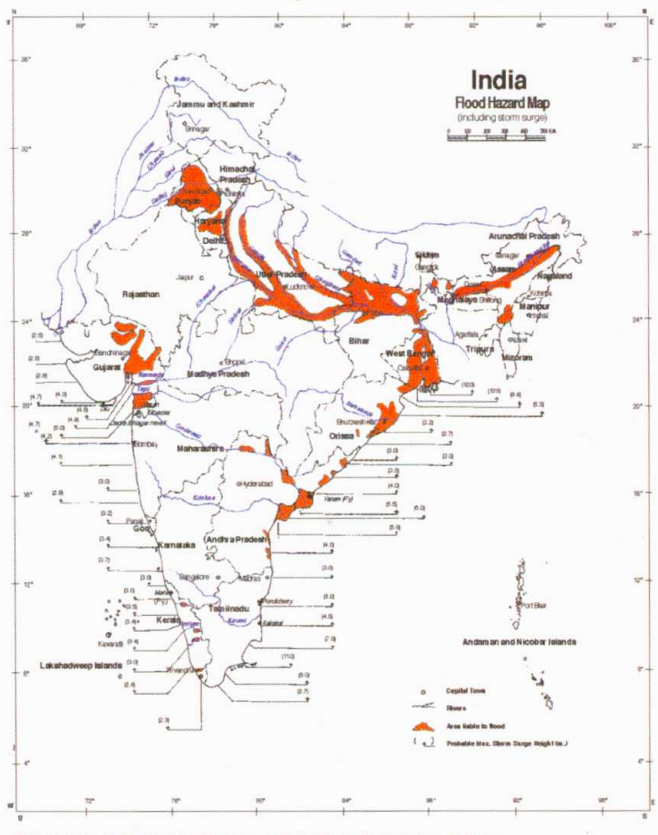
v. Communication with emergency management authorities

A system of rapid communication between IMD and CWC, which forecast the cyclone and flood situations respectively, and the authorities in the States and districts has already been established and functioning quite efficiently. So far as the earthquake is concerned, procedures are in place by which the district authorities of the affected area communicate with the various concerned organisations through wireless/ telephone/faxes to have rapid deployment of the needed personnel. National Computer Network is already in place and E-mail systems are getting established and expanding by which even data communication will become far easier and instantaneous. This can be further improved by dedicated systems for disaster related applications. The most crucial link in this is between the Collector Office and the community at risk, which is being recognised and local officials and NGOs such as CASA and OXFAM are developing ways to strengthen effective linkages between the community and the authorities.

vi. Scenarios of major hazards

Development of scenarios of likely major hazards has not been done in the routine way by disaster management agencies in India so far.

iii. India: Flood Hazard Map *Source: Vulnerability Atlas of India, 1997*



EMTPC Vulnerability Atlas Consultant Dr Anand S. Arya Map is based on: Flood Atlas, 1987, C.W.C., G.O.I. Cyclone and PMP Data, 1891-1994, IMD, G.O.I.

3.2 Risk Assessment

i. Census of Population

India has been carrying out population census every ten years and this data is readily available for the census done in the years 1971, 1981 and 1991. Besides, the data on population, its density in different areas, other indicators like the size of the family, literacy, age groups, housing data etc. are also collected and analysed. For the 1991 census, the whole information is available on computer disks and diskettes, therefore retrieval of this data has become very easy. It was indeed this housing data which has been utilised in the district wise vulnerability and risk tables included in the Vulnerability Atlas of India prepared in 1997. However, vulnerability of communities is an area Government of India is looking into more carefully since the beginning of IDNDR.

ii. Vulnerability of buildings and structures

The proper understanding of vulnerability of buildings and structures to various intensities of hazards has not been studied in a systematic way in the country so far. A proper way of representation of vulnerability versus hazard intensity is to develop *vulnerability functions* such as those developed for various building types under earthquake intensities. In this, attempts are being made by NGOs such as People's Science Institute (PSI) and Ahmedabad Study Action Group (ASAG).

3.3 Disaster Prevention

i. Specific needs and suitable measures

Disaster prevention by definition involves engineering intervention in buildings and structures to make them strong enough to withstand the impact of natural hazards or to impose restrictions on land use so that the exposure of the society to the disastrous situation is avoided or minimised. So far, land use restrictions are not provided in the town and country planning laws or master plan rules or the municipal bye-laws with the result that cities are expanding in all directions, occupying even hazard prone areas, and more and more developed areas are getting threatened by natural hazards.

Indian Standard Codes and Guidelines for earthquake resistant design and construction of buildings and structures were first developed in 1962 and 1967, then revised and updated every few years. Adequate standards on earthquake safety of buildings and structures are therefore available in the country. However, the implementation of the same has not been satisfactory except in the case of some Central Government Departments mainly because the standards are not mandatory and do not yet form part of the municipal bye-laws. Similar standards for cyclone safety and flood safety of buildings are, however, not yet formulated and this task has been taken up by the Bureau of Indian Standards (BIS). Also, safety of buildings under floods or storm surge has to be taken up by the BIS.

ii. Improving resistance of essential services

The essential services include fire stations, hospitals, water supply systems, communications, etc. The most economical and effective way of keeping such services functional in natural hazards is to design and construct the related buildings, structures and systems according to the hazard resistant principles and details. Appropriate maintenance is also necessary to keep them continuously safe at the time of the unforeseen future events. Maintenance can be ensured through a system of check list and making certain personnel responsible for the same. Unfortunately, most such systems are being established at present without due care for hazard resistance.

The reinforced concrete cyclone shelters built after 1977 cyclone were found in damaged state on account of corrosion of reinforcement due to coastal saline environment. It is therefore extremely important that cyclone shelters meant for accommodating the people in distress are well designed, constructed with utmost care, and maintained properly so that they serve the purpose for which they are intended. It is also important that access to these is kept clean of any obstructions.

3.4 Emergency Planning

As stated earlier, the emergency planning and implementation fall in the domain of the State governments. The various States have contingent plans for emergencies related to hydrological hazards, namely, drought and flood situations. Considerable experience has been gained in managing such disasters on account of their recurrence year after year. However, in the case of the rapid onslaught disasters like earthquakes, which occur without any prior warning, the State and District administrations are found in a state of unpreparedness. Fortunately, the cyclonic storms do now permit reasonable prior forecast and warning, so that evacuative actions are being taken to save the people.

3.5 Public Information and Awareness

There are four steps to be taken:

i. to prepare and distribute suitable information materials such as simple maps, illustrated brochures, video and T.V. programmes, etc.
ii. to hold specific training for the community under high risk,
iii. to hold public simulation exercises, and
iv. to analyse the results and improve the plan.

This is an area of work where contributions have been made in India by a number of organisations including the Central Government Relief Office, State Government Relief Offices, Central Government Ministries such as Ministry of Urban Affairs and Employment, Disaster Management Institutions and Voluntary Organisations. Such activities, however, have been limited mostly to the time of few weeks in the aftermath of the occurrence of a major natural disaster, whether it is a earthquake, a cyclone or major flooding of urban and rural areas. As yet, however, there is no concerted and well planned and sustained effort to create appropriate awareness at various levels of the society from policy makers and administrators to the common people.

The Red Cross, CARE (India) and partners of Oxfam (India) Trust have taken active part in community awareness raising in the states of Maharasthra, Andhra Pradesh, Uttar Pradesh and Gujarat. Publications in regional languages and with suitable visual material are being developed.

3.6 Seismological Network in India

The first seismological observatory in India was setup in Calcutta (Alipur) on 1 September 1898. Bombay and Kodaikanal observatories were started in 1898 and 1899 with Milne seismographs. The Shimla observatory setup immediately after the 1905 Kangra earthquake was later shifted to Agra in 1929, then to Delhi in 1944. The number of stations rose to 8 in 1950 and to 15 in 1960. More sensitive instruments like Benioff, Springnether and Wood-Anderson were deployed. At present the national network has 37 seismological observatories mostly of analog type. During 1962-64 the stations at Delhi, Poona, Kodaikanal and Shillong were converted into WWSSN observatories. In 1967 similar equipments were installed at the Hyderabad observatory. At about the same time Gauribidanur array was established by Bhaba Atomic Research Centre.

Network of Seismological Stations

Source: Earthquake Research in India, Earth System Science Division, Department of Science and Technology, Government of India, 1999

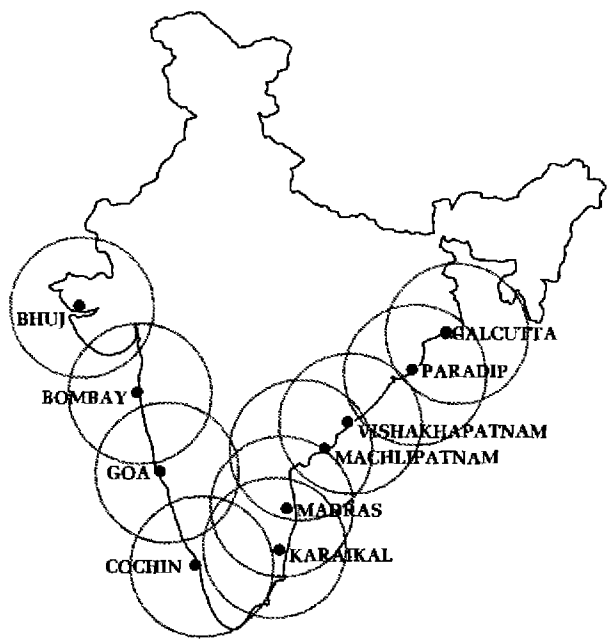
At present the national network of seismological observatories are maintained by the Indian Meteorology Department. Though this network is capable of locating earthquake in the magnitude range of 4 and above, the inter station spacing prohibits accurate location for hazard assessment Other organisations like BARC, NGRI, RRL (Jorhat), WIHG, GSI, University of Roorkee, Kurukshetra University, Kumanon University, MERI and GERI operate local microseismic and strong motion networks in different parts of the country. These observational networks are relatively dense in some parts of Northwest Himalaya, Northeast Himalaya, and Koyna region of Maharashtra

3.7 Cyclone Monitoring Forecasting and Warning System in India

The India Meteorological Department (IMD) has a well established organizational set-up for observing, detecting, tracking and forecasting cyclones and issuing cyclone warnings whenever a cyclonic storm develops in the Bay of Bengal and the Arabian Sea It is tracked with the help of INSAT satellite, powerful cyclone detection radars with a range of 400 km, installed at Calcutta, Paradip, Visakhapatnam, Manchilipatnam, Madras, Karaikal on the east coast; and Goa, Cochin, Bombay and Bhuj along the west coast. The present cyclone surveillance system in the country is such that no cyclone in the region can escape detection any time in its life cycle

Cyclone warnings are provided through six cyclone warning centres located at Calcutta, Bhubaneswar, Visakhapatnam, Madras, Bombay and Ahmedabad. These centres have distinct responsibilities areawise covering both the east and west coasts of India and the oceanic areas of the Bay of Bengal and the Arabian sea, including Andaman & Nicobar Islands and Lakshadweep The cyclone warning bulletins are issued to All India Radio and Doordarshan for broadcasting/telecasting them in different languages, on all India basis The Cyclone Warning Division at Headquarter office, New Delhi also provides warning information to the Control Room and Crisis Management Group set up in the Ministry of Agriculture, Government of India which is finally responsible for coordination with various Central Government agencies. Cyclone Warning Division at New Delhi also caters to the needs of international responsibilities such as issue of cyclone advisories to the neighbouring countries.

Cyclone Detection Radars
Source Report (Part-I) of Expert Group set up by Ministry of Urban Development, 1998



3.8 Flood Forecasting and Warning System

Flood forecasting and flood warning system in a scientific way was commenced in the year 1958 by Central Water Commission (CWC). At present the flood forecasting and warning network of CWC covers 62 major interstate river sub catchments which includes 132 water level forecasting stations and 25 inflow forecasting stations for important reservoirs. Hydrological and hydrometeorlogical data from nearly 700 stations in these rivers are being collected and analysed, and flood forecasts and warning messages are issued, generally 24 hours to 48 hours in advance. In case of very large incoming floods, advisory forecasts 72 hours in advance or more are also issued which predicts the incoming floods at the downstream locations

Coordination between neighbouring districts, states, and countries is being promoted to reduce loss of livelihood and life

3.9 Research & Development, Education & Training

Research, education and training in earthquake engineering were started by University of Roorkee (UoR) through School of Research and Training in Earthquake Engineering in 1960. Through this initiative, national capacity has been built for design and construction of earthquake resistant structures from small to tall buildings, all types of bridges and dams, conventional to atomic power plants and petro-chemical industrial structures etc. Indian Standard codes of practice on earthquake safe design and construction were initially developed in the sixties, later revised and updated from time to time. A master of earthquake engineering degree program exists since 1965 and hundreds of short training programs were organised for engineering teachers and professional. This type of activity has expanded in several institutions, such as IITs, Universities and research institutions to cover floods, cyclones as well as landslides. Sophisticated testing, measuring and computing facilities including shake-tables and wind tunnels are available in a number of institutions