Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

Construction Skill Development Council

Participant Handbook

Sector
Construction

Sub-Sector
Real Estate and Infrastructure Construction

Occupation
Masonry

Reference ID: **CON/Q0105, Version 4.0**
NSQF Level 3.5

Mason Concrete

Published by

Construction Skill Development Council of India (CSDCI)
Tower 4B, DLF Corporate Park, 201 & 202 4B, Mehrauli-Gurgaon Rd, DLF Phase 3,
Gurugram, Haryana 122002, India
Email: standards@csdcindia.org
Website: www.csdcindia.org
Phone:+91-124-4513915

First Edition, July 2023

Construction Skill Development Council of India (CSDCI)
Tower 4B, DLF Corporate Park, 201 & 202 4B, Mehrauli-Gurgaon Rd, DLF Phase 3,
Gurugram, Haryana 122002, India
Email: standards@csdcindia.org
Website: www.csdcindia.org
Phone:+91-124-4513915
This book is sponsored by Construction Skill Development Council of India (CSDCI)

"Skilling is building a better India. If we have to move India towards development then Skill Development should be our mission."

Shri Narendra Modi
Prime Minister of India

Skill India
कौशल भारत-कुशल भारत

Construction Skill Development Council of India

N·S·D·C National Skill Development Corporation
'ansforming the skill landscape

Certificate

COMPLIANCE TO

QUALIFICATION PACK- NATIONAL OCCUPATIONAL STANDARDS

is hearby issued by the

CONSTRUCTION SKILL DEVELOPMENT COUNCIL OF INDIA

for

SKILLING CONTENT:PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role/Qualification Pack:'Mason Concrete'

QP No.'CON/Q0105, Version 4.0 NSQF Level 3.5'

Date of Issuance: Aug 16th 2019
Valid*: Aug 31st 2026

*Valid up to the next review date of the Qualification Pack or the 'Valid up' date mentioned above(whichever is earlier)

Authorised Signatory
(Construction Skill Development Council)

Acknowledgements

This participant's handbook meant for Mason Concrete is a sincere attempt to ensure the availability of all the relevant information to the existing and prospective job holders in this job role. We have compiled the content with inputs from the relevant Subject Matter Experts (SMEs) and industry members to ensure it is the latest and authentic. We express our sincere gratitude to all the SMEs and industry members who have made invaluable contributions to the completion of this participant's handbook.

This handbook will help deliver skill-based training in the Mason Concrete. We hope that it will benefit all the stakeholders, such as participants, trainers, and evaluators. We have made all efforts to ensure the publication meets the current quality standards for the successful delivery of QP/NOS-based training programs. We welcome and appreciate any suggestions for future improvements to this handbook.

About this book

This participant handbook has been designed to serve as a guide for participants who aim to obtain the required knowledge and skills to undertake various activities in the role of a Mason Concrete. Its content has been aligned with the latest Qualification Pack (QP) prepared for the job role. With a qualified trainer's guidance, the participants will be equipped with the following for working efficiently in the job role:

- Knowledge and Understanding: The relevant operational knowledge and understanding to perform the required tasks.
- Performance Criteria: The essential skills through hands-on training to perform the required operations to the applicable quality standards.
- Professional Skills: The Ability to make appropriate operational decisions about the field of work.

The handbook details the relevant activities to be carried out by a Mason Concrete. After studying this handbook, job holders will be adequately skilled in carrying out their duties according to the applicable quality standards. The handbook is aligned with the following National Occupational Standards (NOS) detailed in the latest and approved version of Mason Concrete QP:

- CON/N0114: Carry out IPS/ Tremix flooring
- CON/N0117: Place, level and finish concrete in various structural elements including repairs
- CON/N8001: Work effectively in a team to deliver desired results at the workplace
- CON/N8002: Plan and organize work to meet expected outcomes
- CON/N9001: Work according to personal health, safety and environment protocols at construction site
- DGT/VSQ/N0102: Employability Skills (60 Hours)

The handbook has been divided into an appropriate number of units and sub-units based on the content of the relevant QP. We hope it will facilitate easy and structured learning for the participants, allowing them to obtain enhanced knowledge and skills.

Symbols Used


Key Learning Outcomes


Exercise


Notes


Unit Objectives


Activity

Table of Contents

Table of Contents

It is recommended that all trainings include the appropriate Employability skills Module. Content for the same can be accessed https://www.skillindiadigital.gov.in/content/list

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

1. Introduction to the Role of a Mason Concrete

Unit 1.1 – Introduction to training program

Unit 1.2 - An Overview of Construction Sector

Unit 1.3 - Mason Concrete as a job role

Key Learning Outcomes

By the end of this module, participants will be able to:

1. List out the purpose of training
2. Understand National Occupation Standards and Qualification Pack
3. Explain the benefits of training
4. Explain about construction sector in India
5. Explain urban and rural construction
6. Outline modernization in construction
7. List out major occupations in the construction sector
8. List out roles and responsibilities of a mason concrete
9. Explain career progression for mason concrete

UNIT 1.1: Introduction to Training Program

Unit Objectives

By the end of this unit, participants will be able to:

- Understand the purpose of training
- Understand National Occupation Standards and Qualification Pack
- Explain the benefits of training

1.1.1 Purpose of Training Program

This training program is developed to impart specific skills to individuals who wish to perform as a Mason Concrete. This training program is based on qualification pack for mason concrete.

In past few decades, construction industry in India has grown rapidly. Construction of new structures like residential towers, housing societies, schools, colleges, etc. has resulted in great demand of good skilled workers. There are very few skilled workers for construction works in India. The purpose of this training is to skill construction workers as per the set standards and thereby giving them good career opportunities and growth in the construction sector. The quality of construction work will greatly improve with skilled workforce.

1.1.2 Mode and duration of Training Program

The Training for the Job Role Mason concrete is provided through classroom sessions and practical sessions. The total duration of the training program as recommended in the qualification pack is 8-12 weeks

Fig. 1.1.1 Classroom Session

Fig. 1.1.2 Practical Session

The training program will enable an individual to:

- How to use hand tools and power tools used in Concreting.
- Know about Concrete and its compositions.
- Understand about different concrete mix proportions.
- Carryout IPS and Tremix flooring.
- Carryout concreting activities like placing, screeding, compacting, troweling and vacuum de-watering
- Carryout finishing as per requirement.
- Carryout repairing work in concrete structures.
- Work effectively in a team to deliver desired results at the workplace.
- Work according to personal health and safety and environment protocol at site.

After successful completion of training and passing the assessment candidate will be is- sued a certificate. This will this will help him in getting employment. This certificate will help the candidate to get job and earn better wages than an untrained person.

1.1.3 Benefits of Training Program

- After completion of this training program, trainee will undergo an assessment which will have theory and a practical test.
- On successfully passing the assessment, a certificate will be awarded by the Construction Skill Development Council (CSDCI).
- This certificate will help the trainee to get a job and earn better wages in construction sector.
- The skills acquired along with the certificate will also help the trainee to grow in his career and identify and understand the progression of career.

Exercise

Answer the following questions.

1. What does a QP consist of?
2. What does a NOS specify?
3. Name any two NOS under Mason Concrete QP?
4. Mention any two benefits of this training program?

Notes

UNIT 1.2: An Overview of Construction Sector

Unit Objectives

At the end of this unit, you will be able to:

- Explain about construction sector in India
- Differentiate between urban and rural construction
- Explain about modernization in construction
- List out major occupations in the construction sector

1.2.1 An Overview of Construction Sector

Construction refers to building of different types of structures. The sector comprises of many small, medium and large industries or companies that involve in many different types of projects in the construction sector creating a diverse but specific requirement of workmen.

The construction sector can be broadly classified in two sub sectors, namely:

Real Estate and Infrastructure construction: This sub sector comprises of all the works that are required for construction of all types of infrastructure and real estate projects. Infrastructure projects are those that directly or indirectly affect the growth of the nation e.g. Roads, airports, railway bridges, dams, power plants, metros, industries etc. The real estate projects are those which are mainly focused on providing residential and commercial workplaces to all categories of people e.g. residential towers, independent houses, malls, sports complex etc.

Fig. 1.2.1 Multi Storey Residential Towers

Fig. 1.2.2 Flyovers

Rural Construction: This sub sector focuses on the constructional requirements of rural India and includes construction of rural households, warehouses, village roads etc

Fig. 1.2.3 Rural Roads

Fig. 1.2.4 School in a Rural Area

1.2.2 Modernization in Construction

From the early ages to present day construction sector has not only generated employment, but also undergone extensive modernization, from raw material to use of heavy equipment. The use of modern equipment and technique has increased the speed of construction work and enhanced quality of finished structures. Further, by modernization of construction it is now possible to construct in under water as well as very high altitude, from hi-tech buildings, to atomic power generation plants.

Fig. 1.2.5 Old Bridge

Fig. 1.2.6 Modern Bridge

Fig. 1.2.7 Old Construction Equipment

Fig. 1.2.8 Modern Construction Equipment

Construction is the second largest employment generating sector in India after agriculture. Though there are many different occupations in construction depending on nature of work, some occupations cater to the maximum number of employments and are more prominent than others.

Following occupations are very common in most of the construction projects.

1. Masonry 2. Bar Bending 3. Shuttering Carpentry 4. Scaffolding 5. Painting

Brief details about these occupations are given below:

1. Masonry

Masonry occupation comprises of works in which bricks, stones, concrete blocks, concrete are used along with bonding mixture called mortar to construct components of buildings and other structures. Their basic objectives include:

- Building of structure by laying material such as bricks, blocks, tiles and other construction materials, and bonding them by mortar.
- Constructing, altering, repairing and maintaining walls, sidewalks, street curbs, floors, sink counters, partitions, manholes, and other related structures or surfaces.
- Carry out structural finishes like grit wash, cement wash, POP, plastering, stone cladding etc. on finished masonry surface to impart an aesthetic appeal to the finished structure.

Fig. 1.2.9 Placing Concrete

Fig. 1.2.10 Brickwork

Few Job Roles under masonry occupation are as follows:

- General Mason
- Mason Tiling
- Mason Concrete
- Mason Marble, Granite, Stone
- Mason -Special Finishes

2. Bar bending and fixing

The job of Bar Bending and Fixing includes shifting, cutting, bending and placing the reinforcement bar in order to assemble cage/mesh according to given drawing or specifications.

Fig. 1.2.11 Reinforcement bars fixed at site

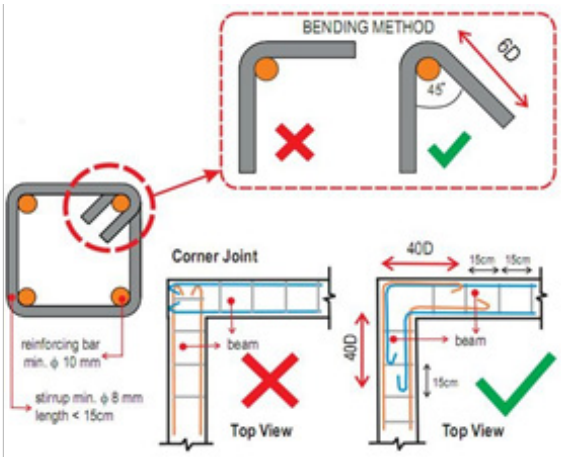


Fig. 1.2.12 Reinforcement bar during bending

Few Job Roles under bar bending and fixing occupation are as follows:

- Helper bar bender and steel fixer
- Assistant bar bender and steel fixer
- Bar bender and steel fixer
- Reinforcement fitter
- Foreman reinforcement

3. Shuttering Carpentry

A shuttering carpenter is a person who specializes in creating shuttering especially using wood/ timber, steel or fiber elements, which are temporary structures used for casting concrete.

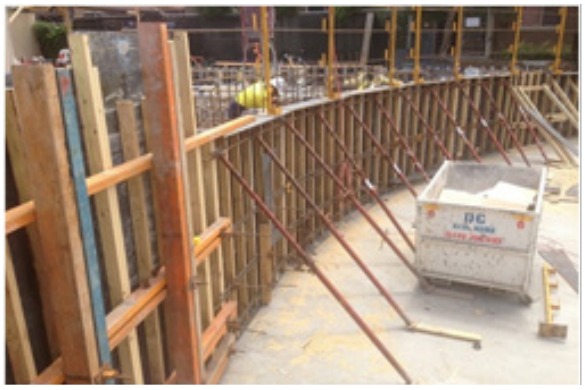


Fig. 1.2.13 Conventional formwork

Fig. 1.2.14 System formwork

Few Job Roles under Shuttering Carpentry occupation are as follows:

- Helper Shuttering carpenter
- Assistant Shuttering carpenter
- Shuttering Carpenter-System
- Shuttering carpentry-conventional

4. Scaffolding

Scaffolding is temporary support structure. The material used are bamboos, timbers or steel members. This support structure helps during construction activities. Scaffolding are made for workmen to do their work and keep their tools and materials.

Fig. 1.2.15 Scaffolding

Few Job Roles under Scaffolding occupation are as follows:

- Assistant Scaffolder-system
- Assistant Scaffolder-conventional
- Scaffolder conventional
- Scaffolder-System

5.Construction Painting

Painting is a key part of the overall finishing work of a construction project. Application of paint lends aesthetic value to a constructed structure. This may also involve a component of decorative painting basis designs and patterns

Fig. 1.2.16 Paint work by a painter

Few Job Roles under Construction Painting occupation are as follows:

- Assistant construction painter and decorator
- Construction painter and decorator
- Construction painter & decorator
- Charge hand-painting & decorating

Notes

Scan the QR code to watch the videos

https://youtu.be/p4f0Ni15EaM

Construction Idustry

https://youtu.be/WmQyPYm_g20

Modernization in Construction

UNIT 1.3: Mason Concrete as a job role

Unit Objectives

At the end of this unit, you will be able to:

- Introduction to concrete structure.
- State roles and responsibilities of a mason concrete.
- List out the required personal and professional attributes for a mason concrete.

1.3.1 Introduction to concrete structures

Concreting is widely used in all kinds of modern construction like:

- High rise buildings
- Bridges
- Dams
- Power or Atomic Plants
- Highways

Currently, the total concrete consumption in India is about 470 million cubic meter and is expected to rise to 580 million cubic meter by 2022 as per The Indian Concrete Journal.

Fig. 1.3.1 Concrete Building

Fig. 1.3.2 Concrete Bridge

Fig. 1.3.3 Concrete Tunnel

Fig. 1.3.4 Concrete Dam

Duties of a Mason Concrete

At the construction site, a mason concrete is expected to carry out tasks as mentioned below.:

- Carry out preparatory work prior to IPS / Tremix flooring
- Check for line, level and alignment.
- Check the materials used for IPS / Tremix flooring in case of manual mixing
- Check the materials used for IPS / Tremix flooring in case of machine mixing
- Carry out IPS flooring / Tremix / VDF flooring
- Carry out preparatory work before pouring of concrete manually & by machine
- Check material used for concreting in case of manual mixing
- Place and compact concrete on PCC & RCC structural elements
- Screed and level wet concrete
- Finish and cure concrete
- Carry out concreting in pre-cast segments
- Carry out simple repair work on hardened concrete surfaces
- Interact and communicate effectively with co-workers, superiors and subordinates across different teams
- Support co-workers, superiors and sub-ordinates within the team and across interfacing teams to ensure effective execution of assigned task

Fig. 1.3.5 Batching Plant for Concrete Mixing

Fig. 1.3.6 Pouring Concrete

Fig. 1.3.7 Spreading Concrete

Fig. 1.3.8 Compacting Concrete using Vibrator

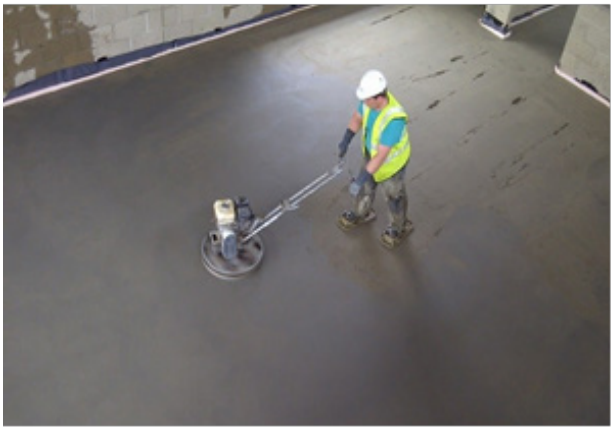


Fig. 1.3.7 Spreading Concrete

Fig. 1.3.10 Curing Concrete by Water Spray

1.3.2 Personal Attributes of Mason Concrete

A Mason Concrete in addition to his technical skills should also possess certain soft skills and personal qualities such as:

- Good communication skill
- Ability to work in a well-organized and accurate way.
- Ability to work in an extreme /weather site conditions
- Awareness about safe working practice especially while doing highly hazardous activities
- Ability to work as part of a team
- Awareness of personal hygiene
- Be Reliable and honest

- Be hard working and dedicated
- Be courteous while interacting with co-workers

1.3.3 Career Path for Mason Concrete

The growth path represents the career progression of a Mason Concrete and also shows the requirement for progression into the next level. The minimum educational qualification required for this job role is preferably 8th standard.

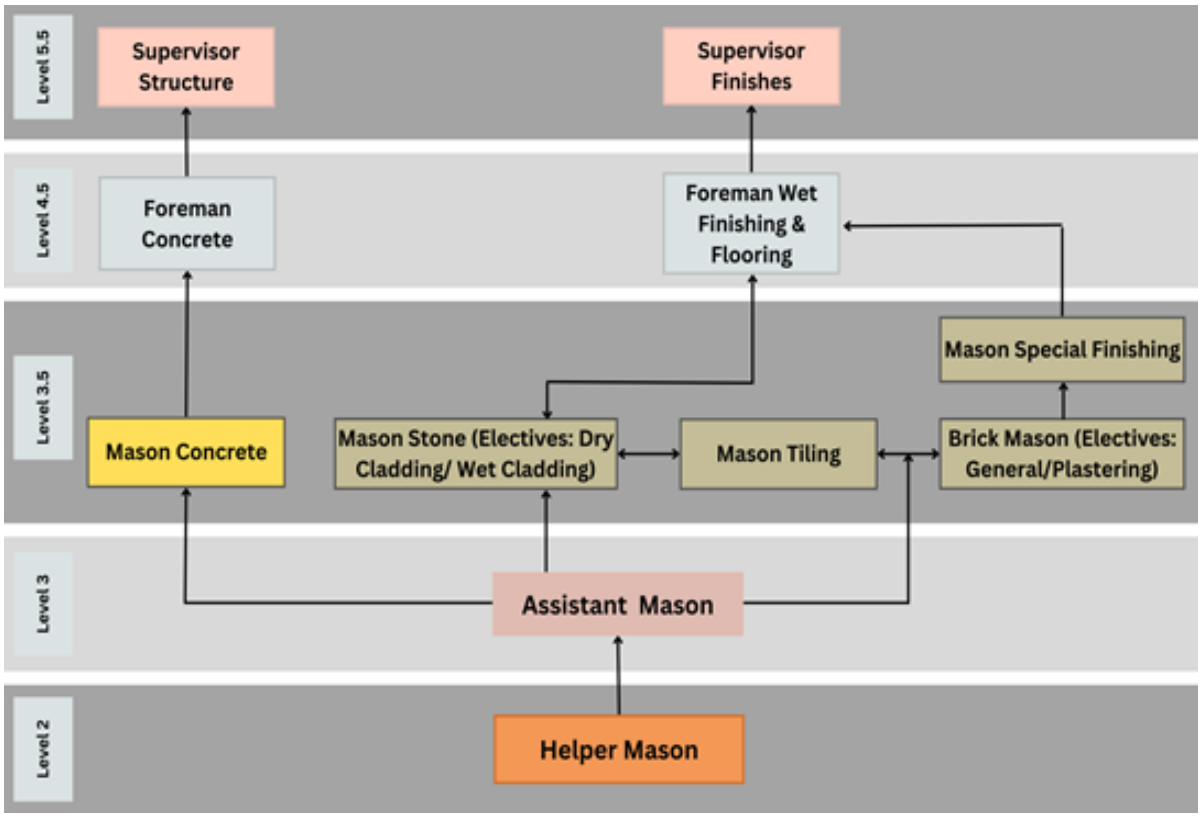


Fig. 1.3.11 Career Progression of Mason Concrete

Exercise

Answer the following questions.

1. Name any three structures constructed with Concrete?
2. Name any three tasks a mason concrete is expected to carry out at the construction site?
3. Name any three personal attributes a mason concrete should possess?
4. What is a growth path?
5. Name the two subcategories in construction sector?
6. What are the main objectives of Masonry?
7. What does shuttering carpenter do?
8. What is a scaffold?

Notes

Scan the QR code to watch the videos

https://youtu.be/J7fTtNI3lwk

Introduction to concrete structures

https://youtu.be/juRxHEF67WQ

Personal Attributes of Mason Concrete

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

Construction Skill Development Council

2. Core / Generic Skills

Unit 2.1 – Numeracy Skills

Unit 2.2 – Systems of Measurements

Unit 2.3 – Calculating Area and Volume of Geometrical Shapes

Key Learning Outcomes

By the end of this module, participants will be able to:

- Perform basic mathematical calculation.
- Identify the different types of geometrical shapes.
- Calculate the area and volume of a square, rectangle, cube and cylinder.
- List the different types of systems of measurement.
- Perform the conversion of measurements.
- Read a measuring tape in imperial system.
- Read a measuring tape in metric system.

UNIT 2.1: Numeracy Skills

Unit Objectives

By the end of this unit, participants will be able to:

- Perform basic mathematical calculation
- Identify the different types of shapes
- Calculate the perimeter of a square, rectangle, triangle and circle

2.1.1 Mathematical Calculation?

A Mason Concrete works involve the skills required to mark the dimensions of the concrete structure to be constructed, set up the temporary scaffold as per the dimensions, repair and maintain concrete structures such as buildings, bridges, heavy plant and heavy duty floorings. He must have a good knowledge of mathematical calculations and geometrical techniques. He must be able to perform basic arithmetic calculations.

Basic Calculations:

Addition

Vertical addition	Horizontal Addition
2 + 2 4	2 + 2 = 4

Addition of 2 digit Numbers	Addition of 2-digit number with 2-digit number	Addition of 3 digits with 2-digit number
24 + 32 56	57 + 34 91	156 + 37 193

Adding two 3 digit numbers with one 2-digit number	Addition with decimal point	Addition with decimal point
224 321 + 31 576	57.4 + 34.3 91.7	156.71 + 371.30 528.01

Subtraction

Subtraction of 2 digit numbers with borrowing	Subtraction of 3 digit numbers with borrowing	Subtraction of 4 digit numbers
74 - 31 43	574 - 343 231	7121 - 1130 5991
Subtraction of 3-digit number from 4-digit number	**Subtraction of decimal numbers**	**Subtraction of decimal numbers**
7456 - 314 7142	57.42 - 34.32 23.10	711.15 - 113.04 598.11

Multiplication

Multiplication of 2-digit number by 1-digit number	Multiplication of two 2-digit number by 2-digit number	Multiplication of 3-digit number by 2-digit number
24 X 3 72	27 X 13 81 +27 108	127 X 23 381 + 254 635
Multiplication of 3-digit number by 2-digit number	**Multiplication of decimal numbers**	**Multiplication of decimal numbers**
427 X 23 1281 + 854 2135	27.3 X 3 81.9	2.7 X 6.3 8.1 + 16.2 24.3

Multiplication

Division of 3-digit number by 1-digit number	Division of 4-digit number by 2-digit number
20 5 | 100 - 10 00	153 14 | 2142 - 14 74 - 70 42 -42 00
Division of 5-digit number by 1-digit number	**Division of given value in decimal**
3206 6 | 19236 - 18 12 - 12 36 -36 00	75.5 4 | 302 - 28 22 - 20 20 -20 00

Notes

UNIT 2.2: Systems of Measurement

Unit Objectives

By the end of this unit, participants will be able to:

- List the different types of systems of measurement
- Follow the conversion of measurements
- Read a measuring tape in imperial system
- Read a measuring tape in metric system

2.2.1 Systems of Measurement

Different measurements have to be used together in order to calculate complex measurements. However, the calculation will only work if all the three measurements are taken in the same system of measurement.

There are two types of systems of measurement which are currently in practice:

1. MKS or Metric System: This system uses Meter, Centimeter and Millimeter
2. FPS or Imperial system: This system uses Yard, foot and Inch

2.2.2 Conversion of Measurement

Units of Measurement for Length

Length is measured in millimeters (mm), centimeters (cm), meters (m), inch (in), and feet (ft).

Conversion from one system to another should be done based on the table below:

1 Meter (m)	100 Centimeter (cm)
1 Centimeter (cm)	10 Millimeter (mm)
1 Meter (m)	1000 Millimeter (mm)
1 Inch (in)	2.54 Centimeter (cm)
1 Foot (ft)	12 Inches (in)
1 foot (ft)	30.50 Centimeter (cm)
1 Meter (m)	39.4 Inches (in)
1 Meter (m)	3.28 Foot (ft)

2.2.3 Reading of Tape in FPS System

Use the big numbered marking for inches.

- The height of marking line at each 1 inch is generally long and may be half width and full width of tape depends on manufacturer and perpendicular to length direction of tape.
- The feet graduation line is generally numbered in different colour and followed by symbol Ft
- Numerals of inch graduation line repeat from 1 - 11 after graduation line at 1 feet.
- The marking line is straight and perpendicular to longitudinal direction of tape.

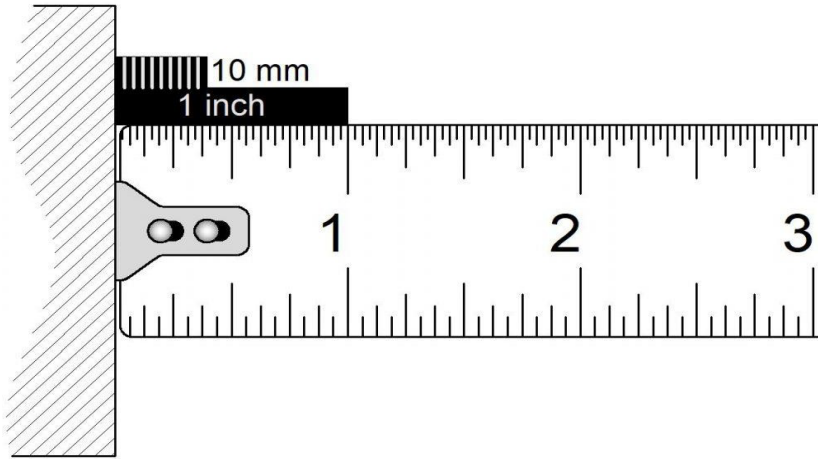


Fig. 2.2.1 Measuring in Inches

The graduation/marking line at 1/2 inch is longer in length than smaller increment marks like 1/4 and 1/8 inch. There is one graduation line between two inch lines which is used for measurement in terms of quarter inch.

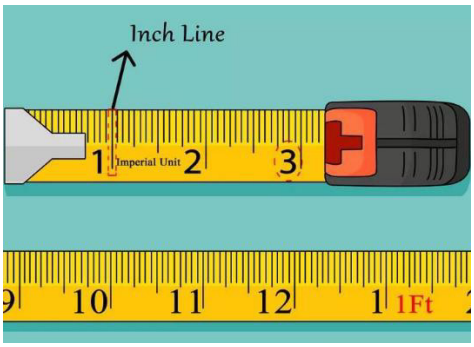


Fig. 2.2.2 Measuring in Inches

There are 3 graduation lines between two inch lines which is used for measurement in terms of quarter inch

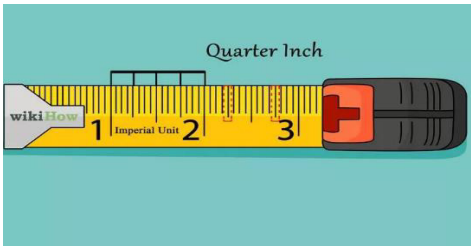


Fig. 2.2.3 Measuring in Inches

The height of marking line for one-eight of inch is longer than sixteenth of inch, there are 7 graduation lines between every inch lines which are used for measurement in terms of one-eighth of inch.

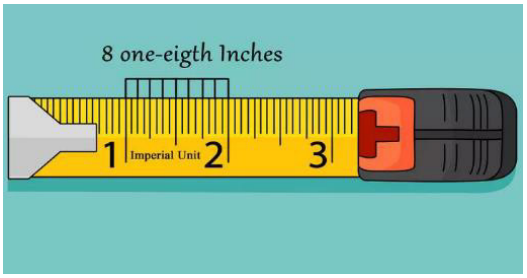


Fig. 2.2.4 Measuring in Inches

There are 15 graduation lines between two inch lines which are used for measurement in terms of one -sixteenth of inch.

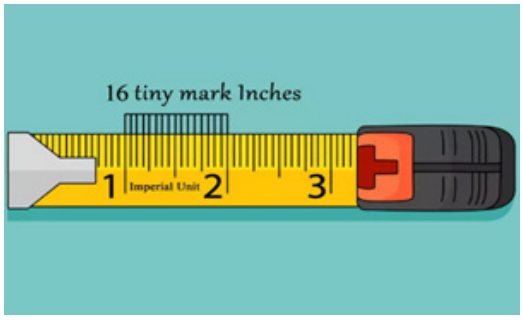


Fig. 2.2.5 Measuring in Inches

Finding measurement in terms of Finding measurement in terms of quarters of inch or one eighth

1. First mark or note down the graduation line which is matching or coinciding with end point of dimension of objects to be measured
2. For an example, in term of quarter inch measurement. The edge shall coincide with either of 3 graduation line between two inch marked line.
3. In case of one eight-inch measurement, the end edge of dimension of objects shall coincide, we need to add:
4. 1 (our inches) + 1/4 (our quarter-inches) + 1/8 (our eighth-inches).

   Since there are two eighth-inches in a quarter-inch, we can rewrite this as:

   1 + 1/8 + 1/8+ 1/8 = 1 3/8 inches.

   1 + 1/8 + 1/8+ 1/8 = 1 3/8 inches.

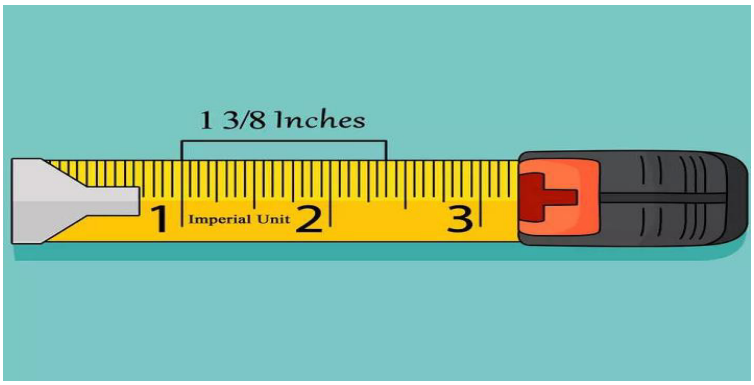


Fig. 2.2.6 Measuring Tape

2.2.4 Reading of Tape in Metric System

The marking line at every 1 meter is numbered and followed by abbreviation m.

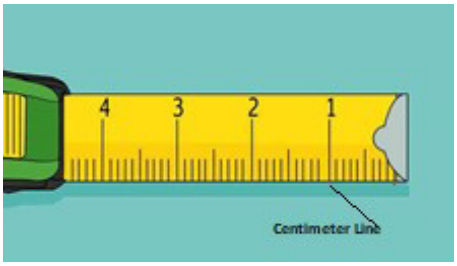


Fig. 2.2.7 Measuring in Centimeter

The height of marking line at each centimeter is longer than millimeter graduation and may be half width and full width of tape and perpendicular to length direction of tape and size.

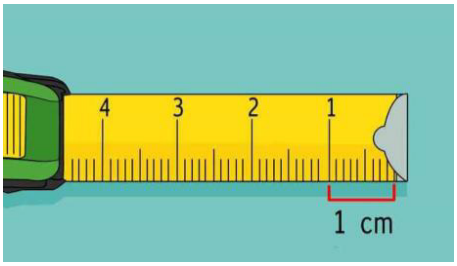


Fig. 2.2.8 Measuring in Centimeter

There are 9 graduation lines between each centimeters line.

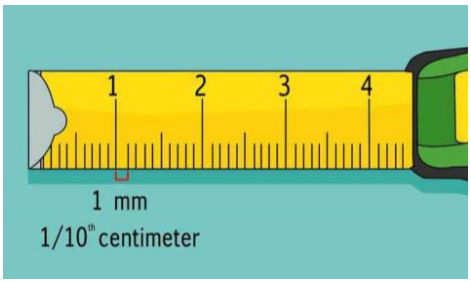


Fig. 2.2.9 Measuring in Centimeter

To measure with a metric measuring tape,

First note down graduation line coinciding or nearly matching with end edge of dimension of objects to be measured

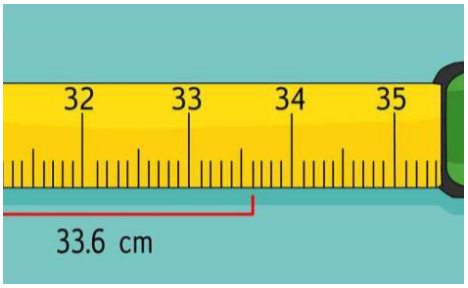


Fig. 2.2.10 Measuring in Centimeter

For example, see below:

- As shown in above figure 2.3.10. the graduation line is noted down which is found to be 6th graduation line past 44 centimeter line so the reading will be = 44 +0.6 =4.6 centimeters.
- To find out measurement in terms of meters, covert centimeters into meters. There are 100 centimeters into one meter.
- To find out measurement in terms of millimeters, covert centimeters into millimeters. There are 10 millimeters into one centimeters. Therefore, multiply it by 10.

2.2.5 Taking Measurements with Metal and Cloth Tape

Measuring tapes are used by a Mason Concrete for marking and measuring in concreting work as per the requirements and specifications. The concrete structure takes the shape as per the form constructed hence the measurements should be accurate.

2.2.5.1 Steps to Take Measurement with Metal

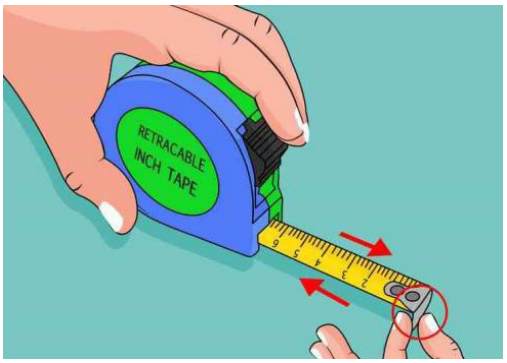


Fig. 2.2.11 Step1. Hold the hooked end of tape and fix this to starting point of distance to be measured

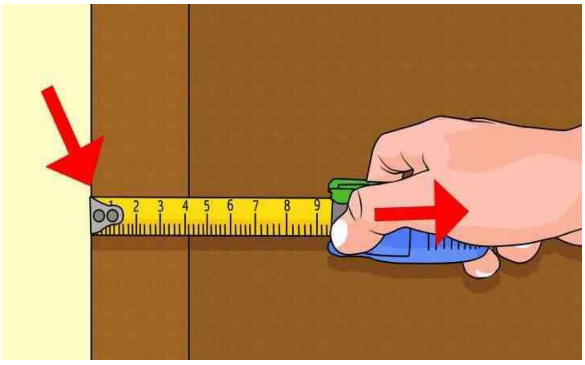
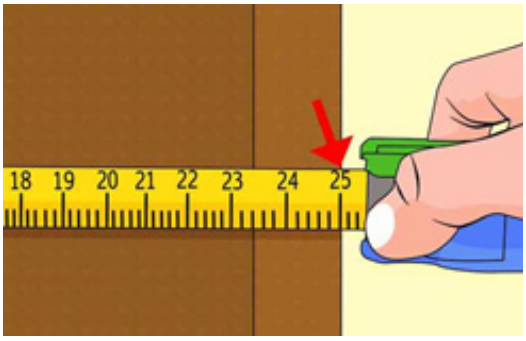


Fig. 2.2.12 Step 2: Stretch the tape across your object



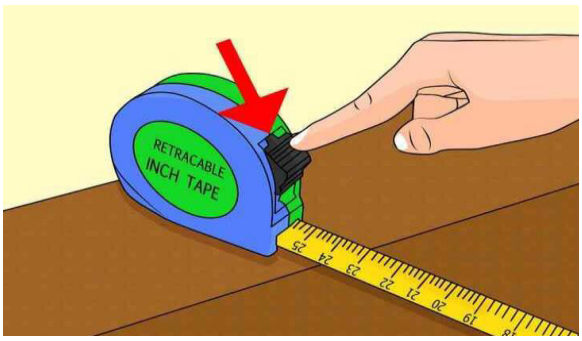
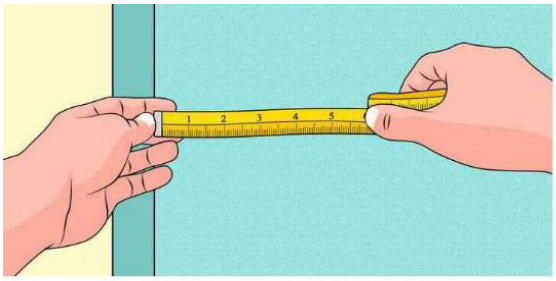
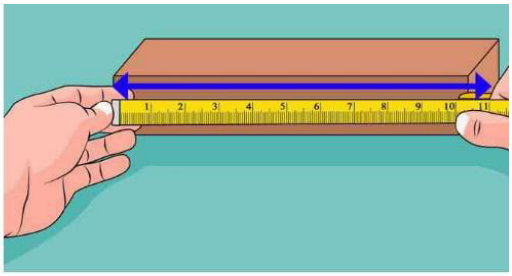


Fig. 2.2.13 Step 3: Take the reading by noting down numerals mentioned in marking line or by calculating marking line past or before the nearest numerals marked line

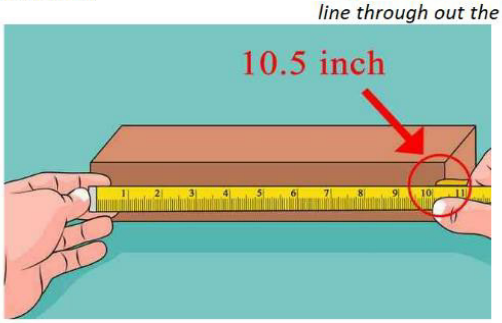
2.2.5.2 Steps to Take Measurement with Cloth Tape



Step 1: Fix the hooked end of tape to starting point of distance to be measured.



Step 2: Stretch the tape maintaining its same level and line through out the length.



Step 3: Take the reading by noting down numerals mentioned in marking line or by calculating marking line past or before the nearest numerals marked line

Fig. 2.2.14 Using Cloth Tape for Measurement

Notes

Scan the QR code to watch the video

https://youtu.be/H1xo5UVJKVo

Systems of Measurement

UNIT 2.3: Calculating Area & Volume of Geometrical Shapes

Unit Objectives

By the end of this unit, participants will be able to:

- Understand and name different types of geometrical shapes
- Calculate area of different geometrical shapes.
- Calculate volume of different geometrical shapes.

2.3.1 Basic Geometrical Shapes

The common shapes comprise of square, triangle and rectangle.

Basic Shapes

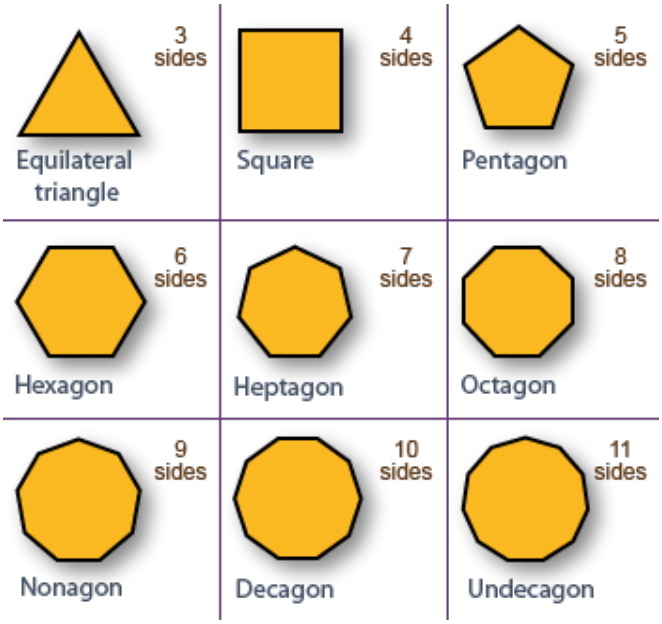


Fig. 2.3.1 Basic Shapes

Curved Shapes

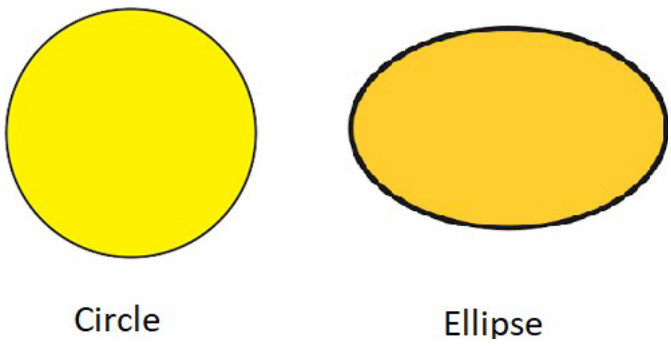


Fig. 2.3.2 Curved Shapes

Other Shapes

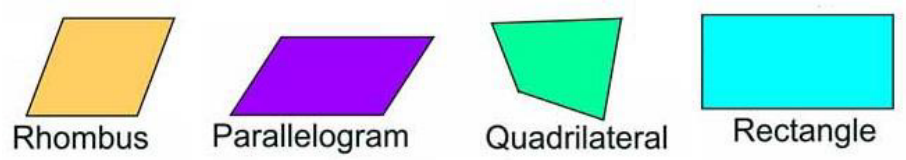


Fig. 2.3.3 Other Shapes

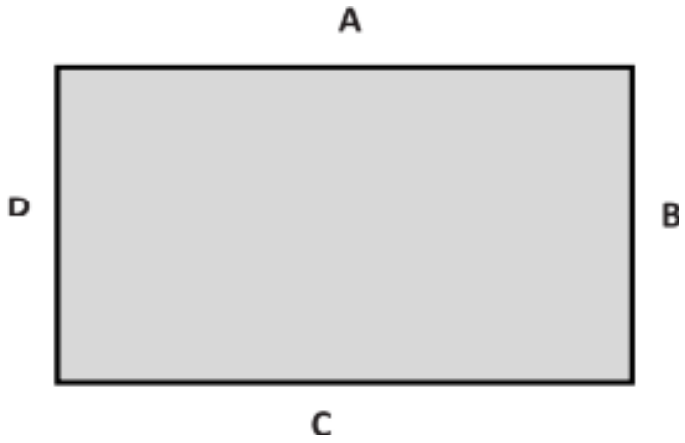
2.3.2 Calculation of Perimeter, Area and Volume

Perimeter

Perimeter is the total length of the boundary of a given figure.

Unit of perimeter in metric system is: meter, centimeter, millimeter Unit of perimeter in FPS system is: inch, foot

Let us see how it is calculated.



Square

A square is a shape that has four equal sides that meet each other at right angles. Perimeter = 4 X side

Rectangle

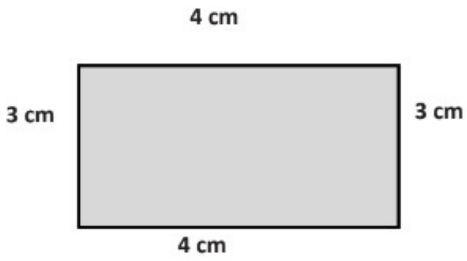
This figure has two adjacent sides of different lengths, and opposite sides which are equal. The shorter side is called the breadth, and the longer side is called the length.

Perimeter = 2 X (Length + Breadth)

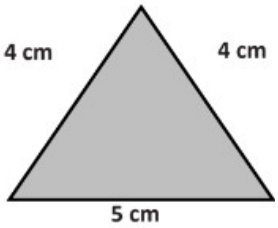
Triangle

A triangle is a shape that has three sides. Perimeter = Sum of all the three sides

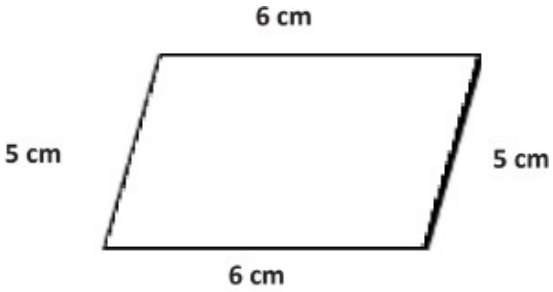
Example



Perimeter = 2(4 + 3) =14 cm



Perimeter = 4 + 4 + 5 = 13 cm



Perimeter = 6 + 5 + 6 + 5 = 22 cm

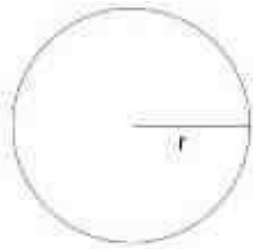
Perimeter of a Circle

The figure shown below is a circle.

To calculate the perimeter of a circle, the following formula is used: 2 x π x r where π = pi or 3.14 or 22/7

r = radius of circle (The radius is the distance from the center of the circle to its edge.)

The radius of a circle is the distance measured between the center point of the circle, and any point on the circumference.



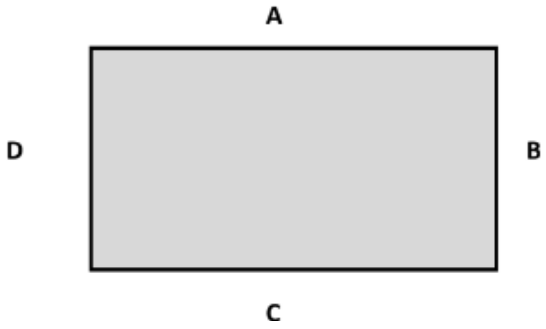
Thus, the perimeter of the given circle is 2 x π x r.

Area

Area is the total space occupied by a two dimensional object.

Unit of Area in metric system is: square meter(m2), square centimeter(cm2), square millimeter (mm2)

Unit of Area in FPS system is: square inch (in2), square foot (ft2 / Sqft.) Let us see how it is calculated.



Area = Space occupied by the rectangle

Square

A square is a shape that has four equal sides that meet each other at right angles. Area = side X side

Rectangle

This figure has two adjacent sides of different lengths, and opposite sides which are equal. The shorter side is called the breadth, and the longer side is called the length.

Area = Length x Breadth

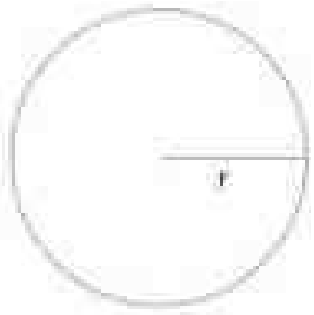
Circle

The figure shown below is a circle.

To calculate the area of a circle, the following formula is used:

π x r x r where π = pi or 3.14 or 22/7 r = radius of circle

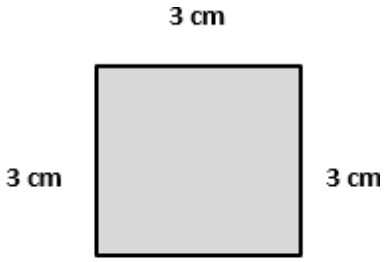
The radius of a circle is the distance measured between the center point of the circle, and any point on the circumference.



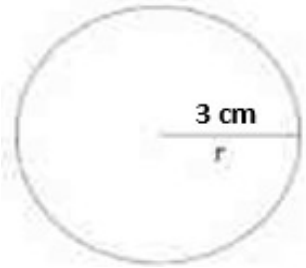
Thus, the area of the given circle is π x r x r.

Example

Area = 4 x 3 =12 cm^2



Area = 3 x 3 = 9 cm^2



Area = π x r x r = 3.14 x 3 x 3 = 28.26 cm2

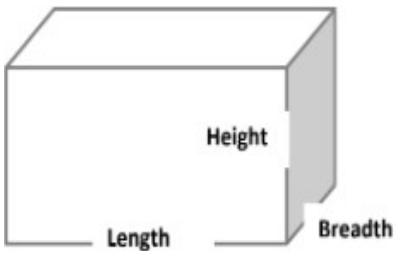
Volume

Volume is the total space occupied by a three dimensional object. It is also equal to the material required to construct a structure of a given dimension.

Unit of Volume in metric system is: Cubic meter(m3), Cubic centimetre (cm3), Cubic millimeter (mm3)

Unit of Volume in FPS system is: Cubic inch (in3), Cubic foot (ft3)

Let us see how it is calculated:



Volume = Length x Breadth x height (depth)

Cube:

A cube is a shape that has all equal sides that meet each other at right angles. Volume = side X side x Side

Cuboid:

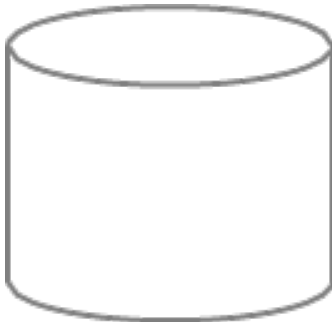
This figure has different length, breadth and height but all the angles are at 90 degrees.

Volume = Length x Breadth x height (depth)

A concrete floor is generally cuboid in shape so the volume of the cuboid will give the amount of the concrete required for construction

Cylinder:

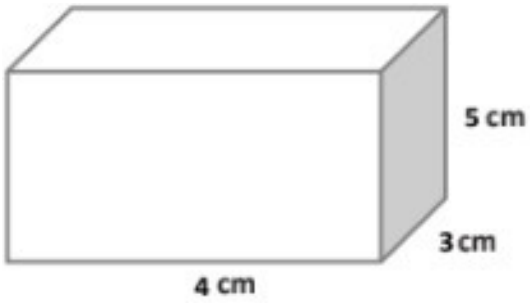
A cylinder is a three dimensional shape whose base is a circle and has a height.



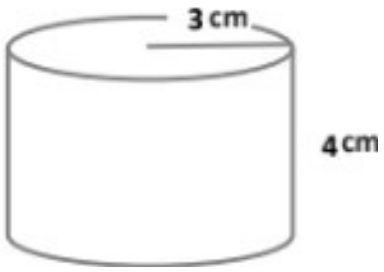
Volume = Area of Circle x height = π x r x r x height

For cylindrical structures the: Volume of concrete required = Volume of the cylinder

Example



Volume = 4 x 3 x 5 =60 cm3



Volume = 3.14 x 3 x 3 x 4 = 113.04 cm3

Measurement Conversion

Conversion within the system and from one system to another should be done based on the table below:

Area	
1 square meter(m2)	10000 square centimeter(cm2)
1 square centimeter(cm2)	100 Square Millimeter (mm2)
1 square meter(m2)	10.76 square foot (Sqft.)
1 square foot (Sqft.)	144 square inch (in2)
Volume	
1 cubic meter(m3)	1000000 cubic centimeter(cm3)
1 cubic centimeter(cm3)	1000 cubic Millimeter (mm3)
1 cubic meter(m3)	35.3 cubic foot (ft3)
1 cubic foot (ft3)	1728 cubic inch (in3)

Exercise

Answer the following questions.

- What is the application of volume calculation in concreting?
- What is radius?
- Define area?
- Define volume?

Notes

Scan the QR code to watch the video

https://youtu.be/OhTubw4C0to

Calculation of Perimeter, Area and Volume

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

3. Place, Level and Finish Concrete in Various Structural Elements Including Repair Works

Construction Skill Development Council

Unit 3.1 – Introduction to Concreting Work

Unit 3.2 – Tools and equipment used in Concreting

Unit 3.3 – Placing, leveling and finishing of concrete in various structural elements

Unit 3.4 – Concreting in Precast Segments

Unit 3.5 – Repair Works in Concrete

(CON/N0117)

Key Learning Outcomes

By the end of this module, participants will be able to:

1. Explain concreting work.
2. Identify different hand and power tools.
3. Understand the application of different hand and power tools.
4. Have knowledge of concreting tools and equipment.
5. Have knowledge of components of Concrete and their attributes.
6. Understand use of Cement and its attributes.
7. Explain various grades of Concrete.
8. Understand the process of concrete mixing and proportioning.
9. Explain the process of Placing, leveling, compacting and finishing of concrete in various structural elements.
10. Know about Construction and expansion joints.
11. Know about Concreting in precast segments.
12. Explain repairing work in concrete.

UNIT 3.1: Introduction to Concreting Work

Unit Objectives

By the end of this unit, participants will be able to:

- Get brief overview about concreting work.
- Define properties of Concrete.
- Explain concrete and its composition.
- Outline different types of cement and aggregates used in concreting.
- Understand concreting operations.
- Explain test performed on cement and concrete.

3.1.1 Concrete

Concrete is composed of aggregates, which is combination of sand (Fine aggregates), gravel or rocks (coarse aggregates) that is held together by cement. The cement itself, when mixed with water and admixture, serves as a paste that holds all the components of the concrete together once sets and hardens.

3.1.1. (a) Plain Cement Concrete or Cement Concrete

- It is a very versatile construction material as it is highly plastic and workable when freshly mixed and gets hardened with time. It is good in compression and weak in tension.
- In plain cement concrete, reinforcement such as steel bars, wire mesh are not used.
- This is used as leveling course for foundation, flooring and as sub-base and base courses for various structural elements.
- Concrete is good in compression and weak in tension.

3.1.1. (b) Reinforced Cement Concrete

- To compensate for the low tensile strength property of the concrete, it is combined with steel bars having a very high tensile strength.
- The embedding of steel bars in concrete improves the load carrying capacity of the structure.
- Steel is reinforced with concrete not only to reduce tension in the structure but also to avoid cracks due to shrinkage.

3.1.2 Properties of Concrete

- When the constituents of concrete (aggregate, cement, water and admixture) come together, the cement and water chemically react and undergo a process called hydration which binds together the aggregates to form concrete.
- The gradual process of hardening of the concrete is called setting and approximately after two hours the hardening process (strength development) becomes irrecoverable and may result in damage during re-working.
- Setting time depends on the climatic conditions prevailing at the construction site.
- Dry and warm weather speeds the chemical reaction and thus reduces the setting time whereas low temperature and high humidity tend to increase the setting time.
- As the concrete sets, its plasticity and workability reduces, making it more difficult to compact and mould, however it still remains inherently weak and can be easily damaged.
- Concrete may take up to 28 days of curing to achieve its optimum strength. But it attains its strength progressively in 3, 7 & 28 days. When it attains its full strength in 28 days, approximately 70 to 75% strength is gained in 7 days.
- Segregation & bleeding are very important factors in achieving the desired strength. Collectively they are governed by water cement ratio.
- Aggregate having high specific gravity out of the concrete constituents, when itself with or without cement paste comes out of concrete called segregation. This may happen due to dropping concrete from height, poor grading of aggregates etc.
- Water with cement together when appears on top surface of concrete called bleeding. This may happen due to over compaction, high water cement ratio and poor grading of aggregates.
- Slump of concrete is also an important parameter to describe the workability of concrete which in turn influences the compressive strength of concrete.

3.1.3 Compositions in Concrete

Concrete is composed of:

- Aggregates (Fine and coarse)
- Cement
- Water
- Admixture

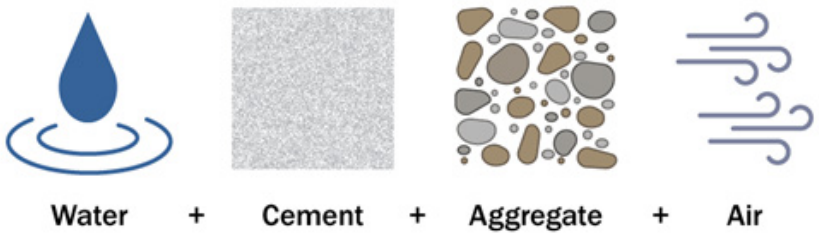


Fig. 3.1.1 Components of Concrete

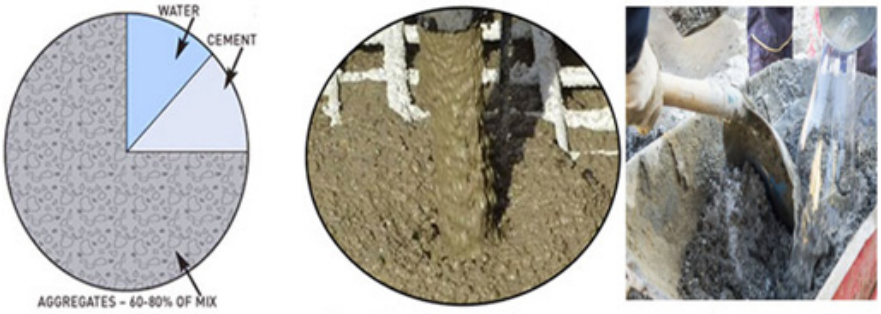


Fig. 3.1.2 Percentage of Components in Concrete by Volume

3.1.3.1 Aggregates

- Aggregates are an essential component in concrete and consist of granular materials such as sand, crushed stone or gravel and account for 60 to 70% of the total volume of the concrete.
- Natural gravel and sand are usually obtained from a pit, river, lake, or seabed and undergo processing: crushing, screening, and washing to obtain proper cleanliness and gradation.
- Crushed aggregate is obtained by crushing boulders, quarry rocks, cobbles or large-size gravel.
- After processing, the aggregates are stored to minimize degradation and prevent them from contamination.
- Quality of concrete highly depends on the quality of the aggregate used.
- To prepare a good quality concrete mix make sure that the aggregates are clean, hard and strong and are free of absorbed chemicals or coatings of clay.

Aggregates are broadly classified in two categories:

- Fine aggregates
- Coarse aggregates

Fine aggregates

Fine aggregates generally consist of natural sand or crushed stone sand with most particles passing through a 3.75 mm sieve.

Fig. 3.1.3 Sand

Coarse aggregates

Coarse aggregates constitute of particles which are greater than 3.75 mm, but their diameter varies in the range between 9.5 and 38.1 mm. Majority of the coarse aggregate used in concrete is crushed.

Fig. 3.1.4 Stone Aggregates

3.1.3.2 Types of coarse aggregates

Natural Aggregate

Aggregates shall consist of naturally occurring (Crushed and Un crushed) stones, gravel and sand or combination thereof. They shall be hard, strong, dense, durable, clear and free from veins and adherent coatings.

Natural Aggregates are broadly classified as follows;

a. Uncrushed Aggregates: which is from natural disintegration of Rocks

b. Crushed Aggregates: which is from crushing of gravel or hard stone.

c. Partially Crushed Aggregates: It is a product of blending of Crushed and Uncrushed

3.1.3.3 Physical properties of aggregates

Properties of the concrete depends on the characteristics of the aggregate; thus it is very important to keep a check on the characteristics of the aggregates. Basic characteristics are:

- Grading: Particle-size distribution for aggregate
- Durability: Strength of the aggregate
- Shape and surface texture of the particles in the aggregate
- Skid resistance and Abrasion resistance of the particles
- Surface moisture present in the particles in the aggregate

3.1.3.4 Effect of aggregate properties on concrete

Shape and surface texture of the aggregates affects the properties of freshly mixed concrete which results in change in the properties of hardened concrete.

More water is required to produce workable concrete if the aggregate used contains rough-textured, angular, and elongated particles, whereas less water is required if the aggregate contains smooth, rounded and compact particles. Flat and elongated particles are generally avoided or are limited to near about 15 % by weight of the total aggregate.

3.1.4 Deleterious Materials

Deleterious materials are those harmful materials which when present in the aggregates affect the strength and durability of the concrete. They may cause one of the below mentioned effects:

3.1.3.1 Effect of deleterious materials on concrete

Reduce setting of cement

Cause weak bond between aggregate and cement paste

Reduce strength of concrete at early ages

Induce disintegration of concrete

Deleterious materials generally found in aggregates, may be grouped as under

Organic impurities

Clay, silt & dust

Salt contamination

3.1.5 Sieving of Aggregates

A sieve, is a device for separating wanted elements from unwanted material or for separating particles as per required sizes, typically using a woven screen such as a mesh or net or metal.

- Aggregates are sieved to separate the particles as per required size and to remove unwanted particles which may affect the quality of the concrete.
- Aggregates may contain excessive lumps of clay, silt, salts, mica and organic matter which may interfere with the bonding between the cement and the aggregate.
- Presence of clay in aggregates forms a film on the aggregate particles and prevents or reduces the adhesion of cement to the aggregates; retards the setting of cement and increases drying shrinkage.

- Clay having a greater surface area than aggregate particles increases the amount of water required for the concrete mix, and thus reduces the ultimate strength of the concrete. This will create weak points in the hardened concrete and may result in stripping, spalling, raveling and pop-outs.
- Aggregate used in drainable base or Subbase may also get affected adversely when excess amounts of friable particles or clay are present. This type of material may result in pavement failure as they tend to fill the void spaces intended for drainability.
- To maintain the quality of the concrete at its best, it becomes very important to sieve the aggregates before using.
- Different size sieves are required for obtaining grain size analysis for both Coarse aggregates and fine aggregates. The details are mentioned in table below in accordance with IS 383

IS Sieve designation	
Coarse Aggregates	Fine Aggregates
80mm, 63mm, 40mm, 20mm, 16mm, 12.5mm, 10mm, 3.75mm, 2.36mm	10mm, 3.75mm, 2.36mm, 1.18mm, 600 Micron, 300 Micron, 150 Micron

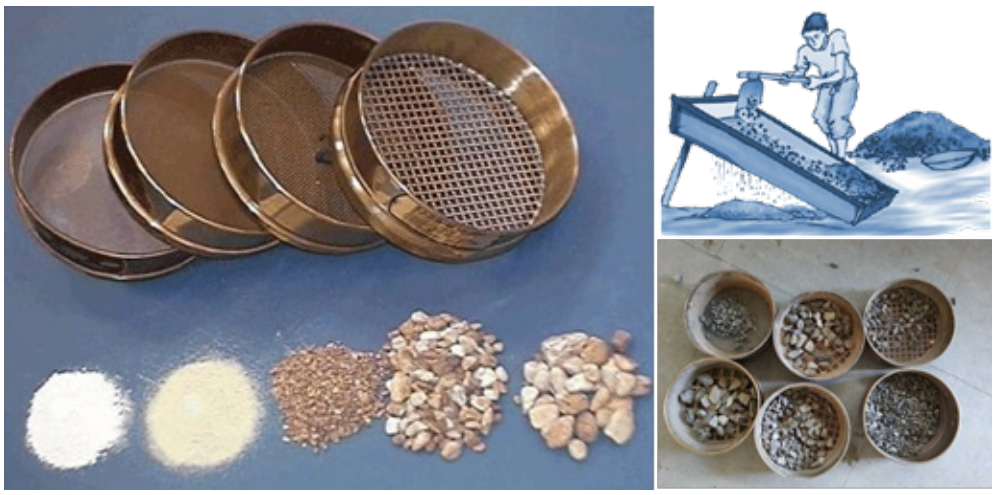


Fig. 3.1.5 Sieving of Aggregates

3.1.6 Cement

Cement is a crystalline compound of calcium silicates and other calcium compounds which have hydraulic properties. Lime and clay have been used as cementing material in constructions throughout centuries. Cements are hydraulic as they have the ability to set and harden with excess water through a chemical process called hydration.

There are different types of cement

- 33 Grade Ordinary Portland Cement(OPC)

- 43 Grade Ordinary Portland Cement (OPC)
- 53 Grade Ordinary Portland Cement (OPC)
- Portland Slag Cement (PSC)
- Portland Pozzolana Cement (fly ash based) (PPC)

Grade of cement indicates the average compressive strength after 28 days in Mega pascal (N/mm^2) of 3 cubes of cement mortar made of ratio 1:3 (1-part cement: 3-part sand) after 28 days.

3.1.6.1 Physical properties of cement

Cement should comply with requirement as specified in bureau of Indian standards code. The physical requirement is as explained below.

- **Strength:** The compressive strength for OPC and PPC should achieve half of the full grade strength at after 3 days, two-third of strength after 7days and full strength after 28 days.
- **Setting time:** The setting time for ordinary port land cement as specified by Indian standard code is minimum 30 minutes for initial setting and maximum 600 minutes for final setting.
- **Fineness:** The fineness of cement is an important requirement for manufacturing required grade of cement as it is related with rate of strength development cement. This varies from minimum 225 m2 for OPC cement to 320 m2/kg for PPC cement.
- **Soundness:** This is property of cement because of which there is no change in its volume after setting.

3.1.6.2 Test performed for cement at site

Various field tests performed at site to ascertain the quality of cement are:

Colour

The colour of cement should be uniform. Generally cement is grey in colour with a light greenish shade. The colour of cement gives an indication of excess lime or clay and the degree of burning.

Rubbing

Rubbing test is done to check the purity of cement. A pinch of cement when rubbed between fingers should feel smooth. If it feels rough, it means the cement has been adulteration with sand.

Hand Insertion

Insert hand in a cement bag. It should feel cool which indicates that cement is good for usage.

Float Test

A small quantity of cement shall be thrown in water. A good Quality cement should not float on water and should sink in water.

Smell Test

Smell a pinch of cement. If it gives an earthy smell it signifies that the cement contains too much of pounded clay and silt as an adulterant.

Presence of Lumps

Open a bag of cement, check whether there are any hard lumps in bag. Lumps indicates cement has absorbed moisture from outside.

Shape Test

Take 100 gram weight of cement, make stiff cement paste cake and immerse it in water. The shape shall be remain same while settling and able to set.

Precautions While Stacking Cement at Site

- Store cement in a damp proof, leak proof and dry shed/fumes to preserve the quality of the cement by preventing it from absorbing atmospheric moisture.
- Stack cement on wooden planks on such that it should be 150-200 mm clear above the floor. The floor may be of lean cement concrete and two brick layers thick.
- Avoid stacks higher than 10 bags to prevent the cement from possibility of lumping up under pressure and width of stack shall be not more than 3 meters.
- There should be space of 600 mm left around stack and exterior wall.
- Stack cement from different manufacturers separately.
- During rainy season or in long duration storage, the cement stack shall be covered by water-proofing membrane such as polyethylene.
- Cement bags shall be stacked close together as possible to reduce air circulation.

Fig. 3.1.6 Right way of stacking Cement Fig.

3.1.7 Wrong Way of Keeping Cement

Cements are of two types:

- Water activated cements.
- Those that develop hydraulic properties when they interact with hydrated lime Ca (OH) (Pozzolanic).

3.1.6.3 Date of Packing

As the strength of cement reduces with age, it is very important to check the date of manufacturing on the bag. A cement bag should not be more than 90 days old. Reduction in cement strength due to storage is listed in below table.

S. No.	Storage Period	Reduction in Strength
1	Fresh cement	Nil
2	Three months old	20%
3	Six months old	30%
4	12 Months old	40%
5	24 Months old	50%

3.1.7 Water

The water used in concrete shall be clean, potable, free from impurities, acids, organic materials and other substances which may be harmful to concrete.

The water unsuitable for concrete can damage concrete in following ways:

- Corrode steel reinforcement
- Induce deterioration of concrete
- Increased/decreased setting time
- Reduced Concrete strength.

The bureau of Indian Standards Is 456:2000 has specified permissible limits on amount of solids such as chlorides, sulphate, organic and inorganic particles water shall contain to make it satisfactory for use in concrete.

3.1.8 Grades of Concrete

The concrete mixes have been designated grades as per Indian standard code of practice IS 456:2000. The mixes are specified into 15 grades.

In this designation the letter M refers to the mix and the number to the specified 28 days 15 cm compressive strength of mix in N/mm2.

Grades of concrete is mentioned in below table as specified by Indian standard code of practice:

Group	Grade Designation	Compressive strength after 28 days
Ordinary Concrete	M-10	10
	M-15	15
	M-20	20
Standard Concrete	M-25	25
	M-30	30
	M-35	35
	M-40	40
	M-45	45
	M-50	50
High Strength Concrete	M-55	55
	M-60	60
	M-65	65
	M-70	70

3.1.9 Hydration

The hydration (hardening of the mixture) process begins as soon as the aggregates, water, and the cement are combined. During this reaction the cement particles adheres to adjacent aggregates.

Once the concrete is properly mixed and workable, it should be immediately placed in the designated forms before the mixture becomes too stiff. During placement it should be ensured that the concrete is compacted within the forms, to eliminate all possible flaws, such as air pockets and honeycombs.

3.1.10 Concrete Mix Proportions

The proportioning of concrete mixes is process of selecting ingredients of concrete and compute the amount of required ingredients to achieve required strength, workability and durability. The mix shall be economical as possible. The cement is costlier among other constituents. So, efforts shall be made to use optimum amount of cement to produce required mix.

The basis on which selection and proportioning of ingredients are done:

- Strength: The mix shall be proportioned to achieve minimum target compressive strength
- Workability: The desired workability of concrete mix is an important factor around which proportioning of ingredients is done.
- Water cement ratio- The ratio of water and cement should be selected in such way that it does not affect the strength and durability of concrete.
- Cement content: the amount of cement in mix is elected in such a way that it does not affect the performance of concrete.

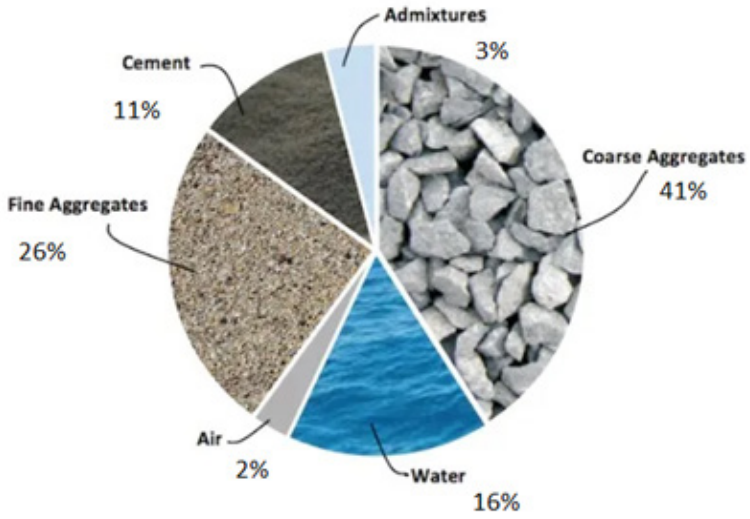


Fig. 3.1.8 Composition of Concrete by Volume

3.1.10.1 Types of Concrete Mix

The mix proportions shall be selected to ensure the workability of the fresh concrete and when concrete is hardened, it shall have the required strength, durability and surface finish

Nominal Mixes

In nominal mixes, the proportion of ingredients are fixed. The mix produced may give strength above than specified. But, the varying characteristics of materials may not give definite relation- ship between strength and workability. Nominal mix concrete may be used for concrete of M 20 or lower.

The proportion of materials in nominal mix concrete shall be as per given table below specified by Indian standard code IS 456:2000.

Grade of Concrete	Total Quantity of dry aggregate by mass per 50 kg of cement, to be taken as the sum of individual masses of fine and coarse aggregates, Kg max	Properties of Fine Aggregate to Coarse Aggregate (By mass)	Quantity of water per 50 kg of cement, Max
M 5	800	Generally 1:2 but subject to upper limit of 1 : 1.5 and a lower limit of 1 : 2.5	60
M 7.5	625		45
M 10	480		34
M 15	330		32
M 20	250		30

Designed Mixes

In design mixes, the characteristics of materials are taken into account. The proportion of materials are selected in such way that, this gives the stipulated strength, workability and other desired properties economically. Indian standard code IS 456:200 has specified minimum requirement for producing design mix of concrete which is mentioned in below table:

3.1.11 Concreting Operation

3.1.11.1 Concrete Preparation

Concrete is prepared by mixing cement, aggregates (sand, gravel or stones), water and admixtures in a predetermined ratio. Admixtures are added in concrete to improve its properties to achieve required strength and workability. The ratio of the compositions of concrete as kept at optimum level for the best performance of the concrete. The amount of water used in mix affects the properties of fresh and hardened concrete. More water in mix makes concrete more workable but it decreases the strength and durability.

The concrete preparation operation involves two processes: Batching, Mixing and Transporting.

a. Batching

The batching involves measuring each ingredient of concrete such as cement, aggregates, water, admixtures for producing fixed proportion of concrete mix. It is done either by mass or volume.

Volume Batching:

Gauge boxes for use in volume batching shall be constructed of timber or steel, with closed bottoms. Each box shall be of such dimension which contains exactly the volume of aggregate required for one batch of any particular mix. In gauge boxes for fine aggregates allowance for bulking due to moisture contained in the aggregate stockpiles on Site.

Fig. 3.1.9 Gauge Box used for Concrete Batching

Weigh Batching:

This is accurate method of batching. It helps in achieving uniform proportioning of concrete mixes. In this type of batching, each ingredient of concrete mix is measured by its mass.

Batching equipment fall into three categories:

i) Manual

Manual batcher shall be charged by devices which are operated manually. In such batching systems, the operator's visual observation of scale is an important factor to achieve accurate batching operation.

ii) Semi-automatic

Semi-automatic batcher shall be charged by devices, which are separately operated manually to allow the material to be weighed but when the predetermined weight of each material reaches, it is actuated automatically.

iii) Fully Automatic

Automatic batcher shall be charged by devices which start the weighing operation of each material by a single starter switch and when the weight of each material reaches to its designated value, it stops automatically. There is interlock between charging and discharging devices.

Fig. 3.1.10 Batching Plant

b. Mixing

The ingredients of concrete in predetermined ratio are mixed to produce uniform, consistent and homogeneous mix.

Methods of Mixing

Hands (using hand shovels)

In small works or in case of breakdown of mixer, the mixing by hand using shovels and spades may be allowed. This shall be done on water -tight platform.

Tilting type

It consists of revolving conical drum which has only one opening for both feeding the unmixed materials and discharging the concrete which is done by tilting the drum.

Non-Tilting type

It consists of revolving drum equipped with power loader to feed material into drums and chute for discharging concrete mix from another end.

Fig. 3.1.11 Winch Machine for Concrete Mixing

Fig. 3.1.12 Manual Concrete Mixing

c. Transporting

After mixing the concrete is made available at pouring site either manually or mechanically through concrete pumps, agitator/non-agitator trucks.

Transit Mixer — A mixer generally mounted on a truck or some other suitable mobile haulage unit, capable of mixing ingredients of concrete and/or for agitation of already mixed/partiality mixed concrete during transit from a concrete batching plant to the point of placement of concrete.

Fig. 3.1.13 Transit Mixer

Fig. 3.1.14 Concrete Pump

3.1.11.2 Placing of Concrete

Concrete can be poured in the form using wheelbarrow, or can be poured directly from the transit mixer. Concrete should not be allowed to free fall too far - preferably no more than 1.5 Meters. Whenever possible use the transit mixer chute to discharge concrete directly into the place of use. The concrete is poured in the place of use / form work either in a single layer or in layers depending upon the thickness of RCC member. But in no case the time gap between two successive layers shall be more than 1-2 hours for which after casting one layer, cement slurry to be applied before pouring the 2nd layer depending upon the time gap.

After pouring compaction of concrete is done thoroughly to exclude air from the concrete in order densify the concrete. The compaction is done manually (tampering, rodding which are known as hand compaction. Compaction is also done by mechanical means (needle vibrator, surface vibrator etc. which is said to be mechanical compaction.

Fig. 3.1.15 Placing of Concrete by Wheelbarrow

Fig. 3.1.16 Placing of Concrete by Chute

Fig. 3.1.17 Pouring of Concrete by Pump

Fig. 3.1.18 Pouring of Concrete by Tower Crane

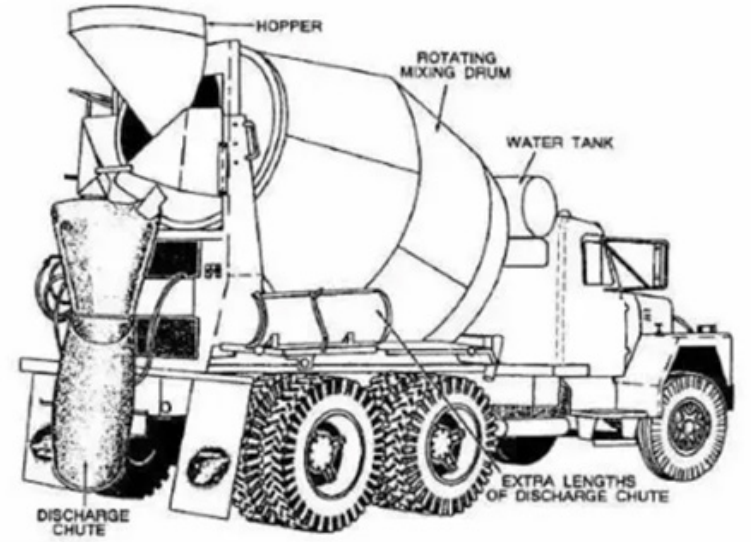


Fig. 3.1.19 Transit Mixer for preparing and pouring Concrete

3.1.11.3 Levelling and Finishing

Floating is the finishing process in concrete which is carried out to reduce surface imperfections and compact consolidate the concrete by tamping to achieve a leveled surface which can be given rough or smooth texture as per requirement.

Floating helps in embed the aggregates and brings mortar on surface. To produce a smooth, hard and dense surface floating is followed by steel troweling.

Troweling is started after sometime, when bleed water comes on surface and starts disappearing so that there is escape route for air bubbles below the top surface.

Fig. 3.1.20 Striking off concrete using straight edge

Fig. 3.1.21 Finishing concrete using bull float

Fig. 3.1.22 Finishing concrete using edging trowel

Fig. 3.1.23 Finishing concrete using concrete trowel

3.1.11.4 Curing

curing is process in which the moisture is maintained in concrete which enables it to gain strength through hydration process.

It also maintains satisfactory temperature range in concrete which is an important factor affecting rate of strength development. The uniform temperature gradient helps in eliminating cracks in concrete which impacts its durability. As per Indian standard code 456:2000, The concrete surfaces shall be constantly kept wet for 7 days for ordinary port land cement and 10 days for blended cement. This duration of curing can be extended up to 14 days in case of concrete containing mineral admixtures and blended cement

There are different methods to cure concrete. which can be divided into two categories

1. Moist curing

- sprinkling by water, b. Moisture absorbent fabrics such as Hessian cloths, cotton mats c. Ponding

2. Memebrane curing

- Plastic sheeting b. Membrane curing compounds.

Fig. 3.1.24 Curing of concrete using water

3.1.11.5 Membrane Curing

Membrane curing using plastic sheeting or membrane is the most efficient method of concrete curing. It reduces the amount of water used for curing and also reduces the dependency on water for curing the concrete.

Membrane curing employs covering the concrete surface with a membrane, either plastic or chemical compound. The covering seals off the pores and retards evaporation of water from the concrete.

Two common types of membrane curing are:

Plastic Sheeting:

Immediately after finishing the exposed concrete surface is covered with a thin plastic sheet, without causing any damage to the concrete finish. The plastic sheeting when used for flat surfaces, such as slabs or pavements, is extended beyond the edges of the slab by at least twice the thick- ness of the slab to ensure that no area remains exposed.

Membrane-Forming Curing Compounds:

The freshly finished concrete surface is sprayed with the curing compounds and then allowed to dry. Evaporation of water present in the concrete is retarded by the impermeable membrane formed by the curing and thus the loss of moisture from the concrete is reduced.

The curing process should start shortly after the chemical reaction that hardens the concrete has started

Fig. 3.1.25 Curing using plastic membrance

3.1.12 Various Tests on Fresh and Hardened Concrete

The quality control measures are taken at site to ensure desired performance of design mix concrete.

The various lab and field tests are performed to assure required quality. The testing for strength and workability is performed at frequency which depends on quantity of concrete.

Tests which are generally carried out at lab and field on fresh concrete:

Test for compressive strength: The three test specimens of a concrete sample which is of cubical shapes in 150x150X150 mm size are prepared. These cubical specimens are compacted by hand or by vibration. In case of hand compaction, this is done by giving 35 strokes per layer. The specimen is then cured by submerging it into clean water for specified period. The testing is done after 28 days in compression testing machine. The testing at 7 days and 14 days may be required to find the early strength of concrete.

Fig. 3.1.26 Cube Mould

Fig. 3.1.27 Slump Cone

Test for workability: There are various test to check workability such as slump test, compacting factor, vee-bee consistometer. Out of these, the slump cone test is widely used Slump cone test: The apparatus for this test:

The mould is of frustum of cone shape having dimension:

- Top diameter- 200 mm Height- 100 mm
- Bottom diameter-300 mm
- Taping rod: This is of 16 mm diameter rounded rod generally made of steel

The mould is filled in 4 layers and given 25 strokes by tamping rod per layer. The mould then shall be removed from the concrete immediately by raising it slowly and carefully in a vertical direction. This allows the concrete to subside and the slump shall be measured immediately by determining the difference between the height of the mould and that of the highest point of the specimen being tested.

Test on hardened concrete: The core cutter and non-destructive testing such as Ultrasonic pulse velocity and rebound hammer is carried out for hardened concrete to ensure its quality.

Notes

Scan the QR code to watch the video

https://youtu.be/EZwRiBDGX0c

Compositions in Concrete

UNIT 3.2: Tools and Equipment Used in Concreting

Unit Objectives

By the end of this unit, participants will be able to:

- List out different concreting hand and power tools
- Identify different concreting hand and power tools
- Understand application of different concreting hand and power tools.
- Store concreting tools and equipment in correct way.

3.2.1 Concreting Tools and Equipments

Tools are classified based on its purpose for which it is used. Tools and equipments are classified as under:

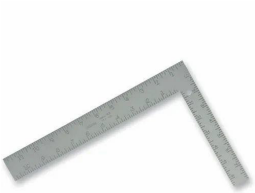
- Mixing tools – concrete mixer, batching plant
- Placing & pouring tools – wheel barrows, chutes, pumps, buckets
- Spreading tools – Trowel, Spade, Straightedges
- Compaction & consolidation tools – Tampering Rod, Needle & double beam screed vibrator
- Measuring & marking tools – Plumb bob, Water level, Spirit level, Measuring tape
- Finishing – Trowel, Float

3.2.1.1 Concreting Hand Tools

Concreting Hand Tools		
1. Square Mouth Shovel	A Shovel is a Tool for lifting and placing wet concrete.	
2. Wheel Barrow	It is a small hand operated cart having bucket mounted on one wheel which is at its front end and two handles at rear end which is used by single person for pushing and guiding purpose. It is used to carryout small amount of construction materials from one place to another.	

3. Trowel	A hand tool having flat blade used for spreading, digging, lifting, leveling small amounts of materials.	
3. Pointing trowel	It is a smaller version of the brick trowel. It is used for filling in small cavities and repairing crumbling mortar joints.	
5.Finishing Trowel	It is generally rectangular in size made of wood, steel and other materials used to smoothen, level or create texture on top layer of hardening concrete.	
6. Step trowel/ edging trowel	It is similar to the corner trowel. It is used for shaping inside angles on concrete steps.	
7. Concrete Float	It helps in finishing the concrete surface by making it smooth and removing sur- face imperfections .it is used after spreading and leveling of concrete.	

9. Tamper	It is used to compact the concrete by pushing the coarse aggregates below the top surface of concrete	
10. Bull Float	It is used to level gaps, voids and smoothen the surface before troweling. It is larger in size than hand float generally 3ft to 10 ft. in length and mainly used for large area where hand float is not applicable.	
11. Groover	It is used to create joints of small width and depth in concrete to avoid cracks in concrete.	
12. Moil (point) chisel	It is used for cutting through concrete and stone. It has a sharp tip rather than a sharp edge.	

13. Plugging chisel	It is used to clean out hardened mortar. The cutting end is tapered in shape which is used for deep or shallow cut- ting depends on its direction.	
13. Screed board or straightedges	It is a straight board made of either wood or metal. It is used to level the surface of concrete by striking off extra concrete and bring the surface as required slope. It is part of finishing operation which is carried out immediately as soon as concrete is placed and done before bleed water appears on surface.	
15. Squares	It is made of metal used to mark and measure right angles.	
16. Spirit level	It consists of metal frame having sealed curved tubes filled with liquid in which air bubbles move between defined graduated line that determines level and plumb. it has either single or double vials, latter is used for both horizontal and vertical measurement.	

7. Plumb Bob	It is used to check verticality of structures and to determine location of points	

3.2.1.2. Concreting Power Tools & Equipment

Batching Plant

A batching plant, also known as concrete plant is an equipment which combines various ingredients to form concrete. The main ingredients which are combined are Cement, aggregates, water and admixtures. It combines all the ingredients at a central location from where the concrete is transported to the required location by transit mixer and this is continuously agitated during conveying to prevent it from setting

Fig. 3.2.1 Batching Plant

Transit Mixer

The main function of the transit mixer is to transport already mixed concrete from batching or ready mix plant to the required location where placing is to be done.

Fig. 3.2.2 Transit Mixer

Concrete Pump

A concrete pump is a machine which pumps liquid (freshly mixed) concrete to the required site. The pump is mounted on a truck or a trailer and requires steel or flexible hoses which are manually attached with the outlet of the machine. The hoses are connected together to carry the concrete to the required site.

Fig. 3.2.3 Concrete Pump

Needle Vibrator

Needle vibrator is also called immersion vibrator which comprises of steel tube called poker inside which it contains vibrating unit. This poker is connected to an electric motor. It is available in diameter sizes of 25-100 mm. Depending on the spacing between the reinforcing bars the poker diameter is determined. The duration of vibration can range from 30 seconds to 2 minutes.

Fig. 3.2.4 Needle Vibrator

Double beam screed vibrator

Fig. 3.2.5 Double Beam Screed Vibrator

Fig. 3.2.6 Screeding of Newly Formed Concrete Floor

Vacuum de-watering Pump

It squeezes out excess water from fresh concrete through vacuum suction process. Filter pads are laid over the wet concrete and then the top cover is spread over it. The vacuum suction pump creates the vacuum to remove the excess water from the concrete.

Fig. 3.2.7 Vaccum De-watering Machine

A Floater/Power Trowel is a piece of light construction equipment used to apply a smooth finish to concrete slabs. There are two types of floaters:

- Ride-on Floaters: They are used by an operator sitting on a seat upon the machinery and controlling the power trowel with the necessary buttons.
- Walk-behind Floaters: They are used by an operator walking behind the machine.

Fig. 3.2.8 Power Trowel

Fig. 3.2.9 Floating of newly formed Concrete Floor

Concrete Saw

It is a power tool used to cut concrete, bricks and other materials. It is powered electrically, gasoline or by other sources. It consists of circular blades of diameter varying from 300mm-600 mm. For cutting concrete, diamond blades are used.

Fig. 3.2.10 Concrete Saw

Fig. 3.2.11 Cutting concrete using Concrete Saw

Notes

Scan the QR code to watch the video

https://youtu.be/wuzQ8dsYJSw

Concreting Tools and Equipments

UNIT 3.3: Placing, levelling and finishing of concrete in various structural elements

Unit Objectives

By the end of this unit, participants will be able to:

- Explain the different stages of Reinforced Cement Concrete construction (Formwork, Reinforcing Bar, Pouring, Finishing, Curing etc.).
- Understand concreting procedures in different structural elements such as foundation, column, tie beam, wall, beam, slab, stair, lintel, etc.

3.3.1 Reinforced Cement Concrete Construction

The Cement concrete are broadly classified in to two types, such as

a. Plain Cement Concrete (PCC)

b. Reinforced Cement Concrete (RCC).

A. Plain Cement Concrete (PCC)

It is used for providing a non-porous, firm & level space for laying RCC structure. Lean Concrete below foundation and floor, damp proof course are the main structural elements of the plain cement concrete. The mixing, pouring, placing and curing have been discussed earlier in section 3.1.

A. Reinforced Cement Concrete (RCC)

Reinforced concrete is a combination of cement concrete with reinforcements (steel bar). This combination is made to utilize the compressive strength of concrete and tensile strength of steel simultaneously.

Foundation, Walls, Columns, Tie Beams, Beams, Lintel, Slabs and Staircase are the main structural elements in Reinforced Cement Concreting.

3.3.2 Stages of Work in Casting of RCC Structural Members

Fig. 3.3.1 Casting of RCC

3.3.2.1 Stages of work before concreting

Stages of work involved RCC construction as mentioned below.

a. Base Preparation

Base Preparation is very important to level and compact the soil sub-grade before casting concrete. It should also be free from standing water and debris. Carry out excavation and add a layer of gravel 100 mm thick if the sub-grade soil is of poor quality.

b. Formwork

Formwork is the term given to temporary support to the Concrete during concreting and gives a required shape and size to the structure. After hardening of the concrete the formwork shall be removed. The time required for removing of the form works is dependent upon the type of structural elements, types of cement used and weathering condition. The form work shall be strong enough to hold the weight of the concrete and the joint of the form work shall be made leakage proof so that cement slurry is not escaped out of concrete during construction during construction. Based on the Material various forms of Formwork are (among the ones mentioned below the plywood and steel formwork are commonly used):

Fig. 3.3.2 Plywood Formwork

Fig. 3.3.3 Timber form work

Fig. 3.3.4 Steel formwork

Fig. 3.3.5 Aluminium Formwork

Fig. 3.3.6 Plastic Formwork

Formwork used in different structural elements:

Foundation formworks can be designed in various ways. Normally sheeting panels along with bracings are used in foundation form works.

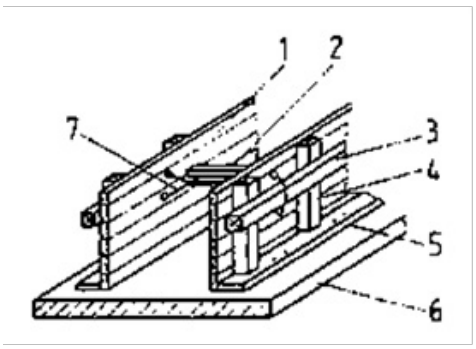


Fig. 3.3.8 Wall formwork

Wall Formworks are generally vertically arranged sheeting boards with required supports

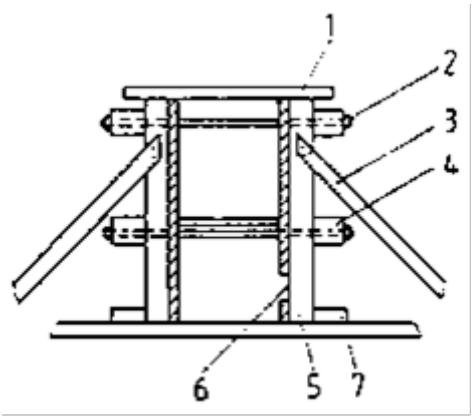


Fig. 3.3.9 Slab formwork

Ceiling Formwork is type of formwork mostly used for slabs and bottom of the beams with proper support to the horizontal surface with help of centering..

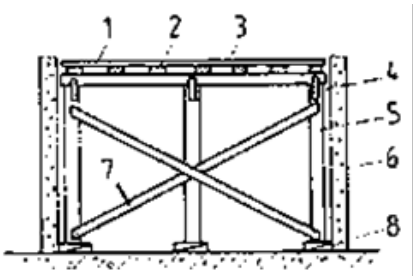


Fig. 3.3.10 Beam Formwork

Beam Formworks is shuttering for bottom and side of the beam with support of centering.

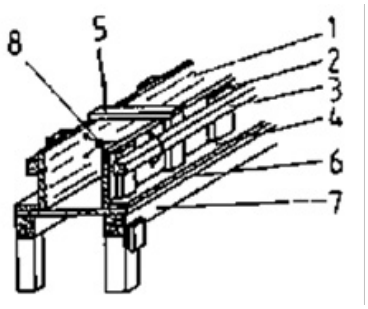


Fig. 3.3.10 Beam Formwork

Column Formworks is a shuttering for side of the columns with properly plumbed.

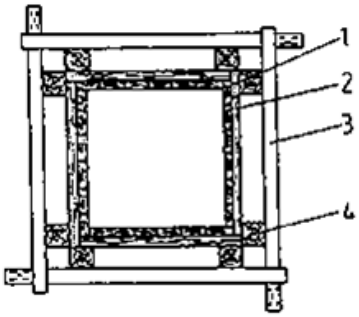


Fig. 3.3.11 Column formwork

c. Reinforcement Work

The steel reinforces concrete to make it withstand the tension force which it is subjected during its service life. The surface of steel rebar is made deformed by creating ribs on its surface to increase its bond with concrete.

Fig. 3.3.12 Cutting of Rebars

Fig. 3.3.13 Bending of Rebars

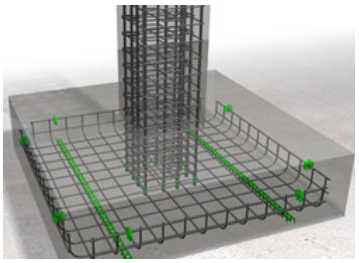


Fig. 3.3.14 Placing of Rebars

Fig. 3.3.15 Binding of Rebars

3.3.2.2 Concreting Operation

a. Pouring and Compacting of Concrete

Concrete can be poured in the form using wheelbarrow, or can be poured directly from the transit mixer. Concrete should not be allowed to free fall too far - preferably not more than 1.5 Meters. Whenever possible use the transit mixer chute to discharge concrete directly into the place of use. The concrete is poured in the place of use / form work either in a single layer or in layers depending upon the thickness of RCC member. The placing of concrete has been discussed at length in Section 3.1.11.2.

b. Leveling and Finishing

Level concrete and brings top surface to grade using straight edges and Start as soon as possible after placing concrete. After that floating and troweling is carried out. Floating helps in level undulations, bringing the cement paste to surface. The troweling is done as final finishing operation to produce hard smooth surface. This has been discussed at length in the Section 3.1.11.3.

c. Curing

Curing is the process of keeping the concrete surface moist throughout the process of hydration for gaining desired strength. It ensures that water required for hydration of cement is maintained so concrete continues to gain strength over time. It also helps in eliminating cracks in the concrete, which severely impacts its durability. This has been discussed at length in the Section 3.1.11.3.

Fig. 3.3.16 Pouring

Fig. 3.3.17 Finishing

Fig. 3.3.18 Curing

3.3.2.3. Stages of work after concreting

a. Removal of Formwork

Removal of the formwork is undertaken as per the type of the structure and various structural members after the concrete achieving designed compressive strength.

Fig. 3.3.19 Removal of Formwork

Surface Defect Corrections

After removing formwork and visually inspecting each concrete structure for the below mentioned defects, necessary repairs are to be carried out.

- Honeycombs
- Spalling and dusting
- Cracks
- Depressions
- Bulges
- Abrupt Irregularities

3.3.3 Cast in Situ Sequences of Reinforced Cement Concrete (RCC) Structural Elements

Mason Concrete is responsible only for performing concreting operation

3.3.3.1 RCC Concrete Column

a. Stages of work before concreting

Fig. 3.3.20 Reinforcement

Fig. 3.3.21 Formwork

Fig. 3.3.22 Pouring & Compacting

Fig. 3.3.23 Finishing

Fig. 3.3.24 Curing

Stages of work after concreting

Fig. 3.3.25 De-shuttering

Fig. 3.3.26 Cured concrete Column

3.3.3.2 RCC Concrete Wall

a. Stages of work before concreting

Fig. 3.3.27 Reinforcement

Fig. 3.3.28 Formwork

b. Concreting Operation

Fig. 3.3.29 Pouring

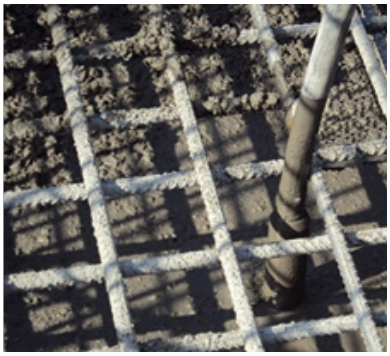


Fig. 3.3.30 Compacting

Stages of work after concreting

Fig. 3.3.31 Finishing

Fig. 3.3.32 Curing

3.3.3.2 RCC Concrete Wall

a. Stages of work before concreting

Fig. 3.3.33 De-shuttering

Fig. 3.3.34 Cured Concrete Wall

b. Concreting Operation

Fig. 3.3.35 Reinforcement

Fig. 3.3.36 Formwork

b. Concreting Operation

Fig. 3.3.37 Pouring

Fig. 3.3.38 Compacting

Fig. 3.3.39 Finishing

Fig. 3.3.40 Curing

c. Stages of work after concreting

Fig. 3.3.41 Concrete Foundation after De-shuttering

3.3.3.3 RCC Concrete Slab & Beam

a. Stages of work before concreting

Fig. 3.3.42 Reinforcement

Fig. 3.3.43 Formwork

b. Concreting Operation

Fig. 3.3.44 Pouring

Fig. 3.3.45 Compacting

Fig. 3.3.46 Finishing

c. Stages of work after concreting

Fig. 3.3.47 De-shuttering

Fig. 3.3.48 Cured Concrete Beam

3.3.4 Things to remember for a Mason Concrete-while concreting

3.3.4.1 During Mixing

- Cement should be batched in bags (50 kg each)
- Do not heap the sand or aggregates in the batch box. It should always be struck level, so that constant volumes are measured out.
- Use separate batch boxes for different grades of concrete and different aggregates.
- Mark on the box with paint the grade of concrete and type of aggregate, whether fine or coarse, over the respective boxes for easy identification. Marking also helps in avoiding use of wrong boxes.
- The size of batch boxes should be so arranged that aggregates can be batched in whole number of boxes. When slight changes are required (say for bulkage) nail marks may be made on the boxes before batching to show the height of filling in the boxes as required.
- Place first the coarse aggregate at the bottom followed by sand and cement.
- If the sand to be used is damp, first place half the coarse aggregate in the skip, then the cement, followed by the fine aggregate and the remainder of the coarse aggregate to prevent the mount of the skip getting choked with the damp sand.
- The mixing time is generally 2 mins. this can be increased until cohesive, uniform colour and free from segregation mix is achieved.
- Do not place materials in the skip unless they are to be mixed and used immediately
- The source of materials in concrete mix shall be same as used in laboratory trials.
- Admixtures: Follow admixtures recommendations from your supplier.

3.3.4.2 During Placing

- There should not be segregation, loss of part of the concrete and loss of slump.
- Do not add extra water to the concrete for the purpose of easy handling
- When using chutes for placing the chutes should be of rounded cross-section and of smooth metal to avoid sticking of concrete.
- It should be of correct slope so that concrete of the required slump will slide without flowing.
- The concrete shall not be laid until proper inspection and approval of place of concreting is done.
- Check whether the formwork has been oiled and the supports are rigid, check whether the reinforcement, cover blocks, inserts and embedded plates have been properly secured in position.
- Where concrete is to be bonded to a previous lift of concrete, clean the surface thoroughly and chip the top to a depth sufficient to expose fresh clean cut concrete without disturbing or loosening the coarse aggregate

3.3.3.3. During Compacting

- The objective of compaction is to eliminate entrapped air.
- Low slump concrete contains more entrapped air than high slump concrete so it requires more vibration or longer compared to concrete with higher slump.
- The concrete shall be placed in layers of thickness 150mm-600 mm to avoid entrapment of air inside concrete.
- The vibrator shall be not forced into concrete and it shall be positioned or inserted vertically.
- The vibration shall be carefully monitored.
- Vibration shall be stopped when mortar appears on surface and there is no more escaping of large air bubbles.
- Over vibration of concrete, particularly if the slump exceeds 100 mm should be avoided as it causes settling of the coarse aggregate at the bottom and the accumulation of the mortar or water at the top.
- The vibrator shall not be used to move concrete horizontally.
- The vibrator shall penetrate the previous layer so that there is formation of strong bond between two layers.
- The vibrator shall not touch formwork and reinforcement so that it may not get displaced.
- It is important to operate vibrator carefully such as to avoid any holes in concrete left behind because of vibrator it shall be operated continuously and withdrawn slowly at each location.

3.3.4.3 During Finishing

- Remove off excess concrete and top surface shall be brought to desired level using straight-edges.
- Use floats to level ridges and voids left by straightedges.
- Striking off of concrete shall be started as soon as placing of concrete is done and completed before bleed water appears.
- End before bleed water appears
- The presence of bleed water while finishing causes defects in concrete such as surface crazing, delamination and dusting.
- The final finishing shall be started after all the bleed water has evaporated and concrete is firm enough to leave only ¼ inch foot prints.
- Final finishing involves floating and trowelling
- Float helps in bringing cement paste to surface
- Float shall be held flat at arm's length as possible, moving it into semi-circular motion until surface becomes smooth
- Trowel only after floating, starting with a wide trowel then moving to smaller trowels on the later passes

- Float shall be held flat at arm's length as possible moving it into semi-circular motion until surface becomes smooth
- Cure the concrete

Notes

Scan the QR code to watch the video

https://youtu.be/8yoHltK1Naw

Process in Making Precast Concrete Segments

UNIT 3.4: Concreting in Precast Segments

Unit Objectives

By the end of this unit, participants will be able to:

- Explain precast segments, their use and benefits.
- Define different types of precast structures and their application.
- Understand materials and process involved in pre-casting of concrete structures.

3.4.1 Precast Concrete

Precast concrete segments are produced by casting concrete in reusable molds or "forms". These segments are then cured in a controlled environment and then transported to the construction site and used as per the construction requirement

Precast concrete components have benefits over on-site casting as listed below:

- Quality and durability is enhanced as compared to concrete cast at construction site it is produced in a controlled environment (precast plant).
- Safety throughout the project is ensured as precast concrete is produced in a controlled environment.
- As the workforce available is more trained and skilled as compared to a construction site the control over material quality and workmanship gets enhanced.
- It is cheaper than on-site casting as the forms used are reused hundreds to thousands of times before being replaced.
- Speed of construction is increased.
- Reduction of on-site labor, activity, noise, disturbance and waste.
- Minimal maintenance and low life cycle cost.

Use of Precast Concrete Structures:

Precast Concrete structures have very wide application, as listed below:

- Construction of Building Floors and roofs, precast architectural panels, facades or free-standing walls used for landscaping,
- Construction of water and sewage pipes, storm water drainage.
- Construction of flyovers, tunnels and bridges

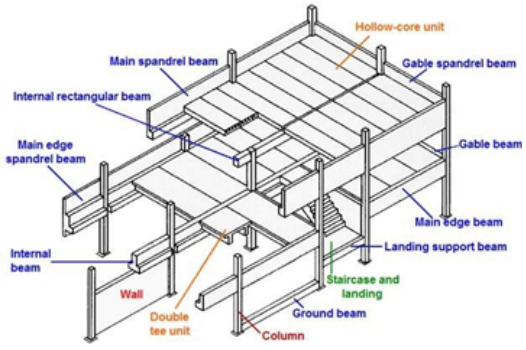


Fig. 3.4.1 Construction using Precast Segments

Fig. 3.4.2 Tunnels constructed from Precast Segments

Fig. 3.4.3 Tunnels constructed from Precast Segments

Precast Concrete Slabs

Precast concrete slabs are used mainly for roof decks and floor. The planks erect quickly to reduce on-site labour needs and are capable of spanning long open spaces to aid design flexibility.

a. Plank
b. Hollow
c. Beam and block
d. Double tee

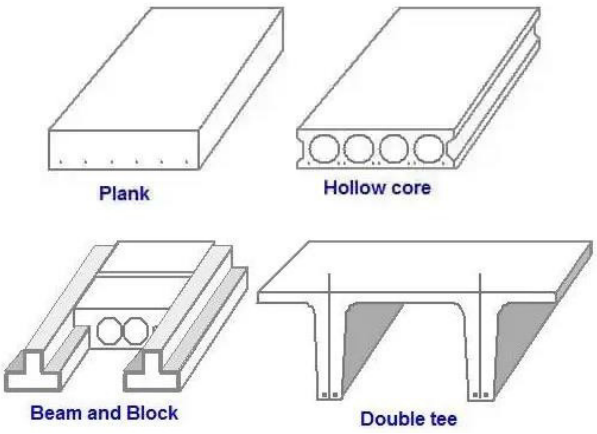


Fig. 3.4.4 Precast Planks Shapes

Fig. 3.4.5 Precast Planks

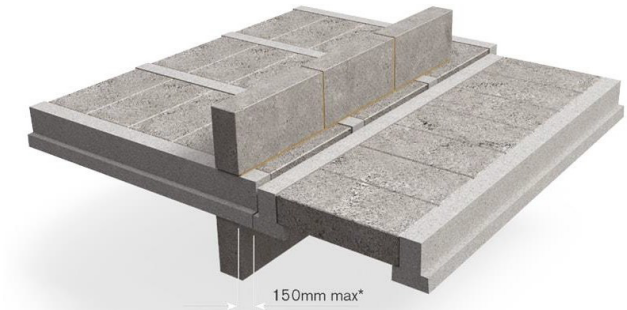


Fig. 3.4.6 Precast Bea-Block and Double tee

Precast Beams:

There are three main categories of beams:

- 'L' beams – L beams have slabs only on one side and are mainly used in flooring.
- Inverted 'T' beams – Inverted 'T' beams are load bearing beams. The top of the t-shaped cross section serves as a flange or compression member. They are mainly used in bride structures.
- Rectangular beams – These beams are used to transfer load from roof to columns.

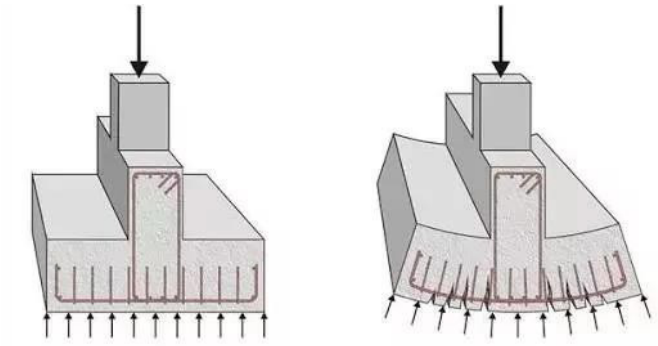


Fig. 3.4.7 Inverted T Beam

Fig. 3.4.8 Rectangular Beam & L Beam

Precast Columns:

Precast columns help in achieving a speedy, economical construction. The quality control which is found better in controlled environment of precast process in comparison to cast in situ produces desired high strength, high dimensional adequacy and durable end products. Columns are delivered to site ready for erection and connected to foundation and beams and other structural component at site. As per design requirement, columns may be rectangular, square or circular.

Fig. 3.4.9 Precast Concrete Columns

3.4.2 Materials for Making Precast Concrete Segments

Forms

The forms used for precast concrete are made of wood, steel, aluminium. The steel forms are extensively used because of its robustness and number of times it can be reused. The surface of

forms shall be smooth. These are cleaned by wire-brush, scrapping, scrubbing and should be coated with releasing agent before casting.

Mould releasing agent

- Release agents are available in oil form.
- This helps in achieving a stain free concrete surfaces
- This facilitates easy and smooth stripping and improved reuse of form-work.
- This coats the form materials so that bond is not formed to concrete.

Admixtures

Admixtures can be divided into four main groups:

- Accelerating admixtures
- Retarding admixtures
- Water-reducing admixtures
- Air-entraining admixtures
- Super plasticizing admixtures
- Admixture is added at time of mixing to change properties of fresh and hardened concrete.
- Accelerators are used to decrease the setting time of concrete whereas retarders used for increasing the setting time.
- Water reducing admixtures increase the workability without increasing water content.
- Air entraining admixtures used to make concrete more resistible to freezing and thawing action.
- Super plasticizers help concrete to achieve high workability without adding water into it.

Reinforcement

- The precast concrete elements are reinforced in many ways such as by placing steel bars, welded wire mesh, pre-tensioning and post tensioning cables in concrete.
- The reinforcement helps concrete in achieving required tensile strength.
- Steel re-bars of different sizes and grades as per design requirements are widely used in precast elements.
- The welded steel wire mesh is suitable for use in thin walled section because of thin wires at close spacing.
- The high strength steel cables called tendons are used in structural elements and then stressed before concreting or post concreting.
- Pretension and post tension cables are generally used to achieve economical thinner section of structural member as it eliminates the use steel Rebars or other reinforcements to achieve required strength.

Fiber reinforced polymer (FRP)

- The use of Fiber reinforcement improves the crack control characteristics of concrete which leads to high durability of concrete product.
- Fibers are made of different materials such as steel, carbon, glass, polymer which are generally found in different sections such as round, oval, triangular depend on manufacturing process.

Colour Pigments

- Pigments are generally used to make colour an integral part of concrete. This is added at time of mixing concrete in mixer.
- The pigments are available in powder, granular and liquid form. The amount of pigment added varies from 1% to 5 % by weight of cement.

Sandblasting

- Sandblasting is done to produce a coarse texture surface in cured precast elements. It varies from just exposing coarse aggregates to deep cuts in members.

3.4.3 Process in Making Precast Concrete Segments

Assemble Mould

- The mould is assembled as per the segment to be casted.
- Level and flatness of the base mould is checked before assembling the mould for casting.
- Dimensions of mould is checked to ensure they are within specified tolerances.
- Shape and the angles are checked in the mould forms.

Fig. 3.4.10 Assembling Mould

Mould Cleaning and Preparation

- Mould is cleaned to ensure that it is free from debris and old mortars.
- Oil or mould release agents are applied evenly on the mould surface.
- Joints and edges of the mould, stoppers, bolts, side props, tie rods and rubber seal are checked to ensure that they are intact and are properly secured.

Fig. 3.4.11 Cleaning Mould and Applying the Oil/Mould release Agents

Reinforcement / fixing of Rebars

- Check to ensure that the Rebars are used as per the specifications.
- Check to ensure that the cast in items, rebars, excesses, lifting hooks, corrugated sleeve pipes, and inserts are correctly positioned and properly secured.
- Check to ensure that tack weld is carried out wherever required.
- Sufficient number of spacers with correct size should be properly placed and secured to achieve the required concrete covering during casting.

Fig. 3.4.12 Adding Rebars to the Mould

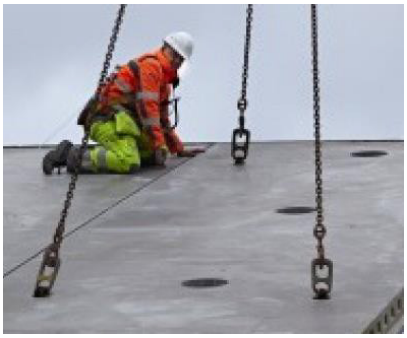



Fig. 3.4.13 Adding Pipe sleeves and lifting inserts

Fig. 3.4.14 Adding Electrical Conduits

Inspection before casting

- Check and verify that all the details are as per the specifications mentioned in the drawings.
- Check the mould fitting conditions.
- Ensure that the mould is as per measurements required.
- Check the mould level before casting as other activities on the site can shift the mould

Fig. 3.4.14 Inspecting the Mould before Concreting

Concreting

- Prepare the concrete as per the mix ratio specified.
- Pour the concrete in the mould.
- The drop height of concrete should not be more than 1 mtrs.
- Carry out compacting of the concrete using vibrator. Form vibrator is used for thin elements.
- Spread and level the concrete after initial setting.
- Use screeder to maintain the required level and thickness.
- Use power trowel for surface finishing.

Fig. 3.4.15 Pouring Concrete in the Mould and Compacting

Fig. 3.4.16 Screeding of Poured Concrete

Curing

- Cure the concrete for an adequate curing time and as per the environment.
- Use the curing technique as per the factory standards.

Demoulding

- Depending on the anchor length of the inserts and type of precast elements the minimum concrete strength required may be higher to overcome the sectional and frictional force during Demoulding.
- Loosen and remove all bolts & pins and end and side mould forms before lifting.
- Ensure that no damage is caused to the form and the concrete structure during the Demoulding process.

Inspection

- Check the condition of the finished product
- Verify critical dimensions. They should be within the specified tolerances.
- Check that the elements have achieved required concrete strength before delivering to construction site.

Fig. 3.4.17 Inspecting the precast structure for defects and measurement corrections

Notes

Scan the QR code to watch the video

https://youtu.be/wXDelzvjyQs

Repairing Concrete Defects

UNIT 3.5: Repair Works in Concrete

Unit Objectives

By the end of this unit, participants will be able to:

- Define the different types of concrete defects and their cause.
- Define the Materials and tools involved in repairing of concrete defects.
- Define the process involved in repairing concrete defects.

3.5.1 Defects in Concrete?

There are various factors which are responsible for defects in concrete. The poor workmanship, quality control and faults in design which result into defects and produce undesirable surface in concrete structural members. The degree of defects varies from just surface imperfections to serious structural damages:

- Honey combing and surface voids
- Form work offsets & Streaks
- Dimensional Deviations
- Various types of cracks such as thermal, shrinkage, subsidence
- Delamination or blisters

Fig. 3.5.1 Defect in concrete structure due to honeycombing

Honeycomb is caused when cement mortar fails to ingress the space between aggregates. This is produced because of congested reinforcement, poor vibration and lower fine materials.

Form streaks are formed as a result of leakage of mortar from joints or holes in joints while placing of concrete. This is mainly caused due to over vibration of concrete and high sump concrete.

Form offsets are caused due to inadequate anchorage of formwork leaving into bulging of concrete surface.

The poor support system in shoring and form work to take ultimate load of concrete structural member during placing results into dimensional deviation.

Cracks around reinforcement steel or near the form. Cracks are produced due to restraint in thermal expansion and contraction of concrete. Restraint to shrinkage provided by reinforcement or other part of structure produces shrinkage cracks.

De lamination and blisters are developed when air bubbles and bleed water entrapped inside the mortar surface. This separates 3-6 mm of layer of mortar from concrete surface.

Scaling of concrete is result of not adopting standard finishing methodology. This results into formation of thin weak layer called laitance which can be easily rubbed off.

Fig. 3.5.2 Defect in concrete structure

3.5.2 Repairing Concrete Defects

Even after, precautions and efforts are taken during finishing to produce a good quality concrete surface. It is very hard to achieve defect free surface. Before patching, make sure that the concrete is structurally sound. It is better to treat the cause than just address a symptom. Sometimes surface defects are a clue that there is a bigger problem at hand. Discuss with your supervisor before starting the repair work.

Steps involved in repair of concrete works:

1. Determine the scope of the problem.

Identify the problem, its probable cause and the related issues which could become more serious in the lifecycle of the concrete structure. Some of the main defects in a concrete work are:

- Expansion or contraction cracks. Properly installed concrete should have joints that prevent this unsightly cracking. For a 4-inch thick slab, joints should be spaced 8 to 12 feet apart. If

- jointing is not sufficient, or improperly placed, cracks can occur. Typically these cracks are not structural and only need to be repaired for aesthetic purposes.
- Debris like piece of wood and steel rod when removed off from plastic concrete.
- Defects created due to use of concrete surface before it sets or hardens.
- Surface scaling caused by improper finishing or freezing temperatures during curing. Scaling is when parts of the concrete surface flake away.

2. Measure the dimensions of the surface to be repaired

- Measure the area of the defect which may include bumps, depressions or ridges.
- Small areas of very shallow surface irregularities may be concealed with floor leveling compounds.

3. Chipping

- The surface to be repaired is chipped off to remove the loose materials and creating a rough surface for bonding with mixture.
- For large repairs, the electric chipping hammer or jack hammer is used which helps in chipping out large area in less time.
- Ensure that the dust and debris of chipped surface is removed before applying repairing mix.
- A wire brush is the best suitable tool for cleaning.
- A stiff bristled broom or paintbrush can also be used for very small defects.
- Depending on the age and condition of the concrete chemical cleaning may be required. Consult your supervisor in case of critical defects.

Fig. 3.5.3 Chipping Tools and Chipping using a Drill

4. Preparing the Repair Mix

- Prepare the repair mix by mixing ingredients by hand tool or small mechanical mixer as per quantum of work.
- The batching and proportionating of ingredients shall be carefully done as this can affects the nature and strength of mix.
- Use bonding agents to develop good bond between old concrete surface and the mixture to be used for repairing.
- Add suitable bonding agent to surface to be repaired before applying the mix.

5. Wet the area to be repaired

- The surface to be repaired shall be thoroughly wetted with water.

- Ensure the surface is damp only, excess wetting may affect the mix proportioning of mixture to be applied.
- The moist surface is required so that the moisture of mix is not drawn out by the dry sur- face which will cause shrinkage and cracks.

6. Applying the Repair Mix

- Mark the patch location, the mixture is placed into it with pressure applied on trowel to ensure no air bubbles inside the area to be repaired.
- The surplus mixture is then strike off and leveled by trowel. The settling and shrinkage of cementitious materials are taken care of while leveling the mixture.
- The Mixture is then allowed to be dry and stiff.
- After laying of mixture, the troweling with steel trowel can be started after which is done intermittently 2or 3 times to bring the mortar to surface and close any pores in surface.
- The final troweling is done after the paste become stiff so that repaired surface get the same appearance as the adjacent finished surface.
- The mixture which spreads on adjacent finished surface is removed off by using trowel.

Fig. 3.5.4 Applying the mix over the area to be repaired

Fig. 3.5.5 Repairing Defects in the Ceiling Area

Exercise

Answer the following questions.

- What are the components of concrete?
- Define Setting?
- Why is sieving of aggregates important?
- What are the deleterious materials present in the aggregates?
- Define rubbing test for cement quality check
- What is a concrete column?
- What are the materials required for making a concrete structure?
- Why is concrete column constructed in a structure?
- How will you prepare the foundation for a concrete column?
- Why is compacting of concrete required?
- What is a precast concrete structure?
- What are the benefits of using precast concrete structures?
- Name the materials required in precasting?
- Why is oil used in a casting mould?
- Why is it necessary to check the measurements before concreting?
- Name some major concrete defects?
- What are main causes of concrete defects?
- What are the tools required for repairing a defect I concrete structure?
- Why is it necessary to wet the surface to be repaired before applying the paste?
- Mentions the steps involved in applying the repair mix?

Notes

Scan the QR code to watch the video

https://youtu.be/Vx0lp4DJxfU

Reinforcement in Cement Concrete Flooring

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

4. Carry Out IPS/Tremix Flooring

Unit 4.1 – Cement Concrete Flooring

Unit 4.2 – IPS Flooring

Unit 4.3 – Tremix Flooring

(CON/N0114)

Key Learning Outcomes

By the end of this module, participants will be able to:

- Explain about IPS flooring and Tremix Flooring.
- Identify the Tools and Materials required for IPS and tremix flooring.
- Understand the use of machines used in IPS and tremix flooring
- Understand the IPS and tremix flooring methodology
- Understand the process involved in preparing the sub base and base
- Explain use of reinforcement as per requirement.
- Understand the correct pouring process
- Carryout various processes like
  - Screeding
  - Compacting
  - Troweling
  - De-watering
- Identify the finishes used in tremix flooring
- Understand the de-watering process used in tremix flooring.
- Outline the benefits of vacuum de-watering.

UNIT 4.1: Cement Concrete Flooring

Unit Objectives

By the end of this unit, participants will be able to:

- Know about Cement Concrete Flooring and its benefits.
- Explain about procedures involved in Cement Concrete flooring
- Explain about hand and power tools required for Cement Concrete flooring.

4.1.1 Cement Concrete Flooring

Cement concrete flooring is widely used which is very economical and durable. This is used in residential as well as industrial buildings.

The sequences of steps for laying this kind of flooring are:

- Preparation of sub base and base course.
- Fix the forms to acquire necessary thickness.
- Laying and spreading specified grade of concrete.
- Vibrate and level the poured concrete.
- Sprinkle hardener as per requirement
- Finish the surface by floats/trowels.
- Curing for 15 days.
- Provide the specified joints with groove cutting.
- Joints to be filled with specified material.

Merits of cement concrete flooring:

- This type of flooring is durable and requires less maintenance.
- It has high resistance against wear and tear.
- It has high temperature resistance and also fire proof.

Demerits of cement concrete flooring:

- Defects in concrete once floor is laid or fixed is difficult to rectify and proves costly.
- The difficulty in achieving fully non-porous concrete leads to water seepage if exposed to water for long time.

There are two types of cement concrete flooring which are widely used:

1. IPS flooring
2. Tremix flooring

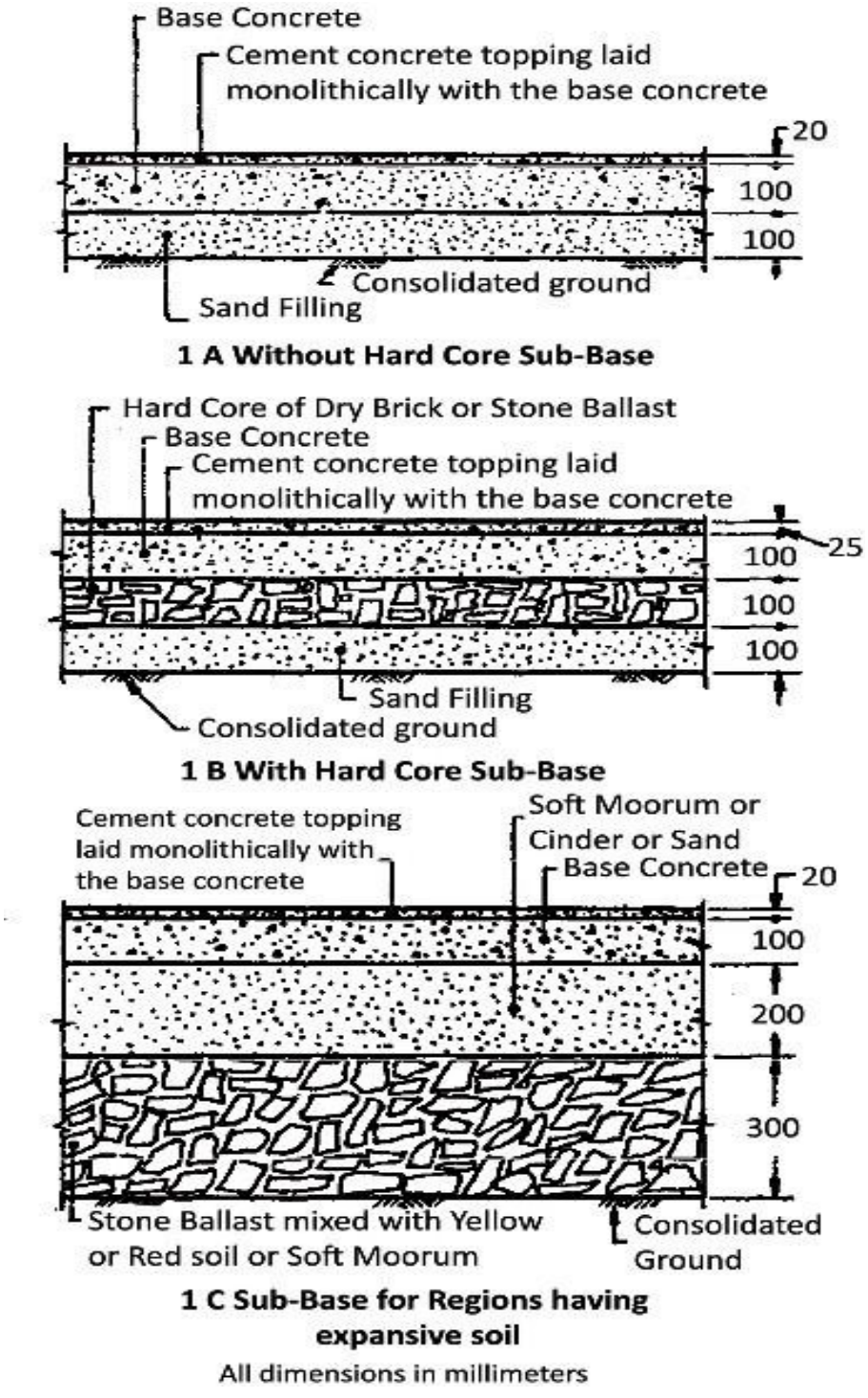


Fig. 4.1.1 Sections of CC Flooring

4.1.2 Preparing Sub Base

Subbase is the surface prepared to take base concrete. Soil can also be used as Subbase only if it is well compacted and highly stable. For preparing Subbase clear all the unwanted objects or materials like rocks, grass, shrubs, trees, and even old concrete that may interfere in the pouring process.

Subgrade is the soil underneath the Subbase and the strength of the final concrete depends on the strength of the subgrade. If the subgrade moves, shifts or craters it will result in the cracking or cratering of the concretes so ensure that the subgrade is properly compacted and stabilized.

Subbase is generally prepared by using Open-grade stone or closed graded fine-grade stone. Open-grade stones are less expensive and contain very less quantity of smaller stones and provide a way for water to pass through. Due to large size of stones they do not compact well as compared to finer-grade stone. Finer-grade stones are highly compactable.

To prepare the Subbase lay a 4–8 inch (10.2–20.3 cm) thick Subbase with the designated ma- terial, and then compact it with a hand tamper or a plate compactor.

Fig. 5.1.2 Soil used as subgrade

Fig. 4.1.3 Ramming of soil before subbase

Fig. 4.1.4 Open grade stone used as subbase

Fig. 4.1.5 Ramming of subbase

4.1.3 Forming

Form work is a temporary shuttering structure for holding the freshly-poured concrete. Existing features, such as Kerbs, walls, edgings can also be a part of the form. For constructing vertical structural concrete members, the construction of the formwork becomes quite complicated and is undertaken by formwork carpenters or formwork erectors. Ground slabs are less complicated and require only the simplest of formwork. The good quality of forms helps in making concrete free from surface defect and achieving better finish.

Steel Formwork

The steel form is durable and more economical as this can be reused more number of times than timber or plywood shutters. This is mainly consisting of thin section of steel plate supported by angles along edges and side opposite to face of shutters. This is easy to erect and dismantle leading to high speed of construction.

Fig. 4.1.6 Steel Formwork

Timber shuttering

There are some situations where use of Roadform is not feasible, so the more traditional timber shuttering is used. As the timber shuttering is 'knocked-up' on site it can be made to accommodate any size, depth, odd shapes and situation. Timber shuttering used in conjunction with modular steel bracing elements is preferred for vertical concrete work.

Form lining: It is the part of the shutter in contact with the concrete.

Hardboard or exterior grade MDF (Medium Density Fibreboard) are also used in some cases.

15mm or 18mm Plywood is generally used as form lining.

As plywood used in form lining is highly vulnerable to rots and disintegration as it is in contact with different climatic and temperature conditions for long period of time.

Horizontal Waler: A horizontal timber or beam used to brace or support the sheeting.

50 mm x 50 mm hard wood is generally used

The load or pressure exerted by concrete on form-work is deciding factor in selection of spacing and size of studs and walers.

Bracing: is the support timber to the waler or formwork so that there is no movement during concreting operation. The support timbers are collectively known as bracings and consists of horizontal walers and vertical noggins.

The size of timbers used for the bracing depend upon the size of the formwork.

- 50 x 50 mm timber can be used to form the walers and noggins for a simple 300mm high, ground slab shutter.
- Straight and true timber are used for bracings and are always used end on as it is the deepest way, to give maximum possible support.
- Raked Brace is in between 300 to 600 as shown below:

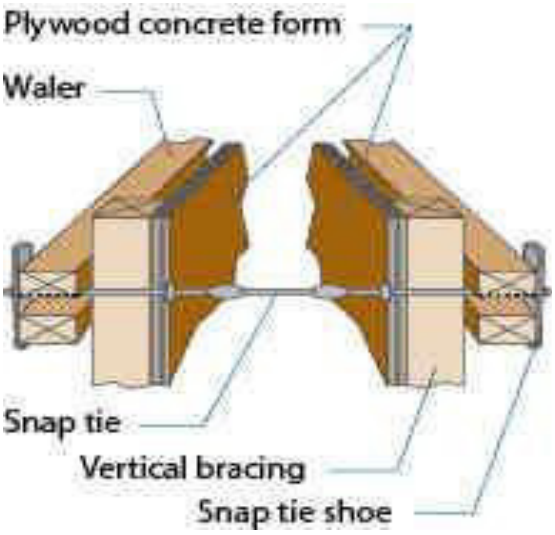


Fig. 4.1.7 Horizontal Waler

- The spacing between walers and between noggins is generally 300-600mm but may vary depending on the size of the shutter.
- Nails are used to fasten the brace members to the formwork as they are easiest to withdraw on completion of the work.
- Fastening is essential as the pressure of the wet concrete and finishing equipment may result in 'springing' (flying loose) of the braces.

Sole Plates: A spreader board is required to be fixed behind peg on soft ground as the weight of the concrete may force the peg back into the ground. A "sole plate", usually is a plank that can be used to support several pegs and help in spreading the load more evenly. The horizontal braces and the raking are nailed to the sole plate.

Ground pegs are those that hold the sole plates firmly to the ground and should be driven at least into a depth of 300 mm to 450 mm.

Fig. 4.1.8 Concrete flooring using Timber Shuttering

4.1.4 Reinforcement in Cement Concrete Flooring

The floor is generally unreinforced or nominally reinforced. The reinforcement is used to control crack width. In floor slab, the reinforcement is placed at the 1/3 of slab and 50mm below top surface to avoid crack. In some cases, there is top and bottom layer of reinforcement to increase load carrying capacity. The most popular way of concrete reinforcement is to use steel mesh. It offers less strength as compared to rebar but it is sufficient to provide sufficient strength to enhance the strength of wall, columns and sidewalks. Steel mesh is easier to use as compared to rebar due to its flexibility. Installing rebar in concrete is a slightly difficult and time taking process but it necessary for heavy duty flooring.

The advantages and disadvantages of Wire mesh and Rebar's are:

Wire mesh: It offers stability (wire mesh is welded, where rebar is often tied together) and pre- vents small cracks growing and spreading. The drawback of wire mesh over Rebar is that it is not very good at providing structural integrity. The diameter of the wire shall vary from 3.0 mm to 12.5 mm.

Fig. 4.1.9 Wire mesh used for reinforcement

Rebar: It offers better structural integrity and is suitable for higher load-bearing surfaces and it is also effective in minimizing and controlling cracks. The spacing of the rebar shall vary from 50 mm x 50 mm to 400 mm x 400 mm depending upon the design requirement. The diameter of the rebar's shall be 8 mm to 12 mm depending upon the floor use.

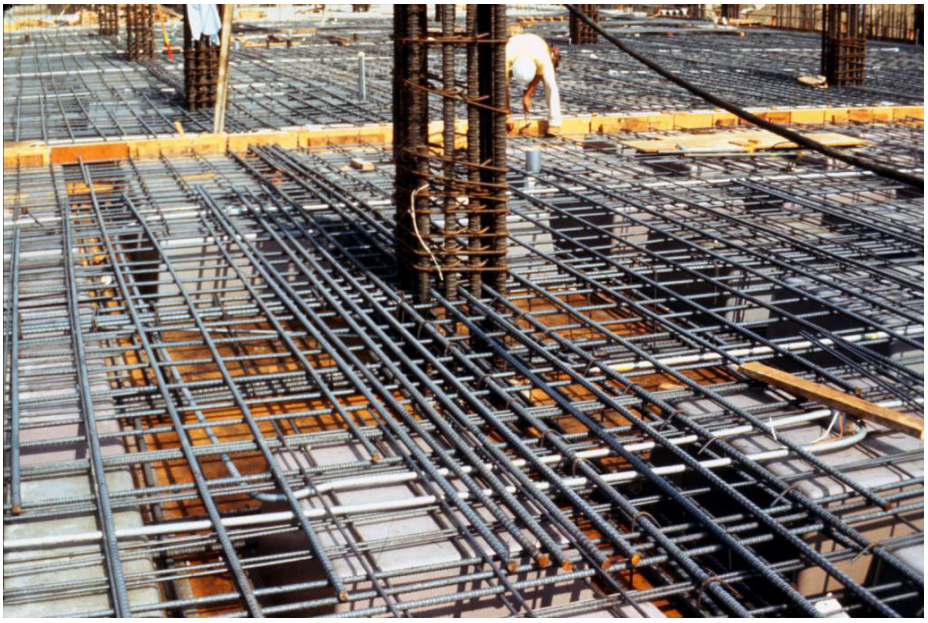


Fig. 4.1.10 Rebar used for reinforcement

4.1.5 Compaction

Compaction method adopted in cement concrete flooring

The compaction is done by needle or poker vibrator near the form panels. This results in prop- er compaction of the concrete and hence elimination of voids and entrapped air. Compacting is generally completed when air bubble stops rising to the surface and the noise of poker stops changing. Therefore, the poker vibration is followed by surface vibration using screed vibrator to get a uniform compacted concrete with a levelled surface. The surface vibrator is guided on steel channel used as formwork for flooring.

Fig. 4.1.11 Compacting using Needle Vibrator

4.1.6 Finishing

The finishing of concrete involves application of hand tools and power tools as per requirement. After the concrete is placed in forms, the initial finishing is started by striking off the concrete by straightedges. The voids and undulations left behind are made leveled by float. The final finishing is done by manual or power trowel as per requirement, when bleed water evaporates and sur- face becomes hard enough to not give any impressions.

4.1.7. Joints in Cement Concrete Flooring

Common types of joints in concrete constructions are:

- **Construction Joints:** This is provided where the works stops. These are full depth joints. Construction should be so planned that day's construction activity may end at the location of contraction/expansion joint.
- **Expansion Joints:** Such a joint provides the space into which pavement can expand thus relieving compressive stresses due to expansion and inhibiting any tendency towards buckling of concrete slabs.
- **Contraction Joints:** This is a joint which helps concrete in relieving tensile stresses in the and prevents formation of irregular cracks due to restraint in free contraction of concrete due to its natural shrinkage. These joints also relieve stresses due to warping.

Dos and Don'ts

- Number of construction joints should be minimum as possible.
- Keep joints as straight as possible.
- Roughen the hardened concrete surface, cleaned with brush, make wet with water and apply cement slurry before starting the fresh concrete at location of joint.
- The contraction joint is not less than 3 mm wide and having a depth equal to one-fourth to one-third the depth of concrete slab.
- The groove is formed preferably by a joint cutting saw and filled by appropriate sealant.
- Deviations of the filler board in the case of expansion joints from the intended line of the joint shall not be greater than ±10 mm.
- The best fit straight line through the joint grooves shall not be more than 25 mm from the intended line of the joint.
- Always Ensure that grooves are dry and clean and free from foreign object or loose material before sealing is done

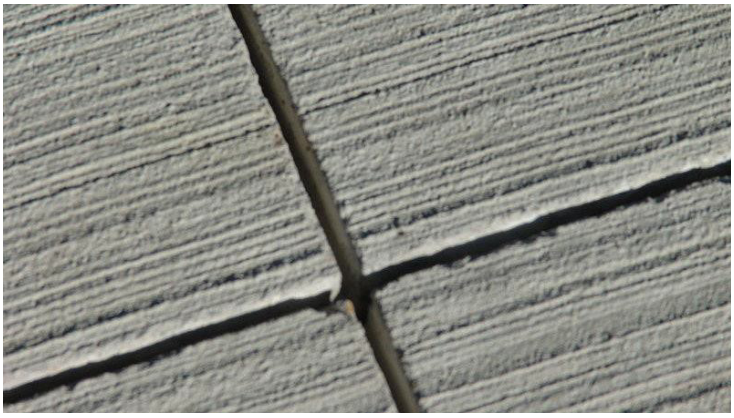


Fig. 4.1.13 Saw cut contraction joint

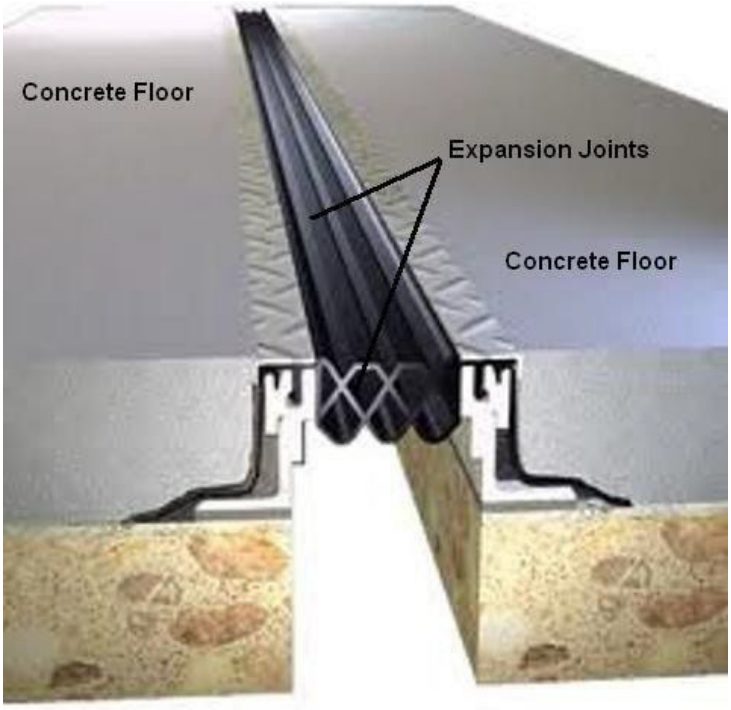


Fig. 4.1.14 Expansion Joint

Notes

Scan the QR code to watch the video

https://youtu.be/Vx0lp4DJxfU

Reinforcement in Cement Concrete Flooring

UNIT 4.2: IPS Flooring

Unit Objectives

By the end of this unit, participants will be able to:

- Understand use and benefits of IPS Flooring
- Explain the procedures involved in IPS flooring
- Explain about the Hand tools and Power tools required for IPS flooring

4.2.1 What is IPS Flooring?

Indian Patent Stone Flooring is a basic type of cement concrete flooring which is good against wear and tear.

It can be used for industrial, commercial or residential purposes.

Indian Patent Stone flooring when has red oxide as topping is called red oxide flooring.

4.2.2 Preparation of sub base and base course for IPS flooring

The earth filling or sub grade shall be properly compacted to ensure that no loose packets are left. Depends on design requirement, sand of 100 mm thickness or stone soling of thickness 150-200 mm is generally used as sub-base course.

The Slope of flooring shall be provided and maintained in base course before laying of topping layer.

Base concrete is generally plain cement concrete of nominal mix of 1.4.8 or design mix of m-7.4.

4.2.3 IPS Flooring Methodology

- The concrete mix generally used in topping layer generally varies from nominal mix of 1:2:4 to 1:1.5:3 or design mix of M15 to M20 depends on design requirements.
- The thickness of concrete in topping layer is generally 25-50mm depends on type and design requirement of flooring.
- Mark reference level and transfer this to location of flooring area.
- Mark the thickness level of flooring.
- The glass and aluminum strips are fixed over base concrete dividing the area into suitable panels with their top at proper levels and required slope.

- The strips are fixed in cement mortar with their tops at required level. The dimensions of panel shall not exceed more than 2 meters.
- Provide dummy dots to ensure required level of flooring.
- The predetermined concrete mix is then placed into panel, thoroughly compacted and leveled by screed board.
- The concrete shall be trowel led at regular intervals to produce desired hard surface.
- The finishing operation is done in period from 1 to 6 hrs depending on atmospheric conditions and temperature.
- The final trowel ling shall be carried out before concrete becomes firm enough to extent that any impression on surface requires considerable pressure.
- No dry cement should be allowed to spread on freshly laid concrete to cater excess water which comes on surface due to floating.
- Cure the flooring for 15 days by different curing methods as per suitability such as ponding and wet hessian cloths.

The sequence of processes involved in IPS flooring is depicted in figures below:

Fig. 4.2.1 IPS Flooring by Mason Concrete

Fig. 4.2.2 IPS Flooring

4.2.4 Advantages of IPS Flooring

- Water sloping finish is achieved at an economical cost.
- No power tools are required which makes it the best suited flooring methodology for rural areas.
- IPS floor has good wearing properties.
- It can be used for residential, industrial or commercial purposes.
- IPS finish can be used for interior areas.

Notes

Scan the QR code to watch the video

https://youtu.be/R2YAcUE_mCg

IPS Flooring Methodology

UNIT 4.3: Tremix Flooring

Unit Objectives

By the end of this unit, participants will be able to:

- Know about Tremix Flooring and its benefits.
- Know about procedures involved in tremix flooring
- List out hand and power tools required for tremix flooring

4.3.1 What is Tremix Flooring?

This is high performance concrete flooring having improved properties such as compressive strength, wear and tear resistance, shrinkage, water permeability. The TREMIX method, pioneered by TREMIX AB, SWEDEN and introduced by Aquarius in India in 1987, (The Vacuum De-watering System) is used for laying high quality concrete floors at an economical cost.

This process involves power tools and equipment.

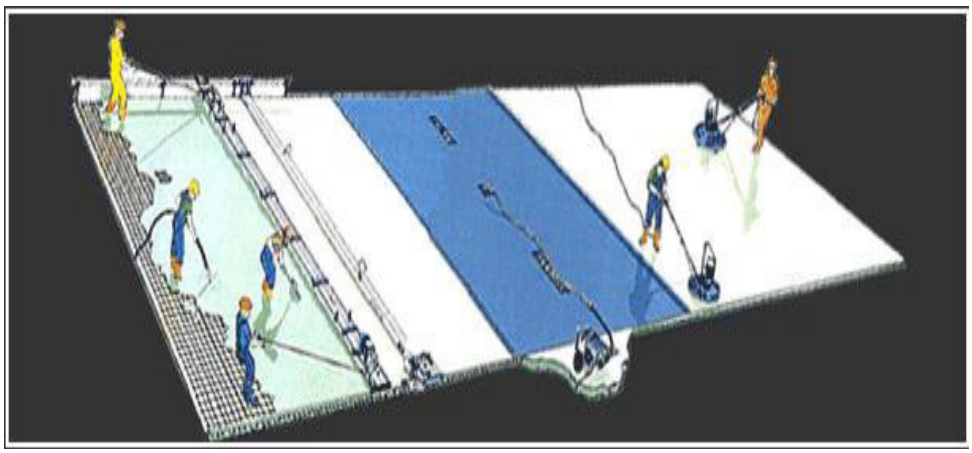


Fig. 4.3.1 Tremix Flooring

4.3.2 Tremix Flooring Methodology

- Preparation of sub base and base course.
- Fix the forms to acquire necessary thickness
- Laying spreading specified grade of concrete into alternate panels. Vibrate and level the poured concrete by double beam vibrator.
- Vacuum de-watering treatment to remove excess water from concrete. Sprinkle hardener as per requirement.

- Float the surface with power floater.
- Final troweling as per requirement and hardener is sprinkled with final troweling when concrete hardens and bleeding water has evaporated.
- Curing for 15 days.
- Provide the specified joints with groove cutting.
- Joints to be filled with specified material.

4.3.3 Tools and Materials Required

Tools and equipments required for performing de-watering process are as follows:

1. Vacuum de-watering Pump with hose
2. Suction mat with filter pad
3. Double beam vibrator
4. Power floater/trowel

Fig. 4.3.2 Power tools for Tremix Flooring

4.3.4 Preparation of Sub-base and Base Course for Tremix Concrete Flooring

The earth filling shall be properly compacted to ensure that no loose packets are left. Depends on design requirement, sand of 100 mm thickness or stone soling of thickness 150-200 mm is generally used as sub-base course. The settlement of sub-base may cause cracking of whole floor.

The concrete which is generally used in base course is plain cement concrete of nominal mix 1:3:6 or design mix of M10.The thickness of base concrete is 100-200mm.

4.3.5 Forming

Steel forms are generally used as form work in tremix flooring. These forms are MS Channels spaced at 3.5 to 4 meters apart. These forms are also used for support of the double beam vibra- tor and act as guide on which it is pulled.

Fig. 4.3.3 Steel forms used in Tremix Flooring

Fig. 4.3.4 Tremix Flooring Work

4.3.6 Concrete Mix for topping

Tremix flooring is mostly being done in the industrial sector where rigid surface is required for machine foundation, movement of vehicles and cranes as it results in increase in the compressive strength of the concrete floor and also provides better resistance against wear and tear.

Concrete of nominal ratio 1:1.5:3 (1 cement: 1.5 sand and: 3 stone aggregates) or design mix of M-20 grade is generally used for topping concrete.

For better wear and tear design mix of M-25 is preferred.

4.3.7 Vacuum De-watering

This is a process in which excess water is removed off from concrete surface after it is laid and vibrated. This is done in following steps:

- After compaction by screed vibrator, and leveling of concrete using screed-board
- Lay the suction mat which comprises of large single PVC sheet in size of 5 x 7 M underneath which honey combed plastic cloth acts as very fine filter
- Top mat is provided with Junction box and hose pipe
- Top mat is connected to vacuum pump through hose pipe
- When pump starts, vacuum is created between filter pad and top mat which squeezes out surplus water from concrete.

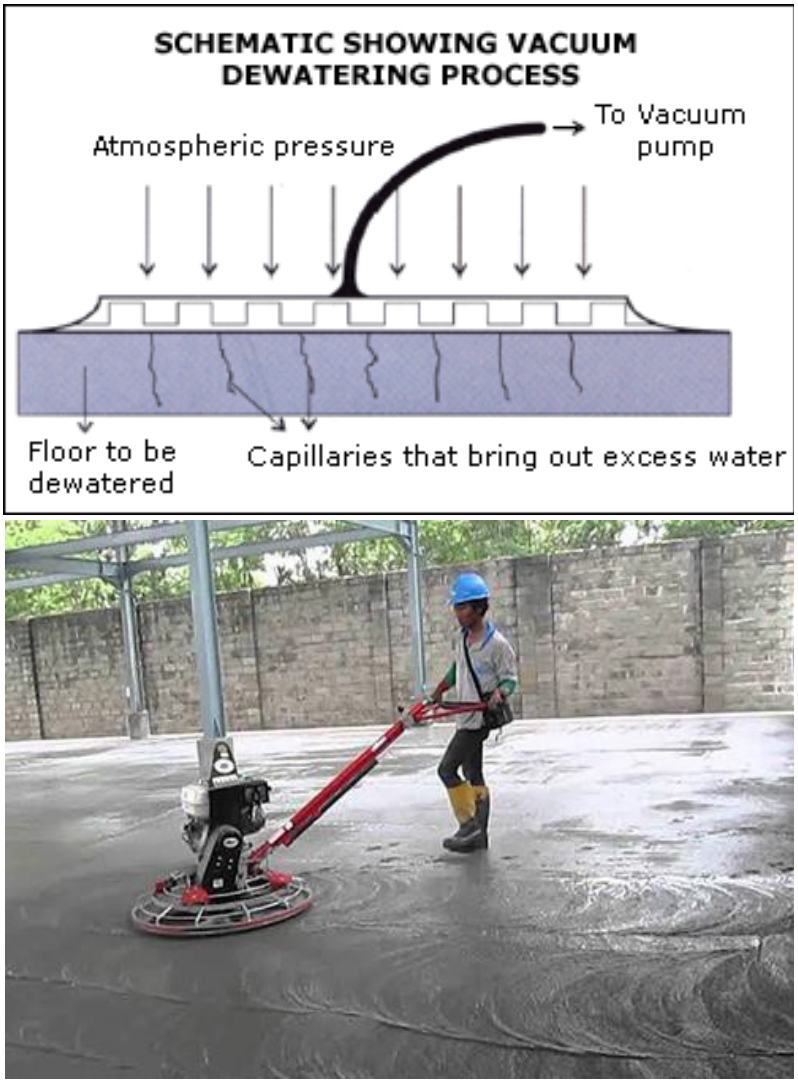


Fig. 4.3.5 Vaccum de-watering for Tremix Flooring

4.3.8 Troweling / Floating

- Power trowel cum floater in used for floating and troweling in a Tremix floor.
- The power floater is fitted with rotating disks for the floating process and is fitted with rotating blades for the troweling process.
- Floating is done immediately after the de-watering process whereas trowelling is done after 30 minutes to 3 hours.
- Trowelling produces very smooth surface so this process is not carried out for floors where rough surface is required like parking lots, sidewalks, etc.

Fig. 4.3.6 Power trowel for floating of wet concrete after de-watering

Fig. 4.3.7 Power trowel for trowelling of hardened concrete for smooth finish

The sequence of processes involved in tremix flooring is depicted in below figures.	
1. Pouring Concrete in the form	
2. Spreading concrete	
3. Compacting using double beam vibrator	
4. Laying the filter pads for de-watering	

5. Placing the top cover over the filter pads	
6. Spreading the top cover for de-watering	
7. De-watering using the vacuum dewatering system	
8. Troweling using troweling blades	

Hardener

In many cases, the hardener is added to floor to increase its resistance against wear and tear. It is available in both powder and liquid form.

4.3.9 Advantages of Tremix Flooring

1. The lower water cement ratio considerably increases the compressive strength
2. Power troweling produces a high wear and tear concrete surface.
3. Vaccum De-watering resulting into low water permeability which ultimately improves durability of flooring.
4. Low water cement ratio leads to less shrinkage cracks.
5. No of strip joints required in this flooring is less which enables it suitable for flooring of large area.

Exercise

Answer the following questions.

- What is Tremix flooring?
- Name the machines required in Tremix flooring?
- Why is form prepared before Flooring?
- What are the advantages of using reinforcement in flooring?
- What are the advantages of Tremix Flooring?

Notes

Scan the QR code to watch the video

https://youtu.be/X0zCZJHv3yI

Tremix Flooring Methodology

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

5. Team Work and Effective Communication at Workplace

Unit 5.1 – Effective Communication and Teamwork

Unit 5.2 – Working Effectively and Maintaining Discipline at Work

Unit 5.3 – Maintaining Social Diversity at Work

(CON/N8001)

Key Learning Outcomes

By the end of this module, participants will be able to:

1. Importance of interacting and communicating in an effective manner.
2. Ways to support co-workers to execute the project requirements.
3. Ways to practice inclusion at workplace.

Unit 5.1 - Effective Communication and Teamwork

Unit Objectives

By the end of this unit, participants will be able to:

- Elucidate own roles and responsibilities.
- Explain the importance of effective communication.
- Explain different modes of communication used at the workplace.
- Elucidate the consequence of poor teamwork on project outcomes, timelines, safety at the construction site, etc.
- Demonstrate how to pass on work-related information/requirements clearly to the team members.
- Show how to report any unresolved problem to the supervisor immediately.

5.1.1 Communication at Workplace

The communication process refers to the steps involved in the exchange of information, ideas, thoughts, or messages between individuals or groups. It is a dynamic process that involves a sender, a receiver, a message, and various channels to convey the information effectively. The communication process typically follows these steps:

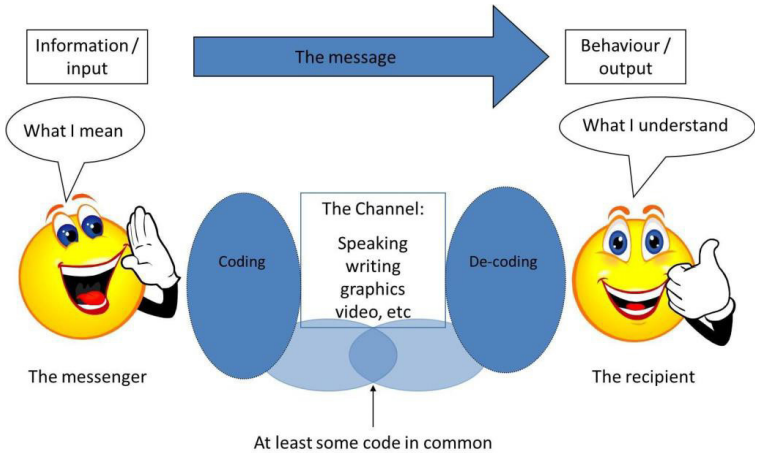


Fig. 5.1.1 Effective Communication – Two-way Process

Sender: The person or entity starting the communication.

Message: The information that the sender wishes to share.

Encoding: Choosing the medium to send a message.

Channel: The medium used to send a message.

- Receiver: The person or entity to whom the message is sent.
- Decoding: Understanding the message received.
- Feedback: The receiver's response to the message.

The 7Cs of communication are essential principles to follow for effective and impactful communication:

- Clear: Be assertive about what needs to be communicated, whether verbally or in writing
- Concise: Use simple words and say only what's needed
- Concrete: Use exact words, phrases, Use facts and figures
- Correct: Use correct spellings, language and grammar
- Coherent: Words should make sense and should be related to the main topic
- Complete: A message should have all the needed information
- Courteous: Be respectful, friendly and honest

Fig. 5.1.2 C's of Communication

5.1.2 Type of Communication at Construction Worksite

Communication at a construction worksite is crucial for ensuring efficiency, safety, and coordination among workers, supervisors, and other stakeholders.

Several types of communication are utilized to facilitate smooth operations and enhance safety at construction sites.

Some common communication methods include:

- **Verbal Communication:** This involves face-to-face conversations, discussions, and instructions between workers, supervisors, and managers on the site. Verbal communication is essential for conveying immediate instructions and clarifications.
- **Hand Signals:** Hand signals are commonly used in noisy construction environments where verbal communication may be difficult. Workers use specific hand gestures to communicate instructions or warnings to each other.

Fig. 5.1.3 Communication at Construction

- **Written Communication:** Written communication includes various documents, such as construction plans, safety guidelines, work permits, and daily progress reports. Written communication helps in conveying detailed information and serves as a reference for all stakeholders.
- **Radios and Walkie-Talkies:** Two-way radios and walkie-talkies are popular communication tools at construction sites, especially for larger projects. They allow instant communication between workers and supervisors across different areas of the site.
- **Visual Communication:** Visual aids, such as signs, symbols, and safety posters, are used to convey important information and warnings. These aids help in reminding workers of safety protocols and hazard awareness.
- **Digital Communication:** Construction sites may use digital communication platforms like mobile apps or messaging services to facilitate real-time communication, share updates, and coordinate tasks.
- **Meetings and Toolbox Talks:** Regular meetings and toolbox talks are conducted to discuss project progress, safety updates, and address any concerns or questions raised by workers.
- **Project Management Software:** Construction companies often use project management software that enables seamless communication between project teams, provides updates, and tracks tasks and schedules.
- **Emergency Communication Systems:** In case of emergencies, construction sites may have emergency communication systems like alarms or sirens to alert workers and initiate evacuation procedures.

Effective communication at construction sites plays a vital role in preventing accidents, minimizing delays, and ensuring the successful completion of projects. It is essential for all team members to be well-versed in the various communication methods used to maintain a safe and productive worksite.

Fig. 5.1.4 Coordination during Construction Work

5.1.3 Adverse Effects of Poor Communication

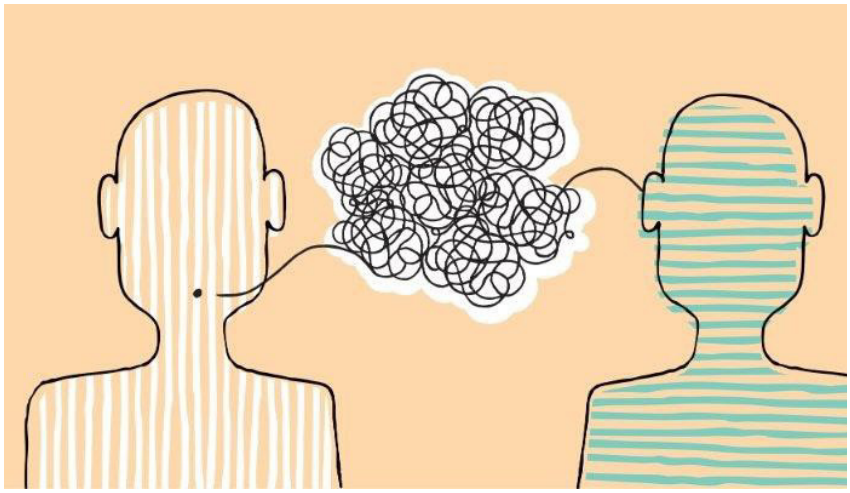


Fig. 5.1.5 Adverse Effects of Poor Communication

Poor communication at a construction workplace can lead to various adverse effects, some of which include:

1. **Safety Risks:** Inadequate communication about safety protocols, hazards, and instructions can increase the risk of accidents and injuries at the construction site.
2. **Misunderstandings:** Miscommunication among workers, supervisors, and managers can lead to misunderstandings about tasks, timelines, and project requirements, resulting in errors and delays.
3. **Inefficiencies:** Poor communication can cause delays in project progress, resource allocation, and decision-making, leading to inefficiencies and increased project costs.
4. **Decreased Productivity:** Lack of clear communication can hinder workers' ability to perform their tasks efficiently, reducing overall productivity at the construction site.
5. **Cost Overruns:** Miscommunication about project budgets, timelines, and scope can lead to cost overruns and financial losses for the construction project.
6. **Quality Issues:** Inadequate communication regarding construction specifications and standards may result in quality issues and subpar workmanship.
7. **Safety Violations:** Poor communication about safety guidelines and procedures may lead to safety violations and non-compliance with safety regulations.
8. **Increased Conflicts:** Communication gaps can create conflicts and tensions among workers and teams, negatively impacting the construction site's working environment.
9. **Lack of Coordination:** Insufficient communication between different construction teams and subcontractors can lead to a lack of coordination, hindering the seamless progress of the project.
10. **Client Dissatisfaction:** Poor communication with clients can lead to misunderstandings, unmet expectations, and client dissatisfaction with the construction project.
11. **Project Delays:** Miscommunication about project timelines and tasks can result in delays, affecting project completion dates and potentially leading to contract disputes.

12. **Reputation Damage:** Repeated instances of poor communication at a construction site can damage the reputation of the construction company, impacting future projects and business opportunities.
13. **Health and Environmental Concerns:** Lack of proper communication about hazardous materials, waste disposal, and environmental regulations can result in health and environmental risks.

To mitigate these adverse effects, construction companies should prioritize effective communication strategies, ensure clear and consistent information flow, and foster a culture of open and transparent communication among all stakeholders involved in the construction project.

5.1.4 Teamwork at Workplace

Teamwork is of utmost importance in various aspects of life, whether it's in the workplace, sports, education, or personal relationships.

Fig. 5.1.3 Communication at Construction

Here are some key reasons highlighting the importance of teamwork:

- **Achievement of Common Goals:** Teamwork brings together individuals with diverse skills and expertise to work collectively towards a shared objective. When team members collaborate effectively, they can accomplish more than what could be achieved individually.
- **Enhanced Creativity and Innovation:** Working in a team allows for the exchange of different perspectives and ideas. This diversity fosters creativity and innovative problem-solving, leading to better solutions and approaches.
- **Improved Productivity:** Team members can divide tasks based on their strengths and expertise, leading to improved efficiency and productivity. This distribution of workload ensures that each aspect of a project is handled by the most suitable team member.

- **Shared Responsibility and Accountability:** In a team, each member has a specific role and responsibility. This sense of accountability motivates individuals to perform their best and take ownership of their contributions.
- **Effective Decision Making:** Teams can pool their knowledge and insights to make well-informed decisions. When diverse viewpoints are considered, the decisions tend to be more balanced and comprehensive.
- **Support and Motivation:** Team members can provide emotional support and motivation to each other, boosting morale during challenging times and celebrating achievements together.
- **Learning and Skill Development:** Teamwork allows individuals to learn from one another, acquire new skills, and improve existing ones. This continuous learning enhances personal and professional growth.
- **Building Trust and Camaraderie:** Effective teamwork strengthens the bond between team members, fostering trust, respect, and camaraderie. This positive team dynamic contributes to a harmonious work environment.
- **Adaptability and Resilience:** Teams are often better equipped to handle changes and uncertainties as they can brainstorm strategies and adapt collectively to new situations.
- **Efficient Problem Solving:** When faced with complex challenges, teamwork enables the pooling of resources and expertise, leading to more comprehensive and efficient problem-solving.
- **Synergy and Performance:** The collective efforts of a high-performing team create a synergy where the overall performance is greater than the sum of individual contributions.
- Improved Work-Life Balance: Effective teamwork can distribute workloads and responsibilities, reducing the burden on individual team members and promoting a better work-life balance.

In conclusion, teamwork is vital for achieving success, fostering innovation, and creating a positive and supportive work culture. Emphasizing the importance of teamwork enables organizations and individuals to harness the full potential of collaboration, leading to remarkable achievements and overall well-being.

5.1.5 The 5Cs of Teamwork

The 5Cs of teamwork are fundamental principles that contribute to effective and successful collaboration within a team. These principles help create a positive team dynamic and foster a cohesive and high-performing group.

Fig. 5.1.7 Effective and Successful Collaboration

The 5Cs of teamwork are:

1. **Co-operation**

   Without cooperation between team members, no group will survive. Cooperation is intimately linked to effective communication and self-assurance. Better communication and a transparent and healthy work environment necessitate some degree of clarity and trust.

2. **Compromise**

   Work relationships are not exempt from the necessity of reaching compromises on particular issues. If our peers' or managers' argument is valid and can contribute to greater performance, we may be required to concur. It is acceptable that not everyone can be on the same page at all times. To manage such circumstances, we must examine the situation and consider potential outcomes.

3. **Communication**

   Considered vital for organising the individual and group efforts of the team. Communication is essential for conflict resolution and problem-solving, and companies must support healthy communication within and between teams. Communication must be open, honest, and timely so that every team member knows what to do and how to do it.

4. **Confidence**

   Team members should have confidence in their skills. The leader must provide the team with a clear and simple explanation of the project, each member's responsibilities, and the final objective. It is essential to remember that confidence does not develop in the blink of an eye. It must be constructed step by step.

5. **Commitment**

The demands and interests of the team take precedence above individual concerns. Every action should contribute to the overall corporate objective.

By embracing the 5Cs of teamwork, teams can cultivate an environment of trust, respect, and collaboration, leading to enhanced performance and achievement of shared objectives.

5.1.6 Consequence of Poor Teamwork

Poor teamwork at a construction site can have significant consequences that impact project outcomes, timelines, safety, and overall project success.

Some of the key consequences of poor teamwork include:

Delayed Project Completion: Lack of effective collaboration and coordination among team members can lead to delays in project progress. When tasks are not properly assigned or synchronized, the project timeline may be extended, resulting in increased costs and client dissatisfaction.

Fig. 5.1.8 Poor Teamwork

Reduced Productivity: Poor teamwork can result in inefficiencies and a decrease in overall productivity. Team members may duplicate efforts, make mistakes due to miscommunication, or lack the support needed to perform their tasks efficiently.

- **Lower Quality Work:** Inadequate teamwork can lead to a decline in the quality of work performed. Without effective collaboration and accountability, errors and defects may go unnoticed, compromising the final deliverables.
- **Increased Rework:** Miscommunication and lack of coordination can result in rework and additional costs. Correcting mistakes and addressing issues that arise due to poor teamwork can be time-consuming and financially burdensome.
- **Safety Hazards:** Construction sites are inherently hazardous environments, and poor teamwork can exacerbate safety risks. When team members fail to communicate effectively or work together safely, it can lead to accidents, injuries, and even fatalities.
- **Conflict and Tension:** Poor teamwork may create a negative work environment characterized by conflict, tension, and lack of trust among team members. This can hamper communication and cooperation, further hindering progress.
- **Budget Overruns:** When teamwork is lacking, projects may experience cost overruns due to inefficiencies, rework, and delays. This can strain the project budget and negatively impact the overall financial performance.
- **Missed Opportunities:** Poor teamwork can result in missed opportunities for innovation, improvement, and optimization. Team members may not leverage their collective expertise and diverse perspectives to identify and capitalize on potential opportunities.
- **Client Dissatisfaction:** Clients expect a well-coordinated and smoothly executed project. Poor teamwork can lead to client dissatisfaction due to missed deadlines, quality issues, and breakdowns in communication.
- **Reputation Damage:** Repeated instances of poor teamwork on construction projects can damage the reputation of the construction company, leading to a loss of trust among clients and stakeholders.

In summary, poor teamwork at a construction site can have serious consequences on project outcomes, timelines, safety, and overall project success. It is essential for construction teams to prioritize effective collaboration, communication, and coordination to mitigate these adverse effects and ensure the successful completion of projects.

Notes

Unit 5.2 - Working Effectively and Maintaining Discipline at Work

Unit Objectives

By the end of this unit, participants will be able to:

- Explain the importance of creating healthy and cooperative work environment among the gangs of workers.
- Elucidate applicable techniques of work, properties of materials used, tools and tackles used, safety standards that co-workers might need as per the requirement.
- Explain the importance of proper and effective communication and the expected adverse effects in case of failure relating to quality, timeliness, safety, risks at the construction project site.
- Explain the importance and need of supporting co-workers facing problems for the smooth functioning of work.
- Demonstrate ways to hand over the required material, tools, tackles, equipment and work fronts timely to interfacing teams.
- Demonstrate ways to work together with co-workers in a synchronized manner.

5.2.1 Discipline at Work

Discipline at work refers to the adherence to rules, policies, and professional standards within a workplace. It involves employees maintaining a responsible and focused approach to their work duties, following established protocols, and upholding ethical principles.

Here are some key aspects of discipline at work:

1. **Punctuality:** Being punctual is a fundamental aspect of discipline. Employees are expected to arrive at work and meetings on time, ensuring smooth operations and respect for others' time.
2. **Following Policies and Procedures:** Employees must follow the company's policies, procedures, and guidelines related to various aspects of work, such as safety, communication, and data privacy.

Fig. 5.2.1 Discipline at Work

3. **Professional Conduct:** Discipline at work involves maintaining professional conduct and demeanor in all interactions with colleagues, clients, and stakeholders.
4. **Meeting Deadlines:** Adhering to deadlines and delivering work on time is a critical aspect of discipline, as it ensures the timely completion of projects and tasks.
5. **Respect for Authority:** Discipline requires showing respect for supervisors, managers, and leadership, following their directions, and seeking guidance when needed.
6. **Self-Discipline:** Individual employees should possess self-discipline to stay focused on their tasks, avoid distractions, and prioritize their responsibilities.
7. **Quality of Work:** Disciplined employees take pride in their work and strive for excellence, ensuring the delivery of high-quality output.
8. **Compliance with Company Values:** Employees should align their actions with the company's values and ethical standards, promoting a culture of integrity and trust.
9. **Conflict Resolution:** Handling conflicts and disagreements in a respectful and constructive manner is an essential part of discipline, maintaining a harmonious work environment.
10. **Accountability:** Disciplined employees take ownership of their actions, admit mistakes, and work towards rectifying any errors they may make.
11. **Adherence to Dress Code:** Following the organization's dress code and appearance guidelines contributes to maintaining a professional and cohesive image.
12. **Attendance and Leave Management:** Discipline includes managing attendance and leave in accordance with company policies and providing prior notice when taking time off.
13. **Use of Resources:** Disciplined employees use company resources responsibly and efficiently, avoiding wastage and abuse.

Discipline at work is crucial for creating a productive and positive work environment. It fosters a sense of responsibility, reliability, and accountability among employees, leading to improved performance and overall organizational success. Employers should also provide clear expectations, guidance, and support to encourage and reinforce a culture of discipline within the workplace.

5.2.2 Time Management

Time management is not about working harder; rather, it is about working smarter so that employees do not overburden themselves and create unnecessary strain.

By effectively managing their time, employees will meet deadlines, increase their effectiveness, become more productive, and produce superior work.

Fig. 5.2.2 Time Management

By effectively managing their time, employees will meet deadlines, increase their effectiveness, become more productive, and produce superior work. They will also have a higher degree of job satisfaction because they will experience less stress, which will help them advance in their careers and reduce your company's staff turnover.

Time management at construction by workers is essential for ensuring that individual tasks and responsibilities are completed efficiently, contributing to the overall success of the project. Here are some time management tips that construction workers can follow to optimize their productivity:

1. **Daily Planning:** Begin each workday with a clear plan of tasks to be completed. Prioritize the most critical tasks and allocate time accordingly.
2. **Set Goals and Deadlines:** Set specific and achievable goals for each workday or week. Establish personal deadlines for completing tasks to stay focused and motivated.
3. **Minimize Distractions:** Limit distractions during work hours, such as personal phone use or excessive socializing. Stay dedicated to tasks at hand to maximize productivity.
4. **Use Tools and Equipment Efficiently:** Familiarize yourself with the tools and equipment required for each task and use them efficiently to avoid wasted time.
5. **Organize Work Area:** Keep your work area clean and organized. A well-organized workspace minimizes the time spent searching for tools or materials.
6. **Time Tracking:** Track the time spent on each task to identify areas where efficiency can be improved and to better estimate future project timelines.
7. **Collaborate with Team Members:** Communicate and coordinate with other team members effectively to ensure a smooth workflow and prevent delays caused by miscommunication.
8. **Break Tasks into Smaller Steps:** For larger tasks, break them down into smaller, manageable steps. This approach helps in maintaining focus and progress.
9. **Take Short Breaks:** Incorporate short breaks into your workday to recharge and avoid burnout. However, ensure that the breaks are kept within reasonable limits to maintain productivity.
10. **Adapt to Changes:** Construction projects often encounter unforeseen challenges or changes. Be flexible and adaptable to adjust your schedule as needed without compromising quality.
11. **Avoid Multitasking:** Instead of trying to tackle multiple tasks simultaneously, focus on completing one task at a time to ensure better quality and efficiency.
12. **Learn Time-Saving Techniques:** Seek out and learn time-saving techniques specific to your tasks or trade. Efficiency comes with experience and knowledge.

13. **Seek Feedback:** Ask for feedback from supervisors or experienced colleagues on ways to improve your time management skills.
14. **Reflect and Improve:** Regularly assess your time management and productivity. Identify areas for improvement and actively work towards refining your approach.

By implementing these time management practices, construction workers can optimize their work efficiency, meet project deadlines, and contribute to the overall success of the construction project.

5.2.3 Interpersonal Conflicts at Construction by Workers

Interpersonal conflicts among construction workers can arise due to various reasons, and if left unaddressed, they can negatively impact the work environment, team morale, and project progress.

Some common causes of interpersonal conflicts at construction sites include:

- Communication Issues: Miscommunication, misunderstandings, or poor communication skills can lead to conflicts among workers, especially when instructions are unclear or not effectively conveyed.
- Differences in Work Styles: Workers may have different approaches to completing tasks, leading to clashes in how work should be performed.
- Competition for Resources: Limited resources, such as tools, equipment, or materials, can create tensions and conflicts when workers need to share or prioritize their use.
- Personal Differences: Diverse backgrounds, personalities, and work habits can lead to clashes in values, beliefs, and interpersonal dynamics.
- Role Ambiguity: Unclear or overlapping roles and responsibilities can cause conflicts between workers who are unsure about their tasks or areas of authority.
- Working Conditions: Challenging working conditions, tight deadlines, and long hours can contribute to stress and tensions among workers.
- Safety Concerns: Differences in safety practices or attitudes towards safety can lead to conflicts, especially when one worker perceives another's actions as risky.
- Leadership Issues: Conflicts can arise when workers feel their supervisors or managers are not effectively leading or addressing issues.
- Past Conflicts or Grudges: Lingering issues from past conflicts that were not adequately resolved can resurface and escalate over time

Fig. 5.2.3 Interpersonal Conflicts

To manage and resolve interpersonal conflicts at construction sites, the following steps can be taken:

Open Communication: Encourage open and honest communication among workers to address concerns and resolve misunderstandings promptly.

- **Conflict Resolution Training:** Provide conflict resolution training to workers to equip them with skills to address and resolve conflicts constructively.
- **Establish Clear Roles and Expectations:** Clearly define roles, responsibilities, and performance expectations to reduce ambiguity and prevent conflicts.
- **Promote Team Building:** Organize team-building activities to foster better understanding and collaboration among workers.
- **Mediation and Third-Party Intervention:** Utilize mediation or involve a neutral third party to help facilitate discussions and find solutions when conflicts are difficult to resolve within the team.
- **Encourage Respect and Empathy:** Foster a culture of respect and empathy where workers understand and appreciate each other's perspectives and backgrounds.
- **Address Safety Concerns:** Ensure that safety protocols are well-communicated and followed to reduce safety-related conflicts.
- **Regular Feedback and Performance Reviews:** Provide regular feedback and conduct performance reviews to address any performance-related conflicts.

By proactively addressing interpersonal conflicts and promoting a positive work culture, construction teams can maintain a harmonious work environment, improve collaboration, and enhance overall project outcomes.

Fig. 5.2.4 Positive Work Culture

Unit 5.3 - Maintaining Social Diversity at Work

Unit Objectives

By the end of this unit, participants will be able to:

- Discuss the fundamental concept of gender equality.
- Explain how to recognise and be sensitive to issues of disability culture and gender.
- Discuss legislation, policies, and procedures relating to gender sensitivity and cultural diversity including their impact on the area of operation.
- Demonstrate effective implementation of gender-neutral practices at the workplace.
- Demonstrate ways to address discriminatory and offensive behaviour in a professional manner as per organizational policy.

5.3.1 Gender Sensitivity

Gender sensitivity is the act of being sensitive towards people and their thoughts regarding gender. It ensures that people know the accurate meaning of gender equality, and one's gender should not be given priority over their capabilities.

Women are an important source of labour in many sectors, yet they have limited access to resources and benefits. Women should receive the same benefits and access to resources as men. A business can improve its productivity and quality of work by providing better support and opportunities to women.

Fig. 5.3.1 Gender Equality

Important Terms

Gender Sensitivity-Gender sensitivity is the act of being sensitive to the ways people think about gender.

Gender Equality - It means persons of any gender enjoy equal opportunities, responsibilities, and rights in all areas of life.

Gender Discrimination – It means treating an individual unequally or disadvantageously based on their gender, e.g. paying different wages to men and women for similar or equal job positions.

Fig. 5.3.2 Gender Discrimination

Strategies for Enhancing Gender Equity

To enhance gender equity, one should:

- Follow gender-neutral practices at all levels at work.
- Participate together in decision-making.
- Help in promoting women's participation in different forums.
- Assist women in getting exposure to relevant skills and practices.
- Assist women in capacity building by mentoring, coaching or motivating them, as appropriate.
- Assist in the formation and operation of women support groups.
- Assist in the implementation of women-centric programmes.
- Combine technical training with reproductive health and nutrition for coffee farming households.
- Assist in making a work environment that is healthy, safe, and free from discrimination.

Bridging Gender Differences

Men and women react and communicate very differently. Thus, there are some work differences as both genders have their style and method of handling a situation.

Although, understanding and maturity vary from person to person, even between these genders, based on their knowledge, education, experience, culture, age, and upbringing, as well as how one's brain functions over a thought or problem.

In order to bridge the gap, one should:

- Not categorize all men and women in one way.
- Be aware of the verbal and non-verbal styles of communication of every gender to avoid any miscommunication and work better.
- Be aware of partial behaviour and avoid it.
- Encourage co-workers of different genders to make room by providing space to others.
- Ways to reduce Gender Discrimination
- Effective steps against sexual harassment by the concerned authorities and general public.
- Gender stereotypes are how society expects people to act based on their gender. This can only be reduced by adopting appropriate behaviour and the right attitude.
- Objectification of females must be abolished.

Fig. 5.3.3 Promoting Gender Sensitivity at Workplace

Ways to Promote Gender Sensitivity in the Workplace

- Practices that promote gender diversity should be adopted and promoted.
- All genders should receive equal responsibilities, rights, and privileges.
- All genders should have equal pay for similar or the same job roles/ positions.

- Strict and effective workplace harassment policies should be developed and implemented.
- An open-minded and stress-free work environment should be available to all the employees, irrespective of their gender.
- Women should be encouraged to go ahead in every field of work and assume leadership roles.
- Follow appropriate measures for women's empowerment.
- Men should be taught to be sensitive to women and mindful of their rights.

5.3.2 PwD Sensitivity

Some individuals are born with a disability, while others may become disabled due to an accident, illness or as they get old. People with Disabilities (PwD) may have one or more areas in which their functioning is affected. A disability can affect hearing, sight, communication, breathing, understanding, mobility, balance, and concentration or may include the loss of a limb. A disability may contribute to how a person feels and affect their mental health.

Fig. 5.3.3 Promoting Gender Sensitivity at Workplace

Important Terms

- Persons with Disabilities (PwD) – Persons with Disabilities means a person suffering from not less than 40% of any disability as certified by a medical authority.
- Types of Disability:
  a. Blindness – Visually impaired
  b. Low Vision

c. Leprosy Cured

d. Hearing impairment

e. Locomotor disability

f. Mental retardation

g. Mental illness

PwD Sensitivity

PwD sensitivity promotes empathy, etiquette and equal participation of individuals and organizations while working with individuals with a disability, e.g. sensory, physical or intellectual.

Ways to be PwD Sensitive

To be sensitive to PwD, one should:

- Be respectful to all Persons with Disabilities (PwD) and communicate in a way that reflects PwD sensitivity.
- Always be supportive and kind towards a PwD with their daily chores.
- Be ready to assist a PwD to help them avail of any benefit/ livelihood opportunity/ training or any kind that helps them grow.
- Encourage and try to make things easier and accessible to PwD so that they can work without or with minimum help.
- Protest where feasible and report any wrong act/behaviour against any PwD to the appropriate authority.
- Learn and follow the laws, acts, and policies relevant to PwD.

Appropriate Verbal Communication

As part of appropriate verbal communication with all genders and PwD, one should:

- Talk to all genders and PwD respectfully, maintaining a normal tone of voice with appropriate politeness. It is important to ensure one's tone of voice does not have hints of sarcasm, anger, or unwelcome affection.
- Avoid being too self-conscious concerning the words to use while also ensuring not to use words that imply one's superiority over the other.
- Make no difference between a PwD and their caretaker. Treat PwD like adults and talk to them directly.
- Ask a PwD if they need any assistance instead of assuming they need it and offering assistance spontaneously.

Appropriate Non-verbal Communication

Non-verbal communication is essentially the way someone communicates through their body language. These include:

- **Facial expressions** - The human face is quite expressive, capable of conveying many emotions without using words. Facial expressions must usually be maintained neutral and should change according to the situation, e.g. smile as a gesture of greeting.
- **Body posture and movement** - One should be mindful of how to sit, stand, walk, or hold their head. For example - one should sit and walk straight in a composed manner. The way one moves and carries self, communicates a lot to others. This type of non-verbal communication includes one's posture, bearing, stance, and subtle movements.
- **Gestures** - One should be very careful with their gestures, e.g. waving, pointing, beckoning, or using one's hands while speaking. One should use appropriate and positive gestures to maintain respect for the other person while being aware that a gesture may have different meanings in different cultures.
- **Eye contact** - Eye contact is particularly significant in non-verbal communication. The way someone looks at someone else may communicate many things, such as interest, hostility, affection or attraction. Eye contact is vital for maintaining the flow of conversation and for understanding the other person's interest and response. One should maintain appropriate eye contact, ensuring not to stare or look over the shoulders. To maintain respect, one should sit or stand at the other person's eye level to make eye contact.
- **Touch** - Touch is a very sensitive type of non-verbal communication. Examples are - handshakes, hugs, pat on the back or head, gripping the arm, etc. A firm handshake indicates interest, while a weak handshake indicates the opposite. One should be extra cautious not to touch others inappropriately and avoid touching them inadvertently by maintaining a safe distance.

Rights of PwD

PwD have the right to respect and human dignity. Irrespective of the nature and seriousness of their disabilities, PwD have the same fundamental rights as others, such as:

- Disabled persons have the same civil and political rights as other people
- Disabled persons are entitled to the measures designed to enable them to become as self-dependent as possible
- Disabled persons have the right to economic and social security
- Disabled persons have the right to live with their families or foster parents and participate in all social and creative activities.
- Disabled persons are protected against all exploitation and treatment of discriminatory and abusive nature.

Making Workplace PwD Friendly

- One should not make PwD feel uncomfortable by giving too little or too much attention
- One should use a normal tone while communicating with a PwD and treat them as all others keeping in mind their limitations and type of disability
- Any help should be provided only when asked for by a PwD
- One should help in ensuring the health and well-being of PwD.

Expected Employer Behaviour

Some of the common behavioural traits that employees expect from their employers are:

- Cooperation: No work is successful without cooperation from the employer's side. Cooperation helps to understand the job role better and complete it within the given timeline.
- Polite language: Polite language is always welcomed at work. This is a basic aspect that everybody expects.
- Positive Attitude: Employers with a positive attitude can supervise the work of the employees and act as a helping hand to accomplish the given task. A person with a positive attitude looks at the best qualities in others and helps them gain success.
- Unbiased behaviour: Employers should always remain fair towards all their employees. One should not adopt practices to favour one employee while neglecting or ignoring the other. This might create animosity among co-workers.
- Decent behaviour: The employer should never improperly present oneself before the employee. One should always respect each other's presence and behave accordingly. The employer should not speak or act in a manner that may make the employee feel uneasy, insulted, and insecure

Fig. 5.3.5 Ramp for PwD Persons

Notes

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

6. Plan and Organize Work to Meet Expected Outcomes

Unit 6.1 – Targets & Timelines

Unit 6.2 – Material Planning

Unit 6.3 – Work Planning

(CON/N8002)

Key Learning Outcomes

By the end of this module, participants will be able to:

1. Understand the necessity of meeting target deadline.
2. Outline dependency of activities on each other
3. Explain material planning.
4. Outline benefits of material planning
5. Understand work Planning.
6. Understand the benefits of work planning

UNIT 6.1: Targets & Timelines

Unit Objectives

By the end of this unit, participants will be able to:

- Define the necessity of meeting target deadline.
- Explain dependency of activities on each other.

6.1.1 Benefits of Achieving Targets & Timelines

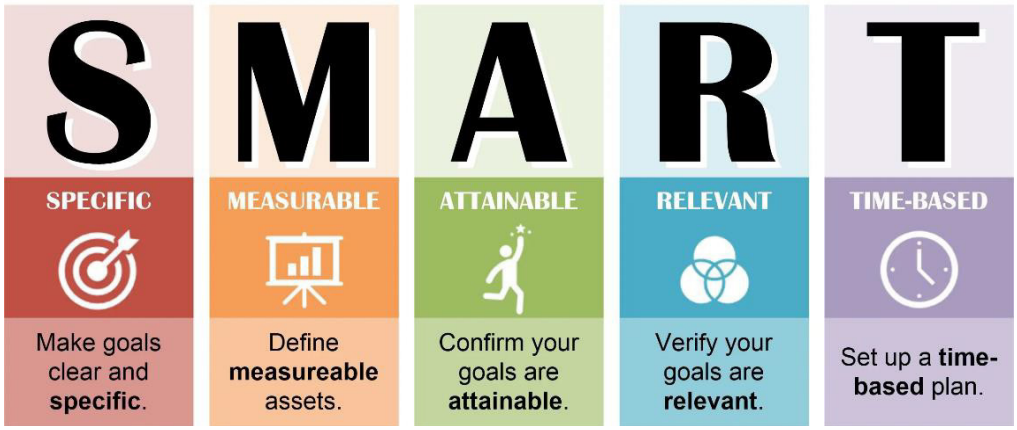


Fig. 6.1.1 SMART Goals

SMART goals are a widely used framework for setting objectives that are Specific, Measurable, Achievable, Relevant, and Time-bound. When applied to masonry and concrete work, SMART goals can help improve project planning, productivity, and overall project success. Here's how SMART goals can be applied in the context of masonry and concrete work:

- Specific: Clearly define the goal with specific details. Instead of setting a vague goal like "Improve masonry work," make it more specific, such as "Achieve precise brick alignment in all exterior walls of the building."
- Measurable: Set measurable criteria to assess progress and success. For example, "Increase the number of concrete blocks laid per day by 20% compared to the previous month."
- Achievable: Ensure that the goal is realistic and attainable within the given resources and constraints. Set goals that challenge the team but are still feasible to achieve. Unrealistic goals can lead to frustration and reduced motivation.

- Relevant: Align the goals with the overall project objectives and the needs of the client. For instance, if the project requires a durable and low-maintenance concrete surface, set a goal to use high-quality concrete mix and proper finishing techniques to achieve this.
- Time-bound: Set a specific timeline for achieving the goal. For example, "Complete the masonry work for the first floor by the end of next month."

The activities involved in construction work is allotted a definite completion time line. The delay in completing the activities on scheduled time adds up to total construction cost. All the activities at

A Mason concrete can begin his work only if:

- The materials are available on time.
- Machinery is available and working properly.
- Subbase has been prepared.
- Compacting of the ground has been done.
- Reinforcement has been done by the barbenders.

All the above mentioned activities involve different teams and delay by any one of them result in delay in the concreting process and will create additional pressure on the mason concrete to complete his work in lesser time.

The activities dependent on mason concrete are:

- Laying of tiles if required.
- Construction of structures on the concrete floor.
- Construction of structures on the concrete columns.
- Finishing of the structure.

As for most of the buildings the base structures is made of concrete the delay in concreting work result in delay in the entire project.

It is very necessary to complete each and every activity on/before time which will require:

- Proper Material planning.
- Proper work planning

Notes

UNIT 6.2: Material Planning

Unit Objectives

By the end of this unit, participants will be able to:

- Define material planning
- Benefits of material planning

6.2.1 Benefits of Material Planning

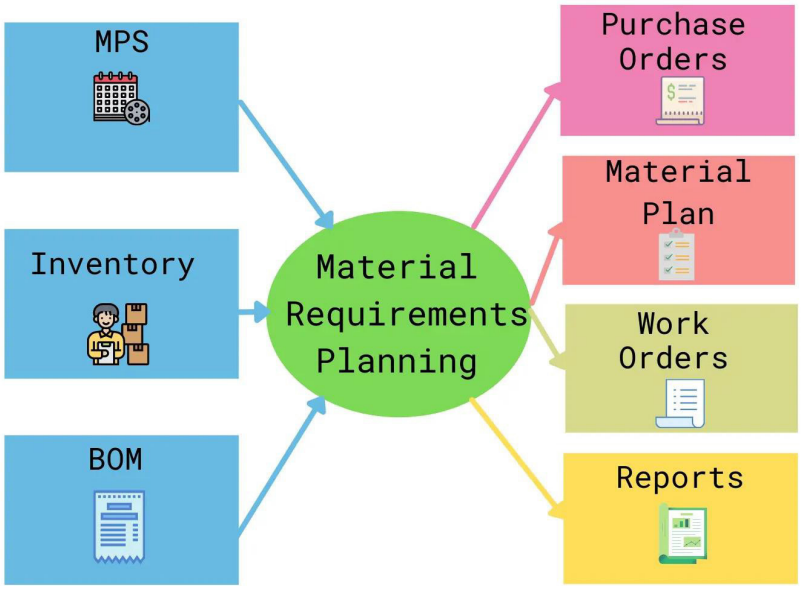


Fig. 6.2.1 Material Requirements Planning

Material planning involves checking the availability of all the raw materials that would be required in the concreting process and to ensure that they are available as and when required. The basic materials required in concreting work are:

- Cement
- Aggregates
- Water
- Reinforcement bars

The mason concrete should check with his supervisor that all these are available on the site in the required quantity.

The quality of the materials is as per the standards.

They are located at comfortable distance from the site so that transportation does not cause unnecessary delay.

They are stored as per the correct stacking and storing guidelines.

In case there is shortage of material the mason concrete should immediately report it to his supervisor well in advance and get them sourced before the work begins.

Proper material planning helps in:

- Proper utilization of manpower as they will not have to sit ideal due to unavailability of materials.
- Reducing the project cost by minimizing delay.
- Helps in achieving the deadlines.
- Reduces the wastage of material due to unavailability of other necessary material.

Material planning in masonry and concrete work is a crucial aspect of project management that involves anticipating, procuring, and managing the necessary materials needed for construction. There are several benefits to effective material planning in these types of construction projects:

- Cost Savings
- Time Efficiency
- Improved Productivity
- Quality Control
- Resource Optimization
- Safety Compliance
- Inventory Management
- Accurate Budgeting
- Flexibility and Adaptability
- Sustainable Construction

In conclusion, material planning in masonry and concrete work offers numerous benefits, ranging from cost savings and time efficiency to improved productivity, quality control, and sustainable construction practices. It is an essential element in successful project execution and helps construction teams deliver projects on time, within budget, and to the desired quality standards.

Notes

UNIT 6.3: Work Planning

Unit Objectives

By the end of this unit, participants will be able to:

- Define work Planning.
- Understand the benefits of work planning

6.3.1 Benefits of Work Planning

Work planning involves scheduling and dividing the work among the team members so as to achieve maximum productivity form each individual and also the team as a whole. Before work planning, it is very essential to do material planning and to ensure the availability of all the tools and equipment, that will be required in the process.

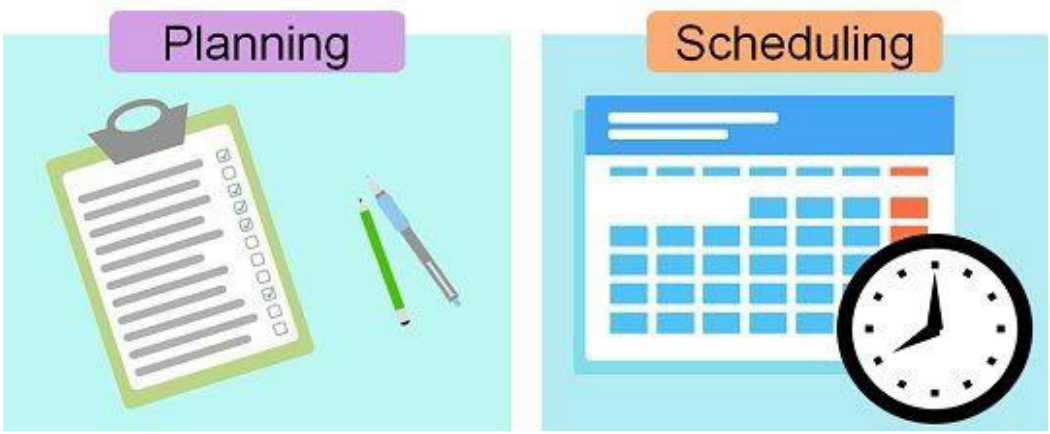


Fig. 6.3.1 Planning versus Scheduling

Work Planning

- Divide the work among the team members
- Distribute the work as per individual capability and skills.
- Ensure sufficient number of manpower is allocated to each task so that the work gets completes as planned.
- Allot all the necessary tools and equipment to the members.
- Organize work output such that no process causes delay for the other.
- Provide guidance to the team members as and when required.
- Plan your individual works as per the tasks involved the process.

Urgency and Importance Assessment: Assess each task based on its urgency (how soon it needs to be completed) and importance (its significance to the overall project). Urgency and importance can be categorized as follows:

- Important and Urgent (Do First): Tasks that are critical and require immediate attention, such as fixing a structural issue that may impact the project's stability or safety.
- Important but Not Urgent (Schedule): Tasks that are essential but can be planned and scheduled for a specific timeframe, such as ordering construction materials in advance.
- Important but Not Urgent (Schedule): Tasks that are essential but can be planned and scheduled for a specific timeframe, such as ordering construction materials in advance.
- Urgent but Not Important (Delegate): Tasks that require prompt action but may not be directly related to the core construction activities, such as administrative paperwork or minor adjustments.
- Not Important and Not Urgent (Eliminate): Tasks that have little impact on the project's success and can be eliminated or postponed if necessary.

Fig. 6.3.2 Urgent versus Importance (Prioritization Matrix)

Exercise

Answer the following questions.

- What is material planning?
- What are the benefits of material planning?
- What is work planning?
- What are the benefits of work planning?
- Why is it important to meet the target deadlines?

Notes

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National Skill Development Corporation
Transforming the skill landscape

7. Work According to Personal Health, Safety & Environment Protocols

Construction Skill Development Council

Unit 7.1 – Hazards and Emergency Situations

Unit 7.2 - Safety Drills, PPEs and Fire Safety

Unit 7.3 - Hygiene and Safe Waste Disposal Practices

Unit 7.4 - Infectious Disease and Its Cure

(CON/N9001)

Unit 7.1 Reinforcement Tools and Equipment

Unit Objectives

By the end of this unit, participants will be able to:

- Understand the types of hazards at the construction sites and identify the hazards specific to the domain related works.
- Recognize the safety control measures and actions to be taken under emergency situation.
- Know the reporting procedure to the concerned authority in case of emergency situations.

7.1.1 Hazards at Workplace

Hazards versus Risk: A hazard possesses the potential to induce harm, whereas risk pertains to the probability of harm occurring as a result of being exposed to that hazard.

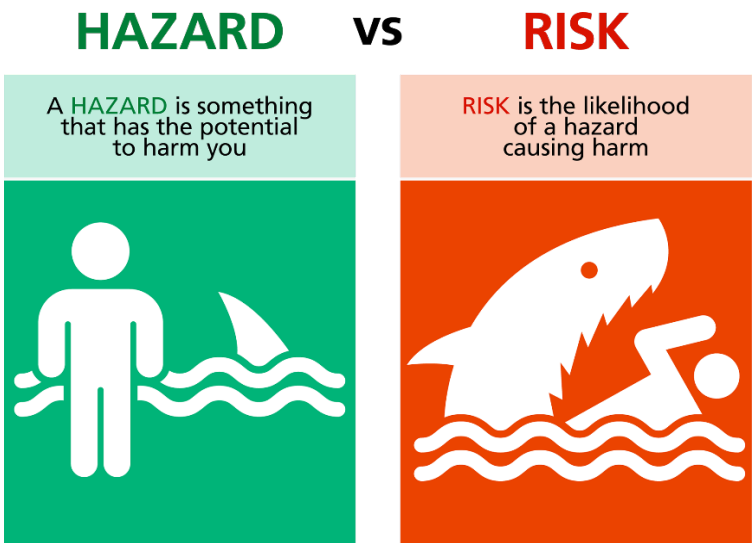


Fig. 7.1.1 Hazards versus Risk

Fig. 7.1.2 Workplace Hazards

Here are some common types of workplace hazards that can be found in various workplaces:

Fig. 7.1.3 Risk Associated with Hazards

- **Physical Hazards:**
  - Slips, trips, and falls
  - Falling objects or materials
  - Contact with moving machinery or equipment
  - Noise and vibration
  - Extreme temperatures (hot or cold)
  - Poor ergonomics leading to musculoskeletal disorders
- **Electrical Hazards:**
  - Electrical shock or electrocution
  - Short circuits or electrical fires
  - Fire and Explosion Hazards:
  - Combustible materials
  - Electrical equipment malfunctions
  - Inadequate fire safety measures
- **Vehicle-Related Hazards:**
  - Accidents involving vehicles or heavy machinery
  - Forklift incidents in warehouses and industrial settings
  - Chemical Hazards:
  - Exposure to toxic or hazardous substances (e.g., chemicals, fumes, gases)
  - Skin contact with irritants or corrosive materials

- Chemical spills or leaks

- **Psychosocial Hazards:**
  - Workplace stress and pressure
  - Bullying or harassment
  - Job insecurity
  - Long working hours and inadequate rest breaks

Identifying and mitigating workplace hazards is essential to ensuring the health and safety of employees. Employers should conduct regular risk assessments and implement appropriate safety measures and training to minimize the risks associated with these hazards.

7.1.2 Hazard Identification and Risk Assessment (HIRA):

Hazard Identification and Risk Assessment (HIRA) is a systematic process used to identify potential hazards in a workplace or any activity and assess the associated risks.

The primary goal of HIRA is to proactively identify and evaluate potential dangers to prevent accidents, injuries, and adverse health effects. It is a fundamental component of occupational health and safety management.

Fig. 7.1.4 Risk Assessment

The HIRA process typically involves the following steps:

- Conduct a comprehensive site survey to identify potential hazards at the construction site.
- Involve workers, supervisors, and safety personnel in the hazard identification process.
- Prioritize hazards based on their severity and likelihood of occurrence.
- Assess the risks associated with each identified hazard, considering potential consequences and exposure frequency.
- Implement appropriate control measures to reduce or eliminate the identified risks.
- Use the hierarchy of controls (elimination, substitution, engineering controls, administrative controls, and PPE) to address hazards effectively.

- Provide necessary training and awareness programs for workers on identified hazards and safety protocols.
- Regularly review and update the hazard identification and risk assessment as the construction progresses.
- Maintain proper documentation of the hazard identification and risk assessment process.
- Foster a culture of safety and encourage workers to report any new hazards or safety concerns.

HIRA is an ongoing process that requires the involvement and cooperation of all stakeholders, including workers, supervisors, safety officers, and management.

It helps create a safer work environment, reduces the likelihood of accidents, and contributes to improved overall occupational health and safety

Fig. 7.1.5 Risk Management Process

Hazards Specific to Domain-Related Works in Construction:

1. Roofing Hazards: Roofers face the risk of falls from heights, especially if proper fall protection measures are not in place.
2. Demolition Hazards: Demolition work involves risks of flying debris, structural collapses, and exposure to hazardous materials.
3. Welding and Cutting Hazards: Welders are exposed to sparks, fumes, and electrical hazards during welding and cutting processes.
4. Crane and Heavy Equipment Hazards: Improper operation of cranes and heavy machinery can lead to struck-by and caught-in accidents.
5. Scaffolding Hazards: Improperly assembled/unstable scaffolding poses fall risks for workers.
6. Concrete and Masonry Hazards: Workers involved in concrete pouring and masonry work face risks of heavy lifting injuries and ergonomic issues.
7. Highway and Roadwork Hazards: Road construction workers are at risk of being struck by vehicles passing through the work zone.
8. Electrical Installation Hazards: Electricians face the dangers of electric shocks and arc flashes during installation and maintenance work.
9. Painting Hazards: Painters may encounter risks from working at heights, using chemicals in paints, and exposure to fumes.
10. Tunneling Hazards: Workers involved in tunnel construction face risks of collapse, flooding, and exposure to harmful gases.

Different domain-related works have their unique risks, and it's essential to tailor safety measures accordingly to ensure a safe work environment for all employees.

7.1.3 Workplace Warning Signs:

Workplace warning signs are essential visual cues used in various environments to convey important information, instructions, or potential hazards.

These signs play a crucial role in promoting safety, providing guidance, and preventing accidents.

Safety signs are essential visual cues used to convey critical safety information and promote safety awareness in various environments.

Safety Signs are generally divided into 4 Categories along with their Colour Codes:

Fig. 7.1.6 Workplace Warning Signs

- Red
- Blue
- Yellow
- Green

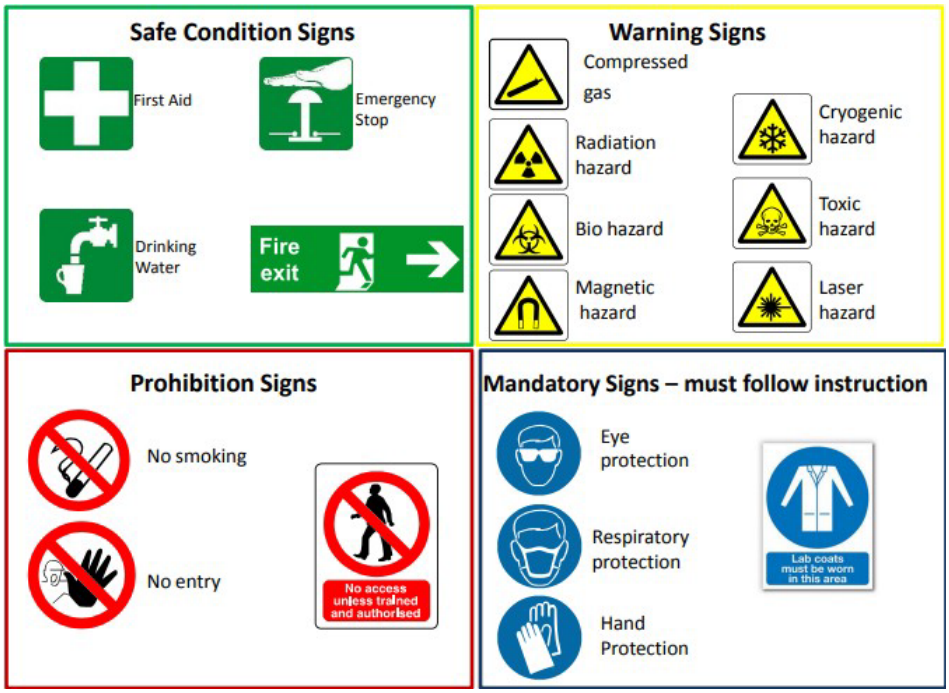


Fig. 7.1.7 Four Types of Safety Signs and their Colour

7.1.4 Emergency Response Plan (ERP)

An Emergency Response Plan (ERP) is a comprehensive document that outlines procedures, protocols, and responsibilities to be followed in the event of emergencies or critical incidents.

The ERP is designed to ensure the safety and well-being of individuals, property, and the environment during emergencies.

Fig. 7.1.8 Emergency Response Plan (ERP)

7.1.5 Reporting Emergency

Reporting procedures in case of emergency situations at a construction site play a crucial role in ensuring the safety of workers and facilitating a swift and coordinated response. The specific reporting procedure may vary depending on the construction site's policies and the type of emergency.

Fig. 7.1.9 Emergency Situations

However, here are general steps to follow when reporting an emergency situation at a construction site in India:

1. **Assess the Situation:** Quickly assess the nature and severity of the emergency while ensuring your safety and the safety of others, if possible.
2. **Activate the Alarm:** If the construction site has an alarm or emergency alert system, activate it to alert other workers and personnel about the emergency.
3. **Call Emergency Services:** Dial the appropriate emergency services number in India, which is 112, to connect to Police, Fire, and Medical emergency services.
4. **Provide Essential Information:** When calling emergency services, provide the operator with the following information:
    - The type of emergency (e.g., fire, collapse, injury).
    - The exact location of the construction site, including the address or nearby landmarks.
    - Any specific hazards or risks present at the site.
    - The number of people involved or injured (if known).
5. **Notify On-Site Personnel:** Inform the on-site supervisor, safety officer, or designated emergency response team members about the emergency.
6. **Follow the Construction Site's Emergency Response Plan:** Comply with the specific reporting procedures outlined in the construction site's Emergency Response Plan. This may involve contacting a specific individual or department responsible for handling emergencies.
7. **Cooperate with Authorities:** Once emergency services arrive at the construction site, cooperate fully with the authorities and follow any instructions provided by them.
8. **Inform Contractors or Site Management:** If the construction site involves multiple contractors or has site management, inform them about the emergency situation.

9. **Document the Incident:** After the emergency has been addressed, document the incident thoroughly, including the details of the emergency, response actions taken, and any injuries or damages incurred.
10. **Review and Improve Procedures:** After the emergency situation has been resolved, review the response and reporting procedures to identify any areas for improvement and make necessary adjustments to the Emergency Response Plan.

It is essential for all personnel working at the construction site to be familiar with the site's specific emergency response procedures and protocols. Regular training, drills, and awareness programs can help ensure that everyone knows how to respond effectively in case of emergencies, reducing the risk of injuries and minimizing damage to property.

Fig. 7.1.10 Reporting Emergency Situations

Notes

Unit 7.2 - Safety Drills, PPEs and Fire Safety

Unit Objectives

By the end of this unit, participants will be able to:

- Explain the classes of fire and types of fire extinguishers.
- Demonstrate the operating procedure of the fire extinguishers.
- Explain the importance of participation of workers in safety drills.
- List out basic medical tests required for working at construction site.
- Explain the purpose and importance of vertigo test at construction site.
- Explain the types and benefits of basic ergonomic principles, which should be adopted while carrying out specific task at the construction sites.
- Demonstrate use of PPEs as per work requirements.

7.2.1 Fire Triangle & Fire Types

Fire is a chemical reaction that occurs when a substance combines with oxygen and releases heat, light, and various combustion products.

It is a rapid oxidation process that can lead to destructive consequences if not controlled.

The fire triangle is a simple model used to illustrate the three essential components necessary for a fire to occur. These three components must be present simultaneously for a fire to ignite and sustain itself.

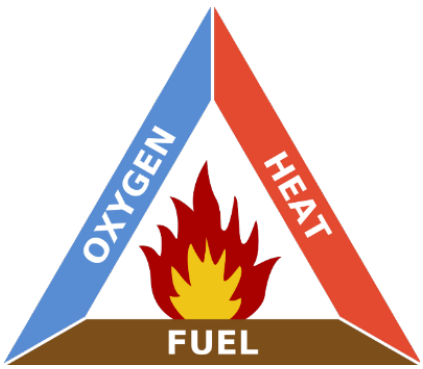


Fig. 7.2.1 Fire Triangle

There are several types of fires, categorized based on the fuel involved. The four main classes of fires are:

A		Ordinary Combustibles	Wood, Paper, Cloth, Etc.
B		Flammable Liquids	Grease, Oil, Paint, Solvents
C		Live Electrical Equipment	Electrical Panel, Motor, Wiring, Etc.
D		Combustible Metal	Magnesium, Aluminum, Etc.
K		Commercial Cooking Equipment	Cooking Oils, Animal Fats, Vegetable Oils

Fig. 7.2.2 Types of Fires

It is essential to use the appropriate extinguishing agents and follow proper fire safety protocols based on the type of fire to ensure effective firefighting and minimize risks to life and property. Fire safety training and understanding the different types of fires are crucial for individuals to respond safely and efficiently in the event of a fire emergency.

7.2.2 Fire Safety

Fire safety is a set of actions aimed at reducing the amount of damage caused by fire.

Fire safety procedures include both those that are used to prevent an uncontrolled fire from starting and those that are used to minimise the spread and impact of a fire after it has started. Developing and implementing fire safety measures in the workplace is not only mandated by law but is also essential for the protection of everyone who may be present in the building during a fire emergency.

Fig. 7.2.3 Fire at Construction Site

The basic Fire Safety Responsibilities are:

- To identify risks on the premises, a fire risk assessment must be carried out.
- Ascertain that fire safety measures are properly installed.
- Prepare for unexpected events.
- Fire safety instructions and training should be provided to the employees.

Prevention of a Workplace Fire:

- Workplace fire drills should be conducted regularly.
- If one has a manual alarm, one should raise it.
- Close the doors and leave the fire-stricken area as soon as possible. Ensure that the evacuation is quick and painless.
- Turn off dangerous machines, and don't stop to get personal items.
- Assemble at a central location. Ascertain that the assembly point is easily accessible to the employees.
- If one's clothing catches fire, one shouldn't rush about it. They should stop, descend on the ground, and roll to smother the flames if their clothes catch fire.

7.2.3 Fire Extinguisher

A fire extinguisher is a portable firefighting device designed to control and extinguish small fires. It is an essential tool for fire safety, allowing individuals to respond quickly to fires before they become unmanageable.

Fire extinguishers work by discharging a firefighting agent onto the fire, either by cooling the fuel, smothering the flames, or interrupting the chemical reaction required for combustion. Each fire extinguisher is specifically designed to combat certain classes of fires.

The most common types of fire extinguishers are:

1. Water Fire Extinguisher (Class A):
    - Suitable for Class A fires involving ordinary combustible materials such as wood, paper, cloth, plastics, and rubber.
2. Foam Fire Extinguisher (Class A and Class B):
    - Effective for Class A fires (ordinary combustibles) and Class B fires (flammable liquids and gases).
3. Dry Powder Fire Extinguisher (Class A, Class B, and Class C):
    - Versatile extinguisher suitable for Class A, B, and C fires.
4. Carbon Dioxide (CO2) Fire Extinguisher (Class B and Class C):
    - Suitable for Class B fires (flammable liquids and gases) and Class C fires (energized electrical equipment).
5. Wet Chemical Fire Extinguisher (Class K):
    - Specifically designed for Class K fires involving cooking oils and fats.

Fig. 7.2.4 Types of Fire Extinguishers

Fire extinguishers should be placed in easily accessible locations throughout buildings, construction sites, vehicles, and other facilities. Regular maintenance, inspection, and employee training on how to use fire extinguishers properly are essential components of fire safety programs. Remember, fire extinguishers are designed for small fires only. For larger fires or situations beyond your control, evacuate the area immediately and call the appropriate emergency services.

Using Fire Extinguisher:

Using a fire extinguisher properly can be instrumental in quickly extinguishing small fires and preventing them from spreading. When using a fire extinguisher, remember the acronym "PASS," which stands for Pull, Aim, Squeeze, and Sweep.

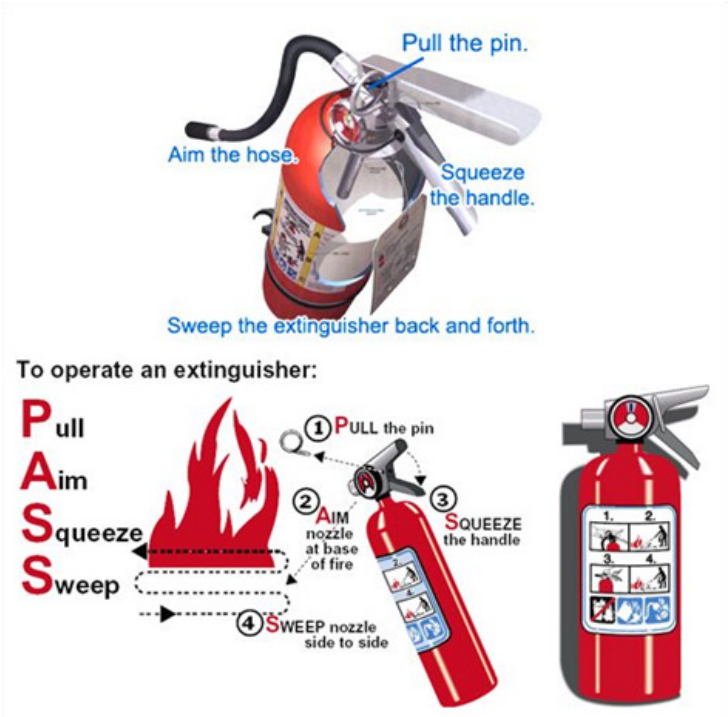


Fig. 7.2.5 Using a Fire Extinguisher

Remember the following important tips:

- Only use a fire extinguisher on small fires that are contained and not spreading rapidly.
- Make sure you are using the right type of fire extinguisher for the specific class of fire (e.g., Class A, B, C, K).
- Always maintain a safe distance from the fire and avoid getting too close to the flames.
- Never turn your back on a fire, and be prepared to evacuate if the fire becomes too large or uncontrollable.
- If the fire does not respond to the extinguisher or starts to grow rapidly, evacuate the area immediately and call the fire department.

7.2.4 Safety Drills and Its Importance for Workers

The participation of workers in safety drills at a construction site is of utmost importance to ensure a safe working environment and reduce the risk of accidents or incidents. Construction sites are inherently hazardous places, and safety drills play a crucial role in preparing workers to respond effectively to emergencies.

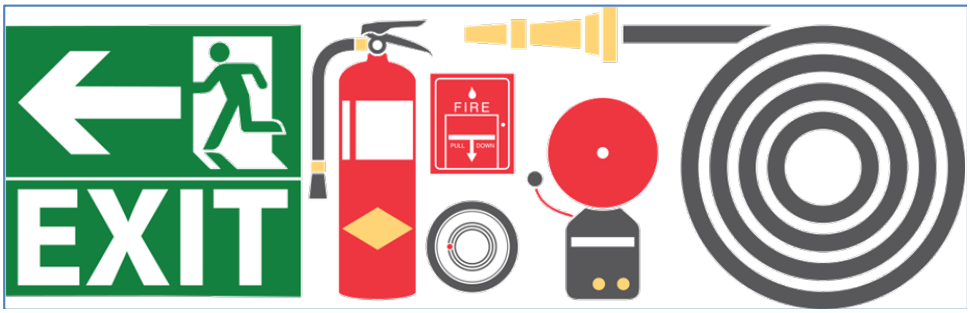


Fig. 7.2.6 Components related to Safety Drill

Here are some specific reasons why worker participation in safety drills is vital in a construction site setting:

1. **Familiarization with Site-Specific Procedures:** Construction sites can have unique layouts and hazards. Safety drills allow workers to become familiar with site-specific emergency procedures, such as evacuation routes, muster points, and the location of emergency equipment.
2. **Practicing Response to Common Construction Hazards:** Safety drills provide an opportunity to practice responding to emergencies related to common construction hazards, such as falls, structural collapses, confined space incidents, and electrical accidents.
3. **Building Muscle Memory for Critical Tasks:** By participating in safety drills, workers develop muscle memory for critical safety tasks, such as donning personal protective equipment (PPE), using fire extinguishers, or performing emergency rescues. Muscle memory helps workers react quickly and instinctively during real emergencies.
4. **Testing Effectiveness of Emergency Plans:** Safety drills allow construction site managers to assess the effectiveness of the site's emergency response plans and identify any gaps or weaknesses that need to be addressed.
5. **Boosting Confidence and Reducing Panic:** Regular participation in safety drills can boost workers' confidence in their ability to handle emergencies, making them less likely to panic and more likely to respond calmly and rationally.
6. **Team Coordination and Communication:** Safety drills encourage teamwork and coordination among workers. It helps them practice effective communication during emergencies, which is essential for a coordinated and efficient response.

7. Compliance with Regulations: Construction sites are subject to various safety regulations and standards. Worker participation in safety drills ensures that the construction site is compliant with safety requirements.
8. Preventing Injuries and Fatalities: The ultimate goal of safety drills is to prevent injuries and save lives. Properly trained and prepared workers are more likely to respond effectively to emergencies, reducing the severity of incidents.
9. Emergency Response Performance Evaluation: Safety drills provide an opportunity to evaluate how well workers respond to emergencies and identify areas that need improvement or additional training.
10. Promoting a Safety Culture: Encouraging worker participation in safety drills sends a strong message about the importance of safety at the construction site. It fosters a safety-first culture and instills a sense of responsibility for safety among all workers.

By actively involving workers in safety drills, construction site management can significantly enhance the site's emergency preparedness, improve response capabilities, and create a safer working environment for everyone involved.

Evacuation:

Evacuation at a construction workplace/site is a crucial aspect of ensuring the safety of all workers and visitors in case of emergencies. Construction sites can be hazardous environments with various potential risks, making preparedness and efficient evacuation procedures essential.

Fig. 7.2.7 Emergency Evacuation

7.2.5 Medical Examination for Construction Workers

The government has mandated that industrial enterprises undertake annual health checkups on their employees. In accordance with the Factories Act of India from 1948, both contractual and permanent employees in manufacturing businesses are required to undergo periodic health examinations. These examinations aim to protect the health and safety of factory workers.

The type of medical examination varies according to an employee's job description or the nature of the industrial process in which he is involved. For instance, if an employee works in the food

business, their hands are routinely inspected for skin disorders. If someone is involved in a hazardous manufacturing process, chest X-rays may be part of the medical checkup.

Consequently, depending on the nature of the production process and the job profile, an employee may be subjected to all standard and specific tests.

In addition, the frequency of medical examinations varies. According to the Maharashtra Plant Rules, for instance, if the factory is involved in the production of lead, workers are inspected once every month.

Medical Check-up Prior to Employment: A young person must have a pre-employment medical examination by a Certifying Surgeon to determine and confirm his fitness to work in a factory, according the Factories Act of 1948. The certificate of fitness is only valid for one year from the date it was issued.

Fig. 7.2.8 Medical Examination for Construction Workers

Medical Examinations for Workers in Hazardous Occupations: According to the Factories Act, a plant that engages in hazardous procedures is required to have its employees examined by a competent medical professional prior to employment and on a recurrent basis thereafter. Workers employed in a "hazardous process" are medically tested once before to employment by a Factory Medical Officer to determine their physical fitness and appropriateness for employment in a hazardous process.

Once every six months, the health status of all workers exposed to occupational health hazards must be determined.

Form 7 is completed, and if the medical findings reveal any abnormality or unsuitability of a person employed in the hazardous process, or if the worker has manifested signs and symptoms of a notifiable disease (as specified in the Third Schedule of the Factories Act), the worker must be removed from the process for health protection and cannot be employed in the same process. Alternatively, if the worker is totally handicapped, he or she will receive appropriate rehabilitation. Only after obtaining a Fitness Certificate from the Certifying Surgeon and Form 7 in accordance with the Factories Act may a withdrawn employee be rehired for the same process.

List of Recommended Medical Tests under the Factories Act:

1. Complete Physical Examination
2. Blood Group, Rh factor
3. Blood CBC, ESR, RBS
4. Urine Test (Routine & Microscopic)
5. Creatinine
6. Electrocardiogram (Computerised ECG)

7. Chest X-Ray (Standard Size)
8. Lung Function Test
9. Vision Test (Screening)
10. Audiometric Test
11. HIV & HBS Tests

7.2.6 Vertigo Test

Vertigo is a symptom, not a condition in and of itself. Vertigo is a sort of dizziness that is frequently described as the sensation that one is spinning or that the world is spinning around them, especially when they alter their position.

Vertigo affects people of all ages. Middle ear pathology is typically the culprit in younger patients. The danger of falls and associated sequelae necessitates a specialised assessment of the elderly. The key to arriving at a diagnosis is distinguishing vertigo from other causes of dizziness or imbalance, as well as distinguishing central causes of vertigo from peripheral causes.

Vertigo is a symptom that is associated with numerous medical disorders. Your doctor may require one or more tests or procedures to better understand your underlying issue. Numerous of these tests require specialised equipment and experienced personnel.

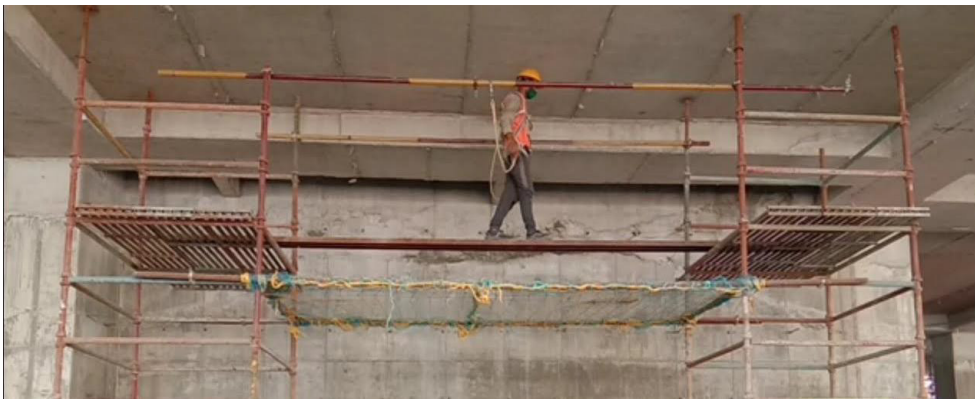


Fig. 7.2.9 Vertigo Test for Construction Workers

Some exams are brief and painless, while others are lengthy and unpleasant Your doctor can recommend the relevant tests for your condition

7.2.7 Basic Ergonomic Principles

Basic ergonomic principles involve designing and arranging workspaces, equipment, and tasks to optimize efficiency, productivity, and worker well-being.

Ergonomics aims to reduce the risk of musculoskeletal disorders (MSDs) and other work-related injuries by ensuring that the work environment fits the worker's capabilities and needs.

Fig. 7.2.10 Basic Ergonomic Principles

Construction sites can be physically demanding and involve various tasks that may lead to musculoskeletal disorders (MSDs) and other injuries if not properly addressed. Here are some basic ergonomic principles to consider at a construction site:

- Proper Lifting Techniques:
  - Train workers in proper lifting techniques to avoid back injuries. Encourage the use of mechanical lifting aids, such as cranes or hoists, for heavy or awkward loads.
- Worksite Organization:
  - Arrange tools, equipment, and materials to minimize excessive reaching or bending.
  - Keep frequently used items within easy reach to reduce unnecessary movement.
- Tool Selection:
  - Provide ergonomic tools with appropriate grips and handles that reduce hand and wrist fatigue.
  - Choose tools that require less force to operate to prevent overexertion.

By applying these basic ergonomic principles at construction sites, employers can create a safer and more comfortable working environment, reduce the risk of work-related injuries, and improve the overall well-being and productivity of construction workers.

7.2.8 First Aid

First aid refers to the immediate and initial care given to an injured or ill person before professional medical help arrives. It is crucial in emergencies to stabilize the injured or sick individual and prevent their condition from worsening.

First aid aims to preserve life, alleviate pain, and promote recovery.

Here are some key points about first aid:

Objectives of First Aid:

- **Preserve Life:** The primary objective of first aid is to assess the situation and provide immediate care to save lives.
- **Prevent Further Harm:** First aid measures aim to prevent the injured person's condition from worsening.
- **Relieve Pain:** First aid techniques can provide pain relief to the injured or ill person.
- **Promote Recovery:** Properly administered first aid can help promote the person's recovery and reduce the severity of injuries or illnesses.

Fig. 7.2.11 First Aid to Injured Person

Common First Aid Procedures:

- Assessment: Assess the situation and the injured or ill person's condition. Ensure your safety and the safety of others.
- CPR (Cardiopulmonary Resuscitation): If the person is not breathing or their heart has stopped, perform CPR to maintain blood flow and provide oxygen.
- Bleeding Control: Apply pressure to stop bleeding from wounds and injuries.
- Wound Care: Clean and dress wounds to prevent infection and aid healing.
- Fracture and Sprain Care: Immobilize fractures and provide support for sprains to prevent further damage.
- Burn Care: Cool burns with running water and cover with a clean, non-stick dressing.
- Choking Response: Perform abdominal thrusts (Heimlich maneuver) on a choking person to clear their airway.
- Seizure Management: Keep the person safe during a seizure and provide comfort afterward.

First Aid Kits:

A well-stocked first aid kit is essential in homes, workplaces, and vehicles. It should contain items such as adhesive bandages, gauze pads, antiseptic wipes, adhesive tape, scissors, tweezers, CPR mask, disposable gloves, and pain relievers, among others.

Note: While first aid can be lifesaving, it is not a substitute for professional medical care. In emergencies, call for professional help (e.g., emergency services) as soon as possible, especially for serious injuries or illnesses.

Fig. 7.2.12 First Aid Kit

It is crucial to receive formal first aid training to effectively administer first aid and respond appropriately in emergency situations. Proper training ensures that you can provide the most appropriate care and support to those in need until professional help arrives.

7.2.9 Ensure Electrical Safety at Construction Sites

Electrical safety is important because hazards such as arc flash and shock can result in death if you are exposed to them.

Fortunately, the likelihood of this occurring is relatively low

However, the control measures that prevent these hazards require careful management, attention to detail and technical competence.

Fig. 7.2.13 Electrical Hazards

- Conduct regular inspections of electrical equipment and wiring to identify any potential hazards or defects.
- Ensure all electrical installations and equipment meet relevant safety standards and codes.
- Provide proper training to construction workers on electrical safety practices and procedures.
- Clearly label electrical panels, switches, and outlets for easy identification.
- Use ground fault circuit interrupters (GFCIs) to protect against electric shock in wet or damp environments.
- Avoid overloading electrical circuits and outlets by distributing loads evenly.
- Keep electrical cords and cables away from heavy machinery, sharp objects, or areas with high foot traffic.
- Store electrical tools and equipment properly when not in use to prevent damage and accidents.
- Use insulated tools and personal protective equipment (PPE) when working with electricity.
- Have a clear emergency plan in place in case of electrical accidents or incidents and ensure workers are familiar with it.

Fig. 7.2.14 Electrical Safety

7.2.10 PPE and Its Importance

Personal Protective Equipment (PPE) plays a crucial role in the construction industry to protect workers from potential hazards and ensure their safety on the job. PPE is designed to shield workers from various risks, such as falling objects, electrical hazards, chemical exposure, noise, and more.

Fig. 7.2.15 PPEs in Construction Industry

Importance of PPE in Construction Industry:

1. Hazard Protection: PPE serves as a barrier between workers and potential workplace hazards, preventing injuries and illnesses.
2. Legal Compliance: Regulatory authorities require the use of appropriate PPE in construction to meet safety standards and comply with regulations.
3. Injury Prevention: PPE can significantly reduce the risk of injuries and accidents, protecting workers' health and well-being.
4. Risk Reduction: PPE mitigates the risk of exposure to harmful substances, noise, dust, and other occupational hazards.
5. Enhanced Productivity: When workers feel safe and protected, their confidence and efficiency increase, leading to improved productivity.

Types of PPE in Construction Industry:

Injury Protection	Description	PPE
Head Injury Protection	Head injuries can occur due to falling or flying objects, stationary objects, or contact with electrical wires. Hard hats provide protection against such injuries by shielding the head. Electrician's hard hat is commonly made of nonconductive plastic. It is accompanied by safety goggles for additional eye protection.	

Foot and Leg Injury Protection	Safety shoes, especially those made of leather, provide essential foot protection. They offer protection against various risks, including falling or rolling objects, sharp objects, wet and slippery surfaces, molten metals, hot surfaces, and electrical hazards. Proper use of safety shoes enhances safety measures for workers in hazardous environments like construction sites.	
Eye and Face Injury Protection	Spectacles and goggles provide protection against hazards like flying fragments, large chips, hot sparks, radiation, and splashes from molten metals. Special helmets or shields offer additional protection for the face and eyes in hazardous environments. Spectacles with side shields and face shields enhance eye safety by preventing exposure to various risks. These protective gears also safeguard against partides, sand, dirt, mists, dust, and glare, promoting overall eye health and safety.	
Protection against Hearing Loss	Hearing protection can be achieved through earplugs or earmuffs. Prolonged exposure to high noise levels can lead to permanent hearing loss, physical strain, and mental stress. Self-forming earplugs made of materials like foam, waxed cotton, or fibreglass wool are commonly used as they offer a good fit. For better fit and protection, workers should be fitted with moulded or prefabricated earplugs by a specialist.	
Hand Injury Protection	Hand protection is crucial for workers exposed to hazardous substances through skin absorption, serious wounds, or thermal burns. Gloves are commonly used as protective gear for hands. Electricians often use leather gloves with rubber inserts when working on electrified circuits. Kevlar gloves are employed when stripping cable with a sharp blade to prevent cuts and injuries.	

Whole Body Protection	Full-body protection is essential for workers to safeguard against heat and radiation hazards. Whole-body PPE includes materials like rubber, leather, synthetics, plastic, fire-retardant wool, and cotton. Maintenance staff working with high-power sources like transformer installations and motor-control centers are often required to wear fire-resistant clothes for added safety.	

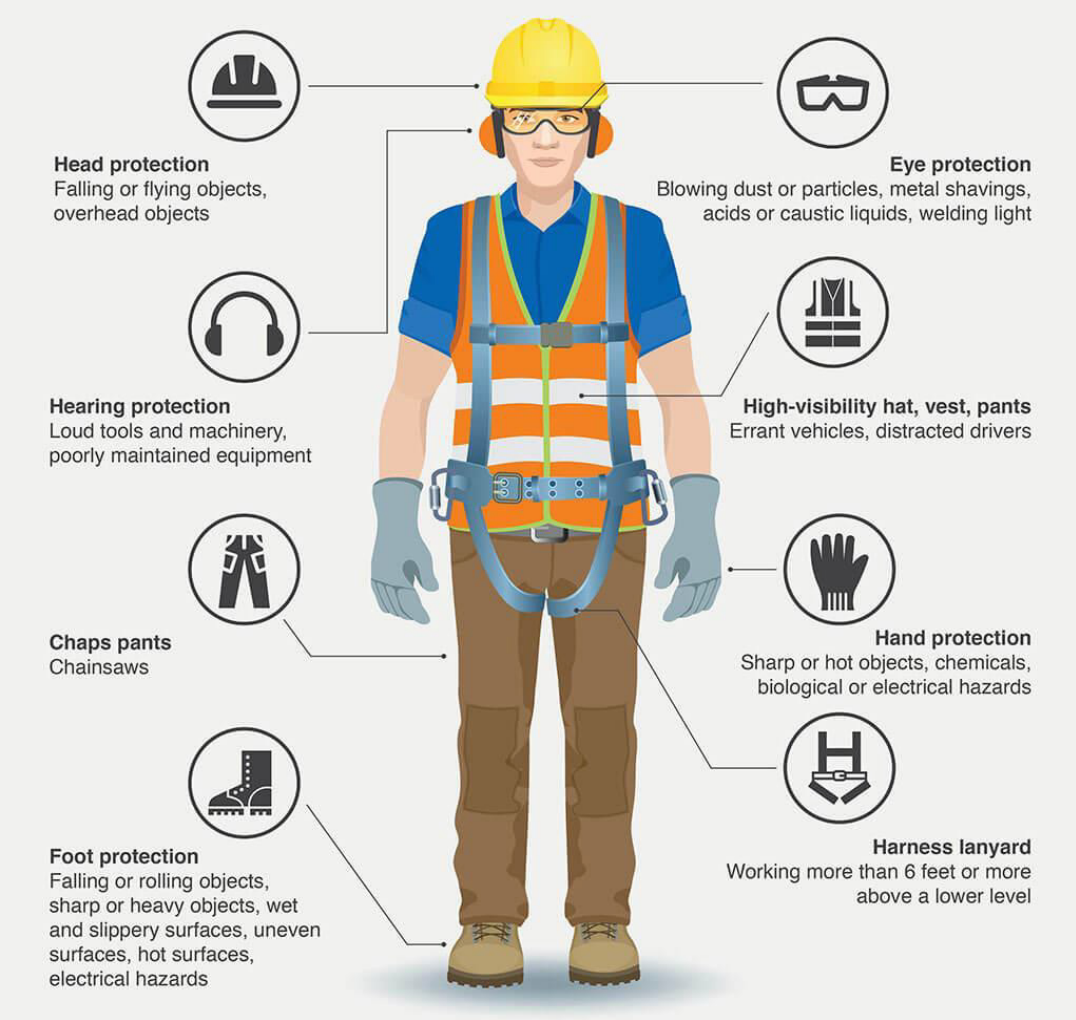


Fig. 7.2.16 A Construction Worker with proper PPEs

Care and Maintenance of PPE:

- Regular Inspection: PPE should be inspected before each use to ensure it is in good condition and free from damage.
- Proper Storage: Store PPE in a clean, dry, and designated area away from direct sunlight and chemical exposure.
- Cleaning: Clean PPE regularly according to the manufacturer's guidelines to maintain its effectiveness.
- Replacement: PPE should be replaced when damaged, worn out, or beyond its usable life as specified by the manufacturer.
- Training: Provide training to workers on the proper use, care, and limitations of PPE.
- Comfort and Fit: Ensure that PPE fits properly and is comfortable for the worker to encourage consistent use.

PPE is essential for protecting workers from harm, but it is also the last line of defence.

Care and Maintenance of Tools & Equipment:

- Regularly inspect tools and equipment for signs of damage or wear.
- Keep tools and equipment clean and free from dirt and debris after each use.
- Store tools and equipment in a dry and secure location, protected from weather elements.
- Follow manufacturer's instructions for battery-operated tools regarding charging and storage.
- Train workers on proper tool usage, care, and maintenance to ensure safe and efficient operation

Notes

Unit 7.3 - Hygiene and Safe Waste Disposal Practices

Unit Objectives

By the end of this unit, participants will be able to:

- Follow the practices to maintain personal hygiene, workplace hygiene and site/ workplace sanitization
- Understand the importance of housekeeping works
- Keep an eye on safe housekeeping practices
- Understand different types of waste at construction sites and their disposal method
- Know safe waste disposal practices followed at construction site

7.3.1 Personal Hygiene and Cleanliness

Personal hygiene and cleanliness are essential practices that involve maintaining cleanliness and taking care of one's body to prevent the spread of germs, illnesses, and maintain overall well-being. These practices are crucial for promoting good health and preventing the transmission of infectious diseases.

Fig. 7.3.1 Personal Hygiene

Here are some key aspects of personal hygiene and cleanliness:

- **Regular Bathing or Showering:** Regular bathing or showering helps to keep the body clean and remove dirt, sweat, and bacteria from the skin.
- **Handwashing:** Proper handwashing with soap and water is one of the most effective ways to prevent the spread of germs and infections.

- **Oral Hygiene:** Brushing teeth twice a day and flossing regularly help maintain good oral health and prevent dental problems.
- **Trimming Nails:** Keeping nails clean and trimmed prevents the accumulation of dirt and germs under the nails.
- **Hair Care:** Regularly washing and maintaining hair cleanliness can prevent scalp issues and promote healthy hair.
- **Wearing Clean Clothes:** Wearing clean clothes helps prevent the spread of germs and keeps the body fresh.
- **Proper Use of Personal Protective Equipment (PPE):** In certain situations, such as during a pandemic or when handling hazardous materials, using appropriate PPE like masks, gloves, and safety gear is crucial for personal protection and hygiene.
- **Handling Food Safely:** Properly handling, preparing, and storing food helps prevent foodborne illnesses.
- **Cough and Sneezing Etiquette:** Covering the mouth and nose with a tissue or elbow when coughing or sneezing helps prevent the spread of respiratory droplets containing germs.
- **Managing Menstrual Hygiene:** Properly managing menstrual hygiene is essential for women's health and well-being.
- **Cleaning and Disinfecting Surfaces:** Regularly cleaning and disinfecting frequently-touched surfaces, such as doorknobs and handles, helps prevent the spread of germs.
- **Managing Personal Waste:** Properly disposing of waste and using clean and sanitary facilities help prevent the spread of infections.

Maintaining personal hygiene and cleanliness is not only important for individual health but also for public health. It is essential for reducing the risk of contagious diseases and maintaining a hygienic living and working environment. By practicing good personal hygiene and cleanliness, individuals can contribute to a healthier and safer community.

Importance of Informing on Personal Health Issues

The importance of reporting to the designated authority about infectious diseases and injuries are:

- The infectious diseases can spread and affect the health of other workers at the farm.
- The infectious diseases can be spread to the consumers if the bacteria and viruses spread through the produces.
- The injuries should be timely reported and should be taken care of immediately. If not timely reported it may worsen and may cause severe diseases and even death.

Fig. 7.3.2 Infectious Disease

7.3.2 Workplace Cleanliness and Sanitization

Workplace cleanliness and sanitization are crucial for creating a safe, healthy, and productive work environment.

Clean and sanitized workplaces not only reduce the risk of the spread of infections and illnesses but also contribute to employee well-being and morale.

Fig. 7.3.3 Workplace Cleanliness

Here are some important aspects of workplace cleanliness and sanitization:

1. Regular Cleaning Routine: Establish a regular cleaning schedule for the workplace, including workstations, common areas, restrooms, and shared equipment. Cleaning should be done daily or as needed, depending on the nature of the workplace.
2. Surface Disinfection: Regularly disinfect frequently-touched surfaces, such as doorknobs, light switches, keyboards, and shared equipment. Use EPA-approved disinfectants that are effective against viruses and bacteria.
3. Hand Sanitizing Stations: Place hand sanitizing stations at convenient locations throughout the workplace to encourage employees and visitors to maintain hand hygiene.
4. Restroom Hygiene: Maintain clean and well-stocked restrooms with proper sanitation supplies. Regularly clean and disinfect restroom surfaces to prevent the spread of germs.
5. Waste Management: Provide clearly marked waste disposal bins and ensure proper waste segregation. Regularly empty trash bins and dispose of waste appropriately.
6. Kitchen and Break Areas: Maintain cleanliness in kitchen and break areas by regularly cleaning countertops, sinks, and shared appliances. Encourage employees to clean up after themselves.
7. Ventilation and Air Quality: Ensure proper ventilation to improve indoor air quality. Clean air filters regularly to remove dust and allergens from the air.
8. Personal Protective Equipment (PPE): Provide appropriate PPE, such as masks and gloves, for employees when needed, especially during pandemics or when handling hazardous materials.

9. Educate Employees: Educate employees about the importance of workplace cleanliness and hygiene practices. Encourage them to follow hygiene guidelines and protocols.
10. Workplace Signage: Display hygiene-related signage, such as handwashing instructions, cough etiquette, and reminders about cleaning protocols, to reinforce good practices.
11. Cleaning and Sanitization Training: Train cleaning staff and employees responsible for workplace cleanliness on proper cleaning and sanitization techniques and the correct use of disinfectants.
12. Workplace Wellness Initiatives: Implement workplace wellness programs that promote good health and hygiene practices among employees.

By prioritizing workplace cleanliness and sanitization, employers can create a healthier and safer environment for their employees, clients, and visitors. Regular cleaning and sanitation efforts help prevent the spread of infections, reduce absenteeism, and foster a positive work culture focused on employee well-being and productivity.

7.3.3 Implement Good Housekeeping Practices at Construction Site

Implementing good housekeeping practices at a construction site is essential to maintain a safe, organized, and efficient working environment. Proper housekeeping helps prevent accidents, reduces the risk of injuries, and enhances productivity.

Here are some effective ways to promote good housekeeping practices at construction sites:

1. Designate Storage Areas:

Fig. 7.3.4 Designated Areas

Assign specific areas for storing tools, equipment, and materials. Keep these areas organized and ensure that items are returned to their designated places after use.

2. Regular Cleanup:

Fig. 7.3.5 Clean-up Debris and Waste

Schedule regular cleanup sessions throughout the workday to remove debris, waste, and hazards from the construction site. Encourage all workers to participate in keeping the site clean.

3. **Dispose of Waste Properly:** Provide clearly marked waste disposal bins and containers. Train workers to segregate waste materials correctly, including hazardous materials, to ensure safe disposal.

Fig. 7.3.6 Disposing of Waste

4. **Keep Walkways Clear:** Ensure that walkways, access routes, and emergency exits are clear of obstructions at all times. Remove trip hazards and obstacles to prevent accidents.

Fig. 7.3.7 Clear Walkways

5. **Store Flammable Materials Safely:** Store flammable materials, such as fuel, solvents, and gases, in designated storage areas away from potential ignition sources. Follow safety guidelines for their storage and handling.

Fig. 7.3.8 Store Flammable Safely

6. **Prevent Slips, Trips, and Falls:** Regularly inspect the site for slippery surfaces, loose debris, and uneven terrain. Address potential hazards promptly to reduce the risk of slips, trips, and falls.

Fig. 7.3.9 Prevent Hazards

7. **Control Dust and Debris:** Use dust control measures, such as wetting down surfaces, using dust collectors, or providing personal protective equipment (PPE), to reduce airborne dust and debris.

Fig. 7.3.10 Wetting Down Dust

8. **Proper Material Handling:** Train workers on proper material handling techniques to prevent injuries caused by lifting, carrying, or moving heavy objects.

Fig. 7.3.11 Material Handling with Safety

9. **Secure Tools and Equipment:** Ensure that tools and equipment are properly stored, secured, and maintained when not in use. Avoid leaving them unattended or in precarious positions.

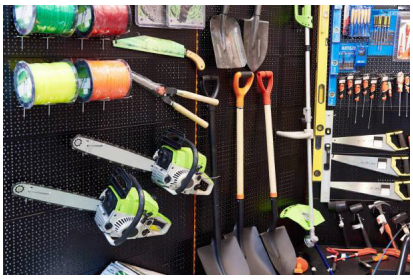


Fig. 7.3.12 Securing Tools & Equipment

10. **Inspect and Maintain Equipment:** Regularly inspect machinery, vehicles, and equipment to identify potential issues or defects. Perform maintenance and repairs promptly to ensure their safe operation.

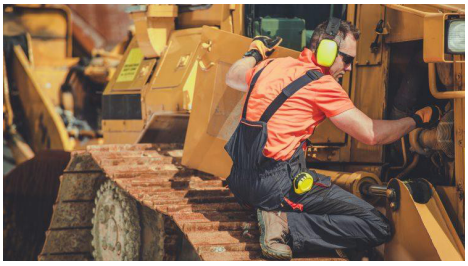


Fig. 7.3.13 Inspect and Maintain Equipment

Fig. 7.3.14 Good Housekeeping and Safety relevance

Remember that good housekeeping is an ongoing effort and requires the commitment and cooperation of all workers and management. By prioritizing cleanliness and organization at the construction site, you can create a safer and more productive work environment for everyone involved.

7.3.4 Handwashing

Handwashing is a simple yet highly effective practice that involves cleaning one's hands with soap and water to remove dirt, germs, and other harmful microorganisms.

Proper handwashing is one of the most important measures to prevent the spread of infectious diseases, including common colds, flu, gastrointestinal infections, and respiratory illnesses.

Proper Handwashing Technique:

- Wet Hands: Wet your hands with clean, running water (warm or cold).
- Apply Soap: Apply enough soap to cover all hand surfaces.
- Rub Hands Together: Rub your hands palm to palm to create lather. Continue rubbing the backs of your hands, between your fingers, and under your nails.
- Scrub for at least 20 Seconds: Scrub your hands for at least 20 seconds. Singing "Happy Birthday" twice is a useful timer.
- Rinse Thoroughly: Rinse your hands thoroughly under clean, running water.
- Dry Hands: Dry your hands using a clean towel or air dry them. If possible, use a paper towel to turn off the faucet to avoid recontamination.

Fig. 7.3.15 Handwashing

When to Wash Hands:

- Before preparing or eating food
- After using the restroom
- After coughing, sneezing, or blowing your nose
- After touching surfaces in public places
- After handling garbage or waste
- After caring for someone who is sick
- Before and after tending to wounds or injuries

Fig. 7.3.16 Wash Hands Properly

7.3.5 Avoid Bad Habits

Avoiding bad habits like smoking, drinking alcohol, and addiction to tobacco and gutkha is essential for maintaining good health and well-being. These habits can have severe negative impacts on physical health, mental health, and overall quality of life.

Here are some reasons to avoid these habits:

- Understand the health risks associated with smoking, drinking alcohol, and using tobacco and gutkha.
- Seek support from family, friends, or support groups to help quit these habits.
- Replace bad habits with healthier alternatives, such as exercise, hobbies, or mindfulness practices.
- Set specific and achievable goals to gradually reduce and eliminate these habits.
- Avoid triggers or situations that may tempt you to engage in these bad habits.
- Practice stress management techniques to cope with stress without turning to harmful substances.

Fig. 7.3.17 Avoid Bad Habits

- Stay informed about the benefits of quitting and the negative impacts of these habits.
- Use nicotine replacement therapies or medications to aid in quitting smoking.
- Find healthy ways to socialize and relax without relying on alcohol or tobacco.
- Celebrate small milestones and successes in your journey to quit these bad habits.

7.3.6 Waste Types at Construction Sites

Construction sites generate various types of waste during the building process.

Some common types of waste found at construction sites include:

1. Concrete and Bricks Waste: Excess or damaged concrete, bricks, blocks, and precast elements.
2. Wood Waste: Includes timber offcuts, pallets, and packaging materials.
3. Metal Waste: Scrap metal from structural elements, reinforcement bars, and metal packaging.
4. Plastic Waste: Packaging materials, plastic sheets, and pipes.
5. Cardboard and Paper Waste: Packaging materials and documents.
6. Glass Waste: Broken or excess glass from windows, doors, and mirrors.

7. Asphalt Waste: Leftover asphalt from road or pavement construction.
8. Paints and Chemicals: Unused or leftover paints, solvents, adhesives, and other construction chemicals.
9. Electrical Waste: Old or damaged electrical components, cables, and wiring.
10. Insulation Materials: Unused or waste insulation materials.
11. Hazardous Waste: Materials containing asbestos, lead, mercury, or other hazardous substances.
12. Packaging Waste: Cardboard boxes, plastic wraps, and other packaging materials.

Fig. 7.3.18 Construction Wastes

Proper waste management and disposal methods are crucial to handle these various types of waste responsibly and minimize their impact on the environment. Recycling, reusing, and responsible disposal in designated landfills or waste treatment facilities are some of the ways to manage construction site waste effectively.

7.3.7 Waste Management

The collection, disposal, monitoring, and processing of waste materials is known as waste management. These wastes affect living beings' health and the environment. For reducing their effects, they have to be managed properly. The waste is usually in solid, liquid or gaseous form.

- Waste management is important because it decreases waste's impact on the environment, health, and other factors. It can also assist in the reuse or recycling of resources like paper, cans, and glass. The disposal of solid, liquid, gaseous, or dangerous substances is the example of waste management.
- When it comes to trash management, there are numerous factors to consider, including waste disposal, recycling, waste avoidance and reduction, and garbage transportation. Treatment of solid and liquid wastes is part of the waste management process. It also provides a number of recycling options for goods that aren't classified as garbage during the process.

Fig. 7.3.19 Waste Management

7.3.8 Methods of Waste Management

Construction waste management is crucial for reducing environmental impact and promoting sustainable practices in the construction industry. The 5Rs framework offers a systematic approach to managing construction waste, focusing on reducing waste generation and maximizing resource efficiency. The 5Rs stand for: Reduce, Reuse, Recycle, Recover, and Residuals. Here's how each of these methods is applied in construction waste management:

1. **Reduce:**
    - Design for Minimal Waste: Employ design strategies that aim to minimize waste generation during the construction phase. This includes accurate quantity estimation, optimizing material use, and choosing construction methods that generate less waste.
    - Prefabrication: Prefabrication and modular construction techniques can significantly reduce on-site waste by producing components off-site with precise measurements and minimal material wastage.
    - Waste Audits: Conduct waste audits to identify the major sources of waste and implement measures to reduce waste generation.
2. **Reuse:**
    - Salvage and Reuse Materials: Salvage and reuse materials from demolition or renovation activities that are still in good condition and can be repurposed in other projects. This includes

doors, windows, fixtures, and lumber.

- Temporary Structures: Utilize temporary structures and materials that can be disassembled and reused in other projects to reduce waste.

3. **Recycle:**

   - On-Site Recycling: Set up on-site recycling facilities to process construction waste, such as concrete, wood, metal, and plastics, into reusable materials like aggregates, mulch, or recycled content products.
   - Use Recycled Content: Incorporate recycled content materials, such as recycled concrete aggregate or reclaimed wood, in new construction to reduce the demand for virgin resources.

4. **Recover:**

   - Energy Recovery: Some non-recyclable construction waste can be converted into energy through waste-to-energy processes, helping to minimize landfill disposal and generate electricity or heat.
   - Anaerobic Digestion: Organic waste can be processed through anaerobic digestion to produce biogas, which can be used as a renewable energy source.

5. **Residuals Management:**

   - Landfill Diversion: For waste that cannot be reduced, reused, recycled, or recovered, focus on diverting it from landfills and explore alternative disposal methods that have a lower environmental impact.
   - Responsible Disposal: Ensure that waste that ends up in landfills is disposed of responsibly, adhering to local regulations and guidelines.

Fig. 7.3.20 Waste Bin Types and their Colour

By implementing the 5Rs framework, construction companies can minimize waste generation, conserve resources, reduce environmental pollution, and move towards a more sustainable and environmentally friendly approach to construction waste management.

7.3.9 Waste Management on a Construction Site

On the construction site, one must be mindful of how they handle waste and garbage. Having a plan for managing these goods is necessary to protect the safety of both workers and the general public. Here are some waste management strategies:

- Before disposing of them in the dumpster, place any hand tools in containers with lids.
- Place empty paint cans in the trash instead than spilling them down drains or onto pavements.
- Rinse disposable cups and other food containers before placing them in a recycling bin. This will help prevent litter from being blown onto the property during windy or rainy weather.
- Recycle equipment and other metal objects by utilising a magnet or air compressor to remove all non-metal components, such as nails, screws, nuts, bolts, electrical wiring, etc. These are then segregated by category prior to proper recycling.
- Insulation should be disposed of in the garbage as opposed to being poured down drains or onto pavements, as it can clog sewer systems.
- Use a tarp to pile dirt, rocks, bricks, and other heavy things into the bed of a truck before hauling them away when the work is complete. This will make future clean-up easier.
- Instead of discarding excess lumber, wrap it in plastic to prevent it from becoming wet and infected with termites.
- Use a leak-proof container or urn to transfer hazardous liquids away for proper disposal; this will keep the workers and others on-site dry and healthy.
- Regularly cleaning up will reduce the amount of debris.
- Using trash cans with lids to prevent rubbish from falling to the ground.
- On your site, provide workers with safety vests for simple identification and protection from concealed threats such as electrical cables and sharp instruments.
- Ensure that there is a designated space for recyclable materials such as glass, plastic, cardboard, and metal containers so that they may be sorted later

It is necessary to have a plan for waste management on construction sites, which are typically untidy places.

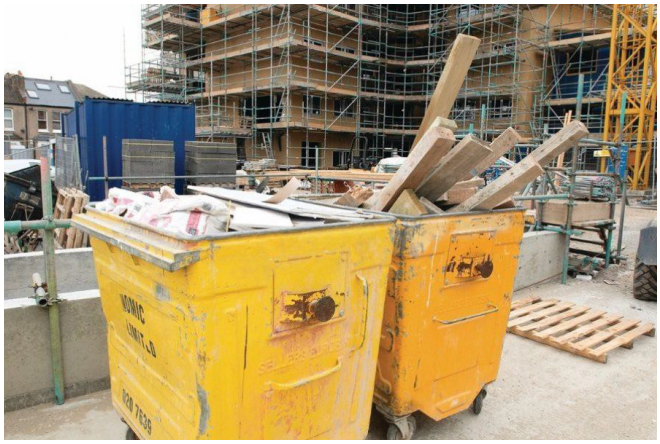


Fig. 7.3.21 Waste Management on a Construction Site

Notes

Unit 7.4 - Infectious Disease and Its Cure

Unit Objectives

By the end of this unit, participants will be able to:

- Know different types of infectious disease that can spread/ originate at a construction site
- Understand the ways of transmission of the various infectious disease.
- Recognize the methods to check the spread of the infectious disease.
- Understand the symptoms and cure of the various infectious disease.
- Apprehend the procedure to report to the concerned authority regarding the outbreak/ hazard of any infectious disease/ pandemic.

7.4.1 Infectious Diseases

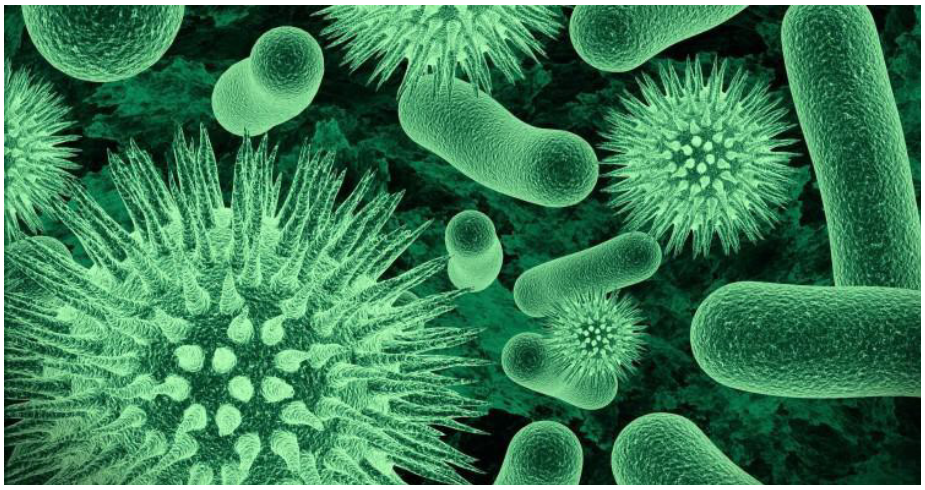


Fig. 7.4.1 Infectious Diseases

Viruses, bacteria, parasites, or fungi can cause infectious diseases. Additionally, uncommon viral disorders known as transmissible spongiform encephalopathies exist (TSEs).

- **Viral infections**
- **Bacterial infections**
- **Fungal infections**
- **Parasitic infections**
- **Transmissible spongiform encephalopathies (TSEs/prion diseases)**

Infectious diseases are extremely common worldwide, but some are more common than others.

Some of the most common infectious diseases are listed here by type.

Common infectious diseases caused by viruses:

- Common cold.
- The flu (influenza).
- COVID-19.
- Stomach flu (gastroenteritis).
- Hepatitis.
- Respiratory syncytial virus (RSV).

Common infectious diseases caused by bacteria:

- Strep throat.
- Salmonella.
- Tuberculosis.
- Whooping cough (pertussis).
- Chlamydia, gonorrhea and other sexually transmitted infections (STIs).
- Urinary tract infections (UTIs).
- E. coli.
- Clostridioides difficile (C. diff).

Common infectious diseases caused by fungi:

- Ringworm (like athlete's foot).
- Fungal nail infections.
- Vaginal candidiasis (vaginal yeast infection).
- Thrush.

Common infectious diseases caused by parasites:

- Giardiasis.
- Toxoplasmosis.
- Hookworms.
- Pinworms.

7.4.2 Prevention of Infectious Diseases

There are numerous simple strategies to minimise the chance of contracting an infectious disease and even prevent certain diseases entirely. While each of them reduces your chance of contracting and transmitting infectious diseases, there is typically no single method that is 100 percent effective. Therefore, it is essential to have several risk-reduction behaviours.

Vaccines

Vaccines lessen the likelihood of contracting an infectious disease by preparing the immune system to recognise and combat dangerous invaders.

Vaccinated individuals may occasionally still get an illness, although their symptoms are typically milder than they would have been without vaccination.

Fig. 7.4.2 Vaccines for Infectious Diseases

Vaccines are available for a number of common infectious diseases, such as:

- **Chickenpox:** Highly contagious viral infection causing itchy skin rash and fever.
- **COVID-19:** Respiratory illness caused by the novel coronavirus, leading to a wide range of symptoms from mild to severe.
- **Diphtheria, tetanus, and whooping cough (whooping cough):** Bacterial infections with symptoms like severe throat inflammation, muscle stiffness, and persistent cough.
- **Hepatitis A:** Liver infection caused by the hepatitis A virus, transmitted through contaminated food and water.
- **Hepatitis B:** Viral infection affecting the liver, transmitted through blood and body fluids, leading to acute or chronic liver disease.
- **Human papillomavirus (HPV):** Common sexually transmitted infection, linked to cervical and other cancers.
- **Influenza:** Viral respiratory infection causing fever, body aches, and respiratory symptoms.
- **Malaria:** Mosquito-borne infectious disease characterized by fever, chills, and flu-like symptoms.
- **Rubella, measles, and rubella:** Viral infections causing rashes, fever, and respiratory symptoms, with potential complications.
- **Polio:** Highly contagious viral infection affecting the nervous system, leading to paralysis in severe cases.
- **Rotavirus:** Common cause of severe diarrhea in young children.
- **Rabies:** Deadly viral disease affecting the nervous system, transmitted through animal bites.
- **Shingles:** Painful viral rash caused by the reactivation of the chickenpox virus.
- **Tuberculosis:** Bacterial infection primarily affecting the lungs, causing persistent cough and fatigue.

- The CDC provides current vaccination recommendations for children, adolescents, and adults. Before you travel, ensure that you have had all of the necessary vaccines for your location.
- Other methods of infectious illness prevention:
- In addition to immunisations and appropriate food handling procedures, you can lower your risk of contracting or transmitting an infectious disease by a few common actions.
- Hands should be washed with soap and water. Before making a meal or eating, after using the restroom, after contact with faeces (human or animal), and after gardening or dealing with dirt, it is essential to wash hands thoroughly.
- When you sneeze or cough, cover your nose and mouth.
- Sanitize regularly touched surfaces in your home and place of business.
- Avoid contact with infectiously ill individuals and the exchange of personal goods with them.
- While suffering from an infectious ailment, you should avoid contact with others.
- Do not drink or swim in potentially contaminated water.
- When sick or as recommended by the CDC, you should wear a mask in public.
- Always use a condom during sexual activity.
- To limit the risk of tick or mosquito bites, apply tick- and mosquito-approved insect repellent, cover as much exposed skin as possible with clothing, and check for ticks after spending time in wooded or grassy areas.

Fig. 7.4.3 Mask and Hand wash during Infectious Disease

7.4.3 General Health Issues and their Symptoms & Cure

General health issues like fever, cough, and cold can affect construction workers, especially when working in diverse weather conditions and exposed to various environmental factors.

Fig. 7.4.4 Symptoms of Fever, Cough and Cold

Here are their symptoms and some recommendations on what construction workers can do to manage these health issues:

Fever:

- Symptoms: Elevated body temperature, chills, body aches, fatigue.
- To-Do:
  - Rest and avoid strenuous physical activity.
  - Stay hydrated by drinking plenty of fluids.
  - Use over-the-counter fever-reducing medications if necessary.
  - Seek medical attention if the fever persists or becomes severe.

- **Cough:**
  - Symptoms: Persistent coughing, irritation in the throat, chest discomfort.
  - To-Do:
    - Avoid exposure to irritants like dust and fumes as much as possible.
    - Stay well-hydrated to soothe the throat.
    - Use a mask or respirator to protect the airways from particles and pollutants.
    - Seek medical advice if the cough worsens or is accompanied by other symptoms.
- Cold:
  - Symptoms: Runny or stuffy nose, sneezing, sore throat, mild body aches.
  - To-Do:
    - Rest and take sufficient breaks to recover.
    - Keep warm and dress appropriately for the weather.
    - Drink warm fluids like soups and herbal teas.
    - Use over-the-counter cold remedies to alleviate symptoms.

General Health Tips for Construction Workers:

- Stay hydrated throughout the day, especially in hot weather.
- Wear appropriate protective gear such as safety shoes, gloves, and helmets.
- Take regular breaks and rest when needed to prevent fatigue.
- Practice proper hand hygiene to reduce the risk of infections.
- Use masks or respirators when working in dusty or polluted environments.
- Eat a balanced diet to maintain overall health and immunity.
- Get regular medical check-ups and vaccinations as recommended.

It's important for construction workers to prioritize their health and safety, as their job often involves physical exertion and exposure to potential health hazards. If any health issue persists or worsens, it is advisable for them to seek medical attention promptly.

7.4.4 Reporting an Outbreak or Hazard of any Infectious Disease or Pandemic

Reporting an outbreak or hazard of any infectious disease or pandemic is crucial for prompt action and preventing further spread of the illness. The specific reporting procedure may vary based on the organization, industry, or country. Here's a general procedure to report such incidents to the concerned authority:

1. Identify the signs and symptoms of the infectious disease or pandemic hazard.
2. Isolate affected individuals to prevent further spread.
3. Inform immediate supervisors or managers about the situation promptly.
4. Contact the appropriate health authorities or public health department.
5. Cooperate with contact tracing efforts and provide necessary information.
6. Implement preventive measures recommended by health authorities.
7. Communicate updates and preventive measures to employees to maintain transparency.

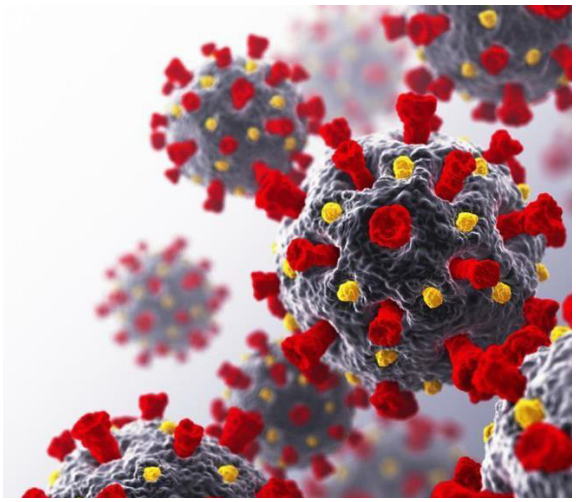


Fig. 7.4.5 Spread of Disease

Remember that reporting an outbreak or hazard of any infectious disease or pandemic promptly is essential for quick containment and mitigation. Cooperate with healthcare professionals, follow their advice, and work together to protect the health and safety of your community and workplace.

Exercise

Answer the following questions.

- Describe the different types of hazards commonly found in the construction industry.
- What are the key steps in handling emergency situations at a construction site, and how should incidents be reported to the concerned authority?
- What are the basic principles of first aid, and how can employees be trained in administering first aid?
- Explain the fire safety measures that should be implemented at a construction site, including fire extinguisher usage and evacuation procedures.
- Why is personal protective equipment (PPE) important in the construction industry, and what are the essential care and maintenance practices for PPE?
- How can good housekeeping practices be effectively implemented at a construction site to improve safety and organization?
- What are safe waste disposal practices that should be followed in the construction industry to protect the environment and prevent health hazards?

Notes

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National Skill Development Corporation
Transforming the skill landscape

8. Employability Skills (60 Hours)

It is recommended that all trainings include the appropriate Employability Skills Module. Content for the same can be accessed

https;//www.skillindiadigital.gov.in/content/list

Scan the QR code below to access the eBook

DGT/VSQ/N0102

Annexure

Annexure of QR Codes for Mason Concrete

Chapter Name	Unit Name	Topic Name	URL	QR Code	Page no.
Chapter 1: Introduction to the role of a Mason Concrete	Unit 1.2: An Overview of Construction Sector	Construction Industry	https://youtu.be/p4f0Ni15EaM	Construction Industry	14
		Modernization in Construction	https://youtu.be/WmQyPYm_g20	Modernization in Construction	14
	Unit 1.3: Mason Concrete as a job role	Introduction to concrete structures	https://youtu.be/J7fTtNI3lwk	Introduction to concrete structures	21
		Personal Attributes of Mason Concrete	https://youtu.be/juRxHEF67WQ	Personal Attributes of Mason Concrete	21
Chapter 2: Core / Generic Skills	Unit 2.2 – Systems of Measurements	Systems of Measurement	https://youtu.be/H1xo5UVJKVo	Systems of Measurement	35
	Unit 2.3 – Calculating Area and Volume of geometrical shapes	Calculation of Perimeter, Area and Volume	https://youtu.be/OhTubw4C0to	Calculation of Perimeter, Area and Volume	44

Chapter 3: Place, level and finish concrete in various structural elements including repairs (CON/N0117)	Unit 3.1 – Introduction to Concreting Work	Compositions in Concrete	https://youtu.be/EZwRiBDGX0c	Compositions in Concrete	66
	Unit 3.2 – Tools and equipment used in Concreting	Concreting Tools and Equipment	https://youtu.be/wuzQ8dsYJSw	Concreting Tools and Equipment	75
	Unit 3.3 – Placing, leveling and finishing of concrete in various structural elements	Reinforced Cement Concrete Construction	https://youtu.be/b_PWGjsa7yc	Reinforced Cement Concrete Construction	91
	Unit 3.4 – Concreting in Precast Segments	Process in Making Precast Concrete Segments	https://youtu.be/8yoHltK1Naw	Process in Making Precast Concrete Segments	102
	Unit 3.5 – Repair works in Concrete	Repairing Concrete Defects	https://youtu.be/wXDelzvjyQs	Repairing Concrete Defects	108
Chapter 4: Carry out IPS/ Tremix flooring (CON/N0114)	Unit 4.1 – Introduction to cement concrete flooring	Reinforcement in Cement Concrete Flooring	https://youtu.be/Vx0lp4DJxfU	Reinforcement in Cement Concrete Flooring	121

	Unit 4.2 – IPS Flooring	IPS Flooring Methodology	https://youtu.be/R2YAcUE_mCg	IPS Flooring Methodology	125
	Unit 4.3 – Tremix Flooring	Tremix Flooring Methodology	https://youtu.be/X0zCZJHv3yI	Tremix Flooring Methodology	135

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
ISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Developmer
Corporation
Transforming the skill landscape

Construction Skill Development Council

Adress : Tower 4B, DLF Corporate Park, 201&, 202 4B, Mehrauli-Gurgaon Rd, DLF Phase 3, Gurugram, Haryana 122002, India

Email: standards@csdcindia.org

Website: www.csdcindia.org

Phone: +91-124-4513915

Price: ₹