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USAID/BHR

The Office of Foreign Disaster Assistance

REPORT

**Program for the Enhancement of Emergency
Response**

Baseline Data

INDIA

Focus: Delhi and Maharashtra

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March 2003

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1. Country Profile

1.1 Introduction

India is one of the most disaster-prone countries in the world. The locational and geographical features render it vulnerable to a number of natural hazards such as cyclone drought, floods, earthquakes, fire, landslides and avalanches.

The country has an integrated administrative machinery for disaster management at National, Provincial (State), District and Sub-District levels. India has a federal system of Government with role of Union and Provincial Governments specified by the Constitution. The responsibility for undertaking rescue and relief measures in the event of natural calamities is that of the State Government concerned. The Union Government supplements the State relief efforts by initiating supportive action. Elaborate procedural mechanism outlined in relief manuals & codes and backed up by Contingency Action Plans along with allocation of resources on a regular basis facilitates emergency management operations. A National Contingency Action Plan has been notified.

The country has an elaborate cyclone detection, tracking system, flood forecasting and warning systems covering major rivers and drought monitoring arrangements.

Long term planning and preparedness for disaster mitigation form part of the process of development planning in India. Science & technology inputs constitute its basic thrust which is manifested in development of forecasting and warning systems, disaster resistant construction technologies, appropriate cropping systems.

A number of special programmes are in operation over many years for mitigating the impact of natural disasters. As the country has been facing natural hazards over centuries, the local communities have developed their own indigenous coping mechanism. The rich store house of this knowledge is the country's proud inheritance. At times of emergencies, spontaneous mobilisation of community action supported by Non-governmental Organisations add strength to national capability in disaster management. However, the areas where efforts made and results achieved have not been commensurate with the magnitude of the problem faced by natural disasters are forging linkages between disaster reduction and development, training and education, participation at the community level, enlisting people's participation in integrating social and human science inputs in vulnerability assessment and appropriate resource allocation against competing demands.

Accepting the fact that the trend of losses is not indicating any sign of improvement inspite of initiating various disaster mitigation measures, the country is planning to give more stress in some vital areas in this field during next century. These include linkage of disaster mitigation with development plans, effective communication system, use of latest information technology, insurance, extensive public awareness and education campaigns particularly in the rural areas, involvement of private sector, strengthening of institutional mechanism and international co-operation.

India is committed to take necessary steps to achieve the goals and objective of the International Decade for Natural Disaster Reduction. Country believe that co-operation among the various countries particularly of the Asian region, is very essential for effective disaster reduction and preparedness. There is a need o have continuous exchange of experience and know how. As a part of regional co-operation, India has hosted some regional conferences. World Disaster Reduction Day is observed on 2nd Wednesday of October every year to create public awareness about natural disasters and motivate them to adopt preparatory measures. India has also become the member of the Asian Disaster Reduction Centre, Kobe, Japan.

1.2 Physiology and Hazards

India covers an area of 32,87,263 sq. kms. extending from now covered Himalayan heights to the tropical rain forests of the South. It is the seventh largest country in the world and is well marked off from the rest of Asia by mountains and the sea which give the country a distinct geographical entity. In the North, it is bounded by the Great Himalayas and stretches southwards tapering off into the Indian ocean between the Bay of Bengal and the Arabian Sea. It means about 3,214 kms from North to South between extreme longitudes. It has a land frontier of 15,200 kms. and coastline of 7,500 kms. It has also group of islands located both in the Bay of Bengal and Arabian Sea.

The main land comprises of four regions, namely, the Great Mountain Zone, Plains of the Ganges and the Indus, Desert Region and the Southern Peninsula. The Himalayan range comprises three almost parallel ranges interspersed with large plateaus and valleys. The mountain wall extends over a distance of 2,400 kms. with a varying depth of 240 to 320 kms.

The plains of the Ganges and Indus, about 2,400 Kms. long and 240 to 320 Kms. broad are formed by basins of three distinct river systems, viz.; the Indus, the Ganges and the Brahmaputra. The desert region is clearly delineated in two parts - the Great Desert running beyond Rann of Kutch to Rajasthan - Sindh Frontier while the little desert extends between Jaisalmer and Jodhpur upto the Northern wastes. Between the two deserts is a zone of absolutely sterile region, consisting of rocky land cut up by limestone ridges.

According to 1991 census, Indian has a population of 843.93 million consisting of a male population of 437.60 million and female population of 406.33 million. The average population density in the country as a whole is 267 persons per sq. km. The literacy rate as per 21991 census is 52.2 percent - 64 percent for male and 39 per cent for female.

The country is a Union of 28 States and 7 Union Territories. The Union Territories are subject to the direct rule - making powers of the National Parliament and the administrative control of the Union Government. The States have elected Legislatures and Governments, which are fully autonomous in relation to the sphere of activities entrusted to them under the Constitution. The States are further divided into Administrative Units called Districts.

The heavy concentration of rainfall within a span of three months in most of the areas causes heavy run-off and high floods. Non-availability of moisture over most parts of the year, particularly in the arid and semi-arid regions, renders 68 per cent of the land-mass vulnerable to drought. The tectonic plates of Indian sub-continent makes it vulnerable to frequent earthquake disturbances.

The Asia Pacific Region faces over 60% of the world's natural disasters. India, on account of its geographical position, climate and geological setting, has had from time immemorial, a fair share of these disasters. There is hardly a year when some part of the country or other does not face the spectre of drought, due to the failure of monsoons in vulnerable areas. One or two cyclones strike the peninsular region of the country every year. Similarly, floods are a regular feature of the Eastern India where Himalayan rivers inundate large parts of its catchment areas uprooting people, disrupting livelihood and damaging infrastructure. The fragility of the Himalayan mountain ranges are a continuing source of concern for their high vulnerability to earthquakes, landslides and avalanches. The recent earthquakes in Gujrat, Maharashtra and Madhya Pradesh have demonstrated that the areas considered comparatively safe till now, are really not so.

1.3 Natural Disasters

1. Floods

Of the annual rainfall, 75 per cent is concentrated over four months of monsoon (June - September) and as a result almost all the rivers carry heavy discharge during this period. The flood hazard is compounded by the problems of sediment deposition, drainage congestion and synchronisation of river floods with sea tides in the coastal plains. The rivers originating in the Himalayas also carry a lot of sediment and cause erosion of the banks in the upper reaches and over-topping in the lower segments. The most flood prone areas are the Brahmaputra and the Gangetic basins in the Indo- Gangetic plains.

The other flood prone areas are the north-west region of the west flowing rivers like Narmada and Tapi, the Central India and the Deccan region with major east flowing rivers like Mahanadi, Krishna and Cavery. While the area liable to floods is 40 million hectares, the average area affected by floods annually is about 8 million hectares. The annual average cropped area affected is approximately 3.7 million hectares. The average annual total damage to crop, houses and public utilities during the period 1953-95 was about Rs.972.00 Crores, while the maximum damage was Rs. 4630.00 Crores in 1988.

2. Drought

As much as 73.7 per cent of the annual aggregate precipitation of 400 million hectare metres is received during the south-west Monsoon period, June to September. Due to erratic behaviour of monsoon, both low (less than 750 mm) and medium (750 - 1125 mm) rainfall regions, which constitute 68 per cent of the total areas, are vulnerable to periodical droughts. The analysis of 100 years of rainfall behaviour reveals that the frequency of occurrence of below normal rainfall in arid, semi-arid, and sub-humid areas is 54-57 per cent, while severe and rare droughts occur once every 8- 9 years in arid and semi-arid zones. In semi-arid and arid climatic zones, about 50 per cent of the severe droughts cover generally 76 percent of the area. In this region, rare droughts of most severe intensity occurred on an average once in 32 years and almost every third year was a drought year. The impact of drought varies from year to year. The 1987 drought, which was one of the worst drought of the century, with the overall rainfall deficiency of 19 per cent, affected 58-60 per cent of cropped area and a population of 285 million.

3. Cyclone

India has a long coast line of 8,000 kms. On an average, about five to six tropical cyclones form in the Bay of Bengal and Arabian Sea every year, out of which two to three may be severe. There are two distinct cyclone seasons: pre-monsoon (May-June) and post-monsoon (October-November). Analysis of cyclone events during the last 100 years period from 1891 to 1991 reveals that as against 117 cyclones of varied intensities formed in the Arabian Sea, 442 cyclones were formed in the Bay of Bengal.

The impact of these cyclones is confined to the coastal districts, the maximum destruction being within 100 Km. from the centre of the cyclones and on either side of the storm track. The principal dangers from a cyclone are: (i) gales and strong winds, (ii) torrential rain, and (iii) high tidal waves (also known as 'storm surges'). Most casualties are caused by coastal inundation by tidal waves and storm surges. The worst devastation takes place when and where the peak surge occurs at the time of the high tide.

4. Earthquake

The Himalayan mountain ranges are considered to be the world's youngest fold mountain ranges. The subterranean Himalayas are, therefore, geologically very active . The Himalayan frontal arc, flanked by the Arakan Yoma fold belt in the east and the Chaman fault in the west constitutes one of the most seismically active regions in the world. Four earthquakes exceeding magnitude 8 in the of 53 years, These are the Assam earthquakes of 1987 and 1950, the Kangra earthquake of 1905 and the Bihar-Nepal earthquake of 1935.

The peninsular part of India comprises stable continental crust regions which are considered stable as they are far away from the tectonic activity of the boundaries. Although these regions were considered seismically least active, an earthquake that occurred in Latur in Maharashtra on September 30, 1993 of magnitude 6.4 in the Richter scale caused substantial loss of lives and damage to infrastructure. The one in Bhuj, Gujrat on 26th January 2001 also caused alarming damage.

5. Landslides

The Himalayan, the north-east hill ranges and the Western Ghats experience considerable landslide activities of varying intensities. The rocks and the debris carried by the rivers like Kosi originating in the Himalayas cause enormous landslides in the valleys. The seismic activity in the Himalayan region also results in considerable landslide movement. The heavy monsoon rainfall, often in association with cyclonic disturbances, results in considerable landslide activity on the slopes of the Western Ghats.

6. Avalanches

Avalanches constitute a major hazard in the higher reaches of the Himalayas. Heavy loss of life and property have been reported due to avalanches. Parts of the Himalayas receive snowfall round the year and adventure sports are in abundance in such locations. Severe snow avalanches are observed during and after snowfalls in Jammu & Kashmir, Himachal Pradesh and the Hills of Western Uttar Pradesh. The population of about 20,000 in Nubra and Shyok valleys and mountaineers and trekkers face avalanche hazard on account of steep fall of 3000 to 5000 metres over a distance of 10 to 30 kilometres.

1.4 Disaster Response

1. Administrative Response

The basic responsibility for undertaking rescue, relief and rehabilitation measures in the event of natural disasters is that of the State Governments concerned. The role of the Central Government is supportive, in terms of physical and financial resources and complementary measures in sectors such as transport, warning and inter-state movement of food grains. Relief Manuals and Codes are available for undertaking emergency operations.

A broad view of the administrative response at national, state and district levels is given below:

2. National Organisation

Under the Indian federal system, disaster management is the responsibility of State Governments. However, there is a Crisis Management Group headed by the Cabinet Secretary and consisting of nodal ministries in charge of various types of disasters and supporting ministries. For natural disasters, the Ministry of Agriculture is the nodal Ministry and the other Ministries play a supportive role. In the event of a disaster, a multi-disciplinary Central Government team, at the invitation of the affected State, carries out disaster assessment and makes recommendation for assistance.

3. State Level Organisation

Disaster preparedness and response in the State is usually delegated to the Relief and Rehabilitation Department or the Department of Revenue. The Crisis Management Group at the State level is headed by the Chief Secretary of the Government, with participation of all the related agencies.

4. District Level

A District Level Co-ordination and Review Committee is constituted and is headed by the Collector as Chairman with participation of all other related agencies and departments.

5. Contingency Action Plan

A National Contingency Action Plan (CAP) has been notified. It facilitates the launching of relief operations without delay. This is updated every year. The CAP identifies the initiatives required to be taken by various Central Ministries/Departments in the wake of natural calamities, sets down the procedure and determines the focal points in the administrative machinery.

At the State level, the State Relief Commissioner (or Secretary, Department of Revenue) directs and controls the relief operations through Collectors or Deputy Commissioners, who are the king-pin of all relief operations, co-ordination, direction and control at the district level.

6. Arrangements for Financing Relief

Schemes for financing expenditure on relief and rehabilitation in the wake of natural calamities are governed by the recommendations of Finance Commissions appointed by Government of India after every five years. Under the existing scheme, in operation for the period 1995-2000, each State has a

corpus of funds called Calamity Relief Fund(CRF), administered by a State Level Committee, headed by the Chief Secretary of the State Government. The size of the corpus is determined having regard to the vulnerability of the State to different natural calamities and the magnitude of expenditure normally incurred by the State on relief operations. The corpus is built by annual contributions of the Union Government and the State Governments concerned in the ratio of 3:1. At present, the aggregate accretion in the States' CRF for a period of five years from 1995-2000 amounts to Rs. 63042.70 million. The States are free to draw upon this corpus for providing relief in the event of any natural calamity. In the event of a major disaster warranting intervention at the national level, a provision exists in the form of National Fund for Calamity Relief with a corpus of Rs. 7000.00 million (for 1995-2000) for the Union Government to supplement the financial resources needed for relief operations.

1.5 Preparedness and Mitigation Measures

India, besides evolving effective post-disaster management operations, has also formulated and implemented pre-disaster mitigation programmes and sectoral development programmes to reduce the impact of disasters as well as reduce the socio-economic vulnerabilities. The reconstruction programmes in the aftermath of disasters such as cyclones and earthquakes are also aimed at building disaster resistant structures to withstand the impact of natural hazards in the future.

1. Floods

Structural methods of flood mitigation has attracted an investment of about Rs. 4,000 crore between 1957 and 1995 in construction of new embankments (16200 kms), drainage channel (32000 Km) and raising 4700 critical villages above the flood level. These measures have protected an estimated area of 14.4 million hectares.

Multi-purpose dams and reservoirs have been built with flood moderation as one of the objectives. Examples of flood moderation through multi-purpose dams are the Damodar Valley systems in eastern India, Hirakud dam in Orissa and the Bhakra on river Sutlej. The Damodar valley system has a flood absorption capacity of 1,867, mcm. which moderates probable floods of 28,300 cusses to 7,075 cusses in the valley.

Control of premature siltation of multi-purpose reservoirs and checking degradation of catchment areas is attempted through a scheme of soil conservation, River Valley Project (RVP) in the catchments of major rivers. The scheme covers 581 watersheds in 27 catchments spread over 17 States.

The increasing trend in the flood damage observed in India during the seventies led to attempts for the development of flood plains in a regulated manner. A model Bill on flood plain Zoning was circulated to the State Governments as early as 1975 to enact suitable legislation for restricting the encroachment of the flood plains and for their development in regulated manner. The model Bill emphasises on non-structural measures. The main features of the model bill were:

- (a) designating flood zoning authority;
- (b) delineation of flood plain;
- (c) notification of limits of flood plains;
- (d) restrictions on use of flood plains;
- (e) compensation; and
- (f) power to remove construction after prohibition.

During the decades of 1960s to 1980s there has been dependence on structural measures. As structural measures alone have not yielded the desired results and flood damages continue to show increasing trend, non-structural measures such as flood forecasting, flood plain zoning, flood proofing of the civic amenities of the affected villages, changing the cropping pattern and public participation in flood management works are being given a fair trial. These measures are also cost and time effective.

2. Drought

India has given attention to irrigation development by harnessing water through the medium reservoirs, developing traditional systems of tanks and exploiting groundwater. The average annual investment on major and medium term irrigation projects rose from 75.00 Crores in the First Five Year Plan to Rs. 2500.00 Crores in the Eighth Five Year Plan creating a total potential of 38.0 million hectares.

The irrigation potential has not been fully utilised for want of on-farm development works like field channels, land levelling, field drains and absence of appropriate system of water distribution to ensure appropriate water management. The Government of India is now operating a Command Area Development Programme(CADP) to strengthen the water management capabilities and enhance the effectiveness of irrigation water application.

The Desert Development Programme(DDP) started in 1977-78 aims at controlling the process of desertification and mitigating the adverse effects on drought in the desert areas through such projects as afforestation, sand-dune stabilisation, shelter belt plantation, grassland development and soil and moisture conservation. A similar programme directed at drought prone areas is under implementation since 1973 and is titled Drought Prone Areas Programme(DPAP). The DPAP is under implementation in 149 districts in 14 States and the DDP in 36 districts in 7 States.

Seventy per cent of India's cultivated land is in the rainfed areas, which often suffer reverses in agricultural production and face drought conditions. A programme titled National Watershed Development Project for Rainfed Areas(NWDPR) has been devised and is under implementation. This programme adopts development measures for all the spatial components of watersheds i.e. arable land, non-arable land and drainage lines as one organic geo-hydrological entity.

There are large areas of degraded land of over 100 million hectares in the country which could be reclaimed. Most of the land needs only basic water and soil conservation measures and some amount of plantation and protection work. A National Wasteland Development Board has been constituted for promoting integrated wasteland development. The National Forest Conservation Act(1980) is an attempt to bring down the erosion of forest cover all over the country.

Natural disasters, particularly droughts throw up huge unemployment and under-employment problems in the rural areas. The Jawahar Rozgar Yojana (JRY) envisaged for this purpose is the largest such programme in the country. The objectives of the programme is to generate additional gainful employment for the unemployed and under-employed men and women in rural areas.

3. Cyclone

Measures such as building of cyclone shelters, afforestation in coastal areas, etc. have been undertaken to deal with cyclones. Reconstruction projects have been taken up in areas affected by major calamities by building elements for mitigation of possible future calamities. The Cyclone Reconstruction Project implemented in the coastal Andhra Pradesh during 1990-93 consisted of such components as housing and public infrastructure, drainage and rural water supply. It also included such mitigation efforts as expanding road and communication network, planning of shelter belt plantation and building up of cyclone shelters.

4. Earthquake

Loss of life during the past earthquakes in the world has occurred due to the collapse of non-engineered traditional buildings. Studies on this problem were started at the University of Roorkee in 1960. Very useful recommendations regarding upgrading of such buildings were available in the G.S.I. Memories on the 1934 Bihar Earthquake and 1935 Quetta (now in Pakistan) Earthquake. These efforts resulted in the preparation and publication of IS:4326 in 1976. After the Koyna Earthquake, the research efforts were devoted to shake-table tests on larger scale specimens for checking the validity of the reinforcing recommendations of IS:4326 and also to further refine the analysis procedures. The Monograph published by the International Association of Earthquake Engineering, namely, Basic Concepts of Seismic Codes, Part II, Non-Engineered Construction, 1980 included many results of the Indian experience, particularly in regard to masonry and wooden buildings. This Monograph has been revised and updated as "Guidelines for Earthquake Resistant Non-Engineered Construction", October, 1986.

The Department of Science and Technology(DST) is executing a World Bank assisted project on Seismological Instrumentation Upgradation and other Collateral Geophysical studies in the Indian Peninsular region. Major organisations like India Meteorological Department, National Geophysical Research Institute, Survey of India, Geological Survey of India and some academic institutions are participating in the World Bank project. Under the project, it is planned to (i) upgrade 20 existing seismological observatories of IMD, (ii) set up 3 Telemetered Seismic Clusters (iii) 10 new Digital Seismic Observatories in the shield region and (iv) Strong Motion Instruments both for free field and structural response studies (v) Geodetic studies using GPS technology.

Long Term Mitigation/Reduction Measures

To improve disaster management strategy and to enhance our capability to mitigate the impact of disasters in the country in the long-run, the following areas have been identified for implementation:-

- a) Intensive training for building up human resource development to improve awareness and capabilities for successful disaster management.
- b) The documentation of events of various natural disasters so as to highlight the lessons learnt in tackling future disasters.
- c) Long-term mitigation measures which will focus on various programmes keeping in view the goals and objectives of IDNDR.
- d) For achieving long-term results there is need to examine critically the development programmes in relation to disaster management in different areas and suggest priorities and strategies for inclusion in the ongoing plans.
- e) To create awareness among the general public about the various aspects of disasters and benefits of the counter-measures.
- f) Programmes of undertaking consultancy services, research programmes etc. to increase the level of understanding and evolving appropriate measures to improve the quality of the disaster management.
- g) To have an integrated approach in developing professional disaster management strategy.
- h) Improvement of forecasting, warning and communication system for effective disaster management.

A Central Sector Scheme on Natural Disaster Management Programmes (NDMP) is being implemented for the first time from December 1993. The main objective of the programme is to enhance the national capability for disaster reduction, preparedness and mitigation. The programme is also expected to enhance the level of awareness of the community about disasters they are likely to face and prepare them adequately to face the crisis situation.

The components of the programme are:-

- i) Human resource development,
- ii) Activities under IDNDR,
- iii) Research and consultancy services,
- iv) Documentation of major events,
- v) strengthening of NDM Division,
- vi) Establishment of National Centre for Disaster Management (NCDM) at the Centre and the Natural Disaster Management Faculties in States.

The major achievements of the programme so far are :-

- i) Setting up of the National Centre for Disaster Management in the Indian Institute of Public Administration, New Delhi, in 1995.
- ii) Setting up of separate Disaster Management Faculties in Training Institutes in 16 out of 25 States in the country,
- iii) Documentation of major events like Uttarkashi and Latur earthquakes, research studies on land-slides in Kerala and Sikkim, droughts in Rajasthan and cyclone mitigation in Andhra Pradesh.
- iv) Preparation of source book for use of trainees of the Lal Bahadur Shastri National Academy of Administration,
- v) Organising/Sponsoring of about training programmes/seminars on various aspects of natural disaster management,
- vi) Public education and community awareness campaign through Newspapers, postal stationery, observation of World Disaster Reduction Day and films,
- vii) Reprinting of 45000 copies of IDNDR publication for children in English and Hindi for distribution among school children.

2. Delhi

2.1 Profile

Delhi has grown as an administrative town through the ages and therefore it is distinctly different from other metropolises in the country. Delhi is the most rapidly growing metropolitan area in the country with a very high growth of population since independence in 1947. The Delhi region is located at the northern end of the Aravallis. To its north lie the Gangetic Plains underlain by alluvium and tertiary (Siwalik) formation. Delhi, which lies in seismic Zone IV and is seismically vulnerable, is currently experiencing mild seismicity. The region has experienced several earthquake of magnitude 6.0 and above since historical times. An earthquake of magnitude 7.0 on the Richter scale, that was once considered hypothetical, can become a nightmare anytime. Recently the seismicity of the region has been monitored by the Indian Meteorological department (I.M.D), employing a network of stations located at Rohtak, Sohna, Sonapat and Delhi (Ridge).

The occurrence of a major earthquake in the recent past indicate that strains are accumulating in several parts of the Indian peninsula as a consequence of its northern movement. Keeping in view the forecast of a major earthquake, it has become imperative to increase awareness on use of earthquake resistant techniques in building construction in the region.

Population Growth (1881 -1991)

Delhi had a population of 183,944 as per the 1881 census. The increase in the population of Delhi during the succeeding three decades was rather slow. By 1911 it had a population of 2,37,944. It was during the same year that Delhi was designated as the capital of British India. Besides this the area of the city was also extended from 43 sq. 4km. to 168 sq.km. After that there had been a rapid population growth from 3,04,420 in 1921 to 4,47,442 in 1931 with the decadal growth rate of population increasing. Subsequently there have been some fluctuations in the population growth during 1941-51 due to large-scale population movement, which started in the wake of partition of the country. The city during this decade recorded a population growth rate of 106.58%. During the decade 1981-91, Delhi's population increased from 6,220,406 in 1981 to 9,370,475 in 1991, recording an overall growth rate of 50.64 % during the last decade. This rate is slightly lower than the corresponding rate of growth for the decade 1971-81, which was 53 %.

Population Information

	1981	1991
Population	6,220,406	9,420,644
Area in sq.km	1,483	1,483
Population Density/Sq.km	4,194	6,352
MCD(Urban)including Census Towns	-	16,833
NDMC	-	7,050
Delhi Cantt.	-	2,197
Delhi	-	12,360
Rural Delhi	-	1,190

Statement showing the population Growth of Delhi from 1901-91

Year	Population	Decadal Growth Rate
1901	405,819	-
1911	413,851	1.98
1921	488,452	18.03
1931	636,246	30.26
1941	917,939	44.27
1951	1,744,072	90.00
1961	2,658,612	52.44
1971	4,065,698	52.93
1981	6,220,406	53.00
1991	9,370,475	50.64

in the form of building byelaws do exist but the awareness for fire resistant building materials is lacking and there is poor enforcement. The areas adjacent to river Yamuna - Trans Yamuna Area, Model Town, Jahangirpuri, Nirankari Colony, Wazirbad, Yamuna Pushta, ITO, Nizamudin, Friends Colony, Okhla etc. are the areas where very high incidence of fires are reported.

The Master Plan of Delhi does not include any earthquake safety measures though there is a limited provision on fire safety measures under the building Byelaws, which also mentions earthquake resistant engineering design for multi storeyed buildings. The scope of this is now being widened to include low-rise buildings in Delhi. Recently recommendation regarding earthquake preparedness of Delhi have been formulated by a group of experts, which are still to be formally released. The group, working on a legal case regarding safety in Delhi, has recommended various measures in this regard. These include (i) Restructuring of national policy on disaster management, (ii) Creating public awareness, (iii) Suitable amendments in Town Planning Acts, Master Plan, Building Regulations etc., and (iv) All housing schemes to have mandatory provision for conforming to earthquake resistant techniques.

View Point of Sunil Mehra, Additional Town Planner, MCD

According to Mr. Mehra, 40% of city's population resides in informal settlements. The villages engulfed in urban extensions, slums and unauthorised colonies are those areas where the roads are extremely narrow. The areas that frequently face fires are Yamuna Pushta, inner city area (Shahjahanabad) and the areas where people are involved in plastic recycling. There are no specifications in the Building Byelaws regarding the use of fire resistant building materials. The Civil Line area, University area, Kingsway Camp, North of Shahadra, East of Loni Road and unauthorised colonies on the riverbank are the areas that experience flooding.

Mr. Mehra is a member of the committee formed to look into the matters of preparedness during earthquake after a public interest litigation was filed in this regard. According to him, recommendations regarding earthquake preparedness of Delhi have recently been made by a group of experts (set up by the Urban Development Department of Delhi).

2.2 Vulnerability Assessment

Earthquakes

Today India still piles headlong into Eurasia. This collision forms a fault that is around 1500 miles long and between 60 and 120 miles wide; from the plains of Northern India it dips north underneath the mountains. The elastic energy that has been built up in the fault to force the blocked continent forward slips 30 feet or more all at once. This generates great earthquakes - of magnitude 8 or greater. There have been four such earthquakes along the detachment fault during the past 100 years. These were:

- 1) magnitude 8.7 in 1897 in Assam,
- 2) magnitude 8.6 in 1905 in Kangra,
- 3) magnitude 8.4 in 1934 in Bihar, and
- 4) magnitude 8.7 in 1950, again in Assam.

Each ruptured a different segment of the fault. But one segment, located between the Kangra and Bihar rupture zones (roughly between the longitudes to Kathmandu and Delhi), has been strangely reserved. Between 300 and 500 miles long, it is called Himalayan seismic gap. Most seismologists believe quakes are most likely to occur in seismic gaps, where they haven't occurred recently. If so, one in the Central Himalayan gap is more than due. According to available historical records this area has not faced a great quake for at least 300 years.

Seismicity of Delhi Region

The city of Delhi is located at the northern end of the Aravalis and is surrounded by Indo - Gangetic alluvial plains in the north and in the east, by Thar desert in the West and by Aravalli hill ranges in the south. The terrain of Delhi is flat except for a low NNE - SSW trending ridge, which is considered an extension of the Aravalli hills of Rajasthan. The eastern part of the ridge extends upto Okhla in the South and disappears below Yamuna alluvium in the NE on the right bank of the river.

The seismic history of the region, dating back as far as 893 AD (maximum estimated magnitude equal to 7 on Richter scale), reveals high seismicity and tectonic instability of the region. Delhi and its hinterland have experienced earthquakes of magnitude 6.0 and above in 1720 and 1803, and form one of the interesting seismic zones in North India that is experiencing mild seismicity now. Since 1960 several events of magnitude 4.0 to 5.6 have been reported near Delhi and Gangetic plains to the north. The efforts to monitor the seismicity of Delhi and the surrounding region have been stimulated by recordings at the Delhi Ridge observatory. In view of the importance of the Delhi region, another seismological station, having short period analog and digital recorders (Kinematic make), was installed at South Campus of Delhi University near Dhoola Kuan (DLK) in October 1990. Intensity of upto MSK VIII will be quite probable in the Delhi territory. Normal depth of 30 km may be assumed for these earthquakes. The effects of such a potential earthquake should be considered before developing any disaster prevention-cum-preparedness plan.

Five earthquakes of Richter Magnitude 5.5 to 6.7 are known to have struck the region around Delhi since 1720 AD. A brief description of the past earthquakes in this region is as follows:

- I.) **15 July 1720 Earthquake:** A major event of intensity IX (Mercalli Scale) took place in Delhi on 15th July 1720. This earthquake, with its epicentre some 15 km from Delhi and magnitude 6.5 on Richter scale, has been described in history as a dreadful one in which walls of a fortress and many houses were destroyed. It was followed by 4 to 5 after-shocks per day for 40 days and occasional shocks for 4 to 5 months.
- II.) **31 August 1803 Mathura Earthquake:** A violent shock of intensity IX is reported to have taken place near Mathura on 1st September 1803. This earthquake with a magnitude of 6.5 on the Richter scale had its epicentre in Garhwal. The earthquake caused widespread damage in Delhi, and the upper portion of the Qutab Minar fell down.
- III.) **10 October 1956 earthquake:** This earthquake of magnitude 6.4 on Richter scale took place near Bulandshahar. It had its epicentre near Garhwal some 270 km from Delhi. This earthquake was felt in a very large area and was responsible for damage to many buildings.
- IV.) **27 August 1960 earthquake:**
An earthquake of intensity VII (mag. 6.0 on the Richter scale), called the Delhi earthquake, took place near Sohna, about 60 km SE of Delhi, on 27 August 1960, at a depth of 109 km. About 50 persons were injured. The earthquake was also felt at Kanpur and Jaipur. Minor property damages and injuries to about 50 people were reported from Delhi.

Particulars of major events reported from Delhi and the adjoining region.

Date	Location	Intensity	Mag	Reference
15 July, 1972	28.5,77.2	VII -IX	-	Oldham, 1883
1 Sept., 1803	27.5,77.7	IX	-	Oldham, 1883
10 Oct., 1956	28.15,77.67	VIII	6.0	ISS
27 Aug., 1960	28.20,77.40	VII	6.0	Srivastava & Somayajulu, 1966
15 Aug., 1966	28.67,78.93	-	5.6	ISC

- V.) **15 August 1966 earthquake:** Two earthquakes, at intervals of 1.2 seconds with magnitude 5.3 and 5.8 respectively, effected the areas around Moradabad and Bareilly, about 100 km south of the Main Boundary Fault (MBF) of the Himalaya. This was attributed to tension prevailing in the crust underneath the Gangetic plains due to bending of the Indian Lithosphere. ~~Fourteen people were killed due to collapse of residential buildings in Delhi.~~

These earthquakes were felt extensively in western UP and adjoining areas of Punjab and Haryana.

A number of events of magnitude 4.0 and above have occurred over the Gangetic plains South of the Main Boundary Fault. In the Southern part of the Aravalli also, several events of magnitude > 4.0 have occurred. The seismicity observed in Delhi is difficult to be attributed to any particular fault or a lineament. It is possible that a number of lineaments are seismically active.

The northeasterly trend of seismicity continues further north beyond the Main Boundary Fault (MBF), in the Kumaun-Garhwal Himalaya region.

Areas affected by earthquakes of M - 6.5

Earthquake	M	I = VIII	I = VII	Total under
	sq km	sq km	sq km	VII & VIII
Koyna 1967	6.5	130	430	560
Uttarkashi 1991	6.6	700	1300	2000
Killari 1993	6.3	420	930	1350

According to Prof. Verma, who has been working on the seismicity of Delhi at the micro earthquake level for many years, since 1994 there has been a marked cessation of seismic activity. The stresses, which earlier were being released periodically, are now getting stored in the rocks like a spring. If the trend continues, then one day these stresses will be released suddenly, resulting in an earthquake of considerably high magnitude. This seems long overdue. The magnitude of the earthquake will depend upon the amount of energy stored in the rocks. The following table lists down the various earthquake events felt in and around Delhi during the period 1992-94, as recorded by various observatories.

Geology and Tectonics of Delhi and the surrounding region

The Delhi region forms the northern most part of Aravalli ranges, which are composed of rocks belonging to Aravalli and Delhi Supergroup. The Aravalli group consists of phyllites, limestones, quartzites, conglomerates and volcanic which are dated at 2000-2500 m.y. These are resting on the basement belonging to the Bundelkhand granite (2500-2650 m.y.). The rocks belonging to the Delhi subgroup mostly consisting of Ajabgarh and Alwar series, and are much younger (1600-2000 m.y.). They are composed of various types of schists, gneisses, marbles, biotite gneisses and quartzites. The rocks exposed near Delhi belong to the Alwar series of Delhi Supergroup. Although these groups of rocks are fairly well exposed in Delhi, the surrounding region is covered mostly by Gangetic alluvium. The basement depth increases sharply towards NE of Delhi and may be as much as 100m near Meerut. However, the basement around Delhi is generally undulating.

Seismic Zoning

The study of relationship between intensity scale and seismic zoning explains that the region with intensity less than V is designated as Zone 0. Thus the designation of area as Seismic Zone V indicates very high seismic activity. Delhi is located in Zone IV that has fairly high seismicity, with probability of the general occurrence of earthquakes of 5-6 magnitude, a few of magnitude 6-7 and occasional incidents of 7-8 magnitude shocks.

The study of local small earthquake events shows a good correlation of seismicity with major fault zones. The seismicity near Rohtak is caused by a fault zone / high gravity of the Aravalli.

Delhi owes its seismicity to two geological features, *the Delhi Hardwar Ridge, and the Central Himalayan Seismic Gap (Delhi - Moradabad faults)*, both having the potential of generating earthquakes of magnitude upto 6.7.

Delhi - Hardwar Ridge

The ridge enters Delhi from the SW. The eastern part of the ridge extends up to Okhla in the south and disappears below Yamuna alluvium in the NE on the right bank of the river. The exposed rocks of Delhi are mainly quartzites with moderate folding.

Much of the seismicity around Delhi appears to be associated with the Delhi-Hardwar Ridge. The Delhi-Hardwar Ridge constitutes an important tectonic block between 28° to 30° N and 76° to 79° E with a NE-SW trend. This feature seems to mark a dividing line between the Indus river system to the west and Ganga-Yamuna basin to the east. It coincides with the extension of the Aravalli Mountain Belt beneath the alluvial plains of the Ganga Basin to the northeast of Delhi towards the Himalaya mountain belt.

The Delhi Hardwar Ridge is not the only transverse feature present in NW India. Another fault zone that crosses Delhi and appears to be active is the Moradabad fault. This and the Tihar fault passing through Mathura and Moradabad are likely to be active and might have caused a few earthquakes.

Tall buildings founded on deep alluvial deposits can be vulnerable to even long distance earthquakes due to resonance effects. The detailed information on the depth of bedrock in Delhi region is not available. GSI reports mention that the bedrock depth is not available. The Geological Survey of India reports mention that *the bedrock depth is 60 m in the Patel Road Area, 15m in Cannught Place Central Park, and 40-50 m near the Aurobindo Marg - Hauz Khas area.*

Soil Considerations

Not only the settlement pattern, but also the geological characteristics, such as depth of alluvial soil, plays crucial role in determining the magnitude of risk. All the areas east of the Yamuna i.e. East, Delhi, the Naraina-Patel Road section and the Yamuna River-bed section, extending till Noida and Faridabad, are more vulnerable to damage even by a moderate earthquake since they are on alluvial soil up to 200 m deep. These regions face a very grave problem of soil liquification during an earthquake. Moreover, earthquakes are amplified by alluvial soils. The Ridge is comparatively safe as it has a rocky soil. According to Prof. Verma, if the epicentre is within 30 km of Delhi, then even an earthquake of 4 on Richter scale can cause a lot of damage.

The three regions in the capital, which are more prone to damage, are as follows:

Trans Yamuna:

This region has seen a lot of growth in the last few years. The biggest problem facing this area is that of soil liquefaction. Lately it has seen the coming up of tall structures like the scope complex.

Chandni Chowk Area:

Most of the structures in the area within the ancient walled city of Delhi have already been declared unsafe and are in a state of decay. The fire Department has also acknowledged this area to be fire prone. Since it is one of the most densely populated areas in the city, even an earthquake of moderate intensity can spell disaster.

Urban Villages (Lal Dora):

All the structures in the Lal Dora pockets all over Delhi face the danger due to their non-engineered nature. Moreover, due to the weak economic status of the residents, the construction techniques used are very poor and practically no earthquake resistant measures are employed.

Concerns and Issues

- ◆ Delhi, which lies in seismic zone IV and is seismically vulnerable, is currently experiencing mild seismicity. An issue of concern today for the development managers and citizens is that many scientists have forecast a major seismic upheaval of a magnitude of 8 or 9 on the Richter scale in North India that was once considered hypothetical. Considering the areas affected during past earthquake of M - 6.5, it can be expected that such an earthquake occurring in Delhi could adversely affect the whole of it with damaging intensities and affect more than 50% of the Delhi Metropolitan Area. Therefore, in terms of probable damage scenario, earthquake would be the worst natural disaster Delhi could have.

- Keeping in view the forecast of a major earthquake, it has become imperative to size up the earthquake scenario of the city and to increase the awareness about the use of earthquake resistant techniques.

So far as housing is concerned, vulnerability analysis has never been carried out and preliminary estimate of possible damage is not available. The management measures in earthquake related disasters mainly cover actions to minimize structural damage and preparedness for rescue and relief. In India, the possibility of occurrence of an earthquake of even a medium scale spells disaster of a formidable proportion, but since no major urban earthquakes have been experienced, the concern regarding this is not very visible.

- The city's settlement pattern has never been viewed in relation to location and geological characteristics. Pockets with high rise buildings or ill-designed high-risk areas such as squatter settlements come up without specific consideration on earthquake resistance. Similarly, unplanned settlements with sub standard structures are also prone to heavy damage even in moderate shaking. The Central Business District - Connaught Place, numerous District Centers and the sprouting high rise Group Housing Schemes are high-risk areas due to their sub standard structures and high densities.

Fire Risk In Delhi

In Delhi there has been a substantial increase in population and industrialisation, since independence. The Master Plan for Delhi has been created as an instrument to control the use of land and protect the welfare of people. The concept of zoning has not yielded desirable results over and above allowing for mixed use and occupancy, authorized as well as unauthorized. Banquet halls in residential areas, cottage industries in congested areas, trade of hazardous chemicals from the highly congested commercial/residential areas, hazardous and non-hazardous industries in close vicinity are illustrations of the deteriorating condition. These have certainly added to the fire risk already inherited the city. As a result, losses due to fire are increasing to both the life and property. This is a dangerous trend.

The Delhi Fire Service is providing coverage to the entire National Capital Territory of Delhi having an area of 1484 Sq. Kilometers with a population of 10.83 millions approximately. The fire units are sent to tackle the incidents irrespective of the fact that the area is under the control of which authority (like MCD, DDA, NDMC and Cantonment Board etc). The Delhi Fire Service is comprised of 36 fire stations and maintained a fleet of total 291 fire fighting and other supporting units.

The Uphaar tragedy of 1997 that claimed 58 lives has not faded from our memories. Zoning and Mixed Use Planning is a vital part of urban design. However, it can fail through abuse, misuse and resistance to change in urban pattern. The price being paid is high. The recent fire incident data, as provided in the table, can give a clear assessment of the fire incidents in Delhi and their increase.

Detail of total fire calls and loss in Delhi

No.	Year	No of calls	App. loss (lakhs)	Property saved (lakhs)	injured	Deaths	Medium	Serious	Major
1	94-95	13334	4620	7144	1397	318	19	5	0
2	95-96	15519	5787	6493	1504	389	16	6	1
3	96-97	14866	4989	8190	1704	398	18	4	0
4	97-98	14254	2439	10389	1967	399	15	6	0
5	98-99	15455	2170	5547	1495	375	22	6	0

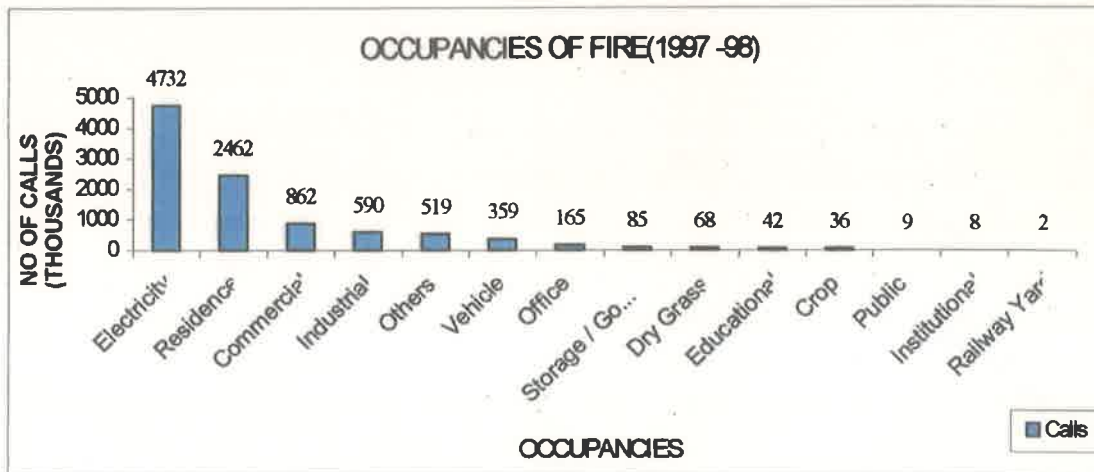
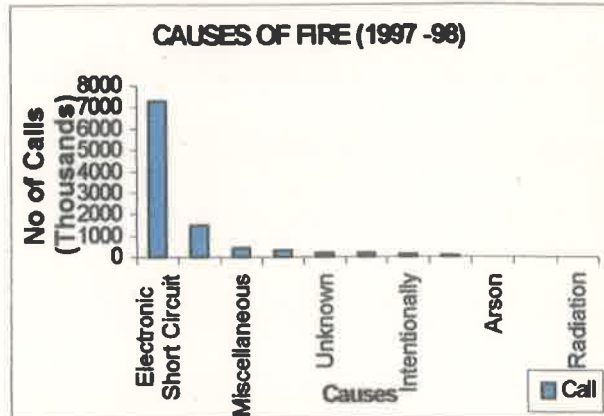
Earthquake induced fires

In the event of an earthquake striking, fires can be expected to break out at a number of locations simultaneously. They will spread fast in congested areas and informal settlements with high content of

combustible material. The problems, due to which fire department are not able to attend most of the fires are: poor communication, blocked roads, heavy traffic, lack of personnel, and lack of water - many water pipes would have ruptured, cutting off supply, and many fire hydrants are out of service even before the earthquake.

Causes in 1997-98

Electric Short Circuits	7268 (73.13%)
Carelessness	1466 (14.57%)
Miscellaneous	387 (3.89%)
Naked Flame	288 (2.89%)
Unknown	166 (1.67%)
Spark / Mechanical Heat	160 (1.69%)
Intentional	109 (1.09%)
Crackers	59 (1.69%)
Arson	16 (.34%)
Children Playing with Fire	0 (0%)
Radiation	0 (0%)



Though the numbers of calls have only marginally increased, numbers of deaths have increased by a greater margin. The basic reason is that deaths are not as much due to burning but more because of inhalation of toxic fumes, which get concentrated in high density areas with less open space. There is lack of circulation / ventilation within tenements. In industrial areas there is disrespect for the safety measures required and hence large number of deaths or injuries due to fires occur. Safety codes are totally neglected and there is lack of awareness amongst workers regarding their safety rights.

Occupancy Wise breakup

Year	J.J.Cluster (No. of huts)	High Rise	Industrial	Residential	Others
1989	168(5856)	158	422	1571	3924
1990	180(5856)	138	489	1760	4357
1991	150(10202)	150	475	1604	4880
1992	168(9634)	128	516	1785	5853
1993	163(4557)	173	458	1882	4950
1994	150(5639)	113	602	2139	5809
1995	173(5277)	72	655	2240	6640
1996	130(2891)	75	767	2606	7734
1997	1159(1985)	87	653	2681	7646
1998	108(5820)	87	590	2462	7081

Number of fire incidents in JJ Clusters / High - rise buildings indicates reducing trend while fire incidents in industrial and residential areas have increased. One of the reasons for such increase is that industrial areas have started hosting non-confirming industries and residential areas have become havens for illegal storage and hazardous commercial activities.

The maximum percentage of calls of fire incidents has been received from Shahadra (East Division), Janakpuri (West division), Moti Nagar (Northwest), Cannaught Circus (Central), Rop Nagar and Nehru Place in South Delhi. The reasons are congestion and illegal storage of recycling material and chemicals.

2.3 Emergency Response Capability and Legal Environment

Facilities Available in Delhi for fire fighting

Sources of Water for Fire Service

The sources of water supply for the fire fighting are "Fire Hydrants and underground Water Storage Tanks". The capacity of these tanks is .1 to .15 million-liters, exclusively for fire fighting purposes. The water supply in the hydrants is restricted and water is available only for the few hours in the morning and evening. The Hydrants are also not the reliable means in the city on account of two reasons. One, the supply of water is intermittent (for limited hours) and two, because power failures are frequent. In case of an earthquake the situation will be tragic as the Static tanks that are the main sources of establishing water supply for the purpose of fire fighting will also become dysfunctional. There are about **7640 fire hydrants, 289 underground static tanks, two canals and one river** in the National Capital Territory of Delhi from which water is taken for the fire fighting. Periodic inspection of fire hydrants and underground static tanks are also carried out to ensure the supply of water.

Fire Stations and Fire fighters

The target was of setting up of 63 fire stations in the capital by the year 2001, the Delhi Fire Service has only **36 fire stations** as of now (2000). The total numbers of fire personnel are only 1700, who are all professionals in various ranks and work round the clock.

Access

Most of the areas in the city are approachable by the fire engines. Only certain parts in the city like walled city, squatter settlements and riverbanks are the areas that cannot be assessed by fire engines due to narrow lanes and dense population. In these areas fire service personnel lay down long lengths of fire fighting hoses (water relaying) with intermediate pressure boosting. The main problem is faced in dealing with squatter settlements/ J.J.Clusters and other unauthorised colonies

in which almost one-third population of the city lives. The areas, which face most frequent fire incidents, are PVC Markets, Sadar, Gandhi Nagar, J.J. Clusters etc.

Structure Status in Squatter Settlement

Type of Structure	% Squatter
Mud Wall and Thatched Roof	73.54
Temporary shell	10.5
Brick Mud Wall and Asbestos Roof	14.4
Permanent wall and Asbestos Roof	.13
Permanent Wall and Tin Roof	1.34

Zone wise percentage of calls in Delhi

Zone	1993-94	1994-95	1995-96	1996-97	1997-98	Average
East	20.63%	20.63%	23.40%	23.56%	22.76%	22.12%
West	14.21%	14.21%	14.27%	15.83%	15.84%	14.38%
North - West	37.05%	19.67%	19.67%	19.04%	18.28%	23.22%
Central	24.20%	22.72%	22.72%	23.33%	23.07%	23.73%
South	20.80%	19.85%	19.85%	21.27%	20.87%	20.67%

Legal Environment

Regulations regarding fire considerations in construction exist only for high rise buildings (Above 15 meter in height) and certain industrial occupancies. These are enforced as per Delhi Fire Prevention and Fire Safety Act, 1986, and rules thereunder. The detail of the Building Byelaws and Act are as follows:

Building Bye-laws

The Building Bye-laws were adopted and duly notified by the Delhi Administration of 23 rd June 1983. They have recently undergone revision. In the case of multi storey buildings, which are of more than 15-meter high and for special buildings the building schemes also need to be cleared by the Chief Fire Officer, Delhi Fire Service. The following additional information shall be furnished, in case of multi storeyed buildings, indicated in the building plans:

- a) Access to fire fighting appliances / vehicles with details of vehicular turning circle and clear motorable accessway around the building;
- b) size of main and alternate staircases along with balcony approach, corridor, ventilated lobby approach;
- c) location and detail of lift enclosures;
- d) location and size of fire lift;
- e) smoke stop door where provided;
- f) refuse chutes, refuse chamber, service duct, etc.,
- g) smoke exhaustor system if any;
- h) detail of fire alarm system network;
- i) location of centralised control, connecting fire alarm system, built in fire protection arrangements and public address system, etc.;
- j) location and dimension of static water storage tank and pump room;
- k) location and details of fixed fire protection installations such as sprinklers, wet risers, hose reels, drenchers, CO₂ installations etc.; and
- l) location and details of first aid and fire fighting equipment / installations

The Delhi Fire Prevention and Safety Act, 1986

The Act was notified by the Government of India through a Gazette notification on 12th December, 1986, and rules framed thereunder are in force from 2nd March 1987. This Act was promulgated "to make more effective provisions for the fire prevention and fire safety measures in certain buildings and premises in Delhi". The act provides for inspection of buildings and premises, measures for fire prevention and fire safety to be provided in buildings, power to seal buildings or premises, default powers to the Chief Fire Officer, and the procedure for filing appeal before the Appellate Tribunal. The provision under section 3 of act is applicable to the buildings whose minimum height are 15 metres. There are 220 multi - storied buildings, which were initially identified as buildings not having fire safety requirements as required under Building Bye-Laws. With the effort of Delhi Fire Service the number has been reduced from 220 to 86.

Specific Precautions against Earthquake induced fires

No specific measures are taken for earthquake induced fire safety. Fires in any kind of situation are dealt with according to the gravity of situation by mobilising different resources available with the fire department and other government agencies like police, health services, Municipal Corporation and other fire services under mutual aid scheme.

Issues

High population density, crowded streets, mixed occupancies, inadequate water supply, poor electrical services, unplanned siting of fire stations, encroachment are few examples of ineffective planning which is adversely affecting the fire response time in case of any disaster and in general also. Under the present circumstances, a response time of 3 minutes in urban areas and 5 minutes in rural areas is very difficult to achieve. Mobilising a large quantity of water to the fire scene is more difficult than the actual fire fighting.

The developmental activities are in full swing in the peri-urban zone with complete disrespect to environment and fire safety aspects due to absence of regulatory laws in these areas. In the coming time they will form a part of the city. Even as of today, there are numerous problems to deal with:

- Database and comprehensive evaluation of risks of each single area, its vulnerability to fires and available equipment, personnel and foolproof communication system is not available.
- Adequate resources for fire services and coordination with the cities is not there.
- Multiplicity of agencies with different objectives causes repetition and lack of responsibility. Coordination is missing.
- There is no interaction between the architects, interior designers, structural engineers and fire professionals. Inflexible regulations have neither helped nor will they help in future. Fire services are fighting a lone battle to get safety norms prescribed in the Building Bye-laws and getting the National Building code implemented.
- Fire services have been placed under the control of the local bodies in the constitution of India. It has been termed as law and order activity.

Medical Facilities

The Directorate of Health Services, Government of Delhi, MCD and NDMC are agencies entrusted with public health functions. Delhi Administration runs the general health services while MCD and NDMC provide maternal and child health and family planning services through child health centres. In addition, a strong private sector operates in the capital. The table given below shows the health facilities available in Delhi. As seen from the table, these are inadequate for a city of Delhi's size. In practice, however, the inadequacy increases manifold as these institutions often serve patients from neighbouring states also. Some super facility hospitals serve patients from all parts of the country. The facilities provided therefore become grossly inadequate for the resident population. Moreover, health facilities provided by the government have failed to keep pace with the rapidly growing population. The facilities have either not increased or the increase has been abysmally low in certain areas. This has made good health facilities almost inaccessible for the poorer sections of the population.

Lack of medical personnel and modern facilities are the bane of most government health establishments. In addition, the extreme apathy and red tapism involved nullify the need for emergency medical attention forcing people to seek medical help from private sources at a greater cost.

Medical Facilities

1	No. of Medical Colleges	4
2	No. of hospitals (1991)	81
3	No. of Dispensaries (1991)	653
4	No. of Registered nursing homes (1991)	107

5	No. of Registered Beds (1991)	20636
6	No. of Doctors (1990)	396
7	Area served per hospital (sq. kms)	18.3
8	Area served per dispensary (sq. kms)	2.27
9	Population served per hospital	115700
10	Population served per hospital and dispensary	49843
11	Population served per dispensary	14350
12	Hospital beds per 100 population	2.2
13	Population served per doctor	2833
14	Total expenditure 1991-1992 (Rs. In Lakhs.)	81915
15	Expenditure on health 1991-1992 (Rs. In lakhs.)	4936
16	Percentage on health (1991-91)	6
17	Per capita expenditure on health 1991-92 (Rs.)	50.73

Source: Delhi Environment Status Report, WWF, 1995

2.4 Agency Interviews

2.4.1 Indian Red Cross Society

(In Conversation with Shri S.C Gupta, Joint Secretary IRCS)

The Red Cross or the Red Crescent is a Neutral International Organization under the International Federation of Red Cross. Born out of conditions of war for the assistance of the people at large, over the Years its Role has expanded and modified from First Aid providers to larger humanitarian services and programmes for total rehabilitation even in India. Today it has a primary mandate for Relief under any Natural Calamity.

The Indian Red Cross Society is governed by the IRCS Act of 1920. In India, it functions as an autonomous body that is answerable to the Parliament under the Ministry of Health. The President of India is also the President of the Society.

It is a Voluntary Organization, which is an auxillary to the Armed Forces.

Communication Networking

The Red Cross being an international organization has the advantage of global networking and almost immediate response from across borders.

The first information is usually received from the State units, incase of a massive disaster even the IFRC can come forward with assistance without Appeal.

Equipped with satellite phone at the national and even in some of the states, the Red C capacity for setting up communications in every district for quick and efficient response emergency however the dist. Offices are badly equipped on there own.

Some countries like Bangladesh have excellent Public Address system, so it can also be need based communication systems.

Assessment

A needs assessment of the emergency situation is carried out with a team formulation from the district, state and if need be from the national headquarters. The District Collector is also the President of the District Branch of Red Cross and hence the time loss for mobilization is Minimal. Red Cross has a presence in 650 districts of India.

Inventory

The human resource available with Red Cross is primarily volunteer based with a record of individual specializations and associations that register with the Red Cross. Its staff in RD clinics and hospitals and member institutions across the country is on call for field operations.

Material and equipment is stored in 7 Regional Warehouses and 25 State Warehouses, exigencies can hence be looked after. The basic components are:

- Food Supplies
- Clothing and Shelter
- Medicines and medical equipment
- Logistics (transportation etc)

Community Participation and ownership is encouraged at the grass root level for their own supplies in areas frequently affected by disasters. Supplementary stocks are however provided by the Red Cross. Stockpile is based on experience in the region

Ad hoc Response

Emergency Response Units that work at the international level are not locally available in India. The Rapid Assessment is refined and the response substantiated over a period of time through regional or international help.

Red Cross is the first to respond and the first to withdraw in any Emergency situation as a general policy of the organization.

Membership and funds

Life Membership

Institutional Membership

The organization generates its own funds at all levels with little assistance from government or other bodies.

Training

Training in First aid and allied services for its members is not mandatory however govt. in states like Karnataka makes it compulsory for truck drivers to under go RC training before issuance of licenses. It is an internalized Disaster Preparedness and Mitigation Program. The dream project of a Central Training Inst. collapsed however the existing programmes held at state and national levels are held with good frequency and are 5 day capsules with 1 day field visit where they conduct a vulnerability and capacity analysis.

Training prog. are not standardised but specific to geographical needs; cyclones , landslides, drowning etc.

Drills are held but not as a regular feature.

Certification is done on completion of course and a recertification after 3 yrs then 5 yrs.

2.4.2 Ram Manohar Lohia Hospital

Super Speciality Hospital

(In conversation with Dr. S. K Sharma, Emergency control Room RMLH)

Introduction

Health in India is a State subject and therefore all medical and health services come under the purview of the state and not the Centre. Though there are 17-18 vertical programmes as they are called that are directly sponsored and monitored by the Centre like the Aids, Polio etc. The Centre however can issue only guidelines while actual planning/organization / leadership and implementation is looked after by the state, however at times of need state asks for central assistance.

Ministry of Health

Director General Health Services has a Dept of Emergency Medical Relief, which is the guiding body for emergency preparedness. EMR makes a Disaster Management Plan mandatory for all hospitals and a copy of it also lies with DGHS.

RMLH, Emergency Control Rm.

The Police Control Room near the ECR is the main source of emergency assistance calls. ECR also has an emergency no. of its own but that is seldom used for emergency assistance. They have a fleet of ambulances (4 are assigned for emergency only) that provide free services for all govt. servants and a nominal charge for others.

Ambulances are inadequately equipped and are either unassisted or manned by a nursing only. The emergency victims who come in are usually accompanied by the relatives or by the police as the case may be.

In case of emergency the concerned authorities to be intimated are:

The Head of the Institute

The Exchange, which contacts the stand by staff

The Nursing Staff

The primary means of contact is telephone however some paging facility is available; while the ECR is put on red alert with the ringing of an Emergency Bell.

Hospital Disaster Plan, is available but not known to the staff on duty.

Team, no defined Medical Team formulation but there is essential attendance from specialists like anaesthetic, surgeon, neuro-surgeon, cardiologist, paediatric and orthopaedic etc. All HODs' and all hostel staff are on emergency call. 4-5 doctors are always on emergency duty at ECR.

Resuscitation and First aid, cardiac life support room available and other facilities include plaster and bandage at ECR.

First Report, prepared for every patient in the ECR, his contact address and immediate symptoms. No reporting from the ambulance that delivers the victim.

Referral, On a case to case basis victims are further referred to the various departmental specialities across the ECR.

Triage, No Patients that are referred to the various departments tagged, therefore no prioritization of handling is established, it is only first come first serve.

Patient Handling, transportation to the various depts. across is based on availability of staff and stretchers (20 available trolleys) however medico-legal cases are always accompanied by

Space Availability, There is a special 25 bedded Disaster Room on the 2nd floor across and all other hospital vacancies are available too. In case of mass casualty the large OPD hall can be vacated and its own activities shifted out. That could then be converted to bedded patient space. The waiting space outside the ECR is minimal.

Maintenance, of the building in totality for all services is done by the CPWD annually.

Training

No Special Training; basic training is part of their profession but no enhancement prog. carried out, particularly essential for the nursing staff and sometimes even medical doctors who do not know critical care components for spinal cord injuries etc.

No Dry Runs; drills and exercises exist on paper and but no annual rehearsals from emergency response. Being a VVIP listed hospital it has a prog. for emergency handling on every 26th January and 15th August with details of duty in-charges and facilities on standby.

Health Ministry grant for training exists but courses are few and the personnel who take them even fewer. These courses are theoretical and rarely practical.

Issues

- Professional management and co-ordination are the primary issues. There is a lack of a well defined standard operating mechanism and therefore a time lag exists for any response to reach the emergency victim.
- Training programme is weak, all service positions are headed on the basis of seniority and not on the basis of training undertaken.
- No accountability, even for the death of a patient.

2.4.3 Home Guards

(In Conversation with Col O.G Mehta, ASG HG)

Like the Civil Defense the Homeguards too are a voluntary organization that is a State subject with only monitoring and guidelines being issued by the Centre that provides reimbursement for raising training etc but as such no budgetary support.

It was an organization that came into being after civil disturbances in Mumbai in the year 1946 however was strengthened only after the aggression of 1962.

Unlike the CD it is an auxiliary to the Police and not the Defence and it works under normal circumstances needing no activation like the CD. Infact in some states its top cadre actually comes from the Police department itself.

Structure

Commandant General at the State level (drawn from the IPS)

District Commandant at the district level and also

Divisional commandants for various municipal divisions.

First yr. Training is basic (see copy)

Second, advanced and then

Third yr. Further.

Till the Company Commander level this is a voluntary organization.

Their recruitment can be for various activities it can even be for traffic management activities.

The tenure of a homeguard is 3-5yrs. And after which he is discharged or re-enrolled (then more training imparted).

Communication

They have no wireless and is usually informed and mobilized through the police channels. It generally the last priority for states with no compulsions hence like the state of Maharashtra is very well

equipped but any other might not be. NO wireless but volunteers contacted through telephones or as the word of mouth reaches them they respond for duty.

Training

There are Central Training Institutes in every State(see attached training structure) this can be combined with the Civil Defence or be Independent depending on what the state chooses to do. These are usually instructor training inst. That further provide staff for District Training Centers. Some personnel also take training at the national level inst. of fire and CD at Nagger. The CTI in Delhi is at Raja Garden and is actually combine with CD. (contact Mr. Vadhava Singh ph. 5168854)

Drills and Demonstration

No drill schedules but for awareness demonstrations are held.

Inventory

The organization has no equipment base, except basic pick, shovels, ropes and crowbars. It keeps a list of technical units that are personnel with special qualifications at the state level who can be equipped from various time consuming sources.

Team Formulation, no standard team formulation for emergencies infact management is dependant on the ingenuity of the Commandant.

2.4.4 Delhi Fire Service

(In Conversation with Chief Fire Officer Mr.Dheri, DFS)

There are 36 fire stations in the state of Delhi receiving on an average 15000 calls in a yr.

Emergency Assistance They are the primary first responders in case of an emergency on the telephone no. 100/101. They are within themselves equipped with wireless communication between all fire brigades, stations and control room with also have a small fleet of ambulances with them. They have a hotline with the POLICE and CATS.

Permanent contact with meteorological department is also under way.

Other Agency , the police is their main co-ordinating agency which cordon's off the area clearing the passage for their easy of movement. There is sometimes contact with the electricity board through the control room for assistance on site and there might be others too.

On-Site management, there is an officer In-charge his rank varies with the scale of the disaster and he is the co-ordinator.

He makes the first assessment and calls in for more help. There is actually a fire classification and accordingly the response is mobilized.

Apart from the brigade staff there is also a Water staff that is aware of all tank and water supplies of the area. They are called in incase there in a need to locally tap water supplies to douse the fire.

Equipment

Casualty Locating System, earlier thermal image camera were used for search now an endoscopic camera is used that can look through even layers of collapsed slab. Fire brigades vary in capacity from 4500-22000 litres capacity.

Maintenance

They have their own workshop in Moti Nagar and are independent in terms of vehicle maintenance.

Basic Safety

Personal safety equipment would be helmets, special clothing gum boots.

Training

(document in this regard available see)

National level institute is in Nagpur otherwise all state have their own inst. At the time of recruitment a 6 months training is provided. With every rank that a person takes he undergoes advanced training.

The Delhi Fire Service Training Centre, located at Moti Nagar, helps in improving the functional efficiency and performance of the DFS personnel with arrangements for running both short term and long term courses covering various aspects of fire prevention, management and use of specialised equipment. Intensive training in fire fighting is imparted to new recruits for six months all comprehensive from physical fitness to handling equipment and situations can be as varied as drowning etc. Refresher courses for the serving personnel and officers are also arranged at periodical intervals (once in three years). Elementary training in fire fighting is organised at the various fire stations on request from the concerned government, semi-government and private organizations for duration of 7 to 10 working days @ 2 hours daily. **There is no special training provided to fire fighters for earthquake management.** They learnt to tackle this type of situations in field duty itself.

Drills

Mandated to be conducted everyday but it usually happens on the day the station has full staff strength.

Media

There is a daily contact with the media a special line available for daily briefing.

Awareness Programmes are occasional held

Disaster Management Scheme

The scheme is to be finally initiated in all the 9 districts of Delhi. The trial is right now under way in the modal district at Nehru Place and is to be soon taken up in 2 other districts. There is a sanction of 11.4crores for the scheme to be taken up in 3 districts.

Under the scheme the DCP of the area is the Commandant and Controller of the station. It is a co-or effort of the Police and the Fire personnel who man the station.

Special equipment training. They use hydraulic and pneumatic based concrete breakers and air bags for lifting slabs.

They have a team which can be readily deputed to an emergency site. The Plan is not available right now.

2.4.5 Civil Defence

Divisional General Office, Ministry of Home Affairs

(In conversation with Col. J R Kaushik ADG, CD)

The Civil Defense organization came into existence after the war of 1962, when a need was felt to look into the interest of the Public when the country was at war.

The Parliament Act of 1968 established the organization at the national, state and dist. Levels.

National Level

Divisional General, Additional Divisional General office the organization who are deputed from army or other government organizations.

State Level

Director, Senior IPS officer

District Level

Controller, District Magistrate

Service Structure

This is a volunteer based organization that draws its membership from amongst the people themselves and all other concerned organizations for the assistance of people. It has little or no inventory of its own in terms of permanent staff or equipment. Hence acts more as an umbrella organization for resourcing out from all govt. and non-govt organizations.

It is mandated to perform 12 specialized services in times of need

1. Headquarters Service
2. Communication Service
3. Warden Service
4. Casualty Service
5. Fire Fighting Service
6. Training
7. Rescue
8. Depot and transport
9. Supply Service
10. Salvage Service
11. Welfare Service
12. Corpse Disposal Service

The District Magistrate activates the organization when the need arrives. The warden services at the level of each ward in the city/town and hence it has a wide reach. The manpower and equipment is then gathered for emergency response.

Training Pr

The National Civil Defence College, Nagpur is the national level inst. for advanced training for personnel of all age groups.

The states too have their own Central Training Institutes with the training activity also percolating to the dist. level.

These are 7 day courses with refresher course also available.

However one has to be enrolled as a civil defence volunteer first, they r usually ex-servicemen, college goers, NCC and even some of the schools are being tapped.

The organization can have a wide reach because its structure is such but for:

Awareness among people to come forward and enroll.

Shortage of funds for equipment and its sourcing out at the time of need from various other agencies leads to time loss. There are norms that guide the CDs' preparedness for a 3 lac population at all times which also does not get satisfied.

Standard Operating Procedure not tied up which is the basic reason for delay in responses.

Drills and exercises for demonstration are recommended but not mandated.

Therefore at the time of need instead of being a primary organization for search and rescue or first aid it manages to do relief operations.

2.4.6 All India Institute of Medical Sciences

(In Conversation with Dr. S.K Sharma, Medical Superintendent Officer, AIIMS)

The administrative functions are under the Medical sup. Office during day time and otherwise the Duty Officer from the Dept of Hospital Admin. Is incharge.

Profile is to co-ordinate and facilitate administration. The staff in this block is trained in management which is a 2 yr. Course after MBBS and is offered at AIIMS, Hyderabad and a few other places.

AIIMS is among the few Hospitals that maintains a full fledged admin section.

Its casualty is comparatively small to the frequency of such cases handled.

Disaster Management Plan: staff widely conversant with it. (see copy for details) The plan is reviewed informally after every major disaster situation. There is a formal team formulation.

Emergency assistance: the hospital does not have a fleet of ambulances and in case of only a major tragedy does it spare its small fleet of 6-7 ambulances which are otherwise used for referral . , call duty and employee emergencies only.

Agencies that alert the hospital for emergency influx are the Police and the Fire.

Emergency contact Senior doctors have cellular otherwise the hospital has an in-house pager service for group paging while the nursing staff (1700 nurse) in the hostel block have a conventional church bell to alert and ask for readiness.

The ward incharges would be asked to come on duty first in emergencies.

At times even the clerical staff and families of staff come forward with assistance of course this is not trained help but extra hands.

Space availability , since the space is less the OPD would be shifted out and a front desk set up. There are also 2 extra room which can accommodate 40-50 patients.

Triage is conducted at the 4 casualty and then the patients referred further.

Facilitation There are 18-20 Operations theatres located on the 8th floor and there are 6 lifts servicing. The relatives in an emergency would be asked to use the staircase. There is no ramp availability however the new IRCH centre has a ramp servicing all the way up.

First Report In case of an emergency papers are made later and the patient referred first. Later a medical Record Technician collects the relevant patient information.

Stockpile the store are full with supplies and in case of emergency. No indents needed to be made.

Other agencies, AIIMS has a strong staff strength and therefore though some volunteer base is attached, it is difficult to co-ordinate their activities and therefore these would be last priority for help.

Training

Doctors; emergency response is part of their profession but some amount of training is imparted particularly if new equipment comes into the market.

Nurse; they have CNE a continuing nursing education prog.

Odly Training, no formal training however at the time of recruitment those with RedCross first aid awareness preferred.

Training prog. are arranged as and when the need is felt, these are usually from within the massive medical staff on board. They also at times conduct these programmes for other agencies like the Punjab Health Services etc.

Drills

There are no emergency management drills as a normal day is packed however from time to time they have fire drills.

External Response; after the Gujarat earthquake the need was felt and therefore an external team formulation and its ready supply stock is being prepared.

2.4.7 Centralized Accident and Trauma Services

(In Conversation with R.L. Srivastav, Joint Secretary CATS)

This is an ambulance assistance in case of emergencies particularly for day to day traffic situations. It has 23 mobile stations that during peak traffic situate themselves at major crossings or important locations. Their primary objectives are :

- reaching the site of the accident as soon as possible
- to give first-aid and emergency management at site
- Quick and safe transportation of the patient
- Spread the knowledge of first aid to public through demonstration and publicity.

The no. of calls received in the entire year of 2000 was almost 26,000 with a response rate of 10-15 minutes and maximum 20 minutes at peak traffic.

Functioning

The Central Control Room is situated at Sushruta Trauma Centre at Metcalf Road near IP College where all calls are received 24 hours of the day free at no.1099 and 102. Calls are also received through Police Control Rooms (PCR) and Delhi Fire Service through wireless. The Central Control Room and the ambulance stations are fitted with wireless sets for facilitating two-way communication.

On receiving the call the ambulance station nearest to the site is activated and they assess and assist on site with ready back up available if required from other stations.

It works with a present budget of 3.5 crores with a staff strength of 203.

Present Fleet: The present fleet of ambulances consists of 25 maruti-omni staffed with the state of the art first-aid equipment and 2 paramedics who are trained in first aid, wireless communication and commercial driving. An addition of 10 more ambulances is on the anvil.

Equipment

Each ambulance has consumables like badages, splints (air or vacuum), suction pumps, oxygen tanks, stretchers (trolleys/scoop/canvas) however no IV fluid is provided.

Training

They have their own 6 months training programs which is also not recognized with refreshers only when new equipment is introduced. This can make them handle cases like bleeding control, fracture immobilization, oxygen requirements, CPR and Brain resuscitation, airway management and suction. They also hold Health melas and Public Awareness sessions.

Stockpile

The main consumables are stockpiled at permanent stations which would usually be nearby base station which could be a government hospital but the monthly stock is released from the Karol Bagh Store on demand.

2.4.8 Indian Medical Association

(In Conversation with Dr. Prem Agarwal, Honorary Secretary)

The IMA is a non-government organization with a socio-political standing. It has one headquarters in Delhi, 29 state branches and 1645 local/district offices across India. Its membership is open only to doctors and is entirely voluntary. It has a formal association with 80 other countries as well.

Objective of the association is to promote and advance the medical and allied sciences but with frequent disasters it acts as a co-ordinating body as well for medical response with its vast human, monetary resources and supplies. Infact in the aftermath of the earthquake in Bhuj it has set up a Disaster management committee for working out a standard operating Procedure in such eventuality.

Activities

This institution is also has an AKN institute of Advanced Learning with distances courses in: gediatrics, Environmental Occupational Health, TB and Chest Diseases and Reproductive Health.

It conducts camps for torture medicine, family health and HIV.

Medical journals are published by the inst. From its Calcutta branch.

In the recent past it has co-ordinated all medical health services from individual practitioners and organizations to the disaster hit state of gujrat

2.5 Profile of Training Institutes

2.5.1 National Civil Defence College, Nagpur

Is a premier institute of training at the National Level, in the year 2000 it held 24 courses with training provided to 602 people on regular courses and 460 in short term courses the no. stands at 33442 officers since inception. These are people from other government organizations and volunteer organizations apart from Civil defence itself.

The Courses cover a wide spectrum including:

Fire fighting, nuclear and biological warfare, Disaster Relief, Unexploded bomb Reconnaissance, Earthquake Preparedness, Civil defence, Communication, Camouflage , First Aid, Advanced Rescue, Civil defence Planning.

2.5.2 Institute of Fire Engineers, Delhi

A small-scale non-government organization it runs short courses that have not been recognized as such however is a personal effort of a retired fire officer for the training of his men. It publishes a technical journal on innovations in the Fire safety and practices field.

2.5.3 National Institute of Health and Family Welfare, Delhi

Under the Hospital Administration the institute conducts 2 three week courses in a year for senior hospital administrators in the government and Public Sector. The emphasis on disaster management is approach based with only a day dedicated to the disaster emergency management. It is elementary for contingency planning in case of disaster.

There are numerous agencies that exist as first responders, stand by responders like the Military, Railways, Civil defense, CISF, Municipal corporation, Police, Revenue, Irrigation, Road and Building Departments, Public Health Centres, Red Cross and local NGO's for first aid and search and rescue. However this is only a sample survey of a few of those agencies on a scale of 0, 1, 2 with;

0- implying no capability

1- not clear or little capability

2- fairly good

Criteria	Agencies ¹								
	DDMP	IRCS	IMA	RMLH	AIIMS	CATS	CD	HG	DFS
Availability of Emergency Medical Equipment & Supplies									
Basic First Aid Kit	2	2	2	1	1	2	1	1	2
Backboard	0	1	1	2	2	2	1	1	1
C-Collar	0	1	1	0	1	0	0	0	0
Splints	0	2	1	0	0	2	1	1	1
Basic Airway	0	1	1	0	0	2	0	0	1
Bag-valve Mask									
Suction Device	0	1	1	0	0	2	0	0	1
Defibrillator									
Oxygen Therapy Accessories	0	1	1	1	1	2	0	0	2
IV Supplies and Fluids	0	1	2	0	0	2	0	0	1
Capabilities of First aid Provider Teams									
Patient Assessment	1	2	2	1	1	2	1	1	1
Basic First Aid	2	2	2	1	1	2	2	2	2
Cardiopulmonary Resuscitation	1	2	2	1	1	2	1	1	1
Cardiovascular Emergency	0	1	2	0	0	1	0	0	0
Shock	0	1	1	0	0	1	0	0	0
Coma and Head Injury	0	1	1	0	0	1	0	0	0
Airway Management	0	1	1	0	0	2	0	0	1
Chest Injury									
Spine Injury	0	1	2	1	1	2	0	0	0
Burns	0	1	2	0	0	2	0	0	1
Dehydration Identification & Treatment	0	2	2	0	0	2	1	1	1
Poisoning Recognition & Treatment	0	1	2	0	0	2	1	1	1
Emergency Childbirth									
Team Personal Protection Equipment & Supplies									
Eye Protection	1	0	0	0	0	0	0	0	1
Respiratory Protection	1	0	0	0	0	0	0	0	1
Body Fluid Protection									
Bio-Chemical Contaminant Protection	1	0	0	0	0	0	0	0	1
Total Points (Highest=61)	37	57	41	15	16	61	31	34	53

- 1 DDMP - District Disaster Management Program
- 2 IRCS- Indian Red Cross Society
- 3 CD- Civil Defence
- 4 HG- Home Guard
- 5 DFS- Delhi Fire Service
- 6 AIIMS- All India Institute of Medical Sciences
- 7 RMLH- Ram Manohar Lohia Hospital
- 8 CATS- Centralized Accident and Trauma Services
- 9 IMA- Indian Medical Association

Table 2.6.2 : Delhi – Search and Rescue Preparedness

Criteria	DDMP	IRCS	CD	HG	DFS
Legislative & Regulatory Environment				None	
Designated Entity	2	2	2	2	2
Self-Regulation	1	2	1	1	1
Supervision	2	2	2	2	2
Training	2	2	2	2	2
Written SAR SOP in the Disaster Management Plan	In Process	None	None	None	None
Activation Plan					
Personnel Notification Plan					
Logistics Plan					
Communication Plan					
Reporting Timeframe to Staging Location					
Built-in System for Worker Rotation					
Community Relations & Participation Plan					
Communication & Dispatch System					
Wireless/Radio	2	2	1	1	2
Cell Phone System	0	0	0	0	0
Runner	2	2	2	2	2
SAR Teams Capabilities					
Structural Evaluation	0	0	0	0	1
Hazmat Monitoring & Evaluation	0	0	0	0	0
Victim Location	2	1	1	1	1
Victim Access	2	1	1	1	1
Victim Stabilization (medical)	1	1	1	1	1
Victim Extraction	2	1	1	1	1
SAR Team Composition	In Process	Not Clear	None	None	Not Clear
Search/ Recon Team Leader					
Licensed Structural Engineer					
Two Canine Specialists					
Technical Search Specialist					
Two Rescue Specialist					
Medical Specialist					
Hazardous Material Monitoring Specialist					
Collapsed Structure Team					
Team Leader/Safety	1				1
Runner					
Workers					
Rescue Squad					
Team Leader/Safety	1				1
Workers					

Criteria	DDMP	IRCS	CD	HG	DFS
SAR Team Response Time					
<i>Urban/Sub-Urban</i>					
< 30 minutes	2	1	0	1	1
> 30 minutes	0	1	2	1	1
<i>Rural</i>					
< 12 hours					
> 12 hours					
Search & Rescue Equipment & Supplies					
Human Resources	1	1	1	1	1
Canine	0	0	0	0	0
Technical Equipment/Devices					
Visual					
Audio	0	0	0	0	1
Building & Victim Marking Supplies	0	0	0	0	0
Hand Tools	1	1	1	1	1
Breaching Equipment	2	0	0	0	1
Hazmat Monitoring Equipment & Supplies	0	0	0	0	0
Sextant	0	0	0	0	0
SAR Team Personal Protection Equipment & Supplies					
Hard Hat					
Steel Toe Shoes	2	0	0	0	2
Leather Gloves	1	1	1	1	1
Eye Protection	2	1	0	0	2
Ear Protection	0	0	0	0	0
Dust Mask	2	1	1	1	2
Safety Vest	1	1	1	0	1
Long Sleeve Shirt	1	1	1	1	1
Long Pants	1	1	1	1	1
TOTAL	36	26	23	22	34

Table No.2.6.3 : Delhi- Hospital Disaster Preparedness

Assessment Factors	AIIMS	RMLH
Hospital Emergency Preparedness Plan		
Written Plan Exists	2	1
Accounts for internal risks	1	0
Appropriate for Regional Disaster Profile	2	1
Written Plan is Understood by Staff	2	0
Responsibilities/Tasks Have Been Identified	2	1

Assessment Factors	AIIMS	RMLH
Maximum Emergency Caseload has Been Determined	1	1
Drill has been Conducted	0	0
Triage Area has been Identified	2	2
Triage Tags Have Been Prepared	0	0
Clear Signage and Markings Exist	1	1
Essential Drugs & Supplies have Been Stocked	1	1
Emergency Food Stock For Staff & Patients Stocked	2	1
Hospital Staff Capabilities:		
Appropriate Triage ⁵	2	1
Fluid and blood resuscitation ⁶	2	2
Airway control and maintenance ⁷	2	2
Immediate surgical intervention ⁸	1	1
Cardiac resuscitation ⁹	2	1
Patient Safety ¹⁰	1	2
Staff Safety ¹¹	1	1
Hospital Earthquake & Fire Safety		
Hospital Physical Structure Earthquake Stabilized	2	1
Hospital Fixtures, Furnishing, Equipment are Anchored	1	1
Emergency Stockpile is Secure & Anchored	0	0
Fire Extinguishers are Visible and Functional	1	1
Unobstructed and Clearly Marked Fire Exits	1	1
Hospital has Independent Water Supply Source	1	1
Hospital has Adequate Power Backup System	1	1
Capability¹²		
Has Hardwired Communication System	2	2
Has Pager System	2	1
Has Cell Phone System	1	1
Has Radio Communication System	0	0
Has Intercom & Loudspeaker System	1	1
Monitoring and Evaluation		
Drills evaluated	0	0

⁵ Ability to screen and identify patients who need care now but are not hopeless.

⁶ Ability to recognize shock, knowledge of crush and burn treatment.

⁷ Ability to recognize ventilation and/or oxygenation difficulties and perform airway maneuvers, intubations. Supplies are at hand.

⁸ Ability to recognize and intervene in tension pneumothorax, sucking chest wound, cardiac tamponade, ability to get patient rapidly to OR for thoracotomy or laparotomy. Blood available stat.

⁹ Ability to recognize and treat cardiac arrhythmia's, cardiac shock and CHF. Equipment and drugs are at hand.

¹⁰ Proper handling of contaminated materials, hand washing, sterile technique, proper blood transfusion precautions and patient identification, knowledge and observation of C-spine precautions. Enough well trained staff to assist in the above, who can recognize patients who are deteriorating in the emergency department and after surgery

¹¹ Barrier technique, proper sharps handling

Assessment Factors	AIIMS	RMLH
Disaster specific response effectiveness assessed	1	0
Emergency Medical Capacity assessed	2	1
Overall Score	43	31

3. Maharashtra

3.1 Profile

The dominant physical trait of the state of Maharashtra is its plateau character. The state is covered by the Satpura range on its northern side while Ajanta and Satmala ranges run through the central part of the state. The Arabian sea guards the western boundary of Maharashtra with a coastal line of 720 kilometres. Gujarat and Madhya Pradesh form the state's boundaries on its northern side with the latter also covering the eastern region while Goa, Karnataka, and Andhra Pradesh are on the Southern side.

The state receives its rainfall chiefly from the southwesterly winds. Normally, there are heavy rains in the coastal region (around 2000 mm), scanty rains in the rain-shadow regions in the central part (around 500 mm) and medium rains in the eastern part of the state (around 1000 mm).

Basic Statistics of Maharashtra

Area (sq.km.) :	3,07,713
Number of administrative divisions :	6
Number of districts :	31
Number of talukas :	325
Number of city and town units :	336
Number of inhabited villages :	40,412
Total population (census 1991) :	78,937,000

Maharashtra is the country's leading industrial state, accounting for 23 per cent of the gross value output from the industrial sector. Its main areas of strength are textiles, pharmaceuticals, petrochemical industries, heavy chemical industries, electrical automobile industries, engineering and food processing. The state is a leading manufacturer of three wheelers, jeeps, synthetics, cold rolled steel products, industrial alcohol and plastic. Around 30 per cent of the sugar output of the country is from Maharashtra.

3.1.1 Mumbai Profile

Greater Mumbai Metropolitan area is divided in to 2 revenue districts viz Mumbai city District and Mumbai suburban District. It has an east to west extend of about 12 km. where it is broadest, and a north - south extend of about 40 km. Geographically speaking, Greater Mumbai is an island outside the mainland of Kokan in Maharashtra separated from the mainland by the narrow Thane Creek. Its height is hardly 10 to 15 meters above sea level The importance of Greater Mumbai is also apparent from the fact that it supports a population of about 9.9 million sharing 12.57 per cent of the population of the State (as per 1991 census) with sizeable day-time floating population from places like Thane, Nashik, Raigad and Pune districts.

Each ward is under the administrative control of a ward officer. There is a Municipal Commissioner along with the Mayor-in-Council to oversee the activities of the BMC.

There is a police commissionerate for the entire BMC area headed by the Police Commissioner with the headquarters at Crawford Market. The BMC area is further divided into seven police zones. The traffic commissionerate headquarters is located at Crawford Market and there are seventeen traffic divisions in Mumbai.

The fire brigade is established under the BMC act, and has its headquarters at Byculla. There are in all 24 fire stations in Mumbai.

Mumbai suburban district (area in sq. km & percentage)

Inhabited area	53.84, 79.45 % 277.5, 75 %
Agricultural area	Nil 18.5, 5 %
Industrial area	13.5, 19.9 % 41.0, 11.69 %
Forest Cover	0.4543, 0.7 % 33.0, 8.31 %
Wastelands	Nil Nil
Total	67.79 square kilometers 370 square kilometres

Backbay and Bandra reclamation are the major reclamation areas of Mumbai in the Arabian Sea.

Geology and Geomorphology

The entire Greater Mumbai area is occupied by Deccan basalt flows and their acid and basic variants, poured out between the late Cretaceous and early Eocene times. The basaltic flows are horizontally bedded and are more or less uniform in character over wide areas. Certain extrusive and intrusive mafic types are associated with basalt's and are found in the Mumbai Islands and its vicinity. Furthermore, some fossiliferous sediment, mainly of tufaceous origin and partly of fresh water origin, rich in fauna, is also found in Mumbai area.

Climate and Rainfall

BrihanMumbai receive rains from southwest monsoons, which commence usually in the first fortnight of June and last till the end of September. Pre-monsoon showers are received in May.

In Mumbai city district, the average maximum temperature is 31.2 degree Celsius, while the average minimum temperature is 23.7 degree Celsius. The average total annual rainfall is 2146.6 mm. The maximum annual rainfall was recorded in 1954 at 3451.6 mm. The climate of the Mumbai Suburban District is tropical martin.

Socio-Economic Features

During last 35 years there has been a continuing shift of population from Mumbai city District to Mumbai Suburban District and now further to part of Thane District.

Demographic Features

According to the 1991 census, the demographic features observed in Greater Mumbai are as follows:

Total number of households	: 2,051,000
Total Population	: 9,926,000
Urban Population	: 9,926,000
Population density	: 16,461
Slum Population percentage	: 74 per cent

Power stations/Electrical installations (receiving station)

The electricity requirements of Greater Mumbai are met by the Tata Hydro-Electric system through three distribution agencies, they receive the power at their 35 receiving stations and distribute the same through the network of 1706 substations and HV & LV underground cables.

Industries

Types of Industries: Engineering, Printing, Garments, Plastic, Textiles, Chemical Oil Installation etc.

Extent of Industrialisation	City	MSD	MIDC
Number of Industrial Estates:	77	336	470
Number of Chemical Industries / tank farms	41	338	--
Total work force in Industries	1,77,779	2,82,062	50,000
Number of pipelines carrying chemicals.	1	29	--
Number of potentially hazardous locations.	8	21	--
Number of vehicles carrying hazardous : raw materials for industries (during a month).	334	502	--
Number of vehicles carrying hazardous : finished products from industries (during a month)	33099	24599	--
Number of container terminals:	1	2	

It is reported by the Director of Industrial Safety & Health, Mumbai that the major types of hazardous chemicals and hazardous finished products transported are: (1) Chlorine, (2) Ethylene Oxide, (3) L.P.G., (4) Motor Spirit, (5) Superior Kerosene Oil, (6) Methanol, (7) Ammonia, (8) Hexene, (9) Naptha, (10) Propylane, (11) Butadiene, (12) Styrene.

Water Supply and Sanitation

There are two rivers in Greater Mumbai, Dahiser River and Mithi River. The Dahiser River originates at Kanheri caves and meets Gorai creek. Similarly the Mithi River originates at Vihar and meets Mahim creek. Over flow of Vihar, Tulshi and Powai lakes go to Mithi River. There are no rivers in Mumbai City District.

There are three dams in Mumbai Suburban District. All the above three dams are impoundage on lakes. Mumbai receives its water supply through these dams and other dams located in Thane district.

Solid waste dumping sites are located at Deonar, Mulund, Malad and Gorai. BMC has focused its efforts to provide the basic amenities like water, toilets and electricity in authorised slum colonies but still large proportion of population is staying in unauthorised slums and these basic amenities are very rare in such slums. All the slum colonies whether authorised or unauthorised are vulnerable to floods, health hazards, fires and cyclones.

Transport and Communication Network

Mumbai has three entry and exit points at Mankhurd, Dahisar and Mulund with octroi check posts at each point. The main road stretches are the Eastern Express Highway from Sion to Mulund leading to NH-3, Western Express Highway from Bandra to Borivali leading to NH-8, and Sion-Panvel road leading to NH-4 and NH-17.

Surface Transport

The main modes of transport are through the mass transport provided by Central Railway (from CST to Khopoli and Kasara on the main line and Panvel on the harbour line), Western Railway (from Churchgate to Virar) and BEST buses within BMC limits and upto Navi Mumbai and Mira Road which are outside BMC limits.

Waterways

Recently, hovercraft services and ferry services have started operating during the non-monsoon period from Gateway of India to Navi Mumbai, Uran, Alibag, Rewas and Juhu.

Air Travel

The international airport is at Sahar, which on an average has 4 million passengers alighting and departing in a day.

The domestic airport is located at Santacruz, which on an average has 4.2 million passengers alighting and departing in a day.

3.1.2 Pune profile

Pune District is one of the districts in the Pune Division. It is located at 17° 5' and 19° 2' north latitudes and 73° 2' and 75° 1' east longitudes, covering an area of about 15621 sq. kms. Pune district is bounded on the north and east by Ahmednagar, on the south by Satara, on the west by Raigad, on the southeast by Sholapur and on the northwest by Thane district of Maharashtra.

Pune district covers an area of 15621 sq. kms. The district is divided into fourteen administrative subdivisions (tahsils). They are Pune, Haveli, Khed, Ambegaon, Junnar, Shirur, Daund, Indapur, Baramati, Purandhar, Bhore, Velhe, Mulshi and Mawal. Shirur is the largest Tahsil with an area of about 1557 sq. kms, while Pune Tahsil is the smallest one with a span of 184 sq. kms. There are 34 towns and 1768 villages in Pune district.

Salient Physical Features & Land Use Pattern

Pune district has three natural divisions based on topographical features: the hilly area comprising of the Sahyadri mountain ranges, the basaltic plateau and the river valleys. The western end of the plateau is comparatively at a higher level than the eastern part. The fertility of the soil increases as one moves from west to east. Red, black and brown colored soils are found in the district.

Occurrence of evergreen forest in small patches has been observed in Ambegaon, Khed and Mulshi tahsils in the Western extremity of the Pune district. Deciduous forest is spread in large areas of the Western part of the district. Degraded forests have been delineated within the deciduous forests.

Small patches of gullied/ravinous land have been observed near the Nira river in Indapur tahsil. Large areas of wasteland categorised as land with or without scrub are scattered all over the district.

- The land use categories of Pune district are given below.

Land Use Category	Area in Hectares	% of Geographical Area
Built-up Land	6350	0.41
Agricultural Land	1007429	64.49
Forest Land	119344	7.64
Wasteland	253494	16.23
Water bodies	32693	2.09
Others	142790	9.14
Total	1562110	100.00

Climate & Rainfall

- The climate in Pune district is very pleasant. It is cooler on the western side, even though the eastern parts of the district are mostly dry and hot. The temperature varies from a minimum of 9.6° C to a maximum of 39.8° C.

- The average annual rainfall received at various places in Pune district show a remarkable variation. In general, the rainfall increases as one moves from east to west. Velhe receives the maximum average rainfall of 2809 mm while Daund receives the lowest rainfall of 465 mm.

Socio-Economic Features

- The total population of Pune district is 55.11 lakhs as per the 1991 Census. This constitutes 6.98% of the total population of Maharashtra. The rural population constitutes 49.24% while the urban population accounts for 50.76% of the population. The male and female population constitutes 51.65% and 48.35% respectively.
- Pune is the most densely populated tahsil with a density of 9389 persons per sq. km. While Shirur tahsil is the most sparsely populated with a density of only 152 persons per sq. km.
- There are four major and two medium irrigation projects irrigating 1,05,000 ha. And 6,000 ha. Respectively.

Economic, Social, Educational and Occupational Profile of the Population

The total area of Pune District is 15642 sq.km. which is about 5% of the total area of the state. The total population of the district according to 1991 census is 5583 lakhs, which is 7% of the total Population of the state. The Population density is 354 persons per sq.km. This drops to 181 in rural areas and is as high as 4520 in urban areas. Out of total population 49% lived in rural areas.

Adult literacy campaign since 1979. Before that 6,84,510 adult between age group 15-35 were illiterate. The literacy level in the district is 71 %, which is higher than the state average of 65%. In March 95 there were 5501 literacy centres functioning and 2,46,707 adults were on the roll. Out of 2,46,707 adults 2,31,611 adults have secured 70% of marks. Out of 71% literacy level 81% in urban and 61% in rural. The literacy percentage of woman was 60% and 82% of Make.

Upto end of Dec. 1994 there were 2817 Industries/Factories in the district out of which 2577 industries were waking which employed a total of 1,65,490 Markers.

During 1993-94 there were 3883 Primary schools in the district and 782 lakh students were taking education in the institution.

There were 669 secondary and higher secondary schools in the district in 1993-94. 5-24 lakhs were taking education in Pre Secondary, Secondary institutions.

There are 49 higher education institution out of 10 engineering College, 4 Medical Colleges, 9 Law Colleges, 9 B.Ed, 15 D.Ed. College where in 97048 students were taking education.

Seasonal Migration

Purpose	Area (specify Talukas)	Period (calendar months)	Estimated population in/out migration
Shepherd	Mulshi	Sept. To Dec.	500 To 700
Sugar Cane Cutting	Shirur	Oct. To April	4000 To 5000
Sugar Cane Cutting	Junner At Dhalewadi	Dec. To Feb.	1500 To 10000
Sugar Cane Cutting	Patas Village	Nov. To April	4700
Sugarcane	Indapur	Oct.To April	2000
Sugar Cane Cutting	Ambegaon(550 Hectors)	Sep. To May	550
Baramati		Oct. To April	3500 To 5500

Agriculture & Cropping Pattern

- Agriculture is the main land use in all tahsils except Pune where the area under cultivation constitutes the major land use category covering about 60% of the total area. The western tahsils of Velhe, Mulshi and Mawal have more forest cover than the other tahsils.
- Cereals dominate the crops in all tahsils except Bhor, Velhe, Mulshi and Mawal.
- The eastern part of Pune district has more area under cultivation than the western part. Large patches under Kharif crops have been delineated in Baramati, Shirur and Junner tahsils. Availability of good irrigation facilities in the area has enabled widespread practice of double cropping along the Nira river forming the Southern boundary of the district, as well as along the Bhima, Mula and Indrayani rivers.
- The bovine population is highest in Khed (1,17,782) followed by Junner (95,547) and is lowest in Pune (12,859). The cattle population is highest in Baramati tahsil with 1,93,844 cattle, closely followed by Indapur, with 1,90,891 cattle and is lowest in Pune with only 24,353 heads of cattle.

River Systems and Dams

- Bhima is the main river of Pune district. It originates at Bhimashankar in the Sahyadri mountain ranges due west of Pune city. The general course of Bhima river is north-west to south-east. It enters Sholapur district after passing through Pune.
- Mula, Mutha and Indrayani on the southern side and Ghod and Vel on the northern side are the main tributaries of Bhima river in Pune district.
- Apart from these rivers, Aria, Goheri, Mina, Ganjauni and Nira are some of the smaller rivers flowing in Pune district.
- The drainage pattern is dendritic.
- Almost entire area of Pune district falls under the Bhima river basin. The only other river basin in the Pune district is the Godavari river basin which covers a very small area constituting about 1% of the total geographical area in the northern part.
- The Bhima river basin is subdivided into 65 watersheds, each covering an area of about 150 to 200 sq. kms.
- Vyankojisagar lake built on the Bhima river on the district boundary in Indapur tahsil is the largest reservoir in Pune district. Besides this, the Bhatghar lake in Bhor tahsil, the Khadakvasla lake, Ghod reservoir built on Ghod river in Shirur tahsil, Andhra lake on Andhra river in Khed tahsil are the major reservoirs delineated in the Pune district.
- Many smaller tanks have also been delineated, many of which are in Baramati, Shirur and Khed tahsils. These smaller tanks are mostly seasonal.

Industries

Extent of Industrialization

Number of Industrial Estates/Areas	16
Types of Industries	Engineering, Chemical, Agro., Electronics, Foods, Plastics, Water Purification, Defence Ordnance Etc.
Total work force in industries	2,20,000
Number of Chemical industries	384
Number of pipelines carrying chemicals	2
Number of potentially hazardous locations	37

Transport and Communication Network

Particulars	Nos.
No. of National Highways	03
Length (in kms.) of National High Ways	364
State High ways (in kms.)	1417
Z.P. Road (In Kms.) (MDR+ODR+VR) (2566 + 2167 + 4550)	9303
No. of bridges on Rivers : Major	116
Minor	606
No. of S T Depots	36
No. of villages not accessible by S.T.	(+)10
No. of Ports and Jetties	Nil
No. of boats Launches	21
No. of Railway Stations with Mail/Express halts	15
No. of bridges	(.) 2
Non Electrified railway Routes (In Kms.)	(+)140
Electrified Railway Routes (in Kms)	311
No. of unmanned Railway Crossing	---
No. of Air Ports / Air Strips.	01

3.2 Vulnerability Assessment

3.2.1 State's Vulnerability

Earthquakes

The state of Maharashtra and its adjoining areas form part of the peninsular shield of India. Maharashtra occupies the central-western portion of peninsular India, technically an intra-plate continental area. Most of Maharashtra is covered by the deccan traps, a sequence of basalt flows placed about 65 million years ago. In most of the area, these flows are nearly horizontal, demonstrating that tectonic deformation accumulated is very little or nil. Though this area was treated as seismically stable with no potential for disastrous earthquakes, this belief was shattered by the Koyna earthquake of December 11, 1967, with magnitude of 6.5 on the Richter Scale. Recent Latur earthquake of September 30, 1993, having magnitude 6.4 which occurred well within the central part of the shield led to a review of the seismic activity in the stable shield zone.

Thus, tectonic stability in the deccan plateau may appear to be inconsistent with the observed level of seismicity. This apparent contradiction reflects the primitive stage of knowledge about seismogenesis in stable continental region, and is the root problem in the assessment of an earthquake. Thus the potentially active tectonic features which could produce earthquakes with engineering consequences need to be studied.

It may be noted that stable continental region worldwide are characterized by a very large number of unknown faults that can at some point produce an earthquake. Many of these faults may be located in areas that have low or no seismicity and are technically stable.

Maharashtra and adjoining regions are prone to earthquakes of moderate magnitude as can be seen from the experience of several years. Koyna region experiences the maximum number of tremors in Maharashtra. Excluding the Koyna region, and other regions of Killari, Khardi (Bhatsa) and Medhi (Surya), the state has been rocked by 137 earthquakes of which 121 earthquakes of magnitude about 3.0 or above are in Maharashtra and 16 are in the adjoining regions.

- Earthquakes in Maharashtra show major alignment along the west coast and western ghats region. Seismic activity can be seen near Ratnagiri, along the western coast, Koyna Nagar, Bhatsa and Surya areas of Thane district.

- The north - south trend further continues deep inside Gujarat. The striking characteristic of this narrow region is its alignment with the hot spring belt. It appears that the off - coast activity is associated with submerged faults along the west coast of Maharashtra.
- In north Maharashtra, the seismic activity near Dhule, Akola, Jalgaon and Amravati could be due to movements on the faults present in the area associated with the complex system of Narmada, Tapi and Purna lineaments. However, the exact seismic status of these lineaments needs to be evaluated with extensive monitoring.
- In north - east corner of Maharashtra, the earthquake activity in Nagpur and Bhandara districts may be associated with Deolapar thrust or sheared and faulted zones of Ramtek and Sakoli Basins. This needs to be confirmed.
- Isolated activity is seen near Beed, Nanded, Ujjani and Solapur in eastern Maharashtra and Uran, Kolhapur and Sindhudurga in south-west Maharashtra. These activities may be due to movements on local faults in the basement.
- Seismicity is also seen near Bhatsanagar and Suryanagar. Recently, isolated activity also occurred in Latur-Osmanabad districts in south-east Maharashtra.

Based on the earthquakes occurred so far in the state and considering the seismic pattern, a rezoning, for new dam designs only, has been proposed by the Deouskar Committee for the state of Maharashtra. It may be noted that even after using sophisticated techniques like carbon dating, it has not been possible to identify whether the fault is active. If some seismicity is associated with a major lineament, it can be considered as an active tectonic feature for the purpose of engineering seismic risk analysis and these regions can be considered as risk prone.

- The west coast - Western Ghats seismogenic region is the most active area in the Maharashtra state. The Koyna-Warna and the Bhatsa areas are located in this region. Even before the occurrence of the Koyna earthquake of 11 December, 1967, with magnitude 6.5, earthquakes with magnitude of about 6.0 are known to have occurred in this region. The report further observes that :
- The activity in the Koyna-Warna region has been continuing for the past three decades with occasional spurts, producing events with magnitude above 5.0. This trend is expected to continue in future.
- Bhatsa region experienced a swarm of seismic activity during 1983-84, with a maximum magnitude of 4.9. The activity has died down since then with only a temporary spurt in 1990.
- The Surya area about 50 km. north-west of Bhatsa, has recently shown increase in seismic activity. The energy in Bhatsa-Surya region may not have been fully released and possibility of an earthquake with a magnitude of around 6.0 in future, cannot be ruled out.
- Further south of Warna, some micro seismic activity has been reported in the past. Because this region lies in the active west coast-Western Ghats, the possibility of a maximum magnitude earthquake of around 6.0 cannot be ruled out in future.
- There was no evidence of any significant seismic activity in the Latur-Osmanabad area in the known past. Also, the tectonic features to which the Killari earthquake of 30 September, 1993, could be attributed are not known sufficiently. However, the occurrence of Killari earthquake of moderate magnitude of 6.4 gives an indication of neotectonic activity in the area. Though, the stress has been released at Killari, a similar magnitude earthquake at some other place in the area cannot be ruled out.
- Before the Killari earthquake, infrequent tremors and subterranean sounds had been reported in the area. Similar instances were also reported from many other locations in Beed, Parbhani and Nanded districts. In the absence of knowledge about any seismotectonic features in this area, low to moderate earthquakes can be experienced.

- In addition to the above seismogenic regions in Maharashtra, the Narmada-Tapi region covering the border areas of Maharashtra and Madhya Pradesh states has been reported to be active since historical times. Tense fracturing, alignment of hot springs and locations of epicenters in these areas leads to the conclusion that these two are the zones of crustal weakness in Maharashtra.
- The Tapi and the Purna lineaments in the northern part of Maharashtra have been recognized as active faults with potential to generate low magnitude earthquakes. The Tapi lineament represents a line of crustal weakness along which activity has been recurrent during different periods. Earthquakes above magnitude 6.0 are known to have occurred in the northern parts of this region across the border of Maharashtra.
- According to a scientist, there is a major anticipated zone of uplift in the Sangola area and another to the east of Sholapur. Vertical movements of these crustal blocks may cause seismic disturbances in the areas, as has happened in Killari.
- Due to increasing trend of seismic activity noticed in Maharashtra in recent times, earthquakes with low magnitudes around 4 to 4.5 may occur in areas where there has been no seismic activity in the past.

The impact of earthquakes differ for urban and rural areas, primarily because of the nature of infrastructure, quality of housing and occupational differences. In rural areas, it is primarily the housing and physical structures (including irrigation infrastructure) which may suffer extensive damage, without necessarily destroying the crops.

In urban areas, in addition to housing and physical infrastructures, it may also disturb the service infrastructure such as water supply, sewage, telephones, electricity, piped gas supply etc., which are essentially underground installations and hence exposed to a direct impact. The disruption, therefore, in urban areas and consequent investments for rehabilitation becomes a major challenge. So, more emphasis may be given on mitigative and preparedness measures to minimise the disastrous effects of an earthquake.

Reservoir Induced Seismicity

While doing a risk assessment for earthquakes, mention has to be made of reservoir induced seismicity (RIS). The 1967 Koyna earthquake of 6.5 magnitude is contended to be due to RIS. Between 1963 to 1998, the Koyna region has faced 102715 tremors, of which 79 were above magnitude of 4 (Richter scale) and seven were above magnitude of 5 (Richter scale).

Earthquake risk assessment is all the more difficult in Maharashtra because of a lack of seismic instrumentation in many parts of the state. Maharashtra is no doubt the most seismically instrumented state in India with 52 seismic risk observatories. However, almost all this instrumentation is concentrated in some pockets such as Koyna-Warna and Bhatsa-Surya areas, while in remaining parts of the state, there is hardly any instrumentation at all, excluding the cities like Pune, Mumbai, Nagpur etc.

The conditions are further aggravated by almost 80 percent of the state being covered by a thick pile of lava, thus hiding from direct view the seismogenic faults lying below the basalts. Added to the above is the very scanty availability of reliable historical records of past earthquakes in the state, which moreover, extend over a short period of only 150 years or so. Popular confidence in the ability of seismologists to provide useful information has been dealt a blow by the Killari earthquake. First, this deadly earthquake occurred in an area previously classified as the least hazardous among five categories. Secondly, popular concerns arising from a burst of precursory seismicity were dubbed as alarmist by expert opinion. Therefore, earthquake prediction is very inexact even with all the technology.

Results from seismological investigations on the Killari earthquake and other recent stable continental region earthquakes suggest, that damaging earthquakes will not be confined to areas that have experienced earthquakes in the past, nor to areas that are characterized by prominent tectonic

features. Thus, a uniform distribution of potential earthquake sources can be expected in Maharashtra, indicating that the risk of earthquakes is omnipresent.

Prediction of earthquakes (as regards time and place of occurrence, magnitude and intensity) is as yet inadequate. With all the sophisticated instrumentation and large array of personnel collecting vital data over a fairly long period, it has not been possible to predict earthquakes and avoid disasters as is seen in the Kobe earthquake in Japan.

Cyclones

Cyclones are considered as one of the most damaging natural disasters. They make impact by killing people, damaging property, crops and infrastructure. In the rural areas, the damage is primarily to lives, crops and to housing. It may also affect the irrigation infrastructure. The damage to forest and plantations, when it occurs, has a long term effect, and also takes a much longer period for restoration. In urban areas, both transport and communication receive a serious damage, in addition to loss of life and shelter.

Cyclones rise in the seas and get calm when it comes in contact with the land. Thus, the coastal areas are very much at risk to cyclones. Maharashtra has a coastal belt of over 720 kilometers between Gujarat to Goa. Thus the Konkan region including Mumbai becomes prone to the risk of cyclones. There are 386 marine fishing villages / hamlets with 17,918 boats engaged in fishing in this coastal belt.

In the Arabian sea, during the period 1890-June 1998, 210 depressions/cyclonic storms/severe cyclonic storms have been recorded. Most of them have moved away from Maharashtra. Thus, the coastal region of Maharashtra is climatologically an area where frequency of cyclonic disturbances is very low. Out of 210 disturbances, only 19 have affected Maharashtra - Goa coast. Of these six were major ones causing 70 deaths, with 150 boats and 160 crew missing and extensive damage to trees and ships. Some of these which made an impact on Maharashtra are listed below. The wind and cyclone hazard map for Maharashtra has also been produced indicating the risk zones according to possible impact.

Thus, in spite of having a long coastal region, Maharashtra has experienced only 6 cyclones in last 50 years, though there have been numerous threats. Thus climatologically, this area is having low risk of cyclone strikes.

Mumbai which is the economic capital of India, is also a coastal city which has faced many threats of cyclones in recent times. The city has been hit by a severe cyclonic storm in 1948. However, it has faced peripheral impact in 1982, 1988 and twice in June and October 1996. It indicates that the city is prone to cyclones. Considering the problems the Indian economy may have to face if Mumbai is hit by a cyclone, it becomes far more important to implement preventive and preparedness measures here.

Due to the devastating effects of cyclonic storms as well as the unpredictability of their movement, it is necessary that adequate preventive and preparedness measures be undertaken, by way of improving the warning systems, for facing such an eventuality. An action plan has already been made and needs to be integrated with the state disaster management action plan.

Floods

It may be noted that there are lots of man-made reasons for the occurrence of floods. Analyzing the floods in Maharashtra, one observes that most floods in Maharashtra are flash floods due to nallah-overflow and poor drainage systems. Very few floods, like the one in Konkan in 1983, are due to heavy rains in the region.

Majority of the floods have taken place either because of a breach in embankments of dams, or because the engineers on dams had to release surplus water from the reservoirs (resulting from heavy rains in catchment area), causing floods in the low-lying areas along the river belt. Thus, areas in

proximity to dams become more risk prone to floods. As per 1978 data, 2.3 lakh hectares of land in Maharashtra is prone to floods and protection work has been undertaken for 0.01 lakh hectares land.

Going by the past experience, it is important to consider the catchment and command areas of the dams as risk prone to flash floods. Ecologists believe that large dams contribute to increased humidity and evaporation which results in heavy rainfall. Though one cannot neglect the importance of irrigation projects, it adds to the risk of heavy rainfall which may result in increased risk of floods.

Only the Konkan region comes under the heavy rainfall region (2000-4000 mm), whereas Vidarbha and a very small part of Marathwada have moderate rainfall (1000-2000 mm). The rest of Maharashtra has scanty rains (below 1000 mm).

Another important factor that causes floods is urbanization. Increasing rates of population due to migration to the urban centers leads to a heavy pressure on the existing storm-water drainage systems in the city. Floods in urban areas mainly result from faulty planning. Available data on Mumbai shows that land reclamation over the years has disturbed the natural drainage system. Therefore, Mumbai's low-lying areas are under the threats of floods even if there are minor rains. Various reasons are attributed to this as mentioned below:

1. Many of the gutters are below sea level and this naturally creates problems in the drainage of water, which aggravates during high tide. Rains during this period flood the city with rain water which takes time to recede, adding to the havoc and disrupting the entire traffic system.
2. The problems in drainage system are also aggravated because of the high number of new buildings that have come up in the city.
3. The drainage system in Mumbai was built 75 years ago. Considering the growth of city during this period, and the damage that has occurred, the system is proving to be inadequate and inefficient.
4. Lots of slums and unauthorized settlements have come up beside the drainage system. Because of these settlements, the width of the 'nallas' get reduced and at the same time lot of garbage and solid waste gets piled on. The problem is aggravated by the number of waste dealers' shops and cattle-sheds built near the nallas, cleaning of which, therefore, becomes difficult. The roads to the nallas are blocked because of these settlements, creating problems in clearing the streams. This clogs the drains resulting in floods in rainy seasons.

In Mumbai alone, there are 111 places in the city – 26 in Mumbai city district, 73 in the eastern suburbs and 12 in the western suburbs – that were identified in 1993 as flood prone areas. Thus, the city of Mumbai has high risk of being flooded in rainy seasons especially if it rains during high tide, resulting in disruption of traffic, loss of man-days and often making slum dwellers in low-lying areas homeless for more than a week.

The above discussion not only reflects the situation in Mumbai, but also can be generalized as an urban situation. The situations are more or less similar for other urban cities too.

3.2.2 Risk Assessment and Vulnerability Analysis of Mumbai

Vulnerable settlements

There are in all 2335 slum settlements as per 1985 data in Mumbai. These slums are considered as vulnerable settlements due to their location and access to infrastructure. The locations include hilltops, slopes, nallahs, low-lying areas (with tendency to flood during high tides), and coastal locations, under high-tension wires, along highways, along railway lines, within industrial zones, pavements, along water mains, along open drainage. These slums are located on the lands of state government (25 %), BMC (20 %), Housing Board and central government (5%), private lands (50 %).

Floods

There are ten rail sections in Central Railway which get submerged during heavy rains. There are number of flooding points which result in disruption of traffic and flooding of settlements.

Most of these flooding points have been listed in the ward plans and have a localised impact. However, some of these flooding points have a tendency to disrupt the traffic and paralyse city life. A number of steps such as de-silting of drainage and clearing of nallahs are taken by BMC and Railways to avoid such flooding. However, a combination of heavy precipitation and high tide may make such flooding unavoidable.

Fires

Greater Mumbai is greatly diversified and practically has every type of fire risk. The fire risk can arise from the following sources:

- Large number of closely built old timber framed buildings in Ward A, B and C
- High-rise buildings with inadequate fire-fighting facilities
- Commercial activities in Kalbadevi, Mumbadevi, Bhuleshwar, Vadgadi, Bhendi Bazar, C.P.Tank
- Small, medium and heavy hazardous industries in suburban areas
- Widespread docks area
- Oil refineries in M-W ward
- Petrochemical industries
- Large slum settlements.

There are 2600 officers and men spread over 24 stations, to fight the fires.

Earthquakes and House crashes

The major earthquakes that have occurred in Mumbai region in the last 400 years are given below:

Year	Intensity (MMI)
1594	IV
1618	IX
1678	IV
1832	VI
1854	IV
1877	IV
1906	VI
1926	V
1933	V
1951	VIII
1963	IV
1966	V

As per the 1991 census, Greater Mumbai has 2,768,910 dwellings, including residential, commercial and industrial establishments. Of these, only 9.08 % of the dwellings were made of re-inforced concrete while 31.35 % were engineered masonry constructions. Thus, 59.57 % of all constructions were non-engineered. This can partly be attributed to the large percentage of population living in the slums.

Therefore, the major risk category of structures is that of the engineered masonry constructions. Many of these are essentially load-bearing structures.

Landslides

Greater Mumbai also faces the risk of Landslides with pressure on land, many vacant sites on hill slopes or bottoms of hills have turned into inhabited area and thereby become vulnerable to landslides.

Most cases of landslides occur during heavy rain associated with high velocity winds. It sometimes results in loss of human lives and damage to structure.

The sites vulnerable to landslides in Mumbai city district are as follows :

The many sites vulnerable to landslides in Mumbai suburban district are essentially located on or near the abandoned quarries and hill ranges. Different authorities like the State/Central Government, BMC or the Maharashtra Housing Board mainly own these hillside lands.

Maharashtra Government has enacted the Maharashtra Slum (Improvement, Abolition and Rehabilitation) Act, 1971 under which slums in specified areas are notified as regularised slums and given protection. Since 1991, under the slum improvement programme, these slums are being improved by Slum Improvement Board, a unit of Maharashtra Housing Area Development Authority (MHADA). These slums are being provided with basic amenities. To avoid the damages due to landslides, the Slum Improvement Board is carrying out a programme of constructing retaining wall.

Road Accidents

The major road sections in Mumbai, which are accident-prone in Mumbai city along with details of fatal and serious injuries from 1993 to 1995 are given below:

Locations of Accident:

1. N.S.Road, Princess St. Fly Over to Birla Krida Kendra
2. Lala Lajpatrai Road, V.P. Stadium to LLR College
3. Sir J.J.Road, J.J.Jn. to Sofiya Zuber Road.
4. Dr.B.A.Rd., Hindmata Jn. to Dadar Fire Brigade.
5. Dr. B.A.Rd., Lalbaug Jn.
6. Dr. B.A.Rd., Kalachowky Jn
7. Dr. A.B.Rd., Glaxo Jn. to Worli Naka
Mahim Causeway to Mahim Jn

The number of accidents from 1990-96 and the deaths resulting from these accidents are given below:

Year	No. of Accident	No. of Deaths
1990	25,331	386
1991	25,477	339
1992	25,029	385
1993	23,268	334
1994	25,214	316
1995	27,564	372
1996	29,768	397

Industrial and Chemical Accidents

There are approximately 900 industries either involved in the manufacture and processing of hazardous goods or in the storage of hazardous goods. Many of these godowns are in the close proximity of the residential areas or other storages, thereby increasing the risk of fires and chemical explosions in residential as well as industrial estates.

The major concentration of the hazardous industries is seen in the Chembur-Trombay belt, spread over an area of about 10 square kilometres, having major chemical complexes, refineries, fertiliser plants, atomic energy establishment and thermal power station. Clustering of various operating units make them highly vulnerable. The atomic energy establishment, with its residential colonies, has taken adequate measures to reduce the risk.

In view of the fact that the ward officer is responsible for co-ordinating disaster response at the ward level, it may be necessary that these units establish a direct contact with the ward officer in all emergency situations, even when on-site emergencies occur, and keep him posted with the status of the emergency. This will improve the co-ordination and allow for timely reinforcement from fire brigade and at the same time provide standby arrangements, if off-site operations are required.

In addition, piped natural gas supply to households has started in some suburban areas and is intended to cover most of the suburbs. In view of this, the risk of fires due to leakage of gas is an added dimension.

Cyclones

Being an island city, the coastal wards (facing the Arabian Sea) are prone to gusty winds and cyclonic impacts. Originally, most of the fishing villages were located along the coast. These include Machimar Nagar in Colaba, Worli village, Mahim village, etc. Additionally, in most of these wards, a number of slums have also mushroomed along the coast. Given the quality of housing material used, these settlements are highly vulnerable and the possibility of their capacity to withstand the cyclonic storm is limited.

3.2.3 Vulnerability of Pune

Earthquake

Till date there is no incidence of earthquake disaster in this district.

Floods

There was no major flood disaster in Pune district since the 1962 Panshet Dam disaster. On all the major rivers there are dams wherein ample water can be stored and extra water is preserved. There are also big canals therein flood water can be diverted to save flood calamity.

However, on the week following 22nd August, Pune district witnessed torrential downpour leading to rise in the water levels in the rivers Mula and Mutha. Subsequently, the Irrigation authorities had to release the water as the water level was crossing the danger mark. This resulted in floods in the low lying areas and several families had to be evacuated.

The Collector has issued instructions to all the Tahsildars to take the precautionary measures for prevention of flood. There are two flood monitoring centres on the river dams which have well means of communications by wireless. Before commencement of monsoon the Collector holds a meeting of the Tahsildars, S.D.Os., Irrigation Department, Police etc. to prepare for flood disaster.

Epidemics

Epidemics generally occur due to contaminated water because of leakages in piped water supply schemes and people who use river water. The Medical Officers of P.H.C., B.D.Os and Tahsildars will inform the epidemic immediately to the District Health Officer, Civil Surgeon and Collector. Necessary action to control the epidemic will be taken without any delay and it is also taken care that it will not spread in the near by villages and towns.

Fires

Generally there is fire on cattle sheds, threshing floors huts and houses in rural areas. Normally the small fires are controlled by local people, Gram Panchayat and Talathis. Late on the Tahsildars manage to ascertain the loss due fire and arrange to pay compensation to the affected persons. Also there were incidences of fire in industries and railway wagons carrying the explosive chemicals. In such cases the local authorities and Municipal council had extended the help in providing fire brigades and other required support.

Road Accidents

Police personnel are attending the road-accidents promptly. There is one flying squad on National Highway, to attend to accidents. The police Dept. and local people are also assisting the police Dept. to handle the accident situation. Main reason of the road accidents is negligent driving.

Industrial & Chemical Accidents

There are sixteen industrial estates in Pune. There are 384 chemical industries and 47 potentially hazardous and polluting industries. 2,20,000 workers are employed in these industrial units. There are two pipelines carrying chemicals.

The industrial units respond effectively to the incidences of accidents in their factories. They have trained their staff to respond to the accidents. All these hazardous units have prepared their disaster management plans and trained their staff fully to face any emergency.

Cyclones

There are no incidence of cyclones in this district so far. But it cannot be said as to when it will occur. If it happens needful action will be done promptly.

Disaster Probability

Damage	Earthquake	Floods	Cyclones	Epidemics	Industrial and Chemical Accidents	Fires	Road Accidents
Loss of Lives	high	medium	low	Medium	high	medium	medium
Injuries	high	low	low	Low	high	medium	medium
Damage to and Destruction of Property	high	high	medium	Low	high	high	low
Damage to cattle and livestock	high	high	low	Low	low	low	low
Damage to subsistence and crops	medium	high	low	Low	low	low	low
Disruption of life style	high	medium	medium	Low	medium	medium	low
Disruption of community life	high	medium	medium	High	low	low	low
Loss of Livelihood	high	high	medium	Low	medium	medium	low
Disruption of services	high	medium	medium	Low	medium	medium	medium
Damage to infrastructure and/or disruption of government systems	high	low	low	Low	low	medium	low
Impact on National Economy	medium	medium	medium	low	low	low	low
Social and Psychological after-effects	high	low	low	medium	low	low	low

Ranking & Probability Of Disaster Episodes In The District

Event	Ranking of events in terms of past occurrence	Probability of future occurrence		
		High	Medium	Low
Earthquake	5		yes	
Floods	4		yes	
Cyclones	5			yes
Epidemics	5		yes	
Industrial and Chemical Accidents	2	yes		
Fires	1	yes		
Road Accidents	3	yes		

3.3 Emergency Response Capability and Legal Environment

Health/Medical Response

Although, the entire state is covered through primary health centres, a more clear statement on its coverage and effectiveness would help in establishing its relevance for the population, in terms of vulnerability reduction. Apart from the total number of posts for medical practitioners in health system, one has to also look at the number of vacancies and non-field posts. This is specifically important in case of tribal and rural areas, where a number of posts are lying vacant in the absence of either the appointment or the postings. Also, the situation of stocks of medicines and usables is reported to be inadequate. The rural and tribal areas, therefore, exhibit a high degree of vulnerability due to the absence of adequate staff manning the services.

In all the districts of Maharashtra, preventive, promotive and curative health is being looked after by the health department, under the leadership of the district health officer supported by the health staff at the district level. Every district headquarter has a civil hospital catering to the curative needs of the patients from the district. There are also PHCs (Primary Health Centre), referral hospitals and community hospitals supplementing the task. It may be noted that bed - population ratio in Maharashtra, which is 1.46 per thousand, is much better than the all india ratio of 0.75 per thousand. Also, as per 1987 statistics, the ratio of persons per doctor is better in Maharashtra (1750:1) as against the national ratio (2290:1)

Out-reach Services

A large number of surgical and diagnostic camps, sterilization camps, eye camps, dental camps, cancer and tuberculosis detection camps are regularly organised by these hospitals in rural areas. They have also adopted some rural hospitals for regular extension services. They also give referral services to the lower institutions like rural hospitals and primary health centres and refer cases beyond their competence to the hospitals attached to the medical colleges or specialised hospitals.

Training and Health Education

All district hospitals conduct regular training programmes for medical officers and para-medical staff for teaching the technique of tubectomy, vasectomy, M.T.P, I.U.D. and other surgical and clinical procedures. They carry out health education activities not only through exhibition of posters, slogans painted on hospital walls, regular screening of films in O.P.D and announcements on public address systems wherever they are installed, but also through inter-personal discussions with the patients and relatives. In order to create public awareness a number of campaigns are launched.

Referral Services

District hospitals not only serve as referral centers for the health institutions located in small urban areas of the district, but also supervise and guide in effective implementation of the National Health Programs.

In terms of infrastructure, therefore, the public health department is a well staffed department which has played a crucial role in practically all the emergencies at the district level. At times, they have also reinforced their efforts with the support from adjoining districts' staff. One therefore cannot undermine the role played by health department in the management of emergencies in the disaster situation. However, there are certain areas, such as diagnostic facilities, that need to be examined in the context of epidemics.

Fire Accident Response

Maharashtra is one of the states which does not have a State Fire Service. Presently, all fire stations are under the jurisdiction of the respective municipalities. There are 233 municipal councils and 13 municipal corporations in Maharashtra. Of these, fire tenders are maintained in 96 councils and 12 corporations.

The data on the number of fire calls attended by the fire services in the state is published every five years in the form of a red book. The latest edition (for 1992-1996) is under preparation.

Most of the reported accidents are in the city of Mumbai and the various reported causes of these accidents, are mainly due to inadequate safety of electrical installations, inadequate fire safety measures to deal with chemical and LPG fires as well as careless practices while handling and storage of inflammable materials. In Mumbai and other cities, fire fighters face severe problems due to the narrow lanes, congested, overcrowded buildings, old buildings and poor internal wiring. Since the fire services are under the jurisdiction of respective municipalities, movement from one municipality to another requires official administrative procedures, resulting in delay in providing assistance across municipalities. This could result in elevation of the risk levels.

Resources available

Maharashtra is one of the states which does not have a state fire service. All fire stations are under the jurisdiction of the municipalities. There are 233 municipal councils and 13 municipal corporations in Maharashtra. Of these, fire tenders are maintained in 96 councils and 12 corporations. Presently, a proposal is being prepared to include all fire stations, except Mumbai, under the State Fire Department, with district and taluka level fire offices.

The fire stations fall under the jurisdiction of the Urban Development Department, unlike in other states where the fire stations are under the State Fire Department, which is within the jurisdiction of the department of Home Affairs.

The facilities in each fire station are proportionate to the municipality's financial position. However, due to a paucity of funds in most municipalities, except Mumbai and other metro cities in the state, the fire stations are poorly equipped. Presently, loans are being provided through General Insurance Company to municipalities by the govt. of Maharashtra to equip the fire stations.

Human resource capacity building is done through regular training programmes. The senior officers are trained at the training college in Nagpur. Field level firemen from all over Maharashtra have to mandatorily undergo training at the State Training Centre at Vidyanagri, Mumbai. The content and duration of the courses are as follows :

- 3-6 month duration courses.
- Practical and theoretical courses with training, on the various methods of fire fighting and equipment used.
- Some practical experiences, especially with respect to fire fighting practices for high rise buildings, are imparted with assistance from Mumbai fire dept.

The strength of the State Training Centre is 19 with only two trainers. There is a need for more equipment, training facilities and hostel facilities to provide training to larger groups of recruits since the current capacity is 25 per batch. A proposal has been sent to the govt. of Maharashtra for upgradation of facilities at the training centre. Community awareness programmes on fire safety are also organised by the State Training Centre.

Industrial Disaster Response

For the purpose of preparation of an emergency action plan for the state of Maharashtra, the focus should be on off site industrial accidents. The Directorate of Industrial Safety and Health maintains records of industrial accidents in Maharashtra. By definition, however, these records include accidents due to chemical incidents as well as mechanical. Records of injuries to workers while on duty, such as fall from height etc. are also included.

The Directorate of Industrial Safety and Health is compiling the records of industrial accidents, year wise. Compiled information for various divisions in the state was available in 1995. This accident record was screened to select the statistics with respect to fatal and non-fatal accidents in certain categories of industries. It must be emphasized at this juncture that this does not provide a comprehensive picture of the vulnerability of locations or the type of industries which are potentially

hazardous. However, this provides some preliminary information on the likely hazard potential due to specific industries, causative factors, as well as indicates the likely areas in the state which may be vulnerable to industrial hazards. A more detailed information database is necessary, which is being collected presently for each district.

The maximum number of accidents in all the selected categories of industries are recorded in Thane and Mumbai. The industry category showing maximum number of accidents and fatalities is the manufacture of rubber, coal and petroleum.

A review of the causes of off-site accidents that have been reported in Maharashtra state indicates that a large number of them are due to negligence of the management with respect to safety of equipment, processes and storage. This is compounded by faulty equipment and poor housekeeping. All these factors make a number of the industries, especially chemical and petrochemical industries extremely hazard prone and the surrounding environment vulnerable to industrial accidents.

Emergency Response Centres

Apart from these district plans, emergency response centres (ERC) have also been established in some of the industrial areas in the state. The Thane-Belapur Industries Association operates and manages a fully government owned emergency response centre at Thane-Belapur. MIDC provided the investment for setting up of this facility to as a part of the disaster management plan for the industrial belt.

A second emergency response centre has started functioning since August 1996, at the Hindustan Organics Limited premises. The Patalganga Industrial Complex, where the ERC is located, is one of the four industrial areas that had been identified by the Ministry of Environment and Forests, govt. of India. This is a joint venture of MOEF and DISH (state government) to be operated by the industries located in this region.

This ERC will respond to emergencies due to hazardous chemicals within a radius of 20 km and for factories located in the Patalganga - Rasayani industrial belt. Presently the ERC is being housed at the fire station in HOCL. Operating procedures for telephone operator, duty manager, fire and safety officers have been developed. A format for recording of the emergencies has also been developed. An inventory of the emergency facilities, such as fire services, ambulances, essential medical services, breathing apparatus etc., available with the member industries has also been prepared.

The Maharashtra Disaster Management Action Plan

The state Disaster Management Action Plan (DMAP) has been prepared for its operationalisation by various departments and agencies of the Government of Maharashtra and other Non-Governmental Agencies expected to participate in disaster management. This plan provides for institutional arrangements, roles and responsibilities of the various agencies, interlinks in disaster management and the scope of their activities. An elaborate inventory of resources has also been formalised.

The purpose of this plan is to evolve a system to

- assess the status of existing resources and facilities available with the various departments and agencies involved in disaster management in the state;
- assess their adequacies in dealing with a disaster;
- identify the requirements for institutional strengthening, technological support, upgradation of information systems and data management for improving the quality of administrative response to disasters at the state level;
- make the state DMAP an effective response mechanism as well as a policy and planning tool.

The state DMAP addresses the state's response to demands from the district administration and in extraordinary emergency situations at multi-district levels. It is associated with disasters like road accidents, major fires, earthquakes, floods, cyclones, epidemics and off-site industrial accidents. The present plan is a multi-disaster response plan for the disasters which outlines the institutional framework required for managing such situations.

The state DMAP specifically focusses on the role of various governmental departments/ agencies like and the Emergency Operations Centre in case of any of the above mentioned disasters. This plan concentrates primarily on the response strategy.

The Emergency Operations Centre is proposed as the hub of activity during a disaster. The structure of the EOC, can expand or contract depending on the situation. The primary function of an EOC is to implement the DMAP which includes coordination, policy-making, operations management, data collection, record keeping, public information and resource management.

The EOC, its system and procedures are designed in such a way that information can be promptly assessed and relayed to concerned parties. Rapid dissemination contributes to quick response and effective decision-making during an emergency. As the master coordination and control point for all counter-disaster efforts, the EOC is the centre for decision-making under a unified command. In a disaster situation, the EOC will come under the direct control of the chief secretary or any other person designated by him as the chief of operations.

The EOC, under normal circumstances, will work under the supervision of the relief commissioner. It is the nerve centre to support, co-ordinate and monitor disaster management activities at the district level.

Under normal circumstances, the activities of EOC are primarily the responsibility of relief commissioner's office, with training and research inputs from YASHADA. The usual activities of the EOC will be to

1. ensure that all districts continue to regularly update the District Disaster Management Action Plan and encourage districts to prepare area-specific plans for areas prone to specific disasters;
2. identify and interact with the central laboratories, research institutions and NGOs to evolve mitigation strategies and setup study groups and task forces for specific vulnerability studies;
3. serve as a data bank and ensure that due consideration is given to mitigation strategies in the planning process; identify agencies and institutions for locating inventory items;
4. upgrade and update the state DMAP according to changing situations in the state;
5. disseminate information about the state DMAP to other departments of the government of Maharashtra and state level agencies;
6. monitor the training imparted to state level officials, private sector and NGOs by YASHADA;
7. organise post-disaster evaluation and update the state DMAP accordingly;
8. ensure that the warning and communication systems and instruments in the EOC are in working condition.

On the receipt of warning or alert from any such agency which is competent to issue such a warning, or on the basis of reports from Divisional Commissioner/District Collector of the occurrence of a disaster, all community preparedness measures including counter-disaster measures will be put into operation. The Chief Secretary/Relief Commissioner will assume the role of the Chief of Operations for Disaster Management.

The occurrence of disaster would essentially bring into force the following :

- The EOC will be on full alert. The EOC can be expanded to include branches with responsibilities for specific tasks.

- An on-going VSAT, wireless communication and hotline contact with the divisional commissioner and collector/s of the affected district/s.

The Chief of Operations will spell out the priorities and policy guidelines, coordinate services of various departments and agencies including national and international aid agencies, and central government agencies. The EOC in its expanded form will continue to operate as long as the need for emergency relief operations continue till the long-term plans for rehabilitation are finalised.

In disaster management, there is a need for coordination between different levels of the government to have a unified command system for coordinated action by all the agencies. The objective is to ensure that the state action is organized in a disaster situation to:

- effectively and efficiently meet needs;
- avoid waste and-duplication of effort; and
- ensure that resources are distributed equitably and to areas of greatest need.

The District Control Room has been organised in a similar fashion to the Emergency Operations Centre.

The flow of information between the EOC and the DCR has been described under normal conditions and disaster situations. Effort is made to evolve a system by which the DCR can set-up site operations centres. The DCR will report all the field activities to the EOC.

In case of disasters which have an impact on more than one district in a division, the role of the divisional commissioner comes into prominence. The commissioner's responsibilities shall include exercising general supervision over the contingency plan and work undertaken by the collectors in his division as also on the relief and rehabilitation operations in those districts.

Non-governmental Organisations (NGOs) and Voluntary Agencies

The capacity of non-governmental organisations and voluntary agencies to reach out to community groups and their sensitivity to local traditions of the community, gives them an added advantage during disasters. Some of the agencies, both from within and outside the state, have technical expertise and capabilities which can be brought into managing difficult situations.

During the post-disaster phase, therefore, efforts should be made to enlist partnership of some of the NGOs with relevant expertise, to assist the district administration in the process of relief and rehabilitation.

Community Participation

The EOC is expected to ensure and monitor the nature of community participation sought at the disaster site. Identification of agencies to monitor and evaluate various aspects of community participation, their impact on efficiency in operations and in the recovery process, is one of the responsibilities of EOC during post-disaster evaluation.

The DDMAP expects the district administration to enlist community participation in the entire disaster cycle.

Community participation can be ensured by:

- identifying opinion, positioning leaders in the community and voicing administration's confidence in their capabilities to undertake the tasks;
- consultations and dialogues expressly indicating the need for assistance to encourage the community and its leaders to come forward;
- having regular feedback meetings and an open book approach to demonstrate transparency; and
- involving community in decision making at local levels.

3.3.1 Response Structure of the State

In a multi-disaster response plan, the response structure recommended is specific to the type and severity of the disaster, its potential impact on individuals, damage to infrastructure, disruption of services, environmental effects, economic and social consequences and secondary effects. The document lists the specific needs to combat the possible impacts.

Operating procedures for different departments include the Preamble, Planning Assumptions, Normal Time Activity, Action Plan Objective in a Disaster Situation, Activities on Receipt of Warning or Activation of District DMAP (DDMAP), Evacuation, Relief and Rehabilitation – Field Office Priorities and Head Office Priorities. These Operating Procedures are given for the following departments : MSEB, Police, Public Health Department, Irrigation Department, Agriculture Department, Animal Husbandry, MWSSB, Public Works Department, DOT, Railways and AAI.

Mitigation strategy and Institutional Arrangements in Mumbai

The analysis shows that various locations in Mumbai are vulnerable to different disasters in varied degrees. Preparedness and mitigation plans, therefore, will have to be evolved and implementation monitored locally at the ward level to reduce the impact of the disasters.

While evolving such area specific preparedness and mitigation plans, types of vulnerabilities will essentially define the levels of preparedness and mitigation strategies. These strategies will have to be concentrated more towards the social and economically backward communities, as against the vulnerability of the overall system.

The Municipal Commissioner vide order No.ENV/1093/DEA/CR/36/TK dated 16th February, 1994 is appointed as the District Disaster Officer for Greater Mumbai. In majority of the disasters within the managerial capacity of BMC, the BMC will manage the disaster situation without intervention from the State authorities. Micro-level plans at ward level have been prepared for all the 23 wards incorporating specific responsibilities of ward officer who will act as Ward Disaster Manager. The disaster management operation for functionaries at the ward level has been given in Section XI.

However, in cases of disasters of exceptionally large magnitude which requires co-ordination with wide range of lateral agencies including central government agencies, the Additional Chief Secretary (Home) will assume the responsibility of Disaster Manager for Mumbai.

Special Features of Greater Mumbai

The bifurcation of Greater Mumbai in Mumbai city and Mumbai Suburban districts is more a revenue administrative arrangement whereas the Greater Mumbai as a whole has a Municipal Corporation divided into wards for managing municipal services. The two District Collectors will assist the Municipal Commissioner in all aspects of disaster management.

There exist the following Control Rooms in Greater Mumbai

- Police Control Room
- BMC Control Room
- Fire Brigade Control Room
- BEST Control Room
- Central Railway Control Room
- Western Railway Control Room
- Konkan Railway Control Room
- District Control Room for Mumbai district
- District Control Room for Mumbai Suburban district
- Civil Defence Control Room

In addition, on specific request from the Additional Chief Secretary (Home), help from the armed forces can be sought, especially for evacuation, medical aid, and provision of relief and establishment of relief camps communication aid, repair to damaged infrastructure, management of International Relief etc. These activities will be co-ordinated through the Army control room, which will form a part of the co-ordination structure.

The experience shows that floods, rail accidents and power failures have mainly been responsible for such disruptions. Therefore, in such cases, there is a need for co-ordination with state and central government agencies and local authorities, particularly, between Central Railway, Western Railway, Police Department and BMC.

Greater Mumbai Disaster Management Action Plan provides for co-ordination of various control rooms, departments of Municipal Corporation, departments of state government with each other and the state level EOC.

Mumbai Disaster Management Committee

There will be a Mumbai Disaster Management Committee under the chairmanship of Additional Chief Secretary (Home). The Committee will consist of the following depending on the type of disaster and its intensity.

Additional Chief Secretary	Chairman
Secretary, Relief and Rehabilitation	Member Secretary
Secretary, Home (Law and Order)	Member
Secretary, Housing	Member
Secretary, Medical Education	Member
Secretary, Food and Civil Supplies	Member
Divisional Commissioner (Konkan)	Member
Transport Commissioner	Member
Municipal Commissioner	Member
Commissioner of Police	Member
General Manager, Central Railway	Member
General Manager, Western Railway	Member
General Manager, Konkan Railway	Member
General Manager, BEST	Member
Dy. Director General, Meteorology Department	Member
Secretary, Industries	Invitee
Chairman, Mumbai Port Trust	Member
Director, MPCB	Invitee
Secretary, Public Works	Member
Director, Airport Authority of India, Mumbai	Invitee
GOC, Maharashtra Gujarat Area	Invitee
Commander, Mumbai Sub Area	Invitee
Colonel General (Staff)	Invitee

Functions of the Mumbai Disaster Management Committee

The functions of the Mumbai Disaster Management Committee would be to:

- Ensure effective inter-departmental co-ordination between all state departments
- Provide policy decisions when required
- Keep the government informed about disaster situation
- Review disaster related activity reports received from BMC Control Room, Police Control Room and Army Control Room and provide appropriate directions.
- Co-ordinate the activities of lateral, and Central Government agencies like
 - Ø Defence Services, SRP, CRPF, Coast Guards, CISF
 - Ø MTNL, AAI, Port Trust, FCI
 - Ø DD, AIR
 - Ø Meteorology Dept, MPCB, BARC

Materials/Equipment's for Resource mobilization

Ambulances	Mobile X-Ray units
Boats/Rescue Boats	Public address systems
Buses	Pumps – diesel and electric
Cranes	Self breathing apparatus
Demolition equipments	Sniffer dogs
Drilling rigs	Tankers
Earth moving equipments	Tents
Foam Tenders	Toxic gas masks
Generators	Tractor
Ham sets	Trucks
Helicopter service	VHF sets with batteries
Mobile trauma care vans	Wireless sets

BMC Disaster Management Committee

In order to ensure speedy and effective response, the execution of disaster related activities will be undertaken under the direction of the BMC Disaster Management Committee. The Committee will also be responsible for continuous monitoring of such activities. Such a committee will be a permanent committee. The composition of the committee will be as follows:

Municipal Commissioner	Chairman
Deputy Municipal Commissioner - In-charge	Member Secretary
BMC Control Room	Member
Collector, Greater Mumbai District	Member
Collector, Mumbai Suburban District	Member
Collector, Thane	Member
Transport Commissioner	Member
Joint Commissioner of Police (Law and Order)	Member
Additional Commissioner of Police (Traffic)	Member
Chief Fire Officer, BMC	Member
General Manager, Central Railway	Member
General Manager, Western Railway	Member
Director, Medical Services, GOM	Member
Executive Health Director, BMC	Member
Director, Civil Defence and Home Guards	Member
General Manager, BEST	Member
General Manager, BSES	Member
Technical Director, MSEB	Member
Executive Engineer, Water and Sanitation, BMC	Member
Controller of Rationing	Member
Director, Industrial Safety and Health	Member
Chief Engineer, PWD, GOM	Member
Director General, Information and Public Relations	Member

Maintenance of essential services

Repair, maintenance and running of essential services can be undertaken in the initial stages of relief.

Evacuation of people to safer areas

Assist in evacuation of people to safe places before and after the disaster.

Management of International Relief

Management of handling of international relief can be undertaken by the defence services.

Non-governmental Organisations (NGOs) and Voluntary Agencies

NGOs have been assigned specific tasks by the Municipal Commissioner to undertake relief work within the overall institutional framework. As and where possible, NGOs may also be able to improve the quality of delivery of services. In addition, Mohalla Committees have been operating at the community level, especially in times of emergencies like house collapses, fires, floods. Such committees have been identified at the ward level.

Private Sector units, NGOs and other organisations have been identified as resource groups for involvement in community preparedness measures. These agencies will be able to get the benefit of training for the same from the training activities undertaken by YASHADA.

Plan dissemination through Community Education

For Greater Mumbai DMAP to be effective it must be disseminated at three levels ;

Central government departments, multilateral agencies (aid agencies), defence services, state level officials

To the municipal authorities, district authorities, government departments, corporate sector, NGOs and other agencies and institutions within Greater Mumbai and through mass media to the general public.

RESPONSIBILITIES OF VARIOUS AGENCIES AT THE TIME OF NEED HAVE BEEN CLEARLY DEFINED IN THE DMAP.

Response Structure at District Level (on occurrence of Disaster)

Chief Secretary / Relief Commissioner Emergency Operation Center
District Collector District Control Room
SDO/Tahasildar Site Operations



Activities	Departments/Agencies
Search & Rescue	Revenue, Police, Health, Irrigation, PWD, Fire Brigade, CERTs, NGOs
Medical Aid (treatment/Transfer)	Revenue, Health, CERTs, Ambulance, NGOs
Disposal of Dead	Revenue, Police, health, Forest, NGOs, CERTs
Carcass Disposal	Revenue, Zila Parishad/Municipality Corporation, CERTS, NGOs
Infrastructure Restoration (water , electricity, road)	PWD, Electricity Board, Telephone Department,

Mandated First Responder Organizations in the State

a) Govt. Departments:

Defence Services, State Police, CISF, CRPF, Home Guards, Coast Guards, Fire Brigade, Revenue, Home, Health, Finance, Transport, Municipality Corporation (in urban areas) & Panchayat Samitis (in Rural Areas), Irrigation, Public Works, Water Supply, Labor & Information.

b) Non Govt. Agencies:

Red Cross, Civil Defence, NGOs,

Specific Roles of First Responder Organizations

1. **Municipality Corporation** (Coordinating Agency for emergency Response): alert, evacuation, emergency water and food, corpse disposal, clearance of debris, emergency repairs, coordination of transport, temporary shelters
2. **Civil Defence**: Evacuation, Search & Rescue, carcass disposal, First Aid & Relief
3. **Fire Brigade**: Fire fighting, Evacuation, Rescue, Salvage
4. **Police**: cordoning of area, rumor control, law & order, rescue, Corpse disposal, traffic management
5. **Revenue**: evacuation, transit camps, arrangements for food, relief
6. **Railways**: standby transport, evacuation, Rescue, transfer of persons. Railway hospitals.
7. **Transport department**: standby transport, transfer of stranded persons
8. **Health**: alert, evacuation, transportation of seriously injured, emergency treatment, corpse disposal, preventive measures, health monitoring
9. **Home Guard**: Rescue
10. **Red cross**: First aid, transfer of injured, emergency treatment, relief

3.3.2 Agency Interviews in Maharashtra

(Experts of the Discussion with different First Responder Agencies in Mumbai & Pune)

1. CIVIL DEFENCE

In India the Civil Defense Organization is established at the national, State and District levels with the objectives of minimizing the loss of people, property and industrial production and to maintain the moral of the people in a war situation. The organization is raised under the provisions of Civil Defense Act 1968.

The Civil Defence plan is based on following three principles:

- extension of peace time duties of Govt. Departments to meet the need of emergency
- To raise the voluntary organisation to supplement the govt./semi Govt. agencies
- The neighboring area/towns to rush additional help to the place of disaster.

Internal security is included in the common list of central and state Govt. responsibility under Home Ministry. However, for effective implementation of Civil Defence measures all the Govt. Departments and Local bodies should participate in the disaster Management Activity especially for civil Defence.

Administrative Structure

At the national level, the Divisional General, Additional Divisional General heads the organization, who are deputed from army or other government organizations. At state level, a senior IPS officer is appointed as Director, Civil Defence. Where as the district magistrate is appointed as controller of Civil Defence ex-officio at the district levels..

Service Structure

This is a volunteer-based organization that draws its membership from amongst the people and all other concerned organizations for the assistance of people. Any Indian national who is above 18 years age can be eligible for Civil Defence Volunteer. However, the volunteers are usually ex-servicemen, college goers, NCC and school students. It has little or no inventory of its own in terms of permanent staff or equipment. Hence acts more as an umbrella organization for resourcing out from all govt. and non-govt organizations.

Mandates of Civil Defence

1. Organisation for control of incidents at the place of damage and priority of action.

2. Detection & reporting of unexploded bomb and cordon and evacuation of danger zones
3. Depot organisation for stationing of mobile civil defence resources
4. Establishment & organisation of rescue services
5. Disposal of dead and identification of dead bodies.
6. Liaison with Military and Mutual Aid schemes between Military and Civil Authorities.
7. Establishment and organisation of casualty services, namely First Aid parties, static & mobile first aid posts, ambulances and mobile surgical units
8. Emergency hospital organisation scheme, provision of ambulance and trains
9. Removal of debris, restoration of essential services
10. Care & evacuation of animals, treatment of injured animals, disposal of dead and transport of injured animals.

Drills and exercises for demonstration are recommended but not mandated. Therefore at the time of need instead of being a primary organization for search and rescue or first aid it manages to do relief operations.

Response Mechanism

As per the Maharashtra Disaster Management Plan, the agency is entrusted, the activities like Search, Rescue, First Aid and evacuation in an emergency situation. The District magistrate activates the organization when the need arises. The warden services at the level of each ward in the city /town and hence it has a wide reach. The manpower and equipment is then gathered for emergency response. There are norms that guide the CDs' preparedness for a 3-lac population at all times.

Training Programme

At the national level, the National Civil Defence College, Nagpur provides advanced training to the volunteers of Civil Defence of all age groups. The states too have their own Central Training Institutes with the training activity also percolating to the district level. These are 7 days courses with refresher course also available.

Strength of the Organisation

The Organisation has a pool of faculty who are well trained in Emergency response especially in Maharashtra and they have training Institutes where they provide training to the Volunteers on SAR/MFR etc. In addition, there are 50,000 Civil Defence Volunteers in Maharashtra State. Out of which 25,000 are in the Mumbai City and 12,000 in the Pune City.

Some of the weaknesses of the Organisation are:

- **Shortage of funds** for equipment and its sourcing out at the time of need from various other agencies leads to time loss.
- **Standard Operating Procedure** not tied up which is the basic reason for delay in responses.

The Civil Defence has a definite Disaster management Plan. As per the Plan the city is divided into 2 zones. Each zone is divided into Divisions each for 3,00,000 population. Every Division is divided into sub division of about 1,00,000 population which further subdivided into warden Post Area at 20,00 population each.

Every Division shall have sub Control Centre. Every Control/sub control center shall have a depot attached to it. One Mobile First Aid post per 3,00,000 population to be stationed at Depot. Three First Aid parties per static F.A post. Six ambulances per depot for use by static FA post. One ambulance per FA party on duty. One rescue party per 25,000 population. There is one rescue vehicle per party on duty. There is Dead disposal squad one per 1 lakh population.

The Mumbai Civil Defence has Mobile Column like Fire Brigade who is manned 24 hrs. Each mobile column consists of 8 persons, 4 ambulances with medical officer and support staff. Mobile emergency response team has no specialized protective equipment. However they are trained in SAR and MFR training. In their Training Institutes they provide trainings on MFR which is of 12-to15 days duration.

They communicate through VHF with the 33 centers in the Mumbai city and communicates with the Districts through HF communication.

The organization usually does not provide equipment to the volunteers but at the time of need sourced out the equipment from the appropriate agencies depending on the requirement.

The organization has pool of trainers and training facilities which can be considered as nodal agency for the training in emergency Response. The CD has also casualty service plan. It has also mobile health center

2. FIRE BRIGADE

• **Mumbai Fire Brigade**

(experts of the discussion with Shri B.B. Surve, Chief Fire Officer, Mumbai and Shri Rahangede, Station Officer, Forte Fire Brigade, Mumbai)

Mandates of Fire Brigade

As per the Mumbai Disaster Management Plan, the Mumbai Fire brigade is assigned following activities in a post disaster situation:

- Fire fighting operations in the affected areas
- Rescue operations
- Transport of injured to the hospitals
- Evacuation of persons from the affected areas
- Ensure safety from electrical installations or power supply at disaster site
- Clearing of roads or pathways
- Salvage operations
- Coordinate with Bombay Municipality Corporation for rescue operations in house collapses
- Communicate to the fire brigade control room details on the field activities including deployment and reinforcement of staff and resources and communicate nature of additional requirement.

Response Structure

The fire brigades control Room monitors the emergency response actions and communicate with BMC control room on the details of the activities. The chief Fire Officer, BMC, Byculla is the key official for overall supervision of the emergency response actions. The fire brigade station officer in coordination with word officer is responsible for the above activities.

Facilities

In Mumbai City there are 24 Fire stations under the Mumbai Fire brigade.

The facilities and resources available with Fire Brigade are :

- Fire appliances
- Special appliances like mini snorkel, DL, 30, rescue van, Breathing apparatus Van
- Water tanker
- Ambulances
- Gears and other sophisticated equipment's

(for details of the equipment and appliances see annexure)

Emergency Assistance

They are the primary first responders in case of an emergency on the telephone no. 101 (for fire & rescue)/102(for ambulance). The Fire Brigade control room has hotline communication with BMC H. Qr., Police control room, State control room, Airport and BEST and VHF communication with the Fire stations. They also have a small fleet of ambulances with them. In addition, one Mobile Trauma Van manned 24hrs, by fire personnel, doctor and nurses is kept at Sion hospital.

Other Agency , the police is their main co-ordinating agency which cordon's off the area clearing the passage for their easy of movement. There is sometimes contact with the electricity board through the control room for assistance on site and there might be others too.

On-Site management, there is an officer In-charge his rank varies with the scale of the disaster and he is the co-ordinator. He makes the first assessment and calls in for more help. There is actually a fire classification and accordingly the response is mobilized.

Apart from the brigade staff there is also Water staff that is aware of all tank and water supplies of the area. They are called in incase there is a need to locally tap water supplies to douse the fire.

Maintenance

They have their own workshop at Godala and are independent in terms of vehicle maintenance.

Basic Safety

Personal safety equipment would be a helmet, special clothing, gumboots etc.

Training

A Fire training Institute at National level at nagpur provides training to the fire brigade personnel. In addition, the state has its own training institute in Mumbai and other places of the state. At the time of recruitment a 6 months training is provided, all comprehensive from physical fitness to handling equipment and situations can be as varied as drowning etc. Only two persons in the whole fire brigade has got advance training on MFR and SAR in abroad. However, the fire brigade has no formal Emergency response team.

Drills

Mandated to be conducted everyday but it usually happens on the day that the station has full staff strength.

Media

There is a daily contact with the media a special line available for daily briefing.

Awareness Programmes are occasionally held

Disaster Management Scheme

The Mumbai Fire Brigade has proposed to establish a Disaster Management team that is yet to be decided at the administrative level.

• **Pune Fire Brigade**

(experts of the discussion with L.N.Raut, Chief Fire Officer, Pune)

There are 7 fire stations in the pune district receiving on an average 1400(fire) and 1500 (rescue) calls in a yr. The pune fire service has a staff of 650.

Emergency Assistance They are the primary first responders in case of an emergency on the telephone. They are equipped with wireless communication between all fire brigades stations and collectors control room.

Other Agency: They mainly coordinates with police and other agencies like hospital, food department, water and transport department , municipal and other private organization

On-Site management, there is an officer In-charge his rank varies with the scale of the disaster and he is the co-ordinator.

He makes the first assessment and calls in for more help. There is actually a fire classification and accordingly the response is mobilized.

Apart from the brigade staff there is also a Water staff that is aware of all tank and water supplies of the area. They are called in incase there in a need yto locally tap water supplies to douse the fire.

Inventory: 22 water tanker, 2 Rescue van (modern van), 4 water tanker, 2 H.P

Equipment

Casualty Locating System like physical search, Audible call out/knocking method, Cameras and now with latest thermal image camera were used for search .

Maintenance

The maintenance is very regular. Every day the tankers, fire vehicles and communication systems are check. The staffs are trained to rescue any emergency at any time.

Basic Safety

Personal safety equipment would be helmets, mask, special clothing gum boots.

Training

National level inst is in Nagpur, Some training from Civil defense at bombay and home gaurd.

At the time of recruitment basic training is provided, all comprehensive from physical fitness to handling equipment and situations can be as varied as drowning etc.

All the officials have to go some or the other training and course if proposed.

Drills

Regular drill and practice is maintain.

Media

During any incident fire officers give the latest information to the media

Communication : wireless, telephone, mobile, walktaiky, pager. Every fire vehicle is equipped with wireless sets

Awareness Programmes: community awareness programme is held frequently. The organization is planning to train 1.25 thousand communities.

Disaster Management Scheme

The chief Fire officer is the key official of Pune Fire Brigade which is under the administrative control of Pune Municipal Corporation. In case of large fire and in the emergency beyond the city and within the district the collector commands the instruction. The collector informs the Police, Mayor, RDC, Hospitals and other important agencies.

3. ARMY

(Experts from the Discussion with Col Mukutesh in Military Actions Squad in Mumbai & Col. C.R. Pal in Bombay Engineering Group, Southern Command, Pune)

The Armed forces join in the Emergency Response actions after recusioned by the State Government. Mumbai Municipal Corporation which is nodal coordinating agency coordinates with the Military Actions Squad stationed at Maharashtra & Gujarat Area headquarter office at Navy Nagar, Colaba, Mumbai. After getting request through proper channel the armed forces responds in the disaster situation. Infact the armed forces are always in the state of readiness to face any kind of emergency. They first sent the one or two column for the damage assessment and emergency Restoration, Rescue and Medical assistance. If situation warrants they seek the assistance from the nearest command headquarter.

Army has proved its effectiveness and efficiency in handling the emergency situations. In fact they are the quickest responders in comparison to other agencies in the country. Though they are not trained specifically trained in disaster Management aspects, but they have been effectively handling the situations.

Considering this fact, the army has taken a policy decision to introduce the disaster management component tin their training curriculum of the Military Training Academy, Dehradun.

Regarding the coordination aspects both of them suggested there needs to be joint command of all concerned agencies while dealing with the emergency situations. The role of Armed forces should be restricted to the Emergency Rescue & Relief Operations.

One of their suggestions is army personnel's at all levels required to be given training on different areas of Emergency Response and handling the state of the art equipment. As Disaster Management is the sole responsibility of Civil administration, and armed forces act as a support organisation, more money and equipment to be given to army for this specific purpose so that army can more effectively contribute in dealing with emergency situations.

4. HOSPITAL

(Experts of Discussion with Medical Superintendents of Soshoon Hospital, Pune and Saint George Hospital, Mumbai)

The Research team had visited the following Hospitals at Mumbai and Pune to know the status of the preparedness of the Govt. Hospitals in the State. There is a clear provision of hospital preparedness in the Mumbai & Pune City Disaster Management Plans. Following are the experts of the Research team.

- **St. Georges Hospital, Mumbai** (Dr.(Mrs) Veena Shangari, Medical Superintendent)

Disaster Management Plan: As such the hospital has no written Disaster management Plan. However, in case of emergencies, hospital has a track record of handling emergency situations. As usual, day to day emergencies is handled in the casualty and in emergency ward. In the event of Mumbai Bomb blast in dec1991 the hospital had treated about 2000 casualties in which 50 were treated.

Emergency contact: Most of the doctors resides in the same campus so in any type of emergency the doctors are available. In emergency telephones and wireless are used to communicate to the staffs. Most of the doctors are having mobile set.

Space availability : St. George hospital have lot of open space. So any thing can be converted to emergency . waiting area/lobby, physician's offices. Parking lots can be converted into space for patient care during emergency

Triage: The hospital does not perform triage.

Facilitation: There is one operation theatre with five operating tables. The operation theatre is at the first floor.

First Report: In case of an emergency papers are made later and the patient referred first. Later a medical Record Technician collects the relevant patient information.

Other agencies : Usually it is very difficult to coordinate. But still during emergency it coordinate with surrounding public(govt.) hospital,

Training: Basically all the doctors are trained for emergency response. In this hospital except the superintendent (Dr.Veena Shangari) no doctor has gone for any type of emergency training.

Drills : No drill

- **Sassoon General Hospital, Pune** (experts of the discussion with Dr Yashwant Doiphode, Medical superintendent)

The sassoon hospital is the biggest hospital in the state. It has 1296 beds in the hospital with 400 doctors.

Disaster Management Plan: There is no formal DMP for major disaster in the hospital. However day to day emergencies treated in the casualty and in emergency ward. There is no formal team formulation.

Emergency contact : Most of the doctors resides in the same campus so in any type of emergency the doctors are available. In emergency telephones, bells and wireless are used to communicate to the staffs.

Space availability : Any thing can be converted to emergency . waiting area/lobby, physician's offices. Parking lots can be converted into space for patient care during emergency

Triage: The hospital does not have separate triage room.

Facilitation: There is 4 operation theatre with 16 operating tables. All the operation theatre are on the ground floor.

First Report : In case of an emergency papers are made later and the patient referred first. Later a medical Record Technician collects the relevant patient information.

Stockpile : All important and emergency items is in stock. Whenever in need the intend is made for the necessary items. There is regular check of the medicine and inventory.

Other agencies : Usually it is very difficult to coordinate. But still during emergency it coordinate with surrounding public(govt.) hospital,

Training : Basically all the doctors are professionally trained for emergency response.

Drills : No drill

External response: Gujarat earthquake. 30 patients were treated here.

• Experts of the Discussion with Dr Padhni, Sree Clinic, Pune)

The Doctor runs a private Nursing Home in The centre of the Pune City. It is a super specialty Hospital in the Pune. During the Gujarat Earthquake the staffs from the hospital had participated in the Emergency medical assistance at Bhuj and treated about 2000 patients. A Emergency Medical team consisting of around specialist doctors and support staff had visited the quake affected areas and performed wonderful job.

After this experience the doctor has himself has established a Mobile Hospital unit which can be used in a disaster situation. The whole hospital will be operated in container with operation room facility. For this he has formed a NGO called RESUE MADE on the lines of "Doctors Sans Borders" (an international Medical NGO). He suggested the size of a Mobile hospital unit should ideally be 30 to 35. Each unit should consists of the pECIALISTS like Anaesthtician, Surgeon, Orthopaedic, Medicine, Gynaecologist, Preventive and social health socialist, Neuro surgeon, Vascular surgeon and 3 support staff per doctor. If possible 5 medical social workers should be included in the team.

This is a first on the part f the private hospitals in India to have such initiatives, However he suggested that thee is need to train the support staff of the mobile hospital and Emergency Medical team so that it would enhance the capability of the Team. There is also a need of creating a database of the Emergency Responders in the Country.

Assessment of First responder organisations in Mumbai City

Table: Mumbai - Medical First-Aid Providers Profile

Criteria	Agencies ¹³						
	DDMP	IRCS	AR	SGH	POL	MFB	CD
Legislative & Regulatory Environment							
Legislative Mandate for Medical First Responder	2	2	2	2	0	1	1
Designation of Medical First Responders	0	2	1	1	0	2	2

DDMP – District Disaster Management Program;

IRCS-Indian Red Cross Society

CD – Civil Defence;

MFB-Mumbai Fire Brigade.

AR – Army,

POL – Police,

SGH- St. George Hospital

Criteria	Agencies ¹³						
	DDMP	IRCS	AR	SGH	POL	MFB	CD
Certification/Licensing of MFR							
National Body	2	2	2	1	0	1	2
Provincial Body	2	2		1	0	2	2
Private Body		0					
Re-Certification							
Automatic/None	1	1					1
Demonstrated Skills		2				2	2
Written MFR Disaster Management Plan							
Scenario-Based Plan	2	2	2		1	2	2
Activation Plan	1	1	2	1	1	2	1
Incidence Command Plan	2	2	2		1	1	1
Inter-Agency Coordination Plan	2	1	1	0	1	1	1
Time Sensitive Drill/Mock Exercise	2	1	0	0	0	1	1
Training Plan	1	1				0	1
Communication & Dispatch System							
Runners ¹⁴	0	1	0	0	1	1	1
Primary Communication System Only ¹⁵	2	2	2	1	1	1	1
Secondary Communication Systems with Support ¹⁶	2	2	2	0	1	1	1
Composition of Medical First Responders							
Driver + Doctor + Nurse	0	1	2	1		1	2
Driver + Trained Medical First Responder or higher	1	2	2	2		1	1
Driver with First Aid/BLS training	2	2	2	2		2	1
Driver without First Aid/BLS training				1		0	1
MFR Teams Average Response Time							
Urban/Sub-Urban							
< 30 minutes	1	1	2		2	2	1
> 30 minutes	1	2		1	0	0	2
Rural							
< 12 hours							
> 12 hours							
Availability of Emergency Medical Equipment & Supplies							
Basic First Aid Kit		2	2	1		2	2
Backboard		1	1		2	2	1
C-Collar		1	2	2			0
Splints		2	2	1	0	1	1
Basic Airway		1	1	0	0	2	0
Bag-valve Mask			2			1	
Suction Device		1	1	1		2	
Defibrillator		1	1	2			

Criteria	Agencies ¹³						
	DDMP	IRCS	AR	SGH	POL	MFB	CD
Oxygen Therapy Accessories		1	2	1			1
IV Supplies and Fluids		1	2	1		2	
Capabilities of Teams							
Patient Assessment	1	2	2	1		2	1
Basic First Aid	2	2	2	1	1	2	2
Cardiopulmonary Resuscitation	1	2	2	2	1	0	1
Cardiovascular Emergency		1	2	1		0	0
Shock	0	1	1	1		1	1
Coma and Head Injury	0	0	1	2			
Airway Management	1	1	2		1	2	2
Chest Injury		1	2	2			
Spine Injury	0	1	2	1			
Burns	1		2	2			
Dehydration Identification & Treatment	0	2	2	2	0		1
Poisoning Recognition & Treatment	0	1	2	2	0		1
Emergency Childbirth		1	1	2			
MFR Team Personal Protection Equipment & Supplies							
Eye Protection	1	0	0	0	0	0	0
Respiratory Protection	1	0	0	0	0	0	0
Body Fluid Protection							
Bio-Chemical Contaminant Protection	1	0	0	0	0	0	1
Total Points (Highest=63)	33	58	63	42	14	43	43

Table: Mumbai – Search and Rescue Preparedness

Criteria	DDMP	IRCS	CD	POL	AR	MFB
Legislative & Regulatory Environment						
Designated Entity	2	2	2	2	2	2
Self-Regulation	1	2	1	1	2	1
Supervision	2	2	2	2	2	2
Training	1	1	1	1	1	1
Written SAR SOP in the Disaster Management Plan						
Activation Plan	2	2	2	2	2	2
Personnel Notification Plan	2	1	2			
Logistics Plan	2	1	2			
Communication Plan	2	2	2	2	2	2
Reporting Timeframe to Staging Location	1	2	1	1	2	2
Built-in System for Worker Rotation	1	2	1	1	2	2
Community Relations & Participation Plan	1	1	1			1
Communication & Dispatch System						
Wireless/Radio	2	2	1	1	2	2
Cell Phone System	0	0	0	0		0
Runner	2	2	2	2		2

Criteria	DDMP	IRCS	CD	POL	AR	MFB
SAR Teams Capabilities						
Structural Evaluation	0	0	2	2		1
Hazard Monitoring & Evaluation	2	2	2	2		1
Victim Location		1	1	1	2	1
Victim Access		1	1	1	2	1
Victim Stabilization (medical)		1	1	1	2	1
Victim Extraction		1	1	1	2	1
SAR Team Composition	Not clear		yes		yes	
Search/ Recon Team Leader		2	2		2	
Licensed Structural Engineer						
Two Canine Specialists						
Technical Search Specialist						
Two Rescue Specialist		2	2	0	2	1
Medical Specialist		2	2		2	1
Hazardous Material Monitoring Specialist			2		2	0
Collapsed Structure Team						
Team Leader/Safety	1	1	1		2	1
Runner (1)						
Workers (3)						
Rescue Squad						
Team Leader/Safety	1	1	2	1	2	1
Workers (5)						
SAR Team Response Time						
<i>Urban/Sub-Urban</i>						
< 30 minutes	2	1	0	1	2	1
> 30 minutes	0	1	2	1		1
<i>Rural</i>						
< 12 hours						
> 12 hours						
Search & Rescue Equipment & Supplies						
Human Resources	1	1	2	0	2	1
Canine	0	0	0	0		0
Technical Equipment/Devices						
Visual					1	1
Audio	0	0	0	0		1
Building & Victim Marking Supplies	0	0	0	0		0
Hand Tools	1	1	1	1	2	1
Breaching Equipment	2	0	0	0	2	1
Hazard Monitoring Equipment & Supplies	0	0	0	0	1	0
Sextant	0	0	0	0		0
SAR Team Personal Protection Equipment & Supplies						
Hard Hat					2	
Steel Toe Shoes		0	0	0	1	2

Criteria	DDMP	IRCS	CD	POL	AR	MFB
Leather Gloves		1	1	1	1	1
Eye Protection		1	0	0	1	2
Ear Protection		0	0	0	1	0
Dust Mask		1	1	1	2	2
Safety Vest		1		0	2	1
Long Sleeve Shirt		1	1	1		1
Long Pants		1	1	1		1
TOTAL	31	46	48	31	57	46

DDMP – District Disaster Management Program;

IRCS-Indian Red Cross Society

CD – Civil Defence;

MFB-Mumbai Fire Brigade.

AR – Army,

POL – Police,

SGH- St. George Hospital

Table: Mumbai- Hospital Disaster Preparedness

Assessment Factors	SGH
Hospital Emergency Preparedness Plan	
Written Plan Exists	2
Accounts for internal risks	1
Appropriate for Regional Disaster Profile	2
Written Plan is Understood by Staff	2
Responsibilities/Tasks Have Been Identified	2
Maximum Emergency Caseload has Been Determined	1
Drill has been Conducted	0
Triage Area has been Identified	2
Triage Tags Have Been Prepared	0
Clear Signage and Markings Exist	1
Essential Drugs & Supplies have Been Stocked	1
Emergency Food Stock For Staff & Patients Stocked	2
Hospital Staff Capabilities:	
Appropriate Triage ¹⁷	2
Fluid and blood resuscitation ¹⁸	2
Airway control and maintenance ¹⁹	2
Immediate surgical intervention ²⁰	1
Cardiac resuscitation ²¹	2

Assessment Factors	SGH
Patient Safety ²²	1
Staff Safety ²³	1
Hospital Earthquake & Fire Safety	
Hospital Physical Structure Earthquake Stabilized	2
Hospital Fixtures, Furnishing, Equipment are Anchored	1
Emergency Stockpile is Secure & Anchored	0
Fire Extinguishers are Visible and Functional	1
Unobstructed and Clearly Marked Fire Exits	1
Hospital has Independent Water Supply Source	1
Hospital has Adequate Power Backup System	1
Hospital Has Adequate Internal/External Communication Capability²⁴	
Has Hardwired Communication System	2
Has Pager System	2
Has Cell Phone System	1
Has Radio Communication System	0
Has Intercom & Loudspeaker System	1
Monitoring and Evaluation	
Drills evaluated	0
Disaster specific response effectiveness assessed	1
Emergency Medical Capacity assessed	2
Overall Score	43

Assessment of First responder Organizations in Pune City

Table: Medical First-Aid Providers Profile of Pune

Criteria							
	DDMP	AR	POL	SGH	CD	PFB	
Legislative & Regulatory Environment							
Legislative Mandate for Medical First Responder		1	0	2	1	1	
Designation of Medical First Responders		1		2	1	0	
Certification/Licensing of MFR							
National Body		2	2	2	2	1	
Provincial Body							
Private Body							
Re-Certification							
Automatic/None				1		0	
Demonstrated Skills				0		0	

Criteria	DDMP	AR	POL	SGH	CD	PFB
Written MFR Disaster Management Plan						
Scenario-Based Plan				1		2
Activation Plan				0		2
Incidence Command Plan				0		0
Inter-Agency Coordination Plan				1		
Time Sensitive Drill/Mock Exercise				0		1
Training Plan				1		1
Communication & Dispatch System						
Runners ²⁵				0		
Primary Communication System Only ²⁶		2	2	1	2	1
Secondary Communication Systems with Support ²⁷		1	1	0	1	1
Composition of Medical First Responders						
Driver + Doctor + Nurse		2	1	2	1	0
Driver + Trained Medical First Responder or higher		1	1	1	1	1
Driver with First Aid/BLS training		2	1	2	2	2
Driver without First Aid/BLS training				0		
Teams Average Response Time						
Urban/Sub-Urban						
< 30 minutes		1	1	2	1	1
> 30 minutes		1	1	1	1	1
Rural						
< 12 hours			1	1	1	1
> 12 hours				1	1	1
Availability of Emergency Medical Equipment & Supplies						
Basic First Aid Kit		2	2	2	2	2
Backboard				1		
C-Collar		1		0		
Splints		1		0		
Basic Airway				0		
Bag-valve Mask			1	0	1	1
Suction Device		1		1		
Defibrillator		2		1		
Oxygen Therapy Accessories		2		1	2	0
IV Supplies and Fluids		2		0		
Capabilities of Teams		2	1	1	1	1
Patient Assessment		2	2	1	2	2
Basic First Aid		2	0	2	1	1
Cardiopulmonary Resuscitation		2		2	1	
Cardiovascular Emergency				2		0
Shock		1		1		

Criteria	DDMP	AR	POL	SGH	CD	PFB	
Coma and Head Injury		2		2			
Airway Management				0			
Chest Injury		2		1			
Spine Injury		2		1			
Burns		2		2	1	1	
Dehydration Identification & Treatment				1			
Poisoning Recognition & Treatment				0			
Emergency Childbirth				2			
Team Personal Protection Equipment & Supplies							
Eye Protection		2	2	2	2	2	
Respiratory Protection		2	2	2	2	2	
Body Fluid Protection		2	2	2	2	2	
Bio-Chemical Contaminant Protection		2	2	2	2	2	
Total Points (Highest=55)		50	25	55	34	32	

Note :

1. AR - Army
2. PO - Police
3. SGH - Sassoon Hospital
4. CD - Civil Defense
5. PFB - Pune Fire Brigade

Table: Search and Rescue Preparedness of Pune

Criteria	POLICE	CD	ARMY	PFB
Legislative & Regulatory Environment			None	
Designated Entity	2	2	2	2
Self-Regulation				1
Supervision	2	1	2	2
Training	1	2		2
Written SAR SOP in the Disaster Management Plan	None	None	None	None
Activation Plan				
Personnel Notification Plan				
Logistics Plan				
Communication Plan				
Reporting Timeframe to Staging Location				
Built-in System for Worker Rotation				
Community Relations & Participation Plan				
Communication & Dispatch System				
Wireless/Radio	2	2	2	2
Cell Phone System	2	2	2	2
Runner	1			1
SAR Teams Capabilities				
Structural Evaluation	1	2	2	2

Criteria	POLICE	CD	ARMY	PFB
Hazmat Monitoring & Evaluation	1	2	2	1
Victim Location	2	2	2	1
Victim Access	2	1	1	1
Victim Stabilization (medical)	1	2	2	1
Victim Extraction	1	1	1	1
SAR Team Composition				
Search/ Recon Team Leader				0
Licensed Structural Engineer	2	2	2	0
Two Canine Specialists	1	1	2	2
Technical Search Specialist	2	1	2	2
Two Rescue Specialist	1	2	2	1
Medical Specialist		2	2	1
Hazardous Material Monitoring Specialist	2	1	2	0
Collapsed Structure Team				
Team Leader/Safety	2	2	2	2
Runner		1		1
Workers				1
Rescue Squad				
Team Leader/Safety				1
Workers				1
SAR Team Response Time				
<i>Urban/Sub-Urban</i>				
< 30 minutes	2	1	2	1
> 30 minutes	1	1	1	1
<i>Rural</i>				
< 12 hours	1	1	1	1
> 12 hours	1	1	1	1
Search & Rescue Equipment & Supplies				
Human Resources	2	2	2	2
Canine	2	1	2	2
Technical Equipment/Devices				
Visual	2	2	2	2
Audio	2	2	2	2
Building & Victim Marking Supplies		2	1	1
Hand Tools	2	2	2	2
Breaching Equipment	1	1	1	1
Hazmat Monitoring Equipment & Supplies	1	1	1	1
Sextant	1	2	2	2
SAR Team Personal Protection Equipment & Supplies				
Hard Hat	2	2	2	2
Steel Toe Shoes				1
Leather Gloves	2	2	2	2

Criteria	POLICE	CD	ARMY	PFB
Eye Protection	2	2	2	2
Ear Protection	1	1	1	1
Dust Mask	2	2	2	2
Safety Vest	1	2	2	1
Long Sleeve Shirt	2	2	2	2
Long Pants	2	2	2	2
TOTAL	60	61	67	65

Note :

1. CD - Civil Defense
2. AR - Army
3. PFB- Pune Fire Brigade

Table: Hospital Disaster Preparedness of Pune

Assessment Factors	SASSOON Hospital
Hospital Emergency Preparedness Plan	
Written Plan Exists	1
Accounts for internal risks	1
Appropriate for Regional Disaster Profile	2
Written Plan is Understood by Staff	0
Responsibilities/Tasks Have Been Identified	1
Maximum Emergency Caseload has Been Determined	1
Drill has been Conducted	0
Triage Area has been Identified	1
Triage Tags Have Been Prepared	0
Clear Signage and Markings Exist	1
Essential Drugs & Supplies have Been Stocked	2
Emergency Food Stock For Staff & Patients Stocked	2
Hospital Staff Capabilities:	
Appropriate Triage ²⁸	1
Fluid and blood resuscitation ²⁹	1
Airway control and maintenance ³⁰	1
Immediate surgical intervention ³¹	1
Cardiac resuscitation ³²	2
Patient Safety ³³	2
Staff Safety ³⁴	2

Assessment Factors	SASSOON Hospital
Hospital Earthquake & Fire Safety	
Hospital Physical Structure Earthquake Stabilized	1
Hospital Fixtures, Furnishing, Equipment are Anchored	1
Emergency Stockpile is Secure & Anchored	0
Fire Extinguishers are Visible and Functional	1
Unobstructed and Clearly Marked Fire Exits	1
Hospital has Independent Water Supply Source	1
Hospital has Adequate Power Backup System	1
Hospital Has Adequate Internal/External Communication Capability³⁵	
Has Hardwired Communication System	2
Has Pager System	2
Has Cell Phone System	0
Has Radio Communication System	0
Has Intercom & Loudspeaker System	1
Monitoring and Evaluation	
Drills evaluated	0
Disaster specific response effectiveness assessed	1
Emergency Medical Capacity assessed	1
Overall Score	35

4. Major Findings & Directions for National Disaster Prevention, Preparedness and Mitigation

4.1 Analysis & Findings

4.1.1 Conclusions on Medical First-Aid Providers

There is a lack of organized Medical First aid Response Capabilities. It is a problem of not only quick response capacity but training programs, equipment and no. of people with such capabilities.

There is a lack of legislation. No Good Samaritan laws exists.

There is also a possibility of misrepresentation of the level of training. There are no set standards and agencies have their own programs with no reviewing umbrella organization. It is to their prerogative therefore the rate of modernization with time is unclear. Data of previous situations handled is missing or limited and that leaves this gap of realization and enhancement.

Budgetary allocation for training and equipment particularly is based on off and on availability of funds and no continued strict adherence to upgradation.

Documentation of intervention done at site is not a standard practise and therefore when the patient is received in the hospital there is wastage of precious time and effort.

Competency is difficult to establish as there are no standards or mandated re-certifications, it is more to do with the trust in the organization in the localized context. Red Cross is known throughout therefore in a few states commercial drivers would have to have mandatory IRSC First Aid training.

A theory based approach to training programs with little or no emphasis on drills and exercises makes it difficult to truly gauge the field preparedness.

There is a constant effort to upgrade to but the demand seems to out weigh the supply many folds in terms of quality and quantity.

The Public demands but is essentially not involved in voluntary activities so to speak.

The communications are extremely poor except in case of CATS, a pilot effort and the Fire Brigade that keeps a fleet of ambulances of its own.

Most ambulances can barely accomodate the patient they are usually Maruti OMNI's converted and are used for patient transport only with most having a first aid bag and some having oxygen tanks.

Recommendations for First Aid Providers

1. Organize a national/regional system under an authority or governing body that does not only issue guidelines but makes it mandatory to follow them. The State should have no choice of capacities of first aid providers that it should train and maintain in accordance with flexible budgets but to review needs and analyse results.
2. Create strict laws/legislation and let it not be termed as charity practises only.
3. Standardization of training program approach and content with more practical orientation for an all pervasive handling is important.
4. Provide more budgetary support for training, equipment and communication network.
5. Establish protocols for continuity of care from the field to the receiving facility.
6. Strengthen local grass-root organizations and training program availability.
7. Concretization of annual expansion and upgradation schedules with proper scrutiny standards.
8. Need to improve the standards for ambulance units (i.e. level of training of personnel and upgrade equipment).
9. Fire, private ambulance services, IRCS and government ambulance personnel from AIIMS AND RMLH are ideal targets for first aid training. Police may also be a target once the other agencies are trained as they are informers usually.
10. Co-ordination and information dissemination for activation lacks in some cases with cross agency co-ordination being extremely poor.
11. Public awareness and participation is necessary about emergency situations and the organizations that can be approached in such times of need.

4.1.2 Conclusions on SAR

SAR capability is minimal.

Delh falls in a high risk zone but is almost incapable of handling wide spread disaster of its own with it barely managing small localized emergencies in the past.

Because of the uncertainty of enforcement of building codes, there is a potential danger of catastrophic incidents (i.e. multistory building collapse).

Training Programs for Search and Rescue are not comprehensive and there proficiency cannot be guaranteed as practical awareness and drills are lacking except probably with the Fire Department.

Equipment availability and timely aquisition of the same is a difficult task, co-ordination between agencies and their capacities are actually not adequate.

Agencies involved in Search and Rescue like the Fire, CD, HG have some form of basic search procedures to quicken the process; at least the Fire Dept. does but for others timely response is not possible because activation and co-ordination can take up a lot of time.

Budgetary allocation and up-gradation of techniques and equipment seems low priority.

Basic training seems in place, a training facility capable of conducting SAR training exists in the grounds NFC (National Fire College, Nagpur) Central Training Institute in all states for CD and HG but then the no. that are been trained seem inadequate.

Safety Standards are minimal for rescuers protection.

The military is no specialist as such but it has manpower its routine training provides it with skills for search and rescue however with the frequency of the disaster it has recommended special training programmes and is also formulating Action Groups.

Recommendation on SAR

1. Training is of utmost importance however technical and equipment support is important too.
2. The agencies co-ordination exists but there is very little emphasis on time management for the process.
3. Modernization and budgetary support for the same is essential.

4.1.3 Conclusions on Hospital Disaster Planning

There seems a level of concern in the hospitals visited because of the gap in demand and supply puts them under a daily strain.

AIIMS had an accessible written disaster plan. RMLH is prepared but its written disaster plan is not in regular circulation and even the staff seemed unaware.

There is lack of equipment in most ER's is a major concern.

There is lack of training in adequate emergency medical procedures (i.e. ATLS, ACLS Disaster management) and the basic learned as part of the professional requirement is the only available with all staff in hospitals.

The attitude was ask one and all at the time of need, which could even be the untrained staff families, that can possible place a few at risk as such.

There are inadequate procedures or hygiene standards for contamination precautions.

There is a lack of emergency evacuation drills for earthquake. The internal disaster management could be slack as enough foresight on the issue does not exist.

Back-up power is insufficient in most hospitals (i.e. power supply is inadequate)

Communications in general seems good but time performance cannot be known as such drills are never done. Team formulation is also basic.

Most hospitals did not have food stocks for major disaster nor did they see this as a problem.

Space allocation for various activities and availability seems less for emergency.

Sanitation and antisepsis in most hospitals needs improvement. It is minimal at best. Disposal of contaminated items is poor or inadequate.

Recommendations on Hospital Disaster Planning

1. A program for emergency preparedness in hospitals is necessary.
2. Some hospitals need a written plan or revise a written plan or drill a plan.
3. Improvement of ER equipment will improve preparedness for disasters.

4. Emergency training needs to be done more regularly and techniques in emergency medical skills can be refined.
5. Need to establish standards of evacuation for fire/earthquake through drills and secondary sources should be put in place in case of an internal disaster.
6. Improve back up power systems in most hospitals and stockpiles.
7. Communication should be better maintained and hotlines introduced with other important agencies like blood banks etc.
8. Increase the stocks in hospitals for prolonged incidents.
9. Improve sanitation and antiseptics standards to prevent the spread of infectious diseases.
10. Improve awareness on need of disaster planning for hospitals
11. Building standards for hospitals should be more strictly formulated and implemented.

3. To prevent or to minimise the addition of unsafe buildings suitable measures are needed at the following levels:
 - a) Town and Country Planning Act and Rules
 - b) Master Plan, Development Area Plans and Rules
 - c) Development Regulations
 - d) Building Byelaws
4. All housing schemes should have mandatory provisions for introducing earthquake resistant features. Existing key structures like hospitals, schools, police stations, power stations etc. need to be retrofitted on priority basis. Some schemes should be initiated for encouraging householders for strengthening the existing private house through retrofitting.
5. In view of the above, the creation of a techno-legal regime for safe development is needed. The staff in regulatory agencies should be given defined responsibility for which they be made accountable towards implementing the measures recommended for safer constructions.

5. Annexures

Annexure A

List of Persons Interviewed in Delhi

12th July 27, 2001

Dr. S. K Sharma, Emergency control Room RMLH

13th July, 2001

Col. J R Kaushik ADG, CD

Shri S.C Gupta, Joint Secretary IRCS

16th July, 2001

Dr S.K Sharma, Medical Superintendent Officer, AIIMS

Dr. J.K Das, National Institute of Health and Family Welfare on telephone

Mr. Virender Kumar, Deputy Relief Comm., Revenue Department on telephone

17th July, 2001

Mr. S.P Batra, Institute of Fire engineers on telephone

Chief Fire Officer Mr.Dheri, DFS

18th July, 2001

R.L. Srivastav ,Joint Secretary CATS

Dr. Prem Agarwal, Honorary Secretary, IMA

19th July, 2001

Col O.G Mehta, ASG HG

Annexure B

List of Persons Interviewed in Maharashtra

I) Mumbai

Agency	Person/Designation
Govt. Relief Department	Shri R.K. Bhargava/Prinncipal Secretary (relief & Rehabilitation)
Bombay Municipality Corporation (BMC)	Shri S.J. Kunte/ Addl. Municipal Commissioner. Mr Vaidya, OSD Disaster Control Room, BMC
Army Actions Squad,	Col. Mukutesh and Lt. Col. Venkatesh/ GS Operations, M& G Area H.Qr, Mumbai
Fire Brigade	Shri B.B. Surve, Chief Fire Officer & Shri rahangdey, Station Officer, Mumbai Fort
Civil Defence	Mr Gonsalves, Asst. Controller, CD
St.Georges Hospital	Dr.(Mrs) Veena S.Shangari, Medical Supcrintendent
Indian Red Cross Society	Mrs. Homai N.Society Jt. Hon. Secretary

II) Pune

Agency	Person/designation
Military H.Qr. , Southern Command	Col. C.R. Pal, GS Operations, Bombay Engineering Group
Civil Defence	Mr S.S. Singh, Asst. Controller, Pune
YASHDA	Prof. Menon
Soshoon General Hospital, Pune	Dr Yashwant Doiphode/ Medical superintendent
Sree Clinic	Dr Phadnis
Police	Shri Ashok G. Dhiruve, Deputy Commissioner of Police
Central Fire Brigade, Pune	Shri L.N.Rout, Chief Fire Brigade Officer
Collector	Shri Yogesh M Patil Additional District Magistrate