SESSION 3: VULNERABILITY-RISK REDUCTION

Topic 3.1 : Introduction

Although it is not possible to stop building development in areas prone to natural disasters, it is possible with appropriate planning measures to steer development away from vulnerable to safer areas. The destructive effects of natural disasters can be decreased through land-use planning and appropriate building technologies.

Physical planning for earthquake risk management has received little attention. The present work shows that physical planning is fundamental and that earthquake risk assessment and reduction methodologies are accessible to planners, and not the exclusive domain of scientists or engineers.

Ultimately, policy and planning decisions depend as much on human factors as on objective criteria. Experience shows us that it is important that "hard" data on earthquake risks be adapted to the needs and language of planners and architects.

The sequence "hazard, vulnerability and risk" is as follows:

1. Identification of the hazard involved and assessing its frequency and magnitude (the phenomenon);
2. assessing how vulnerable the build environment is (the structural effects);
3. estimating damage (the effects);
4. and adopting measures to reduce losses in the future (the options).

Pilot projects on disaster mitigation should be applied and tested in different countries, in order to develop a general methodology in risk reduction and mitigation of losses.

vulnerability-risk reduction

Topic 3.2 : Hazard assessment

Natural hazard (H) can be defined as the probability of occurrence, within a specific period of time in a given area, of a damaging natural phenomenon. It is important to notice that hazard is a probabilistic function of magnitude according to the hazard over time.

It is common to have to extrapolate hazard data from limited data. While the reliability of hazard assessment under such conditions may be open to question, the planner needs to make optimum use of this data for mitigation action in disaster-prone areas. Although it may not be possible at the present stage to forecast when they are going to happen, it is often possible to predict with reasonable accuracy where they are likely to occur, for example, in seismic areas or on unstable slopes.

The form and content of geoscientific and environmental assessments for settled land, and particularly the manner of presentation, should be appropriate to the needs and capabilities of the user.

Hazard maps are basic tools for risk assessment. A hazard zoning map is a means of presenting hazard levels with the intensity of magnitude of each hazard zone. The map consists of a series of defined areas of particular magnitude or risk level. Besides dividing the area to be studied into zones, each with different hazard probabilities, the map may provide other relevant data such as the extent of damage where the hazard occurs, hazard duration etc.

Other products of hazard and risk assessment should be applicable to action concerning practical preventive measures, eg land use planning. These actual needs must be determined and the interpretation of results required, the more effective the results will be.

Underestimation of hazard will result in unsafe planning; however overestimation of hazard may lead to non-economical and non-feasible risk reduction measures.

It is essential that the information should not include a factor of conservatism in the estimation of hazard, without indicating it clearly.

The main earthquake hazards are:

1. Ground shaking;
2. Differential ground settlement, soil liquefaction;
3. Landslides and mudslides, ground lurching and avalanches;
4. Ground displacements along faults;
5 Flood from dam failure;
6. Pollution resulting from damage to industrial plants.

The main parameters for earthquake hazard assessment include:

1. Location and size of known hazard zones,
2. The number and magnitude of earthquakes experienced in each zone;
3. The geological, geomorphological and hydrological characteristics of each zone;
4. Threshold magnitudes;
5. The correlation between seismic intensity and distance;
6. Tectonic maps;
7. Peak ground accelerations or equivalent data, time histories and predominant spectral content.

hazard assessment, natural hazard-definition, hazard maps, earthquake hazards

Topic 3.3 : Vulnerability analysis

Vulnerability (V) can be defined as loss to elements at risk resulting from the occurrence of a natural phenomenon of a given magnitude and expressed on a scale from O (no damage) to 1 (total loss).

It is by establishing the vulnerability of buildings and lifelines that one can obtain an estimate of risk. Vulnerability analysis is, therefore, an intrinsic aspect of disaster mitigation and the linkage in assessment. Vulnerability is expressed as the degree of expected damage (i.e. the cost of repair divided by the cost of replacement) given on a scale of O to 1, as a function of hazard intensity (or magnitude, depending on the convention used).

For the risk assessment of an area, an analysis of the vulnerability of elements at risk is needed. Quality of construction, and the earthquake resisting system of each element are important for controlling vulnerability Losses experienced in past earthquakes are important determinants of physical vulnerability for each element

Identification of elements at risk
The two key building elements at risk are structure and infrastructure.

Structure
The focus here is mostly on low rise structures. Those most exposed to disasters are:

1. Stone masonry buildings;
2. Wooden buildings;
3. Earthen buildings (adobe);
4. Brick masonry buildings;
5. Reinforced concrete buildings,

To identify the elements at risk an inventory can be made of:

1 Types of construction (load-bearing construction, reinforced concrete, steel, etc.);
2. Types of elements with special design requirements (e.g., hospitals) and elements for which vulnerability analysis is feasible;
3. Types of buildings. Vulnerable elements are. construction materials, structural proportions, symmetry in plan, section and elevation, roofing and maintenance.

Infrastructure
Infrastructure includes communications, energy and information lines, which are spread all over a region and are vulnerable.

Waterways
These can be blocked by the secondary effects of earthquakes (landslides, rock falls, etc.). The blocking of rivers, and subsequent flooding, is likely to cause disruption.

Telecommunications
Telephone exchanges may be seriously damaged by earthquakes. Underground lines are usually well insulated and flexible and therefore less susceptible to earthquakes.

Sewage systems
In an earthquake, the vulnerability of open-air channels will be lower than that of underground high-pressure systems. The vulnerability of underground systems can be decreased by the use of flexible joints. Detailed analysis of site conditions remains necessary in earthquake-prone areas.

Classification of elements at risk
For each hazard type (earthquakes, volcanoes and landslides) there should be a ranking of buildings and infrastructure elements from high to low vulnerability.

Infrastructure systems have different degrees of vulnerability. Among the most important are:

1. *Roads:* ie roadways, bridges and tunnels. Although roads are ranked according to their functional importance, vulnerability analysis in concerned only with the technical quality of their construction.
2. *Railways*: ie tracks, bridges and tunnels. Even slight deformation of the track results in the disruption of operations-railways are always more vulnerable than roads.
3. *Water supplies:* ie underground pipelines, pumping stations, sewage and water treatment plants. Restoration of safe drinking-water supplies will be the first priority in most disasters. Even in the immediate aftermath of disaster, water is needed to prepare food, bathing, cleaning of wounds and to fight fires.
4. *Electricity supplies:* ie generators, high-tension cables, transformers and low-tension connections. Installations on the ground are usually the most vulnerable parts of the system. In the case of high winds, cables will be most at risk.
5. *Gas and oil supplies:* During the earthquakes, the vulnerability of oil/gas pipelines depends on their strength and flexibility. Special design criteria are necessary in such areas.

Analysis of regional and local damage records
Existing regional and local damage records should be used to complete the overview of vulnerability analysis. In this part of the analysis, it is important to estimate the degree of damage to be expected for each element at risk resulting from a hazard of given magnitude. However, the planner should be aware that a given hazard is not necessarily expressed by uniform parameters. Uniform methods of assessment are needed if developing countries are to make the best use of data bases.

Regional and local data should be compared with the results of preliminary analysis. This should give a relatively detailed picture of the vulnerability of local structural types and a fairly complete overview of the relationship between hazard and damage.

vulnerability analysis, vulnerability-definition, structure, infrastructure, damage records, elements at risk

SESSION 4: DISASTER PLANNING AND PUBLIC INFORMATION

Topic 4.1 : Objectives

The objective of planning is to anticipate future situations and requirements, by applying effective and co-ordinated measures.

Planning and the Disaster Management Process

National development

Most countries gear national development to a series of time-period plans; for instance, Five Year Plans. The advantage is that this provides substantial flexibility for adaptation to unforeseen events; eg, a nationwide poor harvest of a vital export crop or unexpected effects of world financial systems. This flexibility is also appropriate for adjusting to the effects of disaster. Thus, many nations include disaster aspects in their planning process. Also, management of the environment ranks high in modern national considerations. Therefore there is a strong case for linking disaster and the environment, in national development plans.

Prevention

Preventive measures can range from the construction of expensive flood control structures to controlled burning in forest areas prior to a high-risk season. The latter example comes closer to mitigation and preparedness.

Mitigation

Mitigation as structural and non-structural measures designed to reduce the effects of disasters would more appropriately be applied as a series of programs or regulations, rather than as plans. For instance building codes and land-use regulations better suit a program or regulation category.

Preparedness/response

The combined categories of preparedness and constitute the most widely used basis for disaster plans, especially regarding action planning.

Recovery (Rehabilitation and Reconstruction)

There are various planning options which can be used for recovery. Sometimes a separate plan is utilized so that two main plans exist, a Disaster Response Plan and a Disaster Recovery Plan.

disaster planning, disaster management, development plan

Topic 4.2 : Disaster Planning Strategy

Countries, regions and communities need to respond as systematically as possible to natural disasters. If not, scarce resources, properties and life will be at increased risk. Plans to mitigate disasters follows an accurate hazards assessment, and leads to the adoption and implementation of measures to reduce the vulnerability to these risks. Even if risks cannot be assessed accurately, and reliance has to be put on intuitive risk assessments based perhaps only on local anecdotal knowledge, a systematic and planned response is still more efficient than crisis response following disasters.

Disaster mitigation involves complex decisions, not least because it is concerned with events that may have a low probability of occurrence. Investment in disaster mitigation may also be expensive. Therefore, it is necessary to consider carefully the efficiency with which these scarce resources are used A number of decision-making techniques can assist this choice of disaster mitigation policies, plans and projects, including the following:

1. Efficient allocation of resources.
   The efficiency of expenditure on disaster mitigation must be maximized and the resources allocated valued at their "opportunity cost" (the value to society of the next best alternative use of those resources).

2. Comprehensive planning and decision making.
   Decision making for disaster mitigation can easily be dominated by short-term considerations, especially immediately after a disaster or the threat of a disaster. Such action is liable to be ineffective and to have unintended consequences. Decision making for disaster mitigation should be comprehensive and review a range of alternative strategies against clear criteria (such as economic efficiency or social equity).

3. Planning and decision making is a continuous process

   Disaster mitigation planning should occur continuously in virtually all agencies at a level proportionate to the risks being faced. Adoption of more systematic approaches can be initiated at any stage: it is advisable not to wait until everything is in place before beginning the disaster mitigation planning process.

Adopting these policy guidelines means that a wider range of appraisal is necessary than is often used in evaluating disaster mitigation plans. Care has to be taken not to over-plan: over-preparedness is expensive and may mean that disaster mitigation itself is subsequently discredited when disasters do not occur. Planning and decision making is not an exact science but involves judgment requiring skills in many disciplines. Disaster planning is an on-going process.

A Multi-Level Approach To Disaster Planning
Planning should take place at all levels of government and the community. Particularly important are the following levels:

1. *National Master Plan.*
   Where the scale of disasters facing a country warrants a national approach, a national master plan will give a framework within which regional and local community planning can take place. This can be a lengthy, on-going, flexible process. For example, the United States of America developed a National Response Plan after the 1985 Mexico City Earthquake. Following Hurricane Hugo (1989) the national plan was changed to address all hazards, not just earthquakes. Following Hurricane Andrew (1992), the national plan was scheduled for further change because some of the agencies could not carry out the responsibilities assigned to them. This, then, causes changes in local planning.

2. *Regional Planning.*
   A regional approach is necessary to ensure that all sectors are taken into account when making decisions and when allocating disaster mitigation resources. It should also ensure that local communities work together to maximize the effectiveness of safety measures.

3. *Community-Level Planning.*
   The community needs to harness its limited resources in the most efficient way, with a planned approach to maximizing its energies. Community plans need not be written statements, but should be the subject of community debate and agreement.

Planning should not occur in a vacuum. There is an intricate interrelationship of technical and financial assistance available for disaster response and recovery. These intra-governmental capabilities and responsibilities must be taken into consideration in the planning process or they will not be fully utilized when they are needed.

? a. Why should planning be a continuous process?

disaster planning, mitigation

Topic 4.3 : Risk communication

Once an unacceptable risk has been determined, the risk must be communicated to those officials and citizens who will have a responsibility for initiating and implementing management planning. Those with a responsibility include decisionmakers at the local, regional, and national levels of government, and also private and NGO sector representatives.

Risk can be communicated through explanation of the appropriate data that indicates a community's vulnerability to hazards. By sharing the history of frequency, magnitude, and impacts, supported by maps and photographs, communities can become involved in pursuing disaster management activities. The findings of current post-disaster damage evaluations andthe financial cost of a disaster is also possible. Potential liability implications are another method of communicating risk and encouraging hazard management actions. Failure to evaluate the hazard and identify strategies to lessen their future impact, should they occur again, might lead to negligence law suits.
Acceptable risk means different things to different people, regardless of available information on magnitude and severity. Inaccurate perceptions of risk and vulnerability are often expressed as follows:

1. they may know of hazard, but not view it as a threat;
2. they may rank other threats (such as housing, food, education, crime) higher;
3. they may be unaware of the potential impacts of the hazard; and
4. they may not view those impacts as being significant.

Different perceptions by different people will create obstacles to implementing effective disaster management planning. Such obstacles need to be recognized and addressed in a collaborative manner.
Risk information should be communicated in the context of the goals and objectives of the proposed disaster planning effort, to ensure that there is recognition of, and identification with, the need to pursue and accomplish hazard management. Hazards assessment followed by successful risk communication that results in initiation of disaster management planning (regardless of perception) is key to the disaster planning process.

? a. What methods of communicating risk exist ?
b. In what ways do people's perceptions create obstacles to implementing disaster management planning ?

risk communication

Topic 4.4 : Public Information Planning

Public information communication might vary from a series of rural radio talks to briefings for school officials. To whatever mode of communication, seven principles of communication apply:

1. Confidence in the information source, and in building a climate of belief
2. Familiarity in relaying of information, using understandable terms
3. Simplicity in relating information
4. Repetition and consistency of warnings
5. Forming of a meaningful message for the receiver
6. ¯Use of established and regularly used media for communication
7. Appropriate packaging of information; the message should take into account the audience's habits, literacy and knowledge.

Planning a public information campaign or a long term public education program is key. Planning requires careful study to determine the major factors which led to present conditions, to consider the forces with which the program must come to terms, and to set out a series of future targets.

Public information planning also requires that the planners include the practitioners in discussion of what is possible; set clearly-agreed objectives; allow time to accomplish those objectives; mobilize budgetary or other needed support from the administration; and assist those who haveto coordinate and carry out the program.

? a. Rephrase in your own words the so-called " seven principles of communication ".

public information

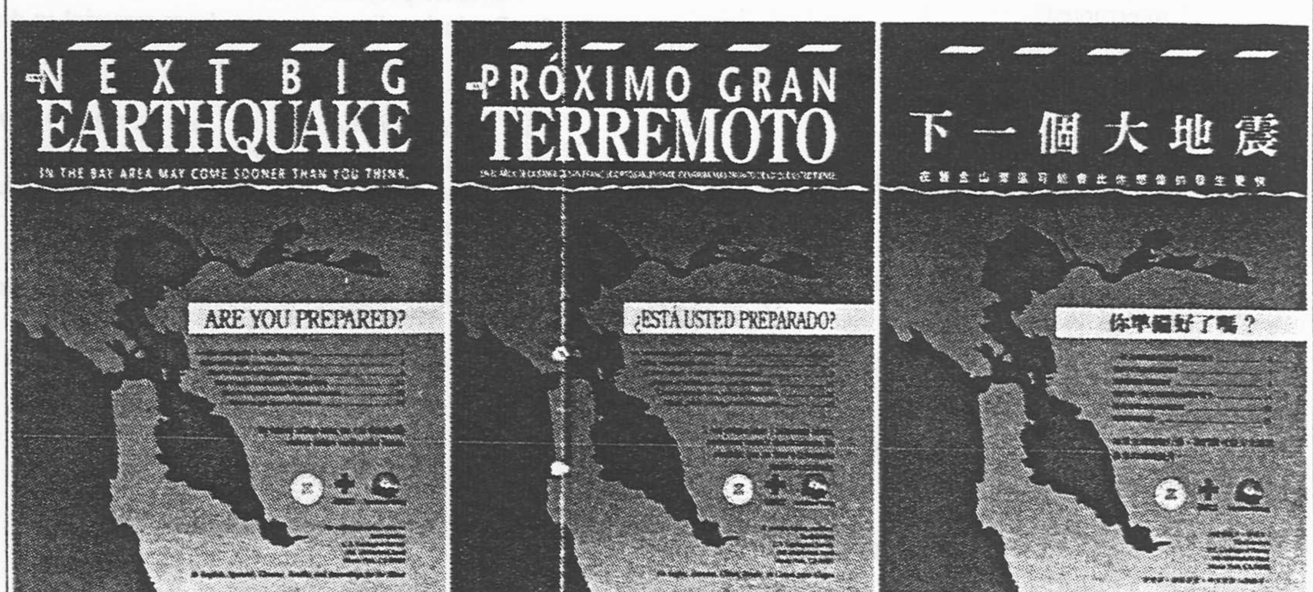

Figure 4.4-1 Public information campaign on earthquakes in the San Francisco Bay Area in 1991: about 3 million Sunday newspapers in Western California included a 24 pages insert on "The Next Big Earthquake".

Topic 4.5 : Education at the community level

The community will be the target of public information campaigns from national or regional organizations. Development committees and disaster management committees should also institute information programs. Consciousness about hazards and vulnerabilities are basic to any preparedness program.

Outline

The public information campaign should be tailored to the needs of the community. The following should be covered:

1. Answering of the following questions:

   - What is a hazard?
   - What hazards affect the community?
   - How will the hazard(s) affect the community in a disaster?
   - What are the vulnerabilities of the settlement?
   - How can these be reduced?
   - What damage can be expected?
   - What actions are to be taken immediately after disaster?
   - What profile should relief appeals have and which target group would respond?
   - How can the residents protect themselves in a disaster?
   - How to get safe drinking water if supplies are interrupted?
   - How to access help from government/non-government sources?

2. Practicing the earthquake drill.
3. Earthquake resistant building techniques.
4. Siting buildings in less vulnerable locations.
5. Alternative food supplies.
6. Developing a community disaster plan.

Media

A variety of media can be used for public information:

1. Local radio and TV stations (where they exist).
2. Community newspapers.
3. School newspapers.
4. Pamphlets produced by the community itself.

Figure 4.5-1 Schoolchildren practicing an earthquake drill

Participation in information efforts include:

1. Running poster competitions in schools.
2. Running essay competitions.
3. Organizing exhibitions by members of the community e.g. youth clubs, religious groups.
4. Producing simple plays or skits on the subject of disaster preparedness.
5. Producing disaster preparedness material in dialects or local languages (where applicable).

The success of the disaster management program will depend largely on the public information program. As much as possible, the material should be produced by the community group, with help from national or regional agencies. If production by the community is not possible then material put out by other groups can be adapted for use.

public information, media