

**6th sem. Hons., CC-14,
Study material prepared by Surajit Let**

EARTHQUAKE MITIGATION MEASURES---LANDUSE MANAGEMENT

There are range of mechanisms or tools available in earthquake mitigation activities which can be categorised in three broad groups,

- 1) Landuse management,
- 2) Strengthening building and facilities and
- 3) Planning for reconstruction activities.

Either of these mitigation measures are applicable to new development activities, or to existing development or to both activities.

Land Use Management

Land use management measures are basically two types, one is structural mitigation measures, another is non-structural mitigation measures. The structural mitigation measures in earthquake are: Zoning, Building codes, Sub-division regulation and land Acquisition. All are basically deals with ground shaking, building failure, and surfacing faulting mitigation measures The non-structural measures in . earthquake mitigation are includes taxation, incentives and disincentives and insurance measures. These measures are essentially protective in nature which includes with designing, architectural, engineering and construction activities. For an effective mitigation measure which usually demand higher financial requirements, therefore the option for utilizing structural mitigation measures in earthquake hazard is limited, but these measures are very effective, protective and essential. Where as, non-structural measures are comparatively economical, though opportunity costs may be substantial. They are primarily concern with the context of landuse planning and other regulations.

Adopting however, Landuse planning mostly lies within the local government responsibility, primarily concerned with the physical location of buildings and/or facilities and the uses to land in a geographical areas. The landuse planning process, as Petak (1994) puts in, consists of surveys, analyses and policy decisions that should begin at the general and develop towards specific regulations regarding the construction, use and function of a building, a structure or a facility at a specific In general context, landuse planning involves three sequential activities: location. Development of general I comprehensive plans; Adoption and administration of zoning regulations, subdivision regulations, and building and grading regulations for 63 implementation of a general plans, and a constant feedback process.

Landuse regulations, zoning and subdivision controls, are major instruments an effective implementation of earthquake along with structural improvement, for policies. The regulations involve legislative and administrative action at the state and local level of the government.

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STRUCTURAL MEASURES:

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| Retrofitting of existing Structures | : | design features over design |
| Reinforcement of new Structures | : | structural safeguards, fail-safe design |
| Safety features | : | |
| Engineering phenomenology | | |
| Probabilistic prediction of impact strength | | |

NON-STRUCTURAL MEASURES:

A) SHORT TERM:

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| Emergency Plans (Civil) | : | Coordinator(s), police and firemen, Redcross and charities volunteer groups, medical services and military forces. |
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| Evacuation plants | : | Routes and reception centers for the general public for vulnerable groups (Children, elderly, sick and handicapped) |
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| Prediction of impact | : | monitoring equipment, forecasting methods and models. |
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| Warning process | : | general message, specialized warning (eg. ethnic) |
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B) LONG-TERM

Building codes and construction norms

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| Hazard microzonation | : | selected risks, all risks |
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| Land-use control | : | regulations, prohibitions, moratoria, compulsory purchase |
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Probabilistic risk analysis
Insurance
Probabilistic risk analysis
Insurance
Taxation
Education and Training

(Source D. Alexander, 1993, p.8)

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Zoning: It is a traditionally preferred method for regulating land use in areas prone to earthquake hazard. Conventional zoning ordinance control the types of land activities permitted in particular parts of a country (e.g. residential, commercial and industrial) as well as their intensity (e.g. bulk, height, floor area ratio). As a result, zoning provisions can control the extent of risk to people and property from earthquake hazards. For instance, open space and recreational uses may be the most appropriate usage to be permitted in high risk fault rupture or liquefaction zones. Further zoning involves the division of geographical governmental unit into districts. Within these districts, zoning can typically regulate: the dimension buildings and other structures; the area of lot whether occupied and the size of the required open space; the density of population and the use of land and building for residing, space; trading and other activities.

Singh and Travis (1991) advocates a three zone program, 1. high-risk zone development and maintain as unpopulated area. 2. Moderate risk which prohibit zone, in which residential area prohibition and 3. Low risk zone development of special sensitive structures such as schools and hospitals are to be prohibited. One major characteristic of zoning is that the regulations can differ from district to district.

Building Codes: Building codes set standards for construction materials, design and procedures in order to protect lives and property from a prescribed magnitude of an earthquake. Building codes play a crucial role during disaster period, when extraordinary stress is imposed upon man-made structures. Indeed building codes are considered among the most important and effective tools for hazard mitigation during pre- and post disaster activities. Basically, there are two types of codes in function, one is performance codes, which allow flexibility in design to meet standards of performance or to withstand the magnitude, followed by specification codes, which implies or specify exact materials and methods to be used in structure. The particular type of code can restrict the use of inferior building materials and demand for better foundation stabilization.

Sub-division regulation: Such regulations refer to the implementation of rules on the use of land that is subdivided into plots purpose to be sold or commercially developed. In a way they operate similar to zoning, to control the amount and density of a particular development site. They can also establish requirements and standards for public improvement, specifically, space between buildings, width of streets and exits, location of resources such as hospital, fire stations, drainage pipes, sewer outlets, parks and so on. The regulation demand(s) the developers to obtain approval of these plan from concerned authorities in conformity with existing regulations.

Local officials can also control various aspects of land use activities in particular area. For example, in an area highly susceptible to earthquake hazard where a public water system should not be allowed to locate on site or to ensure that water and water facilities are located and constructed in greater compatibility.

Land Acquisition: Land acquisition is more common in urban communities. Acquisition of seismically hazardous land is perhaps the most effective earthquake hazard mitigation measures. Acquisition can be used as a tool in controlling and guiding growth in local area. In large-scale hazard prone areas such an

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option is limited because of financial constraint. Thus local government may handle smaller acquisition through combining land swamp, easement purchases and donation.

In high risk areas where pressure for development is also high, therefore, On obtaining such government agencies may well intervene and acquire the land. 73 ownership rights, regulation of its use become easier.

The acquisition of land itself may be used in multipurpose activities such as providing green area park lands and recreational opportunities near centres of population. For instance, in the USA, Salt lake city, several communities have purchased land around and along fault lines and have turned the areas into parks that not only prevent hazardous development but also help to educate people about Apart from the regulatory and structural mitigation measures can be earthquakes. achieved through fiscal policies.

Taxation: This device can be utilized properly for controlling as well as The use of tax incentives and penalties can be adopted by restructuring. Government as a comprehensive tax strategy for earthquake disaster prevention. 7 Special tax treatment could be established to certain land. s The same principles can 76 be introduced to steer development away from risk bearing locations. Indeed, taxation can be used in a creative way more than any other tool to encourage good landuse management. These laws can also be applied to other activities such as in farm land, forest land, open space land, recreational and or lands 77 of historical or ecological importance.

Insurance: Although still in experimental stage, as there are complex issues related to insurance it can be used effectively for implementing building codes and standards. Insurance activities help earthquake management in indirect way. Incentives and Disincentives: Financial incentives and disincentives are used m some jurisdictions by obtaining conjunction with regulations, as a means to encourage compliance with buildings and housing code requirements. These includes low-interest loans, founded by tax-empted bond; community funded repair activities, the removal of tax deductions for interest and tax depreciation or amortization. Further tax incentives can be established for the removal of earthquake hazardous building.