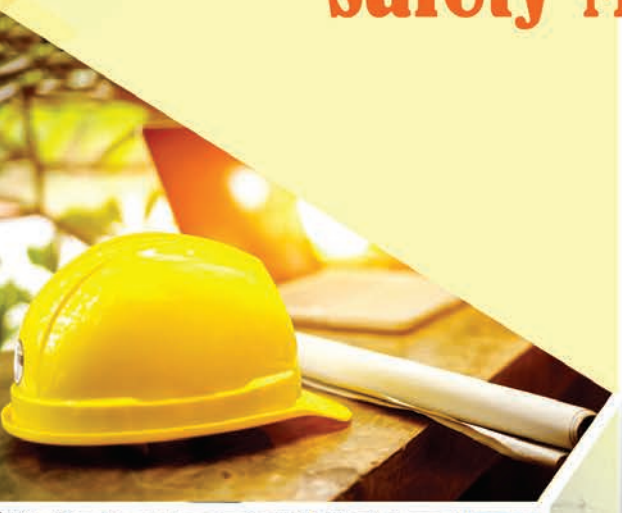
150 YEARS OF CELEBRATING THE MAHATMA

सत्यमेव जयते

स्वच्छ भारत
एक कदम स्वच्छता की ओर

Skilling of Construction Workers & Safety Management in Projects

April 2019









CPWD

CENTRAL PUBLIC WORKS DEPARTMENT
Ministry of Housing & Urban Affairs

Proceedings of Seminar on

SKILLING OF CONSTRUCTION WORKERS & SAFETY MANAGEMENT IN PROJECTS

April 26, 2019

(The views expressed are purely of the authors and not of the editor or their organizations)

DURGA SHANKER MISHRA

सत्यमेव जयते

SECRETARY
MINISTRY OF HOUSING AND
URBAN AFFAIRS
GOVERNMENT OF INDIA



MESSAGE

I am happy to know that Central Public Works Department is organizing a one day Seminar on “Skilling of Construction Workers and Safety Management in Projects” on April 26, 2019 in Vigyan Bhawan, New Delhi.

Indian economy has been on a steady high growth path in the past several years. Construction Sector has played a stellar role in putting India on the path of rapid economic development. There has however been an increasing appreciation that full potential of the construction sector in India's economic development has not been realized due to various challenges.

One of the major challenges has been to increase the productivity of human resource engaged in this Sector. A steady supply of skilled manpower in the Construction Sector is being recognized as one of the keys to achieve India's ambitious infrastructure goals and thus unskilled workforce need to be converted into skilled one. A related issue, which is seeking urgent attention is the Health, Safety and Environment Management at Project Sites aimed at preventing accidents, ill health and eliminating risks to life, thereby improving productivity of the work force.

I congratulate Shri Prabhakar Singh, Director General, CPWD for organizing this much needed Seminar for promotion of the Mission of the Government for 'Skilled India' and Safety Management in execution of the works.

I hope that daylong Seminar will give an opportunity to the participants in knowledge sharing and experiential learning in the field of Skilling and Certification for Construction Workers & Health, Safety and Environment Management.

Place: New Delhi
Date: April 26 2019

(Durga Shanker Mishra)

PRABHAKAR SINGH

सत्यमेव जयते

DIRECTOR GENERAL
Central Public Works Department
Nirman Bhawan, New Delhi



MESSAGE

In the Construction and Infrastructure Sector, Skilling of Construction Workers and Safety Management have become most important to increase their productivity and efficiency at work sites.

Central Public Works Department being a Principal Engineering Organization of Government of India, has accorded highest priority for Skilling of Construction Workers and their Safety at its Project Sites. To promote Mission of the Government for 'Skilled India', skilling of construction workers has been taken by CPWD as a social responsibility. CPWD has already made provisions in its General Conditions of Contract for deploying not less than 20% skilled / semiskilled tradesmen by the agencies in the works. For unskilled workers, a provision has been made for skilling and certification of such workers engaged inthe works. Till now, thousands of unskilled construction workers engaged in CPWD works have been skilled for increased output and quality by them.

I am happy to note that as a part of knowledge sharing and experiential learning in the field of Skilling of Construction Workers and Safety Management at work sites, CPWD is organizing a one-day Seminar on April 26, 2019 in New Delhi. The Seminar will give an opportunity to the participants to deliberate on the various aspects of achieving the skilling of the unskilled workers in the Construction Sector and platform to discuss safety issues.

I am sure that the daylong seminar will give an opportunity to the participants engaged in the Construction Sector to deliberate on the subject of “Skilling of Construction Workers and Safety Management in Projects” and come out with an action plan for the same.

I congratulate Dr. K.M. Soni, Additional Director General (TD), CPWD and his team of officials for their untiring efforts in organizing this seminar and bringing out this useful publication.

Place: New Delhi
Date: April 26 2019

11.12.2018
(Prabhakar Singh)

DR. K. M. SONI

सत्यमेव जयते

ADDITIONAL DIRECTOR GENERAL (TD)
Central Public Works Department
Nirman Bhawan, New Delhi



MESSAGE

India is growing with a very fast speed and large number of Infrastructure Projects of different segments like Bridges, Roads, Ports and Housing are being taken up. All these works require skilled work force to achieve the target with full weightage of accuracy in quality and safety management.

Central Public Works Department is determined to take up "Skilling of Construction Workers and Safety Management in Projects" in its projects all over the country. Skilling of construction workforce is a major constituent of any Engineering Organization for its growth as well as of the Nation. Productivity of any organization also depends on the safety measures taken for the workers and the structure during execution of the projects.

I am happy to note that CPWD is organizing seminar on such an important topic. I wish the seminar a great success

Place: New Delhi
Date: April 26 2019

(DR. K. M. Soni)

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SKILLING OF CONSTRUCTION WORKERS & SAFETY MANAGEMENT AT CONSTRUCTION SITES

J.S. Sharma, CPM, CAPFIMS Prjoect Zone CPWD

Safety management

Safety is one of the vital issues in the success of the project. Safety programme ensures the worker to be mentally and physically prepared to execute a job quickly, fearlessly and efficiently. It must be part of duty of every individual during performance of any activity.

Working in a fearless protected environment makes the team to be more productive and efficient. Although every manager, supervisor, worker accept their safety requirement, but it is by-passed by just lip service due to which construction has become highly accident prone industry.

In India, construction industry is labour intensive, with unskilled and untrained workers. Medical check-up of the workers is also not carried out before engaging them in the construction work. Workers are unaware of the hazards at work site and generally the company hardly makes an effort to explain to workers about inherent risks involved with the job. Due to which Fatal and minor accidents are very frequent.

Many accidents occur due to improper use of tools and equipments. Improper methods and processes are used to cut the time of execution. Such as scaffoldings are not properly made, ladders are not checked properly. Many a time poor quality safety belts are used, which gets broken during accident.

The major causes of accidents in construction industry are due to –

1. Fall from high elevation.
2. Electrocution.
3. Being struck by equipment.
4. Being caught by equipment.
5. Trench cave-in during excavation.
6. Drowning (bridge and offshore construction).
7. Overexertion.

Out of the causes listed ibid, it has been found that more than 40-50% of accidents are due to fall from height or fall of an object.

In order to avoid/minimize the accidents following measures are required to be taken at client & contractor level:

- It is the responsibility of the construction manager to create safety programs that will prevent these accidents.
- The philosophy of the company must be that all accidents are prevented and the actions expected to accomplish that goal must be clearly stated to the employees.
- The safety code of conduct should be communicated to the employees in the company, who should also be made aware of the pros and cons of the accidents.
- During the project planning in the beginning of the work, a unique job-specific safety plan must be developed.
- Task specific hazard should be addressed daily.

Safety program should be developed as a culture of the company. It should be at all times, at all places and all types of work. The workers should feel that the safety constraints are for their betterment. A company can develop its own plan and culture.

Some of the major components of a company safety plan should be –

1. First aid equipment should be available and known to the employee.

2. Personal safety equipment should be provided to every worker.

3. Formal training program for each employee should be mandatory.

4. Procedures for emergency evacuation of injured employees should be clearly explained and employees should be trained for such situations.

5. Safety record and accident report of the company should be honestly examined.

6. Site visit of senior supervisory personnel plays a very important role in safety management.

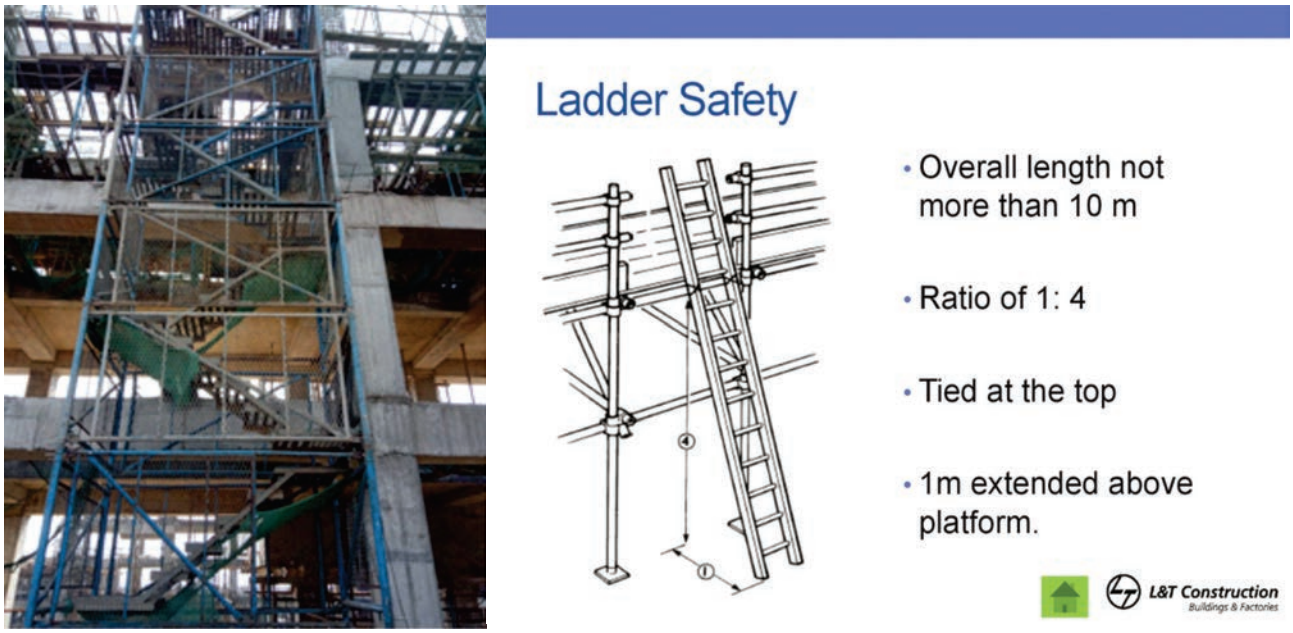
7. Training for all supervisors and the managers should be mandatory.

The role of the owner in the safety management is vital. The cost and time is also dependent on the safety management. In India, large infrastructure construction is carried out by the government agencies. Safety should be included in the contracts for pre-qualification. It has been observed that construction is carried out by many small contractors and they do not follow the safety rules properly. Safety plan should be included in the contract and safety performance should be measured against this plan.

Accordingly CPWD has made the following model code/guidelines for environment, safety and health mandatory in all its projects as part of GCC. These guidelines are generally not

followed at site. However in CAPFIMS project these are being followed to great extent. Details are as below:

1. Ladders to be used, their inclination, their holding to the ground and platform



2. Provisioning of guard rail and Diagonal bracings for scaffolding of staging more than 3.6M height and its fastening so as to prevent it from swaying from the building or structure.



3. Specs and erection of working platforms, gangways and stairways for safer working.



4. Fencing of openings in the floor of a building or in a working platform to prevent the fall of person or materials.





5. Excavation and Trenching-access, timber bracing, method of excavation etc

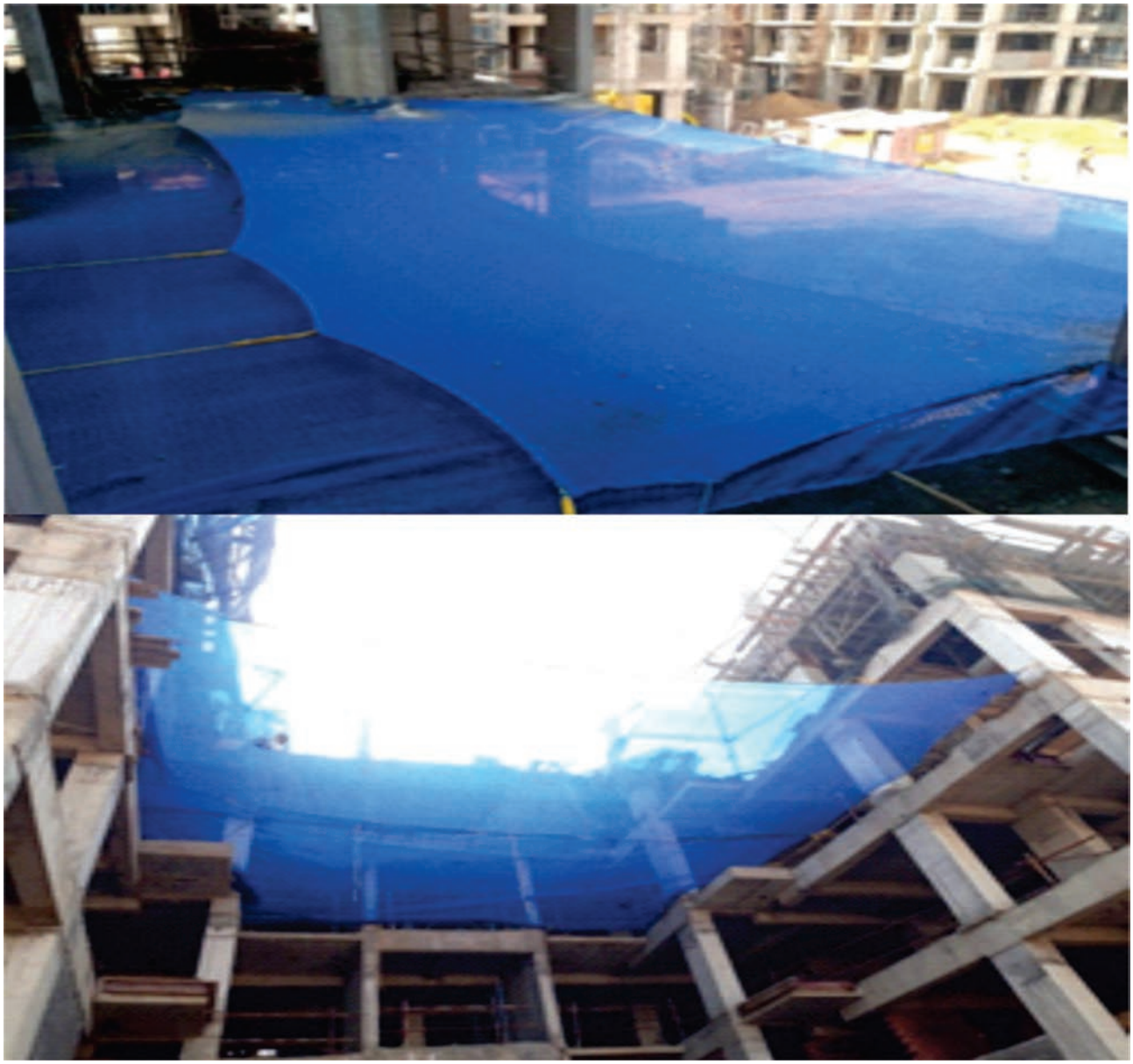
Access to Excavated Pits



Hard Barricade for excavation



6. Safety measures from following objects during Construction or demolition activities.





7. Safety gear & equipments to be used by workers in different activities.



8. Safety precautions while carrying out painting activities.



9. Safety precautions, standards to be followed for hoisting machines, their attachments, anchorage and supports.



10. First Aid facilities required to be maintained at site.





The aforesaid model rules/guidelines can be implemented through carrying out regular EHS(Environment, health, safety) inspections, EHS orientation of workers & staff, enforcing use of PPE(Personal protective equipments) by management

EHS ORIENTATION:

EHS Orientation is intended to teach new workers to identify common on-site hazards and how to guard against them. It will also cover the main requirements of the company's EHS guidelines and instruct newcomers specifically in those areas that affect them personally.

Staff

Orientation program for staff will be framed in such a way that they will be able to perform their work at in a safe & efficient manner. A half-day EHS program with structured contents will be established where all new employees will undergo this orientation.

The salient contents of the program include the following

· Brief details of the project

· Project safety rules & practices

· Details of EHS Management System

· Emergency Response plan & fire prevention program

· Safety in Excavation, electrical safety etc.

Sub - Contractor

Before deploying any Sub - Contractor, site EHS Officer briefs the “EHS Code of Practices” and make them aware of the following

- Their roles & responsibility,
- Importance in achieving conformity to the EHS policy & procedures and to the requirements of the EHS Management system.
- The site safety regulations
- Emergence response plan

EHS officer get the acceptance by obtaining the signature in the form.

Workmen

Orientation of workmen will be as below.

Screening of Workmen:

All workmen are checked for their suitability before deployment by the respective site engineer & safety engineer. His physical fitness, knowledge about the activity and his previous experience are checked before deployed.

Pre-employment Medical Check-up:

Workmen involved in critical activities (such as Drivers & Operators, Height Workers, Food

Handlers at canteen & pantries, Welders) shall be subjected to pre-employment medical checkups); those who do not clear the medical examination shall not be employed. Apart from the above category of workmen, all other workmen also shall be subjected to a pre-medical check - Occupational Health & Hygiene. For example tests for operators include Blood pressure, Vision test etc.

Workmen who are found fit for deployment is sent for EHS induction training.

EHS Induction essentially constitutes an animation film of 40 min duration, which explains a new worker, the various hazards & risks in construction sites and the precautionary measures he should adopt. After completion of film EHS personal give brief site specific safety description.

Visitors

All visitors to site will be given an outline briefing of their responsibilities as contained in the formal induction. The staff concerned with site administration shall arrange for the necessary safety gadgets for the visitors if required. The visitor shall be accompanied by the staff concerned or his nominee throughout the site visit.

PERSONAL PROTECTIVE EQUIPMENT:

"No PPE, No Entry" must be the principle of entering the site.

Safety / Personnel Protective Equipment's (PPE's) does not stop Incident, but it can help to lessen their effects. Employers have a duty to eliminate the hazard and or control the risk, so far as is reasonably practicable. PPE therefore represents a last line of defence for the individual.

Adequate no of Safety equipment's and Personnel Protective Equipment's will be planned and procured, by EHS Manager, with considering sufficient process time and buffer stock depending upon the conditions. On receiving, the safety and personnel protective equipment, EHS Manager will inspect the materials for the approved quality; if the materials are found to be inferior, the materials will be rejected without considering.

All Personnel Protective Equipment must conform to Indian Standards.

PPE Matrix

ACTIVITY	WORKMEN CATEGORY	PPES RECOMMENDED
General – Entry into work premises.	All Employees	Safety Helmet, Safety Shoes & Reflective Jacket
Signalling	Security/ marshal	Reflective Jacket
Working at Height – More than 1.8metres.	All	Full body harness Double lanyard.
Involved with cement & Concrete Handling	All	Gum Boots & Rubber Hand Gloves
Breaking of ceramics & Agglomerate materials	Chippers	Eye protection – Clear Goggles.
Welding & Gas Cutting	Welders & Cutters	Leather gloves, Safety shoe, Welding Shield with proper number.
Working with slush	Un skilled & Excavation gang	Gum boots
Forming and Making shuttering materials	Carpenters and Wood workers	Face shield & Nose Mask
Rebar's handling & Working.	Bar benders	Cotton hand Gloves
Scaffolding	Scaffolders	Cotton hand gloves.
Painting	Painters	Clear Goggles, Nose mask
DG Operators & Other Noise prone areas	Operators	Ear Muff, Rubber Hand Gloves (Electrical Grade)
Electrical Maintenance & Repairs	Electricians	HV Rubber hand gloves.
Concrete Batching Plant	Operators & Loaders	Nose Mask

Color Coding of Helmets:

White	All Staff of L&T/other Respective Person.
Green	Safety Inspectors.
Red	Electricians & Signal men
Blue	Supervisors.
Yellow	Workmen.
Orange	New Workmen (for one month)
Purple	Visitor
Grey	Client

EHS Inspection

The objective of EHS Inspections is to verify that safety provisions and practices conform to worksite rules and regulations and relevant statutory requirements.

In order to ensure the EHS regulation and instruction are adhered to and to identify the potential hazards, EHS Dept. conducts the EHS Inspection on fortnightly basis. EHS Department will follow up with Site Engineers for compliance of inspection highlights.

Types of Inspections

1. General Regular Inspection
2. EHS Committee Inspection
3. Plant, Machinery and Equipment Inspection
4. Electrical Inspection
5. Office / Workmen Habitat Inspection

SKILL UP-GRADATION & CERTIFICATION OF THE CONSTRUCTION WORKERS UNDER BHU PROJECT ZONE, CPWD, VARANASI.

A.K. Gupta, CPM, BHU Project Zone, Varanasi

"Education, vocational training and lifelong learning are central pillars of employability, employment of workers and sustainable enterprise development"

International Labour Organisation

Introduction:

A huge section of India's unorganised workforce engaged in construction sector is unskilled and semi-skilled. Most of them pick up skills and knowledge in an informal set up by observing people or working under their guidance or through complete self-learning. As a result even though they manage to get a job and earn a decent wage or salary, they may not be able to improve their skills. This also affects their productivity and quality of output. They need access to training programs and support from their employers to skill and up-skill themselves. This is where the workers who are engaged at construction sites who have acquired skill and knowledge over a period of time but don't have certificate of their knowledge will be imparted training to bridge the knowledge gap, assessed and finally certified on their current competencies as per NSQF (National Skill Qualification Framework) level.

Objectives:

The skill up-gradation and certification program was conducted on the various project sites under BHU Project Zone, Varanasi in line with the Recognition of Prior Learning Scheme (RPL) under PradhanMantriKaushalVikasYojna (PMKVY). The objectives of this skill up-gradation program are as below:

1. To promote and propagate training & certification of large untapped uncertified skilled workforce working on the construction sites of CPWD.

2. To align the competencies of the un-regulated workforce of the country to the standardised National Skill Qualification Framework (NSQF).

3. To enhance the career/employability opportunities of an individual.

4. To provide opportunities for reducing inequalities based on privileging certain forms of knowledge over others.

Recognition of Prior Learning (RPL) Scheme:

RPL is one of the schemes under PMKVY for certification of the individuals having prior

learning experience or skills. These experience or skills have been acquired by an individual over a period of time by working in informal sector under any guidance or through self-learning. Under RPL scheme these individuals are assessed by Project Implementing Agency (PIA) such as Sector Skill Council (SSC's) or any other agencies designated by Ministry of Skill Development & Entrepreneurship/National Skill Development Council. If required a bridge course is provided to the candidates before certification.

RPL Process:

Implementation of RPL scheme comprises of five steps as below:

Step-I: Mobilisation of the candidates

Step-II: Counselling & Pre-screening

Step-III: Orientation

Step-IV: Final Assessment

Step-V: Certification and Pay-out

In addition to the standardised orientation activities, PIA may propose Bridge courses to be imparted to the candidates. The proposed bridge courses must be of 60-80 hours duration and based on core NOSs of the job roles (Job roles as notified by NSDC).

Skill Up-gradation Program under BHU Project Zone, Varanasi

The Directorate of CPWD vide OM no. 387 dated 31.08.2018 circulated broad guideline for skill development and certification of workers engaged at project sites as per notifications of Ministry of Skill Development and Entrepreneurship vide circular no. H-22011/2/2014-SDE-I dated 26th February 2017, dated 15th July 2017 and 20th May 2016.

In compliance to the above and to realise the vision of making India a Skill Capital, BHU Project Zone has taken initiative of imparting training &certification to the construction workers engaged at the Varanasi Convention Centre site as well as other sites in BHU campus. In the first phase it was targeted for the training & certification of 500 candidates in line with the RPL scheme under PMKVY.

A MoU was signed between CPWD & Construction Skill Development Council of India (CSDCI is Sector Skill Council for construction sector, Constituted under the mandate of National Skill Development Council, MSDE, Govt. of India) on 30.10.2018 in the office of Director General, CPWD.

In the first phase following trades of the workers were covered under this training & certification program:

1. Masonry
2. Bar Bending & Fixing
3. Shuttering Carpentry
4. Construction Painter

Implementation:

Initially, the workers of different work sites at BHU and VCC were briefed about the skill Development programme of the Govt. of India and the benefits of the scheme. All workers had shown very keen interest in doing this course.



Briefing to workers by Sh. A.K. Gupta, CPM, BHU Project Zone, CPWD, Varanasi on 30.09.2018



Signing of MoU between CPWD and CSDCI on 30.10.2018 in the office of Director General, CPWD.



Training Module:

As per the MoU, the orientation and bridge course was done by the training providers attached by CSDCI. The training course comprised of total of 60 Hours duration (12 Hours orientation + 48 Hours on the job training). The final assessment was done by the assessment agency engaged by the CSDCI.

4 Training providers were engaged by CSDCI viz. Bhaskar Foundation, Indiavision Skills, Pratham and OPJCC. The target allotted to different TP's is as below:

- Bhaskar Foundation- 150
- Indiavision Skills- 150
- Pratham- 100
- OPJCC-100

The training providers attached by the CSDCI were allotted various construction sites under BHU Project Zone where they had carried out the whole training program. During orientation program job role kit and safety kit was also distributed to the workers. Apart from training in their trades the workers were also sensitised about the safety measures to be adopted at the construction sites.



Practical session for Assistant Mason by Bhaskar Foundation at the site of Super Speciality Hospital, BHU.



Safety kit distribution to the Candidates at the site of SSB hospital, IMS, BHU.



Practical session for Assistant Bar Bender & Steel Fixer by India-vision skills at the site of Nurses Hostel, BHU.



Assessment of batch of asst. bar bender and steel fixer at the site of Varanasi Convention Centre.

Report and Review:

The overall training program was reviewed jointly by all the parties on monthly basis. Interaction session with the candidates with the representative of CSDCI was also held from time to time to motivate the workers.



Interaction and review session by Ms.Akansha from CSDCI at the site of Super Speciality Hospital, BHU.

Payment Methodology:

The total cost of the project is as under:

A. Payment made to CSDCI by CPWD

Assessment pay-out per candidate	Rs.800/-
Cost for 60 Hours course (12 hrs. orientation+ 48 hrs. on the job training)	Prevailing per hr. rate as notified by MSDE, which is currently Rs.42.40 per hour per candidate)

B. Pay-out to the successfully assessed candidates along with certificate:

An honorarium of Rs.500/- per candidate was given to the successful candidates by the respective contractors along with certificates.

Take Away from this Project:

• With certification to the workers, it will be helpful for the department to ensure the provision under clause-19K of GCC.

• Confidence and motivation to the workers

• Sensitisation in the workers about safety measures and after training it is observed at the site that workers are always wearing PPE's (Personal Protection Equipment's).

• Development of sense of discipline during work like keeping the working place neat and clean.

• In general it is noticed that the overall outcome of workers is more after training.

SKILLING OF CONSTRUCTION WORKERS AND SAFETY MANAGEMENT IN PROJECTS

Daljeet Singh Director (Works) & Devender Gill, General Manager, DMRC

Introduction

India is poised to become the youngest country in the world by 2020, with an average age of 29 years. Its 869 million strong workforce accounts for around 28 percent of the world's workforce. Although India's huge demographic dividend is considered to be one of its strengths, there are still many challenges to be faced. If the youth are not skilled and remain unemployed, they might turn out to be liabilities rather than assets.

India faces a huge skill development challenge. It is estimated that around 50 to 70 million jobs will be created in India over the next five years and about 75 to 90 percent of these will require some vocational training. For India's demographic transformation to be considered a “dividend”, the youth will need to acquire necessary knowledge and skills to contribute towards nation-building or else it will turn into a demographic disaster.

The employment landscape is rapidly changing and new jobs are emerging with fast disruption in business models around the globe. Skills required today as well as job markets are markedly different from those 10 or even 5 years ago. The speed with which these changes are taking place is bound to accelerate. Therefore, the need of the hour is to build a skilling system which would enable the workforce to adapt and match the new requirements, a system that responds well to business needs and also provides new opportunities for all.

Challenges of Skill Development

Skill development for construction workers is something as basic as the need for housing and infrastructure. Not fulfilling this primary need will not only impact the quality of construction, but most importantly, the livelihood of workers.

Skill development will help prospective employees get easier access to the formal job market where they can strive for higher incomes, work under more congenial labour conditions, have greater job security and better access to healthcare and medical facilities. Considering the fact that the academic curriculum is more or less similar across universities and colleges, graduates from tier II and tier III towns typically lose out due to a severe lack of exposure and soft skills in the race for employment.

India is projected to have a skilled-labour surplus of around 245.3 million workers by 2030, owing mainly to its vast supply of working-age citizens and government programmes to boost workers' skills.

Government of India Initiatives:

Skill India is a campaign launched by our Honourable Prime Minister on 15 July 2015 which aims to train over 40 crore people in India in different skills by 2022. It includes various initiatives of the government like "National Skill Development Mission", "National Policy for Skill Development and Entrepreneurship, 2015", "Pradhan Mantri Kaushal Vikas Yojana (PMKVY)" and the "Skill Loan scheme".

The India Skills Report 2018 highlights trends in employment and the outlook of hiring landscape in India while understanding the needs of the job seeker and organizations. The fifth edition of the report aims to bridge the talent demand and supply in the country, by providing a clear understanding of the requirement of skilled manpower in the various industries.

The National Skill Development Corporation India (NSDC) was setup as a one of its kind, Public Private Partnership Company with the primary mandate of catalysing the skills landscape in India. It is based on the following pillars:

1. Create large and good quality vocational institute.

2. Reduce risk by providing patient capital. Including grants and equality.

3. To enable the creation and sustainability of support systems required for skill development.

This includes the Industry led Sector Skill Councils.

DMRC Safety Management Strategies and Role of Skill Development Training in Construction Projects:

With an aim to prepare itself for facing challenges of undertaking large infrastructure project in urban environment, DMRC has focused on two key areas of Prevention and Mitigation. Mitigation efforts attempt to prevent hazards from developing into undesired incidents, or to reduce the effects of such incidences when they occur.

The “Hierarchy of Risk Control” aims at, so far as reasonably practicable, avoiding or reducing risks by applying a series of steps known as principles of prevention and protection. The steps being adopted include the following:

(i) Consider if the hazard can be prevented from arising so that the risk can be avoided (e.g., alter the design to avoid the risk);

(ii) if this cannot be achieved, the risk should be combated at source (e.g., ensure the design details of items to be lifted include attachment points for lifting);

(iii) failing this, priority should be given to measures to control the risk that will protect all people;

(iv) only as a last resort should measures to control risk by means of personal protection be assumed (eg, use of safety PPEs like harnesses).

The philosophy and system adopted by DMRC for ensuring effective safety management in construction as disaster preparedness are:

a. Concept of Self Regulation by the Contractor and Monitoring by DMRC

In the award of any contract by DMRC all contracting parties are obligated to abide by, implement and comply with the DMRC Safety, Health & Environment (SHE) Conditions of Contract. These contract conditions are an integral part of each contract that is awarded.

Whilst there is a concept of "Self-Regulation" in ensuring the prime role for compliance rests with the contractor, DMRC has designed a layered process to safety management. This layered approach ensures regular checking by DMRC which is independent of the contractor. The final layer involves external independent verification and validation of levels of compliance of each contractor concerned.

The Contract Conditions and Manuals are based on Central and State laws concerning Safety and Health and refer extensively to Indian and International standards for Safety in Construction.

b. Contractors Organizational Capability & Competence

Each contractor appoints and employs a team of qualified SHE Professionals. The size, make up and qualifications and experience required is laid down in the Contract conditions. This team within each contractor's organization is dedicated exclusively to safety duties. The Contractor's Project Manager and his Safety Team undertake inspections of the works for ensuring compliance of Safety requirements.

c. External SHE Audit

Under the provisions of the DMRC SHE Conditions each contractor must appoint an External Agency (approved by DMRC) to undertake External SHE Audit. The External SHE Audits must be undertaken every three months (quarterly) for the full term of the contract. The audit is conducted against a comprehensive check list which is based on every compliance point of the Contract conditions on Safety.

d. Site Inspection by General Consultants Safety Experts

Safety Experts of General Consultants are regularly visiting construction sites to monitor the compliance of Safety requirements. Observation Reports are prepared for the Non-

conformances found at site, for which the contractor is directed to submit the compliance report to DMRC

e. Monitoring by the DMRC Site Teams:

The outputs from all of the above auditing and inspection activities are recorded and tracked and performance is monitored by DMRC. For each of the three layers of activity described above, where performance is seen to be lacking instructions are given for correction to be made.

The other very important tool in this effort is training and awareness amongst construction workers. There are five general categories for risk control measures and their effectiveness have also been quantified through various research and studies. Careful study of the research outcome clearly highlights the importance of Training. The details are reproduced below:

Sr. No.	Measure	Effectiveness
1.	Removal or Elimination	100%
2.	Design or Physical Control (engineering)	90%
3.	Administrative Control (procedural)	50%
4.	Training (Work Method Controls) (personnel)	30%
5.	PPE (Personnel Protective Equipment)	20%

The figure clearly demonstrate that Training can easily enhance Safety at worksite in addition to other known benefits of Productivity and enhanced Quality standards.

Safety Training

Training is an important factor in managing safety on construction sites. Realising the importance of Training, DMRC has specified in its Contract Conditions, the requirements of Training to all the construction workers. Under these provisions, all contractors shall provide as a minimum the following types of training:

i. Induction Training shall be given to all persons prior to permitting them to go to the worksite. The workers ID Card should not be issued until this training has been given. This training should include at least the following:

(a) General safety awareness

(b) First aid

(c) Emergency procedures

(d) Use of personal protective equipment

(e) Specific site hazards

ii. Refresher Training shall be conducted at least every three months to ensure that all workers on site are kept up to date with safety requirements on site.

iii. Specific Training shall be provided to persons with safety related tasks, such as Crane Operators, Banksmen, Slingers and Plant Operators etc.

iv. Toolbox Talks shall be designed to highlight relevant safety and industrial health issues to the workforce on a regular basis in order to raise their level of awareness. These should be prepared so that they can be presented by the Site Supervisors.

Few Photographs of such trainings being conducted are attached with this paper.

All training that is carried out shall be formally recorded and signed attendance with copies of the records being kept on the sites for inspection by the Employer's Representative. Details of the respective training course programmes shall be produced, on demand or as per intervals prescribed, which include the following information:

(a) Course Title.

(b) Course Duration.

(c) Course Content.

(d) Target Audience.

(e) Actual Audience with record of attendance.

The Contractor shall keep detailed records of all training undertaken, and shall keep such records available for inspection by the Employer's Representative.

Special initiatives during DMRC Phase- 3 Project Execution

As a part of contract conditions, it was made mandatory for imparting training of 2 weeks/12 days/96 hours duration on Safety Health and Environment (SHE) to all staff and workers of contractors, sub-contractors and their employees. Special Awareness Campaign and safety workshops were held to create awareness and build capacity of the site teams.

In addition, Special focus on Skill based training viz. Safe Lift operation, Scaffolding & Temporary works, Crane Operator Competency, Safe Driving Training etc. were undertaken.

DMRC also participated in Sill India Mission of Govt of India and a pilot program on Recognition of Prior Learning (RPL) was launched under PMKVY scheme.

A brief report of the same is attached.

GLASS SAFETY IN PLANNING AND CONSTRUCTION

Usha Batra, Special DG (WR), CPWD, Mumbai

Abstract

Glass has become an essential building material for use in buildings for functional as well as aesthetic requirements. It is being widely used in various applications such as windows, doors, partitions, railings, floorings, staircases, structural glazing, and architectural features with or without other materials like wood, steel, aluminum.

Glass is a brittle material but with certain modifications, its properties are altered and it becomes specialized material to qualify for being fire resistant, heat resistant, impact resistant, and even bullet resistant and then used in floorings, partitions, curtain walls and railings. Since properties of various type of glasses are different, it has to be selected judiciously to avoid accidents.

Recently, a new section on "Glass and Glazing" Part 6/ Section 8 has been added in the National Building Code (NBC) 2016. This section provides guidance on the selection of appropriate glazing for buildings, determination of thickness of glass used in glazing, specialized operations for fixing and with respect to rescue and fire fighting operations, human safety aspects while using glass in buildings etc. Therefore, glass can now be appropriately selected and used in buildings to ensure safety and structural stability.

Bird safety is also an issue particularly in multi-storeyed glass structures and large windows leading to death of the birds due to hitting the glass. To avoid this, precautions need to be taken in design of windows / glazing.

It must be understood that generally it is not the glass which causes the accidents but inappropriate selection of glass, its use and safeguards in application.

Introduction

Glass has been a fascinating material since it was first made in about 500 BC. By virtue of magical properties, it has come a long way. It is one of the most versatile and oldest materials in the building industry. It has made its journey from a small window pane with grill to large windows without grill to structural glazing to almost every component of building including structural members and glass facades in new age buildings. It has converted opaque offices to transparent offices making them appear pleasing and huge areas.

Properties like transparency, strength, workability, visual appeal, colour ,texture, and recyclable property make it very useful in construction and Architectural purpose. From security benefits to visual appeal glass envelope can offer a lot to the building. Glass building are one of the most beautiful buildings in the . Glass has numerous uses as there is hardly

any component of building where glass cannot be used. From entire facade to doors and windows, floors to walkways, staircases to domes, canopies to skylights, partitions to enclosures, shelves to table tops and counter-tops glass is being used.



Glass enhances the beauty of the building, reduces the dead load of the structure, makes interiors look larger and livelier by reflecting light, illuminating surfaces, connecting spaces and connecting inside to the outside and therefore for confined spaces, glass is the preferred solution. All of us must have observed the wonderful use of mirror in appearance of very small space like toilet or shop as multiplying unlimited spaces.

Use of safety glass

On one hand glass enhances the beauty of built environment but raises safety concerns on the other hand as it can cause severe injury during transportation, cutting, installation, fall, impact, fire and even during occupancy due to human impact, breakage, disasters etc. Glass is one of the most vulnerable material for accidents .In some of the locations in buildings, it is liable to cause severe injury if safety measures are not in place. Glass is a brittle material and needs to be handled with care, therefore, human safety while using glass must be considered.



Glass can break during disasters and broken glass is susceptible to fall, therefore in multi-storeyed structures necessary precautions need to be taken to use safety glass. by architects, engineers, and all other stake holders. Safety measures are also available but seldom used giving least priority to workers safety



Glass usage requires to be given due care for human safety during

- Planning stage
- Execution or construction stage
- During maintenance stage

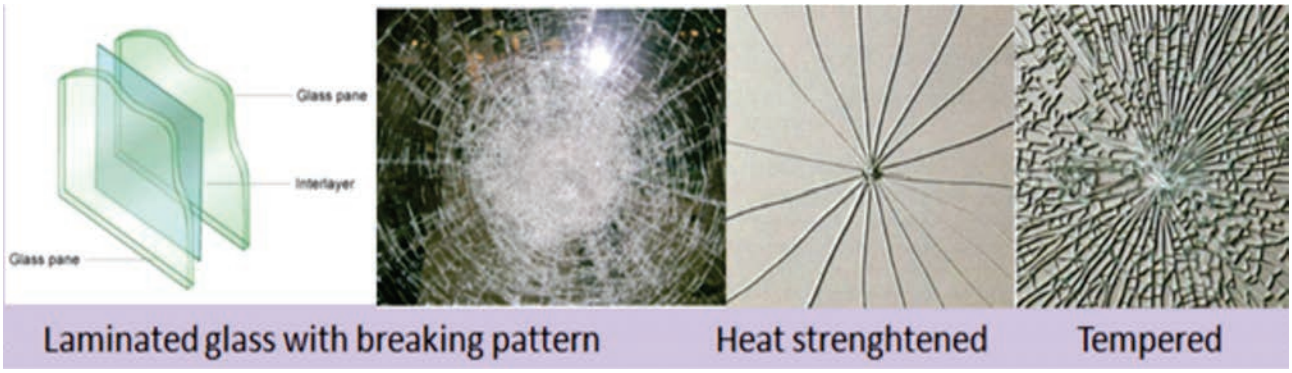
During planning stage safety needs to be considered in design, specification of materials and processes. During construction stage, worker's safety, and Safety due to material transportation,storage, handling and installation and during maintenance stage safety due to fire, disasters and accidents needs to be considered.

First and foremost demand for safety is that presence of glass be made visible. Glass being transparent, can be mistaken as opening and cause head injury. Addition of bands or some other means to make it visible can avoid accident.

Different type of glasses are used in construction for different purposes. Glasses used in construction are Float Glass , Tampered or Toughened Glass , Laminated Glass ,Heat Strengthened Glass ,Fire Resistance glass, Insulated Glass , Patterned glass, Tinted glass, Frosted glass, Bullet proof glass, etc.

Although glass is brittle. Subsequently, chosing right type and at appropriate location makes it safe from fire, earthquakes and even blasts .

Safety glass is constructed, treated or combined with other materials so as to reduce the likelihood of injury to persons by objects from exterior sources or by the glass when is breaks . Laminated glass, Tempered or Toughened Glass and heat strengthened glass are some of the safety glasses used in construction.



Laminated Glass

Laminated glass is composed of two or more layers of glass with one or more layers of a transparent/ pigmented and specially treated plastic Polyvinyl Butyral [PVB] sandwiched between the glass layers. The glass panes (layers) can be either normal glass or tempered

glass. When the glass is broken, fragments tend to adhere to the plastic [PVB] interlayer thereby reducing the risk of injury and helping to resist further damage.

Laminated glass does not shatter like ordinary glass. It absorbs impact, resists penetration, and remains intact even if broken, holding glass fragments in place and lowering the risk of injury. It can even resist bullets, heavy objects, or small explosions.

Laminated glass being an excellent barrier to noise, is ideal for airports, hotels, data processing centers, recording studios, and any building near airports, highways, or train lines. It screens out 99% of the sun's UV radiation thereby protecting interior furnishing, displays or merchandise from fading. Laminated glass remains in the frame, maintaining a protective envelope around the home or building to keep weather out and deter glass shards from flying during earthquake, tornados and hurricanes.

It is easy to clean and retains its colour and strength for the life of the building . When exposed to heat, laminated glass breaks but stays in place longer. The risk of thermal breakage can be avoided by using heat strengthened / tempered laminated glass instead of normal glass.

It is used as Curtain wall glazing , Sloped glazing, Skylights , Glass roofs & floors , Aquariums ,Animal observatory windows , Earthquakes, high velocity winds & fire resistance applications, Museums , Acoustic glazing etc in office buildings, hotels, restaurants, shopping malls, public walkways, hospitals, libraries, museums, churches, airport terminals, residences & apartment buildings, noise control applications, embassies, computer centers.

High security places, for example, banks, teller, and drive-through windows, ticket windows, gas stations, currency exchanges, armoured vehicles, jewellery shops and burglar resistant showcases.

Tempered or Toughened Glass

Tempered glass is an extremely strong glass which is heat treated to a uniform temperature of approximately 650°C and rapidly cooled to induce compressive stresses of 770 kg/m2 to 1462 kg/m2 on the surfaces and edge compression of the order of 680 kg/m2. A deep scratch or an impact penetrates the surface and breaks the glass into number of small particles. All fabrication is required to be completed prior to toughening. Any attempt to cut, drill, grind or sand blast the glass after toughening may result in glass breakage. The heat treatment process does not change the light transmission and solar radiant heat properties of the glass.

It is four to five times stronger than normal glass of equivalent thickness. It provides greater thermal strength, offers increased resistance to both sudden temperature changes and

temperature differentials (up to 250°C compared with normal glass, which can withstand temperature differentials up to 40°C only) is difficult to break and even on breakage it will break into small, relatively harmless fragments thereby reducing likelihood of injury to people, as there are no jagged edges or sharp corners like normal glass. It is used as a safety glazing due to special features like strength, ability to stand impact and breaking pattern safety.

It is used as Curtain walls of high-rise buildings, Spandrels for walls and decorative panelling, Door openings, showroom and lobby facades, escalator side plates, and staircase handrails , Viewing partitions of sports complexes, resorts and airports etc. in commercial applications where wind, snow or thermal loads exceed the strength capabilities of normal (annealed) glass such as safety glazing for entranceway, railings, partitions or fire knock-out windows. Tempered glass can be used in balustrades, escalator side panels, handrails, shower screens, bathtub enclosures, sliding/swing doors, squash, showcases, partitions etc.

Heat Strengthened Glass

Heat strengthened glass is a type of half tempered glass which has been strengthened thermally by inducing a surface compression of 422 to 658 kg/cm2 as compared to a range of 770 to 1462 kg/cm2 in case of fully tempered glass. It is valued for its mechanical strength, which is twice that of normal annealed glass . With the exception of strength and breakage characteristics, heat - strengthened glass retains the normal properties of annealed glass. It provides resistance to thermal stress similar to tinted glass and reflective glass. It also provides necessary resistance to heat building up when used as spandrel glass. Due to its flatter surface facade has less optical distortions.

It is suitable for structural glazing due to safety against thermal breakages. It is used for making laminated glass panels for safety combined with strength. It is used in complex glass combinations like double-glazing as one lite of laminated glass for glass floors and roofs.

CRITICAL LOCATIONS

The following critical locations necessitate use of safety glass

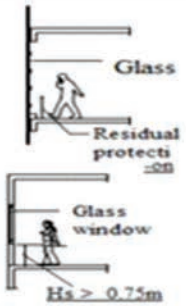
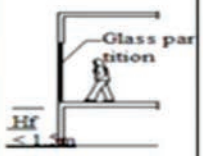
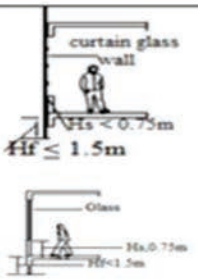
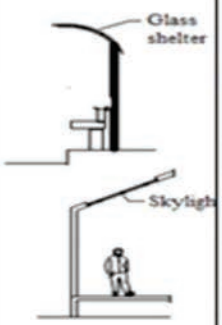
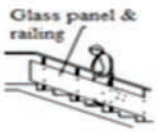
Any glazing within 1.5 metre above the floor level of a building is considered likely to be subjected to human impact

- Where there is danger of falling infill glass materials from overhead glazing, danger of falling due to a change in floor level, and in case of balustrades, stairs and floors.
- In -and-around doors, low windows.
- Panels mistaken for a doorway or opening.

- Panels at low levels in walls and partitions.
- Bathrooms.
- Buildings associated with special activities, e.g. gymnasia, enclosed swimming pools etc.
- Schools and child care facilities.
- Nursing homes and aged care facilities.

Safety glass required in different locations

Locations with no risk of human impact / risk of fall, any glass may be used. Locations with risk of human impact but no risk of fall, are to be provided with safety glass and locations with both risk of human impact as well as risk of fall or only risk of fall must be provided with safety glass preferably laminated glass as per details shown under.

	Case 1 Vertical walls with residual protection# or Hs ≥ 0.75m (not likely to be subjected to human impact)	**Case 2** Vertical walls Hs < 0.75m & Hf ≤ 1.5m (human impact but no risk of fall)	**Case 3** Vertical walls Hs < 0.75m & Hf ≥1.5m (human impact and risk of fall both)	**Case 4** Horizontal or Sloped Glazing (risk of fall)	**Case 5** Glass acting as a balustrade / parapet / railing (human impact and risk of fall both)
					
Type of glass	Any glass*	Safety glass	Safety glass. Laminated float glass is preferred.	Laminated safety glass	Laminated safety glass

If Insulating Glass Unit (IGU) is used in situations mentioned above, then criterion will be followed if IGU is installed in areas subjected to human impact on either side then both the panes of the unit shall be provided with safety glass and in situations where access is restricted to one side of the unit, then only the accessible side should be provided with safety glass .

Strength of the glazing system should be such that it has the ability to hold glass in place and prevent it from falling out as a whole.

Precautions for use of glass in buildings

Glass being prone to accidents, while using normal and even safety glass, some precautions are required to be taken for its use in buildings.

• For Maximum Permissible area of Safety Glass as well as annealed glass corresponding to thickness and supporting conditions i.e 4,3,2 sides etc. upto 7.5sqm , AS:1288-2006 must be referred.

• In cases beyond 7.5 sqm. IS : 875 (Part 3) :1987 (Reaffirmed 1997) is to be referred for external glazing.

Only glass that meets the test criteria as given below in Table 1 is expected to qualify as safety glass

Test	Toughened safety glass	Laminated safety glass	Standard to referred
Resistance to shock test	Yes	-	IS:2553 (Part 1)
Fragmentation test	Yes	-	
Warp test	Yes	-	
Boil test	-	Yes	
Fracture and adhesion test	-	Yes	
Light stability test	-	Yes	

• To protect human beings from injury, appropriate glass must be selected

• Windows or doors must not be operated till the glazing components are installed and the entire glazing system is complete.

• Glazing must never be done at temperatures below 4.44 degC unless precautions are taken to prevent moisture where glass is to be installed.

• It is to be ensured that safety norms are followed not only for glass but for complete assembly i.e. glazing material, gaskets, rope, tape, and glazing clips necessary for setting blocks, glazing compounds and sealants etc.

• The edges of a laminated lite must be grounded and not be exposed to any prolonged contact with moisture. Consideration must be given to the use of weep holes or other alternate glazing procedures to ensure a dry framing cavity.

• All door sizes, transoms, jambs, heads, locks, and any other special requirements must be

detailed and all types of hardware must be selected before tempered glass is ordered, as its size can't be altered.

• Precaution should be taken for right product to ensure proper quality.

Precautions in handling, transportation, cutting and fixing glass

• It should be ensured in multi-storeyed buildings having structural glazing that framework is properly designed and is rigidly fixed to the structure.

• Selection of glass to be based on location, size, breakage characteristics, type of building and its use, in particular the number of the people expected to be in close proximity to the glass in critical locations, requirements for fire, security ,wind loading, thermal breakage, energy efficiency and deflection, vision, acoustics and other consideration and impact of trolleys, carts, luggage etc .

• Presence of glass doors must be made apparent .

• Installation procedures, must be followed as per BIS.

Precautions for use of glass for fire safety

• Fire rating of the glass needs to be considered as per the codal requirements from fire safety as well as from evacuation considerations.

• Sufficient side hung openings/windows need to be provided for fireman to evacuate trapped people .These openable portions have to be left at regular distances for firefighting and smoke exhaust.

• Alternatively, knock-out panels are to be provided with tempered glass to allow fracturing of the glass into small pieces, identified by a non-removable reflective dot (typically 5 cms in diameter) located in the lower corner of the glass to be visible from the ground by the fire fighters.

• Space between the slab and façade to be provided with fire stops and fire rated GI backup panel to stop fire traveling from one floor to another.

• Glass proposed to be used for internal fire compartmentation should either be low radiation (Class EW) or insulated fire rated glass (Class EI) conforming to National Building Code of India 2005.

Fire resistant glass

Glass can actually substitute a brick wall in terms of fire-rating property while maintaining transparency. Glasses recommended for fire safety are ; Wired Glass , Borosilicate Glass , Toughened Glass with flame retardant coating , Toughened Glass with Intumescent gel and

Laminated Glass with Intumescent layers.



Fire protection glass blocks smoke and fire but allows heat to transfer on the other side whereas fire resistive glass blocks smoke, fire as well as heat. Therefore depending upon the requirement, fire resistant glass can be selected.

Bird Hitting

Glass has the property of being transparent, connecting interior to exterior and even reflective surface. These properties are used by the architects for advantage in buildings for humans but for the birds, they sometimes prove to be catastrophic. It is estimated that about one billion birds die from window/glass hitting in US each year. With multi-storeyed structures rising in India, large glass surfaces being provided in windows and balconies and green potted plants being placed inside houses, this problem may increase in the country.

As per the experts, there are two types of bird hitting i.e. day hitting and night hitting. During daylight, birds crash into glass windows because they see indoor potted plants/vegetation from outside and as transparency of glass is mistaken as opening and leads to hitting against glass. During night time, birds collide due to lighted windows. Sometimes birds also hit windows/glass by chance or even by seeing their own image in reflective glass and attacking it mistaken as some other bird. On colliding with glass, most of the birds die due to impact.



To make windows safe from bird hitting, vertical and horizontal marking technique in the form of strips, paint, stickers, tape etc on outside surface can be used. Other arrangements like screen, mosquito nets, solar films etc also act as deterrent due to partial opaque surface. Commercially available options include ABC BirdTape, Acopian BirdSavers, Evonik Soundstop Birdguard, bird safety films, Bedheim Channel glass etc. Sunshades/chajjas provided over the windows also deter the birds to collide.

Conclusions

• Looking at the increase in use of glass in building industry, human safety has become the main concern making it important to select the right type of glass, appropriate thickness and complete glazing system.

• Glass needs to be selected based on its location, requirements of site, function, fire safety and human safety .

• To minimise accidents, it is onus on the Architect / designer to appropriately use the quality of transparency while designing so that presence of glass is made visible.

• Safety measures must be provided to workers for handling glass.

• Problem of bird hitting must be kept in mind while design of glazing.

• Due to increase in fire accidents, all the provisions for fire safety must be mandated and strictly followed.

APPRENTICESHIP INCLUDING NATIONAL APPRENTICESHIP PROMOTION SCHEME

Surajit Roy, Director, National Skill Development Corporation (NSDC)

Context of Apprenticeship in India

India is a young nation- youth educated and skilled; yet not industry ready/employable as they do not have shop floor training. Apprenticeship bridges the High Demand for Industry Ready Skilled Manpower in India and in developed countries that have an aging workforce.

It is essentially an industry demand driven program that allows intake of apprentices to train them on the shop floor of the establishment. Hence it facilitates the much needed shop floor exposure to the apprentice and enables him/her to become industry ready.

Industry Friendly Legislation for Apprenticeship

The apprenticeship programme in India formally started with the promulgation of the Apprentices Act 1961. The Government of India has brought about comprehensive reforms in the Apprenticeship Act in 2014 (& the Apprenticeship Rules in 2015) to make apprenticeship extremely industry friendly and self regulated. Some of key reforms include:

- Removal of prescriptive, quota-based apprenticeship norms and the introduction of a flexible need-based band of 2.5% to 10% of total manpower
- Introduction of Optional Trades under the apprenticeship programme, enabling industry to design their own courses
- The service industry has been brought under the apprenticeship umbrella
- Graduates, Youth who have passed NSQF aligned Short Term Training (STT) courses, and even class VIII unemployed youth are eligible to undergo the Apprenticeship Program.

Difference between Apprenticeship and Skilling in General

While Skill Development is essentially a supply driven programme being run through Training partners, the Apprenticeship program is essentially a demand driven programme to meet specific needs of the industry.Apprenticeship moreover, is mandated by law.

What is Apprenticeship?

The Apprenticeship Program consists of Basic Training and On-the-Job-Training(OJT)/Practical Training at the workplace in the industry. The basic training is an essential component of apprenticeship training for those who have not undergone any institutional training/skill training before taking up on-the-job-training/practical training.

Apart from basic training, there is a component of on-the-job training which is performed in the establishments and undertaken by the establishmentitself. Basic Training usually accounts for 20-25% of the duration of the overall apprenticeship programme but can vary depending on the specific requirement of the curriculum. The basic training and on-the-job training component can run simultaneously or sequentially one after the other, in accordance with the arrangement between employer andSSC/ training partner. In the case of sequential mode, basic training will precede OJT.

National Apprenticeship Promotion Scheme

The Government of India,launched the National Apprenticeship Promotion Scheme (NAPS) in August 2016, to promote the apprenticeship programme in India by introducing a package of financial incentive to establishments engaging apprentices. This package is specially intended to support and promote apprenticeship in the MSME segment for enhancing its productivity and competitiveness as well capacity building.

The financial benefit has two components:

I. Reimbursement of 25% of prescribed stipend, subject to a maximum of INR 1,500 per month per apprentice

II. Reimbursement for cost of basic training, up to INR 7,500 per apprentice for a maximum period of 3 months/500hours.

Apprenticeship Is Mandated By Law
Establishments required to engage Apprentices

Employee Strength	Eligibility	Apprenticeship Band	Apprenticeship Duration
0 - 5	Not Eligible	Not Eligible	Not Eligible
6 - 40	Optional	2.5%- 10% of Employee strength including contractual workers	6-24 months
>40	Mandatory	2.5%- 10% of Employee strength including contractual workers	6-24 months

The establishments have the flexibility to choose the trades/job roles as per their specific requirements. The flexibility to an establishment allows them to even design their own courses and take on apprentices on stipend of 70% of the state minimum wage for semi-skilled workers.

What are the possible benefits of Apprenticeship for establishment

• Freedom to design an industry specific course

• It is a well-established way to make potentially employable people industry-ready

• Reduces attrition-studies conducted by ILO reveal that employees who have come through an apprenticeship program tend to stick to stay on longer in an establishment from where they have undergone an apprenticeship course.

• Hedges the training cost/recruitment costs

Courses under Apprenticeship

As per the amendments under the updated Apprentices Act, 1961/ Apprenticeship Rules 1992, an establishment has full discretion to design & run an Optional Trade Apprenticeship Programme; It needs to only upload the syllabus and duration on the portal. In case an establishment opts for financial support under NAPS it needs to have these course National Skill Qualification Framework (NSQF) aligned as public funding has NSQF alignment as a pre-requisite.

To facilitate establishments to design their own "optional courses" & frame requisite entry qualifications and curriculums under them, a template has been designed to standardize this process. A standardized template makes it easy for all stakeholders to understand the processand the different pathways available to the youth for apprenticeship.

Portal

The registration of Establishments as well as Candidates has been detailed on the portal www.apprenticeshipindia.org. All contracts of apprentices are generated on the portal ; the BTPs and TPAs registration is on the portal as well.

Basic Training Providers (BTPs)

Basic Training (BT) is the theory component of Apprenticeshipwhich theindustry can choose to conduct BT inhouse; or outsource to an independent BTP. BT is envisaged to account for 20-25% (max 3 months) of overall duration of Apprenticeship. It would be provided as per the available curriculum of apprenticeship courses. NAPS benefit of up to INR 7,500 for a period of max 3 months would be extended to the BTP (at INR 15 per hour). All ITIs and NSDC Training Partners registered on SMART or SDMS are eligible for providing basic training under NAPS; any other BTP suggested by the industry and registers on SMART

Third Party Aggregators (TPAs)

TPAs arrange for Basic Training of the candidates who need to do BT under the Apprenticeship program. They also select up to 3 establishments for On-the-Job Training (OJT) in case complete facility as required under the course curriculum is not available with a single establishment. TPAs operate on apprenticeship portal on behalf of the establishment,

create opportunities, select candidates, send offer letters etc. Monitor the apprenticeship program for each apprentice and submit reimbursement claims on behalf of the establishment can also be done through TPAs. They ensure compliance to all formalities regarding assessment and certifications

Conclusion

The Ministry of Skill Development and Entrepreneurship has left no stone unturned to incorporate the industry feedback and create reforms based on real time challenges. With the help of the government as well as the private sector, we can enhance the future of jobs and take on Apprenticeship. The Apprenticeship Program is thus far, the game changer in the skill ecosystem to bring India to the International Standards as a World Skill Hub with industries as the biggest beneficiaries.

Contact Details:

Pangkhuri Borgohain: Pangkhuri.borgohain@nsdcindia.org

Portal Link to Register: http://www.apprenticeshipindia.org

SKILLING OF CONSTRUCTION WORKERS

N.N. S.S. Rao, CE, SZ-II, CPWD

Introduction:

In case of civil construction works hardly 5 to 10 % certified skilled workers are available on sites and in case of Electrical & Mechanical works 40% to 50% certified skilled workers are deployed at site. While there is a system of certification (having a qualification like ITI and license etc) for electrical workers, the same was not existing for civil workers. CPWD is executing construction works of amounting to Rs. 20,000 Crore and over a period of time manual component in work is decreasing and machinery component is increasing. Besides this new materials and technologies are being used. Thus there is an increasing need of training and skill development of workers and their subsequent deployment on construction sites.

Need for Skill Development:

Skill, Speed and Scale are the need of the hour. Skilled worker have higher productivity and give better qualitative and quantitative output and this in turn enhances earning capacity of the workers. Skilled workers in construction sector understand properties of material, use of tools, correct method of applications and the spirit behind application. This leads to less wastages, more speed and finally scaling up of the operations.

Government initiative for Skill Development

The Government of India has launched PMKVY (Pradhan Mantri Kaushal Vikas Yojana) for skill development .and certification. The objective of this skilled certification scheme is to enable a large number of Indian youth to take up industry – relevant skill training that will help them in securing a better livelihood. Individuals with prior learning experience are skills will also be assessed and certified under Recognition of Prior Learning (RPL). CPWD being the premier construction agency of the Government of India has the mandate and responsibility to promote skill development in construction sector. The Skill Development Programme helps in doing a Qualitative work in a time bound manner there by avoiding the time over run and cost over run .

This is also included in clause 19 (K) of the General Conditions of Contract (GCC 2014) for CPWD works which specifies deployment of 20% of certified skilled / semi-skilled tradesmen in a particular trade at each stage of work. Further by two numbers amendments this has been taken to a higher level by incorporating provision for arranging on site training as per National Skill Development Corporation (NSDC) norms for at least 10% of the

unskilled workers engaged in the project for certification at the level of Skilled/ Semi skilled tradesmen for works costing more than Rs. 50 crores and upto Rs.100 crores. For works costing more than Rs.100 crores the contractor shall arrange on site training as per NSDC norms for at least 20% of the unskilled workers engaged in the project for certification at the level of Skilled/ Semi skilled tradesmen.

Implementation of skill development:

Training and skill development programme leading to certification is carried out by CPWD at major sites through reputed institutions like CPWD Training Institute, NICMAR, National Academy of Construction, CIDC etc as per National Skill Development Corporation (NSDC) norms. For bigger sites, workers of that site only are involved, for smaller sites workers are collected from different sites to make a sizeable group of 20 to 30 for imparting of training. Typically this training is imparted for 60 hours to 180 hours depending on the current skill level of the workers.

Skill development programme in CPWD Hyderabad:



A skill development programme was completed recently in coordination with National Academy of Construction, Hyderabad for CPWD works in Hyderabad Central University. This programme was taken up for training of masons. The programme was carried out from 06.02.2019 to 16.02.2019, inauguration was done by the Vice-Chancellor, Hyderabad Central University who emphasized the need for skill development and appreciated the efforts of CPWD in this direction. Since there is no single large construction work, therefore twenty five masons from four different sites within the campus of Hyderabad Central University were collected in a group and imparted training and certificates.



A team of one course co-ordinator and two trainers from National Academy of Construction (NAC) Hyderabad imparted the training.

1. The First step of training is making the workers aware of the benefits of the program and assessing present level of skill of the workers.

2. Depending on the present skill level a training module was designed for 80 hours (8 hours x 10 days).

3. In the mornings a one hour session of theoretical aspects, doubt clearance and discussion was held.

4. Thereafter, the workers were doing their normal work at their respective site and the team of NAC watched their work and suggested improvements.



5. Various aspects of masonary and associated works like brick masonary, stone masonary, mortar preparation, plastering were covered in detail by the NAC team.

6. This was a hands – holding training on site, in this training program 100% of the workers received the certificate.



7. On conclusion of the training a proficiency test of the workers was conducted and thereafter certificates were awarded to qualified workers.



ISO 9001:2015

NATIONAL ACADEMY OF CONSTRUCTION

(A Society of Government of Telangana)

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Certificate

Ref. No. NAC/CTTI/0136072/2018-19 dt 16 February 2019

This Certificate has been awarded to Mr./Mrs./Ms. Chairam Raut

S/o. D/o. W/o. Bhaulal Raut on successful completion

of Masonry Skill Upgradation

Training Course conducted by the National Academy of Construction

from 06 February 2019 to 16 February 2019 at NAC- Hyderabad Centre

in Hyderabad District, under sponsorship of Central Public Works Department, Govt. of India.

Asst. Director

Director, NAC

Challenges:

The main challenges for an effective and continuous training and skill development programme are:

1. Construction workers are mainly migrant labour, not staying at a place for a long time.

2. These workers are basically floating from one site to another and relocating their stations and employer.

3. These days most of the contractors do not have their own permanent set of labour. Hence they do not see any direct benefit to them from this programme.

4. Reluctance of the workers to take-up the programme fearing loss in daily wages.

5. Employment generation schemes of the Government of India where unskilled labourers are employed in large numbers.

6. Lack of positive attitude of the departmental officers and contractors towards essentiality of such a training.

Conclusion:

It is widely accepted that skill development is the need of the hour. It leads to improved productivity, quality and handling of bigger works with less manpower. Besides it helps to improve socio-economic condition of the work force. However this is a major transformation and hence would require a focused attention in a time bound manner, else it would be difficult to get quality works at a good speed. The training programmes will have a long term benefit as it would lead to creation of a data base of certified skilled workers and employment of workers from this pool for construction works.

AN OVERVIEW OF QUALITY SKILL GENERATION

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Abstract:

Presently most of the skill development programme run by CPWD as well by other organization & PSUs are certificate programme by organizing small work shop and/or small training programme. The workers already working in the different trades in which they have acquired skill by getting experience in due course by working in that particular trade or job. These workers are given certificates by the above mentioned skill development programmes .Creation of new skills in a fresh mind is not being created by these programmes.

In the 70s vocational courses to class 8th and 10th standard as well as 11th & 12th standard were in force and vocational training was imparted parallel to the theoretical courses which are missing now a day in 10+2 system. Need of the hour is to bring that trend back and to be implemented to create quality skilled man force.

1. History of Vocational Education in India:

Vocationalization is a programme which can bring education into closer relationship with productivity. By vocationalization more highly skilled, competent & effective and enterprising work force can be produced. This is of special significance in the Indian situation where, the educational system has been training young persons so far mostly for government services and the so called white collared profession

The introduction of practical subjects in secondary schools so as to divert them into different walks of life was first recommended as far back as in 1882, by the Indian Education Commission but due to non effective implementation, the enrolment in the vocational courses at secondary stage is very less of the total enrolment. Even at the University stage, vocational education (other than law, medicine or teaching) was mostly ignored. Great majority of University students pursue literary courses which do not fit them for any but administrative clerical, teaching and indirectly legal careers.

1.1 Abbot Wood Reports on Vocation Education in India(1937)

Abbot and S.H. Wood were the two experts who came to India from England on the request of the Government of India and after a detailed enquiry submitted a report on the organisation of vocational education in India.

Some of the terms of reference were as follows:

"To advise

1) Whether any vocational or practical training should be imparted in primary, secondary and higher secondary schools and if so, what should its nature and extent?

2) In the light of the answer to (1), to advise whether the technical or vocational Institutions already in existence can be improved and, if so, in what manner and, if new institutions for vocational or technical training be required, to suggest:

i) The type of institution or institutions required for the purpose,

ii) The stage at which diversion of the students from the ordinary secondary schools (lower or higher) to such institutions should be effected, and

iii) The means to be adopted for effecting such diversion, i.e. vocational guidance."

The Report of Abbot and Wood suggested a complete hierarchy of vocational institutions parallel with the hierarchy of institutions imparting general education. One important result of their recommendations was that a new type of technical institution called the 'polytechnic' came into existence. Technical, commercial or agricultural high schools also started conducting non-literaiy courses.

1.2 Vocationalization at the Lower Secondary stage

At the lower secondary stage, the enrolment in vocational education need to be increased with a systematic approach to introduce vocational courses at this stage, either part-time or full-time. The mind set of school going children need to be focussed towards self employment of vocational education.

At the primary stage of education from to Socially Useful Productive Work (SUPW) Work Experience (WE) forms an integral part of the curriculum in many states. These programmes at middle school stage aim at developing confidence and sufficient skills in students to enter the world of work directly or through certain occupational training courses and become the part of economical growth of the country.

1.3 Vocationalization at the Higher Secondary

It is the need of hour to vocationalize higher secondary education and to expand the vocational courses to cover about half of the total enrolment at this stage. A large Varity of terminal courses should be organised, varying in duration from one to three years. They will include courses for the training of primary and pre-primary teachers; courses conducted by the industrial training institutions for a large number of trades for which the completion of studies in class X is the minimum qualification, courses in agriculture and industry which will train the middle level of personnel needed, courses for training para-medical health

personnel, courses for secretarial work; and, courses in home Science.

2. Skill Development:

In India, general educational and vocational education & training have been operating as separate verticals: with very little interaction between the two. This has led top hesitation amongst the youth in opting for vocational education and training as it is presumed that this avenue would preclude the concerned individual; from being able to acquire higher degrees and qualifications.

Majority of Indian qualifications are not recognised interationally and vice-versa. This creates a problem for the students and workers as their international mobility is adversely affected and they often have to undergo a course again to get a qualification that is recognised in the host country.

Major section of India's unorganised work force engaged in construction sector is unskilled and semi skilled. Most of them pick up skills and knowledge in an informal set up by observing people or working under their guidance or through complete self learning. As a result of this even though they manage to get job and earn decent wages or salary, they may not able to improve their skills. This also affects their productivity and quality of output. To improve or enhance their skills they need training programmes and support from their employees.

Skill means the ability to apply knowledge and use know how to complete tasks and solve problems. Skills are described as cognitive (involving the use of logical, intuitive and creative thinking) or practical (involving manual dexterity and the use of methods, materials, tools and instruments).

Skills and knowledge are driving forces of economic growth and social development for any country. Countries with higher levels and better standards of skills adjust more effectively to the challenges and opportunities in domestic and international job markets. The first industrial policy in the country was notified in 1956, Science and Technology policy in 1958, Housing Policy in 1988 and National Labour Policy in 1966. The first National Policy on Skill Development was notified in 2009. In the aftermath of this policy, National Skill Development Corporation (NSDC) was established in 2009 to promote private sector participation via innovative funding models. NSDC has tied up with more than 211 training providers, many of whom have started scaling up their operations, to offer short term training programmes. They also supported and incubated 37 Sector Skills Councils (SSCs) which are intended to facilitate much needed participation and ownership of industry to ensure needs based training programmes. National Skills Development Agency (NSDA) which was created in June 2013 has been working with State governments to rejuvenate and synergise skilling

efforts in the States. National Skills Qualification Framework (NSQF) skilling and education outcomes with the competency based NSQF levels. These efforts build on the legacy vocational training infrastructure of Industrial Training Institutes and polytechnics which have now grown in number to approximately 12,000 and 3,200 respectively. The country, however, has a big challenge ahead as it is estimated that only 4.69% of the total workforce in India has undergone formal skill training as compared to 68% in UK, 75% in Germany, 52% in USA, 80% in Japan and 96% in South Korea.

One of the major challenges in the country today is public perception on skilling, which is viewed as the last option meant for those who have not been able to progress/opted out of the formal academic system. A number of factors are responsible for this state of affairs:

Social and traditional view that sees status as being inversely proportional to the degree to which one works with one's hands. This can also be attributed to primeval and archaic ethos which compartmentalized the skilling landscape for several hundred years. This unfortunate legacy has no moral, ethical and constitutional sanction in free India. Nonetheless, this gets at times manifested in norms, attitudes and societal behaviour.

The proclivity of large sections of industry especially in the micro, small and medium sectors to treat skilled and unskilled persons at par, thereby depriving skilling of any meaningful economic incentive.

Most of the vocational training programmes are not aligned to the requirements of the industry As a result of the above, a piquant situation exists in the country wherein unemployment continues to coexist with lack of requisite number of skilled people at functional level to build roads and bridges, lay pipelines, work in factories, engage in offshore drilling, build ships etc.

3. Government Initiatives:

Skill India is an initiative of the Government of India which has been launched to empower the youth of the country with skill sets which make them more employable and more productive in their work environment. The National Skill Development Corporation India (NSDC) was setup as a one of its kind, Public Private Partnership Company with the primary mandate of catalysing the skills landscape in India.

PMKVY is the flagship scheme of the Ministry of Skill Development & Entrepreneurship. The objective is to enable a large number of Indian youth to take up industry-relevant skill training that will help them in securing a better livelihood. Individuals with prior learning experience or skills will also be assessed and certified under Recognition of Prior Learning (RPL). Under this Scheme, Training and Assessment fees are completely paid by the Government.

The National Skills Qualifications Framework (NSQF) is a competency-based framework that organizes all qualifications according to a series of levels of knowledge, skills and aptitude. These levels, graded from one to ten, are defined in terms of learning outcomes which the learner must possess regardless of whether they are obtained through formal, non-formal or informal learning. NSQF in India was notified on 27th December 2013.Under NSQF, the learner can acquire the certification for competency needed at any level through formal, non-formal or informal learning. In that sense, the NSQF is a quality assurance framework. Presently, more than 100 countries have, or are in the process of developing national qualification frameworks.

Skill development programmes of the Central Government over the years have been spread across more than 20 Ministries/Departments without any robust coordination and monitoring mechanism to ensure convergence. The scenario is no different in most of the states except the few states which have moved towards functional convergence by creating State Missions. This legacy has resulted in multiplicity of norms, procedures, curricula, certifications etc. Further, many of these skill development initiatives often remain unaligned to demand, thus defeating its entire objective.

Different states in India face varied challenges in relation to demographics and skill development. There needs to be a shared sense of urgency to address the challenges of the changing demography. While State Skill Development Missions (SSDMs) have been launched in almost all States, there is an imminent need for capacity building and empowerment of SSDMs in many States in order to upscale quality skill development.

4. Challenges of Skill Development:

One of the biggest challenges of skill development in our country is that 93% of the workforce is in informal/unorganised sector. Consequently it is difficult to map existing skills in the unorganised sector and gauge the skilling requirement in the sector. On the other hand, the rate of job growth in informal sector is estimated to be twice that in formal sector.

Women constitute almost half of the demographic dividend. The key challenge here is to increase their participation in the country's labour force, which is directly linked to economic growth of the country. Census data has revealed that there has been a continuing fall in labour force participation rate of women from 33.3% to 26.5% in rural areas and from 17.8% to 15.5% in 6 urban areas between 2004 and 2011. Mainstreaming gender roles by skilling women in non-traditional roles and increasing gender sensitivity in the workplace will have a catalytic effect on productivity and be a smart economic decision.

Job creation for skilled youth is also a major challenge before the nation. Entrepreneurship based on innovation has immense growth potential. However, the number of local

entrepreneurs emerging every year in India is very low. The Global Innovation Index 2014 ranks India 76 out of 143 countries. Accelerating entrepreneurship especially that based on innovation is crucial for large-scale employment generation in India.

The growth and prosperity of all economies remains highly dependent on entrepreneurial activity. Entrepreneurs are the essence of economic growth they provide a source of income and employment for themselves, create employment for others, produce new and innovative products 8 or services, and drive greater upstream and downstream value-chain activities. Supportive environments are increasingly essential to successful entrepreneurship and these are evolving across the world. The ideal entrepreneurial environment has five pillars: Access to funding, Entrepreneurial culture, Supportive regulatory and tax regimes, Educational systems that support entrepreneurial mindsets; and a coordinated approach that links the public, private and voluntary sectors.

The face of entrepreneurship is also changing across the world; entrepreneurs are increasingly young and/or female due to increasing unemployment. The International Labour Organization (ILO) reports that globally, almost 13% of young people (close to 75 million people) are unemployed. This phenomenon is particularly evident in regions where wage employment is difficult to obtain. Access to funding remains the primary obstacle for entrepreneurs from all markets. The public and private sector each have an important role to play in creating entrepreneurial ecosystems that, in addition to funding, are essential to promoting entrepreneurial success.

National Skill Development and Entrepreneurship Policy 2015 attempts to address these concerns. It tries to bring the world of education and training closer to the world of work so as to enable them together build a Strong India.

Beyond the certification courses number of institutions which provides vocational education is to be increased. Number of ITIs, Polytechnic and other institutions imparting vocation training need to be increased. The concept for self employment by vocational education is to be inculcated among the school boys .There mindset that to get only education for blue collar job is to be changed. This shall not be changed in the overnight continuous and consistent efforts are required. This is the need for the countries like India where most of the youth are getting theoretical education and are not able to get the employment. These unemployed youth didn't have the other expertise than clerical job so they do not able to contribute in economical growth of the country.

5. Objectives of Skill Development:

Vision : "To create an ecosystem of empowerment by Skilling on a large Scale at Speed with high Standards and to promote a culture of innovation based entrepreneurship which can

generate wealth and employment so as to ensure Sustainable livelihoods for all citizens in the country."

Mission: The mission is to-Create a demand for skilling across the country; Correct and align skilling with required competencies; Connect the supply of skilled human resources with sectoral demands; Certify and assess in alignment with global and national standards; and Catalyse an ecosystem wherein productive and innovative entrepreneurship germinates, sustains and grows leading to creation of a more dynamic entrepreneurial economy and more formal wage employment.

Objectives:

The core objective of the Policy is to empower the individual, by enabling her/him to realize their full potential through a process of lifelong learning where competencies are accumulated via instruments such as credible certifications, credit accumulation and transfer, etc. As individuals grow, the society and nation also benefit from their productivity and growth. This will involve:

i. Make quality vocational training aspirational for both youth and employers whereby youth sees it as a matter of choice and employer acknowledges the productivity linked to skilled workforce by paying the requisite premium.

ii. Ensure both vertical and horizontal pathways to skilled workforce for further growth by providing seamless integration of skill training with formal education.

iii. Focus on an outcome-based approach towards quality skilling that on one hand results in increased employability and better livelihoods for individuals, and on the other hand translates into improved productivity across primary, secondary and tertiary sectors. .

iv. Increase the capacity and quality of training infrastructure and trainers to ensure equitable and easy access to every citizen.

v. Address human resource needs by aligning supply of skilled workers with sectoral requirements of industry and the country's strategic priorities including flagship programmes like Make in India.

vi. Establish an IT based information system for aggregating demand and supply of skilled workforce which can help in matching and connecting supply with demand.

vii. Promote national standards in the skilling space through active involvement of employers in setting occupational standards, helping to develop curriculum, providing apprenticeship opportunities, participating in assessments, and providing gainful employment to skilled workforce with adequate compensation.

6. Skilling of Construction Workers in Projects:

Flow of labourers from rural belts to cities to work on construction projects has gone down because of employment schemes in villages. Projects are thus getting hampered. While the real estate is the only sector that provides employment to illiterate people and there is huge scope for employment in construction projects.

Workers in this occupation construct , maintain and repair buildings (residential, commercial and other) .Their jobs involve for example constructing and repairing foundations, walls & structure made of bricks, stone and similar materials, cutting, shaping and finishing stone for building, ornamental and other purposes as well as wooden structures and fittings; and general building maintenance tasks.



Skill Development Camps

Occupations include amongst other, house buildings, stone masons, carpenters and joiners, roofers, plasterers, plumbers, floor layers and tile layers and tile settlers, glaziers and painters, typically the skill level required is equivalent to completed first stage of secondary education that includes specialized vocational education and on the job training is required.

The five key skills for building and related trades workers are job specific skills:

- Job specific skills
- Team work
- Problem solving
- Learning
- Communication

7. Conclusion:

• In the country like India where large number educated youth are unemployed, the need is to encourage the youth towards vocational education. This will help in reducing the unemployment as well as major part of unemployed youth can be generated quality skilled work force.

• The prime requirement is to inculcate the concept in school boys that the vocational courses are also at par with the blue collar job and this also gives the financial upliftment as well as respect in the society

• Vocational courses are to be included in the education policy itself to impart vocational /technical knowledge to the 8th to 10th standard and 11th to 12th standard.

• More and more ITIs and Polytechnic institutions are needed to be opened for imparting vocational training/education to the youth at large and school going students also.

• Quality skilled workforce need to be generated from institution itself.

• The availability of good quality trainers is a major area of concern. There is a lack of focus on development of trainer training programmes and career progression pathways for trainers have also not been defined.

• Skill development in construction projects plays major role in enhancement of overall performance and output of a project and also increases the rating /credit of an agency or organization.

• Quality skilled workers need to be deployed in major projects then that will definitely increase efficiency, quality output and the reputation of agency or organization shall also enhanced.

• Skill development and training has its strategic positioning and it directly contributes towards organizational business goals and objectives.

• Quality of output is directly proportional to the efficiency of the worker as well as the person who is supervising the work so if the worker and supervisors are quality skilled and updated with the technology and methods of executing new technology and new materials then it definitely increases the work output as well as quality of work being done.

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A REVIEW ON SAFETY MANAGEMENT SYSTEM OF INDIAN CONSTRUCTION INDUSTRIES

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Abstract

India is a fast developing country with a population of about 133 crores and construction sector plays a key role. The Construction sector is credited with being a second largest employment provider of the country, at the same time it is one of the most casualty's prone industry sectors. Be it a collapse/fall, a mechanical malfunction, or problems with exposure, construction workers can face serious injury while on the job. It is reported about 48,000 workers die in India due to occupational accidents of which 38 fatal accidents take place every day in the construction sector. It is wise to remember and take lesson from under-construction flyover collapse in Varanasi in year 2018 and Under Construction Building Collapses, in Dharwad, Karnataka in year 2019 which killed about at 18 people and 16 people respectively due overlooking of safety norms. This paper proposes Construction Safety Management System (CSMS) and its key elements and models. A good Safety Management System (SMS) can go a long way to help prevent accidents and occupational hazards. Despite of its high fatality rate, construction can be a safe occupation when worker are aware of the hazards, and use an effective Construction Safety Management System. A SMS deals with organizational safety rather than the conventional health and safety concerns in the workplace.

Introduction

Annually, over 48,000 workers die because of occupational accidents in India and there are almost 37 million occupational accidents which causes at least 4 day's absences from work (Hämäläinen 2010). The following points related to worldwide cost of Gross National Product (GNP) due to occupational accidents and work related diseases are briefed as:

• In terms of economics, the International Labour Organization (ILO) has estimated that the total costs of occupational accidents and work related diseases are 4% of the gross national product (GNP).

• The total GNP of the world was approximately = 75,592,941 million USD in 2013 (World Bank 2013)

• Which means that worldwide the annual cost of work-related injuries and diseases is approximately (0.04 x 75,592,941) = 3,023,718 million USD

The construction sector is the second largest employer in India; however, according to

Hämäläinen et al. (2010), accident statistics of the Indian construction sector are neither properly nor regularly published. Therefore, they are not easily available. However, it is expected that many fatal and non-fatal accidents would be happening in Indian construction due to its characteristics such as dynamic nature and involvement of many stakeholders including migrated labours in a project, and a less controlled environment. Whatever data is available seems to be underreported. Although, there is a system prescribed for compiling and recording these statistics the implementation at every places in country is not done with full seriousness. This is one of the reasons for not conducting sufficient research on construction safety in India. In order to mitigate above problem a Construction System Management System (CSMS) is imperative to adopt. The figure-1(a) and figure-1(b), shows the collapse of under-construction work in Varanasi, U.P. in year 2018 and in Dharwad Karnataka in year 2019 respectively.



Figure-1(a): Under-construction flyover collapse in Varanasi in year 2018 which killed about at 18 people.



Figure-1(b): Under-construction Building Collapses, in Dharwad, Karnataka in year 2019 which killed about at 16 people.

Safety management

Safety management is managing business activities and applying principles, framework, processes to help prevent accidents, injuries and to minimise other risk.

Safety management system (SMS)

A safety management system is a systematic approach to managing safety, including organisational structures, accountabilities, policies and procedures. An SMS is scalable so it can be tailored to the size and complexity of an organisation. SMS is composed of four functional components:

· Safety Policy.

· Safety Risk Management.

· Safety Assurance.

· Safety Promotion.

The Benefits of a Safety Management System

• Reduced administrative costs.

• The potential for reduced insurance and liability costs.

• Positive employee impacts and protection of worker health.

• Enhanced image within your company for employees, the communist, clients and customers, and stakeholders.

• Improve regulatory compliance.

• Improved employee performance.

• Reduced costs from injuries and illnesses.

• Improved relations with safety & health associated agencies.

• Better employee relations within the company as everyone is on the same page with regard to safety.

• Other businesses similar to yours may learn how they can do better, too

• Improving Safety is usually a competitive advantage, because of reduced costs

Setting up your safety management system for organisation

A safety management system (SMS) is a continuous improvement process that reduces hazards and prevents incidents. It protects the health and safety of employees and should be integrated into everyday processes throughout the organization. Investing in SMS makes a measurable impact on your bottom line and can be viewed as a competitive advantage. The adoption of an SMS framework and thoughtful implementation of the various facts can have significant impact on protecting employees and enhancing organization's performance and profitability. While safety requirements may differ across industries, model organizations that all focus on continuous improvement, that aims for an ongoing reduction of risk with a goal of zero accidents.

Effective Safety Management System

An effective safety management system has the following aspects:

• People: Nothing gets implemented without people who are committed, engaged, and motivated; real safety change can't happen without a competent, skilled workforce

• Planning: Thinking ahead is half the battle of implementation; planning for foreseeable risks and the administrative parts of a management system will yield smoother rollouts and foster measurement of SMS success

• Programs: Most companies have EHS programs that identify and control hazards, monitor and measure operational impacts to EHS performance, and eliminate deviations from the management system; individual programs must operate as part of the entire system and not independently.

• Progress: The companies need to periodically measure their compliance with regulatory and legal requirements, audit their SMS system, and review SMS performance with upper management

• Performance: Measures of performance need to be set and include both lagging indicators and leading indicators; adopting leading indicators and evaluating safety metrics among the entire business performance metric landscape helps companies solidify safety on equal footing with other key operational practices.

Major and key Elements of CSMS

The major and key Elements of a Construction Safety Management system useful for emulating the SMS are given in Table No. 2, below:

Table 2

System Major Components	Key Elements
Corporate safety leadership	• Designation of safety responsibilities to trained perso • Direct safety talks with workers. • Adequate & timely supply of PPEs. • Regular safety audit.
Risk management	• Systematic hazard identification. • Assessment of risk level.
Safety training	• Safety orientation for new/transferred workers. • Pre-project safety trainings received. • Safety trainings received.
Operational control	• Scheduled in-house inspections. • Proper display of safety/ caution signs. • Resident safety officer at sites.
Effective response	• Availability & adequacy of clinical services. • Functional fire extinguishers. • Clarity of emergency exit.

The above system component are very complex and requires to be intergraded with some safety model to achieve the desired goal for no casualty or minimum casualties.

The Safety model

The safety concern in the Indian construction industry is still lacking as compared to many developed and developing countries, the number of casualties are on much higher side. Seeing the present scenario, it is necessary for the management of a typical construction company to give an urgent attention to their safety management system with an intense interest to standardise its operations and functionality.

The Integrated PCR safety model, based on the TAB philosophy may be one of the drive to mitigate the present concern of high casualty in construction industry. The model as shown in figure-2, indicate that the entire work process must be totally a systematically fused/integrated into the safety management system and vice versa. The Integrated PCR Safety Model exhibits four critical features. They are: Integrated, Proactive, Control and Reactive.

Integrated: It is strongly recommended that safety management system be fitly integrated into the entire work process of a typical construction company spanning project planning to delivery stages. This implies relevant safety measures are factored in project planning, job design and overall contractual agreement before construction activities would commence. Further, the fused system should take input from all relevant stakeholders to construction business: client, workers, management, safety professionals, host community and sub contractors.

Proactive: Every good safety model must incorporate risk management and safety training. Risk management involves systematic identification of potential hazards on construction sites at the design stage; analysing the risk level of each hazard identified, and then determining what appropriate preventive safety plan/measures to initiate and incorporate in the entire work process. Safety training should be organised in response to risk management outcome. Training, which can be in-house or outsourced, should be result-oriented by conducting post training evaluation from time to time until safety behaviour seems permanent and core safety lessons are learned.

Control: A typical construction company should set up an internal and independent Safety Unit, employing well qualified/ experienced safety expert, designated with safety responsibilities. Also reviewing of safety policies and strategies is recommended. This will assure effective monitoring of safety practices and implementation processes.

Reactive: Exigencies are inevitable. Though good safety management system is expected to guarantee maximum safety, some natural disasters like earthquakes may be inevitable.

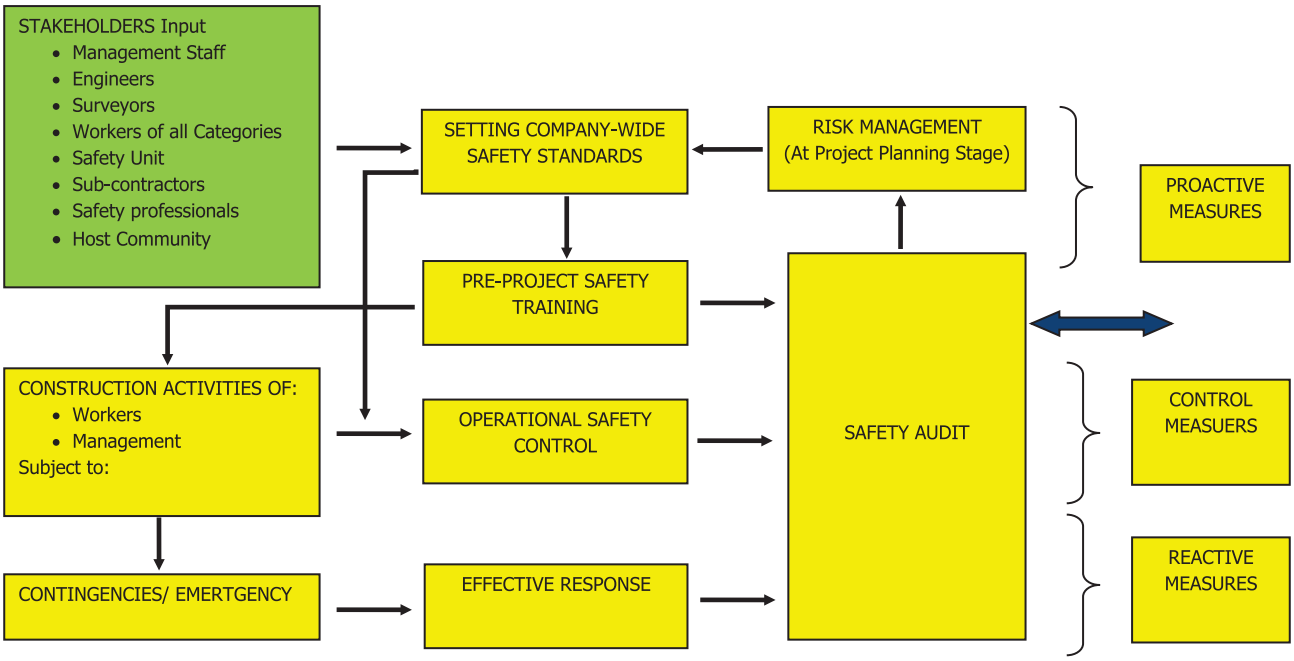


Figure-2: Integrated Proactive Control and Reactive (PCR) Safety Model for Typical Construction Company.

The model incorporates reactive measures that will ensure effective response to arresting unpleasant events as they occur around work sites. Some of these measures include provision of high quality clinic services, fire-extinguishers, clearly marked and paved emergency exits, caution signs, rescue vans and gadgets, alarm bells, etc. With this, consequences of incidences could be reduced from either fatal or severe to "minor".

The TAB philosophy:

The integrated-PCR safety model is a safety philosophy called **Think-Act-Be (TAB).**

Risk management is a typical proactive activities to be carried out at the planning stage which requires **THINKING.** Accordingly the safety culture within the construction industry should be:

• Before starting construction project, think about the possible dangers.

• Before executing any construction job role as an individual, think about the possible dangers.

After assurances of possible dangers are out, then one can **ACT** in a manner that would assure safety so the person as well as property elements within the system can **BE** safe.

Put in another way, **SAFETY** consciousness will lead to **SAFETY** compliance which will in turn lead to **SAFETY** coverage. This sort of philosophy will positively and collectively impact the attitude of everyone in the company towards good safety practices; generate and

reinvigorate a strong safety culture throughout the company and consequently drive continuous improvement in the safety management system of a typical construction Organisation.

Impacts of CSMS on Contractors Business

Contractors are seeing significant positive impacts from investing in strong safety management programs; benefits that can help drive wider adoption of safety practices in the industry. The positive impacts reported by firms include (Smart Market Reports, McGraw Hills Construction):

- Reduced injury rates and
- Improved reputations,
- Improved project ROI and
- Decreased schedules and budgets.

Large firms are more widely adopting safety management practices and benefiting from these outcomes than small firms. In addition, important industry trends, such as the use of building information modelling (BIM) and prefabrication and modularization, are improving safety outcomes for firms that have embraced these new approaches.

Large firms are adopting safety policies and practices more widely than small firms. It is reported from "Smart Market Reports, McGraw Hills Construction", that firm size is directly correlated to the level of adoption of safety policies and programs, with large firms leading the industry. Nearly double (92%) the percentage of large firms with 500 or more employees report having a fully inclusive and widely observed safety program than firms with 1 to 49 employees (48%).

Conclusion:

Safety is a basic physical and psychological need of human beings. Large sections of people are employed in the construction sector for their bread and butter. There is loss of human life as well as loss of asset, due to occupational accidents which directly/indirectly affect GDP/GNP of the country. The accident statistics of the Indian construction sector are underreported and not easily available in form of publication/research in spite of a system prescribed for compiling and recording these statistics due to complex system. In order to safeguard the interest of the worker of the construction sector, the implementation of Construction System Management System (CSMS) is imperative to adopt. This will not only minimize the numbers of casualties but boost the morale, work efficiency, understanding, innovativeness of the workers, which is ultimate boost to the country. We will feel better when

title like “The Untold Deaths of India's Construction Workers” will not appear in the newspaper again, which is only possible if proper CSMS is necessarily adopted.

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SAFETY HEALTH AND ENVIRONMENT CONSIDERATIONS IN CONSTRUCTION WORKS

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Introduction

"Safety is something that happens between your ears, not something you hold in your hands." - Jeff Cooper

There are various parameters that are generally considered while taking up any construction project. Amongst the most popular parameters are economy, functionality and environmental impact. No doubt these parameters are useful in determining long term benefits of the project. Amongst the relatively low priority but high value considerations are safety, health and environmental considerations during the execution of the project. Safe working practices and conditions are important to ensure safety of workmen and public in the vicinity of construction sites.

Workers in construction industry are also exposed to numerous health hazards like other industries. However, the quality of work depends on the hard work of these very workers. Hence, it is utmost important to ensure healthy and safe working environment for the wellbeing of these workmen.It is not only the long term impact of a civil construction work that affects environment. An on-going construction work can affect the environment in various ways. Withdrawing of ground water, pollution of ground water due to construction waste, air pollution due to construction plants, land pollution due to C&D waste are a few to name. All these need to be monitored and controlled to check short and long term adverse impact on the environment.

Relevance of Safety, Health And Environment Considerations In Construction Industry

It is the responsibility of the planners and engineers of a construction project to ensure wellbeing of the workmen engaged on a project and the society at large.

Safety, Health and Environment (SHE) is a discipline and specialty that studies and implements practical aspects of environmental protection and safety at work. In simple terms it is what organizations must do to make sure that their activities do not cause harm to anyone.

Regulatory requirements play an important role in SHE discipline and SHE managers must identify and understand relevant SHE regulations, the implications of which must be communicated to management so the organization can implement suitable measures. Still,

Still, SHE management is not limited to legal compliance and companies should be encouraged to do more than what is required by law, if appropriate.

From a health & safety standpoint, it involves creating organized efforts and procedures for identifying workplace hazards and reducing accidents and exposure to harmful situations and substances. It also includes training of personnel in accident prevention, accident response, emergency preparedness, and use of protective clothing and equipment.

From an environmental standpoint, it involves creating a systematic approach to complying with environmental regulations, such as managing waste or air emissions to reduce the carbon footprint.

SHE guidelines should cover categories specific to construction industry. Examples of some of the considerations are:

1. Environmental

1.1 Air emissions and ambient air quality

1.2 Energy conservation

1.3 Wastewater and ambient water quality

1.4 Water conservation

1.5 Hazardous materials management

1.6 Waste management

1.7 Noise

1.8 Contaminated land

2. Occupational health and safety

2.1 General facility design and operation

2.2 Communication and training

2.3 Physical hazards

2.4 Chemical hazards

2.5 Biological hazards

2.6 Radiological hazards

2.7 Personal protective equipment (PPE)

2.8 Special hazard environments

2.9 Monitorin

3. Community health and safety

3.1 Water quality and availability

3.2 Structural safety of project infrastructure

3.3 Life and fire safety

3.4 Traffic safety

3.5 Transport of hazardous materials

3.6 Disease prevention

3.7 Emergency preparedness and response

4. Construction and decommissioning

4.1 Environment

4.2 Occupational health and safety

4.3 Community health and safety

EXTRACT OF CPWD SAFETY CODE FOR SAFETY OF LABOR, HEALTH AND SANITARY PROVISIONS:

CPWD SAFETY CODE and clause 19 of GCC has some brief provisions for safety of workmen, their health and sanitary facilities but these are not elaborate as is the case in DMRC SHE Manual.

Clause 19 C of GCC mandates contractor to follow CPWD Safety Code for safety of labor and in case of failure there is provision for penalty @ Rs 200/- per default without specifying nature of default.

BRIEF PROVISIONS OF CPWD SAFETY CODE:

A Working at height

Clause 1

Suitable scaffolding for working at heights, Ladder permitted only for carrying workmen and materials –

(i) For short period of working only.

(ii) Provision of footholds and handhold when used for carrying material also.

(iii) Inclination not steeper than ¼ to 1.

Clause 2 & 3

Scaffolding of staging more than 3.6 m height –

(I) Guard rail properly attached or bolted, braced and otherwise secured at least 90 cm high above the platform of such scaffolding or staging and extending along the entire length.

(ii) Scaffolding to be fastened from the building or structure.

Clause 4

Fall protection for openings in the floor of a building or in a working platform - suitable fencing or railing of minimum height 90 cm.

Clause 5

Safe means of access to working platforms –

(i) Securely fixed ladder.

(ii) No portable single ladder over 9m in length and width not less than 29 cm. (11½") for ladder up to 3 m in length.

(iii) For longer ladders, width to be increased min. ¼" for every additional 30 cm of length. Uniform step spacing of not more than 30 cm shall be kept.

(iv) No materials at height be so stacked or placed as to cause danger or inconvenience to any person or the public.

(v) All necessary fencing and lights to protect the public from accident.

Clause 6

(a) Safety measures to be taken in excavation and trenching.

(b) Safety measures for digging bore holes.

Clause 7

Safety measures during demolition, to prevent any injury to workmen, persons passing through adjoining street, path.

Clause 8

Personal safety equipment prescribed for various operations such as, mixing asphaltic materials (protective footwear & goggles), mixing of cement and lime mortars (protective footwear & goggles); white washing and handling cement bags (protective footwear & goggles); welding works (protective eye-shields); stone breaking (protective goggles and

protective clothing); cleaning sewers and manholes (Gas masks with Oxygen Cylinder, Air-blowers, Gumboots or non-sparking shoes bump helmets and gloves

Non-sparking tools safety lights and gas masks and portable air blowers).

Clause 9

Additional clause, regarding painting with products containing lead.

Clause 10

Safety measures while working near places with risk of drowning.

Clause 11 and 12

Safety measures while using hoisting machines: qualification and experience of operator, working condition of equipment, safe load carrying capacity indicators in different positions etc.

HEALTH AND SANITARY PROVISIONS:

- First aid facilities.
- Drinking water.
- Washing facilities.
- Latrines and urinals.
- Shelter during rest.
- Crèches.
- Canteens.
- Anti-malarial precautions.

EXTRACT OF DMRC SHE MANUAL

DMRC has a detailed manual on Safety, health and Environment i.e. SHE Manual and same has been made part of GCC and these are to be read together with Occupational Health and Safety Management System (OHSAS 18001-1999) and Environment Management System of ISO 14002-2004. This is applicable on all construction contractors as well as their sub-contractors.

Salient features of DMRC 'Conditions of Contract for Safety, health and Environment' are as under:

A. SHE Management:

(1) General- This document is mandatorily to be followed by all Contractors, their sub-contractor with the objective to ensure that adequate precautions are taken to avoid accidents, occupational illness and harmful effects on the environment during construction.

(2) Targets and Goals: Zero total recordable injuries, Zero reportable environmental incidents, all personnel inducted in accordance with the approved contractor SHE plan, total compliance of conduction inspections and audits as per approved SHE plan, 100% incident recording and reporting, 100% adherence of usage of appropriate PPEs at work, executing construction work with least disturbance to the environment, adjoining road users and traffic.

(3) Compliance: DMRC and Contractor to enter into MOU for safe execution of contract work, follow all statutory provisions, DMRC SHE Manual, International standards, appointment of ISO consultant for certification on OHSMS and EMS. In case of failure Employer shall do the same at the cost of contractor.

(4) Contractor SHE Policy and Plan: Contractor shall formulate a SHE policy as per section 39 of BOCW Act and get it approved from DG/CIIBC and display it at site in language which can be understood by majority of workers. Within 4 weeks of acceptance of tender contractor is to submit work specific detailed and comprehensive SHE Plan, which should include statement of policy, names and experience of persons responsible for co-ordinating and monitoring of contractor's SHE performance, procedures for identifying and estimating hazards and measures for addressing the same, list of SHE hazards anticipated and contractor's proposal for achieving effective and efficient health and safety provisions, SHE training and drills, details of safety equipment i/c PPEs and their maintenance to keep in safe conditions, Contractor's disciplinary procedures, procedure for reporting and investigating accidents, dangerous occurrences or occupational illness.

(5) Designers Role: Designers primary role includes to minimize risk to health and safety of those, who are going to construct, maintain, clean, repair, dismantle or demolish the structures and others who might be affected with the work. The overall design process may not be to always avoid risk whatever may be the cost but to minimize risk during construction, giving detailed information on the safety and health risk and alert the persons involved and suggest measures to control the risk, preparing method statement for scaffolding, false work, earth retaining structures, launching of girders, approval of same by employer.

(6) Contractor's SHE Organization: Contractors shall appoint SHE personnel having

minimum qualification and experience prescribed, appoint Chief SHE Manager, Safety organization with flow chart having other SHE personnel, Labour Welfare officer and get it approved from Employer, these should be on rolls of contractor and not to be out sourced to other agencies, in case of deficiency Employer to within 14 days Employer to provide at the cost of contractor, all SHE personnel are prohibited from performance of other duties, Chief SHE Manager to report directly to Chief Project Manager of Contractor not below to ensure independence.

(7) Contractor's SHE Committee: SHE committee to be constituted within 14 days of award of contract and should have Chief Project Manager as Chairman, Chief SHE Manager as Secretary, Labour Welfare Officer, in-charge of plant & machinery, stores, Senior Managers/Engineers at site, labour contractor, workers, DMRC's representatives as members, SHE Committee to monitoring of SHE provisions and hold regular weekly meetings, conduct safety drills, inspection, review of training, identify probable cause of accident and unsafe practices, suggest remedial measures, decide disciplinary actions for default etc.

(8) ID card and First day at work, SHE Orientation training: Compulsory Induction training to fresh worker, giving them She handbook, issue of standard ID card.

(9) SHE training: on job detailed training to all workers, SHE Personnel, Managers, Engineers, refresher training every six months, daily safety oath, Tool Box talk to all high risk workers every day, on the spot practical skill development training on height safety including scaffold safety, crane safety, welding safety, electrical safety, traffic safety, for all workmen/traffic marshals associated with the work, defensive driving training to all vehicle drivers, hydra operators in designated driving institutes, in case of failure Employer to arrange same at the cost of Contractor.

(10) SHE inspection: The purpose of SHE inspection is to identify any variation in construction activities and operations, machinery, Plant and Equipment and processes against SHE plan, there should have planned general inspections at periodical intervals i.e. daily, weekly & monthly, routine inspections daily of Plant & equipment, weekly of scaffolding, monthly of electrical hand tools, quarterly of temporary electrical systems by electrical supervisors, six monthly of lifting machinery and gears by Govt approved competent persons, specific inspections before specific activity like heavy lifting operations, formwork for major concreting, welding, before & after entry of a person in confined place, other inspections like Mandatory inspection by Labour Department, DMRC site SHE management team, record of these inspection will be kept safely and shown during SHE audit, Safety Committee Meetings.

(11) SHE Audit: The purpose of SHE audit is to assess potential risk, liabilities and degree of compliance, this is to be jointly done monthly by Contractor and Employers representative from Safety department, evaluation against prescribed parameters, assigning Monthly Audit Rating Score (MARS), Contractor to take remedial action within given time frame, monthly electrical safety audit, external SHE audit by external agencies having competent ISO qualified auditors on quarterly basis, preparation of audit report and its compliance and its verification by audit team.

(12) SHE Communication: Contractor tocommunicate SHE measures through posters, campaigns, banners, low signs around the work site to raise safety awareness, formulate suitable awards.

(13) SHE Submittals to the Employer: The Contractor to submit the Employer daily report of total workmen deployed, detailed monthly SHE report, SHE committee minutes of meeting, SHE inspection report, SHE audit report, Air and Noise Quality monitoring report, Accident report and investigation report without exception, any wilful delay in reporting attract penalty, reporting of dangerous occurrences which includes collapse or failure of lifting appliances, falling of object from heights, fire and explosion, spillage or leakage of hazardous substance/gases, collapse or subsidence of soil, tunnel, pipe line, building, platform, scaffolding etc. conduct independent and impartial investigation in open manner, submit report to Employer

(14) Employer's Independent Incident investigation: Employer to investigate independent investigation of fatal or dangerous occurrence and contractor to facilitate the same.

(15) Emergency Preparedness Plan: The Contractor to prepare Emergency preparedness plan which should have details of procedures, communication arrangements for dealing all emergencies, medical treatment, evacuation of all the victims, tie up with hospitals, fire stations, conduct mock drills.

(16) Experts/Agenciesfor SHE Services: Contractor may seek help of designated SHE agencies for training, internal audit, any other service with the approval of Employer.

B Safety:

This covers various provisions regarding the following sub-heads -

i) Housekeeping: This covers all aspects to ensure cleanliness of site, batching plant, Labor camp, stores, disposal of waste, proper barricading of work space, no obstruction on roads, cleaning of tyres of trucks carrying excavated earth etc.

ii) Working at height: This covers all aspects of safetyprecautions andarrangement for

working at heights i/cworking platform and its supporting structure, guard rail, ladders, scaffolding, personal fall protection system i.e. safety nets, air bags etc, competency of persons, inspection, training, preventing measures to avoid injury from falling objects, segregation of danger areas

iii) Overhead protection

iv) Slipping, tripping, cutting, drowning and falling hazards

v) Lifting appliances and gear: This covers all type of lifting appliances and gears i.e. cranes, hydras, hoist machinery, derrick, winch ropes, chains etc, and it includes selection of suitable equipment, capacity, certificate of fitness by competent person, approval by Employer, qualification and experience of operator, display of fitness certificate, automatic safe load indicator on each appliance, testing for fitness every six months, stoppage of traffic at the time of lifting operations etc.,

vi) Launching operations: Preparation and approval of method statement, qualification and competency of operator, medical test of operator, securing of launching girders, close supervision by responsible engineer, maintaining register for all operational activities, proper lighting of the area, strict penalty for any violation etc.

vii) Construction machinery: This covers all construction machinery and it includes mandatory requirement of safe worthiness certificate, reverse horns, General Operating Procedures, penalty for violation.

viii) Machinery and general area guarding

ix) Manual lifting and carrying of excessive weight

x) Site electricity: Competency of electrical personnel, assessment of power requirement, submission of SLD, schematic diagrams, details of equipment and its approval by Employer, distribution system, protection circuits, connections, cables, penalty for violations.

xi) Lighting: It prescribesgeneral lighting requirement for different type of operations , working i/c type of luminaries,

xii) Hand tools and power tools

xiii) Welding, gouging and cutting

xiv) Dangerous and harmful environment

xv) Fire prevention, protection and fighting system

xvi) Corrosive substances

xvii) Demolition

xviii) Excavation and tunneling: this covers all protection arrangement, permission, supervision by competent person, ventilation, flood protection, communication, fire protection system, temperature control system, etc.

xix) Work permit system: System of written permission and record for entry/exit in/from potentially hazardous locations

xx) Traffic management: To maintain safe and efficient management of traffic, obtaining legal permission,wearing of high visibility jackets by all workers, warning signs, regulatory signs, Delineators, traffic cones and cylinders, barricades, drums, Toe away vehicles, Cleaning of roads,

xxi) Batching plant / casting yard

xxii) Personal protective equipment: This includes safety helmets, footwear/gumboots, jackets, goggles, Gloves, Nose Masks, ear plugs, etc, protocol for different users/color coding for PPEs, maintaining 10% spares for PPEs, no cash payment to workers to buy PPEs.

xxiii) Visitors to site: No entry of visitor to work space without permission, visitors to be provided with PPEs and accompanied by responsible site representative.

C. Occupational health and welfare

I) Physical fitness of workmen

ii) Medical facilities

iii) Noise

iv) Ventilation and illumination

v) Radiation

vi) Welfare measures for workers

D. Environmental management

I) Air quality

ii) Water quality

iii) Archaeological and historical preservation

iv) Landscape and greenery

v) Felling of trees

vi) Fly ash

vii) Waste management

viii) Hazardous waste management

ix) Energy management

E. Penalty and Awards

I) Charges to be recovered from contractor for unsafe act and condition: It prescribes specific amount to be deducted for each type of violation, unsafe, hazardous working, not maintain safety organization, conducting safety committee meetings, training etc.

ii) Stoppage of workby employer in case of gross violation.

iii) Awards for every safe million work hours, zero fatality, 100% adherence to voluntary reporting, best safe project team, etc.

Comparison of Norms In CPWD GCC And DMRC SHE Manual

S. NO.	SUBJECT	CPWD	DMRC
1	Working at height	Cover manual operations	Cover Manual as well as mechanized operations
2	SHE Manual by contractor	No such provision	To be prepared by contractor and approved by Employer
3	MOU and SHE Management Systems	No such provision	Mandatory
4	SHE Training	No such provision	Mandatory
5.	Periodical Inspection	No such provision	Mandatory
6	SHE Committee	No such provision	Vested with complete responsibility involving all stakeholders
7	Lifting and hoisting operations	Brief provisions	Exhaustive and up to date provisions
8	Penalty / awards	Only general provision without specifying type of violation, amount of rs 200/- is also very less. It is also seldom exercised.	Exhaustive provisions with specific amount for each type of violations, amount ranging from Rs 5000/- to Rs 5,00,000/-. **It is regularly exercised.**
9.	Periodical SHE Audit	No such provision	Mandatory
10.	Work Permit System, restriction on entry of Visitors	No such provision	Mandatory
11.	House Keeping	No specific provision	Detailed provisions

Areas of Improvement in CPWD GCC

1. Active involvement and role definition of all stakeholders –

   a. Provisions for proposals to be submitted by contractor need to be incorporated. This will imbibe more responsibility and active participation by contractor.

   b. Monitoring and action by committee comprising all stakeholders will ensure active involvement of department officials. Further, minutes of such committees circulated among senior officers makes them aware of the day to day developments. Presently, all reporting pertains to quality, progress and budgeting.

2. Provisions regarding mechanized operations need to be added. At present these are only briefly covered.

3. Provisions for housekeeping, medical facilities, emergency response system, Work permit system

4. Provisions for safety organization, training, periodical inspection of safety provisions, certification of lifting appliances, construction machinery, qualification and experience of operators, temporary electrical connections, voluntary reporting, investigation, penalty and awards needs to be added and specified. At present there are no such specific provisions.

5. Provision of SHE Audit by external agencies need to be added since CPWD officers are not trained in this field and expert help is essential.

EMERGING SKILLS IN CONSTRUCTION SECTOR - PROSPECTS AND CHALLENGES

Col. Anand Kumar Singh (Retd.) CEO, Construction Skill Development Council of India

Introduction

Construction Industry is a very important sector of the Indian economy and growing at a very fast rate. It is one of the most labour intensive sector and an important contributor in job creation and long term productivity. The construction sector is responsible for provision of housing as well as infrastructural requirement and quality & pace of the construction will play a very vital role in sustained economic growth of the country.

The construction industry continues to face significant challenges in India on various accounts. One of the challenges is availability of latest technology & skill requirements in delivery of technical & quality requirements of the industry. Many of the experts of the industry have been saying that the present skills may not be employable enough or will become extinct very soon and will be replaced by new technological skills. The new and emerging skills within the construction industry are changing the face of the industry and the requirements within it. However there will be still great demand for traditional skills such as masonry, carpentry, and steel working in rural & semi urban areas.

Technological Challenge:

With the advent of new and exciting techniques, technologies and materials emphasis is on creating buildings that are smart, sustainable and energy efficient. As every aspect of the construction process harnesses new techniques and technologies we increasingly need forward thinking skilled work force who would like to be at the cutting edge of construction's innovation revolution.

The changing nature of construction means that a wider set of skills, including those from different disciplines, are increasingly in demand. For example, roof installers can now gain the skills and qualifications to fix solar panels and plumbers are learning to install environmentally-friendly heating systems that rely on renewable energy sources .

By using the latest technologies, visualisation, designing and building of a structure can be carried out at a faster pace. Digital technology finds its use in constructing buildings as 3D-models before actually building it in reality. A building can be virtually modelled right from its conception to its complete management by using Building Information Modelling (BIM). Design of the building van be complemented by using 'Virtual Reality' and 'Augmented Reality' allowinganalysis in a computerised 3D environment.There are new technologies

being introduced to survey and maintain existing structures too using aerial drones for survey and analysis of buildings.

Use of Artificial Intelligence in Construction industry

Artificial intelligence is already ingrained into our livesand serving to make our lives easier. Artificial intelligence utilizes computer processing to complete tasks that normally require human intelligence. However, it performs actions with a greater level of accuracy and much more quickly. Because of this capability, artificial intelligence in construction management is another helpful tool in a contractor's digital toolbox. It can be used in various aspects of construction industry

a. Construction Management

Artificial intelligence serves as a very useful tool for all aspects of the construction. Data collected at various cycles of the construction project across many different projects in construction of projects provides valuable learning information for artificial intelligence applications.

b. Designers and Estimators

AI-based applications enable designers to create complex designs quickly to different design goals and criteria. The applications can generate design along withscheduled data on quantity as well as costs.

AI-based systems analyse data from similar projects to develop cost and schedule estimates. Combining AI with Building Information Modelling (BIM) allows estimators to develop accurate estimates with greater accuracy within a quicker turnaround time.

c. Safety managers

AI-based applications can help in identification & limiting of safety hazards. Safety supervisors /managers are managing multiple projects and cannot be at the jobsite all the time. However, the field team is capturing photos at the jobsite. Safety monitoring solutions that utilize AI can easily and quickly identify workers and instances of likely safety concerns.

d. Site Engineer or Manager

AI-based applications are used for management, progress monitoring, quality of work management, identification errors & inconsistencies. It also provides timely alerts for work corrections.

3D printing in Construction industry

The 21st century is emerging as the 3D age. 3D printing presents promising opportunities for the construction industry to become both greener and more cost-effective. 3D printing research continues to develop and will be exciting to see the benefits the technology will have on the construction industry. Based on 3D printing following works can be performed:

- Rapid Prototyping
- 3D printing
- Digital fabrication&construction
- Contour crafting
- Additive construction
- Concrete printing

Following functions of construction can be performed using3D technology:

a. Binder jetting: Binder jetting is a 3D printing process that creates objects by depositing binder layer by layer over a powder bed. Binder is ejected in droplet form onto a thin layer of powder material spread on top of the build tray. This method incrementally glues 2D cross sections of the intended component to each layer of material powder.

b. Material deposition method (MDM): material deposition method (MDM) is a 3D printing processes that successively lays material as per the CAD model.

c. Contour crafting (CC)": Contour crafting (CC) is a gantry-based system that extrudes material in a layer-by-layer manner. The key feature of CC is the use of trowels attached to the nozzle. The trowel guides the printed material to create exceptionally smooth and accurate surfaces.

d. Digital construction platform: This is a system used for on-site sensing, analysis and fabrication. This system is designed around a large boom, which is used for gross positioning to increase speed, accuracy and ease of access with a small robotic arm.

e. Concrete printing: Concrete printing, is a system built to extrude concrete layer by layer following a digital model.

f. Minibuilders: A coordinated system of three individual robots is built for fabrication of in situ construction. They are lightweight, compact and have autonomous mobility. Each robot has a different function during the printing process.

g. Mesh-mould: This technique utilises a large 6-axis robot to extrude thermoplastics polymer to print in situ structures freely in 3D space.

h. Building information modelling: BIM is a comprehensive approach towards building construction management which covers the complete life cycle of the construction process such as construction planning, scheduling, estimation and post construction facility management.

i. Architectural/topology optimisation: For habitable building components and architectural spaces, it is important to iterate through and assess the results of structural topology, removal of unnecessary material, resulting in optimal performance as well as material usage efficiency.

Geospatial Survey

Land surveyors play a crucial role in land development, mapping and engineering construction. Geo spatial Technology relates to collection or processing of data that is associated with location. For construction sector the applications relate to high resolution imagery, satellite imaging, 3D representations in virtual space, remote sensing technologies such as GPR and electromagnetic induction to create accurate 3D models of underground structures, presentation of data in spatially referenced forms, production of maps & charts and is one of the most emerging area.

The application of these technologies could be used in 3D modelling by designers, topographic surveyors for high end projects, quality and planning engineers. Surveyors and geospatial engineers use modern satellite, aerial and land-based positioning technology to provide mapping services for flood plain studies, coastal monitoring, natural resource management, agriculture, sustainable development, and many more applicationsof environmental monitoring, such as salinity and soil moisture monitoring for precision agriculture, or for emergency management of hazards such as earthquakes or flood monitoringalso.

The Geospatial Technology application can be used by followings:

- Civil Engineers
- Environmental Engineers
- Water Resource Engineers
- Architects & Planners - Residential and Commercial
- Real Estate Developers
- Residential Home Builders
- Municipalities

- Public Works Departments
- Commercial Building Contractors
- Industrial Facilities

Building Information Modelling (BIM)

Building Information Modelling (BIM) is a digital representation of physical and functional characteristics of a facility. A BIM is a shared knowledge resource for information about a facility forming a reliable basis for decisions during its life-cycle; defined as existing from earliest conception to demolition

BIM and allied quantities technologies provide opportunities for the project but also challenges for the project manager. As automation is increasingly used in quantification in the construction industry, BIM models will need to adapt accordingly to allow for more sophisticated management components that incorporate 4D time and 5D cost modelling and sharing this information with the project team in an integrated project delivery approach.

Conclusion:

In view of growing competition in skill requirements in the world, India cannot neglect the emerging areas of skill required for emerging technology and need to be ready for it. Skilled workforce availability in 3D printing, use of artificial intelligence and use of latest machines will provide India the required competitive edge towards making it skill capital of the world.

SAFETY MANAGEMENT PLAN FOR CONSTRUCTION SECTOR

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Introduction

Construction Industry is second largest employer after agriculture sector in India. It has 7.9% share in GDP of India during F.Y. 2018-19. Construction sector is one of the most hazardous industries. Construction sector in turn accounts for one of the largest number of accidents and fatalities. These accidents and fatalities increases the cost of projects due to lost working days costs on workers like treatment cost, compensation etc. apart from loss of precious life. Safety Management plan and implementation in construction sector is essential for avoiding and mitigating accidents at construction workplace.

Planning for safety management

Safety Management plan for the project shall essentially include the following element:

1) Risk Identification and control :

Management has to identify the potential risks on the said workplace and should issue policy guidelines.

2) Assignment of responsibility:

A person or team has to be assigned responsibility for preparation of effective safety management plan.

3) Training and communication:

Safety team and Workers are required to be trained to identify and control the potential risk by using safety procedures & equipment.

4) Continuous monitoring :

The safety team has to monitor continuously the enforcement of safety rules.

5) Documentation and improvement of safety procedures:

The documentation is necessary to evaluate performance of safety management and its improvement after incorporating lessons from past experiences.

Major causes of accident in construction sector

Accidents are defined as “an undesired event that results in physical harm to people or damage to property” (Peyton and Rubio, 1991, 162).

Main causes of accidents in construction sector are as below:

1) Fall from height

2) Accident due to collapse /overturning of equipment, materials etc.

3) Accident due to slip, trip, fall

4) Accident due to moving object or vehicle

5) Accident from Electric contact etc.

Reasons of accidents in construction work

Lack of safety arrangements and not following procedures are main reasons of accidents. These happen either for cost cutting or due to lack of knowledge. It is observed that generally Contractors are mandated to make safety arrangements in the contract. It is not separately paid and it is supposed that contractor will account for its expenses on rates of payable items. In these contracts, it is also difficult to penalise contractor for not taking suitable measures. This encourage contractor to save on some of the safety provisions as it is not separately measured and paid. This arrangement makes room for contractor's behaviour of cost cutting on safety needs. This make contractor feel that he has saved money out of contract without thinking of ill consequences of accidents. He arranges for safety just enough which makes economic sense and ignores risk of loss to human life.

Provisions in NBC for safety in construction of a buildings:-

There are different inherent hazards in construction at different stages of work. Safety management plan is foreseeing various inherent hazards likely to be encountered in different stages of work and planning in advance to avoid accidents by taking suitable precaution. NBC 2016 has compiled in detail, precautions to be observed at construction site during course of construction of various elements of a building are detailed below:

1) Temporary Construction, use of side walls and temporary encroachments:-

Temporary structures include roof or wall made of straw, hay, canvas cloth etc. and site work shades, truck ways, foot brides etc. There should be adequate safety precaution for fire and movement of vehicle in temporary construction. Structures should be structurally safe and shall not be loaded beyond allowable load.

2) Foundation Work:-

i) Before excavation safety of adjoining properties should be assessed and suitable safety including notice to owner of adjoining property should be given.

ii) Excavating machinery should be kept back from the excavation site at a safe distance to

avoid collapse of earth & overturning of machinery.

iii) Excavated materials shall be kept back from the edges of the trench. Protective work shall be provided to support the side of the trench in case of proximity of building, trees etc.

iv) Overhang & slopes would be sufficient to ensure safety of men and machine working nearby.

v) Fencing & warning signals should be provided near area of excavation.

vi) In case of Piling, working area shall be investigated for service lines before start of work.

vii) All piling equipment's should be inspected before its use and should not be loaded beyond working load capacity.

viii) Use of all protective equipment like helmet, safety shoes by worker should be ensured and first aid kit should be maintained at the site.

ix) While piling, effect of vibration on nearby structures should be kept in mind.

x) In case of pile testing, Kent ledge should be well designed for targeted load.

3) Work of Walls:-

i) Height of construction per day should be restricted to ensure gain of strength of lower layers. Long walls should be provided adequate expansions joint as per standards.

ii) False work / Scaffolding should be properly designed and constructed.

iii) Ladders should also be designed property for strength and rigidity. It should be properly secured to prevent slipping.

iv) Opening and projection from walls should be checked for cracking, Collapse and overturning.

v) Electrical wire should be away from scaffolding. Scaffolding area should be guarded from moving equipment's.

vi) Special care should be taken to avoid falling of material by providing safety net etc.

4) Roofing:-

i) For flat roofs formwork should be properly designed to include all possible imposed loads.

ii) While laying reinforcement walking platforms should be provided.

iii) Temporary floor opening and open side floors should be properly guarded to avoid accidental fall.

iv) Roofing with CGI sheets or AC Sheets should be properly checked & secured to avoid slipping.Safety belt for workers and safety nets should be provided.

5) Erection of High rise concrete framed structure:-

i) Tower cranes should be installed on firm ground and level difference between two rails should be within limit to safeguard against toppling of the crane.

ii) Electrical wiring of cranes should be checked & it should not be operated near overhead power line.

iii) Only trained operator should operate crane and his signaller should also be trained with hand signal.

iv) For movement of truck & machinery near working site a loop road should be provided for smooth traffic.

v) Form work should be properly designed after taking into consideration spans, setting temperature of concrete, dead load and working load.

vi) Vertical supports should be braced or secured in position to avoid falling in case of hit or load release.

vii) Bearing capacity of soil should be kept in view for centring layout.

viii) Ramps should be kept free of grease, mind snow or other obstruction to prevent slipping and accidental fall.

ix) Material hoist should be erected on firm ground and firmly supported.

x) Hoist should carry a notice stating safe working load.

xi) Hoist should be checked & tested before use on a site and hoist operator should be adequately trained.

xii) In pre stressing operation caution is required in use of stressing equipment as wires under high tensile stresses are dangerous.

xiii) Wedges and other anchoring devices should be inspected before use and pre stressing jack should be periodically examined for wear & tear.

xiv) Prestressing jacks should be shielded during stressing operation.

xv) While erecting a prefabricated member a spreader beam should be used so that cable can be as per perpendicular to members being lifted as practical angle between the cable and the members to be lifted should not be less than 600.

xvi) Lifting wires should be tested for double the targeted handling loads at least every six

month.

xvii) Method of assembly and erections specified by the designer should be strictly adhere to at site.

xviii) Workers should wear safety belts or other protection should be provided during positions of falling hazard.

6) Erection of structural steel work:-

i) Erection scheme should cover safety aspects from planning stage up to the actual execution of work.

ii) Safety gears to works like helmet etc. are most important. Safety goggles should be used while drilling clothing and welding. Welders & gas cutters should use gloves, safety boots, aprons and hand shields.

iii) Working signs should be displayed to indicate likely hazard like electric line etc.

iv) Gas cutting &welding torches should be lighted by means of special lights and not with matches.

v) All gas cylinders should be stored in upright position only and gas line & compressed air line should be suitably colour coded. Double earthling should be provided to label of welding equipment and should be protected from traffic combustible materials should be removed from welding area.

vi) Area should be cordoned off when work is in prospers to prevent person from lifting against structural members & falling objects.

vii) While connecting pieces it should be ensured that going will not fail due to dead load and erection load. All splice connection in columns girder etc. should be completely bolted / welded as specified in the drawing before erection.

viii) Heavy complicated structural members may be provided with cleats & hooks inshop assembly itself by welding or bolting or riveting and may be left permanently in the place after work.

7) Execution of other Miscellaneous items:-

i) For construction of stair case, precaution on support and form work should be taken to prevent any collapse. Till handrails are fixed temporary arrangement like ropes etc. shall be provided before its use as stair case. Safety net must be provided in the staircase well or lift pits as safeguard against accidental fall.

ii) Lift wells should be protected with signboard or railing with danger sign till lift is installed.

iii) Workers engaged on job handling hot bitumen, for etc. should use protective wears such as boots & gloves while heating & handling hot bitumen and clean dry sand etc. should be kept ready.

iv) Base wires should not be used for temporary electrical connections during construction.

v) All electrical circuits other than those required for illumination of the site shall be switched off at the close of days' work.

vi) Protective clothing should be provided to workers while working with chemical and other risky activity.

vii) Adequate toilet facilities and potable water etc. Should be provided for workers within easy access of their place of work.

viii) Telephone no of local fire brigade, should be prominently displayed near each telephone provided at construction site.

8) Demolition of Buildings:-

i) Before demolition of building surrounding area should be studied and sequence should be so planned to avoid damages to nearby structures.

ii) Access for public should be closed and danger signs should be placed.

iii) All the fragile materials like glass should be removed.

iv) All gas, water and other service line should be closed or controlled appropriately.

v) Dust should be controlled by suitable means.

vi) Sequence of demolition should be planned in such a way to cause minimum nuisances to surrounding areas. Demolition should be carried out systematically storey by storey in descending order.

BIS has also published codes for practice for safety. Few of the codes being old need updating due to changes in technology with time. List of codes published by BIS for practice for safety in construction works is given in Appendix.

CURRENT SCENARIO OF SAFETY PRACTICE IN CONSTRUCTION SECTOR

Government has passed an act for safety in construction “Building and other Construction workers (Regulation of employment and conditions of Services) Act 1996”. CPWD also in its contracts through GCC mandates contractors to make arrangements for safety provisions. However it is seen that proper enforcement of these acts and provisions are yet to be achieved.

Recommendation

The cost of project to owner is both direct and indirect cost as identified in construction contract. The agency generally loads the indirect costs to comply conditions of contract while working out quotes. In case implicit conditions are made explicit, it will introduce transparency and will result appropriate quotes unlike in case of implicit condition which will tend to over quoted by agency. For example it is seen that barricading of site are done more effectively when it is kept as a payable item in contract with respect to barricading done when it is made an implicit condition in contract that site should be fenced by agency on his own cost. Effective barricading of site reduces risk of accident substantially. In view of above it is proposed that we may identify and introduce items necessary to mitigate the risk and incorporate in contract to ensure this implementation.

This will improve implementation of safety provisions, will be easy to measure and contractors will be encouraged as they will get paid for it. Contractor will have no reason to avoid safety measures as he will get benefits of reduced accidents on the safety arrangements paid by owner. Some of the payable items may be employing Safety officer and other members of safety team, training on safety & skill development of workers, Worker's insurance, Worker's amenities, Barricading of site, Safety nets, Scaffolding with proper specifications, placement of warning signs, Fire fighting and other specialised safety equipment etc. Safety gears supplied to workers may also be made reimbursable or may be directly issued by owner.

Few of the above items are available in DSR 2018. Item no 24.2 pertains to double scaffolding system. Item no 26.81 pertaining to scaffolding net, is new item introduced in DSR 2018. These items may be incorporated in BOQ of contract instead of making implicit conditions for making these arrangements as part of contract, which makes its enforcement difficult. More such items should be identified, standardised and introduced in DSR so that it can be incorporated in BOQ of tender.

Further, Safety Provisions made in NBC 2016 and various codes on safety are like ready reckoner on how to work safely. These should be kept handy at site and used for day to day planning of activities. Safety team may be given performance target and a system may be developed for encouraging Safety team by giving incentive when they achieve targets. Contractor may also be rewarded by way of a clause in agreement for accident free construction. These small steps will surely lead to a safer construction industry.

SAFETY IN BUILDING DESIGN AND CONSTRUCTION

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Abstract

Safety measures are provided due to regulatory requirements, insurance and compensation cost involved due to accidents, image building, preventing wastage, improving quality and as a social responsibility. Though overall scenario of the safety culture in the country has not been very encouraging, in construction sector it is lacking badly. It is presumed that the safety cost would enhance the cost of the project hence safety norms are avoided by many in construction sector to make it economical.

In limited applicability of safety norms, it is related only to providing helmets to workers in many sites though in construction structural safety, occupational safety and environmental safety are also very important.

Safety in construction affects not only the personnel working at site but also common public in and around the site and society at large. Thus, safety culture needs to be built in construction sector and it is to be ensured that safety norms are adopted at all sites for safety of structure and personnel.

Safety Management Process

From the standpoint of management, three distinct management styles can be observed as per Pascal Denis: Safety Without Any Management Process (SWAMP), the Naturally Occurring Reactive Management (NORM), and world class safety. As the name suggests, in SWAMP, safety is not the part of the management process, in NORM, reluctant compliers are there while world class have good safety management but are less than 10%.

In India, situation is further complex. In India, out of 24.90 crores houses (Both in urban and rural sector) 11.19 crores are with bricks and 65.40 lakhs with concrete as per the census of 2001. If stone houses are added, these are 11.19 crore. If all these are considered pucca houses, @ 58% houses are pucca houses which are made of bricks, stones or concrete. Out of 58%, hardly 10% may be with engineered construction which means hardly 6 % of total houses. In these 6%, which includes public and private housing, if 7% norms of world class safety are adopted, 0.36% only might be implementing world class safety norm though our country may not even be complying to world class norms. Therefore, professional safety management is generally missing in India.

Safety in Construction

It is said that accidents do not happen they are caused and thus preventable. Accidents are

either due to unsafe act or unsafe conditions. Unsafe act is normally attributed to individuals while unsafe conditions are either attributed to engineering or the management as providing safe conditions is the responsibility of the engineers and the management. Thus for safety management, both unsafe act and unsafe conditions are to be tackled. Unsafe act can be prevented through education and training, orientation programmes, display of posters, signage, safety task assignments etc. while unsafe conditions through management commitment, proper policy, resources, proper planning and implementation, development of effective safety programmes and execution through inspections, checklists, quality etc.

Safety is said to involve 4 Es as Education, Engineering, Enlistment and Enforcement though some include Encouragement as 5th E. Sometimes they are clubbed into 3 Es as Engineering, Education and Enforcement. Engineering include planning, execution and maintenance, Enlistment includes positive attitude of contractor and employer towards safety programme and its purpose while Enforcement requires strong will and determination including promotional measures like rewards, safety competitions, disciplinary actions and punishments. Investigations of accidents/incidents/near miss incidents help for ascertaining corrective and preventive actions.

Engineer's concern in civil engineering includes safety of structures during construction, during occupancy as well as during dismantling of the building, safety of workers and even environmental safety particularly preventing pollution from construction activities. An architect in the planning process has to ensure preservation of environment by minimum disturbance at site, preserving trees and green areas, and use of environment friendly materials. To ensure safety during its life, safety features are to be incorporated during its planning, design, execution and maintenance stages. Thus safety in construction includes:

i. Structural safety

ii. Workers safety

iii. Public safety

iv. Environmental safety

Structural Safety

Structural safety is important during construction as well as maintenance stage thus from inception to dismantling. Thus a structural safety is to be considered for its life cycle. Provisions for safety during construction may include the followings:

i. Foundation safety

ii. Structural safety during normal and critical conditions

iii. Fire safety

iv. Safety due to temporary structures erected for execution

v. Safety during disasters

vi. Safety of the components and process through quality

Structural failures may be due to many reasons such as inadequate design, poor detailing, soil/foundation failure, vertical extension without proper design and detailing, lateral loads due to wind, earthquake, cyclone etc, landslides, soil erosion, early removal of centring or poor/inadequate centring, poor quality, additions and alterations without adequate designing, excessive live loads, change of use of building resulting into excessive loads, increase in dead loads, and due to manmade disasters like fire, floods, impact or blasts.

Foundation of the structure poses a problem of distress as well as failure during construction as well during life cycle. Many times, soil investigation is not carried out or inadequately carried out and foundation is designed on some assumption basis. A general concept may sometimes leads to distress of structures that on increasing width or depth of foundation, bearing capacity of the soil will increase which may not be true in all conditions except in homogeneous soil. In Salt lake area of Kolkata, upper soil layer is sand as Ganga sand was filled up in the area but below this is a layer of highly compressible soil and thus even low rise structures founded on compressible soils at higher depth show distress but not those founded on sand at shallow depth. Large number of structures show failure founded on black cotton soil including boundary walls. It was observed that some private constructions collapsed during Gujarat earthquake because of inadequate foundation.








Many buildings in Delhi and Mumbai collapsed during vertical extensions. Additional storeys are added without any structural analysis and even new constructions are taken up without any structural design leading to failure. Such structures may fail either during construction with their dead loads, during their occupancy when live loads are added on them or during lateral loads due to shocks, vibrations, wind or earthquakes.

Structures which are unsafe due to design may fail as soon as the shuttering/centring/propping is removed or even during their casting. In case, centring provided is not able to take loads or structure is supported on inadequately provided or erected without bracings and lateral loads come on the same, such centring/props may fail leading to failure of the structure.

Structural safety of a structure is important at execution stage and during post construction stage. Failure of a structure during execution stage is mostly due to some of the following reasons;

i. Unsafe design

ii.Not following the correct design. The design might have been revised but execution made based on old drawing. If old drawing is not destroyed, kept at site and even an entry is not made of its revision which create such conditions.

iii. Collapse of temporary structures like failure of scaffolding, centering and shuttering.

iv. Incorrect sequence of removal of props like removal of props from fixed side in a cantilever.

v. Removal of centering and shuttering before specified and required stripping period.

vi. Poor quality of work.

vii. Sudden change of conditions like partly constructed underground tank can float if water gets filled up around it due to sudden rains and there is huge uplift which is more than the load of the tank.

viii.Poor detailing like no overlap of the reinforcement or even say no provision of weep holes in a retaining wall or in a boundary wall leading to water pressure on one side of wall not designed for.

ix. Poor drainage causing to bearing capacity failure.

Collapse of the structures at post construction period is also possible. These failures may be under normal conditions as well as during disasters like earthquakes, cyclones and floods. Some of the reasons are numerated in the followings:

I. Removal of load bearing structural members.

ii. Additions and alterations.

iii. Due to changed conditions because of construction of other structures like underground metro construction may create distress in adjoining structures.

iv. Disasters like earthquakes etc. for which the structures are not designed.

v. Aging of structures and residual strength not adequate to take loads.

vi. Poor maintenance conditions leading to deterioration of strength of the structural members.

vii. Changed use like a building designed for office being used for library or a cinema hall.

viii. Poor drainage conditions around the building or rise of ground water table leading to reduction in bearing capacity of the soil.

Safety during maintenance stage may be due to no or delayed repair and maintenance, and due to temporary structures or arrangements made for carrying out maintenance. Some of the services are not compatible to the life of the structure like plumbing services. But plumbing and sanitary pipes are not changed after their useful life leading to seepage, which corrode the reinforcement and lead to distress in the structure.

Safety of structure may get jeopardize in case of wooden members due to damage by termites. Sometimes wooden members, generally used as beams and lintels, support structural load like of slab or wall. In case, termite attacks the members, from outside these wooden members may appear to be in good conditions however they are damaged by termites at the supports and even they eat inside portion of wooden members and make them hollow.

Safety of steel members embedded in concrete is also to be ensured as in case there is wetting and drying, particularly at the supports, or due to adverse conditions like coastal areas or concrete containing salts, corrosion may damage steel members at the support which may not be visible easily from outside.

Safety from steel members or reinforcement in RCC particularly in case corrosion has started may lead to failure in case spalling of concrete is overlooked or corroded steel bars/members are covered without providing adequate steel required as per the design. Once, corrosion starts, rate of corrosion increase even if member is plastered or guniting is done on the members. Such members may fail due to inadequate quantity of reinforcement available in structural members due to design deficiency.



In case of post tensioned slabs, tendons are stressed and if by chance, such prestressing is damaged, it may cause structural failure.

Workers Safety

Workers safety is to be planned and implemented during construction as well during maintenance operations. Workers safety is not given due importance due to the followings:

i. Economic considerations

ii. Non- availability of safety equipment like personal protective equipment (PPE), safety nets, safety belts, safety gloves, footwear, cloths, safety gear, safety glasses, masks etc.

iii. Old and outlived machines and equipment

iv. No provisions of site and work specific safety measures

v. No provisions for health and welfare measures

vi. Poor knowledge of machines, equipment and the safety provisions

vii. Unawareness

viii. Due to bad workmanship

ix. Due to electric shocks

x. Non adoption of safety measures by workers

xi. Workers not abiding to safety rules

xii. Due to culture of not taking safety seriously

For not implementing safety norms for workers even if required as per contracts and labour laws, contractors, engineers, supervisors, and workers all may be responsible but it is the responsibility of contractors and engineers to get them enforced.

Sometimes, contractors do not make available safety equipments, sometimes engineers do not enforce them as per contract conditions and sometimes workers do not follow safety

rules thus safety culture is missing, though in world class safety day starts with safety. Even workers sometimes meet accidents with their own bad workmanship like not providing correct joint in props or not taking out nails from earlier used props. 4 Es i.e. Education, Engineering, Enlistment and Enforcement are essential in such cases and even 5th as Encouragement.

Public Safety

Like structural and workers safety, public safety is also to be considered during construction as well as during maintenance stage. The provisions for public safety may be required due to the followings:

i. Storage of construction materials on public roads or public places.

ii. Fall of construction material due to no provision of barricading and curtains.

iii. Direct access to site because of no barricading.

iv. Deep excavations in close vicinity of existing structures without taking sufficient precautions to affect other property.

v. Excavations in unprotected areas without protecting them with barricading and without display of warning signs.

vi. Air, water or noise pollution like adopting driven piles for foundation in a habitat area.

vii. No provisions of basic facilities to workers thereby encroachment by them to public facilities or their misuse

In the country, though there are adequate laws, rules and regulations, but not implemented fully, basic reason being absence of safety or even civic culture.

Like any other activity, safety is also required to be planned, designed, implemented, controlled and reviewed for making changes in policy based on its appraisal. Thus a safety cycle is to be created by having a safety policy in the organizations.

Environment Safety

Now environmentalists, NGOs, courts and even public are getting aware for their rights and as such pollution created by any source is being taken up even through PILs so also in the construction. Therefore, environment safety is getting more and more attention particularly in urban areas. Even the technologies which are not safe from environment safety will not be acceptable in future. Green building concept is getting popularity due to environmental and occupational health considerations.

Occupational safety

Every person wants that he feels safe and remains healthy inside his workplace or house and as such occupational health and safety are gaining importance. Use of toxic materials during construction is also not preferred due to adverse effect on health of workers even if cheaper. In future, another dimension of safety from radiation would be added for occupational safety.

Safety Policy

Preparation of safety policy is the responsibility of top management. It has to include participation of all stakeholders to make it implementable. Safety policy should be based on the organization's culture and not just to be copied from other organizations being implemented for a long time. It should include the provisions, which are acceptable and implementable in a reasonable period and then should be promulgated and reviewed from time to time. Once the considerable progress is achieved, policy can be revised by adopting more elaborative and stringent safety norms. All the components of the policy like planning, designing, implementation, control and review/appraisal should be indicated clearly and well documented in the policy document.

Planning

Safety is to be planned in construction activities right from the concept stage of the project. At present no provision is made in the estimates for safety provisions and as nothing is available free of cost, final result is before us. Even if the employer through contract provisions like in Central P.W.D. contracts makes the safety provisions mandatory, cost for safety provisions finds no place in justification and most of the contractors to get the work compromise in safety norms and do not implement them and thus quote the rates without considering its cost. Therefore the cost component of safety provisions and labour welfare measures should be included in the preliminary estimates. Though it may depend upon the size of the project, beginning can be made from any token amount. Recently CPWD has included some items like of barricading and scaffolding nets in its DSR though in future more items are to be included and paid for safety requirements and welfare measures.

Next stage of planning for safety is basically engineering safety which includes provision for adequate and reliable survey and investigation including testing of materials, structural safety provisions, fire safety provisions, electrical safety provisions, use of durable and environment friendly materials and technologies, and strict quality control measures. In the time to come, there will be a need of construction of multistoried dwelling units for labourers, which can be taken on rent by the contractors where all other facilities will be built in.

Integrated Approach considering Safety

If safety is to be designed, it should consider all the provisions whether for the structure,

workers or the public. If the structural safety is considered, design codes and National Building Code are available along with many guidelines, reference manuals, and computer programmes. Design is to be carried out by an expert structural designer. It is essential that not only structure is designed but also temporary and safety structures. If a road is under widening or a culvert or a bridge is under construction, there should be no reason that diversion is not designed and commuters are left to high inconveniences. Similarly if a slab is being cast, centering is to be designed.

Therefore it is important that safety process is included in the design process whether it is earthquake safety, fire safety or workers safety. Local bodies like fire authorities have made mandatory to get the drawings cleared by them before execution. Some banks that are financing the construction activities have also made mandatory for providing loans only if the reputed institutions certify the structural design. This is a good beginning in the field of structural safety. All local bodies can also enlist reputed and qualified structural designers and clear the drawings for construction only if they certify these as few are doing. An integrated approach has to be adopted where safety is part of building planning, and construction.

Implementation

Planning is extremely important process but its implementation is equally important. Many contract documents provide for safety provisions but are hardly implemented. For not implementing these provisions contractor and employer (engineer) both are responsible. If the employer has not implemented safety norms right from the beginning of the work, it would be difficult to implement at a later stage. Apart from this, inertia plays an important role for the contractor and engineer hence it is up to the top management to see that these provisions are implemented either through motivation or force like quality.

Control and Monitoring

Safety needs to be built in the system hence safety officers will be required to be employed in all projects like engineers and architects who will implement safety manuals, and enforce safety through safety implementation committees, review committees, codes, awareness generation programmes, awards and even penalties and punishments.

Safety has to be adopted by all the stakeholders in construction and maintenance. During planning stage, surveyors, consultants, architects, planning engineers, local bodies and structural engineers have a major role to play. During execution, site engineers, quality managers, contractors, and workers are the stakeholders. During maintenance stage, planners, maintenance engineers and workers have to play their role. In all the stages, employer who either is beneficiary or the financier has the greatest role to play in safety management. Therefore all stakeholders are to understand concept and importance of the

safety, introduce safety in their work culture then only the safety programme can be successful.

Training and Awareness

It is not easy to inculcate any new programme due to inertia so also safety culture in the construction. Therefore the inertia is to be removed by training and awareness generation programmes among all the stakeholders. Awareness can be generated through seminars and conferences for middle level and top level managers and at lower level through manuals, workshops, meetings, lectures, and site demonstrations etc. Particularly for workers level, such programmes can be included in various training centres now being opened for construction workers. Contractors play an important role in safety implementation programmes therefore contractor associations should be requested to arrange safety awareness programmes for the contractors and also for their workers.

Public safety is of prime importance as the accidents whether during normal time or during disasters not only kill people but affects nation's economy. Therefore, training and awareness programmes among general people particularly due to structural safety during earthquakes should be arranged at large scales through local bodies.

Safety Cost

Safety cost is misunderstood to be the cost incurred on attaining the safety standards while actually, safety cost is the cost incurred due to not abiding the safety standards. It has two components namely direct cost and indirect cost. Direct cost includes cost on medical care, compensation, loss of property/equipment, replacement cost etc while indirect cost includes loss of production, cost of time spent on investigation, cost of time spent with regulatory authorities etc.

It must be understood that nothing is available free of cost. Therefore, we should pay for it either by making provisions in bill of quantities or by considering in the justification. Mantra is “Pay for Safety, it will be rewarding ultimately”.

Safety Audit

A safety audit is an inventory or checklist of the features in a building which may be affect safety. Safety audit allows taking action to correct these features. The goal of a safety audit is to identify and, if possible, to improve it to make it safer and less threatening for its users. Safety audit is a simple but powerful tool.

Conclusions

Construction poses safety problems to workers, occupants and public. Along with workers safety, structural safety is important which is required to be considered for the life cycle of the

structure. Safety in construction is required to be considered from the concept stage to maintenance stage as it is very difficult to implement the safety norms if the same have not been considered in planning and design stage. This can be achieved by investing a small amount during construction and maintenance, which would reduce the accidents and prove to be economical in long run. Cost of safety provisions should be considered in the preliminary estimates and made part of the bill of quantities. A safety policy should be made in the organizations and awareness should be generated for safety among all the stakeholders. Cost benefit analysis should not be made based on direct cost forming the base for not adopting the safety norms. Ultimately, it must be understood that total safety management can only be achieved if it is included in planning, design, process, materials and equipments and implemented by every person involved directly or indirectly in the process.

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WORKER'S WELFARE MEASURES AND SAFETY MANAGEMENT IN THE CONSTRUCTION WORKS OF IIT GANDHINAGAR

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Abstract

'Labour Welfare' is a broad concept referring to a state of living of an individual or a group as workman within and outside of premises of work, in an acceptable interaction with the total environment-ecological, economic and social harmony. Workers welfare, labour welfare and employee welfare are terms normally used for addressing various facilities and benefits provided to employees in addition to their pay. 'Worker'sWelfare' is an all-inclusive term and constitutes social and economic aspects of welfare such as physical, mental, moral and emotional well-being of an individual worker, which is an imperative aspect and plays very significant role in industrial relations for welfare and productivity. The National Commission on Labour had also said that "the model of welfare is essentially dynamic which constitutes of a different changing interpretation from country to country in various phases of time, and even in the economic development and generallevelofsocio-economicempowermentanddevelopmentoflabour class."

Central Public Works Department has given deserving importance to worker's welfare, as also envisaged in the General Conditions of Contract of CPWD. This paper is with the prime objective of giving glimpse of the workers' welfare measures and safety management being implemented in the construction works of IIT Gandhinagar.

Introduction

International Labour Organization, in its resolution of 1947, defined Labour Welfare as such services, facilities and amenities as adequate canteens, rest and recreation facilities, arrangement for travel to and from work and for the accommodation of workers employed at a distance from their houses and such other services. Amenities and facilities contribute to improvement in the conditions under which workers are employed.

It can be said that worker's welfare denotes to all those activities of governmental authorities, employers, voluntary organizations and trade unions which help workers live up and to be more productive. It constitutes of provisions for the improvement of safety, health, well-being and industrial productivity of the workers.

Worker's welfare works could be broadly bifurcated into five sections:

• Statutory provision by different legal legislations enforced by Central Government.

• Welfare measures given by State Government.

• Welfare measures given by employers.

• Welfare measures forced by trade unions.

• Various welfare activities acted upon by voluntary social organisations.

Implementation of Labour welfare measures couldbe broadly divided into three categories:

• Statutory

• Voluntary

• Mutual.

Further, area of Worker's welfare measures or activities could be further bifurcated into two predominant categories namely (i) Welfare measures inside the work place and (ii) Welfare measures outside the work place. Worker's welfare may be understood to mean such services facility and amenities, which may be established outside or inside the work place to enable the persons employed there, to perform their work in healthy and congenial surroundings and to provide them with amenities conducive to good health and high moral.

Welfare Measures Inside the work place: Conditions of the Work Environment:

Welfare measures inside the work place broadly include:

• Workmen's safety measures and first aid equipment

• Sanitation and cleanliness, proper ventilation and lighting, reasonably comfortable level of temperature, humidity, elimination of dusk, smoke, fumes, gases.

• Distribution of work hours and provisions for rest hours, meal times and breaks.

• Convenience and comfort during work that is operative posture, seating arrangements.

• Provision of drinking water.

• Canteen services.

• Notice boards, posters, pictures, slogans, information or communication.

• Sanitary facilities, wash basins, bathrooms

• Creche facility.

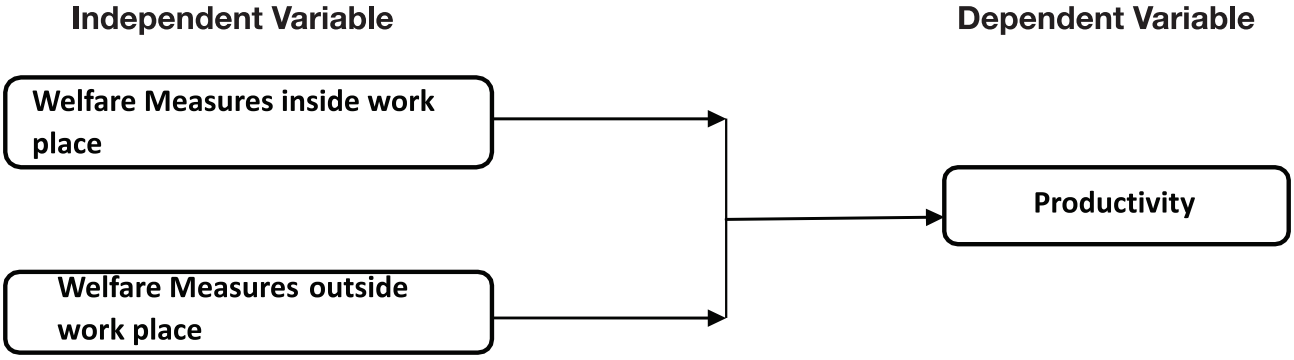
Welfare measures outside the work place:

Welfare measures outside the working environment broadly include the following:

• Well ventilated and lighted Housing.

- Health and medical services.
- Drinking Water, sanitation, waste disposal
- Transportation for travel between work place and residential area.
- Training

Relationship Framework between Welfare measures and performance



If an organization provides better working and living condition to **workers, they will tend to be more efficient and effective and resultant enhanced productivity. Worker's welfare measures such as housing, education, health, training and other welfare measures significantly contribute in enhancement of the overall performance of workers in developing country like India.**

Indian Institute of Gandhinagar

Central Public Works Department entered into MOU with Indian Institute of Technology, Gandhinagar for infrastructure development of its new Campus on 403 acres of land at Gandhinagar. The work was distributed in two phases for the purpose of implementation as per financial phasing.

In the initial phase, construction work of Academic Block, Hostel blocks accommodating 1200 students, 270 faculty residential units, 190 KV solar car port parking, Sewage Treatment Plant, 50 Lakh litres capacity Jal Mandaps for rain water harvesting, Water Treatment Plant have been successfully completed and commissioned in May 2016 and dedicated to the nation by Hon'ble Prime Minister of INDIA in October 2017. The institute is functional in the new campus.

Remaining works of phase 1 comprising of, Hostel Blocks for accommodating another 1200 students, Institute's Guest House, Directors Bunglow, Research park,Studio Apartments, Amphitheatre, Sports Complex with indoor and outdoor sports facilitiesare presently under construction. Workmen force of about 2000 skilled and unskilled workers is deployed on the

construction works at present.

Worker's Welfare Facilities

CPWD being the principal employer, has the responsibilities towards worker's welfare covered under clause 19 of GCC of any contract agreement, to ensure basic worker's habitats with facilities of clean, hygienic and well ventilated housing with adequate drinking water supply, electrical and sanitation facilities, disposal of waste, provision of crèches etc. Dr. Sudhir Jain, Director, IIT Gandhinagar took particular initiatives on the importance of the worker's welfare measures. CPWD and IIT Gandhinagar jointly prepared special conditions for incorporation in the Bid Document regarding worker's welfare measures with particular emphasis on reasonable and decent housing and ensured sincere implementation of the provisions enshrined under clause 19 and its sub clauses of the GCC.

These contractual provisions have been further expanded by inclusion of drawings for worker's housing in the contract document. Also, creation of housing and other facilities for workers has been made a mandatory pre-requisite in the contract document for start of construction work by the contractor. The special conditions incorporated in the NIT are:

"The space for construction of labour housing shall be provided by IITGN at its sole discretion in North Campus free of cost. The bidder himself shall construct clean hygienic and well ventilated labour housing with adequate water supply, electrical, sanitation facilities, etc as per "Model Rules for the Protection of Health and Sanitary Arrangement for the workers Employed by the Contractors" of General Conditions of Contract, or applicable Labour Regulations".

"Adequate number of housing units shall be constructed within two months of the date of start, failing which a recovery will be made at the rate of Rs 10,000/- (Rupees Ten thousand) per day till the workers housing is made available as per given numbers at site to the satisfaction of Engineer-in-Charge. The additional number of houses required to be constructed would be decided by the Engineer-in-Charge based on the assessment of the requirement of labours for the project which shall be constructed within one month from the date of communication of the requirement failing which additional recovery will be made at the rate of Rs 10,000/- (Rupees Ten Thousand) per day, till the workers housing is made available at site to the satisfaction of Engineer-in-Charge".

Permission to start of work is accorded to the construction agency only when the worker housing work is inspected jointly by CPWD & IIT Gandhinagar on completion by the agency in all respects.

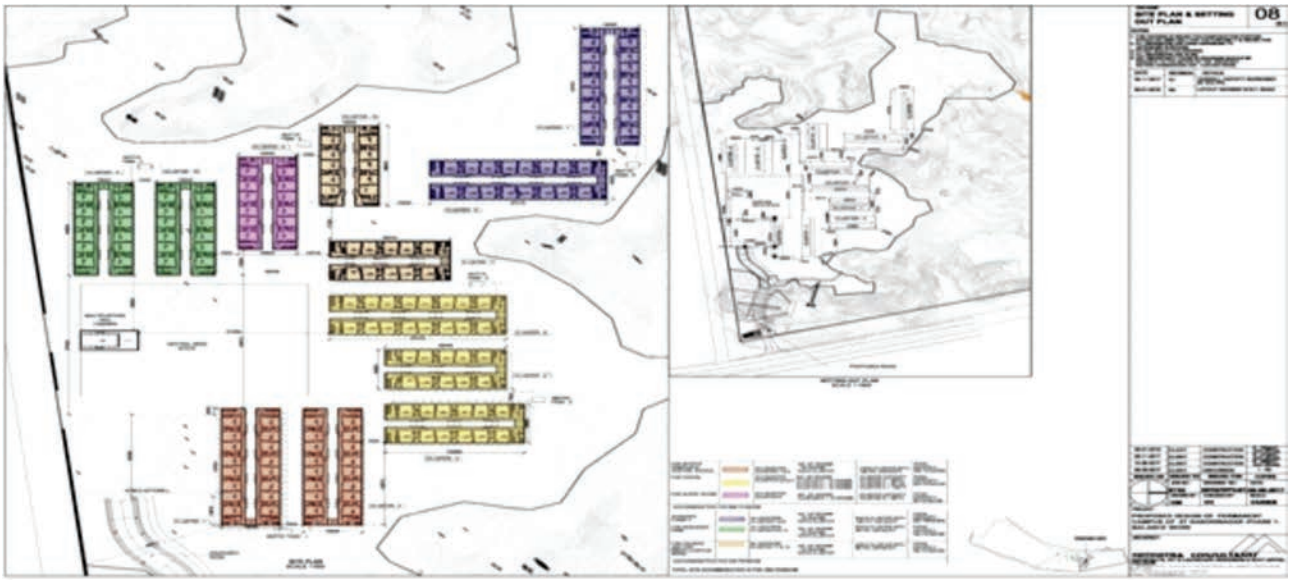
Worker's Housing camp jointly Inaugurated by Shri Prabhakar Singh, Director General, CPWD and Dr. Sudhir Jain, Director, IIT Gandhinagar in August 2018



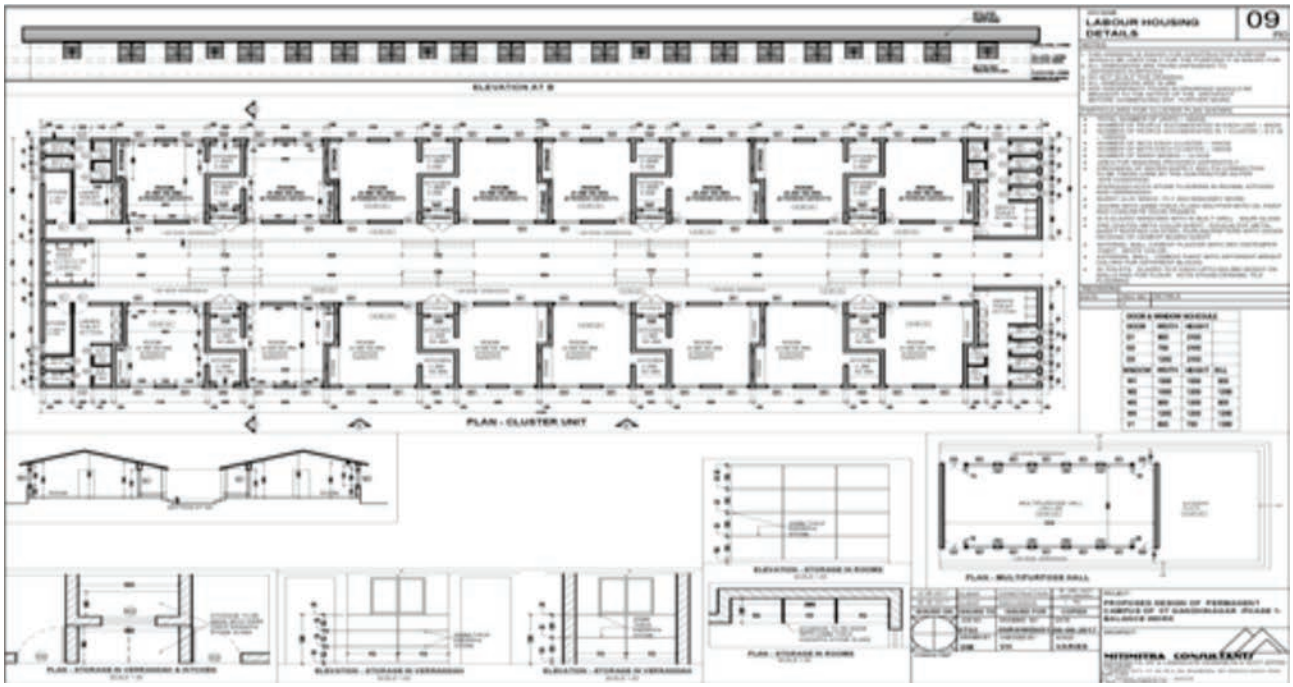
Worker's Welfare Facilities outside Work Place

Initially, assessment regarding manpower requirement was worked out for quantifying housing requirement in respect of each work contract. To ensure faster construction of worker's housing with element of economy, worker housings have been constructed with reusable, prefabricated precast concrete panels, as per the design/ drawing made part of the contract document.

Schematic Layout of Worker's Housing



Further, based on the broad assessment, housing units to accommodate bachelors and



workers with family separately, were decided. A single unit of size 25 ft by 15 ft with an attached kitchenette of size 6 ft by 8 ft to accommodate 8 bachelor workers, smaller units of size 10ft by 8 ft for each worker with family, have been constructed as per requirement. Indicative cost of the construction of worker's housing with prefabricated elements works out to about Rs.200 /sqft.



Separate male and female toilets at the rate of 1 toilet for every 15 persons has been provided in the worker camps, with arrangement for sewage disposal through soak pits/ septic tanks. Compost pits have also been constructed at all the workers camp to utilize the organic waste generated.





Piped gas connection along with burner has been provided for each kitchenet in the workers camp to provide better environment for cooking, reduce pollution and also to create awareness among workers on advantages of use of clean fuel. Cost of piped gas works out to Rs. 2/- per person per day on an average.







Initiatives have been taken by Officer'sWives Association, Gandhinagar towards worker's welfare activities by organizing games for male and female workers to break monotony from their routine and to bring smile on their faces. Such activities have received encouraging response also helping in enhancing efficiency and performance of workers.



Worker's Welfare Facilities inside the Work Place

Creches for children of construction workers have been constructed with one teacher and one maid to take care of children while their parents are at work. Members of CPWD Officers' Wives Association, Gandhinagar regularly visit the creches to monitor and assist in its effective functioning.







Inside the work place, facilities of drinking water, toilets, Canteen, restroom have been provided at each site. Adequate display of safety aspects has implemented.









Safety management (Inside work place)

This subject is being dealt in large perspective with an approach to develop and establish safety culture at work sites in all the construction works being done by CPWD at IIT Gandhinagar campus. Its broad components are:

- Creating awareness.
- Education.

- Training.
- Implementation.
- Enforcement measures.

Importance of safety of workers involved in construction work has been given due place by creating awareness among workers on the importance of observing safety guidelines on regular basis, as first step for it successful implementation.

Every day safety briefing is conducted at site for 10-15 minutes before start of work by the safety supervisors, to all the workers and site engineers, to inculcate the safety habits as integral part rather than feel of burden to use safety gears.



In order to achieve the intended results, provisionscovered under clause 19 C of the GCC have been further supplemented by inclusion of the following conditions in the Bid Documents:

1. The contractor shall employ a Safety Manager and two safety supervisors. They shall be primarily responsible for developing safety programs, training, implementation and propagating safety culture.

2. The contractor shall issue Photo Identity Cards with unique numbers containing salient information of workers. The contractor shall establish a Time Office at the entry to demarcate area of site. The Time Office shall maintain a computerized record of all the workers allowed entry / working inside the demarcated area.

3. Formation of Safety Monitoring Committee

At the start of work, a safety monitoring committee is formed, consisting of authorized representatives of the contractor, associate agencies (if any), CPWD, IITGN and chaired by nominee of the Director, IITGN. The mandate of this monitoring committee is to monitor and achieve the objectives of construction safety continuously, progressively and through affirmative action and to inculcate the safety culture among all stake holders. This committee will oversee implementation of safety program over the entire construction.

4. Training and Awareness:

(a) Training: The training shall be in two phases- first initial training and then periodic Training / refresher workshop.

(b) Initial training: All the workers shall have to undergo a training program of 16 hrs (8 hrs for 2 days) and to be declared satisfactorily trained by the Safety Manager before they are allowed to work on site.

(c) Orientation Program: An orientation program shall be arranged for all people (other than workers) who normally work at or visit the site.

(d) Workshops: Refresher workshops shall be arranged for one day in every three months for all the workers on site.

(e) Advance training: For workers involved in high risk activities (to be identified by the Safety Monitoring Committee) a refresher workshop / training shall be kept once a month.

(f) Training Methodology: The training methodology shall include both classroom and practical demonstration with audio visual techniques. For greater impact, demonstration with dummies will be done to highlight hazards of not following safe practices. The training shall be imparted in vernacular language and may includemeans such as songs, theatre, puppetry etc. for better appreciation and assimilation by worker.

5. Enforcement: The safety team of the contractor and project team of CPWD are entrusted with enforcement of safe practices. If safety program is not followed then recovery as below shall be made:

(a) If the contractor does not employ and / or submit the names of Safety Manager and or Safety Supervisors of specified numbers with appropriate qualification and or experience

then a recovery of Rs. 2000 per day and Rs. 1000 per day shall be affected for Safety Manager and each Safety Supervisor respectively.

(b) No person shall be allowed to enter the demarcated area without adequate safety gadgets (as per occupation / purpose of visit). Failure on this count will result into paying a fine of Rs. 100 by defaulter.

(c) Inside the work area, any person found not using safety gadgets shall have to pay fine of Rs.100 per count of default and shall be barred from site for one day.

(d) In case of default by workers, their employer (hiring agency) will also have to pay a matching fine.

(e) These fines will be collected into workers welfare fund. Money thus collected will be utilized for supporting welfare programmes for workers.

(f) In case the contractor / subcontractor do not impart training the same shall be provided by CPWD through an accredited agency. Twice the amount of fee for such training shall be deducted from the contractor / subcontractor.

(g) A display board shall be kept at site which would list the names of workers / teams and agencies following safety program in the best manner. This would be updated weekly.

(h) During training and workshops, names of persons / teams / agencies that are best following safety program shall be announced and they shall be felicitated.

(i) On completion of the work, shields for best person / team / agencies following safety program in different categories shall be awarded.

(j) In case of an accident resulting in death / permanent disability of a worker, a recovery of Rs. 10 Lakh per death / permanent disability will be made for the contract values more than Rs. 20 crore. Recovery for the contracts with value less than Rs. 20 crore, shall be @ 0.5% of the contract amount per death / permanent disability. The money so recovered will be kept in the "Workers Welfare Fund" and will be at the sole discretion of IITGN for utilizing to support the welfare programs of the workers. This recovery shall be in addition to recovery (recoveries) or compensation under any other Statute / Act / Provision of contract.However the total recovery on this account shall not exceed 2% of the contract value.

Conclusion

The main objective of Worker's welfare measures is to enable and encourage workers to live a more satisfactory working life. Worker's welfare services leadto better physical and mental health of workers. Welfare measures such as medical benefits, education, housing, recreation facilities and cultural activities for the worker and families help in creation of

content environment. Improvement in health, educational and enriching condition of life protects workers from social tribulations like drinking, abusing, gambling etc.A well looked after worker is asset to the organisation and also serves to raise the standards of industry and labour in the country. IIT Gandhinagar is an example of sincere ownership on the part of CPWD and IIT Gandhinagar in discharge of its contractual as well as social obligations towards welfare of construction workers. Implementation of worker's welfare measures with the participation of workers, has shown positive results in terms of productivity, happiness and also conducive working environment.

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FIRE SAFETY HAZARDS AT CONSTRUCTION SITE

Harish Kumar, DDG (W), CPWD

In this presentation we examine the very commonly observed safety hazards at construction sites. A construction site is any piece of land where a building is being built or repaired. Those who work on construction sites are often required to use large tools and pieces of machinery, work at height, and in environments where hazardous materials are present. Because of the nature of such work, working on construction sites can be dangerous. **It can be said that construction work has inherent risk factors and following are commonly observed safety hazards.**

1. FALLS

2. Struck by Objects

3. Electrical SHOCKS

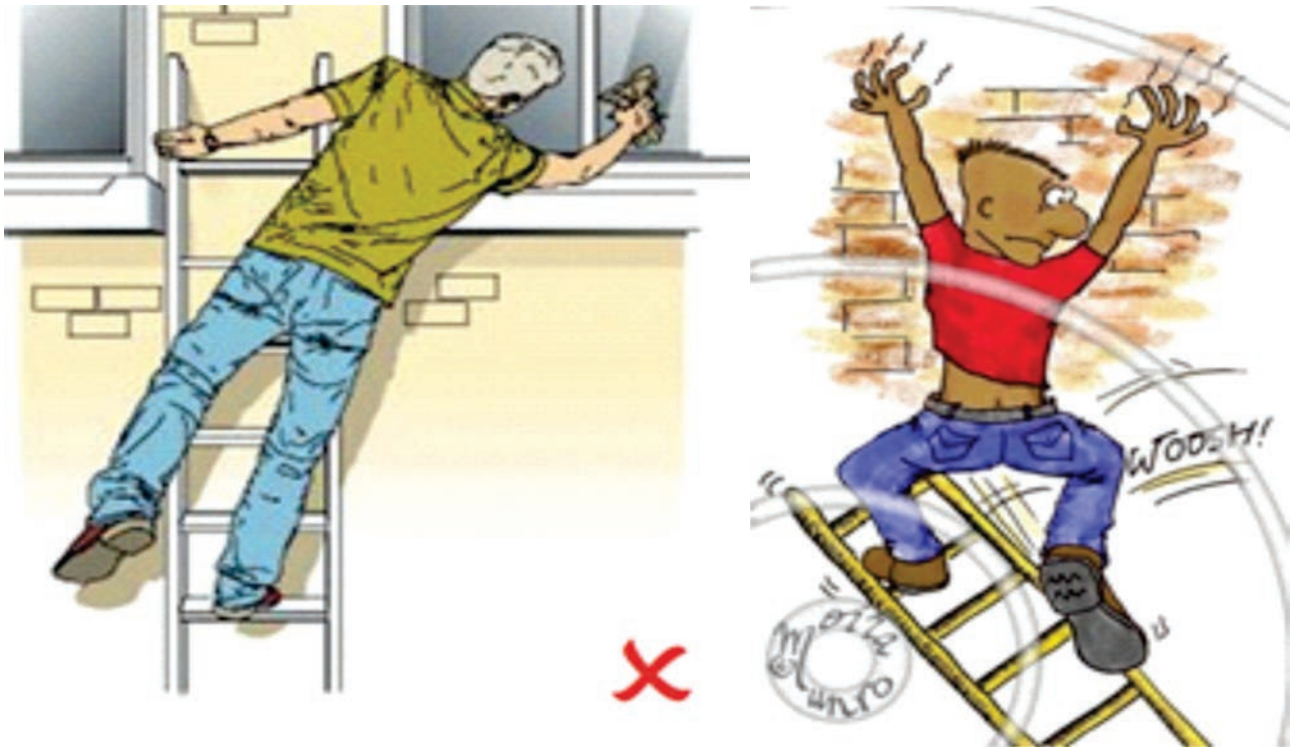
4. Caught-In-Between

5. Hazardous materials

Hazard # 1: Falls

Falling at work site is a common hazard. Fall can occur because of following unsafe conditions

a. Unstable ladder



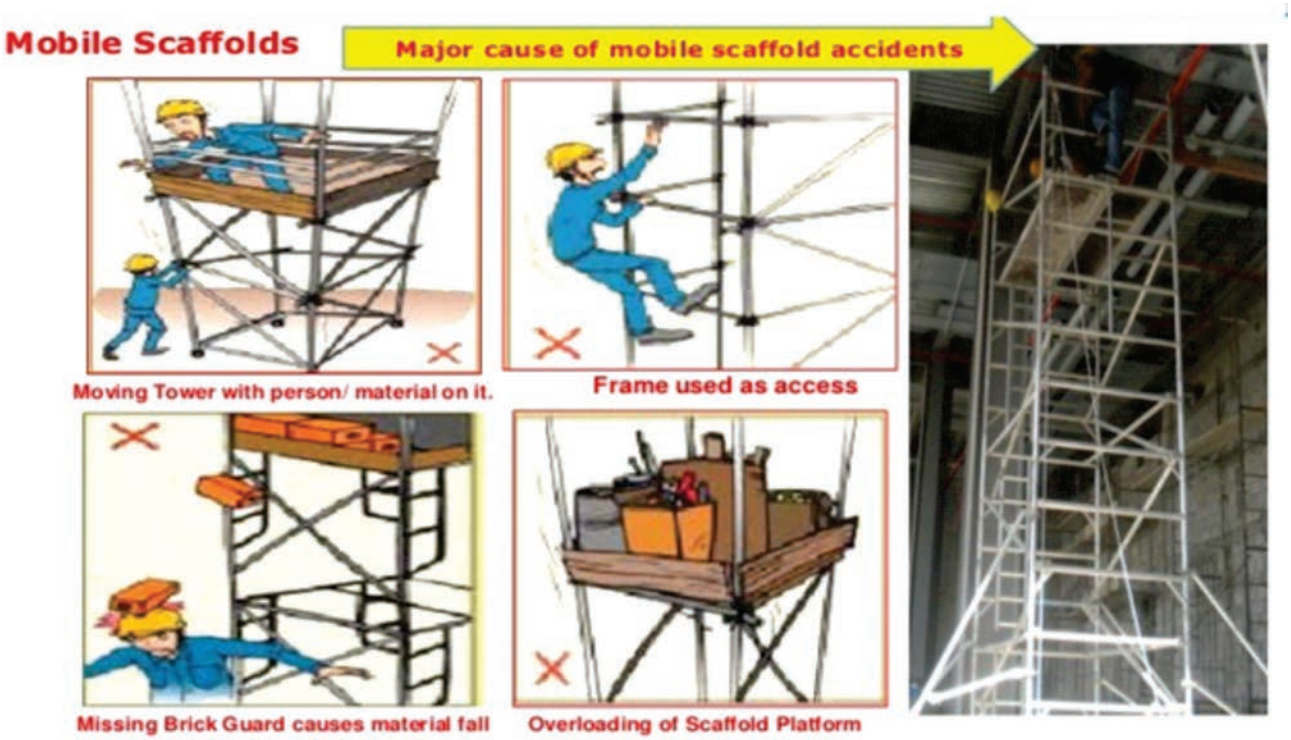
b. Wet conditions



c. Skidding on loose aggregates/gravel.



d. Unsecured scaffolding



e. unstable working surfaces



f. Uneven surfaces

g. Trailing cables

h. Uncovered pits



Each year falls consistently account for more than one-third of construction industry deaths. Often these falls are due to unstable working surfaces, misuse or failure to use fall protection equipment, and unsafe use of scaffolding and ladders.

To protect workers, we have to make sure that ladders and scaffolds meet safety standards and are properly sized for the project requirements. Also ensure that work surfaces are stable, free from holes, and provide proper traction.

Another tip for fall prevention is to apply the six-foot rule. If workers are working more than six feet above another surface, they need to have fall-prevention equipment such as guardrails, fall arrest systems, safety nets, covers, and restraint systems.

Regardless of height, it's always a good idea to ensure that your employees have the right personal protective equipment such as hard hats, non-skid work boots, and tool lanyards.

Of course, the right equipment is only as effective as the training provided. Ensuring that workers are trained to use their equipment and avoid unsafe practices will reduce the risk of accidents and keep your employees safe.

Hazard # 2: Struck by Objects

The next big cause of accidents on construction sites is “struck by objects,” which may be due to following reasons

a. Struck by vehicle.

b. Struck by construction material carried by another worker

c. Struck by load being carried by a crane/Hoist etc.









Vehicle hazards are a big part of this statistic. We must make sure that site safety rules include clear vehicle routes and that employees know how to avoid positioning themselves between moving and fixed objects.

Misuse of heavy equipment such as cranes and forklifts also contributes to these types of injuries.

Make sure that workers are properly trained on the safe use of this equipment and you'll avoid injuries to both their drivers and their team members.

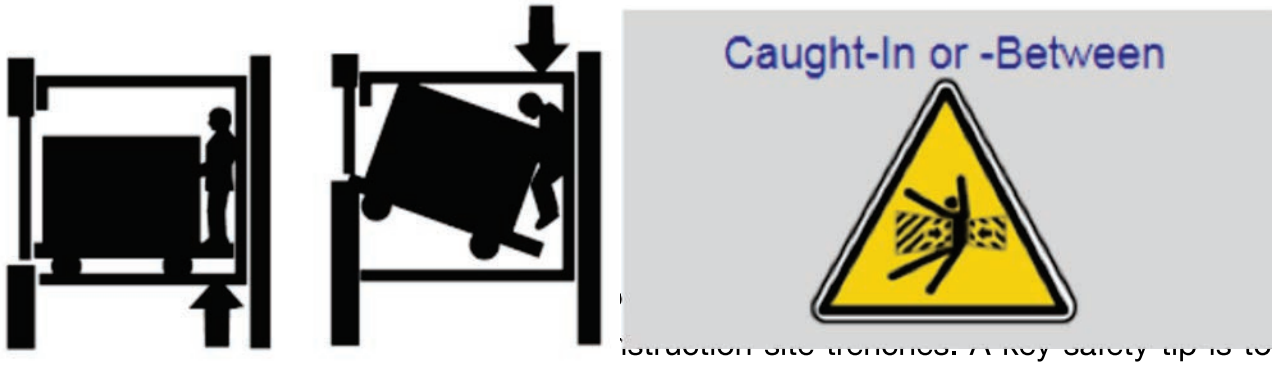
Hazard #3: Electrical Hazards

The dangers of electricity have been known for centuries, and yet electrical safety issues still

account for over 8% of construction site deaths. Before starting any work, locate and identify utilities. If your employees are using equipment, make sure they've located overhead power lines and are familiar with the minimum safe distance requirements.

Providing your employees with portable tools that are grounded or double insulated and using ground-fault circuit interrupters (GFCIs) wherever possible can also prevent avoidable accidents. As previously mentioned, scaffolds, ladders, and platforms pose special safety risks, so make sure your employees are trained to avoid related electrical hazards.

Hazard #4: Caught-In-Between



ensure that trenches which are five feet or deeper have adequate safety measures and trench wall support.

You can also protect your employees by marking all utilities before digging, providing a qualified person to inspect the trench's safety, and training employees on how to protect themselves.

Hazard #5: Hazardous Materials



Construction sites are often filled with hazardous materials that can range from toxic airborne materials which affect respiration to chemical spills which can burn or release toxic fumes.

To prevent exposure, workers should be provided with material safety data for any hazardous chemical being used at the construction site and should be provided with the proper Personal Protection Equipment including respiratory protection. One should also make sure that workers are trained regarding the proper handling of hazardous materials.

We can attribute following reason for above hazards

1. Lack of Awareness

2. No Stress management

3. Lack of effective communication

4. Lack of Physical fitness

5. Mishandling the materials

6. Work distractions

7. Lack of transparency

It is also apparent that above stated reasons are fully avoidable by way of training. Protecting workers requires knowing the potential risks and providing the training and equipment to ensure that they make it safely home from the job site. Knowing these basic hazards can serve as a starting point as we develop a strategy to improve the safety on our construction site.

ENVIORNMENTAL, OCCUPATIONAL HEALTH & SAFETY (EHS) PRACTICES ON ADDITIONAL OFFICE COMPLEX PROJECT FOR SUPREME COURT OF INDIA

B.B. Makkar, CPM, Supreme Court Project, CPWD

Additional office complex for Supreme Court of India has been constructed on a plot of 12.19 Acre. The complex consists of Six blocks varying in height from Ground +3 to Ground +8. The plinth area is about 100000 sqm. The project has three basements with area about 100000 sqm.

The construction industry functions in a dynamically changing work environment in which updating of equipment and standards is a continuous process resulting from changes in operating variables, regulatory requirements and safety practices. An effort has been made to adopt best construction practices by the contracting agency on the project of C/o Additional Office Complex for Supreme Court of India.

Following members of the team from M/s JMC projects (I) Ltd., the contracting agency, were assigned the clear cut responsibilities/authorities to comply the best practices on Environmental, Occupational Health and Safety:-

(i) Project Manager

(ii) Team Leaders & Supervisors

(iii) Sub Contractors

(iv) EHS Officer

(v) Site Admin In-charge

(vi) Site Plant & Machinery in Charge

(vii) Site Engineer

(viii) Worker

1.0 Environmental Risk Assessment (ERA)

1.1 Aspects having significant environmental impacts and its legal requirements, associated with the activities to be performed were identified such as:-

(i) Emission to air

(ii) Release of water

(iii) Noise Generation

(iv) Waste Generation and Disposal

(v) Land Contamination

(vi) Use of Natural resources as raw material

1.2 Ratings of these aspects were made on scale of 1-5 under the following criteria:-

(i) Quantity(A)

(ii) Occurrence(B)

(iii) Impact(C)

(iv) Detection(D)

(v) Control(E)

Value of significance (G) is obtained by multiplying all the above factor i.e.

G=AxBxCxDxE

The aspect is considered significant if the value of G is more than 80 or value of Impact(C) is more then 3.

2.0 Hazard identification, Risk Assessment & Control:

2.1 Occupational Health and safety concern/Hazard-physical, Chemical, Biological, etc involved in all the activities of construction like excavation, PCC work, Bar bending and cutting machine, steel handling and storage, vehicular movement/machinery operation, reinforcement work at height, form work at height, de-shuttering, welding, gas cutting , tower crane operation, passenger hoist, winch(builder hoist) etc. were identified.

2.2 These Activities were further divided into sub activities for example, PCC work was divided into sub activities like Installation of concrete pipe line, delivery of RMC by transit mixer, pouring of concrete etc.

2.3 Each sub activity was classified into Routine/ Non Routine activity. For example installation of concrete pipeline is routine activity whereas Gas-Cutting work at height is Non Routine activity

2.4 All possible hazards in execution of each sub-activity were listed. For Example possible hazards for sub-activity of installation of concrete pipeline can be (i)fall of person/fall of material/hit by object.

2.5 Consequence of each hazard was listed. For example fall of person/fall of material/Hit by object can be incident/injury/emergency.

2.6 Then risk on each sub activity without any control measures was assessed of following parameters:-

(I) Severity(S) - On scale of 1 to 5

(ii) Probability(P) - On scale of 1 to 5

2.7 Risk level=S x P. The same was also classified into High (H), Medium (M) and Low (L). For example risk on severity rating is considered high if it can lead to fatal incident or permanent disability or property loss more than Rs 1,00,000/-. Similar the risk on probability rating was considered high if it occurs frequently or chances are more than 50%, Risk Assessment matrix was prepared on the basis of severity Rating and Probability Rating.

2.8 Risk Rating

1=Trivial

2=Tolerable

3=Moderate

4=Substantial

5=Intolerable

2.9 On the basis of risk assessment, control were determined according to following hierarchy:-

a) Elimination

b) Substitution

c) Engineering control

d) Administrative control

e) Personal protective Equipment (PPE).

For example some of control measures for sub activity of "Installation on concrete pipe line" shall be (i) pipe line to be installed by trained workman(ii) Adequate tools shall be provided for installation (iii) Wear all PPE (iv) Use good technique (v) Be diligent (vi) Keep work area clear of people (vii) Avoid horseplay in work areas etc.

First risk assessment was made with existing control measures. Further control measures were applied wherever there was requirement.

3.0 EHS Awareness, Training and Competence

3.1 EHS Awareness

3.1.1 Awareness about environment, health and safety among all personnel of the project site was developed and maintained.

3.1.2 Project Management communicated the environment, health and safety measures through following procedures:-

(i) Safety walk by the Project Manager along with Team Leaders and Site EHS in charge on weekly basis.

(ii) Mass Housekeeping by Project Manager along with all staff at least on monthly basis.

(iii) Safety committee meeting at site by Project Manager along with site EHS in- charge on monthly basis

(iv) Mass Tool Box at site by Project Manager/site EHS in charge as & when safety alert regarding major accident was received from Head Office.

(v) EHS inductive programme given to the new joined employees, before deploying them to the work site.

3.1.3 EHS Information Boards

(i) EHS information boards are provided at site to display information such as safe man-hours, incidents at site, important contacts nos etc.

(ii) EHS bulletin board was maintained and updated on frequent events

3.1.4 Displaying Posters and Signage

(i) Posters and signage were displayed at site as visual aids for incident prevention, fire prevention and EHS promotion.

3.1.5 EHS talk or Screening of Video on EHS

(i) EHS talk to the work force or Screening of Video on EHS was conducted at site occasionally.

3.1.6 Motivation and Recognition

(I) Good Communication, a viable suggestion system and the recognition of good safety performance, encouraged employee participation in loss prevention programme.

3.1.7 Celebration of Various EHS related occasions

(I) EHS related occasions such as Road safety week, National Safety day, Safety Week, Fire Day, World Environment Day, National Cleanliness day etc were celebrated at site to encourage Occupational Health, Safety and Environmental protection.

3.1.8 Penalties and Fines

(i) Policies were defines at site level according to EHS Violation and were communicated to all Sub-contractors at site.

(ii) All funds collected through penalties and fines were used for EHS promotion activities.

3.2 EHS Training

Training is an essential part of any EHS program. Training includes induction, necessary job related safety procedure, statutory requirement, prevailing safe work practices, tool box and mock drill etc.

3.2.1 EHS Induction

Project EHS In-Charge organized EHS induction for all new personnel on basic EHS requirement of the project site and significant features of the construction work.

3.2.2 Tool Box Talk

a) It was mandatory for all Supervisors/Foremen to conduct and deliver a daily toolbox talk at work location within their respective area prior to commencement of daily work assignments

b) Workers were encouraged for two-way communication and their active participation for betterment of safety implementation system.

c) Some of the topics for discussion were (i) safety while working at height (ii)PPE (iii) Fire Prevention (iv) Eye Protection (v)Electrical Safety (vi) Scaffolding (vii) Manual Material Handling etc.

3.2.3 Trade Skill Training

Trade and skill training is required for Lifting Supervisors, Crane/Hydra Operators, Scaffold Supervisors/Erection team, Excavation , Shoring and Piling Supervisors, Welders and Gas Cutter, Batching plant Operators, Concrete Pump Operators etc.

3.2.4 Training by posters

Training was also given by job specific posters displayed at site.

3.3 EHS Competence

3.3.1 Competence requirement and mapping was carried out for person involved in activities having significant EHS aspects.

3.3.2 Competence of the candidate was reviewed during the recruitment for the job he was appointed.

4.0 Participation &Consultation, Communication

4.1 Participation & Consultation:

4.1.1 EHS committee under the chairmanship of Project Manager with EHS officer as Secretary was formed to facilitate participation and consultation on Environment , Occupational Health & Safety related matters.

4.1.2 EHS committee meeting was held at least once in a month.

4.2 EHS Communication

4.1.3 EHS information was communicated to employees by means of daily toolbox talk, monthly safety meeting, progress review meeting and Circulars.

5.0 Incident reporting and Investigation

5.1 Reasons to investigate the accident:

(i) To find causes so that similar accident is prevented

(ii) To identify the conditions when unplanned/unwanted things occurs

(iii) To recommend what corrective action should be considered

5.1.1 Incident Reporting

a) All incident to be immediately informed to the site in-charges and site EHS in charge.

b) All the reportable incidents to be filled in prescribed format.

c) Administrative department to inform to next of kin of the workers involved in the incident.

5.2 Incident Investigation

5.2.1 Non-Reportable Incidents:

a) Near Miss:

Any event which under slightly unfavorable circumstances might have resulted in harm to people, damage to property, damage to environment etc.

b) Medical Treatment case(MTC) (First Aid Case):-

Any Work related injury like minor scratch, burn, cut, splinter etc, that required one time treatment provided at First Aid Centre by certified first aider at site.

5.2.2 Restricted Work Case(RWC):

Any work related injury which requires treatment by physician and employee can resume to duty within 24 hours

5.2.3 Reportable Incident:-

c) Lost Work case(LWC)

Any work related injury in which the employee remains hospitalized or can not resume duty within 48 hours.

d) Fatal :

Any work related injury resulting into death of person.

Incidents are investigated by a well set procedure a follow up actions are taken.

ENVIORNMENT MANAGEMENT

1. Air quality

1.1 Potential Source of Air Pollution

(i) Construction and demolition activities – emission of fugitive dust by excavation and movement of earth materials, contact of machinery with bare soil and exposure of base soil to wind.

(ii) Exhaust from diesel engines of earth moving equipment as well as open burning of solid waste on site.

1.2 Mitigation Measures

(i) To minimize visible particles from being deposited upon public road including removal of particles from equipments, vehicles sides and tyre cleaning facilities.

(ii) Dumping of excavated materials at the designated areas

(iii) Watering to be done for dust suppression

(iv) The height from which materials are dropped to be kept minimum to limit fugitive dust emission

(v) Other measures like covering with protective covers, barricading, watering etc.

2 Waste Management & spill Prevention

2.1 Segregation of construction waste with aim to increase the feasibility of recycling.

2.2 Use of waste concrete, masonry etc. in preparing site road

2.2 Proper handling, storage and disposal of waste.

2.3 Segregation of waste into Biodegradable waste (Paper, Cloth etc), Contaminated waste(oil soaked cotton etc), Metal waste (Nails, welding etc) and Plastic.

2.4 Spill prevention from machineries, generator sets, cranes etc.

3 Energy Management & conservation of Natural Resources.

3.1 Energy Management

(i) To ensure optimum usage of DG power

(ii) Proper maintenance of equipment to conserve energy

(iii) To switch off all electrical gadget when not required

(iv) No idle running of machineries

(v) Maximum use of day light

3.2 Conservation of Natural Resources

(i) Judicious use of water

(ii) Maximum utilization of bars/pieces of rods

(iii) Minimum consumption of paper

4 Noise pollution

4.1 Noise control so that noise generation level remains within the prescribed limits

4.2 Good quality plants & equipment

4.3 Silencers and mufflers on construction equipment

4.4 Maximum physical separation between noise generators and noise receptors

4.5 Grading of surface irregularities

4.6 Construction of temporary physical noise barriers

4.7 Proper maintenance of equipments.

OCCUPATIONAL HEALTH AND WELFARE

1 OCCUPATIONAL HEALTH

1.1 Physical fitness of worker

1.2 Noise

1.3 Illumination

1.4 Radiation(electromagnetic Waves)

2. WELFARE

2.1 Sanitary Conveniences

2.2 Washing facilities

2.3 Drinking WaterMedical Facilities

2.4 Canteen

2.5 Rest Room Shelters

SAFETY

3.1 General Safety Rules

3.2 First Aid Facilities

3.3 Personal Protection Equipment(PPE)- Helmet, Safety Shoes, Gum boot, Safety Goggles, Ear Plug, Cotton Gloves, Leather Gloves, Rubber Gloves, Dust Mask, Face Shield, Horizontal Lifeline, Vertical Lifeline, Fall Arrester.

3.4 Fire Protection and Prevention

THE PROJECT HAS BEEN AWARDED:

(i) ROSPA Gold Health & Safety Award in 2016 by The Royal Society for the Prevention of Accidents.

(ii) CIDC Vishwakarma Award in 2016 for Construction Health, Safety & Environment.

SKILLING OF CONSTRUCTION WORKERS AND THEIR PRODUCTIVITY : SOME INDUSTRY STRUCTURE CHALLENGES

Manu Amitabh, Dy. Director General (ERP), CPWD, New Delhi

Introduction :

In the modern world technology and innovation have been the single greatest change agent. In India, in the post reform period our economy has seen a pathbreaking rate of growth of GDP. The share of construction sector in the GDP of India is estimated to be around 8% at present. The sectoral share of employment for the construction sector is around 10.6% (RBI, 2014; Nagaraj, 2016), which is far less as compared to the sectoral employment share of agriculture (48.9%), services (26.9%) and industry (13.6%). In general, the construction industry in India is perceived to be a low skill and a low technology industry. This is the primary reason for the low productivity of the sector and the consequent low contribution to the GDP relative to sectors such as manufacturing where the share in GDP is almost 19%.

On the other hand, the employment elasticity of this sector has consistently been one of the highest in the post reform period (Ahluwalia, 2005). Employment elasticity is a measure of the percentage change in employment associated with a 1 percentage point change in economic growth. The employment elasticity indicates the ability of an economy to generate employment opportunities for its population as per cent of its growth (development) process. Apart from quality of policy, economic institutions and quality of technology available in the sector, a dire need has been felt to improve the quality of human capital in the construction sector.

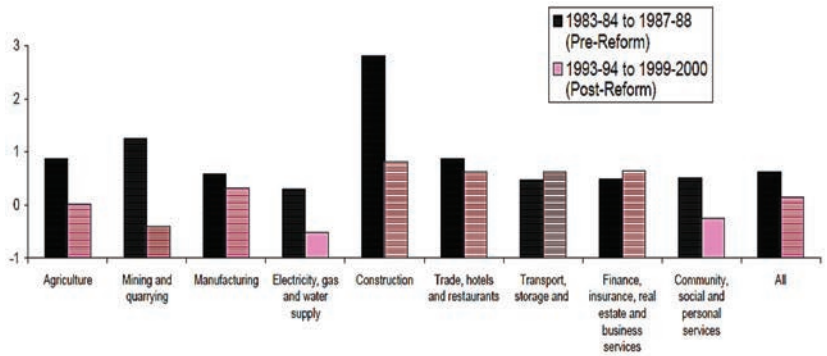


Fig. 1 : Sectoral Employment Elasticities in India (Source : Ahluwalia, 2005)

Need for Capacity Building of Construction Manpower :

The true potential of the construction sector's contribution to the GDP of India is yet to be realized. The Indian construction industry, in general, has been growing at an average rate of 9 to 11% a year (Nihas, Barlish & Kashiwagi, 2013), while the construction employment has grown at over 9% (Nagaraj, 2016). It must be noted that the share of construction workforce in the total workforce of India rose from 4.4% in 1999 – 2000 to 10.5% in 2011 – 12. This is

attributed mainly to the easing of supply side economics in the post-reform period. As compared to this, the share of workforce in the manufacturing sector has practically stagnated during the period at 11%. This indicates a large potential for improvement of productivity and employment.

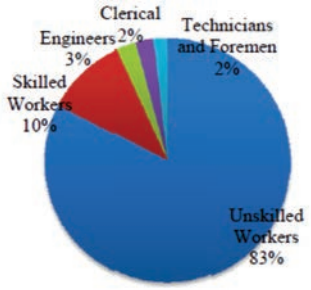


Fig. 2 : Breakup of Employment in Construction Industry of India (Source : NSDC, 2012)

Skilling of construction workers has been regarded as the key to improving productivity, releasing latent employment opportunities in the sector, increasing its rate of growth and contribution to the GDP.

Productivity of Construction Manpower :

Lack of skills impacts productivity in two ways. The first is the direct quality of physical output being delivered by the workers in the most efficient ways. Lack of skills impacts workmanship of every trade from masons to welders to electricians and plumbers. The second impact is on planning of works and projects. A study by the Project Management Institute (PMI), India and KPMG in 2011-12 on the reasons for delays in public sector projects in India found that ineffective procurement planning, design/scope change, delay in decision-making, weak/ineffective project planning and monitoring, location and connectivity to project site, delay in equipment supply, and pre-commissioning teething troubles were some of the major causes of delays in projects. This points to poor planning of projects in India and is directly linked to the level of education/training of construction workers in India as compared to those of the developed nations.

Educational Qualification	India	U K
Ph. D/ Research/ CA/MBA/etc.	1%	6%
Engineers	2%	11%
Diploma or equivalent certification by other agencies	2%	36%
ITI and other vocational courses	13-14%	38%
10th Standard or below	81%	9%

Fig. 3 : Construction Industry – Education Levels (2010) (Source : NSDC, India; UK Commission for Employment & Skills, 2012)

Structural Issues Leading to Low Productivity in Construction Sector :

The construction industry in India is plagued by several structural problems : large vari ation in types of construction, largely unorganized nature of the industry, migration and mobility of labour, low level of automation/mechanization, shortage of labour in mechanized trades , weak contractual enforcement, lack of uniformity in practices etc.



Low worker productivity is closely linked to low skilling levels of construction workers which in turn is an outcome of the nature of the construction industry. Selection of contractors in India is driven by the lowest financial bid and has been identified as one of the major reasons for low quality in works and failure of construction projects (Nihas, Barlish & Kashiwagi, 2013). Frequently, contractors quote very low price bids simply to be awarded a project while expecting to compensate the low margins through claims settled through arbitration and court cases (Singh & Tiong, 2006). This tendency to get a contract solely on the basis of low price bids results in a low premium to worker training and quality by the contractor.

Occupation	Numbers employed in 1995 (in 000's)	Numbers employed in 2005 (in 000's)
Engineers	687	822
Technicians and Foremen	359	573
Clerical	646	738
Skilled Workers	2241	3267
Unskilled Workers	10,670	25,600
Total	14,600	31,000

Fig. 4 : Construction Industry – Number of Unskilled Workers (Source : NSDC, 2012)

In a developing country like India, this makes the project owners resort to extensive monitoring and control systems further contributing to overall inefficiencies. In recent times several partnership strategies - like BOT, BOOT, BOLT etc - have been adopted in the PPP mode, but the structural inefficiencies have continued.

The project managers in both the public sector as well as private sector construction projects have felt an acute shortage of skilled manpower in Project Execution and Planning & Design. This is a result of lack of infrastructure for capacity building and lack of adequate training for unskilled workers. The Indian construction industry is driven by an enormous workforce that is largely unskilled and employed by numerous unregistered contractors. It is estimated that out of the 31 million people employed with the construction industry over 80% are unskilled or semiskilled.

The other issue is the fragmented nature of the construction industry. It is estimated that there are about 30,000 contractors in the organised sector and about 1.2 lakh contractors in the unorganized/ unregistered sector (Nihas, Barlish & Kashiwagi, 2013). Any effort for capacity building of the construction workers is

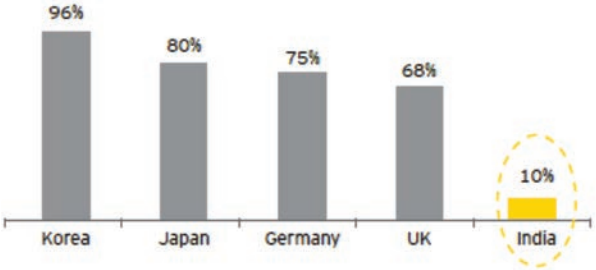


Fig. 5 : Percentage of Workforce receiving Skill Training (2008) (Source : FICCI / E&Y Report, 2011)

therefore an enormous task due to the fragmented nature of the structure of the construction industry. The primary challenge being how to design interventions for training of unskilled workers in both the private and public sector which can directly impact the targeted group.

Conclusions and Recommendations :

There is an urgent need to deal with the structural issues plaguing the construction industry in India leading to the overall loss of productivity. The lowest cost based system forces the bidder to drop quality and ignore worker training and skilling. The lowest cost bid method of tendering can be replaced by more efficient methods such as the Best Value Model which is a selection process suited to identify and select the highest expertise team from amongst the bidders. This model has been successfully adopted in several projects in US, Canada, Netherlands and Malaysia.

Structured skilling of workers needs to be built in the contract by mandate of a law. Such structured training shall empower the unskilled workers with skill sets and knowledge about specific traits which will make them abreast with recent trends and best practices in the construction industry. The model followed by CPWD for skilling and certification of unskilled workers in collaboration with the National Skill Development Corporation/Construction Sector Skill Development Council is very encouraging. The General Conditions of Contract of CPWD provides that at least 10% of unskilled workers are to be provided skilling and certification at site for projects costing more than 50 crores. The same is to be provided for 20% of the unskilled workers for projects costing more than 100 crores. This will help in the creation of a dedicated resource pool of skilled and certified construction workforce for nation building.

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PECULIARITIES OF SKILLSET REQUIRED FOR PRECAST CONSTRUCTION

VG Jana, Sr. Chief Executive, BG Shirke, Construction Tech Pvt. Ltd. &
RB Suryavanshi, Sr. Chief Executive

Abstract

For mitigating the housing shortage through provision of affordable as well as sustainable built environment, adoption of prefab mass housing movement is the only viable solution. The ambitious 'Housing for All' mission can only be realised through Precast Construction. Although 3-S prefab system successfully implemented by BG Shirke Construction Technology Pvt. Ltd. has limited reliance on skilled workforce, continuous skill upgradation to eliminate human errors is inevitable.

Although, Construction industry is the fastest growing industry in India, being unorganized sector, the worker who is contributing to this huge amount remains poor and his standard of living remain largely unchanged. This is because his skills are not being updated as per the need of the construction industry. Precast construction relies heavily on mechanization and due to repeatability and modular concept; the worker has to be aware about efficient handling of machinery and importance of eliminating human errors owing to scale. Methods have to be employed to provide him with right skill sets thus increasing the efficiency of resources and reducing the impact on human health.Proper training and certification methods for construction workers would go a long way in eliminating wastages, ensuring safety thereby increasing their efficiency, productivity and employability.

1. Introduction

The construction industry as a whole has contributed immensely to the national GDP (ashareofaround8%).Precast Mass Housing Construction industry of India is also an important indicator of the development as it creates investment opportunities across various related sectors specifically the mechanization and automation, handling and transportation etc. unlike the construction industry, although the precast sector is less labour intensive including indirect jobs it provides employment immensely.

It is estimated that by 2025, about 70 per cent of Indians will be of working age. This 'demographic dividend' could give India an edge over the developed countries where a larger segment of the population would beby then past retirement age. However, this demographic dividend can easily turn into a demographic disaster if a majority of the working age population remains unemployable due to a lack of skills. Even today, one hears of a shortage of skilled workers across industries, which does not augur well for sustaining India's economic growth. The precast construction industry lacks sufficient qualified

construction activity and increasing the overall cost of projects, posing a major challenge to infrastructure development plans.

Construction industry is the 'Mother' of all industries. The financial health of any nation shall be always encouraging provided the Construction Industry is in boom. Therefore the skills and knowledge in this sector are the driving forces of economic growth and social development. The economy becomes more productive, innovative and competitive through the development of skilled human capital. There is always a difference between knowing and performing, and the gap is explained by in adequacy of skill.

The housing sector in India is growing at a rapid pace and contributing immensely to the growth of the economy. The estimates by Census of India highlight that by 2026, urban population would rise to around 535 million or 38.2 percent of the total population. By 2030, the country is expected to have 68 cities with a population of more than one million, 13 cities with more than 4 million people and 6 megacities with populations of 10 million or more, with Mumbai and Delhi among the biggest cities worldwide.

Today, the living standards of people are changing, affordability of people is improving, and therefore adequate housing & infrastructure are at most important for Nation. We have a challenge in both demand &supply. To meet the ambitious 'Housing for All by 2022' initiative by our Hon. Prime Minister, the only solution is the construction of mass housing projects through precast technology. Consequently, in order to deliver this, there is a need to generate matching skill sets among our tradesmen.

2. Skill Development

In response to the needs of the industry and impetus provided by the government, skill development industry in India has seen a rapid growth. However, it is estimated that only 4.69% of the total workforce in India has undergone formal skill training, a very miniscule population compared to developed nations. While there is an urgent need for Construction skill training across the country, the absence of sufficient training avenues prevents the people from acquiring skill training and certification through formal channels. As a result, most of the skill acquisition takes place through informal channels especially in

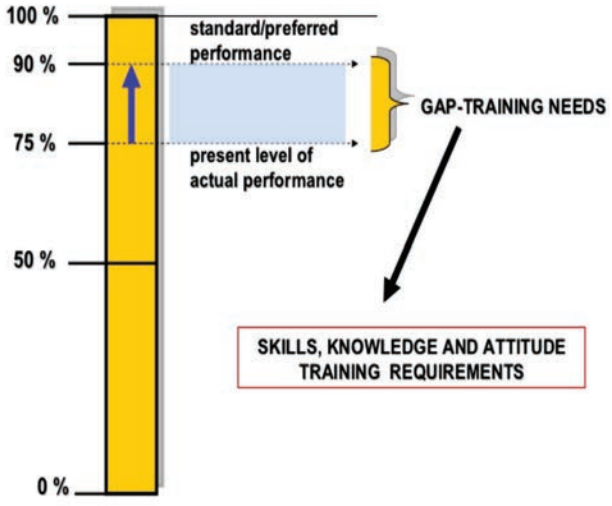


Fig. 1 – Performance Gap

Construction Industry under Master Craftsman who himself has risen up the ladder thus, these skills go unrecognized as they are not acquired through formal means and are never formally recognized.

Skill development impliesall the efforts that allow somebody to learn to do something better than before, or do something new that the personhasnotdone before, and which results in concrete change in their livelihoods besides bridging the gap shown above. Our founder Chairman, Padma Shri B G Shirke was a strong proponent of continuous skill up-gradation of all employees so that upliftment of skill set, knowledge and attitude takes place simultaneously.

Today, one of the biggest factors against promotion of Precast Construction is lack of its knowledge in civil engineering fraternity. In India, the current civil engineering and architecture curricula cover very little on the precast systems. Professionals in conventional construction have many apprehensions about the precast concrete industry. Their lack of expertise in precast systems inclines them to avoid precast usage and this adversely affects the precast growth. The industry is also finding it difficult to find engineers with sound precast technology knowhow.

As far as manufacturing the precast components is concerned, lack of competence can cause failures in production phase which can have a domino effect leading to delaying project schedule and reducing expected cost savings due to wastages and rework.



So far, India has not taken promising initiatives to foster precast knowledge in civil engineering society. Awareness is required not only for fresh graduates but also for the working professionals. To counter this problem, industry-institution collaboration can play a crucial role. For the construction professionals, precast workshops along with conferences on precast can be organized. At the institute level, a separate course on precast construction (an elective in undergraduate level and specialization in post-graduate level), tours to precast plants, small scale precast model development in student technical festival, manufacturing and erection process besides seminars would boost the enthusiasm in students to join the precast concrete industry. In view of this, at Shirke's, there is always an emphasis on

continual skilling through variety of trainings that are regularly conducted for enhancing skill sets of employees and also towards spreading awareness on Precast Construction. These essentially include:

a) Induction training for newly recruited employees.

b) Refresher training -A continual cyclic Training Module conducted perennially.

c) On the job training- Targeted towards Construction Workers for OJT to achieve competence in Precast component manufacturing, handling, stacking and erection in addition to routine construction activities.

d) Specialized training- For equipment operators towards optimal use of Precast factory equipment such as column/beam/slab moulds and pallets, rebar steel handling, accelerated curing process, tower crane operation, training on new software, I.S. Codal provisions etc.

e) Talks by Eminent Speakers on Construction Quality, Waterproofing, Crane

Safety, Motivation, Health & Nutrition etc.

f) Webinars, Seminars and Workshops on various topics to enhance proficiency.

h) Regular mentoring by Superiors to ensure motivation level and mid-course correction to avoid human errors.

j) Industry – Academia interaction to encourage Internship Programs, Visits of Technical Institutes.

k) Spreading awareness on benefits of Precast Construction through active participation in National and International level Seminars, Conferences etc.

l) Contributing papers on Precast Construction in Technical Journal, Publications.

3. Training Need

While formulating the Training Need customised to 3S Precast Construction, a detailed analysis is undertaken to ensure that the goal of the training is aligned with organisational goals. The gap between the two reveals a performance gap which is endeavoured to be filled with training. Here, since the timely project delivery assumes larger importance, the erection and casting of precast components has to be scheduled under tight timelines. The daily target for casting and erection of precast components forms basis for analysing the training need. Gap indicating employee unawareness in Precast Construction due to lack of datum knowledge, skills, and attitude becomes the focal point of training objective. Therefore the Training Need is analysed keeping in view the following –

• To determine what training is relevant to employee's role.

• To determine what type of training will improve the performance.

• To determine if training will make a difference.

• To link improved job performance with the organisational goals.

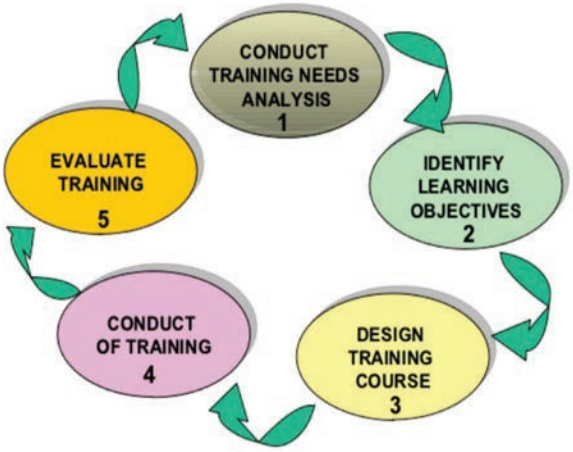


Fig 2 – Training Process followed in Skilling

3.1 Salient Features

• The training is need based and tailor-made to match the site requirements.

• The time period for training is not counted by the number of days; instead the system is based on the number of hours to ensure flexibility in training.

• The daily training courses are for short duration (1hourto2 hours)so that he trainee is able to reap the advantages of the training while working at site.

• The duration of the module is less, thus, enables a person to carry out his regular site work concurrent to the training.

• The place of the training is essentially on site to relate with the site activity.

3.2 Skill Requirement

The training is imparted continuously for the target audience as given in Table1. The continual skill up-gradation being a crucial process towards execution 3S Precast Construction, it is essential to organize the Training customized to every level.

Organisational Levels and Skill Requirement	
Project Managers	Project Management Skills, understanding of nuances of Precast Construction complexities, aptitude, attitude, intellect to react in uncertain times, communication skills, planning and risk management, vision and focus on the end results, leadership & motivation skills.
Site/Project Engineers	Analytical, communication skills, project management skills likeplanning, scheduling, engineering, execution, understanding of Project Risks and legal issues, Safety Management Skills, Preventive Maintenance Skills.
Supervisors	Technical Skills (Precast and Conventional construction), planning skills - ability to Anticipate & Forecast Material, tools, manpower & Machinery needs, materials scheduling, labour management skills, goal Setting.
Bar-Bender, Mason, Erector, Plumber, Painter, Welder, Equipment Operator and other tradesmen	Basic knowledge of construction engineering, Trade Skill – e.g. Bar Bending, Formwork carpentry, erection of precast components, plastering, painting, plumbing, etc., Coordination Skills with unskilled workmen, Ability to comply with safety and quality measures, Knowledge of machine operations and basic machine troubleshooting, Ability to operate key equipment such as precast equipment, cranes, especially tower crane operations, and also mechanisms for loading and unloading of cranes.

3.3 Training Objectives

The skill requirements spelt out at Table1 are then emphasised in terms of learning outcomes which the learner must possess through formal, non-formal or informal training. The training objectives are framed keeping in view the outcome based approach. These state clearly as to what the trainee will be able to do when training is complete. The SMART objectives set before the conduct lays emphasis on these aspects:

- Specific – Relates to a defined action.
- Measurable – It describes the quality of quantity required.
- Achievable – The objective should be possible to achievement.
- Relevant – It should refer to the actual performance required.
- Timed – It should be completed within a specified time limit.

4. Need Based Training

4.1 Technical Employees

Since, the current civil engineering and architecture curricula dwell very minimally on the precast systems; a need based approach customized to the successful execution of 3S precast construction is undertaken. The training modules drafted for continuous skill upgradation have been found to be very effective in raising the performance bar for level 5 to level 7employees. A set of following topics that have direct/indirect impact on site execution to avoid human errors are formulated as Lesson Plans to conduct training at sites. In addition, a regular updating of these lesson plans is an ongoing process to incorporate the revisions in IS Codal provisions, 3S Precast Technological innovations, NBC guidelines etc. The topics for Lesson Plans are:

- Site cleaning, line out, excavation and works up to plinth
- Pile foundation
- Raft Foundation
- Isolated and Combined Foundation
- Casting of ' 3 S ' Precast component
- Lifting and Stacking of ' 3 S' Precast component
- Erection of precast components



- Reinforcement, Formwork for Cast In-Situ works at site
- Internal plumbing and sanitary services
- Concrete at site using Batching plant
- Preconstruction Anti-termite treatment
- Siporex and concrete Block masonry
- Concrete Admixtures
- Waterproofing
- Design Mix Concrete
- Plastering
- Tiling
- Painting
- Water supply
- Sewerage
- UGWT
- Storm Water drain

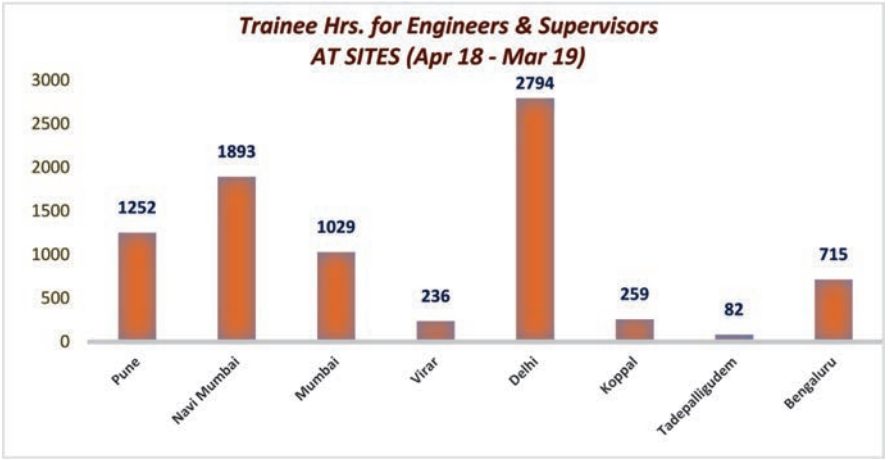


Fig. 3 – Training for Technical Employees

- Construction of bituminous roads
- Compound wall
- Paver Block and Kerb stone
- Housekeeping and Waste Elimination
- Machine Foundation
- Construction of Cement Concrete Road

The Cyclic and Continual Refresher Training on above 28 topics that are relevant to 3S Precast construction are deliberated through following methods:

i) In door training using power point slides.

ii)Out door practical training at site.

iii)Screening of training videos for better assimilation

iv)Site visits by trainers to gauge the effectivity of training and eliminate human errors.

4.2 Trade Training –

A structured approach is required to be adopted while imparting Trade training for improving the skillset of workers at sites. Thesuccess of precast construction projects largely depends on the efficiency and skill of the erection crew. Besides, fortrade sequential training is carried out in order to enhance their skills as can be seen from Table 2, 3 and 4.

Working at height is a major safety challenge due to precast machine intensive construction activities that use hoisting equipment. In order to ensure safe work environment, continual training is imparted for operation and working with Tower Cranes, PM lifts, Builder's hoist, Suspended Wire Rope platforms (Gandolas) and Work platforms. Work permits for such works is issued without fail and strictly followed. A comprehensive SOP which has been issued to ensure zero accidents while using "Fall Arrester System" supported by multilayered safety nets in the ducts and around the periphery is ensured at all costs. Additional safety precautions in terms of barricades to cover lift shaft openings, lifelines, safety tunnels, bridgesover the expansion joints and use of PPEs are practiced as a matter of habit.

Table 2 –One of the Training Modules conducted for Erectors at Navi Mumbai and Delhi.

BroadDescription Of training	Dateof training	Erectors attended	Training Objectives	Benefits achieved
Introduction for safe working practices	Navi Mumbai-04-10-2018 Delhi - 06-01-2019	Navi Mumbai-15, Delhi - 54	1. Awareness about safety PPEs to be used during erection. 2. Awareness about required safety precautions to be taken during erection.	Awareness about safety is improved.
Introduction to the tools used for erection.	Navi Mumbai-04-10-2018 Delhi - 06-01-2019	Navi Mumbai-15, Delhi - 54	3. How to use various tools during erection such as sling,D-shackle, slab lifting cradle etc.	Knowledge gained about v use of various tools required for Erection work.
Loading and unloading of precast components with proper stacking	Navi Mumbai-05-10-2018 Delhi - 06-01-2019	Navi Mumbai-15, Delhi - 54	4. Loading of precast components on open truck for shifting from yard to site. 5. Firm base to be prepared before stacking e.g. placing sleepers for stacking precast components over them. 6. How to identify the components for their respective no men cloture and stack accordingly.	Awareness gained about loading, unloading, firm base preparation and identification of precast components.
Supporting system to the erected components.	Navi Mumbai-16-10-2018 Delhi - 06-01-2019	Navi Mumbai-15, Delhi - 54	7. Prop supports to be provided as per drawing. 8. How to tie the column sling after erecting the column.	Awareness gained about supporting of precast components.
Erection and checking the plumb, line and level of columns, beams and details at joints.	Navi Mumbai-24-10-2018 Delhi - 06-01-2019	Navi Mumbai-15, Delhi - 54	9. To check the verticality of columns using5 kg Plumb. 10. Signaling while Column erection. 11. Jointing, rebar checking, checks before grouting, care during grouting, curing etc.	Awareness gained about how to erect columns in line and plumb.



STEP 1- LIFTING THE BEAM FOR ERECTION



STEP 2 – PLACING IT IN COLUMN NOTCH

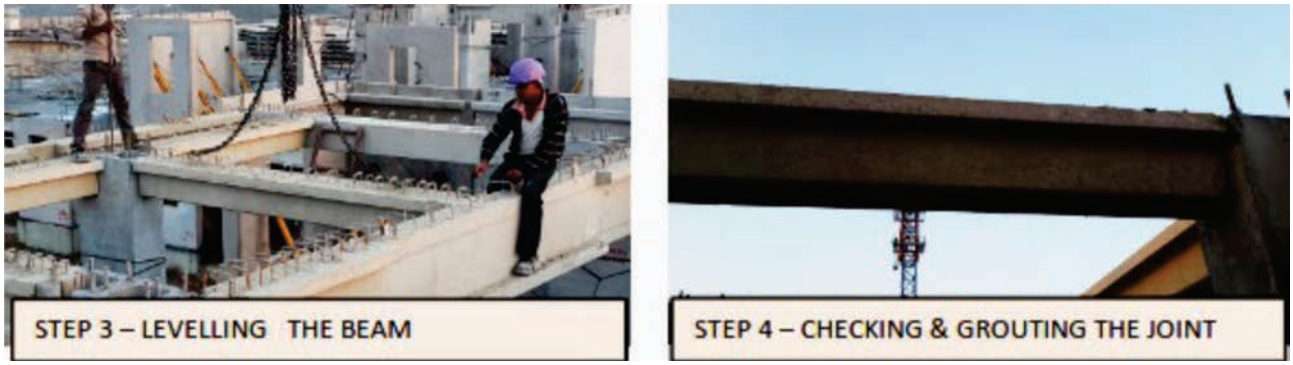


Fig. 4 – Erectors being Trained on Erection of Precast Components

Table 3 - 'Construction Trade Competency Program' conducted through CIDC at Southern India Project Sites

Project Site	District Office Complex Project, Mysuru, Karnataka May 2017	NIT Project, Tadepalligudem, Andhra Pradesh Nov-2018	NIT Project, Tadepalligudem, Andhra Pradesh March 2019
Training Objectives	"Construction Trade Competency Training Program" for Bar-Benders. Their know-how about usage of safety accessories and finally with award of Certificates.	To test the knowledge of workers of various tradesthrough questions(interview type) related to their trade in addition to knowledge of safety accessories for Certification.	
Duration of Training	22/04/2017 to 23/05/2017 One Month Training, Testing & Certification	02 Days for Testing & Certification	02 Days for Testing & Certification
Trade wise no. of trainees attended	Bar-Bender - 43	Bar-Benders-9 Masons-14 Carpenters (Shuttering)-19 Welders - 4	Masons, Fitters and Carpenters
Total Strength attended	43 Trainees	46 Trainees	69 Trainees
Assessment held in	May 2017	December 2018	March 2019
Trainees Awarded Competency Certificate	43 Trainees	46 Trainees	69 Trainees
Benefits due to training	Individual worker istrained on the technical way of working and how to use the tools / tackles in their trade.		



Fig. 5 – Trade traning on casting of Precast Components and Plumbing methods.

Table 4 –Training for Trades conducted at DDA, Delhi Project Sites

Particulars	Training for Carpenter	Training for Electrician /Wireman	Safety Training for Mason	Training for Welder	Training for Fitter
Training Objectives	1. Wood working section details. 2. Wood working in machine shop 3. Knowledge of firefighting equipment 4. Audio visual aids	1. Practice on crimping thimbles, lugs 2. Demonstration of wire gauge 3. Practice in soldering 4. Measurement of specific resistant 5. Use of switches, fuses, sockets , lamp holder 6. Conventional symbols for electrical installation	1. Fall protection, foot protection 2. First aid practice such as use of basic dressing material. 3. Hand & body & respiratory protection. 4. Health safety and accident reporting procedures	1. Arc & its features like length, Polarity types & method of identification 3. Safety precaution in steel rule type. 4. Effect of moisture on electrodes, necessity operations like limitation, care & maintenance. 5. Welding technique left hand method explanation method application	1. Exercise on lapping of gauges 2. Hand reams & fit Paper pin, drilling & holes 3. Simple fixtures fitting 4. Prepare a v block handle lamp 5. All fittings of furniture
Place of Training	DDA Project Delhi	DDA Project Delhi	DDA Project Delhi	DDA Project Delhi	DDA Project Delhi
Duration of Training	13.01.2019 (9.30 am to 1.00 pm) and 17.02.2019 (9.30 am to 1.00 pm)	20.01.2019 (9.30 am to 12.30 pm) and 03.03.2019 (10.00 am to 1.00 pm)	03.02.2019 (9.30 am to 1.00 pm) and 24.02.2019 (9.30 am to 1.00 pm)	10.02.2019 (9.30 am to 12.30 pm) and 17.03.2019 (9.30 am to 1.00 pm)	27.01.2019 (9.30 am to 1.00 pm) and 10.03.2019 (9.30 am to 1.00 pm)
Trainees attended	Carpenter – 44 Nos	Electrician /Wireman – 09 Nos	Mason 54 Nos	Welder - 22 Nos	Fitter 54 Nos
Assessment held in	Feb 2019	Mar 2019	Feb 2019	Mar 2019	Mar 2019
Competency Certificates	44 Nos	09 Nos	54 Nos	22 Nos	54 Nos
Benefits due to training	Individual worker is trained on the technical way of working and how to use the tools / tackles and Safety aspects in their trade.				

Conclusion

The Precast construction industry is continually looking for skilled resources, skilled talent across all levels starting from erectors, asons, plumbers, electricians etc. to supervisors, site engineers etc. Shortage of skilled manpower hinders the progress of work there by imposing delay in meeting the project deliveries i.e. timely output. There is a vast difference between the business need and the skill set possessed by the workers in the industry today. Most of the gaps in the skill sets are in areas of core knowledge and skill required to undertake relevant job role as a part of construction project. The biggest challenge faced by industry today is that most talent available for key construction activities like erection, masonry, carpentry, brick worketc.isunskilledorhascrudeskillswithlimitedjobrelevantknowledge besides migrant and mobile workers.

To reduce this skill gap proper training schemes in collaboration with industry needs to be worked out in line with the innovative technologies, so that the construction industry which is the largest employer of worker force is able to achieve quality construction, provide good wages for skills of workers and in turn mitigate the housing shortage.

SKILLING AND CERTIFICATION OF CONSTRUCTION WORKERS AND SAFETY MANAGEMENT IN IIT ROPAR PROJECT UNDER THE MISSION OF GOVERNMENT FOR "SKILLED INDIA"

Gurubax Singh, CPM, IIT Ropar Project Zone CPWD

Introduction

MoU was signed between Construction Skill development Council of India (CSDCI) and IIT Ropar Project Zone, CPWD, Ropar (Employer**) on dated 08.01.2019 for Skilling & certification of 500 construction workers. The skilling was to be carried out as per Pradhan Mantri Kaushal VikasYojana (PMKVY) guidelines under Recognition of Prior Learning (RPL) with 60 hours of bridge course training.



Signing of MoU by CPWD with CSDCI on 08.01.2019.

Construction Skill Development Council of India (CSDCI) is registered under Indian Companies Act, 2013 under section 8. It is an autonomous industry-led body by National Skill Development Corporation (NSDC) which is responsible for creating of Occupational Standards and Qualification NOS, developing Competency Framework, conducting Training of Trainers (ToT) and Assessors (ToA) Programs, conducting RPL (Recognition of Prior Learning) programmes, and Assessment and Certification of Construction Workers/Trainees on the curriculum aligned to National Occupational Standards developed by them.

Employer is a Central Government Department, having uncertified organized workforce in

the sector in which CSDCI is operational and is ready to collaborate with the CSDCI for certification and bridge course as per requirement, of their workforce engaged at site as per National Skill Qualification Framework (NSQF). Eligibility criteria for the same has been defined by CSDCI.

The objectives of the project was as given below:

i. To promote and propagate training & certification for uncertified skilled workforce working with CPWD.

ii.To provide an opportunity to the workforce for skill certification

iii. To align the competencies of the un-recognised workforce to standardized National Skills Qualification Framework (NSQF).

iv. To enhance the career/employability opportunities of the worker

v. To provide alternative routes for education and opportunities for reducing inequalities based on privileging certain forms of knowledge over others.

Payment Methodology:

- The total cost of project per candidate was as under.

a. Assessment Payout per enrolled candidates -Rs. 800/-

b. Bridge Course Cost for 60 hours per person

(12 hrs Orientation+ 48hrs on Job)-Orientation fees +Per hour rate as per prevailing rate notified by Ministry of Skill Development& Entrepreneurship applicable on date of signing of MoU for bridge course.

c. The payment schedule was as per circular no. H-22011/2/2014-SDE-1 dated 28.02.2017 of Ministry of Skill Development and Entrepreneurship, GOI.

d. The honorarium to the certified workers @ Rs. 500/- each worker is to be given by Employer.

- The complete funding for the program was done by IIT Ropar Project Zone, CPWD, Ropar (Pb.).

Roles and Responsibilities :

a. CSDCI's roles and responsibilities is to provide the following:

i. Onboarding and sensitization of Training Providers (TPs) for the Bridge RPL with CPWD.

ii. Overall implementation and monitoring of the RPL at the CPWD Sites, as deemed fit.

iii. Facilitate the Training Providers (TPs) for uploading the details details of the candidates on the Skill Development Management System (SDMS) of NSDC as per PMKVY RPL Guidelines.

iv. Ensure timely alignment and conduct of assessment of the workforce as per the Guidelines.

v. Co-ordination with Assessment Agency for timely uploading of results along with the required documents and evidences on SDMS.

vi. Issue of co-branded certification of workforce as per NSQF along with CPWD.

b. CPWD's roles and responsibilities includes following :

I. Share details of sites being run in IIT Ropar project Zone, Ropar where the Bridge RPL is to be run with the Training Providers (TPs).

ii. Facilitate establishment of Adhoc Training Premises, Infrastructure to include Class room, Tools & Equipment, raw materials for carrying out the practical exercises, safety equipment and necessary Branding & Communication Job Role and EHS.

iii. Finalization of job Roles with the help of Training Providers (TPs) of the candidates at various CPWD sites.

iv. Make available the candidates to Training Providers for Orientation and Bridge Course Training.

v. Facilitate Certification Ceremony of the candidates.

CPWD helped CSDCI in aligning, motivating &mobilisation of work force engages to take the skilling opportunities and providing temporary infrastructure for training.

Training Program Schedule was as follows:

- **Registration of labours (Documents required)**
  - Bank Account
  - Aadhar Card
  - Educational Documents
  - 2 passport size photo
- Formation of batches by TPs as per Job role:
  - Mason
  - Bar bender

- Shuttering Carpenter
- Electrician

- There is no lower or upper limit of workers in each Batch under RPL but preferably from 30-35 workers was kept in each batch.
- Bridge Course 60hrs per person (12 hrs Orientation+ 48 hrs on Job)
- Assessment of workers.
- Award of Certificate and honorarium after successfully completion of assessment

Training

a) The training period of each batch was of 8 to 10 days and workers were trained for approximately eight hours every day.

b) Total 60 hrs training was given to each worker wherein 48 hours was for training yard/site (Practical) and 12 hours was for class room training.

c) The boarding and lodging arrangements for these workers were provided on Project site.

d) All these workers to be registered under BOCW (Building And Other Construction Workers) and have Aadhar cards.

e) The area for the training center was earmarked in consent with the client and accordingly one covered area was earmarked for the Training Center class room. In addition the open training area at the ongoing construction site was earmarked to complete on the job training and practical practices.

f) Display of charts and Training models and mocks was done as per the given details in different trades of Form work Shuttering Carpentry, Bar-bending & steel fixing, Masonry and electrical work.

g) One certified Trainer in each trade and an overall In-charge of the Training Center was earmarked.

h) Arrangement of filling up the documents and uploading the data in **Workers Skill Management System (WSMS)** for monitoring their performance and productivity was done.

Training Photographs







Assessment Photo





Training Providers (Tps):

CSDCI mobilized 3 training providers affiliated with them for training of the workers. Training was provided by the Training Providers (TPs) with CSDCI certified trainers. TPs were required to motivate the workforce and at the same time they ensured that the work is not disturbed at the site. The TP's were as follows:

• **Bhasker Foundation:** Social arm of Dainik Bhaskar Group registered under Indian Trust Act. Bhaskar Foundation is registered Vocational Training Provider in 4 States. They were assigned to train 180 construction workers.

• **Simplex Infrastructure limited:** Simplex Infrastructures Ltd. is the approved training provider in construction sector by CSDCI and DGT under Ministry of Skill Development & Entrepreneurship. The organization has five Construction Skills Training Centers across the country namely at Delhi, Chennai, Kolkata, Bangalore & Ahmedabad at their project sites. CSDCI entrusted Simplex to conduct the RPL & sixty hours Training for 160 construction workers at CPWD IIT.

• **Indiavision Realty & Infrastructure Pvt Ltd:** India vision is a new age solution driven construction company. The company is founded by alumni of Indian School of Business, Hyderabad and professionals from Construction Sector.They were entrusted to train 160 construction workers.

Certificate Distribution



• At IIT Ropar Project, CPWD, Ropar site total 536 candidates were enrolled in above mentioned job roles. Total 380 candidates were found fit to qualify for the skills and were certified.

• The program was very successful in delivery of the intended objective. It went very smoothly & achieved the target within the given time frame.

SAFETY MANAGEMENT IN CONSTRUCTION PROJECTS

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Abstract:

Construction industry is regarded as one of the most hazardous industries in the world. There has been rapid increase in the construction of commercial, residential, office buildings and civil infrastructure every year. The construction activities are growing due to need of infrastructure facilities, homes, office spaces etc. The construction industry is very complex, labour intensive and involves use of T&P and hence prone to various hazards and accidents. Therefore safety is a vital concern in the construction industry to mitigate the risk of hazard and create safe working environment. It has been analyzed that the major workplace accidents are initiated by unsafe behaviours and that their control is one of the keys to successful accident prevention resulting in low accident rate in construction sites. Today, the major concern is completing projects of required quality in minimum time and cost. Non-compliance of safety protocol and carelessness has been considered as the main reason for accidents and hazards occurring at construction works sites. With the change in working time and schedules along with the change of individual's behavior, construction jobs make the construction industry as one with accident risks.

The construction industry experiences high no. of accidents and is far from achieving a zero-injury goal. Thus, effective safety management systems are crucial to ongoing efforts to improve safety. An appropriate definition of safety management system needs to be devised and the elements included in a safety management system need be identified to be used by practitioners to improve safety.

Introduction

Definition of Safety Management System

Safety Management International Collaboration Group has defined safety management system as “a series of defined, organization-wide process that provides for effective risk-based decision-making related to your daily business”. According to the International Civil Aviation Organization (ICAO), the definition of a safety management system is “systematic approach to managing safety, including the necessary organizational structures, accountabilities, policies and procedures” (ICAO, 2007). International Labor Organization (ILO, 2001) has defined safety management systems as “A set of interrelated or interacting elements to establish occupational safety and health policy and objectives, and to achieve those objectives.”

Recommended practices for safety & health programs in construction (Occupational Safety and Health Administration, OSHA)

Establishing a safety and health program at job site is one of the most effective ways of protecting the most valuable asset: workers. Losing workers to injury or illness, even for a short time, can cause significant disruption and cost to the organization as well as the workers and their families. This can also damage workplace morale, productivity along with turnover and reputation of the organization.

Safety and health programs nurture a proactive approach to "finding and fixing" job site hazards before they can cause injury or illness. In place of reacting to an incident, management and workers collaborate to identify and solve issues before they occur. Such collaboration builds trust, enhances communication and often leads to other business improvements.

These recommended practices provide responsible employers, workers and worker representatives with a sound, flexible framework for addressing safety and health issues on diverse construction job sites.

These recommended practices encourage a proactive approach for managing occupational safety and health. Traditional approaches are often reactive i.e. actions are taken only after a worker is injured or becomes sick, a new standard or regulation is published or an outside inspection finds a problem that need to be fixed. Identifying and fixing hazards before they cause injury or illness is a far more effective approach. Doing this avoids the direct and indirect costs of worker injuries and illnesses and promotes a positive work environment.

CORE ELEMENTS OF THE RECOMMENDED PRACTICES FOR SAFETY AND HEALTH PROGRAMS IN CONSTRUCTION

Management Leadership	• Top management demonstrates its commitment to eliminating hazards and to continuously improving workplace safety and health, communicates that commitment to workers, and sets program expectations and responsibilities. • Managers at all levels make safety and health a core organizational value, establish safety and health goals and objectives, provide adequate resources and support for the program, and set a good example.
Worker Participation	• Workers and their representatives are involved in all aspects of the program—including setting goals, identifying and reporting hazards, investigating incidents, and tracking progress. • All workers, including contractors and temporary workers, understand their roles and responsibilities under the program and what they need to do to effectively carry them out. • Workers are encouraged and have means to communicate openly with management and to report safety and health concerns or suggest improvements, without fear of retaliation. • Any potential barriers or obstacles to worker participation in the program (for example, language, lack of information, or disincentives) are removed or addressed.

Hazard Identification and Assessment	• Procedures are put in place to continually identify workplace hazards and evaluate risks. • Safety and health hazards from routine, nonroutine, and emergency situations are identified and assessed. • An initial assessment of existing hazards, exposures, and control measures is followed by periodic inspections and reassessments, to identify new hazards. • Any incidents are investigated with the goal of identifying the root causes. • Identified hazards are prioritized for control.
Hazard Prevention and Control	• Employers and workers cooperate to identify and select methods for eliminating, preventing, or controlling workplace hazards. • Controls are selected according to a hierarchy that uses engineering solutions first, followed by safe work practices, administrative controls, and finally personal protective equipment (PPE). • A plan is developed that ensures controls are implemented, interim protection is provided, progress is tracked, and the effectiveness of controls is verified.

Benefits of Safety Management System

The benefits of a safety management system in the construction industry are (Choudhry et al., 2007):

1. Reducing the number of injuries to personnel and operatives in the workplace through the prevention and control of workplace hazards,

2. Minimizing the risk of major accidents,

3. Controlling workplace risks improve employee morale and enhance productivity,

4. Minimizing interruptions in production and reducing material and equipment damage,

5. Reducing the cost of insurance as well as the cost of employee absences,

6. Minimizing legal cost of accident litigation, fines, reducing expenditures on emergency supplies and

7. Reducing accident investigation time, supervisors' time diverted, clerical efforts and the loss of expertise and experiences.

Prevailing construction safety acts/laws, standards and practices in cpwd, govt. of India

BOCW Act, 1996

In India, Construction safety is governed by Building and Other Construction Workers (Regulation of Employment and Conditions of Service) Act, 1996. Under this act, Chapter VII titled “Safety and Health Measures” covers the safety aspects at construction sites.

Under clause 40, it mandates appropriate authority to make rules regarding measures to be taken for the safety and health of building workers in the course of their employment. Also, under clause 40(2), it mentions about various aspects to be covered under safety rules.

Various is codes of practice for safety in construction works

There are Indian Standard codes of practice which covers various aspects of safety in construction works. Some of the relevant codes are listed in APPENDIX.

General Condition of Contract (GCC) and Safety Code in CPWD

As per above mandate, CPWD under clause 19C of General Condition of Contract (GCC) has provided following provisions for safety of construction workers at sites –

Clause 19C

"In respect of all labourers directly or indirectly employed in the work for the performance of the contractor's part of this contract, the contractor shall at his own expense arrange for the safety provisions as per CPWD Safety Code framed from time to time and shall at his own expense provide for all facilities in connection therewith. In case the contractor fails to make arrangement and provide necessary facilities as aforesaid, he shall be liable to pay a penalty of Rs.200/- for each default and in addition, the Engineer-in- Charge shall be at liberty to make arrangement and provide facilities as aforesaid and recover the costs incurred in that behalf from the contractor."

Various measures to be taken at work sites have been covered in detail under CPWD Safety Code which is available in General Condition of Contracts.

Discussion

The construction industry has a high number of accidents and long-term injuries. This is not desirable in a modern society and it also makes the industry inefficient. This was found that the high rates of accidents are due to several common factors such as lack of safety in design, poor construction planning, inadequate safety training, workers' behavior and lack of knowledge of site rules. Also, construction risks may be produced by the lack of awareness of organizations to the health and safety of employees, especially in developing countries like India. This is concluded that by adequate health and safety training courses for employees, more emphasis on safety during the project planning phase and greater penalties for poor health and safety practice, the risk to the lives and well being of workers could be reduced.

Falling from height is the most likely accidents to cause fatal and major injuries to workers in the construction industry. To reduce falling from height, it is suggested to use protected edges, safe access and use of appropriate scaffolding with good edge protection. Moreover, use of safety belts by workers would protect them from falling and minimize the harms (including fatality) of such accidents if they do occur. Lifting and handling injuries are the most likely accidents to cause loss of working time. To reduce lifting and handling injuries, it is suggested to use special machines and tools to reduce the quantity of manual handling work

by workers. It is also suggested to use good condition personal protective equipments by workers according to the types of work they are engaged in, presuming these activities cannot be mechanized.

Safety management in construction industry includes organizational safety policy, safety training, meeting, inspection, penalties and workers attitude towards safety. A focused dedication towards safety is needed. Proper practice and evaluation of safety management system can improve the occupational safety in construction site. A relationship between safety management and safety practices can be established. There exists construction safety law but the safety problems are due to the absence of it's enforcement. Even though the laws are maintained, the proper practice of these laws in the construction sites is missing. The project owners, contractors and sub-contractors are related in safety management. For proper implementation of safety management in construction sites, the owner, contractor, sub-contractors and labourers should work together and follow the safety practices. At the planning stage itself the major issues on safety should be erased completely. Early planning of construction processes can be promoted in order to improve safety. Implementation of proper health and safety criteria can improve the sustainable value of projects.

BOCW Act, 1996 under clause 38, has a provision of constituting a Safety Committee as well as deploying a Safety Officer in an establishment wherein five hundred or more building workers are ordinarily employed. But in Safety Code of CPWD provided in GCC, there is no such mandate to constitute a Safety Committee or deploy a Safety Officer.

Clause 19C of GCC mandates the contractor to make arrangement for the safety provisions as per C.P.W.D. Safety Code at his own expense. The responsibility though specified in contract is not quantifiable with associated cost. There is no laid out matrix for the safety management with clear definition of risk and mitigation measures. In case the contractor fails to make arrangement and provide necessary facilities as aforesaid, he shall be liable to pay a penalty of Rs.200/- for each default and in addition, the Engineer-in-Charge shall be at liberty to make arrangement and provide facilities as aforesaid and recover the costs incurred in that behalf from the contractor.

The existing safety provisions as per Safety Code are very difficult to quantify and hence ensuring it's compliance at work sites becomes difficult. Since, the contractor has to make all the safety arrangements at his own expense and the above penalty amount of Rs.200/- being extremely small, he generally prefers to pay the penalty amount instead of complying with the safety provisions of CPWD Safety Code. Also, Engineer-in-Charge remains quite busy performing his other responsibilities hence he finds it difficult to make these safety arrangements on contractor's behalf and recover the cost from the contractor. All above factors result in non-implementation of safety provisions at construction sites.

This would be more practical not to keep burden of above safety arrangements only on the contractors. Rather, items of safety arrangements at work sites shall be identified, their rate analysis shall be prepared and these shall be included in the DSR. These items shall be kept along with other work items in the SOQ and the amount in respect of such items executed at site shall be paid to the contractor. This will encourage the contractor to provide these itemized safety arrangements at work sites. In order to ensure the implementation of above provisions, the penalty amount should be increased to such a level which is commensurate with the defaulting activity.

Conclusion

It has been identified that safety management is the most important area in a construction work which ensures sound health of the workers in the construction site and also prevents occurrence of different types of hazards and accidents in a construction site. The study shows that implementation of safety measures is more important than safety planning and training. In order to ensure safety, a safety engineer or officer should always be present at the construction site to inspect the implementation of safety in the sites. The management should make safety equipments mandatory. All the workers should be provided with personnel protection equipments to ensure their own safety. Proper remedies and measures should be taken in every construction site to prevent any chance of occurrence of any kind of accidents.

It is suggested that the organizations should take care more about health and safety of their construction workers to minimize construction risks to an acceptable level. The contractor should educate workers to identify risks and take necessary mitigation measures. Contractors should sensitize and encourage workers to follow safety instructions. Contract must have provision for Safety Officer in clause 36 of GCC with sufficient experience and knowledge in the field.

The approach of safety management at work sites needs to be changed. Safety management will involve costs associated with mitigation measures and must be included explicitly in the contract. It will help in monitoring and implementation of safety management plan as envisaged. The direct cost of such measures will be much less than the indirect losses on this account.

APPENDIX

VARIOUS IS CODES OF PRACTICE FOR SAFETY IN CONSTRUCTION WORKS

818 : 1968	Code of practice for safety and health requirements in electric and gas welding and cutting operations
2925 : 1984	Specification for industrial safety helmets

3016 : 1982	Code of practice for fire precautions in welding and cutting operations
3696	Safety code of scaffolds and ladders
3764 : 1992	Excavation work - Code of safety
4014	Code of practice for steel tubular scaffolding
4081 : 1986	Safety code for blasting and related drilling operations
4082 : 1996	Recommendation on stacking and storage of construction materials at site
4130 : 1991	Demolition of buildings - Code of safety
4912 : 1978	Safety requirement for floor and wall openings, railings and toe boards
5121 : 1969	Safety code for piling and other deep foundation
5216 (Part 1) 1982:	Guide for safety procedures and practices in electrical work
5916 : 1970	Safety code for construction involving use of hot bituminous materials
5983 : 1980	Eye-protectors
6994 (Part 1) 1973:	Specification for safety gloves
7205 : 1974	Safety code for erection of structural steel work
7293 : 1974	Safety code of working with construction machinery
7969 : 1975	Safety code for handling and storage of building material
8519 : 1977	Guide for selection for industrial safety equipment for body protection
8520 : 1977	Guide for selection of industrial safety equipment for eye, face and ear protection
8758 : 1993	Recommendations for fire precautionary measures in the construction of temporary structures and pandals
8807 : 1978	Guide for selection of industrial safety equipment for protection of arms and hands
8940 : 1978	Code of practice for maintenance and care of industrial safety equipment for eyes and face protection
8989 : 1978	Safety code for erection of concrete frame structure
9167 : 1979	Ear protectors

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SAFETY MANAGEMENT IN PROJECTS

N.N. S.S. Rao, CE, SZ-II, CPWD

Introduction

For projects where man power requirement is more in number or precisely man power intensive works, the requirement of skilled labour to work in coordination with various streams (such as bar binding, shuttering and centering, plumbing works, tower crane operations, electrical conduiting and wiring etc.) is very much essential in major civil works. Knowledge of the other streams is essential.

By following the safety measures the usual accidents can not be avoided but chances of fatal accidents can be avoided. Hence the safety measures are very much essential wherever there is an involvement of labour in construction, industrial and maintenance works.

CPWD is basically into construction and maintenance of buildings, hence the safety aspects dealt with today's topic has been focused on only building construction and maintenance and of connected mechanical equipment and machinery.



The issue of construction safety & standards has gained utmost importance in recent times. This subject is to be dealt with in an overall manner with an approach to developing and establishment a safety culture at work sites. Broadly, its components are:

Creating an awareness

Education

Training

Implementation

Enforcement measures

and behaviour

All workers of contractor and associate agencies, invariably and at all the times, must follow all safety norms, adopt safe construction practices and use all required safety gadgets in their working throughout the project duration.



The contractor will employ Safety Manager and safety supervisors commensurate with scale of project. They shall be primarily responsible for developing safety programs, training, implementation and propagating safety culture. Safety Manager shall be a graduate with one year full time advanced safety diploma from Central Labour Institute, Mumbai / NICMAR Hyderabad / Mahatma Gandhi Labour Institute, Ahmedabad or an equivalent qualification and having a working experience of two years in Construction / Infrastructure or allied sector. The safety supervisor shall be a graduate with safety diploma from Central Labour Institute, Mumbai / NICMAR Hyderabad / Mahatma Gandhi Labour Institute, Ahmedabad or an equivalent qualification.

The contractor shall issue **Photo Identity Cards** with unique numbers containing salient

information of workers. Further the contractor shall establish a **Time Office** at the entry to demarcated area of site. The Time Office shall maintain a computerized record of all the workers allowed entry / working inside the demarcated area. This shall enable to exactly keep a record of persons at site at a given point of time.

Formation of Safety Monitoring Committee: The contractor within 15 days of start of work shall submit the names of Safety Manager and Safety Supervisors to the CPWD, who shall notify a monitoring committee consisting of authorized representatives of the main working agency, associate agencies (if any), CPWD and client, chaired by nominee of the CPWD. The mandate of this monitoring committee will be to monitor and achieve the objectives of construction safety continuously, progressively and through affirmative action and to inculcate the safety culture among all stake holders. This committee will oversee implementation of safety program over the entire construction period.

Training and Awareness:

Training: The training shall be in two phases- first induction training and then periodic training / refresher workshop.

(i) Induction Training: All the workers shall have to undergo a training program of 16 hrs (8 hrs for 2 days) and to be declared satisfactorily trained by the Safety Manager before they are allowed to work on site.

(ii) Orientation Program: An orientation program shall be arranged for all people (other than workers) who normally work at or visit the site.

(iii) Workshops: Refresher workshops shall be arranged in every three months for all the workers on site.

(iv) Advance Training: For workers involved in high risk activities (to be identified by the Safety Monitoring Committee) an intensive training shall be kept once in a month.

The training modules shall be designed by the Safety Manager and approved by the Safety monitoring committee.

Training Methodology: The training methodology shall include both classroom and practical demonstration with audio visual techniques. For greater impact, demonstration with dummies will be done to highlight hazards of not following safe practices.

The training shall be imparted in vernacular language and may include means such as songs, theatre, puppetry etc. for better appreciation and assimilation by workers.

Implementation:

(I) The basic responsibility of implementation of safe practices shall be that of the safety

manager and safety supervisors of the contractor at the first level and project team CPWD on second level. The basic approach of implementation should be towards voluntary acceptability of safe practices by all stake holders.

(ii) The safety arrangement made by the contractor shall be open to inspection by the safety officer or any other representative appointed by the clients/CPWD and the observation made by him shall be complied with by the contractor.

Enforcement: The safety team of the contractor and project team of CPWD are entrusted with enforcement of safe practices. If safety program is not followed (as assessed by either CPWD or client) then recovery as below shall be made:

(I) If the contractor does not employ and / or submit the names of Safety Manager and or Safety Supervisors of specified numbers with appropriate qualification and or experience then a recovery of Rs. 2000 per day and Rs. 1000 per day shall be affected for Safety Manager and each Safety Supervisor respectively.

(ii) No person shall be allowed to enter the demarcated area without adequate safety gadgets (as per occupation / purpose of visit). Failure on this count will result into paying a fine of Rs. 100 by defaulter.

(iii) Inside the work area any person found not using safety gadgets shall have to pay fine of Rs.100 per count of default and shall be barred from site on repeated defaulting.

(iv) In case of default from workers their employer (hiring agency) will also have to pay a matching fine.

(v) These fines will be collected into workers welfare fund. Money thus collected will be utilized for supporting welfare programmes for workers and their children.

(vi) In case the contractor / subcontractor do not impart training the same shall be provided by CPWD through an accredited agency. Twice the amount of fee for such training shall be deducted from the contractor / subcontractor.

(vii) A display board shall be kept at site which would list the names of workers / teams and agencies following safety program in the best manner. This would be updated weekly.

(viii) During training and workshops, the names of persons / teams / agencies that are best following safety program shall be announced and they shall be felicitated.

(ix) On completion of the work, shields for best person / team / agencies following safety program in different categories shall be awarded.

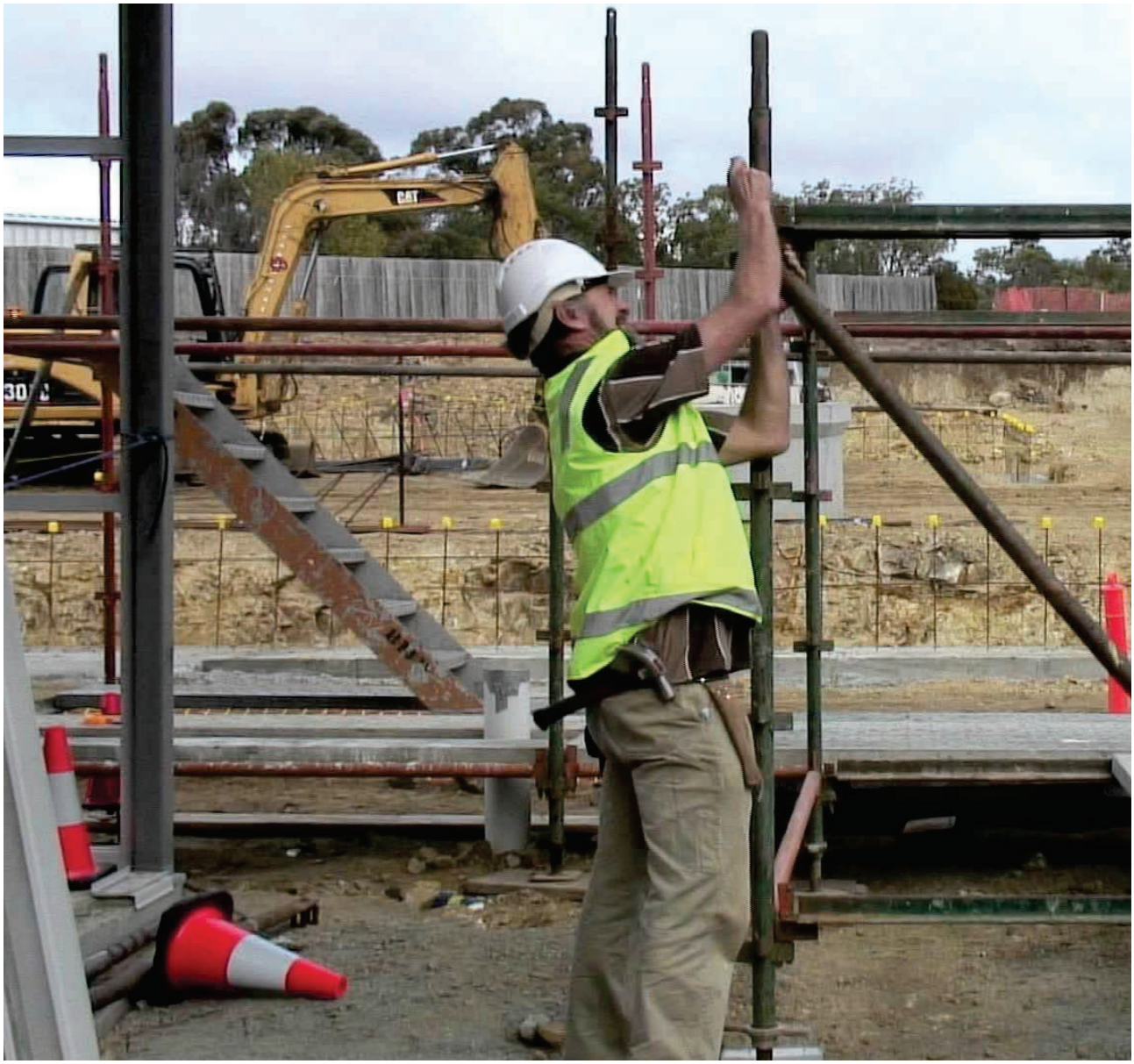
(x) A biometric system will be put in place by the Engineer-in-Charge and the Safety Manager and all the Safety Supervisors will record their presence in the system. Recovery as

suggested will be made for failure to record such presence / non availability of safety personnels.

(xi) In case of an accident resulting in death / permanent disability of a worker, a recovery of Rs. 10 Lakh per death / permanent disability will be made for the contract values more than Rs. 20 crore. The recovery for the contracts less than Rs. 20 crore shall be @ 0.5% of the contract amount per death / permanent disability. The money so recovered will be kept in the "Workers Welfare Fund" and will be at the sole discretion of the client/CPWD for utilizing to support the welfare programs of the workers.

This recovery shall be in addition to recovery (recoveries) or compensation under any other Statute / Act / Provision of contract.

However the total recovery on this account shall not exceed 2% of the contract value.



A robust policy for safety management in projects will minimize accidents at sites leading to increased productivity. For its proper implementation the above note can be incorporated as special condition in tender documents, to start with for works costing more than Rs.30 crores. For smaller works brief special conditions can be incorporated.

Conclusion:

By following proper construction methodology and proper safety measures at site strictly, it is seen that the fatal / minor accidents have come down drastically which is a big benefit as a whole to the construction industry and also to the human beings/work folks.

PROJECT HEALTH, SAFETY MANAGEMENT PLAN FOR ROAD INFRASTRUCTURE WORKS

Rajeev Singhal, CPM, NDPZ & **Rajeev Sharma,** EE, PD-**III**, NDPZ, CPWD, New Delhi

Foreword

Health(H), **Safety(S)** and **Environment(E)** (together **EHS**) is a discipline and specialty that studies and implements practical aspects of environmental protection and safety at work. In simple terms it is what organizations must do to make sure that their activities do not cause harm to anyone.

Better Health at its heart, should have the development of safe, high quality, and environmentally friendly processes, working practices and systemic activities that prevent or reduce the risk of harm to people in general, operators, or patients.

From a safety standpoint, it involves creating organized efforts and procedures for identifying workplace hazards and reducing accidents and exposure to harmful situations and substances. It also includes training of personnel in accident prevention, accident response, emergency preparedness, and use of protective clothing and equipment.

From an environmental standpoint, it involves creating a systematic approach to complying with environmental regulations, such as managing waste or air emissions all the way to helping site's reduce the company's carbon footprint.

Regulatory requirements play an important role in HSE discipline and SHE managers must identify and understand relevant SHE regulations, the implications of which must be communicated to executive management so the company can implement suitable measures. Organisations based in India are subject to HSE regulations. Still, HSE management is not limited to legal compliance and companies should be encouraged to do more than is required by law, if appropriate.

For Road Infrastructure works, the Safety Management Plan, is to be prepared as per the established& implemented Health & Safety Procedures in line with the requirements of IRC:SP:44 -2001 (Highway Safety Code), IRC:SP:55-2001 (Guide Lines for Safety in Road Construction Zones)and further in accordance to the conditions predefined in the Contract Agreement for the Project under implementation.

Purpose

Any construction activity has the potential hazard to Health and safety of its Employees and other interested parties. To attain the standards as per the requirements of relevant IRC publications & Conditions specified in the Contract Agreement all the activities / services should be carried out in a manner that would not affect the Health and safety of the

Employees and other interested parties. Hence to achieve this Safety & health management system should be implemented in a systematic way through a Health & Safety Management Plan.

This Safety Management Plan shall act as a guiding manual at the Project site, which describes in detail how the potential hazards associated with each activity affect the safety & health of the employees and other interested parties. All the potential hazards of the project shall be identified, so that the adverse effect can be prevented, controlled or minimized by having suitable engineering, administrative and operational control measures.

As a part of potential hazard identification, the emergency situation shall also be identified to develop the Emergency Preparedness and Response Plan. All the employees including sub-contractors should be periodically trained about the control measures to be adopted to prevent, control or reduce the relevant potential hazards.

The overall objective of this system implementation is to ensure that the safety requirements are being fulfilled and maintained in such a way that project work can be completed with a healthy working environment with the target to achieve zero accident rate to its employees, other personnel & the interested parties.

Safety Management Plan should consist of following components-

1. Introduction:-

It should demonstrate the ability to consistently provide concern intended for Safety and Health of its employees including Safety of its sub-contractors, employees and to meet all applicable legal requirement & specifications.

The plan should aim to enhance health & safety practice at Project site and satisfactory performance through effective application of the system, including the processes for the continual improvement of system and the assurance of conformity to set objectives.

Site management should follow this plan and if necessary, modification should be made as per the specific site requirement.

2. Scope of Work:-

The scope of work needs to be clearly defined

2.1 Salient Feature of the Project

Besides salient Features, location of site establishments and other facilities also needs to be mentioned in the Plan

2.2. Reference Publication:-

- OHSAS 18002: 2008, Occupational Health & Safety management System Guidelines for the implementation of BS OHSAS 18001:2007.
- Contracts Documents.

2.3.terms & Definitions:-

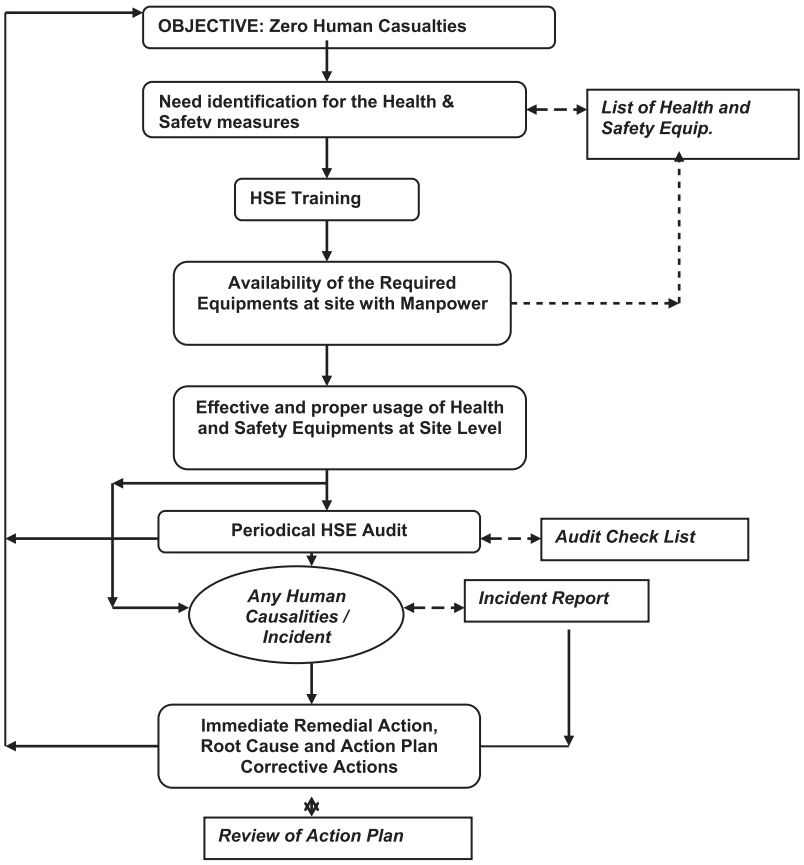
All terms and definition used in the plan need to be elaborated in this Section.

3. Planning:-

Hazards & risk should be identified and feasible control measures to be proposed at planning stage by the project Safety Engineer, Project Manager and work manager to eliminate, reduce or isolate the potential hazards in its each section with the help of procedure. Depending upon the risk level of each hazard, appropriate control measures will be proposed keeping in view of various legal, specifications and contractual requirements.

The site management should keep its documentation, data & records, concerning the identification of hazards & the assessment & control of risks up to date in respect of its ongoing activities & also extends them to cover new developments & new or modified activities, before those are introduced. Safety committee meeting comprising of participation of workmen shall be arranged at least once in a month and MoM shall be circulated to all concerned. Internal audit shall be conducted by the Committee Representatives at various locations at least once in a monthly basis and findings shall be recorded, reviewed and evaluated for monitoring of the continual improvements.

General Flow Chart for the whole process is described in the following diagram:



Flow Chart

4. Review of Hazard Identification, Risk Assessment & Determining Control:-

The hazards identification, risk assessment & determining control process should be reviewed at the pre-determined time or period. The period can vary depending upon nature of hazard and legal requirements.

5. Objective & Programmes:-

In order to meet the requirements of the Health & Safety Policy the following objectives need to be set.

1. Minimize risk to our employees and other interested parties who may be exposed to HEALTH & SAFETY risks associated with our activities.

2. Ensure all employees understand their HEALTH & SAFETY accountabilities and demonstrate visible HEALTH & SAFETY leadership

3. Comply fully with all relevant HEALTH & SAFETY legislation regulations, standards, guidance and codes of practice;

4. Provide and maintain safe plant, equipment (including PPE), systems of work and work facilities for the welfare of employees;

5. Provide sufficient information, instruction, training and supervision for employees to enable them to carry out their tasks competently and safely;

6. Prevent accidents and work related ill health;

7. Investigate any incidents that do occur and implementing any corrective actions identified.

8. Ensure visitors or members of the public are safeguarded from hazardous operations;

9. Continual improvement of the HEALTH & SAFETY Management System.

10. Reducing the frequency of all incidents and minimizing/eliminating loss of man days.

11. Train and retrain the site personnel for enhancing their competence and expertise with the view to reduce accidents/incidents.

12. Ensure raw materials, articles and wastes are correctly handled, used and stored to avoid damage to the health of employees or the environment;

13. Provide sufficient information to ensure that our products are handled, used and disposed of in line with relevant legislation;

14. Replace materials, where practicable, with those deemed to be less hazardous to the environment or human health;

15. Procure best quality and ensure use of Personal Protective Equipments (PPE) thus minimizing the exposure to physical risks.

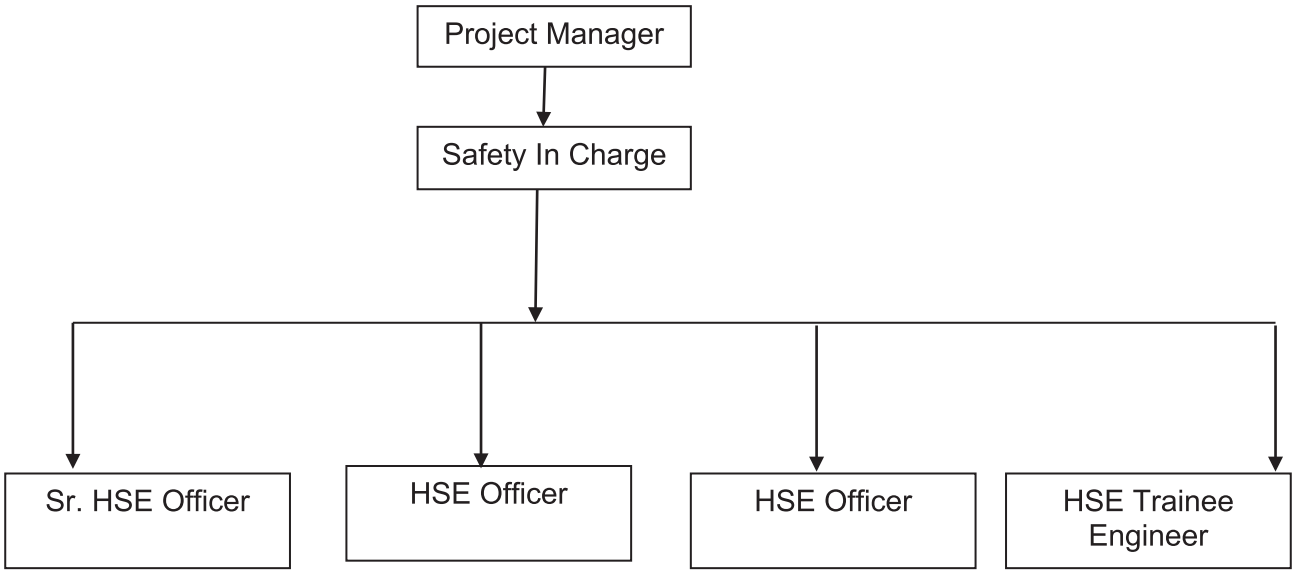
16. Provide all employees with an understanding of this policy, and their responsibilities in controlling and improving performance.

6. Implementation & Operation:-

Resources, Roles, Responsibilities, Accountability & Authority:-

As per procedure for structure & responsibility implementation of this project safety management plan along with other project requirements would be the responsibility of every individual working in the project site. It will be also the responsibility of the company's personnel to educate his partners/suppliers/subcontractors etc. in successful implementation of the plan and the collective responsibility to create and maintain safe and healthy work environment within the project area. The responsibility and authority matrix of the site personnel are as given below:

6.1. HSE Organization Chart



6.2. Responsibility and authority matrix

Sl. No.	Activity	Project Director	Project Manager Highways/ Structures	HEALTH & SAFETY In charge	Store Manager	Site Engineer/S upervisor
1	Implementation of HEALTH & SAFETY Management System	X	X	P	X	X
2	Hazards identification, Risk assessment & Risk Control	X	P	P	P	P
3	All applicable legal and contractual requirements	X	P	P	P	P
4	Setting of HEALTH & SAFETY objectives and target to achieve the above safety objectives	X	X	P	X	X
5	Implementation of HEALTH & SAFETY management programs to achieve the above safety objectives.	X	X	P	X	X
6	Impart safety training,awareness, induction & toolbox talks	X	P	P	P	P
7	Implementation of consultation and communication at site safety committee etc.	X	P	P	P	P
8	Documentation /document and date control	X	X	P	X	X
09	Preparation & Implementation of emergency preparedness & response	X	X	P	X	X
10	Accidents, incidence investigation, reporting and implementation of corrective & preventive action	X	X	P	X	X
11	Performance monitoring & measurements	X	X	P	X	X

X- Responsibility **P-** Performance

7. Statutory & Regulatory Requirements:-

The HSE Manager is responsible for reviewing and updating (as and when required) the register of applicable legal and client requirements and for communicating the changes to the relevant personnel, verifying compliance to these requirements. The organization will keep this information up to date.

The HSE legal and other requirements applicable to the Project are listed below:

1. The Water (Prevention and control of pollution) Act, 1974and Rules, 1975.

2. The Air (Prevention and control of pollution) Acts, 1981 and Rules, 1982.

3. The Environmental (protection)Act 1986 and rules 1986

4. The Hazardous Waste (Management, Handling & Trans-boundary Movement) Rules, 2008.

5. The Manufacture, Storage and Import of Hazardous Chemicals Rules, 1989 amended 2000.

6. The Bio- Medical wastes (management and handling) Rules, 1998.

7. The Noise pollution (regulation and control) rules, 2000.

8. The Ozone Depleting Substances (regulation and control) Rules, 2000.

9. The Batteries (Management and Handling) Rules, 2001.

10. The Gas Cylinder Rules, 2004.

11. The Indian Electricity Act, 2003 and Rules, 1956.

12. The central Motor Vehicle Acts, 1988 and Rules ,1989

13. The Petroleum Act, 1934 and Petroleum Rules, 2002.

14. Building and Other Construction workers (Regulation of Employment and Conditions of Service) Act 1996, Central Rules, 1998. Including requirements of:

- Contract Labor (Regulation and Abolition) Act, 1970.
- Employees State Insurance Act and Rules.
- Workmen Compensation Act.

8. Competence Training & Awareness:-

Site Management should establish and impart a systematic programme of safety induction &ongoing training for safety to the entire staff including sub-contractors, temporary workers; visitor's etc. site management should also conduct training for performing hazards identification, risk assessment & risk control measures.



9. Communication Participation & Consultation:-

To ensure the effective two way communication of information related to occupational health and safety to personnel, the site management should establish site HEALTH & SAFETY Committee as per IMS procedure for consultation & communication. The safety committee meeting will be held minimum once in a month. The project director will be the chairman and site HEALTH & SAFETY In-charge will be the secretary of site safety committee.

The site safety committee should have the representative from both management and employees. The safety suggestion boxes and feedback/suggestion register should also be provided at different locations for the suggestions from all interested parties for continual improvement in existing system.

Construction HEALTH & SAFETY committee shall also be formed for each section as per contract requirements and meeting shall be held at least once in a month.

10. Documentation & Control:-

Site management needs to follow this project safety management plan as a document for the implementation of the HEALTH & SAFETY Management System.

The documentation and data should be available & accessible when required. Under routine & non-routine conditions including emergencies, for examples this should include Safety Flow chart, Safety check lists, Emergency preparedness plan, instructions for the operations, accident reports, details of man hour lost, training given, audit remarks, analysis of improvement in achieving safety objectives etc.

11. Operational Control:-

As per safety procedure for operational control, the safety work instructions &safety check list for different activities for safe operation shall be implemented during execution of work. Prior to start any activity site should have total appreciation of all its significant HEALTH & SAFETY hazards in its domain, after using the process of Hazards identification, risk assessment & determining control.

1. The Hazard identification, risk assessment & determining control process should take into account the cost & time of performing these three processes & the availability of the reliable data. Prior to start of execution or during the due course of execution site will carry out the risk assessment exercise in its each section with the help of the procedure.

2. Hazard identification risk assessment & determining control process will be carried out as proactive measures rather than as reactive ones. i.e. they should precede the introduction of new or revised activities or procedures. Any necessary risk reduction &

control measures that are identified should be implemented prior to the changes are introduced.

3. The site management should keep its documentation, data, & records concerning the identification of hazards & the assessment & control of risks up to date in respect of its ongoing activities & also extend them to cover new developments & new or modified activities, before those are introduced.

4. This risk assessment should not only be applied to normal operations of plants procedures but also to periodic or occasional operation/procedures such as plant cleaning & maintenance.

5. The site should consider the hazards & risk posed by the activities of contractors, sub-contractors & visitors.

6. The site management shall ensure that traffic control devices were provided in the construction zones to perform the crucial task of warning, informing and alerting the driver apart from guiding the vehicle movements so that the driver of the vehicle as well the workers on site are protected and safe passage to the traffic is possible.

7. The site management shall provide and maintain the construction and maintenance signs throughout the stretch.

8. Delineators shall be provided to channelize and guide the drivers along a safe path and to control the flow of traffic.

9. Suitable barricades shall be provided to restrict the outsiders from entering to work areas such as excavations or material storage area or there is a need for separating the two way traffic, barricades can be used.

10. Traffic management practices as per IRC: SP: 55-2001 shall be implemented during temporary diversion partial closure or existing two lane carriageway and carriageway repairs.

11. The size & sitting distance for road signs and cones to be provided for different types of road under various speed limits as per IRC:SP: 55-2001 and IRC: 67.

12. Safety in various Construction Activities

Separate SOP to ensure Safety and environment protection for each major construction activity depending upon scope of work must be enumerated in the HSE Plan. Few of the major activities are given here under-

- **Site Material and Personnel Transportation**

- **Excavation**
- **Formwork Construction**
- **Heavy Duty Tower System**
- **Cutting & placing of reinforcement**
- **Cement Handling**
- **Safe Procedure for Concreting-** This should include Safety Planning for Static Line Pump or Placer Boom, whichever is to be used for concrete pouring.
- **Welding & Cutting**



Inspection of Mahipalpur Underpass work by DG,CPWD

Miscellaneous :

Fire Safety Plan

Introduction

The Fire Safety plan shall be implemented in two phases. One is the Preventive measure and the other is Protective measure. More emphasis will be given for preventive methods. However, certain basic measures and procedures ought to be established to prevent Fire

Accidents. They are given below:-

• Are all employees oriented about FIRE during safety induction program?

• What it is?

• How to prevent its occurrence?

How to extinguish?

Fire Triangle



Fire needs all these three components Oxygen, Fuel & Heat shown in fire triangle above. Fire gets extinguished when one or more of these components are removed. Both Preventive Methods and Protective measures need to be incorporated in HSE Plan.

13. Safety Measures For Plant & Machineries

General Mandatory

All P&M major equipments such as Motor graders, Tippers, Transit mixers, Roller, Tyre mounted crane, etc must go through inspection and check once in a month by safety department accompanied by P&M personnel.

The fitness sticker signed by a P&M Engineer and HSE shall be pasted on the windscreen near the driver.

Only authorized driver must drive the vehicle and he should have valid driving license. Identity cards / Photo Pass shall be compulsory for driving the vehicle at site. Emergency Stop / Pull Card switches are must for the plants.

The equipments should be deployed after obtaining the 'Equipment fitness certificate' from the P&M engineer and the HSE engineer (Equipment fitness report for vehicle and earth moving equipment).

• The plant to be operated, only if all safety devices and safety-related equipment such as removable guards, emergency stops, sound insulation's, suction devices, are in the right position and operative.

• Operators having valid license should only be permitted to operate the equipments.

• The operator shall check the machine/plant, once at least per shift, for externally perceptible damage and defects.

• If any changes / deviations are found, the plant shall be stopped immediately and necessary repair works to be carried out.

• In case of malfunction, stop immediately and safeguard the machine/plant. Have the malfunction immediately cleared.

• Starting and stopping procedures, control devices / signals shall be followed according to the manufacturer's guidelines as mentioned in the operating instruction manual.

• Before starting/actuating the machine / plant, it shall be ensured that nobody is endangered by the starting machine/plant.

• Nobody shall be allowed to step enter in the danger area of skip. The surrounding area shall be cordoned off when the skip is in operation.

• All openings and cut-outs shall be properly covered or adequately guarded. All wire ropes shall be inspected at regular intervals and replaced if required.

• Safety instructions shall be followed according to the manufacturer's guidelines as mentioned in the operating instruction manual

• There should be separating SoP for each important machinery such as -

Batching Plant



Cranes





Commonly used Wheel mounted Cranes





Overhead Transportation/Lifting Equipments (Gantry cranes)



Launching Girder for lifting/Holding pre-cast Segments



Hydraulic Excavators / Earth Moving equipment





Dozers



Transit Mixer



Motor Grader



Wheel Loader



Road Roller

14. Permits to Work

The HSE department should develop a permit-to-work system, which is a formal written system used to control certain types of work that are potentially hazardous. A permit-to-work is a document, which specifies the work to be done, and the precautions to be taken. Permits-to-work form an essential part of safe systems of work for many construction activities. HSE department shall allow work to start only after safe procedures have been defined and must provide a clear record that all foreseeable hazards have been considered. Permits to Work are usually required in high-risk areas as identified by the Risk Assessments.

A 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.

15. Traffic Management Plan:-

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.

Objectives

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

Traffic management plan gives the detailed guideline for traffic management in most of the

common situations at our Road works. Traffic Control Plan is prepared based on this general guideline and applying the following variables, which may vary from project to project. The variables are;

- Average Vehicular Traffic density in peak and non-peak hours
- Maximum width of lane required for construction during various activities
- Number and types of junctions in the road
- Availability of standard footpath and its location and dimensions
- Change in the lane width if any and its location
- Regulatory and advisory speed limits etc.

Construction Zone

Construction Zone is an integral part of any road construction system. The safety practices in construction will, therefore, be oriented towards reducing conditions, which lead to such hazards and consequent stress whereby risk of accident increases.

Safety measures will be aimed at avoiding hazardous conditions especially in work sub zones where major construction activities are going on.

These are the area of the highway which involves the conflict of the right of use between the road users and authority responsible for the maintenance / improvement of the highway. It comprises off our sub-zones which are,

I) Advance Warning Sub-zone

ii) Transition Sub-zone

iii) Working Sub-zone

iv) Terminal Sub-zone





Traffic Control Devices

(This section is from Guidelines for Safety Construction, Indian Road Congress,IRC:SP:55:2001)

The traffic across these sub-zones is guided with the help of various traffic control devices erected at the site. These Devices are

- Regulatory signs
- Warning Signs
- Direction Signs
- Delineators
- Traffic Cones and Cylinders
- Drums
- Barricades:

Note: HSE plan on above lines was implemented on various Sites of Infrastructure Projects in PWD(GNCTD) and recently completed work of Mahipalpur Underpass.

GREEN SKILLING FOR CPWD CONSTRUCTION

C.K.Varma, CE CSQ (E), CPWD

Abstract

Constructing Green Buildings / Habitat and Net zero/Net positive energy buildings is a priority area of CPWD under the National Mission of sustainable Habitat of Govt. of India. With this background, CPWD's venture into building construction makes it a special construction arm of the Government. However, this mandate necessitates a highly skilled workforce to achieve the objectives of Green construction as CPWD's construction technologies are mix of conventional and new & innovative technologies. The green is conceived right from the design stage and is implemented throughout the construction stage and even after the building is put into beneficial use. Hence the quality and safety standards are very high to achieve the end objective of sustainable construction. There are many dos and don'ts associated with this type of construction which need to be followed meticulously if end results are to be achieved. The need for skilling and safety perspectives are accordingly multi-folded. In short, CPWD's construction requires green workforce to attain its green objectives. But how to create a skill eco system for green construction remains a challenge. This paper analyses this and many other associated aspects and suggests recommendations to achieve it for the benefit of our future generation.

Introduction

Skilling is already a great challenge in the Construction industry which is poised for an exponential growth due to rapid pace of urbanisation and ambitious schemes of the Government of India like provide affordable housing for allby 2022.But it remains more so when it comes to construction of sustainable habitat consisting of green and intelligent buildings. This type of construction involves multi- disciplinary approach and encompasses safety , quality, use of sustainable materials including lesser energy embodied and recycled ones, green construction measures, water conservation measures, energy efficient E&M systems, renewable energy systems and their integration in building envelope, Landscaping and related measures etc including innovations in each of these aspects.



Fig 1: Dictum of Green Skill Plan

There are altogether newer technologies for rapid construction and energy efficient technologies involving intelligent and communicative systems and therefore should be properly integrated in the green curriculum of skilling program . Fig 1 depicts the motto of Green Skill Plan.

Although, Construction sector is second only to Agriculture sector in employment generation yet merely 10 % of the workforce is skilled according to one estimate. This figure points out the vast gap between skilled and unskilled and huge potential for efforts needed to fill this gap. While an uptrend is visible in the advent of new and multiple technology options , the increased frequency of worksite accidents necessitate the increased focus on the skilling aspect of construction work force engaged in construction industry. In this scenario, one important factor is Electrical & Mechanical components of any building activity. In urban areas and particularly in Metropolitan cities , there is vertical expansion which is now in up and downdirections both meaning that high rise buildings are now being built with not one but multiple basements. This specialised construction brings forth new ways, methods, technologies and risks of accidents as well. Therefore, theinbuilt of safety in the skillplan is very essential . Fig 2 exhibits the specialised construction by CPWD in the form of Net Zero building.



Fig 2: Indira Paryavaran Bhavan -A green & Net zero building constructed by CPWD

Green Skill Plan & Its Implementation

It is therefore imperative that there is a need to develop green skill plan in order to train workmen to achieve green construction.It is in fact a green depository in a bank of construction which willupdatethe knowledge and consequent skill of already skilled workforce and skilling of unskilled workmen as per the requirement of green construction. The green skill plan will develop not only green work force right from workmen to supervisor

of imparting training because greening has crept into teaching methods as well.

However, the green skill plan needs to be developed with due care and diligence. It is because technology is changing very fast and hence the plan is also to be developed such that it should take care of all changes automatically and suo moto. It means updation of course curriculum should take place systemically but with the pace matching the changes.Construction fundamentals, Good Engineering practices, proper application of key construction materials are some of the elements of skilling and should therefore be incorporated in Green Skill Plan.

Further, following should be emphatically included in the green skilling plan to make it a comprehensive one :

1. All green design parameters including passive architectural features,use of shading devices, daylight harvesting, design of building envelope having special emphasis on thermal comfort in different climatic zones of the country,Integration of renewable energy like solar and wind into the building envelope ,integrated design approach, building accessibility etc with proper documentation in an easy to understand way.

2. Quality assurance plans.

3. An exhaustive compendium of Sustainable building materials and their use in building construction with proper elaboration.

4. Green construction measures in easy to understand details.

5. Integrated Water Management and various ways and techniques to achieve them.

6. Various Energy Efficiency and Renewable Energy measures and the way these can be adopted in construction sector.

7.Waste Management including 3Rs i.e. Reduce, Reuse and Recycling and various technologies available now and how best to implement them.

8. Landscape and Horticulture- various plans, methods and implementable technologies available.

9. Innovations but not **JUGAD** in any or all of the above fields.

Safety Policy and safety plan

Safety at construction sites is an essential requirement to avoid accidents and damage to workmen and assets. Often mistakes happen at site due to speed and economic considerations. To avoid this, every organisation should have a safety policy first. And based on this, safety plan must be formulised to ensure the safety policy. Safety Plan should be all

inclusive. Further, the safety plan must be audited from time to time and also should be monitored by Third party to ensure the adherence of the plan by the company's employees.

"Finally Safety Plan should be blended into Green Skill Plan to make it **Green⁺ Skill Plan** which is shown in fig 3."

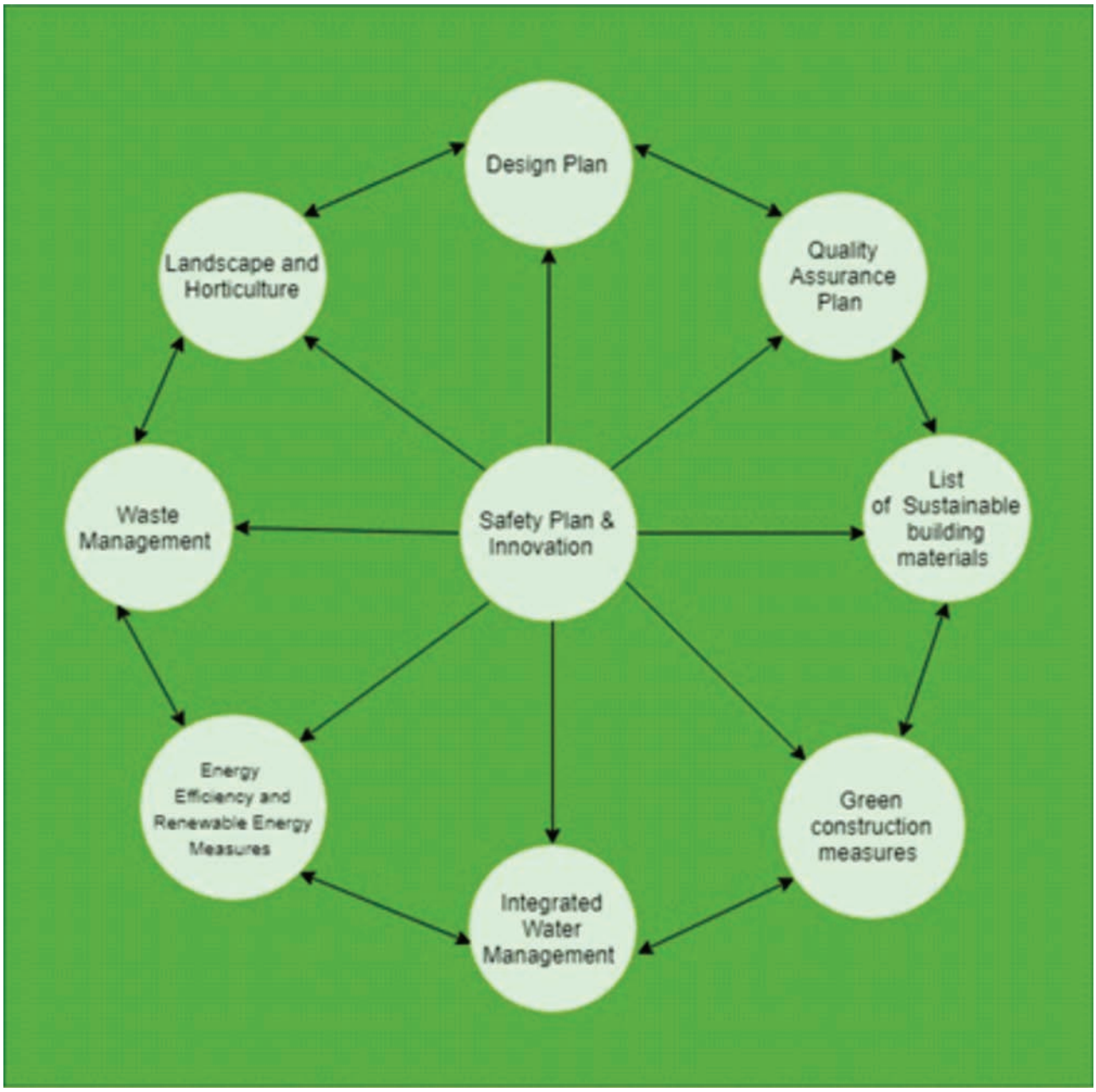


Fig 3: Green⁺ Skill Plan

After development of Green+Skill Plan, it requires effective implementation also. All stakeholders should therefore be sensitised about development of the **Green⁺ Skill Plan** for its smooth take off and implementation. There are various modes of implementation and it will be proper if all modes are given due weight-age and considerations.

Besides onsite training, exhaustive training modules for class room training should be developed. The objective of these modules should be to prepare leaders in the field and not the mere skilled workers. Audio visual equipments should also be used to aid the skilling process. Creation of WhatsApp Group, uploading of relevant and concerned videos on You Tube or on special **Green Skill** App developed for the purpose can be some other measures to make available the knowledge and exchange of knowledge, removal of confusion etc instantly. In addition, IT enabled systems need to be employed effectively to impart education for skill development. Workshops & Question Answer sessions can follow the classroom sessions to test the efficacy of the plan and its effective implementation .Further, besides formal method of examinations as part of the green certification process, testing the skills on prototype buildings can be a method for persons having literacy issues.

Conclusion

1. Green Skilling is the requirement not only for economic as well as social reasons but for global reasons of climate change and providing global opportunities to one and all of demonstrating green skills of the country as a whole and CPWD in particular.

2. A matured skill eco system has already been created by CPWD by taking various initiatives like developing its own green rating system, making suitable amends in its GCC, development of various tangible inputs in terms of sufficient publications, OMs as well as MoUs with BEE, CSDCI, CIDC etc.

3. Now there is a need for all stakeholders to align and not compete for coordinating among themselves effectively and contributing the required efforts substantially which will be apparent when more action will be seen at ground than at board rooms.

4. Within this matured Eco System, acomprehensive green skilling plan must be put in place which may not compromise with safety and quality either.

Recommendations

1. More awareness platforms need be created by CPWD for the benefit of workforce engaged in construction sector.

2. More and more workable skilling models on the ground need to be identified and put to implementation.

3. More MoUs need be entered into by CPWD with organisations working in the field of sustainability like BIS, MNRE, FICCI etc for mutual as well as National benefit.

4. Special but composite Specifications, PAR and SOR for green construction must be developed.

5. More and more disruptive technologies like Internet Of Things, Artificial Intelligence, Data Analytics, Unmanned Aerial Vehicles, GIS Mapping etc should be tried by leading organisations to provide examples to others in the construction sector.

6. A live but non-academic R&D Platform need be created which may assess a building in pre-construction, construction and post construction stage and document the learnings for subsequent constructions.

7. An effective mechanism should be developed to encourage and promote innovations in the field of green construction sector.

8. A green demolition plan should also be worked out in case of construction on a site having an already outlived structure.

9. A time and cost over runs analysis is a requisite for all green constructions for analysing the pros and cons of Greening the construction.

10. Development of Post construction green maintenance Measures.

11. Learnings should be incorporated from the practitioners as well as from projects which are pioneering and ascendable in course curriculum developed for various functionaries of construction sector.

12. IT enabled skilling lessons must be developed for their effective dissemination.

13. Quality and Quantity of skilling both should not be compromised at any stage but should be enhanced progressively with each milestone traversed.

14. Finally, the darker side of the green should also be evaluated side by side like ill effects of Wi-fi which are predominant in all intelligent buildings, security issues of Big data generated, Psychological & physiological impacts of new technologies on inhabitants, safety issues arising out of big solar power generated through building envelope etc. and solutions be worked out.

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ROLE OF SAFETY CULTURE, SAFETY CLIMATE AND SAFE WORK BEHAVIORS OF WORKERS IN IMPROVED SAFETY PERFORMANCE OF THE PROJECT

O.P. Tripathi, CPM IITDPZ, CPWD, IITD Campus, Hauz Khas, New Delhi

Introduction

Safety at work site is utmost important. It is a major social responsibility to ensure workman's safety at work place. At the same time, it is very challenging task also and requires adequate attention of not only persons at site but of the organization as a whole. No project can be called a success if it meets with accidents resulting into loss of life or other severe consequence. It is a global concern to ensure safety at work place. The safety performance of the projects must be a serious concern and must be taken into account in judging the overall success of the project. It should be one of the most important criteria for project success. Safety depends a lot on safe work behavior of workers. A complex relation exist between safe work behavior of workers and the safety climate at work site which in turn is affected by safety culture of the organization. Therefore safety culture, safety climate and safe work behavior of workers are all very important for ensuring safety at work site.

Space for Safety in Project Performance

World over, often, there is a race for attaining project success which is determined on the basis of measurement of project performance on just three criteria i.e. time, cost and quality. In the race to achieve the success on time, cost and quality, other very important criteria of project success such as “safety” is more often being ignored. People tend to ask whether the project has been completed as per the schedule What is the status of quality and whether it has been completed within the sanction budget? But hardly anyone asks, whether the project completed with or without accident What was the standard of safety during construction? Where does a project stand on safety performance Infact, it can be easily observed that currently there is no space for safety in overall project performance report. Even CPWD in it's performance report for works which is considered for judging performance of the contractor for enlistment or tendering has no space for safety performance of the works. When the safety is not getting a space in the assessment of project performance, the same is getting silently ignored.

Therefore, a time has come to give due weightage to safety performance of the project while assessing the overall project performance. CPWD should also introduce a system of assessing safety performance of the project while making overall performance assessment of the work.

Proactive approach to safety

The prevailing and traditional method of assessing the safety performance is based on accident data of the projects. However, for most of the project, the accident statistics are not available and there is a tendency on part of management to hide the accidents. Therefore, this method is not a preferable method. At the same time, this form of safety measurement is purely based on retrospective data or lagging indicator. This is not proactive method.

A more proactive approach is to assess the safety climate at site, prevalent safe work behavior of the workers, which is a "leading indicator" of safety. **Organizational, managerial and human factors are prime causes of risk at site rather than purely technical failure.**

Safety culture of the Organization

Safety culture is defined as "organizational approach to addressing safety management". It is the "organizational principles, norms, commitments and values related to the operation of safety and health".

Thus it is the culture prevalent in the organization be it executing department or the executing agency. A positive safety culture is positively correlated to safety performance. **The organizations should have a written safety policy and a safety management system.**

Safety Climate

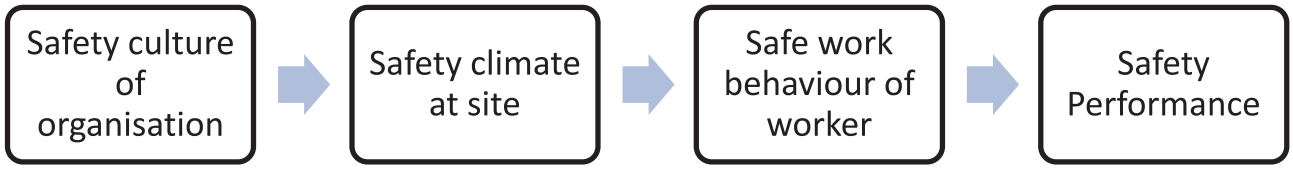
Safety climate is "perception of state of safety" at site at a given time. This is a snapshot of "safety culture" that is prevalent in the organization. Measuring the safety climate at a site is like taking the safety temperature of the department.

Safe work behavior of worker

Safe work behavior of the workers is greatly influenced by the safety culture and safety climate prevalent at site. This is instrumental in influencing attitude and behavior of the worker relating to increasing or decreasing the risk. A behavior based approach to safety performance is a proactive approach and is more sensitive and effective in reducing the accidents and improving the safety performance.

Safety culture, safety climate and safe work behavior of worker are mutually correlated with safety performance as below:

Fig:-1



Ten important aspects of safety at site:

1. Safety rules and procedures
2. Personal appreciation of risk
3. Supervisory environment
4. Employees' involvement
5. Communication
6. Work pressure
7. Commitment
8. Competence
9. Appraisal of physical work environment and work hazard
10. Supportive environment

Provision of safety in CPWD Contracts

Clause 19C of General Condition of Contract provide that "the contractor shall at his own expense arrange for the safety provisions as per CPWD safety code framed from time to time and shall at his own expense provide for all facilities in connection therewith".

CPWD Safety Code

CPWD safety code is a part of General Condition of Contract. It provides in details all the safety measures which are required to be observed at site to ensure safety of workers. Detailed technical safety measures which are required to be taken at site in connection with various kind of activities has been given in details. It has sixteen clauses with many sub-clauses.

Recommendation

Based on above discussion, the following recommendations are made:

1. CPWD should have a written "safety policy" and "safety management system".

2. A system of third party "safety audit" of projects casting above certain value should be developed. It should be conducted at crucial stages of the work. It should be based on leading indicators of safety like compliance to safety norms, assessing safe work behavior of workers, etc. Safe work behaviour of workers can be assessed based on self reporting or co-employees reporting.

3. A system of "safety rating" should be introduced by CPWD for major projects and

provision of incentives should be introduced for better ratings.

4. While assessing overall performance of the work, “safety performance” should also be introduced in the system apart from performance on time, cost and quality.

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ENVIRONMENTAL HEALTH AND SAFETY MANAGEMENT (EHS) IN PROJECTS WITH A CASE STUDY

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Introduction

Construction workers skilling, safety and health issues have gained vital importance throughout for the construction industry, especially in large-scale construction projects and continue to be important elements to project performance and success of project for all the stakeholders. The complex and uncertain nature of this high-risk industry needs an effective skilling and safety management system. Many construction companies are implementing environmental health and safety management (EHS) system to reduce injuries, eliminate illness and to provide a safe working environment in their construction sites. This paper describes a study of site safety environment in a construction site that has been implemented as one of the important elements "above and beyond" routine compliance which has helped the agency to improve worker safety and health performance. The paper also proposes improvement strategies and methods to enhance safety risk management.

Roles & responsibilities of Construction Team Players:

To ensure that workers are protected during construction activities, a construction environmental, health and safety (EHS) management program must be developed, approved, and implemented. All the three major stakeholders - owners, designers & engineers, and contractors & subcontractors, have significant role on the construction worker's safety and health. Each stakeholder influences and contributes to the completed project in its own way and also affects the construction site safety differently. Some of the identified the roles and responsibilities are:

For Owners - Owner safety commitment, Safety requirements in contracts, and owner involvement in safety activities during pre-planning, design, and construction phases etc.

For Designers & Engineers: Safety during conceptual planning stages of the project, Safety in design concept, Safety during constructability reviews, Safety training for designers, Inclusion of hazard symbols in project plans, Involvement of experts in constructability review/design process, Use of the Design for Construction Safety Toolbox etc.

For Contractors & Sub-contractors - Staffing for safety, Safety planning, Safety training and education, Worker participation and involvement, Recognition and rewards, Accident/incident reporting and investigations Drug and alcohol testing etc.

Typical construction risks:

Construction industry is labour intensive where fatal accidents and minor accidents are very frequent. The typical hazards found on construction sites should be understood so that it can be eliminated, minimized, or transferred. A non-exhaustive list includes:

1. Worker injuries and illnesses.
2. Damage to contractors and subcontractors' equipment, vehicle, material, and property on the site.
3. Injuries to the members of the public due to negligence of contractors.
4. Damage to equipment, vehicle, material, and property of the general public due to negligence of contractors.
5. Negligence of one contractor resulting in an injury to another contractor or property damage.
6. Environmental damages.
7. Business interruptions due to any of the items above.

Care should be taken to eliminate or minimize these risks, in addition to purchasing proper insurance coverage.

Major causes of accidents:

In our country, in construction work, a large number of inexperienced unskilled and untrained worker laborers are employed who are unaware of the hazard during their work, and generally the contractors hardly make an effort to explain this worker's inherent risk involved with the job. Major causes for accidents are:

1. Fall from high elevation.
2. Electrocution.
3. Being struck by equipment.
4. Being caught by equipment.
5. Trench excavation, cave-in.
6. Drowning (bridge and offshore construction).
7. Overexertion.

First four termed as “Fatal Four” are responsible for more than half the construction worker deaths and, eliminating the Fatal Four would save lives of number of workers. Other common causes of accidents on a construction site include but not limited to:

Trips and slips, improper use or failure to use Personal Protective Equipment (PPE), lack of warning system, use of defective tools, equipment, or materials, improper lifting and hoisting, inadequate guards or barriers, insufficient safety training for workers, inadequate illumination, poor housekeeping, poor communication and language barrier etc.

EHS Accident Costs:

Construction accidents are very expensive, accounting for substantial direct and indirect costs. Direct costs are workers' compensation claims that pay for medical, loss of wages, and rehabilitation for an injured worker. The indirect costs associated with accidents are increase in workers' compensation insurance premiums, lost reputation or damage to public image, loss of contracts due to poor safety records, work stoppage associated with accidents, damaged or spoiled materials, tools and their replacement, investigation time, lower worker morale, loss of valuable workers, hardship to worker family, There are estimates that the indirect cost is anywhere between 1 to 20 times the direct cost depending on the accident .

EHS Management:

Safety programme ensures the worker to be mentally and physically prepared to execute a job quickly, fearlessly and efficiently. Working in a fearless protected environment makes the team to be more productive and efficient and results in quality output.

However, safety programme usually is not a top priority in a market-driven society where the main focus is completing the projects at the specific quality with minimum time and cost. Thus, safety issues are considered only after an accident occurs at a construction site. Improper methods and processes are used to cut the time of execution, such as scaffoldings are not properly made, ladders are not checked properly or use of poor quality of safety belts are used, which gets broken during job execution.

The philosophy of the company must be that all accidents are prevented and the actions expected to accomplish that goal must be clearly stated to the employees. Without a safety plan, a project cannot be described as a successful construction project. Some of the major components of a company safety plan should be –

1. First aid equipment should be available and known to the employee.
2. Every employee's need requires personal safety equipment.
3. Formal training program for each employee should be mandatory.
4. Procedures for emergency evacuation of injured employees should be clearly explained and employees should be trained for such situations.

5. Safety record and accident report of the company should be honestly examined.

6. Site visit requirement for supervisory personnel plays a very important role in safety management.

7. Training for all supervisors and the managers should be mandatory.

Improvement strategies and methods to enhance safety risk management:

Comprehensive guideline should be prepared for all stakeholders, different personnel and processes. Following guidelines can be prepared:

1. Behavioural approaches to safety and health.

2. Guidelines for top managers.

3. Guidelines for superintendents of project.

4. Guidelines for workers.

5. Physical approaches to safety and health.

6. Education and training in correct methods and procedures.

7. Utilization of safety certified tools in well condition.

8. Use of equipment for personal protection such as hard hats, seat belts, ear plugs, etc.

9. Good housekeeping on job sites.

10. Frequent and thorough job site inspections by knowledgeable and objective professionals.

11. Incorporation of safety review.

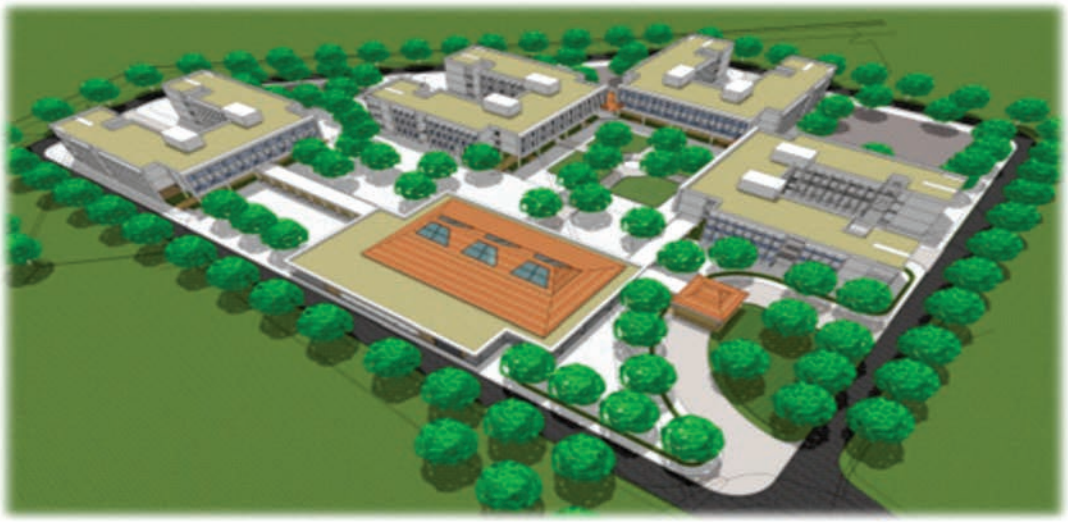
Safety in contracts:

The contract whether between the project owner and the general contractor (or) between the general contractor and their tiers, should clearly specify the safety and health requirements to avoid disputes during construction and also ensure all the parties utilize consistent safety standards. Laws and Regulations Construction contracts, at a minimum, should include provision such as "..the contractor shall develop and implement, and be responsible for, a comprehensive safety program that complies with all applicable (environmental, health, and safety) international, national, state, county, local, contractor, and owner requirements while performing work on the project or facility."

The contract should require all contractors and their sub-contractors to submit a site-specific safety plan prior to commencement of any construction work or with any significant

change in activity. The contract should identify the minimum level of safety staffing expected to manage the safety program, specifying the minimum qualifications of such staffing.

Case Study – Construction of 640 capacity Students Hostel for IIT Goa in the GEC campus at Farmagudi, Ponda – South Goa:



ARCHITECT/CONSULTANT
S.W. MONE & ARCHITECT,
MUMBAI

PMC
CPWD, PANAJI - GOA

CONTRACTOR
SCON PROJECTS PVT LTD
PUNE



EHS practices that have been followed are:

3. EHS Statistics reports (Weekly & monthly):

SCON PROJECTS PVT LTD																					Doc.No : Scon/EHS/F 03 Rev.No. Rev.01 01-07.2017 04-05-19
GOA IIT HOSTEL PROJECT - FARMAGUDI, PONDA - SOUTH GOA																					
Weekly project Report for 14th week of 2019 (for the week of 29-03-2019 TO 05-04-2019)																					
Date										Safety Induction		Tool Box Talk		Safety Training	Total Permits	Accident Statistics						Remarks
	Scon Staff	Total Workers	Scon security	Others (PMC , Client etc)	Total Man Power Worked	Cummulative Man Power worked	Working Hours for one day	Safe Working Hours	Cummulative Safe Manpower worked	No. Of persons attended safety induction	Total persons attended	No. of Persons attended Tool Box Talk	Total Persons attended	No of Specific Training		First Aid Case	Recordable Medical Treatment Case	Reportable Accident	Near Miss	Fire Incident	Accident Details	
UP TO LAST WEEK	8141	75100	2174	816		86227			885650		534		49897	0	946	10	0	1	12	0	0	
30-03-2019	14	95	3	0	112	86339	10	1120	886770	0	0	24	49921	0	1	0	0	0	0	0	0	
31-03-2019	2	5	3	0	10	86349	10	100	886870	0	0	0	49921	0	0	0	0	0	0	0	0	
01-04-2019	13	79	3	1	96	86445	10	960	887830	0	0	23	49944	0	1	0	0	0	0	0	0	
02-04-2019	13	78	3	0	94	86539	10	940	888770	0	0	21	49965	0	1	0	0	0	0	0	0	
03-04-2019	13	74	3	0	90	86629	10	900	889670	0	0	24	49989	0	1	0	0	0	0	0	0	
04-04-2019	12	75	3	1	91	86720	10	910	890580	0	0	23	50012	0	1	0	0	0	0	0	0	
05-04-2019	12	60	3	0	75	86795	10	750	891330	0	0	20	50032	0	1	0	0	0	0	0	0	
Total	79	466	21	0	568	86795	70	5680	891330	0	534	135	50032	0	952	10	0	0	12	0	0	
Sign of Site Safety Officer												Sign of Site Project manager										

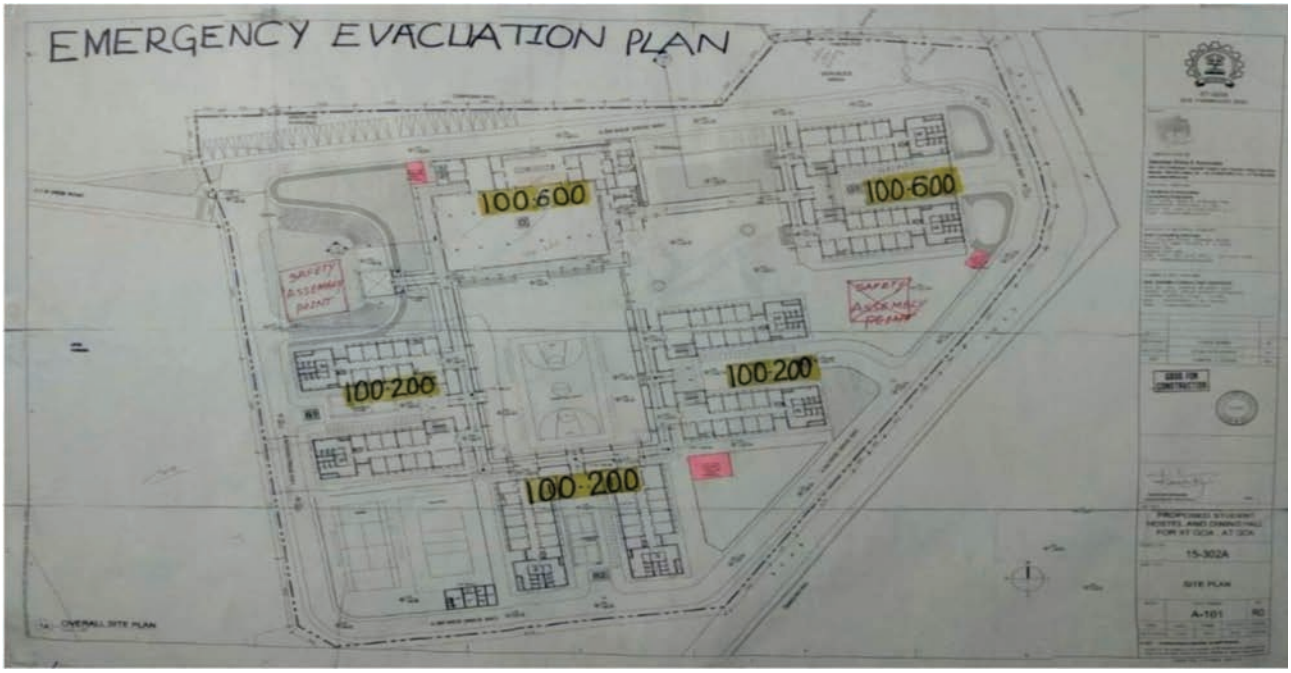
4. Induction training for new workers:



1. Safety Park:



2. Safety evacuation Plan:



Safety evacuation site plan- On hearing a evacuation alarm or on instruction of emergency control personal immediately cease all activities and secure personal valuables. Assist any person in immediate danger, but only if safe to do, in a fire do not use lift to evacuate a building.

5. Daily too box talk with all workers & site staff:



6. Job Specific training for workers

7. Mandatory PPE's:



- SAFETY HELMET
- SAFETY SHOES
- SAFETY REFLECTIVE JACKETS
- SAFETY HANDGLOOVES
- SAFETY GOGGLES
- SAFETY BELTS
- SAFETY EAR PLUG
- FIRST AID BOX
- NOSE MASK

8. Safety Signages Display:























9. Mock drills:

Mock drill is method of practicing how a building would be evacuated in the event of fire or another emergency. The building existing fire system is activated and the building is evacuated as if the emergency had occurred.





FIRE TRAINING AND DEMONSTRATION TO LABOURS & STAFF





EMERGENCY RESCUE OPERATION TRAINING





Height Work – safety demonstration

10. Safety awareness sessions with sub-contractors and staff:



11. Safety motivation & health checkup:



12. Safety audit and inspections:

Safety Audit - It is a general term used to describe an activity where a facility gathers information above one or more aspects of the work place in order to evaluate the risk level for health or safety issues.

Safety internal audit – A safety audit is the detail examination of your company's safety management system to make sure that your safety program and activities are working according to plan and are helping you meet your company safety goal. Safety audit are great tool to assess risk and hazards.

Safety external audit – An external auditor performance an audit in accordance with specific laws or rules of the financial statement of company, Govt. entity other legal entity or of organization.

13. General safety practices:

Permit to work – Systems are formal procedures use to control activities that are considered high risks. Permits only allow authorized personal to perform those activities at specified

times and in a way set out in the permit and referenced documents.

Near misses' report – A near misses is an un planned event that did not result in injury illness or damage – but had the potential to do, so only a fortunate brake in the chain of events prevented an injury, fatality or damage, in other words, a miss that was nonetheless very near.

Unsafe act – Performance of a task or other activity that is conducted in a manner that may threaten the health and safety of worker. For example, lackUnsafe condition – Condition in the work place that is likely to cause property damage or injury, for example using defective tools and equipment or supplies or guards.

Incident investigation – The tern incident can be defined as an occurrence condition, or situation arising in the course of work that resulted in or could have resulted in injuries, illness, damage to health or fatalities.

14. Safety week celebrations:











Safety speech given by workers and staff



Games for staff and workers



Safety speech given by Sh Ashok Naik, IIT Consultant and Varad Salke, AEE, CPWD.

15. Safety Recognition Awards for Best Safety Performance to workers at work place:



16. Good Housekeeping:



17. Routine Watering of the Site, so as to reduce Dust generation.

18. Good Work Practices photographs

Conclusion:

Construction sites are reportedly most high-risk places because of employment of large-scale unskilled workers and absences of health and safety measures. A proper EHS management if in place and monitored closely, safety cases at construction sites can be minimized. Safety training and awareness, worker's attitude towards safety, availability of safety equipment, safety inspections, medical check-up of employees for drugs addicted or mentally issues and organization safety policy are the most important factors affecting safety at construction sites. Based on the study findings it is recommended that the safety training should be conducted for all employees; must hire full time safety engineers and supervisors should monitor the site on daily based and identify the weak point to create a safe working environment resulting in quality output.

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SKILL DEVELOPMENT OF WORKERS IN CPWD PROJECTS

M.K. Mallick, CE(CSQ) (Civil) & **S.K. Dak,** SE(C&M), CSQ

Need for Skill Development

Large number of workers are engaged in the Construction Industry in various trades. Out of these, some workers are skilled/semi skilled and others are unskilled. In order to focus on enhancing employability of youth, in general, through skill development, a “Ministry for Skill Development & Entrepreneurship(MSDE) has been formed by Govt. of India. Under this 'Ministry' the flagship scheme, “Pradhan Mantri Kaushal Vikas Yojana (PMKVY)” has been launched to enable large number of Indian youth to take up industry relevant skill training that will help them in securing a better livelihood. Following govt. bodies have been formed for implementation of skill development activities in the country.

National Skill Development Agency

The National Skill Development Agency (NSDA), an autonomous body, under Ministry of Skill Development & Entrepreneurship (MSDE) was created with the mandate to co-ordinate and harmonise the skill development activities in the country. The main functions of NSDA are as below:-

• To meet skilling targets as envisaged in the 12th Five Year Plan and beyond.

• Coordinate and harmonize the approach to skill development among various Central Ministries/Department, State Governments, the NSDC and the Private sector.

• Anchor and operationalize the National Skill Qualification Framework (NSQF) to ensure that quality and standards meet sector specific requirements

• It is the nodal agency for State Skill Development Missions

• Raise extra-budgetary resources for skill development from various sources such as international agencies, including multi-lateral agencies, and the private sector.

• Evaluate existing skill development schemes with a view to assess their efficacy and suggest corrective action to make them more effective.

• Create and maintain a national data base related to skill development including development of a dynamic Labour Market Information System (LMIS).

• To ensure that the skilling needs of the disadvantaged and the marginalized groups like SCs, STs, OBCs, minorities, women and differently abled persons are taken care of.

National Skill Development Corporation:

The National Skill Development Corporation (NSDC) was setup as a one of its kind, Public Private Partnership Company with the primary mandate of catalysing the skills landscape in India. NSDC is a unique model with underlying philosophy based on the following principles:

1. Proactively catalyse creation of large, quality vocational training institutions.

2. Reduce risk by providing patient capital, including grants and equity.

3. To enable the creation, and sustainability of support systems required for skill development, including the Industry led Sector Skill Councils.

The main objectives of the NSDC are:

• Upgrade skills to international standards through significant industry involvement and develop necessary frameworks for standards, curriculum and quality assurance

• Enhance, support and coordinate private sector initiatives for skill development through appropriate Public-Private Partnership (PPP) models; strive for significant operational and financial involvement from the private sector

• Play the role of a "market-maker" by bringing financing, particularly in sectors where market mechanisms are ineffective or missing

NSDC operates through partnerships with multiple stakeholders in catalysing and evolving the skilling ecosystem as below:-

Central Ministries – Participation in flagship programmes like Make in India, Swachh Bharat, Pradhan Mantri Jan Dhan Yojana and Smart City among many others.

State Governments – Development of programs and schemes, alignment to NSQF and capacity building, operationalization of program, capacity building efforts among others.

University/School Systems – Vocationalisation of education through specific training programs, evolution of credit framework, entrepreneur development, etc.

Non-profit Organizations – Capacity building of marginalized and special groups, development of livelihood, self-employment and entrepreneurship programs.

Private Sector – Areas of partnerships include awareness building, capacity creation, loan financing, creation and operations of Sector Skill Councils, assessment leading to certification, employment generation, Corporate Social Responsibility.

International Engagement – Investments, technical assistance, transnational standards, overseas jobs and other areas.

In order to enhance the skills of the workers engaged in various trades in the projects undertaken by CPWD and for achieving better quality, efficiency & standards in the construction sector, CPWD issued guidelines for training & certification of the unskilled/semi skilled workers engaged in projects in reference to the gazette notification issued by Ministry of Skill Development and Entrepreneurship vide No. H-22011/2/2014-SDE-1 dated 28.02.2017.

The General Conditions of Contract (GCC), 2014 which becomes part of the contract, being entered into by CPWD, envisage the deployment of skilled/semi skilled tradesmen by contractor who are qualified and possess the certifications in a particular trade from various Institution like CPWD Training Institute/Industrial Training Institute/ National Institute of construction Management and Research (NICMAR)/ National Academy of Construction, CIDC or any similar reputed and recognized Institute managed/ certified by State/Central Government. The contractor is required to deploy at least 20% qualified tradesmen out of the total skilled/semi skilled workers required in each trade at any stage of work.

In order to encourage the on-site training for works costing more than Rs. 50 Crores, the provision has been made in the relevant clauses of contract. As per the provision, for works costing more than Rs. 50 crore and upto Rs. 100 crores, the contractor shall arrange on site training as per the norms of NSDC, for at least 10% of the unskilled workers engaged in the project for certification at the level of skilled/semi skilled tradesmen. Similarly, for works costing more than Rs. 100 Crores, the contractor shall arrange for training of at least 20% of the unskilled workers engaged. The provision under Clause 19K in GCC for CPWD works 2014 is as below:-

Clause 19K :- Employment of Skilled/Semi Skilled workers

The contractor shall, at all stages of work, deploy skilled/semi skilled tradesmen who are qualified and possess certificate in particular trade from CPWD Training Institute/Industrial Training Institute/ National Institute of construction Management and Research (NICMAR)/ National Academy of Construction, CIDC or any similar reputed and recognized Institute managed/ certified by State/Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled/semi skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, its scheduling and the list of qualified tradesmen along with requisite certificate from recognized Institute to Engineer in charge for approval. Notwithstanding such approval, if the tradesmen are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesmen within two days of written notice from Engineer-in- Charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesmen will attract a compensation to be paid by contractor at

the rate of Rs. 100 per such tradesman per day. Decision of Engineer in Charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding.

Provided always, that the provisions of this clause, shall not be applicable for works with estimated cost put to tender being less than Rs. 5 crores.

For work costing more than Rs. 50 Crores, and upto Rs. 100 Crores, the contractor shall arrange on site training as per National Skill Development Corporation (NSDC) norms for at least 10% of the unskilled worker engaged in the project in co-ordination with the CPWD Regional Training Institute & National Skill Development Corporation (NSDC) for certification at the level of skilled/semi skilled tradesmen.

For work costing more than Rs. 100 Crores, the contractor shall arrange on site training as per National Skill Development Corporation (NSDC) norms for at least 20% of the unskilled worker engaged in the project in coordination with the CPWD Regional Training Institute & National Skill Development Corporation (NSDC) for certification at the level of skilled/semi skilled tradesmen.

The above provision is being implemented in CPWD Projects MoUs have been signed between CPWD/Contractors & CSDCI (Construction Skill Development Council of India), the Construction Sector Council, recognized & authorized by NSDC.

Thus the on-site training of the workers has come in a big way and is helping develop the skills of the workers which eventually leading to increase in the productivity, quality and steady availability of skilled manpower, which are essential requirements for infrastructure growth in the country.

National Skill Development Corporation

The National Skill Development Corporation India (NSDC) was setup as a one of its kind, Public Private Partnership Company with the primary mandate of catalysing the skills landscape in India. NSDC is a unique model created with a well thought through underlying philosophy based on the following pillars:

1. Create: Proactively catalyse creation of large, quality vocational training institutions.

2. Fund: Reduce risk by providing patient capital. Including grants and equity.

3. Enable: the creation and sustainability of support systems required for skill development. This includes the Industry led Sector Skill Councils.

The main objectives of the NSDC are to:

• Upgrade skills to international standards through significant industry involvement and

develop necessary frameworks for standards, curriculum and quality assurance

• Enhance, support and coordinate private sector initiatives for skill development through appropriate Public-Private Partnership (PPP) models; strive for significant operational and financial involvement from the private sector

• Play the role of a "market-maker" by bringing financing, particularly in sectors where market mechanisms are ineffective or missing

• Prioritize initiatives that can have a multiplier or catalytic effect as opposed to one-off impact.

Partnerships

NSDC operates through partnerships with multiple stakeholders in catalysing and evolving the skilling ecosystem.

Private Sector – Areas of partnerships include awareness building, capacity creation, loan financing, creation and operations of Sector Skill Councils, assessment leading to certification, employment generation, Corporate Social Responsibility, World Skills competitions and participation in Special Initiatives like Udaan focused on J&K.

International Engagement – Investments, technical assistance, transnational standards, overseas jobs and other areas.

Central Ministries – Participation in flagship programmes like Make in India, Swachh Bharat, Pradhan Mantri Jan Dhan Yojana, Smart City, Digital India and Namami Ganga, among many others.

State Governments – Development of programs and schemes, alignment to NSQF and capacity building, operationalization of program, capacity building efforts among others.

University/School systems – Vocationalisation of education through specific training programs, evolution of credit framework, entrepreneur development, etc.

Non-profit organizations – Capacity building of marginalized and special groups, development of livelihood, self-employment and entrepreneurship programs.

Innovation – Support to early- stage social entrepreneurs working on innovative business models to address gaps in the skilling ecosystem, including programs for persons with disability.

Achievements

• Over 5.2 million students trained

• 235 private sector partnerships for training and capacity building, each to train at least 50,000 persons over a 10-year period.

• 38 Sector Skill Councils (SSC) approved in services, manufacturing, agriculture & allied services, and informal sectors. Sectors include 19 of 20 high priority sectors identified by the Government and 25 of the sectors under Make in India initiative.

• 1386 Qualification Packs with 6,744 unique National Occupational Standards (NOS). These have been validated by over 1000 companies.

• Vocational training introduced in 10 States, covering 2400+ schools, 2 Boards, benefitting over 2.5 lakh students. Curriculum based on National Occupational Standards (NOS) and SSC certification. NSDC is working with 21 universities, Community Colleges under UGC/AICTE for alignment of education and training to NSQF.

• Designated implementation agency for the largest voucher-based skill development program, Pradhan Mantri Kaushal Vikas Yojana.

• Skill Development Management System (SDMS) with 1400 training partners, 28179 training centres, 16479 trainers, 20 Job portals, 77 assessment agencies and 4983 empanelled assessors. Hosting infrastructure certified by ISO 20000/27000 supported by dedicated personnel.

National Skill Development Agency (NSDA)

The National Skill Development Agency (NSDA), an autonomous body, (registered as a Society under the Society's Registration Act 1860) was created with the mandate to co-ordinate and harmonise the skill development activities in the country, is part of the Ministry of Skill Development & Entrepreneurship (MSDE).

Functions : Gazette Notification of NSDA

• Take all possible steps to meet skilling targets as envisaged in the 12th Five Year Plan and beyond.

• Coordinate and harmonize the approach to skill development among various Central Ministries/Department. State Governments, the NSDC and the Private sector.

• Anchor and operationalize the NSQF to ensure that quality and standards meet sector specific requirements

• Be the nodal agency for State Skill Development Missions

• Raise extra-budgetary resources for skill development from various sources such as international agencies, including multi-lateral agencies, and the private sector.

• Evaluate existing skill development schemes with a view to assessing their efficacy and suggest corrective action to make them more effective.

• Create and maintain a national data base related to skill development including development of a dynamic Labour Market Information System (LMIS).

• Take affirmative action for advocacy.

• Ensure that the skilling needs of the disadvantaged and the marginalized groups like SCs, STs, OBCs, minorities, women and differently abled persons are taken care of and.

• Discharge any other function as may be assigned to it by the Government of India.

Activities undertaken by the NSDA

Besides anchoring and implementation, the National Skills Qualifications Framework (NSQF), some of the other actions taken by the NSDA are as under:

1. Rationalization of the Skill Development Schemes of the Government of India

NSDA has worked with the concerned ministries and stakeholders to achieve convergence of norms across the various central schemes for skill development, while at the same time recognizingthe special needs of the North Eastern States, the hill States, and other geographies that pose challenging situations for skill development.

2. Creation of an integrated Labour Market Information System

A national database on all major aspects of skill development is being created in partnership with all other Ministries of the Government of India and the State Governments. This would be a one-shop stop where all the relevant information is freely available to citizens. The government has created a National Steering Committee for setting up the Labour Market Information System (LMIS). The LMIS would bring in operational efficiencies, would be transparent and available to all, and would help reduce considerably the situation of one individual being benefitted under different schemes.

3. Engagement with States

The NSDA is newactively engaged with the various State governments to plan out their skill development action plan, help them develop their skill development policies, and set up suitable administrative mechanisms. Through Technical Assistance programmes with the Asian Development bank (ADB), European Union (EU) and DFID (Department for International Development of the Government of UK), NSDA is helping the State Skill Development Missions of eleven states build their respective capacities.

4. Skills Innovation Initiative

A committee has been set up under the Skills Innovation Initiative housed under the NSDA. The NSDA invites innovative ideas, concepts and practices on skill development. The Committee reviews all the proposals of innovations to facilitate their application on a wider scale. Selected innovative practices will be facilitated and propagated for wider application. Five innovative approaches and solutions have already been identified for wider propagation.

ENVIRONMENT, HEALTH AND SAFETY

Shubhendu Bose, L&T

L&T Construction, India's largest construction organization and ranked among the world's top 30 contractors, has been over the past seven decades transforming cityscapes and landscapes with structures of immense size and grandeur. The company's capabilities span the entire gamut of construction - civil, mechanical, electrical and instrumentation engineering - and its services extend to all core sector industries and infrastructure projects.

Several of the country's prized landmarks - edifices, structures, airports, industrial projects, flyovers, viaducts, water and power infrastructure projects carry L&T's signature of excellence in construction. Today, more and more structures beyond India's boundaries are standing tall, thanks to L&T Construction.

L&T Construction straddles six related businesses:

- Transportation Infrastructure
- Heavy Civil Infrastructure
- Power Transmission & Distribution
- Buildings & Factories
- Renewable Energy
- Water & Effluent Treatment
- Smart World & Communication

Environment, Health and Safety

At L&T, Environment, Health and Safety (EHS) is of prime importance with utmost care taken to ensure that every employee is provided a safe and healthy workplace. L&T's corporate management has enunciated policies that emphasize on EHS through structured and well-defined procedures at every stage of construction that protects the environment.

Different business units and facilities in the Heavy Civil Infra vertical are certified to ISO standards. Achieving ISO 9001; ISO 14001; ISO 45001 standards, L&T has been continuously imbibing world-class quality & EHS management principles to improve efficiency and effectiveness in all its systems and operations.

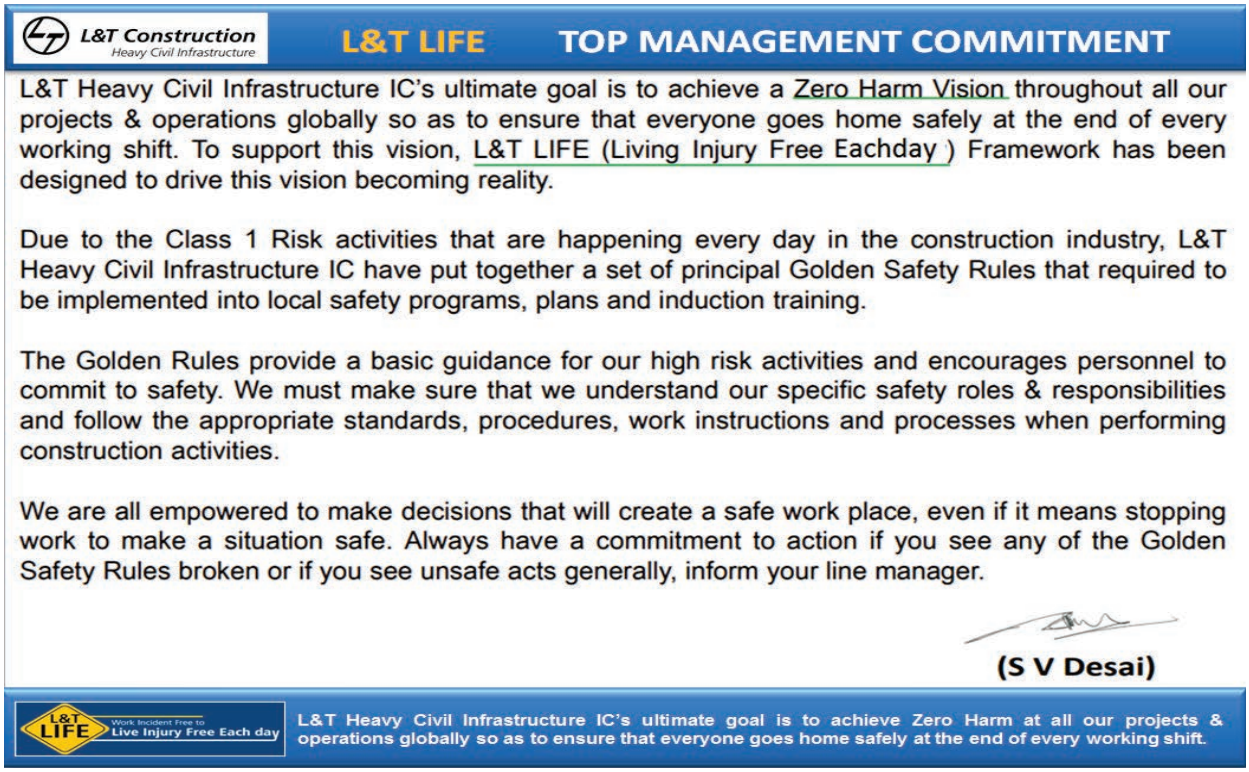
L&T firmly believes that EHS administration at work is the responsibility of every employee and promotion of EHS culture is an integral part and responsibility of all managers. EHS is not

viewed as a separate entity. It is fully integrated with all execution activities and implementation of the required EHS measures is vested with the operational units of the Heavy Civil Infrastructure IC.

The Environment, Health & Safety Department facilitates implementation of the IC's EHS Policy and closely monitors with the respective units as required. This is effected through the Cluster EHS Managers, who report to the Head of EHS at HQ, Chennai. CEHSMs monitor the activities of the EHS In charges posted in the projects of their Cluster.

Organization's EHS structure:

CEO > IC EHS Head > Cluster EHS Head > Project EHS In-Charge > Project EHS Engineers > EHS Supervisors



L&T Heavy civil Infra IC is certified to Integrated Management System conforming to ISO 14001:2015 & OHSAS 18001:2007 (in transition phase to ISO 45001:2018)



DNV·GL

MANAGEMENT SYSTEM CERTIFICATE

This is to certify that the management system of

Larsen & Toubro Limited
(Heavy Civil Infrastructure Independent Company)
Mount Poonamallee Road, Manapakkam, Chennai - 600 089, Tamil Nadu, India

has been found to conform to the Occupational Health and Safety Management System standard:
OHSAS 18001:2007

This certificate is valid for the following scope:
Management of environmental, occupational health and safety requirements at project sites & offices



DNV·GL

MANAGEMENT SYSTEM CERTIFICATE

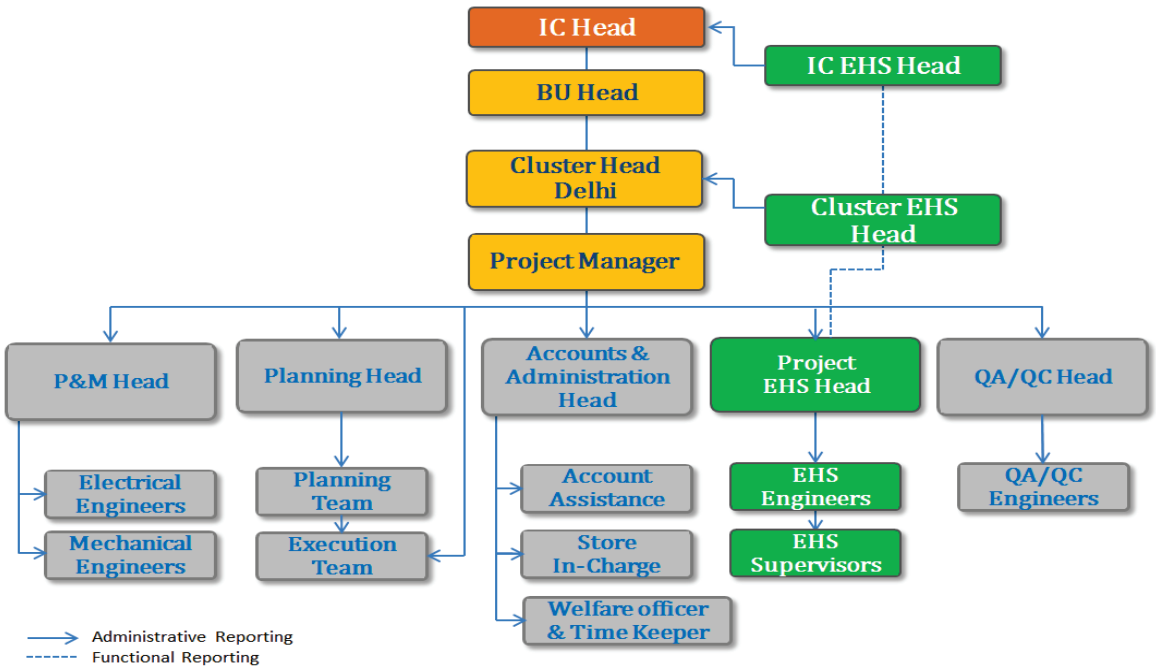
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ISO 14001:2015

This certificate is valid for the following scope:
Management of environmental, occupational health and safety requirements at project sites & offices

Top management demonstrated leadership and commitment with respect to EHS management system by assigned roles & responsibility on EHS from top management to bottom work-force as result in EHS Organization starts from Top management i.e. IC Head to EHS Supervisors to ensure "Zero Harm" to workers.



Corporate EHS Policy

Corporate Top management established, implemented and maintained a EHS Policy that includes a commitment to provide safe and healthy workplace for prevention of work related injury and ill health and surrounding environment too. By setting specific EHS Targets & Objectives with reference to all applicable legal requirement.



Corporate Environment, Health & Safety (EHS) Policy

As an integral part of our business philosophy, we are committed to conserving the environment and providing a safe and healthy workplace to our employees and stakeholders. To achieve this, we shall:

- Incorporate EHS considerations in all business processes
- Ensure compliance with statutory and other applicable requirements
- Prevent adverse environmental impacts and occupational health and safety risks
- Conserve natural resources, minimise waste generation and environmental emissions
- Impart structured training and augment resources for effective EHS performance
- Encourage communication, consultation and collaboration with all stakeholders

11th June, 2013

A M NAIK
Group Executive Chairman

LARSEN & TOUBRO

Driving Policy

Corporate management derived separate Driving policy to establish the ROAD SAFETY measure throughout our project site. Which ensure all L&T owned and contracted vehicles are well maintained, in good running condition and safe to use.

Following control measures for driver / operator

- Competence
- Physically Fit
- Driving Hours
- Adverse Weather Condition / Driving at Night
- Seat Belts
- Traffic Regulations

- Safe Distances
- Two Wheelers
- Emergency Procedures
- Mobile Phones
- Alcohol & Drugs
- Incident Reporting



L&T Construction
Heavy Civil Infrastructure

Driving Policy

L&T LIFE — Work Incident Free to Live Injury Free Each day

L&T Heavy Civil Infrastructure IC recognizes that the driving and the use of company vehicles carries significant high risk of injury or death.

As part of L&T L.I.F.E and a Commitment to Action, L&T Heavy Civil Infrastructure IC is committed to improve the safety of its employees and other stakeholders with the ultimate goal of minimizing injuries due to vehicle transportation and operation.

Safe driving is one of the Golden Rules of L&T L.I.F.E and all employees and other stakeholders are required to adhere to this policy when driving or operating with L&T or hired vehicles at all times and encouraged to comply when driving or operating with their personal vehicle either to and from work location or on routine journeys.

Management Commitment:

1) Ensure when providing any vehicle that it is suitable and sufficient for the purpose it is being used for.
2) Provide L&T owned or contracted vehicles, where applicable with all legal documentation and insurances for use by employee/operator.
3) Ensure all L&T owned and contracted vehicles are well maintained, in good running condition and suitable for the purpose and equipped with all safety and emergency equipment/devices.
4) Investigate driving incidents and analyze them with a view to identifying causes and defining possible measures to avoid their reoccurrence. Discipline any person who violates this policy.
5) All drivers & employees who drive company or their personal vehicles are encouraged to undertake defensive driving training from EHS department.

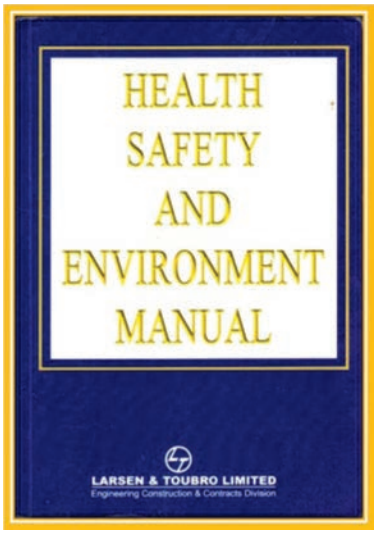
The following control measures have been identified and must be implemented and complied with and are the minimum requirements for compliance by all drivers:

1) **Competence** - Must have a valid driving license with minimum 3 years driving experience and at least 18 years of age to be authorized to drive or operate a company vehicle.
2) **Physically Fit** - Must be in good health and physically able to perform the duties of driving.
3) **Driving Hours** - Drivers should take sufficient rest periods and it is recommended to make journey plan to reach the destination.
4) **Adverse Weather Condition / Driving at Night** - Where roads are affected by fog, rain, ice etc. and in the hours of darkness extra precaution must be taken into consideration either delay or make alternative travel arrangements.
5) **Seat Belts** - It is compulsory that driver and passengers must wear seat belts.
6) **Traffic Regulations** - Must abide by the speed limits and the traffic regulations established by local regulations and site management.
7) **Safe Distances** - A safe distance must be maintained from the vehicle in front to achieve safe braking distance.
8) **Two Wheelers** - When driving any two-wheeler a suitable head protection shall be correctly worn by both driver and pillion rider.
9) **Emergency Procedures** - In case of breakdown or incident the driver must have a list of emergency contacts
10) **Mobile Phones** - Driver must not use a hand held mobile phone while driving.
11) **Prevent Distractions** - Driver must not eat, drink or smoke when operating a vehicle and always have eyes firmly on the road.
12) **Alcohol & Drugs** - Driving under influence of alcohol, drugs or other controlled substances is strictly prohibited. If taking prescription drugs please inform your line manager immediately
13) **Incident Reporting** - Driver and passengers are responsible for reporting all incidents to L&T Local Administration and EHS teams.

Date: 9th May, 2016

S.V.Desai
Executive Vice President and Head
Heavy Civil Infrastructure

Health Safety and Environment Manual "Construction work is tough and the people who work in construction need to be tough, but here is no reason for them to be careless. Accidents can kill or permanently injure the tough as easily as anyone else." - H.R.H. Prince Philips, Duke of Edinburg, London. As quoted, all employees have legal, personal & economic reasons to reduce accidents at their workplace.

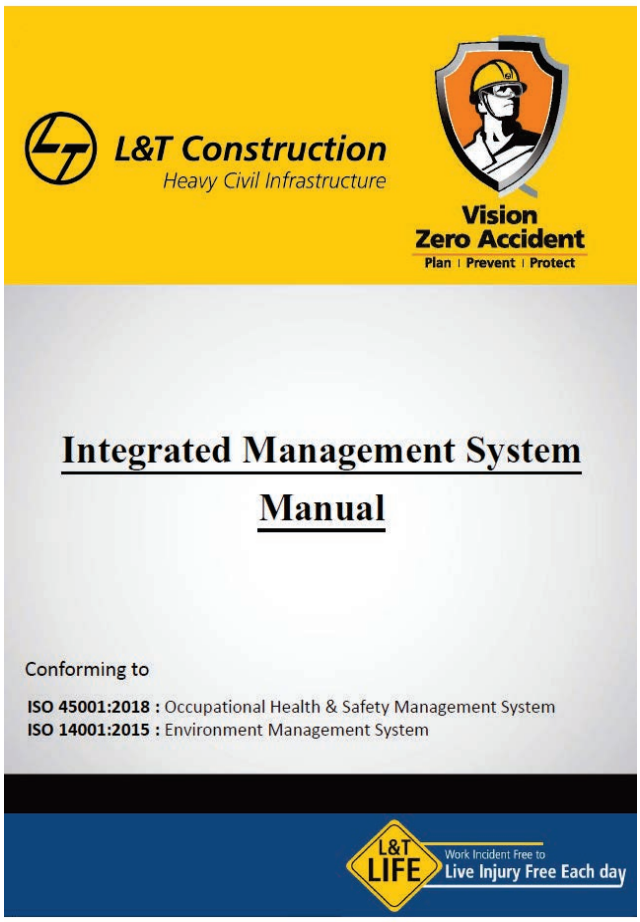


The intent of this Health, Safety & Environment HSE Manual is to provide the HSE norms to be adopted for the activities being carried out and thus prevent injury loss of life and damage to assets and environment. Which covered following activities in

details,

- General
- Civil
- Mechanical
- Electrical Safety
- Occupational Health
- Environment

Integrated management system – EHS

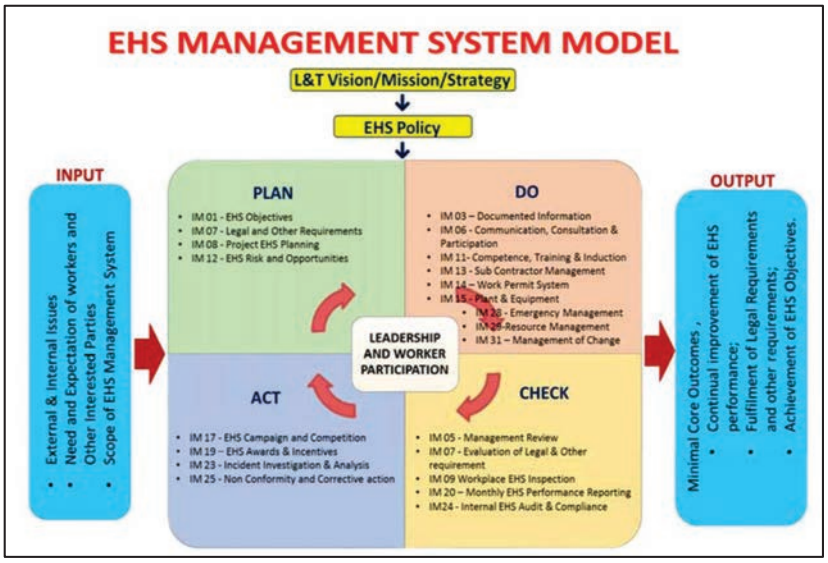


L&T HEAVY CIVIL INFRASTRUCTURE IC firmly believes that EHS administration at work is the responsibility of every employee and promotion of EHS culture is an integral part and responsibility of all managers. EHS is not viewed as a separate entity. It is fully integrated with all execution activities and implementation of the required EHS measures is vested with the operational units of the Heavy Civil Infrastructure IC.

The Environment, Health & Safety Department facilitates implementation of the IC's EHS Policy and closely monitors with the respective units as required.

This is effected through the Cluster EHS Managers, who report to the Head of EHS at HQ, Chennai. CEHSMs monitor the activities of the EHS In-charge posted in the projects of their Cluster.

The scope of the Integrated Management System covers the “MAGAEMENT OF ENVIRONMENTAL, OCCUPATIONAL HEALTH & SAFETY REQUIRMENTS AT PROJECT SITES AND OFFICES” of Larsen & Toubro Limited, Heavy Civil Infrastructure Independent Company.

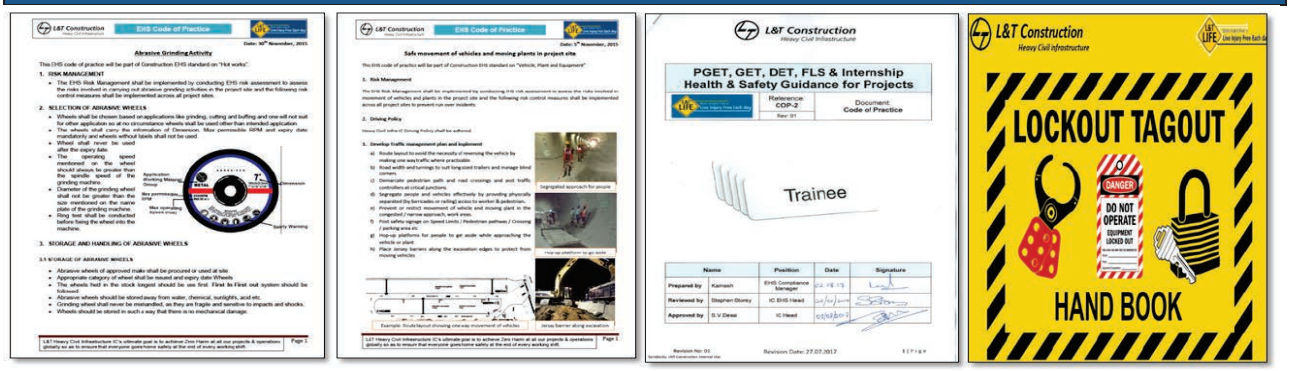




EHS IMS Procedures & Standards



EHS Codes & Practices



Construction EHS Standards



L&T 20 Golden Safety Rules



L&T Construction
Heavy Civil Infrastructure

Golden Safety Rules

Reference: NIL	Document: Golden Safety Rules	Revision: 02
LIFE Live Injury Free Each day	*Commitment to Action*	

Review & Approval:

	Name	Position	Date	Signature
Prepared by	Murali Krishnan	EHS Compliance Manager	21.03.2017	
Reviewed by	Stephen Storey	IC EHS Head	21/03/2017	
Approved by	S.V.Desai	IC Head	21/3/17	

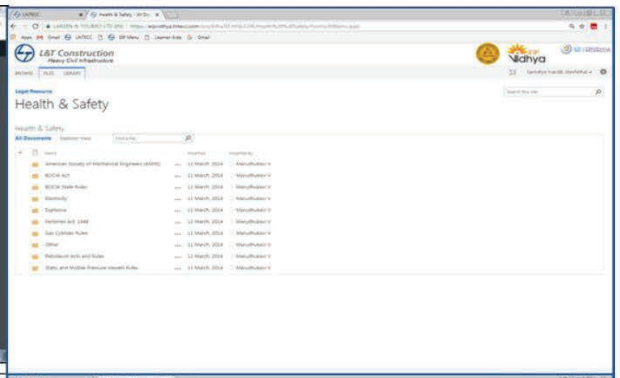
Revision History:

Revision	Date	Change Summary
01	02.05.14	Issued for first issue
02	21.03.17	Change in Organisation

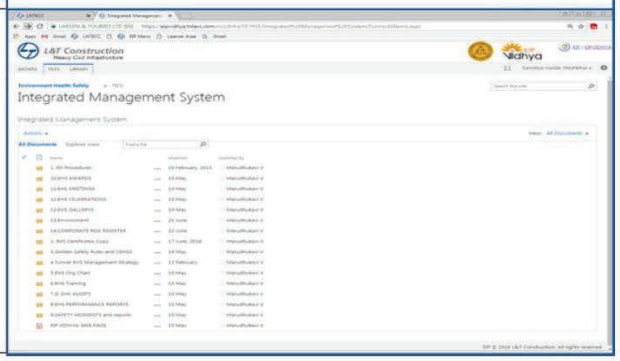


Knowledge Management Portal









EHS Implementation at Barapullah Project



Ambulance



First Aid Centre



EHS Notice Boards



Emergency Contact Number



EHS Display Boards



EHS Induction & Training Hall

Pre-Start Briefing & Verification & Training








Importance of PPEs Training


Welding & Gas cutting Safety Training


Behavior Based Safety Training

Pre-Start Briefing through Digital App








EHS Communications – Displays

















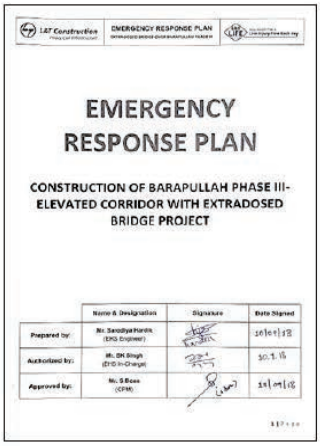
Emergency Preparedness

Emergency contact number display; Emergency Assembly Point; Emergency Evacuation Plan; 24*7 Ambulance Service; Lifebuoy kit; PP Rope; Fire Extinguishers;Siren; Public Announcement System; Life Jacket etc.,













Health Innovation / Initiatives

Emergency Mock Drill

Emergency mock drill conducted at every work location once per six month, it covered every work site. We conduct different mock drill on different emergency situations. Very prepared to Man-made causes, Natural causes.



Health & Welfare Measure

- Anti mosquito spraying at site and workmen camp.
- Grass drying agent spraying at near workmen camp.
- Carbolic acid spraying at site & workmen camp for removing snake and repellent.

Periodically fogging in office & workmen camp.

Pre-employed medical check-up & safety induction of workmen







Safety Induction Assessment





Monthly EHS Committee meeting







Risk Assessment revision meeting





Grass drying agent spraying at near workmen camp.



Periodically anti mosquito spraying in site & workmen camp.

Blood Donation Camp

Blood donation camp organized through external agency on important days such Safety month celebration, Safety Week, Road Safety Week, Environment Day etc.

Workmen, Staff, Contractor all participated in this camp.

Participant will honored during monthly safety committee meeting by CPM & Client representatives.





Safety Innovation / Initiatives

Extension of spider beam for working platform around the well foundation for safe access and working area.



Gantry crane synchronized for lifting of main bridge segment where two gantry cranes used together.



Remote Control for synchronized gantry crane

Punching of unique serial number on Macalloy Bar and Nut and Washer to tracking and identifications.



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सत्यमेव जयते

Government of India

Ministry of Housing and Urban Affairs

CENTRAL PUBLIC WORKS DEPARTMENT