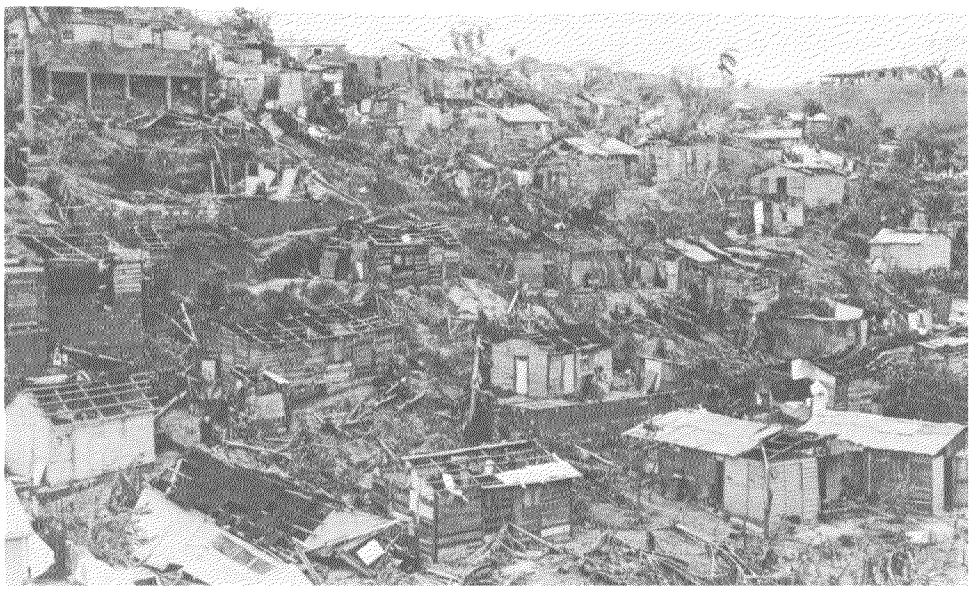

In areas subject to high winds, the roof is the most vulnerable part of the structure, as is indicated in this example after Hurricanes David and Frederick in the Dominican Republic, 1979. Improved building techniques can greatly reduce this risk.

Building research has shown that the performance of a structure in high winds or in an earthquake is in large measure dependent upon the weight and design of the roof, and how it is attached to the frame. Once these problems have been solved, it is almost inconsequential what type of infill is used in the walls. Normally, the local materials which were used before the disaster can be used again.

At present, the most common material used in post-disaster housing programmes is corrugated metal sheeting, available in a variety of forms and usually manufactured in the developing countries (corrugated galvanized iron, corrugated aluminium, etc.). A large market exists for the sale of these materials.

Only minimal efforts are being made to develop other types of light-weight materials from indigenous sources in the developing countries. Simultaneous and co-ordinated research is needed in two areas: development of new roofing materials using purely indigenous materials; and analysis of traditional structural types in order to determine how to improve their performance.

There is a major safety problem with heavy, flat earthen or tiled roofs, especially in earthquake areas. The need here is to try and devise a lightweight substitute that can retain the flat roof form and incorporate the insulation needed for extremes of climate.

2. *The transfer of technical information*

Currently, there is adequate technical information available for qualified architects and engineers to make decisions on design, the selection of materials, etc. However, this information is too technical for most relief or rehabilitation programme administrators. Therefore, simple technical information must be provided, in a form comprehensible to administrators, on:

Advice on the most appropriate type of shelter programme to select for the local situation;

How to use various types of indigenous materials;

Simple structural methods.

This information is needed at all levels of the relief system, to enable a greater number of people to become familiar with the options available. But, most importantly, it must be available at the *field level*, where the survivors' points of view can be taken into consideration. It is necessary to prepare the information needed beforehand, and store it in the disaster-prone developing countries for use by the government and assisting groups, when needed. If one continues to rely on storing information in industrialized societies alone, third world access to it will continue to be limited, no matter how well established are the connections between the disaster-prone countries and the outside storage system. Recent research has indicated that the basic decisions in setting up post-disaster housing programmes are made within two weeks of the disaster's occurrence.[21] Thus, the information must be on hand, in usable form, as soon as the disaster has happened.

The developmental context

1. *Development issues*

Any assisting group involved in post-disaster assistance, whether for relief or reconstruction, is automatically concerned with long-term development. Thus, all the problems of development, such as the growth of "dependency relationships" through the inadvertent stifling of local initiative, are vital considerations. Relief and reconstruction programmes cannot be regarded or conducted as separate or distinct operations. They must be conducted in the context of development.

The development issues which are most overlooked by assisting groups when formulating post-disaster housing strategies and programmes are:

(a) *Land tenure and land-use patterns.* Few agencies initially realize the connection between their housing programmes and land tenure, and prevailing

[21] *Post-Disaster Technical Information Flow for the Reconstruction of Housing*, Everett Ressler, Intertect, Dallas, Texas, 1976.

land-use patterns: there is often the need for better quality, safer land equitably distributed at affordable cost.

(b) *The need to upgrade self-help skills.* Assisting groups consistently overlook the fact that a house provided to a disaster victim is of only limited value, and for the benefit of too few. With housing must come the development of skills.

(c) *The need to facilitate co-operative actions.* Agencies normally gear their housing programmes to help individuals; yet it has been consistently shown that, if a society is to develop socially or economically, residents must maintain a degree of sophistication in conducting co-operative activities. Many agencies overlook this opportunity.

Policy guidelines

Policies to avoid

1. *Restoration of pre-disaster conditions.* Merely to restore "normal" pre-disaster conditions will result in the loss of unique opportunities presented after a disaster to use the financial resources offered, as well as the political and social will for change to building and settlement patterns, which will improve general living conditions and reduce future risks.
2. *Taking too narrow a view of risk-reduction policies.* It is important to avoid regarding the provision of safe housing in isolation from other needs and priorities (land, utilities, employment, education, health, etc.). Communities vulnerable to natural hazards are normally aware of the risks they face, but their economic survival may be directly dependent on their particular location. In such circumstances, to propose relocation or modification of homes, without subsidies to cover the full costs, or technical assistance, is unrealistic.
3. *Confusing the "normal" housing deficit with that created by a disaster.* Experience indicates that authorities undertaking reconstruction are frequently asked to address *chronic* problems as part of the reconstruction process. Thus, pre-disaster housing deficits are added to disaster losses and reconstruction targets. Such a policy is probably inevitable but unrealistic, unless additional resources of cash, land, building skills and planning expertise are made available
4. *Regarding reconstruction as being limited to buildings or infrastructure.* There is an urgent need following a disaster to strengthen all the components of reconstruction, institutions (administration and management), training employment, community development, financing, the building materials industry, etc.

Policies to adopt

1. *Risk reduction.* It is important to introduce policies to modify the conditions which caused disaster. There are unique opportunities following a disaster to make substantial improvements to the infrastructure, building forms, building techniques and land-use patterns. The foundations of risk reduction are hazard mapping, vulnerability and risk analyses.
2. *Varied policies.* The need is not to place reliance on a single, technocratical risk-reduction policy, such as the introduction of structural regulations or land-use controls, but to develop a policy combining technical, social and economic measures.
3. *Establish priorities for building improvements.* It is axiomatic that all buildings must be made safe. However, pragmatism dictates that such a formidable task needs to be tackled according to a scale of priorities.
   (*a*) Buildings for social groups such as children, the disabled and the elderly: schools, crèches, old people's homes,
   (*b*) Public buildings: community halls, churches, mosques, cinemas, markets;
   (*c*) Buildings in regular rather than occasional use;
   (*d*) Vital public buildings that cannot be damaged or destroyed without major, secondary adverse consequences: hospitals, dispensaries, fire stations, stockpiles of emergency goods, cyclone shelters, power stations;
   (*e*) Buildings that are known to be in a dangerous condition

   It is proposed that priority lists of this nature should be drawn up in localities at risk. On the basis of the list, a system of regular structural checking and maintenance should be instituted as a standard preparedness measure.
4. *Modification of existing housing.* It is recognized that this poses considerable difficulties, particularly in a pre-disaster context, in view of potential social upheaval and the cost of such modifications. However, in some situations—most notably houses in arid, seismic zones where there is an absence of timber and other spanning materials—the risks are such as to make it imperative to modify the design of existing structures, as well as offer guidance on improved building methods. More research is required into vulnerable types of indigenous construction. Safe alternatives need to be developed which satisfy the demands of culture, local economics, climate, available materials, skills and risks. In any given area, research priorities need to be formulated and communicated to appropriate national or international bodies providing assistance for upgrading projects
5. *Training for management of relief and reconstruction* There are gaps in training at all levels of relief and reconstruction management. Lack of formal expertise is evident in both administration and technical understanding. It must be emphasized that the provision of shelter and post-disaster housing is as specialized an activity as, for example, the organization of medical or nutritional programmes. The need for properly trained personnel is therefore vital, and applies to both governmental and external agency staff
6. *Training of local builders* The collapse of, or damage to, a structure in a disaster may result either from ignorance of how or where to build in order to resist extreme forces, or from basically inferior building construction. But normally, a combination of both factors provides the fundamental cause of failure. It is apparent that local builders or craftsmen often

TABLE 5

Constituents of a risk-reduction policy

	Low-income housing and settlement	*Middle/high-income (conventional) housing*	*Commerce, industry*	*Public services, utilities, community facilities*
Hazard mapping, vulnerability analyses, risk	•	•	•	•
Structural modification	•			
Land-use adjustments	•			
Building regulations and enforcement		•	•	•
Compulsory reinforcement of buildings		•	•	•
Land-use regulations and enforcement		•	•	•
Training of small builders	•			
Official control and supervision of work done by major bulding and public works contractors		•	•	•
Community preparedness, warning	•	•	•	•

require basic education in the rudimentary principles of building construction and safe building techniques. Training programmes should be devised and implemented by the secondary and primary levels (regional and local), but the allocation of resources requires a policy decision at the tertiary (national) level.

On the one hand, the process of urbanization has resulted in a migration to the town or city of skilled craftsmen who can often obtain higher wages working for contracting firms. This can seriously deplete rural skills. On the other hand, families migrating to towns from rural areas frequently include men with building skills. However, such skills may relate only to the handling of local materials found within the original village—mud, stone, timber, thatch, etc. Once in the town or city, these builders cannot gain access to such materials, and they have to switch to an improvised mode of construction, normally involving makeshift use of recycled materials salvaged from refuse dumps, etc. Inevitably, the resulting buildings are frequently unsafe. In both of these situations, training programmes are necessary. To be fully effective, they should be linked with:

(*a*) Financial assistance for those being trained;

(*b*) Incentives in cash or kind to build safer homes;

(*c*) The supply (possibly at subsidized prices) of key building materials such as timber and lightweight roofing;

(*d*) The provision of simple educational aids.[22]

7. *Mitigation policies as an element of upgrading programmes.* Within large towns or cities, local authorities have frequently undertaken upgrading programmes for the improvement of areas of low-income housing and marginal settlements. Such programmes normally include:

(*a*) Official recognition of the existence of marginal or squatter settlements, i.e. they have been legalized;

(*b*) Provision of essential infrastructure, e.g. roads, bus services, electricity, water, sanitation, schools, dispensaries, etc.;

(*c*) Some form of assistance with local housing, e.g. supply of materials, provision of subsidies and loans;

(*d*) In disaster prone areas, upgrading programmes should also include hazard resistant building methods, and the safe siting of housing. These measures should be based on hazard, vulnerability and risk analyses.[23]

[22] These will probably be needed for people with little reading ability. Techniques originally developed for medical or agricultural education may be adapted to the housing sector. For a detailed description of a major integrated training programme for builders in safe construction, see McKay, Mary, 1981 (Key references to this section).

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[23] See appendix C.

4.2 RELOCATION OF SETTLEMENTS

PRINCIPLE: Despite frequent intentions to move vulnerable villages, towns and cities at risk to safe locations, such plans are rarely feasible. However, at the local level, a disaster will reveal the most hazardous sites (e.g. earthquake faults, areas subject to flooding etc.). Partial relocation within the same town or city may therefore be essential.

Audience

- ○ Private sector: Manufacturers/contractors
- ● Professionals: Architects/planners/engineers
- ● Policy-making administrators: national (tertiary) level
- ● Project managers of post-disaster shelter/housing projects: Regional/provincial (secondary) level.

Time phases

- ● *Pre-disaster phase*—Mitigation/risk reduction
- ○ *Phase 1*—Immediate relief period (impact to day 5)
- ● *Phase 2*—Rehabilitation period (day 5 to 3 months)
- ● *Phase 3*—Reconstruction period (3 months onward)

General characteristics of relocation policies

Experience indicates that governments frequently consider the relocation of entire settlements as part of their reconstruction policy. Relocation usually reflects the will to vacate land that is excessively hazardous. It can also be an attempt to remove people from illegally occupied land (such as squatter settlements), or it can express a political will for change and reform.

The role of assisting groups

Assisting groups often purchase plots of land outside the immediate disaster area and erect large numbers of housing units for survivors. Families are given the opportunity to purchase houses and parcels of land, provided they can afford loan reimbursements.

Problems of relocation

1. Relocation away from urban centres is largely motivated by the availability of cheap (and often undesirable) land.
2. Distances from jobs and the costs of commuting are a cause of either a reduction of income, or missed opportunities for employment.
3. Urban services are frequently missing (schools, hospitals, shops, markets, etc.).
4. Utility systems such as water, sewerage, and electricity are often insufficient, or non-existant, for lack of planning and preparation.
5. Few assisting groups are equipped to master-plan this type of development as part of relief management. The situation is worsened when the local authorities also lack planners, architects, administrators and capital resources.
6. If the economic and environmental situation worsens beyond endurance, people migrate back towards their original sites and jobs, leaving a vacuum behind them, quickly filled by rural-to-urban migrants, thus compounding problems of uncontrolled urbanization.
7. There are problems of default and difficulty to pay instalments on time, creating, for example, problems of overcrowding in order to obtain additional rent, with the environmental and social degradation that ensue.
8. If the new settlements are within the administrative boundaries of the disaster-stricken town, utilities (water, sewerage, electricity, etc.), will have to be extended. The demand for new services will compete with the need for repairs and reconstruction inside the devastated area, at the cost of social and economic recovery.
9. Settlements created outside municipal boundaries subsist in a kind of limbo, with neither the local nor the regional authorities willing to bear the costs of development and maintenance.
10. In developing countries, urban infrastructure costs are extremely high, the per capita costs far exceeding the per capita capacity to amortize such costs. The price of serviced land has risen out of all proportion to the costs of other resources and services, and especially in relation to wages.

A frequent response of governments is the promise to move survivors into new, less hazard-prone areas. But the evidence is clear that in practice this is rarely feasible, for the following reasons:

1. Reconstruction, especially of housing, normally starts very rapidly after a disaster.
2. People are unwilling to abandon well-established patterns of land ownership.
3. Even in a major catastrophe, it is likely that a relatively small proportion of the total urban fabric will

have been destroyed. The costs of relocation heavily outweigh the costs of repair and reconstruction.

4. Vested interests usually apply pressure to rebuild rather than move.
5. Despite the effects of a disaster, people naturally resist moving from their familiar surroundings.

Policy guideline

An alternative to wholesale relocation is the selective relocation of segments of the community away from the most hazardous sites, but remaining within the same general area. Even this alternative can be prohibitively expensive for the public and the local authorities. In any case, it is more than likely that vacated land will be rapidly re-occupied by others who will in turn live at risk, because of the extreme scarcity of serviced urban land, and especially land that is within reach of jobs. In many developing countries there is no formal way out of the dilemma: perhaps the only approach is to persuade communities to reduce their own vulnerability, through public education on the effects of severe natural hazards, and the gains to be derived from partial relocation.

There are five pre-conditions for successful, partial relocation:

The consent of the affected community;

The availability of safe land at a cost the community can bear;

Proximity to employment and social services;

The provision of utilities at the community level (if not for every family);

Facilities for home building as described in this study.

4.3 LAND TENURE AND LAND USE

PRINCIPLE: Success in reconstruction is closely linked to the question of land tenure, government land policy, and all aspects of land-use and infrastructure planning.

Audience

- ○ Private sector: Manufacturers/contractors
- ● Professionals: Architects/planners/engineers
- ● Policy-making administrators: National (tertiary) level
- ● Project managers of post-disaster shelter/housing projects: Regional/provincial (secondary) level

Time phases

- ● *Pre-disaster phase*—Mitigation/risk reduction
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- ● *Phase 3*—Reconstruction period (3 months onward)

Land and population

The major regions of the world exposed to violent natural phenomena (especially earthquakes, tsunamis and tropical cyclones) stretch across the tropical and sub-tropical portions of Africa, Asia and Latin America. These areas coincide with areas of rapid population growth and urbanization, and are extremely disaster-prone. In addition, virtually no country is entirely safe from floods.

Indeed, the rapid growth and spread of population in hazardous areas is a matter of increasing concern, and is rapidly contributing to mounting costs of disasters in terms of lives lost, and damage to property and investments. Most developing countries are doubling their population every 20 to 25 years (assuming national population growth rates of 2 per cent to 3 per cent), while the urban population in these countries is doubling every 12 to 15 years (assuming urban growth rates of 4 to 7 per cent). Equally significant, and of critical importance in areas subject to natural phenomena likely to cause disasters, is the growth rate of low-income slum and squatter settlements around major urban agglomerations.

Slum and squatter populations grow at about twice the average urban rate. In settlements such as these there is a doubling of population every 5 to 7 years, and the density is usually very high. In many cases, entire families may occupy a single room. Urban population densities per square kilometre, as measured in slums and squatter settlements, are even more revealing. In squatter areas, densities may be as high as 100,000 persons per km^2 (Morocco) and rise to 148,000 (India).

Even the average densities for urban areas as a whole are high enough to cause concern in areas exposed to earthquakes, floods or landslides. The older sections of some cities may contain as many as 20,000 to 60,000 persons per km², although the average densities for such cities may be less than 10,000 persons per km².[24] Densities such as these are all the more critical in hazardous areas.

The problem of exposure to disaster risk among rural populations, however, should not be underestimated. Although the population growth rate in rural areas is usually lower than the national average due to rural-urban migration, the scarcity of arable or developed land in many developing countries, combined with the fact that on the average more than 70 per cent of total national populations are still rural, can create significant risks in areas exposed to natural phenomena. Rural population densities can surpass 1,000 persons per km² in areas where rainfall and tropical soil conditions limit the amount of arable land. Wherever rural populations are sedentary (as opposed to being nomadic and pastoral) and engaged in agriculture on hazardous land, the risk of substantial disaster cannot be ignored.

Dramatic increases in population size, distribution and density increase disaster risk: natural hazards such as floods, earthquakes or tropical cyclones do not in themselves constitute disasters until they strike at human lives and property.

The earthquake in Guatemala of February 1976 serves to illustrate how global and unselective disasters can be,[25] affecting rural and urban populations with equal intensity. More than 3.4 million people out of a total of 5 million (64 per cent) were affected by the earthquake. More than 1 million persons were left homeless, and more than 222,000 dwelling units were partially or totally destroyed. Of the 1.2 million people left homeless, 350,000 were in the country's largest urban area, Guatemala City. The remainder were largely rural populations living in small towns or villages, scattered throughout the earthquake zone. The single largest damage impact was on housing. The loss to the private sector (and particularly to low-income housing) was more than two-and-a-half times that incurred by the public sector.

There are two fundamental alternatives to disaster mitigation: the first aims at steering development away from hazardous areas toward safer locations, the second comprises structural measures aimed at resisting or deflecting the impact of natural phenomena. Comprehensive land-use planning is a discipline which began early in the twentieth century in industrialized countries with scarce land resources, such as the Netherlands, Denmark and Great Britain. It is a physical planning tool which has since gained widespread acceptance in most industrialized countries. The more centralized the system of government, the more effectively can land-use be controlled, usually because private ownership of land is limited or strictly regulated. In free market economies, land-use controls are more complex and policies more difficult to implement, due to the high rate of private land ownership and the resultant tensions between public and private interests.

In disaster-prone developing countries, land-use planning and control for disaster mitigation may act as a spur to comprehensive land-use planning, especially where natural disasters have become a permanent development problem owing the their intensity and frequency.

Land-use planning and control are key factors for the orderly and safe growth of human settlements. Although there is no immediate shortage of raw (undeveloped) land for urban expansion in most developing countries, land is ultimately a finite resource and is extremely costly to develop.

Alternative methods have been explored, seeking to expand urban infrastructure and housing in planned and progressive stages with heavy reliance on purely local resources, including self-help. In disaster-prone areas orderly urban expansion becomes prohibitive unless investments in infrastructure, housing and other services are protected from damage at all stages of their development. Land-use control measures establish not only static norms, such as function, density, and location, but also dynamic norms, such as the rate of development and growth.

The major elements of land-use may be summarized as follows:

Land-use policies and plans setting out the social, economic and environmental goals of comprehensive land development, and their stages of development;

Land ownership and land tenure patterns, identifying the legal, social and economic basis of ownership and tenure,

Land values and prices, reflecting the forces of supply and demand for land with respect to free market economies,

Land-use controls which may be subdivided into three broad categories: legal, fiscal and directive (by direct government intervention).

Land and post-disaster housing

1. *A policy of homeowners only.* Many assisting groups are apprehensive of the problems related to land acquisition. Their programmes offer housing preferably to families who have title to land. However, few low-income families are landowners. Thus, programmes such as these only help those who are better off to begin with, and who would in any case be eligible for financial assistance. In the aftermath of a disaster this built in discrimination against the majority of survivors (who, as we have seen, are mostly poor and landless) can be the source of social and political tensions.

2. *Provision of housing for those who do not own the land.* Many agencies offer to provide emergency shelter and/or temporary housing to families on the site of their former house. These units usually evolve into formal structures over a period of years, and become permanent dwellings. If the family has paid for a house, built on land which it does not own, a legal question arises as

[24] *World Housing Survey, 1974*, (ST/ESA/30), United Nations, New York, 1976. Sales No. E.75.IV.8.

[25] *Damage Caused by the Earthquake in Guatemala and its Repercussions on the Country's Economic and Social Development* (CEPAL/MEX/76/Guat 1), February 1976