

EARTHQUAKE MANAGEMENT PLAN

VOLUME 1

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GUJARAT STATE DISASTER MANAGEMENT AUTHORITY
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Abbreviation

BIS	Bureau of Indian Standard
BISAG	Bhaskaracharya Institute for Space Applications and Geo-Informatics
BMTPC	Building Materials & Technology Promotion Council
COR	Commissioner of Relief
CWC	Central Water Commission
CWCs	Cyclone Warning Centres
DEOCs	District Emergency Operation Centres
DM	Disaster Management
EOC	Emergency Operation Centre
ERCs	Emergency Response Centres
GDCR	General Development Control Regulations
GIDM	Gujarat Institute of Disaster Management
GSDMA	Gujarat State Disaster Management Authority
GSI	Geological Survey of India
IDRN	India Disaster Resource Network
IEC	Information Education Communication
IMD	Indian Meteorology Department
IRS	Incident Response System
ISR	Institute of Seismological Research
IS	Indian Standard
MHA	Ministry of Home Affairs
MLA	Member of the Legislative Assembly
MMI	Modified Mercalli Intensity
MoD	Ministry of Defence
MP	Member of Parliament
MSK Scale	Medvedev–Sponheuer–Karnik scale,
MSZ	Makran Subduction Zone
NCC	National Cadet Corps
NDMA	National Disaster Management Authority
NDRF	National Disaster Response Force
NEIC	National Earthquake Information Centre
NGO	Non Government Organization
NGRI	National Geophysical Research Institute
NIDM	National institute of Disaster Management

NSRA	Nevada Seismic Research Affiliates
NSS	National Service Scheme
PGA	Peak Ground Acceleration
PMO	Prime Minister's Office
PS	Principal Secretary
PSHA	Probabilistic Seismic Hazard Assessment
R & B Dept.	Roads & buildings Department
R & R	Rehabilitation & Reconstruction
SAR	Search and Rescue
SCMC	State Crisis Management Committee
SDMA	State disaster Management Authority
SDRF	State Disaster Response Force
SDRN	State Disaster response Network
SEOC	State Emergency Operation Centre
SOG	Standard Operations Guide
UD & UHD	Urban Development & Urban Housing Development

Chapter 1

1.1 Need of the Plan

Gujarat is located in the Himalayan Collision Zone where Indo-Australian tectonic plate slides under Eurasian Plate causing active fault lines beneath. The Vulnerability Atlas of India (BMTPC, 1997) classifies Gujarat into four classes based on a base of 10.3 million buildings recorded in the 1991 Census and BIS standard (IS: 1893 1984). As per the classification 19% of the total area in Gujarat is at a very high risk for earthquake, i.e. seismic zone V, 13% area of the state is at a high risk for earthquake, i.e. seismic zone IV, another 66% area of the state is at a moderate risk for earthquake, i.e. seismic zone III and only 1% area of the state is at a low risk for earthquake, i.e. seismic zone II.

Earthquake Management Plan covers all phases of earthquake management right from mitigation, preparedness, emergency response, relief to recovery. The plan discusses roles and responsibilities of each stakeholder and should be used as a guide by all the concerned line departments to prepare their respective department to play these critical roles and responsibilities.

Earthquake Management Plan is also crucial to achieve the global targets under **The Sendai Framework for Disaster Risk Reduction 2015-2030**. The seven global targets are:

Introduction

- i) Substantially reduce global disaster mortality by 2030, aiming to lower the average per 100,000 global mortality rate in the decade 2020-2030 compared to the period 2005-2015
- ii) Substantially reduce the number of affected people globally by 2030, aiming to lower the average global figure per 100,000 in the decade 2020-2030 compared to the period 2005-2015
- iii) Reduce direct disaster economic loss in relation to global gross domestic product (GDP) by 2030
- iv) Substantially reduce disaster damage to critical infrastructure and disruption of basic services, among them health and educational facilities, including through developing their resilience by 2030
- v) Substantially increase the number of countries with national and local disaster risk reduction strategies by 2020
- vi) Substantially enhance international cooperation to developing countries through adequate and sustainable support to complement their national actions for implementation of this Framework by 2030
- vii) Substantially increase the availability of and access to multi

hazard early warning systems and disaster risk information and assessments to the people by 2030

1.2 Objectives of the Plan

- i) To reduce earthquake risks by reducing vulnerability of people and infrastructure
- ii) To build the capacity of all stakeholders in the State to cope with the earthquakes
- iii) To protect and minimize the loss of lives and property/infrastructure from earthquakes
- iv) To minimize the suffering of people due to earthquakes
- v) To develop efficient earthquake response mechanism in the State.
- vi) To enhance State's resilience to cope with the future earthquakes and better prepare the State Government and the line departments for recovery, reconstruction and rehabilitation after the earthquakes

Chapter 2

Institutional Mechanism

Disaster management structure is in place right from the national to local level. This institutional mechanism plays a crucial role in all activities from policy making to implementation

across the entire disaster management cycle.

2.1 National Level

Agencies	Roles & Responsibilities
National Disaster Management Authority (NDMA)	<ul style="list-style-type: none"> • Apex body in GoI for Disaster Management • Lays down policies, plans and guidelines for disaster management • Coordinates their enforcement and implementation • Takes measures for the prevention, mitigation, preparedness, capacity building or for dealing with a disaster • Oversees the provision and application of funds for mitigation and preparedness measures • Has power to authorize the departments or authorities concerned, to make emergency procurement of provisions or materials for rescue and relief • Provides support to other countries in times of disasters • States keeps in touch with the NDMA for implementing various centrally funded projects / schemes • States appraises the NDMA about the action taken by the State Government regarding preparation of DM plans and implementation of guidelines issued by NDMA for various hazards from time to time.
National Executive Committee (NEC)	<ul style="list-style-type: none"> • Executive committee of the NDMA • Assists the NDMA in the discharge of its functions and also ensure compliance of the directions issued by the Central Government • Coordinates the response in the event of any threatening disaster situation or disaster • Monitors the implementation of guidelines issued by NDMA
National Institute of Disaster Management (NIDM)	<ul style="list-style-type: none"> • Develops and builds capacity through training, research, documentation • Develops national level information base • Functions within the broad policies and guidelines laid down by the NDMA

Agencies	Roles & Responsibilities
National Disaster Response Force (NDRF)	<ul style="list-style-type: none"> • Provides specialized response and emergency search & rescue to a threatening disaster situation • The general superintendence, direction and control of this force is vested in and exercised by the NDMA • Command and supervision of the force is vested in the Director General of Civil Defence and National Disaster Response Force • Comprises 10 battalions and 4 battalions are equipped and trained to respond to situations arising out of CBRN emergencies • Imparts basic training to all the stakeholders identified by the state governments in their respective locations
Agencies providing Early Warning Information	<ul style="list-style-type: none"> • Indian Meteorological Department (IMD) <ul style="list-style-type: none"> ◦ Monitors weather of Indian subcontinent and provides forecasting and other weather services ◦ During the cyclone and flood seasons, the State Government keeps close contact with the IMD – Ahmedabad office for weather related forecasts ◦ Immediately reports to state government all earthquakes of magnitude 3.0 and above on Richter Scale occurring in the state • Indian National Centre for Ocean Information Services (INCOIS) <ul style="list-style-type: none"> ◦ Under Ministry of Earth Sciences, GoI ◦ Provides the coastal and ocean information services, supporting developmental and operational sectors like ports, fisheries, shipping, meteorology, environment, off shore and coastal zone management and promotes advanced oceanographic research in the country ◦ Provides early warning system for Tsunami ◦ Disseminates critical parameters including wind, wave current, mixed layer depth, heat budget and maps on coral reef, mangroves, shore line change and land use pattern, tracks oil spills, etc.

Table 2.1: Institutional Mechanism at National Level

2.2 State Level

The Revenue Department is primarily responsible for emergency response and relief (DM Act - Section 12(2 (b)) in the State, while the Gujarat State

Disaster Management Authority (GSDMA) is designated as the nodal agency for formulation of policies, long-term planning, coordination and monitoring body for mitigation, reduction and preparedness for

disasters in the State. As per the Gujarat State Disaster Management Act, 2003, the responsibility for initiation and execution of emergency preparedness and response measures

before, during and after earthquake rests with the Commissioner of Relief in conjunction with other relevant government departments.

Agencies	Roles & Responsibilities
Gujarat State Disaster Management Authority (GSDMA)	<ul style="list-style-type: none"> Promotes an integrated and coordinated system of disaster management including prevention or mitigation of disaster by the State, local authorities, stakeholders and communities. Collect/cause to be collected data on all aspects of disasters and disaster management and analyze it and further cause and conduct research and study relating to the potential effects of events that may result in disasters. Acts as a repository of information concerning disasters and disaster management Lays down the policies and plans for disaster management in the State. Promotes or causes to promote awareness and preparedness, advices and trains the community and stakeholders
Gujarat Institute of Disaster Management (GIDM)	<ul style="list-style-type: none"> Provides training related to disaster management in close coordination with NIDM. Undertakes activities for human resource development, public education and community awareness, safety etc. in disaster education and management
State Fire & Emergency Services	<ul style="list-style-type: none"> Provides crucial immediate response during any disaster Provides regular training to the fire staff in using and maintaining the equipment
State Crisis Group (In case of earthquake triggers any chemical or industrial incident)	<ul style="list-style-type: none"> Apex body in the state to deal with major chemical accidents and to provide expert guidance for the same Review all district off-site emergency plans in the State with a view to examine its adequacy in accordance with the Manufacture, Storage and Import of Hazardous Chemicals, Rules and forward a report to the Central Crisis Group once in three months Assist the State Government in the planning, preparedness and mitigation of major chemical accidents in state Continuously monitor the post accident situation arising out of a major chemical accident in the State and forward a report to the Central Crisis Group <p>Composition of State Crisis Group in mentioned annexure 3</p>
Institute of Seismological Research (ISR)	<ul style="list-style-type: none"> Engaged in dedicated seismological research Monitors seismic activity of Gujarat round the clock through a dense network of 50 broadband seismograph station (20 connected by VSAT) and 50 Strong Motion Accelerograph in

Agencies	Roles & Responsibilities
	<p>Gujarat</p> <ul style="list-style-type: none"> • Reports earthquake location along with magnitudes within 10 minutes of the arrival of seismic waves • Engaged in seismic micro-zonation of areas prone to earthquakes • Provide consultancy services to various private companies in feasibility studies related to seismicity of the area prior to establishing a major project
Bhaskaracharya Institute for Space Applications and Geo-Informatics (BISAG)	<ul style="list-style-type: none"> • State level nodal agency to facilitate the use of spatial and geo-spatial technologies for the planning and developmental activities pertaining to agriculture, land and water resource management, wasteland development, watershed development, forestry, disaster management, infrastructure and education. • Provides specialized services and solutions in implementing map-based Geo-Spatial Information Systems. • Provides GIS solutions for disaster management and specialized needs of Public Safety agencies like police, fire and ambulance services. • Provides e-governance solutions to address varying GIS and MIS needs of governments and municipal corporations.

Table 2.2: Institutional Mechanism at State Level

In the aftermath of 2001 earthquake in the state, the focus of the government has broadened to include earthquake risk reduction, mitigation and preparedness also, along with response & relief. New institutions are now being set up in the state to deal with disasters in general and earthquakes in particular. An initiative to strengthen the SEOC, DEOCs and TEOCs has also been taken up. The state level earthquake management structure is as under:

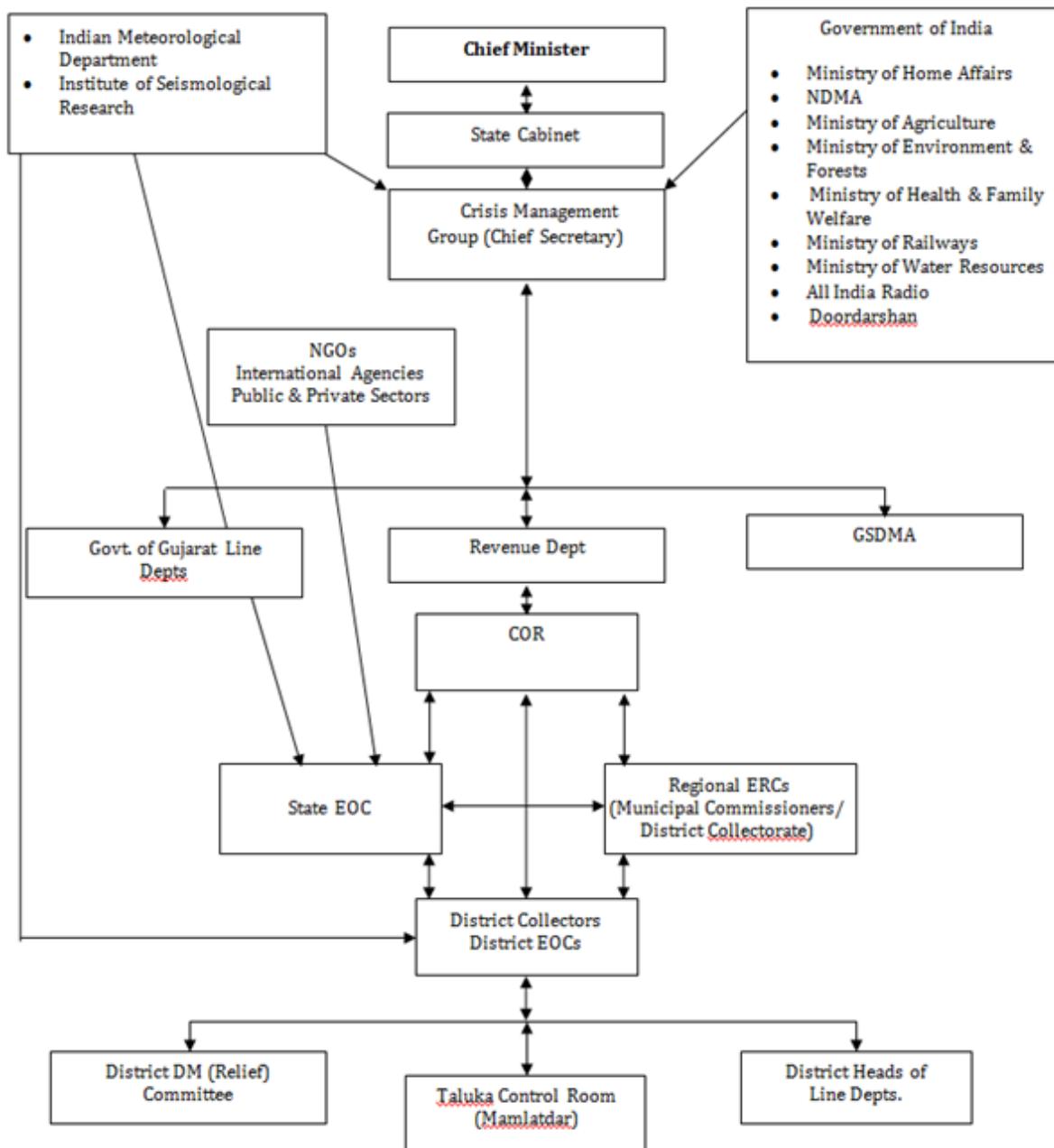


Figure 2.1: Institutional Mechanism at State Level

2.2.1 State Emergency Operation Centre (SEOC)

The new State Emergency Control Centre (SEOC) has been made functional with critical facilities including display room, media room, VIP Conference Room (with provision

for video-conferencing facility, State alert & warning room, room for Hon'ble Ministers and officers, chamber for Relief Commissioner, chamber for Director of Relief, facility management room, conference room, staff sitting room and department room.

The SEOC compound also has utilities like garden, fire fighting system, parking, generator room (160 KVA), security cabin and main gates, water harvesting system, sump room and electric and transformed room (315 KVA).

Each room has been provided with air conditioning system and CCTV cameras. The main building also consists of announcing system, fire extinguishers, smoke detectors and sensors.

a) Activation of EOC

The EOC is a nodal point for the overall coordination and control of relief work. In case of an L1 disaster the DEOC will be activated and in case of an L2 disaster SEOC will be activated along with the DEOC.

b) Command & Control of EOCs

The EOC, its system, and procedures are designed in such a way that information can be promptly assessed and relayed to concerned parties. Immediate dissemination of information contributes to quick response and effective decision-making during emergency. Being the main coordination and control point for all disaster specific efforts, the EOC is the place of decision-making, under a unified command.

The EOC in normal circumstances will work under the supervision of Relief Commissioner at the State level and

under the District Collector at the district level. It is the nerve centre to support, co-ordinate and monitor the disaster management activities at the district level. In a disaster situation, the EOC will come under the direct control of Chief Secretary or any other person designated by the Chief Secretary as Chief of Operations.

c) Functions of EOC

1. Receive, monitor, and assess disaster information
2. Monitor, assess, and track response units and resource requests
3. Proclaim local emergencies as needed
4. Provide direction and management for EOC operations through set priorities and establish strategies
5. Coordinate operations of all responding units, including law enforcement, fire, medical, logistics
6. Augment comprehensive emergency communication from EOC to any field operation when needed or appropriate
7. Maintain EOC security and access control
8. Keep senior, subordinate and tenant officials informed
9. Keep local jurisdictions (Village/town/City, district and State) informed
10. Operate a message centre to log and post all key disaster information

11. Develop and disseminate warnings and instructions

2.2.2 Emergency Response Centres (ERCs)

In order to have speedy response in search & rescue and relief, GSDMA have established ERCs at five strategic locations of the state viz. Gandhinagar, Vadodara, Rajkot, Surat and Gandhidham. The ERCs are equipped with trained manpower and state-of-art equipments to provide support to the District EOCs if the situation becomes worse and goes beyond their control. ERCs will perform response related activities and increase the preparedness through capacity building.

a) Activation of ERC

ERC will get activated in case of :

1. An event is or has the potential to becoming an L2 disaster ; or
2. Specialist rescue operation is required; or
3. There are insufficient local emergency rescue resources

b) Command & Control

The ERCs work under the direct control of Commissioner of Relief (CoR) during response time and under respective Municipal Corporation during peace time. The ERC is the instrument to

provide multi-hazard emergency response to L2 events.

District Collector/ Municipal Commissioner will request the assistance from the ERC team as soon as they have established that district resources are insufficient to deal with the emergency situation at hand. They will issue instructions regarding exact quantum of resources (manpower, equipments and essential items from key departments/ stakeholders) that is required, type of assistance to be provided, time limit within which assistance is needed, and detail of other task/response forces through which coordination should take place.

2.3 District and Local Level

At district level, nodal centre for coordination and communication is District Emergency Operation Centre (DEOC). There are 26 District Emergency Operation Centers (DEOCs) in the state. DEOC gets fully activated in case of L1 emergency. Command & control and functions of DEOC are similar to that of SEOCC.

District and Local Crisis Groups are in place in case of any chemical disaster triggered by earthquake. Composition of the same is mentioned in annexure 4 & 5 respectively.

Chapter 3

Earthquake Hazard, Vulnerability, Capacity & Risk Analysis

3.1 Understanding Earthquake

3.1.1 Earthquake

An earthquake is a series of vibrations on the earth's surface caused by the generation of elastic (seismic) waves due to sudden rupture within the earth during release of accumulated strain energy.

The point on the fault where slip starts is the Focus or Hypocenter and the point vertically above this on the surface of the Earth is the Epicenter. The depth of focus from the epicenter, called as Focal Depth, is an important parameter in determining the damaging potential of an earthquake. Distance from epicenter to any point of interest is called epicentral distance.

3.1.2 Earthquake Predictions

While the probability of an earthquake can be roughly estimated, there is no accepted method at present to predict the time and intensity of earthquake.

3.1.3 Earthquake Measurement

a) Magnitude

Magnitude is a measure of amount of energy released in an earthquake. It is most commonly measured on Richter

scale. The earthquake magnitude is determined by use of a seismograph, an instrument that continuously records ground vibrations. An increase of one unit represents an increase of ground shaking by ten times and energy released by thirty two times. Generally, earthquakes of magnitude greater than 5 cause damages while major earthquakes measure 7 or more on Richter scale.

b) Intensity

Intensity is a qualitative measure of the actual shaking at a location during an earthquake and is assigned Roman capital numerals. There are many intensity scales. Two commonly used ones are the Modified Mercalli Intensity (MMI) Scale and the Medvedev Sponheuer Karnik (MSK) Scale. Both scales are quite similar and range from I (least perceptible) to XII (most severe). The intensity scales are based on three features of shaking – perception by people and animals, performance of buildings and changes to natural surroundings.

The probable maximum intensity expected in different seismic zones in the State is described in the table below:

Seismic Zone	Magnitude	Probable Max. Intensity	Probable Impact
II	Below 4.5	VI	Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
III	4.5 – 5.5	VII	Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
IV	5.5 - 6	VIII	Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned
V	6 or higher	IX or Higher	Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.

Table 3.1: Maximum Intensity Expected in Different Seismic Zones

3.1.4 Impacts of Earthquake

Earthquakes results in primary, secondary and tertiary impacts. Primary impacts include surface vibration, surface rupture and displacement along the fault plane, total or partial damage and collapse of buildings, dams, tunnels, pipelines and other rigid structures.

Secondary impacts of earthquake include liquefaction, landslides, fire, tsunami and floods, regional subsidence or emergence of landmass, change in course of river, changes in ground water level, etc. Most of the deaths by earthquake are caused mainly due to building collapse, falling debris, broken glass panes. Earthquakes also lead to minor and severe injuries, loss of limbs, etc.

Apart from these, earthquake impacts routine services due to the damage caused to lifeline buildings, roads, railway tracks, bridges, highways, disruption of traffic, large amount of debris, disruption of water supply and electricity, etc.

Tertiary impact of earthquake includes Post Trauma Stress Disorder (PTSD), long term psychological issues, loss of livelihood, disruption of social capital due to relocation related issues, etc.

3.2 Earthquake Hazard Analysis (Gujarat)

The Vulnerability Atlas of India (BMTPC, 1997) presents a series of national and state-level maps earthquake hazard (at 1:2.5 million scale). The earthquake

hazard risk for Gujarat has been classified into four categories based on a base of 10.3 million buildings recorded in the 1991 Census and BIS standard (IS: 1893 1984).

As per the Vulnerability Atlas, the area in Gujarat that falls into seismic (MSK Intensity Scale) zones is as below:

- Very High Risk: >MSK IX (19 percent)
- High: MSK VIII (13 percent)
- Moderate MSK VII (66 percent)
- Low Damage: less than or equal to MSK VI (1 percent)

All of Kutch is classified under the Very High Damage Risk Zone while parts of

northern coastal Saurashtra and north Gujarat fall into the High Damage Risk zone. Kutch is framed by a series of semi-parallel neo-tectonic faults that extends north to south from the famous Allahbund Fault, through the Island Belt Fault, the Kutch Mainland Fault, the Katrol-Bhuj Fault, the Wagad Fault and the North Kathiawar Fault.

Urban centres that are located near neotectonic Fault in Gujarat include: Bhuj (Katrol Bhuj Fault), Jamnagar (Kathiawar Fault), Bhavnagar (Marginal Fault 1 of the Cambay Basin), Bharuch (Narmada-Son Fault), Valsad (West Coast Fault).

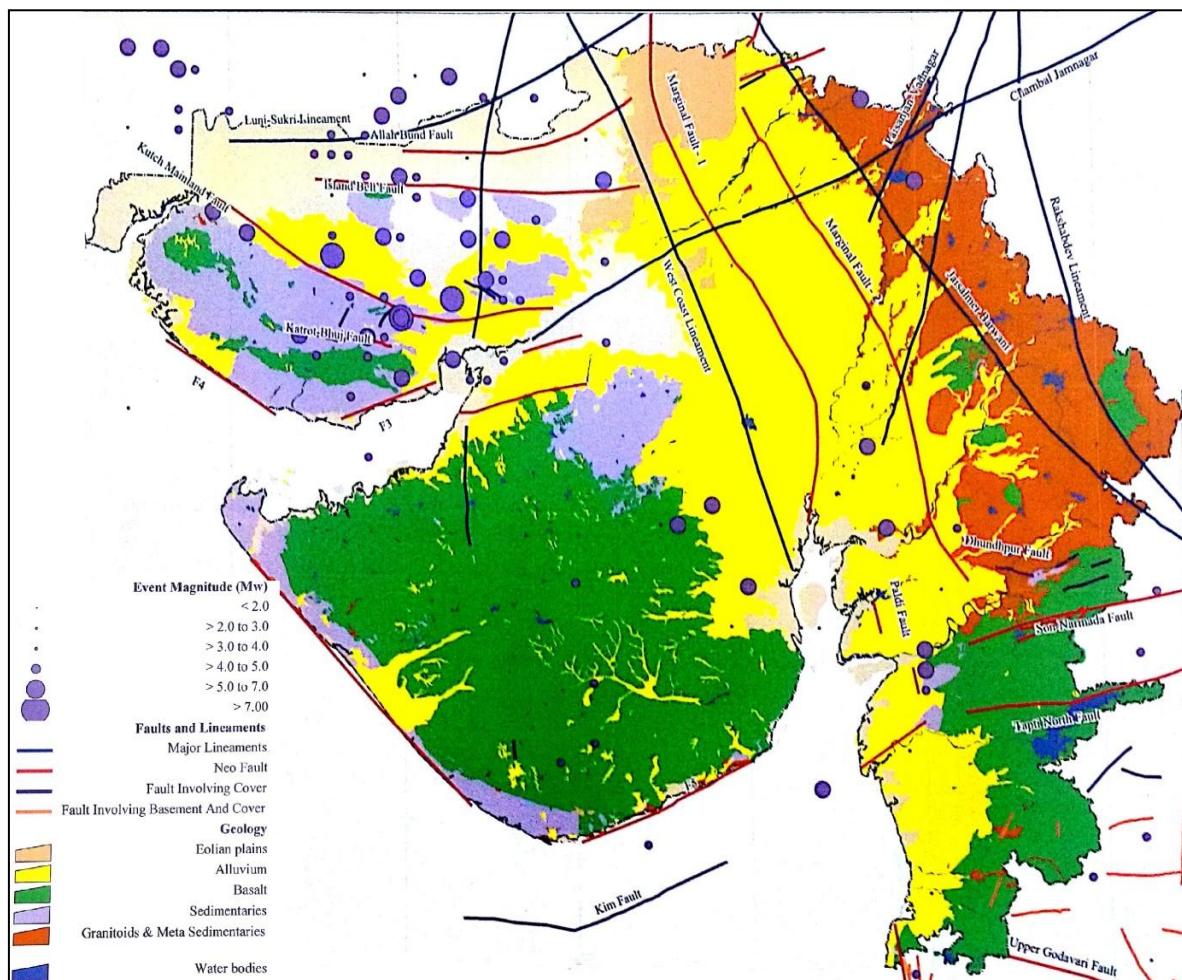


Figure 3.1: Seismotectonic Features in Gujarat

The Anjar Earthquake of 1956 and the Kutch Earthquake of 2001 are among major earthquakes Gujarat has faced in recent past. The 2001 Kutch earthquake was the third largest and second most destructive earthquake in India over the last two centuries.

GSDMA had undertaken a study on Hazard, Risk and Vulnerability Assessment of the State and developed maps for mean Taluka

PGA zonation for return period of 25, 50, 100 and 200 years. This zonation is typically used for design of houses which would have mean design service life of 25, 50, 100 and 200 years respectively.

Accordingly, the estimated mean Taluka PGA (in g) zonation for a 100-year return period is presented in the figure 3.2.

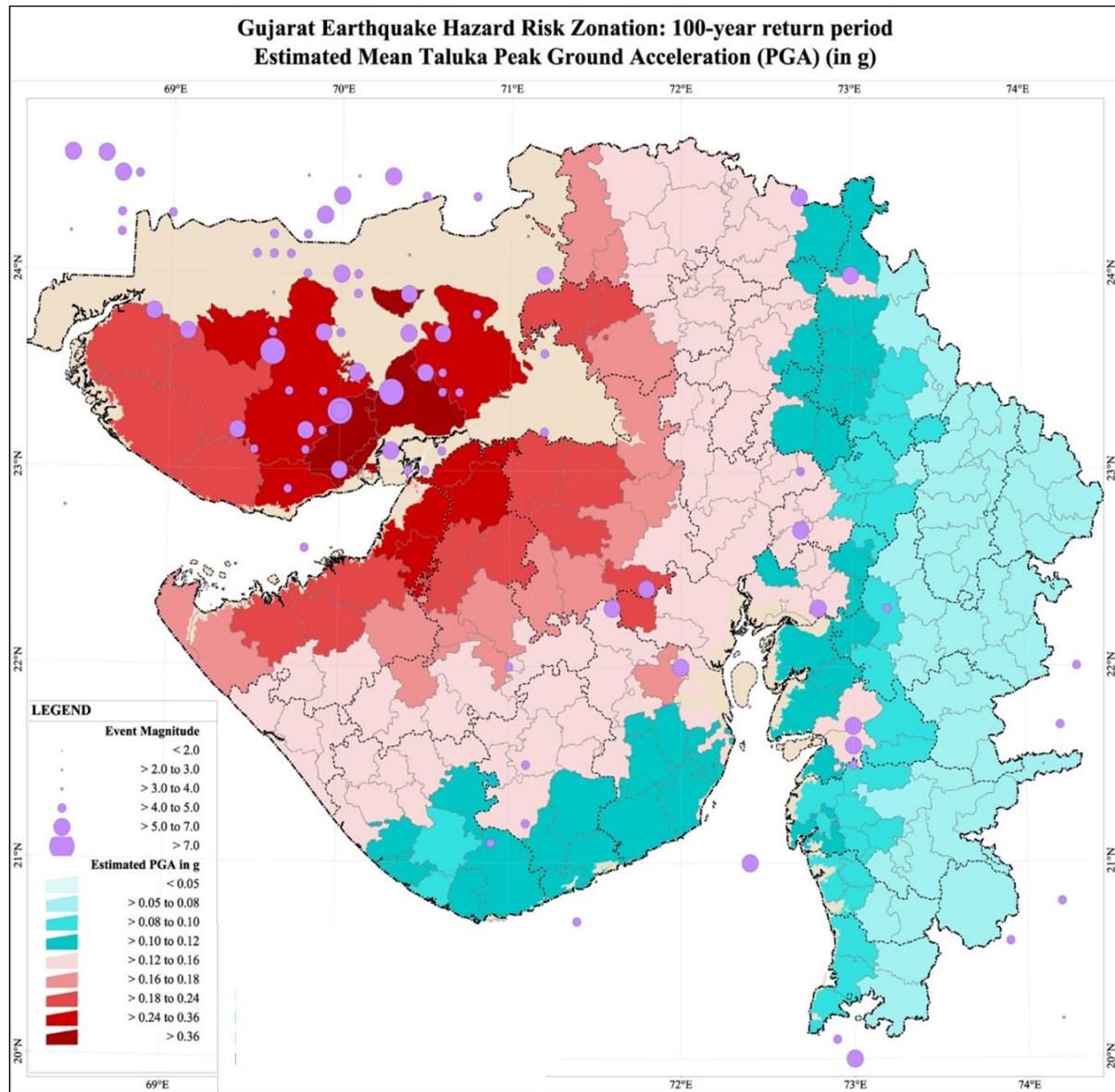


Figure 3.2: Gujarat Earthquake Hazard Risk Zonation

Based on the above figure, all of Kutch, almost the entire coastline of northern Saurashtra that adjoins Kutch and a small area in Patan district fall into the very severe intensity zone over a 100-year return period. This closely follows the pattern of damage that was observed in the 2001 Kutch earthquake. The severe intensity zone extends in a broad sweep from north Gujarat, through central Gujarat and much of central Saurashtra. The cities of Ahmedabad, Baruch, Rajkot, and Bhavnagar falls into the severe intensity zone, while Bhuj and Jamnagar fall in the very severe intensity zone over this time frame.

The boundaries of key structural features emerge in this zonation map with the broad boundaries of the Cambay Graben and the eastern hilly region emerging due a mix of the influence of active faults, distance from historical events and ground amplification due to the deep alluvium within the basins. The eastern hilly region of Gujarat, consisting of stable Granatoids and Basalt, has relatively low estimated intensities – a departure from seismic zonation under the current revision of IS: 1893.

3.3 Earthquake Vulnerability

Analysis

In case of earthquake, there is a major interplay of structural, physical, social and economical vulnerability. While

physical vulnerability is related to geographical location, structural vulnerability is a function of social and economical conditions.

3.3.1 Physical Vulnerability

Based on the classifications of Vulnerability Atlas of India (BMTPC, 1997), 19% of the total area in Gujarat lies in seismic zone V with very high risk for earthquake, 13% area of the state is at a high risk for earthquake, i.e. seismic zone IV, another 66% area of the state is at a moderate risk for earthquake, i.e. seismic zone III and only 1% area of the state is at a low risk for earthquake, i.e. seismic zone II.

Thus areas lying in seismic zone IV and V have high physical vulnerability to earthquakes compared to areas lying in other seismic zones.

3.3.2 Structural Vulnerability

Structural Vulnerability is dependent on various factors like design of structure, type and quality of material used, type of constructions, age of structure, etc.

According to the Gujarat Hazard Risk & Vulnerability Atlas (2005), the bulk of earthquake risk to buildings in Gujarat is to residential buildings because of the large share (87%) of these building in the stock. The mean loss across all end-use categories is estimated at 11% with a concentration in the highly risk prone talukas of Kachchh, Saurashtra and major urban centres. The highest proportional loss is to RCC on brick

buildings (38%) followed by tile on brick (17%), tile on earth (16%), CGI and ACC roofs (9%) and RCC on stone 8%).

As per Census 2011, the material of roof and walls of housing varies widely and include grass/ thatch/ bamboo, mud/unburnt brick, wood, stone, burnt bricks, concrete, etc. Thus depending on the type of material of housing, structural vulnerability is further increased if the proper building codes

and other safety guidelines have not been followed.

Structural vulnerability is more for areas with high physical vulnerability. Thus during development and planning of new infrastructure, geographical location of the site should also be considered along with other factors.

As per Census 2011, the following is the state of housing in Gujarat:

	Total	Good	Livable	Dilapidated
Total	1,17,67,057	79,73,324	36,11,222	1,82,511
Rural	64,36,493	38,87,921	24,12,055	1,36,517
Urban	53,30,564	40,85,403	11,99,167	45,994

Table 3.2: Status of Residential Households

	Total	Good	Livable	Dilapidated
Total	4,14,661	2,19,852	1,90,185	4,624
Rural	3,28,910	1,60,663	1,64,322	3,925
Urban	85,751	59,189	25,863	699

Table 3.3: Status of Residential-cum-other use Households

3.3.3 Social Vulnerability

Social vulnerability is interplay of multiple factors like castes, religion, language, tribe, etc. Due to these factors, the socially vulnerable groups are often forced to live and work in conditions of compromised safety like unsafe and cheap housing, hazardous occupation, etc. Population residing or working or using unsafe or weak structures (housing, schools, offices, hospitals, old bridges, flyover, etc.) is vulnerable to building collapse in case of earthquake or otherwise too.

The state comprises of 40,74,447 schedule caste persons and a total of 8,917,174 tribal populations as per Census 2011.

Apart from SC/ST, other socially vulnerable groups are women, children, differently-abled, old age persons, etc.

Disasters impact not only housing of these socially vulnerable groups but also impact their social relations, livelihood, thus impacting their access and affordability to various services like health, education, etc.

3.3.4 Economical Vulnerability

Gujarat has many economically vulnerable groups. They have limited resources for daily basic needs. The structures they dwell in are mostly not safe enough to face hazards. Thus the limited resources they have are highly prone to loss and damage in case of

any disaster. Economically weaker sections of the society are forced to opt for cheaper housing, cheaper material and practices of construction which adds to their structural vulnerability to building collapse and earthquakes.

These groups include BPL and antoadhya households. According to Census 2011, Gujarat has a total of 247.68 lakhs workers, out of which around 17.8 % are marginal workers. Gujarat also has around 3.46 lakhs of slum households and around 1.4 lakhs of houseless population. All these groups are economically vulnerable and have limited financial capacity to recover from disaster loss.

Gujarat being developed and industrialised, is a hub of important

commercial houses, factories, corporate, etc. Manufacturing sector contributes significantly to the state GDP. Also many fuel pipelines also cross the state. Considering the seismic profile of the state, any significant damage to the state infrastructure can cause a major economical set back to the state and would take its development many year back.

Different sectors of economy like transport, trade and commerce, real estate, etc. are also vulnerable due to seismic profile of the state. Thus any damage to related sector or any part of supply chain can have serious impact on economy of the state. Figure 3.3 depicts composite capital risk to various parts of Gujarat due to earthquake (return period 100 years) as per 2001 prices.

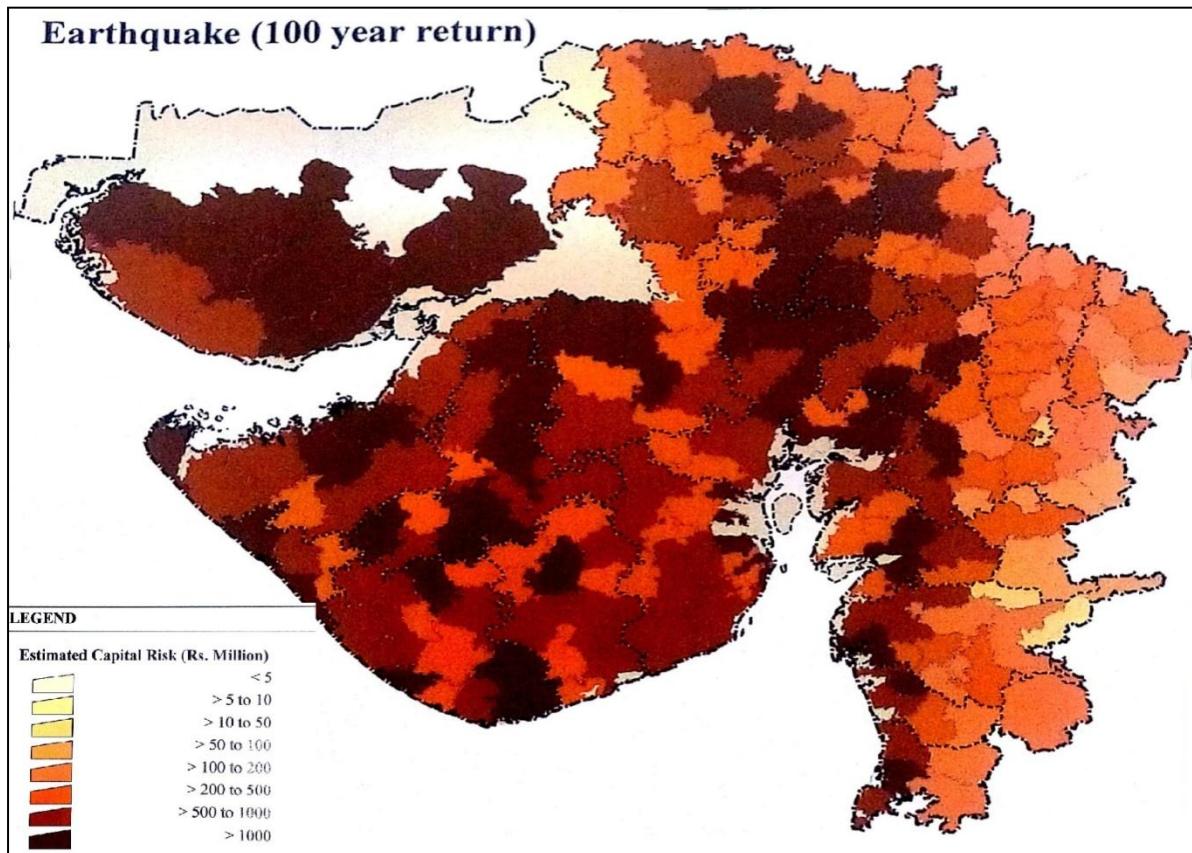


Figure 3.3: Estimated Composite Capital Risk due to Earthquake (100 year return period)

3.4 Earthquake Capacity Analysis

Capacity includes all such resources human, equipments, infrastructure, etc that aid in responding to any phase of disaster management.

A comprehensive database of disaster management related inventory is essential for an organized response. Lack of proper and adequate information hampers and delays timely response during golden hours.

GSDMA created a web based portal named State Disaster Resource Network (SDRN) which contains a database of resources at the Village, Taluka, City and District level which can come in handy during disaster situations. SDRN, a decision support tool, is layered using the existing IT Wide Area Network (WAN) of the State - GSWAN. From 2015 SDRN has been upgraded into a map-based Geo Spatial Information Systems developed by the Gujarat based organization Bhaskaracharya Institute for Space Applications and Geo-Informatics (BISAG). Currently, the SDRN network is being integrated with the GIS based Decision Support System.

SDRN could be accessed by registered users at
<http://117.239.205.164/sdrnguj/>

3.4.1 Human Resources

Staff and officials of various line departments form a huge human resource for various critical functions in both pre and post disaster phase. List of various emergency contacts and contact of various line departments are mentioned in annexure 1.

Trainings are regularly conducted at state level by GSDMA, GIDM, SPIPA and other departmental training institutes. Trainings are also delivered at district level under Disaster Risk Management Programme. These trainings include trainings on search and rescue, first responders, EOC management, architect and engineer's training for safe construction, flood rescue and many other training of trainers also. This has created a large trained human resource both in district and at state level. Details are mentioned in annexure 1 as part of Trained Human Resources.

3.4.2 Equipment

Over the years GSDMA has provided various fire fighting, search & rescue and other emergency equipment to District Collectorate, Municipal Corporations, ERCs and Municipalities, etc. The detail of same in mentioned in annexure 2.

3.5 Earthquake Risk Analysis

As per Gujarat Hazard Risk & Vulnerability Atlas 2005, the main sectors contributing to composite earthquake risk include: Animal Husbandry, Manufacturing, Trade & Hospitality, Building construction, Roads & Bridges, Electricity and Port & Airports.

The Composite Earthquake risk to capital asset is largely on account of damage to buildings, plant and machinery with a significant impact on building construction sector (residential and commercial, manufacturing and institutional

buildings), manufacturing and trade and hospitality sectors. However, the Composite GVA risk also includes the revenue losses due to business

interruption in manufacturing sector apart from a moderate loss of revenue in the power sector due to network dislocation.

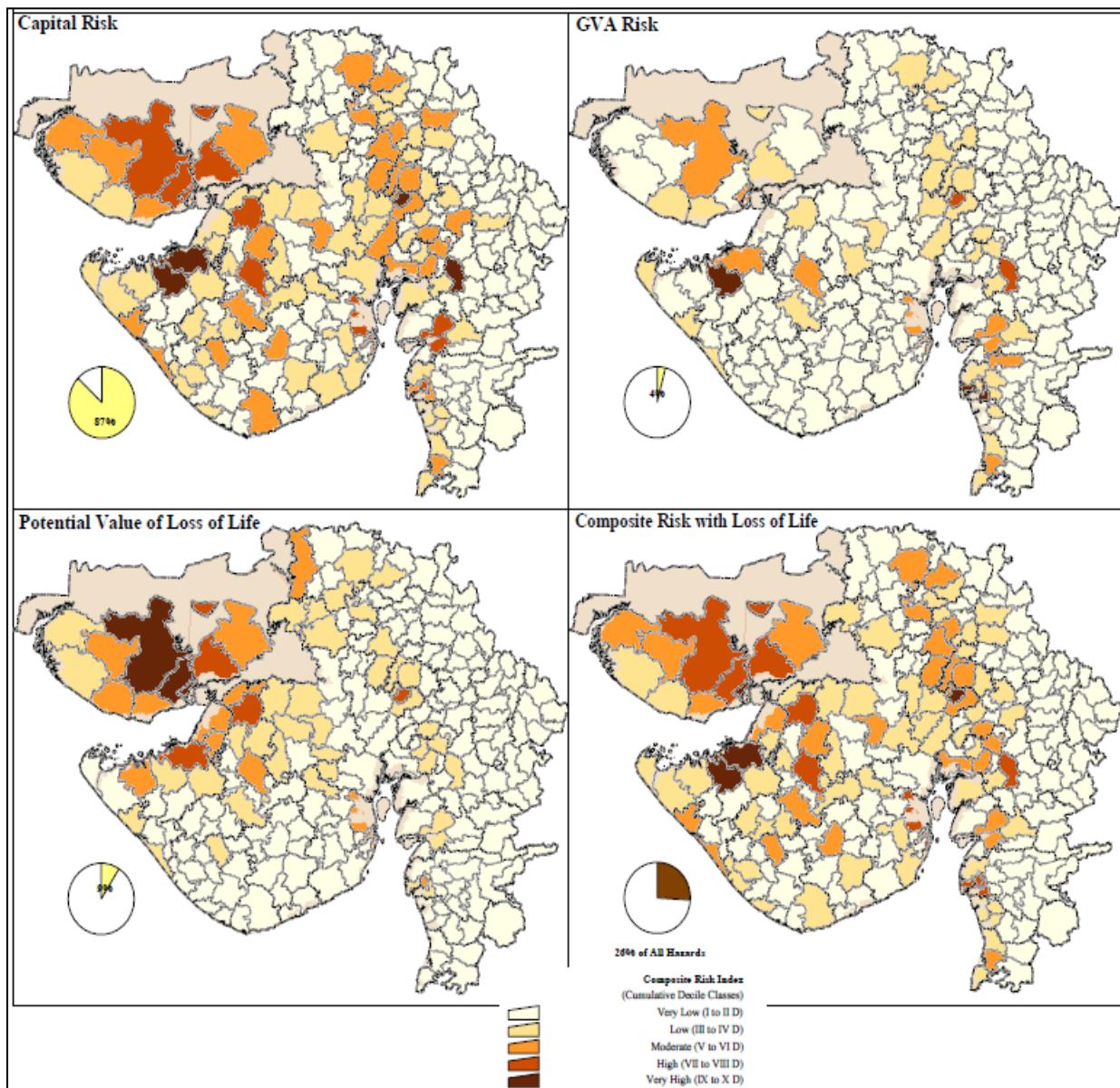


Figure 3.4: Gujarat Composite Earthquake Risk Index (Cumulative Risk Decile Classes)

Almost whole State (except some part of Dahod district) is categorized into three zones namely highest risk, high

risk and moderate risk zone as mentioned in table 3.4.

Risk Ranking	District	Taluka
Highest Risk Zone (30 to	Kutch	Gandhidham, Rapar, Bhachau, Anjar, Bhuj
	Morbi	Morbi

Risk Ranking	District	Taluka
32)	Patan	Santalpur
	Banaskantha	Bhabhar
	Ahemdabad	Sanand, Ahemdabad
	Anand	Petlad, Borsad, Anklav
High Risk Zone (27 to 30)	Kutch	Absada (Naliya), Mundra
	Morbi	Halvad, Maliya
	Botad	Barvala
	Jamnagar	Jodiya
	Amreli	Jafrabad
	Bhavnagar	Bhavnagar
	Ahmedabad	Detroj, Viramgam, Bavla, Mandal, Daskroi
	Mehsana	Bechraji, Kadi, Unjha, Vadnagar, Visnagar, Kheralu
	Banaskantha	Vav, Tharad, Deodar, Kankrej (Sirohi)
	Patan	Radhanpur, Harij
	Anand	Anand, Tarapur, Sojitra, Khambhat
	Vadodara	Vadodara, Padra, Karjan, Sinor
	Bharuch	Bharuch, Ankleshwar
	Surat	Kamrej, Surat, Chorasi, Palsana, Bardoli, Olpad
	Navsari	Navsari, Jalalpore, Gandevi
	Valsad	Valsad
Moderate Risk Zone (23 to 27)	Bharuch	Jambusar, Amod, Vagara, Hansot, Valiya, Jagadia
	Vadodara	Dabhoi, Sankheda, Vadhodiya Nasvadi, Savli
	Ahmedabad	Dholka, Ranpur, Dhandhuka
	Surat	Mangrol, Valod, Mahuva, Vyara, Mandvi, Songadh, Umarpada
	Patan	Vagdod, Chanasma, Sami, Patan, Siddhpur
	Mehsana	Mehsana, Satalasana, Vijapur
	Navsari	Chikhali, Vansada
	Kutch	Nakhtrana, Lakhpat, Mandvi
	Surendranagar	Dhrangadhra, Chuda, Limbdi, Dashada, Lakhtar, Wadhwan

Risk Ranking	District	Taluka
	Amreli	Rajula
	Anand	Umreth
	Valsad	Pardi, Umargam, Dharampur, Kaparada
	Gir Somnath	Sutrapada, Kodinar, Veraval
	Junagadh	Mangrols
	Kheda	Kheda, Matar, Nadiad, Mahudha, Thasara, Kanthal, Mahemdabad
	Mahisagar	Balasinor
	Jamnagar	Jamnagar, Dhrol, Lalpur
	Devbhumi Dwarka	Okha, Khambhaliya
	Porbandar	Porbandar
	Bhavnagar	Ghogha, Talaja, Mahuva, Vallabhipur, Umrala, Sihor
	Rajkot	Paddhari, Rajkot
	Morbi	Tankara
	Banaskantha	Deesa, Palanpur, Dhanera, Vadgam, Dantivada
	Gandhinagar	Dehgam, Mansa
	Sabarkantha	Himatnagar, Talod
	Arvalli	Dhansura, Bayad
	Panchmahals	Kalol
	Narmada	Tilakwada

Table 3.4: Earthquake Risk Analysis
Source: Based on BIS, IS: 1893 (Part-1): 2002

Chapter 4 Earthquake Mitigation

Mitigation would remain the key and the most effective strategy to reduce the risks of earthquake. Broadly mitigation strategies are twofold: structural and non-structural.

Structural mitigation measures generally refer to capital investment on physical constructions or other development works, which include engineering measures and construction of hazard resistant and protective structures and other protective infrastructure. Non-

structural measures refer to awareness and education, policies techno-legal systems and practices, training, capacity development etc.

The structural and non-structural prevention/mitigation measures for the earthquake hazard are mentioned below:

4.1 Structural and Non-structural Earthquake Mitigation Measures

Task	Activities	Responsibility
Structural Measures		
Land Use Planning	<ul style="list-style-type: none"> • To undertake micro-zonation study according to priority area • To provide or make available seismic micro-zonation map • Provide vulnerability and risk assessment map 	<ul style="list-style-type: none"> • Revenue Dept. • COR • Science & Technology Dept. • ISR • GSDMA
Development and Enactment of Building Codes and Standards	<ul style="list-style-type: none"> • Enactment of building codes and construction standards • Enforcement of codes / Land use regulations <ul style="list-style-type: none"> ◦ Restricting development activity in highly seismic risk zone ◦ Shifting of economic activities to less risk areas ◦ Compliance with land use ordinances • Amendment of Town Planning Act and development of regulations to include seismic building codes and standards • Amendment in Panchayats Act, Rules and bye-laws • Revision of General Development Control Regulations (GDCR) 	<ul style="list-style-type: none"> • UD & UHD Dept. • Panchayat & Rural Housing Dept • R & B Dept. • Municipal Commissioners • All line Dept.

Task	Activities	Responsibility
Earthquake Resistance Design for Different Seismic Zones	<ul style="list-style-type: none"> • To develop earthquake resistant design features for the construction of public utility structures • To develop earthquake resistant design features for the construction of residential structures • To develop and promote earthquake-resistant construction in rural and semi-urban areas • To provide earthquake resistant design for incorporating in different types of structures to the line departments • To develop earthquake resistant design features for the housing constructed under various government schemes (i.e. Indira Awas Yojana, etc.) 	<ul style="list-style-type: none"> • Revenue Dept., • COR • R & B Dept. • Panchayat & Rural Housing Dept
Retrofitting of Existing Structure	<ul style="list-style-type: none"> • Create a database of existing structure in the State <ul style="list-style-type: none"> ◦ Public ◦ Private • Identify the available resources • Identify structures that require retrofitting • Prepare a scheme/programme for retrofitting • Prioritising structures especially, critical/lifeline structures 	<ul style="list-style-type: none"> • Revenue Dept. • R & B Dept. • UD & UHD Dept. • Panchayat & Rural Housing Dept
Removal of Unsafe Buildings	<ul style="list-style-type: none"> • Inventory of unsafe buildings • Identify the potential loss due to removal of building • Formulate suitable financial/assistance packages • Empowering the implementing agencies to execute the task. 	<ul style="list-style-type: none"> • Revenue Dept • UD & UHD • Panchayats, RD & RHD Dept • Finance Dept • RD Dept • R & B Dept • Local Self Govt.
Monitoring of Seismic Activities	<ul style="list-style-type: none"> • Establish seismological network and round the clock monitoring • Dissemination of information and reporting • Conduct seismological research 	<ul style="list-style-type: none"> • Science & Technology Dept. • ISR • IMD • CWC

Task	Activities	Responsibility
Non-Structural Measures		
Planning	<ul style="list-style-type: none"> Establish Techno-legal regime for ensuring compliance of earthquake-resistant design and construction practices in all new constructions Prepare earthquake management plan <ul style="list-style-type: none"> Prepare departmental action plan and SOP for earthquake hazard Conduct mock drills at regular intervals Update the plan as per the requirement Monitor similar activities at district & taluka level 	<ul style="list-style-type: none"> Revenue Dept. COR All line depts. Dist. Collectors Municipal Commissioners Disaster Mamlatdar
Capacity Building	<ul style="list-style-type: none"> Develop earthquake hazard IEC materials for Publication & Distribution Organize training programmes, seminars and workshops Include disaster related topics in School and college curriculum Encourage favourable taxation/incentive Development of Rapid Visual Screening procedures and Detailed Vulnerability Assessment 	<ul style="list-style-type: none"> Revenue Dept. COR GSDMA/GIDM Information Dept. Education Dept. Finance Dept./ UD & UHD Dept./Panchayat & Rural Housing Dept.
Awareness	<ul style="list-style-type: none"> To disseminate earthquake risk to general public residing in earthquake prone zones Media campaign for awareness generation in general public 	<ul style="list-style-type: none"> GSDMA Information Dept.
Community Based Disaster Management	<ul style="list-style-type: none"> Strengthening capacity of local self government entities to understand local vulnerability and risk, earthquake prevention needs, preparedness and response capabilities through participatory approach 	<ul style="list-style-type: none"> Revenue Dept. COR GSDMA UD & UHD Dept./Panchayat & Rural Housing Dept.
Encourage Earthquake Engineering	<ul style="list-style-type: none"> Include earthquake engineering topics in curriculum Provide professional training about earthquake resistance construction to engineers and architects 	<ul style="list-style-type: none"> Education Dept. GIDM R & B Dept. GSDMA

Task	Activities	Responsibility
	<ul style="list-style-type: none"> • Provide training to masons • Encourage soil and material testing in laboratories 	<ul style="list-style-type: none"> • UD & UHD Dept. Science & Tech. Dept.
Safety Audit	<ul style="list-style-type: none"> • Carrying out structural safety audit of all critical lifeline structures • Regular conduction of Fire Safety Audits and Electrical Safety Audits • Licensing and certification of professionals • Compliance review by professionals of PRIs and ULBs 	<ul style="list-style-type: none"> • Revenue Dept., • R & B Dept. • UD & UHD Dept • Panchayat & Rural Housing Dept. • Other line Dept.
Promoting Insurance as Risk Transfer Mechanism	<ul style="list-style-type: none"> • Identification and encouragement of Insurance Agencies • Launching of suitable general insurance schemes with the standard premium structure • Sensitization of government depts., and community to undertake insurance • Instituting incentives for promoting insurance • Legislation on compulsory insurance cover in high risks areas 	<ul style="list-style-type: none"> • Finance Dept • Directorate of Insurance • GSDMA • Other line departments
Incentives for Future Developments on Safer Sites	<ul style="list-style-type: none"> • Identification of safer site and land development • Acquisition of site • Providing infrastructure on new site • Planning for new site • Distribution of land to beneficiaries • Assistance (Loans & Subsidies) to beneficiaries to ensure safer construction • Monitoring quality of construction • Promoting Insurance • Favourable taxation 	<ul style="list-style-type: none"> • Revenue Dept • UD & UHD • Panchayats, Rural Housing & Rural Development Dept • Finance Dept • R & B Dept • Information and Broadcasting Dept.

Table 4.1: Structural and Non-structural Earthquake Mitigation Measures

Chapter 5

Earthquake Preparedness & Capacity Building

5.1 Preparedness Measures

From the experience of 2001 Kutch Earthquake, thinking in management of disasters has undergone a quantum change in the state. As per the current thinking and policy of the state government, it is recognized that disaster management is a multi-agency, multi-department and multi-level activity. Now, the state government also pro-actively focuses on prevention and preparedness.

The key stakeholders at state level and the respective preparedness measures to be undertaken by them are discussed below.

5.1.1 State Government

The state government shall:

1. Ensure that appropriate policies and guidelines are developed for earthquake management
2. Ensure that the State Administration and local authorities take into consideration the guidelines laid down by GSDMA and other authorities while planning its activities
3. Ensure that State Government, GSDMA, Heads of Government Departments, COR, District Collectors and local authorities

take necessary steps to be prepared for all probable disasters

4. Facilitate timely procurement related to disaster management of materials, equipment and services in connection with the disaster management and ensure their quality
5. Ensure preparation, implementation timely updation of earthquake management plans by respective State Departments, local authorities, communities and stakeholders.

5.1.2 Departments of the State Government

a. Agriculture & Cooperation Department

1. Formulate a trained team for assessing damage to crops, soil and other agricultural damage

b. Animal Husbandry Department

1. Prepare a database of veterinary hospitals, clinics and agencies working for animals
2. Identify source for procurement of fodder
3. Identify safe locations for cattle camps
4. Ensure proper transportation facilities for sick or critically injured animals

5. Identify space for burial of dead animals

c. Civil Aviation Department

1. Ensure that sites for helipads are identified across the state as per the laid guidelines

d. Education Department

1. Organise camps in school and colleges for awareness of do-s and don'ts for earthquakes
2. Ensure preparation of disaster management plans and first aid kits in all schools and colleges
3. Identify safe schools and colleges which can be used as relief shelters for short duration of time in aftermath of any earthquake

e. Fire & Emergency Services

1. Ensure proper maintenance and functioning of all fire fighting equipments and personal protection equipments
2. Prepare a database of private fire fighting agencies and their resources
3. Keep vigil regarding MAH units and other hazardous installations in the state and prepare for possible emergency situation

f. Food & Civil Supplies Department

1. Prepare for structural and fire safety of godowns
2. Prepare for out movement of stored food grains to a pre-identified safer location

3. Enlist godowns and cold storage facilities, refrigerated transportation vehicles present in the state along with their storage capacities and facilities available
4. Enlist private retailers and wholesale dealers of food items and packaged drinking water
5. Enlist available kerosene depots, petrol pumps, CNG pumps, diesel depots, LPG agencies, etc.

g. Health & Family Welfare Department

1. Develop plan for hospital preparedness and mass casualty management
2. Prepare a database of registered private hospitals, clinics, diagnostic labs, blood banks, etc. along with their capacities and facilities provided
3. Establish paramedic cadre through training programmes and accredit / license them
4. Recognize and accredit trauma centres
5. Establish statewide medical emergency access number
6. Ensure authentic medical database enlisting public and private facilities available in the state. This includes details of manpower, logistics, medical equipments, medicines, antidotes, personal protective equipments, disinfectant, vaccines, etc.
7. Standardize and license ambulance services

8. Ensure availability of adequate supply of life saving equipments and drugs, portable supplies like portable oxygen cylinders, portable x-ray machines, triage tags, etc.
9. Formulate trained medical first responder
10. Prepare trained psychological and psychosocial care teams
11. Impart training to manpower for emergency services
12. Ensure proper and safe management of medical waste

h. Industrial Safety And Health

1. Create awareness for health & safety for workers and factory management
2. Make a database of MAH units and hazardous installations in the state and their safety officers
3. Ensure preparation of onsite emergency management plan by all industrial units
4. Prepare a database of suppliers/ manufacturers of antidotes for hazardous chemicals

i. Information Department

1. Display verified Information Education and Communication (IEC) materials for mass dissemination and awareness among the public
2. Prepare a database of popular media channels and media persons (both print and electronic)
3. Ensure proper mechanism/ channels for addressing public so

as to avoid and manage rumours with help of various media

j. Narmada, Water Resources, Water Supply & Kalpsar Department

1. Ensure proper early warning mechanism for flood in case of damage to dam due to earthquake
2. Ensure proper functioning of all equipments including dewatering pumps
3. Prepare for arrangement of safe drinking water supply for community in the affected areas, relief camps and shelters
4. Prepare for prompt repair of pipelines supplying potable water
5. Ensure availability of adequate number of water tankers, drums, jerry cans or identify their private suppliers to prepare for supply of water, in scarcity period and in emergency
6. Ensure availability of water supply/ filling points for fire tenders, water cannons, hospitals and other necessary life saving infrastructure

k. Police Department

1. Ensure proper functioning of all equipment and vehicles
2. Prepare for quick deployment of Home Guards and volunteers for providing safety to affected population and evacuated structures/ houses
3. Prepare plan for crowd and rumour management

4. Train police personnel and staff of PCR van in first aid and basic life support
5. Prepare communication plan for uninterrupted communication to all police posts and various control room and emergency operation centres across the state

I. Port & Transport Department

1. Ensure proper functioning of filling station, vehicles and equipment
2. Prepare for prompt deployment of vehicles at short notice for various purposes like mass evacuation, transportation of response teams, relief items, victims, etc.
3. Prepare mechanical team for prompt repair of equipment and vehicles.
4. Train drivers, conductors, crew members, port officials in first aid and basic life saving techniques.

m. Revenue Department

1. Develop relief norms and packages
2. Arrange with service provider companies for multiple warning messages to community, officials, etc as the need may be
3. Develop and promote insurance, disaster bonds, tax rebate, etc. against the disaster

n. Road & Building Department

1. Ensure availability and functioning of all equipments like cranes, earthmovers, etc. Prepare a data

base of availability of the same with private agencies also

2. Prepare for prompt clearance of debris in aftermath of earthquake
3. Prepare the demolishing squad for prompt demolition of unsafe buildings post disaster
4. Prepare for prompt clearing and repairing of damaged roads, culverts, bridges and flyovers
5. Ensure prompt construction of new temporary roads for diverting traffic from the affected area
6. Prepare for construction of temporary facilities like that of medical post, temporary shelters, etc at short notice.
7. Prepare for prompt establishment of helipad near the affected site for responding teams and VVIP visits
8. Prepare for restoration of government buildings damaged during disaster

o. Science & Technology Department

1. Ensure proper mechanism to issue alert/ warning through SMS through service providers
2. Prepare for providing safety and serviceability of critical communication towers through respective service providers
3. Prepare for prompt establishment of alternate communication links like HF, VHF, HAM, Satellite Phones, etc., in case of failure of primary

communication channels during disaster

p. Social Justice & Empowerment Department

1. Prepare and regularly update database of scheduled castes, social and economically backward classes, minorities communities, physically and mentally challenged persons, orphans, destitute, beggars, old aged persons and ensure that they are able to avail benefits under respective welfare schemes so as to reduce their vulnerability to disasters

q. Sports Youth & Cultural Activities Department

1. Organise training and awareness camps for youth or first aid, relief and camp management, psycho social care, search and rescue for small incidents, fire fighting and thereby creating a trained volunteer database

r. Tribal Development Department

1. Prepare a database of tribal groups in the state, their population and habitats
2. Ensure they are well covered under all government schemes targeted to them with special focus on the five Particularly Vulnerable Tribal Groups

s. Women & Child Development Department

1. Prepare a database of authentic NGOs working for women and children empowerment/ rights
2. Prepare for prompt action in aftermath of earthquake so as to prevent human trafficking particularly that of women, girls and children
3. Ensure women and children in vulnerable circumstances are well covered under various government schemes targeted to them

5.1.3 Gujarat State Disaster Management Authority (GSDMA)

1. Assist the State Government in formulation of policy for relief, rehabilitation, reconstruction and recovery for earthquake
2. Monitor preparation, updation and implementation of earthquake management plan
3. Promote awareness and preparedness among all stakeholders regarding earthquake
4. Assist in development of methodologies for reducing vulnerability of population to earthquake
5. Publish various guidelines to be followed for earthquake management
6. Inspect existing development plans made by various authorities and recommend measures to be

- incorporated for earthquake management
7. Develop database of key experts, consultants, organisations, agencies, etc working in the field of earthquake management

5.1.4 The State Relief Commissioner (COR)

1. Prepare, review and update State level Earthquake Management Plan and guidelines and ensure that district level plans are prepared, revised and updated
2. Develop an appropriate relief implementation strategy for the State in consultation with the Authority, taking into account the unique circumstances of each district and deficiency in institutional capacity and resources of the State.
3. Strengthen relief distribution and accounting system at state and district level through identification of centralized system for receipt, storage and distribution of relief and by ensuring rate contract, procurement and stockpile of relief material

5.1.5 District Collectors

1. Ensure an updated database of critical resources (equipments, life saving facilities, trained personnel, etc.) available in the district is in place

2. Ensure that all critical life saving equipment are maintained and ready to use
3. Ensure that District Disaster Management Plans are prepared and are timely updated
4. Ensure that local authorities in the district are involved in developing their own earthquake management plans
5. Ensure that earthquake management drills are carried out periodically
6. Ensure that District Emergency Operation Centre is fully functional and communication systems are in order
7. Ensure that open and safe places in the district are identified for mass evacuation
8. Ensure that safe buildings in the district are identified for purpose of relief camps
9. Ensure that site for helipad is identified at key locations in the district

5.1.6 Municipal Commissioners

1. Ensure an updated database of critical resources (equipments, life saving facilities, trained personnel, etc.) is in place
2. Ensure that all critical life saving equipment are maintained and ready to use
3. Ensure that Mahanagarpalika Disaster Management Plans

- (MDMP) are prepared and are timely updated
4. Ensure that earthquake management drills are carried out periodically
 5. Ensure that control room is fully functional and communication systems are in order
 6. Ensure that open and safe places in the corporation area for mass evacuation are identified
 7. Ensure that safe buildings in the corporation area are identified for purpose of relief camps

5.1.7 Local Authority

1. Provide assistance to GSDMA, COR and Collector in earthquake management activities
2. Ensure training of its officers and employees and maintenance of resources so as to be readily available for use
3. Ensure that all construction projects conform to the prescribed standards and specifications
4. Each department of the Government in a district shall prepare a disaster management plan for the district and carry out relief, rehabilitation and reconstruction activities in the affected area within its jurisdiction as per the plan
5. Select vulnerable community and most vulnerable groups at risk
6. Advice and issue direction wherever necessary for community

for earthquake mitigation and preparedness through local resources and participatory approach

7. Take appropriate actions to enhance community preparedness

5.1.8 Indian Railways

1. Ensure proper security and safety measures at each railway station in the state
2. Ensure that do-s and don't-s about earthquake are properly displayed at each railway station
3. Ensure proper mechanism for crowd control at each major railway station
4. Ensure that disaster management plan is in place for the railways
5. Ensure proper mechanism for transportation of mass community and proper handling and distribution of relief material

5.1.9 Private Sector

1. The private sector should ensure their active participation in the pre-earthquake activities in alignment with the overall plan developed by the GSDMA or the Collector.
2. They should also adhere to the relevant building codes and other safety guidelines prescribed by relevant authorities.

5.1.10 Community Groups and Voluntary agencies

1. Local community groups and voluntary agencies including NGOs

should actively assist in mitigation and preparedness activities under the overall direction and supervision of the GSDMA or the Collector.

2. They should actively participate in all training activities as may be organised and should familiarise themselves with their role in disaster management.

5.1.11 Citizen

It is a duty of every citizen to assist the Commissioner, the Collector or such other person entrusted with or engaged in earthquake management whenever his aid is demanded.

All citizens should also ensure preparedness at family and individual level by being aware and proactive.

Indicative components of family emergency survival kit including that of first aid kit are mentioned in annexure 9.

5.2 Capacity Building Measures

Various stakeholders should engage in building their respective capacities by conducting regular trainings to upgrade their skills, by developing techno- legal regime to better deal with different aspects of earthquake management and by taking other proactive measures for the same. Some of the suggestive measures are discussed below.

Task	Activities	Responsibility
Development of Policies & Guidelines	<ul style="list-style-type: none"> • Building construction and retrofitting guidelines • Development of relief norms and packages 	<ul style="list-style-type: none"> • R & B Dept. • UD & UHD Dept. • Panchayat & Rural Housing Dept • Revenue Dept. • Narmada & Water Resources Dept. • Industries Dept. • Energy & Petrochemical dept. • Finance Dept. • GSDMA
Development of Earthquake Management Plan	<ul style="list-style-type: none"> • Provide guidelines for plan preparation to Line Depts. • Prepare departmental Earthquake Management Plans • Review and rehearsal of the Plan • Ensure integration of departmental plan into state plan 	<ul style="list-style-type: none"> • COR • GSDMA • All Line Dept.

Task	Activities	Responsibility
	<ul style="list-style-type: none"> Identify task force leader for each emergency operations 	
Resource Mapping	<ul style="list-style-type: none"> Identify available resources viz. human, financial and equipment for earthquake management available with <ul style="list-style-type: none"> - State Dept. - Dist. Level - Taluka level - Village level - Public sector - Private sector - Community level Identification of gaps of resources as per the need Procurement of lacking resources Collect, compile and regularly update data on State Disaster Resource Network (SDRN) and list of the equipments provided by GSDMA at various level in the State in given in annexure 2 	<ul style="list-style-type: none"> Revenue Dept. COR Line dept. Dist. Collectors Disaster Mamlatdars Other dist. authorities of line dept
Fail Safe Communication and Last Mile Connectivity	<ul style="list-style-type: none"> Undertake study to establish fail safe two way communication – information system from state level to disaster site connecting state, district, taluka and city level Undertake study to establish alert/siren with multi-lingual recorded massages in earthquake prone areas Establishment of multiple/alternative system Training/IEC campaign for general public of the vulnerable areas Plan for re-establishment of disrupted system 	<ul style="list-style-type: none"> Revenue Dept. COR GSDMA Science & Technology Dept. Information Dept. Local and district authorities Municipal Commissioner
Community Preparedness	<ul style="list-style-type: none"> Selecting vulnerable community and most vulnerable groups at earthquake risk Disseminate information about earthquake vulnerability and risk to the community Promote local level earthquake risk management planning through participatory approach 	<ul style="list-style-type: none"> COR- Revenue Dept. GSDMA IMD Finance Dept. All Dist. Collectors All Taluka Mamlatdars

Task	Activities	Responsibility
	<ul style="list-style-type: none"> • Advice and issue direction wherever necessary for community earthquake prevention, mitigation and preparedness through local resources and participatory approach • Provide necessary resources and support for earthquake risk reduction at community level • Promote community managed implementations • Review earthquake preparedness at community level • Take appropriate actions to enhance community preparedness • Promote community education, awareness and training • Disseminate information to community to respond to earthquake 	<ul style="list-style-type: none"> • Local self Govt. • UDD • Panchayat and Rural Housing Dept.
Training	<ul style="list-style-type: none"> • Training of first responders <ul style="list-style-type: none"> ◦ Police ◦ Fire & Emergency Services ◦ First Aid/ 108 ◦ Civil Defense, Home guard ◦ Government officials and staff ◦ NGO & Youth Organisation ◦ NCC,NSS ◦ SDRF 	<ul style="list-style-type: none"> • GIDM • SPIPA • GSDMA • All Line Dept.
Information Education and Communication	<ul style="list-style-type: none"> • Advertisement, hoarding, booklets, leaflets, banners, shake-table, demonstration, folk dancing and music, jokes, street play, exhibition, TV Spot, radio spot, audio-visual and documentary, school campaign, <ul style="list-style-type: none"> ◦ Planning and Design ◦ Execution and Dissemination <p>Do's and Don'ts of the earthquake is given in annexure 11</p>	<ul style="list-style-type: none"> • Revenue Dept. • COR • GSDMA • Information Dept. • Education Dept. • All line dept. • Dist. Collectors • Other Dist. Authorities
Knowledge Management	<ul style="list-style-type: none"> • Documentation of earthquake disasters and to make it available in easy accessible format • Undertake research studies and application of outcomes in earthquake management practices 	<ul style="list-style-type: none"> • Revenue Dept. • COR • GSDMA • Science & Technology Dept.

Task	Activities	Responsibility
	<ul style="list-style-type: none"> • Documenting field data, experience and indigenous technological knowledge from local community • Development of plan by using available resources like SDRN, IDRN, etc. • Sharing of data/information/reports/ proceeding through consultation meeting/seminars etc. • Use of Information and communication technology at disaster management centres, state, district, taluka, village EOCs 	

Table 5.1: Capacity Building Measures

5.2.1 Techno-legal Regime

1. Formulate of professional Civil Engineers Act
2. Formulate of Emergency Medical Service Act
3. Create of an Emergency Medical Services Authority (EMSA)
4. Create of guidelines for Emergency Care of special section of people like children, elders, BPL beneficiaries, citizens of remote and disaster
5. Review and revise building by-laws
6. Review and revise GDCR/CRZ etc.
7. Review and revise town planning Act & Rules
8. Ensure strict implementation of Code and Rules
9. Monitoring of quality construction
10. Construction/Strengthening of SEO/C/ DEOC/ TEOC/ ERC

5.2.2 Training

Training is one of the essential processes to build and enhance capacity to deal with earthquakes. Training the community ensures skilled and trained first responders during earthquake without panic. Secondly, training the officials and responders ensures rapid and appropriate response from various stakeholders, thus minimising the loss. Besides, intensive capacity building measures have been initiated at all levels in the state administration. Gujarat Institute of Disaster Management also imparts training and education in earthquake management to various stakeholders including government officers in various departments responsible for earthquake management. In order to improve emergency response capacity of the state, Emergency Response Centres trained in search and rescue techniques and equipped with specialized equipments have been established in the state.



As part of long term capacity building programmes, the GSDMA has launched school earthquake safety

programme, urban earthquake safety programme and training and certification of Engineers and Masons.

Training	Responsibility
1. Training to civil defence personal in various aspect of earthquake management	<ul style="list-style-type: none"> • Home Dept. • General Home Guards • Civil Defence • GSDMA/GIDM
2. Training to Home Guards personal in various aspect of earthquake management including search and rescue	<ul style="list-style-type: none"> • Education Dep. • NCC • GIDM
3. Training to NCC and NSS personal in various aspect of earthquake management	<ul style="list-style-type: none"> • NIDM • GSDMA/GIDM
4. Training to educational and training institutions personal in various aspect of earthquake management	<ul style="list-style-type: none"> • NIDM • GSDMA/GIDM • NGOs
5. Training to civil society, CBOs and corporate entities in various aspect of earthquake management	<ul style="list-style-type: none"> • NIDM • GSDMA/GIDM • NGOs
6. Training to fire and emergency service personal in various aspect of earthquake management	<ul style="list-style-type: none"> • NIDM • UDD • Municipal Corporation • GSDMA/GIDM
7. Training to police and traffic personal in various aspect of earthquake management	<ul style="list-style-type: none"> • NIDM • GSDMA/GIDM • Home Dept. • Police training Institute
8. Training to State Disaster Response Force (SDRF) Teams in various aspect of earthquake management	<ul style="list-style-type: none"> • NIDM/NDRF • Home Dept. • Addl. DGP (Arms) • Addl. DGP (Training) • GSDMA/GIDM
9. Training to media in various aspect of earthquake management	<ul style="list-style-type: none"> • NIDM • Information Dept. • GSDMA/GIDM
10. Training to govt. officials in various aspect of earthquake management	<ul style="list-style-type: none"> • NIDM • GSDMA/GIDM
11. Training to engineers, architects, structural engineers, builders and masons in various aspect of disaster management	<ul style="list-style-type: none"> • R & B Dept • Irrigation Dept. • NIDM • GSDMA/GIDM
12. Training at local and regional level for undertaking rapid damage and need assessment	<ul style="list-style-type: none"> • GSDMA/ GIDM

Table 5.2: Training for Various Stakeholders

5.2.3 Awareness

A massive IEC programme has been launched by the GSDMA to promote public awareness and education on earthquakes and its management.

In addition 'disaster management' is being included as a subject in curricula of schools, engineering colleges, and other training institutions of state services.

Awareness in the masses regarding dos and don'ts, vulnerable areas, emergency numbers, etc. empowers them to do the needful proactively as and when the situation arises. Having aware community also reduces the chances of chaos and panic.

Following measures can be taken by respective department towards generating awareness:

1. Create mass awareness through advertisement, hoarding, booklets, leaflets, banners, etc.
2. Organise awareness camps for children and make use of folk dance and music, plays, painting competition, debate competition, etc. To disseminate the information
3. Organise disaster management exhibition and use scientific tools like shake-table demonstration, etc to disseminate awareness about earthquake and ways to deal with it

4. Arrange for TV Spot, radio spot, audio-visual and documentary, etc. to reach out to masses at large
5. Media can play a vital role in public awareness and preparedness through educating the public about disasters; warning of hazards; gathering and transmitting information about affected areas; alerting government officials, helping relief organizations and the public towards specific needs; and even in facilitating discussions about disaster preparedness and response

5.2.4 Developing Technical and Computer Aided Databases

1. Update the vulnerability atlas based on new districts created and any change in vulnerability profile of population over the years
2. Develop GIS based information system for different sectors viz. medical and health, civil supply, fire and emergency services, etc.
3. Create and disseminate database of contact details, resources, response agencies, NGOs, trained personnel, most vulnerable groups, evacuation routes, available shelters, relief centres, critical infrastructures, storage godowns, etc.



5.2.5 Knowledge Management

1. Document earthquakes, their impacts, lessons learnt and make it available in easily accessible format
2. Undertake research studies and apply the outcomes in earthquake management practices
3. Document field data, experience and indigenous technological knowledge from local community
4. Share data/ information/ reports/ proceeding of consultation meeting/seminars etc.
5. Use information and communication technology at disaster management centres, state, district, taluka, EOCs, ERCs, etc.
6. Each department should have in place standard operating procedures (SOP) to be followed in case of an earthquake
7. Each department should also conduct mock drill at regular interval and update the SOP based on gaps identified in the mock drill

5.3 Current Projects/ Programmes

Currently GSDMA is undertaking various preparedness and capacity building projects and programmes at different level. Some of the key

projects and programmes focusing on or inclusive of earthquake management are discussed below.

5.3.1 National School Safety Programme

The Government of India in June 2011, approved the 'National School Safety Program (NSSP) – A demonstrative project' with a total cost of Rs.48.47 Crore as a 100% Centrally Sponsored Scheme to be implemented by National Disaster Management Authority (NDMA) in collaboration with the Ministry of Human Resource Development (MHRD) and in partnership with State/UT Governments.

NSSP is a holistic project to promote culture of safety in schools and covers 43 districts of 22 States /UTs of the country falling in seismic zone IV & V.

In Gujarat the NSSP project is being implemented in 400 schools of Kutch and Jamnagar districts (200 schools in each district). GSDMA is implementing the project in collaboration with NDMA and in partnership with the district administration.

The program has following components and activities:

- a. Preparation of School Disaster Management Plans
- b. Printing and Distribution of IEC Material
- c. Review and Approval of School Disaster Management Plans

- d. Sensitisation Program
- e. Rapid Visual Survey (RVS)
- f. Mock Drill in 400 Schools
- g. Disaster Preparedness Kits
- h. Training of Trainers
- i. Training of Teachers
- j. Translation into Regional Language and Printing of Teacher Training Module
- k. Non-structural Mitigation Measures
- l. Structural Retrofitting
- m. Grant-in-aid to State Education Department

5.3.2 School Safety Week

The Gujarat State Disaster Management Authority has decided to organize the School Safety Week in all the schools of Gujarat to aware, educate and build the culture of preparedness among the school children. Initially, School Safety Week was celebrated in 400 selected schools of Kutch, Jamnagar and Devbhumi – Dwaraka districts. The key activities include orientation program, creating awareness about disaster through IEC materials, film screening, understanding non-structural risks, basic life saving skill, slogan and drawing competition and project competition for school children. The initiative also includes shakeout drills and mock exercises.

5.3.3 Disaster Risk Management Programme

The Disaster Risk Management Programme was initiated by Ministry of Home Affairs (MHA), Govt. of India in collaboration with United Nations Development Programme (UNDP) in the year 2002. Gujarat State Disaster Management Authority was the nodal agency for implementing programme activities in Gujarat state. The DRM Programme was formulated with a goal of sustainable reduction in disaster risk in most hazard prone districts in Gujarat state. The DRM Programme was aiming at strengthening of response, preparedness and mitigation measures over a period of time through a variety of activities at the national, state, district, taluka and village levels.

Considering the impact of DRM Programme activities, GSDMA included DRMP as a new scheme and made financial provision in state budget since 2007-08. After UNDP's withdrawal in June-2009, GSDMA owned the DRM Programme and started implementing programme activities more rigorously.

Currently, GSDMA focuses on all 33 districts and 8 municipal corporations of the state for strengthening of response, preparedness and mitigation measures. In order to ensure effective implementation of

programme activities, GSDMA also has appointed District Project Officer/Project Officers at district/corporation level who work under direct supervision of respective District Collector/Commissioners. The set of activities include:

1. Development of multi – hazard plan at various administrative levels.
2. Capacity building through training programmes.
3. Updation of national and state level online resource network for disaster preparedness and management.
4. Awareness generation programmes are done at various levels.
5. Manual development for trainers and practitioner at all levels.

Chapter 6

Earthquake Response & Relief

6.1 Levels of Disaster (L Concept)

The L concept has been developed to define the different levels of disaster in

order to facilitate the assistance to states and districts.

Level	Description	Activities
L0	Normal time	Prevention, preparation and capacity building activities like trainings, preparation and updation of plans, mock drills, procurements of equipments, etc
L1	Can be managed at district level	State and Centre remain ready to assist if need arises
L2	Beyond the capacity of district	Require active participation and mobilisation of resources from State Government
L3	Resources of District and State Government have been overwhelmed	Require Central Government for reinstating the State and District machinery as well as for rescue, relief, and other response and recovery measures

Table 6.1: Levels of Disaster (L Concept)

6.2 Trigger Mechanism

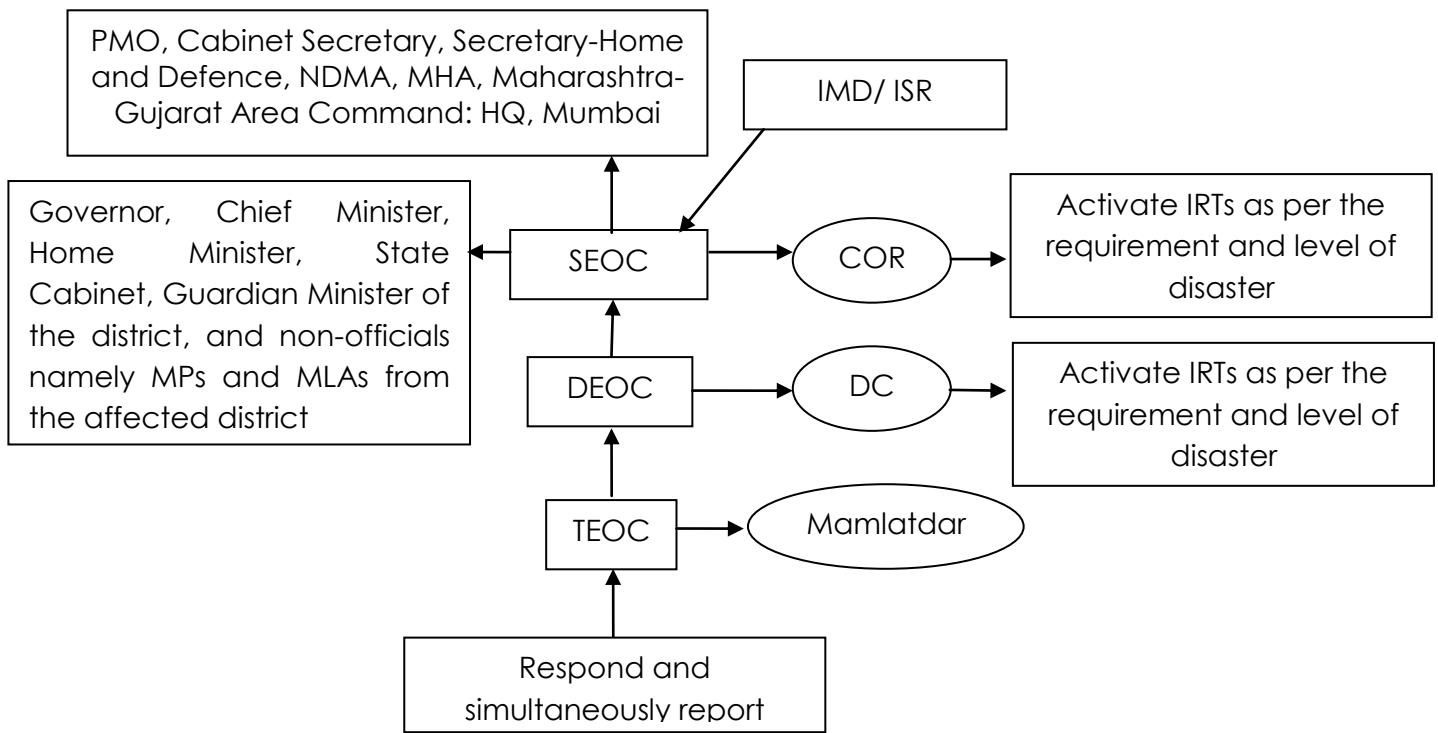


Figure 6.1: Trigger Mechanism

The earthquake response structure gets activated on the receipt of the message of occurrence of earthquake. The State Crisis Management Committee (SCMC) under the chairmanship of the Chief Secretary should be activated immediately on the occurrence of any major earthquake.

The Commissioner of Relief (COR) will activate all departments for emergency response including the State EOC, District EOC and ERCs. Also, they issue instructions to include the following details:

- i) Exact quantum of resources (in terms of manpower, equipments and essential items from key departments/stakeholders) that is required.
- ii) The type of assistance to be provided
- iii) The time limit within which assistance is needed
- iv) Details of other Task/Response Forces through which coordination should take place

The EOCs and ERCs and other control rooms shall be activated with full strength.

6.3 Disaster Declaration

The Gujarat State Disaster Management Act, 2003 (Section 32) provides for the state government to declare any area where earthquake had occurred or likely to occur as

disaster affected area on the recommendations of the State Relief Commissioner or the District Collector. The purpose of declaration of disaster is to organize effective response in managing the after effects of earthquake. Such a declaration provides wide powers and responsibilities to the State Relief Commissioner and the District Collectors in order to handle the incident effectively.

The Revenue Department of the State is the Nodal Department for controlling, monitoring and directing measures for organizing rescue, relief and rehabilitation. All other concerned line departments should extend full cooperation in all matters pertaining to the response management of the earthquake whenever it occurs.

On the receipt of alert from ISR / IMD, or on the basis of reports from District Collector of the occurrence of an earthquake, the response structure of the State Government will be put into operation. The Chief Secretary/Relief Commissioner will assume the role of the Incident Commander during the emergency situation.

The EOCs and ERCs will be put on full alert and expanded to include branch arrangements of Incident Response System, with responsibilities for specific tasks, depending on extent of earthquake. The number of branches

to be activated will be decided by the Incident Commander i.e. the Relief Commissioner/Chief Secretary at the State level and respective District Collectors at the District level.

All Branch Officers and Nodal Officers will work under the overall supervision and administrative control of the Incident Commander. All the decisions taken in the EOC have to be approved by the Incident Commander.

Immediate access to the earthquake affected site will be made through various means of communications such as mobiles, VSAT, wireless communication and hotline contact.

6.4 Incident Response System

Incident Response System (IRS) is one of the crucial tools for coordinated

response. The system envisages that the roles and duties are laid down in advance and the personnel are earmarked and trained in their respective roles and duties. It fixes accountability of the earmarked personnel and also avoids duplication of efforts by clearly demarcating the area specific task force teams.

It provides a participatory, well structured, fail safe, multi disciplinary, multi-departmental and systematic approach to guide administrative mechanisms at all levels of the government. It also provides scope for private sector, NGOs, CBOs, PRIs and communities to work seamlessly in the response activities.

The detailed roles and responsibilities of each section, branch and group are mentioned in annexure 7.

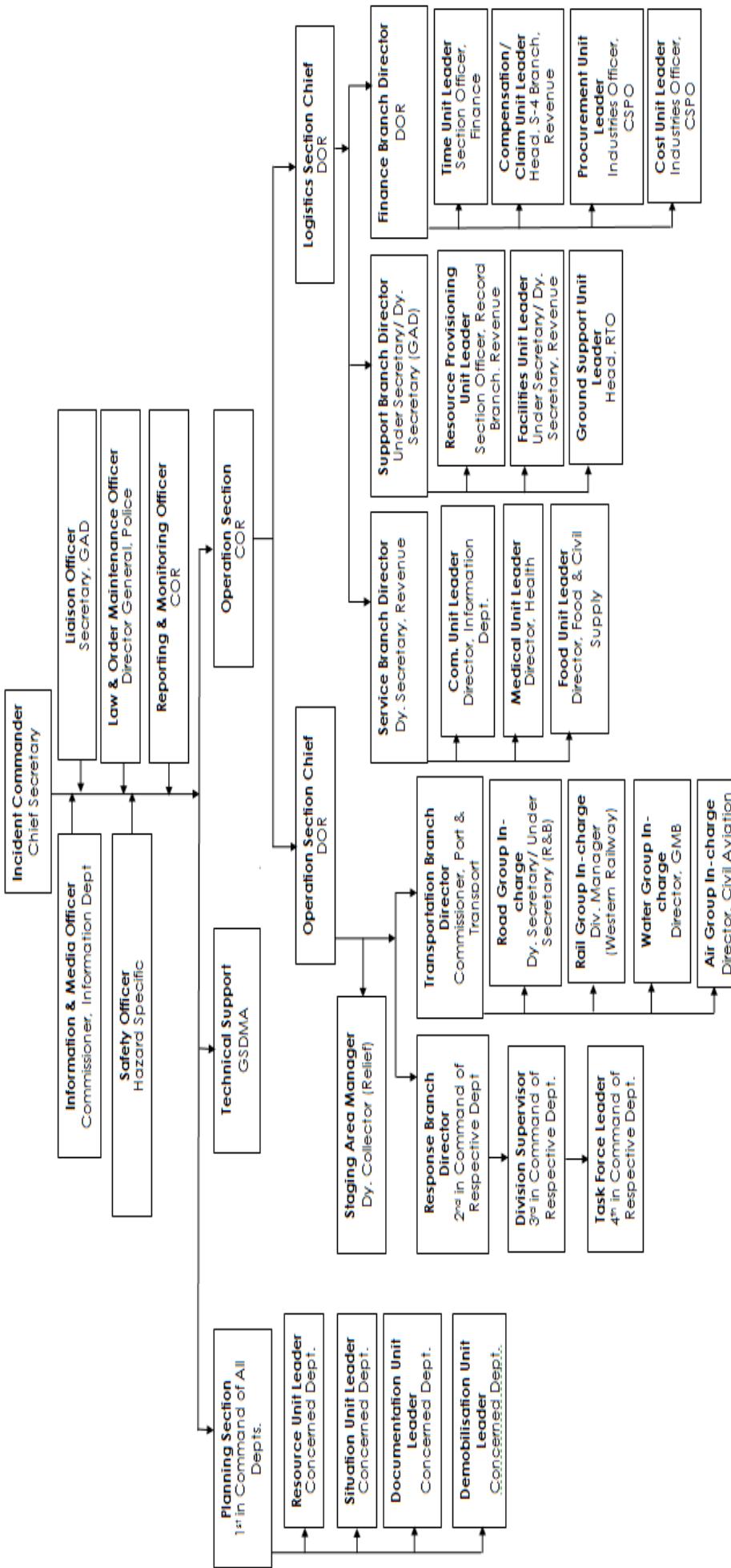


Figure 6.2: Incident Response System

6.5 Standard Operating Procedure for Earthquake Response

For effective response, all the stakeholders need to have a clear understanding of their respective roles and actions that need to be taken in

aftermath of an earthquake. Many tasks are required to be performed in close coordination of multiple departments and stakeholders.

Time Frame	Responsibility	Task
T + 15 Minutes	In-charge SEOCA	Report the occurrence of earthquake to COR, DOR, PS (Revenue Department), CEO (GSDMA), Heads of all line departments, Chief Secretary and Chief Minister's Office and NDMA EOC at MHA, Gol
T + 30 Minutes	In-charge SEOCA	Verify the magnitude & intensity of the incident from agencies like IMD, ISR, DEOCs, TEOCs, Police and Fire Brigade control rooms and find about immediate impacts
	COR/ DOR	In case of L-2 level event, take over overall management of SEOCA
		Deploy Emergency Rescue Vehicles to affected areas for establishing communication link
		Activate ERCs for prompt mobilisation teams and resources to affected areas
		Hold planning meeting of HODs (all line depts.) in SEOCA
		Instruct duty officers of line departments to report in SEOCA and hold meeting for further plan of action/ instructions
		Request for the services of NDRF and Armed forces, if required
		If required, inform GAD to ensure that all State Govt. employees report for emergency duties within half an hour
		Establish alternate communication link through Satellite Phones, HF/ VHF set, HAM Radio, VSAT, etc. in SEOCA, DEOCs, TEOCs
T + 1 Hour	Home Dept., District Collector, Municipal Commissioners	Enforce evacuation from unsafe structures to pre-decided safe evacuation sites
		With help of local authorities, local agencies, volunteers, RWAs, ensure that people do not go back to unsafe structures unless instructed as safe

Time Frame	Responsibility	Task
		Provide security in affected areas and maintain law and order situation to prevent incidents of thefts and stampede
	COR	Mobilise Search & Rescue teams and equipment of Fire Emergency Services, Home Dept., R&B, etc. to affected areas
		Deploy medical teams and paramedics to the affected areas
		Deploy rapid assessment team to affected areas
		Make arrangements for aerial survey of the affected areas
		Contact BISAG, NRSC, ISRO and Ministry of Defence for aerial / satellite imageries of the affected areas
		Instruct local administration to evacuate population at risk to safer sites
		Instruct concerned authorities or agencies to shut down critical operations
		Contact Chief Secretary for deciding on time and venue for holding Crisis Management Group (CMG) meeting at the earliest
		Inform all CMG members to attend CMG meeting in designated venue to assess situation and review emergency measures
	Dept. of Science & Technology	Establish alternate communication links through HF, VHF, HAM, Satellite Phones, etc.
		Issue alert for secondary shocks/disseminate critical information by SMS through service providers
	COR, GUVNL, GWSSB, DOT, Energy & Petrochemicals	Restore essential services like power, water supply, telecommunication of critical infrastructure like hospitals, SEOC, Sachivalya, Raj Bhawan, Control Rooms, AIR, Doordarshan, relief camps and temporary shelters, etc. on priority basis
		Restore essential services or arrange for alternative facilities like power, water supply and telecommunication to the affected area
	Port & Transport, R&B Dept., COR	Assess the conditions of road, rail and air communication link for quick mobilization of emergency responders and teams and resources to affected areas and take follow up actions

Time Frame	Responsibility	Task
	Information Dept.	<p>Establish media management / information cell for public information, guidance and rumour control</p> <p>Instruct district information officers to establish information centre near affected areas to provide guidance to volunteers and aid agencies</p>
T + 2 Hours	Chief Secretary/ COR	<p>Delegate responsibilities for organizing rescue and relief operations as per outcomes of CMG and planning meet</p> <p>Depute senior State Level officers to the affected areas</p> <p>Inform Secretaries of all depts. to provide necessary logistics support to emergency operation task forces</p>
	COR	<p>Activate Operations Section of IRS for Emergency Response Operation</p> <p>If required, seek assistance from neighbouring states, Central Govt. or external agencies</p> <p>Set up separate desks for each operation task force and NGO coordination desk in the SEOC for coordinating emergency operations</p> <p>Contact private / public sector agencies in the State to assist in emergency rescue and relief operations</p>
T + 3 Hours	Port & Transport Dept., Civil Aviation Dept	Make suitable transport arrangement for mobilization of quick response teams to the affected areas
	COR, SEOC	Maintain constant touch with the control room of MHA, NDMA, ERCs, DEOCs and TEOCs
	COR, Information Dept.	Arrange for press / media release for rumour control and public information and guidance
	Health Dept.	Make necessary arrangement for treatment of injured and mass casualty management
	Dept. of Science & Technology, DOT	Restore & ensure serviceability of communication towers in affected area through respective service providers
T + 6 Hours	COR	Establish relief coordination centre at airport, railway station, etc. for arrival of Search &

Time Frame	Responsibility	Task
		Rescue and Medical Teams coming for humanitarian aid
		Arrange for a logistic plan and warehouse for receipt & management of relief material
	Home Dept.	Instruct to cordon affected areas and setting up of check posts to control entry and exit Ensure mechanism to prevent human trafficking
	Home Dept., Port & Transport Dept., R&B Dept.	Open access routes and manage traffic for mobilization of equipment, machinery and volunteers to the affected areas If required, establish temporary access routes & disseminate route maps to all EOCs, control rooms and information cells
	COR/ Head, Quick Assessment Task Force	Conduct aerial survey to understand scale of damage and impacts
	Information Dept.	Establish information centres at the arrival and departure points especially at the airports, railway stations and interstate bus terminus
T + 12 Hours	DOR	Hold review meetings with duty officers in every 12 hours Prepare rapid need assessment report for planning of relief operation and mobilization of resources to the affected areas
	DOR, District Collectors, Municipal Commissioners, Line Depts	Mobilize relief materials i.e. tents, food materials, water, essential medicines, blankets, etc. to the affected districts and talukas Establish relief centres, temporary shelters and godowns near affected areas & ensure provision of basic facilities like food, water, medical aid, toilets, etc.
	Food & Civil Supply	Provide food and other relief material to relief camps, community kitchens, etc.
	Water Supply Dept	Provide water tankers to affected areas, relief camps, temporary shelters, community kitchens, etc.
	Port & Transport Dept.	Arrange to shift people from evacuated sites to temporary shelters

Time Frame	Responsibility	Task
		Arrange road, rail and air transport at State / District headquarters for dispatch of relief materials to the affected areas
	Health Dept.	Set up field hospitals near the affected areas
		Arrange to shift injured persons to field hospitals
	Animal Husbandry Dept.	Ensure medical aid to injured cattle
T + 24 Hours	Home Dept.	Provide security to relief camps, godowns, evacuated structures, medical camps, etc.
	COR	Instruct to set up coordination centres at the Resident Commissioner's Office in New Delhi and other Metro Cities as well
	DOR, Dy. Collector (DM) at SEOC	Prepare and circulate the situation report
		Coordinate with Operation Task Forces mobilized to the affected areas
	COR, Information Dept.	Organise media briefing twice a day at pre-determined intervals
T + 48 Hours	COR, Revenue Dept.	Depute additional officers and supporting staff to affected areas from non-affected areas
	R & B Dept.	Identify and declare unsafe structures in earthquake affected areas
	Home Dept.	Ensure safety and security of personnel deputed in affected areas for emergency response operation
		Arrange for identification, photograph, post mortem and maintenance of records for disposal of dead bodies
	Health Dept.	Earmark storage points for medical supplies at affected sites
	COR, DOR	Arrange information centre at shelter site for maintaining records of victims and to provide guidance to relatives, NGOs, etc.
	Revenue Dept., District Collector, Municipal Commissioners, Health Dept & Local Authorities	Ensure following procedures before disposal/handing over of dead bodies: <ul style="list-style-type: none"> • Photographs of dead bodies are taken • Identification of dead bodies is done • Post mortem of dead bodies is carried out • Handing over dead bodies of persons

Time Frame	Responsibility	Task
		<ul style="list-style-type: none"> known/ identified to their relatives • Disposal of unclaimed and unidentified dead bodies
	Home Dept., COR	Ensure mechanism for complaints regarding missing persons and initiate search in shelters, hospitals and police records
	Port & Transport Dept., Health Dept., Animal Husbandry Dept	<p>Arrange for transportation of dead bodies to their native places if so required</p> <p>Arrange for transportation of injured animal</p>
T + 72 Hours	Home Dept.	<p>Arrange for disposal of unidentified and unclaimed dead bodies</p> <p>Arrange for disposal of unidentified and unclaimed animal carcasses</p>
	Health Dept., Transport Dept	Arrange for transportation of injured from field hospitals to base hospitals
	COR	Arrange for distribution of cash doles to the victims
	COR, Line Depts.	Activate short and interim relief measures
		Continue ongoing rescue & relief activities and plan for reconstruction & rehabilitation

Table 6.2: Standard Operating Procedure for Earthquake Response

6.6 Emergency Support Functions

Emergency Support Functions are critical services which are performed in post disaster scenario to minimise life loss and address various issues in a post disaster situation.

Post earthquake situation gives rise to various new challenges which need to be dealt simultaneously. These include identification and demolition of dangerous structures in the affected areas to minimize further loss of life and injuries, arrangements for debris

removal and its appropriate disposal, arrangements to be made for survey of human loss and distribution of ex-gratia relief to the families of deceased persons, etc.

Table 6.3 lists emergency support functions that need to be performed in aftermath of an earthquake. It also lays down the primary and secondary agencies responsible to perform the function.

ESF	Aim	Primary Department/ Agency	Secondary Department/ Agency
Evacuation	To ensure that people at threat are moved to a safe location	Revenue Department	<ul style="list-style-type: none"> • District Administration
Fire Fighting	To control and manage fire incidences	Fire & Emergency Services	<ul style="list-style-type: none"> • Health • Police
Oil and Hazardous Material Response <i>(In case of such incident due to earthquake)</i>	To provide expert and technical support in case of release of any hazardous material following earthquake	Industrial Safety and Health	<ul style="list-style-type: none"> • Emergency Response Centres • Fire & Emergency Services • Health
Search & Rescue	To provide life saving assistance in aftermath of earthquake	Police	<ul style="list-style-type: none"> • Fire & Emergency Services • Home Guards • Health
Medical Services	To provide emergency medical and mental health assistance	Health	<ul style="list-style-type: none"> • Red Cross Society
Dead Body Management	To identify and properly record the dead bodies and facilitate the appropriate cremation/ burial	Police	<ul style="list-style-type: none"> • Revenue • Health • Local Authorities • Municipal Commissioner
Food	To address the food needs of the affected population and responding agencies	Food & Civil Supplies	<ul style="list-style-type: none"> • Revenue • Police • Women & Child Development
Communications	To provide fail safe communication and last mile connectivity	Department of Science & Technology	<ul style="list-style-type: none"> • Revenue Dept. • COR • GSDMA • GSAN • GIPL • District Administration • Information Dept. • Local authorities • Municipal Commissioner

ESF	Aim	Primary Department/ Agency	Secondary Department/ Agency
Transportation	To provide transport support to responding stakeholders and for various purpose as and when required	Port & Transport Department	<ul style="list-style-type: none"> • RTA • Railways • Civil Aviation
Temporary Shelter/ Camp Management	To address all basic needs of the affected population in the relief camps and ensure	Revenue Department	<ul style="list-style-type: none"> • District Administration • Food & Civil Supplies • Health • Police • Water Supply • Water and Sanitation Management Organisation • Gujarat Electricity Regulatory Commission
Public Works and Engineering	To provide technical support and expertise for repair, restoration and reconstruction of public infrastructure	Roads & Building Department	<ul style="list-style-type: none"> • Water Supply • Water and Sanitation Management Organisation
Energy	To ensure rapid restoration of power to affected areas particularly to critical facilities on the priority	Energy & Petrochemicals Dept.	<ul style="list-style-type: none"> • Gujarat Electricity Regulatory Commission
Public Safety and Security	To ensure safety and security of affected population, their property and responding agencies	Police Department	<ul style="list-style-type: none"> • Home Guards • Women and Child Development • Social Justice & Empowerment Dept.
Media Management	To ensure precise and accurate incident briefing to public and ensure proper rumour and panic management	Information Department	<ul style="list-style-type: none"> • Police • Health

Table 6.3: Emergency Support Functions

6.7 Disaster Reporting and Assessments

There are three kinds of assessment reports made at different timeframe in aftermath of an earthquake. Each assessment report has different format for collection of data and reporting of information. These reports are designed to assess:

- a. Life threatening situation
- b. Need for emergency food, water, shelter and medical assistance
- c. Need for restoration of critical facilities and services

The format for Damage and Need Assessment is mentioned in annexure 8.

The COR shall issue instructions to district collectors to carry out need and loss assessment. Teams are to be formed and dispatched to the affected areas for detailed assessment of houses and property assessment. Adequate manpower, vehicles, stationery etc should also be provided to supplement the efforts for need/loss assessment.

6.7.1 Rapid Report

It is aimed at obtaining a broad picture of extent of damage. It should ideally be undertaken within 4-8 hours of all clear. It helps in identifying the immediate actions necessary to be made.

6.7.2 Preliminary Report

Preliminary report is made within first 7 days of all clear. Within these 7 days, interim SITREP should be prepared and submitted at the end of 48 hours followed by SITREPS at the end of each 24 hours period. The objective of this report is to obtain more detailed and specific data regarding damage and needs. The 48 hours report should include wherever possible preliminary cost estimates of damage.

6.7.3 Detailed Report

Detailed report is made within 21 days of all clear. This assessment is conducted sector-wise and is aimed at finding the detailed damage and need of each sector so as to plan recovery and rehabilitation of the sector. The direct costs associated with recovery and rehabilitation of each sector should be mentioned in detailed wherever possible.

6.7.4 Deactivation of the Process

After the process of damage and need assessment is over, the designated authority shall issue the appropriate directive to deactivate the damage and need assessment process.

6.8 Earthquake Relief Measures

The EOCs and ERCs in its expanded form will continue to operate as long as the need for earthquake relief and operations continue and the long term plans for rehabilitation are finalised. For managing long term rehabilitation

programmes, such as reconstruction of houses, infrastructure and other social amenities, the responsibilities will be that of respective line departments through a well structured R & R Programme. This will enable EOCs and ERCs to attend to other disaster situations, if the need be.

6.8.1 Short-Term Relief Measures

1. Provide temporary shelter to affected people
2. Continue to provide essential services to the affected people i.e. food, water, clothing, sanitation and medical assistance
3. Arrangements for distribution of gratuitous relief and cash doles.

The COR ensures the following in the relief camps:

1. Special emphasis on hygiene and sanitation aspects should be given in relief camp
2. Separate area should be earmarked within the relief camp for storage of relief materials
3. Adequate manpower and transport facilities for camp site
4. Arrangements to be made for trauma management
5. Mobile medical units to be sent to remote areas to provide medical assistance to the victims/injured

6. Information centre should be established by the administration

6.8.2 Interim Relief Measures

1. Arrangements to be made for identification and maintenance of records of disposal of dead bodies in affected areas
2. Arrangements to be made to record complaints of persons reported missing. Follow up action in terms of verification of the report needs to be made.
3. Unclaimed/unidentified dead bodies to be disposed off at the earliest after keeping their records.
4. Additional manpower to be deployed in the affected areas for supplementing the efforts of the local administration.
5. Separate cell to be established at state/district/taluka level to coordinate with the NGOs and outside donor/aid agencies.
6. As reconstruction of houses will take a long time, arrangements to be made to provide interim shelters to affected persons
7. Identification of site for interim shelter
8. Allocation of areas to affected families
9. Providing essential services like water, power, health, sanitation, PDS, etc. at interim shelter sites

10. Regular meetings of different stakeholders/ departments should be organized at state level for sharing of information, developing strategies for relief operations.
11. Information & Broadcasting Dept to coordinate with media to play a positive role in disseminating appropriate information to public and govt to facilitate the speedy recovery.

6.8.3 Relief Kits

Indicative details of immediate relief kit, household kits and family ration kits are mentioned in annexure 10.

6.8.4 Post Relief Assessment

GSDMA, with assistance from line departments, district administration and local authorities shall document learning from relief experience and incorporate the same in plans.

Once the situation is totally controlled and normalcy is restored, the COR declares End of Emergency Response and issues instructions to withdraw the staff deployed in emergency duties.

Chapter 7 Earthquake Recovery

Activities relating to rehabilitation and reconstruction are primarily carried out by the local bodies (Gram Panchayats, District, Taluka, Municipal Corporations, Municipalities, etc.), various Government departments and boards. However, their activities in this phase shall be in accordance with the reconstruction and rehabilitation plans framed by GSDMA, in conjunction with implementing authorities.

On the expiry of a disaster declaration, the Authority shall, where necessary, act as an agency for facilitating and coordinating rehabilitation and reconstruction activities by departments of the Government.

The reconstruction and rehabilitation plan is designed specifically for worst case scenario.

The key activities in this phase are discussed below:

7.1 Detailed Damage and Need Assessment

While a preliminary damage assessment is carried out during disaster phase, a detailed assessment must be conducted before commencing reconstruction and rehabilitation activities (as discussed in 8.7.3 in Chapter 8) The primary objective of post earthquake damage assessment and need analysis is to provide a clear, concise picture of post disaster situation, to identify damage caused to different sector

and to develop strategies for rehabilitation, reconstruction and recovery.

The relevant Government departments and local authorities shall initiate detailed assessment at their respective level for damages sustained in their respective departments and jurisdiction in the affected regions.

For assessing the damage and need of the affected community, the damage and need assessment team should represent all the different communities and groups in the affected area. An ideal team would include expert in the related field, government official and representatives from majority and minority communities, females, Scheduled Caste and Tribes, panchayat member or nagarpalika member, etc.

The format for Detailed Damage and Loss Assessment is given in annexure 8.

7.2 Reconstruction Strategy

Depending on the type of damage and population affected, following measures can be initiated as comprehensive recovery strategy. While the short term reconstruction strategy includes repair, restoration and strengthening of affected structures, long term strategy includes reconstruction and relocation.

7.2.1 Repair and Restoration

GoG, if needed, will formulate a policy of assistance to help the affected to repair and restore damaged houses and dwellings. This should neither be treated as compensation for damage nor as an automatic entitlement.

Respective departments should carry out timely repair and restoration of the related infrastructure, facilities, services, etc. This shall aid in quickly resuming the essential services they provide.

GoG shall coordinate with national and international NGOs, donor agencies and other government bodies to prioritise restoration of critical infrastructure like health institutions, temporary housing, lifesaving facilities, critical government infrastructure, etc.

7.2.2 Reconstruction

GSDMA shall oversee reconstruction and rehabilitation work and ensure that it takes into account the overall development plans for the state. GSDMA shall approve reconstruction and rehabilitation projects based on:

- Identification of suitable projects by relevant departments
- Project detailing and approval by the relevant technical authority

Two essential aspects of reconstruction are:

a. Owner Driven Reconstruction

Reconstruction should be done on the principle of Owner Driven

Reconstruction. Here the district administration aids in provision of funds and technical expertise for construction activity. The principle allows active participation of the affected family/ owner in rebuilding their houses and ensures that their houses suit their cultural, occupational and other personal needs and context. It also gives them a sense of ownership and change their mindset from 'being a beneficiary' to 'being an owner' which also aids in psychological rehabilitation.

The active participation of the owner also ensures regular monitoring of the process, quality of material used, etc. which helps in speeding up the reconstruction process.

Other ways to involve the affected population in the rehabilitation process is through regular communication regarding activities, scope and nature of the proposed reconstruction and rehabilitation effort. Hence, GSDMA and relevant Government departments, district administration and local authorities shall undertake:

i. Ongoing Media Management/ Public Relations

To ensure accurate communication of the reconstruction and rehabilitation measures being taken to various stakeholders

ii. Community Management

This includes communicating to the affected communities with a view to apprise them of efforts being made for

their relocation/ rehabilitation/ reconstruction

iii. Feedback Mechanisms

Efforts should be made to lay down mechanism to get feedback on reconstruction and rehabilitation measures using the communication network.

iv. Dispute Resolution Mechanisms

GSDMA, in conjunction with relevant agencies, shall institutionalize mechanisms to address beneficiary grievances at various levels, as well as explore innovative ways of dispute minimisation like involving the community in reconstruction initiatives. Appropriate mechanism with penalties for dealing with false claims will be evolved to prevent misuse of assistance.

b. Build Back Better

Post earthquake reconstruction also gives an opportunity to build back better. The new construction post disaster should comply of all safety norms, guidelines and building codes. The design of these buildings should be disaster resilient as per the hazard profile of the state.

GoG shall monitor the reconstruction process and ensure that the principle of build back better is followed through disaster resilient reconstruction.

7.2.3 Relocation

The GoG believes that need-based considerations and not extraneous factors drive relocation of people. The

local authorities, in consultation with the people affected and under the guidance of GSDMA, shall determine relocation needs taking into account criteria relevant to the nature of the calamity and the extent of damage. Relocation efforts will include activities like:

1. Gaining consent of the affected population
2. Land acquisition
3. Urban/ rural land use planning
4. Customizing relocation packages
5. Obtaining due legal clearances for relocation
6. Getting the necessary authorization for rehabilitation
7. Livelihood rehabilitation measures for relocated communities, wherever necessary

While planning on site reconstruction or relocation, care should be taken to provide the community with all basic amenities in close vicinity of the reconstruction site. This leads to holistic reconstruction process. Some of the basic amenities are as follows:

1. Health
2. Education
3. Proper drainage system
4. Provision to drinking water
5. Provision for proper sanitation
6. Provision for waste collection and management
7. Market place
8. Connectivity to road and railway

7.3 Rehabilitation

Holistic rehabilitation includes many inter linked aspects. It is critical to

address all needs of affected population in order to achieve early recovery and to bring back normalcy to their lives.

In addition, it is also necessary to constantly monitor ongoing activities to ensure timely completion of the project in accordance with the technical specifications and to the satisfaction of the beneficiaries. GSDMA, in conjunction with relevant Government departments, will monitor the reconstruction activity that is carried out by various implementation agencies.

For managing long-term rehabilitation programmes, such as reconstruction of houses, infrastructure and other social amenities, the responsibilities will be that of respective line departments through a well-structured R&R Programme.

7.3.1 Physical/ Structural Rehabilitation of Infrastructure

It is aimed at rebuilding the lost residential or commercial or public infrastructure and facilities like housing, roads, bridges, railways tracks, public buildings, schools, hospitals, etc.

It is done with an aim of building back better by ensuring disaster proofing and retrofitting of the structures.

7.3.2 Socio-economic Rehabilitation

Socio-economic rehabilitation is aimed at revamping the social and economic fabric to the pre-disaster or a better situation. It also addresses issues like that of livelihood restoration and generation. This is done by

providing required training, skill, tools and equipment to restart the previous or new livelihood options.

Care should also be taken to address the needs of various socially and economically vulnerable groups like that of women, adolescent girls, old age persons, differently abled persons, children, destitute, below poverty line population, scheduled castes, scheduled tribes, particularly vulnerable tribal groups, etc.

7.3.3 Psychological Rehabilitation

Earthquakes often lead to long time stress and trauma due to loss of near and dear ones, injuries, loss of limbs, loss of housing and related property, trauma generated by facing the disaster and fearful sites, fear of repetition of the earthquake, etc. If not addressed appropriately, it may lead to lifelong psychological fear and disorders, thus it is necessary to provide psycho-social first aid and psychological care to the affected population.

7.4 Implementing Initiatives for Recovery of Reconstruction Costs

The GoG shall finalise and implement select recovery measures such as:

1. Imposing tax surcharge levies (central)
2. Imposing local taxes
3. Facilitation of funding responsibility sharing by beneficiaries etc.

Chapter 8

Financial Arrangements

8.1 Funding Mechanism at Various Levels

To ensure the long-term sustenance and permanency of the organisation, funds are generated and deployed on an ongoing basis. Financial mechanism for disaster management is already in place at national, state and district level. Additionally there are various projects, programmes and initiatives catering to different phases of disaster management at nation, state and district level.

8.1.1 Centre Level

a. National Disaster Response Fund

This fund has been created under the legal framework of National Disaster Management Act, 2005. Under the existing guidelines, it is available for assistance from avalanches, cyclone, cloud burst, drought, earthquake/tsunami, fire, flood, hailstorm, landslides, pest attack and frost & cold wave.

In case of calamity of severe nature when State Disaster Response Fund is insufficient to meet the relief requirements, additional central assistance is provided from NDRF to the State Government by following the laid down procedures.

b. Prime Minister's National Relief Fund (PMNRF)

PMNRF provides immediate relief to families of those killed in natural calamities and to the victims of major accidents and riots. The fund is raised entirely by public contributions.

8.1.2 State Level

a. State Budget

GSDMA submits to the State Government for approval a budget in the prescribed form for the next financial year showing the estimated receipts and expenditure, and the sums which would be required from the State Government during that financial year.

The GoG also allocates funds in the State Budget for relief activities. In addition, funds may be available through the State Disaster Response Fund.

b. State Disaster Response Fund

There is a provision for State Disaster Response Force which is made available to Commissioner of Relief, Revenue Department. The Central and State Government share 75% and 25% respectively in case of Gujarat. This was meant for meeting expenditure for providing immediate relief to the victims of cyclone,

drought, earthquake, fire, flood, tsunami, hailstorm, avalanche, cloud burst and pest attack

c. Chief Minister Relief Fund

This provides immediate support to the distressed people affected by the natural calamities, or road, air or railway accidents.

8.1.3 Other Sources of Funds

a. Public Private Partnership

There are projects/schemes in which funding can be done by a public sector authority and a private party in partnership. In this State Govt. along with Private organizations and with Central Govt. share their part.

b. Grant In Aid

State government may receive a grant in aid from Central Govt., World Bank, other departments, bilateral or multilateral funding agencies, etc. to carry out specific projects/schemes related to disaster management/mitigation/ capacity building.

c. Loan

Authority may borrow money from the open market with the previous approval of State government to carry out disaster management functions as described in DM Act 2003.

d. Disaster Bonds

State government can also raise funds for major disasters by exploring the options of long term disaster bonds.

e. Donations

As per the provisions of The Gujarat State Disaster Management Act, 2003 the Authority may accept grants, subventions, donations and gifts from the Central or State Government or a local authority or any individual or body, whether incorporated or not.

f. Recovery Measures

The GoG shall finalise and implement select recovery measures such as imposing tax surcharge levies (central), imposing local taxes, facilitation of funding responsibility sharing by beneficiaries etc.

8.2 Funds Disbursement and Audit

The funds raised from funding agencies are usually accompanied by stringent disbursement and usage restrictions. It is therefore important to monitor the disbursement of such funds to ensure that none of the covenants are breached. GSDMA, in conjunction with relevant agencies, shall monitor disbursal of funds by:

- Prioritizing resource allocation across approved projects
- Establishing mechanisms (like a chain of banks, collection centres, nature of accounts, spread etc) for collection of funds
- Ongoing monitoring and control of fund usage throughout actual project implementation.

Chapter 9

Plan Maintenance

Plan maintenance is a dynamic process of updating the plan on a periodic basis. The back-bone of maintaining the plan is carrying out mock drills and updating the plan based on the lesson learnt as an outcome of the mock exercise which consists of identifying the gaps and putting in place a system to fill the same.

9.1 Plan Testing

The Commissioner of Relief, Revenue Dept. shall prepare, review and update Earthquake Management Plan. He shall also ensure that earthquake management drills and rehearsals are carried out periodically.

While updating the plan the following aspects need to be considered by the COR every year:

- a. Critical analysis of the outcome of exercises & mock drills as part of plan testing.
- b. Incorporation of lessons learnt in the updated plan as an outcome of mock exercises through identification of gaps and measures to fill them.

The plan must be thoroughly tested and evaluated on a regular basis, at least once a year.

The main objectives of plan testing are to:

- a. Determine the feasibility and compatibility of back up facilities and procedures
- b. Identify areas in the plan that needs modification
- c. Identify training needs of key stakeholders
- d. Assess the ability of the organization/department to respond to earthquakes

After plan testing and incorporation of lesson learnt, the COR should send a copy of the revised and updated plan to the following officials:

- a. Chief Secretary, Government of Gujarat
- b. Chief Executive Officer, Gujarat State Disaster Management Authority
- c. Principal Secretary, Revenue Dept
- d. Head of all line Depts.
- e. State EOC
- f. District EOCs
- g. ERCs
- h. IMD
- i. ISR

All the departments, which have specific roles and responsibilities in Earthquake Management Plan, must have a system to ensure that all officers of their departments who have

a specific role to play are fully up to date with their responsibilities/tasks.

9.2 Mock Exercise

- a. Mock exercise debriefing and evaluation is of critical importance as the insights are collected from participants (who participated in the exercise) and is used to modify the plan.
- b. Hot debriefing is very effective as it is carried out immediately after the exercise. It also includes documentation in terms of recommendations and improvements of the plan.

9.3 Review & Updation of Plan

The Earthquake Management Plan should be reviewed and updated annually. The plan updation process should begin in January in each year

and should be completed by month of April, based on inputs from the following:

- a. Drills and rehearsals
- b. Lessons learnt from any disaster event in other states and countries
- c. Directions from Ministry of Home Affairs, National Disaster Management Authority, Government of India, etc.

GSDMA and all other concerned Depts. should encourage formal and informal interaction with various stakeholders at different levels to learn and document their experiences, so that such experiences can contribute constructively towards updation of Earthquake Management Plan for further improving the capability to deal with future earthquakes.

