the building to settle unevenly, causing wall cracks and openings for wind to penetrate.

(b) The houses should have vertical columns made of reinforced concrete in each corner and spaced at appropriate intervals throughout each wall. (Generally, columns should be spaced so that with the foundation and upper ring beam they form a square.)

(c) All windows and doors should have vertical columns on each side of the openings (Fig. F.2).

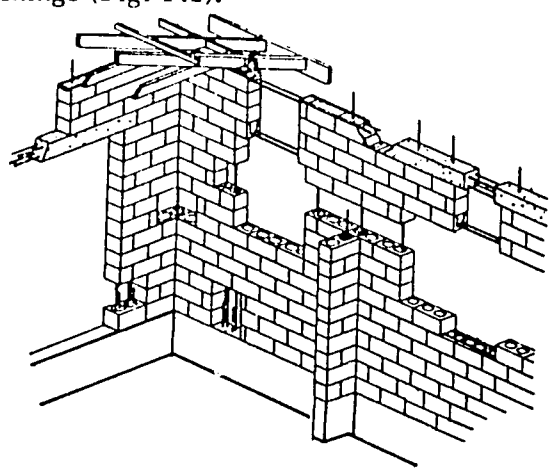

FIGURE F.2

(d) Blocks should be solidly anchored to the foundation using dowels, reinforcing bars, or tie rods. Imbed the anchors at least 25 centimeters into the footing.

(e) Walls and piers should be anchored to the foundation with 15-millimeter rods spaced not more than 2 meters apart along the wall length.

(f) Blocks should be laid according to a running bond rather than a stack bond method.

(g) To control cracking, blocks should be reinforced internally and vertically using metal rods imbedded in grout. Be sure to maintain a tight bond between reinforcement and the surrounding material.

(h) To reduce costs, split cane, bamboo or other suitable tie material may also be used as block reinforcement.

(i) Corner columns or posts should be securely tied to adjacent walls, using tie bars and/or horizontal reinforcement.

(j) Intersecting walls should be made continuous by means of tie bars and/or horizontal reinforcement that extends into neighboring walls and partitions (Fig. F.3).

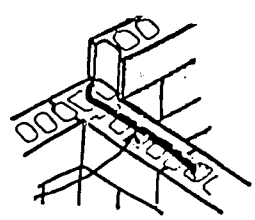

FIGURE F.3

(k) The houses should have a minimum of one horizontal ring beam placed close to the center of the height of the wall or running under window sills.

(l) The houses should have ring beams at the top of the wall.

(m) Gables must be reinforced with vertical columns and surrounded by poured concrete on all exposed edges.

(n) Interior walls should be jointed to exterior walls at a vertical column.

(o) Positive connections should be made between door and window sills, posts and lentels and the walls in which they are placed.

(p) When connecting a timber roof frame to a block wall, special care must be taken to attach the roof frame securely to the structure of the building. One method is to have the roof joists ready prior to the pouring of the upper ring beam. As the upper ring beam is poured, the roof joist is put in place. A fastener should be placed over and around the roof joist. Then the ends of the fastener should be imbedded in the ring beam. Fasteners may be made from iron reinforcing bars or other suitable materials.

6. Materials

Blocks chosen for use should be of high quality and strength and should be properly and sufficiently cured.

(a) Strength. Blocks chosen for use in earthquake-resistant housing should have a compressive strength of 1,000 psi after normal curing.

(b) Blocks may be fabricated from any ratio of sand to cement that provides the above compression strength.

(c) The use of pumice sand as a filler is permissible provided the sand does not contain or is mixed with any clay soils.

7. Safety Standards

(a) All houses should have doors which open outward, or the doorways should be designed so they will not fail or jam in an earthquake.

(b) All doors inside the house should open in the direction of the nearest exit to the outside.

(c) Avoid chimneys, cornices, or any ornamental structure on the roof or elsewhere which could fall into the building or obstruct a door or window.

G. BUILDING GUIDE FOR AID-ASSISTED HOUSING RECONSTRUCTION PROGRAMS: EARTHQUAKE-RESISTANT BRICK HOUSING*

1. Siting

(a) No house should be located closer than 1 meter to another structure or to a dividing wall.

(b) No house should be located closer than 10 meters to a steep slope.

(c) No house should be built on a le' fill or on the edge of a slope known to have been leveled by bulldozing.

2. Configuration of the Structure

(a) No house shall be built in the shape of an "L" unless a crush wall section made of lightweight material separates the two structural parts of the house by a minimum distance of 1 meter. The roof may be continuous as long as it is lightweight and also has a crush section.

(b) No house shall have an exterior wall which is more than 2.5 times longer than the shortest exterior wall.

(c) The parallel walls of all structures must be of equal length.

3. Roof Design

(a) Pitched roofs:

(1) If a pitched roof is specified, a hip roof (4-faced) configuration is recommended. A gable roof (2-faced) may be used as long as the roof is supported by trusses, not by the gable walls.

(2) All trusses must rest on and be structurally secured to the upper ring beam of the wall and not be built into the wall itself.

(3) All houses using a pitched roof must use lightweight roofing materials. Recommended are:

— metal roofing sheets
— lightweight fiber-reinforced cement roofing sheets

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* This guide can also apply to houses built of solid blocks, such as CINVA-RAM blocks.

— lightweight composite tiles and roofing sheets

Not recommended are:

— wood sheets
— wood tiles
— clay tiles
— concrete panels

(b) Flat roofs:

(1) If a flat roof is specified, a reinforced concrete roof is recommended. Ferrocement is also permissible.

(2) Roofs made of wood sheets supported by wooden timbers are permissible as long as the timbers rest on and are secured to a ring beam, and not the wall itself. In addition, the timbers should extend a minimum of 1/2 meter through the outside of each wall. Timbers should not be spliced. Long well-nailed gusset plates should be used where needed to ensure structural continuity.

(3) Roofs made of earth and supported by a wood and timber frame are not approved.

4. Earthquake-Resistant Design Features

All brick houses should be built according to the following design principles:

(a) Exterior walls should be balanced by having doors and windows opposite each other in the parallel walls.

(b) All doors and windows should be a minimum of 1 meter from the end of a wall.

(c) All doors and windows should be a minimum of 1 meter from each other.

(d) All doors in interior walls should be centered or a minimum of 1 meter from the end of the wall.

(e) The highest wall of houses with shed (1 face) roofs should be no higher than 1/2 meter above the opposite wall.

(f) Mortar should not be more than 3 centimeters thick.

5. Structural Specifications

All houses built of brick must meet the following structural specifications (Fig. G.1):

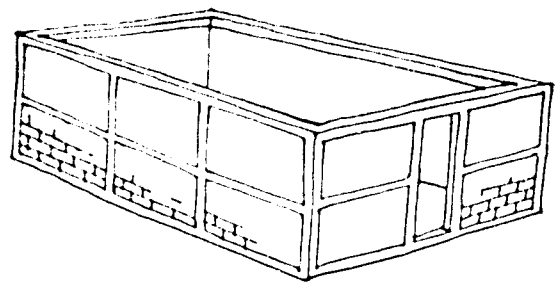

FIGURE G.1

(a) Brick walls should be built on a continuous concrete footing with a moisture barrier. Avoid placing bricks directly on the ground, as this will cause the building to settle unevenly, causing wall cracks and openings for wind to penetrate.

(b) The houses should have vertical columns made of reinforced concrete in each corner and spaced at appropriate intervals, but no farther than 2 meters apart, throughout each wall. (Generally, columns should be spaced so that with the foundation and upper ring beam, they form a square.)

(c) All windows and doors should have vertical columns on each side of the openings.

(d) Bricks should be laid according to a running bond rather than a stack bond method.

(e) Corner columns or posts should be securely tied to adjacent walls, using tie bars and/or horizontal reinforcement.

(f) Intersecting walls should be made continuous by means of tie bars and/or horizontal reinforcement that extends into neighboring walls and partitions.

(g) The houses should have a minimum of one horizontal ring beam placed close to the center of the height of the wall or under the window sills.

(h) The houses should have ring beams at the top of the wall.

(i) Gables must be reinforced with vertical columns and surrounded by poured concrete on all sides.

(j) Interior walls should be jointed to exterior walls at a vertical column.

(k) Positive connections should be made between door and window sills, posts and lentels, and the walls in which they are placed.

(l) When connecting a timber roof frame to a brick wall, special care must be taken to attach the roof frame securely to the structure of the building. One method is to have joists ready prior to the pouring of the upper ring beam. As the upper ring beam is poured, the roof joist is put in place. A fastener should be placed over and around the roof joist. Then the ends of the fastener should be imbedded in the ring beam. Fasteners may be made from iron reinforcing bars or other suitable materials.

6. Materials

Bricks chosen for use should be of high quality and strength and should be properly fired.

(a) Strength. Bricks chosen for use in earthquake-resistant housing should have a compressive strength of 1,000 psi.

(b) Bricks may be fabricated from any ratio of soil and clay that provides the above compression strength.

7. Safety Standards

(a) All houses should have doors which open outward, or the doorways should be designed so they will not fail or jam in an earthquake.

(b) All doors inside the house should open in the direction of the nearest exist to the outside.

(c) Avoid chimneys, cornices or any ornamental structure on the roof or elsewhere which could fall into the building or obstruct a door or window.

ANNEX III

FINANCING SYSTEMS: THE EXPERIENCE OF THE ASSISTED

One of the most important components of a post-disaster shelter program from the point of view of its recipients is its financing method (i.e. the means by which the victim/recipient pays for the shelter aid.

The planning of financing programs requires a "double vision": that of USAID and that of the aided families. This twin approach is crucial to project success. A financing method can have a positive effect of reinforcing the recipients' self-esteem, furthering local development and contributing towards an economic rebound.

After a disaster, USAID typically expands its aid to a host country beyond the normal programs. An appropriation is made specifically for disaster relief and/or reconstruction. A portion of this appropriation is usually designated for the housing sector when large numbers of houses have been damaged or destroyed.

This manual recommends a coordination between this post-disaster appropriation and a housing program funded by the AID housing office. For example, a normal AID housing loan program already in the pipeline and designated for a specific project could be supplemented by the post-disaster appropriation in several ways.

(1) It can finance the sites and services for the portion of families below the income level suited for the 100 percent payback loans.

(2) Because a disaster places such an economic strain on the entire community, any of the various income levels might become eligible for a subsidy in one or more of the forms described. The following discussion presents some financing methods or arrangements that have been, and may be, applicable to an AID post-disaster project. The presentation of their advantages and disadvantages helps to evaluate the more appropriate methods.

A. SELF-HELP

The implementing agency may give construction materials and usually furnish supervisory and administrative personnel to an organized group of families who build houses with self-help construction.

1. Advantages

(1) It reduces the total cost of the house to the owner.

(2) By virtue of building the shelter the recipient will have a greater identity and involvement with the end product than if he didn't build it.

2. Disadvantages

(1) The implementing agency may feel they have a right to dictate the form of organization of the self-help group as well as the time of year of the

construction because they are giving the materials and technical assistance.

(2) The time spent on the construction of the shelter is valuable to the recipient. He may have to make a difficult choice between building a house and providing the family with economic support. A solution may be to include "food for work" as part of the program.

The successful implementation of a self-help program can be achieved only with great care. The design of the program must respond to the traditional patterns of building and to the time and economic priorities of the victims.

B. LOAN PROGRAMS

Extending a loan to a disaster victim is another system of financing. Lenders usually place conditions on the taking up of the loan. The specific conditions vary considerably but include examples such as the recipient must be a disaster victim, live in a certain locale, have a prescribed income range with both minimum and maximum being stipulated, have an income source from a specific economic sector, have prior experience repaying credit and that he agrees to the payback terms of the proposed loan.

The lender could also place the additional conditions that the new construction must conform to minimum safety standards of earthquake or wind resistant construction techniques, or to be built away from flood plains, or even to not finance construciton in an area of economic decline.

The lender is often capable of providing advantageous terms of the loan. Various programs have allowed a subsidy in the form of low interest, no interest, repayment of only a percentage of the principal, long-term payback, and repayment at an affordable proportion of the family's income.

1. Long-Term Straight Loan

The long-term staight loan is perhaps the most commonly conceived form of loan financing. It is typically extended by an entity whose central function is that of a bank or lending institution.

After many major disasters, AID has made large scale loans to local finance institutions that are part of a national government's ministry of housing. this agency, in turn, offers loans to disaster victims for the purpose of the reconstruction of their house. (It may also be coupled with aid to the family's farm or small business to assist economic recovery.) Such a loan may not offer any other assistance to the victim in terms of construction materials or technical support.

While some of these lending institutions existed before the disaster, in other cases they were created by intervenors after the disaster as a response to the need for loan programs. However, embarking on a loan program for agencies that typically do not offer that form of aid has been problematical.

2. Advantages

(1) Victims typically do not have cash to spend on construction materials right after a disaster but can pay the full costs of materials plus interest and administrative charges on a long-term basis.

(2) The required repayment of the loan removes the stigma and problems of free aid.

(3) It may introduce a family to the discipline of credit, becoming an experience that may enable it to obtain future credit for other economic development.

(4) The lending institution is likely to expand its own experience and capabilities and perhaps extend its resources to a new set of clients.

(5) The amount of the loan may be tailored to the need of the recipient.

(6) The recipient has the freedom to rebuild a house of his own choosing or design and not be tied to a housing program where all units are exactly alike or otherwise prescribed.

(7) The lending institution is probably involved with and promoting the economic well-being of the recipients for at least the life of the loan.

3. Disadvantages

(1) The lender may place unduly restrictive conditions on the loan.

(2) Especially in rural areas, it is unlikely there would be a credit facility capable of providing the services of loan administration.

(3) The recipient may not have been adequately prepared for the economic burden of repayment. This could occur where he has no experience with a credit system, does not understand its concept and may not see the point or be adequately motivated to make payments.

(4) Some people are reluctant to undertake loans because they believe that their property would be placed in jeopardy if they did not repay.

(5) Loans made available by conservative financing institutions, including national government housing banks, by the great majority only make their loans available to middle class victims, people with a very low risk factor.

C. LOAN FOR A LOAN

It was previously noted that an advantage of a loan program was that it enabled a victm to acquire building materials or a house when he did not have the cash to make a purchase. However, many lending institutions require a substantial downpayment, for example 20 percent of the loan, in order to qualify for the loan. For the victims without the cash, even such a loan is an inaccessible form of aid.

For victims in that situation, implementing agencies, particularly voluntary agencies, have made a loan to the victim to cover the downpayment. This enables him to obtain the full loan, hence, a loan for a loan.

D. GUARANTEED LOAN

A disadvantage of many loan programs was previously cited as the tendency for lending institutions to make available loans only to the most credit worthy individuals (i.e. middle class or people with a good credit rating). Another reluctance has been to venture out of the lending institutions' most familiar territory (i.e. typically urban areas) at the expense of the people in the unfamiliar territory or rural areas.

Agencies addressing this problem have made guarantees to these lending institutions enabling them to extend loans to the previously disenfranchised population. this is a particularly effective form of assistance for voluntary agencies involved in an ongoing development program in the disaster affected area.

In addition to the list of advantages of loan programs, the advantages of the guarantee of a loan is that, in terms of resources that are committed, it is essentially a very inexpensive program that can reach a proportionately large number of people.

E. REVOLVING LOAN

A revolving loan system allows for the same money brought into a disaster affected community to be used many times. this occurs as the original loan recipients begin to repay the loan. This creates a new fund which can in turn be reloaned to other disaster victims.

This form of aid is a very appropriate one when the intervenor provides assistance as a grant of money that does not need to be recovered as it is with the traditional loan. This financing system has the multiple advantages of extending the use of the original money to many times the original loan recipients. this money would have the side effect of creating additional employment in the community. It further may assist in the creation of a new credit agency and to provide it with a considerable base of experience. This agency and experience may carry the community far into the reconstruction period.

F. MATERIAL PRICE SUBSIDY, MONEY REFLOW

Although they are actually two separate financing mechanisms, material price subsidy and money reflow have been linked together in several shelter programs. The first element is that the intervenor makes construction materials available to the community but sells them at a subsidized price. The money recovered from the sale, instead of returning to the intervenor, is then kept in the community and used to pay disaster victims for their labor on a public works project.

A discussion of a case study will clarify the program. After the 1976 earthquake in Guatemala, USAID implemented a program utilizing this approach to financing.

Corrugated galvanized iron roofing sheets were brought in huge quantities by USAID and shipped to Guatemala. USAID made agreements with cooperatives to be the

agent to distribute the material. The material was then sold directly to victim families at approximately half cost with a limit of 20 sheets per family.

The community was asked to identify community projects, typically public works type projects that needed attention. The money received from the material sales was used to finance the public works project, paying the labor, the same victims, at their daily rate. this, of course, increased the purchasing power of the victims and speeded their economic recovery.

1. Advantages

(1) The subsidized price, as opposed to full price, makes more material available to poorer families.

(2) The subsidized price, as opposed to an outright gift, makes the materials available to many more families, the program goes much further.

(3) The program's benefits are threefold; the victims receive materials, community projects are built, personal income is generated.

(4) The poorest of families not able to initially purchase the material were enabled to do so by participating in the public works project.

(5) The managerial experience accrued to the distributing agency may contribute significantly to the long-term recovery and development of the region.

(6) A materials program allows the recipient the freedom to use the materials in any way at any time as he so chooses. He, therefore, does not have to accept someone else's version of shelter.

An evaluation of the OXFAM/World Neighbor Program in Guatemala cited these additional advantages.

(7) Sales were said to be easier to administer than giveaway programs.

(8) Discrimination on the basis of need was avoided.

(9) Gifts tended, in any case, not to be valued.

(10) The method avoided creating the expectations that solutions would be provided by outsiders.

(11) Readjustment from a percentage cost to full cost at the end of a program was less violent than from gifts to full market price.*

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* Alan Taylor, "Disaster Housing Aid: A Programme Planning Model from Guatemala," Disasters, Vol. 2, No. 1, pp. 17-23.

2. Disadvantages

(1) A large scale program has a large scale administration; it may be difficult to staff the program and adequately train them.

This financing system is actually a hybrid with material supply and community economic development. It combines the advantages of all of them at a period when the disaster struck community is in the most need for these kinds of external support.

A review of the case studies of post-disaster programs demonstrates that typically the intervenor uses a combination of financing mechanisms. For example, an agency provides at no cost to the victim, technical assistance and administrative overhead and requires a payment for only a fraction of the construction material costs. Further variations of this example have been some programs that provide the construction labor and others that require self-help participation.

G. PROBLEM

Where there is a multiplicity of intervenors providing shelter programs in a disaster-struck community, there is most likely a wide range of financing systems employed. As previously demnstrated, some of these systems have serious disadvantages. However, just as serious is the disparity among them. Victims who have suffered the same disaster, incurred similar loss and are of the same economic situation may be subjected to extremely differing financing arrangements for the relief program accessible to them.

The problems created by the wide range of financing systems are clearly illustrated by the experience at Choloma, Honduras, after Hurricane Fifi in 1974. These problems were exacerbated by the fact that there was also a great range in the quality and user desirability of the housing projects. The cost of the agency built housing ranged from US$400 to $2,150. Some families received highly desirable concrete block houses which cost $1,000 and did not have to pay anything. Others received less desirable $600 wood houses and had to pay a portion of the cost, while others received $450 wood houses and were required to repay the entire cost.

Such inconsistencies lead to frustration, confusion and anger on the part of the beneficiaries. For many, there is the uncertainty and insecurity created by an unknown status of payment, even many months or years after occupancy. These feelings sometimes leave a bitterness which upsets social patterns in a community for years to come.*

The issue of financing, then, is also interrelated to the total cost, value and desirability of the project. It should additionally relate to the victims' income and ability to pay. As obvious as that may seem, it has not often been the case, thus becoming another part of the financing problem.

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* C. and P. Thompson, "Post Disaster Housing in Latin America," UNDRO Shelter Study, Phase I.

H. SOLUTION

It is necessary to standardize an approach to financing systems among all assisting agencies. Some authoritative body such as the disaster coordinating agency of the national government should establish a policy to achieve this objective. This policy could take the form of a set of criteria that all shelter program financing systems must meet. Because of the great diversity of cultural traditins and economic bases, it is not possible here to set forth a model set of criteria. Rather a set of principles can act as a guide for each country to develop its own criteria.

(1) All recipients of aid should be required to repay a substantial proportion of the cost of that aid. A nominal repayment of 5 or 10 percent may be perceived and function as virtually a gift. On the other hand, a 100 percent repayment of the cost may be too great a burden for a family that may have suffered in other economic ways from the disaster.

(2) The cost of a shelter should approximate the cost of pre-disaster housing. There may be extenuating factors that may justify a somewhat higher cost that may include, for example, the inefficiencies of the administration of a shelter program or if there are construction modification techniques employed that use additional building materials.

(3) The form of the repayment should be as similar to traditional debt repayment practices as possible. To require a recipient to walk several kilometers every month to a community where he normally never goes and to deal with a person of a substantially different culture to repay a loan may find that person incapable of meeting his obligation. Instead, allow payments at a time sequence that reflects his income availability, at a location with which he is comfortable and has positive associations and to a person that he may know or at least learn to trust.

Further pre-disaster planning should include identifying lending institutions that would cooperate with special post-disaster loan programs such as the guaranteed loan and a loan for a loan.

These same institutions may also agree to act as a loan recuperating agency on contract to intervenors that choose not to set up their own loan recovery administration. This would effectively eliminate the chief argument that these intervenors have fr giving away their assistance.

Where a reflow program is anticipated, the mechanism and institution to operate it can also be planned.

In the end, it is the responsibility of all intervenors to identify the financing system that serves best the interests of the disaster victim and to coordinate that system with all other intervenors.

I. AID ROLES

(1) Coordinate its financing method with other post-disaster programs.

(2) Advocate for a policy of the national level for this coordination.

ANNEX IV

CONVENTIONAL HOUSING PROJECT
BUDGET ESTIMATION FORM

A. EXPENDITURES

1. Administrative Costs

a. Staff:	No. of Persons	X	Individual Salary	X	Years	TOTALS
1) Project Director			$			$
2) Assistant Project Director						$
3) Relocation Officer						$
4) Relocation Field Supervisor						$
5) Relocation Counselor						$
6) Construction Officer						$
7) Construction Field Supervisor						$
8) Loan Counselor						$
9) Draftsman						$
10) Real Estate Officer						$
11) Project Planner						$
12) Comptroller						$
13) Accountant						$
14) Community Relations Officer						$
15) Secretary						$
16) Clerk/Stenographer II						$
17) Clerk/Stenographer I						$
18) Clerk/Messenger/Driver						$

Total Personnel Services $

b. Travel and Per Diem Expense:

1) ___ no. of staff @ $___/day per diem X ___ days $

2) Air/rail/bus trips to site(s): ____ trips @ $_____ $

3) Operation of agency vehicles @ ____/mo. X ___ mos. $

Total Travel and Per Diem $_____

c. Printing of Reports: $_____

d. Attorney Retainer Fees: $_____

e. Sundry Overhead:

1) Supplies _____

2) Postage _____

3) Printing, Data Processing _____

4) Publications _____

5) Telephone _____

6) Equipment Rental and Repairs _____

7) Advertising _____

8) Insurance, Office Equipment _____

9) Office Rental and Utilities,
____ mos. @ $_____/mo. _____

Total Sundry Overhead $_____

f. Non-Expendable Equipment:

1) Executive Desk, ___ @ $_____ _____

2) Executive Chair, ___ @ $_____ _____

3) Office Desk, ___ @ $_____ _____

4) Swivel Chair, ___ @ $_____ _____

5) Secretarial Desk, ___ @ $_____ _____

6) Sec'y. Chair, ___ @ $_____ _____

7) Conference Table, ___ @ $_____ _____

8) Reception Chair, ____ @ $_____ _____

9) Typewriter, ____ @ $_____ _____

10) File Cabinet, ____ @ $_____ _____

11) Calculator, ____ @ $_____ _____

12) Drafting Table and Equipment,
_____ @ $_____ _____

13) Miscellaneous Cabinets and
Fixtures _____

14) Vehicles, ____ @ $_____ _____

Total Non-Expendable Equipment $_____

g. Employee Insurance:

_____ Employees @ $_____/mo. X _____ mos. $_____

h. Social Security: $_____

i. Retirement: $_____

j. Employee Training: $_____

TOTAL ADMINISTRATIVE COST $_____

2. Legal Services

a. Acquisition Expenses,
_____ sites @ $_____ _____

b. Closing Costs, _____ sites @ $_____ _____

c. Title Opinions, _____ sites @ $_____ _____

d. Title Clearing, _____ sites @ $_____ _____

e. Condemnation Expenses, _____ sites
@ $_____ _____

TOTAL LEGAL SERVICES $_____

3. Surveys and Planning

a. Surveys:

1) Boundary Survey _____

2) Platting _____

Survey Subtotal

b. Professional Services by Consultant:

1) Planning _____

2) Hazard Analysis _____

3) Engineering _____

4) Economic Analysis _____

5) Sociological Analysis _____

6) Other _____

Professional Services Subtotal

TOTAL SURVEYS AND PLANNING

4. Land Acquisition Expenses

a. Title Information _____

b. Sundry Direct _____

c. Sundry Condemnation _____

d. Appraisals _____

e. Condemnation Appraisals _____

f. Land Acquisition _____

g. Assemblage _____

TOTAL ACQUISITION EXPENSE

5. Temporary Operation of Acquired Property

6. Relocation and Community Expenses

7. Site Clearances

Structural Units to be Cleared:

a. Residential, ____ units @ $_____ _____

b. Commercial, ____ units @ $_____ _____

TOTAL SITE CLEARANCE $_____

8. Project Improvements

a. Streets, Storm Drains _____

b. Water System _____

c. Sewer System _____

d. St. Lights _____

e. Recreation Facilities & Landscaping _____

f. Fire Alarm _____

Project Improvements Subtotal $_____

Contingencies (____%) $_____

TOTAL PROJECT IMPROVEMENTS $_____

9. Lease/Retention Costs

a. Land Lease _____

b. Options _____

c. Legal Services _____

TOTAL LEASE/RETENTION $_____

10. Rehabilitation or Repair of Buildings on Site

a. Structural Surveys _____

b. A & E Fees _____

c. Construction Costs _____

TOTAL REHABILITATION/REPAIR $_____

11. Off-Site Shelter Expenses

a. Shelter, ____ units X ____ families _____

b. Site Acquisition or Rental,

____ sites X $_____ _____

c. Site Preparation _____

d. Water Supply

1) Tankers _____

2) Water Tanks _____

3) Containers _____

4) Other _____

5) Fuel _____

e. Sanitation Services

1) Latrines _____

2) Installation Costs _____

3) Odor Suppression _____

4) Cleaning & Maintenance _____

5) Servicing & Disposal _____

f. Hygiene Services

1) Shower Facilities _____

2) Washing Facilities _____

3) Other _____

g. Waste Collection

1) Receptacles _____

2) Collection Services _____

3) Site Cleaning Services _____

4) Other _____

h. Fire Protection

1) Fire Barrels _____

2) Extinguishers _____

3) Other _____

i. Service Facilities

1) Clinic _____

2) Community Center _____

3) Admin. Buildings _____

4) Other _____

TOTAL OFF-SITE SHELTER EXPENSES $_____

12. Construction Expenses

a. Single-family Houses, Type I,
____ units X $_____ _____

b. Single-family Houses, Type II,
____ units X $_____ _____

c. Single-family Houses, Type III,
____ units X $_____ _____

d. Two-family Houses, Type I,
____ units X $_____ _____

e. Two-family Houses, Type II,
____ units X $_____ _____

f. Two-family Houses, Type III,
____ units X $_____ _____

g. Multi-family Houses, Type I,
____ units X $_____ _____

h. Multi-family Houses, Type II,
____ units X $_____ _____

i. Multi-family Houses, Type III,
____ units X $_____ _____

j. Building Materials Package, Type I,
____ packages X $_____ _____

k. Building Materials Package, Type II,

____ packages X $ _____ _____

l. Building Materials Package, Type III,

____ packages X $_____ _____

m. Housing Frame Erection, Type I,

____ frames X $_____ _____

n. Housing Frame Erection, Type II,

____ frames X $ _____ _____

o. Housing Frame Erection, Type III,

____ frames X $_____ _____

p. Utility Services Core, Type I,

____ cores X $_____ _____

q. Utility Services Core, Type II,

____ cores X $_____ _____

r. Training Aids _____

s. Tools _____

t. Miscellaneous _____

u. Contingencies (____%) _____

TOTAL CONSTRUCTION EXPENSES $_____

13. Interest Payments $_____

14. Program Inspection, Monitoring & Evaluation $_____

15. Subtotal, Items 1-14 $_____

16. Contingencies (____%) $_____

17. TOTAL ESTIMATED EXPENDITURES $_____

INCOME

18. Real Estate Sales

    a. Residential Lots _____

    b. Commercial Lots _____

TOTAL REAL ESTATE SALES $_____

19. Real Estate Rental

    a. Residential Property _____

    b. Commercial Property _____

    c. Other Facilities _____

TOTAL REAL ESTATE RENTAL $_____

20. Income from Revolving Loans $_____

21. Reflow from Subsidies of Building Materials $_____

22. Interest Income $_____

23. Miscellaneous Income $_____

24. TOTAL ESTIMATED INCOME (Items 18-23) $_____

SUMMARY OF ESTIMATED PROJECT COST

25. Total Estimated Project Expenditures (Line 17) _____

26. Less Total Estimated Income (Line 24) _____

27. Total Estimated Project Cost $_____

ANNEX V

ORGANIZATIONAL RESOURCES AND SOURCES OF INFORMATION

(1) AIA Research Corporation
Director, Earthquake and Flood Research Program
1735 New York Avenue, N.W.
Washington, D.C. 20006
U.S.A.

(2) Building Research Establishment
Overseas Division
Building Research Station
Garston, Watford, Herts
United Kingdom

(3) Caulfield Institute of Technology
Centre for Information and Research on Disasters and Natural Hazards (CIRLNH)
P.O. Box 197
Caulfield East
Melbourne, Victoria 3145
Australia

(4) Centre de Recherche sur l'Epidemiologie des Desastres
Ecole de Sante Publique
Unite d'Epidemiologie
Universite Catholique de Louvain
Clos Chapelle-aux-Champs, 30
B-1200 Bruxelles
Belgium

(5) Earthquake Engineering Research Institute (EERI)
2620 Telegraph Avenue
Berkeley, California
U.S.A.

(6) International Council of Building Research Studies and Documentation
704 Weena
P.O. Box 20704
Rotterdam 3
Netherlands

(7) International Disaster Institute (IDI)
85 Marylebone High Street
London W1M 3DE
United Kingdom

(8) International Institute of Seismology and Earthquake Engineering
Building Research Institute
Ministry of Construction
3-28-8 Hyakunin-cho
Shinjuku-ku, Tokyo
Japan

(9) International Society on Disaster Medicine
10-12 Chemin de Surville
1213 Petit-Lancy
Geneva
Switzerland

(10) International Tsunami Information Center (ITIC)
P.O. Box 50027
Honolulu, Hawaii 96850
U.S.A.

(11) INTERTECT
P.O.Box 10502
Dallas, Texas 75207
U.S.A.

(12) James Cook University of North Queensland
Center for Disaster Studies
P.O. James Cook University
Queensland 4811
Australia

(13) League of Red Cross Societies
17 Chemin des Crets, Petit-Saconnex
1211 Geneva 19
Switzerland

(14) Lewis, James
101 High Street
Marshfield, Avon
Nr. Chippenham SN14 8LT
United Kingdom

(15) Middle East Technical University
Earthquake Engineering Research Institute
Ankara
Turkey

(16) Munchener Ruckversicherungs-Gesellschaft
Koniginstrasse 107
D-8000 Munchen 40
Federal Republic of Germany

(17) National Building Research Station
Director, Small Buildings Under Earthquake Stress Program
Rorkee
North India

(18) National Climatic Center
NOAA Tropical Cyclone File
Federal Building
Asheville, North Carolina 28801
U.S.A.

(19) National Geophysical and Solar-Terrestrial
Data Center
NOAA Earthquake Data File
Environmental Data and Information Service
Boulder, Colorado 80303
U.S.A.

(20) National Information Service for Earthquake Engineering
EERC, 415 RFS
47th Street and Hoffman Boulevard
Richmond, California 94804
U.S.A.

(21) National Science Foundation
Dr. Frederick Krimgold
Earthquake Hazard Mitigation
1800 G Street, N.W.
Washington, D.C. 20550
U.S.A.

(22) Ohio State University
Disaster Research Center
127-129 West Tenth Avenue
Columbus, Ohio 43201
U.S.A.

(23) Oxford Polytechnic
Ian Davis
Disaster and Human Settlements Group
Headington, Oxford OX3 OBP
United Kingdom

(24) PADCO, Inc.
1834 Jefferson Place, N.W.
Washington, D.C. 20036
U.S.A.

(25) Pan American Health Organization
Dr. Claude de Ville de Goyet
Emergency Preparedness and Disaster Relief Coordination
525 Twenty-Third Street, N.W.
Washington, D.C. 20037
U.S.A.

(26) United Nations Development Programme
One U.N. Plaza
New York, New York 10017
U.S.A.

(27) United Nations Disaster Relief Office (UNDRO)
Palais des Nations
Ch-1211 Geneva 10
Switzerland

(28) United Nations High Commissioner for Refugees
Palais des Nations
Ch-1211 Geneva 10
Switzerland

(29) United Nations Regional Housing Center
Nirman Bhawan, Maulana Azad Road
New Delhi 110011
India

(30) University of Colorado
Natural Hazard Research Program
Institute of Behavioral Science No. 6
Boulder, Colorado 80309
U.S.A.

(31) University of Michigan
Professor Glen V. Berg
Earthquake Codes Program
Department of Civil Engineering
Ann Arbor, Michigan
U.S.A.

(32) University of Minnesota
Underground Space Center
11 Mines and Metallurgy Building
221 Church Street, S.E.
Minneapolis, Minnesota 55455
U.S.A.

(33) Universidad Nacional de San Juan
Instituto de Investigaciones Antisismicas
San Juan
Argentina

(34) University of Toronto
Natural Hazard Research Program
Department of Geography
Toronto, Ontario
Canada

(35) U.S. Department of Housing and Urban Development
Office of International Affairs
Washington, D.C. 20410
U.S.A.

(36) U.S. Department of State
Agency for International Development
Office of Foreign Disaster Assistance
Washington, D.C. 20523
U.S.A.

(37) Volunteers in Technical Assistance, Inc. (VITA)
3706 Rhode Island Avenue
Mt. Rainier, Maryland 20822
U.S.A.

IMPORTANT RELIEF AND DEVELOPMENT PERIODICALS

Appropriate Technology
Intermediate Technology Publications Ltd., 9 King Street, Covent Garden, London WC2, U.K. A forum for the exchange of ideas among those directly involved in development work; technical articles, book reviews, readers' contributions. Quarterly.

Basics: A Source of Shared Information on Rural Development
Rural Communications, 17 St. James Street, South Petherton, Somerset, U.K. Newsletter providing information on development problems in an easily understood form: settlements and housing; education and training; appropriate technology ideas and options. Bi-monthly.

Development Communication Report
Clearing House on Development Communications, 1414 22nd Street, N.W., Washington, D.C. 20037, U.S.A. Good source for information on communications projects and technology. Quarterly.

Development Forum
Division of Economic and Social Information, United Nations, 1211 Geneva, Switzerland. Primarily devoted to development issues but includes some relief/reconstruction information. Good source for publications and contacts. Articles on non-governmental organizations, U.N. agencies, technology, desertification, ecology-virology, development education. Monthly.

Disaster Preparedness in the Americas
Pan American Health Organization, Emergency Preparedness and Relief Coordination Unit, 525 23rd Street, N.W., Washington, D.C. 20037, U.S.A. Newsletter giving information on PAHO, WHO, UN and other agencies. Reviews publications, journals and newsletters on disasters. Good resource. Monthly.

Disasters: International Journal of Disaster Studies and Practice
Pergamon Press, Headington Hill Hall, Oxford OX3 OBW, U.K. Edited by the staff of the International Disaster Institute. Articles and information on all facets of relief: pre-disaster planning and mitigation, disaster case studies, epidemiology. Good resource for publications and contacts. Quarterly.

Invention Intelligence
Department of Science and Technology, National Research Development Corporation of India, 61 Mahatma Gandhi Marg, Lajnagar III, Delhi 4, India. Includes articles on technology for the poor, rural-based industry, housing. Monthly.

Natural Hazards Observer
Institute of Behavioral Science #6, University of Colorado, Boulder, Colorado 80309, U.S.A. Primarily aimed at researchers. Information on available studies and contacts; conferences and meetings; federal and state policies, regulations and forthcoming legislation; organizations and their projects; grants for research; recent publications. Quarterly.

Soundings from Around the World
World Neighbors, 5116 N. Portland, Oklahoma City, Oklahoma 73112, U.S.A. Review of books, reports, periodicals, audio-visual training aids, etc. produced by World Neighbors and other organizations throughout the world. Excellent resource for all aspects of development. Quarterly.

TAICH News
Technical Assistance Information Clearing House, 200 Park Avenue South, New York, New York 10003, U.S.A. This Newsletter is an excellent source of information on U.S. overseas development assistance projects, contacts and publications, forthcoming meetings and conferences. Quarterly.

TRANET Newsletter
TRANET (Transnational Network for Appropriate/Alternative Technologies), P.O. Box 567, Rangeley, Maine 04970, U.S.A. Publishes lists of appropriate technology centers, low cost and self-help housing groups, citizen planning; forthcoming meetings and workshops. Good resource for contacts and information about other organizations; fair resource for publications. Quarterly.

UNDRO Newsletter
Office of the United Nations Disaster Relief Coordinator, Palais des Nations, 1211 Geneva 10, Switzerland. Reviews recent disasters throughout the world and the response by U.N. agencies, other organizations and the national governments involved. Good resource for meetings and conferences organized by the UN.N, non-governmental and intergovernmental organizations, voluntary agencies and others. Also good resource for recent publications, articles, etc. on natural disasters and related subjects. Monthly.

Unscheduled Events
Disaster Research Center, Ohio State University, College of Social and Behavioral Sciences, 128 Derby Hall, 154 N. Oval Mall, Columbus, Ohio 43210, U.S.A. Articles on studies and research prjects, forthcoming conferences and meetings, recent publications. Good resource for contacts and references. Quarterly.

VITA News
Volunteers in Technical Assistance Inc., 3706 Rhode Island Avenue, Mt. Rainier, Maryland 20822, U.S.A. Articles on international information exchange, technology transfer/diffusion, rural development programmes, appropriate technology, recent publications, networks and entacts. Good reference. Quarterly.

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