



Participant Handbook

Sector
Construction

Sub-Sector
**Real Estate and
Infrastructure Construction**

Occupation
Masonry

Reference ID: **CON/Q0101, Version 4.0**

NSQF Level 2



Helper Mason

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Shri Narendra Modi
Prime Minister of India

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



Construction Skill
Development Council of India



Certificate

COMPLIANCE TO QUALIFICATION PACK- NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the
CONSTRUCTION SKILL DEVELOPMENT COUNCIL OF INDIA
for

SKILLING CONTENT: PARTICIPANT HANDBOOK

Complying to National Occupational Standards of
Job Role/Qualification Pack: 'Helper Mason'

QP No. 'CON/Q0101, Version 4.0 NSQF Level 2'

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Authorised Signatory
(Construction Skill Development Council)

Acknowledgements

This participant's handbook meant for Helper Mason 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 Helper Mason. 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 Helper Mason. 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 Helper Mason. 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 Helper Mason QP:

- CON/N0101: Erect and dismantle temporary scaffold of 3.6-meter height
- CON/N0102: Identify, handle, shift and store materials, tools & equipment relevant to masonry work
- CON/N0103: Prepare cement mortar /concrete mix and carry out curing of masonry structure
- CON /N0104: Carry out manual earthwork at construction sites
- CON/N9001: Work according to personal health, safety and environment protocol at construction site
- DGT/VSQ/N0101: Employability Skills (30 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

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1. Introduction of Construction Sector and Job Role



Unit 1.1 – Objectives of the Training Program

Unit 1.2 – Introduction to Construction Industry in India

Unit 1.3 – Brief about Masonry Occupation



Key Learning Outcomes

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

1. Explain the overview and objective of the training program
2. Discuss about the construction sector and its sub-sectors in India
3. Summarize the key job roles in the construction sector
4. Describe the employment opportunities in construction sector
5. Define the masonry work
6. Discuss the job description of a Helper Mason
7. Describe the responsibilities of a Helper Mason
8. List down the essential knowledge and skills required for the job of a Helper Mason
9. Discuss the career progression of a Helper Mason

UNIT 1.1: Objectives of the Training Program

Unit Objectives

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

- Understand the purpose of training
- Recognize the benefits of training

1.1.1 Purpose of Training

This training programme is intended to impart basic skills and knowledge to helper masons. Over the past few decades, the construction industry in India has experienced rapid growth, leading to an increase in the construction of new structures such as residential towers, housing societies, schools, colleges, and more. This surge in construction has created a significant demand for skilled workers. Unfortunately, there are very few skilled workers available for construction works in India.

The purpose of this training is to equip construction workers with the necessary skills and knowledge to meet industry standards, providing them with better career opportunities and growth within the construction sector. By enhancing the skillset of the workforce, the quality of construction work will greatly improve, leading to better outcomes in construction projects.



Fig. 1.1.1 Classroom Session



Fig. 1.1.2 Practical Session

This training program will cover the skill and knowledge required by a helper mason to perform at construction site. Helper mason should know and perform the following:

- Identify and handle materials to be used for construction purpose
- Identify hand and power tools to be used in masonry work
- Carry out excavation, backfilling and compaction of earth
- Preparation of cement mortar and concrete mix
- Curing of concrete surfaces

- Upkeep of tools
- Healthy and safe working practices followed at construction site
- Cleaning and housekeeping of workplace § Communicate efficiently in the workplace



Fig. 1.1.3 Work Environment of a Helper Mason

1.1.2 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 (CSDC).
- This certificate will help you to get a job and earn better wages in construction sector.
- The skills acquired along with the certificate will also help you to grow in your career.

UNIT 1.2: Introduction to Construction Industry in India

Unit Objectives

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

- Explain about construction sector in India
- Compare urban and rural construction
- Observe and outline modernization of construction
- About major occupations in the construction sec Discuss tor

1.2.1 Overview of Construction Sector in India

Construction industry helps in developing and enhancing economic sector as well as aids in the development of the country. Construction activity plays an important role in country's infrastructure and industrial development. Construction refers to building of different structures such as hospitals, schools, townships, offices, and houses and other buildings (including water supply, sewerage, and drainage), highways, roads, ports, railway tracks, dams etc. If we are covering a wide spectrum, construction activity becomes the basic input for socio-economic development.







Fig. 1.2.1 Construction Industry

Construction is the second largest employment generating sector in India after agriculture.

This sector comprises of small, medium and large industries or companies which are involved in different types of projects. This creates a diverse requirement of work force.

Some examples of Infrastructure are:

<p>Buildings</p>	
<p>Bridges</p>	
<p>Dams</p>	
<p>Power Plants</p>	

Railway Bridges



Hotels



Airports



Buildings



Construction industry is broadly divided into two major sub-sectors:

1. Real estate & infrastructure construction; and
2. Rural construction

Real Estate & Infrastructure Construction

The real estate sector holds significant global recognition, encompassing housing, retail, hospitality, and commercial sub-sectors. Its growth is closely linked to the expansion of the corporate landscape and the rising demand for office spaces, urban, and semi-urban accommodations. Among the 14 major sectors, the construction industry ranks third, considering its direct, indirect, and induced effects on the economy as a whole.

In India, the real estate sector stands as the second-largest employment generator, trailing only the agriculture sector. There is a strong expectation of increased investment from non-resident Indians (NRIs) in both the short and long terms. Bengaluru is anticipated to be the most favored destination for NRI property investments, followed by Ahmedabad, Pune, Chennai, Goa, Delhi, and Dehradun.

According to the Economic Times Housing Finance Summit, about three houses are built per 1,000 people per year compared with the required construction rate of five houses per 1,000 populations. The current shortage of housing in urban areas is estimated to be ~10 million units. An additional 25 million units of affordable housing are required by 2030 to meet the growth in the country's urban population.



Government Initiatives under Urban Development

Indian government has undertaken several initiatives under urban development to address the challenges posed by rapid urbanization and to promote sustainable and inclusive growth in cities and towns.



Fig. 1.2.4 Building Construction Site



Fig. 1.2.5 Industrial Building Construction Site

Some of the key government initiatives include:

- **Smart Cities Mission:** Launched in 2015, the Smart Cities Mission aims to develop 100 smart cities across the country. These smart cities are intended to be equipped with advanced infrastructure and technology to enhance quality of life, promote sustainable development, and provide efficient urban services to residents.
- **Atal Mission for Rejuvenation and Urban Transformation (AMRUT):** The AMRUT scheme was launched in 2015 to focus on providing basic urban infrastructure in cities and towns, such as water supply, sewerage, and urban transportation. The goal is to improve the quality of life for urban residents.
- **Pradhan Mantri Awas Yojana (PMAY):** This scheme, launched in 2015, aims to provide affordable housing for all by 2022. It consists of two components: Pradhan Mantri Awas Yojana (Urban) for urban areas and Pradhan Mantri Awas Yojana (Gramin) for rural areas.
- **Swachh Bharat Mission (Urban):** The Swachh Bharat Mission focuses on promoting cleanliness, sanitation, and hygiene in urban areas. It aims to eliminate open defecation, improve solid waste management, & ensure a clean urban environment.
- **Heritage City Development and Augmentation Yojana (HRIDAY):** This scheme aims to preserve and revitalize the rich cultural heritage of heritage cities in India, making them more livable and tourist-friendly.
- **National Urban Livelihoods Mission (DAY-NULM):** DAY-NULM was launched to reduce poverty and vulnerability of urban poor households. It provides self-employment opportunities, skill development, and access to credit and capital.

Rural Construction

Rural Construction: This sub-sector aims at the constructional requirements of rural India and construction of rural households, warehouses, village roads etc.



Fig. 1.2.6 Rural Roads



Fig. 1.2.7 Rural House

Rural infrastructure is not only an important element of rural expansion but also a significant element in ensuring any sustainable poverty reduction plan. The appropriate expansion of infrastructure in rural zones improves the rural financial system and quality of life. It encourages augmented agricultural profits, satisfactory employment etc.

Government Initiatives under Rural Development

Indian government has launched various initiatives under rural development to uplift rural areas, improve the living standards of rural communities, and promote inclusive growth. Some of the key government initiatives under rural development include:

- Pradhan Mantri Gram Sadak Yojana (PMGSY): Launched in 2000, PMGSY aims to provide all-weather road connectivity to unconnected rural habitations. The program focuses on improving rural access and connectivity, which has a positive impact on economic development and social integration.
- Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA): MGNREGA, launched in 2005, guarantees 100 days of wage employment to every household in rural areas. It aims to provide livelihood security to rural households and promote rural development through the creation of durable assets and infrastructure.
- Pradhan Mantri Awaas Yojana - Gramin (PMAY-G): Launched in 2016, PMAY-G aims to provide affordable and quality housing to rural households. It focuses on improving the living conditions of the rural poor and providing them with a safe and secure dwelling.
- Swachh Bharat Mission (Gramin): Similar to the urban counterpart, this mission focuses on promoting cleanliness and sanitation in rural areas. It aims to achieve an open defecation-free rural India and improve rural sanitation facilities.

"Bharat Nirman"

"Bharat Nirman" was an initiative launched by the Indian government in 2005 to accelerate rural development and bridge the infrastructure gaps in rural areas.



Fig. 1.2.8 Bharat Gramin Yojna for improving Rural Infrastructure

It aimed to enhance the quality of life and economic opportunities for rural communities by focusing on six key areas:

- **Rural Housing:** Bharat Nirman aimed to provide affordable housing to the rural poor and ensure that every rural household had access to a safe and secure dwelling.
- **Rural Roads:** The initiative focused on improving rural connectivity by constructing and upgrading rural roads under the Pradhan Mantri Gram Sadak Yojana (PMGSY). This helped in facilitating easier access to markets, healthcare, and education for rural residents.
- **Rural Water Supply:** Bharat Nirman aimed to provide safe and sustainable drinking water to rural areas under the National Rural Drinking Water Programme (NRDWP). The goal was to ensure that every rural household had access to potable water.
- **Rural Electrification:** The initiative sought to electrify all unelectrified villages and provide electricity connections to rural households. The focus was on enhancing rural electrification and promoting energy access in remote areas.
- **Rural Telecommunication:** Bharat Nirman aimed to extend telecommunication services to rural areas, including mobile and broadband connectivity, to bridge the digital divide and enable access to information and services.
- **Irrigation:** The initiative sought to increase the irrigation potential in rural areas to enhance agricultural productivity and income. This was done through various schemes and projects promoting water conservation and management.

Bharat Nirman played a significant role in boosting rural development and improving the overall socio-economic conditions in rural India. It brought attention to the importance of infra development in rural areas and contributed to rural empowerment and growth.

Notes 

Scan the QR code to watch the video



<https://youtu.be/yhjDhav4Pfw>

Overview of Construction Sector in India

1.2.2 Major occupations in Construction Sector

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

Masonry: Masonry involves the work to use mortar for fixing constituents like brick, stone, block or others to build walls and buildings.

The basic objectives of masonry work 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 tiling, 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 Brick work



Fig. 1.2.10 Plastering Work

Few job roles under masonry occupation are:

- I. Helper Mason
- II. Assistant Mason
- III. General Mason
- IV. Mason Tiling
- V. Mason Concrete
- VI. Mason marble, granite & stone; and
- VII. Mason Special Finishing
- VIII. Mason Form Finishes & Special concrete.

Bar Bending and Fixing: Bar bending and Steel Fixing involves works like shifting, straightening, cutting, bending and placing of the reinforcement bars in order to assemble cage/mesh according to given working structural drawing or specifications.



Fig. 1.2.11 Bar bending

Few job roles under bar bending occupation are:

- I. Helper bar bender & steel fixer;
- II. Assistant bar bender & steel fixer;
- III. Bar bender & steel fixer; and
- IV. Reinforcement fitter.



Fig. 1.2.12 Reinforcement bars fixed at site

Shuttering Carpentry: Shuttering Carpentry involves the use of timber boards or metal plates to create a temporary structure for casting of concrete. These timber boards or metal plates are placed, positioned and fixed using rods and stakes known as false work. After fixing these boards or plates in designated area, concrete can be dispensed within these fixed moulds. These moulds contain the concrete in its place till it sets, thereby generating a hard, smooth structure.

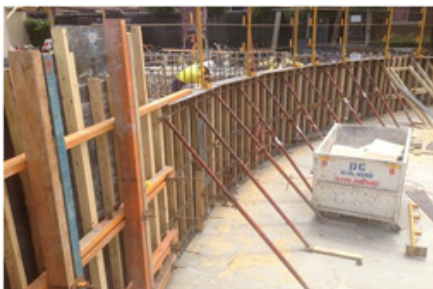


Fig. 1.2.13 Conventional formwork



Fig. 1.2.14 System formwork

Few job roles under shuttering carpentry occupation are:

- I. Helper shuttering carpenter;
- II. Assistant shuttering carpenter;
- III. Shuttering carpenter – system; and
- IV. Shuttering carpenter – conventional.

Scaffolding: Scaffolding works involve creation of temporary support structure for providing support to workman during construction process. It is use as a platform to carry on construction works and keep tools and materials



Fig. 1.2.15 Scaffolding work

Few job roles under scaffolding occupation are:

- I. Assistant scaffold – system; and;
- II. Assistant scaffold – conventional.;
- III. Scaffolder-System
- IV. Scaffolder-Conventional.
- V. Chargehand Scaffolding –System
- VI. Foreman Scaffolding

Fabrication: Fabrication is the process of construction of an item from raw materials using cutting, bending assembling process, instead of creating it from ready to use components or parts. It involves various tasks such as cutting & heating, welding followed by final assembly of welded, sand-blasted, primed, painted components.

Key part of this process is also the initial phases of grinding, drilling and surface preparation, essential for fabrication.

Few job roles under Fabrication occupation are:

- I. Grinder Construction;
- II. Construction fitter;
- III. Construction welder;
- IV. Fabricator; and
- V. Plasma cutter.



Fig. 1.2.16 Welding

Rigging: Rigging is a set of actions used for moving, lifting and transferring objects by scheming and fitting various components and equipment. A team of riggers designs and installs the lifting or rolling equipment needed to raise, roll, slide or lift objects such as with a crane.

Few job roles under rigging occupation are:

- I. Khalasi;
- II. Rigger structural erection;
- III. Rigger precast erection; and
- IV. Rigger piling.



Fig. 1.2.17 Rigging work at site

1.2.3 Typical Layout of a Construction Site

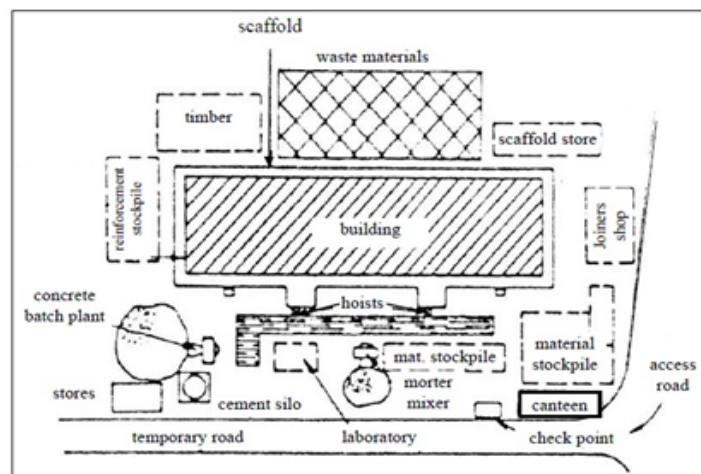


Fig. 1.2.18 Layout of a construction site

UNIT 1.3: Brief about Masonry Occupation

Unit Objectives



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

- Understand masonry and its elements.
- Understand the career progression under masonry occupation.

1.3.1 About Masonry

Masonry is a construction technique that involves the use of bricks, blocks, stones, or other materials to build structures. It is one of the oldest and most durable forms of construction known to humanity. Masonry structures can be found all around the world, and they are commonly used in residential, commercial, and industrial buildings.

Here are some key points about masonry:

- 1. Materials:** Masonry can be constructed using various materials, including bricks, concrete blocks, natural stones (such as granite, limestone, or marble), clay tiles, and more. The choice of material depends on factors like the desired appearance, structural requirements, and budget.
- 2. Types of Masonry:**
 - Brick Masonry: Uses bricks as the primary building material, typically arranged in courses using mortar.



Fig. 1.3.1 Stone masonry

- Stone Masonry: Involves using natural stones of varying shapes and sizes, skilfully laid together with mortar.



Fig. 1.3.2 Brick masonry

- Concrete Block Masonry: Utilizes concrete blocks, which are larger and faster to lay compared to individual bricks or stones.



Fig. 1.3.3 Block masonry

- Adobe Masonry: Incorporates sun-dried mud bricks (adobe) for construction, commonly found in some regions with suitable soil composition.



Fig. 1.3.4 Adobe masonry

3. **Construction Process:** Masonry construction typically involves laying individual units (bricks, blocks, or stones) in a bed of mortar, which is a cementitious mixture that binds the units together. Skilled workers, known as masons, carefully place each unit, ensuring proper alignment, spacing, and levelling.
4. **Strength and Durability:** Masonry structures are known for their strength and durability, making them suitable for withstanding various weather conditions and natural disasters. Properly constructed masonry can last for centuries.
5. **Advantages of Masonry:**
 - **Fire Resistance:** Masonry materials are inherently fire-resistant, making them a preferred choice for fire-safe construction.
 - **Thermal Mass:** Masonry structures can provide thermal mass, helping regulate indoor temperatures and reducing energy consumption.
 - **Aesthetic Appeal:** Masonry offers a wide range of textures, colors, and patterns, allowing for aesthetically pleasing designs.
 - **Low Maintenance:** Well-built masonry requires minimal maintenance over the years.
6. **Challenges:**
 - **Labor-Intensive:** Masonry construction can be time-consuming and labor-intensive, requiring skilled workers to achieve quality results.

- **Cost:** Depending on the materials used and intricacy of design, masonry construction can be relatively more expensive than other building methods.



Fig. 1.3.5 Labor intensive

Masonry continues to be a popular construction method due to its time-tested reliability, visual appeal, and ability to create long-lasting structures. Advances in technology and modern construction techniques have also improved the efficiency and versatility of masonry in contemporary building projects.

Various Masonry Structures:

Masonry techniques yield a diverse array of structures, each tailored to distinct functional and aesthetic needs. Load-bearing walls, foundational to most buildings, support vertical loads and distribute weight efficiently. Retaining walls combat erosion and maintain gradients, while facades showcase artistic masonry craftsmanship while protecting structures from the elements.

Arches and vaults, epitomizing architectural ingenuity, both beautify and support spaces. Fireplaces and chimneys blend utility with charm, while garden walls and fences delineate property boundaries. Columns and pillars provide structural reinforcement while adding architectural elegance.

From pavements to ornate structures, masonry embodies both practicality and artistic finesse in diverse construction applications.

Brick Arch



Rubble masonry in boundary wall



Bricks masonry used in building



Masonry using masonry arches & stone



Table 1.3.1 Various infrastructure related to masonry

1.3.2 Job Description of a Helper Mason

This job role is responsible for identification, handling and use of tools and tackles, materials and equipment. The responsibilities also include site clearance, providing support for masonry works, carrying out mortar & cement concrete mixing, curing of structure and erection and dismantle of temporary scaffolding. The individual should have good knowledge about the environment, health, safety and safe working practices.

Key responsibilities are:

- Demonstrate transfer of levels as per drawings/instructions.
- Demonstrate the setting out of the layout as per drawings/instructions.
- Construct load bearing /non load bearing wall, columns and footings using bricks.
- Carry out pointing in brick masonry.
- Perform specialized masonry works such as arches, staircase, manholes and walkways.
- Repair and restore brick masonry.
- Lay blocks for construction of wall.
- Repair and restore block masonry.
- Demonstrate effective communication with co-workers, superiors and sub-ordinates across different teams.
- Provide support to co-workers, superiors and sub-ordinates within the team and across interfacing teams to ensure effective execution of assigned task.
- Demonstrate practices sensitive to disabilities (physical, mental, intellectual or sensory impairment), cultural diversity and gender neutrality.

- Demonstrate prioritizing of work activities to achieve the desired productivity
- Demonstrate organizing of resources as per work plan prior to commencement of work
- Perform safe waste disposal at construction site.
- Demonstrate the activities to check the spread of infection as per medical/ organizational guidelines.
- Demonstrate brick bat coba water proofing.
- Perform preparatory works for IPS flooring.
- Demonstrate laying of IPS flooring.
- Demonstrate plastering of internal and external masonry and RCC structures.
- Perform checks for line, level and alignment.
- Perform preparatory works for VDF flooring.
- Demonstrate VDF flooring.
- Demonstrate laying of coursed and un-coursed random rubble masonry.
- Demonstrate pointing in rubble masonry and laying of dry rubble masonry.
- Perform checks for line, level and alignment of rubble masonry works.

Material shifting and storage:



Fig. 1.3.6 Material shifting and keeping by helper mason



Fig. 1.3.7 Helper mason preparing cement mortar and curing by spraying water

Carry out manual earthwork:



Fig. 1.3.8 Helper mason cutting/digging earth manually or performing compaction

Erection of temporary scaffolding:



Fig. 1.3.9 Helper mason doing scaffolding work and ensuring correctness

Carry out cleaning and prepare tools for future use:



Fig. 1.3.10 Helper mason carrying out cleaning of debris/wastes and cleaning used tools

1.3.3 Personal Attributes of a Helper Mason

A Helper Mason 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
- Awareness of safety issues, especially when working at heights and carrying loads
- Ability to work as part of a team
- A good level of fitness
- Awareness of personal hygiene
- Reliable
- Honest
- Hardworking
- Courteous
- Dedicated
- Punctual



Fig. 1.3.11 A helper mason

1.3.4 Career Progression of a Helper Mason

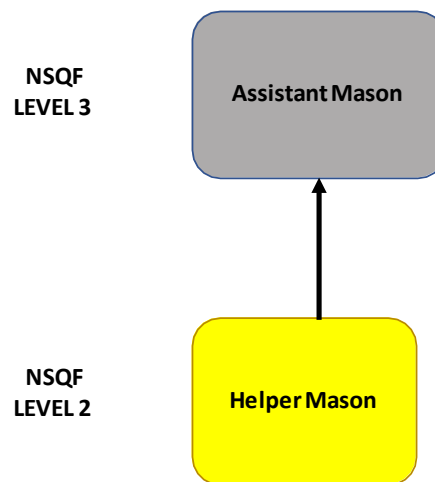


Fig. 1.3.12 Career progression of helper Mason

Exercise

Answer the following questions.

- What is the Construction Industry?
- What is the role of a Helper Mason?
- What are the primary tasks performed by a Helper Mason?
- What skills are essential for a Helper Mason in the Construction Industry?
- What are the potential career growth opportunities for Masonry professionals?
- How important is safety training in the Construction Industry, particularly for Helper Masons?
- Name the structures where Masonry work is needed?

Notes 

Scan the QR code to watch the video



<https://youtu.be/KfUEF5drpMM>

Job Description of a Helper Mason



2. Core/Generic Skills



Unit 2.1 – Numeracy Skills

Unit 2.2 – Systems of Measurements



Key Learning Outcomes



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

- Use skill of measuring and marking
- Conversion of linear measurement units

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 $\begin{array}{r} 2 \\ + 2 \\ \hline 4 \\ \hline \end{array}$	Horizontal Addition $2 + 2 = 4$	
Addition of 2 digit Numbers $\begin{array}{r} 24 \\ + 32 \\ \hline 56 \\ \hline \end{array}$	Addition of 2-digit number with 2-digit number $\begin{array}{r} 57 \\ + 34 \\ \hline 91 \\ \hline \end{array}$	Addition of 3 digits with 2- digit number $\begin{array}{r} 156 \\ + 37 \\ \hline 193 \\ \hline \end{array}$
Adding two 3 digit numbers with one 2-digit number $\begin{array}{r} 224 \\ 321 \\ + 31 \\ \hline 576 \\ \hline \end{array}$	Addition with decimal point $\begin{array}{r} 57.4 \\ + 34.3 \\ \hline 91.7 \\ \hline \end{array}$	Addition with decimal point $\begin{array}{r} 156.71 \\ + 371.30 \\ \hline 528.01 \\ \hline \end{array}$

Subtraction

Subtraction of 2 digit numbers with borrowing $\begin{array}{r} 74 \\ - 31 \\ \hline 43 \end{array}$	Subtraction of 3 digit numbers with borrowing $\begin{array}{r} 574 \\ - 343 \\ \hline 231 \end{array}$	Subtraction of 4 digit numbers $\begin{array}{r} 7121 \\ - 1130 \\ \hline 5991 \end{array}$
Subtraction of 3-digit number from 4-digit number $\begin{array}{r} 7456 \\ - 314 \\ \hline 7142 \end{array}$	Subtraction of decimal numbers $\begin{array}{r} 57.42 \\ - 34.32 \\ \hline 23.10 \end{array}$	Subtraction of decimal numbers $\begin{array}{r} 711.15 \\ - 113.04 \\ \hline 598.11 \end{array}$

Multiplication

Multiplication of 2-digit number by 1-digit number $\begin{array}{r} 24 \\ \times 3 \\ \hline 72 \end{array}$	Multiplication of two 2-digit number by 2-digit number $\begin{array}{r} 27 \\ \times 13 \\ \hline 81 \\ +27 \\ \hline 108 \end{array}$	Multiplication of 3-digit number by 2-digit number $\begin{array}{r} 127 \\ \times 23 \\ \hline 381 \\ + 254 \\ \hline 635 \end{array}$
Multiplication of 3-digit number by 2-digit number $\begin{array}{r} 427 \\ \times 23 \\ \hline 1281 \\ + 854 \\ \hline 2135 \end{array}$	Multiplication of decimal numbers $\begin{array}{r} 27.3 \\ \times 3 \\ \hline 81.9 \end{array}$	Multiplication of decimal numbers $\begin{array}{r} 2.7 \\ \times 6.3 \\ \hline 8.1 \\ + 16.2 \\ \hline 24.3 \end{array}$

Multiplication

<p>Division of 3-digit number by 1-digit number</p> $\begin{array}{r} 20 \\ \underline{5 \overline{) 100}} \\ - 10 \\ \hline 00 \end{array}$	<p>Division of 4-digit number by 2-digit number</p> $\begin{array}{r} 153 \\ \underline{14 \overline{) 2142}} \\ - 14 \\ \hline 74 \\ - 70 \\ \hline 42 \\ - 42 \\ \hline 00 \end{array}$
<p>Division of 5-digit number by 1-digit number</p> $\begin{array}{r} 3206 \\ \underline{6 \overline{) 19236}} \\ - 18 \\ \hline 12 \\ - 12 \\ \hline 36 \\ - 36 \\ \hline 00 \end{array}$	<p>Division of given value in decimal</p> $\begin{array}{r} 75.5 \\ \underline{4 \overline{) 302}} \\ - 28 \\ \hline 22 \\ - 20 \\ \hline 20 \\ - 20 \\ \hline 00 \end{array}$

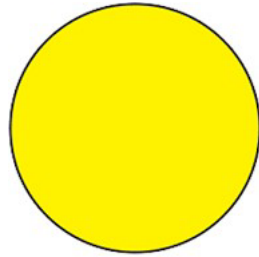
Division

<p>Division of 3-digit number by 1-digit number</p> $\begin{array}{r} 20 \\ \underline{5 \overline{) 100}} \\ - 10 \\ \hline 00 \end{array}$	<p>Division of 4-digit number by 2-digit number</p> $\begin{array}{r} 153 \\ \underline{14 \overline{) 2142}} \\ - 14 \\ \hline 74 \\ - 70 \\ \hline 42 \\ - 42 \\ \hline 00 \end{array}$
<p>Division of 5-digit number by 1-digit number</p> $\begin{array}{r} 3206 \\ \underline{6 \overline{) 19236}} \\ - 18 \\ \hline 12 \\ - 12 \\ \hline 36 \\ - 36 \\ \hline 00 \end{array}$	<p>Division of given value in decimal</p> $\begin{array}{r} 75.5 \\ \underline{4 \overline{) 302}} \\ - 28 \\ \hline 22 \\ - 20 \\ \hline 20 \\ - 20 \\ \hline 00 \end{array}$

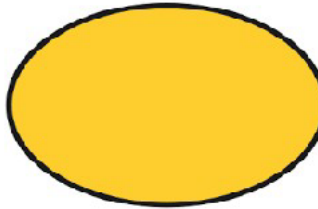
2.1.2 Basic Geometrical Shapes

The common shapes comprise of square, triangle and rectangle.

Curved Shapes



Circle



Ellipse

Fig. 2.1.2 Basic Shapes

Basic Shapes

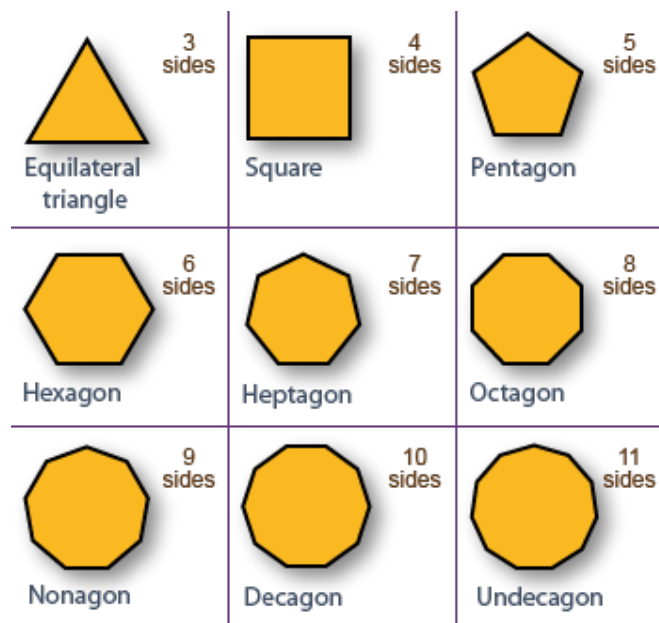


Fig. 2.1.1 Curved Shapes

Other Shapes

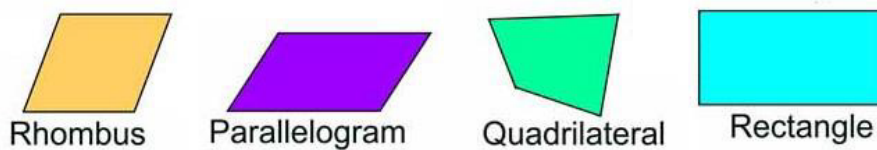


Fig. 2.1.3 Other Shapes

Notes 

Scan the QR code to watch the video



<https://youtu.be/H1xo5UVJKVo>

Different System of Measurement

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)

Table 2.2.1 Measurement unit's conversion

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.

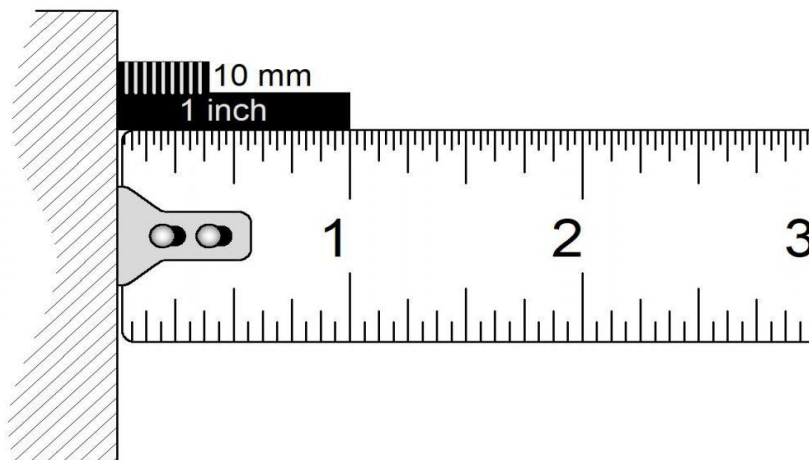


Fig. 2.2.1 Measuring in Inches

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.

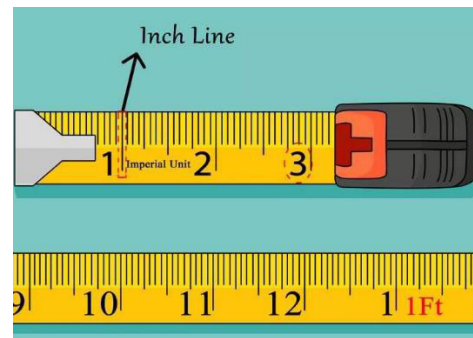


Fig. 2.2.2 Measuring in Inches

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

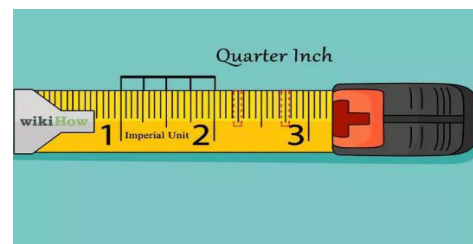


Fig. 2.2.3 Measuring in Inches

The height of marking line for one-eighth 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.

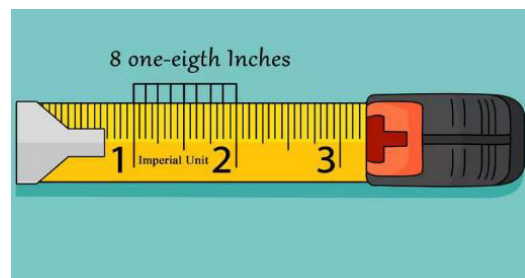


Fig. 2.2.4 Measuring in Inches

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

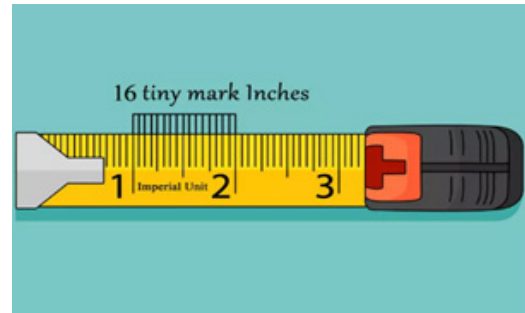


Fig. 2.2.5 Measuring in Inches

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:

$$1 + 1/8 + 1/8 + 1/8 = 1 \frac{3}{8} \text{ inches.}$$

$$1 + 1/8 + 1/8 + 1/8 = 1 \frac{3}{8} \text{ inches.}$$

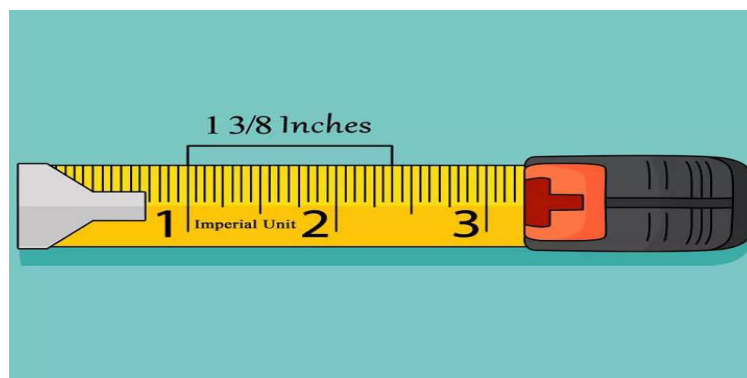


Fig. 2.2.6 Measuring Tape

2.2.4 Reading of Tape in Metric System

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

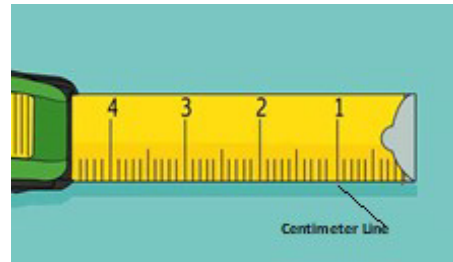


Fig. 2.2.7 Measuring in Centimeter

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.

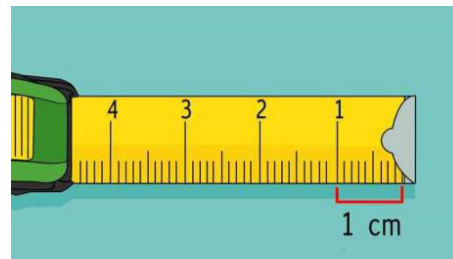


Fig. 2.2.8 Measuring in Centimeter

There are 9 graduation lines between each centimeters line.

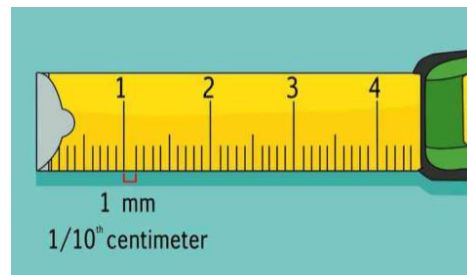


Fig. 2.2.9 Measuring in Centimeter

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

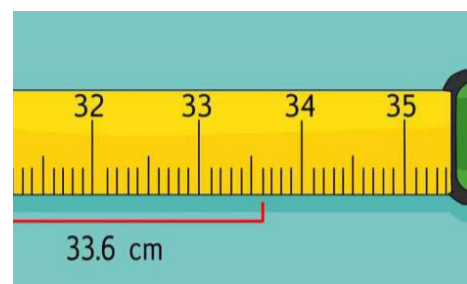


Fig. 2.2.10 Measuring in Centimeter

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 = $44 + 0.6 = 44.6$ 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

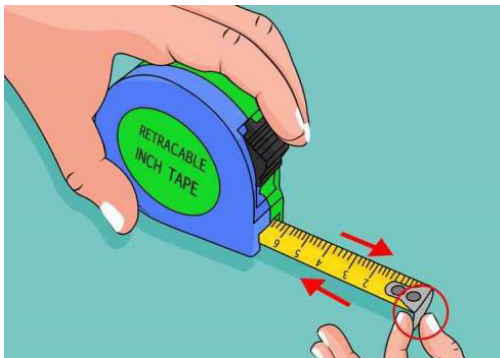


Fig. 2.2.11 Step 1: Hold the hooked end of tape and fix this to starting point of distance to be measured

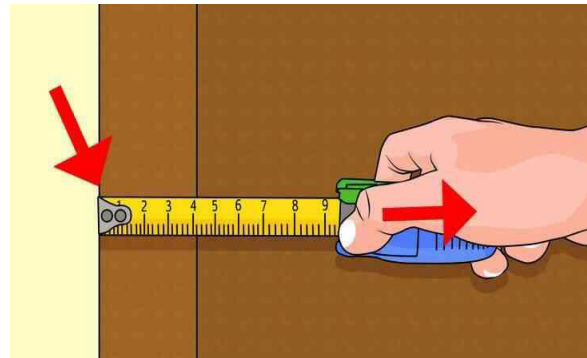


Fig. 2.2.12 Step 2: Stretch the tape across your object

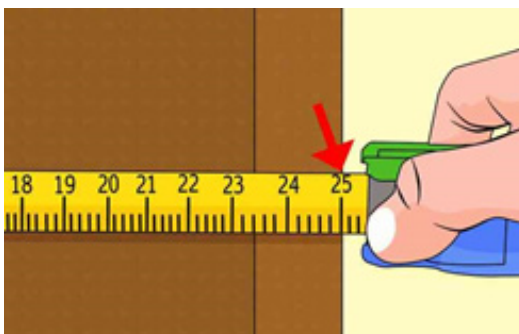
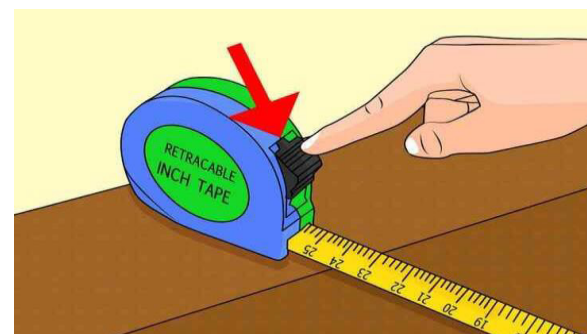
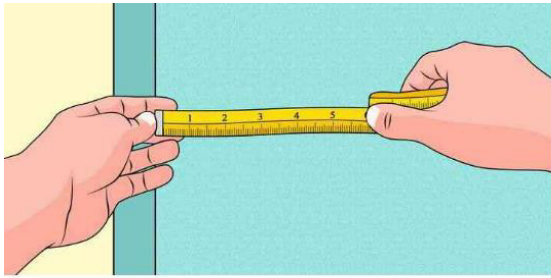


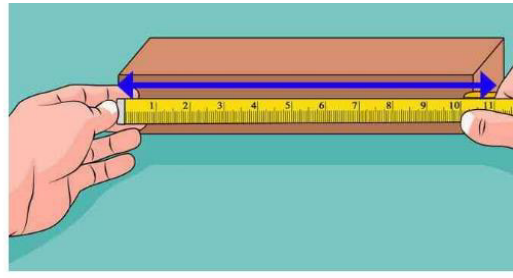
Fig. 2.2.13 Step 3: Take the reading by noting down numerals mentioned in marking line or by calculating marking line past or before the nearest numerals marked line



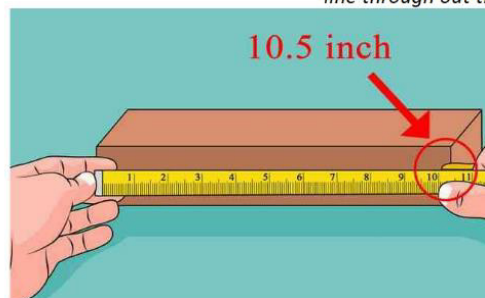
2.2.5.2 Steps to Take Measurement with Cloth Tape



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

2.2.3 Measurement units relevant to a Mason

- **Length/Distance:**

- Foot (ft): 1 ft = 12 inches
- Inch (in): 1 inch = 2.54 centimeters (approx.)
- Meter (m): 1 m = 3.28084 feet (approx.)

- **Area:**

- Square Foot (sq ft): 1 sq ft = 144 square inches
- Square Meter (sq m): 1 sq m = 10.7639 square feet (approx.)

- **Volume:**

- Cubic Foot (cu ft): 1 cu ft = 7.48052 gallons (approx.)
- Cubic Meter (cu m): 1 cu m = 35.3147 cubic feet (approx.)
- Weight/Mass:
- Pound (lb): 1 lb = 0.453592 kilograms (approx.)

- Kilogram (kg): 1 kg = 2.20462 pounds (approx.)

Brick and Block Size:

- Standard Brick: 7.625 inches (length) x 3.625 inches (width) x 2.25 inches (height)
- Concrete Block (typically): 16 inches (length) x 8 inches (width) x 8 inches (height)
- Mortar Mixing Ratios (by volume):
- Common mortar mix: 1 part cement : 3 parts sand
- High-strength mortar mix: 1 part cement : 2 parts sand
- Note: Water is added to achieve the desired consistency.

Tile Size:

- Tile size can vary significantly, but common dimensions include 12 inches x 12 inches, 18 inches x 18 inches, etc.



Fig. 2.2.15 Helper mason helping Mason

2.2.4 Calculation of Perimeter and Area by a Mason

1. Rectangle:

- Perimeter (P) = $2 * (\text{Length} + \text{Width})$
- Area (A) = $\text{Length} * \text{Width}$

2. Square:

- Perimeter (P) = $4 * \text{Side Length}$
- Area (A) = Side Length^2

3. Circle:

- Perimeter (Circumference) (P) = $2 * \pi * \text{Radius}$
- Area (A) = $\pi * \text{Radius}^2$

4. Triangle:

- Perimeter (P) = $\text{Side1} + \text{Side2} + \text{Side3}$
- Area (A) = $0.5 * \text{Base} * \text{Height}$

5. Parallelogram:

- Perimeter (P) = $2 * (\text{Side1} + \text{Side2})$
- Area (A) = $\text{Base} * \text{Height}$

6. Trapezoid:

- Perimeter (P) = $\text{Side1} + \text{Side2} + \text{Side3} + \text{Side4}$
- Area (A) = $0.5 * (\text{Sum of Parallel Sides}) * \text{Height}$

Remember that all dimensions should be in the same unit (e.g., inches, feet, meters) for accurate results.

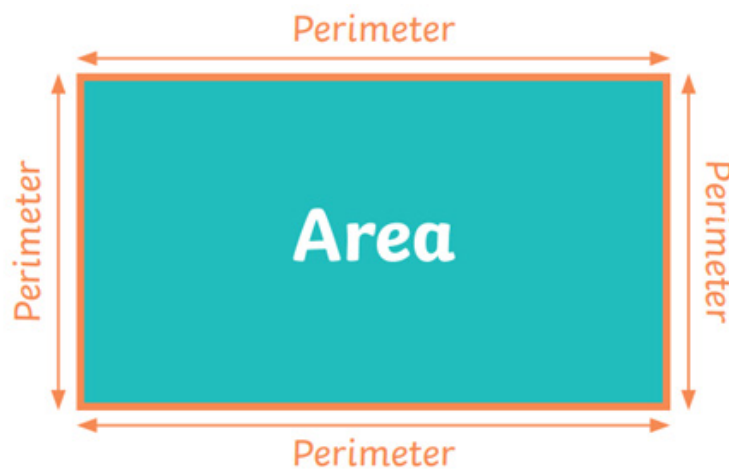


Fig. 2.2.16 Area & perimeter

For irregular shapes, you can divide them into smaller regular shapes, calculate their individual perimeters and areas, and then sum them up to get the total perimeter and area.

In some cases, you may need to work with three-dimensional shapes, such as calculating the surface area and volume of a concrete block or brick. Specific formulas apply to those scenarios, like:

1. Surface Area of a Cuboid (Rectangular Prism):

$$\text{Surface Area (SA)} = 2 * (\text{Length} * \text{Width} + \text{Length} * \text{Height} + \text{Width} * \text{Height})$$

2. Volume of a Cuboid (Rectangular Prism):

$$\text{Volume (V)} = \text{Length} * \text{Width} * \text{Height}$$

3. Volume of a Cylinder:

$$\text{Volume (V)} = \pi * \text{Radius}^2 * \text{Height}$$

Knowing these formulas and being proficient in their application will help you make accurate calculations of perimeter and area during your masonry work. Precision in measurements is vital for ensuring materials are used efficiently and construction is done correctly.

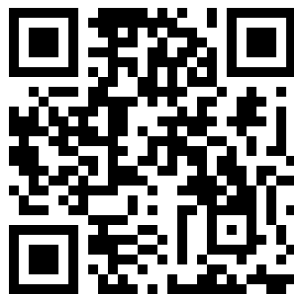
Exercise

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>

Area, volume and perimeter of geometrical shapes



3. Tools, Materials and Consumables



Unit 3.1 – Masonry Hand Tools and Equipment

Unit 3.2 – Construction Materials

Unit 3.3 – Handling and Storage of Material



(CON/N0102)

Key Learning Outcomes



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

1. Identify different basic masonry tools and equipment
2. Use basic masonry tools and equipment
3. Maintain and handle tools and equipment in correct and safe way
4. Distinguish between materials used in masonry work at site such as bricks, blocks, stones, cement, mortar, concrete, tile, marble, granite, glass, admixtures and chemicals, etc.
5. Store masonry tools, equipment and materials like sand, cement, bricks, tiles, aggregates, admixtures etc. in correct way
6. Identify and distinguish other common construction materials like reinforcement bars, plywood, timber, paint etc.
7. Stack the materials as per the nature, size and shape of material and the space available
8. Arrange and shift construction material on the construction site safely and effectively
9. Lift and shift materials using right techniques
10. Use conveyance equipment for movement of materials for shifting

UNIT 3.1: Masonry Hand Tools and Equipment

Unit Objectives



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

- Identify basic masonry hand tools and equipment
- Use basic hand tools and equipment
- Maintain and protect tools and equipment

3.1.1 Masonry Tools and Equipment

Masonry tools are devices construction of brick, block, stone and concrete masonry Tools are classified based on its purpose for which it is used. Tools are classified as under:

1. Tools for masonry
2. Levelling tools
3. Measuring and marking tools
4. Cutting tools
5. Earthwork tools
6. Other helping tools

Based upon mode of operation they can be classified as under:

- Hand tools – Trowel, Chisel, Float, Hammer, Groover, Jointer, etc.
- Power tools – Vibrator, Plate compactor, Rammer, Concrete mixer, etc.



Fig. 3.1.1 Tools for masonry work

3.1.2 Masonry Tools

The masonry tools are described as under:



Fig. 3.1.2 Mason using trowel

Size and shape

- It comes in several shapes and sizes.
- It is a triangular-shaped tool.
- Sizes of trowels can vary and can reach up to about 11 inches long and from 4 to 8 inches wide.
- Ex. Trowels used for pointing are small (3-6 inches long and 2-3 inches wide).

Uses

- To pick up mortar from a board
- To place and spread the mortar into a brick, or set of bricks
- To secure a brick into the mortar by tapping

<p>Brick trowel Or mason's trowel</p>	<ul style="list-style-type: none"> • It is a point-nosed trowel for spreading mortar on bricks or concrete blocks. 	
<p>Bucket trowel</p>	<ul style="list-style-type: none"> • It is a wide-bladed trowel for scooping mortar from a bucket. • It is also good for buttering bricks and smoothing mortar. 	
<p>Gauging Trowel</p>	<ul style="list-style-type: none"> • It is a round-nosed trowel used for mixing mortar and applying small amounts in confined areas. • It is also used to replace crumbled mortar and to patch concrete. 	
<p>Pointing trowel</p>	<ul style="list-style-type: none"> • It is a smaller version of the brick trowel. • It is used for filling in small cavities and repairing crumbling mortar joints. 	




<p>Tuck pointer</p>	<ul style="list-style-type: none"> • It is used for neatly packing mortar between bricks and blocks. 	
<p>Step trowel/edging trowel</p>	<ul style="list-style-type: none"> • It is similar to the corner trowel. • It is used for shaping inside angles on concrete steps. 	
<p>Notched trowel</p>	<ul style="list-style-type: none"> • It is used to spread adhesive for tile laying. • It has teeth on two sides and other two sides are plain. 	

Table 3.1.1 Masonry tools

Chisel

Chisels used in masonry work have specific characteristics, sizes, and shapes to suit the requirements of cutting and shaping stone, bricks, or concrete blocks. Here are three points each about the size, shape, and uses of chisels in masonry:

Size and Shape of Masonry Chisels:

- **Size:** Masonry chisels come in various sizes, ranging from small handheld chisels to larger chisels designed for heavy-duty tasks. The size you choose depends on the scale of your masonry project and the level of detail required.
- **Shape:** The cutting edge of masonry chisels is usually flat or slightly beveled to cut through stone or bricks efficiently. The chisel's shaft is typically straight for precise control and stability during use.



Name	Uses	Picture
Flat or bolster chisel	<ul style="list-style-type: none"> It is used to cut bricks or stone into specific sizes. It is also used to remove old hard mortar from walls. The chisel is held with one hand and struck with a hammer. Chisel width ranges from 2.5 to 4.5 inches. 	
Moil (point) chisel	<ul style="list-style-type: none"> It is used for cutting through concrete and stone. It has a sharp tip rather than a sharp edge. 	
Flexible chisel	<ul style="list-style-type: none"> It removes materials such as tile, or anything similar without damaging the base material. It is also used to scrap the surface. 	
Plugging chisel	<ul style="list-style-type: none"> It has a tapered edge for cleaning out hardened mortar. The direction of the taper in the blade determines if the chisel cuts deep or runs shallow along the joint. 	

Table 3.1.2 Masonry chisels

Uses of Masonry Chisels:

- Cutting Stone: Masonry chisels are used to cut through stone or brick surfaces, creating clean lines or edges during masonry work. They are essential for shaping stones to fit specific areas in construction.

- **Splitting Bricks:** Chisels are used to split bricks into desired shapes or sizes. This is particularly helpful when you need to customize bricks to fit corners or irregular spaces.

Removing Excess Material: Masonry chisels help remove excess material from stones or bricks to achieve smooth surfaces and precise dimensions in the process.

Floats

In masonry work, floats are important tools used to apply and manipulate various materials like mortar and grout. They come in different sizes and shapes, each serving specific purposes. Here are three points each about the size, shape, and uses of floats in masonry:

Size and Shape of Masonry Floats:

- **Size:** Masonry floats vary in size, but they are generally handheld tools with a comfortable grip. They are designed to be easily manageable during application.
- **Shape:** Floats have a flat or slightly curved rectangular surface. Some floats have square corners, while others have rounded edges to suit different masonry tasks.



Fig. 3.1.3 Mason using float

Uses of Masonry Floats:

- **Applying Mortar:** Masonry floats are used to spread and apply mortar evenly to bricks, blocks, or stones during the construction of walls or other structures. They help ensure consistent mortar coverage and adhesion.

- **Smoothing Surfaces:** After laying bricks or blocks, floats are used to smooth and level the surface of the mortar. This process enhances the appearance of the masonry and prepares it for further finishing.
- **Grouting:** Floats are also used for applying and compacting grout between tiles or stones. They help fill the gaps evenly and remove excess grout for a clean finish.




Name	Uses	Picture
Bull float	<ul style="list-style-type: none"> • Bull float is used to work large areas of concrete. • They are typically 8 inches in width and 3 to 10 feet in length. • It has a long handle attached to a flat wood, or aluminum piece magnesium called a float. • It is used after screeding or tamping of the concrete. 	
Hand float	<ul style="list-style-type: none"> • It is used in small areas. • It ranges in width from 3 to 5 inches and in length from 12 to 24 inches 	
Rubber grout float	<ul style="list-style-type: none"> • It is used for grouting. • It has a non-stick gum rubber pad which prevents absorption of grout and other materials. 	

Table 3.1.3 Masonry floats

Hammer

In masonry work, hammers are essential tools used for various tasks, including setting bricks, splitting stones, and driving nails. They come in different sizes and shapes, each serving specific purposes. Here are three points each about the size, shape, and uses of hammers in masonry:

Size and Shape of Masonry Hammers:

- Size: Masonry hammers vary in size, but they are generally heavier and more robust than standard carpentry hammers. The size can range from 1.5 to 4 pounds, depending on the specific application.
- Shape: Masonry hammers typically have a flat striking face on one side, used for hitting materials like bricks or stones. The other end usually has a chisel-shaped edge, used for splitting stones or trimming bricks.

Uses of Masonry Hammers:

- Setting Bricks or Stones: Masonry hammers are used to set bricks or stones in place by gently tapping them into position. They help ensure a tight fit and proper alignment during construction.
- Splitting Stones: The chisel-shaped edge of the masonry hammer is used for splitting stones along their natural grain or cleavage lines. This allows masons to create stones of desired sizes for specific masonry tasks.
- Trimming Bricks: When bricks need to be cut or trimmed to fit into corners or irregular spaces, masonry hammers are used to carefully chisel and shape them.



Name	Uses	Picture
Brick hammer	<ul style="list-style-type: none"> • It has a square face on one end and a long chisel on the other. • It is used to split hard bricks and stone, and also to shape the brick and stone. 	
Mason hammer	<ul style="list-style-type: none"> • It is used to split and rough-break masonry units. 	

Table 3.1.4 Masonry hammers

Groover

A groover, also known as a jointer or grooving tool, is a specialized tool used in masonry to create grooves or joints in mortar. These grooves not only enhance the aesthetic appeal of

the masonry work but also improve the structural integrity of the construction. Here are three points each about the size, shape, and uses of a groover in masonry:

Size and Shape of a Groover:

- **Size:** Groovers come in various sizes, ranging from small handheld tools to larger groovers for more significant masonry projects. The size you choose depends on the width of the groove you need to create.
- **Shape:** A groover typically consists of a long handle and a blade at the end. The blade can be straight or slightly curved to create different types of grooves, such as V-shaped or rounded.

Uses of a Groover in Masonry:

- **Creating Control Joints:** Groovers are primarily used to create control joints in masonry. Control joints are intentional gaps or grooves cut into the mortar joints at specific intervals to control cracking caused by temperature changes or settlement of the building.
- **Aesthetic Enhancements:** Groovers are used to add decorative patterns and designs to mortar joints, enhancing the visual appeal of the masonry work.
- **Improving Water Drainage:** By creating grooves at the correct angle, groovers help improve water drainage from the masonry surface, preventing water from pooling and potentially causing damage over time.

Name	Uses	Picture
Handheld Groover	<ul style="list-style-type: none"> • Handheld groovers are manual tools typically used for smaller concrete projects or touch-up work. • They have a long handle for easy maneuverability and a blade at the end for creating grooves in the concrete surface. 	
Walk-Behind Concrete Groover	<ul style="list-style-type: none"> • Walk-behind concrete groovers are larger machines designed for cutting longer and straighter grooves in larger concrete surfaces, such as highways, sidewalks, or driveways. • These machines are operated by a person walking behind them, guiding the groover along the concrete surface. 	

Table 3.1.5 Masonry groover

Screed

In masonry and concrete work, a screed is a tool used to level and smooth the surface of freshly poured concrete or mortar. Screeds help achieve a uniform surface by removing excess material and filling low spots. There are different types of screeds available, each designed for specific applications. Here are three points each about the size, shape, and uses of a screed in masonry:

Size and Shape of a Screed:

- **Size:** Screeds come in various sizes, ranging from small handheld tools to larger ones used with mechanical equipment for larger concrete pours.
- **Shape:** The most common shape of a screed is rectangular or straight, allowing it to level a wide area at once. Some screeds may have a slight curve or profile to match the desired slope of the surface.



Name	Uses	Picture
Straight Edge or Wooden Screed	<ul style="list-style-type: none"> • A straight edge or wooden screed is a basic and traditional type of screed commonly used for small-scale masonry projects. • It consists of a straight piece of wood, typically 2x4 lumber, that is pushed or pulled across the concrete surface to level and smooth it. • Wooden screeds are affordable, easy to use, and suitable for achieving a basic level finish. 	
Roller Screed	<ul style="list-style-type: none"> • A roller screed is a type of screed that utilizes a rolling tube or cylinder to level the concrete surface. • The tube is pulled over the concrete, displacing excess material and filling low spots as it moves along. • Roller screeds are commonly used for paving and slab applications, providing a more controlled and uniform finish. 	

Table 3.1.6 Masonry screed

Uses of a Screed in Masonry:

- **Leveling Concrete:** Screeds are primarily used to level and flatten the surface of freshly poured concrete or mortar. They help remove excess material and fill low spots, ensuring a smooth and even surface.

- **Achieving Desired Slope:** In cases where a sloped surface is required, such as for drainage purposes, screeds are used to create a consistent slope across the concrete surface.

Preparing for Finishing: By using a screed, the concrete or mortar surface is prepared for further finishing techniques, such as troweling or adding texture.






3.1.3 Levelling Tools

In masonry work, various levelling tools are used to ensure that the surfaces and structures being built are level and plumb. Proper levelling is crucial for the structural integrity and overall appearance of the construction.



Fig. 3.1.4 Mason using spirit level

Here are some common levelling tools used in masonry:

Name	Uses	Picture
Plumb bob	<ul style="list-style-type: none"> It is used to check verticality of structures and to determine location of points. 	
Water level tube	<ul style="list-style-type: none"> A water level is a long tube filled with water. A water level is used to transfer heights from one part of the building site to another. 	
Line thread/brick line	<ul style="list-style-type: none"> Brick lines are used to create layouts for building and masonry work. They are also used as reference lines when laying bricks, helping to 	
Squares	<ul style="list-style-type: none"> Squares are used when constructing and measuring right angles and for corner layouts. They are usually made of metal. They come in various sizes. 	
Spirit level	<ul style="list-style-type: none"> It is used to check plumb (vertical lines), and level (horizontal lines). It is typically made of wood, metal, or a combination of both. It comes equipped with either single or double vials. The latter is preferred by more masons since they can be used for both horizontal and vertical 	


	measurements.	
Straightedge	<ul style="list-style-type: none"> • It is used when levels are shorter than the area that needs to be measured or assessed. • Its width can be from 1.25 inch to 1.5 inch. • It can be as long as 16 feet. • It is available with spirit level also. 	

Table 3.1.7 Masonry levelling tools

3.1.4 Measuring and Marking Tools



Measuring and marking tools are essential for masons to ensure accuracy and precision in their work. These tools help masons take precise measurements and mark reference points, guiding them during construction.







Fig. 3.1.5 Tools for mason for measurement or marking

Measuring and marking tools are essential companions in the mason's toolkit, guaranteeing meticulousness in construction projects. Tape measures extend precision by gauging lengths, while spirit levels meticulously ensure both vertical and horizontal alignments. Chalk lines offer the convenience of drawing straight guidelines, and brick gauges preserve uniform spacing for brick courses. These tools serve as guiding stars, allowing masons to meticulously

plan, execute, and maintain the structural integrity and aesthetics of their masonry endeavors.

Name	Type	Uses	Picture
Measuring tape	Measuring tool	<ul style="list-style-type: none"> • Hold the measuring tape steady and taut to ensure accurate measurements. • Use a level or straight edge when measuring long distances to keep the tape straight and aligned properly. • Double-check measurement and cross-check against multiple points for consistency and accuracy. 	
Gauge box	Measuring tool	<ul style="list-style-type: none"> • Gauge box is a measuring container used by masons to accurately measure the proportions of cement, sand, and aggregate while preparing concrete or mortar mix. • It helps maintain consistency and uniformity in the mix, ensuring the desired strength and quality of the masonry work. • Masons can quickly measure the required volumes of each material by filling the gauge box to the appropriate level, making the mixing process efficient and precise. 	

Rope	Marking tool	<ul style="list-style-type: none">• Ropes are used by masons as guidelines for laying out straight and level courses of bricks or blocks during construction.• They are essential for achieving accurate alignment and spacing, ensuring the structural integrity and aesthetic appeal of the finished masonry work.• Masons stretch the rope taut between two points to create a straight reference line, which serves as a guide for positioning the bricks or blocks during the construction process.	
Wooden pegs	Marking tool	<ul style="list-style-type: none">• Wooden pegs are used by masons to mark reference points or establish layout lines during the early stages of masonry construction.• They are driven into the ground or a soft surface at specific intervals to create a guide for aligning walls, corners, and other structural elements.• Wooden pegs are particularly helpful for setting the foundation layout, ensuring accurate dimensions and alignment before the actual construction begins.	

<p>Flags</p>	<p>Marking tool</p>	<ul style="list-style-type: none"> • In masonry, flags refer to small markers or pieces of tape used to indicate specific points or measurements on the construction site. • Masons use flags to mark reference lines, elevations, or key locations for accurate placement of bricks, blocks, or other materials. • Flags act as visual cues, allowing masons to work more efficiently and maintain consistency in the construction process. They help ensure that the masonry work aligns with the project's plans and specifications. 	
<p>Lime powder</p>	<p>Marking tool</p>	<ul style="list-style-type: none"> • Lime powder, also known as hydrated lime or slaked lime, is used in masonry as a binder and additive to improve the properties of mortar and plaster. • It is mixed with water and sand to create lime mortar, which offers enhanced workability, better adhesion, and improved flexibility compared to traditional cement-based mortar. • Lime powder is particularly suitable for historic masonry restoration and 	





		<p>conservation projects due to its compatibility with older building materials.</p>	
Pencil	Marking tool	<ul style="list-style-type: none"> • Masons use pencils to mark measurements, layout lines, and cutting points on bricks, blocks, or other masonry materials. • Pencils provide a clear and precise marking that can easily be seen on the surface of the materials, guiding the masons during construction. • They are essential for accurately transferring measurements and layout points from plans or templates onto the actual masonry work, ensuring precision and consistency in the project. 	
Chalk	Marking tool	<ul style="list-style-type: none"> • Chalk is used by masons to create temporary reference lines on various surfaces, including concrete, bricks, blocks, and stones. • Masons often use chalk lines to mark straight and level guidelines, allowing them to align and position materials accurately during construction. 	

Table 3.1.8 Measuring & marking tools

3.1.5 Cutting Tools

Masons use a variety of cutting tools to shape and cut bricks, blocks, stones, and other masonry materials. These tools enable them to achieve precise cuts and shapes for a wide range of masonry projects.

Here are some common types of mason cutting tools:

Name	Uses	Picture
Tile scribe	<ul style="list-style-type: none"> • A tile scribe, also known as a tile scriber or glass cutter, is a hand tool used to score and cut tiles, glass, and other brittle materials. • Masons use a tile scribe to create precise and clean cuts on tiles, allowing them to fit the tiles into specific spaces or make intricate shapes. • The tile scribe works by dragging a hard and sharp carbide or tungsten wheel across the tile's surface to create a scoring line. After scoring, pressure is applied to the tile along the scored line, causing it to snap cleanly along the cut. Tile scribes are particularly useful for making straight cuts and notches in tiles to fit them around obstacles or edges. 	
Hand held tile cutter	<ul style="list-style-type: none"> • A handheld tile cutter is a manual tool used by masons to cut ceramic, porcelain, and other types of tiles accurately. • It consists of a cutting wheel or blade attached to a handle, allowing masons to score and cut tiles to their desired size or shape. • Masons can make straight cuts along the surface of the tile by guiding the handheld cutter along a straight edge or ruler, ensuring precise and clean cuts for their masonry projects. 	



Power wet cutter	<ul style="list-style-type: none"> • A power wet cutter, also known as a wet tile saw or masonry saw, is a motorized tool used by masons to cut through hard masonry materials, such as tiles, bricks, and stones. • It is equipped with a diamond-tipped blade that rotates rapidly and is cooled with water, allowing for efficient and smooth cutting of masonry materials without overheating or damaging the blade. • Masons use power wet cutters to make accurate and precise cuts, especially for larger masonry pieces or when dealing with intricate shapes and angles. The water-cooling system minimizes dust and debris, ensuring a cleaner work environment and preventing dust inhalation during cutting. 	
Hole drilling machine	<ul style="list-style-type: none"> • A hole drilling machine, also known as a masonry drill or hammer drill, is a power tool used by masons to create holes in masonry materials, including bricks, blocks, and concrete. • It operates by combining rotary drilling with a hammering action, allowing the drill bit to penetrate hard masonry surfaces more effectively. • Masons use hole drilling machines to install anchors, fasteners, electrical conduits, or other fixtures securely into masonry structures, providing a reliable and stable attachment point. The tool's variable speed and hammering feature make it suitable for drilling different hole sizes and depths in various masonry materials. 	

Table 3.1.9 Cutting tools

3.1.6 Earthwork tools and Equipment

Earthwork tools and equipment are used by masons for excavation and earthmoving tasks during construction projects.

Earthwork tools form the backbone of a mason's arsenal for groundwork tasks. These tools empower masons to mold the earth, establishing the groundwork for resilient structures that endure the test of time.

Based on the operation perform earthwork tools are classified as under:

Name	Uses	Picture
Shovel	<ul style="list-style-type: none"> Masons use shovels for various tasks, including digging and moving soil, sand, gravel, and other loose materials during foundation preparation and excavation. Shovels are also used to mix and distribute mortar or concrete for masonry work, making them versatile tools for both excavation and construction tasks. 	
Trenching hoe	<ul style="list-style-type: none"> A trenching hoe is a specialized tool used by masons for digging narrow and deep trenches for utilities, pipes, or foundation footings. Its narrow blade and long handle allow masons to efficiently excavate trenches with precise depths and widths, essential for proper placement of utilities and structural elements. 	
Pick axe	<ul style="list-style-type: none"> Masons use pick axes for breaking up hard or compacted soil, rocks, or concrete during excavation and site preparation. The pointed end of the pick axe allows masons to break through tough materials, making it useful for rough excavation work and preparing surfaces for construction. 	

Tamper	<ul style="list-style-type: none"> • A tamper, also known as a hand compactor, is used by masons to compact and level soil, gravel, or other loose materials before concrete or pavement is laid. • It is especially important for creating a stable and firm base, ensuring proper load-bearing capacity and preventing settling or shifting of structures. 	
Roller	<ul style="list-style-type: none"> • Rollers are heavy machinery used by masons to compact large areas of soil, asphalt, or concrete during road construction or other projects. • They use the weight and rolling action of the machine to compress the materials, increasing their density and stability. 	
Machine Compactor	<ul style="list-style-type: none"> • Machine compactors are powerful construction equipment used by masons to achieve high-density compaction of soil, gravel, and asphalt. • These machines are ideal for large-scale projects, ensuring a strong and stable foundation for buildings, roads, and other structures. 	

Table 3.1.10 Earthwork tools

3.1.7 Other Power tools and Equipment

Power tools and equipment, such as angle grinders with diamond blades, are used by masons for cutting and shaping masonry materials like bricks, blocks, and stones:

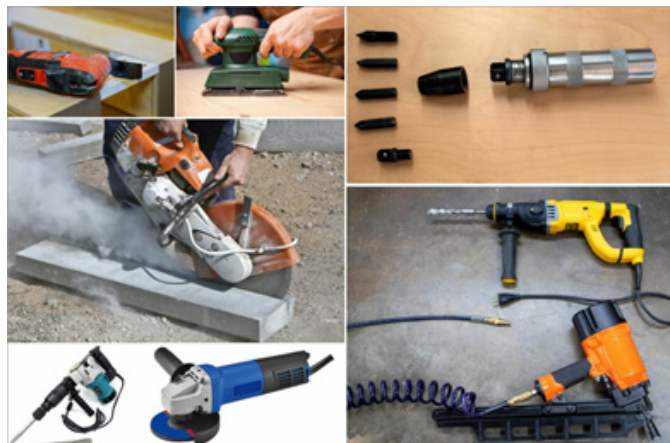







Fig. 3.1.6 Other power tools needed by a mason

Name	Uses	Picture
Vibrator	<ul style="list-style-type: none"> • Concrete vibrators, also known as poker vibrators or immersion vibrators, are used by masons to remove air bubbles and compact concrete during pouring. • Vibrators ensure concrete is free of voids and has increased density, strength and durability. 	
Concrete mixer	<ul style="list-style-type: none"> • Concrete mixers are power equipment used by masons to mix cement, sand, gravel, and water to create concrete for various construction tasks. • They come in different sizes, from portable electric mixers for smaller projects to larger drum mixers for commercial construction. • Concrete mixers save time and effort for masons by producing consistent and uniform concrete mixes, ensuring high-quality construction. 	
Drill	<ul style="list-style-type: none"> • Power drills are essential tools for masons, used to create holes in masonry materials such as bricks, blocks, and concrete. • They come in various types, including hammer drills for drilling into harder materials, and are used for installing anchors, fasteners, and conduits in masonry structures. • Masons rely on power drills for precise and efficient hole-making, which is crucial for secure and accurate installation of fixtures and attachments. 	

Table 3.1.11 Other tools & equipment

3.1.8 Other Helping tools and Equipment

Beyond the core tools, masonry requires additional assisting tools and equipment that enhance efficiency and precision in various tasks.

Name	Uses	Picture
Brushes/ brooms	They are used to clean brick/stone walls and cured concrete. They are of two types - soft and hard.	
Sponge	It is used to clean the brick/stone walls.	
Wheel barrow	It is used to transport the material at site.	
Sand sieve	It is used to sieve sand before mixing it into the mortar.	
Water hose	It is used for curing of concrete and store water.	

Mortar pan	Mortar pan is used for manual shifting.	
Hand-operated mixer	It is used for mixing large quantities of concrete mortar.	
Grinder	<ul style="list-style-type: none"> • It is used for cutting and grinding stone and metal. • It is also used for removing adhesives and leveling. 	
Plate vibrator	It is used for compaction of flat horizontal concrete surfaces.	
Tremix machine	It is used for preparation of tremix and VDF flooring.	

Table 3.1.12 Helping tools

3.1.9 Storage, maintenance and upkeep of tools

Proper storage, maintenance, and upkeep of tools are crucial aspects of masonry work to ensure their longevity and optimal performance.

Here's a concise overview of these practices:



Fig. 3.1.7 Storage of tools

- Clean your tools after the work.
- Scrub the wheelbarrow and tools with a stiff-bristle brush before the concrete starts to harden. Rinse them well.
- Keep the tools in their designated place after finishing the work.
- Keep chisels in the plastic end cover.
- Check power tools for broken plug, condition of cord or frayed wires, etc.
- Report to supervisor if the tool is damaged or unsafe.

3.1.9 Storage, maintenance and upkeep of tools

- Always use the right tool for the job.
- Always use personal protective equipment while working with tools.
- Do not talk while working with tools.
- Do not work with damaged tools.
- Do not keep sharp tools in your pocket.
- Do not use power tools near water, inflammable gas, oil.
- Check power tools before using them for broken plug or poor condition of the cord.

- Follow the instructions from the superior.
- Report to supervisor for any damaged tool.



Fig. 3.1.8 Safety precautions while using tools

Notes 

Scan the QR code to watch the video



<https://youtu.be/wuzQ8dsYJSw>

Masonry Tools and Equipment

UNIT 3.2: Construction Materials

Unit Objectives

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

- Identify different types of construction materials

3.2.1 What is Construction Material?

All the building structures are constructed using different types of materials. These materials are either called building materials or construction materials.

There are two types of construction materials:

- Natural materials – They are naturally occurring substances, such as mud or clay, stone, gravel, rocks, sand, wood, etc.



Fig. 3.2.1 Stone dust



Fig. 3.2.2 Sand and boulders

- Artificial materials – They are man-made products, such as cement, bricks, blocks, tiles, etc.



Fig. 3.2.3 Cement in bags



Fig. 3.2.4 Bricks

3.2.2 Bricks

There are different types of bricks used in construction work. The most common type is clay brick.

Types of Bricks

Clay Bricks:

These are used to make walls, pavements and other elements in masonry construction.

They are artificial material made by moulding clay in rectangular blocks of uniform size, which are finally dried and burnt at high temperature.

They are bonded together with cement mortar.

Easy availability, light weight, comparative cheapness, ease in handling, flexibility of moulding into required shape and size and ease in working are the main characteristics of bricks.



Fig. 3.2.5 Clay bricks

Standard size of a clay brick:

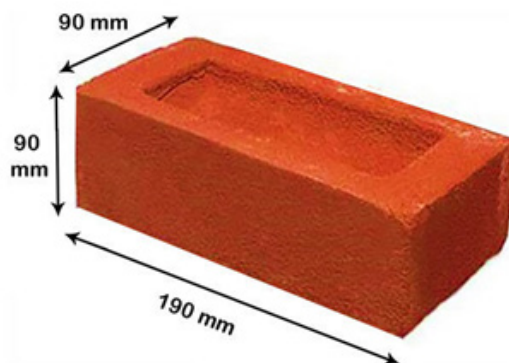


Fig. 3.2.6 Dimensions of a clay brick

Fly ash bricks:

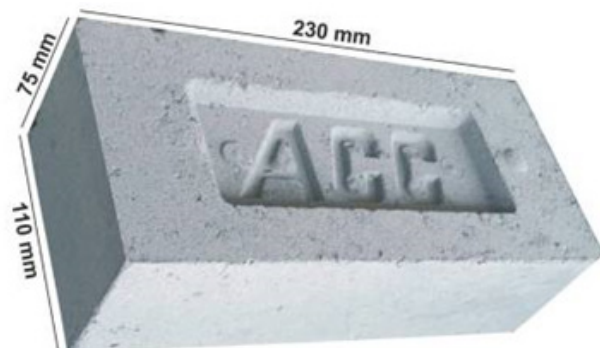
- Fly ash bricks are environmental friendly which can be used as an alternate of burnt clay bricks.
- These are made of fly ash which is a by-product of thermal power station, hydrated lime, gypsum, sand/stone dust and water.
- These are moulded, air dried for one or two days and then water cured for 14-21 days.
- They are grey or dark grey in colour.
- These bricks are uniform in size and shape.
- They require less mortar in brick work.
- These bricks have high compressive strength and lower water absorption.



Fig. 3.2.7 Fly ash bricks

Standard size of a fly ash brick:

- 230 x 150 x 80 mm
- 230 x 150 x 100 mm
- 230 x 100 x 75 mm
- 230 x 100 x 100 mm



Fire bricks:

- These bricks are also known as refractory bricks.
- They usually contain aluminium oxide and silicon dioxide.
- These are molded rectangular block of clay that has been baked and treated to be heat resistant.
- They can tolerate long exposure to high temperatures without cracking, decomposition, or distortion.
- Refractory and fire clay mortar are often used to join fire brick together.
- They used in lining furnaces, kilns, fireboxes, wood fired oven, and fireplaces.



Fig. 3.2.9 Fire brick

Standard size of a fire brick:

There are two standard sizes of fire-brick:

- 229 × 114 × 76 mm
- 229 × 114 × 64 mm
- Also available are firebrick "splits" which are half the thickness and are often used to line wood stoves and fireplace inserts. The dimensions of a split are usually 229 × 114 × 32 mm.

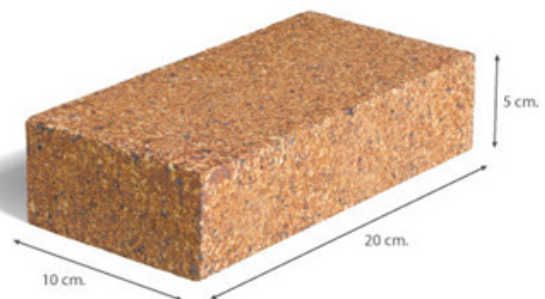


Fig. 3.2.10 Size of a fire brick

Quality of Bricks

Based on the quality of bricks they are classified in 4 categories. To classify the bricks following checks are carried out:

- **Colour:** The colour of good brick should be uniform. It may deep red, cherry or copper coloured.
- **Shape:** Bricks should be uniform in shape with sharp straight right angled edges.
- **Size:** Size of the bricks should be standard as prescribed by Indian standards.
- **Soundness:** A good brick should give metallic ringing sound when struck with another brick.
- **Hardness:** A good brick should be sufficiently hard which can be tested by a finger nail. No mark should be left on the surface of the brick when scratched with thumb-nail.
- **Water absorption:** First class brick should not absorb water more than 20% of its dry weight when soaked in water for 24hrs.
- **Structure:** A good brick should show fine, compact and uniform structure in broken form.
- **Strength:** Bricks should not break when dropped on hard ground from a height of about 1m.

Types of bricks based upon quality

First class bricks:

- These bricks are table-moulded and of standard shape.
- The surfaces and edges of the bricks are sharp, square, smooth and straight.
- They are well burnt and have uniform texture, metallic ringing when struck against each other.
- These bricks are used for superior work.



Fig. 3.2.11 First class brick

Second class bricks:

- These bricks are ground-moulded.
- The surface of these bricks is rough and shape is also slightly irregular.
- These bricks may have hair cracks and their edges may not be sharp and uniform.
- These bricks are commonly used at places where brickwork is to be provided with a coat of plaster.



Fig. 3.2.12 Second class brick

Third class bricks:

- These bricks are ground-moulded.
- These bricks are not hard and they have rough surfaces with irregular and distorted edges.
- These bricks give dull sound when struck together.
- They are used for unimportant and temporary structures.



Fig. 3.2.13 Third class brick

Fourth class bricks:

- These are over-burnt with irregular shape and dark color.
- These bricks are used as aggregate for concrete in foundations, floors, roads, etc.



Fig. 3.2.14 Fourth class brick

3.2.3 Blocks

- They are also called hollow block, concrete block, cement block, or cinder block.
- Concrete blocks are made from cast concrete, e.g. cement and aggregate, usually sand and fine gravel.
- They are moulded and cured at a manufacturing plant.
- Most concrete blocks have one or more hollow cavities, and their sides may be cast smooth or with a design.
- They are bonded together with cement mortar.

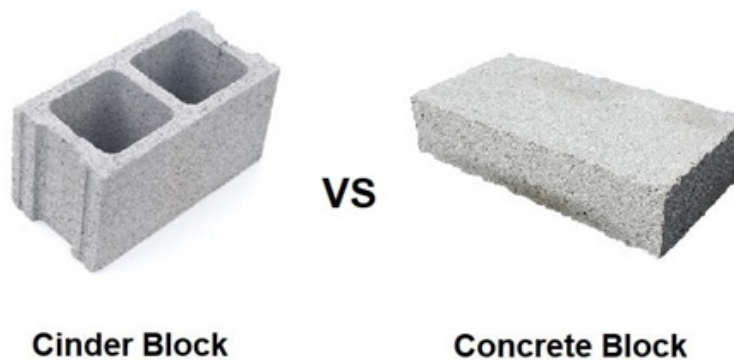


Fig. 3.2.15 Cinder versus concrete blocks

Standard size of a block:

- Concrete blocks can be made in nearly any size.
- The most common are 6 X 8 X 16 inches and 8 X 8 X 16 inches.

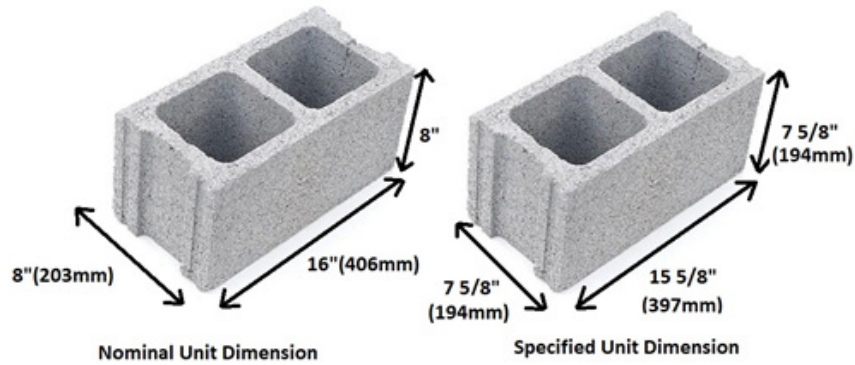


Fig. 3.2.16 Blocks of different shapes and sizes

3.2.4 Stone

- Stone is a natural construction material.
- They may be used in construction as is or after cutting to proper shape.
- They are used for building foundations, walls, pillars, arches, cladding work, pavements, etc.



Fig. 3.2.17 Stone masonry work

3.2.5 Cement

- Cement is fine, soft and powder type binder that sets and hardens.
- It can bind other material together.
- Cement is usually gray. White cement can also be found but it is usually more expensive than gray cement.
- Cement mixed with water, sand and gravel, forms concrete.
- Cement mixed with water and sand, forms cement mortar.



Fig. 3.2.18 Cement usage in masonry

3.2.5 Cement

- It gives body to concrete and reduce shrinkage.
- They are of different types depending on weight, structure and size.

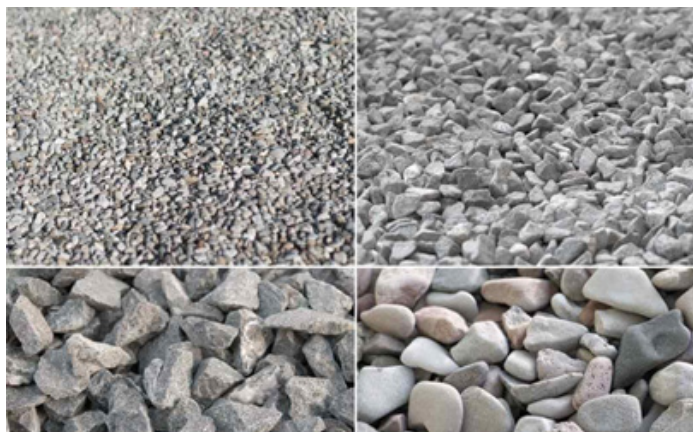


Fig. 3.2.19 Aggregate

3.2.7 Sand

- It is a natural product obtained from pit, river beds, shores, sea beds, etc.
- It is used in cement mortar, lime mortar, Reinforced Cement Concrete, etc.
- It is also used for plinth filling.



Fig. 3.2.20 Sand types

3.2.8 Concrete

- Concrete is a mixture of cement, sand, aggregate and water.
- It is durable and hard.
- When fresh it can be moulded in any shape.
- It requires little maintenance and it is cheaper than steel.



Fig. 3.2.21 Concrete

3.2.9 Admixtures

- Admixtures often are added to mortar.
- It can either fasten or slow down the setting time of cement mortar.
- It can make concrete water replant.
- It minimizes efflorescence at the mortar joint.
- It improves workability.
- It prevents cracks and other defects during the setting process.
- Types:
 - Plasticizers
 - Retarding admixtures
 - Accelerating admixtures
 - Air-entraining admixtures
 - Water proofing admixtures



Fig. 3.2.22 Admixtures

3.2.10 Marble



Fig. 3.2.23 Marble types

- Marble is a natural stone used for flooring and wall cladding.
- They are available in a variety of colour, from black to brown, green, red, pink, white.
- Each slab of stone has its own unique patterns and streaks of color.
- They are available in pre-polished finish as well as unpolished finish.
- Some common marbles are Botticino, Emperador, Travertine, Agaria white, Carrara, Udaipur green, Jaisalmer yellow, Dyna, Onyx, Makrana white, Katni, Marquina, etc.

3.2.11 Granite

- Granite is one of the most durable stone, ranging in color from pink to grey and black.
- It is used in buildings, bridges, paving, monuments and many other exterior projects.
- Indoors, polished granite slabs and tiles are used in countertops, floors, stairs.

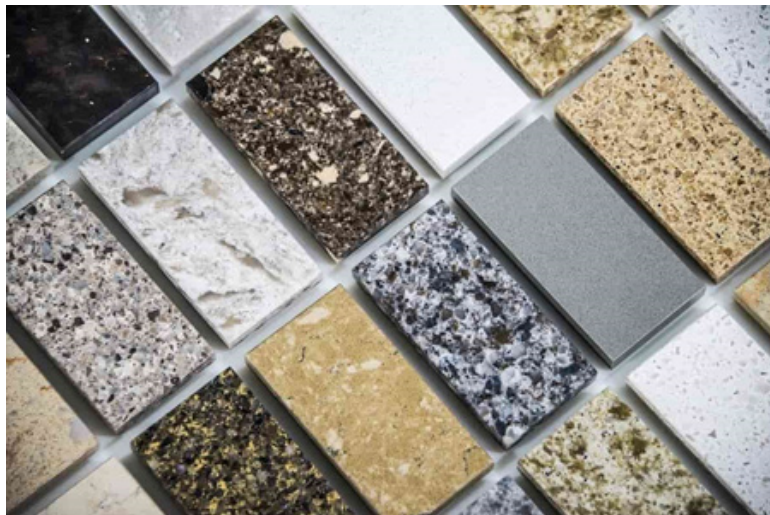


Fig. 3.2.24 Granite used in flooring/finishing work

3.2.12 Tiles

- Tiles are made from hard-wearing material such as ceramic, stone, metal, or even glass.
- Tiles can be used on interior walls, ceilings and floors.
- They Protect walls from moisture damage.
- They are decorative.
- They are available in a variety of shapes, colours and sizes.

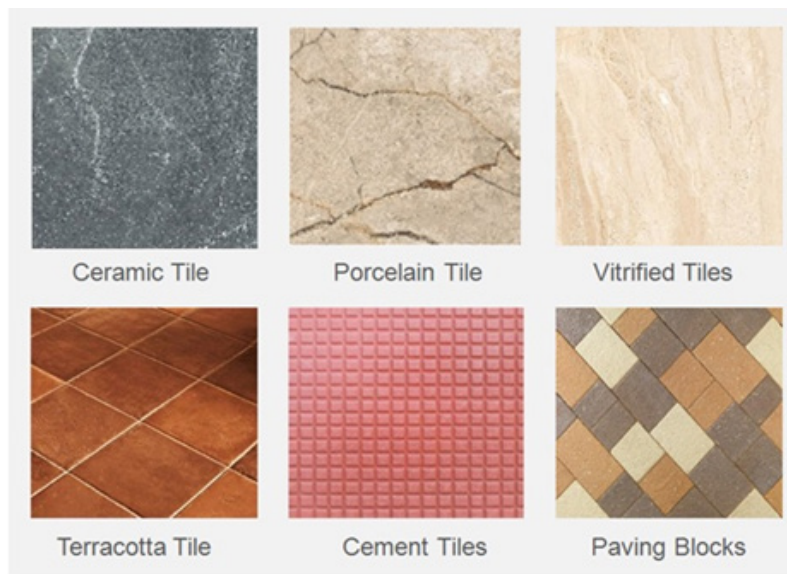


Fig. 3.2.25 Tiles in masonry use

3.2.13 Architectural glass

- It is mostly used as transparent glazing material in the building, including windows. It is also used for internal partitions.
- There are different types of glass - Float glass, Tinted glass, Toughened glass, laminated glass, Shatterproof glass.
- Glass blocks are used for partitions and also in windows.



Fig. 3.2.26 Glass in use and glass block

3.2.14 Other Common Construction Materials

Reinforcement bars and binding wires:

- They are also known as rebar, reinforcing steel, or reinforcement steel.
- They are used to provide strength to the concrete, such a concrete is called reinforced cement concrete.
- They are generally ribbed so that the concrete can have a better grip.
- They are binded together using binding wire to form reinforcement cage.



Fig. 3.2.27 Reinforcement bars and binding wires

Timber:

- Timber or wood is a natural resource which is suitable for building or carpentry purposes.
- It is remarkably strong in relation to its weight, and it provides good insulation from the cold.
- It can be fabricated into all kinds of shapes and sizes to fit any construction need.
- Wood is classified into two primary categories – hardwood and softwood.
- Hardwoods are commonly used in the construction of walls, ceilings and floors. Some examples – Oak, Maple, Mahogany, Cherry, Walnut and Teak.
- Softwoods are often used to make doors, furniture and window frames. Some examples – Pine, Cedar.



Fig. 3.2.28 Timber for construction use

Plywood:

- Plywood as a building material is very widely used.
- Plywood is an engineered wood product made from three or more plies or thin sheets of wood. These are glued together to form a thicker, flat sheet.
- Some of its common uses are:
 - To make light partition or external walls
 - To make formwork, or a mould for wet concrete
 - To make furniture, especially cupboards, kitchen cabinets and office tables, etc.
 - To make doors and shutters



Fig. 3.2.29 Plywood

Bamboos and Ballis:

Fig. 3.2.30 Bamboos/Ballis used in conventional scaffold

- Bamboo is a widely available resource.
- It has high strength and low weight, and is easily worked using simple tools.
- It is usually used as a temporary exterior structural material.
- Because of its load-bearing capacity and weight, bamboo is used for the construction of scaffoldings, even for very tall buildings.

3.2.15 Other Common Construction Materials

Paint, Paint roller and Shade card:

- Paint provides a protective layer against weathering, corrosion, and moisture, while also contributing to the aesthetics of buildings. Different types of paints, such as water-based, oil-based, or specialty coatings, are chosen based on the surface type, environmental factors, and the desired finish.
- A paint roller is a tool used to apply paint quickly and evenly onto surfaces. It consists of a cylindrical roller cover attached to a handle, allowing masons to cover large areas efficiently. Paint rollers are particularly useful for walls, ceilings, and other broad surfaces. Selecting the right roller cover, which can vary in nap length, helps achieve the desired texture and coverage.
- A shade card, also known as a color chart or paint swatch, displays a range of available paint colors and their variations. It assists masons and clients in choosing the right color for a construction project, helping to visualize how different hues will look in various lighting conditions. A shade card ensures informed color choices that align with the project's aesthetics and design objectives



Fig. 3.2.31 Paint, paint and shade card

Notes 

Scan the QR code to watch the video



<https://youtu.be/XsFeVuVQE-E>

What is Construction Material

UNIT 3.3: Handling and Storage of Construction Materials

Unit Objectives



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

- Handle different materials at construction site
- Store different materials at construction site
- Take safety precautions while handling and storing the construction materials

3.3.1 Handling Masonry Materials

Introduction to Material handling and its importance

Safe and efficient material handling depends on good co-operation and co-ordination between a helper mason and other co-workers. Some construction materials are heavy which requires two or more persons to transport them at construction site.

Some materials, such as cement, aggregate, etc. should be stored, transported and handled carefully to preserve its quality. There are certain guidelines which need to be followed at the site while storing and handling different types of materials.

Planned stacking and storage, and proper handling of construction materials at the site result in:

- Efficient and effective work.
- Prevent hazards, risks and injuries at site.
- Losses due to unsuitable and haphazard storage and stacking
- Reduces time loss in shifting the material
- Reduces time required for preparation of site



Fig. 3.3.1 Coordination during handling and storage

Handling and Storage of Bricks and Blocks

A helper mason normally undertakes the handling, lifting and loading of bricks to a working platform for mason.

Storing of Bricks and Blocks at site

- Stack the bricks close to the site of work so that less effort is required to unload and transport the bricks to the work location.
- Different types of bricks such as clay bricks, clay fly ash bricks, etc shall be stacked separately.
- Bricks of different sizes and quality should be stacked separately.
- Blocks of different types such as solid bricks, hollow bricks, and perforated bricks should be stacked separately.

Stacking of Bricks and Blocks at site

While stacking the bricks, following guidelines must be followed. Stack the bricks –

- on dry firm ground
- in alternate directions
- in a manner that they do not fall

Handling of Bricks and Blocks

- Use your head or wheelbarrows to transport the bricks on the construction site.
- Lift brick carefully and place them safely while shifting to avoid injury and damage.
- Do not carry bricks more than your lifting capacity.
- While carrying bricks on head use both hands for support.
- Always wear safety helmet while shifting bricks on head.
- Provide gap between two bricks for lifting with fingers.
- Unload/place bricks carefully so that they are not damaged.
- Unload/place bricks carefully to avoid any injury.



Fig. 3.3.2 Stack of bricks



Fig. 3.3.3 Stack of solid bricks



Fig. 3.3.4 Traditional way of handling bricks



Fig. 3.3.5 Handling bricks with safety measures

Handling and Storage of Cement

Storing and Stacking Cement at site

Guidelines to be followed while storing and stacking of cement:

- Protect cement from dampness and moisture.
- The cement bags should be stored in a dry, well-ventilated and enclosed structure.
- The stacked cement bags should be kept covered with waterproof sheets or tarpaulin.
- Do not place cement bags directly on concrete or wood floors.
- Store the bags on a raised surface with a plastic sheet underneath.
- Do not store the cement bags with other products.

- Keep sharp objects away from bags to prevent the bags from being punctured or damaged.
- A gap of minimum one foot should be left around between the stack and the walls.
- There should be a gap of minimum two feet between top of the stack and the ceiling.
- They should be laid flat with their broad sides down.
- They should be stacked in alternate directions.
- Height of one stack should not be more 10 bags to prevent them to fall down.

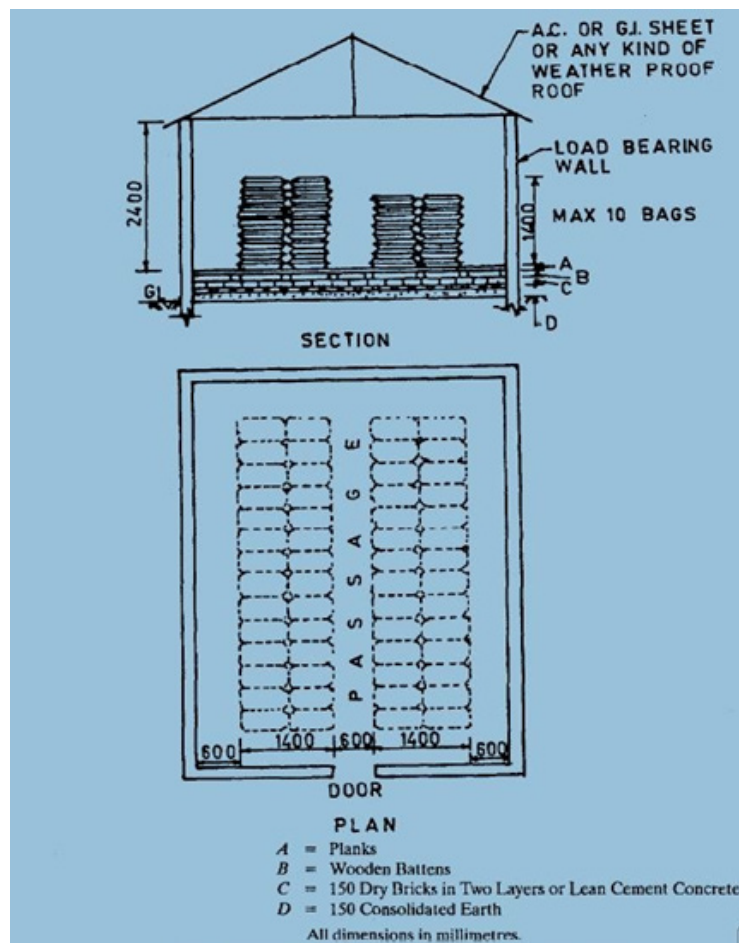


Fig. 3.3.6 Cement bags stored at godown

Handling of cement

- Make sure the cement bags are not dropped while lifting. This can weaken and damage the packaging.

- Roll the cement bags over before lifting. This helps to loosen up the cement, and reduces the chances of splitting the bag.
- Do not carry them by holding at the ends. Make sure the bag is held by supporting on the underside.
- Take help from other co-workers to lift the bags.



Fig. 3.3.7 Handling of cement bags



Fig. 3.3.8 Best practice for storing cement bags

Handling and Storage of Aggregates

Storing and Stacking of Aggregates

The quality, size and shape of the aggregates influence the strength of the finished concrete. Proper care should be taken while storage and handling to avoid mixing of different aggregates. It is also important to keep the aggregates protected from rains and moisture.

- Do not heap different sizes of aggregates in such a way that they overflow into each other. This can cause different sized aggregates to get mixed, making it difficult to obtain the expected concrete mix.
- Keep the aggregate piles covered with plastic sheets or tarpaulin.
- Store the aggregates on clean, hard ground away from trees to avoid contamination.



Fig. 3.3.9 Stacking of course aggregate

Handling of Aggregates

- Use trenching hoe or shovel to collect the aggregate in pan or sacks.
- Use appropriate for shifting as per requirement e.g.:
 - Wheelbarrow for transporting large quantity over large distance.
 - Pan for small quantity over small distance etc.



Fig. 3.3.10 Using concrete having aggregates

Handling and Storage of Marble slabs/Granite slabs/Tiles

Storing and Stacking Marble slabs/Granite slabs/Tiles

Stone and tiles are all fragile and easy to be scratched, chipped and damaged if not being handled and stored properly.

- The storage areas should be adequate in size, accessible, and the moving of other materials around them should be limited.
- They should be kept near the area where cutting of them would take place.
- Stones of different sizes and types should be stored separately.
- Stone slabs should be stacked on dry firm ground.
- They should be kept covered with thick plastic sheets.
- Unpolished slabs must be protected from possible staining.
- Do not remove the fiber from the slabs before laying it.
- Lift the slab vertically to prevent from breakage.
- Tile boxes should be stacked in proper layers and in tiers. They should not be dumped in heaps.
- Tiles of different quality, size and thickness should be stacked separately for easy access.
- Report the supervisor for any damaged stone or tile.

Handling of Marble slabs/Granite slabs/Tiles

- Warm up before lifting. Stretch with side and back bends to avoid sprains and injuries.
- Lift only loads that can be safely handled.
- Bend the knees, not the back
- Establish good footing.
- Keep the load close to the body.
- Get a full handgrip; keep the body erect and the spine in an upright position.
- Lift smoothly, straightening the legs (avoid jerky lifts). Reverse the procedure to set the slab down.
- Avoid twisting your body when lifting.
- When turning, shift the position of your feet rather than twisting your body at the waist.
- Never lift or carry a stone slab in the flat (horizontal) position. Always lift the slab on end in the vertical position. Lifting the slab flat can cause the slab to break, resulting in injury.
- When unloading slabs, never have a person support a slab alone.
- Always stand at the end of the slab.



Fig. 3.3.11 Stacking of marble slab



Fig. 3.3.12 Stacking of tiles



Fig. 3.3.13 Lifting of slab using clamps



Fig. 3.3.14 Lifting of slab using trolley

Storage of Hazardous Materials

- They should be stored in a locked cabinet or a locked store. Only authorized persons can access the store.
- The chemical store should have adequate ventilation.
- The chemical store should be locked when not in use to prevent unauthorized access.
- Make sure admixtures or chemicals are not kept near the source of water and ignition, for example sparks from building works and welding.
- Keep incompatible chemicals separate from each other.
- All containers should be clearly labelled.
- Report the supervisor for any vandalism, leakages and spillages.



Fig. 3.3.15 Storage of hazardous materials

3.3.2 Proper lifting techniques

One of the most common risks at construction site is back injury. The main cause of back injury is inappropriate lifting technique. Safe and correct lifting is vital to minimize stress on the spine. Proper lifting technique is very important to back safety, but perhaps more important is proper planning.

Before you lift the heavy material, or tools, or piece of equipment, take a moment to consider your action:



Fig. 3.3.16 Lifting in a right way

- Do you need to lift the item manually?
- How heavy is it?
- Where are you moving the item from?
- Where does it have to go?
- What route do you have to follow?

Before You Lift

- Plan ahead
 - Know what you are lifting and how you will lift it.
 - Be aware of the weight of the object.
 - Determine whether or not it's safe to lift on your own.
 - Make sure the work area is flat, dry and clear of debris.
- Check your pathway
 - Make sure the lift pathway is clear.
 - Remove any tripping hazards or debris.
 - Check for any wet surfaces.
- Use ergonomic equipment
 - Use lift assists, forklift, dolly, cart, handtruck or hoist.
 - Make sure you are trained before using the equipment.
- Get help when needed
 - When lifting heavy loads, utilize a two-person lift.
 - Make sure you lift at the same time and keep the load level.
- Wear proper PPE
 - Wear proper required personal protective equipments, such as shoes and gloves. Do's and don'ts while loading and unloading the material

Ergonomics refers to the study and application of designing tools, equipment, tasks, and workspaces to fit the capabilities and needs of people. In the context of construction, ergonomics aims to create a work environment that minimizes physical strain, discomfort, and the risk of injury for workers.

This involves designing tools and work processes to accommodate the natural movements and limitations of the human body. By integrating ergonomic principles, construction projects can enhance worker well-being, productivity, and safety, ultimately contributing to better overall project outcomes.

Examples include designing tools with comfortable grips, optimizing work heights to reduce bending and reaching, and providing proper seating and lifting techniques.



Fig. 3.3.17 Do's and don'ts while loading and unloading the material

Exercise

Answer the following questions.

- What is the primary purpose of a brick trowel in masonry work?
- How does a mason's level contribute to ensuring accurate vertical alignment in construction?
- Name a hand tool masons use to create bevelled edges on bricks or blocks.
- What is the purpose of a jointer in masonry, and what types of joints does it create?
- How does a masonry brush play a role in achieving a clean and polished finish?
- Differentiate between cement and concrete in terms of their composition and usage.
- What are the key characteristics of a mortar mix, and how does it differ from concrete?
- Describe one application where rebar (reinforcement bars) is commonly used in construction.
- How do natural stones differ from manufactured stones in masonry applications?
- Give an example of a sustainable construction material choice and explain its environmental benefits.
- Why is proper handling essential when transporting glass panels to a construction site?
- What precautions should be taken when storing bags of cement to prevent moisture infiltration?
- How can materials like lumber and plywood be stored to minimize warping and degradation?
- When handling heavy steel beams, what safety measures should be taken to prevent accidents?
- Explain why it's important to segregate hazardous materials properly during storage on a construction site.

Notes 

Scan the QR code to watch the video



<https://youtu.be/Ks2qnadxLqA>

Handling Masonry Materials



4. Carrying Out Earthwork Manually



Unit 4.1 – Preparatory Work and Soil Cutting

Unit 4.2 – Backfilling and Compaction Manually



(CON/N0104)

Key Learning Outcomes



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

1. Describe the work to be done during earthwork
2. Select and use tools required for cutting earth and cleaning excavated pit
3. Describe the function of different tools used for manual excavation
4. Perform cleaning and preparatory works to be carried out prior to excavation work
5. Excavate the earth maintaining required slope, length, width and depth
6. Perform backfilling and compaction of earth using hand operated compactors
7. Follow appropriate safety measures while working in confined space
8. Illustrate the precautions to avoid the collapse of trenches or pit

UNIT 4.1: Preparatory Work and Soil Cutting

Unit Objectives

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

- Discuss the operations done in earthwork
- Carry out preparatory work prior to earthwork
- Excavate the earth manually like digging, trenching
- Carry out the dressing work after excavation job
- Identify the Do's and Don'ts in excavation

4.1.1 Introduction to Earthwork

The preliminary step of any construction activity is earthwork.

Excavation is carried out to lay foundation of various structures. Excavation are carried out manually and also by using heavy equipments. We will learn about manual earthwork carried out by a helper mason at a construction site.

Earthwork in construction mainly involves two operations:

- Excavating the earth
- Backfilling and compacting the earth



Fig. 4.1.1 Soil excavation



Fig. 4.1.2 Back filling

Importance of Earthwork

Earthworks are to be carried out as a part of the development of any construction work.

The earth may be moved to another locations and form into a desired shape for a purpose.

Earthworks are carried out prior to construction of buildings, roads, railway beds, causeways, dams, levees, canals and berms. Other common earthworks application land grading is for reconfiguring the topography of a site and to stabilize slopes.



Fig. 4.1.3 Earth work for roads



Fig. 4.1.4 Earth work for canals

Operations done Under Earthwork

Earthwork and related operations consists of excavation for the construction of the roadway, excavation for structures and pipe, constructing backfill around structures and pipe and constructing embankments as required for the roadway, ditches and channel changes.

Operations done under earthwork include clearing, grubbing, removing and disposing of all vegetation and debris within the limits of construction and soil cutting and dressing as per requirement for construction works.

Clearing, grubbing, removing and disposing of all vegetation and debris



Fig. 4.1.5 Clearing the construction area

Soil cutting and dressing

Excavation (soil cutting) is used in construction to create foundations. The process used in excavation work includes marking, digging and removal of soil/rock.

Each of these processes requires different techniques, tools and machinery to get the job done right.



Fig. 4.1.6 Soil marking



Fig. 4.1.7 Soil cutting

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Fig. 4.1.6 Soil marking



Fig. 4.1.7 Soil cutting



Fig. 4.1.8 Soil dressing

4.1.2 Earthwork Process

Excavation (soil cutting) is carried out to create foundations for various structures. The process used in excavation work includes marking, digging and removal of soil/rock. Each of these processes are done using different techniques, tools and machinery.



Fig. 4.1.9 Excavated trench and pit (large and circular)

Tools for cutting earth

			
Trenching hoe	Pick axe	Rake	Fork
			
Spade	Shovel	Rope	Flags
			
Wooden sign	Marking lime	Wheelbarrow	Pan
			
Safety helmet	Gumboots	Safety goggles	Dust mask

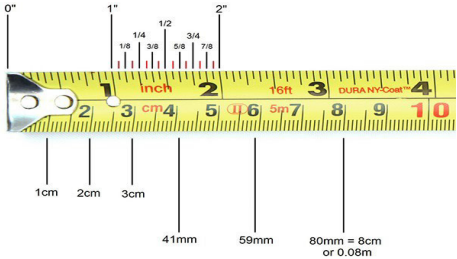
	
<p>Warning signage & barricading materials</p>	<p>Measuring tape for Measurement</p>

Table 4.1.1 Tools for cutting earth

The helper mason is responsible for carrying out manual earthworks at construction sites. The helper mason carries out the following activities for manual earthwork:

- Identification and selection of tools of earthwork.
- Preparatory activities for earthwork such as removing vegetation, unwanted materials etc. from the site
- Marking the ground as per instructions and cutting of soil manually using appropriate tools
- Carry out surface dressing works.

Preparatory Work Prior to Earthwork

There are certain works at construction sites which are required to be completed before carrying out the earthwork.



Fig. 4.1.10 Preparatory work prior to earthwork process



Step 1: Ready all earth cutting tools needed to complete the work on hand before



Step 2: 101 Wear personal protective equipment



Step 3: Remove unwanted materials, organic substances manually using spade, shovel and rake



Step 4: Remove and dispose gravels, plant roots, sludge, muck or debris



Step 5: Have all marking tools like lime, wooden pegs, rope, flag, etc. ready.



Step 6: Assist in the marking of layout.



Step 7: Barricade the area using fencing or barricade materials and place safety signage.

Table 4.1.2 Steps for performing works at construction sites

How to Cut Soil Manually

Cutting soil manually for masonry work or construction typically involves excavating or removing soil from a specific area to achieve the desired depth or slope.



Fig. 4.1.11 Cutting soil manually



Fig. 4.1.12 Soil types



Step 1: Loosen hard soil using a pick axe or fork.



Step 2: Define the sides of the trench or pit using the point of spade.



Step 3: Start digging using trenching hoe.



Step 4: Lift the soil on the blade of shovel and pull it out.



Step 5: Place all the soil that you pull out of the trench or pit on one side. This will leave the other side of the trench/pit easier to access. Dispose soil as per instructions.



Step 6: Continue digging until the desired depth is not achieved.



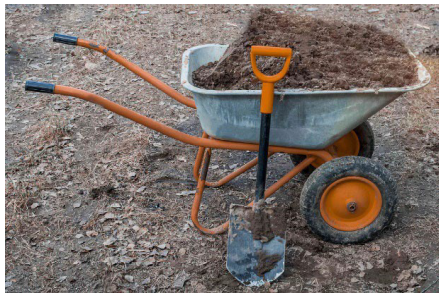
Step 7: Check the depth and slope of the pit or trench.



Step 8: Continue digging until the whole trench or pit is complete. Recheck the depth and slope of the trench or pit.

Table 4.1.3 Processing of cutting soil manually

Surface dressing work after excavation



Step 1: Dispose the excavated earth from the site using wheel barrow, pans, and etc.



Step 2: Check and clean the trench/pit for any lump, gravel, or debris etc.



Step 3: Compact the base layer of the pit or trench by ramming manually.

Table 4.1.4 Surface dressing work after excavation

Ways to avoid the collapse of trench or pit

- **Shoring and Timbering:** The length, breadth and depth of trench should be as per the drawing and design given in the map. Where the soil is wet or cohesion less the side slopes are supported by the use of cross bars and side shutters (planks) in order to prevent the collapse of the trench.



Fig. 4.1.13 Shoring and timbering

- **Providing Soil Embankment:** If it is required to construct a soil embankment, at least 10% more soil should be added i.e. if the designed height of the embankment is 6.0 m, the embankment of 6.6 m height should be constructed initially to allow for the settlement of soil at a later stage.

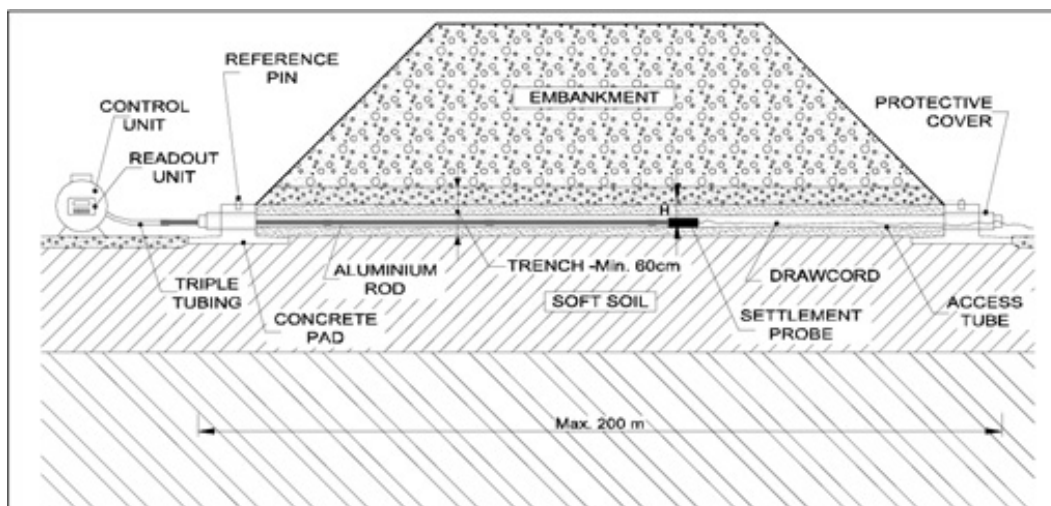


Fig. 4.1.14 Soil embankment

- **Sloping:** Sloping digging the trench wall at an angle away from the opening, so that soil weight is away from the worker. The trench is somewhat funnel shaped.

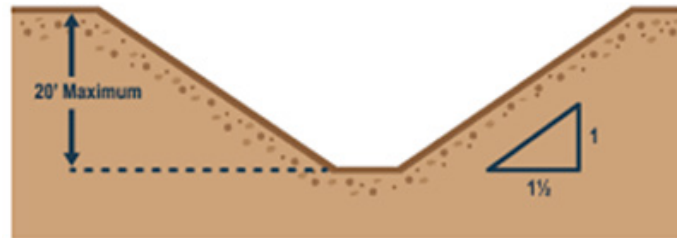


Fig. 4.1.15 Slopping a trench

- **Benching:** If it is required to put new soil over old soil, Benching is required to be done so that a perfect bonding between old and new soil is achieved. Benching means construction of steps.

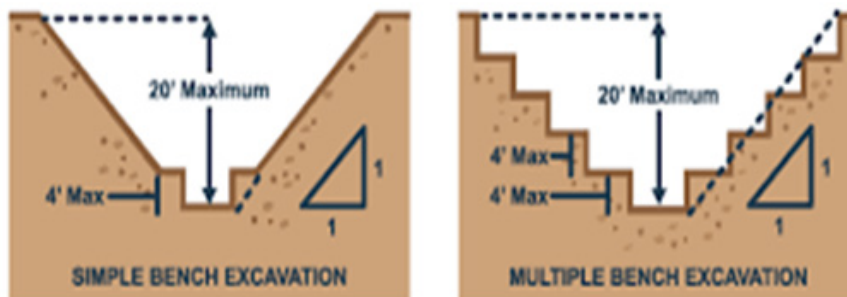


Fig. 4.1.16 Benching a trench

Do and Don'ts of Excavation

Do's	Don'ts
Planning reduces the chance that something will go wrong when a job is started. So execute prior planning before performing task.	Never use damaged chains or frayed cables, slings, straps, or ropes.
Remove debris near the excavation site	Never stand in line with, or next to, a sling that is under tension.
Provide safe means of access in to the excavated place.	Do not allow vehicles and other mobile equipment to operate near the excavation sites.
Provide barriers to protect people from falling into the excavation	Don't excavate below the base or footing of any foundation
Plan for possibility of water in the excavation	--

the Foundation wall.	
Compact the backfill; Compaction is needed to reduce the amount of soil settlement that occurs with time.	--
While compacting use precautions to protect the foundation columns, plinth wall etc.	--

Table 4.1.5 Excavations related do's and don'ts

4.1.3 Safety precautions to follow:

- Always wear personal protective equipment while excavating the earth.
- Look for any underground cables in the location marked for excavation.
- Excavation should be done to the required level, slope, shape, and pattern.
- Excavated material should be deposited away from the pit to prevent collapsing of edges.
- Do not operate heavy equipment near the sides of a trench/pit.
- Provide a safe means for entering and exiting the deep trench/pit, such as ladder.
- Protect the trench/pit with fencing, flagging, or other means to prevent someone from accidentally falling into it.
- Report to the supervisor for any potential risk or hazard.



Fig. 4.1.17 Safety related precautionary measures

Notes 

Scan the QR code to watch the video



<https://youtu.be/0yVyFD5RAFc>

Introduction to Earthwork

UNIT 4.2: Backfilling and Manual Compaction

Unit Objectives



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

- Understand the importance of backfilling
- Carry out backfilling work effectively
- Understand the importance of compaction
- Carry out compacting work effectively
- Understand the Do's and Don'ts in backfilling and compaction

4.2.1 Backfilling: Importance and need

Backfilling is the process of putting soil back inside a trench or in a foundation when the excavation has been completed. Backfilling can be done in several ways and can be used in tasks such as protecting foundations, landscaping, or filling in voids in underground structures.

- It is used to strengthen and support a structure's foundation.
- The excavated material from the pits or procured from outside is used for back filling.
- The space between sub-structure that is foundation and sides of excavation should be filled back to the original surface level in layers.
- These layers should not exceed more than 250mm in thickness.
- It should be watered and well compacted by means of rammer to achieve maximum consolidation.



Fig. 4.2.1 Backfilling

There are four key elements to proper backfilling:

- Protecting the foundation wall from damage during backfilling
- Using the right backfill materials
- Compacting the backfill
- Final finishing to the subgrade to ensure that water drains away from the foundation



Fig. 4.2.2 Backfilling

4.2.2 What is Compaction?

Compaction is the process in which a stress applied to the soil or concrete to consolidate and remove any voids.

Advantage of Effective Compaction:

- Compaction increases density of soil.
- It reduces porosity of soil.
- It increases shearing resistance of soil.

Difference between Soil Compaction and Concrete Compaction:

- Soil compaction involves compacting loose soil.
- Concrete compaction involves compacting concrete to fit tightly into certain required area.
- Soil compaction is done by using hand rammer or plate compactor.
- Concrete compaction can be either done manually or mechanically.
- Manual concrete compaction is either done by rodding with the steel rods or tamping using rammer.

- Manual concrete compaction is suitable for small jobs.
- Mechanical concrete compaction is done by using vibrators.
- Vibrators are very effective in compacting the concrete stiffer resulting in highly dense concrete.



Fig. 4.2.2 Backfilling

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Fig. 4.2.3 Soil compaction by power rammer



Fig. 4.2.4 Concrete compaction by vibrator

Above process can be done manually also.

4.2.3 Steps for Carrying out Backfilling and Compaction

Backfilling and compaction are crucial steps in construction to ensure the stability and proper settlement of foundations, trenches, and other excavated areas.

Remember that specific procedures and equipment may vary based on the type of project, soil conditions, and local regulations.



Fig. 4.2.5 Carrying out Backfilling and Compaction

It's essential to follow industry best practices and guidelines to ensure effective backfilling and compaction.

- Step 1: Have all things and tools needed to complete the work on hand before beginning.
- Step 2: Wear personal protective equipment.
- Step 3: Place safety signage.
- Step 4: Remove gravels or oversized aggregates from soil to be used for backfilling.
- Step 5: Transport the soil to the pit or trench using the wheelbarrow or pan.
- Step 6: Place and spread the soil in pit or trench in uniform layers, each being 15cm to 25cm thick.
- Step 7: Water uniformly over the layer to be compacted.
- Step 8: Pound the earth with hand tamper to compact the soil.
- Step 9: Repeat step 6 to step 8 until soil stops to settle.

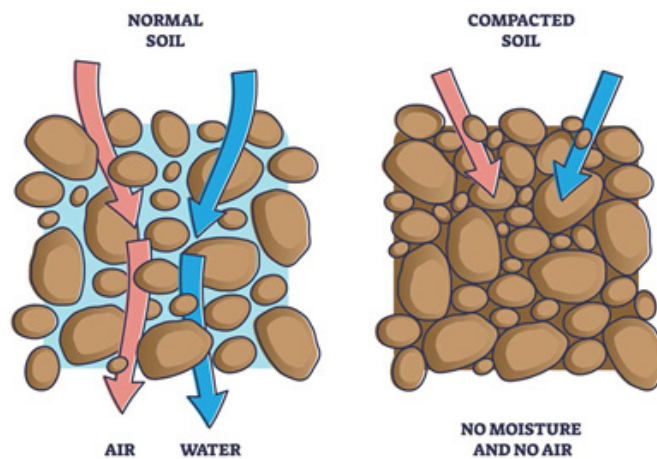


Fig. 4.2.6 Soil compaction

4.2.4 Do's and Don'ts of Backfilling and Compaction

Do's	Don'ts
Backfilling should be done after the foundation has completely set.	Inadequate compaction is likely to cause settlement of backfilling resulting in development of cracks in flooring.
Backfilling should be carried out in layers.	Don't do backfilling with large clumps of clay, with soil full of roots or tree branches, or other organic materials.
Each layers should be thoroughly compacted.	--
Choose the right backfill material: granular fill makes it easier for water to move toward	--

the Foundation wall.	
Compact the backfill; Compaction is needed to reduce the amount of soil settlement that occurs with time.	--
While compacting use precautions to protect the foundation columns, plinth wall etc.	--

Table 4.2.1 Soil



Fig. 4.2.7 Do's and Don'ts of Backfilling and Compaction

Exercise

Answer the following questions.

- Write down two ways of compacting the earth.
- Write down the names of power tools used for compaction.
- Why is backfilling required for ground work of a building?
- Write down any three jobs to be done prior to digging the earth.
- How can one mark the layout on the ground?
- Write down the two main operations involved in earthwork.

Notes 

Scan the QR code to watch the video



https://youtu.be/BxSLst_fVP4

Steps for Carrying out Backfilling and Compaction



5. Erect and Dismantle Temporary Scaffolding



Unit 5.1 - Basics of Scaffolding

Unit 5.2 - Concept of Conventional Scaffolding

Unit 5.3 - Concept of Modular Scaffolding System

Unit 5.4 - Erecting and Dismantling of Temporary Scaffolding



(CON/N0101)

Key Learning Outcomes



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

1. Discuss about scaffolding and the purpose of its erection
2. Describe the types of scaffolding
3. Define the different systems of scaffolding
4. Understand about the components of modular scaffolding system
5. Select and use the right tools for erection of a scaffolding
6. Erect the temporary scaffolding in level and plumb
7. Dismantle the temporary scaffolding
8. Follow safety measures to be followed while erecting and dismantling a scaffolding

UNIT 5.1: Basics of Scaffolding

Unit Objectives

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

- Describe about the basic concept of a temporary scaffolding
- Understand the benefits of a scaffolding
- Discuss the types of temporary scaffolding

5.1.1 What is Scaffolding

- Scaffolds are temporary work platforms.
- Scaffolds are used when work cannot be performed from the ground level.
- Scaffolds provide a platform for workers to work at heights, and keep materials and tools.
- Scaffolds are erected used, and dismantled and removed to another construction site for reuse.
- Scaffolds are made from various types of material including wood, bamboo etc.

Now-a-days metal scaffolding is used as they are easy to erect and dismantle.



Fig. 5.1.1 Scaffolding

5.1.2 Advantages of using Scaffolding

- Provides a secure elevated work area for workers and tools.
- Offers a safer alternative for working at heights store than ladders.
- Helps workers to access the work area.
- Provides a stable platform to transport and store building materials from the base to the topmost parts of structures.

5.1.3 Types of Scaffolding

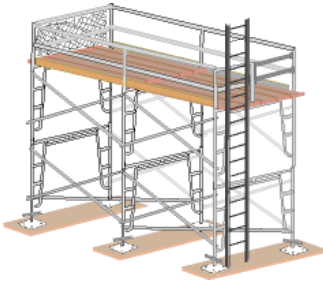
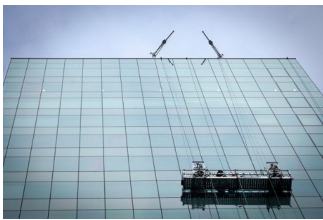


Types	Description	Picture
Supported Scaffolding	<ul style="list-style-type: none"> • The most commonly used form of scaffolding • Built from the base upwards • The easiest, safest, and most cost effective form of scaffolding • Very convenient and flexible in terms of application/use. 	
Suspended Scaffolding	<ul style="list-style-type: none"> • Suspended from a tall building or roof • Used when constructing a base is difficult or impossible • Ideal for just one or two workers • Allows workers to reach very high levels on buildings • Commonly used by window cleaners 	
Rolling Scaffolding	<ul style="list-style-type: none"> • Castor wheels on the base • The wheels allow the scaffolding to be moved without dismantling it • The wheels are locked when workers or materials are on the scaffolding 	
Aerial Lifts	<ul style="list-style-type: none"> • The most common are vehicle-mounted aerial platforms • Allow workers to access multiple levels in order to do their job • Save the time in erecting and dismantling scaffolding • Commonly seen when people are working on lampposts and telephone poles 	

Table 5.1.1 Types of scaffolding

5.1.4 Types of Scaffolding - Based on Material

There are mainly two types of systems of scaffolding:

Conventional System (Bamboo & Ballie and Pipe & Coupler)

In this system, Vertical and horizontal members are bamboo which are joined together at the intersection of joints by means of knotted rope.



Fig. 5.1.2 Bamboo system

Modular System (Cuplock and Frame)

In this system, different prefabricated parts are assembled together with the help of pins, wedges or cups.

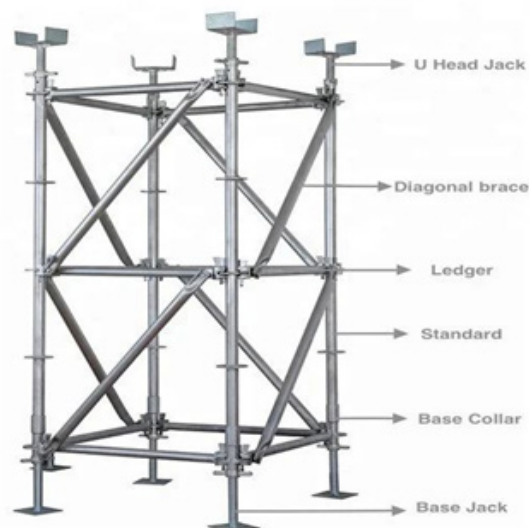


Fig. 5.1.3 Cuplock system



Fig. 5.1.4 Frame system

Notes 

Scan the QR code to watch the video



<https://youtu.be/YuBFUtGGcbk>

Types of Scaffolding

UNIT 5.2: Concept of Conventional Scaffolding

Unit Objectives



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

- Describe the material used in bamboo scaffolding
- Know how to erect and dismantle a bamboo scaffolding

5.2.1 Introduction

Scaffolding is a temporary structure constructed to support man and materials for various construction activities.

- In bamboo scaffolding, plastic fibre straps or coconut and bamboo shoots together form a solid and secure scaffold structure without screws.
- Bamboo scaffolding does not need to have a foundation on the ground as long as the scaffolding has a fulcrum for structural support.
- Bamboo scaffolding is widely used in India for construction.
- It was widely used in the building of houses and multi-story buildings (up to four stories high) prior to metal scaffolding.
- It is also useful for short-term construction projects such as durga puja pandals, marriage pandals etc.
- Bamboo is an ideal material for scaffolds due to its high resistance and its lightness. The joints are done so that a vertical force acts directly on the tied node.
- In the case of high diameter canes, the friction can be increased by making the rope pass between the two canes.
- The ropes used are soft, so that it's possible to modify their tension



Fig. 5.2.1 Bamboo scaffolding



Fig. 5.2.2 Safety net

5.2.2 Material used in Conventional Bamboo

- Bamboo Members
- The Bamboo members should be 3 to 5 years old and air-dried in vertical positions under indoor condition for at least 3 months before use.
- All bamboo members should be free from visual defects, and meet the following requirements on the cross-sectional dimensions:
 - The nominal external diameter should not be less than 40-70 mm with a nominal minimum thickness of 10 mm.



Fig. 5.2.3 Bamboo and ropes used in conventional bamboo scaffolding

Organic ropes (mostly bamboo and rattan coconut, or Nylon Strips for Knotting)

- Usually these natural materials are softened in water and only after tied they get dry and create a very strong joint
- Nylon strips of adequate strength, stiffness and durability can be used for knotting in bamboo scaffolds.
- All knots should be tightened with at least 5 rounds of rope. The ends of the ropes should be crossed and twisted to form a single twisted end which passes through the knot twice to give one round turn for proper anchorage.

Lateral Restraints

- Effective lateral restraints should be provided to the main posts of the outer layer of double-layered bamboo scaffolds.
- An effective lateral restraint takes the form of putlog which consists of a metal tie and a bamboo strut. It should be properly anchored to structural elements with the use of an anchor bolt together with a properly installed bamboo strut.
- The free-standing portion of bamboo scaffolds at the top should be tied back to the building structure.

5.2.3 Sequence of Operations to Join Two Bamboo Culms

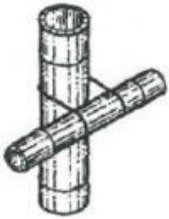



	
<p>Step 1: Put bamboos in a cross form or parallel as may be required</p>	<p>Step 2: First fix the rope around the vertical culm making a loop</p>
	
<p>Step 3: Then start to pass the rope diagonally between the two beams some times in one sense and then some times in the other sense (the number depends on the specific case).</p>	<p>Step 4: Finally tie the rope with a simple knot</p>

Table 5.2.1 Sequence of operations to join two bamboo culms

About Balli Joints

"Bamboo Balli Joints" typically refer to a traditional method of joining bamboo poles together in construction. Bamboo is a versatile and sustainable material that has been used for centuries in various construction practices, particularly in regions where it is abundant. "Balli" is a term used to describe a specific type of joint used to connect bamboo members.

Bamboo Balli Joints have been utilized in various construction applications, such as building frameworks for huts, temporary shelters, scaffolding, and even more complex structures. These joints capitalize on bamboo's natural strength, flexibility, and resilience, making them suitable for lightweight construction purposes



Fig. 5.2.4 Balli joints

5.2.4 Erection Procedure of Bamboo Scaffolding

To start the erection, erect two bamboos as the main vertical posts. Posts are the vertical members which rest on the ground or steel brackets and are usually in good quality and strong. They would then be connected with horizontal ledgers in order to fix their position. Then, three bamboos will be erected in between the two vertical bamboos as standards.

Standards are vertical members that overhang on the ledgers and would not rest on ground and brackets. Thus, a total of five bamboo poles now span over a distance of about 3m so that the distance between two adjacent standards is about 750mm. The vertical distance between two ledgers (i.e. distance between an upper ledger and a lower ledger) is also about 750mm (2.5 feet); therefore, the bamboo scaffolding is in square form. The inner layer is erected in the same way.

Transoms: They are erected to connect the inner and the outer layers. These transoms are used to support the working platform.

Bracing: The integrity and lateral stability of bamboo scaffolding structure rely on the provision of bracing. Each bracing section should consist of two pieces of bamboo, which are fixed in an “X” shape and usually in an angle between 60 - 70° over the section of bamboo scaffolding to be braced. Each bracing should also be tied to both the standards and the transoms of the scaffolding. In this way, the loading on the scaffolding can be distributed evenly.

Working platforms: These are used to provide access for workers and provide a levelled and safe working area for workers to carry out their construction work. Working platforms may be covered by planks and are mainly used by plasterers and painters.



Fig. 5.2.5 Bamboo Scaffolding with working platforms

5.2.5 Systems to Anchor the Scaffold to the Building and to the Ground

- To anchor of the scaffold to the building there are different methods, like ropes (the same used to tie the beams) fixed to some hooks put into the facade or to the gutter pipes or to any other element and bamboo beams that pierce windows or walls.

- Sometimes we can find other beams contrasting the detachment of the scaffold from the building.
- For the ground joint, the beams are simply lean and aren't fixed in any way.
- They are many times cut at the end so that the surface in contact with the ground is less, to limit the problems with water infiltration.



Fig. 5.2.6 Anchoring bamboo scaffold with building

5.2.6 Dismantling of Scaffolding

- Bamboo scaffolds must be immediately removed once the construction/repair works are completed.
- Dismantling work must be carried out by trained workmen under the immediate supervision of a competent person.
- Before dismantling the critical members, such as ledgers, ties, struts, transoms or bracings, the stability of the bamboo scaffolds must be assured by fixing a similar piece of bamboo member at a lower level before removing that critical member.
- Dismantling should start from upper level to lower level, from exterior to interior and from non-loadbearing parts to load-bearing parts.
- No materials or debris shall be stacked on the scaffold.



Fig. 5.2.7 Dismantling of scaffolding

5.2.7 Do's and Don'ts for Bamboo Scaffolding



Fig. 5.2.8 Working on bamboo scaffolding

For material shifting and Stacking

- Do
 - A suitable place should be provided at the site for storage of bamboo members and the associated materials, tools or equipment.
 - The storage area should be clearly shown on the site plans.
 - The bamboo members should be stored in dry area and in vertical position to prevent the accumulation of waste water inside, thus causing them to decay.
 - Bamboo should be properly stacked and tied to prevent accidental displacement and collapse.
- Don't
 - Don't use defective materials.
 - Defective material on the site should be properly labelled to show that they are defective and should not be used.

For Erection

- Do
 - The ground or structure on which a scaffold is constructed should be solid, levelled and rammed to give a hard surface, and should be strong enough to keep the scaffold upright.

- Bamboo scaffolds shall be erected, added to, or altered by trained workmen under the immediate supervision of a competent person
- All workers must wear protective equipment. For example, safety helmets, safety nets and safety belts with suitable anchorage.
- Guard-rails and toe-boards shall be installed at edges where persons are liable to fall from height.
- Work should be started from the bottom level to the top level and from the interior part to the exterior part.
- The height of the bamboo scaffold erected at any side should not be higher than the topmost part of the building/structure by one storey.
- Where a scaffold is erected adjacent to a road or pathway, overlay or screen nets must be erected to envelop the scaffold for the protection of person or vehicular traffic against falling objects.
- All the fastenings between bamboo members should be tight and secure.

For Dismantling

- Do
 - For dismantling start the work from upper level to lower level, from exterior to interior and from non-loadbearing parts to load-bearing parts.
 - Dismantling should be orderly and planned and should proceed generally from the top in horizontal sections.
 - If dismantling has reached the stage at which a critical member has to be removed, for example, a tie or a brace, fix an adequate member in place lower down before the member to be taken out is removed.
 - All the stacked materials and debris placed on the scaffold should be removed.
 - Every scaffolder involved in the dismantling work at height should wear safety belt attaching to suitable and sufficient anchorage and suitable fixings as well as other PPE
- Don't
 - Scaffolds should not be dismantled in vertical sections from one end towards the other unless special consideration is given to ties and bracings.
 - Lower level of scaffolds should not be loosened till upper ones are completely removed.
 - Don't keep the removed bamboos and ropes close to the dismantling area otherwise it can result in tripping or slippage

Notes 

Scan the QR code to watch the video



https://youtu.be/8DP_7OK6dCw

Material used in Conventional Bamboo

UNIT 5.3: Concepts of Modular Scaffolding Systems

Unit Objectives



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

- Understand about types of modular scaffolding
- Summarize the components of cuplock system scaffolding
- Identify the components of frame system scaffolding

5.3.1 What is a Modular Scaffolding System?

Modular scaffolding system consists of different prefabricated individual components that can be connected with each other.

The basic components of modular scaffolding are tubes, couplers and boards. Tubes are usually made either of steel or aluminium. They are either galvanized (tinted black), or painted with other darker colours in order to prevent accidents caused by glare.



Fig. 5.3.1 Modular scaffolding system

5.3.2 Advantages of Modular Scaffolding System

Modular Scaffolding System:

- can be adjusted to any shape
- are quick to erect and dismantle
- can be erected outside as well as in inside the structure

- are safe and reliable
- are easy to transport
- are easy to store; they can be easily stacked
- have higher strength compare to similar sized
- conventional bamboo scaffolding system

5.3.3 Types of Modular Scaffolding System

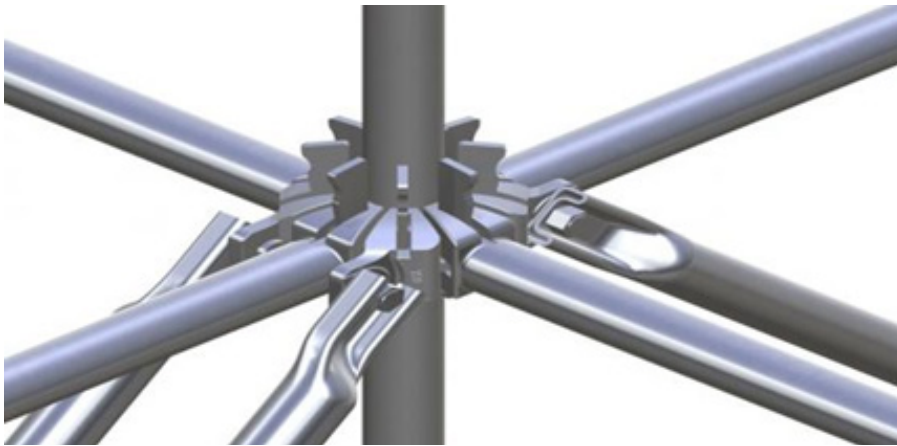


Fig. 5.3.2 Ring system scaffolding



Fig. 5.3.3 Cuplock system scaffolding

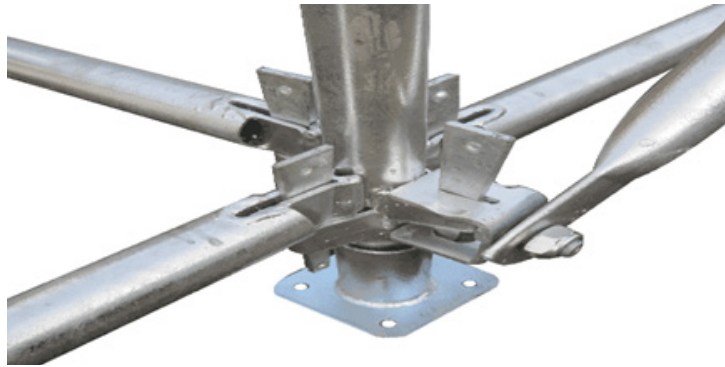


Fig. 5.3.4 Kwikstage scaffolding

5.3.3 Types of Modular Scaffolding System

Cuplock system scaffolding is widely used in construction because of its easy-to-use and highly versatile nature.

In cuplock system, there is a node point connection which allows up to four horizontal members to be connected to a vertical member in one single action - without the use of nuts and bolts, or wedges.

Advantages of cuplock system scaffolding:

- Easy to erect - does not use nuts and bolts or wedges
- Versatile
- Time tested and proven design with safety accessories
- Quick fastening of horizontals
- Time and labour saving
- Lightweight
- Low maintenance

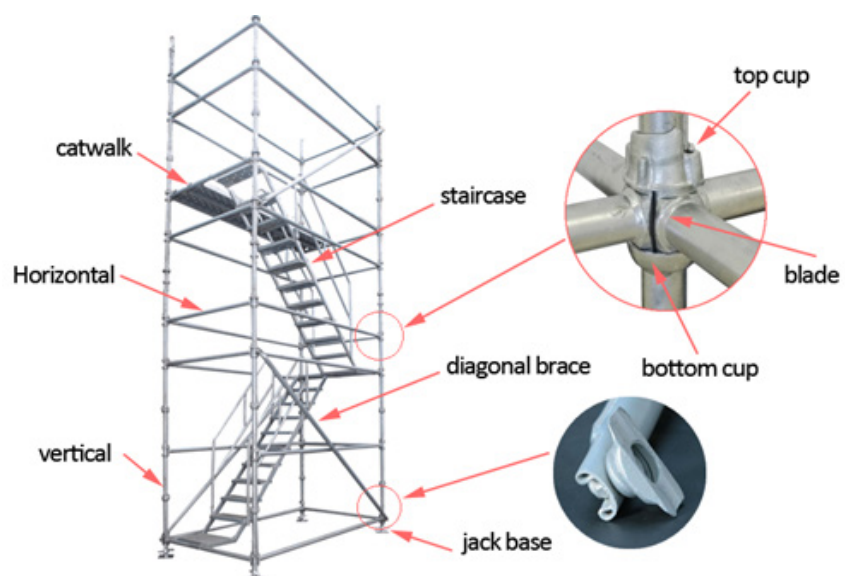


Fig. 5.3.5 Components of cuplock system scaffolding

5.3.5 Components of Cuplock System Scaffolding

Standards

- They are vertical load-carrying members.
- They are made from high grade steel tubing.
- All standards have lower fixed cups at 500mm intervals.
- They are available.

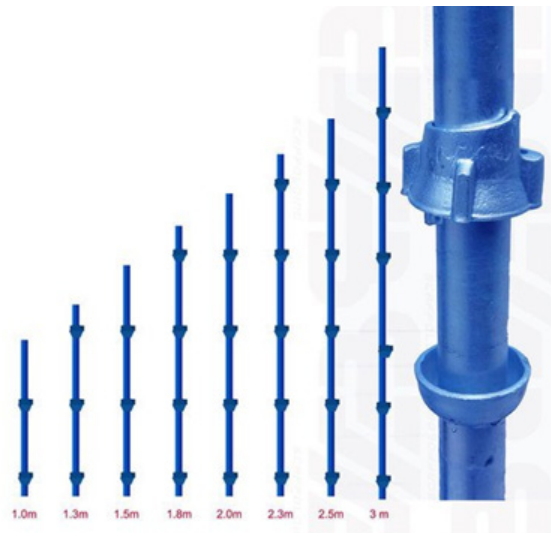


Fig. 5.3.6 Standards

Ledgers

- They are horizontal members made from tube.
- They have two forged blades at both sides which fit in bottom cups of the standards and are locked in place by the corresponding top cups.
- They are available in various lengths from 0.6m to 2.5m.
- They are also used as guardrail and midrail.

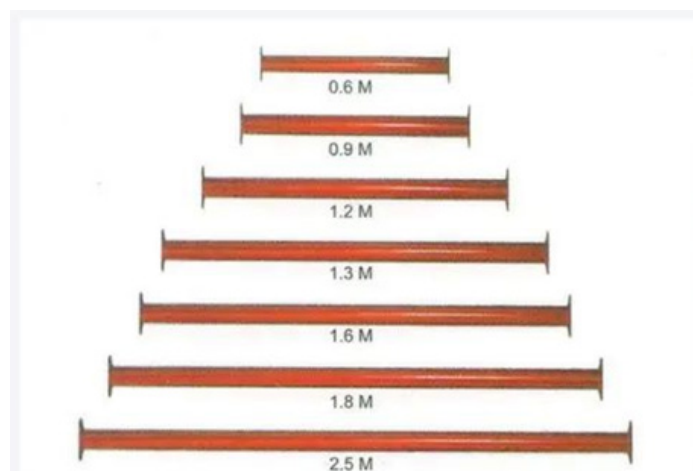


Fig. 5.3.7 Ledgers

Transoms

- They are made of high grade steel tubing.
- They are fabricated from angles fixed back to back with a drop forged blade at each end.
- The transom blade locates into a bottom cup and is locked in position by the top cup.
- Intermediate transoms have two 'U' shape hooks at both sides and they can be put to anywhere between horizontals to decrease the free space.
- They are available in various lengths.



Fig. 5.3.8 Transoms

Braces

- The vertical braces are made of high grade steel tubing with wedge connections at both ends.
- The vertical braces increase the stiffness of the scaffold.



Fig. 5.3.9 Braces

Base jack

- It is a square plate that distributes the load of the scaffolding.
- It is connected with the standards.
- The adjustable base jack is used for levelling the standards at the same height.
- U-Head is used to insert in the top of the vertical standard to support beam etc.



Fig. 5.3.10 Base jack

Side bracket

- The side bracket can be used to expand the working platform.
- This expansion can be made by a one board bracket (0.39m wide bracket) or by a two board bracket (0.73m wide bracket).



Fig. 5.3.11 Side bracket

Toe board

- The toe boards are mounted on every working platform.
- They prevent material from falling down from the working platform.

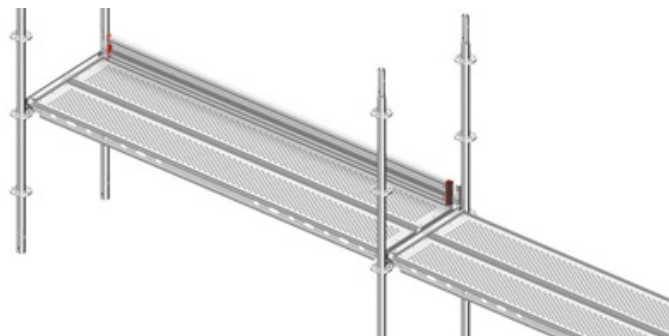


Fig. 5.3.12 Toe board

Platforms/walk boards – Steel deck

- The steel deck is used to create platforms.
- The decks are made of light-weight steel sheets with a non-skid surface.
- The steel decks are placed on the transoms.
- They have two hooks at both sides which fit in the horizontals.



Fig. 5.3.13 Platforms/walk boards – Steel deck

Timber sole plate

- It is laid under base jacks.
- Base jack is screwed with sole plate.
- It prevents scaffolding from displacement or sinking.
- It should be of at least 25cm wide and 5cm thick.



Fig. 5.3.14 Timber sole plate

5.3.6 Frame System Scaffolding

Frame scaffolds are a common type of scaffold because they are versatile, economical and easy to use.

Frame system scaffolding has two frames. These frames are rigid welded frame of horizontal and vertical pipes. They can be connected with diagonal/cross brace, horizontal brace, walk board, adjustable jack base etc.

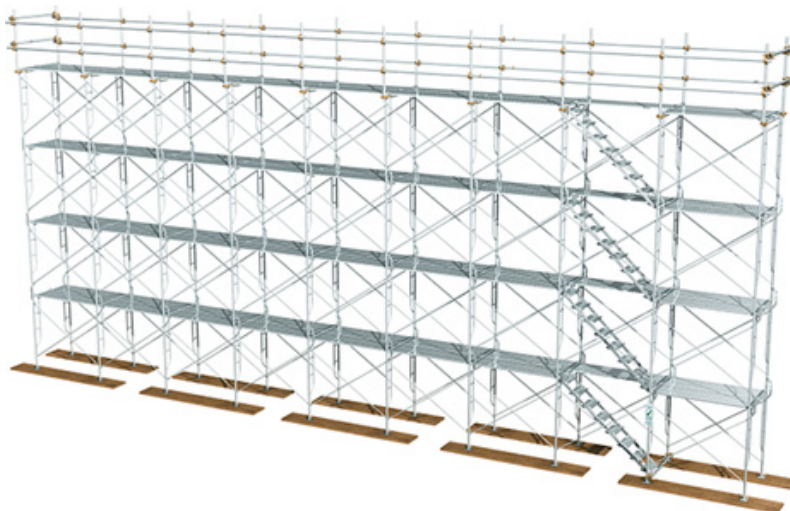


Fig. 5.3.15 Frame System scaffolds

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

H-frame or U-frame:

- These frames are prefabricated.
- They are fabricated from galvanized tubing.
- Vertical and horizontal members are welded together to form a frame.
- Walkthrough frames provide an easy access for human mobilization with clear head room throughout the erected scaffolding structure.

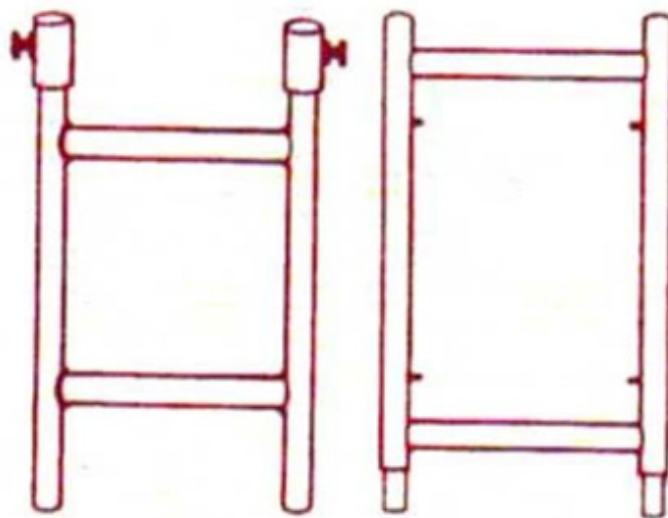


Fig. 5.3.16 H-frame or U-frame

Cross braces:

- All cross braces are fabricated from galvanized steel tubing.
- Cross braces are used to brace the frames with drop locks at various spacings.

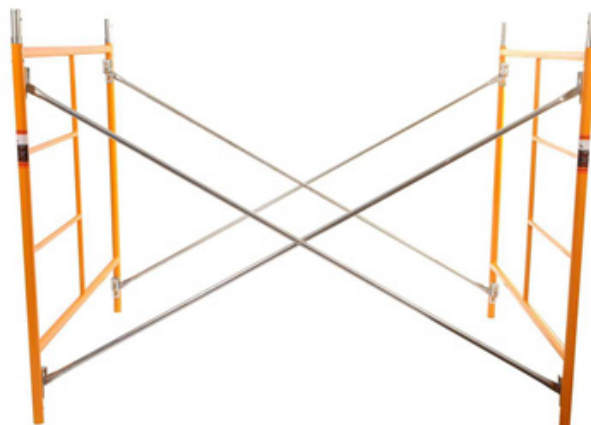


Fig. 5.3.17 Cross braces

5.3.7 Components of Frame System Scaffolding

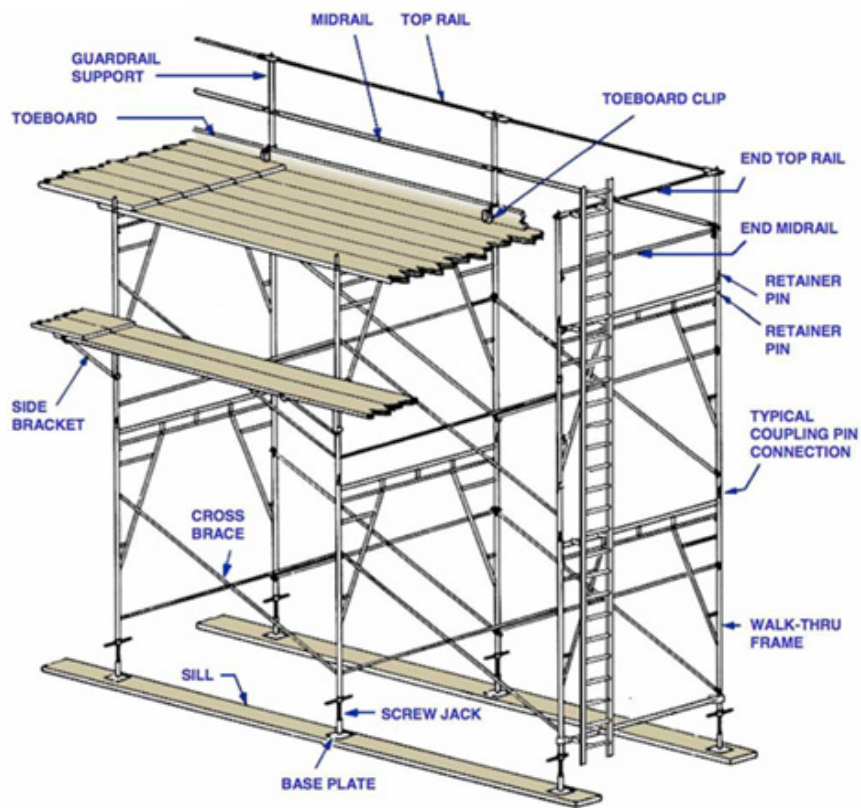


Fig. 5.3.18 Components of Frame System

Notes 

Scan the QR code to watch the video



<https://youtu.be/oRyg2LLfxO4>

Modular Scaffolding System

UNIT 5.4: Erecting and Dismantling Modular Scaffolding System

Unit Objectives

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

- Describe the scaffolding tools
- Use the scaffolding tools
- Erect cuplock system scaffold in correct way
- Erect frame system scaffold in correct way
- Dismantle the scaffold
- Work safely while erecting and dismantling the scaffold

7.4.1 Scaffolding Tools

A scaffold has four basic parts: the planks, cross-bars, frame and connecting pins or clamps. It is very important to correctly assemble different parts to prevent accidents. Several scaffolding tools are necessary to properly erect scaffold sections and secure them in place.



Level:

It is used to check the plumb and level of the assembled components of the scaffold.



Measuring tape:

It is used to measure the height, the distance between the scaffold and building and helps to square up the frames.



Hammer:

A heavy-duty hammer is used to drive the pins or cups into place or to help remove them when scaffold is dismantled.



	<p>Ratchet, Wrenches & Podger: Ratchet and wrench is used to tighten or loosen the nuts.</p>
	<p>Pliers: It is a hand tool used to hold objects firmly.</p>

Table 5.4.1 Scaffolding tools

Erect a Frame-System Scaffold

Erecting a scaffold is a team work. It should be erected by a team of 2 persons.

Let us now look at how to erect a frame-system scaffold. This type of scaffold is put together using prefabricated components.

Resources needed:

Components	Scaffolding tools	PPE & Warning signages
<ul style="list-style-type: none"> • Sole plates • Leveling jacks • 5' high frames • Cross-braces • Decks & Guardrail • Midrail & Toeboard • Side bracket 	<ul style="list-style-type: none"> • Level • Measuring tape • Hammer • Ratchet • Wrench • Plier • Nails 	<ul style="list-style-type: none"> • Safety helmet • Safety shoes • Safety gloves • Safety goggles • Warning signage • Safety harness

Table 5.4.2 Scaffolding resources

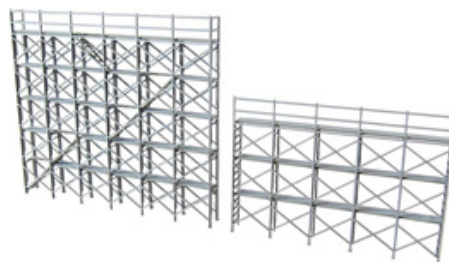
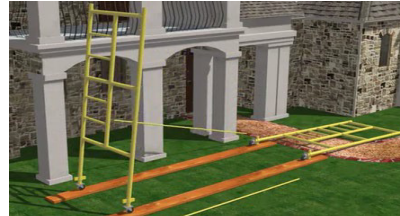


Fig. 5.4.1 Scaffolding work

Steps to erect a frame system scaffold:



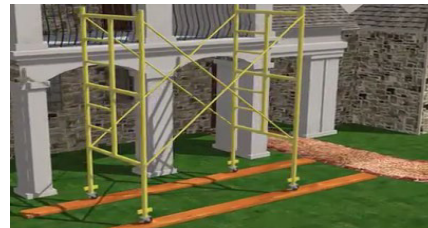
Step 1: Place sole plates, set out their position and bed them as level as possible.



Step 2: Set levelling jacks to their lowest adjustment and place on top of the sole plates.



Step 3: Stand a unit frame on each jack at one side.
Step 4: Attach cross-braces to one frame on one side.
Step 5: Stand another unit frame on other pair of jacks.



Step 6: Attach cross-braces to second frame and Fit another cross-brace to the other side of the same bay.
Step 7: Check the level and plumb of the bay and adjust the jacks.
Step 8: Fix jacks to the sole plates.



Step 9: Deck the working platform with planks.



Step 10: Fit toeboards, guardrails and midrails.

Table 5.4.3 Steps to erect a frame system scaffold

Steps to Erect a Cuplock-System Scaffold

Let us now look at how to erect a cuplock-system scaffold.

Resource needed

Components	Scaffolding tools	PPE & Warning signages
<ul style="list-style-type: none"> • Sole plates • Leveling jacks • Standards • Ledgers • Vertical component • Toeboards • Walkways 	<ul style="list-style-type: none"> • Level • Measuring tape • Hammer • Ratchet • Wrench • Plier • Nails 	<ul style="list-style-type: none"> • Safety helmet • Safety shoes • Safety gloves • Safety goggles • Warning signage

Table 5.4.4 Steps to erect a cuplock-system scaffold

Steps to erect a cuplock systems scaffold

- Step 1: Sift and stack all the components to the place where scaffold has to be erected.
- Step 2: Place sole plates, set out their position and Set levelling jacks to their lowest adjustment and place on top of the sole plates.
- Step 3: Stand vertical on each jack at one side.
- Step 4: Attach ledgers between two adjacent erected vertical.
- Step 5: Stand another vertical on other pair of jacks.
- Step 6: Attach ledgers to second frame.
- Step 7: Fit another ledger to the other side of the same bay
- Step 8: Fix ledgers at multiple levels.
- Step 9: Adjust the jacks as per levelling requirement.
- Step 10: Place walkways on the ledgers.
- Step 11: Deck the working platform with planks as shown in the picture.
- Step 12: Fit toe boards, guardrails and midrails as shown in the picture.



Fig. 5.4.2 Scaffolding work by mason

5.4.2 Dismantling the Scaffold

The scaffold should be dismantled section by section as it was erected.

- Remove the toeboards, guardrail and midrail.
- Remove the decks.
- Loosen the top cups using hammer.
- Remove ledgers.
- Remove standards.
- Clean all parts properly.
- Check all parts for any damage.
- Stack them in the store for re-use

5.4.3 Safety Precautions and Practicest

- Erect the scaffolding on level and solid ground.
- Plumb and level the scaffold as it is being erected.
- Ensure all components are installed and fixed in proper way.
- Check all components for any damage before erecting the scaffolding.
- Scaffolding components must not be allowed to drop at any time.

5.4.4 Storage of Scaffolding Material

- Store material of same size and type at one place
- Stack material properly up to desirable height
- Provide adequate ground clearance to the material stack to avoid contact with water/ moisture
- Store damaged material separately
- Tag stacked material as per their size and type



Fig. 5.4.3 Scaffolding storage

Exercise

Answer the following questions.

- What is the purpose of temporary scaffolding in construction projects?
- Define what temporary scaffolding is and its primary function on a construction site.
- How does temporary scaffolding enhance worker safety and efficiency during construction?
- What are the key components of a conventional scaffolding system?
- How is the stability of a conventional scaffolding structure ensured during construction tasks?
- How does a modular scaffolding system improve adaptability and ease of setup?
- Mention some advantages of using modular scaffolding systems for construction projects.

Notes 

Scan the QR code to watch the video



<https://youtu.be/VQ1e0VZmTmM>

Erecting a Frame-System Scaffold



6. Cement Mortar and Concrete Mix – Preparation & Curing



Unit 6.1 – Preparing Cement Mortar and Concrete Mix

Unit 6.2 – Introduction to Masonry Curing



Key Learning Outcomes



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

1. Select and use different tools and equipment used for mixing of cement mortar/concrete mix
2. Describe different types of materials required for cement mortar and concrete mix including other bonding materials/admixtures
3. Describe ratio of different materials required for mixing mortar and concrete by volume
4. Prepare the cement mortar as per prescribed ratio
5. Prepare the concrete mix as per prescribed ratio
6. Provide brief about different admixtures used in masonry works
7. Operate hand-operated concrete mixer
8. Provide brief about various techniques and importance of curing
9. Carry out curing operation using correct method

UNIT 6.1: Preparing Cement Mortar and Concrete Mix

Unit Objectives

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

- Select and use ingredients required to make cement mortar and concrete mix
- Understand setting time of cement for preparation of mortar
- Prepare cement mortar as per given ratio
- Prepare concrete mix as per given ratio
- Work safely while working with cement and other chemicals
- Understand Do's and Don'ts for preparation and use of mortar within specified time.

6.1.1 Cement Mortar

Mortar is a thick mixture of sand, cement and water. It works as a binder which holds building materials such as brick or stone together.

Some of the applications of cement mortar:

- Binding bricks, stones block, tiles etc.
- Plastering and pointing works
- Fill and form joints
- Improve the appearance of structure
- For water proofing of roofs

According to nature of application mortars are of two types:

- Masonry mortars
- Finishing mortars



Fig. 6.1.1 Laying mortar



Fig. 6.1.2 Finishing mortar

The preparation of cement mortar can be done by:

- Manual mixing – for smaller works
- Mechanical mixing – in larger quantities to be used in continuous order

Bricks/Blocks should be soaked before application of mortar. If this precaution is not taken, water of mortar will be absorbed by the bricks/blocks and mortar will become weak.



Fig. 6.1.3 Manual mixing



Fig. 6.1.4 Mechanical mixing

Ratio of cement mortar mix proportion

Ingredients for mortar are measured by volume (never by weight). Ratio of cement and sand vary for different applications.

Type of work	Nominal cement: Sand ratio for cement mortar
Masonry work in foundation	1:6
Masonry work in superstructure	1:6 to 1:8
Internal Plaster	1:6
External Plaster	1:5
Pointing Works	1:2 to 1:3

Table 6.1.1 Work and material requirements

Setting time of Cement

After mixing of water to the cement powder, there are two stages in process of stiffening of cement paste. First stage is initial setting time and the second stage is final setting time. Initial setting occurs when the paste begins to stiffen considerably.

Initial setting time is regarded as the time elapsed between the moment that the water is added to the cement, to the time that the paste starts losing its plasticity. For OPC grade (ordinary Portland Cement) it is specified as 30 minutes.

Final setting occurs when the cement has hardened to the point at which it can sustain some load. The final setting time is the time elapsed between the moment the water is added to the cement, and the time when the paste has completely lost its plasticity and has attained sufficient firmness to resist certain definite pressure.

For construction purposes, the initial set must not be too soon and the final set must not be too late

Water cement ratio

- Water cement ratio is the ratio of volume of water to volume of cement used in concrete mix and has important influence on quality of concrete produced.
- The strength and work ability of mix depends upon the amount of water used. If amount of water is more, mix will be more dilute
- There is an optimum amount of water for a given proportion of material, which provides it a greatest strength.
- If the amount of water is less than the optimum amount, strength of mix decreases.
- If the amount of water is more than the optimum amount, strength of mix decreases although workability of mix increases.

Hand Operated Concrete Mixer

- Hand cement mixer is applicable for the mixing of various concrete and mortars, and it is distinguished from other mixers by its convenient operation, portable movement, overall control and high flexibility.
- It has the merits of small volume, convenient transportation, high working efficiency and outstanding quality. It places an important role in rural areas.



Fig. 6.1.5 Hand operated concrete mixer

6.1.2 How to Prepare Cement Mortar?



Fig. 6.1.6 Mortar making

Steps:

1. Collect all required all materials and tools at one place.
2. Wear personal protective equipment.
3. Measure cement and sand using a volume box. Sieve the sand.
4. First spread the measured amount of sand on a clean and dry platform or on a steel trough.
5. Spread the cement over the sand.
6. Then mix them dry by turning over & over, backward & forward several times by a shovel, till the mixture looks uniform in colour.
7. Out of this dry cement & sand mix, take out only that amount of mix which can be used within 30 minutes, and form it into a heap.
8. Make a small depression on top of the heap.
9. Add additives, if required or instructed by chief mason.
10. Add required amount of water so as to give it required consistency, to the center of the heap.
11. Mix the whole mass thoroughly for 5 to 10 minutes using a shovel.
12. Clean the tools. Run clear water over the tool and rub with gloved hand until all the mortar is removed.

Summary

- Contact with wet cement can damage skin and/or eyes.
- Always wear protective gloves and safety goggles before handling.
- Avoid contact with the eyes, or uncovered skin.
- The sands and the cement have to be thoroughly mixed by hand before adding any water.
- Do not use dirty water, or water from puddles or ponds. The water should be free from clay, earth and other impurities. Use portable water.
- Keep any sugar-containing liquids, such as soft drinks, away from the mix.
- Once the mortar begins to set and harden, do not attempt to thin the mix by adding more water.

- Too much water will result in weak mortar, while too little water will make the mortar unworkable. It's better to start with less water. It can be always added if needed.
- If you are mixing a coloured mortar, add the cement dye to the dry aggregates and mix in thoroughly before adding water.
- Wash the tools. Scrub the wheelbarrow and tools with a stiff-bristle brush before the mortar starts to harden. Rinse well.
- If the mortar has set on the tools, beat the tools to break off the dried mortar, then rinse while scrubbing.
- Prepare only that much amount of mortar which can be used within 30 minutes.

6.1.3 Concrete Mix

Concrete mix is a mixture of cement, sand, coarse aggregates, water and admixtures (if required). This mixture is used for PCC and RCC work.

Grade of concrete:

The process of relative proportions of cement, sand, coarse aggregate and water, so as to obtain a concrete of desired quality is known as the proportioning of concrete.

IS 456-2000 has designated the concrete mixes into a number of grades as M10, M15, M20, M25, M30, M35 and M40. In this designation the letter M refers to the mix and the number to the strength of mix in N/mm² specified 28-day cube.

Nominal ratio by volume for various mixes of concrete

M10	1 : 3 : 6 (1 part cement:3 part sand:6 part coarse aggregate)
M15	1 : 2 : 4 (1 part cement:2 part sand:4 part coarse aggregate)
M20	1 : 1.5 : 3 (1 part cement:1.5 part sand:3 part coarse aggregate)
M25	1 : 1 : 2 (1 part cement:1 part sand:2 part coarse aggregate)

Table 6.1.2 Nominal ration by volume for various mixes of concrete

6.1.4 How to prepare concrete mix manually

The following procedure should be followed to prepare concrete mix by hand mixing:

1. Collect all required all materials and tools at one place.
2. Wear personal protective equipment.
3. Measure cement, sand and coarse aggregates using a volume box.
4. First spread the measured amount of coarse aggregates on a clean and dry platform or on a steel trough.

5. Spread the sand and cement over the coarse aggregates.
6. Then mix them dry by turning over & over, backward & forward several times by a shovel, till the mixture looks uniform in appearance.
7. Form it into a heap and make a small depression on top of the heap. Add required amount of water so as to give it required consistency, to the center of the heap.
8. Mix the whole mass thoroughly for 5 to 10 minutes using a shovel.
9. Check the consistency of mixture.
10. Clean the tools. Run clear water over the tool and rub with gloved hand until all the mortar is removed.



Fig. 6.1.7 Material for making concrete mix

6.1.5 Steps to prepare concrete in hand-operated mixer

Mixing concrete in a hand-operated concrete mixer is most efficient way of mixing. It produces better quality concrete at a faster rate.

1. 1/4 quantity of water is to be poured first in the drum.
2. Add 1/2 quantity of coarse aggregates and sand, and then full quantity of cement.
3. Then Add remaining quantities of aggregates, sand and water.
4. Ingredients are to be mixed at least for 2 minutes.



Fig. 6.1.8 Using hand-operated mixer

6.1.6 Admixtures

Admixtures are material other than water or cement that is used as an ingredient of concrete or mortar to control setting and early hardening, workability, or to provide additional cementing properties.

Accelerator: It is an admixture for the use in concrete or mortar. The addition of an accelerator shortens the setting time and thus cure time starts earlier.

Retarder: It is an admixture which is used in concrete or mortar. The use of retarder extends the setting time resulting in improved workability.

Plasticizer: It reduces the amount of water required to mix a mortar and improve its workability.

Concrete: Pigments/Dye They are added to the concrete mix prior to pouring.

Tile adhesives: These products are ready-to-mix, self-curing, and with excellent adhesion properties. Their superior bond strength prevents shrinkage, cracks and slippage of tiles.



Fig. 6.1.9 Various admixtures

6.1.7 Preparatory works prior to brick/block works

Soaking of brick/block:

Bricks should be soaked in water before using it in any brick work. The time of soaking depends on the type of brick, its porosity and water absorption. Soaking of bricks has the following advantages

- Wetting of bricks removes any dirt, sand and dust from them.
- Soaked bricks prevents suction of water from the wet mortar. If dry bricks are used, then it will absorb water from mortar and mortar will become dry and cannot attain any strength.



Fig. 6.1.10 Soaking of brick/block

Summary:

- Manufacturers' instructions should be followed regarding quantity to be added in the mix.
- Do not add extra admixture as it does not have any added benefit and may weaken the mortar.
- Liquid agents are usually stirred into the gauging water before being added to the mix, whereas powder forms are normally mixed in with the dry ingredients before the gauging water is added.
- Always wear safety gloves and safety goggles.
- Use clean water to mix the concrete.
- Mix sand, cement and coarse aggregates thoroughly before adding any water.
- Prepare mix as per requirement or the instruction of chief mason.
- Always prepare small batch of mix.
- Wash the tools. Scrub the mixer, wheelbarrow or trough and tools with a stiff-bristle brush before the concrete starts to harden. Rinse well.
- Plates of hand-operated mixer should be aligned.

Notes 

Scan the QR code to watch the video



<https://youtu.be/j9MxR-fr2m0>

Cement Mortar and Concrete

Unit 6.2 – Introduction to Masonry Curing

Unit Objectives



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

- Understand the importance of curing process
- Describe the different methods used for curing
- Carry out curing in correct and efficient way
- Minimise the wastage of water

6.2.1 Curing

Cement starts to set when mixed with water. If cement dries out, it develops cracks and shrinkage resulting in weak structure. To maintain the moisture content in concrete, curing is done.

Curing is the process in which the concrete/cement is protected from loss of moisture and kept within a reasonable temperature range using different methods. Curing is done to the finished brick or block walls, concrete and plastered surfaces.

The period of curing depends on atmospheric conditions such as temperature, wind and humidity.

Effects of improper curing:

- Appearance of minute cracks on concrete surface
- Development of internal cracks
- Development of uneven strength across section
- Increase in permeability of concrete
- Reduction in resistance to frost and weathering



Fig. 6.2.1 Improperly cured concrete surface

Advantages of curing process:

- Increased durability
- Increased strength
- Water tightness
- Abrasion resistance
- Volume stability



Fig. 6.2.2 Spraying of water for curing

Methods of Curing:

There are various methods of curing. The adoption of a particular method will depend upon the nature of work and the climatic conditions.

The following methods of curing of concrete are generally adopted.

- Ponding
- Wet covering and sprinkling or spraying water
- Plastic sheets

Ponding Method:

Fig. 6.2.3 Ponding method for curing of slab

- Ponding method is a popular and widely used concrete curing method.
- Concrete is cured by storing water on the horizontal plane i.e. slab, roof, road etc.
- Small rectangular ponds are made on the surface.
- Water is filled in these ponds.
- A boundary is given in all the 4 sides so that the water cannot flow out.

Plastic sheets:



Fig. 6.2.4 Plastic sheets for curing of exposed concrete slab

- Curing concrete with plastic sheeting requires covering all exposed areas of the concrete as soon as possible without damaging concrete finish.
- When plastic sheeting is used over flat surfaces, such as pavements or slabs, it should extend beyond the edges of the slab at least twice the thickness of the slab.

Wet covering and spraying or sprinkling of water:

- This is a widely used method of curing, particularly for structural concrete.
- Exposed surface of concrete is prevented from drying out by covering it with hessian or empty gunny cement bags.
- The covering over vertical and sloping surfaces is secured properly.
- These coverings are periodically wetted using water hose.
- Brick or block walls are directly sprayed with water hose.



Fig. 6.2.5 Wet covering for curing

6.2.3 Concrete Curing Compound and Surface Hardeners

Concrete Curing Compound:

- Curing compound can be used where wet curing is not possible.
- It is very suitable for large areas of concrete which are directly exposed to sunlight, heavy winds and other environmental factors.
- Concrete curing compound consists essentially of waxes, natural and synthetic resins, and solvents of high volatility at atmospheric temperatures.
- The compound forms a moisture retentive film shortly after being applied on fresh concrete surface.

Surface Hardeners:

- Concrete surface hardeners are chemical compounds either liquid or powder used to harden green concrete.
- These are applied to the surface when the initial set is taking place and then are trowelled into the surface to absorb excess water, reduce laitance and provide a hard, dense surface.



Fig. 6.2.6 Using curing agent/compound

6.2.4 Curing Period and Temperature

The curing period depends upon the type of cement used, mixture proportions, required strength, size and shape of member, weather, future exposure conditions, and method of curing. Since all these properties are improved with curing, the period should be as long as practical. For most concrete structures, the curing period at temperatures above 5° C (40° F) should be a minimum of 7 days. For most structural use, the curing period for cast-in-place concrete is usually 3 days to 2 weeks. Bridge decks and other slabs exposed to weather usually require longer curing periods. Tiled/Marbled surface is left to dry for almost 24 hours prior to its use in walking

Summary

- Curing should start as soon as concrete has stiffened.
- Concrete should not be allowed to dry fast in any situation.
- Curing should be continued for minimum of 10 days for OPC and 14 days for Blended cement.
- Extra care should be taken during curing process.
- Intermittent curing results in cracking and crazing of concrete.
- Ensure that the concrete or plastered surface is not allowed to dry even for a short time during the curing period.
- Use correct quantity of water to be sprayed as per the requirement or instructions from supervisor. Do not waste water while doing the curing job.
- Use appropriate types of hessian cloth or polythene.
- Clean the surface after ponding method curing is finished.

Exercise

Answer the following questions.

- What is the primary ingredient in cement mortar?
- How is cement mortar prepared?
- What is the purpose of adding sand in cement mortar?
- What is a concrete mix unit?
- What is the standard water-cement ratio in concrete mix design?
- What is masonry curing?
- Why is masonry curing important?

Notes 

Scan the QR code to watch the video



<https://youtu.be/OqJsNCLPAJo>

Methods of Curing



7. Maintaining a Safe, Hygienic and Secure Working Environment



- 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



Unit 7.1 - Hazards and Emergency Situations

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

Workplace Hazards Types: Workplace hazards can vary depending on the type of work and the industry.



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

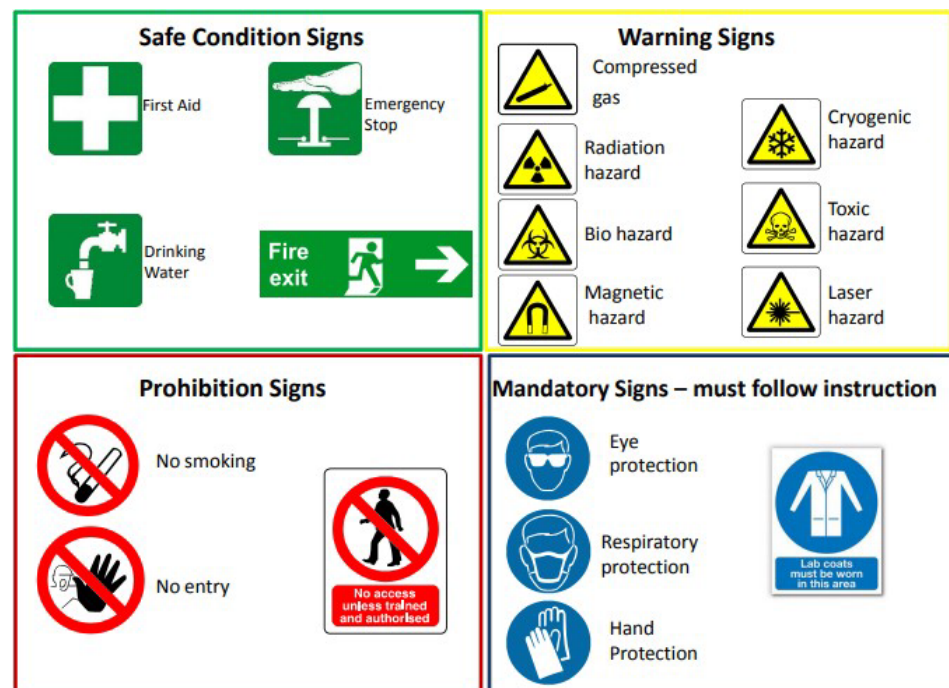


Fig. 7.1.7 Four Types of Safety Signs and their Colour

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

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.

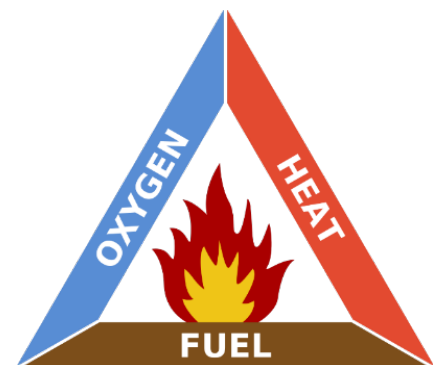


Fig. 7.2.1 Fire Triangle

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










		Ordinary Combustibles	Wood, Paper, Cloth, Etc.
		Flammable Liquids	Grease, Oil, Paint, Solvents
		Live Electrical Equipment	Electrical Panel, Motor, Wiring, Etc.
		Combustible Metal	Magnesium, Aluminum, Etc.
		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.

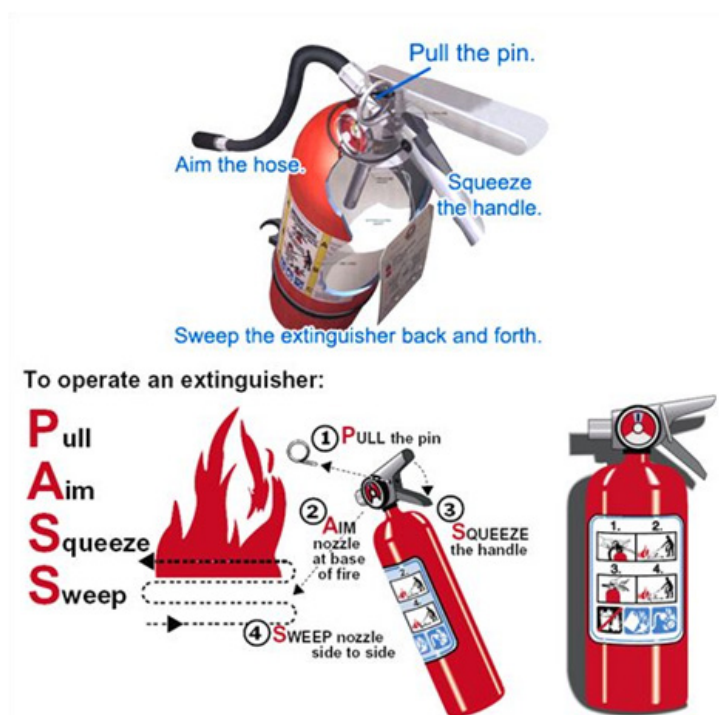


Fig. 7.2.5 Using a Fire Extinguisher

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.

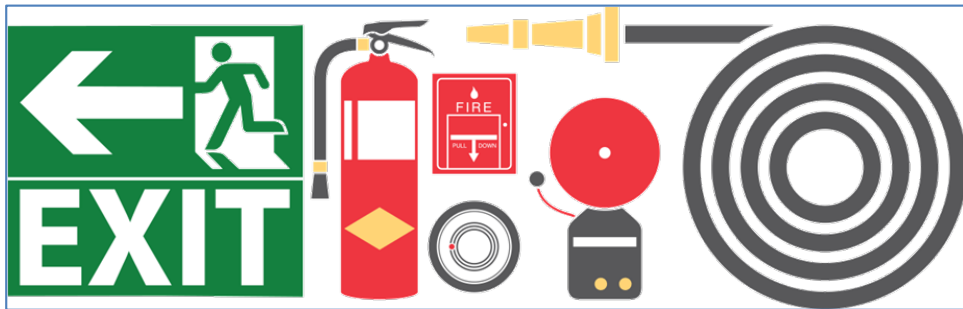


Fig. 7.2.6 Components related to Safety Drill

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 to the Factories Act of 1948. The certificate of fitness is only valid for one year from the date it was issued.

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)



Fig. 7.2.8 Medical Examination for Construction Workers

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.

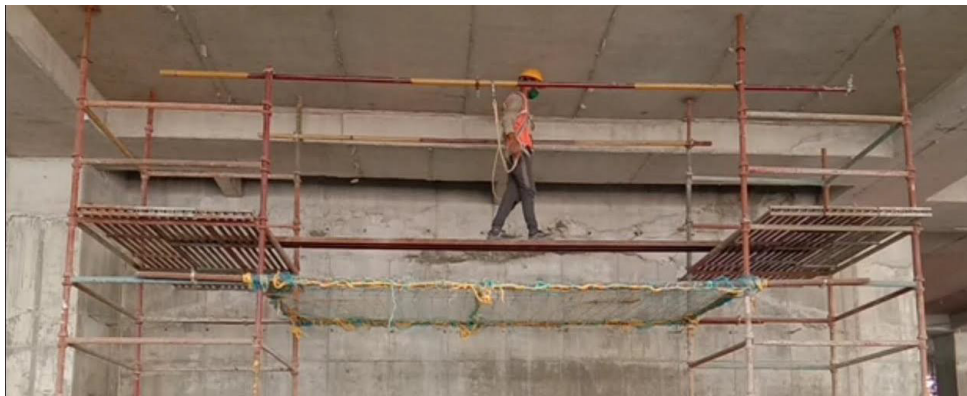


Fig. 7.2.9 Vertigo Test for Construction Workers

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.

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.



Fig. 7.2.12 First Aid Kit

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

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


<p>Whole Body Protection</p>	<p>Full-body protection is essential for workers to safeguard against heat and radiation hazards.</p> <p>Whole-body PPE includes materials like rubber, leather, synthetics, plastic, fire-retardant wool, and cotton.</p> <p>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.</p>	
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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

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:

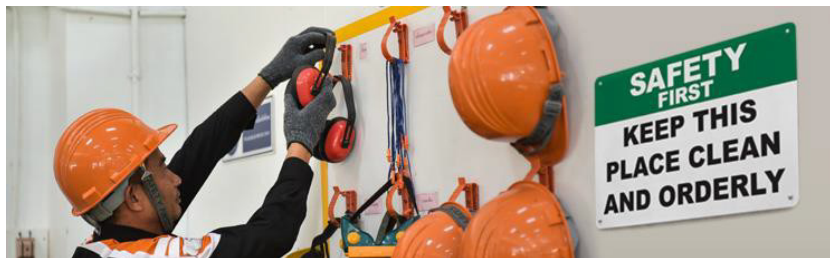


Fig. 7.3.4 Designated Areas

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.

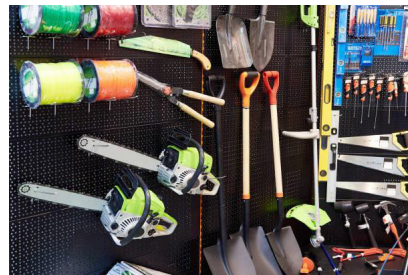


Fig. 7.3.12 Securing Tools & Equipment

- 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

**GOOD
HOUSEKEEPING
IS THE
KEY TO
SAFETY**



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.
- 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.



Fig. 7.3.17 Avoid 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.

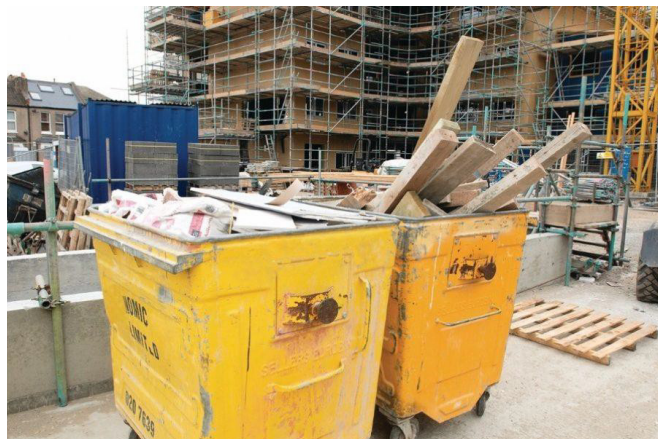


Fig. 7.3.21 Waste Management on a Construction Site

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

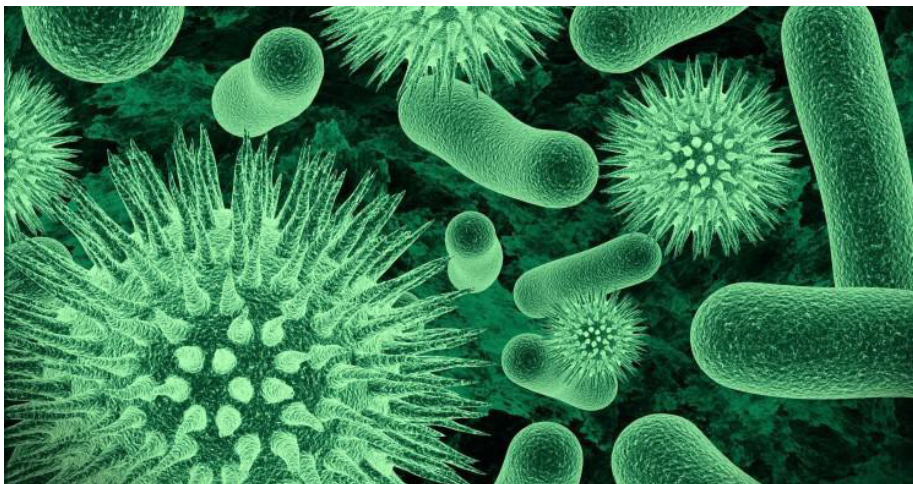


Fig. 7.4.1 Infectious Diseases

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.

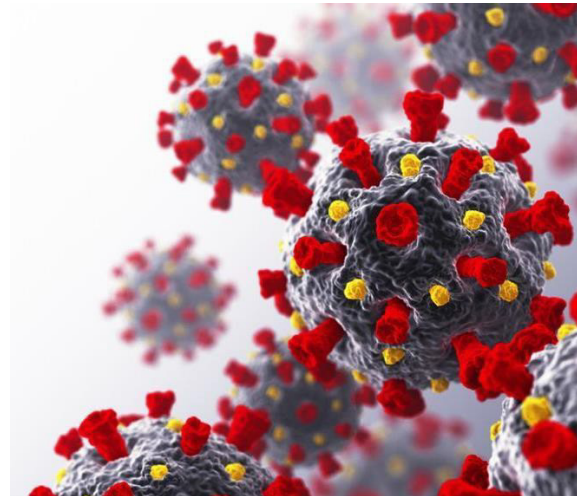


Fig. 7.4.5 Spread of Disease

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?



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



Annexure

Annexure of QR Codes for Helper Mason

Chapter Name	Unit Name	Topic Name	URL	QR Code	Page no.
Chapter 1: Introduction of Construction Sector and Job Role	Unit 1.2 – Introduction to Construction Industry in India	Overview of Construction Sector in India	https://youtu.be/yhjDhav4Pfw	 Overview of Construction Sector in India	14
	Unit 1.3 – Brief about Masonry Occupation	Job Description of a Helper Mason	https://youtu.be/KfUEF5drpMM	 Job Description of a Helper Mason	31
Chapter 2: Core/Generic Skills	Unit 2.1 – Numeracy Skills	Different System of Measurement	https://youtu.be/H1xo5UVJKVo	 Different System of Measurement	39
	Unit 2.2 – Systems of Measurements	Area, volume and perimeter of geometrical shapes	https://youtu.be/OhTubw4C0to	 Area, volume and perimeter of geometrical shapes	50
	Unit 3.1 – Masonry Hand Tools and Equipment	Masonry Tools and Equipment	https://youtu.be/wuzQ8dsYJSw	 Masonry Tools and Equipment	80

Chapter 3: Tools, Materials and Consumables (CON/N0102)	Unit 3.2 – Construction Materials	What is Construction Material	https://youtu.be/XsFeVuVQE-E	 What is Construction Material	97
	Unit 3.3 – Handling and Storage of Material	Handling Masonry Materials	https://youtu.be/Ks2qnadxLqA	 Handling Masonry Materials	110
Chapter 4: Carrying Out Earthwork Manually (CON/N0104)	Unit 4.1 – Preparatory Work and Soil Cutting	Introduction to Earthwork	https://youtu.be/OyVyFD5RAFc	 Introduction to Earthwork	127
	Unit 4.2 – Backfilling and Compaction Manually	Steps for Carrying out Backfilling and Compaction	https://youtu.be/BxSLst_fVP4	 Steps for Carrying out Backfilling and Compaction	135
	Unit 5.1 – Basic Concept of Temporary Scaffolding	Types of Scaffolding	https://youtu.be/YuBFUtGGcbk	 Types of Scaffolding	142

Chapter 5: Erect and Dismantle Temporary Scaffolding (CON/N0101)	Unit 5.2 – Concept of Conventional Scaffolding	Material used in Conventional Bamboo	https://youtu.be/8DP_7OK6dCw	 Material used in Conventional Bamboo	150
	Unit 5.3 – Concept of Modular Scaffolding System	Modular Scaffolding System	https://youtu.be/oRxg2LLfxO4	 Modular Scaffolding System	162
	Unit 5.4 – Erecting and Dismantling of Temporary Scaffolding	Erecting a Frame-System Scaffold	https://youtu.be/VQ1e0VZmTmM	 Erecting a Frame-System Scaffold	169
Chapter 6: Cement Mortar and Concrete Mix – Preparation & Curing (CON/N0103)	Unit 6.1 – Preparing Cement Mortar and Concrete Mix	Cement Mortar and Concrete	https://youtu.be/j9MxR-fr2m0	 Cement Mortar and Concrete	181
	Unit 6.2 – Introduction to Masonry Curing	Methods of Curing	https://youtu.be/OqJsNCLPAJo	 Methods of Curing	188





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