



SAFETY PERFORMANCE IN A CONSTRUCTION SITE USING IS3786:1983

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1.ABSTRACT

The aim of this project is to measure the safety performance at a construction industry by calculating the frequency rate and severity rate and evaluating the activities using risk assessment to improve safety by providing possible control measures at the workplace.

Walk-around inspections were conducted on a construction site; the hazards associated with activities, the percentage of occurrences of activities, and accident statistics data were recorded. Using the Indian standard 3786, the frequency rate and severity rate were estimated. From the risk assessment result, work at height, De-shuttering and dismantling, excavation, concreting, vehicle movement, lifting, erection, traffic management, work at height, blasting, hot work, and scaffolding activities were found to be severe. Possible control measures were suggested and put into practice.

2.INTRODUCTION

CONSTRUCTION

The construction industry in India has travelled a long distance in a relatively short period of time. From the beginnings of building simple structures and minor civil work projects, the industry has changed significantly, particularly over the seventy-seven years following independence. The construction industry in India today is very large and complex in nature. The social concern for the safety of construction workers and their protection against injury arising out of their employment has been evident for a long time. However, the measures taken to translate this social concern into concrete programs of action—legislative, administrative, or educational—did not bring the desired results. This happened largely due to the peculiar nature of this industry, including the lack of formal organization. Basically, the rate of growth in this industry has been so rapid that the legislation and standards, as well as their implementation, could not keep pace with it. This gap must be narrowed down to the extent possible and in the shortest possible time. Construction is a relatively hazardous undertaking.

In the developed as well as developing parts of the world, the construction industry is one of the most significant industries in terms of contributing to GDP and in terms of its impact on the health and safety of the working population. Compared to other industries, the construction industry is regarded as a dangerous industry due to two characteristics: decentralization and mobility, which lead to longer working days. The meaning of decentralization is that the employees are separated by sites. Although regulations and plans are available, they still have to make decisions by themselves when facing specific problems. Mobility implies that employees in the construction industry move among companies, sites, and positions more frequently than those in their traditional industries. Because of these two characteristics, the promotion of safety management

and working conditions is achieved in a manner that is used by several industries to consciously improve safety performance.

By identifying the hazards in the construction industry, we can eliminate the risk associated with the workplace, activity and reduce the occurrence of incidents.

Incident statistics

Cause	Percentage
Fall of person	45%
Fall of objects	12%
Hit and Run	10%
Electrocution	9%
Collapse	3.5%
Natural	2%

The above table shows the statistics of accidents that occurred in India in various activities carried out in the construction industry.

IMPORTANCE OF SAFETY PERFORMANCE IN CONSTRUCTION INDUSTRY

The construction industry, which employs the largest workmen force in the country, has accounted for about 11% of all occupational injuries and 20% of all deaths resulting from occupational accidents. The cost of accidents is expensive.

However, economic cost is not the only reason for which a contractor should be conscious of construction safety. The reasons for considering safety include:

a) Humanitarian concerns: When the accident happens, the resulting suffering of the injured workers and their families is difficult to quantify in economic terms. The contractor should never ignore this, even if he has insurance against accidents.

b) Economic reasons: Even if a contractor has insurance, he will find out that the cost of accidents will come out of his own pocket through an increase in insurance premiums. In addition, there are other indirect costs that result from accidents. The direct and indirect costs of accidents can be: -

Direct cost:

- Medical care/treatment expenses for injured.
- Workmen's compensation costs
- Insurance premiums increase.
- Replacement cost of equipment and material damaged in an accident.
- Facility repair and clean-up
- Fees for legal counsel

Indirect costs:

- Slowdown in operation
- Decrease in morale which affects productivity.
- Productive time lost by injured worker and fellow workers.

- Administrative work associated with accident.
- Loss of client's confidence
- Overtime necessitated by work slowdown.
- Increase absenteeism.

c) Laws and Regulations: As per different act and laws the employer should look after the safety of the employee. Violation of these laws will be subject to Punishment.

d) Organisational Image: A good safety record can produce higher morale and productivity and stronger employee loyalty. It will also improve the company's public image and therefore make it easier to acquire negotiated jobs.

e) Social Concerns: The social concern of the safety of construction workers and their protection against injury arising, out of their employment has been quite evident for a long term.

f) HSE(Safety) department: A formal safety department is essential in a company. This department should be in charge of the safety staff and jobsites representatives, recording and analysing safety and other accident prevention program.

NEED FOR STUDY

1. Construction is one of the areas of employment where hazardous conditions are part of the everyday working environment.
2. Safety is important in construction because of many risks to worker's health and the fatalities that occur in construction site also has a great barrier towards cost involving in a project.
3. To overcome these barriers there is a great need to evaluate activity-based performance of safety in construction sites.

OBJECTIVE OF THE STUDY

1. To analyze the safety performance by calculating frequency rate and severity rate using IS 3786:1983 (METHOD OF COMPUTATION OF FREQUENCY RATE AND SEVEIRITY RATE IN INDUSTRIAL INJURIES) in a construction site.
2. To predict the high percentage of incidents or accidents in activities carried out on a construction site.
3. To predict the cause of the occurrences of activities using incident analysis by finding the type of injuries and to suggest corrective measures using Hazard Identification and Risk Assessment to increase safety performance.

3.REVIEW OF LITERATURE

RELATED LITERATURE

Naray Venkataraman (2008) introduced a factor called the safety performance factor, which he defined as the average human-hour unit lost due to occupational incidents. To calculate workplace safety performance, he compared it with the frequency rate and severity rate to show the safety performance of the organization. By reporting all near miss and incidents, a safety performance factor is obtained.

Aref Charehzehi and Alireza Ahankoob (2012) studied details about the safety performance of construction projects. He described some important elements that create accidents and factors influencing the improvement of safety performance at construction sites.

Elements that create accidents are:

- Safety management error
- Poor training programs
- Human elements
- Outdated procedure
- There is no clear monitoring policy.
- Poor Supervision
- Natural calamities

S.Z.S. Tabish and K.N.Jha (2015) studied attributes influencing general safety performance in construction practices. They find out various success factors that would help management improve safety performance.

4.METHODOLOGY

DEFINITION

These terms are used to study.

Safety: A definition that describes safety is “the surety that the environment of the personnel or items is subjected to is free from inadvertent or unexpected events which may result in injury to personnel or damage to the items exposed, or safety is freedom from hazard.

Lost time incident: It is defined as an injury causing death or disablement of the victim for 48 hours or more, excluding the day of the shift on which the incident occurred.

Man days lost: Man days lost is defined as the day on which injury occurred for any period arising out of injury that caused his earlier disablement; such subsequent disablement is taken as Man days lost.

Man hours worked: The total number of employee hours worked by all employees working for the company.

Lost Time Injury Frequency Rate (LTIFR): A mathematical calculation that describes the number of reportable lost time injuries per million-man hours worked. $FR = \text{No of reportable lost time injuries} \times 10^6 / \text{Man hrs worked}$.

Lost Time Injury Severity Rate (LTISR): A mathematical calculation that describes the number of man-days lost experienced as compared to the number of incidents experienced.

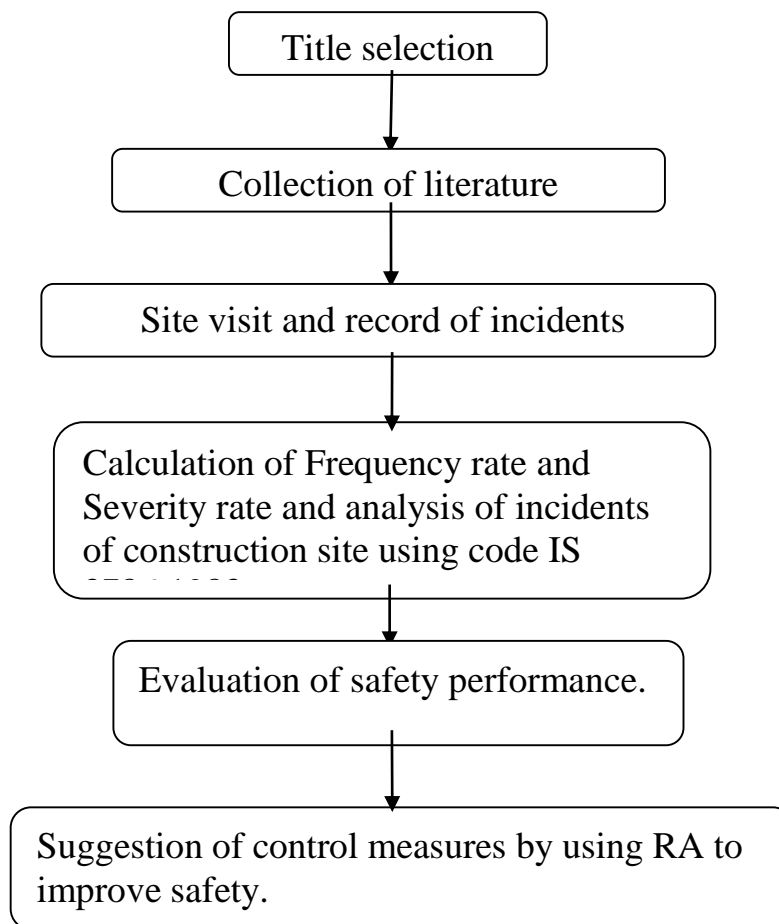
$SR = \text{No. of Man Days Lost Due to Reportable LTI} \times 10^6 / \text{Man Hours Worked}$

Hazard: source, situation, or act with a potential for harm in terms of injuries, ill health, property damage, or a combination of both.

Risk: a combination of the likelihood and consequence of a specified hazardous event occurring.

METHODOLOGY OF WORK

A Clear Picture of the project methodology is presented below chart. The methodology begins with by visiting site and collecting data of incidents to calculate Frequency Rate, severity Rate and Analysis of incidents of a construction site by using IS 3786:1983 for deciding the safety performance of premises, finally suggesting control Measures by assessing Risk Assessment (RA).



RISK ASSESMENT PROCEDURE

Steps to create and maintain a RA:

1. Collecting information to support RA
 2. Hazard identification.
 3. Risk Assessment.
 4. Risk analysis.
 5. Monitoring and reviewing
 6. **Collection of information:** In this step, incident data and illness health data are collected in a construction and used to calculate FR and SR, which give the safety performance, and to start to create Hazard Identification and Risk Assessment.
1. **Hazard Identification:** In this step, the hazards associated with any activity that could impact the site are identified.
 2. **Risk Assessment:** In this step, the level of risk for each hazard is examined. This may involve speaking with hazard experts and researching past occurrences and possible scenarios. The likelihood of the hazard occurring and the potential impacts of the hazard on people, property, the environment, business and finance, and critical infrastructure should be examined.
 3. **Monitor and Review:** It is important to remember that a HIRA is an on-going process, and hazards and their associated risks must be monitored and reviewed.

Steps to manage health and safety at the workplace,

- Spot the hazards.
- Assess the risk.
- Make the changes (risk control).

Hazard Identification

Hazard identification is a critical and important step that is done by tracking sources and taking into account some of the conditions, like

- Unsafe condition.
- Unsafe Act/practice.

- Task observation.
- Site assessment.
- Accident information.
- Health data: industrial hygiene assessment.
- Work environment-related health risks.

- Behavioral and mentality by personal appropriate.
- Toxicology data.
- Past hazard studies.
- Neighboring industries data.
- Legal requirements.
- Audit results.
- Commutation with associates.

The procedures adopted after the hazard identification process to control and minimize the hazards and risks are to check and ensure control over all the following activities:

- Routine and non-routine activities
- Activities of all personnel, including sub-contractors and visitors
- Physical facilities and
- Equipment of the organization.

The types of categories that are considered in categorizing hazards include:

- Incidental hazards
- Physical hazards (like noise, pressure, heat, illumination, radiation, etc.)
- Chemical hazards (like toxic, inflammable, explosive, corrosive, etc.)
- Biological hazards
- Ergonomic hazards

Risk Assessment

A risk assessment is a thorough look at the workplace to identify those things, situations, processes, etc. that may cause harm, particularly to people. After identification is made, the risk should be evaluated to determine how likely and severe it is, and then it will be decided what measures should be in place to effectively prevent or control the harm from happening.

Importance of Risk Assessment

Risk assessments are very important, as they form an integral part of a good occupational health and safety management plan. They help to:

- Create awareness of hazards and risks.
- Determine if existing control measures are adequate or if more should be done.
- Prioritize hazards and control measures.

Evaluation of Occupational Hazards and Associated Risks to Health and Identification of Significant Occupational Health Hazards and Risks

The criteria for risk assessment are developed through brainstorming and discussion by the core team. The scoring is based on three factors:

- Probability of occurrence.
- Severity rate.
- Hierarchy of control.

Table RA Matrix format

The below table shows the format of Risk Assessment

Sl No	Activity	Hazard	Risk Involved	Existing control measures	Assessment				Additional Control Measures	Re-assessment				
					P	S	Risk	Risk level		P	S	Risk	Risk level	

Table Probability of occurrence, severity rate and Risk rating

Severity	Risk Rating	Probability	
Fatality	4	Very Likely	The event is almost certain to occur and has occurred repeatedly in the construction industry
Reportable Injury or illness resulting in more than two days off work	3	Most Likely	The event will probably occur in most circumstances
Non-Reportable Lost Time Injury/ Illness resulting less than two days off work	2	Unlikely	The event may occur only in exceptional circumstances
Injury or illness requiring First Aid treatment, Minor Pollution etc	1	Very Unlikely	Very unlikely but remotely possible

The above table shows the Probability of occurrence, severity rate and Risk rating for the activities carried on construction site.

5.RESULTS AND DISCUSSION

COMPUTATION OF FREQUENCY RATE, SEVERITY RATE

Frequency Rate - The frequency rate shall be calculated both for lost time injury and reportable lost time injury as follows,

$F_A =$ Number of lost time Injuries x 1000000/Man Hours Worked.

$F_B =$ Number of Reportable lost time Injury x 1000000/Man Hour Worked.

NOTE 1 - If the injury does not cause loss of time in the period in which it occurs but in a subsequent period, the injury should be included in the frequency rate of the period in which the loss of time begins.

NOTE 2 - If an injury causes intermittent loss of time, it should only be included in the frequency rate once, that is, when the first loss of time occurs.

NOTE 3 - Since frequency rate is based on the lost time injuries reportable to the statutory authorities, it may be used for official purposes only.

Severity Rate - The severity rate shall be calculated from man days lost both of lost time injury and reportable lost time injury.

$S_A =$ Number of Man days lost x 1000000/Man Hour Worked.

$S_B =$ Number of Reportable Man days lost x 1000000/Man Hour Worked.

Calculation of Man-Hours Worked

Man-hours worked shall be calculated from the pay roll or time clock recorded, including overtime. When this is not feasible, the same shall be estimated by multiplying the total man-days worked by the period covered by the number of hours worked per day. The total number of man-days for a period is the sum of the number of men at work on each day of the period. If the daily hours vary from department to department, separate estimates shall be made for each department and the results added together.

Calculation of Frequency Rate and Severity Rate.

From my observation, a construction site has 1250 employees. There are 3 reportable lost time incidents for the June to August months, and the number of days lost is 69. In September and up to October 15th, 1 reportable lost time incident and 29 man days lost.

Table Quarterly Incident Statistics

Quarterly incidents Statistics	
Months	Number of incidents
July 1 st to September 30 th	47
October 1 st to November 30 th	26

Table shows Reportable incidents for July to September months.

Sl. No	Incident Description
1. Reinforcement, Form work shoring and Concreting	One crew was engaged for lifting a bunch of rebar (10mm, 3mtr length, approximately 8 pieces) to 2.5mtr elevation using rope. There was a scaffold about 4mtr height in the same area, the rebar bunch struck with one horizontal member of scaffold resulting the wire got cut and one rod hit on the worker's right hand who was standing on ground got seriously injured.
2. Material handling	A worker was engaged for rebar shifting works. He reached rebar bending area and his pant entangled with reinforcement rod and fell down on the floor, victim got sustained fracture on his left leg toe.
3. Road filling	A sand carrying truck was engaged to fill the sand for levelling a road. While a worker was standing near to tyre of truck, driver didn't see him and the truck was reversed, it went on the top of his foot resulting crush injuries in his left foot. He was taken to the hospital immediately for treatment.

Table -Recorded Incidents for period of October to November Months

1	Excavation	A Labour working on an Excavation pit and a scaffold pipe placed at the edge of excavation fall on his leg. Got injured on his little finger of his leg and he was given first aid.
2	Excavation	A Labour working in an Excavation pit and a small steel rod placed at the edge of excavation fall down near to him.
3	Vehicle Movement	A tipper lorry got struck into sand and slowly one of wheel got up and fell down. Driver escaped without any injury.
4	Hot work	A group of labours performing welding for making template suddenly gas leaked and fire occurred near to it and it was put off no injury reported.

5	Material handling	A gang of three people engaged for shifting of reinforcement from storage area to bar bending area during that time one worker suddenly cross on that way the edge point of the reinforcement hit he got injured on his right hand he was given first aid and reported to job.
6	Scaffold	While holding a scaffold pipe vertically having 3 mtr length for the scaffolding erection activity, one clamp which was not fixed properly on the other end of the pipe, slide down and hit on the left middle finger of hand and got injured.
7	Reinforcement, Form work shoring and Concreting	On performing of formwork one worker throw the wooden block of formwork it landed just near to the one of the labour.
8	Concreting	A group of labour while performing PCC work in excavation pit near to it a bulldozer levelling the road due to heavy vibration the cave in occurred no one got injured.
9	Material handling	A gang of labour engaged for shifting of sheltering sheet from making area to excavation pit for formwork of column one of labour suddenly lost the balance and dropped it no one got injured.
10	Scaffold	While holding a scaffold pipe vertically having Three mtr length for the scaffolding erection activity, one clamp which was not fixed properly on the other end of the pipe, slide down and hit on the left middle finger of leg and got injured.
11	chipping work	A labour engaged for chipping work at Plinth beam area Sustained injury on his left hand when a projected rod of beam hit him while doing chipping works.
12	Reinforcement, Form work shoring and Concreting	A crew was engaged in form works, while extending the Prop it slipped. A worker was holding the prop at pinch point which resulted in injury on his right middle finger.
13	Reinforcement, Form work shoring and Concreting	A worker was engaged in shuttering works suddenly a wooden ply fall from 2meter height he was standing beside the area and got injury on leg.
14	Reinforcement, Form work shoring and Concreting	A worker was engaged in de-shuttering works suddenly a wooden ply fall from 3meter height and another worker standing below it drop near to him.

15	Material handling	Steel bundle was stacked at a height at steel yard, for steel shifting bundle was cut suddenly steel rods get rolled as result no injury occurred.
16	Plastering	Mason engaged for sludge wall plastering. While doing so he was hold his work at 12.35pm for lunch break and he jumped from working level to lower level (Taking short cut) for get down from scaffold access. Due to jump from elevation the working platform fell down on ground. There is no injury occurred.
17	P & M	A Crane operated without third party certificate & daily inspection was not carried out by operator and started lifting for shifting pumps ,rescue bucket, general materials etc.
18	Housekeeping	Form work materials stacked two weeks before over the 50mm cable which is lay there, due to over burden of materials stacked over the cable, cable busted, but no injury occurred to anyone.
19	Material handling	Workmen engaged in for shifting the materials one person left hand thumb hit by the sharp edge of binding wire which is very near to him as a result his left thumb was punctured by the binding wire. But he failed to report his injury on that day, as a result his hand was infected and he was reported on later to first aider and he was taken to hospital for further treatment.
20	Shuttering work	De-shuttering of canteen building slab was in progress. During de-shuttering of the same, the worker was using tie rod to remove span which is used as bottom shutter for the slab. During the process tie rod with which he was pushing the span, slipped from his hand and hit his right chin resulting in cut injury. Immediately he was administered first aid and taken to hospital for further process.
21	Housekeeping	Workmen engaged for the Hoarding board and G.I sheet removing work for the hydra movement while removing sheet, Sheet slipped from his hand as result cut injury in his left hand little finger
22	Material handling	workmen engaged for the steel loading activity ,Steel bundle lifted in one end for keeping wooden slipper, due to over load sling was cut and fell from height as a result no

		injury occurred.
23	Material handling	A group of workmen engaged for steel bundle loading activities in steel yard, steel bundle lifted from steel yard to trailer for that one end of the steel bundle lifted with sling for providing wooden slipper packing purpose, but the wooden pieces inserted ¼ only, while lowering the steel bundle, wooden pieces suddenly broken and length piece hit on his right leg thigh resulted a minor abrasion.
24	Reinforcement, Form work shoring and Concreting	A concrete mixer engaged for transport of concrete from batching plant to grid A of site. A RCCB is held on near to excavation pit the driver did not see it he hit and it fall into excavation no injured reported.
25	Shuttering work	A gang of workers engaged for shuttering work. one worker holding the plywood sheet lost his grip and dropped it and fall on another worker resulted cut injury on his hand.
26	Concreting	A gang of labour engaged for shifting of sheltering sheet from excavation pit for formwork of column one of labour suddenly lost the balance and dropped it no injury reported.

Table-Recorded Man days Lost

For June to August months			
S.No	Incident Description	Man Days Lost	Total Man Days Lost
1	One crew was engaged for lifting a bunch of rebar (10mm, 3mtr length, approximately 8 pieces) to 2.5mtr elevation using pp rope. There was a scaffold about 4mtr height in the same area, the rebar bunch struck with one horizontal member of scaffold resulting the wire got cut and one rod hit on the worker's right hand little finger that was standing on ground got series injured.	25	69

2	A worker was engaged for shifting works he reached rebar bending area victim pant entangled with reinforcement rod and fell on the floor, victim got sustained fracture on his left leg toe.	14	
3	A sand carrying truck for filling of land for levelling while pouring sand a worker was near to tyre of truck driver didn't see him suddenly, he reversed his foot got into tyre. He was taken to the hospital.	30	

September To October			
S.No	Incident Description	Man Days Lost	Total Man Days Lost
1	A group of workmen engaged for steel bundle loading activities in steel yard, steel bundle lifted from steel yard to trailer for that one end of the steel bundle lifted with sling for providing wooden slipper packing purpose, but the wooden pieces inserted ¼ only, while lowering the steel bundle, wooden pieces suddenly broken and length piece hit on his right leg thigh	29	29

Table -Comparison of Frequency Rate and Severity Rate in a construction site.

Description	July to September	October to November	Remarks
Frequency Rate	$\frac{3*1000000}{1250*78*11} = 2.79$	$\frac{1*1000000}{1250*39*11} = 1.86$	Month October to November is better with lower FR and SR.
Severity Rate	$\frac{69*1000000}{1250*78*11} = 64.33$	$\frac{29*1000000}{1250*39*11} = 54.079$	

From the above table the frequency rate and severity rate are calculated for the construction site.

EVALUATION OF ACTIVITIES USING RA

From the incident collected through walk around inspection to identify the unsafe acts and unsafe conditions carried out inside a construction site. Unsafe Act and Unsafe Condition are reported to HSE officer. Involvement of workers and supervisors by giving safety awareness, and conducting separate meeting is done.

Table-Hazard Identification

S.NO	ACTIVITY	HAZARDS	SAFETY IMPACTS
1	Excavation	Fall hazard, Cave in.	Injury/Fatal
2	Concreting	Fall from height. Slips, trips, fall.	Amputation/injuries/fatal

		Fall of wooden boards. Hit by objects.	
3	Reinforcement, form work.	Fall from height. Hit by object. Caught between object.	Cut injuries/fatal
4	Material handling	Hit by object. Slips, trips, fall. Pain on body	Back pain/injuries
5	Vehicle movement	Hit by vehicle, Dust.	Fatal/diseases
6	Hot work	Fire hazard	Injuries/fatal
7	Shuttering work	Fall of object, Hit by object.	Cut injuries/fatal
8	House keeping	slips, Trips, fall Environmental hazards.	Diseases/injuries
9	Scaffolding	Fall of person, Fall of material, Collapse of scaffolding.	Fatal/injuries

Colour Code	
Low	
Medium	
High	

RISK MATRIX

Risk Assessment matrix is prepared on two criteria.

1. Likelihood: Probability of the event occurring.
2. Consequences: Harm realized if the event takes place.

Table-Risk Matrix

		Severity (S)			
		Injury or illness (1)	Non-Reportable (2)	Reportable Injury or illness (3)	Fatality (4)
Probability (P)	Very Unlikely (1)	1	2	3	4
	Unlikely (2)	2	4	6	8
	Likely (3)	3	6	9	12
	Very Likely (4)	4	8	12	16

4.4 RISK LEVEL

Table - Risk level

Risk Rating	Risk level	Recommended actions
1 to 3	Low Risk	No additional risk control measures may be needed.
4 to 8	Medium Risk	Work can be carried out with Risk controls in place
9 to 16	High Risk	Don't start work. Risk level must be reduced to Medium / low before commencing work.

Table-Risk Assessment (Hazard identification and risk assessment)

	Activity	Hazard	Risk Involved	People at risk	Control Measures	Assessment			Additional Control Measures	Re-assessment			Action By
						P	S	Risk Level		P	S	Residual Risk	
1	Rock breaking / Foundation excavation (Manual /	Hit by flying objects	Serious Personal injuries	Staff, Workmen & Visitors	<ul style="list-style-type: none"> Work area should be barricaded. Operator cabin shall be guarded to prevent the falling of rocks 	2	3	06		1	3	3	Site Engineer

	Activity	Hazard	Risk Involved	People at risk	Control Measures	Assessment			Additional Control Measures	Re-assessment			Action By
						P	S	Risk Level		P	S	Residual Risk	
2	Mechanical Excavation)	Failure of breaking tool / equipment	Serious Personal injuries	Staff, Workmen & Visitors	<ul style="list-style-type: none"> • Breaking tool & equipment shall be inspected before the start of the activity & should be free from damages. • Hose condition & oil leakage shall be checked. • All the reciprocating / rotating parts shall be lubricated sufficiently. • Bushes and the cotter pins shall be checked 	2	3	06		1	3	3	Site Engineer
3		Unauthorized operator engaged	Fatal, Serious Personal injuries	Staff, Workmen & Visitors	<ul style="list-style-type: none"> • All operators should display their Operator Authorization card, on their vehicles / machineries, which is certified by P&M and EHS in Charge • No operator should be allowed to continue to work more than a shift 	2	4	08	<ul style="list-style-type: none"> • Daily vehicle checklist shall be used to inspect the vehicles on daily basis 	1	4	04	Site Engineer

	Activity	Hazard	Risk Involved	People at risk	Control Measures	Assessment			Additional Control Measures	Re-assessment			Action By
						P	S	Risk Level		P	S	Residual Risk	
4		Unauthorized vehicle engaged	Fatal, Serious Personal injuries	Staff, Workmen & Visitors	<ul style="list-style-type: none"> No vehicle shall work inside the site premises without Green card, which is issued after the joint inspection by P&M and Safety Engineer 	2	4	08		1	4	4	Site Engineer
5		Workmen hit by the movement of the excavator / vehicle	Fatal, Serious Personal injuries	Staff, Workmen & Visitors	<ul style="list-style-type: none"> Work area to be barricaded. Workmen shall be instructed to stay out of the swing area of the excavator and machineries involved. Signalmen shall be deputed to give signal & direction. 	2	4	08		1	4	4	Site Engineer
6		Touching the overhead electric lines	Fatal, Serious Personal injuries, Burn Injuries	Staff, Workmen & Visitors	<ul style="list-style-type: none"> Safe clearance as per electricity rule (based on the voltage) shall be maintained or work can be carried after taking shutdown. Drivers of the earth moving machinery shall be trained and instructed about the overhead electric lines. Signalmen shall be deputed to give signal & direction. 	2	4	08	Power shut down shall be taken if required	1	4	04	Site Engineer

	Activity	Hazard	Risk Involved	People at risk	Control Measures	Assessment			Additional Control Measures	Re-assessment			Action By
						P	S	Risk Level		P	S	Residual Risk	
7		Contact or damaging underground utilities (drainage, electrical cables, petroleum / gas lines communication cables and other utilities)	Fatal, Serious Personal injuries	Staff, Workmen & Visitors	<ul style="list-style-type: none"> Excavation permit should be taken for excavations above 2 mtr and above. Cable shall be identified; caution signs shall be displayed and safe distance shall be maintained or these utilities shall be removed/ relocated. Power to be disconnected from power source if underground cable is live. The operator shall be instructed to wear safety shoes to avoid any potential shock. The workers in the area shall be advised not to touch any kind of electrical lines. 	2	4	08	Utility agency shall be contacted for shifting of the same if required	1	4	04	Site Engineer
8		Failure of Make shift tools used	Fatal, Serious Personal injuries	Staff, Workmen & Visitors	<ul style="list-style-type: none"> Only standard & sound tools to be used since there is a possibility for breakage of makeshift tools while using it which may injure the workmen 	2	4	08	Tools shall be checked before every use	1	4	04	Site Engineer

	Activity	Hazard	Risk Involved	People at risk	Control Measures	Assessment			Additional Control Measures	Re-assessment			Action By
						P	S	Risk Level		P	S	Residual Risk	
9		Working with sharp materials	Cut injuries	Staff, Workmen & Visitors	<ul style="list-style-type: none"> Required PPE such as Cut resistant hand gloves, Industrial safety shoes and approved helmets to be used by the workmen. 	2	3	06		1	3	3	Site Engineer
10	Concreting (PCC and flooring)	Hit or run over of vehicle	Fatal, Serious Personal injuries	Staff, Workmen & Visitors	<ul style="list-style-type: none"> Provide banks man for vehicle movement. Ensure green card and daily checklist for vehicles are followed religiously Ensure Authorization card for the operator Reverse horn to be checked Provide the rest shed for worker to avoid taking rest under the vehicle. Speed limit 20 km / hr to be displayed and maintained throughout the site Proper ramp for concrete unloading in bucket/pump should be provided 	2	4	08		1	4	4	Site Engineer
11		Contact with rotating parts/Moving parts	Fatal, Serious Personal injuries	Staff, Workmen & Visitors	<ul style="list-style-type: none"> All rotating parts/Moving part to be guarded 	2	4	08		1	4	4	Site

	Activity	Hazard	Risk Involved	People at risk	Control Measures	Assessment			Additional Control Measures	Re-assessment			Action By
						P	S	Risk Level		P	S	Residual Risk	
					<ul style="list-style-type: none"> In build concrete chute to be rigidly locked Loose garments shall not be worn 								Engineer
12	Column & truss fabrication and erection	Crane failure	Fatal, Serious Personal injuries	Staff, Workmen & Visitors	<ul style="list-style-type: none"> Work area to be barricaded Ensure authorization card for the operator Ensure valid green card for the crane Crane should be positioned on firm surface Daily inspection checklist to be followed Ensure the lifting and erection being done under the safe load capacity of the crane Check all the limit switches and ASLI of the crane Ensure safe clearance distance is available from the nearby overhead and underground utilities Third party inspection certificate of the crane should be verified 	2	4	08	Daily inspection shall be done to the crane with the daily checklist	1	4	04	Site Engineer

	Activity	Hazard	Risk Involved	People at risk	Control Measures	Assessment			Additional Control Measures	Re-assessment			Action By
						P	S	Risk Level		P	S	Residual Risk	
					<ul style="list-style-type: none"> Wire rope, sheave, hook, boom & hook latch shall be visually inspected before the start of operations 								
13		Failure of tools and tackles	Fatal, Serious Personal injuries	Staff, Workmen & Visitors	<ul style="list-style-type: none"> Ensure validity of third party certificate for all lifting accessories Check the physical condition & color coding of the tools and tackles, as per EHS plan Ensure the load capacity of the tools and tackles is more than the load to be lifted 	2	4	08	Tools & Tackles shall be checked before every use	1	4	04	Site Engineer
14		Fall of workmen and materials	Fatal, Serious Personal injuries	Staff, Workmen & Visitors	<ul style="list-style-type: none"> Only height screened workmen should be engaged Safe access to be provided Hand tools and loose materials to be carried in a bag or tied in hand Truss / column to be arrested rigidly before removing the sling Double lanyard safety harness shall 	2	4	08		1	4	4	Site Engineer

	Activity	Hazard	Risk Involved	People at risk	Control Measures	Assessment			Additional Control Measures	Re-assessment			Action By
						P	S	Risk Level		P	S	Residual Risk	
					<ul style="list-style-type: none"> be anchored to rigid support • Safety net shall be provided, where necessary • Height work permit shall be taken, whenever working height exceeds 2.5 mtr • Fall arrestor rope & life line to be provided 								
15		Fire hazard	Fatal, Serious Personal injuries	Staff, Workmen & Visitors	<ul style="list-style-type: none"> • Remove the combustible materials from the work area • Firefighting equipment's should be kept ready at workplace • Only authorized welder / gas cutter should be engaged • Hot work PPE's should be used • Hot work permit shall be taken 	2	4	08		1	4	4	Site Engineer
16		Electrocution	Fatal, Serious Personal injuries, Burn Injuries	Staff, Workmen & Visitors	<ul style="list-style-type: none"> • Ensure good insulation cable condition • ELCB testing to be done periodically 	2	4	08		1	4	4	Site Engineer

	Activity	Hazard	Risk Involved	People at risk	Control Measures	Assessment			Additional Control Measures	Re-assessment			Action By
						P	S	Risk Level		P	S	Residual Risk	
					<ul style="list-style-type: none"> •Welding machine to be body earthed •Rain water covering stand to be provided for the welding machine •Welding and earth holder should be free from damages •Electrical equipment shall be inspected by electrician / P&M personnel and certified 								
17	Brick work	Improper material handling	Serious Personal injuries	Staff, Workmen & Visitors	<ul style="list-style-type: none"> •Material handling training and manual lifting training to be provided for all workmen •Hand gloves to be provided for the all workmen involved in the activity •Mechanical material handling shall be done as far as possible 	2	3	06		1	3	3	Site Engineer
18		Fall of workmen or materials	Fatal, Serious Personal injuries	Workmen	<ul style="list-style-type: none"> •Safe access to be provided •Brick wall should not be disturbed until it gets its strength 	2	4	08		1	4	4	Site Engineer

	Activity	Hazard	Risk Involved	People at risk	Control Measures	Assessment			Additional Control Measures	Re-assessment			Action By
						P	S	Risk Level		P	S	Residual Risk	
19	Fixing of Purlin & roof sheets	Fall of workmen & materials	Fatal, Serious Personal injuries	Workmen	<ul style="list-style-type: none"> • Only height screened workmen should be engaged • Work area to be barricaded • Safe access to be provided • Double lanyard safety harness shall be anchored to rigid support • Safety net shall be provided wherever necessary • Hand tools and loose materials to be carried in a bag or tied in hand • Only standard lifting rope to be used for lifting purlin & roof sheeting • Care should be taken to prevent the cutting of lifting rope by sharp edge of the purlin and roof sheeting 	2	4	08		1	4	4	Site Engineer
20	Plastering & painting works	Fall of workmen & materials	Fatal, Serious Personal injuries	Workmen	<ul style="list-style-type: none"> • Only height screened workmen should be engaged • Work area to be barricaded. 	2	4	08		1	4	4	Site Engineer

	Activity	Hazard	Risk Involved	People at risk	Control Measures	Assessment			Additional Control Measures	Re-assessment			Action By
						P	S	Risk Level		P	S	Residual Risk	
					• Safe access to be provided								
21		Contact with cement, paint & thinner	Fatal, Serious Personal injuries	Workmen	<ul style="list-style-type: none"> • Rubber hand gloves to be used • Workmen should be cautioned about the hazard involved in the activity • Chemicals to be cleaned off immediately, if any physical contact occurs • MSDS of the chemical should be kept readily available 	2	4	08		1	4	4	Site Engineer
22	Plumbing, Electrical and Sanitary & other	Tiny objects falling into eye during chipping works	Eye injuries	Workmen	• Goggles to be used	2	3	06		1	3	3	Site Engineer

	Activity	Hazard	Risk Involved	People at risk	Control Measures	Assessment			Additional Control Measures	Re-assessment			Action By
						P	S	Risk Level		P	S	Residual Risk	
23	installation works	Power failure tool	Fatal, Serious Personal injuries	Workmen	<ul style="list-style-type: none"> Only authorized person should operate the power tools Power tools should be inspected periodically and green sticker system should be implemented Necessary PPE's with respect to the type of power tools to be used. 	2	4	08		1	4	4	Site Engineer
24		Tripping / falling hazard over	Serious Personal injuries	Staff, Workmen & Visitors	<ul style="list-style-type: none"> No materials should be kept in access. Good Housekeeping should be maintained in the work area. 	2	3	06		1	3	3	Site Engineer

Unsafe action and condition photos



Workmen accessing unsafely, guard rail and fall protection not available.



Workmen working at height without fall protection arrangements.



Overhead fall protection arrangements are not provided at adjacent to live road, materials may fall to the road.



Poor housekeeping on site/Unwanted scrap and Debris observed on site creating tripping hazard. C & D waste not disposing regularly.

6.FUTURE WORK AND EXPECTED OUTCOME OF PROJECT

FUTURE WORK

A model will be developed to control and prevent construction worksite accidents by collecting the incident/accident statistics of first aid, near-misses, and reportable cases. It is widely accepted that human error is the main reason for incidents or accidents in complex, high-risk construction systems. The project will be carried out with the help of HFACS (Human Factor Analysis and Classification System), along with the framework to create a model. The issues raised by construction workers, the accident/incident case studies

collected, and the casual influences involved, indicating the manner of humans and the condition of the work area, which in turn lead to incidents or accidents at the construction work site, will be considered. It is decided that control measures will be suggested for the hazards identified to reduce incidents and improve the safety performance at a construction site.

EXPECTED OUTCOME

1. Hazards will be eliminated, and risks will be minimized.
2. No. of Incidents/Accidents will be decreased.
3. The frequency rate and severity rate will be reduced.
4. Site safety standards will be improved.
5. Employee morale will be improved.
6. All legal regulations will be fulfilled.
7. Training and toolbox talk shall be conducted.
8. Near miss reporting shall be done to avoid re-occurrence.
9. Involving workers in controlling of risk with face-to-face interaction.
10. Safety walkdown shall be done to once in a week.

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