



Design, Build, Finance, Operate, Maintain and Transfer (DBFOMT) of Existing State Highway Hungund – Muddebihal – Talikot in the state of Karnataka on DBFOMT Annuity Basis (WCP-7)”

Karnataka Road Development Corporation Limited (A Government of Karnataka Enterprise)

**Design, Build, Finance, Operate, Maintain and Transfer
(DBFOMT) of Existing State Highway Hungund –
Muddebihal – Talikot in the state of Karnataka on DBFOMT
Annuity Basis (WCP-7)”**

Traffic Safety Management Plan (TSMP)

Package No. : Road No. 7 - Hungund - Muddebihal - Talikota
Employer : Karnataka Road Development Corporation Limited
Concessionaire : Ashoka Hungund Talikot Road Limited
Consultant : EGIS India Consulting Engineers Pvt.Ltd.
EPC Contractor : Ashoka Hungund Talikot Road Limited

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CHAPTER 1. INTRODUCTION AND GUIDANCE TO USERS

1.1 STRUCTURE AND CONTENT

This manual includes two introductory chapters:

- Legislation
- Safety, Health and Environment Management

These are followed by the following six units

1. Health and Safety Management
2. Traffic Safety Management
3. Safety in Road Construction Work
4. Temporary Structures Safety
5. Workplace Safety
6. Electrical and mechanical safety

The units provide users with information enabling them to respond to key safety questions:

- What are the appropriate methods and approaches for preventing accidents and injuries in different settings?
- What strategies will be implemented for maximum benefits?
- What can road construction and maintenance professionals do to initiate and sustain viable programmes to improve safety?

This manual provides principles and information to meet training needs in different settings. It will be used in facilitator-guided training, as well as for self-learning. Professionals managing safety have different levels of prior knowledge. Some may have had formal training, while others may not. Also, these professionals are likely to be working on different aspects of safety. Trainers are advised to consider the needs of different audiences, especially their pre-existing knowledge and practical needs in their work. The modular structure of this manual allows for flexibility in customizing the content to meet different training need

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Project Information:

The Project road comprises of two State Highways viz. SH 41 – 1 Km and SH 60 – 54.537 Km and which starts from NH-13 Junction at Hungund and ends at Talikoti Junction on SH-61. The total length of the project stretch is 58 km. The project stretch passes through Bagalkot and Bijapur District and mainly passes through Hungund, Dannur Cross, Tangadagi, Lebageri, Muddebihal, Kuntoji, Mukihal and ends at Minajagi. The total length of project stretch from Mundargi to Harapanahalli consists of the two State Highways, SH-60 and SH-41.



1.2 LEGISLATION

1.2.1 LAWS AND RULES RELATED TO HEALTH, SAFETY AND WELFARE OF CONSTRUCTION WORKERS

The law provides a set of limits or minimum standards of protection for workers’ health and safety. It establishes the boundaries as to what may be negotiated between unions and employers, and what may be imposed on workers by employers acting under economic pressure. It also mandates and regulates the conditions of work so that workers will be not subjected to unsafe environments and may take recourse to the courts to enforce the provisions. The following laws are of relevance to the issues of workplace hazards and safety and some of the provisions of the main ones are mentioned below. However, it is incumbent on safety officers to keep copies of all the laws and become familiar with the provisions therein.

The EPC shall develop a thorough understanding of the Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act 1996, the Factories Act, 1948, Central Rules 1998, Building and Other Construction Workers’ Welfare Cess Act, 1996, to not only satisfy the Inspectors but also to develop a

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perspective on the use of these legislation as the main tool for safety of workers at construction worksites. The EPC is strongly advised to practice the principle of voluntary self-regulation rather than merely adopt a compliance attitude.

In addition to this, the construction works shall be undertaken in accordance with all applicable Legislation and Indian statutory requirements listed below for better health and safety management at construction worksites.

- As per concession agreement(CA) scheduled D B2.1.5.6 111.7 and B2.1.6 clause 112
- Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989
- Hazardous Wastes (Management and Handling) Rules, 1989
- Motor Vehicles Act, 1988
- Workmen’s Compensation Act, 1923
- Employees State Insurance Act, 1948
- Employer’s Liability Act, 1938
- Trade Unions Act, 1926
- Industrial Disputes Act, 1947
- Contract Labour (Regulation & Abolition) Act, 1970
- Inter-state Migrant Workmen (Regulation of Employment and Conditions of Service) Act,1979
- Bonded Labour System (Abolition) Act, 1976
- Child Labour (Prohibition and Regulation) Act, 1986
- Children (Pledging of Labour) Act, 1933
- Minimum Wages Act, 1948
- Payment of Wages Act, 1936
- Equal Remuneration Act, 1976
- Payment of Gratuity Act, 1972
- Payment of Bonus Act, 1965
- Employees Provident Funds and Misc. Provisions Act, 1952
- Maternity Benefit Act, 1961
- Public Liability and Insurance Act, 1991
- Indian Electricity Act
- Boiler Act
- Explosives Act and Rules prescribed under the Act like SMPV Rules and Gas Cylinder Rules
- Mines Act
- Plantation Act
- Shops & Establishments Act

1.3 SAFETY, HEALTH AND ENVIRONMENT MANAGEMENT

The EPC as per Section 39 of the BOCW Act shall formulate a SHE policy and get it approved by DG/CIIBC respectively and display it at conspicuous places at work sites in Hindi and a local language understood by the majority of construction workers.

Within 4 weeks of the notification of acceptance of the tender, the EPC shall submit a detailed and comprehensive Contract specific SHE Plan. The HSE Plan shall include detailed policies, procedures and

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regulations which, when implemented, will ensure compliance of the contract provisions. The HSE Plan shall include the following but not be restricted to:

- 1) A statement of the EPC's policy, organisation and arrangements for SHE.
- 2) The name(s) and experience of person(s) within the EPC's proposed
- 3) Management who shall be responsible for co-ordinating and monitoring the
- 4) EPC's SHE performance;
- 5) The number of SHE staff who shall be employed on the Works, their
- 6) Responsibilities, authority and line of communication with the proposed
- 7) EPC's agent;
- 8) A statement of the EPC's policy and procedures for identifying and
- 9) Estimating hazards, and the measures for addressing the same;
- 10) A list of SHE hazards anticipated for this Contract and sufficient information to
- 11) Demonstrate the EPC's proposals for achieving effective and efficient health and safety procedures;
- 12) A description of the HSE training courses and emergency drills which shall be
- 13) Provided by the EPC, with an outline of the syllabus to be followed;
- 14) Details of the safety equipment which shall be provided by the EPC,
- 15) Including personal protective equipment;
- 16) A statement of the EPC's policy and procedures for ensuring that
- 17) EPC's Equipment used on the Project Site are maintained in a safe
- 18) Condition and are operated in a safe manner;
- 19) A statement of the EPC's policy and procedures for ensuring that sub-Contractor comply with the EPC's safety plan;
- 20) A statement of the EPC's disciplinary procedures with respect to SHE related matters, and
- 21) A statement of the EPC's procedure for reporting and investigating accidents, dangerous occurrences or occupational illnesses

The EPC shall, from time to time and as necessary are required by the Employer to produce supplements to the HSE Plan such that it is at all times a detailed, comprehensive and contemporaneous statement by the EPC of his site safety, industrial health and environment obligations, responsibilities, policies and procedures relating to work on Site. Any and all submissions of supplements to the HSE Plan shall be made to the Employer in accordance with the agreed procedures.

If at any time the HSE plan is, in the Employer's opinion, insufficient or requires revision or modification to ensure the security of the Works and the safety of all workmen upon and visitors to the Site, the Employer may instruct the EPC to revise the HSE plan and the EPC shall within 7 days submit the revised plan to the Employer for review.

Any omissions, inconsistencies and errors in the HSE Planer the Employer's acceptance or rejection of the HSE Plan and/or supplements thereto shall be without prejudice to the EPC's obligations with respect to site safety, industrial health and environment and shall not excuse any failure by the EPC to adopt proper and recognized safety practices throughout the execution of the Work.

The EPC shall adhere to the HSE Plan and shall ensure, as far as practically possible, that all sub-EPCs of all tiers require that contracting parties each have a copy of the Site HSE Plan and comply with its provisions.

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1.4 QHSE Policy and Objectives & Targets

ASHOKA

QHSE Policy

We, at **ASHOKA BUILDCON LTD.** are committed to become an icon in infrastructure development, through innovation, professionalism, active leadership in product quality and sustained growth by delivering value to our customers.

We, shall conduct our operations in a manner so that we protect people, property and the environment by identifying, controlling and reducing all associated risks to a level As Low As Reasonably Practicable.

This will be achieved by:-

1. Our commitment to continual improvement of quality, environmental, occupational health & safety management system performance.
2. Commitment to prevention of pollution, injury and ill health
3. Complying with all applicable legal and contractual requirements.
4. Adopting state of art technology available.
5. Communicating and consulting all associated stakeholders for establishing organizational objectives.


Ashok Katariya
Chairman

Date : 1st August 2013

ASHOKA

Quality, Health, Safety and Environmental Objectives

- To improve planning
- To reduce customer complaints
- To enhance motivation of employees
- To improve skills through training
- Complying with all the statutory rules and regulations
- Minimising Air, Land and Water Pollution and preventing injury and ill health.

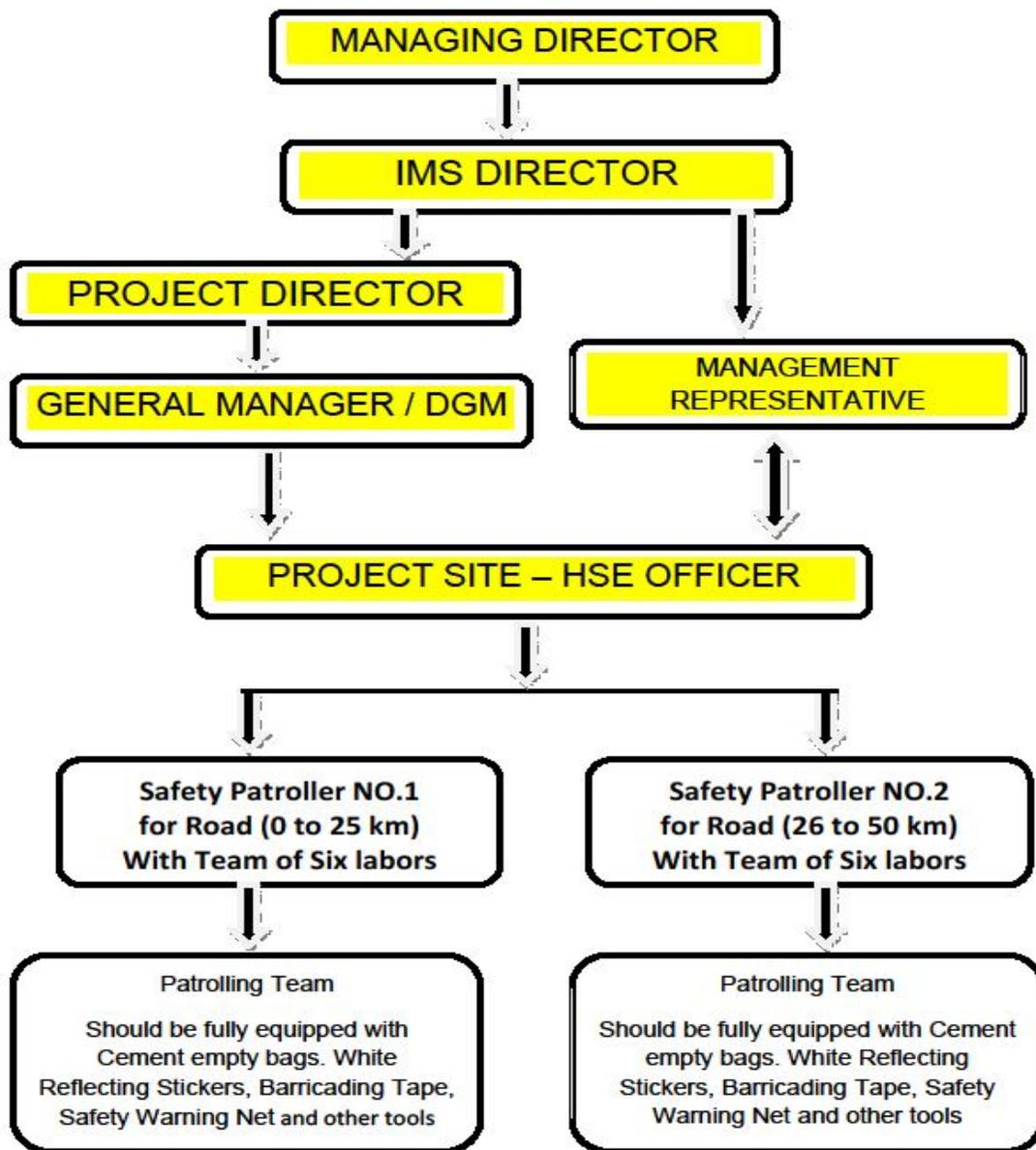
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1.5 ROLES & RESPONSIBILITIES OF ORGANIZATIONS

In the following sections the responsibilities and scope of work of the major stakeholders are briefly described.

1.5.1 ORGANIZATION STRUCTURE



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1.5.2 RESPONSIBILITIES

HSE management is a line responsibility requiring active participation of all levels of management and supervision. Individual HSE roles and responsibilities, along with task and target shall be distributed to the individuals for action. as described below.

1.5.3 SAFETY MANAGER

No	TASK	TARGET	VERIFICATION DOCUMENT
1.	Supplement Project HSE Inspections & relevant HSE training at the jobsites in co-ordinations with HSEO.	Once in Six Month	HSEM Site Visit Report
2.	Investigate all serious incidents & recommend preventive action at projects.	As and when required	Incident Investigation Report
3.	Co-ordinate purchase and quality control activities related to PPE/ safety gadgets.	After receiving MR	Approved Vendor list
4.	Monitor all HSEO activities & co-ordinate with clients, Project in charges, CH, BUH, Service Dept. heads	As and when required	No documentary evidence
5.	Organize campaigns, competitions & other special emphasis programmes to promote HSE at workplace.	During January & as and when required	Record of HSE Campaign and competitions
6.	Conduct HSE Audit and Inspection during the Project duration	As per schedule	Audit Report

1.5.4 SAFETY OFFICER

NO	TASK	TARGET	VERIFICATION DOCUMENT
1.	Disseminate and Communicate HSE Management system requirements to project personnel.	Project Duration	
2.	Provide necessary advice, information and support in the effective implementation of the HSE Management System requirements and this HSE plan.	Project Duration	
3.	Update the HSE Plan to the requirements of the activities being carried out when there is a revision.	Project Duration	HSE Plan
4.	Plan and conduct Internal HSE training Programs, initiate drive to promote HSE awareness and performance.	Project Duration	HSE Training Records
5.	Carry out HSE inspection of work Area, P&M Equipment & Machineries, etc. as per the IMS	As per Monthly Active Plan	HSE Inspection Report, P&M Inspection Report.

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NO	TASK	TARGET	VERIFICATION DOCUMENT
	requirement.		
6.	Creating HSE awareness through Tool Box talks.	Every Day	Tool Box talk Report
7.	Advise and co-ordinate with line management in preparing HSE Risk Assessment for new activities	Project Duration	HSE Risk Assessment Records
8.	Conduct Investigation of all incidents & recommend appropriate corrective measures.	When reported	Investigation Report
9.	Convene HSE Committee meeting & minute the proceedings for circulation & follow-up action.	Min Frequency-Once in a month	MOM- Project HSE Committee Meeting
10.	Advise & co-ordinate for Implementation of work Permit Systems.	Whenever work requiring WPS is executed	Completed Work Permit
11.	Plan procurement of PPE & safety devices and inspect before use as per laid down norms.	Project Duration	Requirement & Release of Safety Materials, Delivery Challan Records
12.	Report to BU-HSEM on all matters pertaining to status of HSE and promotional programme at project level.	Regular basis	-
13.	Facilitate screening of workmen and conduct HSE induction.	Project Duration	Screening & Induction Records.
14.	Monitor administration of First Aid	Project Duration	First Aid Register
15.	Conduct Fire Drill, Procure, inspect & arrange to maintain Fire Extinguishers.	As scheduled in the monthly activity plan	Register, Fire extinguishers inspection register
16.	Organize campaigns, competitions & other special emphasis programs to promote HSE in the workplace.	As and when required	Record of HSE Campaigns & Competitions
17.	Register Customer complaints and take corrective action.	Project Duration	Customer Compliant Register
18.	Record, analyze & cascade lateral learning points from First Aid Cases, Near Miss Cases & Accidents to all project personnel and analyze the trends & effectiveness.	Monthly	First Aid Register, Incident Investigation Report
19.	Maintain all HSE related documents Update HSE training records	Continual	HSE related Documents

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1.5.5 SAFETY SUPERVISOR

NO	TASK	TARGET	VERIFICATION DOCUMENT
1.	Understand the HSE requirements of the Project from this Plan, HSE Management Systems, HSE Manual & follow the same in execution of the work.	Continuous	No. of findings in the HSE Inspection
2.	Give Tool box talk to the workmen under him.	Daily	Tool box report
3.	Ensure the workmen under him wear the necessary personal protective equipment relevant to the job.	Continuous	Subcontractor Evaluation Report
4.	Elimination all unsafe conditions in the workplace.	Continuous	HSE Inspection Report
5.	Keeping the workplace neat & clean	Continuous	HSE Inspection Report
6.	Know the critical activities of his job based on HSE Risk Assessment & ensure implementation of the control measures.	Project Duration	HSE Risk Assessment & Safe work method
7.	Participating with the HSEO or the committee Members in the Project HSE Inspection.	As per schedule	HSE Inspection Report
9.	Report all near miss cases / reportable LTI / dangerous occurrences / fatality to HSEO immediately verbally & submitting the preliminary incident report within 12 hours.	As and when required	Preliminary Incident report
10.	Inform the concerned authority as per the emergence response plan.	As and when required	Emergency Response plan

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1.6 PROJECT HSE COMMITTEE

Considering the wide spread work activities during the project execution apart central safety committee two sub safety committees will be formed such that one in each package.
Central Safety committee, functioning under the chairmanship of the Chief Project officer, is constituted and it will meet once in two months.

CENTRAL SAFETY COMMITTEE

CHAIRMAN : Project Incharge
MEMBERS : Members of each department (10)
SECRETARY : HSE & HR Officer

Project HSE Committee Members Responsibility:-

NO	TASK	TARGET	VERIFICATION DOCUMENT
1.	Attend meeting regularly as per schedule to discuss and decide the ways and means of eliminating the factors affecting HSE.	Minimum once in a month	MOM- HSE Committee Meeting
2.	To analyses all the activities of the forthcoming period & identify the possible hazards and finalizing the precaution to be taken.	Minimum once in a month	MOM- HSE Committee Meeting
3.	To monitor the HSE Performance of the project and suggesting improvements whenever needed.	Minimum once in a month	MOM- HSE Committee Meeting
4.	Actively participate in the HSE Committee Inspections & assess Key performance indicators on HSE.	As per Schedule	HSE Inspection Report, KPI on HSE report

Periodicity: - Central safety committee will meet. At least once in two months Each Sub safety committee will meet at least once in every month.

Agenda: - Shall be circulated by the secretary at last 48 hrs. Before the meeting.

Circulation: - Gist of the meeting will be circulated to

- **Chairman**
- **Invitees**
- **Members**
- **CHSEM**

Date:

Signed By:
CHAIRMAN

1.7 SAFETY REPORTING

- a.** Safety supervisor shall prepare Daily Report including minutes of Daily Safety meeting. The report will be sent to PSO and DO. Weekly Safety Report will include summary of progress against Corrective Action Register (CAR), record of incidents/ accidents/ near miss situations, security report, medical treatment record, water and fuel consumption etc.
- b.** Accident and incident: All incidents shall be reported at the earliest possible with an initial incident report being completed in 24 hours.
- c.** Unsafe acts/ Conditions- Near miss incidents: It is in the interest of improving safety that all unsafe acts/ conditions and any near misses are reported so that preventative measures may be drawn up. Field supervisors will encourage full participation with a no blame culture for this reporting.
- d.** Corrective Action Register: Corrective action register would be maintained on site and would be updated on a daily basis.

1.8 MEETINGS

Safety meeting shall be held quarterly with the PQC meeting and safety agenda will be discussed with all PQC members and safety team

Safety meeting of safety team shall be called immediately after the occurrence of an accident affecting safety.

CHAPTER 2. HEALTH AND SAFETY MANAGEMENT

2.1 THE NEED TO LOOK AT THE ENTIRE SYSTEM

Traditionally, analysis of risk has examined the user, technology and environment separately. Furthermore, there is a tendency by researchers and practitioners to look for one or a few factors, when in actual fact; they will be analyzing a multiplicity of factors. The essence of using a systems approach is to consider, not only the underlying factors, but also the role of different agencies and actors in prevention efforts.

For example, if road traffic crashes are reduced to one "cause" only, it is obvious that the components of the system - human, infrastructure and vehicle factors - are necessarily considered as independent. Measures addressing either group will be thus be implemented separately, which makes things easier as the decision-makers responsible for each area of intervention do not have to coordinate with the others. However, opportunities to influence one type of factor through another (for example, to obtain more adequate driver behavior through changes in road design) are entirely ignored.

2.2 DATA COLLECTION AND ANALYSIS PRINCIPLES

Data collected from primary or secondary sources need to be analyzed to answer such questions as:

- What are the most common causes and types of injuries in different age groups?
- What are the characteristics of persons who are most likely to be injured?
- What are the circumstances under which injuries are most likely to occur?
- What policies and programmes will be reduce the likelihood and severity of injuries in a community?

Analyzing data, producing regular outputs and disseminating information on work zone injuries are all vital activities. It is necessary to share and disseminate data and evidence on injuries with colleagues, other researchers, policy makers, victims and the community at the local and national levels. Though writing reports is central to this activity, this will not be an end in itself. The design of databases will therefore take account of the principal needs of their users, providing quality data without overburdening those collecting the data.

2.3 INDICATORS

Two very common indicators are the number of injuries/deaths per worker/person, and the number of injuries/deaths per vehicle/equipment. Both of these indicators, though, have limitations regarding their reliability and validity that place restrictions on how they will be used and interpreted. The number of deaths per person is widely used with reasonable confidence to monitor changes over time in "personal risk" levels and to make comparisons between locations. Deaths/injuries per type of equipment/machine will help to establish priorities in dealing with improvement in specific equipment' design and operating guidelines.

2.4 INVESTIGATION AND DATA COLLECTION PROCEDURES

1. Establish a data collection and analysis team with a leader who reports directly to the chief operating officer at the site head office.

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2. Establish norms and procedures for the reporting and recording of all injury events associated with those working for the project.
3. Establish procedures for reporting and collecting road traffic crash data as observed by employees of the EPC.
4. Establish procedures for collecting road traffic crash data from all police stations on a weekly basis.
5. Establish a procedure for collecting injury details for those who get admitted to hospitals or receive outpatient treatment.
6. Data collection officers will be trained in the use of the forms designated for road traffic and work injuries.
7. The data so collected will be entered on a computer at a central location soon after the forms are filled so that the current situation will be monitored by the management on a regular basis.

2.5 FORMS FOR RECORDING EVENTS

Two different forms will be used for recording injury and fatality producing events: one for road traffic crashes and one for all other injuries. These two forms are attached (Annexure 2.1 and 2.2). The minimum data to be collected is indicated in these forms. Each EPC will be modifying the form to include any other items that may be considered important based on local requirements. However, the basic format will be retained so that these data will be consolidated centrally to enable regional and national assessments.

Data analysis for worker injuries

The data collected may be organized in the following statistics and tables:

Treatment	Number	Number per 100 workers
First Aid		
OPD		
Hospital admission		
Fatality		
Total		

Total injuries per year:

2.6 EMERGENCY RESPONSE PLAN

The Emergency Response Plan, include detailed communications arrangements, for dealing with all emergencies that could affect the Site. This include where applicable, injury, sickness, evacuation, fire, chemical spillage, severe weather and rescue.

The Emergency Response Plan is prepared to deal with emergencies arising out of:

- i) Fire and explosion
- ii) Collapse of lifting appliances and transport equipment
- iii) Collapse of building, sheds or structure etc.
- iv) Gas leakage or spillage of dangerous goods or chemicals
- v) Bomb threatening, criminal or terrorist attack
- vi) Drowning of workers
- vii) Landslides getting workers buried floods, Earthquake, storms and other natural calamities.

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Arrangements shall be made for emergency medical treatment and evacuation of the victim in the event of an accident or dangerous incident occurring, the chain of command and the responsible persons of the EPC with their telephone numbers and addresses for quick communication shall be adequately publicized and conspicuously displayed in the workplace.

EPCs shall require to tie-up with the hospitals and fire stations located in the neighborhood for attending to the casualties promptly and emergency vehicle kept on standby duty during the working hours for the purpose.

EPC shall conduct an onsite emergency mock drill once in every month for all his workers and his sub-Contractors workers.

It shall be the responsibility of the EPC to keep the Local Law & Order Authorities informed and seek urgent help, as the case may be, so as to mitigate the consequences of an emergency. Prompt communication to NHAI, telephonically initially and followed by a written report, shall be made by the EPC.

2.7 HEALTH OF WORKERS

2.7.1 PRE-EMPLOYMENT HEALTH CHECK UP

General:

A pre-employment health check-up is the medical examination conducted when a potential employee applies for a job. It will be designed to assess general fitness as well as the susceptibility of the worker to any particular hazard he/she may encounter on the job.

I The EPC shall ensure that the following examinations are carried out:

- A. Complete physical check-up of the worker
- B. The doctor will record the medical history of the employee, including previous sickness or present conditions, medications, and therapies
- C. The usual tests like blood tests, x-rays, urine, and stool exams

2.7.2 RECORDS

The following records shall be maintained by the EPC:

- i. Records containing details of employees, work done, hours worked, rest, wages, receipts in the prescribed form will be maintained.
- ii. Medical examination of every worker in hazardous jobs before assignment and records to be maintained annually.
- iii. Register of workers containing workers name, work, group, relay etc.
- iv. Certificate of fitness of the workers that is to be granted by certifying surgeon after examination to be renewed every 12 months.
- v. Notice of accidents for death and injury and enquiry status for every month.
- vi. Documents containing certain dangerous occurrences of bodily injury or disability or not and notices that are sent by the EPC and Manager to the authorities as per prescribed form and time.
- vii. Notice of diseases which is to be sent by Medical Practitioner to the Chief Inspector giving name, address, disease of patient, and name and address of factory.
- viii. Safety and occupational health surveys to be undertaken by Chief Inspector, DGFAS, DGHS, or their authorised officers at their discretion.

2.7.3 PROVISION OF FACILITIES

The facilities that are to be provided by the EPC are:

I. Ventilation and temperature

- A. Adequate ventilation by the circulation of fresh air.
- B. Comfortable temperature to prevent injury to health at the construction site.

II. Overcrowding

- A. No room shall be overcrowded that will be cause injury to the health of workers.
- B. At least 35 Sqft. area has to be provided for each worker.

III. Drinking water

- A. Effective arrangement and maintenance at suitable points for sufficient marked supply of wholesome drinking water.
- B. All such points shall be legibly marked as “Drinking Water” and such point shall be situated at more than 6m from any source of contamination.
- C. Cool drinking water during summer for sites employing more than 300 workers.

IV. Latrine and Urinals

- A. Conveniently located and sufficient latrines and urinals which are accessible to workers at all times.
- B. Separate enclosed accommodation for male and female workers.
- C. Such accommodation will be adequately lighted and ventilated and will not be directly connected to the work room.
- D. Clean and sanitary conditions at all times.
- E. Sweepers are to be employed to keep the facilities clean.

2.7.4 PROVISION OF MEDICAL STAFF:

The EPC shall give special attention to the provision of medical staff as follows:

- I. There will be tie up is the local hospital / Nursing home from nearby locations

2.8 TRAINING

The EPC shall organize regular safety training courses to acquaint Managers, Supervisors, workers and other personnel in the principles of work safety, implementation of mandatory safety provisions, and how to audit and improve safety performance.

2.8.1 SAFETY TRAINING

Project HSE manager in co-ordination with Head-HSE- will conduct safety-training programs on different topics. Site engineers, supervisors attend the program to enhance their technical knowledge with respect to safety and learn how to integrate into the work-practices. “Safety in Construction” – This is the programme conducted by HQ- HSE dept. Site staff members has to be nominated for this programme. This the comprehensive programme of two days duration will organized as per the Training calendar of MARP.

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It is compulsory for all staff member to attend this programme at least once as early as possible from the date when they joined in company service.

List of training programmes conducted at project site:

❖ **For staff members**

In addition to the above two day training programmes for two days programmes of short duration (about one to one and half hour) will be arranged at construction sites on these following topics.

1. Principles of accident prevention and safety management
2. Safety during excavation activity
3. Safety during blasting and other quarrying activities
4. Scaffolding safety
5. Safety while working at height
6. Awareness programme on work permits
7. Traffic management during road construction activities
8. Safety during welding and gas cutting operations
9. Electrical safety
10. Safety with P&M operation
11. Safe Material handling practices
12. First aid
13. Fire prevention and control
14. Environmental protection measures at construction sites
15. Occupational injuries and deceases- preventive measures

❖ **For supervisors and change-hands & S/c supervisors**

1. Safety plan briefing programme
2. Safe material handling practices
3. Traffic management at road works
4. Excavation safety
5. Safety while working with road construction machinery
6. Safe practices while working in plant area
7. Safe blasting operation
8. Safety while working at height
9. Defensive driving and road safety
10. Basic electrical safety
11. Fire drill and fire prevention
12. Environmental prevention measures at construction site
13. First aid
14. Safety during welding and gas cutting operations

❖ **For workmen**

1. Awareness programme on safety rules and regulations at construction site
2. Demonstration of safe handling of form work components
3. Good housekeeping practices

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4. Safety during welding
5. Safety during gas cutting
6. Safe material handling practices
7. Safety during working on live roads
8. Safety with hand tools & Inspection of hand tools
9. Basic electrical safety
10. Safety during travelling inside and outside the site
11. Safety while working with concreting machinery
12. Safety during manual concreting
13. Safety while working at plant area
14. Safety while using portable power tools
15. Defensive driving
16. Safety while working at reinforcement yards
17. Safety while working near excavation machinery
18. Safety while working with road construction machinery
19. Fire fighting
20. To Maintain safe environment at work place and labour colony
21. Best practices to maintain good health

HSE Engineer shall prepare quarterly training calendar scheduled topic, proposed date and month and he will coordinate to conduct the training accordingly. The concerned in charges and the engineers shall also join with the safety engineers in training the workmen.

Minimum of one training to be programme for staff and one training programme for supervisors and four training programmes for workmen will be conducted in a month and the detailed of training programmes conducted will be maintained by HSEO.

List of the trainers to be prepared in consultation with the site staff and it is to be displayed in safety Induction room and to be updated as required.

❖ **Pep Talks**

In order to enhance the safety awareness amongst workmen, site engineer conducts pep talks regularly. He organizes the meeting with the help of site Engineers. He explains the safety precautions to be followed craft wise. A pep talk matrix shall be prepared in the beginning of every month. The plan shall have a broad spectrum of attack. Workmen of same trade shall be trained individually.

2.8.2 TRAINING FACILITY

- I. The EPC shall determine the training requirements for all the employees and initiate a training program to demonstrate that all persons employed, including sub-Contractors, are suitably qualified, competent, and fit to implement safety provisions. This will include:
 - A. Detailed job descriptions for all personnel to include their specific safety responsibilities.
 - B. Specification of qualifications, competency and training requirements for all personnel.
 - C. Assessment and recording of training needs for all personnel, including sub-Contractors' employees in the workforce, vendor representatives, and site visitors.

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- D. A system for assessing the competence and training requirements of newly hired persons.
 - E. A safety protocol for evaluating and confirming that the system is effective.
 - F. A matrix and schedule of training requirements covering general, task– specific, and SHE-related training, showing the training frequency and the interval between refresher courses.
 - G. Timely, competent delivery of training courses by certified instructors.
- II. The EPC shall arrange training programmes for all executives in how to identify, recognize, and eliminate unsafe acts and unsafe conditions.
- II. The refresher-training programme of all employees shall be conducted once in six months.

2.9 TOOL BOX MEETING

The EPC shall ensure that:

- A. Toolbox meetings and trainings are conducted on site on a daily basis by safety managers and supervisors.
- B. On-the spot practical skill development training on safety including scaffold safety, crane safety, welding safety, electrical safety, and traffic safety for marshals shall also be conducted for all foremen/ workmen associated with the concerned jobs.
- C. Daily Safety Oath is to be administered to every employee including all workmen to remind them about their responsibilities to themselves and fellow workers.
- D. All vehicle drivers including Hydra operators shall be trained on defensive driving at training centres. All vehicle drivers shall also undergo refresher training on defensive driving provided by the same institute once in 6 months.

2.10 AUDITING

I. Objectives of the safety audit

- A. To find out the contractual compliance level in quantitative terms exclusively for safety aspects. The safety here covers traffic safety, construction safety, workers and work zone safety, occupational safety, temporary structures safety, mechanical, electrical, plant and equipment and fire safety. It does not however include safety considerations during the design stage.
- B. To identify good practices and adopt them in future.
- C. To identify poor practices and eliminate them from the worksite.

II. Audit Procedure

- A. It is EPCs responsibility to ensure that the audit team briefs the work package team regarding the purpose of the audit, methodology of audit, and the terms of reference of the audit team
- B. After the briefing by the audit team, the leader of the work team makes a presentation before the audit team. The presentation will cover the topics mentioned below:

a. General:

- a. Project description (consisting of project start date, likely completion date, percentage progress)
- b. Major activities in progress and their location in terms of their chainage
- c. Major plant and equipment deployed by the EPC of the work package

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b. Safety Management

- a. Establish safety system and procedures
- b. Prepare safety policy
- c. Appoint safety officer
- d. Set up safety committee
- e. Plan for worker’s/ visitor’s induction
- f. Provision for Personal Protective Equipment (PPE)
- g. Job safety analysis
- h. Training programs conducted in safety
- i. Accident reporting
- j. Accident investigation process
- k. Safety data sheets

c. Other Aspects

- A. Fire safety provisions
- B. Electrical safety provisions
- C. Mechanical safety provisions
- D. Dust control
- E. Storage, transportation, handling process
- F. Road side resident safety norms
- G. First aid and emergency response arrangement
- H. Construction accident records at site
- I. Details of environmental officers, qualification and experience
- J. Details of safety officers, qualification and experience
- K. Labour camp arrangement

Identification of work-zones

- A. The audit team members are equipped with a *check list covering different aspects related to safety*. Against each of the checklist items, the compliance/non-compliance is recorded. While some of the activities would be audited at all locations, for some of the subgroups only sample auditing would be done. The sample audit takes place only for plant and machinery items and appliances. The sample size will be about 20% of the existing stock, subject to a minimum of two for each of the plant and machinery items and appliances
- B. Besides recording the compliance/non-compliance, the audit team will also record the good and bad practices prevailing at site with reference to safety aspects
- C. The audit team computes the contractual compliance of safety provisions after the completion of audit of different activities
- D. The audit team conducts a closure meeting at the work package office and shares the findings of audit with the work package team in the presence of the EPC

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Hazard Identification, Risk Assessment and Control Measures

I. General: The purpose of hazard identification and risk assessment is to identify all the significant hazards prior to the commencement of any potential high-risk operations, which may occur during the operations, and to rank them according to their severity. Having ranked the risks the EPC shall then take measures to mitigate the effects of that risk by recording his findings on appropriate worksheets that show what measures the EPC is going to take to remove or reduce the level of risk to acceptable levels.

II. Safety principles: 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 Safety team, 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 will be function in an unsafe environment.

III. General precautions to be maintained by the Safety team:

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

CHAPTER 3. TRAFFIC SAFETY MANAGEMENT

3.1 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.

3.2 GUIDING PRINCIPLES

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

- i. Warn the road user clearly and sufficiently in advance;
- ii. Provide safe and clearly marking lanes for guiding road users;
- iii. Provide safe and clearly marked buffer and work zones;
- iv. 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.

Safety standards will be adopted as per relevant guidelines such as IRC: SP: 55-2001, 'Guidelines for Work Zone Road Safety on all NHAI Projects'- Ref. NHAI policy circular no. NHAI/2008/Road Safety/LMNHP/504 dated 26.10.2011.

3.3 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.

3.4 COMPONENTS OF 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 EPC 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 will ensure that traffic safety is an integral and high priority element of the project. This will be ensured by avoiding inconvenience to traffic control elements and traffic operations will be carried out so that care and attention to roadside safety is never slack during the progress of project.

3.5 TRAFFIC CONTROL ZONE

1. 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 will 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.
2. In rural areas, the problems at many construction zones is accentuated by the availability of only an undivided carriageway, which may involve problems of either the temporary acquisition of land for diversions, or the sharing of the limited remaining road space by road users under some form of traffic control. In any case it will be ensured that road user is properly segregated from the working zones.
3. In urban areas where construction zones are likely to be even more constrained, diversions may have to be taken over adjacent sections of the road network in addition to the sharing of road space to road users (for example, shuttle working under signal control). The effects of construction zones may therefore be felt over a wide area.
4. The Traffic Control Zone will 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.

3.6 ADVANCE WARNING ZONE

- a. 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 will provide information on:
 - i. The presence of the hazard through the "Road Work Ahead" sign, accompanied by the distance to the hazard;
 - ii. 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;
 - iii. Extent of the hazard (for example; the length of restriction); and for general information;

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- iv. The type of hazard.
- b. The advance warning zone is also where the reduction in speed of vehicles will be notified. The drivers will 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.

3.7 APPROACH TRANSITION ZONE

- a. 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.
- b. The initial part of the transition zone called Approach Transition Zone will further reduce the approach speed of vehicles and channel them into the narrower and/or restricted number of lanes, if this is necessary.
- c. 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 will take into account the following factors:
 - i. the turning radius of the longest vehicle that generally uses the road will be the ruling radius for curves;
 - ii. where changes in vertical profiles are required these will be enough to allow safe passage of animal drawn vehicles (if these are present in significant numbers);
 - iii. the zone will have good drainage to avoid any ponding on the road surface;
 - iv. sources of dust will be minimized .This is not only essential for good visibility but also for clearance maintenance of signs and barricades in the zone.
- d. The traffic is taken across the transition zone mostly with the help of signs, barricades, channelizes and pavement marking.
- e. All the signs/barricades are to be maintained properly and kept clean of dust at all times. Sufficient stock of these will be maintained at the site so as to replace the damaged or vandalized signs/barricades. Proper lighting arrangements for illuminating these signs will 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 will therefore be used for the signs/barricades so that these are visible at all times.
- f. 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.

3.8 WORKING ZONE

- a) 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.

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- b) Speeds will continue to be controlled in this zone because of the close proximity of moving construction plant and site operatives.
- c) The path of the traffic will be very clearly delineated through the traffic control zone to avoid vehicle intruding into the work area. Delineators and channelizes discussed below will be used effectively for this purpose. Where the work site uses machinery with revolving booms like cranes or excavators the intrusion of moving parts will be taken into account when determining the lateral clearances for the buffer or safety zone.

3.9 TERMINAL TRANSITION ZONE

- a) 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.
- b) A downstream or closing taper may be placed in the TTZ. It may be useful in smoothing 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.
- c) There may be occasions when TTZ could include a transition. If a taper is used to shift traffic into opposing lanes around the work area, then the TTZ will have a taper to shift back to its normal path. This taper would then be in the TTZ for the opposing direction of traffic.
- d) If the construction zone is situated on a divided-carriageway, there will need to be a smaller length transition zone to return the traffic to the original lanes.

3.10 OTHER ASPECTS

Following sections are from guidelines for Safety Construction, Indian Road Congress, The distance between two traffic control zones will be such that the flow of traffic will be return to normal stream between them.

The length of traffic control zone will vary and depend on the work being undertaken. The lengths of the advanced warning and transition zones are governed by the speed of approaching vehicles and the locations of the site.

It may be necessary to extend the advance warning zone where approach visibility is poor and this will vary on a site by site basis but will not be less than that specified. On occasions additional signing to that discussed later may need to be provided to give not only sufficient warning but additional reminders through the advance warning zone. The longitudinal and lateral buffer zone clearances are shown in Table 3.

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Table 2 Recommended Lengths of Traffic Control Zones

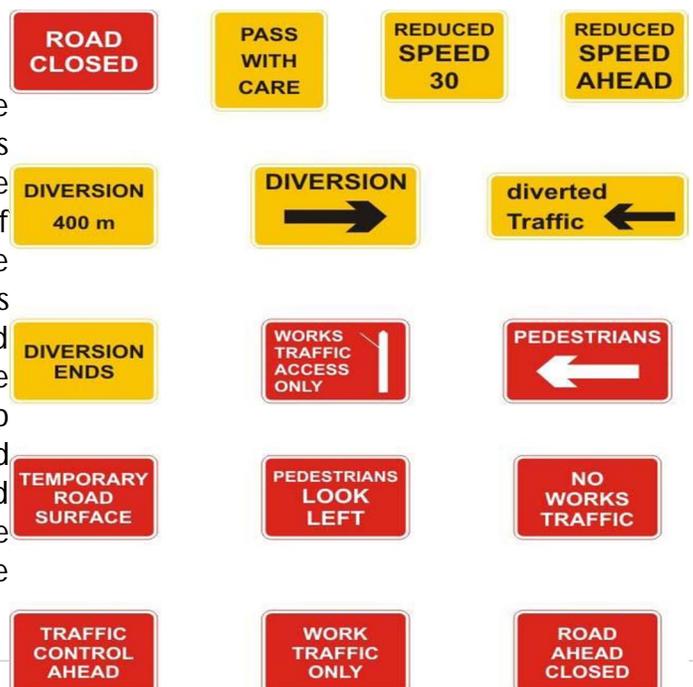
Average Approach Speed (km/h)	Length of Advance Warning Zone (m)	Length of Approach Transition Zone (m)	Length of Working Zone (m)
50 or less	100	50)
51-80	100-300	50-100) Varies
81-100	300-500	100-200)

Highway passing through villages and small towns

- i. 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 will be taken into account.
- ii. In urban situations where road works are to be carried out, more attention will be given to the problems of pedestrians and non-motorized vehicles in heavy traffic volumes. As far as possible, then only day time repairs will be carried out. Repairs during peak hours will also be avoided.
- iii. Road users channelized and routed and around area under repair with minimum of delays .Driver behaviour will be effectively influenced so that the speeds are reduced to desired levels on approaches to construction zones. The traffic control and construction activity will 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.
- iv. As pedestrians are likely to be present at urban sites, there will always be safety or buffer zone between the outer pedestrian barrier and the traffic.
- v. Availability of proper sight distance for the movement of vehicles at the recommended speed for the stretch in the work zone will be always kept in the mind.

3.11 SIGNS

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 will 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 will be of retro-reflective Sheeting’s of high intensity grade or Prismatic grade



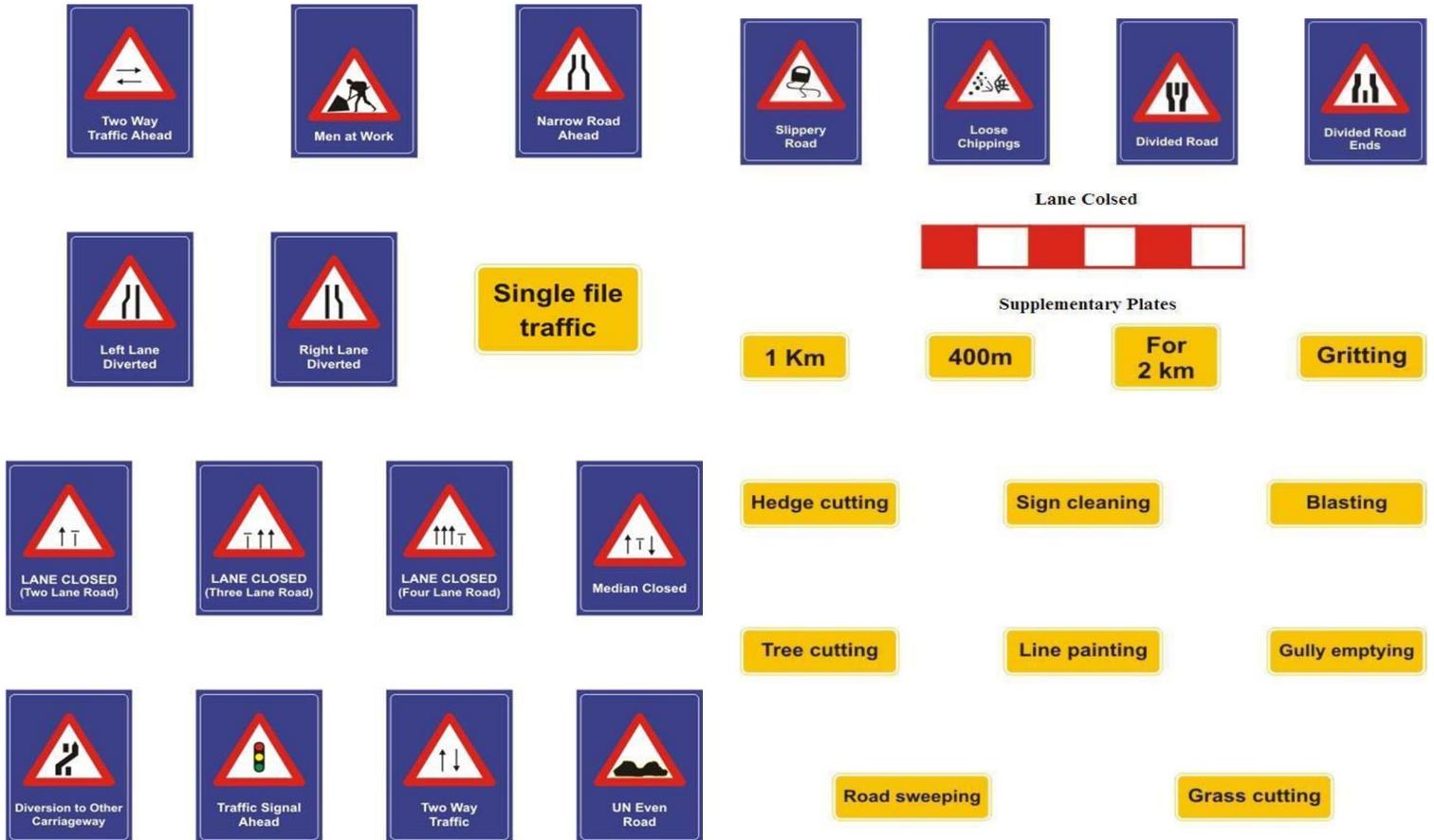
Sharp deviation of Route



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depending upon the importance of the road as directed by the Engineer.

All road signs shall be made of High Intensity Grade Retro-Reflective sheeting. However, as stipulated in IRC:67-2010, Aluminum Composite Material (ACM) can be used as sign plates which is cheaper as compared to Aluminum and it is theft-proof as it has no resale value. All signs must conform to IRC-67 & IRC-SP-55.



3.11.1 SIGN PLACEMENT

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

The following principles will govern the positioning of signs:

- a) Their location will have clear visibility;
- b) They will be so placed that driver would have adequate time for responses.
- c) As a general rule, signs will be placed on the left-hand side of the road. Where special emphasis is required, duplicate signs will 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 ;
- d) Roll up signs mounted on portable supports may be placed within the roadway itself.
- e) Roll up signs may also be mounted on or above the barricades
- f) The signs will 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 will 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) fig.3.6. but during wet conditions will 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 will 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 will follow normal rules for the mounting of permanent signs.

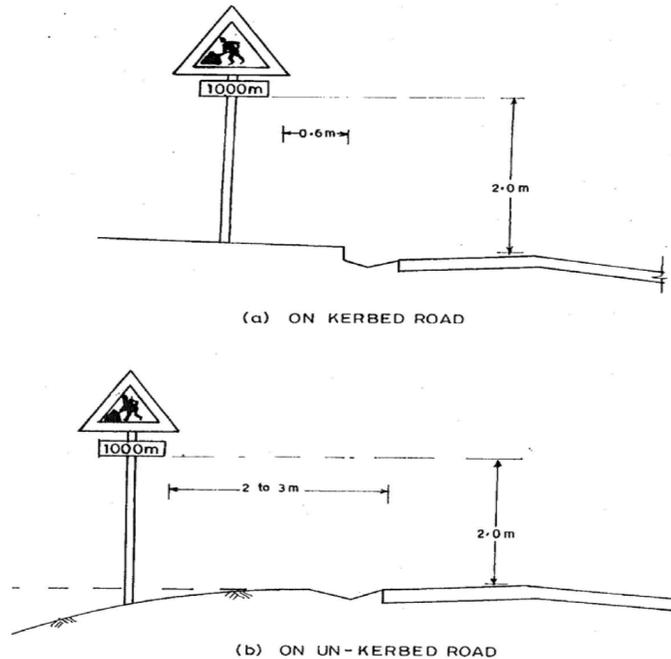
3.11.1.1 REGULATORY SIGNS

- i. Regulatory Signs impose legal restriction on all traffic. It is essential, therefore, that they are used only after consulting the local police and traffic authorities. The most likely type of regulatory signs to be used in traffic control zones are STOP, Give way, Do Not Enter, One Way, Straight Prohibited, Vehicle Prohibited in Both directions, Left turn Prohibited, Right turn Prohibited, "U" Turn prohibited, Overtaking Prohibited, No Parking, No stopping and No standing, keep left ,Compulsory Left Turn, Compulsory Right Turn, Compulsory Straight, Compulsory Straight or Right Turn, Compulsory straight or Left Turn, Priority to Vehicles in Other Direction, Priority to Vehicles in this Direction, weight limit, Axle Limit, Height Limit, Length Limit, Restriction Ends, Speed Limit
- ii. Various other signs that are needed to regulate traffic may be required which have not been standardized.

3.11.1.2 WARNING SIGNS

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i. Warning Signs in the traffic control zone are utilized to warn the drivers of specific hazards that may be encountered. Drivers will be alerted to potential hazards in sufficient time to adjust their movement and speed. The most common type of warning signs for the use in the traffic control zone are: Men at work, Road Narrows, Right lane Diverted, Right Lane Closed, Left lane closed, Right Lane Closed, Median Closed, Diversion to Other Carriageway, Traffic Signal Ahead, Two traffic, Rough Road, Loose chipping, Divided Road and divided Road Ends [Fig 3.1 (d) and (e)].



- ii. Wherever it would be advisable to make the meaning of a sign suitable and more explicit, an inscription is placed below the sign in a rectangular definition plate of width appropriate to the size of warning triangle
- iii. Definition/supplementary plate shall have white background and black letters and black border 20 mm wide. This definition plate shall be placed (below) 150 mm from the bottom of the triangle.
- iv. In case of divided carriageways, the signs will be provided both adjacent to the willer and on central median so as to be visible from all lanes. Larger sign sizes than IRC: 67 are recommended for higher speed roads.
- v. **Direction Signs:** Direction or Guide signs are required at traffic control zones to provide the necessary information and guidance for the alternative route and work being done. These signs shall have black letters, arrows on yellow background. The commonly used guide signs are Diversion, Detour and Diverted Traffic.

Table 3 Minimum Sightline Distances and The Minimum Size of The Signs

Average Speed (km/h)	Distance of first sign in advance of the first channelizing device(m)	Size of Warning Sign (mm)	Minimum number of signs in advance of the hazard	Distance E to “End of Road Works” Sign (m)
Under 50	100	600	3	10-30
51-60	100-300	750	3	10-30
61-80	120-300	900	3 or 4	10-30
81-100	300-500	1200	4	30-45

3.11.2 DELINEATORS

The delineators are the elements of a total system of traffic control and have two distinct purposes:

- (i) To delineate and guide the driver to and along a safe path.
- (ii) As a taper: to move traffic from one lane to another.

The channelizing devices such as cones, traffic cylinders, tapes, drums are placed in or adjacent to the roadway to control the flow of traffic. These will normally be retro-refractories.

All delineators must conform to IRC 79-1981 and NHA1 guidelines on Work Zone safety. Non-standard delineators will not be allowed.

3.11.3 TRAFFIC CONES AND CYLINDERS

- a) Traffic cones will be 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-refractories red and white band. Their advantages are that they:
 - i. Cause minor impediments to traffic flow and capacity,
 - ii. Are well recognized and understood, without damaging vehicle when hit,
 - iii. Will be easily stored and transported,
 - iv. Will be fastened to the pavement and self-restoring when hit.
- b) Their disadvantages are that they have minimal respect of drivers , will be equally penetrated displaced and knocked over and require special treatment for night times.
- c) 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 will not present a hazard. The cones will be placed close enough together to give an impression of continuity. The spacing of cones will be 3 m (close) or 9m (normal) or 18m (wide) with reflective red & white tape tied in between cones. Where cones have to be used at between 45° and 90° to the line of traffic, their spacing will be 1.2. Larger size cones will be used where speeds are relatively high or wherever more conspicuous guidance is needed.
- d) Concrete cones painted with retro reflective paints will be used as delineators as shown in figure.

3.11.4 DRUMS

- 1. Drums about 800 mm to 1000 mm high and 300 mm in diameter will be used as either channelizing or warning devices. These are highly visible, give the appearance of being formidable objects and therefore command the respect of drivers.
- 2. The drums are normally made of lightweight and deformable material such as LLDPE/Plastic. Plastic drums are lighter, pose fewer hazards to vehicles and workers and will be needed for easy transportation and storage and generally have one or more flat sides to preclude rolling. Drums may be filled up with earth or sand for stability. They will be painted in circumferential stripes of alternate black and white of 100 mm to 150 mm width. Drums will be reflective for use at night and will never be placed in the roadway without advance warning.

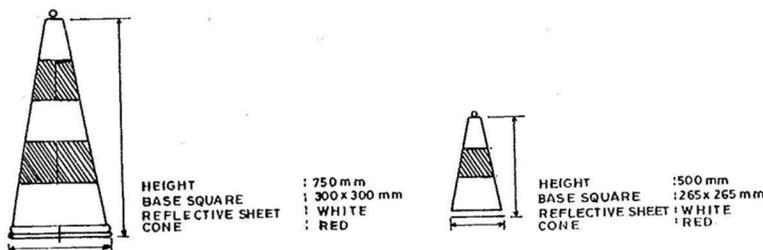
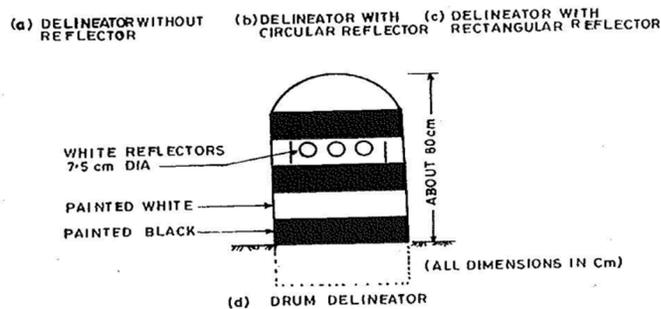


Figure 2 Cone, Delineator and Drum specification



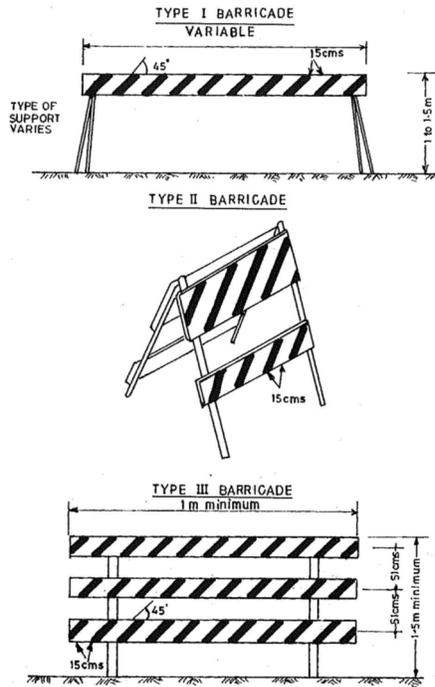
3.11.5

- 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:
- (i) Prevent traffic from entering work areas, such as excavations or material storage sites;
 - (ii) Provide protection to workers;
 - (iii) Separate two-way traffic; and
 - (iv) Protect construction such as false work for culverts and other exposed objects.
- b. Barricades will be portable or permanent .Portable barricades will 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.
- c. Types of barricades as indicated above shall conforms to IRC:SP:55 viz. Types-I, II & III. However, strong inviolable iron sheet (MS-Plain) barriers will be used at deep excavation sites. This is a major safety requirement.

Maintenance of Traffic control & safety devices:-

Proper maintenance of the Traffic control & Safety Devices viz. signs, delineators, barricades etc. must be ensured in order to keep these in good working condition.

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Barricade specifications

Table 4: Barricade Characteristics

Type / Component	I	I	III
Width of Rail	200 mm-300 mm	200 mm-300 mm	200 mm-300 mm
Length of Rail	2 m – 2.5 m	1 m – 1.2 m	1 m min – variable max.
Width of Strip	200 mm	200 mm	200 mm
Type of Frame	Heavy 'A' Frame	Light 'A' Frame	Fixed, Demountable
Flexibility	Essentially movable	Portable	Essentially Permanent

Barriers specification

3.11.6 FLAGMEN

- a) The control of traffic through work area is an essential part of road construction and maintenance operations. Flagmen with hand signalling 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.
- b) Instead of red and green flags hand paddles of at least 600 mm diameter will be used painted with red and green retro reflective paints. Sign paddles will be at least 600mm wide and provided with a rigid handle. The background colour of STOP will be red and its shape shall be octagonal confirming to IRC: 67. The word STOP will be in white, in the middle of the sign. The background of SLOW will be yellow with black letter and border.

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- c) 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 will, 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.

3.12 TRAFFIC MANAGEMENT PRACTICES

3.12.1 INTRODUCTION

During the past two decades, the traffic on roads has increased manifold and most of the roads are expected to operate at their maximum capacity in the near future. Under the circumstances, the existing methods of maintenance and construction which compromise safety and cause delay are no longer acceptable and a change in work procedures and method has become inevitable. Under the existing method of maintenance and reconstruction, the traffic is invariably diverted over unprepared willers or forced to use part of the existing roads under maintenance. This results in the vehicle operating cost and reduction in safety besides causing environmental pollution. Therefore, the existing work procedure and contract conditions are required to be changed to provide for proper management strategies to be used at traffic control zones will include the following fundamental principles:

- i. Make traffic safety an integral and high priority element of every project,
- ii. Avoid inhibiting traffic as much as a possible,
- iii. Guide drivers in a clear and positive way,
- iv. Perform routine inspection of traffic control elements and traffic operations,
- v. Give care and attention to roadside safety.

3.12.2 SITE LAYOUT DEFINITIONS

Work zone: the excavation, chamber opening, etc. at which workmen will be working.

Working space: the space around the works area that will need to store tools, excavated material, equipment and plant. It is also the space to allow workmen to move around to do the job. Enough working space will be left to make sure that the movement and operation of the plant (e.g. swinging of jibs and excavator arms) is clear of passing traffic and is not encroaching into the safety zone.

Safety Zone: The zone that is provided to protect workmen from traffic and to protect the traffic from them. The safety zone will not be entered in the normal course of work. Materials and equipment will not be placed in the zone either. Workmen will only need to enter the zone to maintain cones and other road signs. The safety zone is made up from

Approach Transition Zone: This will vary with the speed limit and the width of the works as given in Table 5.

Longitudinal Buffer Zone: This is the length between the end of the lead-in taper of cones(T) and the working space. It will vary with the speed limit as given in Table 5.

Lateral Buffer Zone: This is the width between the working space and moving traffic. It will vary with the speed limit as given in Table 5.

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The lateral buffer zone safety clearance is measured from the outside edge of the working space to the bottom of the conical sections of the cones on the side nearest to the traffic .For roads with a speed restriction of 80 km /h or greater as additional traffic barrier is required at the end of the lead-in taper.

Table 5: Buffer Zone Safety Clearances

Speed restriction (km/h)	Minimum longitudinal buffer zone (L) (m)	Minimum lateral buffer zone (S) (m)
50 or Less	5.0	0.5
60	15	0.5
80	30	1.2
100	60	1.2

Where an advisory speed limit is in operation, use it (rather than the mandatory speed limit) to determine the minimum longitudinal and lateral buffer zone safety clearances. Whenever traffic speeds are to be reduced, the method will be agreed in advance with the EPC. Site Engineer will consider advising emergency services of the location and duration of the works.

Working space and safety zones will be provided when personnel are present, but when a site becomes unoccupied it may be possible to make it smaller. This will make it less of an obstruction to traffic. However, if pedestrians are diverted into the carriageway, a safety zone will be provided at all times between the outer pedestrian barrier and the traffic.

Where the road width is so restricted as to prohibit the provision of the appropriate lateral buffer safety clearance detailed in Table 5, and diversion of traffic would be impractical, traffic speeds will be reduced to less than 15 km/h and an agreed safe method of working imposed on the site. This method of working will preclude working in the safety zone wherever possible. It will be decided in advance of the works. It is also advised that it will be recorded in writing.

As stipulated in the “Guidelines for work zone road safety on all NHA1 projects”, site specific Traffic Management Plan will be prepared for all work sites and shall include signage, lighting arrangements for night time visibility, facilities for pedestrians, especially at underpasses & major bridge locations.

3.12.2.1 BASIC LAYOUT

- a) Though each construction zone will pose unique problems there is a basic layout that will be followed for all schemes but that will need to be amended within the guidelines set out in these guidelines. These will be influenced by :
 - i. environment; rural ;urban;
 - ii. type of carriageway such as single lane ,two lane ,four lanes, multi lanes, divided carriageway;
 - iii. traffic volume and speed with and without work in progress on road;
 - iv. type of traffic such as mixed or segregated;
 - v. available sight distance in construction zones; and
 - vi. Mobility of work zone, that is, for minor pot hole repairs, lane marking etc., the workers and equipment may move along the road.
- b) Figure 6 shows the basic layout that would permit two-way flow of traffic pass the working zone. The road width will be at least 6.5 m for two way traffic to ensure that problems for buses and Lorries are minimized. It will be noted that pedestrians are retained on the existing footway. It will be noted that where the

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working zone is long, cyclists will be experience problems and this will also be taken into account. Temporary markings and signage’s will be used as shown in figure 6.

- c) On the roads with no buses or goods vehicles and low flows of vulnerable road users, width of 5.5m could be acceptable but two-way working would not be possible. In this case the cones will be used to reduce the carriageway to not more than 3.7 m and traffic will be controlled by one of the methods given below.
- d) The minimum width for one-way traffic is 3.25 m with an absolute minimum of 3 m. As the basic layout will be used in all cases, including lightly used roads in housing areas where there are only cars and other light vehicles, in these special circumstances, the minimum width may be reduced to 2.75 m with an absolute minimum of 2.5 m.
- e) In cases where a traffic control zone may affect an adjacent railway crossing and there is a chance that traffic may block back across the railway line the railway authorities will be informed .It may be necessary to put in place additional safe guards through the use of additional staff to monitor traffic at the railway and to ensure that at no time does traffic wait on the crossing itself.
- f) Similarly, and more commonly, care needs to be taken if the shuttle working area contains a road junction, the simpler layout may not be acceptable and it will be necessary to use traffic signals to control all the arms. This is dealt with in a separate section.

3.12.2.2 ROAD MARKING

Road marking used at construction zones comprise of lane lines, warning lines, edge markings, directional arrows etc. Details of the road markings shall conform to IRC:35-1997.

3.12.2.3 ROAD MAINTENANCE

Road maintenance is briefly illustrated in Project Operation and maintenance Manual. However, most important points which we have to follow are as follows:

- i. Steps for maintenance of roads & drains
- ii. Road/carriageway surface must be rendered skid-resistant and free from major potholes.
- iii. Willers will be maintained properly and willer edge-drops will be repaired/removed without delay.
- iv. Arrangement for removal of dusts, wherever necessary, will be made by sprinkling of water.
- v. Stacking of construction materials, equipment, and machinery will be sufficiently away from the traffic lanes & willers.
- vi. No construction material, equipment, and machinery will be kept close to the willer along curves.
- vii. Machinery will be parked at appropriate places with red flags and red lights on.

3.12.2.4 CONSTRUCTION VEHICLES AND EQUIPMENT

Construction vehicles and equipment share the existing operational carriageway for their movement into and out of the work zones. Such vehicles are generally slow moving, over dimensioned and open loaded and can cause some amount of friction and traffic hazards. All construction vehicles and equipment will have a colour code, reflective markings and Flashing light.

3.12.2.5 TRANSPORTATION & STORAGE OF MATERIALS

Following measures will be taken during transportation and storage of materials –

- i. Cover on materials during transportation
- ii. Proper stacking of fine materials e.g. Stone Dust, Sand, Cement.
- iii. Proper storage of Hazardous/ Toxic/ Inflammable/ Chemical/ Explosive materials.
- iv. Safety measures during loading/ unloading operations.

3.12.2.6 VARIATIONS ON THE BASIC LAYOUT

- a) **Give and take system:** the Give and Take system of shuttle working. This is intended for low flows and very low volumes of Lorries and no buses. The following conditions
 - total two -way traffic flow of less than 400 veh/ hour ;
 - less than 20 lorries /hour;
 - speed limit is 50 km / h or less and
 - length of the working zone plus both transition zones is not more than 50 m ; and
 - drivers approaching from either direction will be see both ends of the site.
- b) **Priority signs:** As flows and the difficulties of the site increase, enhanced systems are more appreciable. the next stage; under traffic control by priority signs the following condition apply:
 - total two-way traffic flow of less than 850 veh/hour
 - length of the working zone plus both transition zones is not more than 80 m ;
 - drivers approaching from either direction will be see through the site from a point 60 m from their entry transition zone to a point 60 m beyond their exit transition zone (coned area), for roads with a 50 km/h speed limit, on higher speed roads the appropriate clear visibility distances are
 - 70m on 60 km/h roads;
 - Not applicable above this speed limit.

In Indian conditions, its use is not recommended on higher speed roads.

Priority will be given to either:

- The unobstructed vehicle lane; or
- Vehicles going up a steep gradient

3.13 WORKS ON FOOTWAYS ALTERNATIVE WAY FOR PEDESTRIANS

1. An alternative safe route for pedestrians will be provided if it is necessary to close a footway or part of a footway. Additional equipment may be required to do this. Pedestrian access to property will always be ensured. Temporary pedestrian ways will never be less than 1 m wide and, wherever possible, they will be 1.5 m or more in width.
2. It will be ensured that pedestrians are not diverted onto an unguarded carriageway. If the temporary footway is in the carriageway, the approach will be properly guarded and provided with signs. The lateral buffer safety clearance (S) of the safety zone will be on the traffic side of the pedestrian barriers. These clearances are shown in Table 4. and an illustration of how to put them into practices is shown in Fig.4.6. The signage and barricades will be in place before the footway is blocked.

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3. Exceptionally, the use of the other footway may be acceptable in some quiet roads, but if this option is selected the alternative route will be safe to use, and the needs of the children and of people with disabilities will be taken into account.

3.14 PEDESTRIAN SAFETY

1. It will be ensured that there is no danger to pedestrians from falling objects or sharp edges and they will not fall over or bump into anything. Scaffolding be marked with white bands at eye level and allow at least 2.1 m head room.
2. Kerb ramps or raised footways will be provided to help blind, poorly sighted, elderly and disabled people and for those with prams or wheelchairs.

3.15 WORKS AT JUNCTIONS

The two-way traffic will be kept flowing past the works if possible. If this is not possible, a diversion route may be required and will be identified by the EPC.

Men at Works signs with arrow plated will be required on the main route if the workspace located on a side road.

a. The Central line of the road shifted (eccentric widening) : While constructing the additional carriageway, the center line of new road/highway gets shifted to a new location. It would have two stages of construction:-

- a) The new carriageway shall be constructed in the first stage, adjacent to the existing one and the willer in between would become part of the central median of the improved divided carriageway facility. The traffic would continue to ply in both directions on the existing carriageway and an approached diversion would be taken out of the works zone for the movement of construction and supervision vehicles.
- b) In the second stage of improvement, the strengthening of the existing carriageway shall be taken up and the traffic would be allowed on the newly constructed carriageway. This would involve crossing of the traffic from existing to the new carriageway. This would involve crossing of the traffic from existing to the new carriageway and then again from the new carriageway to old carriageway.

b. No shift in central line of the road (co-centric widening): This activity would be mostly required to be taken up in the stretches of the road/highway passing through built up portions where there may be constraints of land availability. At such locations service roads would also be necessarily constructed for the segregation of the local traffic.

Typically it would have three stages

1. Stage I shall be construction of service roads or diversion road and the traffic moving on the existing carriageway in both directions.
2. Stage II of the construction activity shall be strengthening of the existing carriageway and the construction of the median. The traffic shall move in one direction only on the service /diversion road constructed on both sides in stage I
3. In stage III, the work zone shall be shifted to take up the co-centric widening to the adjacent stretch of the road/highway.

3.16 DIVIDED CARRIAGEWAY ROADS

Divided Carriageway Roads will be found in urban areas where the main purpose is to cope with the expected traffic volumes besides providing fast communications between urban centers. The section deals with divided carriageways in general while expressways and high speed divided carriageway roads are dealt with in a separate section.

- a) Great care will be taken on main divided roads, as both traffic volumes and speeds are likely to be high. If the work on these roads involves closing the right hand lane, liaison with the police and EPC will be necessary.
- b) Right Lane closure: Care has to be taken in this situation. The traffic will be led into the left lane in good time to allow drivers time to merge into a single lane.
- c) Left Lane closure: If the left-hand lane is closed merging traffic to the left by using a guide island is advisable before transferring into the right – hand lane. If two or more lanes have to be transferred to the right, the carriageway markings will be changed to make sure that the traffic lanes are continuous. The length of the guide islands will be
 - d) 50 m long for roads with an 80 km/h or less speed limit, and 100 m long for roads with a 100 km/h or more speed limit (section on expressways and high speed divided carriageway roads will also be referred.)
- e) It may be necessary to merge traffic to the right at a left lane closure – for example from lane 1 into lane 2. It will be done when:
 - f) lane 1 of a six lane divided carriageway is being closed ; or
 - g) There will be no more than about 60 vehicles per 3 minutes on each traffic lane which is left open.
- h) Signage Requirements: The signage requirements will vary with the speed limit as follows.

Speed Limit	Signage Requirements
50 Km/h	As shown in Figs below except that distance plates may be omitted
60 Km/h	As shown in Figs below
80 Km/h or more	As shown in Figs below, but with an extra Lane closed to traffic sign added on each side of the carriageway to give the sequence of signs on the right of this page.

Other planning aspects - execution of maintenance operations: Minor maintenance operations will be confined to small lengths, at a time say 30 m, or so, on half the pavement width, leaving the other half for use by traffic. The basic layout and its variations will be used in all cases to ensure optimum safety during these operations including:

- i. Repairing the edges of the carriageway, willers, cleaning out drains, cutting grass etc, where carriageway is basically not affected. Before starting the work, all warning signs and traffic control devices will be placed as discussed above. These will, however, be suitably modified duly keeping in view the size of construction activities and whether it is rural or urban area. A flagman is probably sufficient and will be present during the work duration;
- ii. Repairing small areas of the carriageway, the traffic is to be restricted only due to repairs being carried out as major pothole and / or patch repairs , The work will preferably be so organized that only half

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width of carriageway is closed at a time and traffic is allowed on other half and traffic control devices as discussed above

- iii. While working on the centre of the carriageway such as centre line, lane marking necessitates the traffic to use restricted width on either side. This situation is generally not acceptable and where possible, the work will be undertaken through the closure of half of the carriageway .If this is not possible, the layout will be used, with extreme caution.

3.17 EXPRESSWAY AND HIGH SPEED DIVIDED CARRIAGEWAY ROADS

An Expressway is a road intended for motorized traffic only where pedestrians, pedal cycles, 2/3 wheelers, small engine motor cycles (mopeds) and rickshaws are not allowed. If these categories are allowed, the road is described as a high speed divided carriageway. These carriageway facilities can have two, three or four lanes in each direction.

Because of the high speed of the vehicles using these roads, extreme care has to be taken when road works are carried out. Stopping distances increase considerably with each 10 km/h increase in speed. Drivers therefore have to have very early warning of restrictions on the road. If an accidents happens on this type of highway are discussed in succeeding pares.

Many traffic management techniques are available for longer duration operation:

- i. Partial closure for work on the carriageway;
- ii. Partial closure for work on willers;
- iii. Detour on secondary network;
- iv. Detour on a temporary diversions; and
- v. Speed control

3.18 CARRIAGEWAY ROADS

3.18.1 TWO LANE DIVIDED CARRIAGEWAYS-RIGHT LANE CLOSURE

The basic layout for a two lane divided high speed road is similar to those Great care has to be taken in this situation. The traffic will be led into the left lane in good time to allow drivers time to merge into a single lane.

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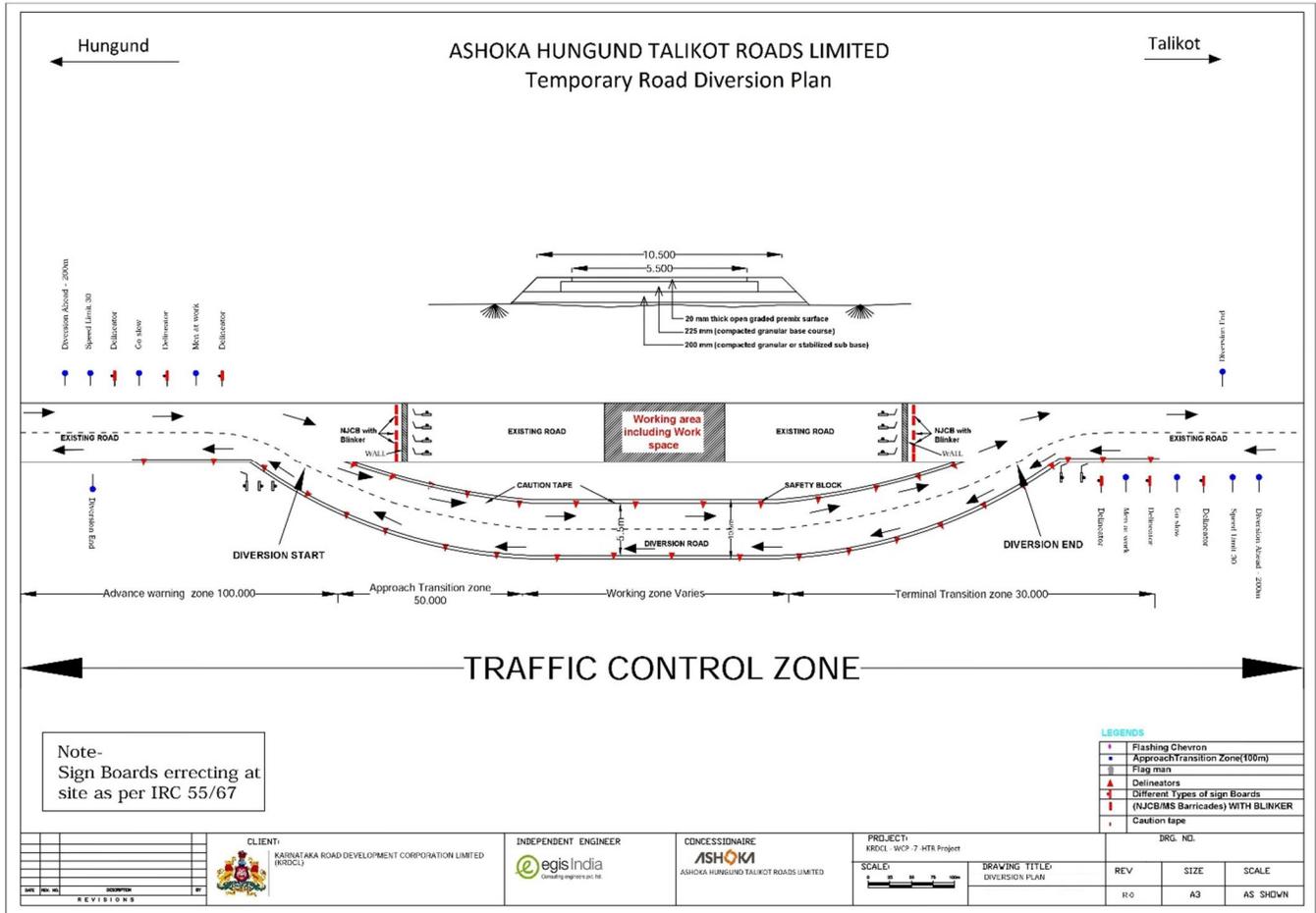


FIG 7: RIGHT SIDE DIVERSION

3.19 TEMPORARY DIVERSIONS

Where the construction zone would close the road completely, the remaining carriageway space would be insufficient for the traffic and create large delays, and there is no suitable alternative route, it will be necessary to construct a temporary carriageway for all or part of the traffic. This is most common situation in the cases of any major or reconstruction of cross drainage works and of pavement failure due to, for example, floods.

The temporary carriageway will satisfy the following requirements:

- i. It will have smooth horizontal and vertical profile with smooth vertical and horizontal and vertical profile with smooth vertical and horizontal curves.
- ii. It will not get overtopped by flood or drainage discharges under any conditions
- iii. It will have adequate capacity to cater to the expected traffic
- iv. It will be dust free and will ensure clear visibility at all times of day and night;
- v. Barricading will be provided to prevent construction material falling on the diversion.

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This requires that some of the existing work practices and procedures are changed or abolished. For example, any separate area for stockpiling of construction material on or very near carriageway will have to be discontinued. The present practice of exposing the workman to traffic while carrying out works in the center of the carriageway will be discontinued.

3.20 SPEED CONTROL

In most cases, work on the existing road encroaches on the running lanes and willers and, therefore, cause a hindrance to the normal flow of traffic. In such situations the closing of lanes is a normal practice. In any traffic management at road works situation, traffic using lanes which are to be closed will have time and space for merging with traffic in the next parallel lane as well as to transfer to provisional or altered lanes or both. Normally this requires some reduction in speed, enough advance information to enable safe merging. The critical information for approaching drivers is as to which lane is blocked so that they will be begin moving into the open lane at an early stage.

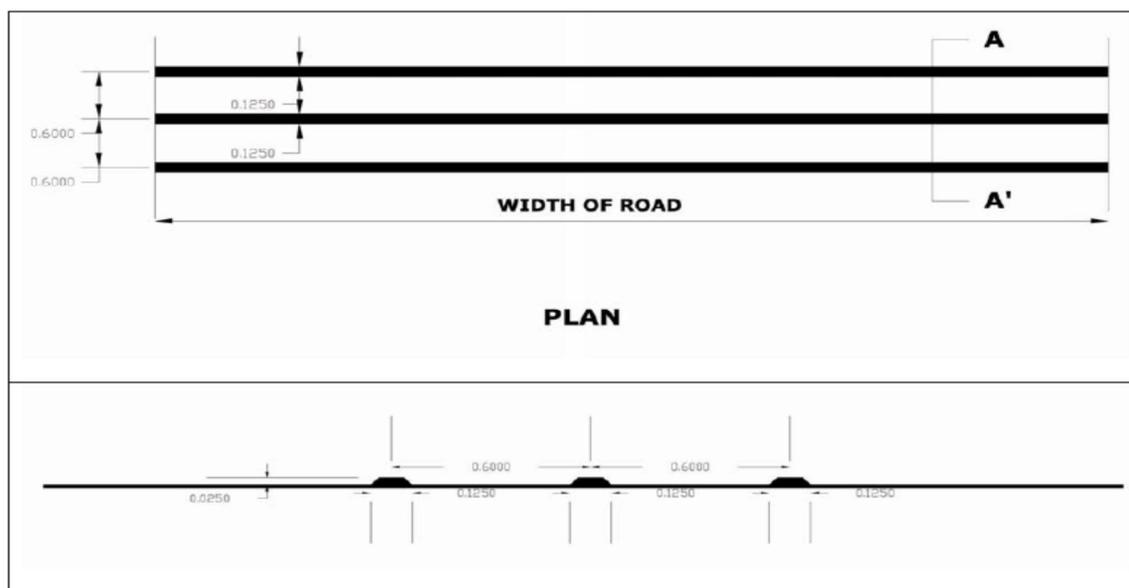
It is preferable to close first the fastest lane and not the slowest, even if the work zone occupies the latter. The reason for this is that slow moving commercial vehicles are more reluctant to give way than the more maneuverable cars which use the fast lane. In this method a reduction in speed is also more easily achieved. If the work zone occupies a center lane of a multi - lane road, it is recommended to close the adjacent lane to avoid an 'island' situation.

Speed Control will often extend through the work site and will depend on the volume of traffic and the width of the traffic lanes that it is feasible to permit. Traffic lanes will be reduced to 3.0 m where space is restricted and, if used by cars and light vehicles only may be reduced to 2.75m with caution. The maximum length of a lane closure would depend upon the traffic volume and number of remaining lanes and normally it will not exceed 5 km where speed control is in operation.

The co-operation of the local police will be sought to the introduction of a temporary but mandatory speed limit, lower than the existing speed limit on the approaches and through the working zone. This may be as low as 50 km/h even for high speed roads, where only one lane is available for traffic.

Usage of Rumble Strip at work site on the main carriageway will be approved by the Competent Authority. Speed reducing measurement such as speed rumbles will be installed as explained below

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Details of Rumble Strip

Types of Signs and Colour Used (Table 6)

S.N	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 Control signs	Orange	Black	-----
5	Informatory Signs	Orange	Black	Black
6	Cautionary signs	Orange	Black	Red
7	Supplementary Signs	Orange	Black	Black

3.20.1 SHORT DESCRIPTION OF THE WORKS

I. **Road Work:** Design, Build, Finance, Operate, Maintain and Transfer (DBFOMT) of Existing State Highway Hungund – Muddebihal – Talikot in the state of Karnataka on DBFOMT Annuity Basis (WCP-7)”

1	Length of Project Highway	Km	56.987
2	Major Realignment	Km	0.450
3	Pedestrian Crossing	Nos	11.00
4	Groundwater Recharge Pit	Nos	6.00
5	Busbay with Bus Shelter	Nos	16.000

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6	Schedule of At-grade Major and Minor Intersections	Nos	31.00
7	Bridge Proposed for New/ Reconstruction	Nos	2
8	Bridge Proposed for Widening	Nos	3
9	Bridges retained with repairs	Nos	5
10	Box Culvert Proposed for New/ Reconstruction	Nos	4
11	Box Culvert to be Widened	Nos	11
12	Box Culvert retained with repairs	Nos	1
13	Pipe Culvert Proposed for New/ Reconstruction	Nos	7
14	Pipe Culvert to be Widened	Nos	41
15	Pipe Culverts retained with repairs	Nos	7
16	RCC Covered Drain	Mtr	10,024
17	Toll	No's	2

CHAPTER 4. SAFETY IN ROAD CONSTRUCTION WORKS

4.1 GENERAL

The method statement for all the activities that taking all the precautions for safe guard the environment during the course of the construction of the work is described below:

Pollution from Plants and Batching Plants

Stone crushing and screening plants, bituminous hot-mix plants, concrete batching plants etc. shall be located sufficiently away from habitation, agricultural operations or industrial establishments. The EPC shall take every precaution to reduce the levels of noise, vibration, dust and emissions from his plants and shall be fully responsible for any claims for damages caused to the owners of property, fields and residences in the vicinity and violation of pollution control norms, if any.

Substances Hazardous to Health

The EPC shall not use or generate any materials in the road construction works which are hazardous to the health of persons, animals or vegetation. Where it is necessary to use some substances which will be cause injury to the health of workers, the EPC shall provide protective clothing or appliances to his workers.

Use of Nuclear Gauges

Nuclear gauges shall be used only where permitted by the Engineer. The EPC shall provide the Engineer with a copy of the regulations governing the safe use of nuclear gauges he intends to employ and shall abide by such regulations.

The EPC will take all reasonable steps to minimize dust nuisance during the construction of the works.

All existing highways and roads used by vehicles or equipment of the EPC or any of his sub-EPCs or suppliers of materials or plant, and similarly any new roads which are part of the works and which are being used by traffic, shall be kept clean and clear of all dust/mud or other extraneous materials dropped by the said vehicles. Similarly, all dust/mud or other extraneous materials from the works spreading on these highways shall be immediately cleared by the EPC.

Clearance shall be effected immediately by sweeping and removal of debris, and all dust, mud and other debris shall be removed entirely from the road surface.

Additionally, if so directed by the Engineer, the road surface shall be hosed or watered using suitable equipment.

4.2 METHODOLOGY AND SEQUENCE OF WORK

Prior to start of the construction activities at site, the EPC 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.

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The general part of the method statement shall describe the EPC’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:

- a) Source of materials like coarse aggregate and fine aggregate, quantity and quality of materials available in different sources;
- b) 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;
- c) Location of the site facilities such as batching plant, hot mix plant, aggregate processing unit etc;
- d) Details of facilities available for transportation of men/material and equipment;
- e) Information on procedure to be adopted by the EPC for prevention and mitigation of negative environmental impact due to construction activities;
- f) Safety arrangement during construction:

Any other information required by the Engineer.

4.3 EARTH WORK

1. Before commencing the excavation underground structures are identified so as to avoid any risk and injury.
2. No borrow pit or part thereof is excavated within the designated right of way or the toe of the embankment.
3. No borrow pit is excavated with in the vicinity of any dwelling unit, Roadway, Railways or any other structure.
4. The disposal of excavated material are not placed where natural drainage or storm water will be pond and becomes stagnant or where it will be erode the material and cause salutation in natural or manmade water course.
5. Construction materials are not stacked near the edge of any excavation to avoid any collapse of the sides of the pit/trench.

4.4 CONCRETING WORKS

1. Adequate precaution is to be taken while carrying out concreting work. All workers involved in the work will be fully equipped with the necessary PPE.
2. Rubber gloves and gumboot are to be provided while handling concrete. Concrete/cement may cause skin inflammation.
3. Ensure that a good foundation is established while handling a vibrator engine.
4. While carrying out mixer sling/wire rope will be checked before lifting the hopper filled with ingredients.

4.5 EXCAVATION

1. Support system for excavation will be designed and installed taking into account site/soil conditions and the depth of excavation.

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2. Worker will not be allowed down into an excavation of depth more than 2.5 M until an inspection has been carried out and recorded by a competent supervisor who will complete a checklist for excavation support.
3. Regular inspection of excavation supports will be carried out daily before workers enter excavation.
4. The area of excavation shall be properly lighted and barricaded during the night.

4.6 USE OF LADDERS

1. Ladders are only intended as a means of ascent and descent where it is impractical to scaffolding to carry out the work. Ladders will be allowed to be used provided.
2. Do not use the top rung as a working platform

4.7 HEAVY LIFTING WORKS AND MATERIAL HANDLING

1. Proper procedure will be followed and precaution taken while carrying out heavy lifting work and material handling.
2. Whenever a crane is to be used the following will to be ensured.
3. Out rigger of crane shall be properly extended on a strong foundation. Suitable material such as timber will be used to strengthen the foundation
4. Ensure it will be that the load being lifted does not exceed the SWL (safe working load) of the crane.
5. Only a person holding an appropriate operators license will be allowed to operate a crane.
6. No will be allow person to pass under a suspended load.
7. Limit switches radius angle indicators will be in good working order.
8. Wire runner shall be regularly lubricated and inspected for any defects.
9. Sling chain and ropes which are linked, knotted or heavily corroded will be replaced.
10. Worker involved in material handling shall be fully equipped with necessary PPE including Safety shoes, safety helmet and suitable hand gloves.
11. Cranes shall not be allowed to operate without the certificate of fitness issued by the concerned regulatory authority.
12. In addition to the above whenever lifting is carried out on the roads site. Proper signs precautionary makers are to be installed and traffic control established.
13. The wire ropes used for lifting shall be as per specification and strong enough to lift the load.

4.8 WELDING

- The following general requirement will to be followed while carrying out gas cutting during welding works.
1. Appropriate PPE including filtered face shield long sleeve jacket, leather gloves and boots will be worn.
 2. Earth cable will be firmly secured.
 3. Electrode holder will be properly insulated and electrode removed from the holder when not in use.
 4. Welding cables will be well insulated and in good condition and properly laid to avoid damage of cable or tripping hazards.

4.9 WORKS ON UPGRADATION OF CARRIAGEWAY

The nature of project is up gradation of roads from existing four lane road to six lane divided carriageway. The traffic and safety management have been carefully planned in advanced before taking up the execution of the project. There will be to situations requiring different plant for traffic control.

4.10 WIDENING

The strengthening of existing carriageway shall be taken up one side(left/right) after providing properly barricading with safety board for movement of traffic. This involves movement of traffic on existing carriageway. Similarly we shall take up another side same way.

CHAPTER 5. TEMPORARY STRUCTURES SAFETY

5.1 INTRODUCTION

Unit 5 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 permanent 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 EPC 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.

5.2 DEFINITION OF TEMPORARY STRUCTURES RELATED TERMS

The following definition of formwork related terms shall apply.

According to IS 6461 Part V, formwork (shuttering) is a complete system of temporary structure built to contain fresh concrete so as to form it to the required shape and dimensions and to support it until it hardens sufficiently to become self-supporting. It includes the surface in contact with the concrete and all necessary supporting structure.

The terms sheeting (sheathing), form (shutter), false work, centering, mould, scaffold (scaffolding), and are commonly used in the context of formwork which will be clearly understood. The definition given in IS 6461 Part V is reproduced in the Table 1.

Sheeting (Sheathing) - That part of the form, which is in contact with the concrete.

Form (Shutter) - (a) That part of formwork, which consists of the sheeting and its immediate supporting or stiffening members. (b) A temporary structure or mould for the support of concrete while it is setting and gaining sufficient strength to be self-supporting.

False work- (a) False work is the temporary structure erected to support work in the process of construction. It is composed of shores, formwork for beams or slabs (or both) and lateral bracing. (b) That part of formwork, which supports the forms usually for a long structure, such as a bridge.

Centering (Centering)- It is a temporary supporting structure to a soffit. It is the specialized formwork used in the construction of arches, shells space structure where the entire false work is struck or decentered as a unit to avoid introducing injurious stress in any part of structure.

Mould -A frame for casting, precast concrete units.

Scaffold (Scaffolding) - A temporary structure for gaining access to higher levels of the permanent structure during construction.

5.3 GUIDELINES FOR THE PREPARATION OF FORMWORK SCHEMES (PLANS)

The formwork plans will include the following information:

1. Design assumptions
2. Types of materials, sizes, lengths, and connection details
3. Sequence of removal of forms and shores

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4. Anchors, form ties, shores, and braces
5. Field adjustment of the form during placing of concrete
6. Working scaffolds and gangways
7. Weep holes, vibrator holes, or access doors for inspection and placing of concrete
8. Construction joints, expansion joints
9. Sequence of concrete placements and minimum/maximum elapsed time between adjacent placements
10. Chamfer strips or grade strips for exposed corners and construction joints
11. Foundation details for false work
12. Special provisions such as protection from flood water, ice, and debris at stream crossings
13. Form coatings and release agents
14. Means of obtaining specified concrete
15. Location of box outs, pipes, ducts, conduits and miscellaneous inserts in the concrete, attached to or penetrating the forms
16. Location of spacing of rubber pads where shutter vibrations are used.

5.3.1 REPORTING OF DANGEROUS OCCURRENCES

All cases of collapse or subsidence of any other part of any structure, formwork, launching girder, working platform, staging, scaffolding or means of access including shall be reported to the Inspector having jurisdiction, whether or not any disablement or death caused to the worker. (To be cross link with reporting section given earlier)

5.3.2 FREQUENCY OF INSPECTION

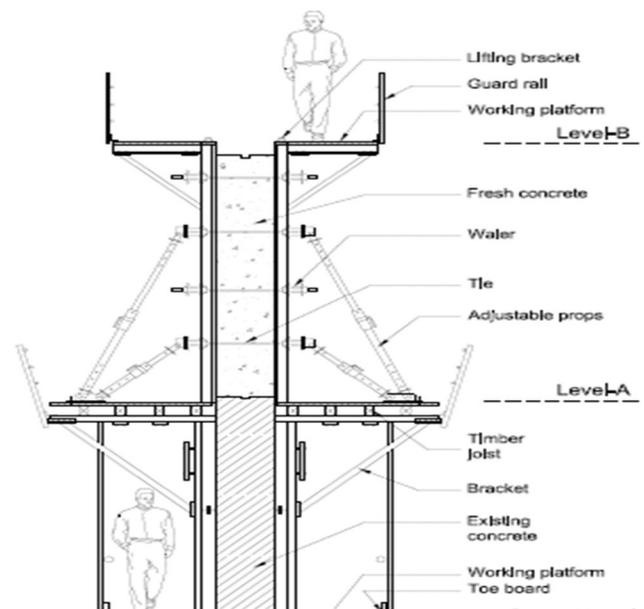
There will be a weekly Inspection of scaffold by scaffolding supervisor and the record for the same will be maintained. The inspection of scaffold will be based on the checklist provided for scaffold in the work zone road safety manual.

EPCs' 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 method statement submitted or developed procedures, Employer's requirements, the same shall be modified. The EF audit.

5.4 FORMWORK ARRANGEMENT FOR TYPICAL STRUCTURAL ELEMENTS

In the following sections some suggested formwork arrangement provided. A number of manufacturers are available in the would prepare a list of approved manufactures and include tl

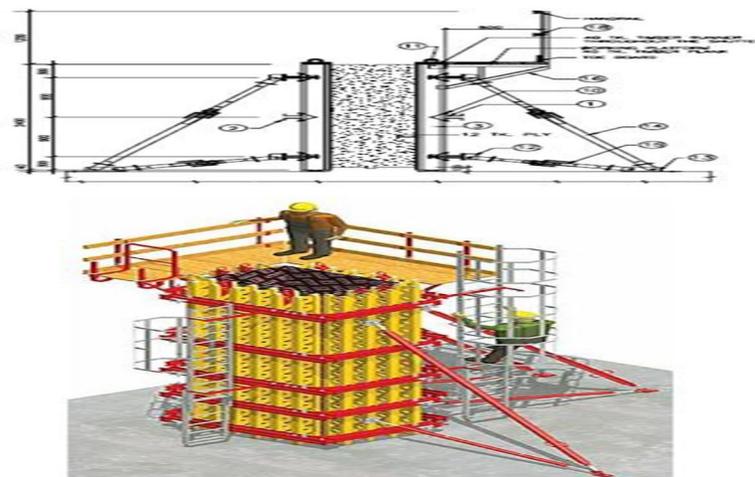


5.4.1 WALL FORMWORK

Wall formwork will be so designed to take the pressure exerted by the concrete on formwork besides other anticipated loads. The formwork components will be designed according to relevant Indian Standards and the manufacturer’s guidelines. Suitable provision for working platform shall be provided (see Fig. 12). Application of travelling and climbing formwork shall be encouraged in case wall is to be cast in more than 2-3 lifts.

5.4.2 COLUMN FORMWORK

Wall formwork will be so designed to take the pressure exerted by the concrete on formwork besides other anticipated loads. The formwork components will be designed according to relevant Indian Standards and the manufacturer’s guidelines. Suitable provision for working platform shall be provided (see Fig.13). Suitable arrangement for reaching the working platform shall also be provided. One such arrangement is shown in Fig-13.



Column formwork showing access arrangement

An arrangement similar to the one shown in Fig. 14 may be adopted for casting the edge beams for flyovers and bridges.

5.5 WORK AT HEIGHT

Inspection of places of work at height

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The EPC shall so far as is reasonably practicable ensure that the surface and every parapet, permanent rail or other such fall protection measure of every place of work at height are checked on each occasion before the place is used.

Duties of persons at work

Any workmen employed by the EPC shall report to the supervisor about any defect relating to work at height which he knows is likely to endanger the safety of himself or another person.

Every workmen shall use any work equipment or safety device provided to him for work at height by the EPC, in accordance with (a) any training in the use of the work equipment or device concerned which have been received by him; and (b) the instructions respecting that use which have been provided to him by the EPC as per the requirements of the Employer

Requirements for existing places of work and means of access or egress at height

Every existing place of work or means of access or egress at height shall

- (a) Be stable and of sufficient strength and rigidity for the purpose for which it is intended to be or is being used;
- (b) Where applicable, rest on a stable, sufficiently strong surface;
- (c) be of sufficient dimensions to permit the safe passage of persons and the safe use of any plant or materials required to be used and to provide a safe working area having regard to the work to be carried out there;
- (d) Possess suitable and sufficient means for preventing a fall; (e) possess a surface which has no gap
 - (i) Through which a person could fall;
 - (ii) Through which any material or object could fall and injure a person; or
 - (iii) Giving rise to other risk of injury to any person, unless measures have been taken to protect persons against such risk;
- (f) Be so constructed and used, and maintained in such condition, as to prevent, so far as is reasonably practicable -
 - (i) The risk of slipping or tripping; or
 - (ii) Any person being caught between it and any adjacent structure;
- (g) Where it has moving parts, be prevented by appropriate devices from moving inadvertently during work at height.

Requirements for guardrails, toe-boards, barriers and similar collective means of protection

- i) Unless the context otherwise requires, any reference in this section to means of protection is to a guardrail, toe-board, barrier or similar collective means of protection.
- ii) Means of protection shall
 - (a) Be of sufficient dimensions, of sufficient strength and rigidity for the purposes for which they are being used, and otherwise suitable;
 - (b) Be so placed, secured and used as to ensure, so far as is reasonably practicable, that they do not become accidentally displaced; and
 - (c) Be so placed as to prevent, so far as is practicable, the fall of any person, or of any material or object, from any place of work.
- iii) In relation to work at height involved in construction work
 - (a) The top guard-rail or other similar means of protection shall be at least 950 millimeters above the edge from which any person is liable to fall;

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- (b) toe-boards shall be suitable and sufficient to prevent the fall of any person, or any material or object, from any place of work; and
- (c) Any intermediate guardrail or similar means of protection shall be positioned so that any gap between it and other means of protection does not exceed 470 millimeters.
- iv) Any structure or part of a structure which supports means of protection or to which means of protection are attached shall be of sufficient strength and suitable for the purpose of such support or attachment.

5.6 WORKING PLATFORMS

In this section the requirements for all working platform,

5.6.1 REQUIREMENTS FOR ALL WORKING PLATFORMS

- i) Every working platforms requires a supporting structure for holding it
- ii) Any surface upon which any supporting structure rests shall be stable, of sufficient strength and of suitable composition safely to support the supporting structure, the working platform and any loading intended to be placed on the working platform.
- iii). Stability of supporting structure: Any supporting structure shall
 - (a) Be suitable and of sufficient strength and rigidity for the purpose for which it is being used;
 - (b) In the case of a wheeled structure, be prevented by appropriate devices from moving inadvertently during work at height;
 - (c) In other cases, be prevented from slipping by secure attachment to the bearing surface or to another structure, provision of an effective anti-slip device or by other means of equivalent effectiveness;
 - (d) Be stable while being erected, used and dismantled; and
 - (e) When altered or modified, be so altered or modified as to ensure that it remains stable.
 - (f) Have suitable base plates and properly footed thereby.
- iv). Stability of working platforms
 - A working platform shall
 - (a) Be suitable and of sufficient strength and rigidity for the purpose or purposes for which it is intended to be used or is being used;
 - (b) Be so erected and used as to ensure that its components do not become accidentally displaced so as to endanger any person;
 - (c) When altered or modified, be so altered or modified as to ensure that it remains stable; and
 - (d) Be dismantled in such a way as to prevent accidental displacement.
- v) Safety on working platforms
 - A working platform shall
 - (a) be of sufficient dimensions to permit the safe passage of persons and the safe use of any plant or materials required to be used and to provide a safe working area having regard to the work being carried out there;
 - (b) Possess a suitable surface and, in particular, be so constructed that the surface of the working platform has no gap
 - i) Through which a person could fall;
 - ii) Through which any material or object could fall and injure a person;
 - or

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- iii) Giving rise to other risk of injury to any person, unless measures have been taken to protect persons against such risk; and
- (c) Be so erected and used, and maintained in such condition, as to prevent, so far as is reasonably practicable
 - i) The risk of slipping or tripping; or
 - ii) Any person being caught between the working platform and any adjacent structure.
 - iii) Loading

A working platform and any supporting structure shall not be loaded so as to give rise to a risk of collapse or to any deformation, which could affect its safe use.

5.7 SCAFFOLDING

Safety Provisions in Building the Scaffolds.

- i. Every scaffold will be braced by means of longitudinal and transverse bracing systems so as to form a rigid and stable structure. So also every scaffold will be effectively tied to a building to prevent movement of scaffold either away or towards the building.
- ii. 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.
- iii. Guide rails and toe boards will be provided for all working platforms to ensure safety for workmen.
- iv. All working platforms will be fully covered to prevent materials falling and causing injury to the workers or passers-by.
- v. Safety nets or other screens will be provided to catch any falling materials.
- vi. The use of barrels, boxes, loose earth pads or other unsuitable objects as supports for uprights and working platform, will not be permitted.
- vii. Care will be taken to see that no un-insulated wire exists within 3 m of the working platforms, gang ways, runs etc. of the scaffolds.
- viii. Scaffolds on thoroughfares will be provided with warning light, if general light is not sufficient to make it clearly visible.
- ix. Men will not be allowed on scaffolds during storms or high winds.
- x. Grease, mud, paint, gravel or plaster or any such material shall be removed from scaffold platforms immediately.
- xi. Either sand or saw dust or other suitable material shall be spread on platforms to prevent slipping.
- xii. All projecting nails from platforms or other members shall be removed.
- xiii. 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.
- xiv. When scaffolds will be used to a great extent and for long period of time, they will be inspected from time to time to ensure its soundness.
- xv. Boards and planks used for platforms, gangways will be of sound quality and proper thickness closely laid and securely fastened and placed.

Additional requirements for scaffolding

Strength and stability calculations for scaffolding shall be carried out unless

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- (a) A note of the calculations, covering the structural arrangements contemplated, is available; or
- (b) It is assembled in conformity with a generally recognized standard configuration.
- i. 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.
 - ii. 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.
 - iii. 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.
 - iv. 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.
 - v. 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
 - a. Understanding of the plan for the assembly, dismantling or alteration of the scaffolding concerned;
 - b. Safety during the assembly, dismantling or alteration of the scaffolding concerned;
 - c. Measures to prevent the risk of persons, materials or objects falling;
 - d. Safety measures in the event of changing weather conditions which could adversely affect the safety of the scaffolding concerned;
 - e. Permissible loadings;
 - f. Any other risks which the assembly, dismantling or alteration of the scaffolding may entail.

5.8 LADDERS

- 1) Every EPC shall ensure that a ladder is used for work at height only if a risk assessment has demonstrated that the use of more suitable work equipment is not justified because of the low risk and
 - i) The short duration of use; or
 - ii) Existing features on site, which he cannot alter.
- 2) Only metal ladders shall be allowed. Bamboo ladders are prohibited.
- 3) Any surface upon which a ladder rests shall be stable, firm, of sufficient strength and of suitable composition safely to support the ladder so that its rungs or steps remain horizontal, and any loading intended to be placed on it.
- 4) A ladder shall be so positioned as to ensure its stability during use
- 5) A suspended ladder shall be attached in a secure manner and so that, with the exception of a flexible ladder, it cannot be displaced and swinging is prevented.
- 6) A portable ladder shall be prevented from slipping during use by -
 - i) Securing the stiles at or near their upper or lower ends;
 - ii) An effective anti-slip or other effective stability device; or
 - iii) Any other arrangement of equivalent effectiveness.

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- 7) A ladder used for access shall be long enough to protrude sufficiently above the place of landing to which it provides access, unless other measures have been taken to ensure a firm handhold.
- 8) No interlocking or extension ladder shall be used unless its sections are prevented from moving relative to each other while in use.
- 9) A mobile ladder shall be prevented from moving before it is stepped on.
- 10) Where a ladder or run of ladders raises a vertical distance of 9 metres or more above its base, there shall, where reasonably practicable, be provided at suitable intervals sufficient safe landing areas or rest platforms.
- 11) Every ladder shall be used in such a way that
 - (a) A secure handhold and secure support are always available to the user; and
 - (b) The user will be maintain a safe handhold when carrying a load unless, in the case of a step ladder, the maintenance of a handhold is not practicable when a load is carried, and a risk assessment has demonstrated that the use of a stepladder is justified because of
 - (i) The low risk; and
 - (ii) The short duration of use.

5.9 LAUNCHING OPERATION

As launching operation is one of the riskiest job, the EPC shall take utmost precaution at all stages like; planning, establishing casing yard, casting segments, transporting segments, fabrication and erection of launching girders, launching of segments, pre-stressing, auto launching of girders and dismantling of launching girders.

The EPC shall prepare a comprehensive Method Statement for the launching operation, adhering to the SHE conditions laid down in conditions of contract on SHE and project SHE manual. Particular reference shall be made to the provisions on working at height. As the entire process of launching has to be undertaken at an elevated level the safety of workers and the girder is paramount important. The following general guidelines shall be adhered throughout the launching operation.

- i. Necessary ‘working platforms’ and fall protection anchorage arrangement shall be provided in the launching girder itself.
- ii. Provisions for mounting light fittings shall also be made available in the launching girder.
- iii. The casting yard shall be established ensuring the provision given in clause 38.0
- iv. The workmen engaged in fabrication of reinforcement, concreting the segment shall be provided with necessary PPEs including compulsory hand protection gloves.
- v. Casting and curing of segment shall be undertaken under the direct supervision of the responsible engineer of the EPC.
- vi. Trucks with valid registration, licence, safe worthiness certificate, Employer’s approval certificate, and pollution under check certificate shall only be used for transport of segments
- vii. Drivers shall also have undergone proper medical examination as per relevant clause mentioned under ‘Medical Facilities’.
- viii. The segments shall rigidly secured to the truck with necessary wooden wedges and necessary red indicators/safety tapes provided so that the vehicle is clearly seen by other road users both in day / night time.
- ix. Every launching girder shall have a responsible engineer on duty all the time.
- x. All the time from erection to dismantling the area between the two piers wherein launching is in progress shall always be barricaded.

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- xi. Unloading of segments from trucks, lifting of segments, shifting of segments, gluing shall be done under the direct supervision of the approved engineer of the EPC.
- xii. Auto launching shall be done only after approval from the Employer. After every auto launching the stability of launching girder shall be ensured.
- xiii. The vertical deflection of launching girder shall be monitored at all critical stages like with/without loads and after every auto launching.
- xiv. A register containing all important operational details from erection to dismantling of launching girders shall be maintained and made available to Employer whenever called for.
- xv. Test certificate for all lifting gears including Macalloy bars shall be maintained at a location closer to the launching girder itself so that it will be referred during all inspections.
- xvi. Adequate lighting at all time shall be ensured in the entire area of operation.
- xvii. Access to drinking water & toilet shall be ensured to all workmen engaged for launching process.
- xviii. Proper access ladders/stairways shall be maintained for safe ascending / descending of workmen / engineers.

Non-adherence to any of the clauses mentioned above shall be viewed seriously by the Employer and penalty levied as per relevant clause.

5.10 BATCHING PLANT / CASTING YARD

- i. 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 will be avoided.
- ii. The batching plant / casting yard shall be barricaded and made as a compulsory PPE zone
- iii. 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.
- iv. 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.
- v. Drainage shall be effectively provided and waste water shall be disposed after proper treatment
- vi. 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.
- vii. 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.
- viii. The PPEs provided to cement handling workmen shall conform to international standards.
- ix. Access roads and internal circulation roads shall be well laid and maintained properly at all time.
- x. Non-adherence to any of the above provision shall be penalised as per relevant penalty clause.

5.11 WORK OVER WATER

- 1. The EPC shall ensure that all construction personnel wear minimum requirements of PPE as mentioned under clause (PPE)

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

Rescue Equipment

1. Lifebuoys with rescue lines will be provided at intervals along the site and positioned conveniently for use in an emergency. Floating grab lines will be attached at intervals or floating plant.
2. Personnel will wear life jackets, or buoyancy aid equipped with a whistle and lights (during darkness).
3. All rescue equipment will be checked by a competent person to ensure it is present and in good condition.
4. Enough personnel will be made available who are trained in the use of rescue equipment and emergency procedures.

Rescue Boats

1. On tidal water or fast flowing rivers, a power-driven boat will be provided and properly equipped; including lifebuoy with buoyant rope (or) rowing boat may be sufficient in some canals and island waterways.
2. Swivelling searchlights will be fitted during darkness in the rescue boats.

Standby person continuously manned while working over water

1. Competent boatmen, trained first aiders will be made available on this area and not to be used for other purposes.
2. Keeping platforms and ladders clean and clear of debris, slime and other tripping hazards.
3. Safety nets to arrest fall where standard working platforms or harnesses cannot be provided.
4. Safety lines and harnesses to be used in conjunction with temporary ladder access over water

CHAPTER 6. WORKPLACE SAFETY

6.1 MATERIAL HANDLING

6.1.1 HAZARDOUS MATERIALS HANDLING, STORAGE, AND USE

I. General responsibility of the EPC during construction activity

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

- A. Identification of major accident hazards in construction activities
- B. Taken adequate steps to prevent major accidents and to limit their consequences
- C. Provide workers with information, training, and equipment, including antidotes
- D. Notification of major accidents
- E. Undertake full analysis and send information to Labour Directorate and the concerned Ministry
- F. Not to undertake any construction activity without submitting safety report to the authority 3 months before commencing activity
- G. Furnishing a further report if the EPC makes any change in construction activity.
- H. Preparation of an up-date on-site emergency plan to deal with major accidents with names of responsible persons and those authorised to take action
- I. Every worker to be informed of emergency plan.
- J. 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
- K. Maintenance of Safety Data Sheet of all the materials that are being used in the construction activities and providing this information to the workers
- L. Container of hazardous chemicals to be clearly labelled about contents, manufacturer, and physical, chemical and toxicological data
- M. Provision of adequate steps to contain contaminants and prevent accidents; and provide workers with safety information, training and equipment
- N. Proper labelling of all hazardous materials
- O. Packaging, labelling, and transport shall be done in accordance with Motor Vehicles Act, 1988
- P. Reporting of polluting accidents to the State Pollution Control Board

6.1.2 MANUAL MATERIAL HANDLING

- I. **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 will be also be caused by other tasks which involve repetitive movements, force, unusual postures, prolonged pressure on a joint, badly organised working practices or work environment. Effects on health will be include:
 - ✓ Sprains or Strains
 - ✓ Backache
 - ✓ Sciatica
 - ✓ Hernias

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- ✓ Arthritis
- ✓ Swelling of the wrist, forearm, elbow and willer.

II. Safety Precautions that are to be maintained by the EPC are:

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

6.1.3 MECHANICAL MATERIAL HANDLING

- I. **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.

II. General precautions for Mechanical material handling:

- K. The EPC 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
- L. 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
- M. All vehicles shall be fitted by the EPC 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 banks man.

III. General operating instructions that shall be maintained by the EPC at any construction site are:

- A. 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.
- B. No passengers shall be carried, unless specific seating has been provided in accordance with the manufacturer’s recommendations
- C. Working on gradients beyond any equipment capability shall not be allowed
- D. Prevention of dumper and dump truck accidents will be managed by providing wheel stops at a sufficient distance from the edges of excavations, spoil heaps, pits, etc.
- E. The manufacturer’s recommended bucket size will not be exceeded in excavators

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- F. If excavators are operating on a gradient which cannot be avoided, it will 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 will never be permitted to travel in a confined area, or around people, without a banks man to guide the driver, who will 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 will be employed when the machine is excavating
- G. 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
- H. When operating the backhoe in poor ground conditions, the stabilisers 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 will always be lowered to the ground to stabilise the machine when the backhoe is employed
- I. The netting operation of the skip wagons will be carried out prior to lifting the skip to reduce the risks of working on the rear platform
- J. If a tractor dozer is employed on clearing scrub or felling trees, it shall be provided with adequate driver protection
- K. When two or more scrapers are working on the same job, a minimum distance of at least 25m shall be kept between them
- L. In case of hydraulic breakers, hydraulic rams and hoses shall be in good working condition
- M. 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
- N. Every moving and dangerous part to be securely fenced, and regularly examined to prevent contact with the worker
- O. Examination/operation of machinery to be done only by trained/certified adult worker wearing tight fitting clothing
- P. Provision of suitable devices shall be available for cutting off power in emergencies from running machinery
- Q. All parts such as lifting machines, chains, ropes and lifting tackle shall be properly maintained and examined every 12 months
- R. The lifting machines, chains, ropes and lifting tackle shall not be loaded beyond marked safe working load
- S. Crane will not approach within 6m of the working place
- T. Safe working speeds of revolving machinery will not to be exceeded
- U. Floors, stairs and means of access shall be of sound construction, properly maintained, free of obstructions, and provided with handrails
- V. Fencing will be provided for working at heights
- W. Pits, sumps, openings in floors, etc shall be securely covered / fenced
- X. Provision of escape, fire extinguisher and adequate training to the workers in case of fire
- Y. Safety Officers to be appointed where more than 1000 workers are employed
- Z. Compulsory disclosure of information regarding dangers, detailed health and safety policy, and emergency plan to the workers.

6.1.4 HANDLING OF PETROLEUM PRODUCTS

I. General provisions that are to be maintained by the EPC at every construction site are:

- A. No person shall deliver or dispatch any petroleum other than the holder of a storage license
- B. 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 authorised to store with or without a license under the “The Petroleum Rules, 1976”
- C. 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
- D. 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
- E. 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
- F. 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

II. Some Special precautions against accident that shall be maintained by the EPC are:

- G. 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.
- H. 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

6.1.5 SPILL CONTROL MANAGEMENT

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

- I. The procedure and guidelines that the EPC shall follow for spill management process are:
 - a. Identification of potential chemical spill hazard
 - b. Risk assessment of spill via:
 - i. The nature of the spilled chemical (high/low hazards)
 - ii. The quantity of the spill (large or small)
 - iii. Location of the spill
- II. The EPC shall ensure that measures to control or eliminate the potential risk shall follow the principles of:
 - a. Elimination: complete removal of risk of exposure
 - b. Replacement the substance with a less hazardous one

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- c. Isolation through distance or enclosure
 - d. Adoption of new engineering methods for redesigning the work area and proper maintenance
 - e. Administrative – standard operating procedure, supervision, training, rotation and signage
 - f. Provision of Personal Protective Equipment – protective clothing, safety shoes, goggles, safety glasses and gloves etc.
- III. Preparation for chemical spill shall be done through:
- a. 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
 - b. Spill kits will be available for use where assessed as required
- IV. Requirements for spill facility to be monitored by the EPC are:
- a. Permanently installed secure roll-over bunds
 - b. Adequate supply of emergency drain covers
 - c. Necessary chemical spill station
 - d. Proper chemical storage areas
 - e. All areas where chemicals are stored shall have access to a spill kit (in close proximity of the storage area)
 - f. Chemical storage cabinets
 - g. Provision of trays that are compatible with the contents
 - h. Chemical waste storage areas
 - i. Adequate supply of emergency drain covers
 - j. Adequate ventilation
 - k. Laboratory spill kit
 - l. Training and awareness
- V. Cleaning up a chemical spill will be done through immediate actions of:
- a. Clear the affected area.
 - b. Check for any persons involved
 - c. Personnel contaminated with chemicals will be decontaminated via emergency shower and taken for medical examination
 - d. First aid facility at the site
 - e. Isolate the spill (if safe to do so)
 - f. Contact the laboratory technician for lowering risk of spills
 - g. Gather any information possible, i.e. identify the material and quantity, gather relevant MSDS and assess any immediate risks.

6.2 HOUSE KEEPING

- a. **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 will cooperate.
- b. **General provisions** that will be maintain adequate housekeeping and will be ensured by the EPC 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

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- 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 will 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 flammable liquid storage cabinets
- x. Effective arrangement for treatment of wastes and effluents to render them innocuous and for their eventual disposal.

6.3 NOISE

a. 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 will be cause deafness and associated conditions such as tinnitus (ringing in the ears). Despite this, workers are exposed to noise levels which will be 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.

b. Control Requirement: EPC has to ensure that construction material is operated and transported in such a manner as not to create unnecessary noise as outlined below:

- I. 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.
- II. 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.
- III. Schedule and conduct operations in a manner that will minimise, 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.
- IV. The EPC 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 EPC proposes to use during daytime and night time and of the

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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 EPC.

- V. The NMCP prepared by the EPC 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.

6.4 DUST AND EMISSION CONTROL

Dust will 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 will be damage the health of the worker through occupational asthma.

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

General Precautions:

- ❖ The EPC shall take all necessary precautions to minimise 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 EPC’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 EPC, submitted for review to the Employer and implemented
- ❖ In developing these remedial measures, the EPC shall inspect and review all dust sources that may be causing health effects
- ❖ The EPC 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 EPC shall cover loads of dust generating materials like debris and soil being transported from construction sites. All trucks carrying loose material will 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 EPC at all times until the excavate is re-utilised for backfilling or as directed by the Employer. Dust control activities shall continue even during any work stoppage

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- ❖ The EPC shall place material in a manner that will minimise dust production. Material storage shall be minimised each day and wetted to control dust production. During dry weather, dust control methods will be used daily, especially on windy, dry days, to prevent any dust from blowing across the site perimeter
- ❖ The EPC shall water down construction sites as required to suppress dust, during handling of excavation soil or debris or during demolition. The EPC 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 EPC shall design and implement his blasting techniques so as to minimise dust, noise, vibration generation, and prevention of fly rock
- ❖ The EPC 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 will be ensured by the EPC.
- Exhaust of internal combustion engine to open air will be ensured.

6.5 PERSONAL PROTECTIVE EQUIPMENT AND OTHER SAFETY APPLIANCES

I. General:

Personal Protective Equipment (PPE) is the **third** line of defense for protection of the employee’s health and safety. The **first** line of defense 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 will be help to eliminate an injury or reduce its severity, but it also hampers the work of the worker. PPE will 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:

- A. Respiratory system due to contaminated air
- B. Head and feet, for example, from falling materials
- C. Eyes, for example, from flying particles of stone works
- D. Skin, for example, from contact with corrosive materials
- E. 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 will be used in conjunction with engineering work practices and/or administrative controls to provide maximum employee safety and health in the workplace. All EPCs are responsible for providing training and ensuring the proper use of required personal protective equipment. The principal requirements of PPEs are:

- A. To safeguard the workers from identified hazards to which he/she is exposed
- B. To afford reasonable comfort while working under adverse circumstances
- C. To permit essential movement of limbs required for efficient job performance
- D. To be amenable to easy cleaning and maintenance

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III. The required PPEs for the construction workers are:

- A. Head protection (safety helmets): The EPC will ensure that all those who are present at a construction site are wearing helmets whoever.
- B. Foot protection (safety footwear, gumboots etc.): Safety shoes are highly recommended for all workers. Sneakers, sandals or canvas shoes are not to be permitted.
- C. Wearing Appeals: The EPC will 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. All workers, supervisors and inspecting officers at the construction sites shall wear Reflective Clothing in the form of vests, shirts, jackets, pants, raincoats etc. which shall be of bright colours of fluorescent Red-orange or yellow-green visible from a distance of at least 300m. These clothing shall have Retro-reflective bands.
- D. Personal fall protection (full body harness, rope-grip fall arrestor etc.):
- E. Eye and Face protection: It is required that all contract employees, sub-Contractor, visitors, and delivery personnel in exposed areas wear eyeglasses as a minimum safety. More specialised eye protection (goggles, welder’s glasses) will be ensured by the EPC as per the demands of the work being performed.
- F. 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 energised cables or breakers racking in and out. The EPC shall have the gloves tested on an annual basis to ensure their integrity.
- G. 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.

6.6 Working at Height

I. General: Working at a height is the largest single cause of serious accidents in the construction environment. Work at height is work in any place, including a place at, above, or below ground level, where persons will be injured if they fall from that place. Access and egress (getting in and out) from a place of work will be also be work at height.

Examples of work activities that are classified as working at a height include:

- A. working on a flat roof
- B. erecting false work and formwork
- C. working from a ladder
- D. working at ground level adjacent to an open excavation, and
- E. working near or adjacent to fragile materials

IV. Safety precautions to be taken by the EPC for working at a height:

Use of Scaffolds

- All scaffolds will be erected and dismantled by workmen who are thoroughly experienced in the erection and dismantling of scaffolding

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- All scaffolds will be inspected by a competent person at least every three days after erection and the results of inspections recorded and the records shall be kept available for checking by the Employer’s representative
- Tags shall be fitted to all scaffolds to show whether they are safe for use or not. All Safe for Use tags shall be signed by a senior site engineer from the EPC
- All scaffolds shall be constructed of sound materials free from patent defect
- The following measures shall be taken:
 - a) The scaffold shall be constructed for the correct use (Light or Heavy Duty)
 - b) Securely fixed to existing structures or adequately buttressed
 - c) The use of barrels, boxes, loose tiles or other unsuitable material shall not be used as supports for working platforms
 - d) All working platforms shall be fully boarded
 - e) All working platforms shall have guard rails at one meter height and shall also have an intermediate rail at half height
 - f) All working platforms shall be provided with toe boards
 - g) All working platforms shall be kept free of unnecessary obstruction or rubbish
 - h) Secure ladder access shall be provided

Use of Ladders

- ❖ All ladders shall be of sound construction and shall be free from patent defects
- ❖ Ladders will be checked weekly and defective ladders shall be promptly and properly repaired or replaced
- ❖ Ladders shall not be used as working platforms but may be used for work of short duration of up to thirty minutes
- ❖ Metal ladders shall not be used near or adjacent to overhead power lines unless they have been certified dead under a permit to work system

Ladders shall:

- a) Be secured at the top or footed at the bottom to prevent slippage
- b) Not be used if any rung is missing
- c) (c) Not be used for any other purpose than to provide access
- d) Be set at an angle of seventy five degrees unless designed for vertical access
- e) All vertical ladders shall be fitted with hoops to prevent falls

Fencing for work at a height

- EPC has to conduct a risk assessment
- When any person has to work at a height from where he/she is likely to fall, provision shall be made, so far as is reasonably practicable, by fencing or otherwise, to ensure the safety of the person so working.

CHAPTER 7. ELECTRICAL AND MECHANICAL SAFETY

7.1 GENERAL

1. The EPC is wholly responsible for the safe condition of tools and equipment used by his employees and that of his sub-EPCs.
2. Use of short / damaged hand tools shall be avoided and the EPC 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-EPCs) for proper use thereby.
3. All hand tools and power tools shall be duly inspected before use for safe operation.
4. All hand tools and power tools shall have sufficient grip and the design specification on par with national/international standards on anthropometrics.

7.1.1 HAND TOOLS

1. Hand tools shall include saws, chisels, axes and hatches, hammers, hand planes, screw drivers, crow bars, nail pullers.
2. The EPC shall ensure that,
 - i) 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.
 - ii) Mushroom headed chisels shall not be used in the worksite where the fragments of the head may cause injury.
 - iii) Unless hatchet has a striking face, it shall be used as a hammer.
 - iv) Only knives of retractable blades shall be used in the worksite.
 - v) No screwdrivers shall be used for scraping, chiselling or punching holes.
 - vi) A pilot hole shall always be driven before driving a screw.
 - vii) Wherever necessary, usage of proper PPEs shall be used by his employees.

7.1.2 SAFETY IN GAS CUTTING AND WELDING

1. 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.
2. Hose clamp or clip shall be used to connect hoses firmly in both sides of cylinders and torches.
3. All gas cylinders shall be fixed with pressure regulator and dial gauges
4. Non-return valve and Flashback arrester shall be fixed at both end of cylinder and torch.
5. Domestic LPG cylinders shall not be used for Gas welding and Cutting purpose.
6. 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 will confirm to IS 2190: 1992.
7. Use firewatchers if there is a possibility of ignition unobserved by the operator (e.g. on the other side of bulkheads).
8. 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.
9. Transformer used for electrical arc welding shall be fixed with Ammeter and Voltmeter and also fixed with separate main power switch.

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10. Welding grounds and returns will 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.
11. Use a low voltage open circuit relay device if welding with alternating current in constricted or damp places.
12. 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.
13. Avoid being in contact with water or wet floors when welding. Use duckboards or rubber protection.
14. All electrical installations shall meet the IS: 5571: 1997 and NFPA 70 for gas cylinder storage area and other hazardous areas.
15. The current for Electric arc welding shall not exceed 300 A on a hand welding operation.

7.1.3 SAFETY IN ELECTRICITY GENERATION, DISTRIBUTION, AND USE

1. Competency of Electrical personnel:
 - 1.1 The EPC shall employ qualified and competent electrical personnel
- 2 Assessment of power
 - 2.1 The EPC 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.
 - 2.2 The EPC 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.
 - 2.3 The main EPC shall take consideration, the requirements of the sub / petty EPCs' electric power supply and arrive at the capacity of main source of power supply from diesel generators.
 - 2.4 As the sub / petty EPCs' 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.
 - 2.5 If any unsafe noise making small capacity diesel generators are found used by sub / petty EPCs the main EPC shall only be penalised.
- 3 Work on site
 - 3.1 The EPC 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.
- 4 Strength and capability of electrical equipment
 - 4.1 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.
- 5 Adverse or hazardous environments
 - 5.1 Electrical equipment which may reasonably foreseeable be exposed to-
 - a) mechanical damage;
 - b) the effects of the weather, natural hazards, temperature or pressure;
 - c) (c) the effects of wet, dirty, dusty or corrosive conditions; or
 - d) 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.

7.2 DISTRIBUTION SYSTEM

1. The EPC shall provide distribution system for control and distribution of electricity from a main AC supply of 50Hz for typical appliances,

- i) Fixed plant – 400V 3 phase
- ii) Movable plant fed via trailing cable over 3.75 kW – 400 3 phase
- iii) Installation in site buildings – 230V single phase
- iv) Fixed flood lighting – 230V single phase
- v) Portable and hand tools – 115V single phase
- vi) Site lighting - 115V single phase
- vii) Portable hand lamps – 115V single phase

7.2.1 ELECTRICAL PROTECTION CIRCUITS

1. 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.
2. 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.
3. Appropriate electrical protection shall be provided for all circuits, against over load, short circuit and earth fault current.
4. The EPC 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.
5. All protection devices shall be capable of interrupting the circuit without damage to any equipment and circuits in case of any fault may occur.
6. Rating of fuses and circuit breakers used for the protection of circuits will be coordinate with equipment power ratings.
7. Protection against lightning shall be ensured to all equipment kept in open at sites.

7.2.2 CABLES

1. 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.
2. 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.
3. 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.
4. 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 under ground cables BS 6346 and BS 6708
5. 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.

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6. 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.
7. 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.
8. 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 EPC. In case of flexible and trailing cables such earthed metal sheath and/or armour will be in addition to the earth core in the cable and shall not be used as the protective conductor.
9. 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

7.2.3 PLUGS, SOCKET-OUTLETS AND COUPLERS

1. The EPC shall ensure plugs, socket-outlets, and couplers available in the construction site as “splash proof” type. The minimum degree of Ingress Protection will be of IP44 in accordance with BS EN 60529.
2. Only plugs and fittings of the weatherproof type shall be used and they will be colour coded in accordance with the Internationally recognised standards for example as detailed as follows:
 - a) 110 volts: Yellow.
 - b) 240 volts: Blue.
 - c) 415 volts: Red.

7.2.4 CONNECTIONS

1. 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.
2. No loose connections or tapped joints shall be allowed any where 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.

7.2.5 PORTABLE AND HAND-HELD EQUIPMENT

1. The EPC 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.

7.2.6 OTHER EQUIPMENT:

1. All equipment shall have the provision for major switch/cut-off switch in the equipment itself.
2. All non-current carrying metal parts of electrical equipment shall be earthed through insulated cable
3. Isolate exposed high-voltage (over 415 Volts) equipment, such as transformer banks, open switches, and similar equipment with exposed energized parts and prevent unauthorised access.
4. 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.

7.2.7 WORK ON OR NEAR LIVE CONDUCTORS

1. 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
 - b) It is reasonable in all the circumstances for him to be at work on or near it while it is live; and
 - c) Suitable precautions (including where necessary the provision of suitable protective equipment) are taken to prevent injury.

7.2.8 INSPECTION AND MAINTENANCE

1. All electrical equipment will be permanently numbered and a record kept of the date of issue, date of last inspection and recommended inspection period.
2. Fixed installations shall be inspected at least at three monthly intervals; routine maintenance being carried out in accordance with equipment manufactures recommendations.

7.2.9 MAINTENANCE AND WORK PERMIT SYSTEM

1. The EPC 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.
2. 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:
 - i. Entry into confined spaces
 - ii. Work in close proximity to overhead power lines and telecommunication cables.
 - iii. Hot work.
 - iv. To dig—where underground services may be located.
 - v. Work with heavy moving machinery.
 - vi. Working on electrical equipment
 - vii. Work with radioactive isotopes.
 - viii. Heavy lifting operations and lifting operations closer to live power line
3. The permit-to-work system will be fully documented, laying down:
 - i) How the system works;
 - ii) The jobs it is to be used for;
 - iii) The responsibilities and training of those involved; and
 - iv) How to check its operation;
4. A Work Permit authorization form shall be completed with the maximum duration period not exceeding 12 hours.
5. 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.

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7.3 FIRE SAFETY

1. The EPC 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.
2. Recharging of fire extinguishers and their proper maintenance will be ensured and as a minimum will meet Indian National Standards
3. All drivers of vehicles, foreman, supervisors and managers shall be trained on operating the fire extinguishers and fire fighting equipment.
4. The EPC shall also give consideration to the provision of adequate fire fighting arrangements within the underground and tunnelling operations including the provision of Fire Service compatible hose connections and emergency lighting
5. As per the DBOCW Rules 2002, Rule 63(a) (vii), all lifting appliances’ driver cabin will be provided with a suitable portable fire extinguisher.
6. Combustible scrap and other construction debris will be disposed off site on a regular basis. If scrap is to be burnt on site, the burning site will be specified and located at a distance no less than 12 meters from any construction work or any other combustible material.
7. Every fire, including those extinguished by EPC personnel, shall be reported to the Employer representatives.
8. Emergency plans and Fire Evacuation plans shall be prepared and issued . Mock drills will 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 will be prominently displayed near each telephone on site.

7.4 PRE-WORK REVIEW AND MEETING

At the start of every work day, the supervisors will review the safety environment at site and take necessary corrective action. Once a week at the start of the work day, the supervisors will have a pre work safety meeting and decide on any improvements or measures necessary for ensuring continued safety.

7.5 MONTHLY INSPECTION

Safety Inspection with the purpose of identifying state cleanliness, unsafe condition, unsafe practices and infringement of safety, health and environment aspect shall be carried out monthly by the safety officer.

7.6 CHECK LIST FOR IMPLEMENTATION OF SAFETY MEASURES

Sl.	Item	Remarks
1	Weather Project Safety Manual specific to the project covering statutory and regulatory and other requirements pertaining to safety has been prepared and issued to all concerned?	
2	Weather safety Team, Safety officer & emergency controller have been nominated?	
3	Whether site safety plan has been drawn and kept updated?	

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Sl.	Item	Remarks
4	Whether safety Manual, Safety procedures and safety checklists are available at the place of work and with the concerned employees?	
5	Whether work instructions, checklist, safety posters, safety instructions and list of nearby Hospitals and Doctors are distributed/displayed at the place of work in a language understandable by the staff and workers?	
6	Whether the staff / workers of IRCON and the sub – contractor are being regularly trained and adequately aware to implement safe practice in executions in execution of works?	
7	Whether the staff / workers have been provided with proper safety gadgets, tools and equipment? Whether the same are being regularly used by them on work for their own safety?	
8	Whether first aid box and other facilities of first aid provided at place of work?	
9	Whether all safety provisions are enforced at work site?	
10	Whether Activity In – charges conduct safety checks/inspections at their work place at regular intervals . If so, whether record of the same is maintained showing date and place of inspection and the activity inspected etc.?	
11	Has ever any accident, major or minor or even “ near miss” (narrowly missed/ escaped accident) taken place at your project ? If so , any detailed report has been prepared and the cause of accident established to take corrective and preventive action to avoid such incident in future?	
12	Whether fire extinguishers are provided at fire hazardous locations. Are they being checked regularly and refilled, when required, by the authorized persons? Whether occasionally mock drills being conducted to train the personnel in its use ?	
13	Whether proper earthing has been done of all electrical installations to prevent electric shock/electrocution?	
14	Whether danger board/sign have been displayed near high tension and other installations.	
15	Are safety weeks being observed to lay emphasis on safety among workers?	

7.7 SAFETY INDUCTION TRAINING

Project site personnel will undergo safety induction/ training sessions with the aim of familiarizing them with the aim of familiarizing them with the requirements of the safety, health and environment as detailed in the SAFETY MANUAL – General and the Project Safety Manual.

Awareness program shall be ensured for Contractors staff and workers and new employees regarding safety practices while at work before being allowed to work at project sites. Such items will include “fundamental Safety Rules applicable to each employee”.