RISK ASSESSMENT AND DISASTER MANAGEMENT PLAN

1. DISASTER MANAGEMENT, RISK ASSESSMENT & MITIGATION PROCEDURES

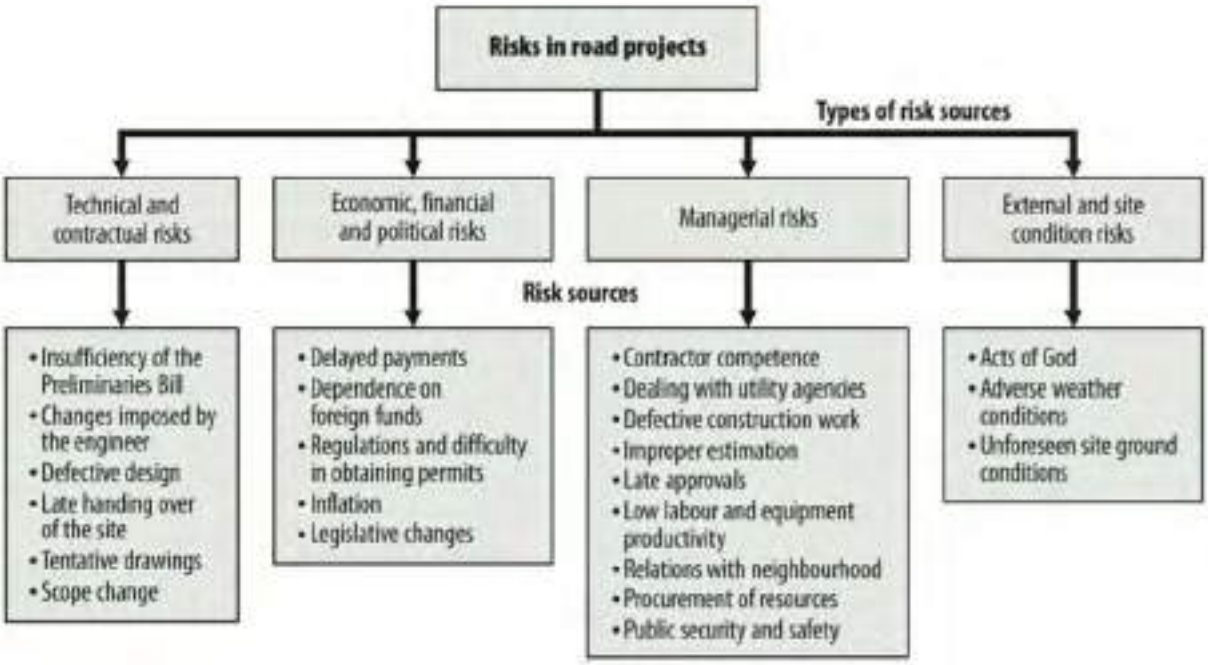
The primary requirement for making disaster management plan is the reliable and upto date information about topography and socio-economic and climatic conditions of this region. This will help in identifying the areas vulnerable to environmental and manmade hazards. Risk is involved in every aspect, and the construction of highway projects are no exception. A risk is defined as the combination of probability of an event and its impacts on project objectives. The adverse impacts due to gas tanker explosions, fire hazards, major road mishaps, floods, cyclones, earth quakes *etc.* occur due to avoidance of hazard. Elimination of the risk (avoidance of accidents) is given prime importance and NHAI has introduced road safety provisions during the design of highway with the help of Road Safety Manual. Some of these are listed below:

- Traffic signs and pavement markings
- Removal of junctions and direct access points on main roads
- Safety barriers/delineators hard shoulders on main roads
- Improved median openings with stacking lanes
- Separate provisions and direct access point
- Underpasses and other grade separators at congested junctions
- Service roads in towns and villages for segregating local and highways traffic.
- Maintenance of means of safe access and egress
- Safe use, handling, storage and transportation

1.1 The Risk Assessment Process and Hazard Identification

Risk assessment is fundamentally a management activity supported by persons familiar with risk management activities. A comprehensive risk assessment combines both qualitative and quantitative assessments. The qualitative assessment is useful for screening and prioritizing risks and for developing appropriate risk mitigation and allocation strategies. The quantitative assessment is best for estimating the

numerical and statistical nature of the project's risk exposure. It is important that unsafe conditions are not confused with hazards, during hazard identification.



1.2 Risk Control Measures and Hierarchy of Risk Control

The next stage in the risk assessment is the control of the risk. The basic principles that govern the identification of and protection from hazards, in order of priority, are:

a. Remove
b. Reduce
c. Protect

Thus the contractor, having identified the risk and ranked it according to severity, has to first take steps to remove the risk itself. If this step leaves behind some residual hazards, then the attempt has to be to reduce it to acceptable levels. Only in the last resort is the worker to be issued with personal protective equipment (PPE) so that he/she can function in an unsafe environment.

General precautions to be maintained by the Contractor:

Ensure health, safety, and welfare of all workers while at work, including:

a. Maintenance of safe systems and without risks to health
b. Safe use, handling, storage and transportation
c. Information, instruction, training and supervision for health and safety
d. Maintenance of means of safe access and egress
e. Safe working environment
f. Provision of Safe articles for use and without risks to workers
g. Necessary tests and examination for the use of articles before works
h. Adequate information for the use of articles in factory
i. Elimination/minimization of risks to health and safety wherever necessary
j. Application of suitable methods for prevention and accumulation of dust and fumes
k. Exhaust system for extracting toxic fumes and dust
l. Fencing system for every dangerous and moving part; all moving parts shall be enclosed
m. Striking gear and devices for cutting off power in an emergency

Safe working speeds not to be exceeded for any revolving machinery.

1.3 Risk Assessment Matrix

Table No. 1: Consultations with Community / Primary Stakeholders

Likelihood (L)	Consequence (C)				
	a	b	c	d	e
A					
B					
C					
D					
E					

Description	Action
HIGH	Unacceptable. Major disruption likely. Different approach required. Priority management attention required.

MODERATE	Some disruption. Different approach may be required. Additional management attention may be needed.
LOW	Minimum impact. Minimum oversight needed to ensure risk remains low.

1.4 Probability/Likelihood of Occurrence

Likelihood of occurrence of an accident or incident or ill health is classified as per the table given below:

Table No. 2: Classification of Occurrence of Likelihood

Level	Likelihood	Description
A	Unlikely	Is practically impossible and has never occurred
B	Remote	Has not been known to occur after many years
C	Likely	Might be occur at sometime in future
D	Possible	Has a good chance of occurring ad is not unusual
E	Most Likely	The most likely result of the hazard/event being realized

1.5 Severity of hazard (Occurrence)

Severity is the highest level of damage possible when an accident occurs from a particular hazard. Severity of hazard is classified as per the table given below:

Table No. 3: Consequences Descriptions

Level	Result of hazard to personnel	Result of hazard to assets/progress
a	First-aid treatment only	Minor damage, no delay
b	Injury requiring medical treatment but not lost time	Moderate damage, minor delay
c	Lost time accident	Serious damage, Moderate delay
d	Serious injury requiring hospitalization	Major damage, serious delay
e	Single or multiple fatality	Catastrophic damage, critical delay may result in fatality

Table No. 4: Risk Matric Assessment Descriptors

Rating	Probability	Severity
Low	• Unlikely event, has not occurred bu could happen • May happen once in 10 years • Has never been observed, but possible • Less than 10% chance of occurring	• No injury or minor injury requiring first aid • Costs to repair / replace property damage • Minor business interruption
Medium	• Event is known to occur, but no frequently • Occurs less than once a year • Has occurred in similar circumstances • 10% to 50% chance of occurring	• Injury requiring medical aid with o without lost time from work • Costs to repair / replace property damage • Loss of business function for shor period, modest consequences fo business
High	• Frequent or repeated event • Occurs at least once a year • Occurs several times during a project • Occurs often in similar circumstances • Greater than 50% chance of occurring	• Serious or disabling personal injury permanent disability or fatality • Costs to repair / replace property damage • Loss of business function for extended period, substantial consequences fo business

1.6 Hazard Identification Risk Assessment (HIRA)

Hazard Identification Risk Assessment (HIRA) is a process of defining and describing hazards by characterizing their probability, frequency, and severity and evaluating adverse consequences, including potential losses and injuries. The methodology for hazard identification and risk assessment is as follows:

- The identification time frame and keeping of a record of the hazards.
- Risk involved in each activity and control measures are analyzed and impact rating and probability rating are given in HIRA sheet.

- Risk level is identified from the matrix based on the rating given.
- Control measures are evolved to bring the risk level to ALARP (as low as reasonably practicable and residual risk is also identified. If the residual risk is not an acceptable level, then assessment process shall be repeated to bring the residual risk at ALARP.
- The lists of control measures for the activities should be handed over to the concerned execution engineer for implementation and the HIRA shall be explained to the concerned workmen / supervisors and engineer for implementation

2. ROAD SIDE SAFETY MEASURES

2.1 General

The Central Government through the MoRT&H / NHAI and other State Agencies (Transport & Highways) has put sustained efforts to evolve appropriate methods and approaches for preventing road accidents and injuries.

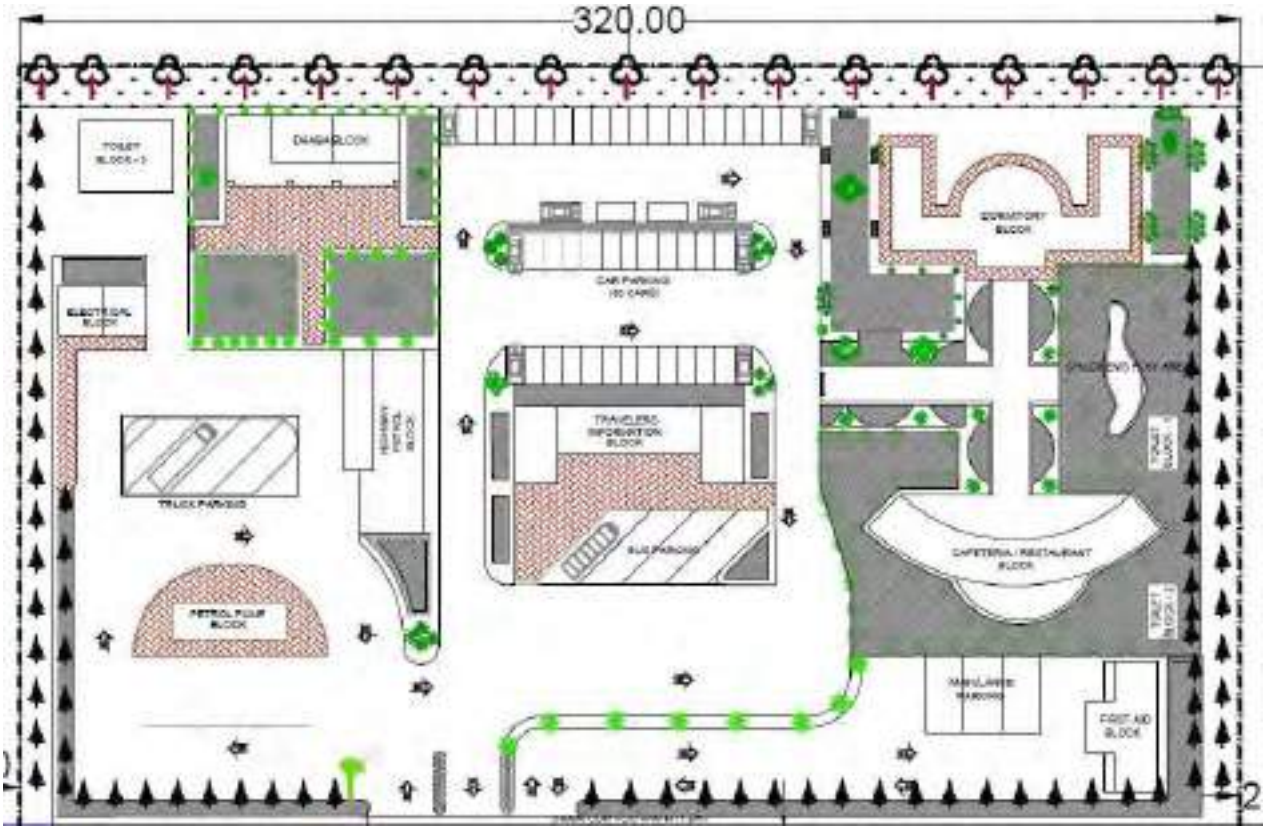
Still Road safety is a concern for all the stakeholders and the road users. Traffic fatalities increased by about 5% per year from 1980 to 2000, and since then have increased by about 8% per year in recent years.

This is attributable partly to an increase in the number of vehicles on the road, and partly to the absence of a coordinated official policy to control the problem. Many of these traffic injuries and deaths take place in constructions zones on all roads and highways.

In addition, a significant number of workers associated with construction and maintenance of roads also get injured and killed every year. This increasing trend in injuries and fatalities has been recognized as a public health problem of significance by the Central Government and other various State Government authorities and public at large.

Highway Amenities

This project will also have highway amenities at Chainage 37+500, 78+150.



The amenities proposed during operation phase are toll plaza, administrative buildings, weighing stations, parking areas, rest areas, roadside furniture, pedestrian facilities, landscaping and tree plantation, truck lay-bys, bus-bays and bus shelters, highway lightings and office cum residential complex of PIU. The toll plaza location will be selected based on the traffic studies and a study of the existing physical features including the availability of land & designed as per IRC 84.

Multi-lane highways being built under various road development programme adopting the geometric standards specifications, signage, road marking, etc. as per the provisions contained in the codes of practice and the Standards of the Indian Roads Congress supported by the Ministry's specifications. However, accident data indicates that motorists leave the roadway for numerous reasons including errors of judgment.

To ensure long term road safety on these highways, the following suitable engineering measure are considered essential for adoption so as to help in improving road safety leading to reduction of accidents.

There would be an estimated 12000 Passenger car units equivalent per day on the proposed stretch. There would also be hazardous chemicals transportation. Hence, there ought to be adequate precautions especially

for management of spills and leakages.

2.2 Objective

To achieve the objectives of safety of road users and protection of workers, the following are to be ensured:

- Proper training to the workers at the time of induction
- Deployment of trained and experienced staff and workers at site.
- Protection of workers on site through strict enforcement of safety plans / standards,
- Implementation of applicable and adequate safety measures at site through proper fencing, barricading, safe access to work zone , lighting and use of Personal Protective
- Equipments (PPE) & other safety tools and equipments.
- Ensure smooth, safe and uninterrupted traffic flow on the project highway at all times during construction.
- Give adequate information / warning sufficiently in advance about the situation that affects the project highway through proper signage's, Demarcations, deployment of marshals etc.
- Ensure safety of road users against the hazards due to Diversion
- Road Condition
- Low Visibility
- Vehicle breakdown on carriageway
- Repair & Maintenance work etc. on carriageway or for any other reason resulting in disturbance in free flow of traffic.
- Avoid risk of damage / disturbance to the properties adjacent to the project highway.

2.3 Guiding Principles

The guiding principles for safety in road construction zones are to:

1. Warn the road user clearly and sufficiently in advance;
2. Provide safe and clearly marking lanes for guiding road users;
3. Provide safe and clearly marked buffer and work zones;
4. Provide adequate measures that control driver behavior through construction zones.

2.4 Road Safety & Traffic Management

Road Safety & Traffic Management can be classified under:

2.5 Planning & Design Phase

- To identify and include traffic control requirements in the contract specification, work program and

method of construction.

- To design the Traffic Control Plan in detail, with regard to types, location and layout of traffic control devices for submission to the road authority for approval.

Construction Phase:

- To install the temporary traffic control devices safely in accordance with the approved Traffic Control Plan.

Operation and Maintenance Phase:

- To inspect the Traffic Control Plan and devices regularly by day and night to ensure that they are effective and absolutely safe.

Close out Phase:

- To remove all the traffic control devices safely and reinstate the permanent traffic scheme

Planning & Design Phase

Various aspects taken into consideration in planning and design of project highway. Also NHAI has directed road safety engineering measures as per directions of MoRT&H vide letter no. NHAI/2008/Road Safety/IRF/588 dated 12.07.2010. These engineering measures are considered essential for adoption, to help in improving road safety leading to reduction of accidents during the design phase.

During Survey and Investigations, proper traffic control devices (signs, cones, barriers, flashing lamps or other devices placed temporarily on or adjacent to a road to regulate, warn, or guide road users) are put to use.

2.6 Geometric Design of Project Highway

The Project Highway is proposed to be developed as under:

1. 2-Lane Carriageway with Paved Shoulders
2. 4-Lane dual Carriageway with Paved Shoulders

For 2- Lane sections, the carriageway is proposed 7 m with 0.5 Kerb shyness, 1.5 m paved shoulders and earthen shoulders.
For 4-Lane sections, the carriageway is proposed 9 m wide on either side with 0.5 Kerb shyness for each

carriageway. 2m/1.5 m wide paved shoulders of the same composition as of main carriageway will be provided for both the carriageways.

In built-up areas, the width of Paved Shoulders is kept 2 m for each carriageway and 1.5m/1.75m footpath/footpath cum drains are provided on both side of the carriageways.

Desirable stopping sight distances as per IRC SP 73-2015 and IRC SP 84-2014 have been followed.

Design speed of 100 kmph ruling/80 kmph minimum for Plain and Rolling terrain and 60 kmph/40 mph has been followed as per IRC SP 15-2015 and IRC SP 84-2014 have been adopted.

Raised median of 4 m is proposed in open areas. In built-up areas, the median width will be 2.5 m including Kerb shyness has been kept.

Transition of 1 in 20 will be provided for the change in width. New Jersey type Concrete crash barriers are recommended in urban areas or wherever required as per site conditions along with anti-glare screen for avoidance of headlight glare.

Lateral clearance will kept at least 1.5m width from the edge of the carriageway without any obstacles.

Wherever a permanent object cannot be removed for some reason, provision of fenders and

Hazard markers with reflectors will be given. Frangible lighting columns and sign posts are proposed for minimizing the severity in case of collision.

In constrained situations where deep road side drains with depth of 1.0m or more exist (including those along the central median), these will be covered by concrete or steel gratings, and should be protected by W-beam crash barrier .

Wherever embankment height is 3m or more, the W-beam metal crash barrier are provided at the edge of the formation.

For ensuring effectiveness of recovery zone has a slope of 1:4, slopes steeper than 1:4 will be provided with W-beam metal crash barrier for safety of the traffic.
Road Protection works via; retaining walls/breast walls have been proposed in Ghats sections.

Service Roads

For the safety of traffic operation, local traffic would be separated / segregated from the through traffic plying on the main carriageway by provision of 5.5m /6m wide service roads with safety fence, railings, etc.

where required.

Pedestrian Facility

In the urbanized sections footpaths are proposed for safety of the pedestrians with railings at the outer edge of the service roads.

Truck Lay byes

In order to ensure that service roads are always available for safe movement of local traffic, Truck lay byes are provided at suitable locations where there would be no conflicts or safety obstructions.

Bus Bays

Bus bays are provided with designs to site requirements along the main carriageway, using extra width together with approach and exit transition lanes. At such locations the arrangement for the dispersal of the passengers will be designed considering their safety & comfort. The passengers (pedestrian) should move to the demarcated locations, or footpaths provided, and then use the cross over facilities.

Illuminations

All critical locations, Stretches of the built-up areas, the underpasses and Flyovers, ROBs, Toll Plazas, Parking and rest areas will be adequately illuminated, ensuring a minimum of 40 lux with 24 hour power supply.

Development of Junctions & Intersections

At the crossing of a highway by a primary road (National Highway / State Highway) junctions are designed as per IRC: SP: 73: 2015 and IRC: SP: 84-2014 for 2-Lane & 4-Lane configuration respectively. In case of other categories of roads (MDR, ODR and VR) grade junctions are designed.

In all such cases, the cross roads will be brought to the level of the main carriageway and flared for appropriate length, and stop / yield line and centerline marking will be provided, in addition, rumble strips/speed breaker will also be provided on each cross road with warning sign and road marking for the same.

The grade junction below the grade separation is designed with proper channelization of traffic flows and to prevent undesirable movement.
To enable the traffic on the service road to cross over to the other side of the main carriageway, suitably designed cross passages are recommended as follows:

SVUPs : 51 Nos.
LVUPs : 09Nos.
VUPs : 10 Nos.
Culverts : 340 Nos.
Flyovers : 0 Nos.
ROB (s) : 0 Nos.

Road Signs and Markings

Traffic Control Devices, Road Safety Devices and Road Side Furniture shall comprise of road signs, road markings, object markers, hazard markers, studs, delineators, attenuators, safety barriers, pedestrian guard rails, boundary stones, km stones, etc. Guidelines given in IRC: 8, IRC: 25, IRC: 26, IRC: 35, IRC: 67, IRC: 79, IRC: 103 and Section 800 of MORTH Specifications are recommended for providing these items unless otherwise approved by the Client.

Some of the commonly encountered roadside obstacles are bridge piers, abutments and railing ends, roadside rock mass, culverts, pipes and headwalls, cut slopes, retailing walls, lighting supports, traffic signs and signal supports, trees and utility poles.

All signs and markings will be of retro-reflective type only.

- All curves with R < 750m delineated on outer side of the curve from both the Directions by chevron signs. (For RHS curve it will be on shoulder and for LHS curves it will be on median)
- All embankments with height 3m or more will have W-beam metal crash barriers with delineating reflectors on them.
- In low embankments and flat curves, where crash barriers are not provided, these will be delineated by 1.5m high reflectorized delineators.
- One-way reflective road studs provided on edge lines and lines on the approach to an intersection or a high level bridge/culvert/ROB etc. with high embankment. Also, such studs provided along sharp curves.

Bridges / CD Structures

In the approaches to and exit from, bridges and other CD structures, W-beam metal crash barriers shall be provided in continuation of the parapet on both the carriageways for at least 30m in addition to hazard marker signs.

Miscellaneous

At special locations like open well or pond of the village, etc. along the highway located close to the

formation of the highway, W-beam metal crash barrier are recommended at approaches for the safety of traffic operation on the highway.

Road Safety Audit (RSA)

Road Safety Audit is an important aspect of the project report preparation. It is carried out at every stage of the DPR preparation i.e. feasibility Stage, Preliminary Design Stage and Final Stage to ensure that the safety is not compromised at any stage. The basic aim for road safety audit is to identify areas of major concern, including black spots and accident prone stretches on individual project roads and to propose measure to be taken for improving the engineering design with respect to road safety aspects.

Safety Audit at Feasibility stage was carried out by the audit team comprising of a Sr. Highway Engineer and a Traffic and Transportation Expert, who carried out the reconnaissance of all the road sections.

Construction Phase

For Safety of Road workers:

Following safety rules and regulations are recommended for safety of workers

- No drugs, alcohol or alcoholic beverages are permitted on work site
- Proper provisions for sanitation, health care and solid waste disposal facilities to avoid possible transmission of communicable diseases.
- Work will only be carried out if an authorized person has ordered it.
- All connection for electricity, water supply and other temporary facilities made by authorized persons only and will be in accordance with legal and contractual requirements
- Workmen would be given safety induction before work commences.
- First Aid training programs would be given to certain identified workmen, who in turn would provide first aid to the workmen at site, when needed.
- During night hours, workers must be provided with fluorescent jackets and safety helmet with reflective tapes.
- Adequate barriers are provided to protect the workforce
- Adequate temporary lighting is provided wherever it is required.
- Adequate measures to be taken for the supply, use and storage of bituminous materials.
- Suitable precautions to be taken for underground & overhead cables.

For Safety of Road User

The Contractor shall obtain materials from quarries only after the consent of the Forest Department or other concerned authorities is obtained. The quarry operations shall be undertaken within the purview of the rules and regulations in force.

The material, equipment and machinery would be stocked / parked in places sufficiently away from the road Machinery would be parked at appropriate places with red flags and red tights on during night.

- Adequate measures are implemented to prevent operatives, tools, materials, etc. from falling onto live carriageways.
- Speed limits are set, marked, and enforced.

Construction Management

It is recommended to have a Safety Expert Consultant during the Construction activities.
Construction work on the highway will be carried out in a manner creating least interference to the flow of traffic. In advance, a Traffic Management Plan is to be prepared or and or updated as per IRC: SP: 73-2015 and IRC: SP: 84-2014 by the Contractor/Concessionaire and to be submitted to the Client/IE/AE, as the case may be. The construction work shall be followed as per the approved Traffic Management Plan.

Traffic Management during Construction

The traffic diversion plan during construction shall be prepared as per IRC: SP: 55 for the entire project highway. Separate traffic diversion plan shall be prepared for structures and CD works. The suggested layouts presented in IRC: SP: 55 and as per IRC: SP: 73-2015 (2-Lane configuration) & IRC: SP: 84 2014 (4-Lane with paved Shoulders) are recommended for various construction scenarios. Suiting the specific site requirements, the application steps described there in shall be followed.

Operation and Maintenance Phase

To inspect the Traffic Control Plan and devices regularly by day and night to ensure that they are effective and absolutely safe.

Traffic control devices are the devices which perform the crucial task of warning, informing and alerting the driver / road user apart from guiding the vehicle movements so that the driver of the vehicle as well as the workers on site are protected and safe passage to the traffic is possible.

The primary traffic control devices used are signs, delineators, barricades, cones, pylons, pavement markings, flashing lights etc. They will be such that they are easily understood without any confusion, are clearly visible during day and night, conform to the prevailing speeds in immediate vicinity, stable against sudden adverse weather conditions and are easy in installation, removal and maintenance.

Advanced Traffic Management Systems (ATMS)

ATMS is used to collect information for traffic and incident management and for the safety of the users. Highway Control System is an integrated tool for highway control and supervision. It is a real time decision

support system for traffic operators to record and solves contingency situations. ATMS operation and function is based on a centrally managed system in which operators, located in the control room are able to use systems (including computers and communications devices).

Functions of ATMS are:

- Traffic Monitoring and Detection
- Control and Response
- Information dissemination
- Report Generation

Components of ATMS are as under

- Control Centre
- Emergency Call Box (ECB)
- Closed Circuit Television (CCTV)
- Variable Message Signs (VMS)
- Automatic Traffic Classifier and Counter (ATCC)
- Meteorological data station

Close Out Phase:

To remove all the traffic control devices safely and reinstate the permanent traffic scheme.

3. MITIGATION PLAN FOR TRAFFIC SAFETY

Preamble

The two primary objective of temporary traffic control is to manage the traffic as efficiently and safely as possible under all work conditions and second objective of these guidelines is to lay down procedures to be adopted by field engineers to ensure the safe and efficient movement of traffic and also to ensure the safety of workers at site undertaking the construction.

Traffic control aims to give adequate warning and clear information to motorists about the nature of works on site. This will translate into correct actions required in order to pass the work site safely. Traffic control shall also include measures to safeguard pedestrians when necessary. Proper traffic control also protects those who are directly involved in carrying out the works. It is necessary that the existing work procedure and contract conditions are standardized to provide for the proper management of the construction site so that all road users (that is pedestrians, cyclists, motor cyclists, animal traffic and vehicular traffic) are properly and safely accommodated.

Guiding Principles

The guiding principles for safety in road construction zones are to:

- Warn the road user clearly and sufficiently in advance
- Provide safe and clearly marking lanes for guiding road users;
- Provide safe and clearly marked buffer and work zones
- Provide adequate measures that control driver behaviour through construction zones.

Roads with construction sites have higher accident rate, when compared with similar sections of road without construction sites.

Phases of Traffic Control

There are five phases of traffic control for major projects:

Planning Phase: To identify and include traffic control requirements in the contract specification, work program & method of construction.

Design Phase: To design the Traffic Control Plan in detail, with regards to types, location and layout of traffic control devices for submission to the authority for approval.

Implementation: - To install the temporary traffic control devices safely in accordance with the approved traffic control Plan.

Operation and Maintenance Phase: - To inspect the Traffic Control Plan and devices regularly by day and night to ensure that they are effective and absolutely safe.

Close out Phase: - To remove all the traffic control devices safely and reinstate the permanent traffic scheme.

Safety Plan at Construction Zone

The policy under these guidelines is to keep the closure of the roads to a minimum and to ensure that traffic is delayed as little as possible by the construction operations. Highest regard is to be given to traffic safety as well as to provide a safe working environment to the workmen. Before starting the construction work, which will influence traffic, the contractor has to get the legal permission of the road traffic authority and local police about the means and extent of securing the construction zone. The traffic management strategies to be used at construction zones should ensure that traffic safety is an integral and high priority element of the project. This can be ensured by avoiding inconvenience to traffic control elements and traffic

operations must be carried out so that care and attention to roadside safety is never slack during the progress of project.

Traffic Control Zone

For the purpose of these guidelines, the construction zone describes that area of the road which is affected by the works and which affects traffic flow and road users. The main area of interest can be called in this context as the "Traffic Control Zone ". It includes all those areas of carriageway in advance of the actual work site which are required for advance warning of the hazard as well as safety zones, the transition zones and the working zone itself.

These elements are shown in Fig 2.1 and defined in succeeding Para. (Draft revision IRC: SP: 55)

The Traffic Control Zone can be divided into three components, that is, the Advance Warning Zone, the Transitions Zone and Working Zone. All construction zones will have a working zone, which is flanked, by a transition zone for each direction of approaching traffic and an advanced warning zone will precede these in turn.

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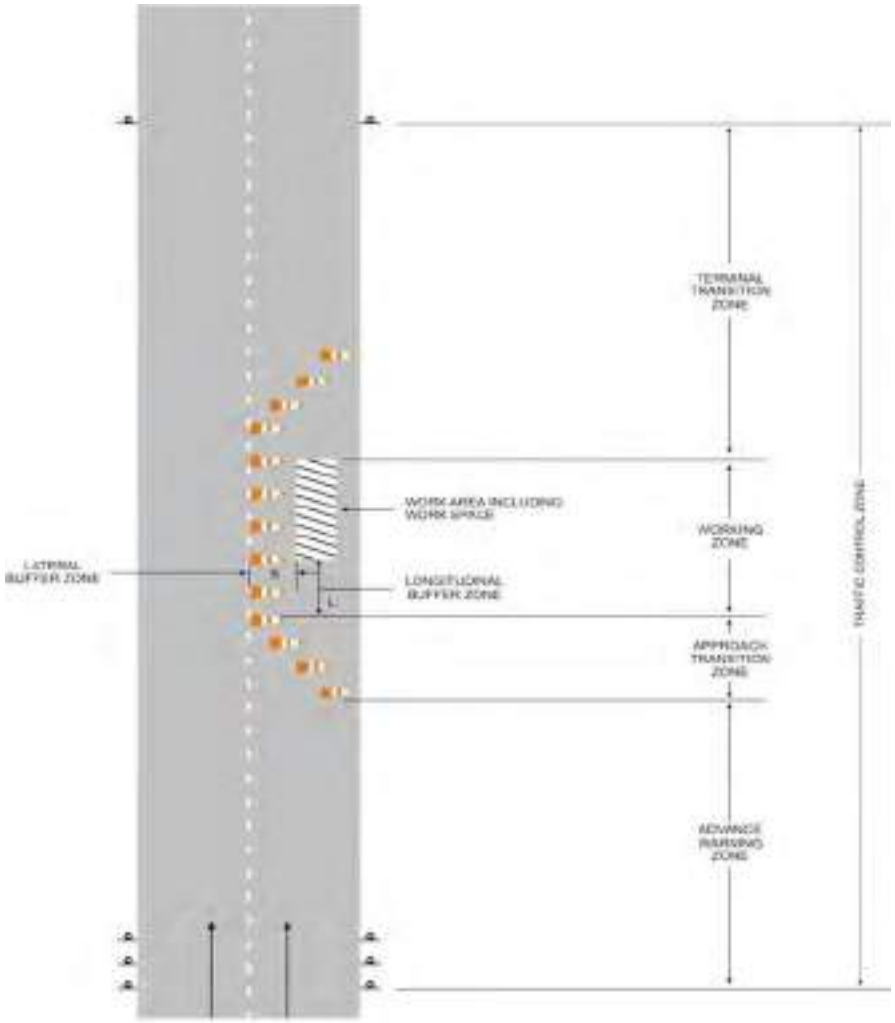
TERMINAL TRANSITION ZONE
WORK AREA INCLUDING WORK SPACE
WORKING ZONE
LATERAL BUFFER ZONE
LONGITUDINAL BUFFER ZONE
APPROACH TRANSITION ZONE
ADVANCE WARNING ZONE
TRAFFIC CONTROL ZONE

Advance Warning Zone

- The "Advance Warning Zone", is the area to warn the road user of the approaching hazard and to prepare them for the change in driving conditions. It is essential for traffic control in the construction zone. It should provide information on:
- The presence of the hazard through the "Road Work Ahead" sign, accompanied by the distance to the hazard;
- Any change affecting traffic arrangements(such as a reduction in the number of lanes and/or in the speed limit) within the traffic control zones;
- Extent of the hazard (for example; the length of restriction); and for general information;
- The type of hazard.

The advance warning zone is also where the reduction in speed of vehicles should be notified. The drivers should be advised to reduce their speed so as to achieve the desired approach transition zone. The information in this zone is conveyed through a series of traffic signs along the length of the zone. Actual signs to be used are discussed in later paragraphs.

Approach Transition Zone

The transition zone is the area in which the traffic is guided into the altered traffic flow pattern around the working zone. This is one of the most crucial zones as far as safety aspects are concerned because most of the movements involved are merging/turning movements. The transition zone has two components: The Approach Transition Zone and Terminal Transition Zone.

The initial part of the transition zone called Approach Transition Zone should further reduce the approach speed of vehicles and channel them into the narrower and/or restricted number of lanes, if this is necessary.

At other construction zones, it may be necessary to divert traffic away from the original carriageway and the design of the temporary road geometry through the transition zone should take into account the following factors:

- the turning radius of the longest vehicle that generally uses the road should be the ruling radius for curves;
- where changes in vertical profiles are required these should enough to allow safe passage of animal drawn vehicles (if these are present in significant numbers);
- The zone should have good drainage to avoid any ponding on the road surface; sources of dust should be minimized .This is not only essential for good visibility but also for clearance maintenance of

signs and barricades in the zone.

The traffic is taken across the transition zone mostly with the help of signs, barricades, channelisers and pavement marking. The various types of barricades and channelisers are discussed in detail in later paragraphs. The guiding principle for their design is that they should convey the message clarify and unambiguously. The colour and shape of the signs should also be as the standards noted in later paragraphs to eliminate the conclusion caused by use of different signs for the same purpose.

All the signs/barricades are too maintained properly and kept clean of dust at all times. Sufficient stock of these should be maintained at the site so as to replace the damaged or vandalized signs/barricades. Proper lighting arrangements for illuminating these signs must be made during the night hours. Most of the accidents at nights involve collision between vehicles and objects rather than vehicle to vehicle collision. Reflective paints/sheets must therefore be used for the signs/barricaded so that these are visible at all times.

Very often the road width available through the transition and working zones is quite insufficient for simultaneous passage of both the up and down traffic signals. In both the cases a waiting area with a properly demarcated stop line has to be provided for the vehicles.

Working Zone

The working zone is where the actual construction is being undertaken. It contains the work area and a working space, as well as lateral and longitudinal buffer zones to create the safety zone to protect both the workforce from wayward vehicles entering the area of actual work and the road users from construction equipment.

Speeds should continue to be controlled in this zone because of the close proximity of moving construction plant and site operatives.

The path of the traffic must be very clearly delineated through the traffic control zone to avoid vehicle intruding into the work area. Delineators and channelisers discussed below must be used effectively for this purpose. Where the work site uses machinery with revolving booms like cranes or excavators the intrusion of moving parts must be taken into account when determining the lateral clearances for the buffer or safety zone.

Terminal Transition Zone

The terminal Transition Zone (TTZ) provides a short distance to clear the work area and to return to normal traffic lanes. It extends from the downstream end of the work area to the sign indicating the end of works.

A downstream or closing taper may be placed in the TTZ. It may be useful in smoothening the flow of traffic. However, it may not be advisable when the trucks carrying material move into the work area by

reversing from the downstream end of working zone. The length of the downstream taper may be 25-30m.

Highway passing through villages and small towns

- The same basic rules and layouts will apply in urban areas but may be it would be necessary to modify the layouts according to site requirements. At all times the safety of all roads users as well the site operatives should be taken into account.
- In urban situations where road works are to be carried out, more attention should be given to the problems of pedestrians and non-motorized vehicles in heavy traffic volumes. As far as possible, then only day time repairs should be carried out. Repairs during peak hours should also be avoided.
- Road users channelized and routed and around area under repair with minimum of delays. Driver behavior should be effectively influenced so that the speeds are reduced to desired levels on approaches to construction zones. The traffic control and construction activity should be coordinated in such a manner as to provide for safe and efficient flow of traffic together with safe, efficient and rapid progress of construction activity.
- As pedestrians are likely to be present at urban sites, there must always be safety or buffer zone between the outer pedestrian barrier and the traffic
- Availability of proper sight distance for the movement of vehicles at the recommended speed for the stretch in the work zone should be always kept in the mind.

Traffic Control Devices

Visibility and Stability: Devices should be within the cone of vision of the driver and be placed such that it allows adequate response time at the average speed or the desired speed through the traffic control zone. All traffic control devices should be clearly visible by day and night, at these speeds and under the usually prevailing climatic conditions. They should be kept properly aligned and legible at all times. Foliage or any other obstruction should not be allowed to impede the view of these devices, nor should wind, road dirt or the like be allowed to obscure their face. The traffic control devices must be able to resist the local wind pressure, rain and the vibrations etc., of the passing traffic but these should not act as rigid obstacles in the event of a collision.

Sign

The road construction and maintenance signs fall into the same three major category as do other traffic signs, that is Regulatory signs, Warning signs and Direction (or Guidance) signs. Where possible, the size, colours and placement of shall confirm to Appendices .The main signs that would be utilized are shown in figure. This manual also covers signs that are not included in IRC: 67 but are considered desirable to aid drivers' comprehension of the route through the road works. Each sign should be well located so that its

message is seen and is clear, which will be assisted if the surroundings are devoid of “unnecessary" signs and other clutter. These signs should be of retro- reflective Sheeting’s of high intensity grade or Prismatic grade depending upon the importance of the road as directed by the Engineer.

Figure 1 : Safety Signage

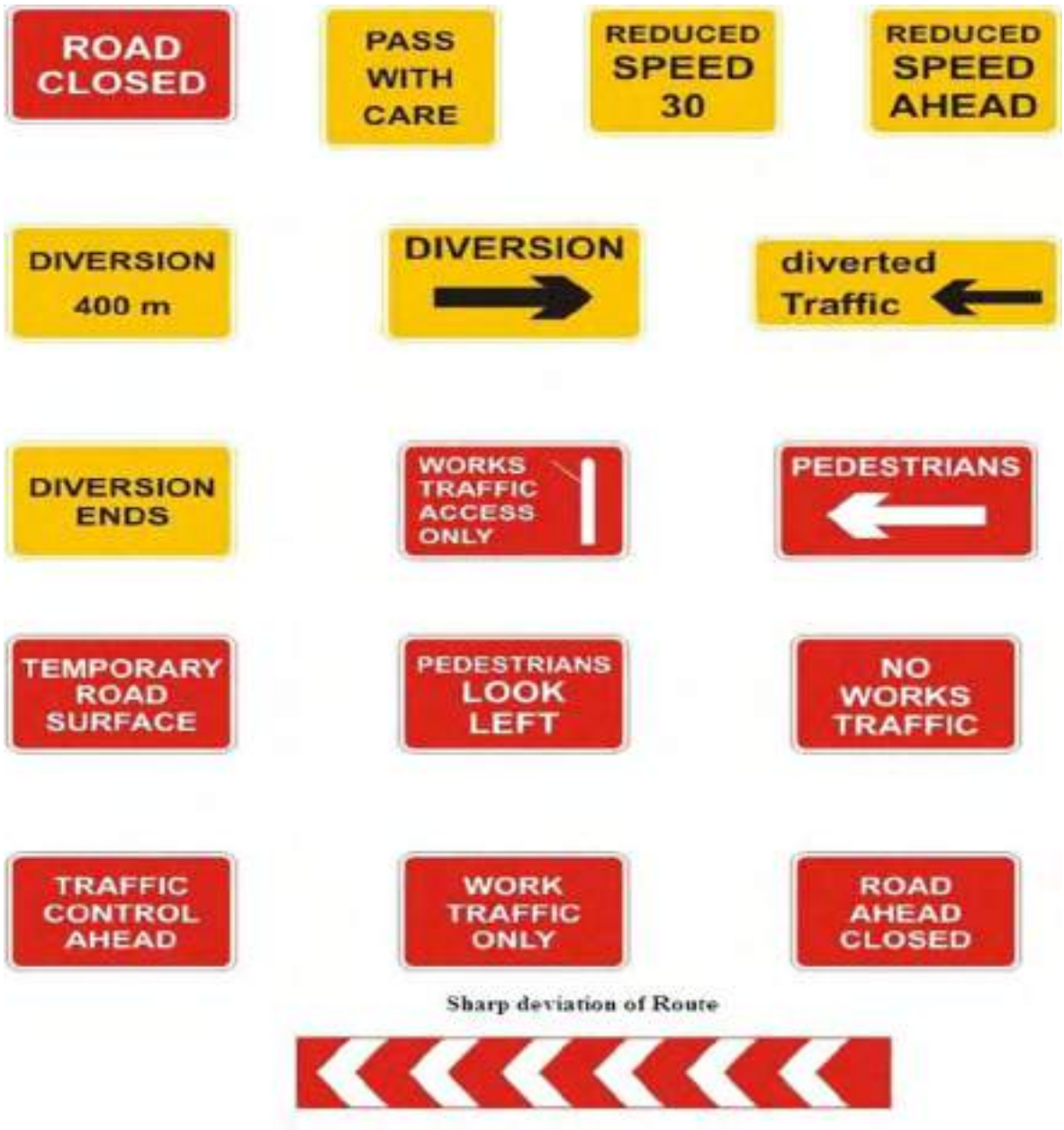

Figure 2: Safety Signage

Sign Placement

The correct positioning and size of signs will ensure that it can observed and recognized, thereby providing the driver with more time to react and take action.

The following principles should govern the positioning of signs:

- Their location should have clear visibility;
- They should be so placed that driver would have adequate time for responses.
- As a general rule, signs should be placed on the left-hand side of the road. Where special emphasis is required, duplicate signs should be installed on the left and right side of roadway
- In case of hill roads, the sign shall generally be fixed on the valley side of the road unless traffic and road conditions warrant these to be placed on the hill side ;
- Roll up signs mounted on portable supports may be placed within the roadway itself.
- Roll up signs may also be mounted on or above the barricades
- The signs should be covered or removed when they are not required.

On kerbed roads, the extreme edge of the sign adjacent to the road shall not be less than 600 mm away from the edge of the Kerb. On un-kerbed roads, the extreme edge of the sign adjacent to the road shall be a distance of two to three meter away from the edge of the carriageway depending on local conditions but in no case, shall any part of sign come in the way of vehicular traffic. Where signs are in position for some time and pedestrians are expected, the lower edge of the lowest sign should not be less than two meter above the surface on which it stands. Where pedestrians are not expected, signs may be mounted on trestles (tripod), but during wet conditions should be mounted away from the traffic “splash" zone so that they do not become obscured by dirt. Trestle mounted signs are particularly for short term temporary works. These should be so placed that pedestrian’s movements are not obstructed. In urban conditions, it may not be possible to erect new sign poles in footways crowded with public utilities and "A" frames may be the only alternative. Signs for longer term works should follow normal rules for the mounting of permanent signs.

Traffic cones and cylinders

Traffic cones are 500mm, 750 mm and 1000mm high and 300mm to 500mm in diameter or in square shape at base and are often made of plastic or rubber and normally have retro-reflectorized red and white band. Their advantages are that they:

- cause minor impediments to traffic flow and capacity,
- are well recognized and understood, without damaging vehicle when hit,
- can be easily stored and transported ,
- can be fastened to the pavement and self-restoring when hit.

Their disadvantages are that they have minimal respect of drivers, can be equally penetrated displaced and knocked over and require special treatment for night times.

Cones and cylinders are easily blown over or displaced unless their bases are loaded with ballast or anchored. It may, therefore be sometimes necessary to double the cones in order to provide added

weight, use the cones with special weighted bases, use heavier weighted cones or use weights such as sand bag rings to provide increased stability but this weight should not present a hazard. The cones should be placed close enough together to give an impression of continuity. The spacing of cones should be 3 m (close) or 9m (normal) or 18m (wide).Where cones have to be used at between 45º and 90º to the line of traffic, their spacing should be 1.2. Larger size cones should be used where speeds are relatively high or wherever more conspicuous guidance is needed.

Drums

Drums about 800 mm to 1000 mm high and 300 mm in diameter can be used as either channelizing on warning devices. These are highly visible, give the appearance of being formidable objects and therefore command the respect of drivers.

The drums are normally metal drums e.g. empty bitumen drums cut to the required height. They can be made of plastic also. Plastic drums are lighter, pose fewer hazards to vehicles and workers and can be needed for easy transportation and shortage and generally have one or more flat sides to preclude rolling. Drums may be filled up with earth or sand for stability. They should be painted in circumferential stripes of alternate black and white of 100 mm to 150 mm width. Drums should be reflectorized for use at night and should never be placed in the roadway without advance warning signs.

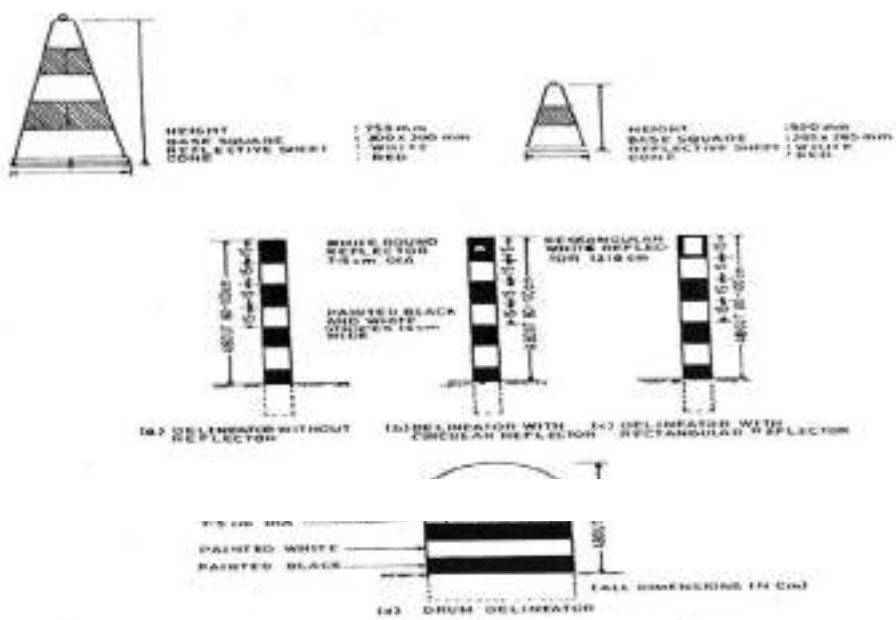

Figure 3: Cones & Drums

Barricades

a. Barricades are intended to provide containment without significant deflection or deformation under impact and to redirect errant along the barrier. They are designed to be easily relocated and have four specific functions to:

- Prevent traffic from entering work areas, such as excavations or material storage sites;
- Provide protection to workers;
- Separate two-way traffic; and
- Protect construction such as false work for culverts and other exposed objects.

b. Barricades can be portable or permanent .Portable barricades should be stable under adverse weather conditions and appear substantial but not so much as to cause excessive damage to the vehicle if they are struck. Types-I and II are portable whereas Type-III is permanent. The recommended dimensions of various components are given in Table 4. (2001: Guidelines for Safety Construction, Indian Road Congress, IRC: SP: 55:2001 p 19-22).

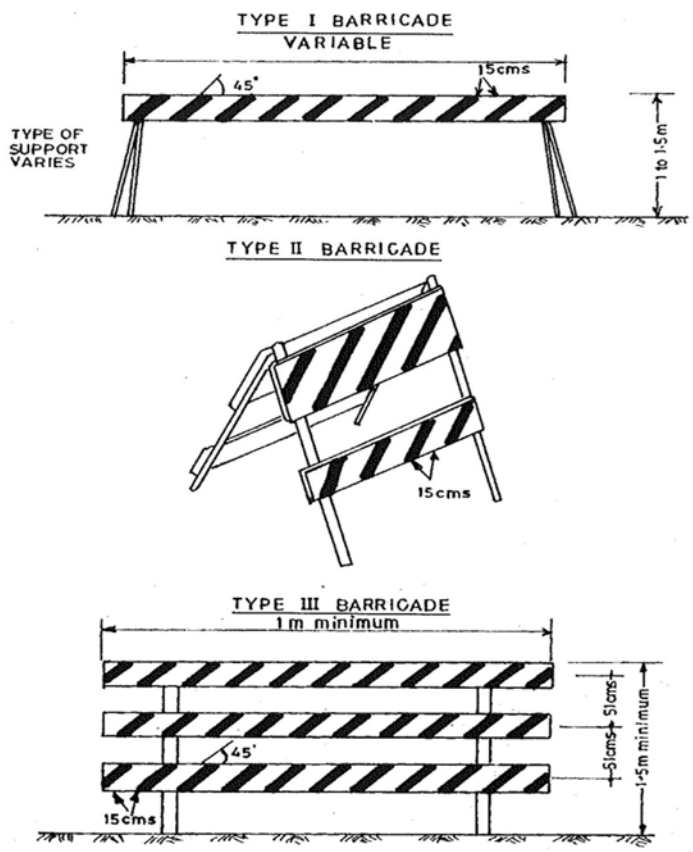

Figure 4: Barricade Specification

Flagman

The control of traffic through work area is an essential part of road construction and maintenance operations. Flagmen with hand signaling devices such as flags and sign paddles play crucial role in this direction. Red Flags, STOP, SLOW paddle and lights and are used in controlling traffic through work area.

Instead of red and green flags hand paddles of at least 600 mm diameter should be used painted with red and green retro reflective paints. Sign paddles should be at least 600mm wide and provided with a rigid handle. The background color of STOP should be red and its shape shall be octagonal confirming to IRC: 67.The word STOP should be in white, in the middle of the sign. The background of SLOW should be yellow with black letter and border.

Since, Flagmen are responsible for human safety, it is important that qualified personnel be selected. The flagmen at the work sites are expected to stop traffic intermittently and to maintain continuous traffic past a work site at reduced speeds to help protect the workmen. For both of these functions, the flagmen must, at all-time be clearly visible to approaching traffic for a distance sufficient to permit proper response by the drivers to the flagging instruction and to permit traffic to reduce speed before entering the work site. This distance is basically related to approach speed and site conditions; however 60 m to 100 m is desirable. In urban areas, this distance shall be reduced to 20 m to 50 m. The use of the flag and sign paddle is illustrated below;

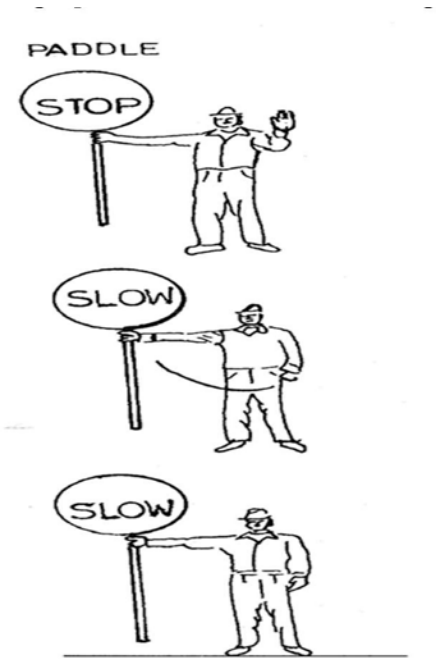

Figure 5: flagman's signals

TABLE 5: SIGN BOARD COLOUR CODE

S. No.	Type of Signs		Colour	
		Background	**Legend/Arrow**	**Border**
1	Stop	Red	white	white
2	Give Way	White	Black	Red
3	Prohibitory Signs	Orange	Black	Black
4	Compulsory Direction Contro signs	Orange	Black	----
5	Informatory Signs	Orange	Black	Black
6	Cautionary signs	Orange	Black	Red
7	Supplementary Signs	Orange	Black	Black

Methodology and Sequence of Work

Prior to start of the construction activities at site, the Contractor shall, within 28 days after the date of the Letter of Acceptance unless otherwise stipulated in the Contract, submit to the Engineer for approval, the detailed method statement. The method statement shall be submitted in two parts.

The general part of the method statement shall describe the Contractor's proposals regarding preliminary works, common facilities and other items that require consideration the early stage of the contract. The general part shall include information on:

- Source of materials like coarse aggregate and fine aggregate, quantity and quality of materials available in different sources;
- Source of manufactured materials like cement, steel reinforcement, pre-stressing strands and bearings etc. He shall also submit samples/ test certificates of materials for consideration of the Engineer;
- Location of the site facilities such as batching plant, hot mix plant, aggregate processing unit etc.
- Details of facilities available for transportation of men/material and equipment;
- Information on procedure to be adopted by the Contractor for prevention and mitigation of negative environmental impact due to construction activities;
- Safety arrangement during construction:
- Any other information required by the Engineer.

4. PROTECTION OF THE ENVIRONMENT

4.1 General

This Appendix sets out limitations on the Contractor's activities specifically intended to protect the environment.

The Contractor shall take all necessary measures and precautions and otherwise ensure that the execution of the works and all associated operations on or off site are carried out in conformity with statutory and regulatory environmental requirements including those prescribed elsewhere in these Specifications.

The Contractor shall take all measures and precautions to avoid any nuisance or disturbance arising from the execution of the Works. This shall wherever possible be achieved by suppression of the nuisance at source rather than abatement of the nuisance once generated.

In the event of any spoil, debris, waste or any deleterious substance from the Site being deposited on any adjacent land, the Contractor shall immediately remove all such material and restore the affected area to its original state to the satisfaction of the Engineer.

4.2 Water Quality

The Contractor shall prevent any interference with the supply to or abstraction from, and prevent any pollution of, water resources (including underground percolating water) as a result of the execution of the Works.

Areas where water is regularly or repetitively used for dust suppression purposes shall be laid to fall to specially-constructed settlement tanks to permit sedimentation of particulate matter. After settlement, the water may be re-used for dust suppression and rinsing.

All water and other liquid waste products arising on the Site shall be collected and disposed of at a location on or off the Site and in a manner that shall not cause nuisance or pollution.

The Contractor shall not discharge or deposit any matter arising from the execution of the Works into any waters except with the permission of the Engineer and the regulatory authorities concerned.

The Contractor shall at all times ensure that all existing stream courses and drains within, and adjacent to, the Site are kept safe and free from any debris and any materials arising from the Works.

The Contractor shall protect all watercourses, waterways, ditches, canals, drains, lakes and the like

from pollution as a result of the execution of the Works.

4.3 Air Quality

The Contractor shall devise and arrange methods of working to minimize dust, gaseous or other air- borne emissions and carry out the Works in such a manner as to minimize adverse impacts on air quality.

The Contractor shall utilize effective water sprays during delivery manufacture, processing and handling of materials when dust is likely to be created, and to dampen stored materials during dry and windy weather. Stockpiles of friable materials shall be covered with clean tarpaulins, with application of sprayed water during dry and windy weather. Stockpiles of material or debris shall be dampened prior to their movement, except where this is contrary to the Specifications.

Any vehicle with an open load-carrying area used for transporting potentially dust producing material shall have properly fitting side and tail boards. Materials having the potential to produce dust shall not be loaded to a level higher than the side and tail boards, and shall be covered with a clean tarpaulin in good condition. The tarpaulin shall be properly secured and extended at least 300 mm over the edges of the side and tail boards.

In the event that the Contractor is permitted to use gravel or earth roads for haulage, he shall provide suitable measures for dust palliation, if these are, in the opinion of the Engineer, necessary. Such measures may include sprinkling water on the road surface at regular intervals.

4.4 Noise

The Contractor shall consider noise abutment measures in his planning and execution of the Works. The Contractor shall take all necessary measures so that the operation of all mechanical equipment and construction processes on and off the Site shall not cause any unnecessary or excessive noise, taking into account applicable environment requirements. The contractor shall use all necessary measures and shall maintain all plant and silencing equipment in good condition so as to minimize the noise emission during construction works.

4.5 Control of Wastes

The Contractor shall control the disposal of all forms of waste generated by the construction operations and in all associated activities. No uncontrolled deposition or dumping shall be permitted.

Wastes to be so controlled shall include, but shall not be limited to, all forms of fuel an engine oils,

all types of bitumen, cement, surplus aggregates, gravels, bituminous mixtures etc. The Contractor shall make specific provision for the proper disposal of these and any other waste products, conforming to local regulations and acceptable to the Engineer.

4.6 Emergency Response

The Contractor shall plan and provide for remedial measures to be implemented in the event of occurrence of emergencies such as spillages of oil or bitumen or chemicals.
The Contractor shall provide the Engineer with a statement of the measures he intends to implement in the event of such an emergency, which shall include a statement of how he intends to provide personnel adequately trained to implement such measures.

4.7 Measurement

No separate measurement shall be made in respect of compliance by the Contractor with these provisions. The Contractor shall be deemed to have made allowance for such compliance with these provisions in the preparation of his prices for items of work included in the Bills of Quantities and full compensation for such compliance will be deemed to be covered by them.

5. TEMPORARY STRUCTURES SAFETY

This unit presents guidelines on formwork, scaffolds, and work at height, working platform, ladders, ramps etc. These are referred to as temporary structures and they are required for the construction of permanents structures. In the early part of this section, the terms pertaining to temporary structures are defined. The guidelines for the preparation of formwork scheme (plan) are presented. The suggested formwork arrangements for commonly used structural elements are provided. The unit also contains the checklist to be used by the contractor for implementing the formwork arrangement. It also contains the checklist to be used for auditing purposes. The unit ends with the description of penalties for non-compliance of various provisions provided in this unit.

Frequency of inspection

There should be a weekly Inspection of scaffold by scaffolding supervisor and the record for the same should be maintained. The inspection of scaffold must be based on the checklist provided for scaffold in the work zone road safety manual.

Contractors' Site SHE Manager will ensure that a system of routine inspections is carried out periodically to all temporary structures that will pose a hazard to workmen.

Specific inspections (without a predetermined date and as and when needed) shall be performed for formwork before concreting by formwork erector. Competent supervisors shall usually perform

such inspections in accordance with the check list specified in the manual. The check list is indicative only and depending on the method statement submitted or developed procedures, the Indian standards, rules and regulations, and Employer's requirements, the same shall be modified. The contractor shall preserve the records for such inspection for audit.

Wall formwork

Wall formwork should be so designed to take the pressure exerted by the concrete on formwork besides other anticipated loads. The formwork components should be designed according to relevant Indian Standards and the manufacturer's guidelines. Suitable provision for working platform shall be provided. Application of travelling and climbing formwork shall be encouraged in case wall is to be cast in more than 2-3 lifts.

Column Formwork

Wall formwork should be so designed to take the pressure exerted by the concrete on formwork besides other anticipated loads. The formwork components should be designed according to relevant Indian Standards and the manufacturer's guidelines. Suitable provision for working platform shall be provided. Suitable arrangement for reaching the working platform shall also be provided. One such arrangement is shown in **Fig. 7.9.**

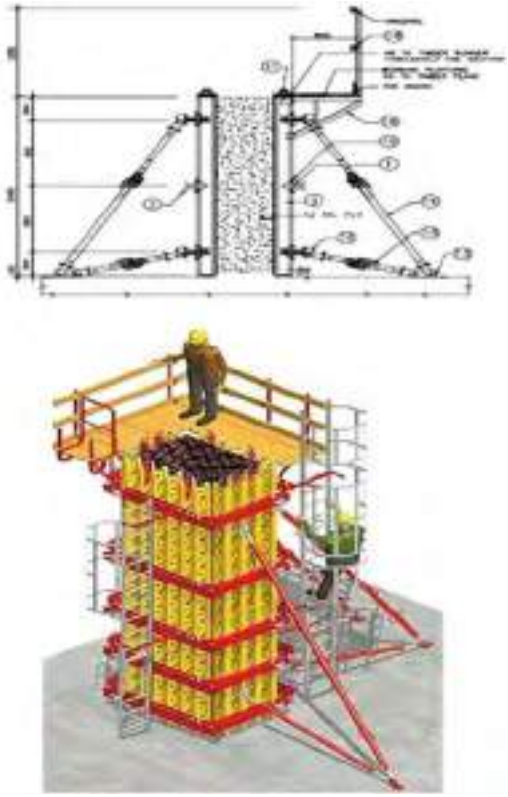

Figure 6: Column formwork showing access arrangement (courtesy peri)

Scaffolding

Safety Provisions in Building the Scaffolds

Every scaffold should be braced by means of longitudinal and transverse bracing systems so as to form a rigid and stable structure. So also every scaffold should be effectively tied to a building to prevent movement of scaffold either away or towards the building.

Where heavy wind or gale force are expected, it would be necessary to take special precaution and install additional ties to the scaffold to prevent overturning and collapse.

- Guide rails and toe boards must be provided for all working platforms to ensure safety for workmen.
- All working platforms should be fully covered to prevent materials falling and causing injury to the workers or passer-by.
- Safety nets or other screens should be provided to catch any falling materials.
- The use of barrels, boxes, loose earth pads or other unsuitable objects as supports for uprights and working platform, should not be permitted.

- Care should be taken to see that no un-insulated wire exists within 3 m of the working platforms, gang ways, runs etc. of the scaffolds.
- Scaffolds on thoroughfares should be provided with warning light, if general light is not sufficient to make it clearly visible.
- Men should not be allowed on scaffolds during storms or high winds.
- Grease, mud, paint, gravel or plaster or any such material shall be removed from scaffold platforms immediately.
- Either sand or saw dust or other suitable material shall be spread on platforms to prevent slipping.
- All projecting nails from platforms or other members shall be removed.
- During dismantling or scaffolds necessary precautions shall be taken to prevent injury to persons due to fall of loose materials. The bracing and other members of the scaffolds shall not be removed prematurely while dismantling the entire scaffolds so as to avoid danger of collapse.
- When scaffolds are to be used to a great extent and for long period of time, they should be inspected from time to time to ensure its soundness.
- Boards and planks used for platforms, gangways should be of sound quality and proper thickness closely laid and securely fastened and place.

Additional requirements for scaffolding

Strength and stability calculations for scaffolding shall be carried out unless a note of the calculations, covering the structural arrangements contemplated, is available or it is assembled in conformity with a generally recognized standard configuration.

Depending on the complexity of the scaffolding selected, a competent person shall draw up an assembly, use and dismantling plan. This may be in the form of a standard plan, supplemented by items relating to specific details of the scaffolding in question.

A copy of the plan, including any instructions it may contain, shall be kept available for the use of persons concerned in the assembly, use, dismantling or alteration of scaffolding until it has been dismantled.

The dimensions form and layout of scaffolding decks shall be appropriate to the nature of the work to be performed and suitable for the loads to be carried and permit work and passage in safety.

While a scaffold is not available for use, including during its assembly, dismantling or alteration, it shall be marked with general warning signs in accordance with and be suitably delineated by physical means preventing access to the danger zone.

Scaffolding may be assembled, dismantled or significantly altered only under the supervision of a competent person and by persons who have received appropriate and specific training in the operations envisaged which addresses specific risks which the operations may entail and precautions to be taken, and more particularly in

- Understanding of the plan for the assembly, dismantling or alteration of the scaffolding concerned;
- Safety during the assembly, dismantling or alteration of the scaffolding concerned;
- Measures to prevent the risk of persons, materials or objects falling;
- Safety measures in the event of changing weather conditions which could adversely affect the safety of the scaffolding concerned;
- permissible loadings;
- Any other risks which the assembly, dismantling or alteration of the scaffolding may entail.

6. BATCHING PLANT / CASTING YARD

The batching plant / casting yard shall be effectively planned for smooth flow of unloading and stacking the aggregates reinforcements and cement, batching plant, transport of concrete, casting the segment, stacking the segment and loading the segments to the trucks. As far as possible the

conflicts should be avoided.
The batching plant / casting yard shall be barricaded and made as a compulsory PPE zone
If in case of material unloading area is not maintainable as PPE zone, the same shall be segregated properly and made as a non-PPE zone with appropriate barrications.

Electrical system shall also be suitably planned so that location of diesel generator, if any, location of DBs, routing of cables and positioning of area lighting poles/masts does not infringe on any other utility and pose danger.

Drainage shall be effectively provided and waste water shall be disposed after proper treatment

Time office, canteen, drinking water, toilet and rest place shall be suitably located for the easy access to workers. All the facilities shall be properly cleaned and maintained during the entire period of operation.

Manual handling of cement shall be avoided to a larger extent. Whenever it is absolutely necessary the workmen shall be given full body protection, hand protection and respiratory protection as a basic measure of ensuring better health.

The PPEs provided to cement handling workmen shall conform to international standards. Access roads and internal circulation roads shall be well laid and maintained properly at all time. Non-adherence to any of the above provision shall be penalized as per relevant penalty clause.

7. WORK OVER WATER

The contractor shall ensure that all construction personnel wear minimum requirements of PPE as mentioned under clause (PPE)

- The contractor shall display the warning Signs of Deep water at appropriate locations.
- The contractor shall ensure edge protection including guard rails and toe boards etc.
- The contractor shall ensure suitable rescue equipment and provide training on how to use them.

8. WORKER AND WORK ZONE SAFETY

8.1 Hazardous materials handling, storage, and use

General responsibility of the Contractor during construction activity

The Contractor has to maintain evidence to show he has performed the following tasks:

- Identification of major accident hazards in construction activities

- Taken adequate steps to prevent major accidents and to limit their consequences
- Provide workers with information, training, and equipment, including antidotes
- Notification of major accidents
- Undertake full analysis and send information to Labour Directorate and the concerned Ministry
- Not to undertake any construction activity without submitting safety report to the authority 3 months before commencing activity
- Furnishing a further report if the Contractor makes any change in construction activity.
- Preparation of an up-date on-site emergency plan to deal with major accidents with names of responsible persons and those authorized to take action
- Every worker to be informed of emergency plan.
- Maintaining information about persons outside the worksite and the nature of accident hazard to which they are exposed and the safety measures to be adopted
- Maintenance of Safety Data Sheet of all the materials that are being used in the construction activities and providing this information to the workers
- Container of hazardous chemicals to be clearly labeled about contents, manufacturer, and physical, chemical and toxicological data
- Provision of adequate steps to contain contaminants and prevent accidents; and provide workers with safety information, training and equipment
- Proper labeling of all hazardous materials
- Packaging, labeling, and transport shall be done in accordance with Motor Vehicles Act, 1988
- Reporting of polluting accidents to the State Pollution Control Board

8.2 Manual material handling

General

Construction workers are at a higher risk than most workers in receiving a manual handling injury. Manual handling involves any activity requiring the use of force exerted by a person to lift, lower, push, pull, carry or otherwise move, hold or restrain a person, animal or thing. Workers may suffer from musculoskeletal problems such as aches, strains and sprains as a result of manual handling. These can also be caused by other tasks which involve repetitive movements, force, unusual postures, and prolonged pressure on a joint, badly organized working practices or work environment. Effects on health can include:

- Sprains or Strains
- Backache
- Sciatica
- Hernias

- Arthritis
- Swelling of the wrist, forearm, elbow and shoulder

Safety Precautions that are to be maintained by the Contractor are

- Designing and organizing tasks to avoid manual handling completely, or at least restrict it.
- Using automation and lifting equipment.
- Organizing manual handling tasks in a safe way, with loads split into smaller ones, and proper and regular rest periods provided.
- Information and training to workers for each task, and the use of equipment and correct handling techniques

8.3 Mechanical material handling

General: Construction equipment may include dumpers and dump trucks, lift trucks and telescopic handlers, piling rigs, vibro hammers, rail welding equipment, mobile elevating work platforms, cranes, tipper lorries, lorry loaders, skip wagons, 360° excavators, 180° backhoe loaders, crawler tractors, scrapers, graders, loading shovels, trenchers, side booms, pavers, planers, chippers, road rollers, locomotives, tankers and bowsers, trailers, hydraulic and mechanical breakers etc.

General precautions for Mechanical material handling

The Contractor shall ensure that all construction equipment is in sound mechanical working condition and certified by either a competent person under Factories Act, or manufacturers' warranty in case of brand new equipment or authorized persons / firms approved by the Employer before induction at any site.

Every such certificate shall have the date of purchase, main overhauling undertaken in the past, any accident to the equipment, visual examination details, critical components, checklist of safety devices and its working condition, manufacturer's maintenance checklist, past projects wherein the equipment were used etc. as its minimum content.

All vehicles shall be fitted by the Contractor with audible reverse alarms and maintained in good working condition. Reversing shall be done only when there is adequate rear view visibility or under the directions of a banksman.

General operating instructions that shall be maintained by the Contractor at any construction site are:

- Drivers entering site shall be instructed to follow the safe system of work adopted on site. These shall be verbal instructions or, preferably, written instructions showing the relevant site rules, the site layout, delivery areas, speed limits, etc.
- No passengers shall be carried, unless specific seating has been provided in accordance with the manufacturer's recommendations
- Working on gradients beyond any equipment capability shall not be allowed
- Prevention of dumper and dump truck accidents should be managed by providing wheel stops at a sufficient distance from the edges of excavations, spoil heaps, pits, etc.
- The manufacturer's recommended bucket size must not be exceeded in excavators
- If excavators are operating on a gradient which cannot be avoided, it must be ensured that the working cycle is slowed down, that the bucket is not extended too far in the downhill direction, and that travel is undertaken with extreme caution. A large excavator must never be permitted to travel in a confined area, or around people, without a banksman to guide the driver, who should have the excavator attachment close in to the machine, with the bucket just clear of the ground. On wheeled excavators, it is essential that the tyres are in good condition and correctly inflated. If stabilizing devices are fitted, they should be employed when the machine is excavating
- When the front shovel of the 1800 backhoe loaders is being employed, the backhoe attachment shall be in its "travel" position, with the safety locking device in place
- When operating the backhoe in poor ground conditions, the stabilizers tend to sink into the surface of the ground, reducing stability. Therefore frequent checks shall be made for the stability of the machine. The loading shovel should always be lowered to the ground to stabilize the machine when the backhoe is employed.
- The netting operation of the skip wagons should be carried out prior to lifting the skip to reduce the risks of working on the rear platform
- If a tractor dozer is employed on clearing scrub or felling trees, it shall be provided with adequate driver protection
- When two or more scrapers are working on the same job, a minimum distance of at least 25m shall be kept between them
- In case of hydraulic breakers, hydraulic rams and hoses shall be in good working condition
- All wood working machines shall be fitted with suitable guards and devices such as top guard, riving knife, push stick, guards for drive belts and chains, and emergency stop switch easily accessible by the operator
- Every moving and dangerous part to be securely fenced, and regularly examined to prevent contact with the worker
- Examination/operation of machinery to be done only by trained/certified adult worker wearing tight fitting clothing

- Provision of suitable devices shall be available for cutting off power in emergencies from running machinery
- All parts such as lifting machines, chains, ropes and lifting tackle shall be properly maintained and examined every 12 months
- The lifting machines, chains, ropes and lifting tackle shall not be loaded beyond marked safe working load
- Crane should not approach within 6m of the working place
- Safe working speeds of revolving machinery should not to be exceeded
- Floors, stairs and means of access shall be of sound construction, properly maintained, free of obstructions, and provided with handrails
- Fencing should be provided for working at heights
- Pits, sumps, openings in floors, etc shall be securely covered / fenced
- Provision of escape, fire extinguisher and adequate training to the workers in case of fire
- Safety Officers to be appointed where more than 1000 workers are employed
- Compulsory disclosure of information regarding dangers, detailed health and safety policy, and emergency plan to the workers

8.4 Handling of petroleum products

General that are to be maintained by the Contractor at every construction site are:

- No person shall deliver or dispatch any petroleum other than the holder of a storage license
- The petroleum delivered or dispatched shall be of the class, and shall not exceed the quantity, which the person to whom it is delivered or dispatched is authorized to store with or without a license under the "The Petroleum Rules, 1976"
- Notwithstanding any other rule, petroleum Class B not exceeding 15,000 litres in quantity and packed in sealed air tight approved containers, may be dispatched to a person not holding a storage license
- Precautions shall be taken at all times to prevent escape of petroleum into drain, sewer, harbour, river or watercourse or over any public road or railway line.
- No child under the age of eighteen years and no person who is in a state of intoxication shall be employed on the loading, unloading, or transport of petroleum or in any premises licensed under these rules
- Unless expressly provided in these rules, no person shall smoke and no matches, fires, lights or articles or substances capable of causing ignition of petroleum shall be allowed at any time in proximity to a place where petroleum is refined, stored or handled or in a vehicle, carriage or vessel in which petroleum is transported

Some Special precautions against accident that shall be maintained by the Contractor are:

No person shall commit or attempt to commit any act which may tend to cause a fire or explosion in or about any place where petroleum is refined, stored or handled or any vehicle, carriage or vessel in which petroleum is transported.

Every person storing petroleum and every person in charge of or engaged in the storage, handling or transport of petroleum shall at all times:

Comply with the provisions of these rules and the conditions of any license relating thereto; observe all precautions for prevention of accident by fire or explosion; and Prevent any person from committing any act referred to in the earlier rule.

Spill control management

There are numerous chemicals like asphalt, coal tar, gasoline, diesel which are being used for construction purpose and spill control management is one of the prime concerns for the safety of workers.

The procedure and guidelines that the Contractor shall follow for spill management process are:

- Identification of potential chemical spill hazard
- Risk assessment of spill via:
- The nature of the spilled chemical (high/low hazards)
- The quantity of the spill (large or small)
- Location of the spill
- The Contractor shall ensure that measures to control or eliminate the potential risk follow the principles of:
- Elimination: complete removal of risk of exposure
- Replacement the substance with a less hazardous one
- Isolation through distance or enclosure
- Adoption of new engineering methods for redesigning the work area and proper maintenance
- Administrative – standard operating procedure, supervision, training, rotation and signage
- Provision of Personal Protective Equipment – protective clothing, safety shoes, goggles, safety glasses and gloves etc.
- Preparation for chemical spill shall be done through Safety Data Sheet including the special requirements for spill control such as the type of fire extinguisher required, incompatible substances, and reactivity with substances such as water or air **Spill kits should be available for use where assessed as required**

- Requirements for spill facility to be monitored by the Contractor are:
- Permanently installed secure roll-over bunds
- Adequate supply of emergency drain covers
- Necessary chemical spill station
- Proper chemical storage areas
- All areas where chemicals are stored shall have access to a spill kit (in close proximity of the storage area)

Chemical storage cabinets

- Provision of trays that are compatible with the contents
- Chemical waste storage areas
- Adequate supply of emergency drain covers
- Adequate ventilation
- Laboratory spill kit
- Training and awareness

Cleaning up a chemical spill can be done through immediate actions of:

- Clear the affected area.
- Check for any persons involved
- Personnel contaminated with chemicals must be decontaminated via emergency shower and taken for medical examination
- First aid facility at the site
- Isolate the spill (if safe to do so)
- Contact the laboratory technician for lowering risk of spills
- Gather any information possible, i.e. identify the material and quantity, gather relevant MSDS and assess any immediate risks.

8.5 House Keeping

General: Many injuries result from poor housekeeping, improper storage of materials, and cluttered work areas. To maintain a clean, hazard-free workplace, all groups of management, supervisors, and workers must cooperate.

General provisions that can maintain adequate housekeeping and must be ensured by the Contractor at the construction site as well as in the campsites are:

i. Daily removal of dirt and refuse

ii. Keep tools in boxes, racks, or trays when not in use
iii. Do not let materials such as scrap lumber, metal, and debris accumulate which might cause a tripping hazard
iv. Weekly washing of floor. Keep aisle clear for safe passage of people and material
v. Nails, pieces of wood with protruding nails, and other sharp objects should not be left on floors and walkways; store them where they cannot be stepped on
vi. Effective drainage of floor
vii. Regular painting of walls, partitions, ceilings
viii. Keep exits clear; keep fire extinguishers readily accessible and free of obstruction
ix. Store flammable and combustible materials in proper containers and in effective arrangement for treatment of wastes and effluents to render them innocuous and for their eventual disposal

8.6 Noise

General: Noise may be defined as unwanted sound. Noise is perhaps the most widespread hazard in any construction environment and it is well known that workplace noise can cause deafness and associated conditions such as tinnitus (ringing in the ears). Despite this, workers are exposed to noise levels which can cause permanent noise-induced hearing loss. For example, noise from:

- Trucks
- Machinery
- Tools in a workshop
- Batching plant and HMP site
- Stone crusher unit
- Compressor and Generators

Hearing protection is very necessary for construction workers who are directly exposed to a high level noise for more than the permissible limit (more than 90 decibels for 8 hours), and where the noise cannot be reduced or isolated from the worker.

Control Requirement

Contractor has to ensure that construction material is operated and transported in such a manner as not to create unnecessary noise as outlined below:

Perform work within the procedures outlined herein and comply with applicable codes, regulations, and standards established by the Central and State Government and their agencies.

Keep noise to the lowest reasonably practicable level. Appropriate measures will be taken to

ensure that construction works will not cause any unnecessary or excessive noise, which may disturb the occupants of any nearby dwellings, schools, hospitals, or premises with similar sensitivity to noise. Use equipment with effective noise-suppression devices and employ other noise control measures so as to protect the public.

Schedule and conduct operations in a manner that will minimize, to the greatest extent feasible, the disturbance to the public in areas adjacent to the construction activities and to occupants of buildings in the vicinity of the construction activities.

The Contractor shall submit to the Employer a Noise Monitoring and Control Plan (NMCP) under contract specific Site Environmental Plan. It shall include full and comprehensive details of all powered mechanical equipment, which the Contractor proposes to use during daytime and night time and of the proposed working methods and noise level reduction measures. The NMCP shall include detailed noise calculations and vibration levels to demonstrate the anticipated noise generation and vibrations by the Contractor.

The NMCP prepared by the Contractor shall guide the implementation of construction activity. The NMCP will be reviewed on a regular basis and updated as necessary to assure that current construction activities are addressed. It may appear as a regular agenda item in project coordination meetings, if noise is an issue at any location in the contract.

Elimination or control of exposure to the noise at workplace.
Protection against the effects of occupational noise exposure should be provided when the sound level exceeds the threshold values as specified by “The Control of Noise at Work Regulations 2005”.

Contractor shall ensure about elimination of risks from noise at source. Provision of personal hearing protectors, which are appropriate to the activity, shall be undertaken only when all other possible noise abatement methods have been undertaken.

Actions that shall be based on the prevention are:

- Other working methods which reduce exposure to noise
- Appropriate work equipment emitting the least possible noise
- Proper design and layout of workplaces, work station and rest facilities
- Reduction of noise by technical means
- Maintenance programmes for work equipment, the workplace and workplace system
- Limitation of the duration and intensity of exposure to noise
- Appropriate work schedule with adequate rest periods
- Ensure that employees are not exposed to noise above the exposure limit

- If an exposure limit value is exceeded the Contractor shall:
- Identify the reason
- Reduce the value
- Modify the organizational pattern or adopt appropriate technical measures
- Exposure to noise level shall be low in rest areas.

The Contractor shall ensure the availability of personal hearing protectors in the workplace only when all noise reduction measures have been adopted and the levels are still above the specified limits.

8.7 Illumination

The Contractor shall ensure that sufficient illumination is provided at all times for maintaining safe working conditions at a site of a building or other construction work, where building workers are required to work or pass and for passageways, stairways, and landings. Such illumination should not be less than that provided in the relevant national standards.

The Contractor shall make every effort to illuminate the work site as per the Employer's requirement. The Contractor shall conduct a monthly illumination monitoring by lux meter for all the locations and the report shall be sent to the Employer within the 7th of the next month and the same shall be reviewed during the monthly SHE committee meeting.

8.8 Dust and Emission Control

Dust can be a problem in almost all construction sites. Dust at work has been one of the largest occupational killers of all time. It has shortened life and caused misery to hundreds of thousands of people. Whenever materials are handled and broken down, dust is liable to be produced, i.e. dust from the stone crusher units can damage the health of the worker through occupational asthma.

TABLE 6: TYPES OF DUST AND THEIR EFFECTS

Dusts	Effects
Fibrosis Dusts	Pneumoconiosis
Toxic Dusts	Poisoning
Irritant Dusts	Cell Damage , Bronchitis
Allergic Dust	Allergies, Asthma, Aveolitis
Carcinogenic Dusts	Cancer

General Precautions:

The Contractor shall take all necessary precautions to minimize fugitive dust emissions from operations involving excavation, grading, and clearing of land and disposal of waste. He shall not allow emissions of fugitive dust from any transport, handling, construction or storage activity to remain visible in the atmosphere beyond the property line of emission source for any prolonged period of time without notification to the Employer

If after commencement of construction activity, the Employer believes that the Contractor's equipment or methods of working are causing unacceptable dust impacts then these shall be inspected and remedial proposals shall be drawn up by the Contractor, submitted for review to the Employer and implemented

In developing these remedial measures, the Contractor shall inspect and review all dust sources that may be causing health effects

The Contractor shall establish and maintain records of routine maintenance program for water sprinkling method in the dust generated areas and shall keep records available for inspection by the Employer

The Contractor shall cover loads of dust generating materials like debris and soil being transported from construction sites. All trucks carrying loose material should be covered and loaded with sufficient free-board to avoid spills through the tail board or side boards

The temporary dumping areas shall be maintained by the Contractor at all times until the excavate is re-utilized for backfilling or as directed by the Employer. Dust control activities shall continue even during any work stoppage.

The Contractor shall place material in a manner that will minimize dust production. Material storage shall be minimized each day and wetted to control dust production. During dry weather, dust control methods must be used daily, especially on windy, dry days, to prevent any dust from blowing across the site perimeter.

The Contractor shall water down construction sites as required to suppress dust, during handling of excavation soil or debris or during demolition. The Contractor will make water sprinklers, water supply, and water delivering equipment available at any time that it is required for dust control use.

Dust screens will be used as feasible and when additional dust control measures are needed, especially where the work is near sensitive receptors.

The Contractor shall design and implement his blasting techniques so as to minimize dust, noise, vibration generation, and prevention of fly rock.

The Contractor shall submit to the Employer an Air Monitoring and Control Plan (AMCP) under contract specific Site Environmental Plan to guide construction activity insofar as it relates to monitoring, controlling, and mitigating air pollution.

- Prevention of inhalation and accumulation (exhaust near enclosed point of origin) by the workers must be ensured by the Contractor.
- Exhaust of internal combustion engine to open air must be ensured

8.9 Personal Protective Equipment and Other Safety Appliances

General

Personal Protective Equipment (PPE) is the third line of defence for protection of the employee's health and safety. The first line of defence is to eliminate accident-causing situations at the work place by effective process changes, and the second is to reduce it through engineering measures. PPE does not and cannot eliminate hazards at work. As a barrier between the hazard and the worker, PPE can help to eliminate an injury or reduce its severity, but it also hampers the work of the worker. PPE should be resorted to only if absolute removal of the hazard or its reduction in the work environment is impossible or impracticable. Even where technical/engineering control, safe systems of work, and other techniques have been applied, it is possible that some hazards might remain. These hazards may lead to injuries to the:

- Respiratory system due to contaminated air
- Head and feet, for example, from falling materials
- Eyes, for example, from flying particles of stone works
- Skin, for example, from contact with corrosive materials
- Body, for example, from extremes of heat or cold

PPE includes clothing and other accessories designed to create a barrier between the user and workplace hazards. It should be used in conjunction with engineering work practices and/or administrative controls to provide maximum employee safety and health in the workplace. All Contractors are responsible for providing training and ensuring the proper use of required personal protective equipment. The principal requirements of PPEs are:

- To safeguard the workers from identified hazards to which he/she is exposed
- To afford reasonable comfort while working under adverse circumstances
- To permit essential movement of limbs required for efficient job performance

- To be amenable to easy cleaning and maintenance

The required PPEs for the construction workers are:

Head protection (safety helmets): The Contractor must ensure that all those who are present at a construction site are wearing helmets whoever.

Foot protection (safety footwear, gumboots etc.): Safety shoes are highly recommended for all workers. Sneakers, sandals or canvas shoes are not to be permitted.

Wearing Appeals: The Contractor must ensure the supply of high visibility clothing, waist coat, jacket, apron for the workers at the construction site. Employees whose work may bring them into contact with fire or flames may wear clothing only made from natural fibres as an outer layer.

Personal fall protection (full body harness, rope-grip fall arrestor etc.):

Eye and Face protection: It is required that all contract employees, subcontractors, visitors, and delivery personnel in exposed areas wear eyeglasses as a minimum safety. More specialized eye protection (goggles, Welder's glasses) should be ensured by the Contractor as per the demands of the work being performed.

Hand protection (gloves, finger coats, etc.):

Wear work gloves when handling materials or using tools, which may cause blisters, burns, or cuts. Special gloves shall be worn when handling hot materials, acids, alkalis and chemicals. Approved electrical gloves shall be worn when handling energized cables or breakers racking in and out. The Contractor shall have the gloves tested on an annual basis to ensure their integrity.
Respiratory protection: Respiratory protection like nose masks, ear muffs, etc. shall be used when engineering controls are not adequate to protect employees from exposure to air contaminants above the safe levels.

8.10 Electrical and Mechanical Safety

- Equipment Fitness Certificate
- Drivers and Operators
- Vehicle Speed
- Hand and Portable Power Tool

General

The contractor is wholly responsible for the safe condition of tools and equipment used by his employees and that of his sub-contractors.

Use of short / damaged hand tools shall be avoided and the contractor shall ensure all his hand tools used at his worksite are safe to work with or stored and shall also train his employees (including his sub-contractors) for proper use thereby.

All hand tools and power tools shall be duly inspected before use for safe operation.

All hand tools and power tools shall have sufficient grip and the design specification on par with national/international standards on anthropometrics.

Hand tools

Hand tools shall include saws, chisels, axes and hatches, hammers, hand planes, screw drivers, crow bars, nail pullers. The contractor shall ensure that,

- For crosscutting of hardwood, saws with larger teeth points (no. of points per inch) shall be preferred to avoid the saw jumping out of the job.
- Mushroom headed chisels shall not be used in the worksite where the fragments of the head may cause injury.
- Unless hatchet has a striking face, it shall be used as a hammer.
- Only knives of retractable blades shall be used in the worksite.
- No screwdrivers shall be used for scraping, chiseling or punching holes.
- A pilot hole shall always be driven before driving a screw.
- Wherever necessary, usage of proper PPEs shall be used by his employees.

Portable Power tools

Power tools include drills, planes, routers, saws, jackhammers, grinders, sprayers, chipping hammers, air nozzles and drills.
The contractor shall ensure that

- Electric tools are properly grounded or / and double insulated.
- GFCIs/ RCCBs shall be used with all portable electric tool operated especially outdoors or in wet condition.
- Before making any adjustments or changing attachments, his workers shall disconnect the tool from the power source.
- When operating in confined spaces or for prolonged periods, hearing protection shall be required. The same shall also apply to working with equipments, which gives out more noise as mentioned in clause 43.0 of this contract document.
- Tool is held firmly and the material is properly secured before turning on the tool.
- All drills shall have suitable attachments respective of the operations and powerful for ease

of operation.

When any work / operation need to be performed repeatedly or continuously, tools specifically designed for that work shall be used. The same is applicable to detachable tool bit also.

Size of the drill shall be determined by the maximum opening of the chuck n case of drill bit. Attachments such as speed reducing screwdrivers and buffers shall be provided to prevent fatigue and undue muscle strain to his workers.

Stock should be clamped or otherwise secured firmly to prevent it from moving.

Workers shall never stand on the top of the ladder to drill holes in walls / ceilings, which can be hazardous, instead standing on the fourth or fifth rung shall be recommended.

Electric plane shall not be operated with loose clothing or long scarf or open jacket.

Safety guards used on right angle head or vertical portable grinders must cover a minimum of 1800 of the wheel and the spindle / wheel specifications shall be checked.

- All power tools / hand tools shall have guards at their nip points.
- Low profile safety chain shall be used in case of wood working machines and the saw shall run at high rpm when cutting and also correct chain tension shall be ensured to avoid “kickback”.
- Leather aprons and gloves shall be used as an additional personal protection auxiliary to withstand kickback.
- Push sticks shall be provided and properly used to hold the job down on the table while the heels moves the stock forward and thus preventing kickbacks.
- Air pressure is set at a suitable level for air actuated tool or equipment being used. Before changing or adjusting pneumatic tools, air pressure shall be turned off.
- Only trained employees shall use explosive actuated tools and the tool shall also be unloaded when not in use.
- Usage of such explosive actuated tools shall be avoided in case of places where explosive/flammable vapours or gases may be present.
- Explosive actuated tools and their explosives shall be stored separately and be taken out and loaded only before the time of immediate use.
- Misfired cartridges of explosive actuated tools must be placed in a container of water and be removed safely from the project.
- No worker shall point any power operated / hand tool to any other person especially during loading / unloading.

Safety in Gas Cutting and Welding

- Gas cylinders in use shall be kept upright on a custom-built stand or trolley fitted with a bracket to accommodate the hoses and equipment or otherwise secured. The metal cap shall be kept in place to protect the valve when the cylinder is not connected for use.
- Hose clamp or clip shall be used to connect hoses firmly in both sides of cylinders and torches.
- All gas cylinders shall be fixed with pressure regulator and dial gauges
- Non-return valve and Flashback arrester shall be fixed at both end of cylinder and torch.
- Domestic LPG cylinders shall not be used for Gas welding and cutting purpose.
- DCP or CO2 type Fire Extinguisher not less than 5 kg shall be fixed at or near to welding process zone in an easily accessible location. Fire Extinguisher should confirm to IS 2190: 1992.
- Use firewatchers if there is a possibility of ignition unobserved by the operator (e.g. on the other side of bulkheads).
- Oxygen cylinders and flammable gas cylinders shall be stored separately, at least 6.6 meters (20 feet) apart or separated by a fire proof, 1.6 meters (5 feet) high partition. Flammable substances shall not be stored within 50 feet of cylinder storage areas.
- Transformer used for electrical arc welding shall be fixed with Ammeter and Voltmeter and also fixed with separate main power switch.
- Welding grounds and returns should be securely attached to the work by cable lugs, by clamps in the case of stranded conductors, or by bolts for strip conductors. The ground cable will not be attached to equipment or existing installations or apparatus.
- Use a low voltage open circuit relay device if welding with alternating current in constricted or damp places.
- Take precautions against the risk of increased fume hazards when welding with chrome containing fluxed consumables or high current metal inert gas (MIG) or tungsten inert gas (TIG) processes.
- Avoid being in contact with water or wet floors when welding. Use duckboards or rubber protection.
- All electrical installations shall meet the IS: 5571: 1997 and NFPA 70 for gas cylinder storage area and other hazardous areas.
- The current for Electric arc welding shall not exceed 300 A on a hand welding operation.

Safety in Electricity Generation, Distribution, and use Competency of Electrical personnel:

- The contractor shall employ qualified and competent electrical personnel as specified in

general instruction DMRC/SHE/GI/001/MPR/281105.

- Assessment of power
- The contractor shall assess the size and location of the electrical loads and the manner in which they vary with time during the currency of the contract.
- The contractor shall elaborate as to how the total supply is to be obtained / generated. The details of the source of electricity, earthing requirement, substation / panel boards, distribution system shall be prepared and necessary approval from Employer obtained before proceeding of the execution of the job.
- The main contractor shall take consideration, the requirements of the sub / petty contractors' electric power supply and arrive at the capacity of main source of power supply from diesel generators.
- As the sub / petty contractors' small capacity generators create more noise and safety hazard, no small capacity diesel generators shall be allowed for whatsoever the type of job to be executed under this contract.
- If any unsafe noise making small capacity diesel generators are found used by sub / petty contractors the main contractor shall only be penalized.

Work on site

The contractor shall also submit electrical single line diagram, schematic diagram and the details of the equipment for all temporary electrical installation and these diagrams together with the temporary electrical equipment shall be submitted to the Employer's for necessary approval. Failure to do so shall invite penalty as per relevant clause.

Strength and capability of electrical equipment

No electrical equipment shall be put into use where its strength and capability may be exceeded in such a way as may give rise to danger.

Adverse or hazardous environments

Electrical equipment which may reasonably foreseeable be exposed to- mechanical damage;

- the effects of the weather, natural hazards, temperature or pressure;
- the effects of wet, dirty, dusty or corrosive conditions; or
- any flammable or explosive substance, including dusts, vapours or gases, shall be of such construction or as necessary protected as to prevent, so far as is reasonably practicable, danger arising from such exposure.

Distribution system

- The contractor shall provide distribution system for control and distribution of electricity from a main AC supply of 50Hz for typical appliances,
- Fixed plant – 400V 3 phase
- Movable plant fed via trailing cable over 3.75 kW – 400 3 phase
- Installation in site buildings – 230V single phase
- Fixed flood lighting – 230V single phase
- Portable and hand tools – 115V single phase
- Site lighting - 115V single phase
- Portable hand lamps – 115V single phase

Electrical protection circuits

Precautions shall be taken, either by earthing or by other suitable means, to prevent danger arising when any conductor (other than a circuit conductor) which may reasonably foreseeable become charged as a result of either the use of a system, or a fault in a system, becomes so charged. A conductor shall be regarded as earthed when conductors of sufficient strength and current-carrying capability to discharge electrical energy to earth connect it to the general mass of earth.

If a circuit conductor is connected to earth or to any other reference point, nothing which might reasonably be expected to give rise to danger by breaking the electrical continuity or introducing high impedance shall be placed in that conductor unless suitable precautions are taken to prevent that danger.

- Appropriate electrical protection shall be provided for all circuits, against over load, short circuit and earth fault current.
- The contractor shall provide sufficient ELCBs (maintain sensitivity 30 mA) / RCCBs for all the equipment (including Potable equipment), electrical switchboards, distribution panels etc. to prevent electrical shocks to the workers.
- All protection devices shall be capable of interrupting the circuit without damage to any equipment and circuits in case of any fault may occur.
- Rating of fuses and circuit breakers used for the protection of circuits should be coordinate with equipment power ratings.
- Protection against lightning shall be ensured to all equipment kept in open at sites.

Cables

- Cables shall be selected after full consideration of the condition to which they shall be exposed and the duties for which they are required. Supply cable up to 3.3 kV shall be in accordance with BS 6346.

- For supplies to mobile or transportable equipment where operating of the equipment subjects the cable to flexing, the cable shall conform to any of these codes BS 6007 /BS 6500 / BS 7375.
- Flexible cords with a conductor cross sectional area smaller than 1.5 mm2 shall not be used and insulated flexible cable shall conform to BS 6500 and BS 7375.
- Where low voltage cables are to be used, reference shall be made to BS 7375. The following standards shall also be referred to particularly for underground cables BS 6346 and BS 6708
- Cables buried directly in the ground shall be of a type incorporating armour or metal sheath or both. Such cables shall be marked by cable covers or a suitable marking tape and be buried at a sufficient depth to avoid their being damaged by any disturbance of the ground. Cable routes shall be marked on the plans kept in the site electrical register.
- Cabling passing under the walk way and across way for transport and mobile equipment shall be laid in ducts at a minimum depth of 0.6 meters.
- Cables that need to cross open areas, or where span of 3m or more are involved, a catenary wire on poles or other supports shall be provided for convenient means of suspension. Minimum height shall be 6 m above ground.
- Cables carrying a voltage to earth in excess of 65V other than supply for welding process shall have metal armour or sheath, which has been effectively earthed and monitored by the contractor. In case of flexible and trailing cables such earthed metal sheath and/or armour should be in addition to the earth core in the cable and shall not be used as the protective conductor.
- Armoured cables having an over-sheath of polyvinyl chloride (PVC) or an oil resisting and flame retardant compound shall be used whenever there is a risk of mechanical damage occurring

Plugs, socket-outlets and couplers

The contractor shall ensure plugs, socket-outlets, and couplers available in the construction site as “splash proof” type. The minimum degree of Ingress Protection should be of IP44 in accordance with BS EN 60529.

Only plugs and fittings of the weather-proof type shall be used and they should be colour coded in accordance with the internationally recognized standards for example as detailed as follows:

110 volts: Yellow.
240 volts: Blue.
415 volts: Red.

Connections

Every joint and connection in a system shall be mechanically and electrically suitable for use to prevent danger. Proper cable connectors as per national/international standards shall only be used to connect cables.

No loose connections or tapped joints shall be allowed anywhere in the work site, office area, stores and other areas. Penalty as per relevant clause shall be put in case of observation of any tapped joints.

Portable and hand-held equipment

The contractor shall ensure the use of double insulated or all-insulated portable electrical hand equipment may be used without earthing (i.e. two core cables), but they shall still be used only on 110V because of the risk of damage to trailing leads.

Other equipment

- All equipment shall have the provision for major switch/cut-off switch in the equipment itself.
- All non-current carrying metal parts of electrical equipment shall be earthed through insulated cable
- Isolate exposed high-voltage (over 415 Volts) equipment, such as transformer banks, open switches, and similar equipment with exposed energized parts and prevent unauthorized access.
- Approved perimeter markings shall be used to isolate restricted areas from designated work areas and entryways and shall be erected before work begins and maintained for entire duration of work. Approved perimeter marking shall be installed with either red barrier tape printed with the words "DANGER—HIGH VOLTAGE" or a barrier of yellow or orange synthetic rope, approximately 1 to 1.5 meter above the floor or work surface.

Work on or near live conductors

No person shall be engaged in any work activity on or so near any live conductor (other than one suitably covered with insulating material so as to prevent danger) that danger may arise unless a) it is unreasonable in all the circumstances for it to be dead; and it is reasonable in all the circumstances for him to be at work on or near it while it is live; and suitable precautions (including where necessary the provision of suitable protective equipment) are taken to prevent injury.

Inspection and Maintenance

All electrical equipment should be permanently numbered and a record kept of the date of issue,

date of last inspection and recommended inspection period.
Fixed installations shall be inspected at least at three monthly intervals; routine maintenance being carried out in accordance with equipment manufactures recommendations.

9. CONSTRUCTION PLANTS SAFETY

- Fitness certificate
- Operators
- Maintenance and Work Permit System
- The Contractor shall develop a Work Permit system, which is a formal written system used to control certain types of work that are potentially hazardous. A work permit is a document, which specifies the work to be done, and the precautions to be taken. Work Permits form an essential part of safe systems of work for many construction activities. They allow work to start only after safe procedures have been defined and they provide a clear record that all foreseeable hazards have been considered. Permits to Work are usually required in high-risk areas as identified by the Risk Assessments.
- A permit is needed when construction work can only be carried out if normal safeguards are dropped or when new hazards are introduced by the work. Examples of high-risk activities include but are not limited to:
- Entry into confined spaces
- Work in close proximity to overhead power lines and telecommunication cables.
- Hot work.
- To dig—where underground services may be located.
- Work with heavy moving machinery.
- Working on electrical equipment
- Work with radioactive isotopes.
- Heavy lifting operations and lifting operations closer to live power line The permit-to-work system should be fully documented, laying down:
- How the system works;
- The jobs it is to be used for;
- The responsibilities and training of those involved; and
- How to check its operation;

A Work Permit authorization form shall be completed with the maximum duration period not exceeding 12 hours.

A copy of each Permit to Work shall be displayed, during its validity, in a conspicuous location in

close proximity to the actual works location to which it applies.

Fire Safety

The contractor shall ensure that construction site is provided with fire extinguishing equipment sufficient to extinguish any probable fire at construction site. An adequate water supply is provided at ample pressure as per national standard.

Recharging of fire extinguishers and their proper maintenance should be ensured and as a minimum should meet Indian National Standards.

All drivers of vehicles, foreman, supervisors and managers shall be trained on operating the fire extinguishers and firefighting equipment.

The contractor shall also give consideration to the provision of adequate firefighting arrangements within the underground and tunneling operations including the provision of Fire Service compatible hose connections and emergency lighting

As per the DBOCW Rules 2002, Rule 63(a) (vii), all lifting appliances' driver cabin should be provided with a suitable portable fire extinguisher.

Combustible scrap and other construction debris should be disposed of site on a regular basis. If scrap is to be burnt on site, the burning site should be specified and located at a distance no less than 12 meters from any construction work or any other combustible material.

Every fire, including those extinguished by contractor personnel, shall be reported to the Employer representatives.

Emergency plans and Fire Evacuation plans shall be prepared and issued. Mock drills should be held on a regular basis to ensure the effectiveness of the arrangements and as a part of the programme, the Telephone Number of the local fire brigade should be prominently displayed near each telephone on site.

Source: Safety Manual of National Highway Authority of India, Prepared by IIT, Delhi, 2010.

10. OCCUPATIONAL HEALTH & SAFETY MANAGEMENT PLAN

Purpose

The Occupation Health & Safety Management Plan has been formulated to address the occupational health and safety related impacts that may arise from proposed project activities viz.

exploratory/development drilling and testing operation of construction machinery/equipment, storage and handling of fuel and chemicals, operation of drilling rig and associated equipment, during drilling and decommissioning/site closure.

Mitigation Measures

- All machines to be used in the construction will conform to the relevant Indian Standards (IS) codes, will be kept in good working order, will be regularly inspected and properly maintained as per IS provisions and to the satisfaction of the site Engineer.
- Contractor workers involved in the handling of construction materials viz. borrow material, cement etc. will be provided with proper PPEs viz. safety boots, nose masks etc.
- No employee will be exposed to a noise level greater than 85 dB(A) for a duration of more than 8 hours per day. Provision of ear plugs, ear muffs etc. and rotation of workers operating near high noise generating areas.
- Hazardous and risky areas, installations, materials, safety measures, emergency exits, etc. shall be appropriately marked.
- All chemicals and hazardous materials storage container will be properly labeled and marked according to national and internationally recognized requirements and standards. Materials Safety Data Sheets (MSDS) or equivalent data/information in an easily understood language must be readily available to exposed workers and first-aid personnel.
- The workplace must be equipped with fire detectors, alarm systems and fire-fighting equipment. Equipment shall be periodically inspected and maintained to keep good working condition.
- Health problems of the workers will be taken care of by providing basic health care facilities through health centers temporarily set up for drilling base camp.
- The sewage system for the camp must be properly designed, built and operated so that no health hazard occurs.
- Adequate sanitation facilities will be provided onsite for the operational workforce both during construction and operational phase of the project.
- Garbage bins will be provided in the camp and regularly emptied and the garbage disposed off in a hygienic manner.
- Training programs will be organized for the operational workforce regarding proper usage of PPEs, handling and storage of fuels and chemicals etc.
- Project sites should be enabled with proper evacuation system and public address system.

11. DISASTER MANAGEMENT MANUAL

11.1 General

Disaster Management involves planning what to do before, during and after a disaster or emergency occurs. Through further understanding these hazards, and assessing a structure's behaviour to them, we can better prepare for disasters. These are adversely impacting our heritage as well. These disasters include earthquakes, cyclone, drought, tsunamis, floods, volcanoes, fires, and wildfires *etc*.

11.2 Community awareness and involvement

Awareness in the masses regarding dos and don’ts, vulnerable areas and emergency numbers empower them to do the needful proactively as and when the situation arises. Having aware community also reduces the chances of chaos and panic. The community will be awarded to keep their T.V., Radio on and listen to latest weather warnings and advisories from the Doordharsan & and all India Radio station and any announcement through public address system. Following measures can be taken by respective department towards generating awareness:

- Create mass awareness through advertisement, hording, booklets, leaflets, banners, etc.
- Organize awareness camps for children and make use of folk dance and music, plays, painting competition, debate competition, etc. to disseminate the information.
- Organize disaster management exhibition and use scientific tools like shake-table demonstration, etc. to disseminate awareness about various hazards and ways to deal with them.
- Arrange for TV Spot, radio spot, audio-visual and documentary, *etc*. to reach out to masses at large.
- 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.

11.3 Earthquake

As per Indian Seismic Zone Map, Gujarat region lies in three zones- Zone III, IV and V. Kachchh region (about 300km x 300km) lies in zone V where earthquakes of magnitude 8 can be expected. A belt of about 60-70km width around this zone covering areas of North Saurashtra and areas bordering Eastern part of Kachchh lie in zone IV where intensity VIII can be expected mainly due to earthquakes in Kachchh and some local earthquakes along North Kathiawar Fault in Northern Saurashtra. The rest of Gujarat lies in zone III where intensity VII earthquakes can be expected due to moderate local earthquakes or strong Kachchh earthquakes.
(Source: http://gsdma.org/uploads/Assets/other/gsdmp-2016-17-volume-106072017115412038.pdf)

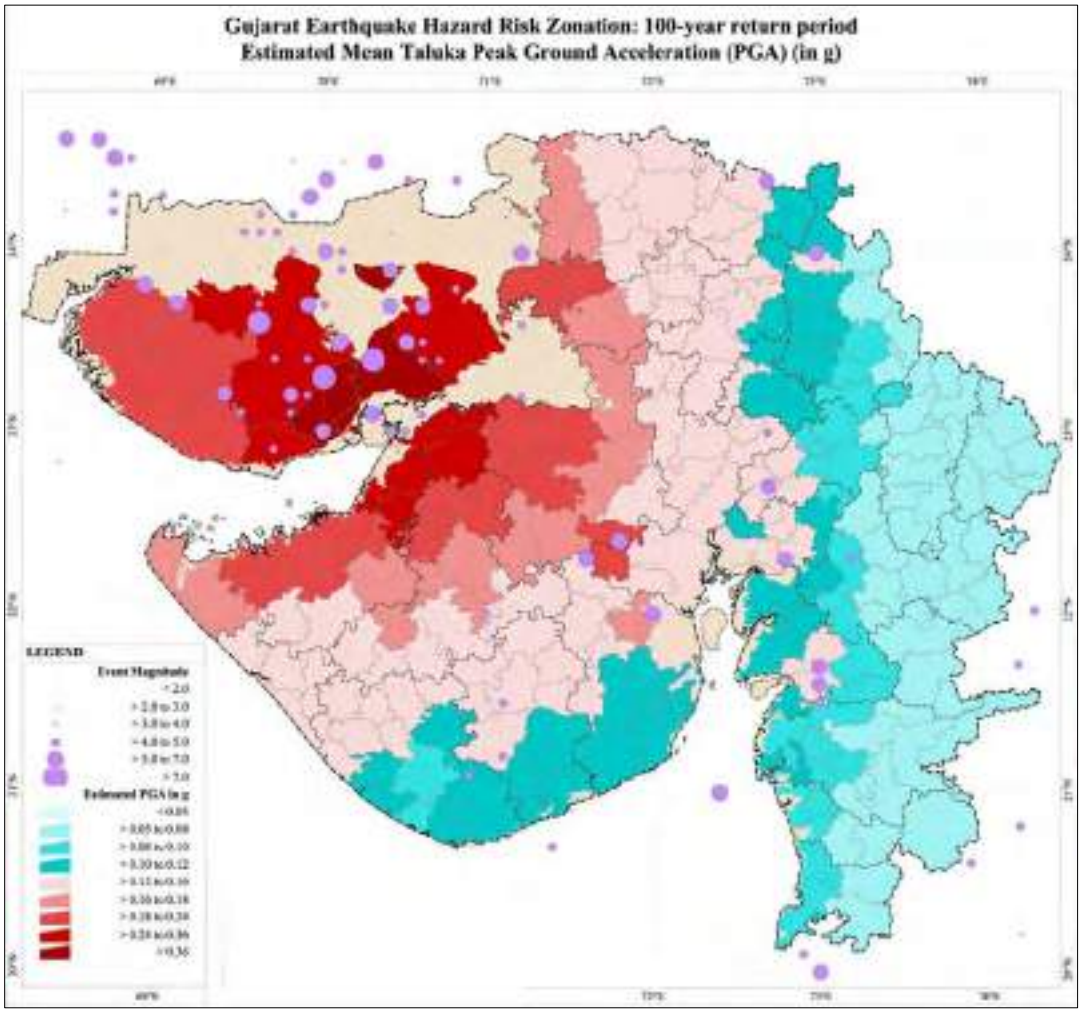

Figure No. 7: Gujarat Earthquake Hazard Risk Zonation Map

11.4 Drought

Daily temperature of the State ranges from a minimum 13°C to 27°C in January to 27°C to 41°C in the summer during May. The South-West winds mostly bring rain between June to September and approximately 90 to 95% of precipitation is registered in these three months. From the North-West areas to South Gujarat areas, the rainfall varies from 300 mm to 2000 mm per annum. In Gujarat, 60% of rainfall is uncertain, unprecedented and unequal and the regions of Saurashtra, Kutch and North Gujarat face famine every third year. Since 1900, the state has faced scarcity of water and food almost 30 times.

Gujarat is one the chronic drought prone state of India, with an average annual rainfall about only 700 mm with more than half of the Talukas of Gujarat receiving rainfall within the range of 200-400 mm.

Substantial portions of the State are arid to semiarid. With large parts of North Gujarat and Saurashtra having source of alternate irrigation, groundwater exploitation is leading increased threats of droughts. Falling water tables have added stress on crops and water supplies.
(Source: http://gsdma.org/uploads/Assets/other/gsdmp-2016-17-volume-106072017115412038.pdf)

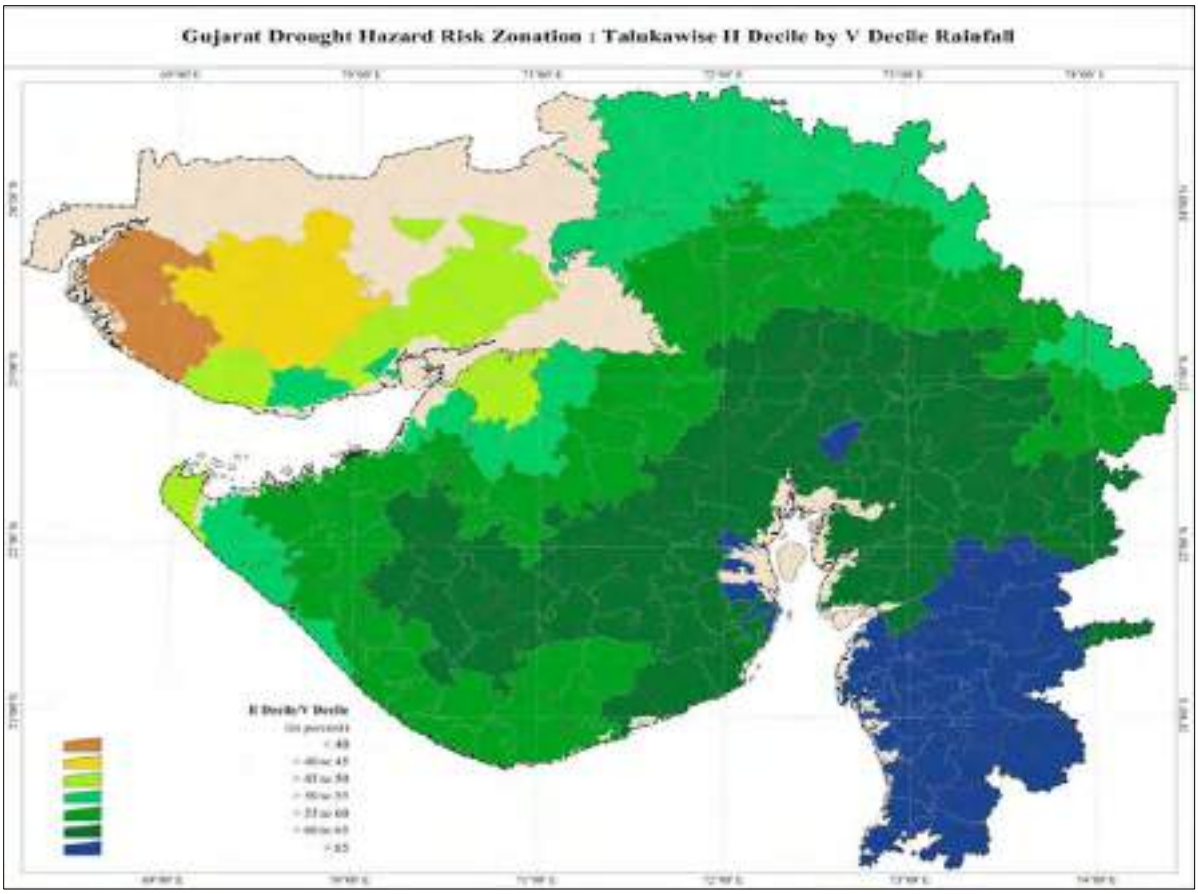

Figure No. 8: Gujarat Drought Hazard Risk Zonation Map

11.5 Cyclone & Storm

Gujarat falls in the region of tropical cyclone. With the longest coast line of 1600 km in the country, it is highly vulnerable to cyclone and its associated hazards such as floods, storm surges, etc. Most of the cyclones affecting the state are generated in the Arabian Sea. They move North-East and hit the coast particularly the Southern Kutch and Southern Saurashtra and the Western part of Gujarat.
(Source: http://gsdma.org/uploads/Assets/other/gsdmp-2016-17-volume-106072017115412038.pdf)

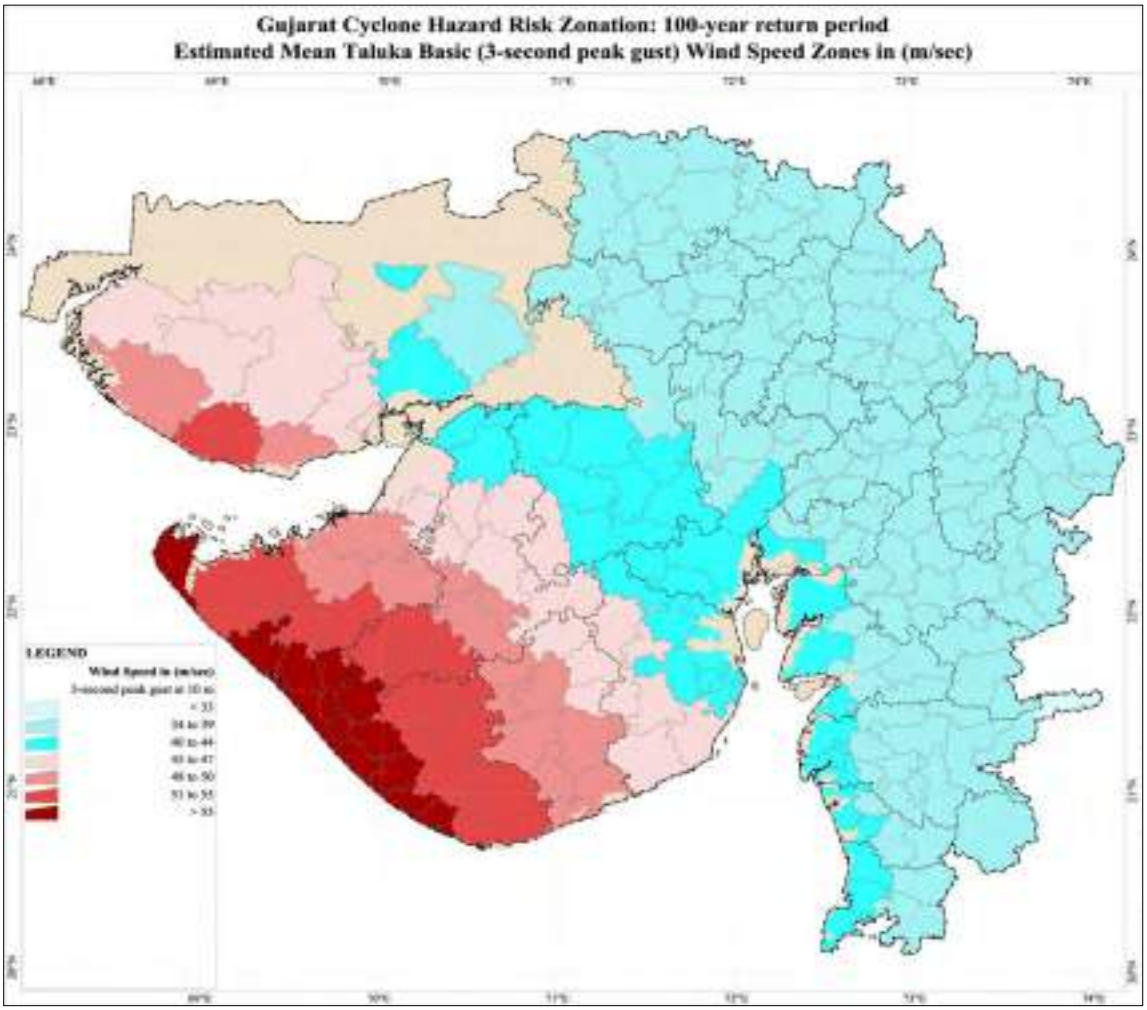

Figure No. 9: Gujarat Cyclone Hazard Risk Zonation Map

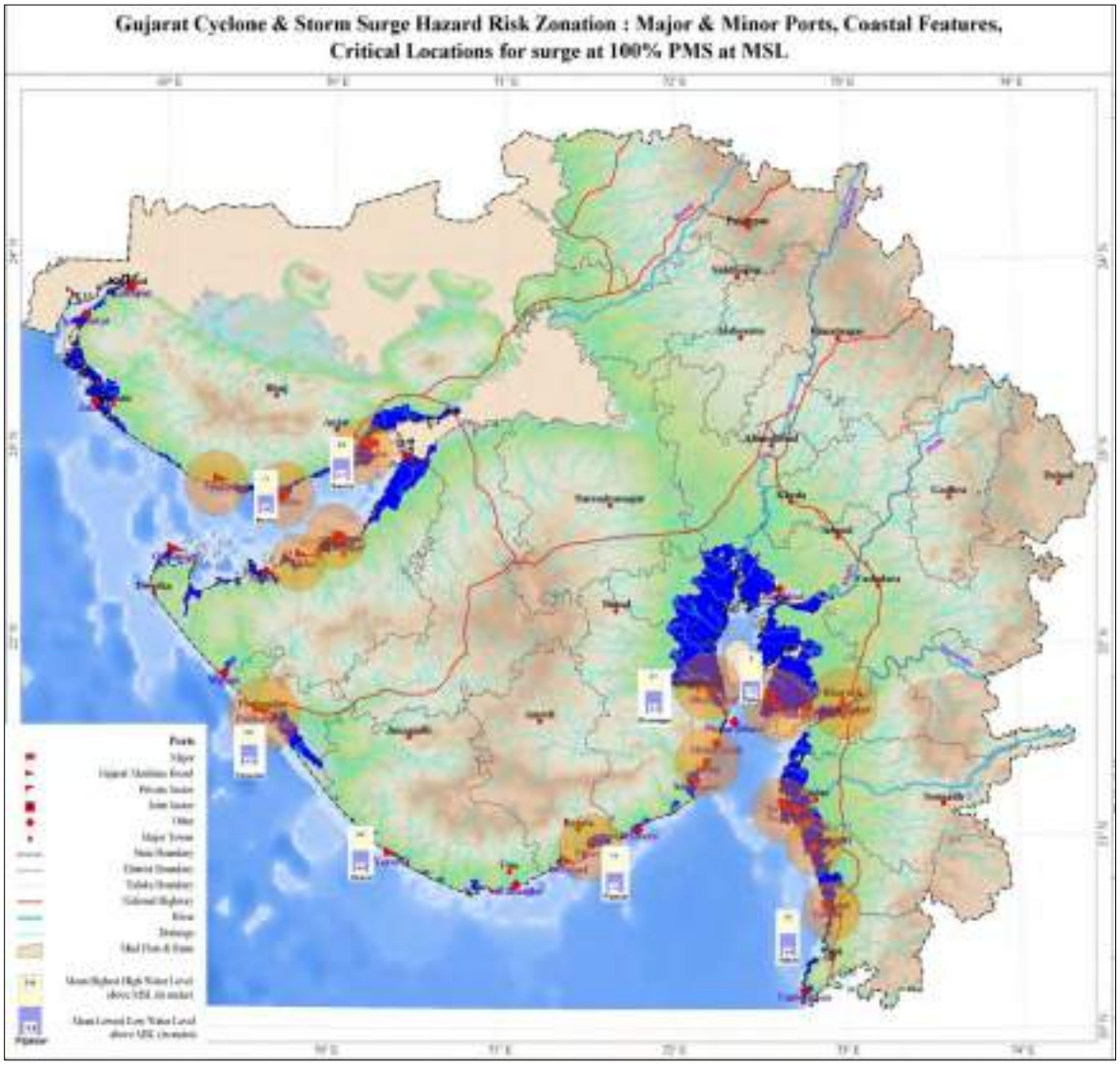

Figure No. 10: Gujarat Storm Surge Hazard Risk Zonation Map

11.6 Flood

The climatology of Gujarat is influenced by the Arabian Sea in the West and three hill ranges along its Eastern border. A long coastline makes parts of arid Saurashtra and Kutch occasionally experience very high rainfall. These occasional heavy rainstorms are responsible for most of the floods in the State. While the Northern part of the State is mostly arid and semi-arid, the Southern part is humid to sub-humid. Extremes of climate, be it rainfall or temperatures are quite common in this region. All major rivers in the State pass through a wide stretch of the very flat terrain before reaching the sea. These flat lowlands of lower river basins are prone to flooding. The flood prone river sections were identified from settlement level analysis.

Below figure shows the majority of the area of Gujarat is flood prone, irrespective of the size of the catchment. The flat plains in the lower basic areas with hilly catchments in upper parts of South Gujarat accentuate flood risks. Few villages in the North Gujarat are flood prone too.
(Source: http://gsdma.org/uploads/Assets/other/gsdmp-2016-17-volume-106072017115412038.pdf)

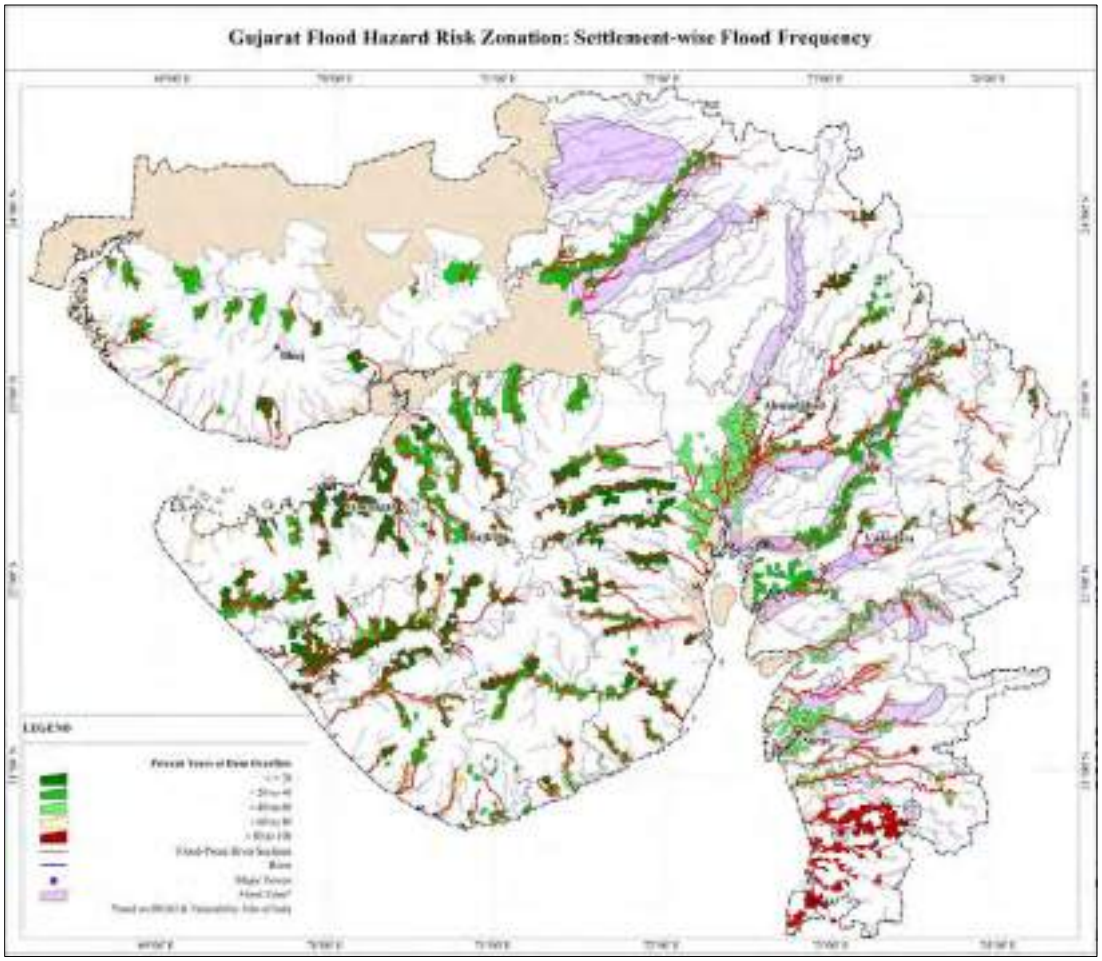

Figure No. 11: Gujarat Flood Hazard Risk Zonation Map

11.7 Tsunami

Gujarat is prone to tsunami risk due to its long coastline and probability of occurrence of near and offshore submarine earthquakes in the Arabian Sea. Makran Subduction Zone (MSZ) -South West of Karachi is an active fault area which may cause a high magnitude earthquake under the sea leading to a tsunami.
(Source: http://gsdma.org/uploads/Assets/other/gsdmp-2016-17-volume-106072017115412038.pdf)

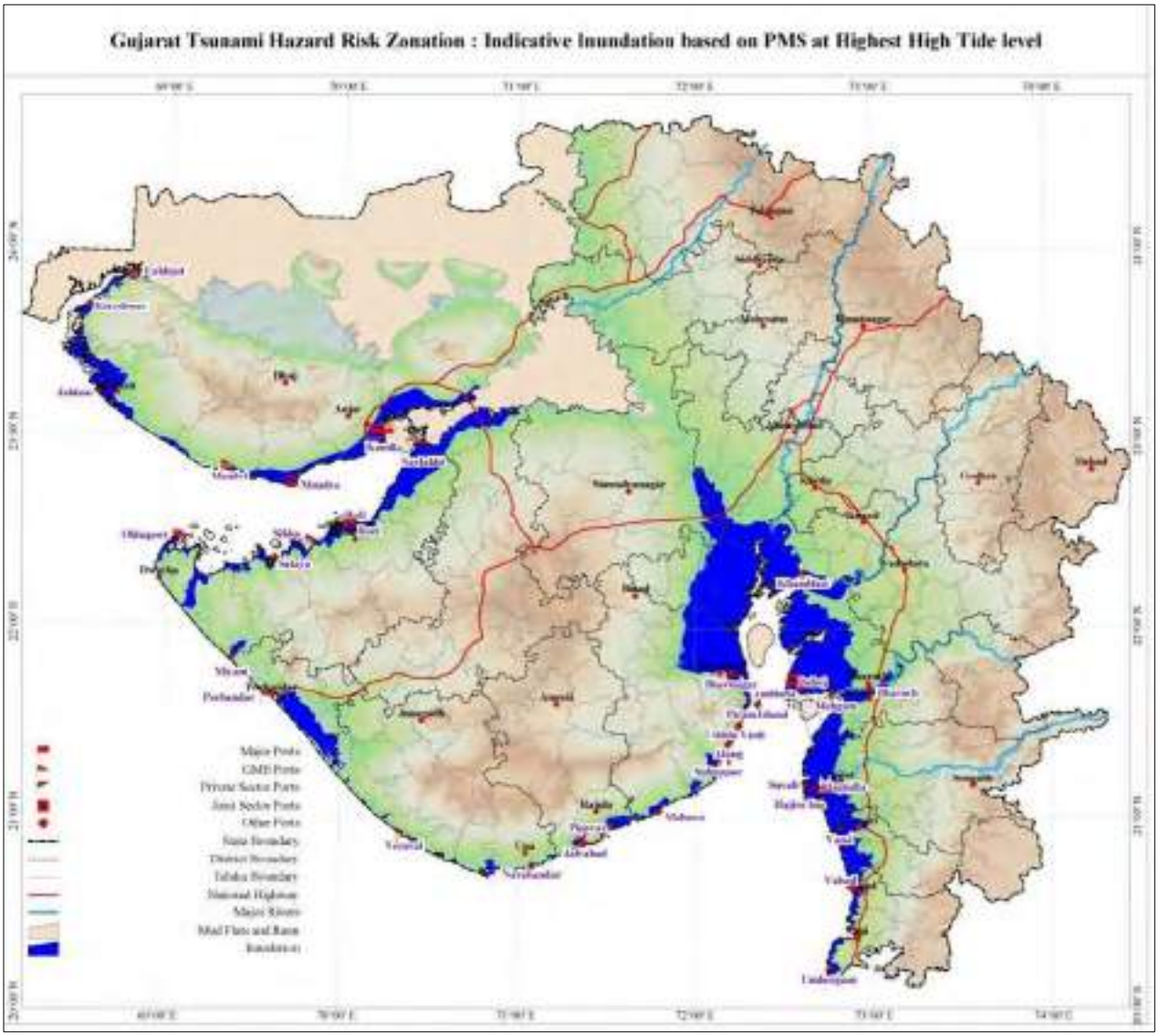

Figure No. 12: Gujarat Tsunami Hazard Risk Zonation Map

11.8 Trigger Mechanism and Operational Direction

The response mechanism shall be put into action considering the situation prevailing at a given point of time as per the Disaster Management Plan. Response process begins as soon as it becomes apparent that a disastrous event is imminent and lasts until the disaster is declared to be over. Response is triggered on receiving any early warning or at occurrence of disaster as the case may be. Every new experience and instances that encountered every year are added so as to take a cue and derive a lesson. So that Disaster Management Plan is prepared and updated.

Table No. 7: Agencies Competent for issuing Disaster Specific Early Warning

Disaster	Agencies
Earthquakes	IMD, ISR
Floods	IMD, Irrigation Dept.
Cyclones	IMD
Tsunami	IMD, ISR, INCOIS
Drought	Agriculture Dept.
Epidemics	Health & Family Welfare Dept.
Industrial & Chemical Accidents	Industry, Labour & Employment Dept., DISH
Fire	Fire & Emergency Services

(Source: http://gsdma.org/uploads/Assets/other/gsdmp-2016-17-volume-106072017115412038.pdf)

11.9 Damage Assessment and Immediate Restoration/Rehabilitation

There are three kinds of assessment reports made at different timeframe. 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

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.
While a preliminary damage assessment will be carried out during disaster phase, a detailed assessment shall be conducted before commencing reconstruction and rehabilitation activities. The primary objective of any post–disaster 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 shall be a composite representation of 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.

11.10 Mitigation Measures Undertaken

11.11 Relief Measures

Relief measures shall be taken with co-ordination of all Departments.

Table No. 8: Role and Action Plan of Various Departments

S. No.	Department	Disaster specific Action Plan
1.	Revenue Department	• Revenue Department is the nodal department for controlling, monitoring and directing measures for organizing rescue, relief and rehabilitation. • Develop relief norms and packages • Arrange with service provider companies for multiple warning messages to community, officials, *etc.* as the need may be • Develop and promote insurance, disaster bonds, tax rebate, *etc.* against the disaster
2.	Agriculture & Co-operation Department	• Identify area prone to droughts, floods and pest attack and monitor them during vulnerable season • Spread awareness among farmers regarding various crop diseases, prescribed use of fertilizers and pesticides, crop insurance, alternate cropping pattern in disaster prone areas, proper seed and fodder management, etc. • Formulate a trained team for assessing damage to crops, soil and other agricultural damage • Ensure a proper mechanism for communicating early warning to farmers regarding rainfall, flood, droughts, cyclone, etc.
3.	Animal Husbandry Department	• Ensure proper mechanism for disease surveillance among animals • Prepare a database of veterinary hospitals, clinics and agencies working for animals • identify source for procurement of fodder • Identify safe locations for cattle camps • Ensure proper administration of de-worming and vaccinations for cattle, sheep and goats, pigs and other relevant measures for disease management • Aware rural population regarding management of sick or diseased animals • Ensure proper transportation facilities for sick or critically injured animals • Identify space for burial of dead animals

4.	Climate Change Department	• Promote green technology, CNG usage, use of solar energy, etc. • Aware citizens regarding ways to preserve ground water, saving power and reducing carbon footprint in day-to-day life • Increase and protect mangrove cover • Prepare a comprehensive policy on Climate Change for the state and guidelines to be followed for the same
5.	Education Department	• Organize camps in school and colleges for awareness of do-s and don'ts of possible hazards in the state, hygiene and other issues of public health • Ensure preparation of disaster management plans and first aid kits in all schools and colleges • Identify safe schools and colleges which can be used as relief shelters for short duration of time in aftermath of any disaster
6.	Fire & Emergency Services	• Ensure proper maintenance and functioning of all firefighting equipment and personal protection equipment • Prepare a database of private firefighting agencies and their resources
7.	Food & Civil Supplies Department	• Prepare for safety of stored food grains in godowns against inundation and water logging, fire and other possible hazards • Prepare for safety of stored food grains in godowns against inundation and water logging, fire and other possible hazards • Enlist godowns and cold storage facilities, refrigerated transportation vehicles present in the state along with their storage capacities and facilities available • Enlist private retailers and wholesale dealers of food items and packaged drinking water • Enlist available kerosene depots, petrol pumps, CNG pumps, diesel depots, LPG agencies, etc.
8.	Forest & Environment Department	• Formulate a team to catch wild animals in case they enter inhabited areas • Gujarat Pollution Control Board should ensure that all industries are following proper guidelines for hazardous waste management
9.	Health and Family	• Organize awareness camps for hygiene and other public health issue

	Welfare Department	• Develop plan for hospital preparedness and mass casualty management • Prepare a database of registered private hospitals, clinics, diagnostic labs, blood banks, etc. along with their capacities and facilities provided • Establish statewide medical emergency access number • Recognize and accredit trauma centres • Ensure authentic medical database enlisting public and private facilities available in the state. This includes details of manpower, logistics, medical equipment, medicines, antidotes, personal protective equipment, disinfectant, vaccines, etc. • Standardize and license ambulance services • Prepare trained psychological and psychosocial care teams • Ensure proper and safe management of medical waste
10.	Police Department	• Ensure proper functioning of all equipment and vehicles • Prepare for quick deployment of Home Guards and volunteers for providing safety to affected population and evacuated structures/ houses • Prepare plan for management of terrorist attack, bomb blast, stampede, etc. • Train police personnel and staff of PCR van in first aid and basic life support • Prepare communication plan for uninterrupted communication to all police posts and various control room and emergency centres across the state
11.	Port & transport Department	• Ensure proper functioning of filling station, vehicles and equipment • Prepare for prompt deployment of vehicles at short notice for various purposes like mass evacuation, transportation of response teams, relief items, victims, etc. • Prepare mechanical team for prompt repair of equipment and vehicles • Train drivers, conductors, crew members, port officials in first aid and basic life saving techniques
12.	Road & building	• Ensure availability and functioning of all equipment like cranes, earthmovers, etc. Prepare a data base of

	Department	availability of the same with private agencies also • Prepare for prompt clearance of debris post disaster • Prepare the demolishing squad for prompt demolition of unsafe buildings post disaster • Prepare for prompt clearing and repairing of damaged roads, culverts, bridges and flyovers • Ensure prompt construction of new temporary roads for diverting traffic from the affected area • Prepare for construction of temporary facilities like that of medical post, temporary shelters, etc. at short notice. • Prepare for restoration of government buildings damaged during disaster • Prepare for prompt establishment of helipad near the affected site for responding teams and VVIP visits
13.	Science & Technology Department	• Ensure proper mechanism to issue alert/ warning through SMS through service providers • Prepare for providing safety and serviceability of critical communication towers through respective service providers • 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
14.	Social Justice & Empowerment Department	• Prepare and regularly update database of scheduled castes, developing 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
15.	Tribal Development Department	• Prepare a database of tribal groups in the state, their population and habitats • Ensure they are well covered under all government schemes targeted to them with special focus on the five Particularly Vulnerable Tribal Groups
16.	Women & Child Development Department	• Prepare a database of authentic NGOs working for women and children empowerment/ rights • Prepare for prompt action in aftermath of any disaster so as to prevent human trafficking particularly that of women, girls and children • Ensure women and children in vulnerable circumstances are well covered under various government schemes

		targeted to them
17.	State Disaster Management Authority	• Assist the State Government in formulation of policy for relief, rehabilitation, reconstruction and recovery. • Monitor preparation, updation and implementation of disaster management plans • Promote awareness and preparedness among all stakeholders regarding potential disasters • Assist in development of methodologies for reduction of vulnerability of disasters • Publish various guidelines to be followed for various phases of disaster management • Inspect existing development plans made by various authorities and recommend measures to be incorporated for disaster management • Develop database of key experts, consultants, organizations, agencies, etc. working in the field of disaster management
18.	Industrial Safety & Health	• Create awareness for health & safety for workers and factory management • Conduct health & hygiene survey and inspection in various industrial sectors • Ensure preparation of onsite emergency management plan by all industrial units
19.	Sports Youth & Cultural Activities Department	• Organize training and awareness camps for youth or first aid, relief and camp management, psycho social care, search and rescue for small incidents, firefighting and thereby creating a trained volunteer database
20.	Information Department	• Display verified Information Education and Communication (IEC) materials for mass dissemination and awareness among the public • Prepare a database of popular media channels and media persons (both print and electronic) • Ensure proper mechanism/ channels for addressing public so as to avoid and manage rumours with help of various media