15

DISASTER MANAGEMENT

15.1 BACKGROUND

Human settlements are frequently affected by natural disasters, which take heavy toll on human lives, destroy buildings and infrastructure and have far reaching economic and social consequences for the community. Among all the natural disasters that the country faces, river floods are the most frequent and often most devastating.

According to a Study undertaken by UNCHS (Habitat) and HUDCO, on an average, natural disasters take a toll of over 3,663 human lives, affect 14.2 lakhs hectares crop area and damage 26.3 lakhs houses annually. Past statistics reveal that about 80% of of human lives were lost, due to collapse of houses and buildings.

15.2 VULNERABILITY AND RISK ASSESSMENT OF THE REGION DUE TO NATURAL HAZARDS

The Vulnerability Atlas of India indicates that the National Capital Region falls within:

i) High damage risk zone (MSK VIII)-with regard to earthquake
ii) Very high damage risk zone B (V_b = 50m/s)-with regards to wind and cyclone hazard and
iii) Areas liable to floods

Regional development/construction in NCR need to be planned taking care of the above natural and man-made hazards.

The occurrence of earthquakes in and around Delhi is attributed to the following prominent tectonic features:

a) The Sohna fault
b) Aravalli fault
c) The hidden Moradabad fault in the Indo-Gangetic basin
d) Sonepat-Delhi-Sohna fault
e) Junction of Aravalli and Sohna fault
f) Delhi-Haridwar ridge

Earthquakes of intensity lower than four on the Richter scale have originated from 14 epi-centres located in the NCR and shown on Map 15.1 National Capital Region: Seismo-tectonic Features. Besides, there are several other parallel faults inferred from geomorphological studies. Earthquake in Delhi and neighbourhood areas is related to tectonic activity along these faults.

Table 15.1 below provides the list of earthquakes of 5.0 intensity and higher on Richter scale in the National Capital Region.

Table 15.1: Earthquake with Intensity more than 5 on Richter scale

Date	Time of Origin (GMT)	Latitude (^{0}N)	Longitude (^{0}E)	Focal Depth (Km)	Magnitude
1	2	3	4	5	6
1720, 15th July	-	28.40	77.10	-	6.5
1803, 1st September	-	27.00	77.00	-	6.8
1809	-	30.00	79.00	-	6.0
1842, 16th January	-	27.00	78.00	-	5.5
1842, 5th March	-	30.00	78.00	-	5.5
1956, 10th October	15:31:36	28.20	77.70	-	6.7
1960, 27th August	15:58:592	28.20	77.40	109.0	6.0
1966, 15th August	02:15:28	28.67	78.93	5.0	5.6

Source: IMD Catalogue

Similarly, the region lies in the flood prone area and inundation during monsoon is a regular feature. As per the past history of the floods in the Ganga and Yamuna sub-basin, the districts affected are Meerut, Ghaziabad & Bulandshahr in U.P. and Rohtak, Panipat & Sonepat in Haryana.

Earthquake

Seven earthquakes of Richter magnitude 5.5 to 6.8 are known to have occurred in NCR and its surrounding areas since 1720 AD. Two major lineaments, namely Delhi-Hardwar ridge and Delhi-Moradabad fault, pass through the territory, both having potential of generating earthquakes of magnitude up to 6.5 to 6.7 and normal depth of 30 kms. It will be prudent to consider the effects of such a potential earthquake for developing a prevention-cum-preparedness plan.

NCR region falls in seismic zone IV as per seismic zone map of Indian Standard IS 1893. This makes the area liable to MSK intensity of "VIII" and is considered as High Risk Zone. Such intensity may cause severe damages some of which are listed below:

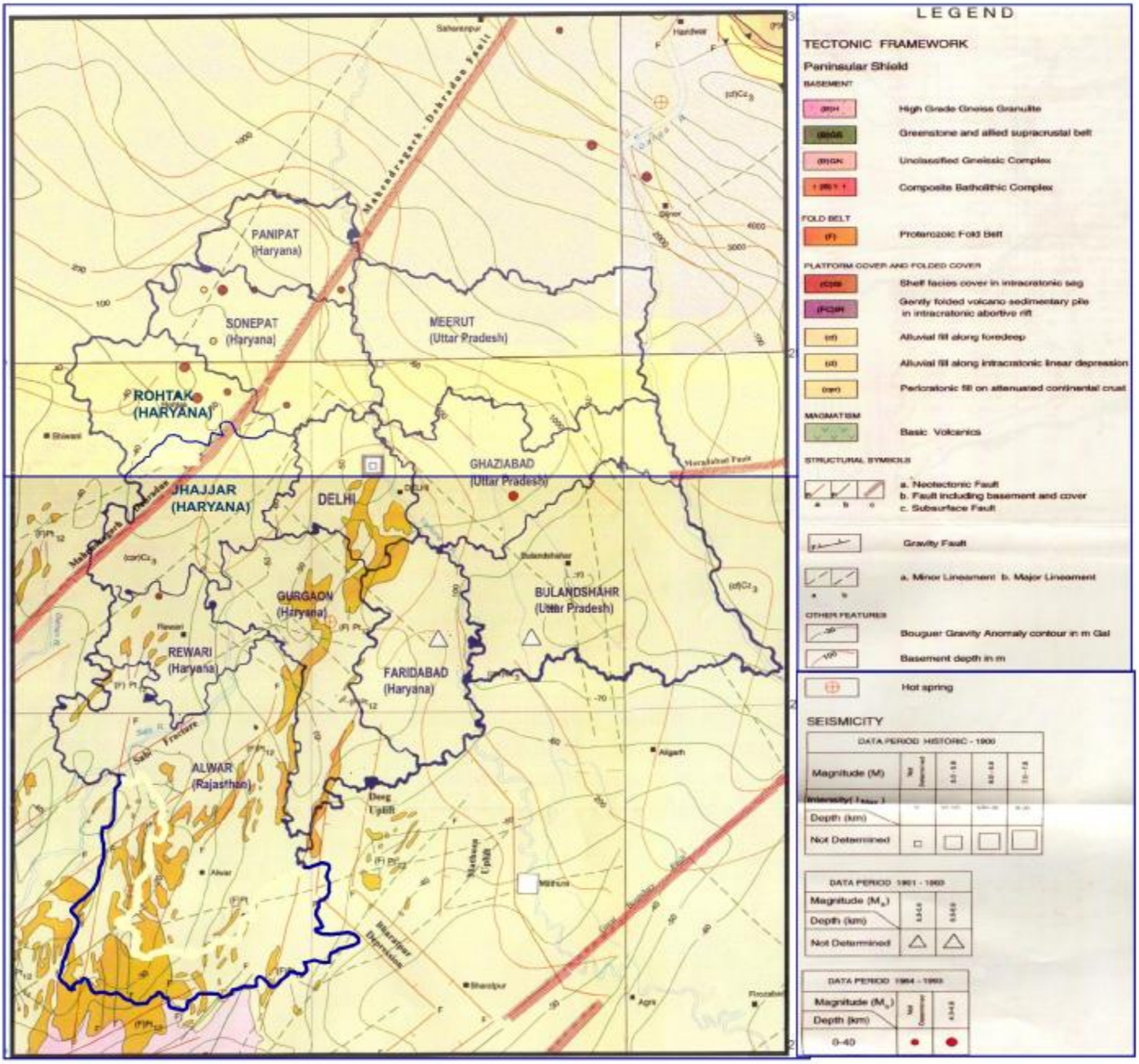
- Type A-Houses constructed with stone, rural structures, un-burnt bricks, clay etc. may suffer destruction causing gaps in walls, collapse of parts of buildings, loosening of cohesion of parts of buildings and collapse of inner walls.
- Type B-Buildings construction with ordinary bricks, large blocks, natural stone and prefabricated type buildings may suffer heavy damage causing large & deep cracks in walls.
- Most buildings of Type C i.e., RCC buildings may have small cracks in walls, fall of large pieces of plaster, slipping off tiles, cracks/fall in chimneys etc.
- Fright and panic is caused among people, breaking off of branches of trees etc. takes place.

The areas subjected to damaging intensities MSK VIII and VII in three earthquakes on Richter scale 6.5 are as given in Table 15.2.

Table 15.2: Areas Affected under Earthquake of Magnitude 6.5 (in sq kms)

Earthquake	Magnitude	I=VIII	I=VII	Total under VII & VIII
1	2	3	4	5
Koyna, 1967	6.5	130	430	560
Uttarkashi, 1991	6.6	700	1300	2000
Killari, 1993	6.3	420	930	1350

NATIONAL CAPITAL REGION
SEISMO-TECTONIC FEATURES



NATIONAL CAPITAL REGION PLANNING BOARD
MAP 15.1

Considering the areas affected during past earthquake of M 6.5, it can be expected that such an earthquake occurring in NCR could adversely affect the entire region with damaging intensities and could affect more than 50% of CNCR depending on the location of the epi-centre. Therefore, in terms of probable damage scenario, *the National Capital Region is most prone to earthquake. The whole urban development must be checked for safety against an intensity "VII" probability of occurrence, and upgraded for required seismic resistance in buildings and infrastructure as found necessary.*

Floods

As per the Flood Atlas of India prepared by Central Water Commission, it is observed that only small portion towards the south-east in Delhi is unprotected flood prone area (about 1.7% or 25 sq kms) and considerable area (about 5% or 74 sq kms) in the north-eastern parts which is protected by earthen embankments. Flood levels in Yamuna cross the danger level almost every year and people living in low lying areas behind the 'bunds' (embankments) are forced to evacuate to the top of the bunds or on road sides at higher elevations. The flow and the expected flood levels of the river Yamuna at Delhi is forecast by the Central Water Commission through hydrological and hydraulic observations on the upstream, particularly taken at Tajewala headworks about 130 km upstream from where two canals take off from the Yamuna, one on its left bank (WJC) and the other on the right bank (EJC). Since the Tajewala Barrage/headworks and the two canals have limited capacity, in the event of heavy precipitation in the catchment area of Yamuna and its tributaries, the river downstream comes in spate, overflowing its banks and flooding the adjoining low lying areas. Also great damage is caused to areas deep inside the region because of the back flow in the drains which is otherwise meant to discharge excess water into the river. In addition, heavy precipitation within the region causes local flooding of streets and localities on a large scale.

High Winds

So far as the wind hazard is concerned, design wind speed in the entire region is 47 m/s (169 km/h) as per IS 875 (Part 3), which could be reached only occasionally in what is called 'Andhi' (wind storm). The structures in this region should be designed keeping in view the above wind speed. In such events, weak houses of thatch, sheets etc. and those with sloping roofs using thatch, tiles, AC sheets and corrugated Galvanized Iron (CGI) sheet roofs, which are not fully anchored and integrated, will suffer damage. The damage occurring in 'Andhis' is again of localized nature and does not result in 'disaster' in the region.

Using the houses type data based on the Census 2001, the risk to the housing stock from the wind hazard could be worked out for different regions similar to the vulnerability risk tables prepared using Census 1991 data in the Vulnerability Atlas of different States.

This wind scenario does not cover the risk of tornado, which is a seldom case in respect of its occurrence, intensity and path, and is extremely difficult to deal with in general hazard risk studies. Also, in any one wind storm, it is unlikely that the whole or a large part of Delhi will be affected at once, and neither is there any possibility of a disastrous consequence from this hazard.

Fire Hazard

Fast growing cities like Delhi located in NCR are threatened by fire hazards, which may be attributed to following main reasons:

- Non-implementation of fire safety norms as part of building bye-laws.

- Encroachment, over crowded and haphazard growth affect the movement and timely approachability of fire tenders in emergency.

- Illegal and loose electric connections.
- Sub-standard wiring and over loading of electrical system.
- JJ clusters constructed with highly flammable material and some constructed with very toxic materials like plastics, polyethylene sheets, bamboo, soft wood etc. without proper access for fire tenders.
- Illegal storages and hazardous commercial activities.
- Inadequate pumping facilities hamper fire fighting and control of fire.
- Inadequate availability of special fire fighting equipments with local bodies especially for high rise multistoried buildings, where it is a prerequisite.

NCT-Delhi Sub-region with multi-faceted activities and a large number of multi-storied buildings, increased population density and mixed occupancy, is most vulnerable to fire hazard. Other towns such as Ghaziabad, Gurgaon, Noida, Alwar, Faridabad, etc. are also more vulnerable to fire hazard, with increased industrialization and development of multi-storied buildings.

A comprehensive study of the vulnerability due to fire hazards in the region and in different areas of fast growing towns should be taken up and adequate safety provisions be made for future planning of NCR and improvement in the quality of electrical cabling, wiring and distribution systems should be made.

15.3 POLICIES AND PROPOSALS

Following policies and strategies for disaster management are being proposed:

i) Disaster management is a multi-sectoral, multi-disciplinary subject, which involves many groups. Therefore, all the groups (Government/NGOs/Community) should work together. There is a need to have proper planning at various levels for disaster preparedness, mitigation and response. Disaster Management Committee (DMC) may be formed at Sub- regional level and District Disaster Management Committee (DDMC) at district level. Further, detailing of roles and responsibilities of the Committees should be given in the Sub-regional Plans.

   It is also suggested that Post-disaster Management Plan should form part of the Sub-regional Plan. The contents and guidelines required to be followed by the participating States and NCT-Delhi for this purpose should be clearly defined.

ii) Human resource development is an important aspect of capacity building where several players are involved. For this, training programmes are essential for people from various organizations. Organizing workshops, seminars, research activities etc. should be undertaken periodically.

   Disaster Management Centres may be established at strategic locations in the region for sensitizing people, training of personnel and mitigation measures.

iii) Efforts need to be made on using state of art technologies viz., GIS, GPS, remote sensing, computer modeling and expert systems, electronic information and management systems etc. for collection,

storage, retrieval and dissemination of information. The control rooms need to be modernized and made more effective and community friendly in the participating States.

Detailed database should be compiled on the occurrence of hazards, damage caused to buildings and infrastructure and the economic losses suffered by various government departments, public and private enterprises, agriculture and horticulture and the related infrastructure in the area. This information should be widely publicized to create awareness among public. District administration should be prepared for all eventualities in future.

Telecommunications in terms of disaster warning systems need to be provided for rapid dissemination of warnings to the designated addressees even at remote places in vernacular languages. Disaster warning sets may be located in the States and district level headquarters.

iv) A complete techno-legal regime has to be proposed for amending the present building bye-laws to include safety aspects from natural hazard's point of view.

The relevant Town and Country Planning acts, Development and Municipal Acts of the participating States should be carefully examined and amendments be carried out to incorporate necessary provisions on safety aspects relating to natural hazards. Development Control Rules and Building Bye-laws applicable in the Sub-regions should be appropriately modified by the constituent States, having provisions on safety aspects relating to natural hazards and fire safety. All multi-storied and high-risk buildings [as defined by the Earthquake manuals and National Building Code (NBC)] should be established keeping in view their ability to withstand earthquake of the defined intensity.

The States need to take up review of relief manuals and scarcity preparedness guidelines to suit local needs and geo-climatic conditions.

Appropriate guidelines have to be developed to cover the aspects of land use zoning, hazard resistant building construction. Transfer of better technologies can be effected through building centers.

v) The participating States should undertake the vulnerability and risk assessment of their respective Sub-regions due to natural hazards and prepare Prevention cum Preparedness Plan as a part of Sub-regional Plan. Priority should be given to public buildings (such as hospitals, educational institutional, power stations, infrastructures, heritage monuments, life-line structures and those which are likely to attract large congregation) keeping in view their ability to withstand earthquake of the defined intensity. Suitable action should be taken by the State Governments for retrofitting and strengthening of structures identified as vulnerable as per earthquake manuals and NBC. Innovative construction technologies should be studied and implemented.

Keeping in view the geotectonic features of the region, it is observed that rocky ridges, although form a small part (as indicated in Map 15.1), yet act as water divides for recharging the aquifer of the surrounding areas and therefore, should be kept preserved.

vi) Earthquake: Seismic micro-zonation on a scale of 1:1,00,000 to 1:1,50,000 should be prepared by the participating States for their respective Sub-regions based on the already available data/indicators. Seismic micro-zonation for selected areas/towns, having high growth rates should be taken up on priority.

There are certain areas like Rohtak, which are topographically low and flood prone, as such any development in these areas should be taken up keeping in view that these are also seismically intense zones.

vii) Flood: Different areas in NCR, which are liable to flooding in rivers of return period of 5, 10, 25, 50 and 100 years, need to be identified on map for land use zoning at regional and Sub-regional levels. Participating States should prepare detailed Contour Maps for their respective Sub-regions on a scale of 1:1,5000 at a contour interval of 0.3 to 0.5 metre and mark areas that are flood prone.

viii) High Winds: It is also observed that desert is extending eastward in the southern part of NCR. Suitable measures should be adopted to arrest the tendency of desert extension in this part of the region.

ix) Fire: Comprehensive risk evaluation of growing towns should be undertaken on priority in order to identify areas in each town vulnerable to fires and database in terms of available equipments and personnel should be compiled and periodically updated.

Areas in cities and towns in NCR may be classified as High Vulnerability, Moderate Vulnerability, and Low Vulnerability from fire hazard's point of view. Fire safety measures for different areas should be worked out as per the basic character of cities/towns.

Part IV of National Building Code and other related Indian Standards provide safety regulations. These should be followed by the participating States as guide for formulating Development Control Rules/bye-laws for mitigation of the fire hazard.

Fire departments/authorities should be involved in planning for NCR from the initial stage so that there is a coordinated effort among different participating States.