



Participant Handbook

Sector
**Construction Skill
Development Council of
India**

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

Occupation
Masonry

Reference ID: **CON/Q0113, Version 2.0**
NSQF Level 4



Brick Mason

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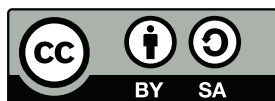
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Prime Minister of India

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SKILLING CONTENT: PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role/Qualification Pack: **'Brick Mason'** QP No. **'CON/Q0113, Version 2.0 NSQF Level 4'**

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Authorised Signatory
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Acknowledgements

This participant's handbook meant for Brick 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 field of Brick Masonry. 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 Brick Mason. Its content 344rhas 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 Brick 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 Brick Mason QP:

Compulsory NOS:

1. **CON/N0143:** Mark the layout for brick/block works
2. **CON/N0144:** Carry out brick laying work
3. **CON/N0145:** Carry out block laying work
4. **CON/N8001:** Work effectively in a team to deliver desired results at the workplace
5. **CON/N8002:** Plan and organize work to meet expected outcomes
6. **CON/N9001:** Work according to personal health, safety and environment protocols at construction site

Electives (mandatory to select at least one):

Elective 1: General

1. **1CON/N0146:** Carry out brick bat coba waterproofing
2. **2CON/N0147:** Carry out IPS (Indian Patent Stone) flooring

Elective 2: Plastering

1. **CON/N0111:** Apply plaster on internal & external surfaces of masonry & RCC structure

Options (Not mandatory):

Option 1: VDF flooring

1. **CON/N0148:** Carry out VDF (Vaccum dewatered floor) flooring

Option 2: Random rubble works

2. **CON/N0113:** Build structures using random rubble masonry

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

Symbols Used



**Key Learning
Outcomes**



Exercise



Notes



Unit Objectives



Activity

Table of Contents

| S.No. | Modules and Units | Page No. |
|-----------|---|------------|
| 1. | Introduction to the Job Role of a Brick Mason | 1 |
| | Unit 1.1 - Introduction to Construction Industry | 3 |
| | Unit 1.2 - Role and Responsibilities of a Brick Mason | 10 |
| 2. | Process of Marking the Layout for Brick/Block Works (CON/N0143) | 19 |
| | Unit 2.1 - Interpretation of Construction Drawings | 21 |
| | Unit 2.2 - Marking the Layout for Brick/Block Works | 39 |
| 3. | Process of carrying out Brick Laying Work (CON/N0144) | 52 |
| | Unit 3.1 - Performing Brick Laying | 54 |
| | Unit 3.2 - Staircases | 89 |
| | Unit 3.3 - Paver's Block | 98 |
| | Unit 3.4 - Arches | 105 |
| | Unit 3.5 - Manholes | 113 |
| | Unit 3.6 - Repair and Restore Brickwork | 117 |
| | Unit 3.7 - Pointing in Masonry Works | 121 |
| 4. | Process of carrying out Block Laying Work (CON/N0145) | 130 |
| | Unit 4.1 - Performing Block Work | 132 |
| 5. | Work according to Personal Health, Safety and Environment Protocols at Construction Site (CON/N9001) | 149 |
| | Unit 5.1 - Hazards and Emergency Situations | 151 |
| | Unit 5.2 - Safety Drills, PPEs and Fire Safety | 161 |
| | Unit 5.3 - Hygiene and Safe Waste Disposal Practices | 182 |
| | Unit 5.4 - Infectious Disease and Its Cure | 200 |
| 6. | Plan and organize work to meet expected outcomes (CON/N8002) | 210 |
| | Unit 6.1 - Prioritise Work Activities to achieve Desired Results | 212 |
| | Unit 6.2 - Organising Resources | 220 |
| | Unit 6.3 - Sequence of Work for Brick Mason | 225 |
| 7. | Work effectively in a Team to deliver Desired Results at the Workplace (CON/N8001) | 231 |
| | Unit 7.1 - Effective Communication and Teamwork | 233 |
| | Unit 7.2 - Working Effectively and Maintaining Discipline at Work | 243 |
| | Unit 7.3 - Working Effectively and Maintaining Discipline at Work | 250 |



Table of Contents

| S.No. | Modules and Units | Page No. |
|-------|---|------------|
| | Elective 1 | |
| 8. | Process of carrying out Brick Bat Coba Waterproofing (CON/N0146) | 260 |
| | Unit 8.1 Brick Bat Coba Waterproofing | 262 |
| 9. | Process of carrying out IPS (Indian Patent Stone) Flooring (CON/N90147) | 283 |
| | Unit 9.1 IPS (Indian Patent Stone) Flooring | 285 |
| | Elective 2 | |
| 10. | Process of applying Plaster on Internal & External Surfaces of Masonry & RCC Structure (CON/N0111) | 309 |
| | Unit 10.1 Plastering Internal and External Surfaces | 311 |
| | Option 1 | |
| 11. | Process of carrying out VDF (Vacuum Dewatered Floor) Flooring (CON/N0148) | 329 |
| | Unit 11.1 Vacuum Dewatered Flooring (VDF) | 331 |
| | Option 2 | |
| 12. | Process of Building Structures using Random Rubble Masonry (CON/N0113) | 348 |
| | Unit 12.1 Introduction to Rubble Masonry | 350 |
| 13. | Employability Skills 60 Hours (DGT/VSQ/N0102) | 376 |
| | 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 | |
| |  | |
| 14. | Annexure | 378 |
| | Annexure I - QR Codes -Video Links | 379 |





1. Introduction to the Job Role of a Brick Mason



- Unit 1.1 - Introduction to Construction Industry
- Unit 1.2 - Introduction to Brick Masonry
- Unit 1.3 - Role and Responsibilities of a Brick Mason



Key Learning Outcomes

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

1. Explain the role and responsibilities of Brick Mason.
2. Discuss the career progression for the job role for Brick Mason.

Unit 1.1: Introduction to Construction Industry

Unit Objectives



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

1. Describe the size and scope of the Construction industry and its sub-sectors.

1.1.1 Construction Industry

The construction industry is the oldest and one of the largest in the world, with a market size of over 10 trillion dollars. Construction has traditionally been a contracting sector, and the industry consists of a huge number of small businesses. Currently, the building industry is one of the main economic sectors. It contributes significantly to the national economy and employs a substantial number of people. The construction industry contributes significantly to the growth and enhancement of the economy while also playing a pivotal role in the overall development of the nation. Construction activities hold a crucial position in shaping a country's infrastructure and industrial progress. Construction encompasses the creation of various structures such as hospitals, schools, residential areas, office complexes, and houses, along with essential facilities like water supply, sewerage, and drainage systems, as well as the construction of transportation networks like highways, roads, ports, railway tracks, and dams. When we consider its broad scope, construction activity emerges as a fundamental catalyst for socio-economic advancement. Notably, construction stands as the second largest employment-generating sector in India, following agriculture. This sector comprises a diverse range of businesses, including small, medium, and large enterprises, all engaged in different types of projects. As a result, a varied workforce is required to meet the demands of this sector. The construction industry is broadly divided into two major sub-sectors: -

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

1.1.2 Real Estate & Infrastructure Construction



Fig 1.1.1 Township construction



Fig 1.1.2 Bridge construction

Only 30% of India's population resides in urban areas. According to the latest projections from the Government of India, urban development in the country is poised to surge at an impressive rate of 38%. The existing Indian urban infrastructure and services, established during the British colonial era, are ill-equipped to adequately address such burgeoning demands.

Approximately INR (Rs.) 43,55,000 crores is projected to be necessary for urban development over the upcoming two decades. A significant portion of this amount, nearly 45%, is earmarked for the construction of urban roadways. The Twelfth Five Year Plan outlines that 48% of these funds are expected to originate from private sources, capitalizing on various national policy initiatives designed to restore investor confidence. To expedite the pace of urban development throughout the nation, the government has undertaken various measures, allocating a substantial sum of INR (Rs.) 13,400 crores under the Jawaharlal Nehru National Urban Renewal Mission (JNNURM). Additionally, for the enhancement of small and medium-sized towns, the government has launched the Urban Infrastructure Development Scheme, involving an investment of INR (Rs.) 6,700 crores, aimed at addressing the infrastructural requirements of these smaller urban centres.

Government initiatives under urban development



Fig 1.1.3: Building construction site



Fig 1.1.4: Industrial Building construction site

Through the implementation of the 'City Challenge Competition,' a subset of Smart Cities (as part of the Smart Cities Mission, encompassing fewer than 100 cities) will be designated based on their ability to align funding with their capacity to achieve multifaceted goals in urban infrastructure development. These objectives include ensuring access to clean and safe water sources, effective sanitation and solid waste management, streamlined and effective public transportation, accessible housing options for marginalized populations, efficient power distribution, robust IT connectivity with a specific focus on e-governance and citizen engagement, as well as prioritizing the well-being, safety, and security of residents, along with promoting healthcare, education, and fostering a sustainable urban environment.

- The Swachh Bharat Mission (SBM) is aimed at eradicating open defecation, implementing scientific municipal solid waste management, eliminating manual scavenging, and fostering a shift in behavior towards healthy sanitation practices.
- The expansion of heritage cities focuses on improving the quality of life with a strong emphasis on hygiene, waste management, tourism, heritage preservation, and maintaining the essence

of the city's identity.

- The Indian Government plans to establish several new airports in the upcoming years to enhance local connectivity.
- The Sagarmala project is launched to develop India's ports and inland waterways, promoting port-led growth and industrialization along the coastlines. The project entails an investment of INR 670 billion.
- The Indian Government has allocated Rs 50,000 crore for the development of 100 smart cities across the country. A list of 98 cities was shortlisted for the smart cities project in August 2015.
- Ambitious road network projects are underway, including the expansion of the road network by 2020 and the construction of 15,000 kilometres of new roads by 2017.

Various Indian railway initiatives have been initiated, encompassing the establishment of new railway stations, high-speed rail networks, modernization of rolling stock, improved port-rail connectivity, and other measures aimed at enhancing railway development and connectivity.

1.1.3 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 1.1.5 Rural roads



Fig 1.1.6 Rural house

Rural infrastructure serves as a vital component of both rural growth and a sustainable strategy for poverty alleviation. The proper development of infrastructure in rural areas not only enhances the rural economy but also plays a crucial role in supporting effective poverty reduction initiatives. By strategically expanding infrastructure in rural regions, we can bolster the rural economy and elevate the overall standard of living. This approach contributes to increased productivity, higher agricultural incomes, improved employment opportunities, and various other positive outcomes.

Government initiatives under rural development

- The Bharat Nirman initiative is dedicated to enhancing rural connectivity across diverse

geographical landscapes in India, encompassing coastal, mountainous, and backwater areas, tribal regions, plains, hills, deserts, swamps, and more, spanning over 6 lakh villages.

- Central to the Bharat Nirman initiative is the construction of rural housing, with the government committed to providing adequate housing for rural communities.
- The Pradhan Mantri Gram Sadak Yojna (PMGSY) is designed to ensure road connectivity to every village, making it a cornerstone of rural infrastructure development.
- Facilitating the transfer of technology from the workshop to the field, including the dissemination of information on the cost-effective and environmentally friendly (CEEF) construction of buildings in both rural and urban areas.
- The improvement and elevation of workforce skills are emphasized, creating a skilled pool of individuals capable of undertaking various construction services in both rural and urban contexts.

1.1.4 Types of Construction:

The following are the types of construction:

a. Building construction:

Building construction is the act of adding a structure to the undeveloped ground and adapting it for various uses, including residences, commercial buildings, garages, etc. The bulk of building construction projects involve minor improvements, such as adding a room, renovating a bathroom, enhancing a porch, etc.

There are differences between building construction projects, but there are some aspects and procedures that are universal. For example: design considerations, a budgetary estimate, and ethical and legal factors.

In the case of commercial building construction, multiple strategies are utilised. They consist of Design & Build, Cost Estimating, Competitive Bidding, Contract Management, Construction Management, and Design-Build Bridging.

The governments of all states and nations have enacted laws and regulations governing the construction of both commercial and residential buildings. During the designing and building processes, these norms and regulations must be properly adhered to. The materials required for the construction process should be readily accessible at the construction site. Brick construction is the most common technique of house construction in India.

b. Industrial Construction:

Industrial construction represents a minor portion of the construction sector. Even so, it is regarded as quite vital. Planning the layout of an industry, establishing industrial sectors, installing heavy machinery, and planning and constructing the size of an industry are the procedures involved in industrial construction.

Infrastructure, power transmission and distribution, metallurgy and material handling, medicine, petroleum, chemical, power generation, manufacturing, etc. are the primary aspects to be considered.

This form of building requires extremely specific knowledge of planning, cost estimation, design, and construction. When a large construction business launches a project, it typically assigns the task of ensuring the project's success and safety to a team. Architects and civil engineers are employed to assist in the planning of construction projects. In this instance, construction entails the construction or assembly of infrastructure.

Large-scale building projects necessitate the completion of several jobs by a large number of individuals. Different jobs are provided to different teams. For instance, a Project Manager is responsible for Project management, while a Construction Manager oversees Project construction. Additional examples include Design Engineer, Project Architect, and Financial Advisor. If a project is to be conducted successfully, the following must be ensured: Effective planning, successful scheduling, budgeting, construction site safety, availability of building materials, and logistics are essential for a successful construction project (that is transport of raw materials, etc.).

c. Infrastructure Construction

Infrastructure, often known as heavy civil or heavy engineering, consists of massive public works, dams, bridges, highways, railroads, water or wastewater systems, and utility distribution. Civil engineering encompasses the design, building, and maintenance of the physical and naturally built environment, such as roads, bridges, canals, dams, tunnels, airports, water and sewage systems, pipelines, and railways.



Fig. 1.1.8 Under Construction Bridge

The infrastructure sector is an important economic driver in India. The sector is largely responsible for driving India's overall growth, and the government has placed a great deal of emphasis on implementing laws that will expedite the establishment of world-class infrastructure in the country. The infrastructure sector consists of power, bridges, dams, highways, and the development of urban infrastructure. In other words, the infrastructure sector functions as a catalyst for India's economic growth by driving the expansion of associated industries such as townships, housing, built-up infrastructure, and construction development projects.



Fig. 1.1.7 Industrial Construction Site Plan

1.1.5 Market Segment of Construction Industry

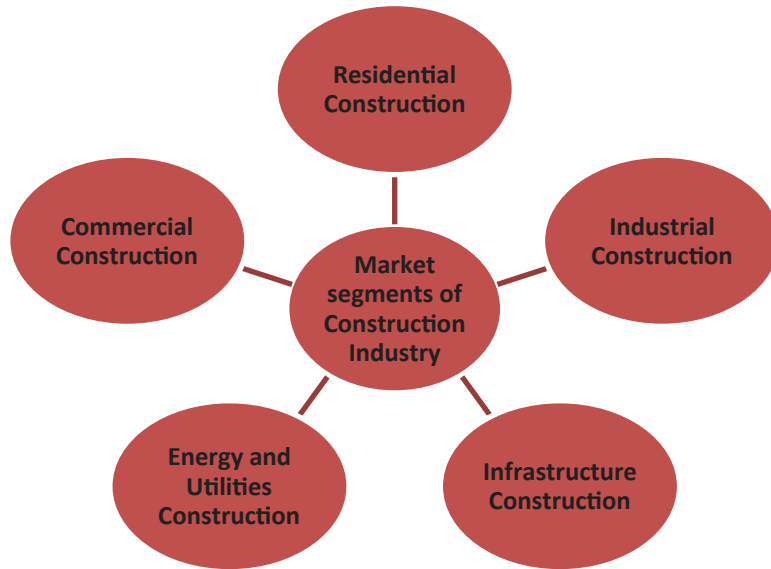


Fig. 1.1.9 Market segments of construction industry

Notes 

QR Codes

Scan the QR code to watch the video



<https://youtu.be/yhjDhav4Pfw>

Overview of Construction Sector in India

Unit 1.2: Role and Responsibilities of a Brick Mason

Unit Objectives



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

1. Describe the role and responsibilities of Brick Mason (general/ plastering).
2. Define the personal attributes required in masonry occupation.
3. Explain the future possible progression and career development options of a Brick Mason (general/ plastering).

1.2.1 Brick Mason

A brick mason, in both general and plastering contexts, is a skilled construction professional who specializes in working with bricks, concrete blocks, and other masonry materials to create various structures and surfaces. Their expertise lies in assembling these materials in a way that ensures structural integrity, aesthetic appeal, and functionality. There are two main aspects of brick masonry: general brick masonry and plastering.



Fig. 1.2.1 Brick Mason

- A. General Brick Masonry:** A general brick mason is responsible for constructing walls, buildings, and other structures using bricks, concrete blocks, or other masonry units. Their tasks involve:
- **Layout and Planning:** Understanding architectural blueprints and designs to properly plan the layout and arrangement of bricks. This includes determining the dimensions, patterns, and alignment of bricks to achieve the desired structural and aesthetic results.
 - **Brick Cutting and Preparation:** Cutting bricks to fit specific spaces, corners, and angles as

required by the design. This might involve using tools like brick chisels, saws, and hammers.

- **Mixing Mortar:** Preparing mortar by mixing cement, sand, and water to the right consistency. Mortar is the adhesive substance that holds the bricks together in a stable arrangement.
 - **Laying Bricks:** Placing the bricks or masonry units according to the planned pattern, using mortar to bond them together. Proper techniques are crucial to ensure structural stability and uniformity.
 - **Creating Openings:** Incorporating openings for doors, windows, and other architectural features while maintaining the overall strength and integrity of the structure.
 - **Checking Alignment and Levelling:** Ensuring that each course (horizontal layer) of bricks is level, plumb (vertical), and properly aligned to create straight and stable walls.
 - **Joint Finishing:** Applying finishing touches to the mortar joints between the bricks, which might involve striking the joints for a neat appearance.
- B. Plastering:** Brick masons skilled in plastering specialize in applying plaster to walls, ceilings, and other surfaces. This involves:
- **Surface Preparation:** Prepare the surface by cleaning, smoothing, and sometimes applying a base coat of mortar or plaster to improve adhesion.
 - **Mixing Plaster:** Creating plaster by mixing materials like cement, lime, sand, and water to achieve the desired consistency and properties.
 - **Application:** Apply plaster onto the prepared surface using appropriate tools like trowels. Plasterers need to ensure even thickness and a smooth finish.
 - **Finishing:** Creating various textures and finishes on the plastered surface according to the architectural requirements. This could include smooth finishes, textured patterns, or decorative designs.
 - **Curing and Maintenance:** Properly curing the plaster to ensure it dries evenly and gains strength over time. This might involve applying a curing agent and protecting the plaster from excessive moisture during the drying process.

Both general brick masons and plastering experts play crucial roles in the construction industry, contributing to the creation of functional and aesthetically pleasing structures. Their skills encompass not only technical know-how but also a keen eye for detail and precision.

1.2.2 Roles and Responsibilities

The role of a brick mason, both in general brick masonry and plastering, encompasses a range of tasks related to the construction and finishing of structures using masonry materials. Here are the specific responsibilities for each aspect:

General Brick Mason (General Brick Masonry):

1. **Layout and Planning:** Interpret architectural plans and layouts to determine the arrangement, pattern, and alignment of bricks in construction projects.
2. **Material Preparation:** Cut, shape, and prepare bricks and other masonry units as needed to fit specific spaces, corners, and angles.
3. **Mortar Mixing:** Prepare mortar by accurately mixing cement, sand, and water to the appropriate consistency required for effective brick bonding.
4. **Brick Laying:** Carefully place bricks in designated patterns, applying mortar between layers to create structurally sound walls and structures.
5. **Alignment and Levelling:** Ensure that each layer (course) of bricks is levelled, aligned, and plumb to maintain the integrity of the construction.
6. **Openings and Features:** Create openings for doors, windows, and architectural elements, integrating them seamlessly into the brickwork.
7. **Joint Work:** Finish mortar joints by striking or tooling them for a neat appearance and consistent width.
8. **Safety and Regulations:** Adhere to safety protocols and construction regulations to ensure a secure work environment and code-compliant structures.
9. **Quality Control:** Maintain high standards of workmanship, checking for flaws, irregularities, or misalignments, and making corrections as needed.
10. **Clean-up:** Keep the work area clean and organized, disposing of waste materials appropriately.
11. **Collaboration:** Coordinate with other construction professionals, such as architects, engineers, and fellow tradespeople, to ensure smooth project execution.

Brick Mason (Plastering):

1. **Surface Preparation:** Prepare surfaces by cleaning, smoothing, and applying a base coat of mortar or plaster to create a suitable substrate for plaster.
2. **Plaster Mixing:** Mix plaster materials, such as cement, lime, sand, and water, to achieve the desired consistency and properties for the plaster.
3. **Plaster Application:** Apply plaster evenly and smoothly to surfaces using trowels and other tools, ensuring consistent thickness and adhesion.
4. **Texturing and Finishing:** Create desired textures, patterns, or finishes on plastered surfaces to meet architectural specifications.
5. **Quality Inspection:** Check for air bubbles, cracks, or irregularities in the plaster and address them promptly to maintain the quality of the finished surface.
6. **Curing and Drying:** Implement proper curing techniques to facilitate even drying and strengthen

the plaster over time.

7. **Maintenance:** Ensure that plastered surfaces are protected from moisture and environmental factors during the drying and curing stages.
8. **Coordination:** Collaborate with other trades to ensure that plastering activities integrate seamlessly with other construction processes.
9. **Safety:** Follow safety guidelines when working with plaster materials, tools, and equipment.
10. **Clean-up:** Keep the work area clean after plastering tasks, and disposing of waste materials appropriately.

1.2.3 Personal Attributes Required in Masonry

The masonry occupation requires a combination of technical skills, physical abilities, and personal attributes to excel in the field. Here are some essential personal attributes required for success in the masonry profession:

1. **Attention to Detail:** Precise alignment and accurate laying of materials.
2. **Physical Stamina:** Ability to handle heavy loads and work outdoors.
3. **Manual Dexterity:** Skill in using tools and handling materials with precision.
4. **Problem-Solving Skills:** Adaptability to overcome challenges in construction.
5. **Teamwork and Communication:** Effective collaboration with colleagues and clear communication.
6. **Safety Awareness:** Prioritizing safety through protocols and protective gear.
7. **Time Management:** Efficient use of time to meet project deadlines.
8. **Adaptability:** Willingness to learn and apply new techniques.
9. **Patience and Perseverance:** Commitment to intricate and time-intensive tasks.
10. **Work Ethic:** Diligence, punctuality, and dedicated effort.
11. **Spatial Awareness:** Understanding of spatial relationships for proper alignment.
12. **Pride in Craftsmanship:** Aiming for excellence and durable results.
13. **Continuous Learning:** Keeping up with industry advancements and trends.

These attributes, along with technical skills, define successful masons, contributing to quality construction work that meets both functional and aesthetic standards.

1.2.4 Career Progression for a Brick Mason

The career progression is as follows:

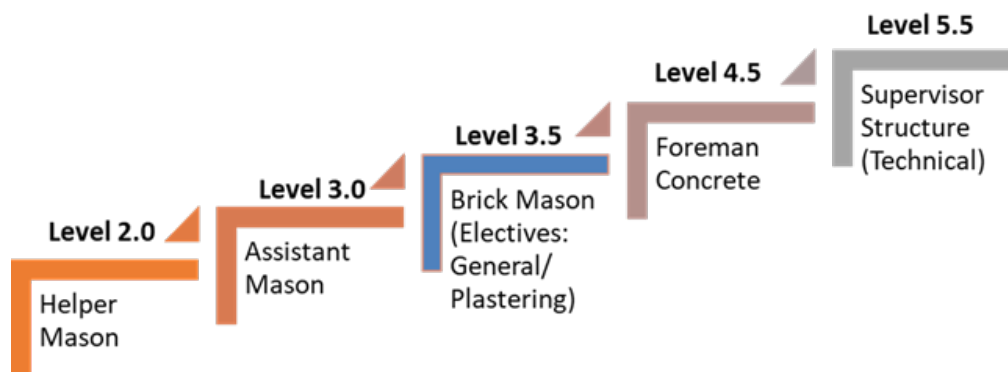


Fig. 1.2.2 Career Progression for Brick Mason

Exercise

Answer the following questions:

A. MCQs (Multiple Choice Questions)

1. What is the primary purpose of the construction industry?
 - a. Entertainment
 - b. Agriculture
 - c. Infrastructure development
 - d. Fashion
2. Which type of brick is known for its high compressive strength and suitability for structural applications?
 - a. Burnt Clay Mix
 - b. Concrete Bricks
 - c. Sand Lime Bricks
 - d. Engineering Bricks
3. What is the key responsibility of a general brick mason?
 - a. Mixing plaster materials
 - b. Applying finishes to surfaces
 - c. Building structural walls with bricks
 - d. Managing financial aspects of projects
4. What is the purpose of the “Flemish Bond” in brick masonry?
 - a. To create a smooth texture on brick surfaces
 - b. To enhance thermal insulation properties
 - c. To align bricks diagonally across a wall
 - d. To arrange alternating headers and stretchers for stability
5. Which personal attribute is crucial for a mason to prioritize safety on construction sites?
 - a. Manual dexterity
 - b. Adaptability
 - c. Patience
 - d. Safety awareness

B. Fill in the Blanks

1. The construction industry is one of the _____ industries in the world, with a market size of over 10 trillion dollars.
2. Brick masons are skilled professionals who work with materials like _____ to create various structures and surfaces.
3. _____ Bond is a masonry pattern where each layer consists of alternating headers and stretchers.
4. _____ Lime Bricks offer good thermal insulation and are made from sand, lime, and a small percentage of cement.
5. Personal attributes such as _____ and dedication are essential for success in the masonry occupation.

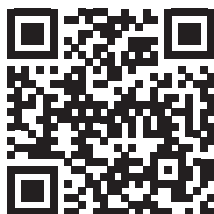
C. Short Answer Questions

1. Describe the role of a brick mason in general brick masonry.
2. What are the primary responsibilities of a brick mason specializing in plastering?
3. Explain the significance of proper surface preparation in the plastering process.
4. What are the personal attributes required for success in the masonry occupation?
5. Outline the possible career progression options for a brick mason specializing in general brick masonry.

Notes

QR Codes

Scan the QR code to watch the video



<https://youtu.be/3XGt-p-hpdU>

About Brick Masonry



2. Process of Marking the Layout for Brick/Block Works



Unit 2.1 - Interpretation of Construction Drawings

Unit 2.2 - Marking the Layout for Brick/Block Works



Key Learning Outcomes

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

1. Demonstrate transfer of levels as per drawings/instructions.
2. Demonstrate the setting out of the layout as per drawings/instructions.

Unit 2.1 Interpretation of Construction Drawings

Unit Objectives

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

1. Interpret the sketches/basic working drawing for brick/block

2.1.1 Construction Drawings

Construction drawings are highly detailed visual depictions that are utilised within the construction sector to effectively convey the design, specifications, and necessary criteria of a given architectural endeavour. The aforementioned drawings play a crucial role in conveying vital information to contractors, builders, and tradespeople, effectively guiding them throughout the entirety of the construction process. Construction drawings commonly encompass a diverse range of architectural representations, such as plans, elevations, sections, details, and notes, which collectively communicate the necessary instructions for the construction of a building.

2.1.2 Types of Construction Drawings

Construction drawings play a crucial role in guiding the work of a brick mason, facilitating the precise execution of brick or block masonry while maintaining structural soundness, aesthetic coherence, and effective coordination with other building systems. The following is an elaborated elucidation that encompasses how a brick mason might read several types of construction drawings:

I. Architectural Plans:

1. **Floor Plans:** These plans outline the layout of walls, openings, and architectural features.

Role of Brick Mason: A brick mason studies floor plans to understand the placement of walls where brick or block masonry will be applied. This helps them plan the masonry layout accurately. To interpret floor plans, a brick mason should identify the locations of walls where brick or block masonry will be applied. They should note dimensions, openings, and architectural features that affect masonry placement.

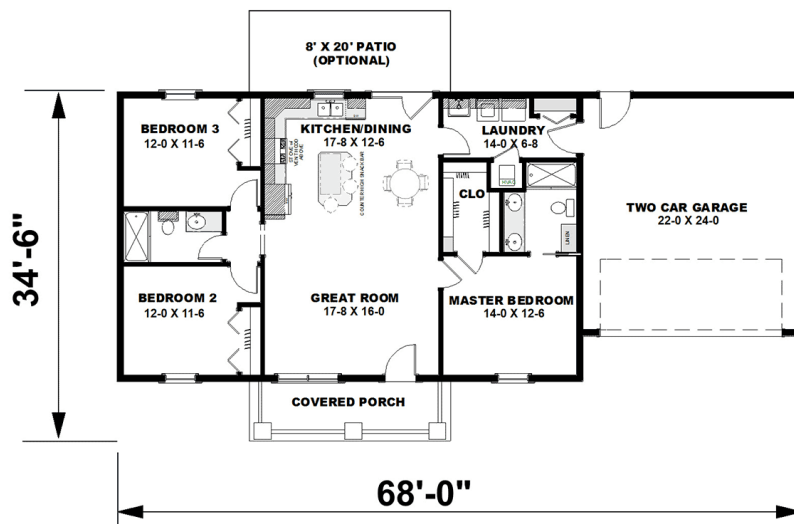


Fig. 2.1.1 Floor Plan

2. **Elevations:** Elevations provide vertical views of the building's exterior faces.

Role of Brick Mason: The brick mason refers to elevations to ensure that brick or block masonry aligns with the vertical arrangement of windows, doors, and architectural details, creating an aesthetically pleasing finish. When interpreting elevations, the brick mason should recognize the heights, windows, and doors on each side of the building. This information helps plan the vertical arrangement of the brickwork.

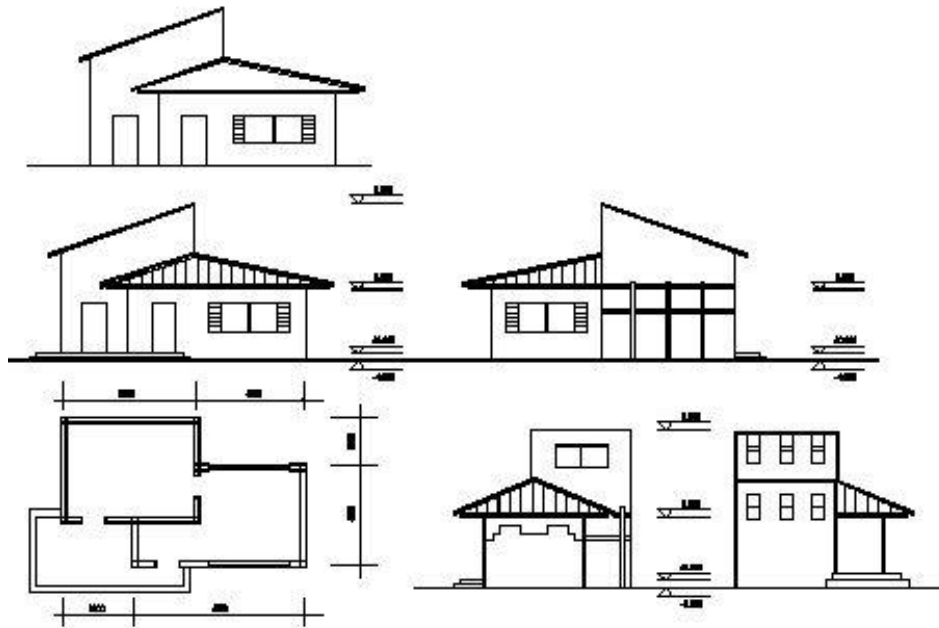


Fig. 2.1.2 Elevation Drawing

3. **Sections:** Section drawings cut through the building vertically, showing internal structures and relationships.

Role of Brick Mason: By reviewing section drawings, the brick mason understands wall thickness and how masonry interacts with other elements. This knowledge ensures accurate brick placement. When reviewing section drawings, the brick mason should understand the thickness of walls, the placement of openings, and how brick masonry interacts with other building elements vertically.

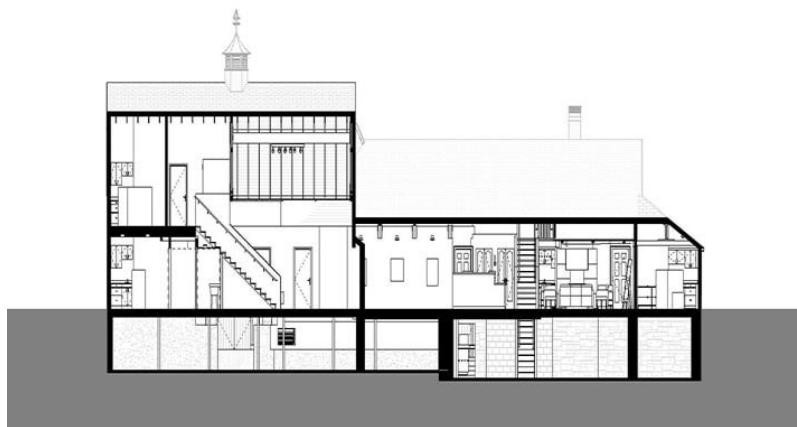


Fig. 2.1.3 Section Drawing

4. **Details:** Detail drawings offer close-up views of specific areas or junctions.

Role of Brick Mason: Detail drawings guide the brick mason in executing intricate portions of the brickwork, ensuring precision in features like corners and decorative elements. Detail drawings require the brick mason to focus on specific areas, such as corners or decorative elements, to grasp the precise techniques required for execution.

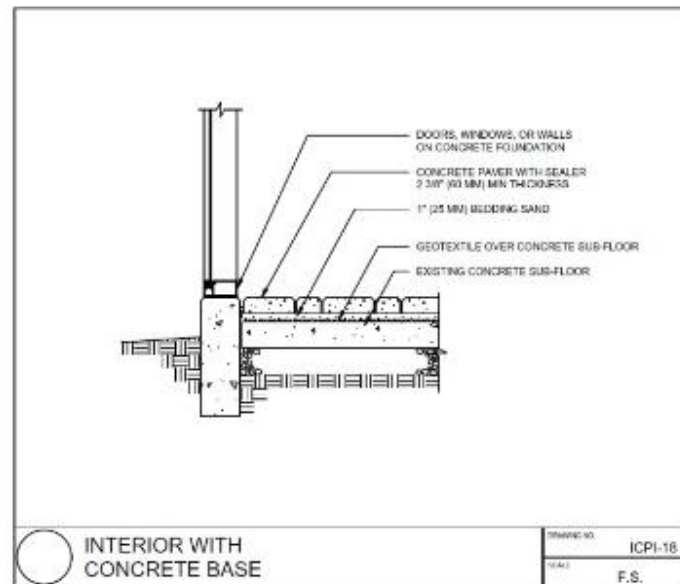


Fig. 2.1.4 Detail Drawing

II. Structural Plans:

1. **Foundation Plans:** These plans show the layout and dimensions of footings and foundation walls. **Role of Brick Mason:** The brick mason uses foundation plans to integrate brick or block masonry with the foundation, ensuring proper load distribution and structural stability. On foundation plans, the brick mason should identify the locations of footings and foundation walls, ensuring proper integration of the brick or block masonry with the foundation.

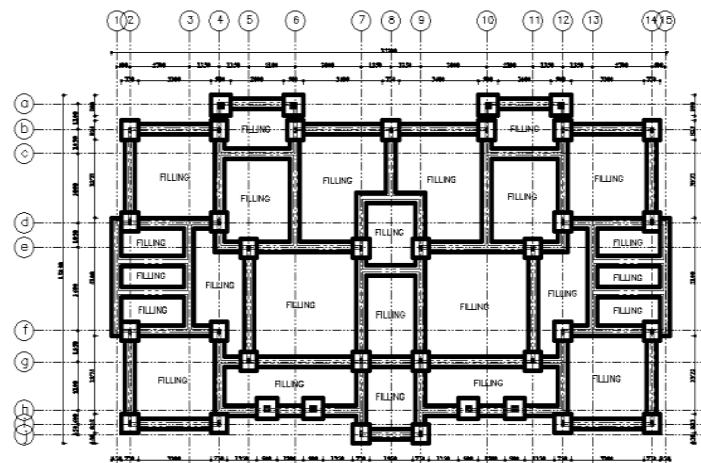


Fig. 2.1.5 Foundation Plans

2. **Framing Plans:** Framing plans outline the layout of structural components like beams, columns, and load-bearing walls.

Role of Brick Mason: Understanding framing plans helps the brick mason ensure that brick or block masonry aligns with load-bearing requirements and interacts seamlessly with the building's structural framework. When interpreting framing plans, the brick mason should understand the layout of load-bearing elements like beams and columns to ensure brick or block masonry aligns with structural requirements.

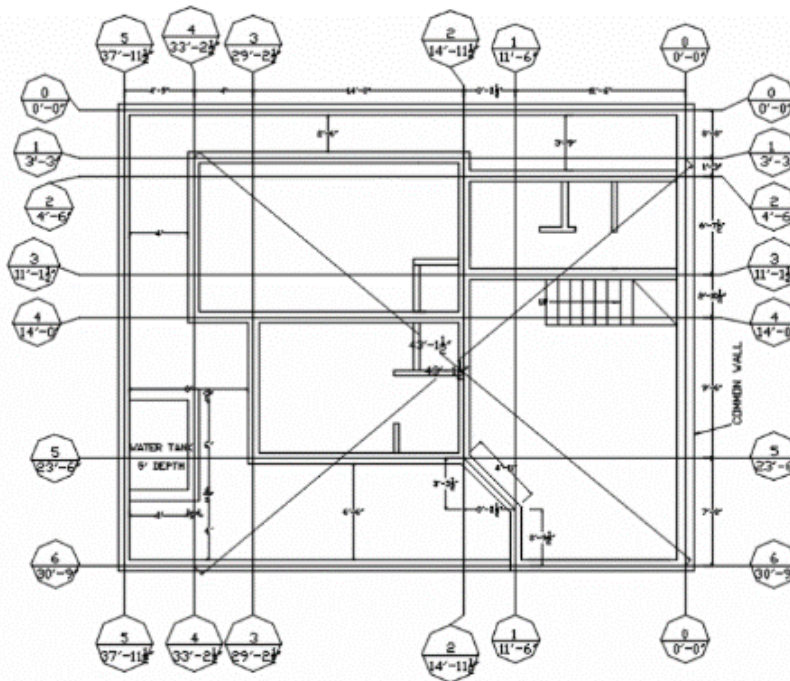


Fig. 2.1.6 Framing Plans

III. Mechanical, Electrical, and Plumbing (MEP) Plans:

1. **Mechanical Plans:** These plans illustrate HVAC system layouts.

Role of Brick Mason: Brick masons coordinate with HVAC professionals to ensure that ducts, vents, and equipment do not interfere with masonry installation. To interpret mechanical plans, brick masons should identify the paths of HVAC ducts and equipment, ensuring these systems don't interfere with masonry installation.

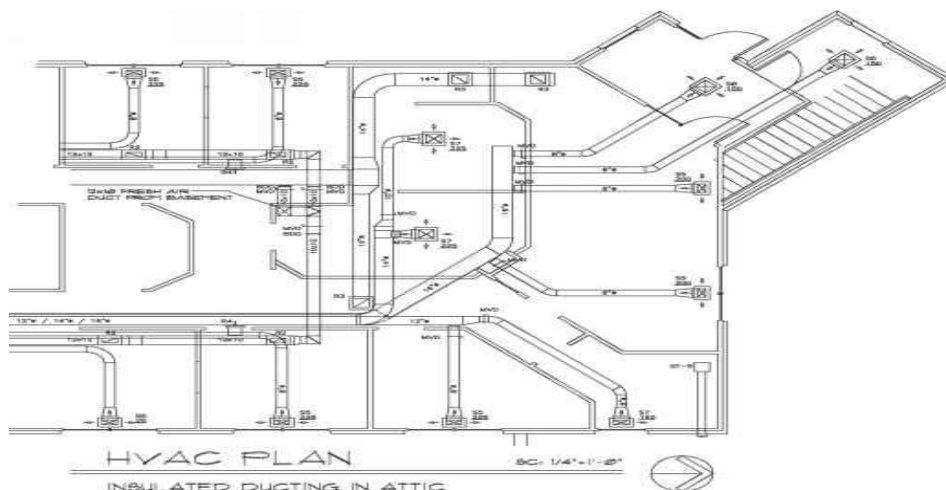


Fig. 2.1.7 Mechanical Plan

2. Electrical Plans: Electrical plans show outlet and switch placements.

Role of Brick Mason: Brick masons work with electricians to ensure that wiring paths and outlet locations align with the masonry layout, avoiding conflicts. Brick masons interpreting electrical plans should understand the placement of outlets, switches, and lighting fixtures, planning the masonry layout to accommodate these features.

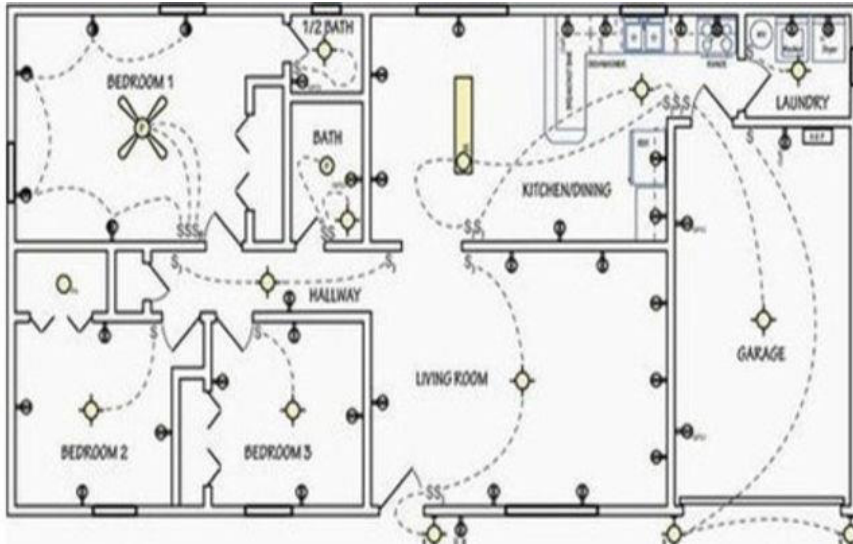


Fig. 2.1.8 Electrical Plans

3. Plumbing Plans: Plumbing plans depict pipe layouts and fixture placements.

Role of Brick Mason: Collaboration with plumbers ensures that pipes and fixtures are integrated smoothly with the brick masonry, avoiding clashes and maintaining structural integrity. When reviewing plumbing plans, brick masons should recognize the layout of pipes and fixtures, collaborating with plumbers to ensure seamless integration with the masonry.

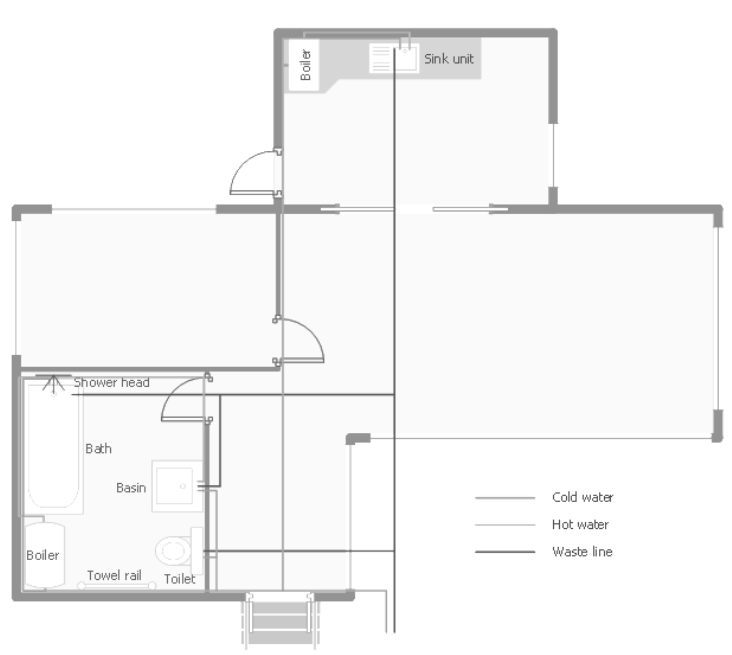


Fig. 2.1.9 Plumbing Plans

IV. Site Plans:

1. **Site Plans:** Site plans show the building's location on the property.

Role of Brick Mason: Site plans help the brick mason understand the building's orientation and access points, aiding in planning masonry work that aligns with site requirements. On-site plans, the brick mason should identify the building's location and orientation on the property, understanding access points and how these factors influence masonry work.

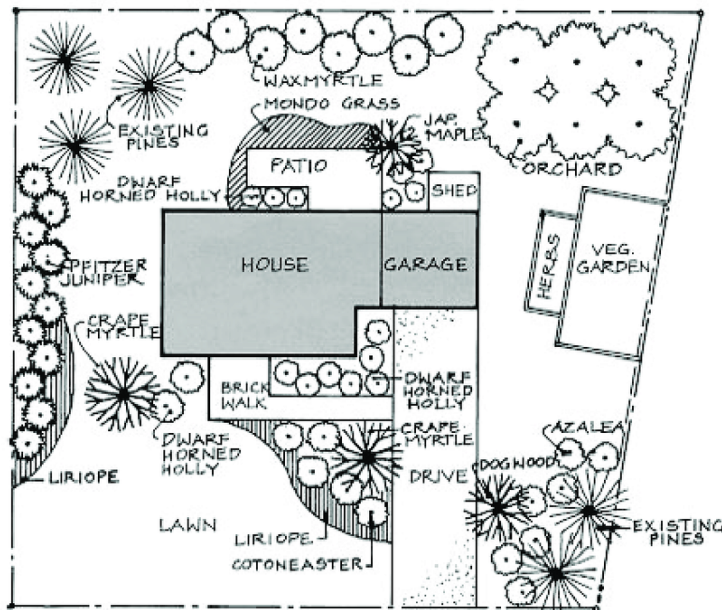
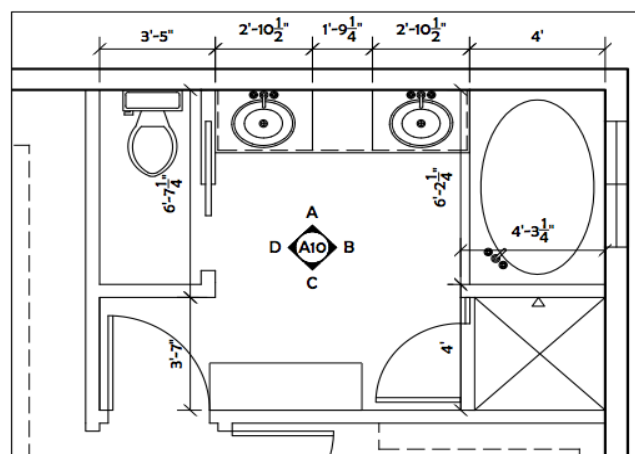


Fig. 2.1.9 Plumbing Plans

V. Enlarged Plans:

1. **Enlarged Plans:** These plans provide detailed views of specific components.

Role of Brick Mason: Enlarged plans help brick masons understand intricate areas, allowing them to execute complex features accurately. When interpreting enlarged plans, brick masons should focus on specific components, such as complex features or intersections, to execute intricate brickwork accurately.



1
A10

ENLARGED PLAN @ MASTER BATHROOM

SCALE: 1/4" = 1'-0"

Fig. 2.1.11 Enlarged Plans

2.1.3 Understanding the Lines

Construction drawings employ several types of lines. These are commonly referred to as “alphabet lines”. All lines are uniformly depicted in a single colour. There is variation in terms of width. Certain objects possess a solid structure, whereas others exhibit a composition characterised by broken lines. Each of these conveys a distinct message.

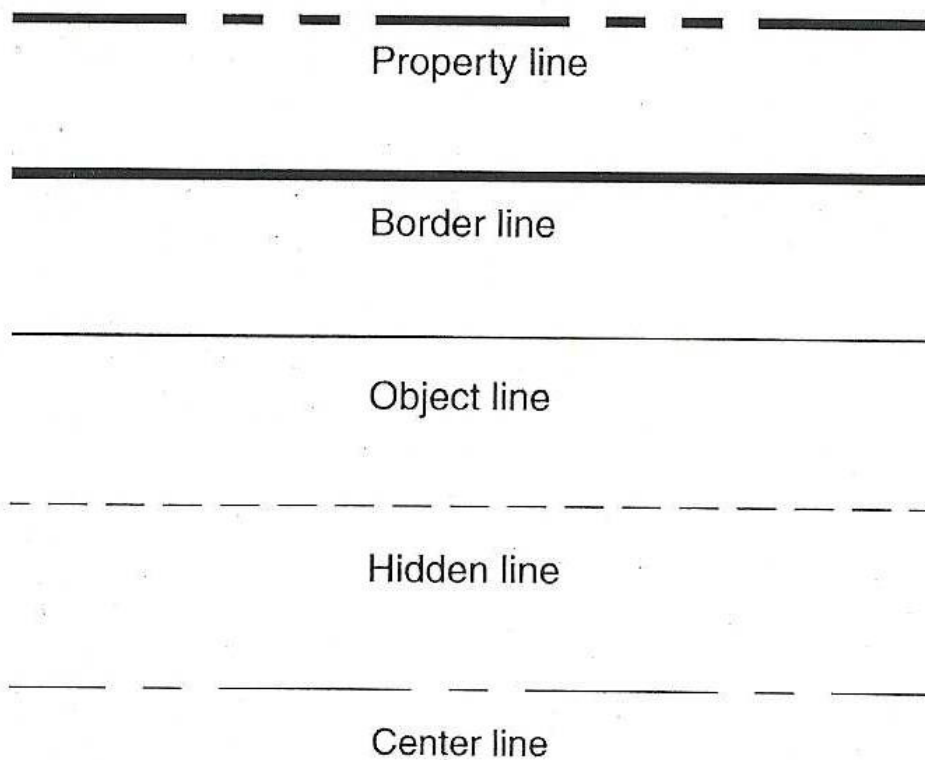


Fig. 2.1.13 Common Lines

- **Property line:** The property line is an extra heavy line made up of long dashes and alternating with two short dashes.
- **Borderline:** Borderlines are located near the edge of the sheet of drawing paper. They are also used to separate the various portions of the drawing such as the title block, notes, and revision block.
- **Object line:** Object lines represent the main outline of the features of the object, building, or walk. The object line is a heavy, continuous line showing all edges and surfaces.
- **Hidden line:** Hidden lines are medium-weight and are composed of short dashes. They define edges and surfaces that are not visible in a particular view. One must look for another view in the set of drawings to find where these edges occur. Hidden lines are omitted if they do not clarify the drawings.
- **Equipment, and fixtures:** The center line is also used to indicate a finished floor line. The line is light in weight and composed of alternating long and short dashes.

- Dimensioning and extension lines: Dimension and extension lines are thin lines that indicate the extent and direction of dimensions.

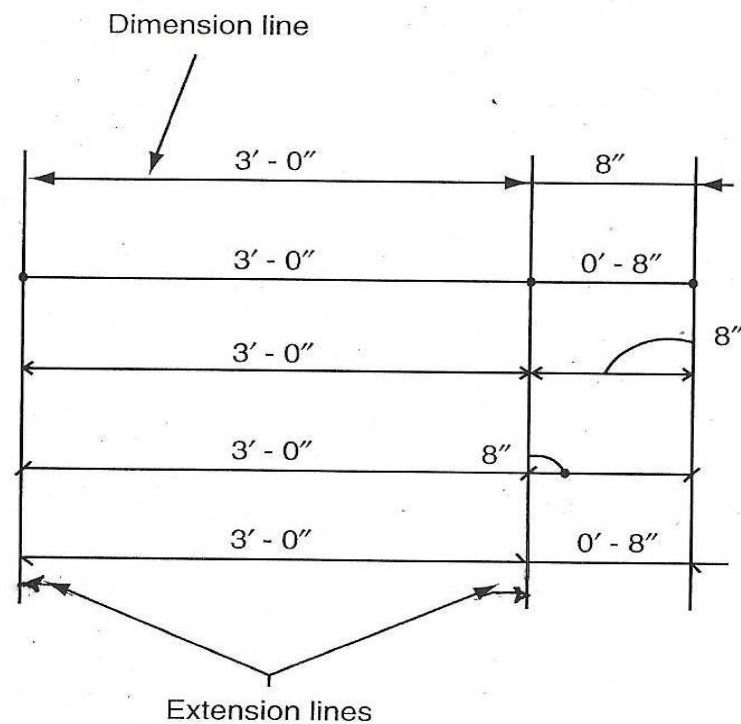


Fig. 2.1.14 Dimension and Extension Lines

Dimension lines extend the length of the distance being measured. A marking device such as an arrow, dot or tick mark, is placed at the end of the dimension line.

Extension lines are drawn perpendicular to the dimension line to specify the features between which the dimension applies.

- Break lines: Break lines are used to indicate that an object continues but is not shown on the drawing or to indicate that the object's full length is not shown to save space.

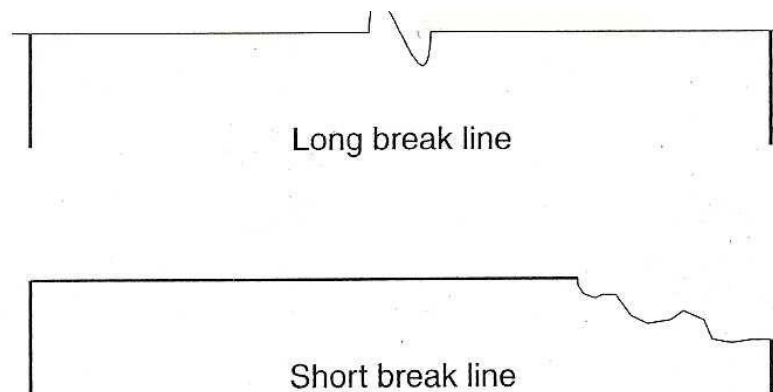


Fig. 2.1.15 Break Lines

- Section cutting lines – Section cutting lines are used with sectional views.

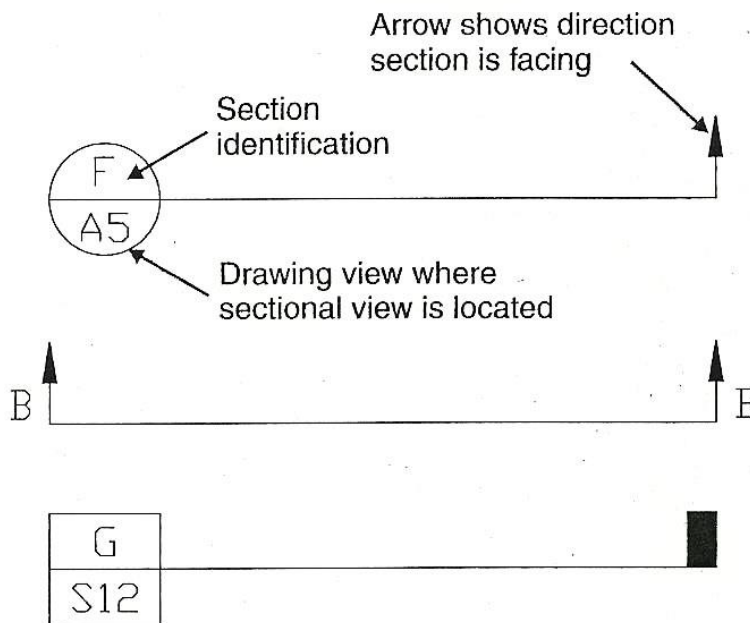


Fig. 2.1.16 Section Cutting Lines

A section cutting line marks the part of the drawing being “cut” to create a sectional view. Arrows on the end of the line indicate the direction from which the section is being viewed. If the sectional view is on another drawing, the drawing number is included with the section identification.

- Section lines and rendering: Section lines, also called ‘crosshatch lines’ are thin lines, usually drawn at a 45° angle.

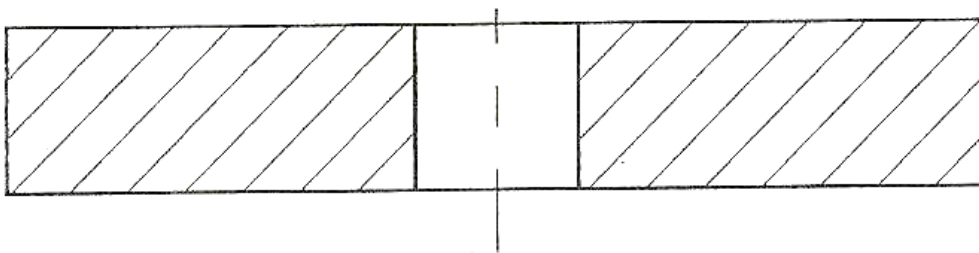


Fig. 2.1.17 Section Lines

(They are used in a sectional view to show material that has been “cut” by the cutting-plane line.)

2.1.4 Understanding the Symbols

Construction drawings frequently make use of a variety of symbols. These images stand for fittings and building supplies. Symbols are typically described in a legend, which is a list of symbols and their associated meanings.

I. Building Material Symbols

II. Plan Symbols

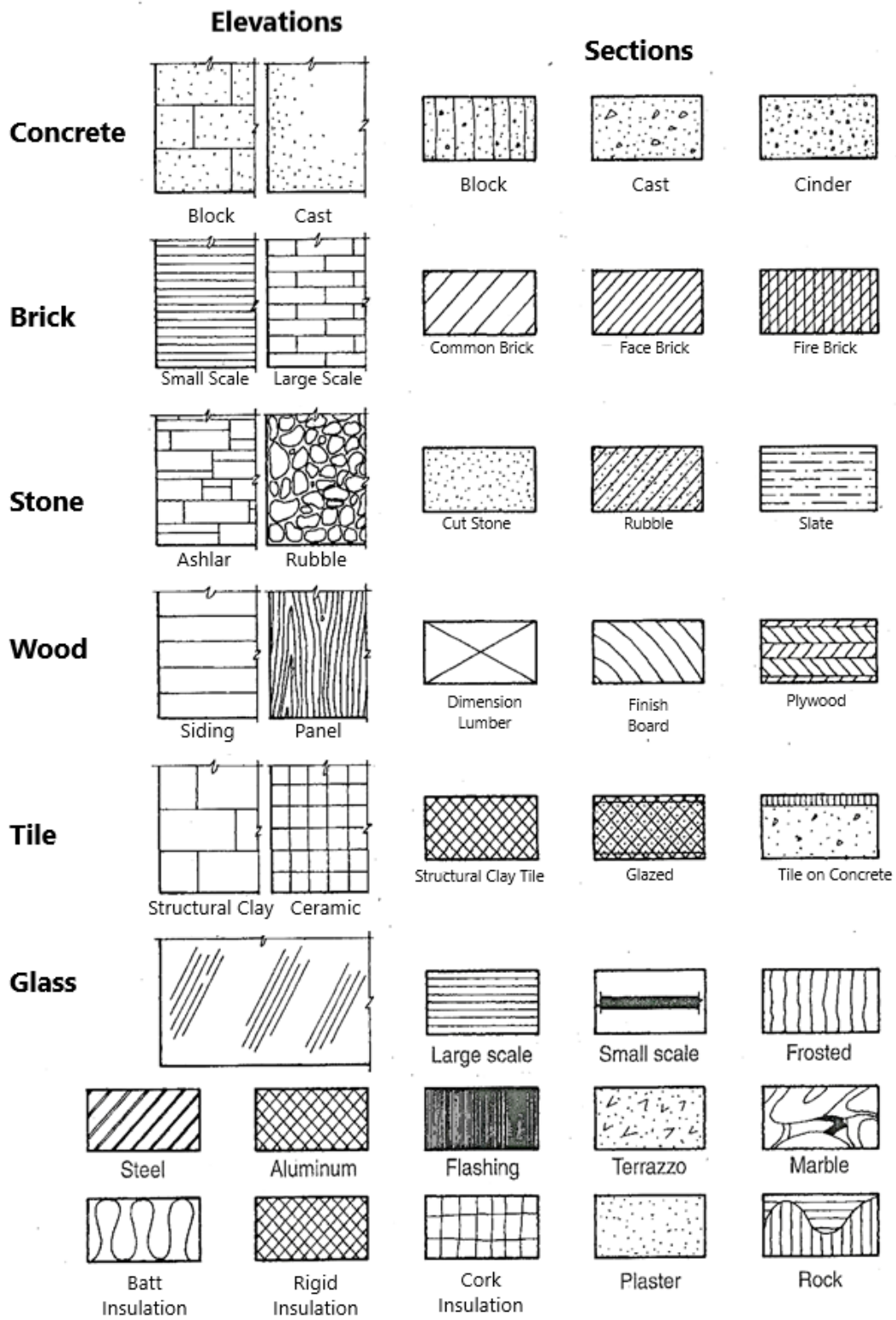
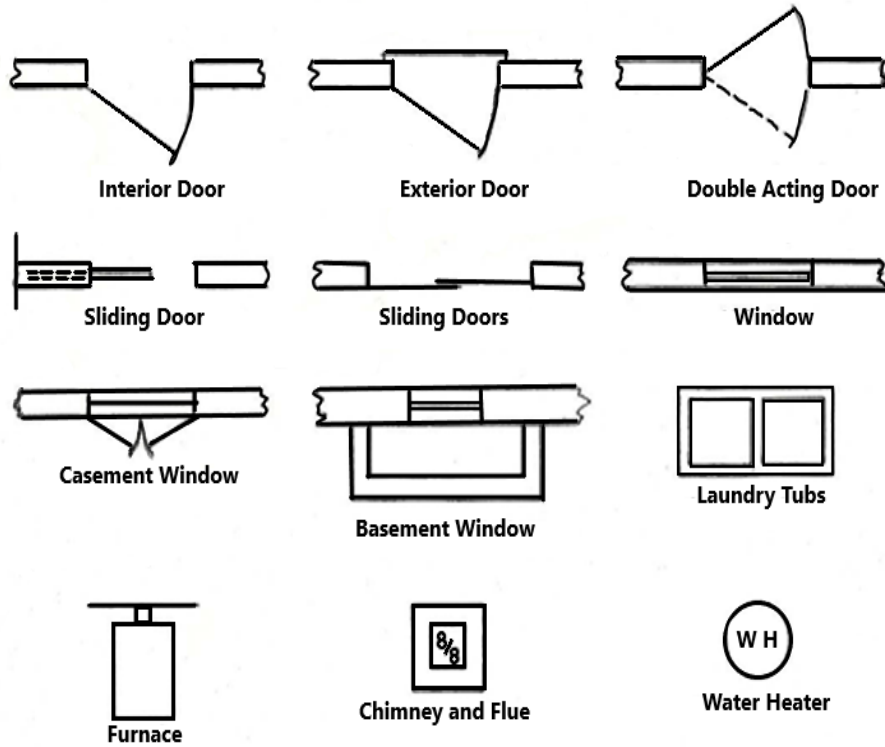


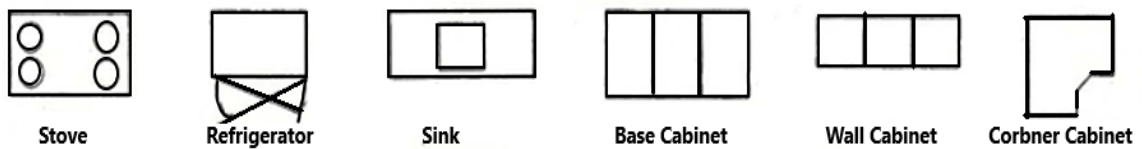
Fig. 2.1.18 Building Material Symbols

III. Climate Control Symbols

General Plan Symbols



Kitchen Plan Symbols



Bathroom Symbols

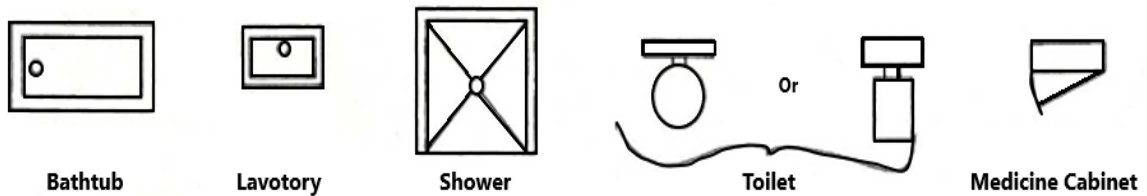


Fig. 2.1.19 Plan Symbols

IV. Piping Symbols

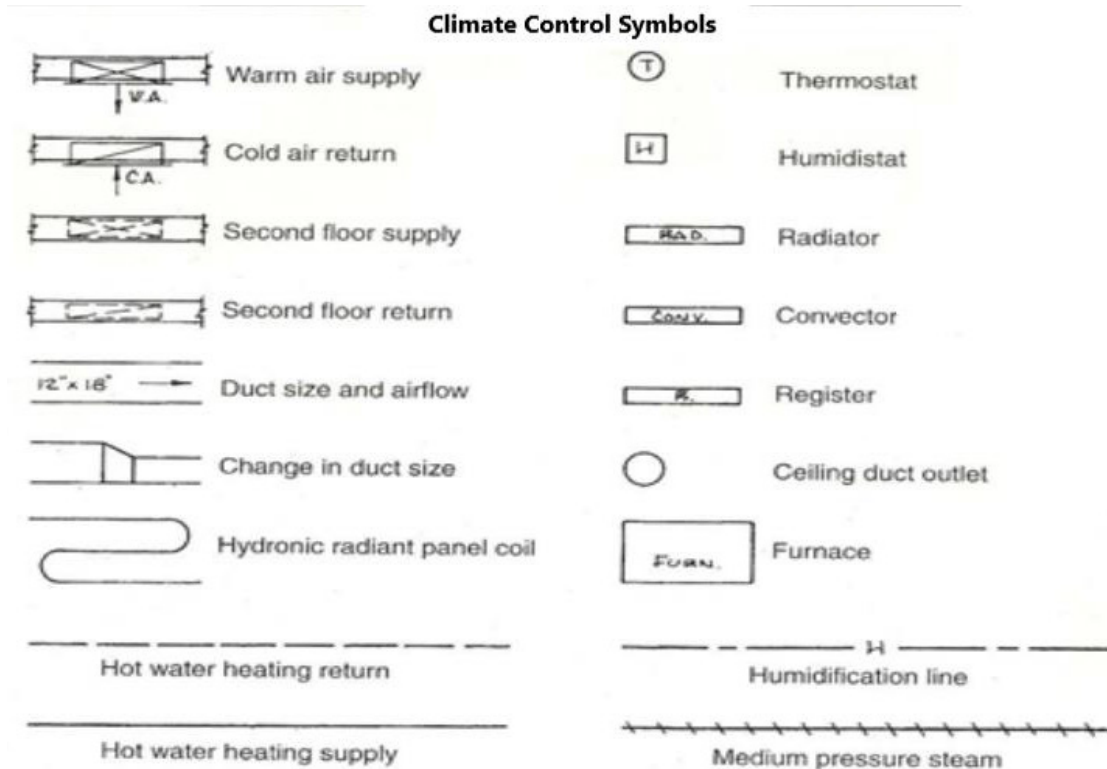


Fig. 2.1.19 Plan Symbols

V. Plumbing Symbols

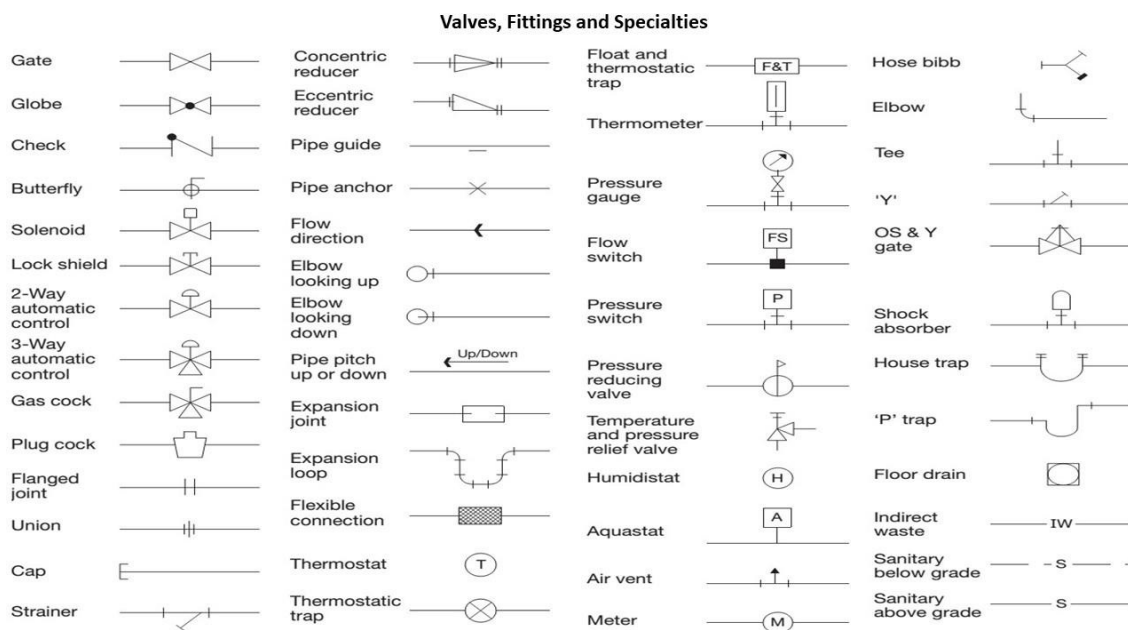


Fig. 2.1.19 Plan Symbols

VI. Electrical Symbols

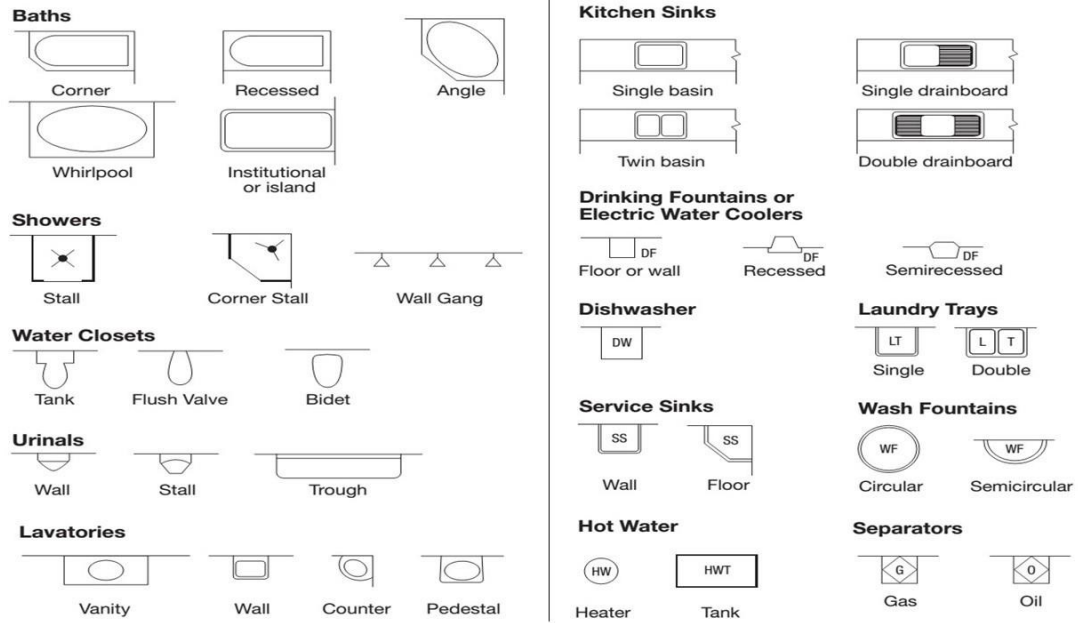


Fig. 2.1.22 Plumbing Symbols

VI. Electrical Symbols

























































| Lighting outlets | Receptacle outlets | Switch outlets |
|---|---|--|
|  Ceiling outlet |  Duplex receptacle outlet |  Single pole switch |
|  Drop cord |  Duplex receptacle ground fault circuit interrupter |  Double pole switch |
|  Fan outlet |  Weatherproof receptacle outlet |  Three way switch |
|  Junction box |  Triplex receptacle outlet |  Four way switch |
|  Lamp holder with pull switch |  Quadruplex receptacle outlet |  Key operated switch |
|  Exit light outlet Outlet controlled by low voltage switching when relay is installed in outlet box |  Duplex receptacle outlet—split wired |  Switch and pilot lamp |
|  Surface or pendant individual fluorescent fixture |  Single special-purpose receptacle outlet |  Weatherproof circuit breaker |
|  Recessed individual fluorescent fixture |  Range outlet |  Weatherproof switch |
|  Recessed incandescent |  Special purpose connection |  Switch for low voltage switching system |
| |  Clock hanger receptacle |  Time switch |
| |  Floor single receptacle outlet |  Ceiling pull switch |
| |  Underfloor duct and junction box for triple, double, or single duct system as indicated by number of parallel lines |  Switch and single receptacle |
| Signaling system outlets residential occupancies | Panels, circuits, and miscellaneous |  Switch and double receptacle |
|  Push button |  Ground |  Circuit breaker |
|  Buzzer |  Lighting panel |  Remote control switch |
|  Bell |  Power panel |  Fused switch |
|  Telephone |  Wiring, concealed in ceiling or wall |  Master switch for low voltage switching system |
|  Intercom |  Wiring, concealed in floor |  Automatic door switch |
|  Electric door opener |  Conduit run to panel board | |
|  Chime |  *Indicates number of conductors | |
|  Television outlet |  Externally operated disconnect switch | |
|  Thermostat | | |

Fig. 2.1.23 Electrical Symbols- 1










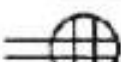
















| | | | |
|---|----------------------------|---|--|
|  | Electrical switchbox |  | Single Pole Switch |
|  | Three-Way Switch |  | SinglePlex Receptacle |
|  | Duplex Receptacle |  | Duplex Receptacle WP= Waterproof |
|  | GFCI Duplex Receptacle |  | Isolated Ground Receptacle |
|  | Switched Receptacle |  | FourPlex Four Gang Receptacle |
|  | 240-Volt Receptacle |  | Ceiling Mounted Light Fixture PC= Pullchain |
|  | Wall-Mounted Light Fixture |  | Recessed Light Fixture |
|  | Weatherproof Light Fixture |  | Fluorescent Light Fixture |
|  | Ceiling Fan |  | Combination Light & Fan |
|  | Power Vent Fan |  | Electric Motor Number=HP |
|  | Smoke Detector |  | Circuit Breaker |
|  | Telephone Jack |  | Doorbell Transformer |
|  | Doorbell Pushbutton |  | Ground |

Fig. 2.1.24 Electrical Symbols- 2

| ITEMS | SYMBOL | IN WORDS | OPERATION FUNCTIONS | | | | | | |
|---------------------------------|--------|-------------------------------|---|---------------|-----------|--------------|--|--|--|
| RELAY | | RELAY COIL | CLOSES INSTANTANEOUSLY WHEN COIL IS ENERGIZED OPENS INSTANTANEOUSLY WHEN COIL IS ENERGIZED | | | | | | |
| | | NORMALLY OPEN CONTACT | | | | | | | |
| | | NORMALLY CLOSED CONTACT | | | | | | | |
| TIME DELAY RELAY | | RELAY COIL | <table border="0"> <tr> <td></td> <td>ENERGIZED</td> <td>DE-ENERGIZED</td> </tr> <tr> <td></td> <td colspan="2"> </td> </tr> </table> | | ENERGIZED | DE-ENERGIZED | | | |
| | | ENERGIZED | | DE-ENERGIZED | | | | | |
| | | | | | | | | | |
| | | NORMALLY OPEN TIMED CLOSED | | CLOSE OPEN | | | | | |
| | | NORMALLY CLOSED TIMED OPEN | | CLOSE OPEN | | | | | |
| | | NORMALLY OPEN TIMED OPEN | | CLOSE OPEN | | | | | |
| NORMALLY CLOSED TIMED CLOSED | | CLOSE OPEN | | | | | | | |
| LIMIT SWITCH | | NORMALLY OPEN | CLOSES WHEN ACTUATED BY MECHANICAL FORCE | | | | | | |
| FLOW SWITCH | | NORMALLY OPEN | CLOSES WHEN WATER STARTS TO FLOW | | | | | | |
| | | NORMALLY CLOSED | OPENS WHEN WATER STARTS TO FLOW | | | | | | |
| PRESSURE SWITCH | | NORMALLY OPEN | CLOSES AS THE PRESSURE INCREASES TO A SPECIFIC RANGE (IN PSI) | | | | | | |
| | | NORMALLY CLOSED | OPENS AS THE PRESSURE INCREASES TO A SPECIFIC RANGE (IN PSI) | | | | | | |
| FLOAT SWITCH | | PUMP UP OPERATOR | CLOSES AS THE WATER LEVEL FALLS TO A SPECIFIC DEPTH | | | | | | |
| | | PUMP DOWN OPERATOR | OPENS AS THE WATER LEVEL FALLS TO A SPECIFIC DEPTH | | | | | | |
| PUSH BUTTON SWITCH | | NORMALLY OPEN | PUSH TO CLOSE, RELEASE TO OPEN | | | | | | |
| | | NORMALLY CLOSED | PUSH TO OPEN, RELEASE TO CLOSE | | | | | | |
| | | SOLENOID VALVE CONTROL | FOR FLOOR PLANS <ul style="list-style-type: none"> ○ LIGHTING FIXTURE, CEILING MOUNTED ○-1 LIGHTING FIXTURE, WALL MOUNTED AT HEIGHT SHOWN D FLOODLIGHT FIXTURE, WALL MOUNTED D-○ FLOODLIGHT FIXTURE MOUNTED ON POLE TOP ○ FLOURESCENT LIGHTING FIXTURE LIGHTING FIXTURE DESIGNATIONS (LOCATED ADJACENT TO FIXTURES). "A" INDICATES FIXTURE TYPE. (SEE FIXTURE SCHEDULE FOR ALL TYPES). "2/40" = TWO 40 WATTS LAMPS | | | | | | |
| | | SELECTOR SWITCH | | | | | | | |
| | | TIME METER | | | | | | | |
| | | CONNECTED WIRES | | | | | | | |
| | | NON-CONNECTED WIRES | | | | | | | |
| | | OUT-GOING TERMINAL | | | | | | | |
| | | PROBE | | | | | | | |

Fig. 2.1.25 Electrical Symbols- 3
























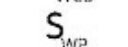

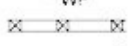



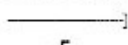
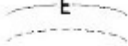

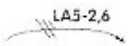
| | | | |
|---|--|---|---|
|  | S_F Fused switch, wall mounted |  | S Single pole switch, wall mounted |
|  | Fused safety switch xxAF= frame size xxAT= trip size |  | S_L Switch with locator lamp glow, wall mounted |
|  | Key controlled switch, wall mounted |  | S_{TH} Thermal rated motor switch |
|  | Low voltage switch, wall mounted |  | T Thermostat |
|  | Low voltage master switch, wall mounted |  | S₃ Three-way switch, wall mounted |
|  | Manual motor switch, wall mounted |  | S_T Timer or motor switch with thermal overload wall mounted |
|  | Manual motor switch, with thermal overloads wall mounted |  | TC Time clock switch |
|  | Momentary contact Intermittent switch, wall mounted |  | S_V Variable speed or volume control switch, wall mounted |
|  | Motion detector sensor |  | S Wall bracket pull switch |
|  | Photoelectric switch |  | S_{WCB} Weather proof circuit breaker, wall mounted |
|  | Pilot/remote light switch load off, wall mounted |  | S_{WP} Weather proof switch, wall mounted |
|  | Pilot/remote light switch load on, wall mounted |  | X Cable tray |
|  | Remote control switch receiver, wall mounted |  | ○ Conduit turning up |
|  | Ceiling pull switch ceiling mounted |  | ● Conduit turning down |
|  | Chain pull switch |  |] Conduit with capped end |
| | |  | E Emergency circuit |
| | |  | - - - Exposed circuit |
| | |  | LA5-2,6 Homerun to panel letters indicate panel numbers indicate circuits |

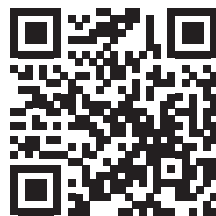
Fig. 2.1.26 Electrical Symbols- 4

Notes



QR Codes

Scan the QR code to watch the video



<https://youtu.be/LY8CfY2nj1k>

Types of Drawings in Construction Work

Unit 2.2 Marking the Layout for Brick/Block Works

Unit Objectives

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

1. Describe the basic principles of measurement, simple arithmetic's and conversion of units of measurement
2. Explain the process of 3-4-5 method.
3. Explain the use of levelling instruments like spirit level and water levelling and their setting.
4. Explain the process of transferring levels.
5. Explain the use of tools for marking of layout and checks for their serviceability.
6. Performing checks to confirm workability of tools.
7. Demonstrate transfer of levels as per drawings/instructions.
8. Demonstrate the setting out of the layout as per drawings/instructions.
9. Demonstrate marking of the centre lines of a room by 3-4-5 method
10. Demonstrate marking of acute angle, obtuse angle, splayed wall etc.
11. Demonstrate the checking of diagonals of a marked square/rectangle.

2.2.1 Basic Principles of Measurement

Measurement is the process of quantifying a physical quantity or attribute using a standard unit. The basic principles of measurement include:

1. **Precision:** Precision refers to the level of detail and accuracy to which a measurement can be made. A precise measurement provides consistent and repeatable results.
2. **Accuracy:** Accuracy refers to how closely a measurement corresponds to the true value of the quantity being measured. An accurate measurement is free from systematic errors.
3. **Standardization:** Standard units are established to provide a consistent and universally accepted basis for measurement. These units are defined based on fundamental constants of nature.
4. **Comparability:** Measurements should be made using standardized methods and instruments so that they can be compared and understood by different individuals and across different contexts.
5. **Reliability:** Reliability implies that measurements should be consistent and dependable. Reliable measurements can be reproduced under similar conditions.

2.2.2 Simple Arithmetic in Measurement

Arithmetic operations such as addition, subtraction, multiplication, and division are often involved in measurements. When performing arithmetic with measurements, it's important to consider the following:

- **Precision Preservation:** In addition and subtraction, the result should be rounded to the least precise measurement. For multiplication and division, the result should have the same number of significant figures as the least precise measurement involved in the calculation.
- **Units:** Always include units in calculations. Make sure units are compatible, and if not, convert them before performing arithmetic.
- **Conversion of Units:** Units of measurement can vary based on different systems and contexts. Converting units is important for making measurements consistent and comparable.

2.2.3 Reading Measuring Tools

The construction industry uses several tools, including framing squares, bench rules, steel rules, and tapes. The customary measurement system, often known as the English measurement system, categorises lengths into units of feet, inches, and fractional increments of an inch. The basic concept employed in this system can be referred to as the “fractional rule.” The metric system is characterised by its divisions into metres, centimetres, and millimetres. This regulation is commonly referred to as the “metric rule.”

1. **Fractional rule** – This rule is divided into 16ths. See Figure below. In this figure, the inch is divided into 16 parts. Thus, each small division is 1/16th of an inch.

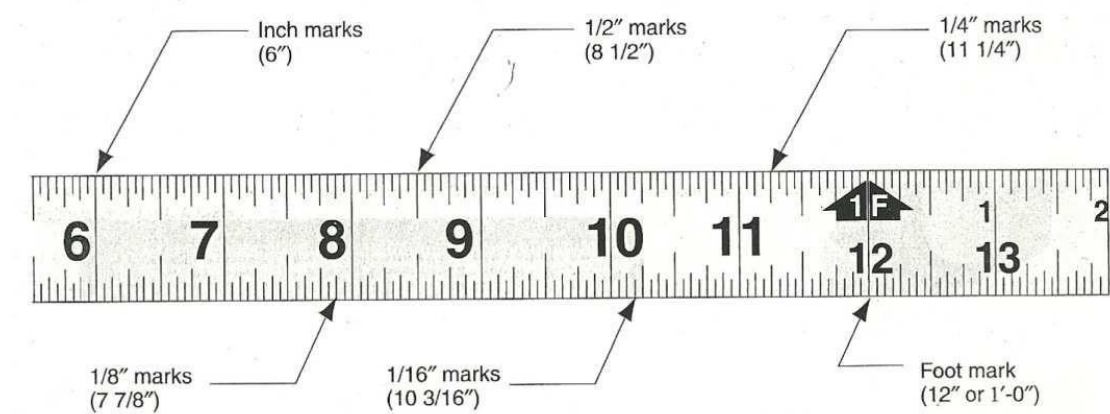


Fig. 2.2.1 Measuring Tape

2. **Metric rule** – The basic unit of linear measure in the metric system is the meter (m). Other linear units are either fractions or multiples of a meter. The most common units are the following:

| Unit | Abbreviation | Equal to |
|------------|--------------|------------|
| Millimeter | mm | 1/1000th m |
| Centimetre | cm | 1/100th m |
| Kilometer | km | 1000 m |

Metric dimensions are better to work with because they can be added or subtracted more easily than English units. However, the customary system is used almost exclusively in this country. The relationship between the customary and the metric systems is given below:

1 inch = 25.4 millimeters

1 foot = 304.8 millimeters

1 yard (3 feet) = 914.4 millimetres

39.37 inches = 1 meter

2.2.4 3-4-5 Method or Method for Squaring Corners

3-4-5 method is used as a method for squaring corners.

Introduction to 3-4-5 rule

The 3-4-5 rule is based on the Pythagorean Theorem. The sum of the squares of the lengths of the legs of a right triangle ("A" and "B" in the triangle shown below) is equal to the square of the length of the hypotenuse ("C").

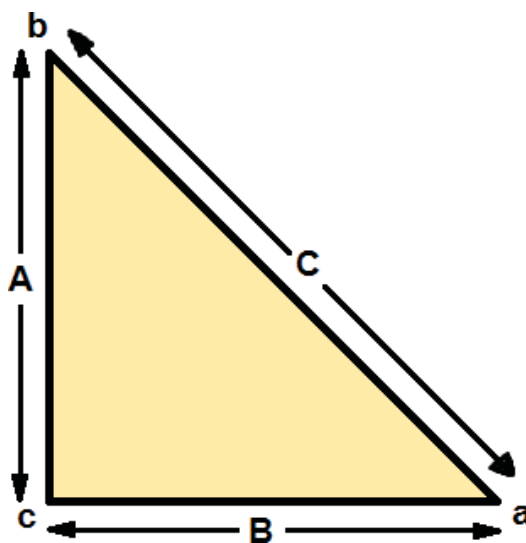


Fig. 2.2.2 Pythagorean Theorem

Application of 3-4-5 rule to lay out a wall:

- On one side of corner measure 3'-0" and make a mark
- On the opposite side of the corner measure 4'-0" and make a mark
- Measure between the two marks when this distance equals 5'-0" the two walls are 90 degrees to each other (i.e. square).
- For larger layouts any multiple of the 3-4-5 rule can be used (i.e. 6-8-10 etc.)

The 3-4-5 method, also known as the "Pythagorean triple method," is a simple geometric technique used to ensure that a corner is at a perfect 90-degree angle. This method is particularly useful in construction and carpentry for ensuring accurate right angles when setting out foundations, walls, fences, and other structures. The principle behind the 3-4-5 method is based on the Pythagorean theorem, which states that in a right triangle, the square of the length of the hypotenuse (the side opposite the right angle) is equal to the sum of the squares of the other two sides.

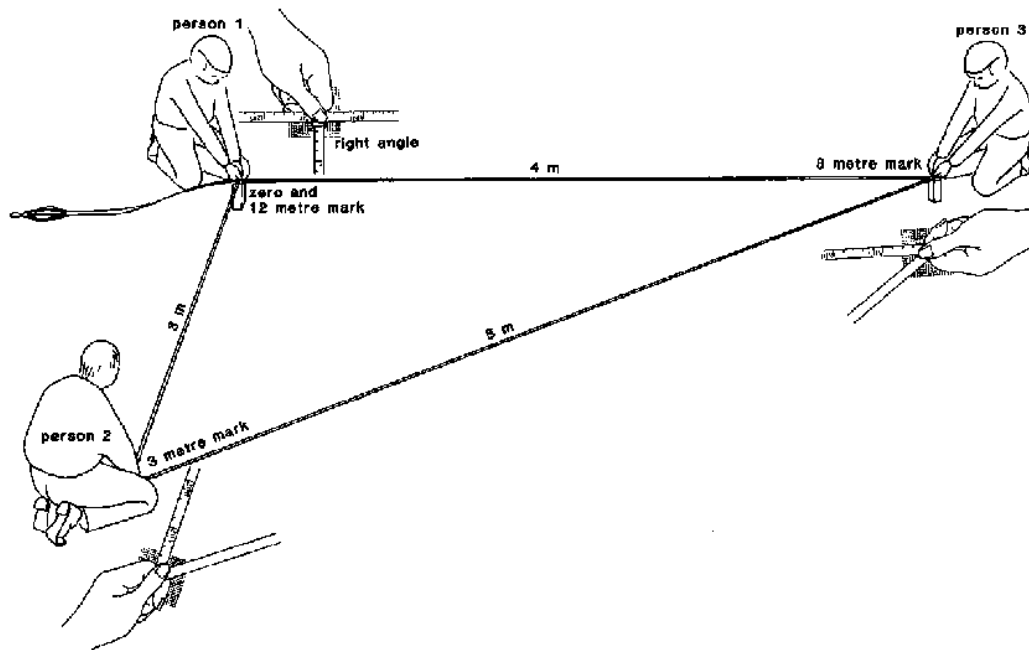


Fig. 2.2.3 The 3-4-5 method

Here's how the 3-4-5 method works:

1. **Choose a Corner:** Start by selecting the corner where you want to ensure a 90-degree angle. Let's call this corner "A."
2. **Measure and Mark One Side:** From corner A, measure and mark a distance of 3 units along one of the two perpendicular sides that meet at corner A. This is often referred to as the "3" side.
3. **Measure and Mark the Other Side:** From the same corner A, measure and mark a distance of 4 units along the other perpendicular side. This is the "4" side.
4. **Connect the Marks:** Now, with the marks at 3 units and 4 units along the two sides, connect these

marks with a straight line. This line will represent the hypotenuse of a right triangle.

- 5. Check for a Perfect Right Angle:** Measure the length of the line you drew between the 3-unit mark and the 4-unit mark. If the length of this line measures exactly 5 units, then the corner at A is a perfect 90-degree angle.

This method works due to the Pythagorean theorem: $(3^2) + (4^2) = (5^2)$, which simplifies to $9 + 16 = 25$.

If the length of the line between the 3-unit and 4-unit marks is not exactly 5 units, it means the corner is not a perfect 90-degree angle. In that case, you may need to adjust the corner until you achieve the correct measurements.

The 3-4-5 method provides a quick and accurate way to check right angles in situations where precision matters. It's a handy technique for maintaining the geometric integrity of structures during construction and layout work.

2.2.5 Levelling Instruments

Levelling instruments like spirit levels and water levels are tools used in construction, surveying, and various other applications to determine and maintain horizontal and vertical reference lines. They are essential for ensuring that structures and surfaces are level, straight, and aligned correctly. Here's an explanation of the use of these instruments and how to set them up:

Spirit Level:

A spirit level, also known as a bubble level or simply a level, consists of a rectangular or circular tube partially filled with a liquid (usually alcohol) and an air bubble. The bubble moves within the liquid in response to changes in the instrument's orientation. The goal is to position the level in such a way that the bubble is centered between two marked lines on the tube, indicating a level surface.

Setting up a Spirit Level:



Fig. 2.2.4 Spirit Level

1. **Choose a Level Surface:** Place the spirit level on a surface that you want to check for levelness. This could be a floor, a countertop, a beam, or any other horizontal surface.
2. **Position the Level:** Place the spirit level parallel to the surface you're testing. The level should have two or more leveling vials, one for each direction (longitudinal and transverse).
3. **Check the Bubble:** Look at the vials containing the air bubble. Adjust the position of the level until the bubble is centered between the marked lines. When the bubble is centered, the surface is level in the direction of the vial.
4. **Verify in Different Directions:** Rotate the level 90 degrees and check the bubble again. If the bubble remains centered, the surface is level in both directions.

Water Level:

A water level is a simple but effective tool for determining the same horizontal level between two points at a distance. It consists of a transparent hose or tube filled with water. When the water level is at the same height in both ends of the tube, the points being measured are at the same level.

Setting up a Water Level:

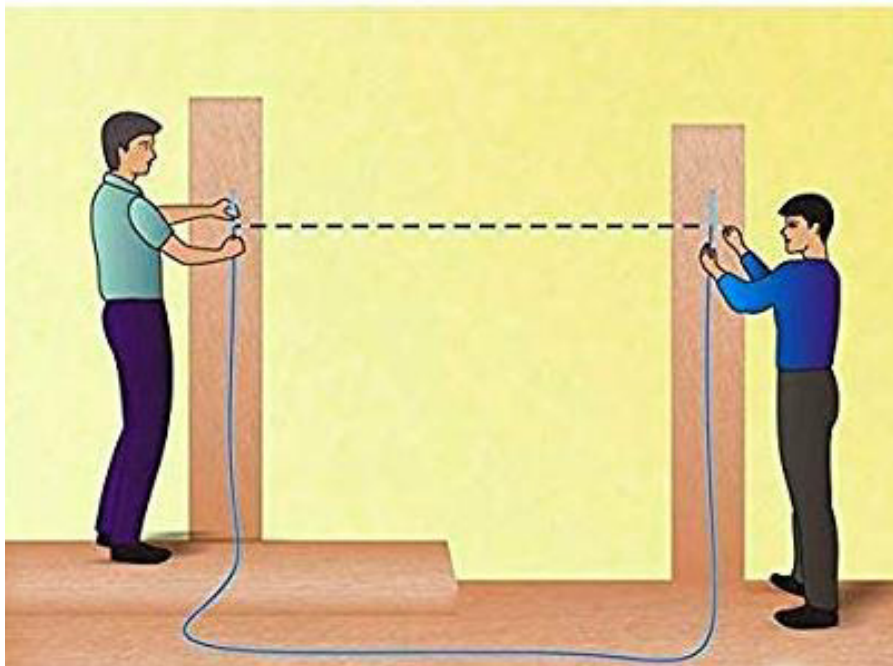


Fig. 2.2.5 Water Level

1. **Prepare the Tube:** Fill the transparent tube or hose with water, ensuring that there are no air bubbles inside. Plug or pinch one end of the tube to keep the water from flowing out.
2. **Position the Tube:** Hold one end of the tube at a known reference point, often referred to as the benchmark. The water level in the tube should be at the same height as the benchmark.
3. **Move to the Second Point:** Move the other end of the tube to the point you want to check

for levelness. Adjust the height of this end until the water level inside the tube is at the same height as the benchmark end.

4. **Measure the Difference:** Measure the vertical difference between the benchmark and the second point. This difference indicates the levelness between the two points.

Both spirit levels and water levels provide reliable methods for ensuring horizontal and vertical alignment. Spirit levels are more compact and convenient for shorter distances, while water levels can be advantageous for longer distances where a more direct line of sight is not feasible.

2.2.6 Transfer of Levels

The transfer of levels in brick masonry is accomplished by following a series of steps as per the provided drawings or instructions. This process ensures that the constructed masonry aligns accurately with the desired elevation points.

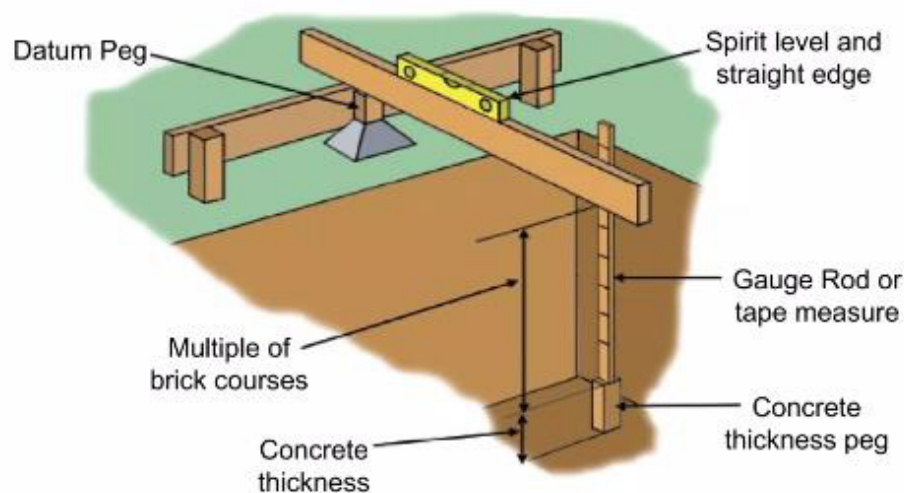


Fig. 2.2.6 Transfer of levels

The steps for transferring levels in brick masonry are as follows:

1. **Preparation of Tools and Materials:** The required tools and materials, such as a spirit level, a measuring tape, a plumb bob, and masonry units (bricks), are gathered and made ready for use.
2. **Establishment of Reference Points:** Reference points are established on the existing structure or foundation at the specified elevation levels mentioned in the drawings. These points act as benchmarks for the transfer of levels.
3. **Attachment of Spirit Level:** A spirit level is attached securely to a leveling staff or a reference

line, ensuring it is properly calibrated.

4. **Initial Benchmark Setup:** The leveling staff, equipped with the spirit level, is positioned at the first reference point. The spirit level is adjusted until the bubble is centered within the level's vial, ensuring a horizontal line of sight.
5. **Reading and Recording:** The reading on the leveling staff's scale is carefully observed and noted. This reading represents the initial benchmark elevation.
6. **Transferring Levels to Other Points:** Moving along the masonry construction line, the leveling staff is placed at subsequent reference points. The spirit level is adjusted at each point to ensure the bubble is centered, and readings are taken and recorded accordingly.
7. **Comparing Readings:** The recorded readings from each reference point are compared to the desired elevation levels mentioned in the drawings. Any discrepancies are identified and corrected by making necessary adjustments during the construction process.
8. **Plumb Bob Usage (If Required):** In cases where vertical alignment is crucial, a plumb bob can be used to ensure accurate vertical reference points. The plumb bob is suspended from the top of the masonry, aligning with the reference point's elevation mark on the leveling staff.
9. **Brick Installation:** Based on the transferred elevation levels, bricks are laid one by one using mortar. The top surface of each brick is aligned with the established levels, ensuring a uniform and level masonry structure.
10. **Continuous Monitoring:** Throughout the construction process, the levels are continuously monitored and adjusted as necessary to maintain the desired elevations accurately.
11. **Completion Check:** Once the masonry construction is completed, a final check is conducted using the spirit level and leveling staff to ensure that all specified elevation points have been accurately transferred.

2.2.7 Setting Out a Layout

Setting out a layout according to drawings or instructions involves the process of transferring the dimensions and positions from a design plan onto the actual site or surface where the construction or project will take place.

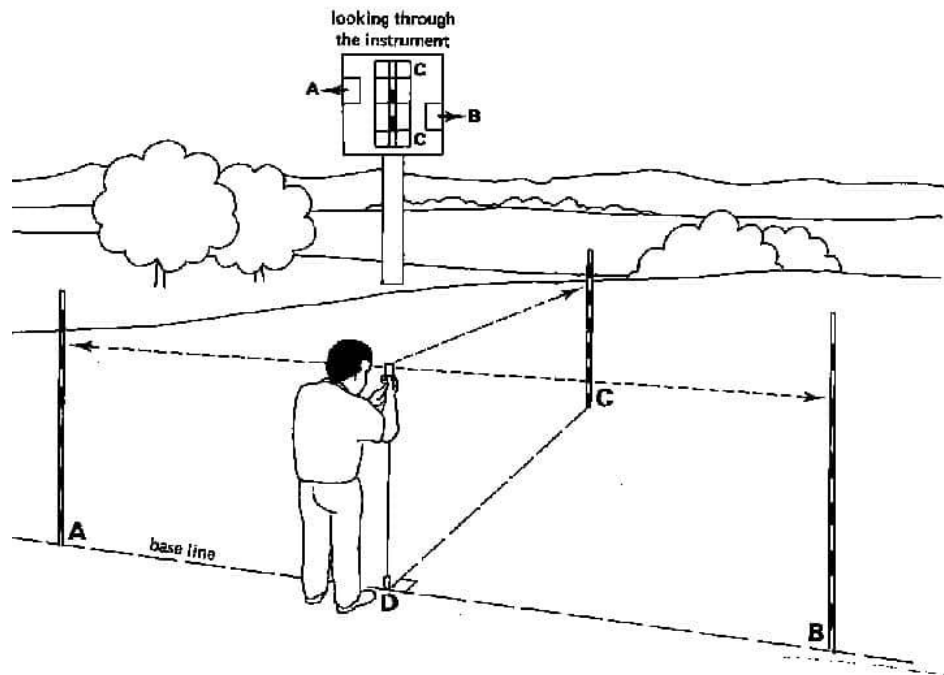


Fig. 2.2.7 Setting out on ground

This is a crucial step in ensuring that the final result matches the intended design. Here are the steps involved in setting out a layout:

1. **Understand the Drawings/Instructions:** Review the architectural and engineering drawings thoroughly to understand the layout, dimensions, positions, and levels of various elements such as walls, columns, foundations, utilities, etc. Clarify any doubts or ambiguities with the design team if needed.

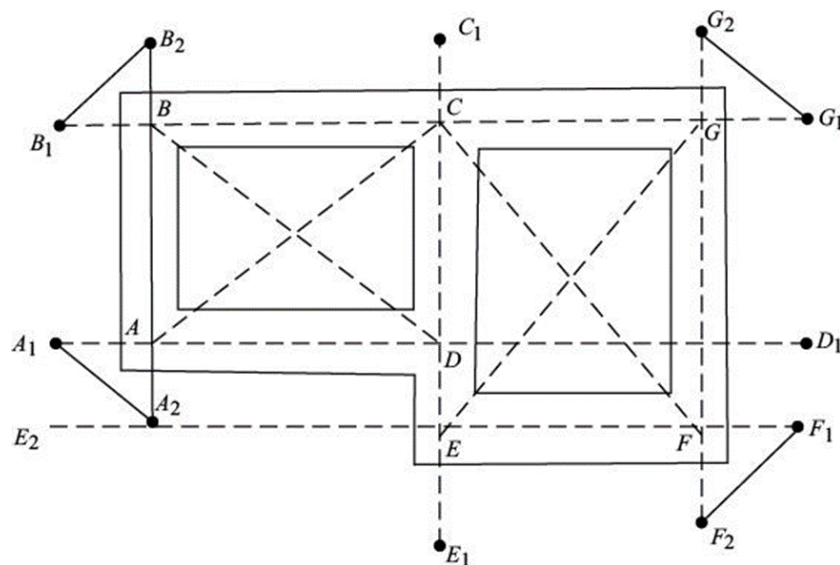


Fig. 2.2.8 Centre-line Method

2. **Establish a Base Point:** Choose a fixed reference point on the site, often referred to as a benchmark or control point. This point should be stable and easily identifiable, and it will be used as a starting reference for all measurements and layout work.
3. **Set Up Surveying Instruments:** Depending on the complexity of the project, you may need various surveying instruments such as total stations, theodolites, leveling instruments, and measuring tapes. These instruments help ensure accurate measurements and alignments.
4. **Transfer Horizontal Dimensions:** Use measuring tapes, strings, or other measuring tools to transfer the dimensions from the drawings onto the site. Measure from the established base point to key points on the site, such as corners, intersections, and important features.
5. **Establish Layout Lines:** Using the measurements taken, drive pegs, place stakes, or mark the ground with chalk to indicate the exact positions where walls, columns, and other structural elements will be located. Use strings and lines to mark out the layout with precision.
6. **Check Alignments and Angles:** Use theodolites or other angle-measuring instruments to ensure that the layout lines are properly aligned with the desired angles specified in the drawings. This is crucial for maintaining accurate geometric relationships.
7. **Transfer Vertical Dimensions:** Measure the heights and elevations for different elements, such as floor levels and top of foundations. Use leveling instruments to establish accurate heights relative to the established benchmark.
8. **Mark Foundations and Footings:** Outline the locations of foundations, footings, and other below-ground elements. Ensure that these are accurately positioned and leveled.
9. **Check and Recheck:** Regularly verify the accuracy of your measurements, alignments, and elevations throughout the process. Mistakes at this stage can lead to significant issues later in the construction process.
10. **Document the Layout:** Take photographs and notes of the layout for future reference. These records can be valuable for cross-checking during construction and for any potential disputes.
11. **Communicate with the Construction Team:** Share the layout information with the construction team, including contractors, engineers, and laborers. Clear communication ensures everyone is on the same page and follows the correct layout.
12. **Monitor Progress:** Keep an eye on the construction process as it progresses to ensure that the actual work matches the layout. If discrepancies or errors arise, they should be addressed promptly.

Exercise



Answer the following questions:

I. Multiple Choice Questions (MCQs):

1. What is the purpose of the 3-4-5 method in construction? a) To calculate the area of a triangular structure b) To ensure accurate right angles c) To measure the lengths of sides in a triangle d) To determine the volume of a rectangular prism
2. Which tool is commonly used to measure and maintain horizontal and vertical reference lines in construction? a) Measuring tape b) Spirit level c) Plumb bob d) Vernier caliper
3. What is the primary purpose of setting out a layout on a construction site? a) To create artistic patterns on the ground b) To transfer dimensions from drawings to the actual site c) To perform soil testing d) To determine the cost of construction
4. The Pythagorean theorem is used in which method for ensuring accurate right angles? a) 2-3-4 method b) 5-12-13 method c) 3-4-5 method d) 1-2- $\sqrt{3}$ method
5. Which unit is commonly used for measuring length in the metric system? a) Foot b) Inch c) Centimeter d) Yard

II. Fill in the Blanks:

1. Levelling instruments like _____ and _____ are used to maintain horizontal and vertical reference lines in construction.
2. The _____ method involves measuring sides of lengths 3, 4, and 5 units to ensure a perfect 90-degree angle.
3. Architectural drawings include various representations such as plans, elevations, sections, and _____.
4. The _____ rule divides an inch into 16 parts in the customary measurement system.
5. The purpose of setting out a layout is to transfer dimensions and positions from _____ onto the actual construction site.

III. Short Answer Questions:

1. Explain the process of using a spirit level to ensure a level surface. What is the significance of centering the bubble?
2. What is the purpose of the 3-4-5 method in construction layout? Provide a step-by-step explanation of how this method is applied.
3. Describe the role of architectural plans in construction. What information can a brick mason obtain from floor plans, elevations, and sections?
4. Why is it important to transfer levels accurately during construction? Explain the process of transferring levels using a leveling staff and a benchmark.
5. What are some common symbols used in construction drawings? Provide examples of building material symbols, plan symbols, and electrical symbols.

Notes 

QR Codes

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<https://youtu.be/EcuEbP8K3lk>

How to Check Brick or Block Layout as per Drawing





3. Process of carrying out Brick Laying Work

Unit 3.1 - Performing Brick Laying

Unit 3.2 - Staircases

Unit 3.3 - Paver's Block

Unit 3.4 - Arches

Unit 3.5 - Manholes

Unit 3.6 - Repair and Restore Brickwork

Unit 3.7 - Pointing in Masonry Works



Key Learning Outcomes

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

1. Construct load bearing /non load bearing wall, columns and footings using bricks.
2. Carry out pointing in brick masonry.
3. Perform specialized masonry works such as arches, staircase, manholes and walkways
4. Repair and restore brick masonry.

Unit 3.1: Performing Brick Laying

Unit Objectives

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

1. Explain the use of various tools used in bricklaying.
2. Describe the use of raw materials like cement, sand, aggregate, bricks/blocks etc., the size and physical attributes.
3. Explain the visual checks required for assessing the quality of bricks.
4. Describe the techniques for cutting, and chiselling of bricks as per closure using appropriate tools.
5. Explain cement mix proportion and its importance.
6. Discuss the water-cement ratio.
7. Describe the English, Flemish, stretcher and header bond.
8. Explain the process of laying and fixing bricks in position with uniform joints.
9. Explain the use of the 3-4-5 method for squaring corners.
10. Explain the various method of curing masonry structure
11. Show how to interpret sketches, method statements, formats, permits, protocols and checklists for brickwork.
12. Demonstrate the visual checks for brick/block, cement, aggregate
13. Provide a rough estimate for the quantity of material required for work.
14. Demonstrate the breaking of breaks to the required size and shape.
15. Demonstrate the construction of a brick wall as per the standard tolerance limit, as per the relevant drawing.
16. Demonstrate checks for maintaining the line and level of each course of brick wall
17. Demonstrate setting out of 90° corners using builders square or 3-4-5 method.
18. Demonstrate raking and cleaning of joints as specified before drying of bonding mortar

3.1.1 Brick Masonry






Brick masonry is the technique of placing bricks and properly joining them with mortar to create a desired structure that can safely transport the super-imposed load to the base. Lime and cement mortar are typically used for brick masonry in permanent construction, however, mud mortar can also be utilised in temporary construction. There are different types of bricks and mortars that are used to construct brick masonry.













Fig. 3.1.1 Brick Masonry

3.1.2 Tools, Equipment and Accessories used in Brick Work

| Tools, Equipment and Accessories | Image | Specification |
|----------------------------------|---|--|
| Measuring tape |  | Measuring tape is used to measure the distance. These are available in 3M, 5M, 15M and 30M. |
| Trowel |  | Trowel helps you to pick up the mortar and spread it evenly while laying the blocks. The common masonry trowel is triangular in shape, the size of which varies from 10 cm to 20 cm in width and up to 28 cm in length. The pointing trowel used for pointing and striking joints, is smaller in size and varies from 8 cm to 16 cm in length and 5 cm to 8 cm in width. |
| Wooden floats |  | Wooden floats are used to finish the plastering. |
| Wire brush |  | Stiff wire brush helps you to remove the dust and loose material from the raked joints |

| | | |
|---------------------------------|---|---|
| <p>Screed board</p> |  | <p>A screed board is used to level a wall floor or ceiling surface while plastering.</p> |
| <p>Straight edge</p> |  | <p>Straight edge is a tool used to check the flatness/straightness of surface or lines. The commonly used straight edge is hollow, rectangular in shape, the length of which can be up to 500 cm and width from 4.5 cm to 3.5 cm.</p> |
| <p>Concrete Mixer</p> |  | <p>The concrete mixer is a machine which can mix large quantity of cement, water, coarse aggregates and sand to produce concrete for ready use.</p> |
| <p>Mortar Boards and Stands</p> |  | <p>A square shaped board to hold mortar.</p> |
| <p>Shovels</p> |  | <p>Rubbish is removed using shovel.</p> |

| | | |
|-------------------|---|--|
| Wheelbarrows |  | The wheelbarrow is convenient for easier transport of smaller loads of sand, cement, mortar, bricks or other building materials at the site without the use of powered machines. |
| Hawks |  | Hawks along with trowels are used to apply plaster on a wall. |
| Jointer |  | A brick jointer is used to make various type of mortar joints. These are of various shapes based on the type of mortar joint to be finished. In case of block work sled jointers are used. |
| Mason's square |  | Mason's square is used to set the right angles. Also, used for testing corners during plastering. |
| Chisel or Bolster |  | A hand tool used to cut and shape stone, bricks, wood, metal etc. It is usually 6 cm to 12 cm wide. |

| | | |
|----------------|---|--|
| Mason's Hammer |  | A hand tool having a heavy round/ square head at one end and chisel edge on other end for cutting and breaking stone, brick units. It weighs roughly 1 kg to 1.5 kg. |
| Spade |  | The spade can be used for digging or mixing mortar. |
| Spirit Level |  | Use the spirit level to check the evenness across a wall or surface. While marking the lines, look from the top and make sure the air bubble is in the center of the tube. |
| Plumb bob |  | Use the plumb to check the evenness of the edges up and down a wall or column. While dropping the Plumb, make sure that the tip is not tilting |
| Line Thread |  | Nylon rope helps you to ensure that bricks are aligned properly in the form of a mason's line. |


| | | |
|-------------------------|---|--|
| Water Pipe Levelling |  | <p>It is used to fix or transfer a level to another point. While marking make sure there is no air bubble in the tube level.</p> <p>This water pipe will come in handy for rinsing your masonry tools as you work and for keeping the mortar sufficiently moist.</p> |
|-------------------------|---|--|

Table 3.1.1 Tools, Equipment and Accessories Used in Brick Work

3.1.3 Raw Materials used in Brick Work

Types of raw materials used in construction of masonry structures are cement, sand, aggregates and brick:

1. Cement

- Cement is a material which is in the form of powder.
- There are two varieties of cement: Ordinary Portland Cement (OPC) and Portland Pozzolana Cement (PPC).
- Standard cement has an ISI mark and can be recognized by its colour. OPC cement is grey in colour, while PPC cement is red in colour.



Fig. 3.1.2. Cement

2. Sand

- The sand particles consist of small grains of silica.
- It is formed by the decomposition of sand stones due to various effects of weather.



Fig. 3.1.3 Sand

a. Pit Sand:

- Pit sand is coarse in nature and is generally red-orange in colour.
- It is commonly referred to as badarpur.
- It is procured from deep sand pits with abundant supply of sand.
- The grains of sand are sharp, angular and free from salts etc.
- It is mostly used in concreting.

b. River Sand

- River sand is fine in quality and is procured from river streams and banks.
- It is generally white-grey in colour and has rounded grains.
- It is used for plastering.

3. Aggregate

i. Fine Aggregate

It includes natural sand and aggregate which passes through 4.75 mm IS sieve and contains only so much coarser as is permitted by specification. Fine aggregate may be described as:



Fig. 3.1.4 Fine Aggregate

- a. **Natural Sand** – It is type of aggregate formed from the natural disintegration of rock and which has been deposited by streams or glacial agencies.
- b. **Crushed Stone Sand** – It is a type of fine aggregate produced by crushing hard stone.
- c. **Crushed Gravel Sand** – It is a type of fine aggregate produced by crushing natural gravel.
 - Based on the size the fine aggregate may be described as coarse sand, medium sand and fine sand.
 - The IS (Indian Standard) specifications classifies the fine aggregate into four types according to its grading namely as fine aggregate of grading Zone-1 to grading Zone-4.
 - These grading zones become progressively finer from grading Zone-1 to grading Zone-4. 90% to 100% of the fine aggregate passes 4.75 mm IS sieve and 0 to 15% passes 150 micron IS sieve depending upon its grading zone.

ii. Coarse Aggregate

It includes the aggregate which is retained on 4.75 mm IS sieve and contains only so much finer material as is permitted by specification. Coarse aggregate may be:



Fig. 3.1.5 Coarse Aggregate

- a. **Uncrushed Gravel or Stone** – It is produced from natural disintegration of rock.
- b. **Crushed Gravel or Stone** – It is produced from crushing of gravel or hard stone.
- c. **Partially Crushed Gravel or Stone** – It is produced from the blending of crushed and uncrushed gravel.
 - According to size coarse aggregate is described as graded aggregate of its nominal size i.e. 40 mm, 20 mm, 16 mm and 12.5 mm etc. for example, a graded aggregate of nominal size 20 mm means an aggregate most of which passes 20 mm IS sieve.
 - A coarse aggregate which consists of particles belonging mainly to one sieve size is known as single size aggregate. For example, 20 mm single size aggregate mean an aggregate most of

which passes 20 mm IS sieve and its major portion is retained on 10 mm IS sieve.

4. Bricks

Physical attributes of bricks:

The bricks should have plane smooth rectangular face and sharp right angled corners.



Fig. 3.1.6 Bricks

The standard modular size of common building bricks shall be as follows:

| Length (L) mm | Width (W) mm | Height (H) mm |
|---------------|--------------|---------------|
| 190 | 90 | 90 |
| 190 | 90 | 40 |

The following non-modular sizes of the bricks may also be used.

| Length (L) mm | Width (W) mm | Height (H) mm |
|---------------|--------------|---------------|
| 225 | 111 | 70 |
| 225 | 111 | 44 |

3.1.4 Types of Bricks

1. Burnt Clay Mix

- **Composition:** Made from clay that is fired or baked in a kiln.
- **Color:** Typically red or brown, but can vary.
- **Texture:** Generally rough and porous.
- **Strength:** Moderate compressive strength.
- **Durability:** Suitable for general construction purposes.
- **Insulation:** Offers moderate thermal insulation.
- **Absorption:** Absorbs water, and can be susceptible to weathering in extreme conditions.

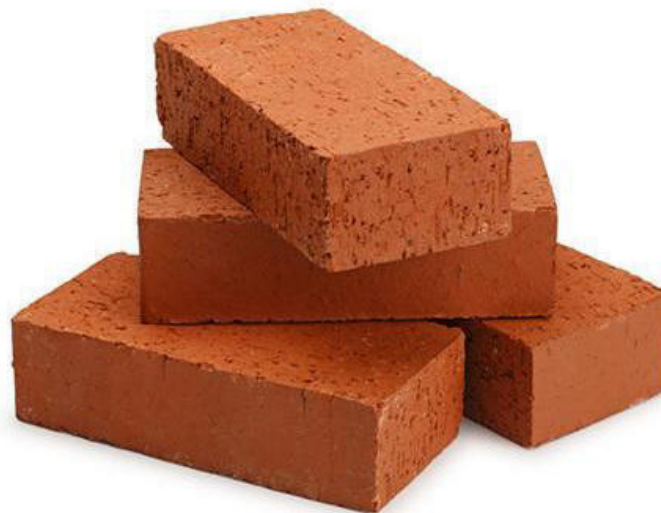


Fig. 3.1.7 Burnt Clay Mix Bricks

2. Concrete Bricks

- **Composition:** Made from a mixture of cement, sand, aggregate, and water.
- **Color:** Gray, similar to regular concrete.
- **Texture:** Smooth or textured surface, depending on mould.
- **Strength:** High compressive strength.
- **Durability:** Resistant to weathering and moisture, suitable for various applications.
- **Insulation:** Low thermal insulation unless modified.
- **Absorption:** Lower water absorption compared to clay bricks.



Fig. 3.1.8 Concrete Bricks

3. Sand Lime Bricks (Calcium Silicate Bricks)

- **Composition:** Made from sand, lime, and a small percentage of cement.
- **Color:** Gray or white.
- **Texture:** Smooth and uniform.
- **Strength:** Moderate to high compressive strength.
- **Durability:** Resistant to weathering, suitable for load-bearing walls.
- **Insulation:** Provides good thermal insulation.
- **Absorption:** Relatively low water absorption.



Fig. 3.1.9 Sand Lime Bricks

4. Fly Ash Clay Bricks

- **Composition:** Made from a mixture of fly ash (a byproduct of coal combustion) and clay.
- **Color:** Can vary, often grey due to fly ash content.
- **Texture:** Smooth or textured.
- **Strength:** Moderate compressive strength.
- **Durability:** Generally durable and resistant to weathering.
- **Insulation:** Provides some thermal insulation.
- **Absorption:** Moderate water absorption.



Fig. 3.1.11 Engineering Bricks

5. Engineering Bricks

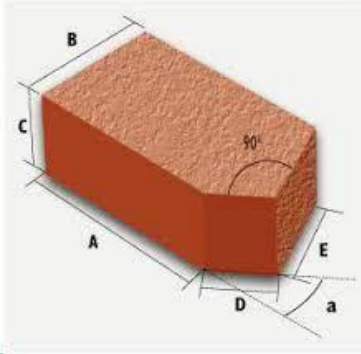

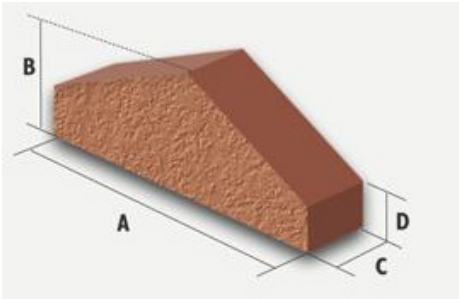

- **Composition:** Made from dense clay, often with additives for increased strength.
- **Color:** Usually red or blue.
- **Texture:** Smooth and dense.
- **Strength:** High compressive strength, designed for structural applications.
- **Durability:** Highly durable, suitable for areas exposed to severe weather conditions.
- **Insulation:** Limited thermal insulation.
- **Absorption:** Very low water absorption, making them resistant to frost and moisture.



Fig. 3.1.11 Engineering Bricks

3.1.5 Shapes of Bricks

Usually, a brick is in a rectangular shape, but there are places where a right rectangular-shaped brick would not be suitable. It has to be modified. Hence, the bricks can be classified based on size and modifications:

| Brick Name | Description | Image |
|-------------------|---|--|
| 1. Squint Brick | They are cut at a corner at an angle of more than 90 degrees. They are required to shape the outer or inner corner of a wall. |  |
| 2. Splay Brick | They have a level top part, width-wise, length, or in both directions. The individual shapes are grouped under gleaming bricks, which are also made for use indoors and windows, vents, and plinths. |  |
| 3. Coping Bricks | They are used for coping on the walls to give them a good appearance and can also be used for easy drainage of water. When a coping is to be provided to a wall, a particular shape may be desired. Chuffed, half-round, and saddleback bricks are some common imitating bricks. |  |
| 4. Bullnose Brick | Bullnose bricks are used on the sides of the wall to obtain round corners. It is a standard brick with one edge rounded. |  |

| | |
|------------------|--|
| 5. Cownose Brick | It is similar to the bullnose, but it has both sides rounded to one side. It can also be called double bullnose bricks. They have the same use as bullnose, but they only give additional roundness. |
|------------------|--|

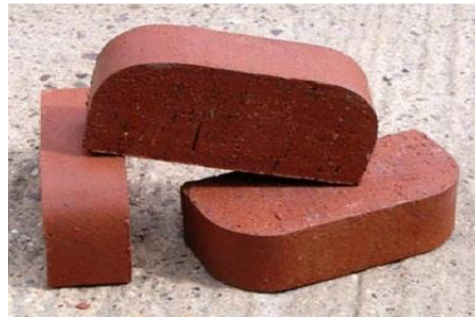


Table 3.1.2 Shapes of Bricks

3.1.6 Types of Bond Used in Brick Masonry

1. Stretcher Bond

In a stretcher bond pattern, all the bricks are positioned as stretchers along the wall's faces. This particular bond type is most suitable when constructing walls with a thickness of half a brick. In the stretcher bond, the bricks are placed in successive stretcher courses, while attention must be given to stagger the vertical joints.

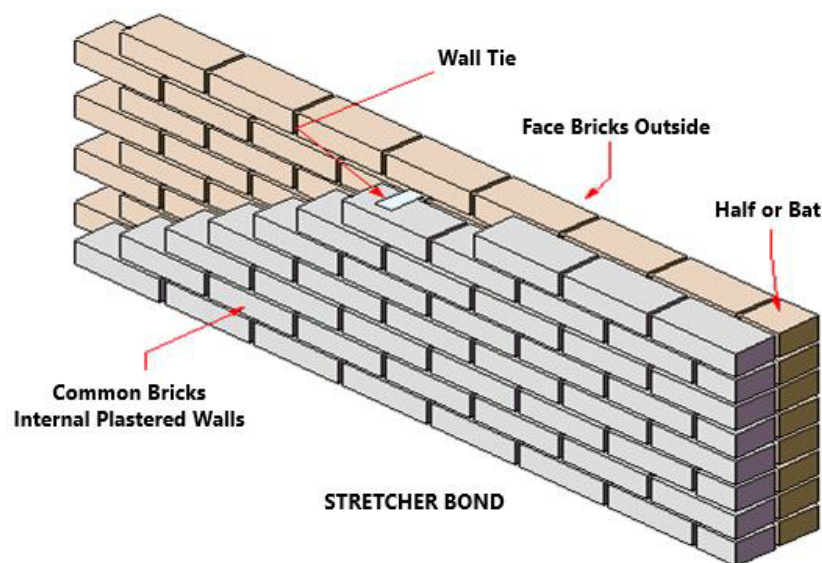


Fig. 3.1.15 Flemish Bond

2. Header Bond

In a header bond arrangement, all the bricks are positioned with their headers (short ends) facing outwards on the wall's surface. This type of bond is typically well-suited for constructing single-brick walls.

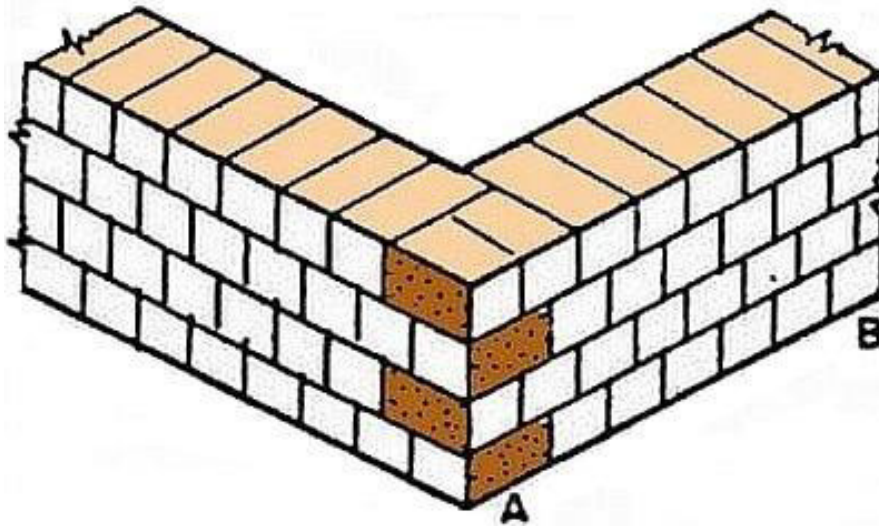


Fig. 3.1.13 Header Bond

3. English Bond

English Bond is a prevalent masonry technique where successive courses consist of alternating headers and stretchers. This bonding pattern is widely utilized and adaptable to various wall widths. Its reputation stems from being one of the sturdiest bonds available.

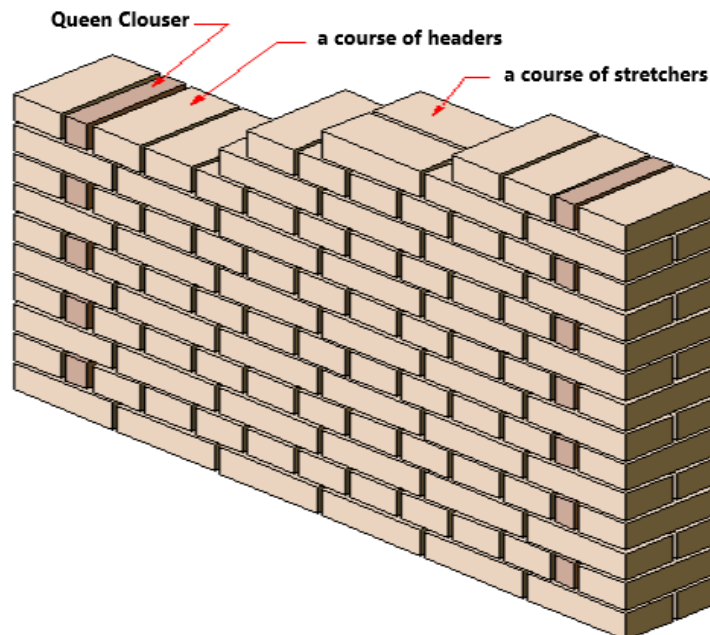


Fig. 3.1.14 English Bond

4. Flemish Bond

In Flemish Bond, every layer of bricks consists of a pattern where a header brick is followed by a stretcher brick, and vice versa. The header bricks in each layer are positioned directly above the stretcher bricks beneath them, with central support. Additionally, each alternating layer begins at the corner with a header brick.

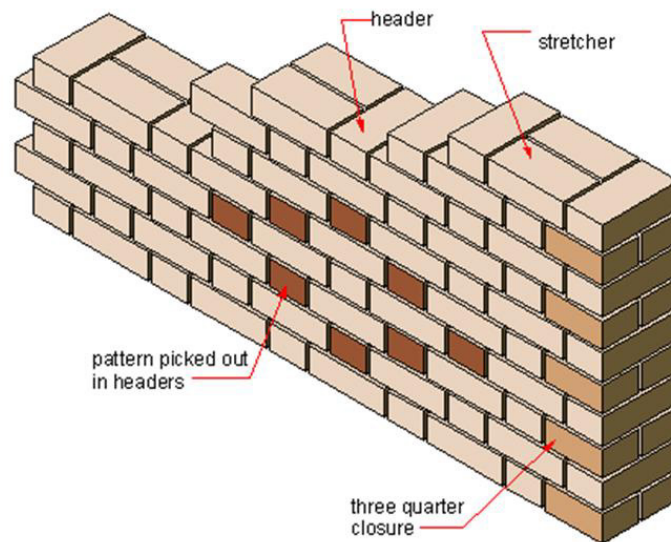


Fig. 3.1.15 Flemish Bond

3.1.7 Quality Check for Assessing Bricks

Bricks are the foundation of a building and therefore it is important to check their quality before using them. If the quality of the bricks used in the structure is of inferior quality, it can lead to immense damage. There are various tests that we can conduct to check the quality of bricks. They are as follows:

1. **Water Absorption** – In this test approximately 5 bricks are taken and weighed when they are dry. After this, the same bricks are soaked in water for 24 hours and weighed again. The weight after being soaked in water for 24 hours should not exceed over 20% of the average weight of dry bricks.



Fig. 3.1.16 Water Absorption

2. **Visual inspection** – Here the bricks are examined closely. Quality bricks should be uniform in shape i.e. rectangular shape with sharp edges.



Fig. 3.1.17 Visual Inspection

3. **Efflorescence** – This test should take place in a well-ventilated room. A brick will be placed vertically in a dish where 2.5 cm of the brick will be immersed in distilled water. Water is allowed to be absorbed and then evaporated from the brick. After water has evaporated and the brick looks dry, it is again immersed in the same quantity of water and is again left for the water to be evaporated. After this, the bricks are examined.



Fig. 3.1.18 Efflorescence test of bricks

4. **Dimension** – At random, 20 bricks are checked their length, height, and width. These dimensions should be measured in batches that these bricks have been produced. Variations in dimensions should be allowed only in narrow limits.



Fig. 3.1.19 Dimension measure of bricks

- 5. Hardness** – A finger nail is used to make a scratch on the brick for this test. If there is no impression left on the brick, it is treated as sufficiently hard.



Fig. 3.1.20 Hardness Check

6. **Soundness** – Here, 2 bricks are taken and are struck against each other. A good quality brick will not break.



3.1.21 Soundness Test

7. **Structure** – A brick is broken and the structure is examined. It should be free from defects such as holes, lumps, etc.

3.1.8 Water Cement Ratio

Water–cement ratio is the ratio of the weight of water to the weight of cement used in a concrete mix.

- If the water cement ratio is low, it increases the strength and durability, but reduces the workability of the mix.
- Addition of additional water may increase workability but effects the durability and strength of concrete.
- Hence, the use of admixtures named plasticizers and super- plasticizers reduce water requirement and make concrete strong and workable.
- Water-cement ratios of 0.45 to 0.60 are more typically used.
- Plasticizers are added to increase flow ability in high strength concrete where water cement ratio is low.
- Increase in amount of water causes segregation of concrete components like sand and aggregates from the cement paste.
- A concrete mix with too much water reduces the strength of concrete causing shrinkage leading to internal cracks and visible fractures (particularly around inside corners).

3.1.9 Preparatory Procedure before Beginning Brick Work

The preparatory procedure before beginning brick work is as follows:

| Steps | Images |
|---|--|
| <p>Step 1</p> <p>Wear the safety equipment.</p> <p>You should wear the following safety equipment: Boots, Safety Jacket, Gloves, Helmet, Goggles</p> |  |
| <p>Step 2</p> <p>Perform the following tasks before beginning with the procedure:</p> <ul style="list-style-type: none"> • Wear the safety equipment. • Gather the materials and tools needed. • Mark and clean the job site. • Select the bricks. • Soak the bricks. • Prepare the mortar. • Pour the mortar on the surface. |  |
| <p>Step 3</p> <p>Locate and clean the job site.</p> <ul style="list-style-type: none"> • Locate the job site and the reference points from where you need to build the brick wall. • Then, clean the site. <p>Note: Take care not to inhale the dust.</p> <p>Tip: Preferably use a nose mask.</p> |  |

Step 4

Select the bricks.

- From the construction site, pick the clay bricks with sharp edges and uniform size. Discard the over burnt or under burnt bricks.

**Step 5**

Stack the bricks.

- To save your time and effort later; stack a set of bricks on the job site.
- Put another or the required number of stacks along the job site.

**Step 6**

Soak the bricks.

- Remember that bricks absorb too much moisture from the mortar. To prevent this, soak the bricks in the GI bucket for two hours before beginning the work

Note: It is advisable to avoid inhaling dust particles during mixing/handling of dry mortar.



Step 7

Prepare the mortar.

- Take a mortar pan
- Collect all dry material in it
- Mix all the dry material until you get a uniform colour

Note: Take care to avoid mixing more mortar than that is needed. It leads to wastage and cleaning the mortar from mixing container creates problems. Also, disposing off hardened mortar creates problems.

**Step 8**

- Make a heap.
- Make a depression on the top in the heap.
- Start pouring water from the top of the depression.

Note: It is advisable to avoid inhaling dust particles during mixing/handling of dry mortar.

Remember if the mortar is too wet, you will make the brick sag. If the mortar is too dry, you will find it difficult to “set” the brick in the mortar bed. Therefore, the mortar should be kept workable enough to aid in ease of placing and spreading with a trowel. If required more water can be added while mixing and placing of mortar.



Mix these wet materials until you obtain a uniform colour.



Table 3.1.3 Preparatory procedure before beginning brick

3.1.10 Procedures to Construct English Bonds

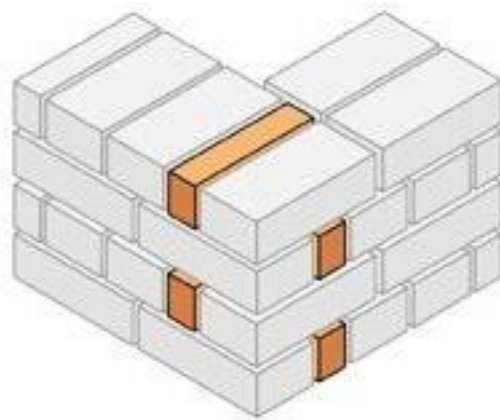
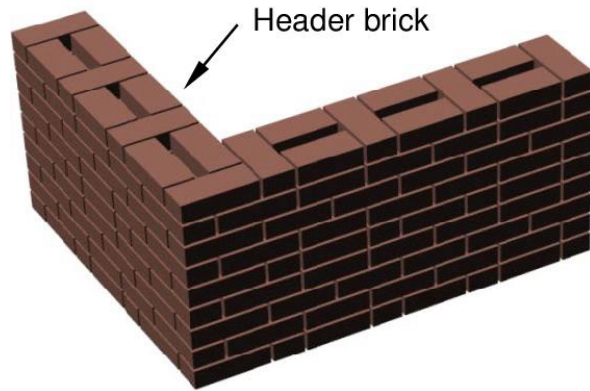
The procedure is as follows:

| Steps | Images |
|---|--|
| <p>Step 1</p> <p>Lay the bricks in a stretcher course.</p> <ul style="list-style-type: none"> • Set the bricks in the mortar bed as headers. • Behind this row, set another row of bricks in the mortar bed as stretchers. • With the handle of the trowel, tap the brick down on the mortar bed, so that it is levelled and parallel to wall and edge is in plumb. • Use the edge of the trowel to cut away the excess mortar that is shoved out from under the brick as you go. • Use the spirit level to check the evenness of the surface. |  |
| <p>Step 2</p> <p>Apply the mortar on the brick layer.</p> <ul style="list-style-type: none"> • Pour the mortar on top of the brick layer. • Flush all the joints. • Fill the joints with mortar. • Make sure there are no cavities left in between. • Use the spirit level to check the evenness of the surface. |  |

Step 3

Lay the bricks in a header course.

- Set a brick at the beginning of the course as a header. Technically, this is called quoin header.
- Cut a brick into half of its length. These portions are called queen closers.
- Set the queen closer next to the quoin header to develop a face lap.
- Lay the bricks alongside the queen closer in a header course.
- With the handle of the trowel, tap the brick down on the mortar bed, so that it is levelled and parallel to wall and edge is in plumb.
- Using the edge of the trowel, remove excess mortar that comes out from under the brick as one go.
- Use the spirit level to check the evenness of the surface



Queen Closure

Step 4

Repeat this process of laying the alternative courses of bricks in stretchers and headers up to 3 feet.

Table 3.1.4 Procedures to Construct English Bonds

3.1.10 Procedures to Construct English Bonds

The procedure is as follows:

| Steps | Images |
|---|--------|
| <p>Step 1</p> <ul style="list-style-type: none"> • Lay the first course as headers alternated by a pair of stretchers. • Set a brick at the beginning of the course as a header. Technically, this is called quoin header. | |

- Cut a brick into half of its length. These portions are called queen closers.
- Set the queen closer next to the quoin header.
- Lay a pair of stretchers next to this queen closer.
- Repeat alternating the header with a pair of stretchers.
- Use the mason's square to check the angles of the corners.
- Pour the mortar on the brick layer.
- Flush all the joints.
- Ensure there are no cavities in between the joints.
- Level the surface.
- Use the spirit level to check the evenness of the surface.



Step 2

Lay the second course as a pair of stretchers alternated by headers.

- Set a pair of stretchers.
- Alongside these stretchers, set a header.
- Repeat alternating a pair of stretchers with a header.
- Remember to use the queen closer at the end of the courses, if required.
- Use the plumb to check the edges.
- Spread mortar on the brick layer.
- Flush all the joints.
- Ensure there are no cavities in between the joints.
- Level the surface.
- Use the spirit level to check the evenness of the surface.



Step 3

Repeat the pattern in other courses.

- Repeat laying the headers and the stretchers with a quoin header and queen closer, followed by another course with just stretchers and headers.
- Once you have finished the second course,
- Lay the next course as headers alternated by a pair of stretchers, followed by another course with a pair of stretchers alternated by headers.
- A 9-inch wall with a Flemish bond has been constructed.



Table 3.1.5 Procedures to Construct Flemish Bonds

3.1.12 Constructions of Wall Junction and Corners in Brickwork

Wall junction is a technical term given to the region along which one wall joins another. Types of Wall Junction

The two types of wall junctions are:

- Corner Junction:** A corner junction means the region along which the end of one wall joins that of another. Typically, a corner junction is formed when one full brick wall joins another.

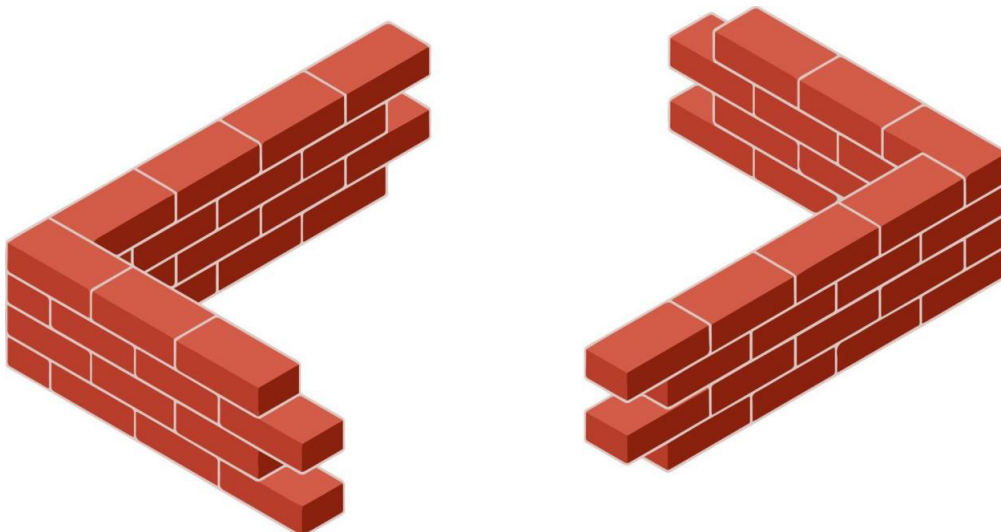


Fig. 3.1.22 Corner Junction

b. Tee Junction: A tee junction means the region along which the end of one wall intersects the surface of another. Typically, a tee junction is formed when a half brick wall intersects a full brick wall.

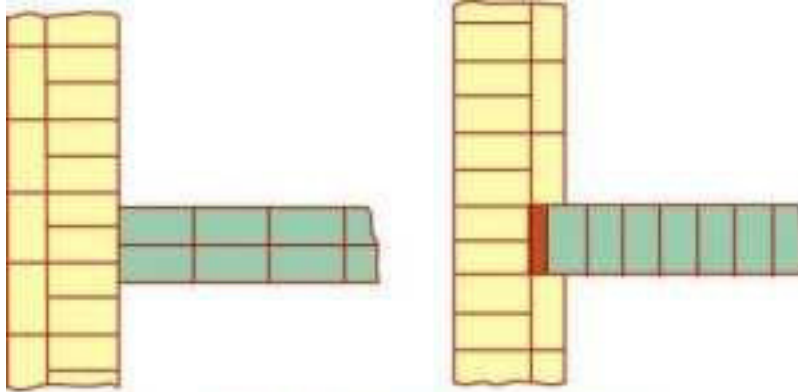





Fig. 3.1.23 Tee Junction

3.1.13 Procedure to Construct a Corner Junction

| Steps | Images |
|--|--|
| <p>Step 1 Set up the mason's line. Set up the mason's line using the nylon thread</p> |  <p>Step 2 Lay the first course of the first wall. Lay the bricks in the first course as headers.</p>  |
| <p>Step 3 Lay the bricks in the corner.</p> <ul style="list-style-type: none"> Lay a queen closer beside a header. <p>Step 4</p> <ul style="list-style-type: none"> Lay the first course of the second wall. closer Lay the bricks as stretchers. Note that you must lay all the bricks with the frogs facing upwards. |  |

**Step 5**

Check the corner formation.

- Use the mason's square to check whether the corner formation is correct.

**Step 6**

Lay and spread the mortar over both the first courses.

- Spread out the mortar along the first course of both the walls.
- Flush and fill all the joints.
- Use the trowel to flush and fill the joints with mortar, without leaving any unfilled gaps between bricks.

**Step 7**

- Lay the second course of the first wall.
- Lay two half bats, one behind other to begin the second course of the first wall.

**Step 8**

- Lay the first course of the first wall.
- Lay the bricks in the first course as headers.

Step 9

- Lay the second course of the second wall.
- Behind the queen closer, lay one stretcher behind another to form the second course of the second wall.
- End the second course of the second wall with a queen closer and a stretcher.



Step 10

- Carry out the checking tasks on the courses.
- Lay the first course of the second wall.
- Lay the bricks as stretchers.
- Note that you must lay all the bricks with the frogs facing upwards.

Step 11

- Repeat the pattern until both the walls are finished and the corner junction is formed.
- Note that the corner junction is formed by the combination of a header and queen closer in successive courses, one laid across the one below.

Table 3.1.6 Procedure to Construct a Corner Junction

3.1.14 Procedure to Construct a Tee Junction

| Steps | Images |
|--|--|
| <p>Step 1 Set up the mason's line.</p> <p>Step 2 Prepare the mortar bed.</p> <ul style="list-style-type: none"> • Spread the mortar along the path of the half-brick wall. | <p>Step 3 Lay the first course of the half brick wall.</p> <ul style="list-style-type: none"> • Lay the bricks in a single row of stretchers. |
| <p>Step 4 Lay the first course of the full brick wall.</p> <ul style="list-style-type: none"> • First spread the mortar to one side of the half brick wall. • Then, lay the bricks as pairs of stretchers. Then, repeat these actions on the other side. | |

Step 5

Carry out the checking actions.

- Check the horizontal evenness of the bricks with the spirit level.
- Check the vertical straightness of the courses with the plumb.

**Step 6**

Spread the mortar upon the bricks of the first course.

- Spread the mortar on the bricks of the first course of both the walls.
- Flush and fill all the joints.

**Step 7**

Lay bricks upon the intersection.

- At the intersection of both the walls, lay a pair of stretchers between two headers, as shown.

**Step 8**

Lay the second course of both the walls.

- Lay the second course of the half brick wall with stretchers.
- Lay the second course of the full brick wall with headers, placing queen closers near the end.

**Step 9**

Repeat the pattern.

- Repeat the pattern until both the walls are completed and the tee junction is formed.
- Note that the tee junction is formed in one course by the half brick wall running



Table 3.1.7 Procedure to Construct a Tee Junction

3.1.15 Construction of Curved Wall in Brickwork

Curved brickwork is constructed in modern buildings to provide semi-circular, segmental and elliptical curves.

It is important to set out and plot curve points for construction of curved walls.



Fig. 3.1.24 Curved Wall

The following three methods are used construct curved brickwork:

1. **Moulds or full templates:** This is used in construction of windows. This process utilizes wooden templates and moulds made as per specification .They are made to give line and curvature of outer face of wall.
2. **Small templates:** This method is used for wall with large radii. After contrition of the first course using full template or trammel method, line level points are marked around the curve. Each course of brickwork, levelled horizontally with main wall, is placed in bond at these points. These points are then plumbed vertically from the first course.
3. **Trammels:** A trammel is a tool used for both faces of wall. A trammel is a wooden/steel batten 20-25mm set in wooden peg or concrete block.

The trammel is constructed by drilling hole in one end of trammel which can be placed over the mild steel rod, and a point is cut at the other end. The pivot is fixed in vertical plumb

The level of the curve is given by swing of the trammel and courses of brickwork are laid horizontally.

Method of Construction of Curved Wall

1. Plot key curve points on the slab/ground using trammel or other specified method.
2. Mark the curve of the wall using suitable tool.
3. Mix mortar in required specification and spread it over established wall location.
4. Lay first course of bricks/blocks as per specified bond according to specifications.
5. Lay first course of brick/block maintaining uniformity of joints and adhering to tolerance levels.

6. Check and ensure line plumb of vertical face of curved wall.
7. Cut bricks as per specification and lay them along length of the wall as per profile of the wall.
8. Lay more courses of brick/block with perpendicular joints maintained in uniform line.
9. Remove excess mortar from wall surface.
10. Carry out raking of joints as per requirement.
11. Finish the mortar joints as per specification.
12. Clear work area upon completion of task.
13. Check and ensure tools and equipment are cleaned and stored as per standard work practices.

3.1.16 Procedure to Frame Windows/Doors in Brick Wall

Door and window openings consist of three basic parts: head, sill and jamb. This also includes a lintel placed above the opening which acts as support for bricks over the open space.

Steps to frame window/door in brick wall are:

1. Wear the safety equipment.
2. Gather the materials.
3. Prepare the frame
4. For preparation of sill surface, a bed of mortar needs to be spread on the surface where frame is to be placed.
5. Fix the frame and hold it in position supporting it with braces when wall reaches window height or at floor level for a door.
6. Check for line, level and plumb.
7. After laying each course or two courses of bricks, check the line, level and plumb. Walls along the frame exert pressure on frame keeping it in position.
8. Prior to fixing bricks over the lintel, the lintel is provided support with a mullion (a wooden post 5 to 10 cm wide). This mullion should be left in place till the completion of wall.

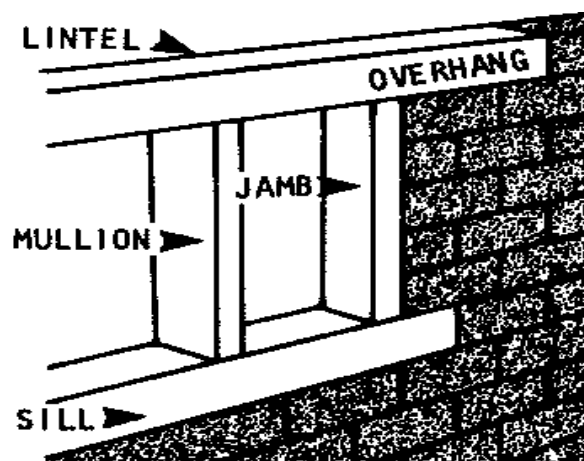


Fig. 3.1.25 Framing windows and doors in brick wall

3.1.17 Curing of Brick Masonry

Importance of Curing

If a slab is not cured well, then, it will develop cracks and eventually break. The cracks occur as a result of build-up of heat caused by reaction of cement with water. This is called the heat of hydration. Curing absorbs this heat and removes it away from the surface.

Therefore, curing is needed to:

- Absorb the heat of hydration
- Reduce the shrinkage of concrete that occurs due to this heat
- Provide water, which is absorbed by the concrete, thereby strengthening it

Methods of Curing Concrete

The methods of curing vertical and horizontal surfaces are almost the same. Spraying water and using wet coverings are the usual methods of curing vertical surfaces. The suggested methods of curing horizontal surfaces are:

- Spraying
- Ponding
- Covering with moist earth, sand or wet gunny bags
- Curing for Vertical Concrete Surfaces
- Spraying water by means of a hose is the most effective and convenient way of curing vertical surfaces.
- Cover the concrete surface with wet gunny bags when there is not enough water for curing by spraying.



Fig. 3.1.26 Curing vertical surfaces

Curing for Horizontal Surfaces

- When spraying water on horizontal concrete surfaces, it is better to let the water fall in one place and let it flow all over the surface.

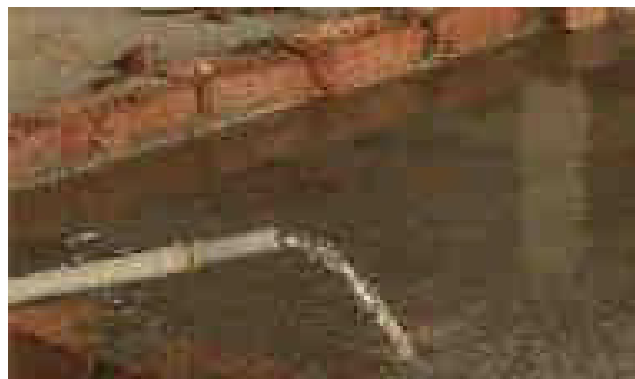


Fig. 3.1.27 Curing horizontal surfaces

Ponding

- Ponding is the preferred method of curing surfaces like slabs. Form a boundary with bricks around the area to be cured. Then pour water in the boundary. Thus, a 'pond' is created, that supplies ample water to the horizontal concrete surface.

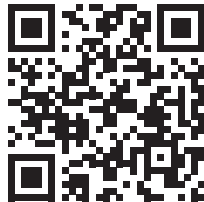


Fig. 3.1.28 Ponding

Notes 

QR Codes

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<https://youtu.be/Eo4JqJaTkHY>

Tools and Equipment's for brick and stone wall
Construction

Unit 3.2: Staircases

Unit Objectives

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

1. Describe the technique of marking and layout of tread and risers for the staircase.
2. Explain the process of laying and fixing bricks in the staircase.
3. Demonstrate set out of tread and riser and building of small staircase maintaining bond, alignment and plumb.

3.2.1 Staircases and its uses

A stair is structure used for connecting different floors of the building. It set of steps arranged in way to connect vertically with different floors of a building. An enclosure in which stairs are placed is called staircase.

- Stair case should be made of fire resistive material for protection.
- It should bear live and dead load correctly
- It should not fail or dislocate from position due to loads.
- It is used both for emergency stair case and front face stair case in the auditoriums, conference halls etc.
- It is necessary to have at least one stair case in a building for emergency exit.

3.2.2 Different Types of Staircases

Stairs are of different shape as per the requirement. There are different type of stairs based on their shape:

Stairs are classified into the following types

1. Straight Stairs

In this type, stairs directly connect two floors and do not change direction between successive floors. These are present in small houses.

Straight stairs can be of following types.

- Straight run with a single flight between floors
- Straight run with a series of flight without change in direction
- Parallel stairs
- Angle stairs
- Scissors stairs



Fig. 3.2.1 Straight Stairs

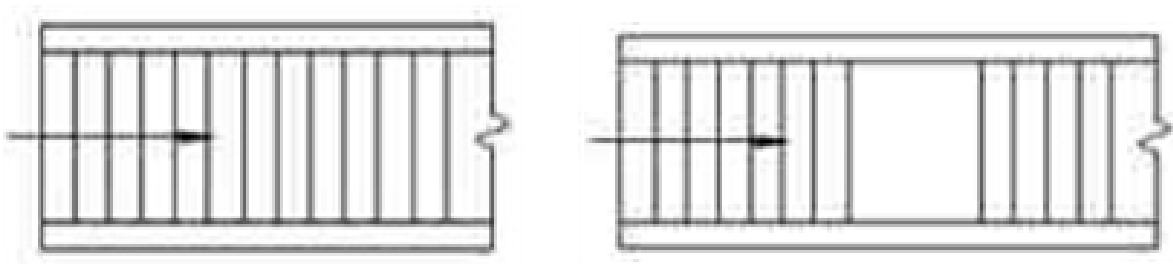


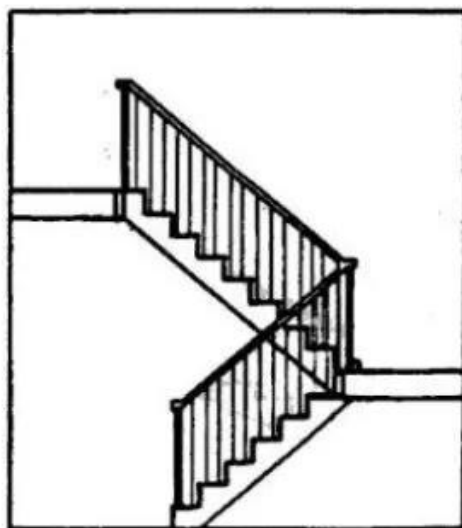
Fig. 3.2.2 Straight run with a single flight and Straight run with a series of flight

2. Quarter Turn Stairs

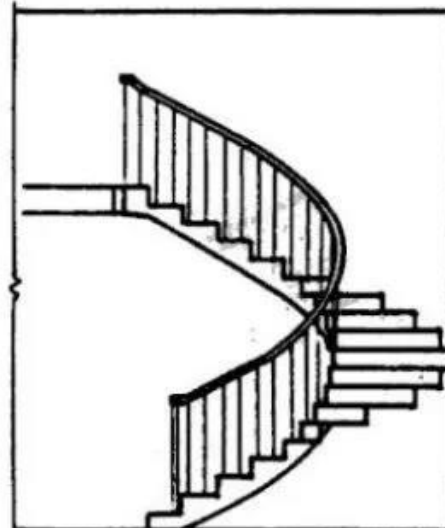
They are provided when the direction of flight is to be changed by 90°.



Fig. 3.2.2 Straight run with a single flight and Straight run with a series of flight



Section G.G.



Section H.H.

Fig. 3.2.3 Quarter Turn Stairs

3. Half Turn Stairs

These stairs change their direction through 180° . They can be:

- Dog-legged type
- Open newel type

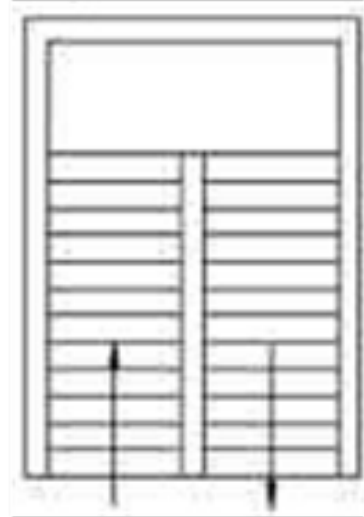


Fig. 3.2.4 Half Turn Stairs

4. Three Quarter Turn Stairs

These types of stairs change their directions through 27° .

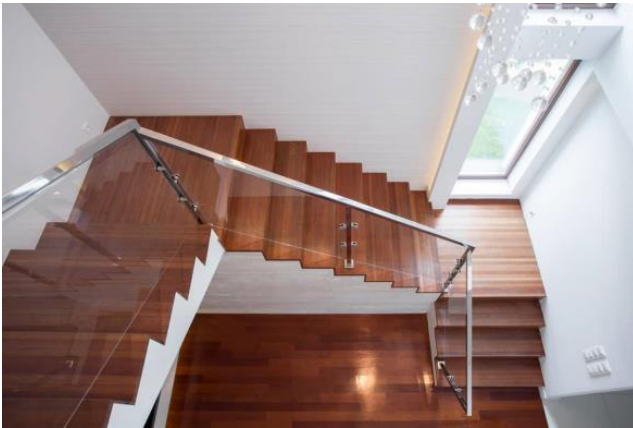
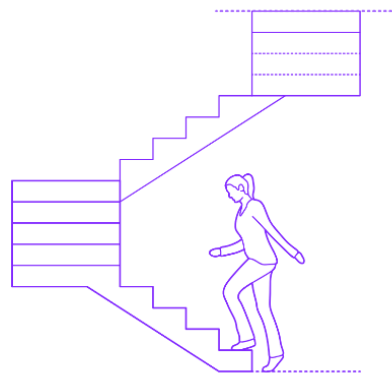


Fig. 3.2.5 Three Quarter Turn Stairs

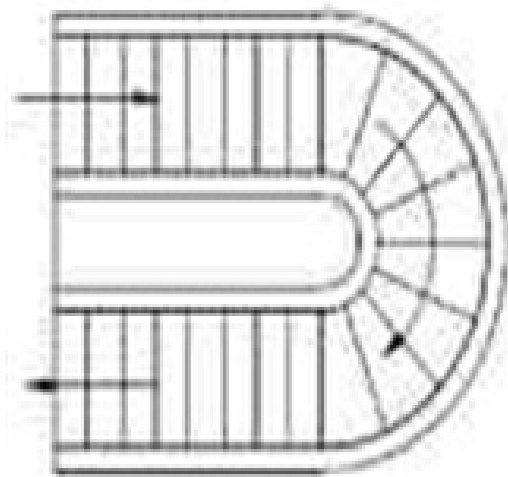


5. Circular Stairs

These stairs are made mostly from cast iron, R.C.C, metal and stone. They are constructed where space is limited and appear circular. They are used as emergency stairs in buildings.



Fig. 3.2.6 Circular stairs



6. Spiral Stairs

These stairs are similar to circular stairs but they have smaller radius of curvature (radius ranges from 2m to 5m) and may be supported at the centre by a centre post.



Fig. 3.2.7 Spiral Stairs

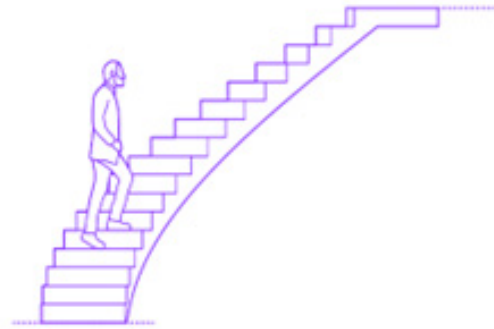


7. Curved Stairs

They are used for aesthetic purpose. These stairs, are circular when viewed.



Fig. 3.2.6 Circular stairs



8. Geometrical Stairs

These stairs have a geometrical shape and do not have a newel post. The construction of this type of stairs requires high skills. Any change in direction is done through winders.



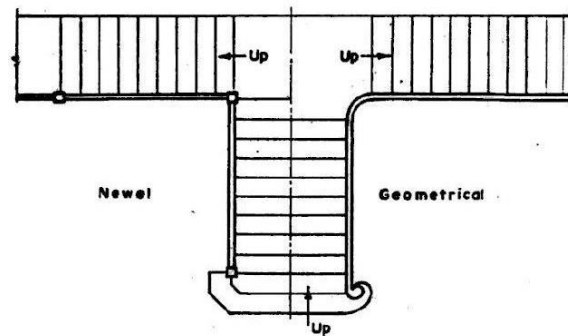
Fig. 3.2.6 Geometrical Stairs

9. Bifurcated Stairs

These stairs are used in modern building big in size. This has a wide flight at the start/bottom and bifurcates into left and right narrow flights at the mid-landing.



Fig. 3.2.7 Bifurcated Stairs



3.2.3 Different Components of Staircases

1. **Step:** It permits ascend and descend having treads and risers. A stair comprised of a set of steps.
2. **Tread:** It is the horizontal portion of the steps upon which the foot is placed.
3. **Riser:** It is the vertical portion of step which provides support to the tread.
4. **Flight:** It is the unbroken series of steps between the landings.
5. **Landing:** It is the levelled platform having no tread and risers between the top and bottom of a flight and is situated between the floors. It facilitates change of direction and provides opportunity for taking rest during the use of stair.
6. **Rise:** It is the vertical distance between the two successive tread faces and is normally kept half of the going distance for easy access.
7. **Going:** It is the horizontal length between the two successive riser faces.
8. **Nosing:** It is the projection of the tread beyond the riser face which is mostly used for providing complete coverage for footing.
9. **Scotia:** It is the support provided under nosing for improving elevation of steps and also provides strength to the nosing. It may or may not be present in a stair case.
10. **Line of Nosing:** It is the imaginary line which is parallel to the strings and tangential to the nosing. It's useful for getting a level for constructing hand rail.
11. **String or Stringers:** These are the sloping member which supports the steps in a stair.

3.2.4 Different Steps in Construction of Staircases

4. Measure the height of the area where you will install the stairs.
5. Divide the total rise by the typical rise per step.
6. Divide the total rise by the number of steps to get the actual rise per step.
7. Establish the run of each step to get the total run of the staircase.

DOs

- The stairs should be constructed of sound material and with good workmanship
- The width of the stairs should be sufficient for two persons to pass on it simultaneously and for furniture to be carried up and down the stair
- The staircase in a residential building should not have a rise of more than 230 mm and a going of less 230 mm.
- For commercial building it is desirable to have a rise of not more than 180 mm and a going of not less than 270 mm.
- In ideal condition rise should be 150mm and going should be 300mm.
- The stairs should be located at a well-lighted and well ventilated place.
- Don'ts
- Do not provide a flight with more than 12
- Do not use combustible material for lining of wall and ceiling of staircase

Unit 3.3: Paver's Block

Unit Objectives

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

1. Demonstrate fixing of paver blocks

3.3.1 Paver's Block

Interlocking Concrete Block Pavement (ICBP) is used as replacement for conventional hot bituminous mix and cement concrete mix. This is extensively used where conventional construction of pavement is not feasible.

Concrete paver blocks are used for creating decorative pavement, driveway, town centres road surfacing etc. They are laid in different patterns to obtain different aesthetic finish. These paver blocks are of different shape, size and colour. These are made of brick, stone and concrete as per the requirement.



Fig. 3.3.1 Paver's Block

- Paver blocks are of different shapes and colour.
- They are similar in size to the bricks
- When these are produced in factories for mass scale construction, their quality and size is accurate
- and consistent.
- The quality of paver blocks affects the durability of the constructed pavement.

3.3.2 Types of Paver Blocks

1. **Regular paver blocks:** Regular paver blocks: These are the common ones which are seen installed in public places like parking, foot paths, railway stations etc.



Fig. 3.3.2 Regular paver blocks

2. **Clay paver blocks:** Clay paver blocks, known for their eco-friendly properties, are predominantly employed in the construction of walls or pillars. These entities are alternatively referred to as bricks. The product is offered in a variety of natural hues, and its colour remains resistant to fading over time. Furthermore, individuals have the ability to personalise the form while selecting clay paving stones.



Fig. 3.3.3 Clay paver blocks

Fig. 3.3.3 Clay paver blocks

3. **Concrete paver blocks:** Concrete paver blocks: Available in many colours, concrete blocks come in both, smooth and rough surfaces. They are mostly used in places that support heavy load. They

are the preferred choice when it comes to constructing a pavement. Note that the colour can fade from concrete blocks.

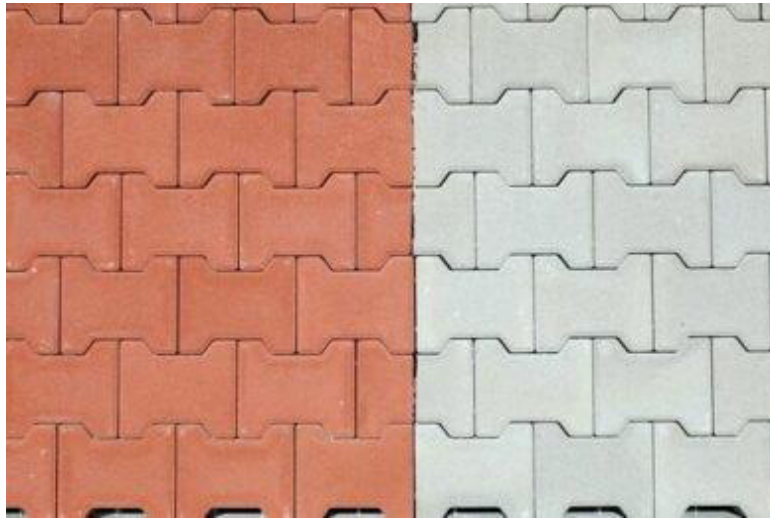


Fig. 3.3.4 Concrete paver blocks

- 4. Plastic paver blocks:** Plastic paver blocks are manufactured from recovered waste plastics, so rendering them environmentally sustainable.



Fig. 3.3.5 Plastic paver blocks

- 5. Rubber paver blocks:** Rubber paver blocks are commonly employed in various settings such as playground flooring and swimming pool decks due to its composition of recycled rubber materials..



Fig. 3.3.6 Rubber paver blocks

- 6. Permeable paver blocks:** Permeable paver blocks: These are heavily used in garden and backyards as they allow the water between them to drain.

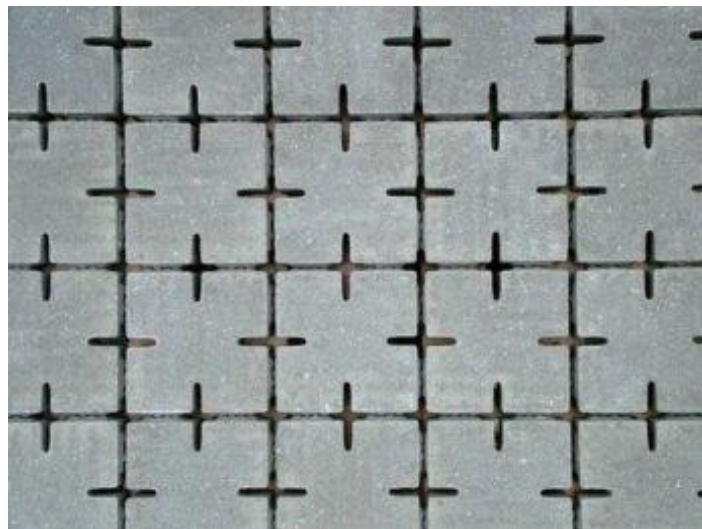


Fig. 3.3.7 Permeable paver blocks

- 7. Stone paver blocks:** Stone paver blocks are composed of densely packed stone and sand, and are manufactured by the process of cutting naturally occurring stones.



Fig. 3.3.7 Stone paver blocks

3.3.3 Procedure for Laying the Paver Blocks

The steps to be followed for laying the paver blocks are:

Step 1: Mark out the place to lay the pavers, using either chalk or string.

Step 2: Dig the marked site with an appropriate tool like garden shovel up to the required depth, taking allowance for paver depth. (addition of 5 inches).

Step 3: Ensure the edges of the site which is excavated should be straight, vertical and uniform as possible.

Step 4: To provide drainage and a sturdy foundation to the paver blocks, gravel is spread at the bottom of excavated space. This layer of gravel is approximately around 3 inches thick.

Step 5: Spread, level and compact the gravel with tamping tool.

Step 6: Cover the gravel with a sheet of landscaping fabric or weed cloth. This is done to avoid growing of weeds and other vegetation in between your pavers.

Step 7: Spread bedding sand of specified gradation over the landscaping fabric.

Step 8: Lay the paver blocks over the bedding sand.



Fig. 3.3.8 Laying pavers blocks

Step 9: Fill the joints between the pavers with gravel.



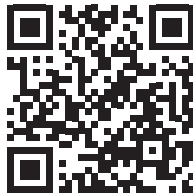
Fig. 3.3.9 Filling joints between pavers blocks

Notes



QR Codes

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https://youtu.be/8PpXhwq_0Hk

Installation Process of Concrete Paver Block

Unit 3.4: Arches

Unit Objectives

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

1. Describe the different components of the arch and their terminology.
2. Explain the process of laying and fixing bricks in arches providing keystones, levelling and aligning appropriately.
3. Explain the importance of providing proper joint spacing and gauging in arches.
4. Demonstrate installations and fixing of arch elements for building arches.
5. Demonstrate building of arches, cutting creepers around corners and filling of joints for arches.

3.4.1 Arches and their uses

Brickwork arch creates the visual feeling to the building. Brickwork arches lend aesthetic appeal to the building. Various types of arches are constructed using bricks which increase the aesthetics of a building. In building design, Romans first adopted the structural capabilities of an arch.



Fig. 3.4.1 Arches

The most important element of brickwork arches is:

- The structural integrity
- The importance as a support

A brickwork arch consist of individual bricks bonded in mortar. The load is transferred both; sideways and downwards.

3.4.2 Components of Arches

In architecture and construction, an arch is a curved structural element that spans an open space. It is designed to support loads and distribute them downward and outward along its curved shape, effectively transferring the weight to its supporting elements. The primary components of an arch include:

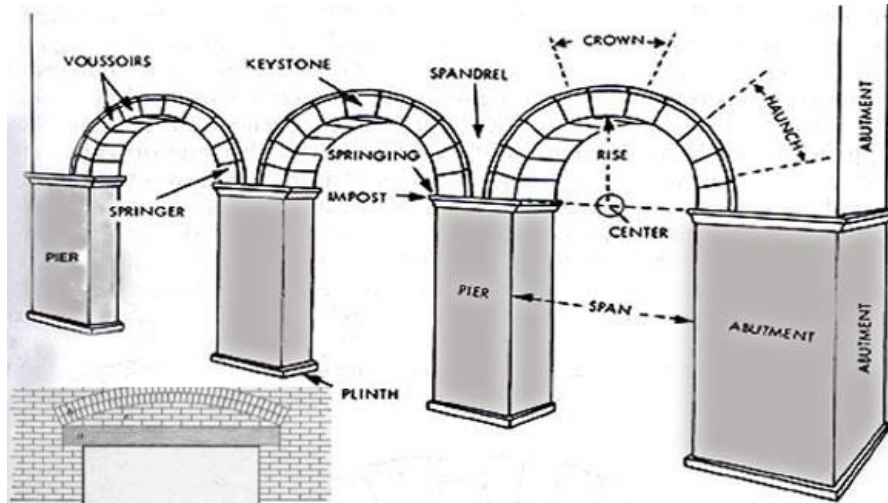


Fig. 3.4.2 Components of Arches

- **Vousoir:** A voussoir is a wedge-shaped element, typically a stone, used in building an arch (A voussoir used in building an arch is a wedge shaped element, typically a stone)
- **Springer:** The springer is the lowest voussoir on each side, located where the curve of the arch springs from the vertical support or abutment of the wall or pier.
- **Abutment:** The structure supporting one side of an arch
- **Crown:** The apex of the arch's extrados.
- **Skewback:** The surface on which the arch joins the supporting abutment.
- **Springing:** The point where the skewback intersects the intrados.
- **Pier:** A pier, in architecture, is an upright support for a structure or superstructure such as an arch
- **Keystone:** A keystone is the wedge-shaped stone piece at the apex of a masonry arch
- **Impost:** An impost is a projecting block resting on top of a column or embedded in a wall, serving as the base for the springer or lowest voussoir of an arch.
- **Haunches:** the part midway between the crown and the springing
- **Intrados:** The interior surface of an arch
- **Extrados:** The exterior surface of an arch
- **Rise:** It is the vertical distance between the spring line of an arch and the keystone
- **Span:** The horizontal distance between the two supporting members of an arch
- **Spandrel:** A spandrel is the space between two arches or between an arch and a rectangular enclosure.

3.4.3 Laying and Fixing Bricks for an Arch

The brickwork arches are constructed in following ways:

1. Pointed Shape Arch:

This particular architectural structure consists of two arcs of circles that intersect at a central point, resulting in the formation of a triangular shape. The shape in question has the potential to exhibit either isosceles or equilateral properties. The pointed Shape arch is also commonly referred to as the Gothic arch.

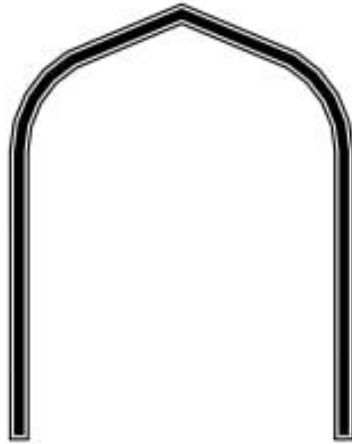


Fig. 3.4.3 Pointed Shape Arch

2. Flat Arch:

The Flat arch, which is derived from the intrados, is characterised by an equilateral triangle shape formed at a 60-degree angle. This type of arch is frequently utilised in the construction of lightweight constructions. Despite the intrados exhibiting a flat profile, the inclusion of a tiny increase in camber, approximately 10 to 15 mm per metre width of the entrance, facilitates the establishment of minor settlements.

The extrados also exhibits a flat and horizontal orientation. Flat arches are frequently employed in situations where the stresses are relatively light and the span does not exceed 1.5 metres.



Fig. 3.4.4 Flat Arch

3. Rough Arch

- Arches constructed using standard bricks are called rough arches.
- It is advisable not to use standard brick in construction of arches as they can cause performance issues in future.
- When standard bricks are used, wide mortar joints are created in arches towards extrados.
- During the design and construction of brickwork arches, the brickwork gauge (uniform joints between bricks) should be kept in mind.



Fig. 3.4.5 Rough Arch

4. Segmental Arches

- Segmental arch construction is most widely and preferred method of arch construction.
- The segments are known as “voussoirs”.
- In this type of construction, each brick is tapered towards the intrados of arches.
- This type of segment provides stability to arches and prevents them from falling out.
- In comparison to rough arches where the strength of arches is dependent on the mortar joint used to key the bricks, the tapered bricks provide the required strength.
- The use of Voussoirs has a greater structural integrity.

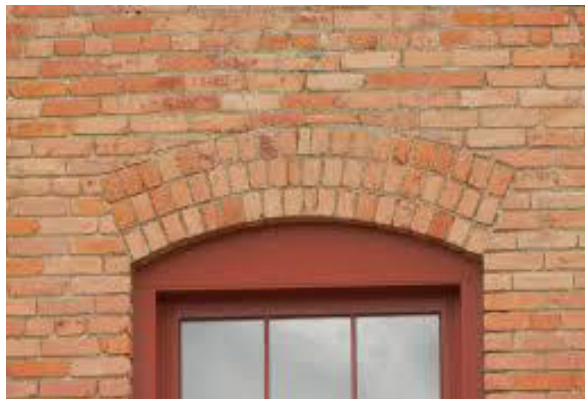


Fig. 3.4.5 Segmented Arch

- The segmented arch is much more vertically than the rough arch.
- The Tapered or Voussoirs bricks can be obtained in pre-designed form from the manufacturer or can be cut by the Bricklayer.
- Purchasing pre- made segments is more beneficial as it will increase the accuracy of the arch and
- easier for the Bricklayer to achieve consistent results.
- Although the cost factor is an initial issue in purchasing the tapered bricks but it is compensated by the amount of time, as the marking and cutting of each brick is time consuming.
- In case many arches are to constructed, to maintain uniformity, it is recommended to purchase bricks for arches.
- This would reduce the construction time considerably as only brick insertion and replacement would be required in an arch.
- The only drawback in ordering pre-cut tapered bricks is the time required in transportation of brick, which could cause delay. In such cases one should cut the bricks individually.

5. Horseshoe Shape Arch:

The architectural feature known as the horseshoe arch, resembling the shape of a horseshoe, is regarded as a significant design element despite deviating from a perfect semi-circular form.



Fig. 3.4.4 Flat Arch

6. Semi Circular Arch:

The midpoint of the semi-circular arch will coincide with the spring line. The vertical thrust exerted on the abutment by the semi-circular arch is transferred.

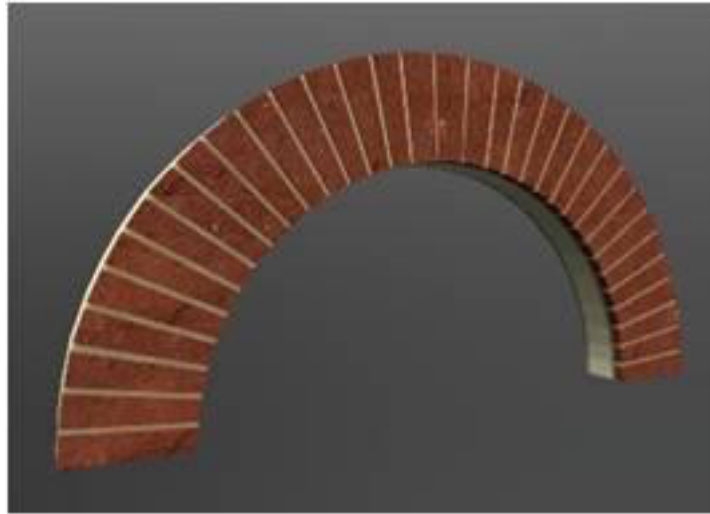


Fig. 3.4.4 Flat Arch

3.4.4 Step Wise Procedure of Laying and Fixing of Bricks in Arches

1. Construct a temporary arch form known as wood centering from plywood and wood spacers.
2. Build the brick masonry all around the opening portion exclusively kept for the arches.
3. Make the predetermined shape of the Arch shell with the help of the wood/plywood duly supported below to support the Arch portion of the brick masonry.
4. Keep the voussoirs or regular bricks thereafter on this wooden Arch properly as per the drawings.
5. Fill the gaps/openings between these bricks and or voussoirs with cement mortar of required portion.
6. Lay the voussoirs in the shape of an Arch which is previously made with the help of ply or wood.



Fig. 3.4.8 Laying Laying of segmented arch

3.4.5 Dos and Don'ts

Dos

- It is advisable to carry out arch construction from both the ends simultaneously and key in centre.
- The joints in the bricks should be thin and uniform and bricks should be flush with mortar.
- Use small size bricks to build the pleasing arch
- When the diameter of the arch is small use two or more rows of bricks in the row locked position rather than one row
- Evenly space bricks on each side of key stones to ensure stability
- Demarcation should be properly carried out and its accuracy needs to be ensured

Don'ts

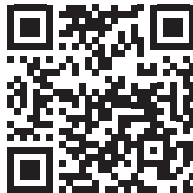
- Do not load the arch till the construction is complete in all respects, including curing for the required number of days.

Notes



QR Codes

Scan the QR code to watch the video



<https://youtu.be/CTZwd58LkR8>

Building Brick Arch Feature Step by Step

Unit 3.5: Manholes

Unit Objectives

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

1. Demonstrate building of manhole as per required drawing as per specifications

3.5.1 Manholes and their Purpose

Manholes are masonry or RCC underground utility chambers.

- Manholes are openings on ground used to access and maintain underground services like public utility, water, sewer, electricity, gas, heating etc.
- They are constructed at suitable intervals along the sewer or drainage lines for providing access into them.
- Manholes act as access points to rectify and repair the various underground services.
- The opening of a manhole is covered by a manhole cover. A lid prevents accidental or unauthorised access to the manhole. The manhole cover can be made of cast iron, concrete, glass reinforced plastic or other composite material.
- The manholes usually have metal steps installed inside the chamber.
- The manholes are generally circular in shape to prevent accidental fall of the cover into the hole.
- In urban areas where public services utilization is maximum, manholes are found in walkways and streets.

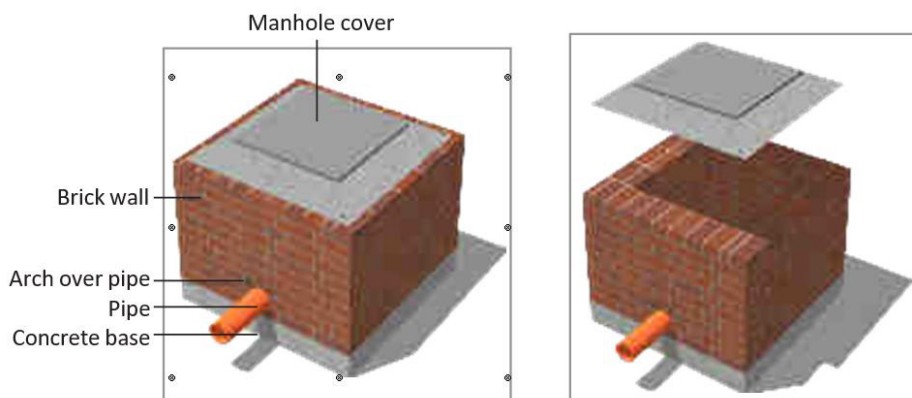


Fig. 3.5.1 Manholes

3.5.2 Procedure for Building Manhole as Per Required Drawing and Specification

Step 1: Determine the Size of the Manhole The size of a manhole depends on:

- the diameter of a pipe.

- the depth between the road level and the crown of the pipe. Shallow manholes come in two sizes:
- Manhole Type A: It is used for small diameter pipes up to 500mm diameter. Size: 900x700mm,
- Manhole Type B: It is used for pipes ranging from 500mm up to 900mm diameter. Size: 1000x1050mm

Step 2: Laying RCC foundation

- On the PCC layer place a reinforcement mesh as shown in the diagram.
- Place concrete spacers for a cover of 40 mm.
- Pour a layer of 150 mm thick concrete on the mesh up to the pipe outlet.

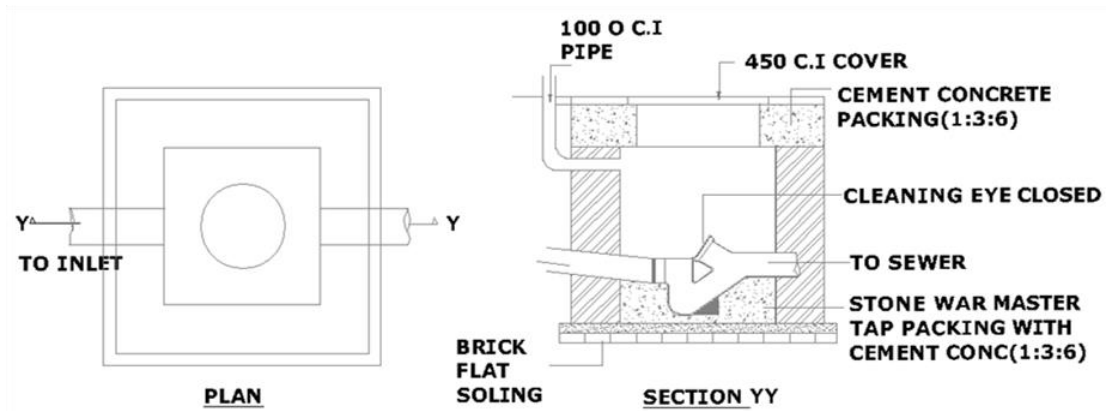


Fig. 3.5.2 Details of inspection chamber

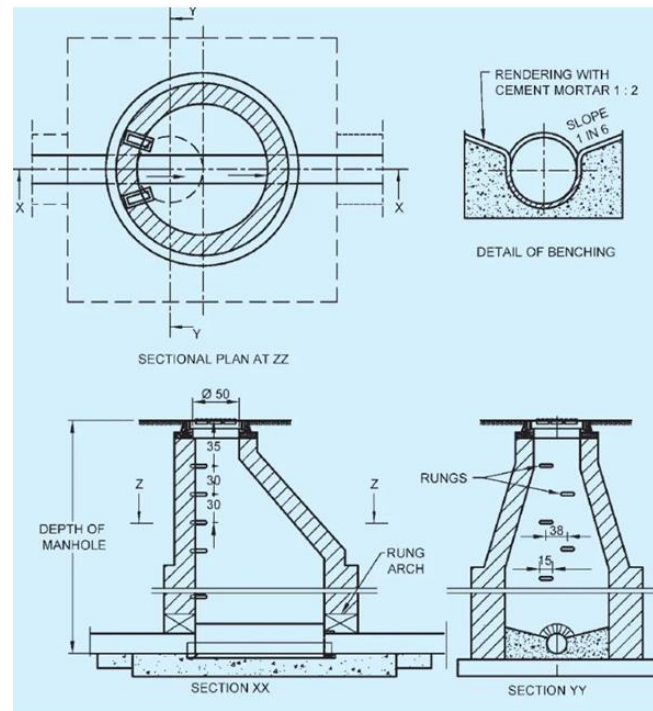


Fig. 3.5.3 Details of round chamber

3.5.3 Dos and Don'ts in Case of Manholes

Dos:

- Top diameter should be minimum 60 cm (24 inches) clear. Bottom diameter as per the depth of the sewer line from ground level.
- Manholes should be located as per the drawing on the proposed main sewer alignment.
- Manholes walls should have appropriate thickness as below:
 - a. Up to 1.8 m depth (38 cm to 23 cm)
 - b. More than 1.8 m depth wall thickness should be minimum 45 cm.
- Frame and cover of manhole need to be precast heavy duty one.
- Manholes must be plastered inside with cement mortar of 1:4 and finished with extra cement.
- Top level of manhole should be same as road level on roads.

Don'ts:

- Workers should not enter the manhole unless minimum amount of oxygen is available inside. This needs to be ensured by smoke test.

Notes

QR Codes

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https://youtu.be/U_g8ZoS8OU8

Manhole - Components & Functions

Unit 3.6 Repair and Restore Brickwork

Unit Objectives

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

1. Describe the various techniques for repairing and finishing brickwork
2. Demonstrate removal of deteriorated elements from old masonry works and reinstallation of bricks to match adjacent surfaces.
3. Demonstrate filling and raking of repaired masonry work.

3.6.1 Different Defects in Brickwork

Defects in Brickwork Enlisted below are some of the common defects in brickwork found at construction site.

- The quality of the bricks is inferior to that specified in contracts.
- Efflorescence test and water absorption test of bricks is not carried out to assess quality of bricks.
- Pre-soaking/pre-wetting of bricks prior to construction is not carried out.
- The brick joints are not uniform and are thicker than required.
- Below ground level brick work was not carried as per specifications as they were hidden below ground after filling of earthwork.
- Gaps exist in brick joints as many joints were left hollow.
- The mortar was not cured properly and failed to gain required strength.
- Joints were raked before to proper setting of mortar.
- Fillers and closures used brick bat instead of cut bricks.
- Mortar mixing not carried out properly on a clean platform.
- The bricks were not levelled properly so brick layer is uneven and out of plumb.
- The brickwork not aligned properly.
- The mortar used is inferior and not as per specification.
- Gaps between door /window frames not filled completely.
- Water used for brickwork was not suitable causing efflorescence.
- Masonry in partition wall is weak as its is done without reinforcement.
- Holes in brickwork left after removal of scaffold, were filled with dry bricks without proper bonding with adjacent surface.

3.6.2 Different Types of Repairs in Brickwork

Brickwork can be repaired by anyone or more of the following methods:

- Filling cracks, crevices joints and junctions with hand packed cement mortar or polymer mortar forcing the mortar to penetrate the cracks, crevices, joints or junctions.
- Guniting the brickwork with cement grout to fill all cracks, hollows, joints and junctions.
- Mortar joints deteriorate because of water soaking like, under windows and walls, at ground level or at any exposed wall top. This water needs to be stopped from getting into bricks and foundation and requires timely repair of mortar joints. Such repairing of worn-away and cracked mortar joints is called pointing, repointing or tuck pointing.

In order to repair and restore eroded joints, proper tools and techniques are to be used.

Professional Pointing is required for:

- Larger-scale pointing jobs
- Repair work at height which requires use of scaffold
- Repair work at area with loose bricks or bricks missing at corners
- Getting appropriate colour match of new mortar to adjacent mortar in a building with high visibility

Repointing Works in Brickwork

Removing of Loose Mortar

- Use a hammer/cold chisel/flat utility chisel to chip out loose mortar from joints.
- Using the chisel, remove 2 cm to 2.5 cm of old mortar for proper bonding. Wear safety glasses and a dust mask while doing this work.
- If bricks loosen up, then remove and reset the mortar.



Fig. 3.6.1 Removing of loose mortar

- In case the mortar is hard, cut the centre of joint and chip the mortar.
- Make relief cuts using an angle grinder with extreme care as the grinder may easily nick and chip the brick. In case joints are too hard, use angle grinder to make cuts in the joints. It is advisable to cut and chip vertical joints first and then the horizontal joints.
- Dust out the joints after removing the old mortar.
- Spray some water lightly to prepare the joints for the new mortar.

Mixing the mortar

Add specified amount of water gradually in the mortar mix while mixing with a brick trowel. Check the consistency of mix by seeing if it sticks to an overturned trowel.

In case it is dry, add water till it sticks to an overturned trowel. The mortar should be workable and not crumbly.

Do not try to revive mortar that's drying out by adding more water to it.

Filling the mortar joints

Steps to follow the pointing techniques:

- Fill the joints fully with mortar so that no voids are there. This ensures water-resistant joints.
- In case the joints are deeper than 2.5 cm, fill them in two steps, letting the first layer harden sufficiently (leaves thumb impression) and then filling the second layer.



Fig. 3.6.2 Repointing in brick work

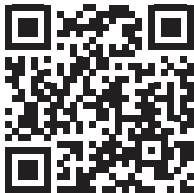
Tips:

- Mix smaller batches of mortar in hot weather and work in shaded areas to avoid drying of mortar.
- Avoid working in temperatures below 10 degrees C.

Notes 

QR Codes

Scan the QR code to watch the video



<https://youtu.be/8WvQpMcEbvA>

How To - Brick Repairs

Unit 3.7: Pointing in Masonry Works

Unit Objectives

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

1. Explain the various pointing in brickwork including Flush pointing, Keyed/grooved pointing, Recessed pointing, Struck pointing etc.
2. Discuss the different mortar mixes used for pointing works.
3. List the various tools used for pointing and raking
4. Demonstrate preparation of pointing mortar and filling of joints with the same to obtain the specified type of pointing using appropriate tools.

3.7.1 Introduction to Pointing

Pointing refers to the finishing of mortar joints in the exposed brick masonry or stone masonry using suitable cement or lime.

Use of Pointing

- Pointing protects the mortar joints from the effects of weather and improves the appearance of the building.
- In new brickwork, for pointing we can apply harder mortar to increase weather protection on exposed faces.
- In old brickwork, pointing is often used to repair mortar joints which have been eroded due to weathering or any other reason of Pointing

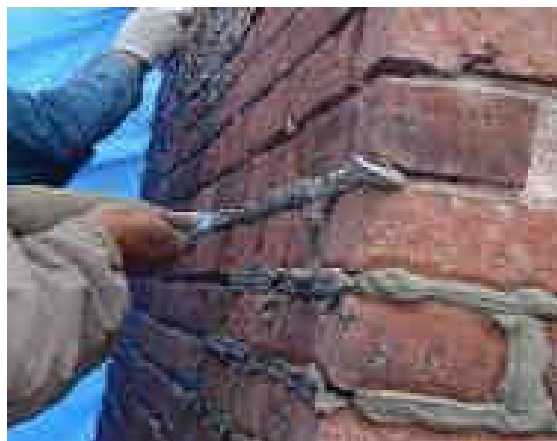


Fig. 3.6.2 Repointing in brick work

3.7.2 Tools used in Pointing Works

Tools used in Pointing

- Stiff brush
- Soft brush
- Pointing trowel
- Pointing bar
- Hose/buckets/plastic drums
- Mortar board
- Wire brush
- Lime
- Sand
- White cement
- Scaffolding



Fig. 3.7.2 Tools used in Pointing work

3.7.3 Mortar used in Pointing Works

Mortar required for pointing work:

Lime mortar of 1:2 (1 fat lime : 2 sand or surkhi) Cement mortar of 1:3 (1 cement : 3 sand)

A range of colours and textures can be obtained by mixing mortar in different proportions.

- **Lime Mix:** Mostly lime mortar is used in pointing. Although the cost of lime mortar is greater than cement mortar, they are beneficial in long run as they not prone to defects because of inappropriate cement mix.
- **Cement Mix:** The use of cement in repointing mixes causes decay and damp earlier than with lime mixes damp more.

As cement mortar is harder and less porous in comparison to lime, its weathering properties increase considerably.

Cement mortar is prone to salt and sulphate attack while lime mortar faces no such difficulty.

3.7.3 Mor 3.7.4 Different Types of Pointing Works tar used in Pointing Works

Types of Pointing

There are different types of pointing such as:

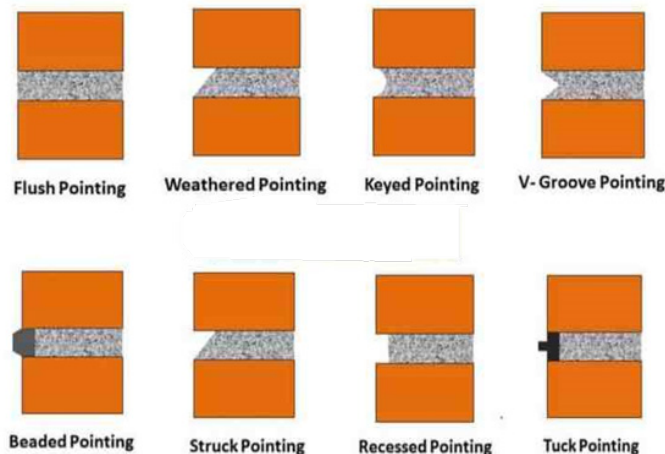


Fig. 3.7.3 Types of pointing

1. Flush pointing:

Flush pointing is a technique commonly employed in masonry construction to create a smooth and seamless appearance between adjacent bricks or stones. This method

During the process of flush pointing, the mortar is inserted and compacted into a mortar joint. Subsequently, the surface is meticulously aligned with the periphery of the bricks or stones, resulting in a seamless aesthetic presentation. The last step involves meticulously cutting the edges with a trowel and a straight edge.

The process of achieving a flush finish in pointing is accomplished by utilising a trowel or a piece of coarse fabric to wipe over the completed pointing. The visual presentation is not satisfactory. However, its durability is demonstrated by its ability to prevent the buildup of dust, water, and other substances. The aforementioned pointing technique is often regarded as the most prevalent method employed in the realm of building construction.

2. Weathered Pointing

In the process of Weathered Pointing, the mortar is applied into a joint and subsequently, while the mortar is in its fresh state, the upper portion of the horizontal joints is meticulously forced back by a distance of 3-6 mm using a pointing tool. The observed appearance exhibits a downward inclination from the upper region of the joint to the lower region of the joint.

3. Keyed Pointing

Keyed pointing is a method of input used in computer systems to control the movement of a cursor or pointer on a display screen.

In the context of these Keyed varieties of pointing, the mortar is applied to the joints using a trowel and meticulously smoothed using the face of the masonry surface. Subsequently, the joint is repositioned by means of a longitudinally applied force exerted by a small-diameter steel rod (6 mm in diameter). The process involves the creation of a curved arc groove within a mortar joint. The vertical joint is also completed in a similar manner.

In this case, joints are initially compacted with mortar.

- A tool or small steel bar creates a semi-circular curve-type notch.
- These kinds of details give the wall a beautiful aspect.
- Most superior-type work, especially for vertical wall joints, uses keyed pointing.

4. V-Grooved Pointing (V Pointing)

Keyed pointing work and V pointing are comparable. A joint was filled and shoved into the mortar. After that, a V-shaped tool is used to create the groove in the joint.

5. Beaded Pointing

In Beaded Pointing, a steel tool with a concave shape is used to make concave grooves into a joint when the mortar is pressed into a masonry connection. Although it offers the mortar joint a beautiful appearance, beaded pointing is easily damaged.

6. Struck Pointing

In this method of pointing, the top edge of the joint is driven inside about 10 mm relative to the bottom corner after the mortar has been filled and pressed to fit the face of the brick masonry work. It will take the shape of a slope from top to bottom so that the rain wall can easily drain off.

7. Recessed Pointing

These pointing styles typically do not shed water well, making them unsuitable for structures in exposed locations.

- Recessed pointings are created by pushing mortar at least 5 millimetres away from the edges.
- Keep the vertical face that is forced outward.
- With recessed joints, it is advised to utilise only bricks with exceptional frost resistance.
- It has a pleasing appearance.

8. Tuck Pointing

The mortar joint is filled and forced to the level surface of the masonry in various methods of pointing.

Grooves are carved into the mortar joint while the mortar is still new. 5mm wide by 3mm deep is the size of the slot. It is then filled with white cement putty and allowed to protrude 3 mm past the joint's face. If these projections are made using a mortar, the technique is known as half-tuckpointing or bastard pointing.

3.7.5 Procedure for Carrying out Pointing Works

Preparation of surface:

- While the mortar is still green, rake down the masonry joint up to 2 cm depth.
- Ensure cleaning and wetting of joints prior to pointing.



Fig. 3.7.3 Types of pointing

Methods of pointing:

1. After surface preparation place the mortar carefully in joints using a small trowel
2. Ensure to place mortar in desired shape.



Fig. 3.7.5 Pressing the mortar in the joints

3. Press the fresh mortar in the joints to gain strong bond with the old mortar.
4. Take care while using ashlar or else the mortar does not cover the face edges
5. Keep the pointed surface wet for at least a week or till it sets after application



Fig. 3.7.5 Wetting the surface

3.7.6 Advantages and Disadvantages

Advantages of Pointing work

The most efficient method for improving the physical condition and aesthetic of a building structure is brick pointing work, which is a crucial component of general and continuing building maintenance.

The following are the advantages of pointing work,

- Enhance the building's structural integrity.
- provide external, weather-resistant walls.
- Restore the building's general appearance.
- Your home or property's overall worth will be maintained or greatly increased.
- Reduce any ongoing brickwork upkeep.
- Disadvantages of Pointing in Construction
- The process of pointing might be time-consuming.
- It calls for competent labour.
- Due to weathering, the pointing can readily degenerate.

Exercise



Answer the following questions:

I. Multiple Choice Questions (MCQs):

1. What is the purpose of the 3-4-5 method in bricklaying?
 - a. Measuring aggregate proportions
 - b. Checking joint thickness
 - c. Squaring corners
 - d. Mixing cement and sand
2. Which type of pointing involves creating a groove along the joint?
 - a. Flush pointing
 - b. Recessed pointing
 - c. Struck pointing
 - d. Keyed pointing
3. Which component of an arch provides central stability and is placed at the crown?
 - a. Impost
 - b. Spandrel
 - c. Keystone
 - d. Voussoir
4. What is the primary purpose of curing in masonry construction?
 - a. Enhancing joint aesthetics
 - b. Preventing termite infestations
 - c. Increasing compressive strength
 - d. Reducing water-cement ratio
5. What is the process of breaking larger bricks into desired sizes called?
 - a. Chiselling
 - b. Marking
 - c. Cutting
 - d. Gauging

II. State whether True or False:

1. The water-cement ratio influences the strength and durability of concrete.
2. Flemish bond is a type of brick bonding pattern.
3. The 3-4-5 method is used to estimate the quantity of materials required for bricklaying.
4. Raking joints after laying bricks helps improve the aesthetics of the wall.
5. Arch elements are usually fixed at the springing level of the arch.

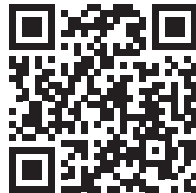
III. Very Short Answer:

1. What is the central stone in an arch called?
2. Name a type of pointing that involves creating a recess along the joint.
3. What is the purpose of curing in masonry?
4. What is the significance of the 3-4-5 method in construction?
5. Explain the importance of maintaining line and level in bricklaying.

Notes

QR Codes

Scan the QR code to watch the video



<https://youtu.be/DzM0MobulsE>

An ideal regular mortar mix for pointing





4. Process of carrying out Block Laying Work

Unit 4.1 - Performing Block Work



Key Learning Outcomes

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

1. Lay blocks for construction of wall.
2. Repair and restore block masonry.

Unit 4.1: Performing Block Work

Unit Objectives

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

1. Interpret sketches, method statements, formats, permits, protocols and checklists for block work.
2. Explain the use of various tools used in block laying.
3. Describe the use of raw material like cement, sand, aggregate, blocks etc., the size and physical attributes.
4. Explain the visual checks required for assessing the quality of blocks.
5. Explain cement mix proportion and its importance.
6. Discuss the water cement ratio.
7. Explain the process of laying and fixing blocks in position with uniform joints.
8. Explain the use of 3-4-5 method for squaring corners.
9. Describe the thin joint masonry.
10. Describe the various techniques for repairing and finishing in block work.
11. Perform visual checks to ascertain quality of blocks.
12. Provide a rough estimate for the quantity of material required for block work.
13. Demonstrate the construction of a block wall as per standard tolerance limit, as per relevant drawing.
14. Demonstrate fixing of blocks using adhesives.
15. Demonstrate checks for maintaining line and level of each course of block wall
16. Demonstrate setting out of 90° corners using builders square or 3-4-5 method.
17. Demonstrate removal of deteriorated elements from old block masonry works and reinstallation of blocks to match adjacent surfaces.
18. Demonstrate filling and raking of repaired block masonry work.

4.1.1 Block Masonry

Block masonry refers to the construction technique in which rectangular building units, known as blocks or concrete masonry units (CMUs), are laid and bonded together using mortar to create walls, partitions, and other structural or non-structural elements in a building. These blocks are made from materials like concrete, clay, or other composite materials, and they are designed to be modular, easy to handle, and efficient to install.



Fig. 4.1.1 Block Masonry

Types of Concrete Blocks

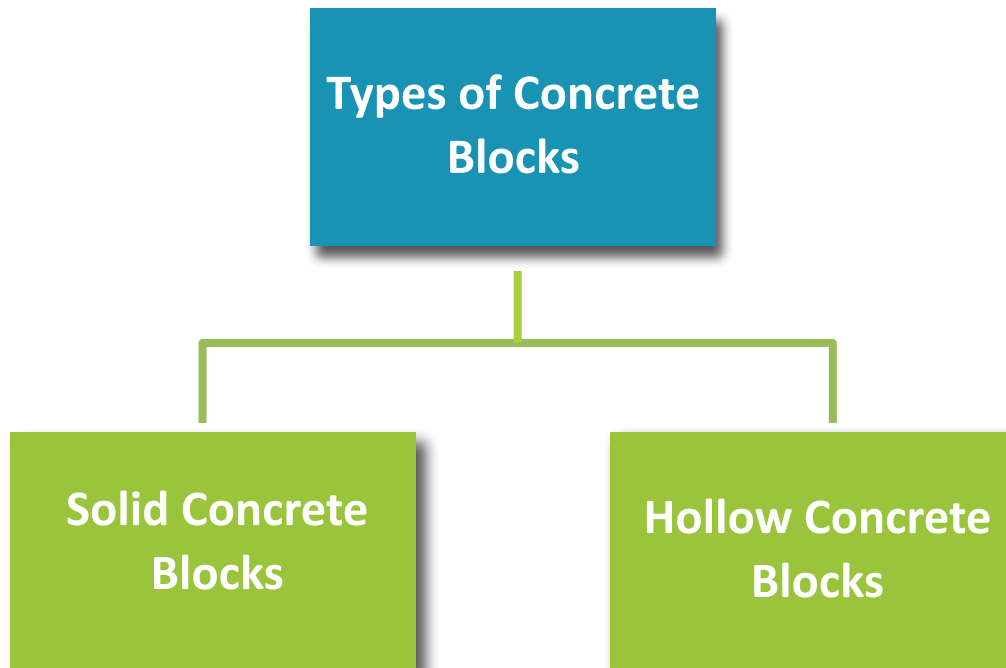


Fig. 4.1.2 Types of concrete blocks


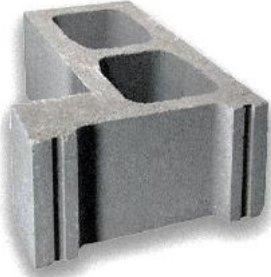

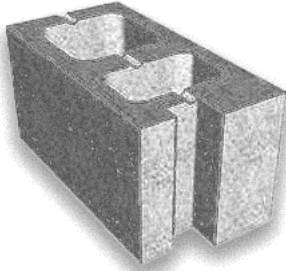
- a. **Solid Concrete Block:** The most popular type of block is solid concrete, which is made of dense aggregate and is substantial in weight. Since they are so powerful, they give the structures good stability. Consequently, these solid blocks are preferred for large masonry projects like load-bearing walls. In comparison to bricks, they are offered in big sizes. Construction of concrete masonry, as opposed to brick masonry, requires less time.



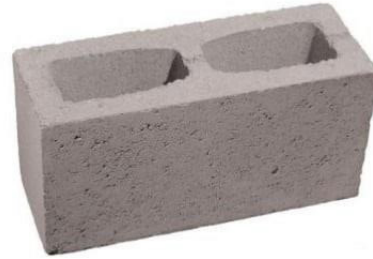
Fig. 4.1.3 Solid Concrete Block

- b. Hollow Concrete Block:** The void area in hollow concrete blocks exceeds 25% of the gross area. There should be more than 50% solid surface in hollow bricks. Depending on our needs, the hollow part might be separated into a few pieces. They are produced using light-weight aggregates. These blocks are portable and simple to erect.

Types of Hollow Concrete Blocks:

| Block | Image |
|---|--|
| <p>1. Concrete Stretcher Blocks: The corner of the masonry is joined using concrete stretcher blocks. Concrete hollow blocks called stretcher blocks are frequently used in construction. Their length is parallel to the wall's surface as they are laid out.</p> |  |
| <p>2. Concrete Corner Blocks: Corner blocks are used at masonry ends or corners. The ends, which might be window or door apertures, are placed so that the plane end is visible from the outside and the other end is secured with the stretcher block.</p> |  |
| <p>3. Concrete Pillar Blocks: Double corner blocks are another name for pillar blocks. These are typically utilised when two corners are visible. These blocks are frequently utilised in the case of piers and pillars.</p> |  |
| <p>4. Jamb Concrete Blocks: When there is a complex window opening in the wall, jamb blocks are employed. They are attached to corner and stretcher blocks. Jamb blocks are particularly helpful for providing space for the window casing parts when providing double hung windows.</p> |  |

5. Partition Concrete Block: In most cases, partition walls are constructed using concrete blocks. The height of partition blocks is greater than their breadth. In the case of partition blocks, the hollow part is divided into two to three components.



6. Lintel Blocks: For the purpose of providing a beam or lintel beam, lintel blocks or beam blocks are utilised. A lintel beam is typically installed on the top of doors and windows to support loads coming from above. As seen in the illustration, concrete lintel blocks have deep grooves running the length of the block. This groove is filled with concrete and reinforcement once the blocks have been set.



7. Frogged Brick Blocks: A frog, header, and stretcher, similar to frogged brick, are all present on the top of the frogged brick block. This frog will assist the block in holding mortar and creating a solid link with the block on top.



8. Bullnose Concrete Block: Corner blocks and bullnose blocks are similar. Their functions are the same, but bullnose bricks are favoured when we desire rounded edges at corners.



Table 4.1.1 Types of hollow blocks

4.1.2 Interpreting sketches, method statements, formats, permits, protocols, and checklists for block work

Interpreting sketches, method statements, formats, permits, protocols, and checklists for block work involves understanding and applying the information provided in these documents to carry out block-related construction tasks effectively. Here's a brief overview of what each of these terms entails:

1. **Sketches:** Sketches are simple, visual representations of the construction project. They may include drawings of the layout, dimensions, and specific details related to block work. Interpreting sketches involves understanding the spatial arrangement, measurements, and relationships between different components of the block work.
2. **Method Statements:** Method statements outline the step-by-step procedures for carrying out specific construction tasks. For block work, a method statement would detail how the blocks are to be laid, how mortar is to be mixed, how joints are to be treated, etc. Interpreting method statements ensures that the work is performed in a systematic and safe manner, following established guidelines.
3. **Formats:** Formats refer to standardized templates or layouts used for documenting various aspects of construction. These could include documentation for work orders, progress reports, quality control records, and more. Interpreting formats involves filling out the necessary information accurately and comprehensively to communicate project details and progress.
4. **Permits:** Construction permits are legal authorizations required for specific construction activities. These could include permits for block work related to structural changes, safety, or environmental considerations. Interpreting permits involves understanding the scope of work allowed under the permit and adhering to any conditions or restrictions outlined.
5. **Protocols:** Protocols are established procedures or guidelines that need to be followed to ensure safety, quality, and compliance with standards. In the context of block work, protocols might cover aspects such as handling of materials, mixing mortar, using tools, and maintaining a safe work environment. Interpreting protocols ensures that work is carried out in a consistent and regulated manner.
6. **Checklists:** Checklists are lists of items or tasks that need to be verified or completed. They are used for quality control and to ensure that no crucial steps are missed during construction. For block work, a checklist might include items like proper mortar consistency, alignment of blocks, joint thickness, etc. Interpreting checklists involves ticking off items as they are completed and verifying compliance.

4.1.3 Tools used for Block Work

The tools used are:

1. Trowel
2. Spirit Level
3. Mason's Line
4. Brick Hammer
5. Brick Jointer
6. Chalk Line
7. Mortar Hoe



Fig. 4.1.4 Tools used for Block Work

8. Mason's Square
9. Brick Jointer
10. Joint Raker
11. Bolster Chisel
12. Club Hammer
13. Masonry Saw
14. Line Blocks
15. Plumb Bob
16. Rubber Mallet
17. Brick Jointer
18. Pointing Trowel
19. Mortar Board
20. Hopper Gun (for mortar application)

4.1.4 Cement Concrete Block Masonry

Cement concrete block masonry is used as a substitute for brick masonry in modern construction sites. Cement concrete blocks are preferred to bricks for the following reasons:

- They are larger than bricks, yet lighter. So they make construction easier and quicker.
- They are available at a low cost and they can be reused in preparing concrete. So, they are used in temporary structures.
- They require no plastering or painting so they are used in the construction of budget homes for the community.



Fig. 4.1.5 Cement Concrete Block Masonry

From the above, one can conclude that masonry using cement concrete blocks is better than masonry using bricks.

4.1.5 Water Cement Ratio

The mix proportion and water-cement ratio for making blocks depend on factors such as the type of blocks being produced (concrete, clay, etc.), the desired strength, workability, and local material availability. However, I can provide you with a general guideline for making concrete blocks.

Mix Proportion for Concrete Blocks:



A typical mix proportion for making concrete blocks might be as follows:

1. Cement: 10-12% by weight
2. Fine Aggregate (Sand): 40-50% by weight
3. Coarse Aggregate (Crushed Stone or Gravel): 40-50% by weight
4. Water: Depending on the water-cement ratio

Water-Cement Ratio:

The water-cement ratio is a critical factor that determines the strength, workability, and durability of the concrete mix. It is the ratio of the weight of water to the weight of cement in the mix. For concrete block manufacturing, the water-cement ratio typically ranges from 0.4 to 0.6.

4.1.6 Construction of Block Masonry

| Steps | Images |
|---|--|
| <p>Step 1</p> <p>Wear safety equipment.</p> <ul style="list-style-type: none"> • Safety gloves, jacket, boots and helmet. <p>Step 2</p> <p>Gather the materials and tools needed.</p> |  |
| <p>Step 3</p> <p>Mark and clean the job site.</p> |  |

Step 4

Select the blocks.

- Once you have cleaned the site, select the required number of full-size blocks and a few half-size blocks.

Ensure that the blocks have no cracks or breakages.

Step 5

Stack the blocks at the job site.

- Now that you are ready with the blocks to be used in construction, stack the cement concrete blocks at the job site.

Step 6

Prepare the mortar.

Step 7

Spray the blocks with water.

- After you have formed the mortar bed, spray the blocks with water.
- Do not soak the blocks as they tend to shrink and make the wall weak.

However, be sure to spray them with water, or else they will absorb water from the mortar.

**Step 8**

Form the mortar bed.

- You are now ready with the required quantity of fresh mortar to form the mortar bed.
- First, pour half an inch of mortar on the selected surface.
- Spread it evenly on the surface.

Then, use the spirit level to check that this surface is even. If the surface is uneven, the blocks laid on it and the structure will be uneven.

**Step 9**

Lay the blocks in a stretcher course.

- For laying the first course, Set the blocks in the mortar bed as stretchers.
- Tap the blocks down with the handle of your trowel, until they are upright and accurately aligned.



- Use the edge of the trowel to scoop up any mortar displaced from beneath the blocks.
- Use the spirit level to check the evenness along the tops of the blocks.
- Do not water the blocks before you use them.
- However, do spray them with water or else they might absorb moisture from mortar and cause the joints to become weak.

Step 10

- Cover the top of the course with mortar.
- As you have successfully laid out the first course of the wall, you must now cover the top of the course with mortar.

**Step 11**

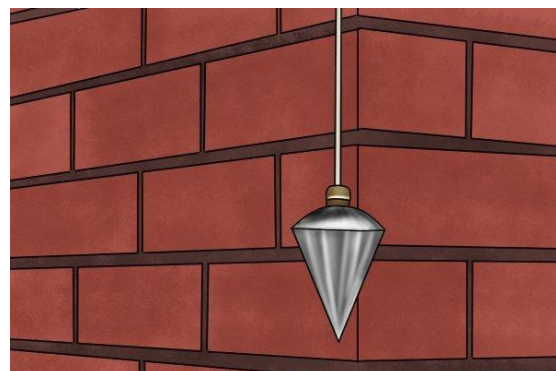
Flush and fill all the vertical joints.

- After covering the top of the course with mortar.
- Flush and fill all the vertical joints of the course by using the trowel.
- By flushing and filling-up the joints, mortar gets packed into the vertical joints and binds the blocks lying adjacent to each other well.
- After flushing and filling the vertical joints, spread the mortar along the course with a trowel and check whether the surface of the mortar is levelled.

**Step 12**

Place a half-size block at the beginning of the course.

- This half size cement concrete block is essential to the construction of a block wall because, if a course in the wall begins with a full sized block, the next course must begin with a half-block.



- This way, full blocks placed next to the half-block stretch across the vertical joints of the course beneath.
- As a result, the vertical joints of the wall, which are its weak points, remain separated and compact, rather than continuous and slender.
- So, if half-size blocks are not used in alternate courses, the vertical joints line up and make the wall weak.

Step 13

Lay full-size blocks for the rest of the course.

- After you have laid the half-size block, lay full-size blocks for the rest of the course.

**Step 14**

Repeat these steps until the wall measures three feet in height.

Repeat the steps, such as:

- Laying a stretcher course.
- Covering the course with mortar.
- Flushing and filling the vertical joints.
- Laying another stretcher course, using the half-size block at the beginning of alternate courses.
- Check the vertical straightness of the wall by using the plumb, halfway through the job and also at the end of three feet



Table 4.1.2 Process of Construction of Block Masonry

- Thin Joint Masonry is a clean, fast and accurate system for construction.
- Autoclaved aerated concrete blocks of close dimensions tolerance with 2mm – 3 mm mortar joints

- It requires only pre-mixed cement thin layer mortar that requires only addition of water.



Fig. 4.1.4 Tools used for Block Work

4.1.8 Do's and Don'ts in Blockworks

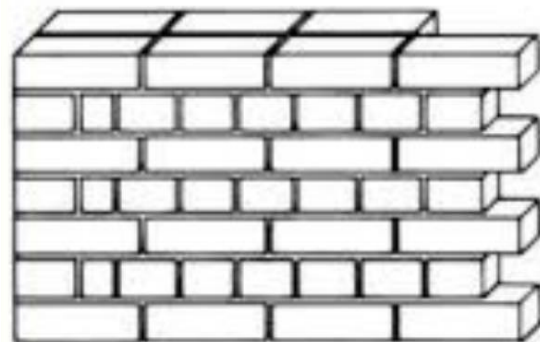
Dos with Respect to Block Masonry

For a good block masonry:

- Use larger blocks, as they consume less mortar in the joints.
- Always use only the stretcher bond when using blocks. This way, the masonry is completed quicker.
- Place the blocks such that the size of the joints is between 5 to 10 millimetres. Any farther results in poor bonding.
- Always ensure that mortar for binding blocks is made with a cement-sand ratio between 1:4 and 1:6.
- Always use concrete blocks.



Use larger blocks



Always use only the stretcher bond



Placing of blocks



Mortar for binding blocks



Always use concrete blocks



Spray the blocks with water



Place the blocks for proper bonding

Table 4.1.3 Do's of Blockwork

Don'ts with Respect to Block Masonry

For a good block masonry:

- Do not use smaller blocks. Smaller blocks consume more mortar in the joints.
- Don't use improper mortar mix. It leads to shrinkage in the blocks, causing them to crack.
- Do not use ordinary cement- sand blocks in construction.
- Do not soak the blocks before construction. Just spray the blocks with water before using them.



Fig. 4.1.7 Don'ts of Block Masonry

4.1.9 Repairing and Finishing Techniques

Repairing and finishing techniques in block work involve addressing imperfections, enhancing aesthetics, and improving the overall quality of the constructed walls or structures. Here are several techniques commonly used for repairing and finishing block work:

1. **Rendering:** Rendering involves applying a layer of mortar or cement-based mixture to the surface of the block wall to improve its appearance and provide protection. Different types of renders, such as smooth render, textured render, or colored render, can be used based on aesthetic preferences. Rendering also helps to cover surface irregularities and create a more uniform appearance.
2. **Pointing:** Pointing is the process of filling and finishing the joints between blocks with mortar. Proper pointing enhances the structural integrity of the wall and provides protection against water infiltration. Different pointing techniques include flush pointing (smooth finish), recessed pointing (grooved finish), and weather-struck pointing (angled finish).
3. **Plastering:** Plastering is the application of a thin layer of plaster or mortar over the block surface to create a smooth and even finish. Plastering can be used for both interior and exterior walls. It improves the appearance of the block work and provides a base for painting or other decorative finishes.

4. **Sculpting and Carving:** For decorative or artistic purposes, blocks can be sculpted or carved to create intricate patterns, designs, or reliefs on the surface. Skilled craftsmen use tools to shape the blocks according to the desired artistic vision.
5. **Polishing:** Polishing involves grinding and smoothing the surface of the blocks to achieve a polished or glossy finish. This technique is often used with certain types of blocks, like natural stone blocks, to enhance their visual appeal.
6. **Waterproofing:** Applying waterproofing coatings or sealants can protect block work from moisture penetration, which can lead to deterioration over time. Waterproofing is especially important for exterior walls exposed to weather conditions.
7. **Texturing:** Texturing techniques, such as creating rough or patterned surfaces, can add visual interest to block work. This can be achieved by using specialized tools or applying textured coatings.
8. **Staining or Painting:** Staining or painting block work can alter its color and appearance, allowing for customization and aesthetics. Stains can penetrate the surface, while paints provide a protective layer and a range of color options.
9. **Tile or Cladding Installation:** Adding tiles or cladding to the block surface can improve both appearance and functionality. Tiles or cladding can be applied to create decorative accents or provide additional protection against weather and wear.
10. **Grouting:** If block work has voids, gaps, or open joints, grouting can be used to fill these spaces with a cementitious or epoxy-based material. Grouting enhances the structural stability and appearance of the blocks.
11. **Cleaning:** Regular cleaning using appropriate methods and cleaning agents can remove dirt, stains, and pollutants from block surfaces, restoring their original appearance.

Exercise

Answer the following questions:

I. Multiple Choice Questions (MCQs):

1. What are the primary building units used in block masonry? a) Bricks b) Stones c) Blocks or concrete masonry units (CMUs) d) Timber
2. Which tool is used to ensure the vertical alignment of blocks during construction? a) Chalk Line b) Mason's Line c) Spirit Level d) Mortar Hoe
3. What is the primary advantage of using cement concrete blocks over bricks? a) They are cheaper. b) They require less mortar. c) They are heavier. d) They are preferred for high-rise buildings.
4. Which step involves forming a mortar bed on the selected surface for block placement? a) Lay the blocks in a stretcher course. b) Cover the top of the course with mortar. c) Form the mortar bed. d) Stack the blocks at the job site.
5. What is the primary purpose of curing in concrete and block masonry? a) To increase the strength of the materials. b) To reduce the need for painting. c) To absorb heat of hydration and prevent cracks. d) To speed up the construction process.

II. Fill in the Blanks:

1. Sketches help in understanding the _____ arrangement, measurements, and relationships of components in block work.
2. Method statements provide step-by-step procedures for carrying out specific construction _____.
3. _____ refer to standardized templates for documenting various aspects of construction.
4. When interpreting permits, it's important to adhere to any conditions or _____ outlined.
5. Thin Joint Masonry uses autoclaved aerated concrete blocks with thin _____ joints for construction.

III. Very Short Answer:

1. Why is the keystone in arch construction important?
2. What is the purpose of using line blocks in block masonry?
3. Explain the role of protocols in block work construction.
4. What is the primary difference between cement concrete blocks and bricks?
5. Why is spraying water on concrete surfaces during curing important?

Notes



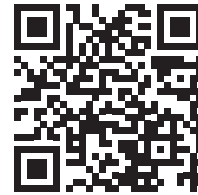
QR Codes

Scan the QR code to watch the video



<https://youtu.be/YfsrHLYc7tY>

Types of Hollow Blocks



https://youtu.be/UBDZxL9__OM

How to Use the 3 4 5 Method to Square Up a Wall
Perfectly



5. Work according to Personal Health, Safety and Environment Protocols at Construction Site



Unit 5.1 - Hazards and Emergency Situations

Unit 5.2 - Safety Drills, PPEs and Fire Safety

Unit 5.3 - Hygiene and Safe Waste Disposal Practices

Unit 5.4 - Infectious Disease and Its Cure



Key Learning Outcomes

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

1. Describe the reporting procedures in cases of breaches or hazards for site safety, accidents, and emergencies as per guidelines.
2. Explain different types of safety hazards at construction sites.
3. Demonstrate how to follow emergency and evacuation procedures in case of accidents, fires, or natural calamities.
4. Discuss basic ergonomic principles as per applicability.
5. Describe the procedure for responding to accidents and other emergencies at the site.
6. Explain the importance of handling tools, equipment, and materials as per applicable norms.
7. Explain the effect of construction material on health and environments as per applicability.
8. Describe various environmental protection methods as per applicability.
9. Explain the storage requirement of waste including non-combustible scrap material and debris, combustible scrap material and debris, general construction waste and trash (non-toxic, non-hazardous), any other hazardous wastes and any other flammable wastes at the appropriate location.
10. Show how to collect, segregate and deposit construction waste into appropriate containers based on their toxicity or hazardous nature.
11. Explain how to use hazardous material in a safe and appropriate manner as per applicability.
12. Explain types of fire.
13. Describe the procedure of operating different types of fire extinguishers.
14. Show how to operate different types of fire extinguishers corresponding to various types of fires as per EHS guidelines.
15. State safety relevant to tools, tackles, and equipment as per applicability.
16. Demonstrate the use of appropriate Personal Protective Equipment (PPE) as per work requirements for Head Protection, Ear Protection, Fall Protection, Foot Protection, Face and Eye Protection, Hand and Body Protection, and Respiratory Protection (if required).
17. Demonstrate how to check and install all safety equipment as per standard guidelines.
18. List housekeeping activities relevant to the task.
19. Elucidate ways of transmission of infection Explain the ways to manage infectious risks at the workplace.
20. Describe different methods of cleaning, disinfection, sterilization, and sanitization.
21. Show how to clean and disinfect all materials, tools and supplies before and after use.
22. List the symptoms of infection like fever, cough, redness, swelling, and inflammation.

Unit 5.1 - Hazards and Emergency Situations

Unit Objectives

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

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

5.1.1 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.

HAZARD

VS

RISK

A **HAZARD** is something that has the potential to harm you



RISK is the likelihood of a hazard causing harm



Fig. 5.1.1 Hazards versus Risk

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



Fig.5.1.2 Workplace Hazards

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

- **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.



Fig. 5.1.3 Risk Associated with Hazards

5.1.2 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. 5.1.4 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.



Fig. 5.1.5 Risk Management Process

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.

Hazards Specific to Domain-Related Works in Construction:

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

- **Painting Hazards:** Painters may encounter risks from working at heights, using chemicals in paints, and exposure to fumes.
- **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.

5.1.3 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:

- Red
- Blue
- Yellow
- Green



Fig. 5.1.6 Workplace Warning Signs

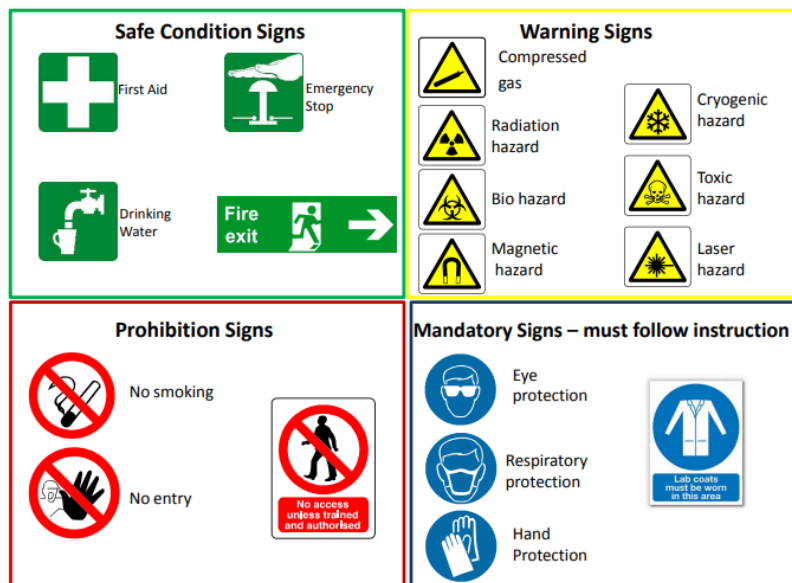


Fig.5.1.7 Four Types of Safety Signs and their Colour

5.1.4 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. 5.1.8 Emergency Response Plan (ERP)

5.1.5 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. 5.1.9 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. 5.1.10 Reporting Emergency Situations

Unit 5.2: Safety Drills, PPEs and Fire Safety

Unit Objectives

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

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

5.2.1 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.

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

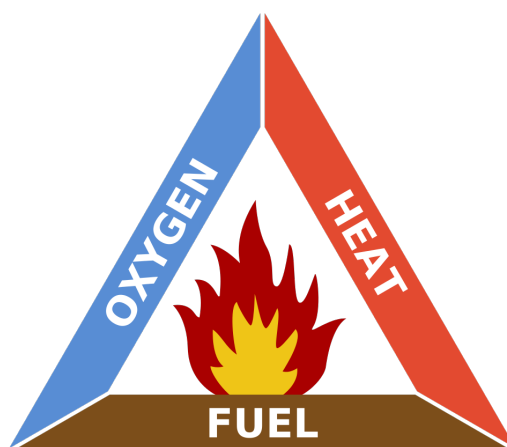


Fig. 5.2.1 Fire Triangle











| | | | |
|---|---|------------------------------------|---|
|  |  | 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. 5.2.1 Fire Triangle

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.

5.2.2 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. 5.2.3 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.

5.2.3 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.

1. **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).

2. **Wet Chemical Fire Extinguisher (Class K):**

- Specifically designed for Class K fires involving cooking oils and fats.



Fig. 5.2.4 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.

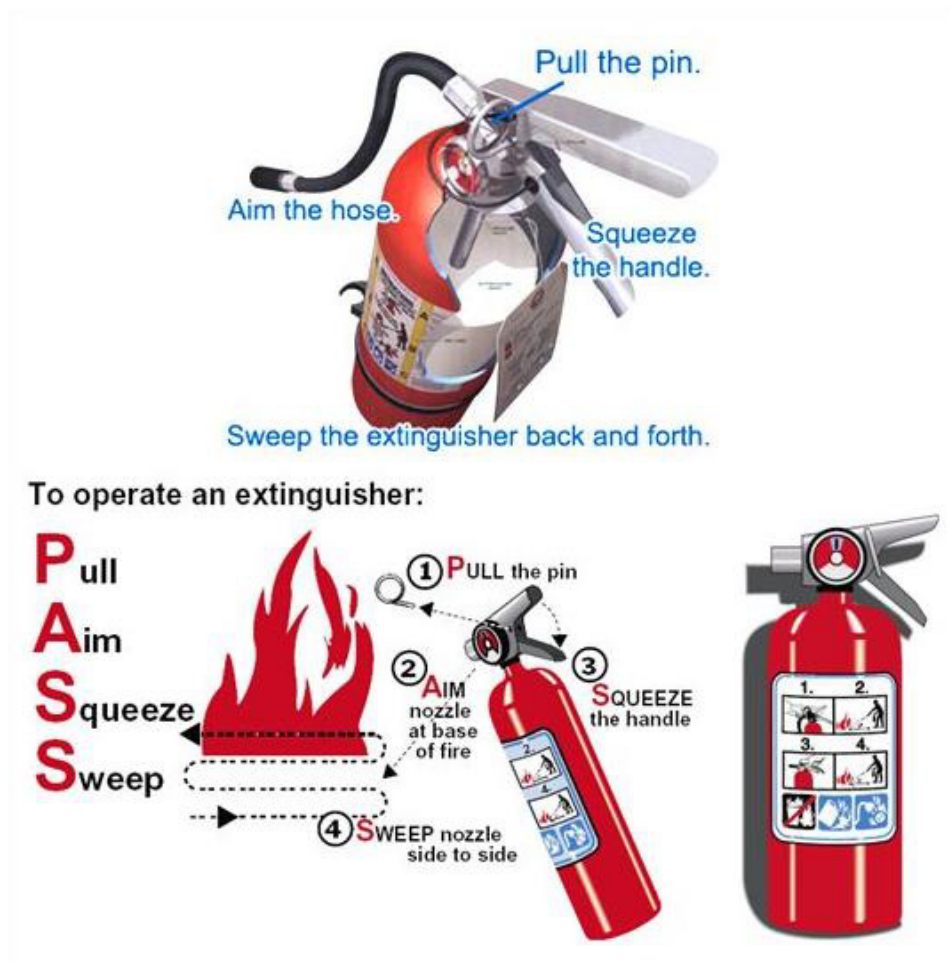


Fig. 5.2.5 Using a Fire Extinguisher

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.

5.2.4 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. 5.2.6 Components related to Safety Drill

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

- **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.
- **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.
- **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.
- **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.
- **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.
- **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.
- **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.

- **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.
- **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.
- **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. 5.2.7 Emergency Evacuation

5.2.5 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 1947, 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 1949. 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.



Fig. 5.2.8 Medical Examination for Construction Workers

Form 7 is completed, and if the medical findings reveal any abnormality or unsuitability of a person employed in the hazardous process, or if the worker has manifested signs and symptoms of a notifiable disease (as specified in the Third Schedule of the Factories Act), the worker must be removed from

the process for health protection and cannot be employed in the same process. Alternatively, if the worker is totally handicapped, he or she will receive appropriate rehabilitation. Only after obtaining a Fitness Certificate from the Certifying Surgeon and Form 7 in accordance with the Factories Act may a withdrawn employee be rehired for the same process.

List of Recommended Medical Tests under the Factories Act:

1. Complete Physical Examination
2. Blood Group, Rh factor
3. Blood CBC, ESR, RBS
4. Urine Test (Routine & Microscopic)
5. Creatinine
6. Electrocardiogram (Computerised ECG)
7. Chest X-Ray (Standard Size)
8. Lung Function Test
9. Vision Test (Screening)
10. Audiometric Test
11. HIV & HBS Tests

5.2.6 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.

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



Fig. 5.2.9 Vertigo Test for Construction Workers

5.2.7 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.

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:



Fig. 5.2.10 Basic Ergonomic Principles

- 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.

5.2.7 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:



Fig. 5.2.11 First Aid to Injured Person

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.

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. 5.2.12 First Aid Kit

5.2.9 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.

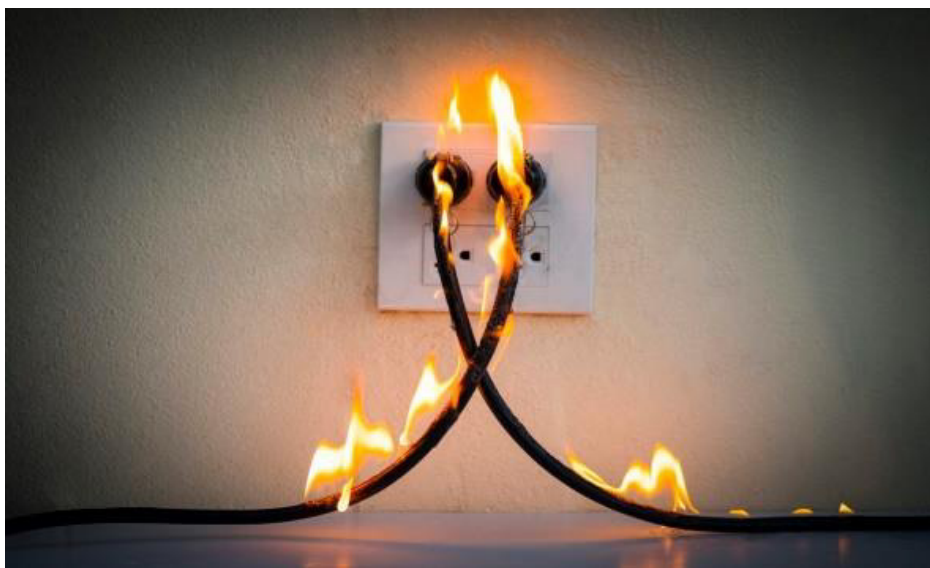


Fig. 5.2.12 First Aid Kit

- 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. 5.2.14 Electrical Safety

5.2.10 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. 5.2.15 PPEs in Construction Industry

Importance of PPE in Construction Industry:

- **Hazard Protection:** PPE serves as a barrier between workers and potential workplace hazards, preventing injuries and illnesses.
- **Legal Compliance:** Regulatory authorities require the use of appropriate PPE in construction to meet safety standards and comply with regulations.
- **Injury Prevention:** PPE can significantly reduce the risk of injuries and accidents, protecting workers' health and well-being.
- **Risk Reduction:** PPE mitigates the risk of exposure to harmful substances, noise, dust, and other occupational hazards.
- **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> |  |
| Foot and Leg Injury Protection | <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> |  |
| Eye and Face Injury Protection | <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. Prolonged exposure to high noise can lead to permanent hearing loss, physical strain & mental stress. Self-forming earplugs made of materials like foam, waxed cotton, or fibreglass wool are commonly used as they offer a good fit. For better fit and protection, workers should be fitted with moulded or prefabricated earplugs by a specialist.</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. Gloves are commonly used as protective gear for hands. Electricians often use leather gloves with rubber inserts when working on electrified circuits. Kevlar gloves are employed when stripping cable with a sharp blade to prevent cuts and injuries.</p> |  |
| <p>Whole Body Protection</p> | <p>Full-body protection is essential for workers to safeguard against heat and radiation hazards. Whole-body PPE includes materials like rubber, leather, synthetics, plastic, fire-retardant wool, and cotton. Maintenance staff working with high-power sources like transformer installations and motor-control centers are often required to wear fire-resistant clothes for added safety.</p> |  |

Table 5.2.1 PPEs for Construction Worker

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.

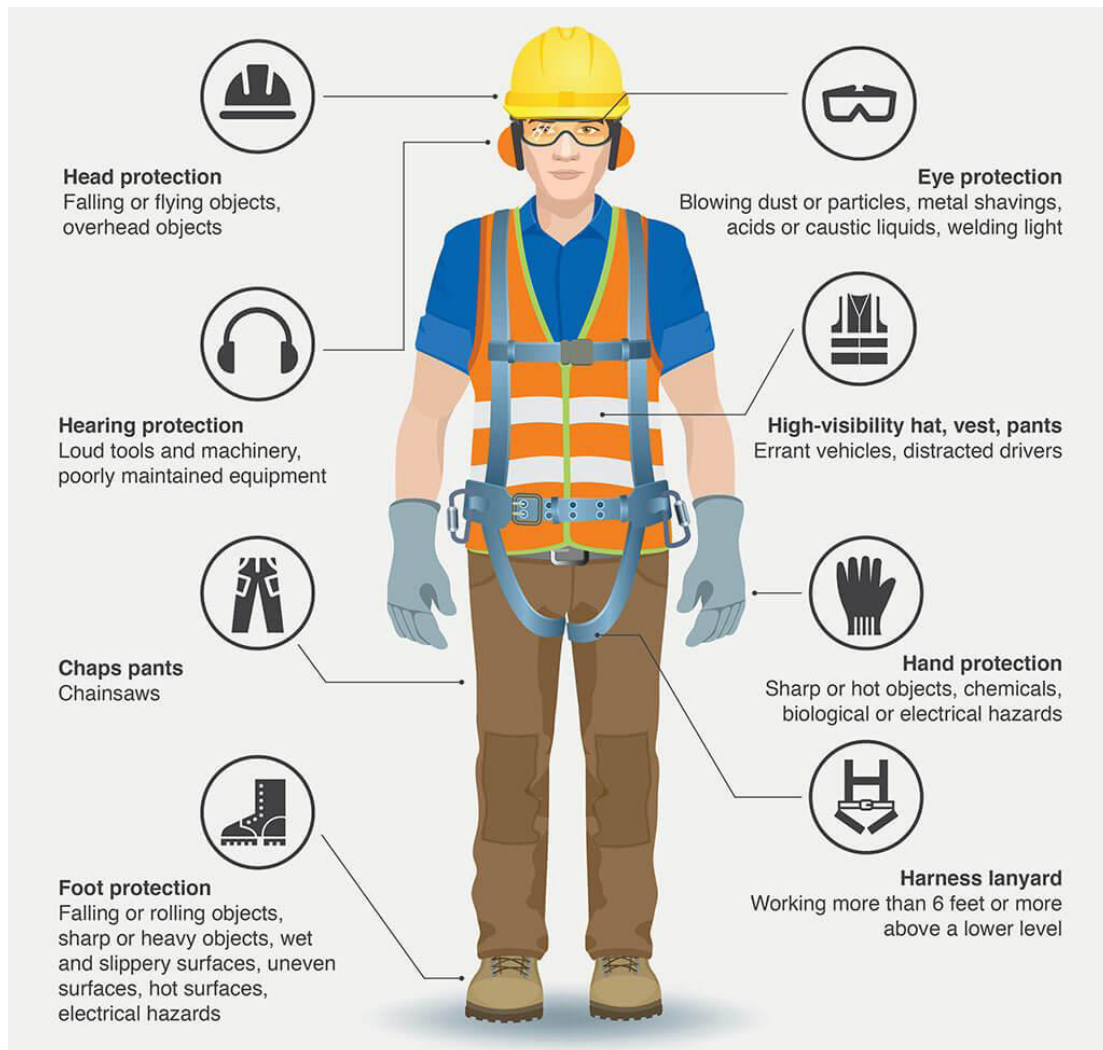


Fig. 5.2.14 Electrical Safety

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

5.2.11 Ladder Safety in Construction

Ladder safety is crucial in the construction sector to prevent accidents and injuries. Here are some important guidelines and practices that workers should follow when using ladders:

- Choose the right ladder for the task, considering height and weight capacity.
- Inspect the ladder for defects, cracks, and damage before use.
- Place the ladder on a stable and level surface to prevent tipping.
- Maintain three points of contact while climbing (two hands, one foot, or two feet, one hand).
- Never overreach while on the ladder; reposition it if necessary.
- Keep the ladder area clear of obstacles and debris.
- Ensure there are no overhead hazards like power lines or obstacles.
- Secure the ladder at the top to prevent sliding or shifting.
- Use non-conductive ladders when working near electrical sources.
- Provide training to workers on proper ladder usage and safety measures.

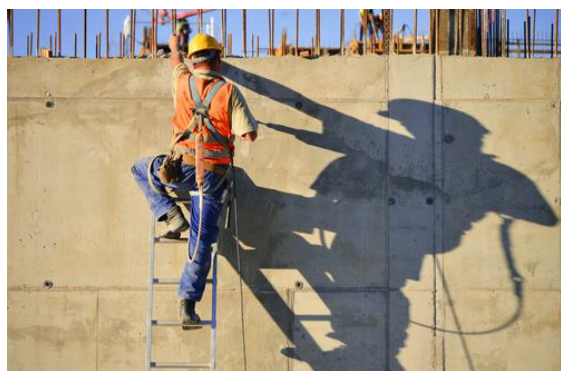


Fig. 5.2.17 Ladder safety

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- Secure the ladder at the top to prevent sliding or shifting.
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- Provide training to workers on proper ladder usage and safety measures.



Fig. 5.2.17 Ladder safety

Unit 5.3: Hygiene and Safe Waste Disposal Practices

Unit Objectives

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

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

5.3.1 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. 5.3.1 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 food-borne 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. 5.3.2 Infectious Disease

5.3.2 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. 5.3.3 Workplace Cleanliness

Here are some important aspects of workplace cleanliness and sanitization:

- **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.
- **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.
- **Hand Sanitizing Stations:** Place hand sanitizing stations at convenient locations throughout the workplace to encourage employees and visitors to maintain hand hygiene.
- **Restroom Hygiene:** Maintain clean and well-stocked restrooms with proper sanitation supplies. Regularly clean and disinfect restroom surfaces to prevent the spread of germs.
- **Waste Management:** Provide clearly marked waste disposal bins and ensure proper waste segregation. Regularly empty trash bins and dispose of waste appropriately.
- **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.
- **Ventilation and Air Quality:** Ensure proper ventilation to improve indoor air quality. Clean air filters regularly to remove dust and allergens from the air.
- **Personal Protective Equipment (PPE):** Provide appropriate PPE, such as masks and gloves, for employees when needed, especially during pandemics or when handling hazardous materials.
- **Educate Employees:** Educate employees about the importance of workplace cleanliness and hygiene practices. Encourage them to follow hygiene guidelines and protocols.
- **Workplace Signage:** Display hygiene-related signage, such as handwashing instructions, cough etiquette, and reminders about cleaning protocols, to reinforce good practices.
- **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.
- **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.

5.3.3 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:** 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.

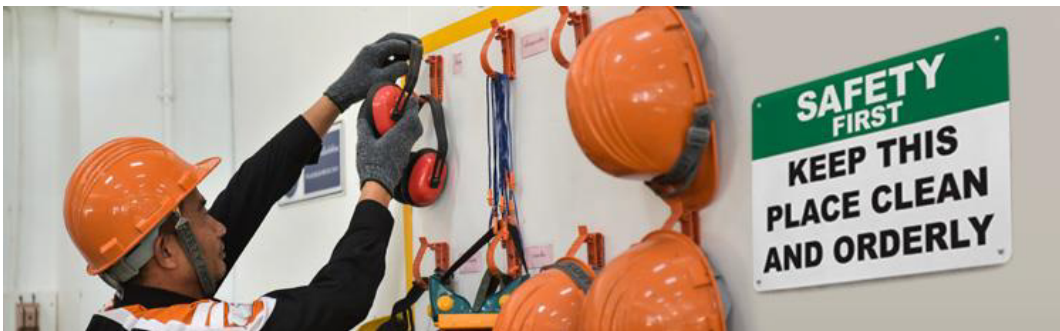


Fig. 5.3.4 Designated Areas

2. **Regular Cleanup:** 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.



Fig. 5.3.5 Clean-up Debris and Waste

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. 5.3.6 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. 5.3.7 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. 5.3.8 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. 5.3.9 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. 5.3.10 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. 5.3.11 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. 5 .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. 5.3.13 Inspect and Maintain Equipment

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.



Fig. 7.3.14 Good Housekeeping and Safety relevance

5.3.4 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. 5.3.15 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. 5.3.16 Wash Hands Properly

5.3.5 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.



Fig. 5.3.17 Avoid Bad Habits

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.

5.3.6 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. 5.3.18 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.

5.3.7 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.



Fig. 5.3.18 Construction Wastes

The importance of waste management is:

- 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.

5.3.8 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. 5.3.20 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.

5.3.9 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.

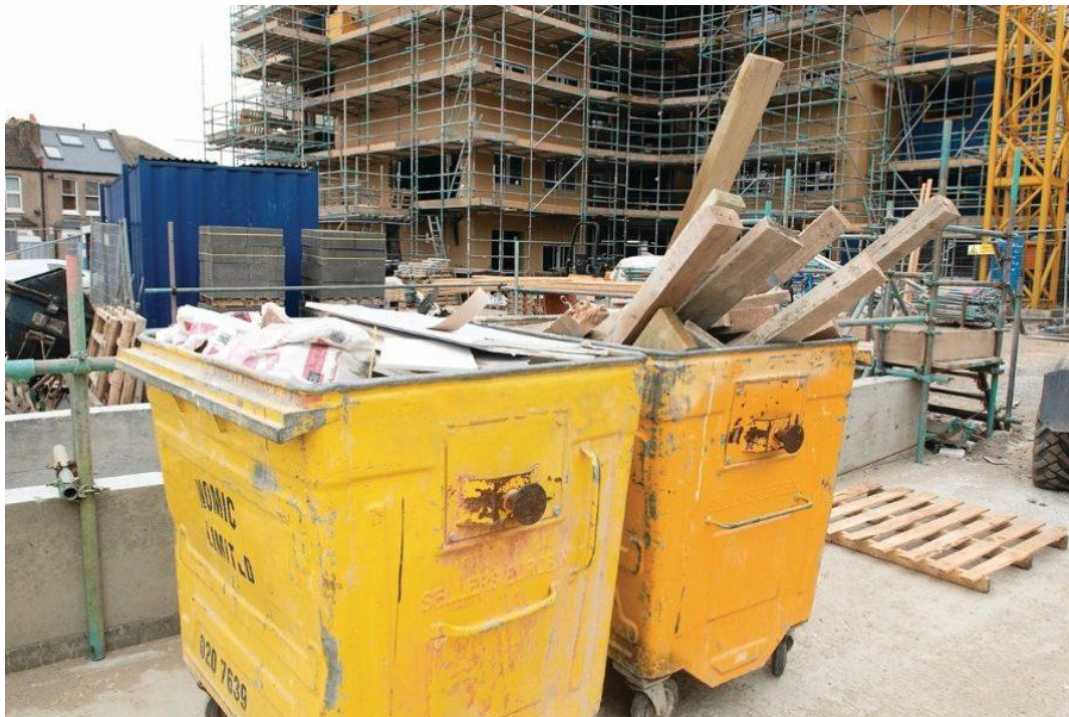


Fig. 5.3.21 Waste Management on a Construction Site

Notes



Unit 5.4: Infectious Disease and Its Cure

Unit Objectives

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

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

5.4.1 Infectious Diseases

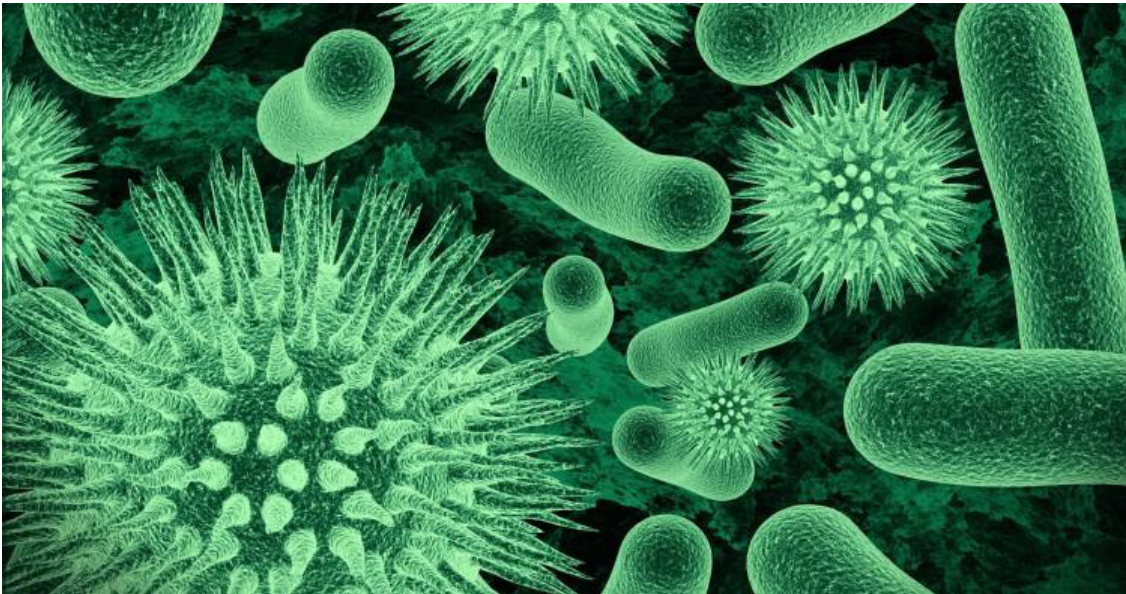


Fig. 5.3.21 Waste Management on a Construction Site

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.

5.4.2 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.

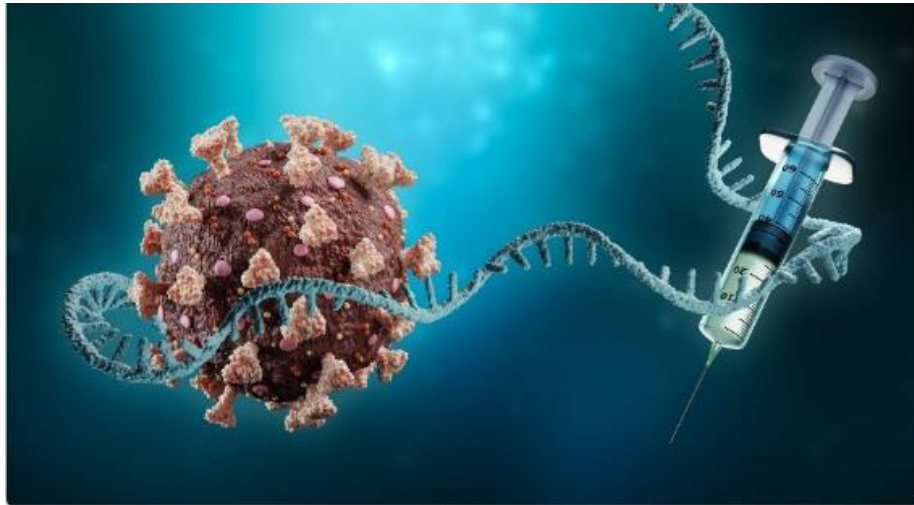


Fig. 5.4.2 Vaccines for Infectious Diseases

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.

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. 5.4.2 Vaccines for Infectious Diseases

5.4.3 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. 5.4.4 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.

5.4.4 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:

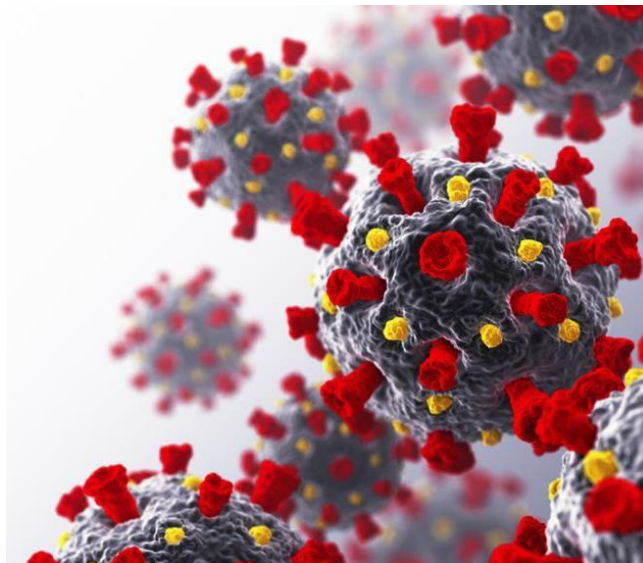


Fig. 5.4.2 Vaccines for Infectious Diseases

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

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:

A. Short Questions:

1. What are the reporting procedures for breaches or hazards at the construction site as per guidelines?
2. Can you identify different types of safety hazards commonly found at construction sites?
3. How would you demonstrate following emergency and evacuation procedures in the case of an accident or fire?
4. What are basic ergonomic principles and how are they applicable to construction work?
5. What steps should you take in responding to accidents and other emergencies at the construction site?

B. Fill-in-the-Blanks Questions:

1. Proper handling of tools, equipment, and materials is essential as per (project schedule / applicable norms).
2. Different types of fire extinguishers correspond to various types of (weather conditions / fires).
3. Using hazardous materials safely involves following (project deadlines / standard guidelines).
4. Proper (cleaning / disposal) methods are important to manage construction waste.
5. Personal Protective Equipment (PPE) includes items like head protection, ear protection, and (sunglasses / fall protection).

C. True/False Questions:

1. Accidents and hazards don't need to be reported if they result in minor injuries. (True/False)
2. Ergonomic principles focus on optimizing workspaces and equipment for worker comfort and safety. (True/False)
3. All types of fire extinguishers can be used interchangeably on different types of fires. (True/False)
4. Using Personal Protective Equipment (PPE) is not necessary if you're experienced in construction work. (True/False)
5. Proper cleaning and disinfection of materials, tools, and supplies is not important in construction work. (True/False)



6. Plan and organize work to meet expected outcomes



Unit 6.1 - Prioritise work activities to achieve desired results

Unit 6.2 - Organising resources

Unit 6.3 - Sequence of work for Brick Mason



Key Learning Outcomes

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

1. Demonstrate prioritizing of work activities to achieve the desired productivity.
2. Demonstrate organizing of resources as per work plan prior to commencement of work.

Unit 6.1: Prioritise Work Activities to achieve Desired Results

Unit Objectives

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

1. Explain methods to upkeep, store and stack tools, materials used for domain specific works.
2. Explain the process of planning of the given tasks and activities relevant to the trade/job role within defined scope and duration.
3. Explain basic concept of labour productivity and work productivity.
4. Identify the work target and plan activities to achieve the desired productivity.
5. Demonstrate the planning for various activities relevant to task as per the scope and schedule.
6. Demonstrate how to organise the required tool, manpower and material resources for the assigned task.
7. Select required quantity of materials, tools or devices for defined work activities.
8. Demonstrate how to prioritize all works/ activities to maximise output.

6.1.1 Setting Objectives

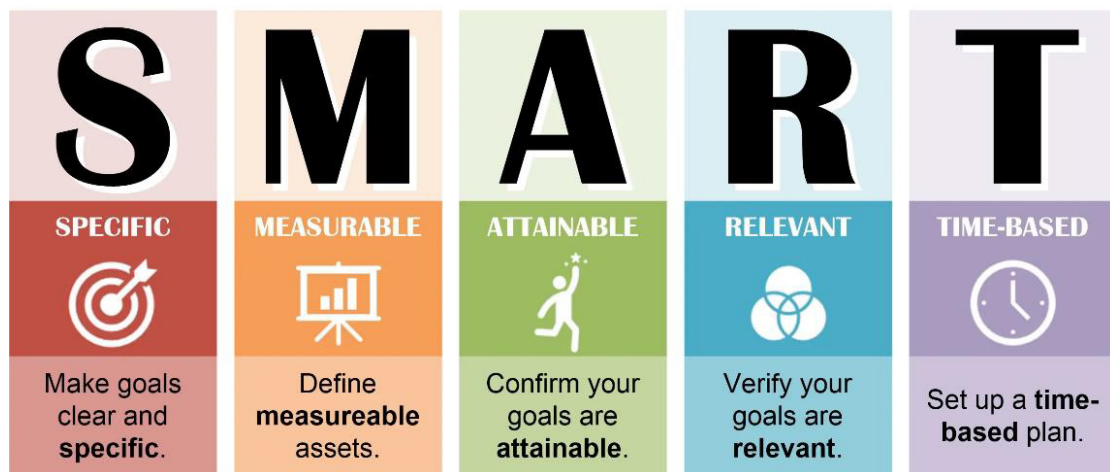


Fig. 6.1.1 SMART Goals

SMART goals are a framework used to create specific, measurable, achievable, relevant, and time-bound objectives. When applied to the work of a brick mason, SMART goals help provide clear direction, set achievable targets, and ensure accountability. Here's how SMART goals can be defined for a brick mason:

1. **Specific:** A specific goal clearly defines what is to be achieved and why it is important.

Example: "I will improve my bricklaying skills to create neat and level brick walls, ensuring proper

alignment and joint thickness.”

2. **Measurable:** A measurable goal has clear criteria for tracking progress and determining when the goal has been achieved.

Example: “I will measure my progress by consistently achieving at least a 95% accuracy rate in brick alignment and joint thickness, as evaluated by my supervisor.”

3. **Achievable:** An achievable goal is realistic and attainable given the available resources, skills, and timeframe.

Example: “I will complete an advanced bricklaying course over the next six months to gain the necessary skills and knowledge to improve my craftsmanship.”

4. **Relevant:** A relevant goal aligns with the mason’s role, career aspirations, and broader objectives of the project or organization.

Example: “By improving my bricklaying skills, I will contribute to higher-quality construction, reduce rework, and enhance the reputation of the construction company.”

5. **Time-Bound:** A time-bound goal has a specific deadline for completion, providing a sense of urgency and focus.

Example: “Within the next year, I will become proficient in laying brick arches by attending specialized workshops, practicing regularly, and seeking guidance from experienced colleagues.”

By setting SMART goals, a brick mason can track their progress, continuously improve their skills, and contribute effectively to construction projects. It’s important to regularly review and adjust goals as circumstances change to ensure they remain relevant and achievable.

pathies (TSEs/prion diseases)

6.1.2 Planning Tasks and Activities

Planning tasks and activities is crucial for a brick mason to ensure that work is organized, efficient, and meets quality standards. Here’s a step-by-step process for planning tasks and activities as a brick mason:

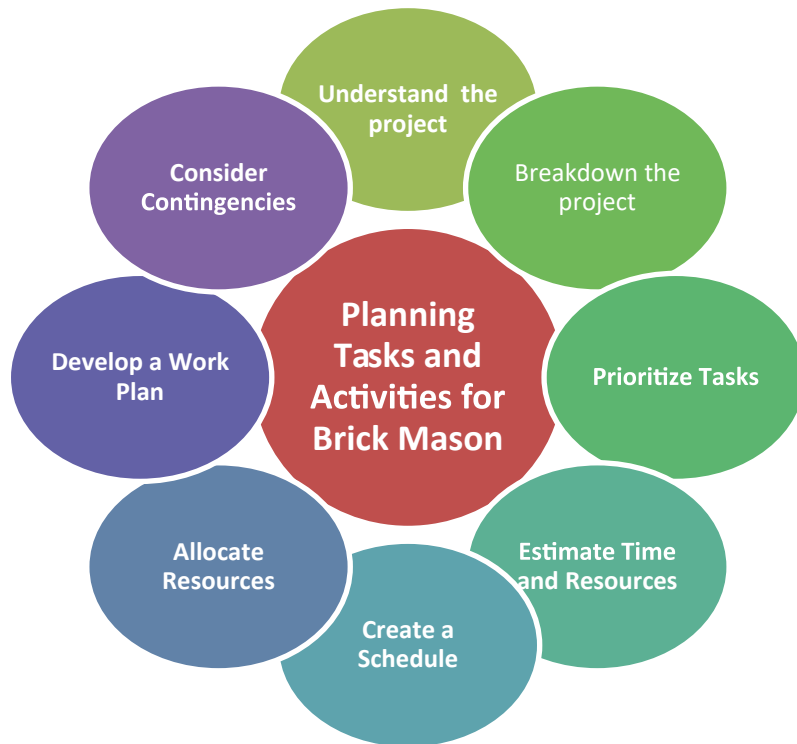


Fig. 6.1.2 Planning Tasks and Activities for Brick Mason

1. **Understand the Project:** Gather all available information about the project, including architectural drawings, plans, specifications, and project scope. Understand the layout, design, and materials to be used in the brickwork.
2. **Break Down the Project:** Divide the project into smaller tasks and activities. This could include tasks like preparing the site, laying the foundation, setting up scaffolding, mixing mortar, laying bricks, pointing, and cleaning up.
3. **Prioritize Tasks:** Determine the order in which tasks should be completed based on their dependencies and critical path. Identify tasks that need to be done first, tasks that can run concurrently, and any tasks that are time-sensitive.
4. **Estimate Time and Resources:** Estimate the time required to complete each task and the resources needed, including materials, tools, and manpower. Be realistic in your estimations and consider any potential challenges or delays.
5. **Create a Schedule:** Using the estimated timeframes for each task, create a schedule that outlines when each task will start and finish. Use a calendar or project management software to visualize the timeline.
6. **Allocate Resources:** Assign specific resources, including tools, equipment, and workers, to each task. Ensure that each task has the necessary resources available when needed.
7. **Develop a Work Plan:** For each task, create a detailed work plan that outlines the steps to be taken, the sequence of actions, and any safety considerations. Include details such as mortar mix ratios, brick patterns, and joint thickness.
8. **Consider Contingencies:** Identify potential risks and challenges that could impact the schedule or quality of work. Develop contingency plans to address these issues if they arise.

6.1.3 Labour Productivity

Labour productivity refers to the amount of output or work accomplished by a specific amount of labor input. In the context of a brick mason, labour productivity measures how efficiently and effectively the mason completes tasks and activities related to bricklaying and masonry work. It quantifies the relationship between the amount of work accomplished and the amount of effort or time invested by the brick mason and their team.

Labour productivity can be calculated using the following formula:

Labour Productivity = Total Output / Total Labor Hours

In the case of a brick mason, “Total Output” could refer to the number of bricks laid, the area covered with mortar and bricks, or the number of completed structures. “Total Labor Hours” represent the cumulative time spent by the mason and their team working on the project.

Factors Affecting Labour Productivity for Brick Masons:

1. **Skill Level:** Highly skilled brick masons are often more productive due to their efficiency and ability to produce high-quality work faster.
2. **Experience:** Experienced masons are familiar with various techniques, tools, and best practices, which can lead to increased productivity.
3. **Work Conditions:** Favorable work conditions, such as proper tools, equipment, and a comfortable environment, contribute to higher productivity.
4. **Supervision:** Effective supervision and clear communication from supervisors can enhance productivity by providing guidance and addressing challenges promptly.
5. **Team Collaboration:** Smooth collaboration within a team can lead to coordinated efforts and efficient completion of tasks.
6. **Task Complexity:** Complex tasks might require more time and attention, affecting productivity compared to routine tasks.

6.1.4 Work Productivity for Brick Masons

Work productivity, specifically for brick masons, focuses on how efficiently they complete their specialized tasks, such as laying bricks, setting mortar, and constructing walls or structures. Work productivity considers the quality, accuracy, and speed at which these tasks are executed.

Factors Influencing Work Productivity for Brick Masons:

1. **Brick Laying Techniques:** Efficient techniques for laying bricks, such as using the right mortar consistency and maintaining proper alignment, contribute to work productivity.

2. **Mortar Mixing:** Proper mixing of mortar ensures consistent quality and workability, which affects how smoothly and quickly bricks can be laid.
3. **Joint Thickness:** Maintaining consistent and appropriate joint thickness between bricks is essential for structural integrity and aesthetic appeal.
4. **Alignment and Leveling:** Accurate alignment and leveling of bricks enhance the quality of the finished wall while reducing the need for rework.
5. **Time Management:** Efficient use of time during tasks, including minimizing breaks and downtime, impacts overall work productivity.
6. **Adaptability:** Being able to adapt to different types of bricks, layouts, and designs helps maintain productivity even in varied situations.
7. **Equipment Use:** Proper utilization of tools and equipment, such as trowels, spirit levels, and masonry saws, contributes to streamlined work processes.
8. **Quality Control:** Regular quality checks during and after work ensure that mistakes are caught early and corrected promptly.

6.1.5 Organizing the Tool, Manpower, and Material Resources

Organizing the required tool, manpower, and material resources for a task assigned to a brick mason involves careful planning and coordination. Here's a step-by-step guide on how to do it effectively:

1. **Understand the Task:** Clearly understand the scope of the task assigned to the brick mason. This includes knowing the specific bricklaying requirements, the timeline for completion, and any quality standards that need to be met.
2. **Create a Task List:** Break down the task into smaller activities. For instance, if the task is to construct a brick wall, activities could include setting up the foundation, mixing mortar, laying bricks, pointing, and cleaning up.
3. **Identify Required Resources:**
 - **Tools:** Identify the specific tools required for each activity. For bricklaying, this might include trowels, spirit levels, masonry saws, jointers, and line blocks.



Fig. 6.1.3 Tools used by a Brick Mason

- **Manpower:** Determine the number of brick masons and laborers needed based on the scale of the task and the estimated completion time.
- **Materials:** List the necessary materials, such as bricks, mortar, sand, water, safety equipment, and any specialized materials required for the task.

4. Determine Quantity:

- **Tools:** Ensure there are enough tools available for each worker involved in the task. Assign specific tools to each mason to avoid conflicts.
- **Manpower:** Assign roles and responsibilities to each brick mason and laborer. Clearly communicate expectations and timelines.
- **Materials:** Calculate the quantity of materials needed based on the size of the task and the specifications. Ensure an adequate supply of materials to avoid interruptions.

5. Schedule the Task:

- **Tools:** Ensure that tools are organized and easily accessible at the work site. Set up tool storage areas to prevent clutter and confusion.
- **Manpower:** Establish work shifts or schedules to ensure a consistent presence of brick masons and laborers throughout the task.
- **Materials:** Schedule the delivery of materials based on the progress of the task to avoid shortages or excess.

6. Coordinate Communication:

- **Tools:** Communicate tool assignments and locations to each brick mason. Ensure tools are returned to their designated places after use.
- **Manpower:** Establish a communication channel to provide updates, share progress, and address any concerns among the team members.
- **Materials:** Maintain communication with suppliers to ensure timely delivery of materials and manage any changes in requirements.

7. Allocate Workspace:

- **Tools:** Designate specific areas for tool storage and organize them for easy access. Implement a system for tracking tools to prevent loss or misplacement.
- **Manpower:** Allocate work zones for each brick mason to avoid interference and promote a smooth workflow.
- **Materials:** Arrange materials in an organized manner, keeping them within reach of the brick masons. Use pallets or racks to prevent damage or wastage.

8. Ensure Safety and Training:

- **Tools:** Ensure that all tools are well-maintained and in safe working condition. Provide training on proper tool usage and safety precautions.
- **Manpower:** **Ensure that brick masons and laborers are aware of safety protocols, including** proper lifting techniques, use of personal protective equipment (PPE), and emergency procedures.
- **Materials:** Store materials in a way that minimizes the risk of accidents or injuries. Keep hazardous materials properly labeled and stored.

9. Monitor Progress: Regularly monitor the progress of the task to ensure that the allocated resources are being utilized effectively. Address any challenges or issues that arise promptly.

10. Document and Learn: After completing the task, evaluate the organization of resources and identify areas for improvement. Document lessons learned and apply them to future tasks for continuous improvement.

Unit 6.2: Organising Resources

Unit Objectives

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

1. Explain requisition of resources, reporting for requirement of resources orally and in written to concerned authority.
2. Demonstrate optimum use of resources while performing domain specific work activities.
3. Demonstrate waste collection and disposal as per organisational norms.
4. Explain how to minimise wastage of resources.
5. Explain the plan for waste collection and disposal after task.
6. Demonstrate requisition of resource citing an example.

6.2.1 Organisation of Resources

Organising is a process of engaging co-workers and developing a productive relationship amongst them for the purpose of completing a given task. Organising and planning are the two most important factors for efficient and successful job.

Organising includes:

- Identification of activities.
- Grouping and classification of activities
- Identification of appropriate tools, equipment and materials before starting work
- Identification and arranging proper Manpower.
- Assignment of duties to appropriate people.
- Creation and delegation of responsibilities among co-workers for completion of work.
- Coordination of work among the team and across teams.
- Organising training or providing guidelines to avoid damage of equipment.
- Planning and organising work environment to avoid accidents.
- Organising resources to avoid waste of materials.



Fig. 6.2.1 Organization of required Resources

Being organised helps to:

- Make better decisions.
- Identify available resources.
- Anticipate needs and problems.
- Get work done accurately by avoiding costly mistakes.
- Be more efficient and productive.
- Complete desired tasks and activities.

6.2.2 Monitoring

Monitoring is done to ensure that everything goes according to set rules and timelines

Steps for Monitoring

- Prioritising work activities & create a work plan for completing own work
- Measuring actual work progress of self and sub ordinates at regular intervals
- Comparing actual work done with the plan and identifying the gaps if any
- Taking corrective measures to rectify the gaps.



Fig. 6.2.2 Monitoring of Work

6.2.3 Optimising use of Resources

Resources can be used in an optimum way by following the guidelines mentioned below.

- Analyse the capabilities of individuals and the characteristics job requirements
- Match the right people with the right job
- Rotate jobs to avoid boredom
- Rotate people to give them varied experience and training opportunities
- Make provisions for absenteeism



Fig. 6.2.3 Optimising use of Resources

Unit 6.3: Sequence of Work for Brick Mason

Unit Objectives

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

1. Explain the procedure adopted for prioritizing an activity and sequencing of activities.
2. Explain the work plan and flow of activities in sequence for the assigned work.
3. Demonstrate completion of work within stipulated time and plan.

6.3.1 Sequence of Work for Brick Mason

The sequence of work for a brick mason involves a systematic approach to bricklaying and masonry tasks to ensure efficiency, quality, and structural integrity. Here's a general sequence of work for a brick mason:



Fig. 6.3.1 Brick Mason Working

1. Clear the area, set up scaffolding for site preparation.
2. Lay a level foundation and footings for stability.
3. Mix cement, sand, and water to create mortar.
4. Start with the alignment of the first course of bricks.
5. Build subsequent courses, maintaining a level surface.
6. Construct openings for doors and windows, adding lintels when needed.
7. Fill joints with mortar, ensuring neat finishes and uniformity.

8. Allow time for proper curing and drying of the mortar.
9. Regularly inspect for alignment and leveling as part of quality checks.
10. Remove excess mortar and clean the finished brickwork.
11. Perform a final inspection to ensure quality and compliance.
12. Complete the work and hand over the area for further construction.
13. Keep records of work and materials used for documentation purposes.

6.3.2 Urgency and Importance Assessment

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

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



Fig. 6.3.2 Urgent versus Importance (Prioritization Matrix)

Exercise

Answer the following questions:

- I. Multiple Choice Questions (MCQs): What does SMART stand for in SMART goals?
 - a. Simple, Measurable, Achievable, Realistic, Time-bound
 - b. Specific, Measurable, Achievable, Relevant, Time-bound
 - c. Strategic, Measurable, Aligned, Relevant, Time-bound
 - d. Specific, Meaningful, Achievable, Realistic, Time-bound

1. What is the purpose of monitoring in work activities?
 - a. Increase workload
 - b. Ensure timely breaks
 - c. Ensure work meets set rules and timelines
 - d. Reduce communication with coworkers

2. Which of the following is NOT a factor influencing work productivity for brick masons?
 - a. Brick laying techniques
 - b. Joint thickness consistency
 - c. Time management
 - d. Work attire color

3. What is the first step in the sequence of work for a brick mason?
 - a. Laying bricks
 - b. Mixing cement and sand
 - c. Clearing the work area
 - d. Inspecting the final work

4. What should be considered when organizing resources to avoid waste of materials?
 - a. Quantity of resources available
 - b. Identifying appropriate tools and equipment
 - c. Rotating jobs to avoid boredom
 - d. Delegation of responsibilities among coworkers

II. Fill in the Blanks:

1. Organizing resources involves identifying appropriate _____, equipment, and materials.
2. Measuring actual work progress and comparing it with the plan is part of _____.
3. _____ is the efficient use of resources to achieve optimal results.

4. Clearing the work area and setting up scaffolding are part of the _____ of work for a brick mason.
5. Matching the right people with the right job and providing provisions for absenteeism help in optimizing the use of _____.

III. Very Short Answers:

1. What are SMART goals used for?
2. Why is monitoring important in work activities?
3. What is the purpose of joint thickness consistency in bricklaying?
4. Name one factor that influences work productivity for brick masons.
5. What is the final step in the sequence of work for a brick mason?



7. Work effectively in a Team to deliver Desired Results at the Workplace



Unit 7.1 - Effective Communication and Teamwork

Unit 7.2 - Working Effectively and Maintaining Discipline at Work

Unit 7.3 - Maintaining Social Diversity at Work



Key Learning Outcomes

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

1. Elucidate own roles and responsibilities.
2. Explain the importance of effective communication.
3. Elucidate the consequence of poor teamwork on project outcomes, timelines, safety at the construction site, etc.
4. Demonstrate how to pass on work related information/ requirement clearly to the team members.
5. Explain different modes of communication used at workplace.
6. Explain the importance of creating healthy and cooperative work environment among the gangs of workers.
7. Show how to report any unresolved problem to the supervisor immediately.
8. Elucidate applicable techniques of work, properties of materials used, tools and tackles used, safety standards that co-workers might need as per the requirement.
9. Demonstrate ways to hand over the required material, tools, tackles, equipment and work fronts timely to interfacing teams.
10. Explain the importance of proper and effective communication and the expected adverse effects in case of failure relating to quality, timeliness, safety, risks at the construction project site.
11. Explain the importance and need of supporting co-workers facing problems for the smooth functioning of work.
12. Demonstrate ways to work together with co-workers in a synchronized manner.
13. Discuss the fundamental concept of gender equality.
14. Explain how to recognise and be sensitive to issues of disability, culture and gender.
15. Discuss legislation, policies, and procedures relating to gender sensitivity and cultural diversity including their impact on the area of operation.
16. Demonstrate effective implementation of gender neutral practices at workplace.
17. Demonstrate ways to address discriminatory and offensive behaviour in a professional manner as per organizational policy.

Unit 7.1: Effective Communication and Teamwork

Unit Objectives

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

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

7.1.1 Communication at Workplace

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

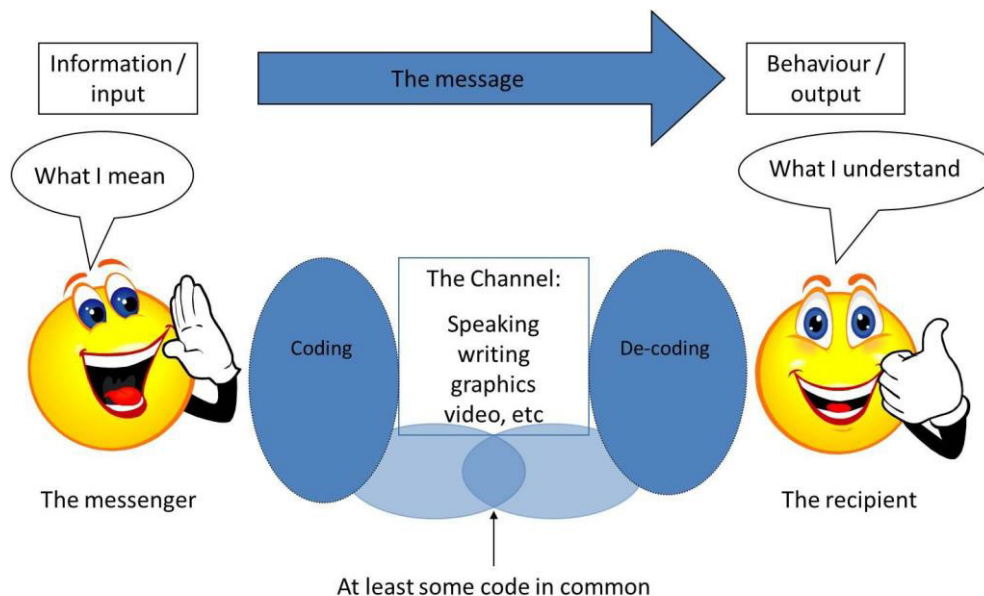


Fig. 7.1.1 Effective Communication – Two-way Process

- **Sender:** The person or entity starting the communication.
- **Message:** The information that the sender wishes to share.

- **Encoding:** Choosing the medium to send a message.
- **Channel:** The medium used to send a message.
- **Receiver:** The person or entity to whom the message is sent.
- **Decoding:** Understanding the message received.
- **Feedback:** The receiver's response to the message.

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

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



Fig. 7.1.2 C's of Communication

7.1.2 Type of Communication at Construction Worksite

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

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

Some common communication methods include:



Fig. 7.1.3 Communication at Construction

- **Verbal Communication:** This involves face-to-face conversations, discussions, and instructions between workers, supervisors, and managers on the site. Verbal communication is essential for conveying immediate instructions and clarifications.
- **Hand Signals:** Hand signals are commonly used in noisy construction environments where verbal communication may be difficult. Workers use specific hand gestures to communicate instructions or warnings to each other.
- **Written Communication:** Written communication includes various documents, such as construction plans, safety guidelines, work permits, and daily progress reports. Written communication helps in conveying detailed information and serves as a reference for all stakeholders.
- **Radios and Walkie-Talkies:** Two-way radios and walkie-talkies are popular communication tools at construction sites, especially for larger projects. They allow instant communication between workers and supervisors across different areas of the site.
- **Visual Communication:** Visual aids, such as signs, symbols, and safety posters, are used to convey important information and warnings. These aids help in reminding workers of safety protocols and hazard awareness.
- **Digital Communication:** Construction sites may use digital communication platforms like mobile apps or messaging services to facilitate real-time communication, share updates, and coordinate tasks.
- **Meetings and Toolbox Talks:** Regular meetings and toolbox talks are conducted to discuss project progress, safety updates, and address any concerns or questions raised by workers.

- **Project Management Software:** Construction companies often use project management software that enables seamless communication between project teams, provides updates, and tracks tasks and schedules.
- **Emergency Communication Systems:** In case of emergencies, construction sites may have emergency communication systems like alarms or sirens to alert workers and initiate evacuation procedures.

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





Fig. 7.1.4 Coordination during Construction Work

7.1.3 Adverse Effects of Poor Communication



Fig. 7.1.5 Adverse Effects of Poor Communication

| Hearing | Listening |
|---|--|
| Receiving any message through ears is known as hearing. | On the other hand explanation of the received message can be labeled as listening. |
|  |  |
| Function of hearing is just to receive the verbal message. | Listening involves decoding or interpretation of the message. |

Understanding instructions correctly is crucial for project success. Active listening ensures that workers grasp the requirements, specifications, and safety measures provided by supervisors and project managers. It minimizes the risk of miscommunication and mistakes that could lead to delays, rework, or even accidents.

Safety is of paramount importance in the construction industry. Active listening helps workers' pay attention to safety briefings, hazard warnings, and emergency procedures. By actively engaging in safety protocols, workers can protect themselves and their colleagues from potential risks, accidents, and injuries.

Teamwork is vital on construction sites, where multiple professionals collaborate to achieve project objectives. Active listening fosters a culture of open communication, where workers feel comfortable sharing ideas, concerns, and feedback. It promotes mutual respect, trust, and inclusivity, leading to better collaboration and problem-solving.

Adaptability is essential in the dynamic construction environment. Active listening keeps workers informed about changes, updates, and unexpected challenges. Being receptive to new information enables them to adjust their approach and work efficiently, ensuring project progress remains on track.

Moreover, active listening enables construction professionals to build strong relationships with team members, clients, and stakeholders. By understanding and acknowledging others' perspectives, workers demonstrate empathy and enhance client satisfaction.

Overall, active listening at a construction site enhances safety, teamwork, productivity, and client relations. It empowers workers to communicate effectively, respond to challenges proactively, and contribute to the successful completion of construction projects.

7.1.4 Teamwork at Workplace

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



Fig. 7.1.6 Teamwork at Workplace

Here are some key reasons highlighting the importance of teamwork:

- **Achievement of Common Goals:** Teamwork brings together individuals with diverse skills and expertise to work collectively towards a shared objective. When team members collaborate effectively, they can accomplish more than what could be achieved individually.
- **Enhanced Creativity and Innovation:** Working in a team allows for the exchange of different perspectives and ideas. This diversity fosters creativity and innovative problem-solving, leading to better solutions and approaches.
- **Improved Productivity:** Team members can divide tasks based on their strengths and expertise, leading to improved efficiency and productivity. This distribution of workload ensures that each aspect of a project is handled by the most suitable team member.
- **Shared Responsibility and Accountability:** In a team, each member has a specific role and responsibility. This sense of accountability motivates individuals to perform their best and take ownership of their contributions.
- **Effective Decision Making:** Teams can pool their knowledge and insights to make well-informed decisions. When diverse viewpoints are considered, the decisions tend to be more balanced and comprehensive.

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

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

7.1.5 The 5Cs of Teamwork

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

The 5Cs of teamwork are:

1. Co-operation

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



Fig. 7.1.7 Effective and Successful Collaboration

1. **Compromise**

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

2. **Communication**

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

3. **Confidence**

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

4. **Commitment**

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

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

7.1.7 Consequence of Poor Teamwork

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

Some of the key consequences of poor teamwork include:

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



Fig. 7.1.8 Poor Teamwork

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

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

Unit 7.2: Working Effectively and Maintaining Discipline at Work

Unit Objectives

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

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

7.2.1 Discipline at Work

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



Fig. 7.2.1 Discipline at Work

Here are some key aspects of discipline at work:

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

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

7.2.2 Time Management

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

By effectively managing their time, employees will meet deadlines, increase their effectiveness,

become more productive, and produce superior work.



Fig. 7.2.2 Time Management

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

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

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

1. **Avoid Multitasking:** Instead of trying to tackle multiple tasks simultaneously, focus on completing one task at a time to ensure better quality and efficiency.
2. **Learn Time-Saving Techniques:** Seek out and learn time-saving techniques specific to your tasks or trade. Efficiency comes with experience and knowledge.
3. **Seek Feedback:** Ask for feedback from supervisors or experienced colleagues on ways to improve your time management skills.
4. **Reflect and Improve:** Regularly assess your time management and productivity. Identify areas for improvement and actively work towards refining your approach.

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

7.2.3 Interpersonal Conflicts at Construction by Workers

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

Some common causes of interpersonal conflicts at construction sites include:

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



Fig. 7.2.3 Interpersonal Conflicts

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

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

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



Fig. 7.2.3 Interpersonal Conflicts

Unit 7.3: Maintaining Social Diversity at Work

Unit Objectives

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

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

7.3.1 Gender Sensitivity

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

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



Fig. 7.3.1 Gender Equality

Important Terms

- **Gender Sensitivity-** Gender sensitivity is the act of being sensitive to the ways people think about gender.
- **Gender Equality** - It means persons of any gender enjoy equal opportunities, responsibilities, and rights in all areas of life.
- **Gender Discrimination** - It means treating an individual unequally or disadvantageously based on their gender, e.g. paying different wages to men and women for similar or equal job positions.



Fig. 7.3.2 Gender Discrimination

Strategies for Enhancing Gender Equity

To enhance gender equity, one should:

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

Bridging Gender Differences

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

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

In order to bridge the gap, one should:

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



Fig. 7.3.3 Promoting Gender Sensitivity at Workplace

Ways to Promote Gender Sensitivity in the Workplace

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

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

7.3.2 PwD Sensitivity

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



Fig. 7.3.4 Disability-Friendly Workplace

Important Terms

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

- f) Mental retardation
- g) Mental illness

PwD Sensitivity

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

Ways to be PwD Sensitive

To be sensitive to PwD, one should:

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

Appropriate Verbal Communication

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

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

Appropriate Non-verbal Communication

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

- **Facial expressions** - The human face is quite expressive, capable of conveying many emotions without using words. Facial expressions must usually be maintained neutral and should change

according to the situation, e.g. smile as a gesture of greeting.

- Body posture and movement - One should be mindful of how to sit, stand, walk, or hold their head. For example - one should sit and walk straight in a composed manner. The way one moves and carries self, communicates a lot to others. This type of non-verbal communication includes one's posture, bearing, stance, and subtle movements.
- **Gestures** - One should be very careful with their gestures, e.g. waving, pointing, beckoning, or using one's hands while speaking. One should use appropriate and positive gestures to maintain respect for the other person while being aware that a gesture may have different meanings in different cultures.
- **Eye contact** - Eye contact is particularly significant in non-verbal communication. The way someone looks at someone else may communicate many things, such as interest, hostility, affection or attraction. Eye contact is vital for maintaining the flow of conversation and for understanding the other person's interest and response. One should maintain appropriate eye contact, ensuring not to stare or look over the shoulders. To maintain respect, one should sit or stand at the other person's eye level to make eye contact.
- **Touch** - Touch is a very sensitive type of non-verbal communication. Examples are - handshakes, hugs, pat on the back or head, gripping the arm, etc. A firm handshake indicates interest, while a weak handshake indicates the opposite. One should be extra cautious not to touch others inappropriately and avoid touching them inadvertently by maintaining a safe distance.

Rights of PwD

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

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

Making Workplace PwD Friendly

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

Expected Employer Behaviour

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

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



Fig. 7.3.4 Disability-Friendly Workplace

Exercise



Answer the following questions:

Short Questions:

- A. Why is effective communication important in construction job roles?
- B. What are the consequences of poor teamwork on project outcomes and safety at a construction site?
- C. How can you pass on work-related information clearly to your team members?
- D. What are some different modes of communication used in the workplace?
- E. Why is creating a healthy and cooperative work environment important among gangs of workers?

Fill-in-the-Blanks Questions:

- A. _____ (Effective / Limited) communication ensures that project goals and tasks are understood by everyone.
- B. Poor teamwork can lead to delays, compromised _____ (Quality / Efficiency), and increased safety risks.
- C. To ensure clarity, it's essential to provide work-related information to team members in a _____ (Concise / Detailed) manner.
- D. Communication modes include verbal, written, visual, and _____ (Digital / Auditory) forms.
- E. Creating a cooperative work environment fosters efficient collaboration and _____ (Unity / Isolation) among workers.

True/False Questions:

- A. Effective communication is only important for supervisory roles. (True/False)
- B. Poor teamwork rarely affects project timelines or safety on a construction site. (True/False)
- C. Passing on work-related information is not necessary if everyone has their own tasks. (True/False)
- D. Communication modes in the workplace are limited to verbal and written forms. (True/False)
- E. A cooperative work environment can enhance productivity and worker morale. (True/False)



Elective 1

8. Process of carrying out Brick Bat Coba Waterproofing



Unit 8.1 Brick Bat Coba Waterproofing



Key Learning Outcomes

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

1. Demonstrate brick bat coba water proofing.

Unit 8.1: Brick Bat Coba Waterproofing

Unit Objectives

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

1. Interpret the sketches/basic working drawing for waterproofing works
2. Describe the standard practices for waterproofing works.
3. Explain the use of various tools and equipment used for waterproofing works and their standard specifications.
4. Describe the different surface preparation method prior to waterproofing.
5. Describe the procedure for laying out brick bat coba waterproofing course.
6. Describe the procedure of checking water leakage in waterproofed surface.
7. Describe the procedure for carrying out horizontal and vertical alignment of waterproofed course.
8. Describe the procedure for transferring levels on floor for maintaining desired slope.
9. Demonstrate preparation of surface (filling of non-structural gaps) prior to waterproofing works.
10. Demonstrate marking and transferring of required levels for maintaining slope in waterproofing works.
11. Demonstrate application of cement mortar to the prepared surface using appropriate tools.
12. Demonstrate laying of brick bat coba course for waterproofing works ensuring line, level and alignment.
13. Perform checks for detecting leakage on the waterproofed surface
14. Demonstrate filling of gaps in brick bat coba course using appropriate cement mortar of specified thickness.

8.1.1 Waterproofing Works

As the constructed structure becomes old, cracks develop in the walls and leakages begin visible. To secure the building from leakages/seepages waterproofing is the best solution. Waterproofing helps in increasing the life of the structure. It also enhances the appearance of the building.

The traditional method of brick bat coba is the most popular waterproofing method for terraces in India.

8.1.2 Types of Defects on Concrete Surfaces

Different types of defects on concrete surfaces are:

| Defects | Image |
|---|--|
| <p>Cracking: Cracking occurs because of either one of the factors like restraint, thermal contraction, shrinkage drying, sub grade settlement, applied load or combination of these factors.</p> |  |
| <p>Curling: This occurs because of distortion of a corner and edges of a slab because of difference in temperature and moisture content between top and bottom of a slab.</p> |  |
| <p>Delamination: This mostly occurs in power finished concrete where surface mortar layer is detached from main mortar layer because of trapping of water and air in the mortar surface.</p> |  |
| <p>Efflorescence: It is a type of discoloration. A deposit, usually white in colour, that sometimes develops, just after a structure is completed.</p> |  |

Low spots: Low spots are depressions because of uneven levelling of concrete. They effect drainage of slab.



Pop-outs: It is a conical fragment that breaks out of the surface of the concrete leaving a hole that may vary in size.



Spalling: It occurs because of presence of water inside concrete which causes the concrete to peel off. It appears as circular or oval depressions on surfaces or as elongated cavities along joints.



8.1.3 Different Types of Waterproofing Works

Waterproofing works is carried out for W.C, bathroom, terrace, sloping roofs, water tanks, basement, and swimming pools.

Different types of waterproofing works are given below:

1. **Brick Bat Coba Method:** Brick Bat Coba Method: It is carried out by placing and levelling broken bricks and aggregates and covering them with concrete of thickness 80-100 mm. Concrete can be either of lime or cement mixed with waterproofing compound. This is useful for giving the surface the required slope so that the water is drained-out quickly. Waterproofing with brick bat coba is carried out by first cleaning the RCC slab. All loose particles, dust and debris

are cleared off. Cement slurry mixed with waterproofing compound is spread on the cleaned surface and filling up uneven surface is carried out.



Fig. 8.1.1 Brick Bat Coba Method

- 2. Cement / Lime based waterproofing:** This type of waterproofing involves coating the surface with cement lime mortar. This also results in increase in heat insulation.



Fig. 8.1.2 Cement / Lime based waterproofing

- 3. Silicon based impregnators:** This type of waterproofing is popular as it is easy in application and is economical. It finds application for aesthetic purpose as it is transparent in use and is used in stone masonry and brick masonry where there is no plaster.



Fig. 8.1.3 Silicon based impregnators waterproofing

- 4. Waterproofing adhesives for tiles, marble, granite:** For this type of waterproofing, chemical agents like waterproofing adhesives are used for fixing tiles, granite on various structures.

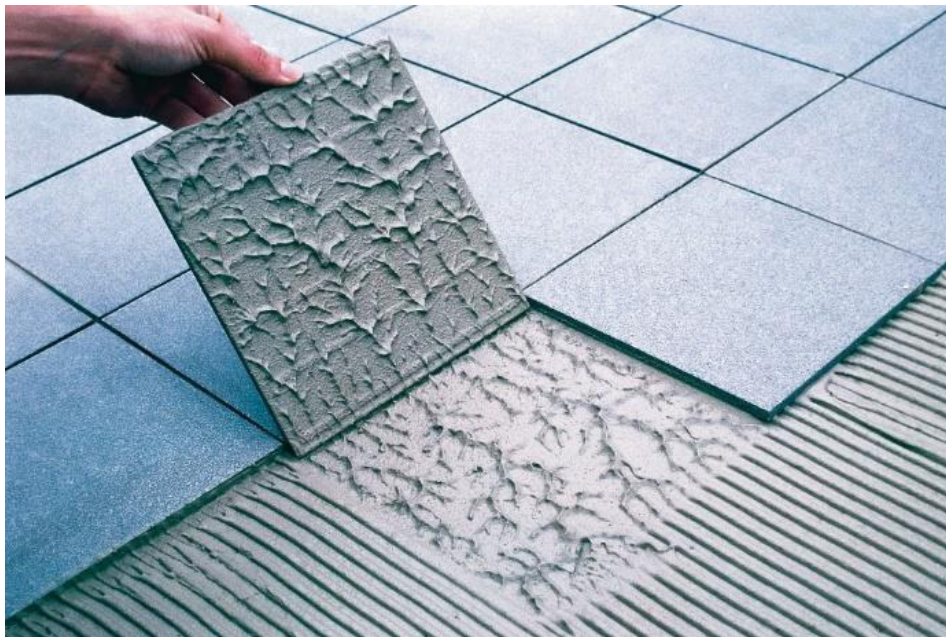


Fig. 8.1.4 Waterproofing adhesives for tiles, marble, granite

8.1.4 Sketches for Waterproofing Works

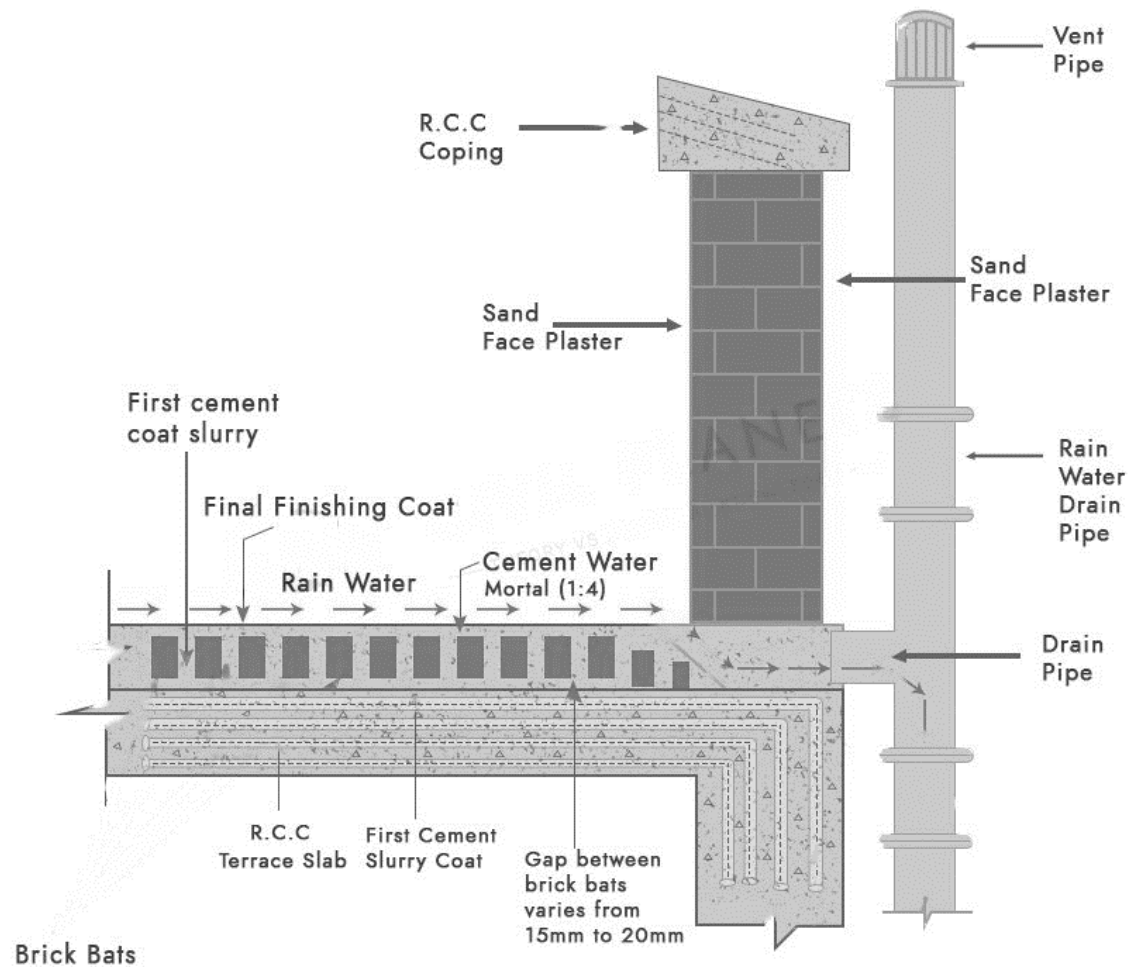


Fig. 8.1.5 Sketches for Waterproofing

With reference to the sketch given, this shows:

- A cross section of brickbat coba waterproofing over flat roof slab.
- Water proofing layer need to be given slope and finish with vata at junction.
- Top of proper wall surface to provide with DPC (Damp proof course) sloping towards inner face of roof/terrace.

Quantities of material required for 1 cum waterproofing on flat surface in CM 1:4

- Total Quantity required = 1.00 cum
- Brick bats = 65 percent of 1.00 cum = 0.65 cum = 22.96 cft say 25 cft
- Cement mortar = $1.0 - 0.65 = 0.35$ cum
- 15 percent more for voids and 33 percent more as dry quantity.
- Wet cement mortar = 0.425 cum

- Dry quantity = 0.5353 cum (33% more)
- Cement required = $0.5353 / 5 = 0.1076$ cum = 3.05 bags say 3.00 bags
- Sand = $0.1076 \times 4 = 0.42824$ cum = 15.13 cft say 16.00 cft
- (Conversions used: 1 brass = 2.83 cum = 100 cft and 1 bag of cement = 0.035 cum)


Summary of materials required for 1.00 cum of brick bat coba w/p in CM 1:4




Brick bats = 25 cft, Cement = 3 bags and Sand = 16 cft





8.1.5 Standard Practices for Waterproofing Work





1. The good quality material is selected.
2. The brick bats are soaked in water before use.
3. The brick bat are placed on the edge and not flat.
4. Proper gaps are maintained between the brick bats.
5. The slope of the brick bat coat are checked, towards the trap.
6. The waterproofing compound is mixed in the mortar, for every stage of work.
7. The top coat is carried out in one stroke.
8. Proper finishing is done near traps and spouts.
9. Each stage is checked for leakage, by flooding it with water.
10. The waterproofing of the terrace is cured with the ponding method.





8.1.6 Tools used in Waterproofing

| Tool | Image | Use |
|----------------|---|---|
| Air Compressor |  | Faulty and patchy concrete surface is cleaned with wire brush and then air compressor is used or water jet to completely remove dust. |

| | | |
|----------------|---|--|
| Trowel |  | <p>Trowel helps you to pick up the mortar and spread it evenly while laying the blocks. The common masonry trowel is triangular in shape, the size of which varies from 10 to 20 cm in width and up to 28 cm in length. The pointing trowel used for pointing and striking joints, is smaller in size and varies from 8 to 16 cm in length and 5 to 8 cm in width.</p> |
| Rollers |  | <p>Rollers are used to apply waterproofing compound on masonry surface.</p> |
| Brushes |  | <p>Used to apply waterproofing compound (mixed in cement slurry) on the waterproofing surface.</p> <p>Brushes are also used to clean the surface of loose stone, dirt and dust.</p> |
| Angle grinders |  | <p>All sharp extensions are grinded with angle grinder or electrical grinder before waterproofing.</p> |

| | | |
|-----------------|---|---|
| Shovels |  | Shovels are used to break corners and uneven surfaces where the area is huge. |
| Electric drills |  | Approximately 12 mm diameter holes in the concrete is created using electric drill in a grid pattern at required spacing as per the site conditions but in no case exceeding 1 mtr. |
| Concrete mixer |  | The concrete mixer is a machine which can mix large quantity of cement, water, coarse aggregates and sand to produce concrete for ready use. |
| Wheel barrows |  | The wheelbarrow is convenient for easier transport of smaller loads of sand, cement, mortar, bricks or other building materials at the site without the use of powered machines. |

| | | |
|---------------------------------|---|--|
| <p>Knives or cutting blades</p> |  | <p>Honey comb areas on concrete surfaces are scrapped by knife to smoothen the surface.</p> |
| <p>Hammers</p> |  | <p>Hammer is used for breaking or splitting masonry units.</p> |
| <p>Brooms</p> |  | <p>It is used to give the concrete floor a finished texture. It provides a durable, high-traction surface.</p> |
| <p>Vacuum cleaner</p> |  | <p>All dust, dirt and loose plaster from damp surfaces are effectively removed through vacuum cleaner.</p> |

| | | |
|---------------|---|--|
| Straight edge |  | <p>Straight edge is a tool used to check the flatness/ straightness of surface or lines. The commonly used straight edge is hollow, rectangular in shape, the length of which can be up to 500 cm and width from 4.5 cm to 3.5 cm.</p> |
| Spirit Level |  | <p>Sprit level is used to check the levelling of horizontal surface.</p> |
| Plumb bob |  | <p>Use the plumb to check the verticality of a wall or column.</p> <p>While dropping the Plumb, make sure that the tip is not tilting</p> |
| Line Thread |  | <p>Nylon rope helps you to ensure that bricks are aligned properly in the form of a mason's line.</p> |

| | | |
|----------------|---|---|
| Mason's square |  | Mason's square is used to set the right angles. Also, used for testing corners during plastering. |
|----------------|---|---|

Table 8.1.2 Tools used in Waterproofing

8.1.7 Safety Gears used in Waterproofing

While carrying out waterproofing work, workers need to wear Personal Protection Equipment (PPE).

These are necessary to protect the skin of workers particularly from heat of hydration when cement and water are mixed or from vapour of chemicals (if used for bond coat or membranes etc.)



Fig. 8.1.5 Sketches for Waterproofing

8.1.8 Materials used for Waterproofing

Type of Waterproofing Materials

Waterproofing materials are subdivided based on their purpose into anti seepage, anticorrosion and hermetic and based on material into asphalt, mineral, plastic, and metallic.

- Asphalt waterproofing materials are used in the form of petroleum bitumens with mineral powder, sand and crushed stone.
- Mineral waterproofing materials are prepared with a base of cements, clay, and other mineral binding agents. Used in anti-seepage protection for painted and plastered coatings.
- Plastic waterproofing materials are used for painted, plastered and glued waterproofing of surfaces. Used for sealing of deformation joints.
- Metallic waterproofing materials include metals such as copper, steel, brass, lead, and stainless steel sheets. They are used for surface waterproofing. They seal joints with deformation in critical areas like storage tanks, dams, etc.

8.1.9 Types of Waterproofing Compounds

Waterproofing chemicals are compounds which are mixed with cement at the time of concreting, to act as a protective barrier and prevents water penetration and provides concrete with long lasting water proofing property.. Few chemical compounds used in waterproofing works are:

- Tar/bitumen based compounds
- Inorganic compounds with little percentage of chlorides and sulfates
- Acrylic based compounds
- Epoxy Resins
- Polysulphides
- Polyurethanes
- Silicones

8.1.10 Surface Preparation for Terrace Waterproofing

Steps to be followed for preparing surface for terrace waterproofing:

Step 1: Clean the roof surface and remove extra mortar by using chisel.

Step 2: Thoroughly clean the surface/roof on which brick bat coba is to be applied.

Step 3: Make a slurry by adding one bag of cement to hundred litres of water and stir it.

Step 4: place and spread the slurry on the roof surface covering the surface completely.

Step 5: Check the grading of the sand.

Step 6: Check the terrace door level. Ensure there is enough margin (15cm approximately) for waterproofing is left from the bottom side.

Step 7: Check the level.

Step 8: Ensure the rainwater pipe is bent in the correct position.

Step 9: Stack the brick bats on the terrace and soak them in water before use.

Step 10: Check all the tools and materials are handy.

8.1.11 Line and Level Alignment

- Fix the slope from lowest point to the drainage outlet by using line thread fixed in a slope of 1:125.
- Cover drainage/rain water outlets with gunny bags to prevent cement slurry from entering them.

8.1.12 Procedure for Preparing Waterproofing Cement Mortar Mixture

Step 1: Ensure all the ingredients like cement, sand are dry mixed thoroughly

Step 2: Add water to cement sand mix to make mortar of proper consistency. Wash the ingredients thoroughly to remove chemicals and dust

Step 3: Dilute the waterproofing compounds with water and mix with wet cement mortar

Step 4: Follow manufacturer's specification specimen for the process

Step 5: Prepare cement concrete in ratio of (1:2:4) i.e. cement: sand: coarse aggregate

Step 6: For normal plastering the cement mortar mixed is generally with the ratio of 1:3 or more



Fig. 8.1.7 Waterproofing Cement Mortar Mixture

8.1.14 Preparation before Laying Brick Bat Coba Coat

Step 1: Fix a line thread in a slope 1:150 starting from the lowest point of rainwater down-take and by keeping a minimum thickness of 65mm, below the rainwater outlet.

Step 2: Fix bricks bats in cement-mortar layer of 1:6 proportion in a slope of 1:150 with the water proofing compound.

Step 3: Fill the cement –mortar 1:4 with water-proofing compound in the brick bat joints.

Step 4: The brick bats should be soaked in water prior to use.



Fig. 8.1.8 Dampening of brick in water

Step 5: If the work is incomplete at the end of the day and if joints are required for the next day's work then provide brick bats in staggered manner at the end of same day.

Step 6: Fix small pieces of brick bats along with 20mm metal for rounding at the bottom of the parapet wall.



Fig. 8.1.9 Fixing of small pieces

Step 7: Take proper care for achieving the round shape near the rain water pipe.

Step 8: Cover drainage/rain water outlets with gunny bags to prevent cement slurry from entering them.

Step 9: Cure the brick bat for at least seven days.

8.1.15 Process of Transferring Levels on Floor for

Maintaining Desired Slope

Step 1: Levels at certain intervals are calculated. (30cm x 30cm squares are marked with thread line).

Step 2: These levels are marked on surface by nails.

Step 3: Thread is tied to the nail.

Step 4: Finishing course is applied maintaining the thickness equal to that of thread

8.1.16 Procedure for Laying Brick Bat Coba Coat

Step 1: Spread cement-mortar mixed with water proofing compound over the placed brick bat coba.

Step 2: Spread the cement mortar over the brick bat coba to a specified depth.



Fig. 8.1.10 Spreading of cement-mortar

Step 3: Carry out levelling of the surface using float or a suitable tools up to 1" thickness.

Step 4: Apply thick cement slurry over the levelled surface, along with the waterproofing compound for a smooth finish.

Step 5: Polish the surface with metal float

Step 6: Make vertical and horizontal lines at an interval of 30cm x 30 cm, using a line thread of minimum 3mm thickness to avoid cracking of the top layer



Fig. 8.1.11 Vertical and horizontal lines

Step 7: Clean and cure the final coat.



Fig. 8.1.12 Curing the final coat

Points to be remembered for brick bat coba waterproofing are:

- The surface of waterproofing should be cured for seven days by ponding method to avoid any shrinkage cracks and swelling.
- Make provision of plastic sheet to protect waterproofing in case of occasional rain.

8.1.17 Do's and Don'ts in Waterproofing

Do's

- Select the type of waterproofing appropriately, keeping in mind performance required of that particular wet surface (bathroom/ terrace/basement wall/water tank wall).
- Do prepare surface properly
- Do mix chemicals as per manufacturer's guidelines
- Give proper slope during finish
- Do provide sufficient curing

Don'ts

- Do not expect waterproofing layer to perform structural load carrying member.
- Do not forget to insert cut-outs or place sleeves where ever necessary
- Do not forget to give proper treatment at joints.

Exercise



Answer the following questions:

I. Multiple Choice Questions (MCQs):

- What is the primary purpose of waterproofing in construction?
 - Increasing structural strength
 - Enhancing appearance
 - Improving insulation
 - Preventing leakages
- Which traditional method is commonly used for waterproofing terraces in India?
 - Cement/Lime based waterproofing
 - Silicon-based impregnators
 - Waterproofing adhesives for tiles
 - Brick bat coba
- What does “efflorescence” refer to in waterproofing?
 - A type of waterproofing compound
 - Circular depressions on surfaces
 - Discoloration caused by deposits after construction
 - The process of adding waterproofing to concrete
- Which tool is NOT used in waterproofing?
 - Trowel
 - Rollers
 - Angle grinders
 - Chisel
- What is the purpose of applying a thick cement slurry over the levelled surface in brick bat coba waterproofing?
 - To add color to the surface
 - To increase the surface’s roughness
 - To provide a smooth finish
 - To create a waterproof membrane

II. Fill in the Blanks:

- The _____ method involves placing and leveling broken bricks and aggregates and covering them with concrete for waterproofing terraces.
- Waterproofing adhesives are commonly used for fixing tiles, marble, and granite on various _____.
- During the preparation of the waterproofing cement mortar mixture, the waterproofing compounds are mixed with _____.
- Slope is provided in brick bat coba to ensure the quick _____ of water.
- The surface of waterproofing should be properly cured for at least _____ days using the ponding method.

III. Very Short Answer Questions:

- Why is waterproofing important for the longevity of a structure?
- What types of defects can occur on concrete surfaces?
- How is the slope achieved in the brick bat coba method?
- What is the purpose of silicon-based impregnators in waterproofing?
- Name one tool used in waterproofing and briefly explain its use.

Notes 

QR Codes

Scan the QR code to watch the video



https://youtu.be/O51fub_3T9U

Brickbat Waterproofing Procedure



9. Process of carrying out IPS (Indian Patent Stone) Flooring



Unit 9.1 - IPS (Indian Patent Stone) Flooring



Key Learning Outcomes

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

1. Perform preparatory works for IPS flooring.
2. Demonstrate laying of IPS flooring.

Unit 9.1: IPS (Indian Patent Stone) Flooring

Unit Objectives

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

1. Describe the standard practices for IPS flooring.
2. Explain the use of tools used in IPS flooring.
3. Explain the procedure for marking reference level and transferring of levels.
4. Explain the process of preparation of sub-base.
5. Explain the various grades of cement used in IPS flooring.
6. Describe the different mix proportions/grades of concrete.
7. Describe the procedure for manual mixing of concrete and nominal mix proportion.
8. List the various admixtures used in concreting.
9. Describe the sequence and procedure of concrete pouring and placing in alternate panels.
10. Explain the provision of cover for reinforcement w.r.t size of reinforcement
11. Describe the different type of vibrators used for concrete curing and their influence area.
12. Describe the different construction and expansion joints.
13. List the different tools used for grooving/providing expansion joints.
14. Describe the procedure for final trowelling of concrete for desired finish.
15. Demonstrate the checks to be carried out for inspection of area prior to concreting
16. Demonstrate checks for formwork and deviation in slope and alignment in PCC.
17. Demonstrate marking and transfer of levels on floor for required thickness using appropriate tools.
18. Demonstrate checks for assessing the quality of materials used in manual and machine mixing of mortar, for IPS flooring works.
19. Demonstrate fixing of glass, aluminium or brass strip in cement mortar with their tops at appropriate level and according to slope.
20. Demonstrate pouring, compaction and finishing of concrete in alternate panels.
21. Demonstrate cutting of groves for providing construction joints and expansion joints as per requirement.
22. Demonstrate levelling and curing of the finished floor surface.

9.1.1 IPS Flooring

IPS flooring stands for Indian Patent Stone Flooring.



Fig. 8.1.12 Curing the final coat

- Indian Patent Stone Flooring, is used generally for flooring, to achieve a water sloping and economical finish with a decent appearance.
- It is a basic type of cement concrete flooring which is good against wear and tear.
- It can be used for industrial, commercial or residential purposes.
- Indian Patent Stone flooring when has red oxide as topping is called red oxide flooring.

9.1.2 Standard Practices for IPS Flooring

Indian Patent Stone (IPS) flooring is a type of flooring commonly used in India for both residential and commercial spaces. It is known for its durability, affordability, and ease of maintenance. IPS flooring is often used in areas with heavy foot traffic, such as corridors, lobbies, warehouses, factories, and other similar spaces. Here are the standard practices for installing IPS flooring:

1. Surface Preparation:

- The base surface should be cleaned thoroughly to remove any dirt, dust, oil, or debris.
- Any existing flooring or loose materials should be removed, and the surface should be leveled and made even.

2. Mixing of Materials:

- IPS flooring is typically composed of a mixture of Portland cement, coarse aggregate (usually granite chips), and water.
- The mixture is prepared in a ratio of cement to aggregate, ensuring a proper consistency and workability.

3. Laying the IPS Mixture:

- The prepared IPS mixture is spread and leveled on the prepared surface using trowels, ensuring a uniform thickness throughout the area.
- The thickness of the IPS layer is usually maintained between 15mm to 20mm.

4. Surface Finishing:

- Once the IPS mixture is laid, it is finished using a wooden or metal float to create a smooth and even surface.
- The surface can be left as is for a rough finish or can be further polished for a smoother finish.

5. Curing:

- After the IPS layer is laid and finished, it needs to be cured to ensure proper strength development. Curing involves keeping the surface moist for a certain period of time.
- Curing can be done using wet gunny bags, water sprinkling, or curing compounds.

6. Expansion Joints:

- Expansion joints should be provided in the IPS flooring to accommodate any potential movement due to temperature changes or structural shifts.
- These joints are usually filled with a flexible joint filler material to prevent cracks from forming.

7. Surface Protection:

- Once the IPS flooring is cured, it can be coated with sealers or floor finish materials to enhance its appearance and protect it from stains, dust, and wear.

8. Maintenance:

- IPS flooring is relatively low-maintenance. Regular cleaning using mild detergents and water can help keep the surface clean.
- In case of any cracks or damages, repairs should be carried out promptly to prevent further deterioration.

9.1.3 Tools used in IPS Flooring

Cement is a binding material used to create the concrete mixture. Coarse aggregate, often granite chips, adds strength and stability to the concrete. Sand provides fine particles that fill gaps and contribute to the mixture's consistency. Water is essential for mixing and curing the concrete. A concrete mixer or batching plant efficiently blends these components. Marking tools like chalk and pencils, along with measuring tapes, ensure accurate reference points. Spirit levels and laser levels help achieve precise leveling. Wooden planks or metal panels serve as formwork to shape the concrete. Buckets and wheelbarrows are used for transporting and pouring the concrete. Safety gear including gloves, safety glasses, masks, and helmets protect workers during the process.



Fig. 9.1.2 Tools used in IPS Flooring

9.1.4 Types of Cement Used in IPS Flooring

In IPS flooring, different grades of cement are used based on the specific requirements of the project. The choice of cement grade depends on factors such as the type of space, environmental conditions, load-bearing capacity, and durability. Here are explanations of various grades of cement commonly used in IPS flooring:

1. **Ordinary Portland Cement (OPC):** OPC is the most commonly used cement in IPS flooring. It comes in various grades, such as OPC 33, OPC 43, and OPC 53, indicating its strength in megapascals (MPa). OPC 43 and OPC 53 are often preferred for IPS flooring due to their higher strength, making the flooring more durable and capable of withstanding heavy foot traffic.



Fig. 9.1.3 Ordinary Portland Cement (OPC)

2. **Portland Pozzolana Cement (PPC):** PPC is a blended cement that contains both Portland cement clinker and pozzolanic materials like fly ash or volcanic ash. It offers improved workability, reduced heat of hydration, and enhanced durability. PPC is suitable for IPS flooring in areas where sulfate attack and aggressive environmental conditions are a concern.



Fig. 9.1.4 Portland Pozzolana Cement (PPC)

3. **White Cement:** White cement is used for applications where a lighter color or aesthetic appeal is desired. It is used in IPS flooring to achieve a clean and bright appearance. It's important to note that white cement tends to be costlier than regular gray cement.



Fig. 9.1.5 White Cement

4. **Sulphate Resistant Cement (SRC):** SRC is designed to resist the harmful effects of sulfate ions present in soil or water, which can cause the deterioration of concrete. In areas with high sulfate

content in the ground, SRC is used to ensure the longevity of IPS flooring.

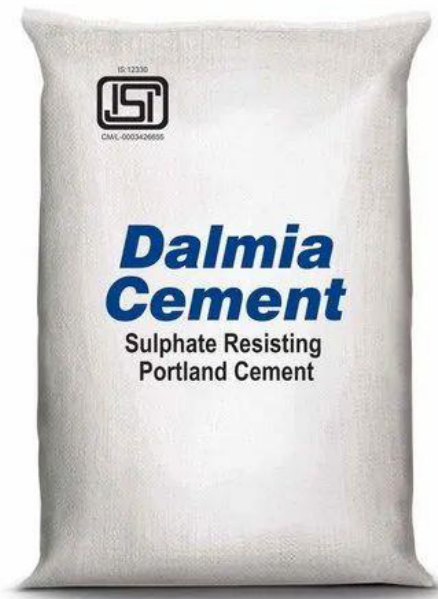


Fig. 9.1.6 Sulphate Resistant Cement (SRC)

- 5. Low Heat Cement:** Low heat cement generates less heat during the hydration process, making it suitable for mass concrete pours where the risk of thermal cracking is high. While not as commonly used in IPS flooring, it can be considered for specific scenarios.



Fig. 9.1.7 Low Heat Cement

- 6. Colored Cement:** Colored cement is used when the IPS flooring requires a specific color other than the natural gray of regular cement. It's often used for decorative or creative flooring designs.



Fig. 9.1.8 Colored Cement

9.1.5 Manual Mixing of Concrete

Manual mixing of concrete for IPS flooring involves the careful combination of cement, coarse aggregates (usually granite chips), sand, and water to create a homogeneous mixture.



Fig. 9.1.9 Manual Mixing of Cement, Sand and Coarse Aggregate

Here's the procedure for manual mixing of concrete using a nominal mix proportion in the context of IPS flooring:

Nominal Mix Proportion (example: 1:1.5:3 for cement: sand: coarse aggregates)

1. Gather Materials and Equipment:

- Collect the required amount of cement, coarse aggregates, sand, and clean water.
- Prepare the measuring containers or buckets for accurate proportioning.

2. Proportion the Ingredients:

- Use the specified nominal mix proportion (e.g., 1:1.5:3) to determine the quantities of cement,

sand, and coarse aggregates.

- Measure the quantities accurately using the measuring containers.

3. Dry Mixing:

- Start by placing the dry materials – cement, sand, and coarse aggregates – on a clean and dry mixing platform or surface.
- Use shovels to create a pile of the dry materials, and then use the shovels to mix them thoroughly until a uniform mixture is achieved.

4. Wet Mixing:

- Create a depression or well in the center of the mixed dry materials.
- Gradually pour a calculated amount of water into the well. Start with a portion of the total water to avoid overwetting.
- Use shovels or hoes to fold and turn the mixture, incorporating the water gradually.

5. Adjusting Consistency:

- Continue adding water while mixing until the mixture reaches the desired consistency. The mixture should be workable and cohesive but not too wet.

6. Thorough Mixing:

- Continue mixing the entire batch thoroughly until a uniform mixture is achieved. Ensure that all components are evenly distributed.

7. Checking Consistency:

- To check the consistency, use the “slump test.” Create a conical pile of mixed concrete and measure the slump – the decrease in height of the cone – as an indicator of workability.

8. Transport and Use:

- Once the concrete mixture is ready, it needs to be transported and placed onto the prepared IPS flooring area immediately.
- Use buckets, wheelbarrows, or other suitable containers to transport the concrete to the required location.

9. Placing and Compacting:

- Spread the concrete mixture evenly over the prepared flooring area.
- Use trowels and compacting equipment like vibrators to ensure proper compaction, eliminate air voids, and achieve a level surface.

10. Finishing and Curing:

- Depending on the design and finish requirements, proceed with trowelling and finishing the

concrete surface.

- Cure the concrete by providing adequate moisture for a specific curing period (e.g., 15 days) to ensure proper strength development.

9.1.6 Preparation of Sub-base and Base

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

The Slope of flooring shall be provided and maintained in base course before laying of topping layer. Base concrete is generally plain cement concrete of nominal mix of 1:4:8 or design mix of M-7.5.

9.1.7 Procedure of IPS Flooring

1. The concrete mix generally used in topping layer is nominal mix of ratio 1:1.5:3 and design mix of M20.



Fig. 9.1.10 Concrete Mixture

2. The thickness of concrete in topping layer is generally 25-50mm depends on type and design requirement of flooring.
3. Mark reference level and transfer this to location of flooring area.
4. Mark the thickness level of flooring.
5. Provide dummy dots to maintain required level of flooring.

6. After dummy dots are set, concrete is poured as per specification, length of a panel shall not exceed 14 times its breadth.



Fig. 9.1.11 Marking dummy dots

7. The glass and aluminium strips are fixed over base concrete with their top at proper levels and as per required slope.



Fig. 9.1.12 Glass panel fitting

8. The concrete mix shall be placed in panel and thoroughly compacted and levelled by straightedges.



Fig. 9.1.13 Levelling

9. The final trowelling shall be done well before concrete has become so hard to extent that considerable pressure is required to mark any impression on surface.



Fig. 9.1.14 Pouring Cement

10. Dry cement or mixture of dry cement and sand should not be spread on concrete to absorb excess water coming on top due to floating.



Fig. 9.1.15 Levelling Cement

11. Cure the flooring for 15 days by different curing methods as per suitability such as ponding and wet hessian cloths.



Fig. 9.1.16 Completed IPS Flooring

9.1.8 Sequence of Fixing of Brass Strips

| | |
|--|---|
|  <p>Straightening of Brass strip</p> |  <p>Marking levels</p> |
|  <p>Thread for position of strip</p> |  <p>Laying of strip</p> |
|  <p>Temporary support for Brass strip</p> |  <p>IPS floor with Brass strips</p> |

Table 9.1.1 Sequence of Fixing of brass strips

9.1.9 Construction Joints

In construction, joints are intentional gaps or separations introduced into concrete structures to accommodate various factors like expansion, contraction, and design aesthetics. Different types of joints serve different purposes, ensuring the structural integrity and performance of concrete elements. Here's an explanation of the types of joints commonly used in concrete construction:

- 1. Concrete Construction Joints:** Concrete construction joints are planned gaps left between two consecutive concrete placements, such as between two pours in a foundation or wall. These joints are used to facilitate construction sequencing, allowing work to proceed in stages while

maintaining structural continuity. Construction joints are usually formed using keyways, dowels, or other mechanical devices to ensure proper load transfer between the sections.



Fig. 9.1.16 Completed IPS Flooring

- 2. Expansion Joints:** Expansion joints are designed to absorb the expansion of concrete due to temperature changes, moisture variations, and other environmental factors. These joints are flexible and accommodate the movement of concrete without causing cracks or structural damage. They are often installed in large concrete slabs, bridges, and structures to prevent the concrete from buckling or cracking as it expands.



Fig. 9.1.17 Expansion Joints

- 3. Contraction Joints:** Contraction joints, also known as control joints, are introduced to create predetermined cracks at specific locations. These joints guide the formation of cracks along a controlled path, reducing the chances of random, uncontrolled cracking. They help manage the

natural shrinkage of concrete as it cures and dries. Contraction joints are typically grooved or tooled into the surface of the concrete at regular intervals.



Fig. 9.1.18 Contraction Joints

- 4. Isolation Joints:** Isolation joints are used to separate different sections of a concrete structure that may experience differential movement. They prevent the transfer of stresses and loads from one section to another, reducing the risk of cracks forming due to movement discrepancies. Isolation joints are commonly used between building elements like walls, slabs, and columns.



Fig. 9.1.19 Isolation Joints

9.1.10 Tools used for Grooving

Grooving or providing expansion joints in concrete surfaces involves creating controlled, straight-line gaps that allow for movement without causing cracking. Here are some tools commonly used for grooving or providing expansion joints in concrete:

1. Jointing Trowel: A jointing trowel is a handheld tool with a flat, rectangular blade used to create shallow grooves in freshly poured concrete. It's often used to form contraction joints and helps control the location of future cracks.



Grooving Machine: Grooving machines are mechanical tools equipped with multiple blades that create grooves in concrete surfaces. These machines are especially efficient for creating expansion joints in larger areas, such as highways, airport runways, and concrete slabs.



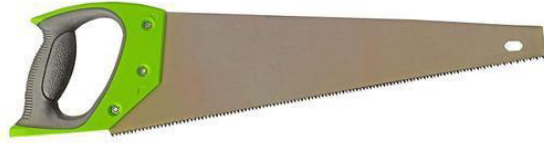
Jointing Edger: A jointing edger is similar to a trowel but has a rounded edge. It's used to create rounded or beveled edges along the sides of contraction joints to prevent chipping and promote a smooth transition.



Grooving Tool: Handheld grooving tools, also known as hand groovers or jointers, have a V-shaped or U-shaped blade that is manually pushed along the surface to create grooves. These tools are suitable for creating decorative or functional expansion joints on smaller concrete surfaces.



Saw Cutter: A walk-behind or ride-on concrete saw with diamond-tipped blades is often used to create deep, straight expansion joints in existing concrete surfaces. Saw cut joints are precise and can be made to specific depths.



Laser-Guided Grooving Machine: For large-scale projects requiring high precision, laser-guided grooving machines are used. These machines use laser technology to ensure accurate and straight grooves, enhancing the quality of expansion joints.



String Line: String lines are used as guides when manually creating straight grooves in concrete surfaces. The string is stretched taut and aligned along the intended path of the joint to ensure accuracy.



Chalk Line: Chalk lines are used to mark the intended path of expansion joints on the concrete surface. The chalk line provides a visible guideline for grooving.



Measuring Tools: Straightedges, rulers, and measuring tapes are used to mark the spacing and alignment of expansion joints before grooving.



Safety Gear: When using power tools like saw cutters, safety gear including gloves, safety glasses, masks, and hearing protection is essential to ensure the safety of workers.



Table 9.1.2 Tools used for Grooving

9.1.11 Concrete Vibrators

Concrete vibrators are essential tools used to consolidate and compact freshly poured concrete to remove air voids and ensure proper compaction. They improve the strength, durability, and overall quality of the concrete. Different types of vibrators are available for various applications, including concrete curing. Here are some types of concrete vibrators used for curing and their influence areas:

1. Internal Vibrators (Immersion Vibrators):

- Internal vibrators, also known as immersion vibrators or poker vibrators, are directly inserted into the concrete mixture.
- They come in different sizes and lengths to accommodate various concrete depths.
- The influence area of an internal vibrator is localized around the point of insertion. It generally extends to a radius of about 150mm (6 inches) from the vibrator's tip.



Fig. 9.1.20 Internal Vibrators

2. External Vibrators (Form Vibrators):

- External vibrators are attached to the exterior of the formwork or mold used to shape the concrete.
- They are used to vibrate the formwork itself, allowing the concrete to flow freely and consolidate without getting trapped air.
- The influence area of external vibrators depends on their placement and the size of the formwork. It can extend to the entire surface of the concrete section being poured.



Fig. 9.1.21 External Vibrators

3. Surface Vibrators (Screed Vibrators):

- Surface vibrators, also known as screed vibrators, are used on the surface of freshly placed concrete to level and compact it.
- They are commonly used for horizontal surfaces like floors and pavements.
- The influence area of a surface vibrator extends along the length of the screed blade, which ranges from a few feet to several meters, depending on the tool's size.



Fig. 9.1.22 Surface Vibrators

4. Formwork Bracing Vibrators:

- These vibrators are designed to attach to formwork braces or shoring to ensure proper consolidation of concrete in vertical structures like columns and walls.
- They help prevent voids and honeycombing within the concrete near the formwork.



Fig. 9.1.23 Formwork Bracing Vibrators

5. Pneumatic Vibrators:

- Pneumatic vibrators use compressed air to create vibrations in the concrete.
- They are often used in areas where electrical power sources might be limited or unsafe.



Fig. 9.1.24 Pneumatic vibrators

6. High-Frequency Vibrators:

- High-frequency vibrators operate at higher frequencies and are suitable for high-strength concrete mixes with lower water-cement ratios.

- They are designed to handle higher-consistency mixes that might be challenging for traditional vibrators.



Fig. 9.1.25 High-Frequency Vibrators

9.1.12 Final Trowelling

The final trowelling of concrete is a critical step in achieving a smooth, even, and visually appealing surface finish. It involves using trowels to refine the texture and appearance of freshly placed and partially cured concrete. Here's a detailed procedure for the final trowelling of concrete to achieve the desired finish:

1. Timing:

- Begin the final trowelling process when the concrete has reached the appropriate stage, known as the "initial set." It should be firm enough to support the weight of the trowelling equipment but still plastic enough to be worked.

2. Gather Equipment:

- Collect the necessary trowelling tools, including finishing trowels, steel trowels, and edging tools.
- Ensure that the tools are clean and free of any debris or residue.

3. Initial Trowelling:

- Start by using a finishing trowel to work the surface. Hold the trowel at a slight angle to the

concrete and press down gently.

- Begin trowelling from one edge of the concrete slab and move in a straight line, working your way across the surface.
- Apply light to moderate pressure to smooth out any ridges and level the surface.

4. Floating:

- Switch to a float blade (wooden or magnesium) to further refine the surface. The float will help consolidate the concrete, close surface pores, and create a smoother texture.
- Use circular or sweeping motions to work the float across the concrete. Overlapping passes help ensure even coverage.

5. Multiple Passes:

- Make multiple passes with the float blade, changing the direction of each pass to create a cross-hatch pattern. This helps achieve uniform compaction and an even texture.

6. Edging:

- Use an edging tool or a rounded trowel to create smooth and rounded edges along the perimeter of the concrete. This prevents chipping and provides a neat appearance.

7. Water Sprinkling:

- If necessary, lightly sprinkle water on the surface during trowelling to aid in achieving a smoother finish. This helps prevent the concrete from becoming too dry and improves workability.

8. Trowelling Pressure:

- Gradually increase the pressure applied to the trowel as you progress. However, avoid excessive pressure that might force excess water to the surface.

9. Finishing Trowelling:

- Switch to a steel finishing trowel for the final trowelling passes. This trowel helps achieve a polished and smooth finish on the surface.

10. Check for Uniformity:

- Continuously inspect the surface for any inconsistencies, ridges, or air voids. Address these areas by applying additional trowelling as needed.

11. Curing:

- After trowelling, the concrete should be properly cured using methods like wet curing, curing compounds, or coverings to promote hydration and strength development.

12. Clean and Maintain Tools:

- Clean the trowelling tools immediately after use to prevent concrete buildup and ensure they remain effective for future projects.

Exercise



Answer the following questions:

I. Multiple Choice Questions (MCQs):

- Which type of cement is commonly used for IPS flooring due to its durability against wear and tear?
 - White Cement
 - Portland Pozzolana Cement (PPC)
 - Ordinary Portland Cement (OPC)
 - Low Heat Cement
- What is the primary purpose of expansion joints in concrete construction?
 - Prevent cracking due to shrinkage
 - Provide a smooth surface finish
 - Enhance the strength of concrete
 - Improve workability of concrete
- What is the recommended thickness range of the topping layer in IPS flooring?
 - 5-10mm
 - 15-20mm
 - 30-40mm
 - 50-60mm
- Which tool is commonly used for creating controlled grooves in concrete surfaces?
 - Finishing trowel
 - Float blade
 - Saw cutter
 - Spirit level
- What is the purpose of curing in IPS flooring?
 - To enhance the surface appearance
 - To create decorative patterns
 - To improve workability of concrete
 - To promote proper strength development

II. Fill in the Blanks:

- IPS flooring is used for achieving a water sloping and economical finish with a decent appearance.
- _____ is a basic type of cement concrete flooring used for industrial, commercial, and residential purposes.
- The mixture for IPS flooring consists of _____, coarse aggregate, and water.
- The thickness of concrete in the topping layer of IPS flooring is generally _____ mm.
- Expansion joints are introduced in concrete structures to accommodate _____ changes.

III. Very Short Answer Questions:

- What does IPS stand for in IPS flooring?
- Why are construction joints introduced in concrete structures?
- What tool is used to create shallow grooves in freshly poured concrete for contraction joints?
- Explain the purpose of providing isolation joints in concrete construction.
- How do internal vibrators influence the consolidation of concrete?



Elective 2

10. Process of applying Plaster on Internal & External Surfaces of Masonry & RCC Structure



Unit 10.1 Plastering Internal and External Surfaces



Key Learning Outcomes

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

1. Demonstrate plastering of internal and external masonry and RCC structures.
2. Perform checks for line, level and alignment.

Unit 10.1: Plastering Internal and External Surfaces

Unit Objectives

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

1. Interpret the sketches/basic working drawing for plastering.
2. Discuss the standard practices for plastering works.
3. Describe the use of tools and equipment used for plastering works and their standard specifications.
4. Describe the process of carrying out layout marking and levelling for plastering works
5. Describe the different materials used for plastering and various ratios of mix proportion used for plastering on internal and external surfaces.
6. Describe the various visual checks performed on materials and surface for plastering.
7. Discuss the gradation of sand for internal plastering works.
8. Explain the different types of plasters such as sand faced plaster, rough cast plaster, pebbled cast plaster, smooth cast plaster etc.
9. Explain the procedures and techniques for plastering internal and external masonry and RCC structures.
10. Explain the procedure for determining the horizontal and vertical alignment using plumb bob.
11. Demonstrate setting out of the layout as per drawing/instruction and transferring of levels as per layout
12. Perform visual checks for sand, cement and surface to be plastered
13. Provide a rough estimate for the quantity of material required for plastering.
14. Demonstrate the checks to ensure the compliance of cement mortar mix to specified proportion.
15. Demonstrate placing of dummy dots, application of cement slurry and cement mix for obtaining desired thickness of plaster using appropriate tools.
16. Demonstrate checks for vertical and horizontal alignment using appropriate tools of plastered surface.
17. Demonstrate setting out of 90° at corners is required.

10.1.1 Introduction to Plastering

Plastering means applying covering and decorative layers on the walls, ceilings, columns and shelves. The decorative layers are made with a mixture of cement and fine sand, known as 'plaster'. Plastering covers rough walls and other uneven surfaces of a building with a smooth covering coat so that the building's appearance and durability are improved.



Fig. 10.1.1 Mason Plastering

Importance to Plastering

Plastering imparts a covering coat on the unfinished masonry surfaces of a building. The appearance and preservation of the interiors depends on the quality of the plastering. Hence it is important to do plastering with very good workmanship. In this module, you will learn some basic and initial tasks to make the actual job of plastering easier and to get a lasting finish on the surface.

Purpose of Plastering

Plastering is done to obtain smooth, clean and durable finished surfaces.

- Plastering on a building's exteriors preserves and protects it from atmospheric influences by acting as a protective coating.
- Plastering on a building's interiors conceals unsightly brickwork and masonry joints.

It also covers walls and ceilings with fine mortar which acts as the base that is essential for painting or whitewashing.

Interpreting Sketches or Basic Working Drawings for Plastering

Interpreting sketches or basic working drawings for plastering involves understanding the visual representations provided and translating them into the actual plastering process. Here's a step-by-step guide to help you with the interpretation:

1. **Review the Sketch:** Carefully examine the sketch or working drawing provided. Look for indications of wall sections, corners, openings (doors and windows), and any other architectural details that

will affect the plastering process.

2. **Identify Layers and Thickness:** Determine if the sketch indicates the number of plaster layers required (such as base coats and rendering coats) and their respective thicknesses. Look for labels or notes that specify the type of plaster mix to be used for each layer.
3. **Locate Reference Points:** Identify any reference points or dimensions that will guide the plastering process. These could include measurements from the floor or ceiling, which help ensure a consistent and level application of plaster.
4. **Understand Opening Treatments:** Pay attention to how openings (doors and windows) are treated in the sketch. This could involve adjusting the thickness of plaster around openings or specifying details like plastering stops or reveals.
5. **Note Joint Treatment:** Look for any details regarding the treatment of joints and corners. These details might include information on corner beads, expansion joints, or any special techniques required for achieving clean and stable corners.
6. **Texture and Finish:** Determine if the sketch indicates the desired texture or finish for the plastered surface. Different types of finishes (smooth, textured, sgraffito, etc.) may require different application techniques.
7. **Incorporate Weep Holes and Vents:** Check if the sketch includes the placement of weep holes, vents, or drainage details, which are important for moisture management within the plastered surface.
8. **Consider Wall Material:** If the sketch indicates the type of substrate (brick, concrete, etc.), consider its characteristics and how it might affect the plastering process. Different substrates might require specific surface preparation or treatment.

10.1.2 Types of Plastering

Sand faced plaster: Cement mortar is used to do the first coat of sand faced cement plaster, in 1:4 with coarse sand. After curing the plaster for seven days, the second coat of cement plaster, with 1:3 ratio will be done. Sponge is used in the second coat of plastering, when it is wet. Hence, the density of sand grain on the surface is equal and uniform. For 15 days, the surface is kept well watered.

Rough Cast Plaster: Rough cast plaster is prepared by mixing gravel and sand in a specified proportion. This is then applied over fresh plastered surface. This type of plaster is carried out on surface prepared by cement mortar of ratio 1:3 placed in two layers of thickness 12mm and 10 mm respectively. It will make the base more plastic.

Pebbled Dash Plaster: Pebbled dash plaster is similar to rough cast finish, only clean pebble of size from 6 mm to 12.5 mm are dashed against the surface.

Smooth cast plaster or plain face plaster: Smooth cast plaster is similar to sand faced finish, only fine grained sand is used instead of coarse sand in this method. Additionally, no sponging is done to expose the sand grain.



Fig. 10.1.2. Sand faced plaster



Fig. 10.1.3. Rough Cast Plaster








Fig. 10.1.4. Pebbled Dash Plaster



Fig. 10.1.5. Smooth cast plaster or plain face plaster

10.1.3 Plastering Tools and Equipment

| Tool | Image | Use |
|------------------|---|--|
| Finishing Trowel |  | <p>A finishing trowel is a rectangular tool used to apply, spread, and smooth plaster. It mostly has aluminium or steel blade and a metal or plastic handle. Standard width of a finishing trowel is 10 inches, while its length can vary between 30 to 50 inches. It can also be used to finish small surfaces.</p> |

| | | |
|--------------------------|---|--|
| Plastering Corner Trowel |  | A plastering corner trowel is a trowel having double sided blades. It is used to prepare corners running along two sides at the same time. |
| Plastering Trowels |  | Plastering trowel is a tool used for finishing plaster surfaces on inside corners. It is also used for plastering and scraping. Additionally, it repairs the damage. |
| Pre-worn Permashape |  | A pre-worn permashape is similar to a plastering trowel, but its blade is slightly curved (like how it wears during normal use). This helps in applying plaster with ease. Additionally, it helps in removing line and ripple marks. |
| Plasters Hawk |  | A hawk is a square, lightweight tool with a vertical central handle used while plastering. It is usually used with a finishing trowel to apply a smooth finish of plaster to a wall. It is also used to carry mortar from the mortar board to where it is to be applied. A hawk is around 10 to 14 inches. |




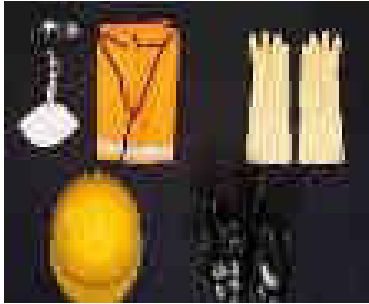
| | | |
|-----------------------------------|---|---|
| Plastering Float or Floating rule |  | <p>A float is another flat tool used to fill voids and hollows, while plastering, as well as to level bumps caused due to previous operations. Additionally, it helps to impart a texture to the surface. Some commonly used floats include wood float, angle float and sponge float.</p> |
| Plastering Feather Edges |  | <p>Feather Edges are rod like looking tools mostly used for wet plastering. It has a wooden or lightweight metal blade, which is 15 cm wide to 1.2 m to 2.5 m in length. Its blade tapers to a sharp edge and is used to cut in inside corners and to shape sharp, straight lines at outside corners where walls intersect.</p> |
| Plastering Darbies |  | <p>Darby is an aluminium scale-like tool, which is about 1.5 m long. It comes along with adjustable handles for manual operations. It is used for further smoothing and levelling after applying base coat. Additionally, it is used to level plaster screeds and to level finish coats.</p> |

Table 10.1.1 Plastering Tools and Equipment

10.1.4 Preparation for Plastering Work



Step 1

Wear the safety equipment. One should wear:

- Boots
- Safety Jacket
- Gloves
- Helmet



Step 2

Gather the materials and tools needed.

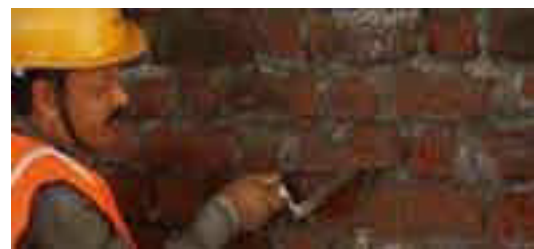
- One will need mortar to fill up the holes or cavities, if any, on the surface.
- One will need these tools: Trowel, Chisel, Wire brush, and Water hose



Step 3

- Clean the surface and the joints.
- Clean the surface and the joints with a wire brush to remove foreign material.

Tip: One can also use a wire brush to clean the surface. But, ensure that the surface is free from dirt, oil and grease. A clean and grease-free surface is necessary for the plaster to adhere properly. Preparing the surface ensures that the plastering lasts long and is free from defects.



Step 4

- Rake the mortar joints.
- Drag the trowel along the mortar joints, while keeping it lightly pressed, to rake the joints properly.

Table 10.1.2 Preparation for Plastering Work

10.1.5 Method of Plastering

The two methods of plastering used most widely are cement plastering and lime plastering.

- In cement plastering, plaster made from cement and fine sand is used. When cement plaster is used, plastering is done in two coats.
- Lime plaster is a mixture of lime and sand in various proportions depending upon the nature of the work. When lime plaster is used, plastering is done in three coats.

Procedure for Plastering in Base Coats and Rendering Coats

Plastering can be done in two ways such as:

- Base Coats
 - Rendering Coat
1. **Base Coats:** Base coats, also known as undercoats or scratch coats, are the initial layers of plaster applied directly to the masonry or concrete substrate. The purpose of base coats is to provide a level surface, improve adhesion, and create a solid foundation for the final plaster layers. Base coats are typically thicker and contain a mix of sand, cement, and sometimes lime. There are usually two types of base coats:
 - **Scratch Coat:** This is the first layer of plaster applied to the substrate. It's called a "scratch coat" because, once applied, it is scratched with a comb-like tool to create a rough surface. This textured surface helps the next layer, or rendering coat, to bond effectively.
 - **Brown Coat:** The second layer, known as the brown coat or leveling coat, is applied over the scratch coat. Its purpose is to level the surface, filling in any irregularities left by the scratch coat. The brown coat is worked to achieve a uniform and smooth surface for the final plaster layer.
 2. **Rendering Coat:** The rendering coat, also called the finishing coat or skim coat, is the final layer of plaster applied over the base coats. This layer is relatively thin and is responsible for providing the desired texture, appearance, and finish to the wall or ceiling. The rendering coat is often made from a mix of finer sand, cement, and sometimes lime. It is carefully worked to achieve a smooth and even surface, and it can be finished in various ways:
 - **Smooth Finish:** The surface is worked to create a completely smooth and polished appearance, suitable for painting or other decorative finishes.
 - **Textured Finish:** Different tools or techniques can be used to create various textures, such as stippled, brushed, or troweled finishes.
 - **Sgraffito Finish:** This is a decorative technique where a top layer of plaster is scratched to reveal the contrasting base coat color underneath, creating intricate patterns or designs.

In most cases, two coats are standard, while three coats are applied in superior quality

Here are the steps to plaster in two and three coats:

Step 1

Place a small patch of plaster on the surface.

- Dash a trowel of plaster against the wall.
- Spread the plaster around so that it is not more than 12 mm thick.
- Use the float to rub and make the patch flat and level.



Step 2

Place an identical patch, two metres below it.

- Place an identical patch, two metres below it.
- Use the plumb bob to check whether both the patches line up along the same vertical path.

Note: These patches of plaster are called 'dots'



Step 3





- Place another such pair of dots.
- Place another such pair of dots, two metres beside the first pair.

Note: The patches of the second pair must line up accurately with each of the corresponding patches of the first pair, horizontally and vertically.

Step 4

Connect both the dots in each pair with a strip of plaster.

- Apply cement slurry between both the patches.
- Lay a vertical strip of plaster, not more than 12 millimetres thick, over the strip of cement slurry.

| | |
|---|---|
| | <ul style="list-style-type: none"> • Spread the plaster along the strip with the trowel using an up-down hand motion, so that you get a length of plaster between the dots. • Rub the strip of plaster with the float so that it becomes smooth. • Repeat these steps with the other pair of dots so as to get another vertical strip of plaster on the surface. <p>Note: These vertical strips of plaster are called screeds. They serve as gauges by which you can lay a uniformly thick coat of plaster on the surface.</p> |
|  <p>Step 5 Apply the base coat.</p> <ul style="list-style-type: none"> • Apply cement slurry on the surface between the screeds. • Apply the first coat by dashin plaster over the cement slurry. <p>Note: Ensure that the thickness of the first layer does not exceed that of the screeds, that is, 12 millimetres. The first coat must be 20 millimetres thick if the surface is made of rubble masonry</p> |  <p>Step 6 Level the base coat.</p> <ul style="list-style-type: none"> • Using the screeds as guides, level the first coat by sliding the floating rule over the plaster while keeping it gently pressed into the surface. • Use the straight edge to check whether the coat is levelled with the screeds. |
|  |  |

Step 8

Make furrows on the base coat.

Sprinkle water on the base coat.

- Sprinkle sufficient water frequently on this coat and rub it well with the float
- Use the scratching tool to make furrows on the coat.
- The furrows made on the coat act as the 'key' or the texture which holds the second coat of plaster in place.

Step 9

Apply the rendering coat.

- Apply the second coat of plaster over the first by spreading it around with the trowel.

Note: The second coat of the plaster must not be more than 3 millimetres thick.

Step 10:

Rub the rendering coat with the floating rule.

- Use the floating rule to make the surface of the coat flat and uniformly levelled.

Note: The process of plastering in three coats is the same as plastering in two coats; an additional coat of plaster being the only difference.



Table 10.1.3 Steps to Plaster

10.1.6 Plastering on Brick Masonry and RCC Surfaces

Plaster is prepared by mixing cement, sand and water. For masonry surface, cement–sand ratio is 1:6. The thickness of plaster depends on the surface condition which ranges from 12 mm to 25 mm.

10.1.7 Internal Plastering

Internal Plastering involves application of cement mortar over masonry works. This acts as finishing coat for masonry works.

Application and use of Internal Plastering

- Internal Plastering is used for creating a finished smooth surface in terms of masonry and RCC structures.
- It is used in order to protect the outer structure from temperature variation

10.1.7 Procedure for Internal Plastering on Brick Masonry

Steps to be followed for Internal Plastering on Brick masonry surface are:

Step 1: Clean the surface before plastering

Step 2: Use the level pegs on walls with reference to the off lines to brick walls set out in floors. Ensure to use centre plumb bob and nylon thread.

Step 3: Make sure to water all the brick walls before pasting mortar on them.

Step 4: Apply first coat mortar filling (1:4 Cement and Sand) up to 15 mm on surfaces where required mortar thickness exceeds 25mm.

Step 5: Apply plaster to walls and columns of 1:4 cement and sand ratio to achieve semi rough finished surface.

Step 6: Vertical joint of structural columns/walls and bricks wall shall be treated by fixing 200 mm width chicken mesh with wire nails/ concrete nails by centering the mess to the vertical wall joint.

Step 7: Complete all the embedded service lines and provisions (Conduits, Boxes and etc.) on brick walls and check with the MEP drawings.

Step 8: Joints between walls and beams shall be formed up to a maximum of 20 mm and will be sealed using 30 minutes fire rated flexible filler. (Material description will be submitted for the approval of the Engineer)

Step 9: Plastering on surfaces of concrete column, beams and walls which are aligned with surfaces of brick walls and other concrete surfaces shall be finished with cement base easy plaster. (Material description will be submitted for the approval of the Engineer).

10.1.8 Procedure for Internal Plastering on RCC Surface

Steps to be followed for Internal Plastering on RCC surface are:

Step 1: Clean the surface before plastering.

Step 2: Use the level pegs on walls with reference to the off lines to brick walls set out in floors. Ensure to use centre plumb bob and nylon thread.

Step 3: Apply first coat mortar filling (1:4 Cement and Sand) up to 15 mm on surfaces where required mortar thickness exceeds 25mm.

Step 4: Apply plaster to walls and columns of 1:4 cement and sand ratio to achieve semi rough finished surface.

Step 5: Vertical joint of structural columns/walls and bricks wall shall be treated by fixing 200 mm

width chicken mesh with wire nails/ concrete nails by centring the mess to the vertical wall joint.

Step 6: Joints between walls and beams shall be formed up to a maximum of 20 mm and will be sealed using 30 minutes fire rated flexible filler. (Material description will be submitted for the approval of the Engineer)

Step 7: Plastering on surfaces of concrete column, beams and walls which are aligned with surfaces of brick walls and other concrete surfaces shall be finished with cement base easy plaster. (Material description will be submitted for the approval of the Engineer)

10.1.9 Procedure for Plastering at the Junction of Masonry Wall and RCC Surface

Steps to be followed are;

Step 1: Choose the chicken mesh of 12 mm holes and 24 gauge for external plaster.

Step 2: Cut the chicken mesh in minimum 20 cm (8") to 23 cm (9") width by cutter.

Step 3: Fix the chicken mesh on joint of RCC & masonry wall by plumbing nails on RCC members and wire nails on masonry member.

Step 4: Ensure that half the width of chicken mesh is on the masonry wall and half will be on the RCC members.

Step 5: Make sure that chicken mesh is tight enough in both the directions, vertical and horizontal.

Step 6: Ensure that spacing of nails should not be less than 9" to avoid buckling and loosening of chicken mesh.

Step 7: Remove all wooden pieces, papers, kathiya etc. and unwanted material from the RCC and masonry surfaces.

Step 8: Wet the surfaces a day before plastering.

Step 9: Follow rest of the procedure as per the type of plaster.

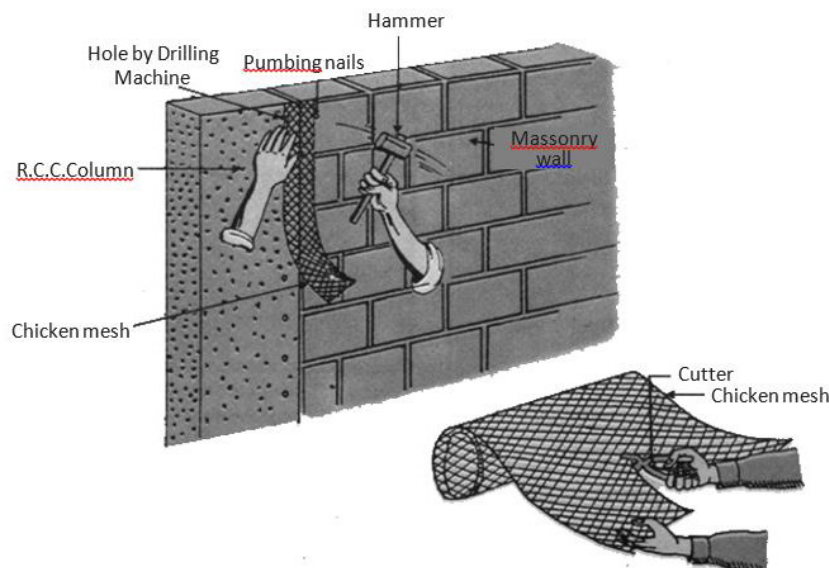


Fig. 10.1.1 Mason Plastering

10.1.10 External Plastering

External Plastering is a layer of cement- sand mortar applied over the masonry work, which also acts as a damp-proof coat over the masonry work. External Plastering is a coating of cement mortar applied over external surfaces which acts as damp- proof coating over the surface.



Fig. 10.1.1 Mason Plastering

- It increases aesthetic appeal of the building.
- Application and use of External Plastering
- Application and use:
 - It is used for creating a finished surface in terms of masonry and RCC structures for their aesthetic look.
 - In order to protect the outer structure from temperature variation and attack of different atmospheric elements

The process of application of plaster on external surfaces remains the same as that of the application of plaster on internal surfaces. The only difference is in surface finishing, mortar mixing and while working at a height.

Which plaster is to be adopted depends upon the type of a surface and its location.

- For walls where it is brickwork, cement plaster in two coats is normally adopted.
- For ceilings, which are invariably RCC surfaces cement plaster with minimum thickness is adopted(Minimum thickness of external (15 mm) and internal plastering (12 mm).
- For external surfaces, which are combination of RCC and brickwork and subjected to changing weathering conditions, external plaster in two coats is adopted.
- At junctions of brick work and RCC the gaps are to be filled with rich mortar followed by a chicken/ wire mesh

10.1.11 Points to be Remembered for Plastering Work

1. At the time of masonry wall construction apply a thin layer of rough cement-sand plaster, at the junction of masonry and column.
2. Sieve the sand as required, as too coarse or too fine sand leads to poor strength and cracks in plaster.
3. Do not allow the use of stale mortar as its initial setting time is over, as it leads to cracking of plaster.
4. Do not allow plastering over fully dry masonry surface as it absorbs the water from the plaster mortar.
5. Always plaster the ceiling first and then the wall from top to bottom.
6. Do not apply plaster on oily surfaces a poor bonding to plaster may cause cracks or peeling of the plaster.
7. Do the curing for minimum of 4 to 5 days
8. Ensure that masonry work is complete in all respects before starting plastering work.
9. Construct scaffolding in advance , where plaster is to be done
10. Fill the external side gaps in masonry and joints of the beams and wall, which was not possible earlier without scaffolding. This should be done with rich cement mortar 1: 3 ratio and finish the surface by roughening with wires. The process should begin minimum two days prior to plastering for gaining enough strength.
11. Take the plumb or line from top to bottom at all the edges. Plaster work confirming to these lines will give the finished surface.
12. Keep the thickness of the plaster to minimum. If beam or column is bulged out, then chiselling is to be done with a sharp chisel and hammer only after the RCC designers permission.
13. The mixed mortar should be used within 30 minutes after adding water with cement-sand mix.
14. Make holes on the wall, column and beam with a drilling machine, for fixing chicken mesh to corner all joint of masonry and RCC work.
15. Cut the chicken mesh in minimum 20 cm (8 inches) to 23 cm (9 inches) width by cutter.
16. Fix chicken mesh on joint of RCC and masonry wall, by plumbing nails on RCC members and wire nails on masonry member.
17. Wet the surface a day before starting the external plaster.
18. Do not apply dry cement-sand mix on the prepared surface.
19. For external plastering of building add water proofing agent 0.50% by weight of cement. For plastering of reservoir and basement wall add water proofing agent 0.25% by weight of cement.

Exercise



Answer the following questions:

I. Multiple Choice Questions (MCQs):

1. Plastering is done to achieve which of the following?
 - a. Rough and textured surfaces
 - b. Damp-proof surfaces
 - c. Decorative surfaces with intricate designs
 - d. Transparent and glass-like finishes
2. What is the purpose of the base coat in plastering?
 - a. To provide a smooth and polished finish
 - b. To create a protective coating
 - c. To level the surface and improve adhesion
 - d. To add decorative patterns to the surface
3. Which type of plastering finish involves scratching the surface to create a rough texture for the next layer to bond effectively?
 - a. Smooth finish
 - b. Textured finish
 - c. Sgraffito finish
 - d. Scratch coat
4. What is the main difference between cement plastering and lime plastering?
 - a. Lime plastering is applied in fewer coats than cement plastering.
 - b. Lime plastering is used only for exteriors, while cement plastering is used for interiors.
 - c. Lime plastering is used for decorative finishes, while cement plastering is for structural purposes.
 - d. Lime plastering uses a mixture of lime and sand, while cement plastering uses cement and sand.
5. Which tool is used to apply, spread, and smooth plaster during the plastering process?
 - a. Plastering corner trowel
 - b. Finishing trowel
 - c. Plastering darby
 - d. Plasters hawk

II. Fill in the Blanks:

1. Plastering covers rough walls and uneven surfaces with a smooth _____ coat.
2. The process of applying plaster in two layers, scratch coat and brown coat, is collectively referred to as _____ coats.
3. A _____ is a square tool used to carry mortar and apply a smooth finish during plastering.
4. Lime plastering is applied in _____ coats compared to cement plastering.
5. The purpose of the _____ coat is to provide a textured base for the rendering coat to adhere effectively.

III. Very Short Answer Questions:

1. What is the purpose of plastering in construction?
2. How is a scratch coat different from a brown coat in plastering?
3. What is the purpose of using a plumb bob and nylon thread in plastering?
4. How do you create a texture known as “sgraffito” in plastering?
5. Why is it important to wet the surface before applying plaster?

Notes



QR Codes

Scan the QR code to watch the video



<https://youtu.be/gqJplphsRdg>

How To Plaster A Brick Wall (Float & Set Plastering For
Beginners)

Option 1

11. Process of carrying out VDF (Vacuum Dewatered Floor) Flooring



Unit 11.1 - Vacuum Dewatered Flooring (VDF)



Key Learning Outcomes

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

1. Perform preparatory works for VDF flooring.
2. Demonstrate VDF flooring.

Unit 11.1: Vacuum Dewatered Flooring (VDF)

Unit Objectives

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

1. Describe the standard practices for VDF flooring.
2. Explain the use of tools used in VDF flooring.
3. Explain the procedure for marking reference level and transferring of levels.
4. Explain the process of preparation of sub-base for VDF flooring.
5. Explain the various grades of cement used in VDF flooring.
6. Describe the different mix proportions/grades of concrete for VDF flooring.
7. Describe the procedure for manual mixing of concrete and nominal mix proportion.
8. List the various admixtures used in concreting.
9. Describe the sequence and procedure of concrete pouring and placing in specified panels for VDF flooring.
10. Explain the provision of cover for reinforcement w.r.t size of reinforcement.
11. Describe the different type pf vibrators used for concrete curing and their influence area.
12. Describe the different construction and expansion joints.
13. List the different tools used for grooving/providing expansion joints.
14. Describe the process of excess water removal using vacuum dewatering machine.
15. Demonstrate the checks to be carried out for inspection of area prior to concreting
16. Demonstrate checks for formwork and deviation in slope and alignment in PCC.
17. Demonstrate marking and transfer of levels on floor for required thickness using appropriate tools.
18. Demonstrate checks for assessing the quality of materials used in manual and machine mixing of mortar, for VDF flooring works.
19. Demonstrate the laying of stone soling/ boulder soling layer.
20. Demonstrate the laying of floor above the stone soling maintain appropriate slope.
21. Demonstrate pouring, compaction and finishing of concrete in specified panels for tremix flooring using tools such as floaters and vacuum dewatering machines.
22. Demonstrate cutting of groves for providing construction joints and expansion joints as per requirement.
23. Demonstrate levelling and curing of the finished floor surface.

11.1.1 Vacuum Dewatered Flooring (VDF)

Vacuum Dewatered Flooring (VDF), also known as Tremix Flooring, is a specialized technique used for finishing concrete floors to achieve a high-quality, durable, and smooth surface. It's commonly used in industrial, commercial, and residential projects where a superior concrete floor finish is desired. The process involves using vacuum dewatering equipment to remove excess water from freshly laid concrete, resulting in a dense and well-compacted surface.

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

In this method of flooring, the surplus water which in concrete mix is removed off by vacuum DE-watering process resulting into low water -cement ratio. This low ratio is main factor behind improving the properties of concrete.

By lowering the water-cement ratio, the tendency of shrinkage and subsequent cracking is greatly reduced.

Vacuum de-watering leads to improvement in each of the properties like compressive strength, wear resistance, less shrinkage and minimum water permeability. This process involves power tools and equipments.



Fig. 11.1.1 VDF or Tremix Flooring


11.1.2 Methodology for VDF Flooring

The steps are as follows:

1. **Preparation of Sub Base:** Prior to VDF installation, the sub base is meticulously prepared by compacting the soil to ensure a stable foundation for the concrete flooring.
2. **Fixing the Forms for Thickness:** Wooden or metal forms are strategically set up along the perimeter of the flooring area to define and achieve the desired thickness of the concrete layer.
3. **Laying and Spreading Specified Grade of Concrete:** The concrete mixture, tailored to a specific grade, is uniformly poured and spread over the prepared sub base within the formed boundaries.
4. **Vibrating and Leveling with Double Beam Vibrator:** A double beam vibrator is employed to vibrate and level the freshly poured concrete, effectively eliminating air voids and ensuring a consistent and even surface.
5. **Vacuum Dewatering Treatment:** Vacuum dewatering equipment is employed to create a vacuum beneath the concrete surface. This process aids in the swift removal of excess water, accelerating the drying and consolidation of the concrete.
6. **Sprinkling of Hardener as per Specifications:** Depending on project specifications, a hardener is evenly sprinkled onto the surface to enhance its durability, abrasion resistance, and overall performance.
7. **Floating the Surface with Power Trowel:** A power trowel is employed to further refine the surface texture by smoothing out any irregularities and achieving a more uniform appearance.
8. **Curing for 14 Days:** The cured surface's strength and longevity are ensured through a prescribed 14-day curing period, during which the concrete is kept moist to facilitate proper hydration.
9. **Providing Specified Joints with Groove Cutting:** Expansion and contraction joints are intentionally created in the concrete to accommodate structural movements. Grooves are carefully cut into the concrete to form these joints at designated locations.
10. **Filling Joints with Specified Material:** Once the joints are established, they are filled with appropriate joint filler material to prevent debris accumulation and to enable controlled expansion and contraction.

11.1.3 Tools and Equipment Required for Dewatering

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

| Tools and Equipment | Image |
|--|--|
| 1. Vacuum Dewatering Pump with Hose: A vacuum dewatering pump, coupled with a hose, extracts excess water from freshly poured concrete to enhance its density and quality. |  |




| | |
|--|--|
| <p>2. Suction Mat with Filter Pad: A suction mat, equipped with a filter pad, aids in efficiently removing water from the concrete surface during the vacuum dewatering process.</p> |  |
| <p>3. Double Beam Vibrator: A double beam vibrator is a specialized tool used to vibrate and level freshly poured concrete, ensuring thorough compaction and uniformity</p> |  |
| <p>4. Power Floater/Trowel: A power floater or trowel is employed to achieve a smooth and even surface finish on the concrete by mechanically troweling the top layer.</p> |  |

Table 11.1.1 Tools and Equipment required for De-watering

11.1.4 Preparation of Sub Base and Base

The earth filling shall be properly compacted to ensure that no loose packets are left. Depends on design requirement, sand of 100 mm thickness or stone soling of thickness 150-200 mm is generally used as sub-base course. The settlement of sub-base may cause cracking of whole floor. The concrete which is generally used in base course is plain cement concrete of nominal mix 1:3:6 or design mix of M10. The thickness of base concrete is 100-200mm.

11.1.5 Forming

In Tremix flooring, steel road forms are used. M.S channels are fixed at generally 4 meters spaced apart. The screed vibrator is also supported on this channel shuttering and runs over the concrete surface.

Things to remember while fixing steel road form

The formwork in tremix concrete flooring has to be done in panels and each panel shall be of 3.5 meter and appropriate reinforcement bar shall be laid in layer of two or one keeping the concrete cover of 50 mm (it may differ as per standards/design).



Fig. 11.1.2 Steel Road Form

It should be capable of bearing weight and force of the vibration equipment.

There should be no leakage of the concrete mixture during vibration and/or curing. Make sure that the corners form 90 degree angles for square or rectangular forms. Measure both diagonals of the square or rectangular using the tape and they should exactly correspond to one another.



Fig. 11.1.3 Forming of RCC flooring using steel road form

11.1.6 Concrete Mix

Concrete of nominal mix ratio 1:1.5:3 (1 cement: 1.5 sand and 3 stone aggregates) or Design Mix of M-20 grade or as specified is generally used for Tremix flooring.

For better wear and tear mostly rich Nominal mix of 1:1:2 or Design Mix of M-25 grade or higher is preferred.

11.1.7 Vacuum Dewatering Process

This procedure involves the extraction of surplus water from the surface of concrete subsequent to its placement and comprehensive compaction.

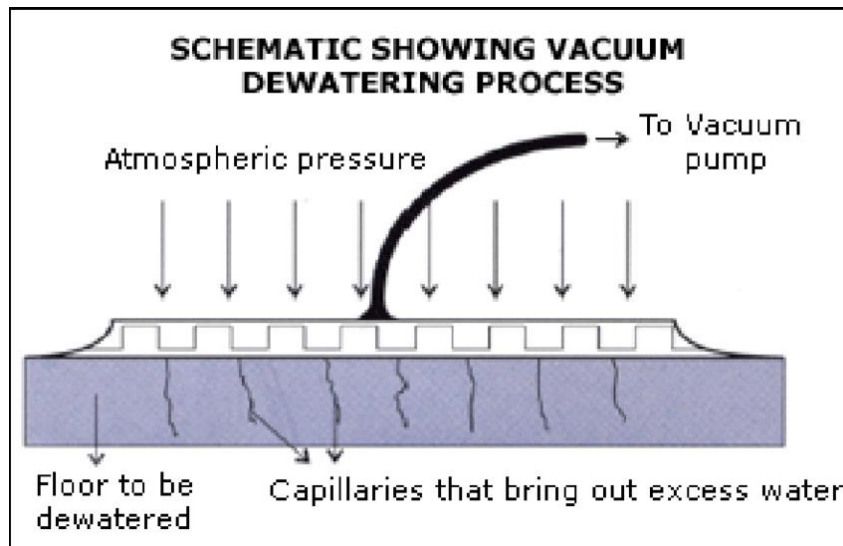


Fig. 11.1.4 Vacuum Dewatering Process

The process is executed through the following sequential steps:

1. The compaction process should be conducted by employing a screed vibrator, followed by levelling the concrete using a screed-board.
2. The suction mat consists of a single PVC sheet of 5 by 7 metres, with a honeycombed plastic cloth serving as a highly effective filter, placed underneath it.
3. Position the top mat that is included with the junction box and hose pipe.
4. The top mat should be connected to the vacuum pump by means of a hose pipe.
5. When the pump is activated, a vacuum is generated between the filter pad and top mat, resulting in the expulsion of excess water from the concrete.



Fig. 11.1.4 Vacuum Dewatering Process

11.1.8 Advantages of Vacuum Dewatering

The advantages are:

1. **Increased Compressive Strength:** Vacuum Dewatering boosts cement hydration by removing excess water, resulting in stronger bonds between particles. This leads to higher compressive strength and structural durability.
2. **Increased Tensile Strength:** The system enhances particle bonding, improving tensile strength and the concrete's ability to resist cracking and tension forces.
3. **Reduced Cement Consumption:** By optimizing hydration and eliminating excess water, the Vacuum Dewatering System achieves desired strength with less cement, reducing costs and environmental impact.
4. **Enhanced Weather and Abrasion Resistance:** Denser concrete surfaces from vacuum dewatering offer improved resistance to moisture, chemicals, and wear, making them more durable and longer-lasting.

11.1.9 Troweling

A power trowel cum floater serves a dual purpose in a Tremix floor application, involving both floating and troweling procedures. The power floater is equipped with rotating disks to facilitate the initial floating stage, which is conducted immediately following the dewatering process. In contrast, the power trowel utilizes rotating blades to perform troweling, a process carried out between 30 minutes to 3 hours after floating. This trowelling phase results in an exceptionally smooth surface finish. It's important to note that trowelling is avoided in areas like parking lots and sidewalks, where a rougher surface texture is desired for traction and practicality purposes.



Fig. 11.1.4 Power Trowel Machine

11.1.10 Process for Vacuum Dewatered Flooring (VDF)

The Process for VDF or Tremix flooring is as follows:



Step 1: Pouring Concrete in the form



Step 2: Spreading concrete



Step 3: Screeding using double beam vibrator



Step 4: Laying the filter pads for dewatering



Step 5: Placing the top cover over the filter pads



Step 6: Spreading the top cover for dewatering



Step 7: Dewatering using the vacuum dewatering system



Step 8: Troweling using troweling blades

Table 11.1.3 Process for VDF or Tremix flooring

11.1.11 Construction Joints

In construction, joints are intentional gaps or separations introduced into concrete structures to accommodate various factors like expansion, contraction, and design aesthetics. Different types of joints serve different purposes, ensuring the structural integrity and performance of concrete elements. Here's an explanation of the types of joints commonly used in concrete construction:

1. **Concrete Construction Joints:** Concrete construction joints are planned gaps left between two consecutive concrete placements, such as between two pours in a foundation or wall. These joints are used to facilitate construction sequencing, allowing work to proceed in stages while

maintaining structural continuity. Construction joints are usually formed using keyways, dowels, or other mechanical devices to ensure proper load transfer between the sections.



Fig. 11.1.5 Completed IPS Flooring

- 2. Expansion Joints:** Expansion joints are designed to absorb the expansion of concrete due to temperature changes, moisture variations, and other environmental factors. These joints are flexible and accommodate the movement of concrete without causing cracks or structural damage. They are often installed in large concrete slabs, bridges, and structures to prevent the concrete from buckling or cracking as it expands.



Fig. 11.1.7 Expansion Joints

- 3. Contraction Joints:** Contraction joints, also known as control joints, are introduced to create predetermined cracks at specific locations. These joints guide the formation of cracks along a controlled path, reducing the chances of random, uncontrolled cracking. They help manage the

natural shrinkage of concrete as it cures and dries. Contraction joints are typically grooved or tooled into the surface of the concrete at regular intervals.



Fig. 11.1.6 Contraction Joints

- 4. Isolation Joints:** Isolation joints are used to separate different sections of a concrete structure that may experience differential movement. They prevent the transfer of stresses and loads from one section to another, reducing the risk of cracks forming due to movement discrepancies. Isolation joints are commonly used between building elements like walls, slabs, and columns.



Fig.11.1.8 Isolation Joints

11.1.12 Tools used for Grooving

Grooving or providing expansion joints in concrete surfaces involves creating controlled, straight-line gaps that allow for movement without causing cracking. Here are some tools commonly used for grooving or providing expansion joints in concrete:

1. Jointing Trowel: A jointing trowel is a handheld tool with a flat, rectangular blade used to create shallow grooves in freshly poured concrete. It's often used to form contraction joints and helps control the location of future cracks.



Grooving Machine: Grooving machines are mechanical tools equipped with multiple blades that create grooves in concrete surfaces. These machines are especially efficient for creating expansion joints in larger areas, such as highways, airport runways, and concrete slabs.



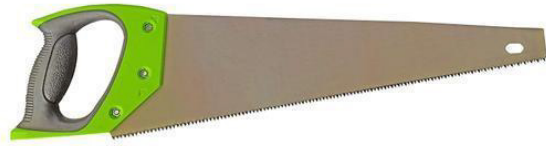
Jointing Edger: A jointing edger is similar to a trowel but has a rounded edge. It's used to create rounded or beveled edges along the sides of contraction joints to prevent chipping and promote a smooth transition.



Grooving Tool: Handheld grooving tools, also known as hand groovers or jointers, have a V-shaped or U-shaped blade that is manually pushed along the surface to create grooves. These tools are suitable for creating decorative or functional expansion joints on smaller concrete surfaces.



Saw Cutter: A walk-behind or ride-on concrete saw with diamond-tipped blades is often used to create deep, straight expansion joints in existing concrete surfaces. Saw cut joints are precise and can be made to specific depths.



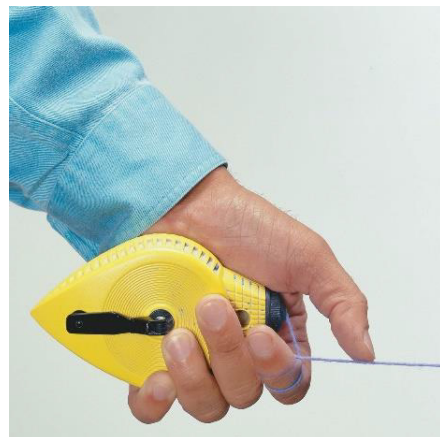
Laser-Guided Grooving Machine: For large-scale projects requiring high precision, laser-guided grooving machines are used. These machines use laser technology to ensure accurate and straight grooves, enhancing the quality of expansion joints.



String Line: String lines are used as guides when manually creating straight grooves in concrete surfaces. The string is stretched taut and aligned along the intended path of the joint to ensure accuracy.



Chalk Line: Chalk lines are used to mark the intended path of expansion joints on the concrete surface. The chalk line provides a visible guideline for grooving.



Saw Cutter: A walk-behind or ride-on concrete saw with diamond-tipped blades is often used to create deep, straight expansion joints in existing concrete surfaces. Saw cut joints are precise and can be made to specific depths.



Laser-Guided Grooving Machine: For large-scale projects requiring high precision, laser-guided grooving machines are used. These machines use laser technology to ensure accurate and straight grooves, enhancing the quality of expansion joints.



Table 11.1.4 Tools used for Grooving

Exercise

Answer the following questions:

I. Multiple Choice Questions (MCQs):

1. What is another term for Vacuum Dewatered Flooring?
 - a. Concrete Resurfacing
 - b. Cementitious Overlay
 - c. Tremix Flooring
 - d. Aggregate Polishing
2. What is the main purpose of the Vacuum Dewatering System?
 - a. Enhancing color pigmentation in concrete
 - b. Removing excess water from freshly laid concrete
 - c. Creating decorative patterns on the surface
 - d. Adding additional texture to the concrete
3. Which tool is used to create rounded edges along the sides of contraction joints?
 - a. Grooving Machine
 - b. Jointing Edger
 - c. Saw Cutter
 - d. String Line
4. What is the recommended curing period for Vacuum Dewatered Flooring?
 - a. 3 days
 - b. 7 days
 - c. 14 days
 - d. 21 days
5. When is trowelling typically carried out in the VDF process?
 - a. Immediately after vacuum dewatering
 - b. After 7 days of curing
 - c. Before pouring the concrete
 - d. Only in outdoor applications

II. Fill in the Blanks:

1. Vacuum Dewatered Flooring is also known as _____ Flooring.
2. The _____ process involves removing excess water from freshly laid concrete.
3. A _____ is used to create grooves in concrete surfaces, especially in larger areas like highways.
4. _____ joints are introduced to create controlled cracks at specific locations.
5. String lines are used as guides to ensure _____ grooves in concrete surfaces.

III. Very Short Answer Questions:

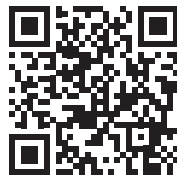
1. What are the advantages of Vacuum Dewatering in concrete flooring?
2. Explain the purpose of isolation joints in concrete construction.
3. What is the role of a power trowel cum floater in Tremix flooring?
4. How is the compaction process carried out in Vacuum Dewatering?
5. Why is it important to perform grooving in concrete surfaces?

Notes



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<https://youtu.be/DNfAN381h2U>

Methodology for VDF Flooring | Full process of Trimix
Flooring



Option 2

12. Process of Building Structures using Random Rubble Masonry



Unit 12.1 - Introduction to Rubble Masonry



Key Learning Outcomes

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

1. Demonstrate laying of coursed and un-coursed random rubble masonry
2. Demonstrate pointing in rubble masonry.
3. Demonstrate laying of dry rubble masonry
4. Perform checks for line, level and alignment of rubble masonry works.

Unit 12.1: Introduction to Rubble Masonry

Unit Objectives

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

1. Interpret sketches, method statements, formats, permits, protocols and checklists for rubble masonry works.
2. Describe the standard practices for rubble masonry works.
3. Explain the use of tools and equipment required for rubble masonry.
4. Explain the different type of coursed and un-coursed rubble masonry works.
5. Describe the different types of plasters and mortar requirements for the rubble masonry works.
6. Describe the various types of cement paste / adhesives used on the base.
7. Describe the various types of stones used in rubble masonry.
8. Explain the basic method of stone work and finishing in rubble masonry.
9. Explain the procedure for preparation of sub base for random rubble masonry works.
10. Explain the visual checks performed on the materials used in random rubble masonry works.
11. Explain the procedure for cutting stones to prepare for sides, edges and bed for random rubble masonry works.
12. Explain the procedure for preparation of mortar for random rubble masonry works.
13. Explain the various techniques / procedures to work with undressed and hammer dressed stones used for un-course and course random rubble masonry.
14. Describe the procedure for building of wall in coursed and un-coursed random rubble masonry.
15. Explain the importance of bond stones (through stones) and jambs at corners of random rubble masonry wall.
16. Describe the procedure for laying course of dry rubble masonry works.
17. List the various pointing and raking tools.
18. Describe the different mortar mixes used for pointing in random rubble masonry.
19. Describe the procedure for preparation of lime/cement mortar and for performing various pointing works on random rubble masonry, namely:
 - ◆ flush pointing
 - ◆ weathered pointing
 - ◆ ribbon pointing

20. Provide a rough estimate for the quantity of material required for rubble masonry work.
21. Perform checks to ensure preparation of sub- base for rubble masonry work.
22. Demonstrate preparation of the sides, edges, bed of stones for rubble masonry.
23. Demonstrate laying and fixing of stones for both coursed and un-coursed random rubble masonry.
24. Demonstrate the checking of line and level of random rubble masonry work at regular intervals.
25. Demonstrate raking and cleaning of joints for pointing works.
26. Demonstrate preparation of mortar and filling of joints for pointing works.
27. Demonstrate laying of stone for dry random rubble masonry works in desired line, level and alignment.

12.1.1 Different Types of Coursed and Un-coursed Rubble Masonry Works

Based on the type of stones used, stone masonry can be classified into two categories.

- Rubble Masonry
- Ashlar Masonry

Rubble Masonry is basic form of stone masonry using rough, irregular shaped stones.



Fig. 12.1.1 Rubble Masonry

- Rubble Masonry is used for the construction of small low height walls, cost-effective residential buildings, go-downs and boundary walls.
- The amount of mortar required for binding these stones is comparatively high, as there are many large gaps formed between the stones.

Ashlar Masonry is constructed using fine dressed stones. It is stronger, costlier, and superior quality masonry work.



Fig. 12.1.2 Ashlar Masonry

- This is built using stones that are precisely dressed and fixed to perfection with uniform joint thickness of approximately 3mm.
- By arranging the stone blocks in various patterns, different types of appearances can be obtained.

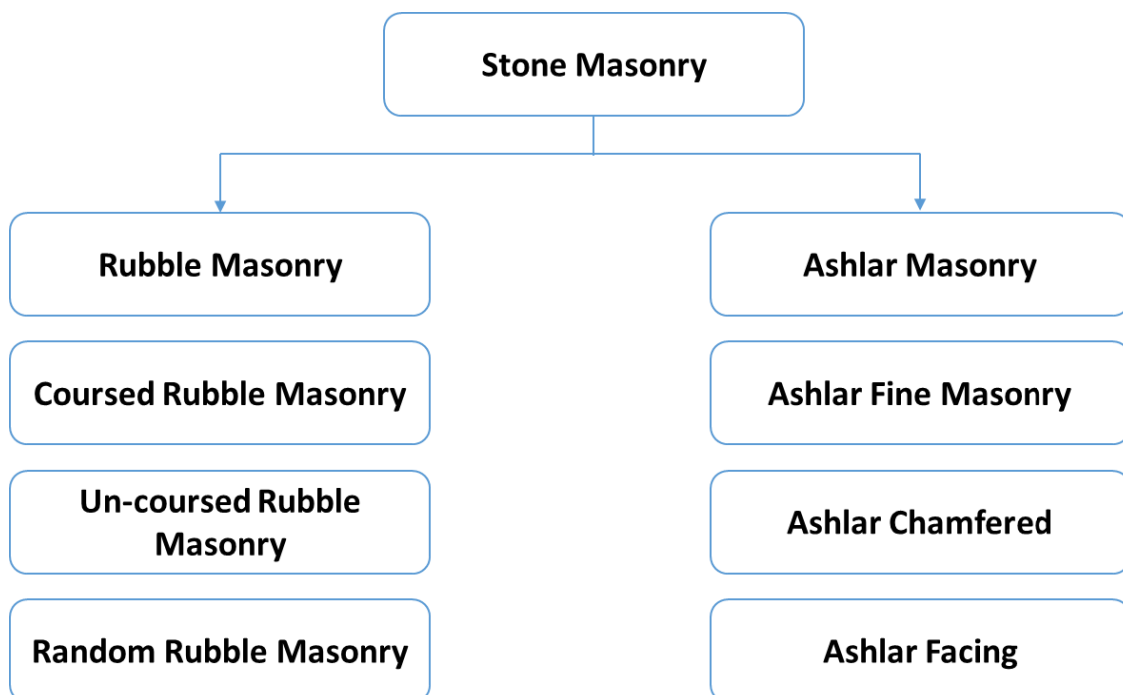


Fig. 12.1.3 Stone Masonry

Random rubble masonry uses irregular, rough, undresses or hammer dressed stones. This masonry consumes lot of mortar as spaces left in irregularities of stone blocks are filled with mortar and small size stone chippings.

Un-coursed Random Rubble Masonry

- The random rubble masonry in which stones are laid without forming courses is known as un-coursed random rubble masonry.
- Rubble Masonry is used for the construction of small low height walls.
- Coursed Random Rubble Masonry
- The random rubble masonry in which stones are laid in layers of equal height.

Used in construction of residential buildings, warehouses, boundary walls etc.

12.1.2 Types of Stones in Rubble Masonry Stone Selection

The selection of stone depends on the following factors.

- Aesthetics like colour, pattern and surface appearance are considered for stone used in building interiors.
- For exterior use, the history of performance of a stone in the local environment
- Durability is also an important factor.
- Properties like Density, Water absorption, Compressive strength, Abrasion resistance are also considered.

Type of Stones Used in Rubble Masonry

i. Igneous stones

Igneous stones are a type of rock that originates from the solidification and cooling of molten magma or lava. They are formed through volcanic and intrusive processes, with volcanic rocks cooling quickly on the Earth's surface, and intrusive rocks forming beneath the surface, allowing for slower cooling and larger crystal growth.



Fig. 12.1.4 Igneous Stone

Igneous stones can be classified into two main categories:

1. **Extrusive Igneous Rocks:** These rocks, also known as volcanic rocks, form when lava erupts from a volcano and cools quickly on the Earth's surface. Examples include basalt, andesite, and rhyolite. Due to their rapid cooling, extrusive rocks typically have fine-grained textures.
2. **Intrusive Igneous Rocks:** These rocks, also called plutonic rocks, form when magma solidifies beneath the Earth's surface over longer periods of time. Examples include granite, diorite, and gabbro. The slower cooling allows for larger mineral crystals to develop, resulting in coarse-grained textures.

Igneous stones are often prized for their durability, strength, and unique mineral compositions. They are commonly used in construction, sculpture, and as decorative materials due to their varied appearances, ranging from dark and dense to light and colorful, depending on the specific minerals present in the rock.

ii. Metamorphic Stones

Metamorphic stones are a type of rock that forms from pre-existing rocks (igneous, sedimentary, or other metamorphic rocks) due to changes in temperature, pressure, and chemically active fluids over long periods of time. These changes cause the minerals within the rock to recrystallize and rearrange, resulting in a new rock with different physical and mineralogical characteristics.



Fig. 12.1.5 Metamorphic Stones

Examples of metamorphic stones include marble, which forms from limestone or dolomite; slate, which originates from shale; and schist and gneiss, which often arise from shale and granite, respectively. The distinctive patterns, textures, and colors seen in these stones are a result of the mineral changes and rearrangements that occur during the metamorphic process. Metamorphic stones are commonly used in architecture, sculpture, and decorative applications due to their unique appearances and durability.

iii. Fine Stone

“Fine stone” typically refers to a high-quality, well-crafted type of natural stone that is carefully

selected and processed for various applications, including construction, interior design, and decorative purposes. The term “fine stone” emphasizes the quality, appearance, and aesthetic value of the stone.



Fig. 12.1.6 Fine Stone

Characteristics of fine stone include:

- **Quality:** Fine stones are chosen for their superior quality, often based on factors such as color, texture, durability, and absence of flaws or impurities.
- **Appearance:** Fine stones exhibit visually pleasing features, such as consistent coloration, interesting patterns, and a polished or well-finished surface.
- **Craftsmanship:** Fine stone is processed and cut with precision to ensure it fits seamlessly in construction or design projects. This craftsmanship contributes to the stone’s overall value and appeal.
- **Versatility:** Fine stone can be used in a variety of applications, ranging from flooring and countertops to decorative elements in architecture and landscaping.
- **Durability:** High-quality natural stone is known for its durability, making it suitable for both indoor and outdoor applications.
- **Aesthetic Value:** Fine stone is often chosen not only for its functional properties but also for its aesthetic contribution to a space. It can enhance the visual appeal and ambiance of an environment.

Common types of fine stone include marble, granite, limestone, travertine, and slate. These stones are often used in upscale projects where both functionality and aesthetics are important considerations.

iv. Sedimentary Stones

Sedimentary stones, or rocks, form from layers of sediment over time. This sediment comes from broken-down rocks and organic matter. The process involves deposition, compression, and cementation. Examples include sandstone (sand grains), limestone (calcium carbonate), shale (clay particles), and

conglomerate (rounded pebbles). These rocks often have visible layers, fossils, and varied textures. They're essential for understanding Earth's history and are used in construction, decoration, and as sources of resources like coal and oil.

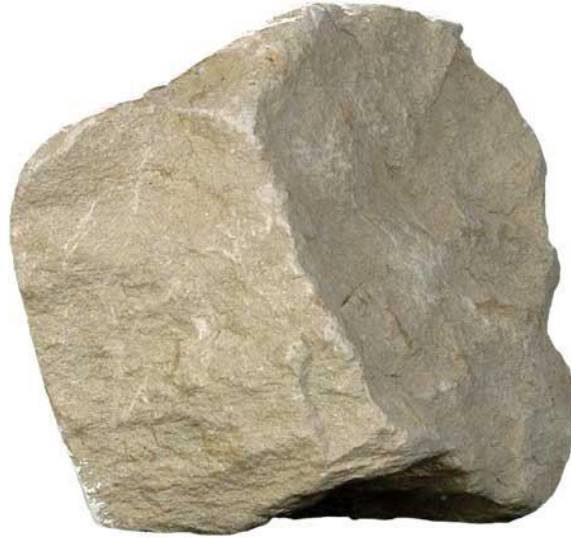


Fig. 12.1.5 Metamorphic Stones

12.1.3 Basic Methods of Stone Work and Finishing in Rubble Masonry

In this masonry, stones are not dressed. This masonry consumes lot of mortar as spaces left in irregularities of stone blocks are filled with mortar and small size stone chippings.

i. Coursed Random Rubble Masonry

- Stones are laid in somewhat level courses.
- Headers of one coursed height are placed at certain intervals.
- Stones are undressed but selected regular stones and hammer dressed.
- Used for construction of residential buildings, go downs, boundary walls etc.
- Stones are picked up from heap of stones and fitted in the course.
- More than one stone may be used to obtain the full height of the course.



Fig. 12.1.8 Coursed Random Rubble Masonry

ii. Un-coursed Random Rubble Masonry

- Irregular stones are laid in non-uniform manner so that courses are not formed.
- Stones are laid without forming courses.
- The roughest, weakest and cheapest type of masonry and is of varying appearance.
- Stones used are of different sizes and shapes.
- Stones used are picked at random from the heap and used wherever they fit in.
- Projecting corners are knocked off and edges are made smooth.
- Joints in this un-coursed random rubble masonry are filled flush ,and vertical joints are not in plumb.
- At corners and jamb, large stones are used for increasing strength.
- Used for the construction of small low height walls.



Fig. 12.1.9 Un-coursed Random Rubble Masonry

iii. Ashlar Fine Masonry

Ashlar Fine Masonry involves meticulously cut and precisely placed rectangular stones in construction. These stones, known as ashlar, boast smooth faces and sharp edges, creating a polished appearance. This technique demands expert craftsmanship, as stones fit together seamlessly with minimal mortar. The result is a visually appealing and structurally sound surface, celebrated for its aesthetic value and durability. Ashlar Fine Masonry has been widely employed in historical and architectural landmarks, showcasing its ability to combine functionality and artistry in construction.



Fig. 12.1.8 Coursed Random Rubble Masonry

iv. Ashlar Chamfered Masonry

Ashlar chamfered masonry refers to a type of stone construction technique commonly used in architecture, particularly in the construction of walls and buildings. The term “ashlar” refers to finely cut and dressed rectangular stones that are arranged in a precise manner to create a well-finished and visually appealing surface. “Chamfered” refers to the practice of cutting or beveling the edges of the stones, resulting in an angled or sloped edge.

In ashlar chamfered masonry, the stones are carefully shaped and arranged to fit tightly together, usually with minimal mortar joints. The chamfered edges provide a decorative detail and can also serve practical purposes, such as preventing water from pooling on the edges of the stones and minimizing the visibility of irregularities or size discrepancies between individual stones.

This type of masonry technique was commonly used in historical and traditional architecture, such as in medieval castles, churches, and other stone-built structures. It’s valued for its precise and aesthetically pleasing appearance, as well as its durability. Ashlar chamfered masonry requires skilled craftsmanship and attention to detail to achieve a high-quality finished product.



Fig. 12.1.11 Ashlar Chamfered Masonry

v. Ashlar Facing

- It uses a composite type of stone construction where chamfered and dressed stones are used in the face side.
- The backing portion can be filled either by bricks or rubble or by concrete.
- Height of the course is never kept less than 20 cm. and the width of each stone is about 1½ times its height.
- Bed joints of all the stones are dressed and square.
- For walls upto 60 cm in thickness, the bond stones should extend for the full thickness of the wall
- For walls more than 60 cm thickness, the bond stones should overlap each other by 15 cm.

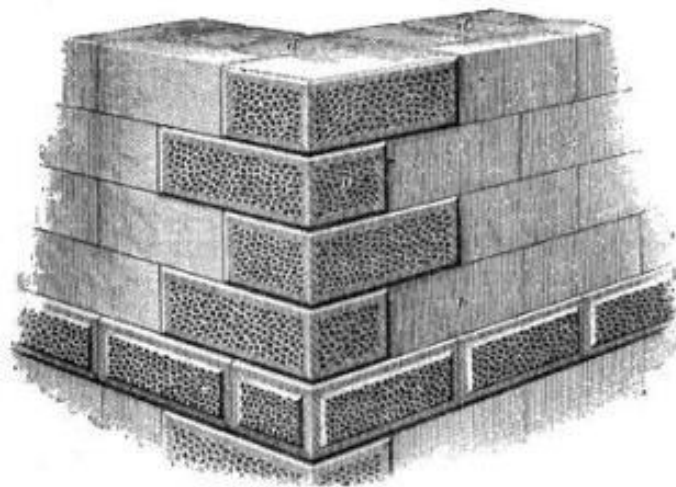


FIG. 26

Fig. 12.1.12 Ashlar Facing

vi. Flint Masonry

Flint masonry refers to the construction technique of using flint as a primary building material. Flint is a hard and durable sedimentary rock composed mainly of silica. It is known for its conchoidal fracturing, which means it breaks into sharp-edged pieces when struck, making it valuable for creating tools and as a construction material.



Fig. 12.1.13 Flint Masonry

Flint masonry involves shaping flint pieces into usable blocks or elements and then arranging them to build walls, structures, or other architectural features. This technique was historically used in various parts of the world, especially during ancient times. The stones were sometimes knapped (chipped) to create flat surfaces and edges for fitting together.

Flint masonry has been found in historical sites and archaeological remains, particularly in regions where flint was abundant. While it might not be as common in contemporary construction due to the availability of more versatile and easily workable materials, its historical significance and use in ancient structures showcase the ingenuity of past civilizations in utilizing the resources available to them.






vii. Dry Rubble Masonry

Dry rubble masonry is a construction method where stones are stacked without mortar to create walls or structures. Stones are chosen for their shape and size to fit together snugly, forming a stable arrangement. This technique relies on the friction and interlocking of the stones for stability. Dry rubble masonry was commonly used in ancient and traditional construction, especially in areas with limited access to mortar. While it lacks the adhesive properties of mortar, this method showcases the skill of masons in selecting and arranging stones. Dry rubble masonry can be seen in historic sites and adds a rustic, textured aesthetic to structures.



Fig. 12.1.14 Dry Rubble Masonry

12.1.4 Tools used for Rubble Masonry

| Tool | Image | Use |
|---------------------------|---|--|
| Measuring tape |  | Measuring tape is used to measure the rods. These are available in 3M, 5M, 15M and 30M. |
| Masonry Drill Bits |  | Drill bits are cutting tools used for cutting holes or removing materials to cut holes in circular manner. Drill bits are of various shapes and sizes as per the different type of holes cut and materials used. |
| Trowel |  | Trowel helps to pick up the mortar and spread it evenly while laying the blocks. |
| Straightedge |  | Straight edge is a tool used to check the flatness/ straightness of surface or lines. The commonly used straight edge is hollow, rectangular in shape, the length of which can be up to 500 cm and width from 4.5cm to 3.5 cm. |
| Level |  | The purpose of the level is to maintain level vertically or horizontally. |






| | | |
|----------------|---|--|
| Scrapers |  | Used for scraping, especially for removing dirt, paint, or other unwanted matter from a surface. |
| Mason's Hammer |  | A hand tool having a heavy round/ square head at one end and chisel edge on other end for cutting and breaking stone, brick units. It weighs roughly 1 kg to 1.5 kg. |
| Chisel |  | A hand tool used to cut and shape stone, bricks, wood, metal etc. It is usually 6 cm to 12 cm wide. |
| Raking tools |  | Raking tools are used for removal of mortar from the joints |
| Pointing tools |  | Pointing tools are used to fill and finish masonry joints with mortar or cement |

Table 12.1.1 Tools used for Rubble Masonry

12.1.5 Type of Plasters and Mortar used in Rubble Masonry

In rubble masonry, which involves using irregularly shaped stones, various types of plasters and mortars can be used to enhance the stability and appearance of the structure. The choice of plaster and mortar depends on factors such as the local materials available, climate conditions, and the desired final look of the construction. Here are a few common types:

1. **Lime Mortar:** Lime mortar is a traditional mortar made from lime, sand, and water. It is often used in historic and traditional construction due to its compatibility with softer stones and its ability to allow the structure to “breathe.” Lime mortar is flexible and allows for some movement, which can be important in rubble masonry where stones might not have uniform shapes.
2. **Cement Mortar:** Cement mortar is made from cement, sand, and water. It provides a strong and rigid bond between stones, suitable for more load-bearing applications. However, it may not be as compatible with certain types of stones due to its rigidity, which can lead to issues if the stones have different rates of expansion and contraction.
3. **Mud Mortar:** In some regions, mud mortar or clay-based mortar is used for rubble masonry. This type of mortar is readily available and has been used for centuries. It provides a more flexible bond similar to lime mortar and can work well with softer stones.
4. **Stabilized Mud Mortar:** This is a mixture of mud, sand, and stabilizers like straw or lime. It combines the benefits of mud mortar with added strength and durability.
5. **Polymer-Modified Mortar:** In modern construction, polymer-modified mortar can be used to improve the bond between stones and add some flexibility to the structure.

For plastering the surfaces of rubble masonry walls, various types of plasters can be used:

1. **Lime Plaster:** Similar to lime mortar, lime plaster is a breathable material that is compatible with softer stones. It can be used for both exterior and interior surfaces.
2. **Cement Plaster:** Cement plaster provides a hard and durable finish suitable for areas where additional strength is needed. However, it might not be as compatible with all types of stone due to its rigid nature.
3. **Clay Plaster:** Clay plaster is an eco-friendly option that can provide a rustic and textured appearance. It's often used in more traditional and natural building approaches.

12.1.6 Type of Cement Paste and Adhesives

In random rubble masonry, which involves using irregularly shaped stones without a uniform pattern, the type of cement paste and adhesives used can play a crucial role in ensuring the stability and durability of the structure. Cement paste and adhesives are used to bind the irregular stones together and create a cohesive structure. Here are the common types of cement paste and adhesives used in random rubble masonry:

- 1. Cement Mortar:** Cement mortar is a mixture of cement, sand, and water. It is commonly used in random rubble masonry to bind the irregular stones together and fill the gaps between them. The mortar helps provide structural integrity and stability to the masonry wall.
- 2. Lime Mortar:** Lime mortar is a mixture of lime, sand, and water. It has been traditionally used in masonry construction and is particularly suitable for historic or traditional buildings. Lime mortar is more flexible and breathable compared to cement mortar, which can be beneficial for older structures.
- 3. Polymer-Modified Mortar:** Polymer-modified mortar is a type of mortar that contains polymer additives, which improve its adhesive properties, flexibility, and durability. This type of mortar is often used when there's a need for better bonding between irregular stones and increased resistance to cracking.
- 4. Epoxy-Based Adhesives:** Epoxy-based adhesives are high-strength adhesives that can provide excellent bonding for various materials, including stone. They are especially useful when working with irregular stones that might not fit together perfectly. Epoxy adhesives can create a strong and durable bond between the stones.
- 5. Polyurethane Adhesives:** Polyurethane adhesives are another type of adhesive used for bonding irregular stones in masonry. They offer good flexibility and adhesion properties, making them suitable for structures that may experience slight movement.

When selecting the appropriate cement paste or adhesive for random rubble masonry, it's essential to consider factors such as the type of stones being used, the structural requirements of the project, and the environmental conditions the structure will be subjected to. Additionally, following industry standards and guidelines for masonry construction is crucial to ensure the safety and longevity of the structure. It's recommended to consult with experienced architects, engineers, or masonry professionals to determine the best materials and techniques for your specific project.

12.1.7 Preparing Sub Base for Random Rubble Masonry

- Locate the job site and the reference points from where you need to build the random rubble masonry.
- Then, clean the site. Take care not to breathe-in the dust.
- Carry out watering and ramming of the site to ensure compaction of soil.
- Once the cleaning is done, mark the proposed site with chalk powder.
- Set up the line. Note that the line must be longer than the wall.
- Pull the line tightly in order for it to be straight.
- With the help of nails, fix the line to the reference points

12.1.8 Visual Checks on Materials

- The stone shall be free from defects like cavities, cracks, flaws, sand holes veins, patches of soft or loose materials, etc.
- Cement used for mortar should be free of lumps
- Sand used for mortar shall be free of organic impurities and sieved as per grade requirement.

12.1.9 Dressing Stones to Prepare for Sides, Edges and Bed

1. Stones from quarry are cut into small pieces
2. Stones are dressed and chiselled very little to knock off very rough angles.

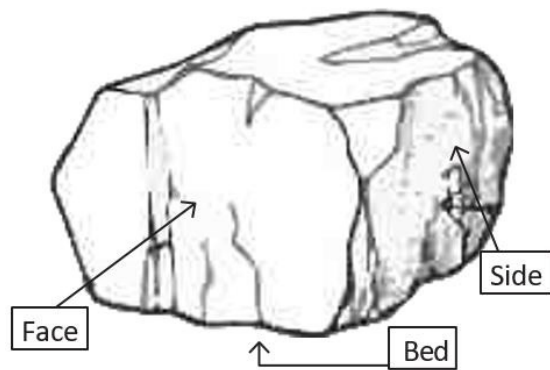


Fig. 12.1.15 Dressed one and cutting of stone

12.1.10 Stones used in Construction

The following shapes of stones are used in construction

Line Stones

Stones used between corner stones are called line stones. They can be plain surfaced.



Fig. 12.1.16 Line Stone

Corner Stones

Stones used at corners are corner stones. The two faces of corners are squared and shaped to a plain surface.



Fig. 12.1.17 Corner Stone

12.1.11 Mortar Mix for Random Rubble Masonry

Proportion of Mortar

- Masonry in cement/lime mortar 1:8
- Masonry in cement/lime mortar 1:6
- Masonry in cement/lime mortar 1:4
- Masonry in cement/lime mortar 1:2 etc.

(1 stands for cement/lime and 8, 6, 4, 2 stands for sand)



Fig. 12.1.18 Mixing Mortar

12.1.12 Estimation of Amount of Material Required for Random Rubble Masonry

- Quantity of rubble depends on the size of structure and the size of stone, the type of bond and the shape of the rubble stones (dressed, undressed,)
- Take a tolerance of 30% wastage for un-coursed and 20% wastage for coursed random rubble.
- Amount of sand and cement depend on the size of structure, type of masonry and type of mortar used.
- Water is required for wetting of stones and for preparation of mortar.

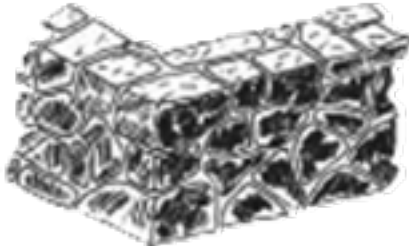
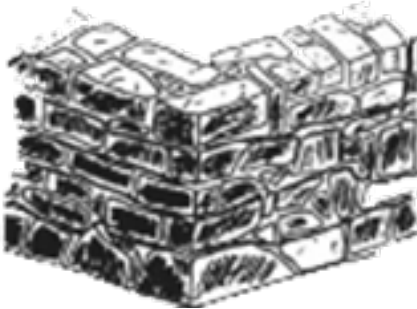




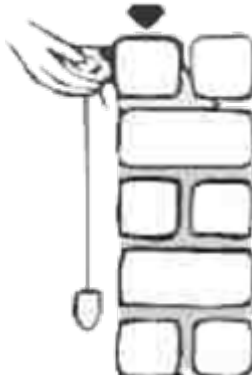
| Type | Approximate width of the joints | Material required for 1m ³ finished wall |
|---|---------------------------------|--|
| Undressed rubble stone masonry  | 10 mm to 40 mm | Stones: approximately 1.3 to 1.5 (including wastage) Mortar = 1:6 Cement = 85 Kg Sand = 0.35 m ³ |
| Dressed rubble stone masonry  | 10 mm to 25 mm | Stones: approximately 1.3 to 1.5 (including wastage) Mortar = 1:6 Cement = 85 Kg Sand = 0.35 m ³ |

Table 12.1.2 Estimation of Amount of Material Required for Random Rubble Masonry

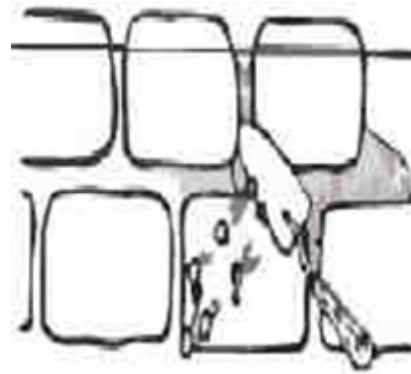
12.1.13 Procedure for Laying Course and Un-course Random Rubble Masonry

Steps to construct a stone wall are:

| | |
|---|--|
|  |  |
| <p>Step 1</p> <p>Wear the safety equipment.</p> | <p>Step 2</p> <p>Gather the materials and tools needed.</p> |
| <p>Step 3</p> <ul style="list-style-type: none"> Mark and clean the job site. <p>Step 4</p> <ul style="list-style-type: none"> Apply a layer of mortar on the row of stones. Spread it evenly with a trowel. Using a tube level, check if the mortar layer is levelled. |  |
| <p>STEP 5</p> <ul style="list-style-type: none"> Wet the stones before use. Each stone to be placed in close proximity to already placed stones to avoid thick mortar (should be less than 2 cm.) Lay a row of stones over this layer of mortar. Place one more row of stones behind the front row. Place stone in a suitable arrangement so as face stones are in staggered position thereby avoiding long vertical joints. Use a plumb to check the evenness of the edges of the front row. Gently release the plumb down from the front row up to the lower row of stones. Use the nylon rope to ensure that the stones are properly aligned. |  |

**Step 6**

- Pour mortar in between and over these two rows of stones.

**Step 7**

Cover the front surface of the stones with a layer of mortar.

Spread the mortar evenly with a trowel.

Table 12.1.2 Estimation of Amount of Material Required for Random Rubble Masonry

12.1.14 Importance of Bond Stones and Jambs

Bond stones and jambs play crucial roles in masonry construction, providing structural stability, load distribution, and proper alignment. Here's an explanation of their importance:

Bond Stones: Bond stones are large stones strategically placed at regular intervals within a masonry wall, especially in rubble masonry or random stone construction. Their primary function is to bond or tie together different layers of masonry, enhancing the wall's structural integrity. Key points regarding the importance of bond stones include:

1. **Structural Stability:** Bond stones distribute the load and forces across the wall, preventing the formation of vertical cracks and ensuring that the wall acts as a unified structure.
2. **Preventing Differential Settlement:** By creating a continuous connection between the layers of masonry, bond stones help prevent differential settlement, where one part of the wall sinks or shifts differently from another.
3. **Enhancing Durability:** Bond stones reduce the likelihood of water infiltration and penetration between layers, reducing the potential for freeze-thaw damage and improving the wall's long-term durability.
4. **Alignment:** Bond stones help maintain the vertical alignment of the wall, ensuring that the masonry courses are properly stacked on top of each other.

Jambs: Jambs are vertical side portions of a doorway or window opening in a wall. They are essential for maintaining the stability of the structure around openings and for supporting the load of the wall

above the opening. The importance of jambs includes:

1. **Load Distribution:** Jambs transfer the weight of the wall and any loads above the opening down to the foundation, ensuring that the load is properly distributed and preventing structural failure.
2. **Frame Support:** Jambs provide support for the door or window frames, ensuring that they are securely held in place and properly aligned within the opening.
3. **Preventing Cracks:** Properly constructed jambs help distribute stress around the opening, preventing the formation of cracks in the masonry caused by uneven load distribution.
4. **Architectural Aesthetics:** Well-constructed jambs contribute to the architectural aesthetics of the building, framing doorways and windows in a visually appealing manner.

Both bond stones and jambs are integral components of masonry construction that contribute to the overall stability, durability, and aesthetic appeal of the structure. Their proper design and placement are essential to ensure the longevity and safety of the building.

12.1.15 Do's and Don'ts in Random Rubble Masonry

Dos with Respect to Stone Masonry

For a good stone masonry:

- Always use hard stones in masonry.
- Use strong and durable stones in masonry.
- Use the stones that are of uniform and pleasing shade.
- Use stones with polished edges.
- Always use the stones that are dressed at quarry stage.
- As the stability of wall is dependent on the foundation or bearing of stone, it is advisable to use straightest, largest stone as footing course.
- First the corners of the wall are built up to a height of about 1m, making sure that outer and inner faces are plumbed and squared.
- The corners must be of large stones that will bond the two walls together in the best manner to resist strain. Additional strength may be given to the wall by the addition of galvanized iron or wire bonds, especially if small stones are used
- When the corners are up, the building can now continue by fixing two lines (rope) in and outside the wall. The purpose of those lines is to guide the masons during laying, and they should be 2 mm away from the face of the wall. The shaped line stones are then laid in a mortar-bed to the line and then checked for alignment.
- After a thorough check small stones (spalls) are laid into the interior cavities and filled with

mortar to tie the two faces (lines) together. These interior cavities are known as hearting

- Bond stones (trough stones) should cover the thickness of the wall at frequent intervals of not over
 - ♦ m. Their ends should be dressed to conform to the wall on either side
- Minimum length of a bond stone is 1/3 of the wall thickness
- Headers should extend not less than 2/3 the thickness of the wall
- The largest stones should be used for the lowest courses!
- Stratified stones should be laid on their natural beds (Sandstones)

Dos:

Select Appropriate Stones: Choose stones that are well-shaped and have reasonably flat surfaces for better stability and ease of placement.

Sort and Grade Stones: Sort stones based on size and shape to ensure a more even distribution and to create a balanced appearance.

Use Adequate Mortar: Ensure proper mortar mix with the right ratio of cement or lime to sand, providing adequate strength and bonding between stones.

Use Bond Stones: Incorporate bond stones at regular intervals to tie the layers of masonry together and distribute loads evenly.

Level and Plumb: Regularly check and adjust the vertical and horizontal alignment of the stones using a level and plumb bob.

Provide Proper Curing: Allow the mortar to cure gradually by keeping it damp for a few days, which enhances its strength.

Use Adequate Mortar Joints: Maintain consistent mortar joint thickness throughout the construction for uniform strength and appearance.

Weather Protection: Protect the fresh masonry from rain, extreme temperatures, and direct sunlight during the curing process.

Inspection: Regularly inspect the work as you progress to identify any issues and make necessary adjustments.

Don'ts:

1. **Use Unstable Stones:** Avoid using stones that are too irregular, rounded, or have excessive cracks, as they can lead to instability and poor bonding.
2. **Ignore Bonding Patterns:** Don't ignore the importance of proper bonding patterns; irregular placement can weaken the structure.
3. **Rush the Process:** Avoid rushing the construction; take your time to ensure proper alignment, bonding, and curing.
4. **Use Poor-Quality Mortar:** Don't compromise on the quality of mortar; weak mortar can lead to structural instability and reduced longevity.

5. **Neglect Mortar Consistency:** Don't allow the mortar to become too wet or too dry; inconsistent mortar can weaken the wall.
6. **Overuse Mortar:** Avoid excessive use of mortar, as it can diminish the natural beauty of the stones and reduce the structural integrity.
7. **Ignore Drainage:** Ensure proper drainage by allowing for weep holes or gaps in the wall to prevent water accumulation.
8. **Neglect Vertical Alignment:** Don't overlook the vertical alignment of stones; improper stacking can lead to instability and aesthetic issues.
9. **Skip Inspection:** Avoid neglecting regular inspections and adjustments during construction, as problems can compound if left unaddressed.

Exercise

Answer the following questions:

I. Multiple Choice Questions (MCQs):

- Which type of stones are commonly used in random rubble masonry?
 - Smooth and polished stones
 - Irregularly shaped stones
 - Perfectly rectangular stones
 - Synthetic stones
- What is the primary purpose of bond stones in random rubble masonry?
 - To enhance the aesthetic appearance
 - To provide structural stability
 - To create a smooth surface
 - To reduce water absorption
- Which type of mortar is often used in historic buildings due to its flexibility and breathability?
 - Cement mortar
 - Polymer-modified mortar
 - Epoxy mortar
 - Lime mortar
- What is the function of jambs in masonry construction?
 - To distribute electrical wiring
 - To provide extra insulation
 - To frame door and window openings
 - To enhance acoustic properties
- What should be done to protect fresh masonry from adverse weather conditions during curing?
 - Expose it to direct sunlight
 - Cover it with plastic sheets
 - Keep it damp and shield it from rain and extreme temperatures
 - Apply a sealant immediately

II. Fill in the Blanks:

- Bond stones are strategically placed within the masonry wall to enhance _____.
- In random rubble masonry, it's important to maintain consistent _____ joint thickness for uniform strength.
- Lime mortar is preferred for historic buildings due to its _____ properties and compatibility with older materials.
- Jambs provide support for door and window _____, ensuring proper alignment and stability.
- Weep holes or gaps in the masonry wall help prevent _____ accumulation and improve drainage.

III. Very Short Answer Questions:

- Why are bond stones important in random rubble masonry?
- What is the purpose of using polymer-modified mortar in masonry construction?
- How do jambs contribute to the stability of a masonry opening?
- Briefly explain why limestone is commonly used in construction.
- What role do weep holes play in preventing masonry-related issues?



13. 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>










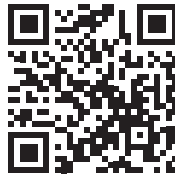

14. Annexure






Annexure I - QR Codes - Video Links











Annexure-I

Annexure of QR Codes for Brick Mason

| Chapter Name | Unit Name | Topic Name | URL | Page no. | QR Code | Video Duration |
|---|--|---|---|----------|--|----------------|
| Chapter 1: Introduction to the Job Role of a Brick Mason | UNIT 1.1: Introduction to Construction Industry | Overview of Construction Sector in India | https://youtu.be/yhjDhav4Pfw | 9 |  Overview of Construction Sector in India | 0:13:24 |
| | UNIT 1.2: Introduction to Brick Masonry | About Brick Masonry | https://youtu.be/3XGt-p-hpdU | 17 |  About Brick Masonry | 0:04:55 |
| | UNIT 1.3: Role and Responsibilities of a Brick Mason | Build A Brick Wall | https://youtu.be/ExltDReEdno | 38 |  Build A Brick Wall | 0:06:48 |
| Chapter 2: Process of Marking the Layout for Brick/Block Works (CON/N0143) | Unit 2.1: Interpretation of Construction Drawings | Types of Drawings in Construction Work | https://youtu.be/LY8CfY2nj1k | 50 |  Types of Drawings in Construction Work | 0:14:02 |
| | Unit 2.2: Marking the Layout for Brick/Block Works | How to Check Brick or Block Layout as per Drawing | https://youtu.be/EcuEbP8K3lk | 68 |  How to Check Brick or Block Layout as per Drawing | 0:14:27 |

| | | | | | | |
|--|---|---|---|-----|--|---------|
| Chapter 3: Process of Carrying Out Brick Laying Work (CON/ N0144) | Unit 3.1: Performing Brick Laying | Tools and Equip- ment's for brick and stone wall Construc- tion | https://youtu.be/ Eo4JqJaTkHY | 97 |  Tools and Equipment's for brick and stone wall Con- struction | 0:01:36 |
| | Unit 3.2: Staircases | How To Build Brick Stairs, Craft Skills | https://youtu.be/ QGQd-R39oPo | 104 |  How To Build Brick Stairs, Craft Skills | 0:10:35 |
| | Unit 3.4: Arches | Building Brick Arch Feature Step by Step | https://youtu.be/ CTZwd58LkR8 | 112 |  Building Brick Arch Fea- ture Step by Step | 0:10:53 |
| | Unit 3.5: Manholes | Manhole - Compo- nents & Functions | https://youtu. be/U_g8Zo- S8OU8 | 116 |  Welding defects cause and remedies | 0:06:07 |
| | Unit 3.6: Repair and Restore Brickwork | How To - Brick Re- pairs | https://youtu. be/8WvQpMc EbvA | 120 |  How To - Brick Repairs | 0:05:41 |

| | | | | | | |
|--|--|--|---|-----|---|---------|
| | Unit 3.7: Pointing in Masonry Works | An ideal regular mortar mix for pointing | https://youtu.be/DzM0MobulsE | 128 |  An ideal regular mortar mix for pointing | 0:02:15 |
| Chapter 4: Process of carrying out Block Laying Work (CON/N0145) | Unit 4.1: Performing Block Work | Types of Hollow Blocks | https://youtu.be/YfsrHLYc7tY | 147 |  Types of Hollow Blocks | 0:07:03 |
| | | How to Use the 3 4 5 Method to Square Up a Wall Perfectly | https://youtu.be/UBDZxL9_OM | |  How to Use the 3 4 5 Method to Square Up a Wall Perfectly | 0:07:03 |
| Chapter 8: Process of carrying out Brick Bat Coba Waterproofing (CON/N0146) | Unit 8.1: Brick Bat Coba Waterproofing | Brickbat Waterproofing Procedure | https://youtu.be/O51fub_3T9U | 281 |  Brickbat Waterproofing Procedure | 0:15:37 |
| Chapter 9: Process of carrying out IPS (Indian Patent Stone) Flooring (CON/N90147) | Unit 9.1: IPS (Indian Patent Stone) Flooring | How to Do IPS, Cement Concrete CC Flooring for House Construction In India | https://youtu.be/R2YAcUE_mCg | 307 |  How to Do IPS, Cement Concrete CC Flooring for House Construction In India | 0:15:57 |

| | | | | | | |
|---|---|--|---|-----|---|---------|
| Chapter 10: Process of applying Plaster on Internal & External Surfaces of Masonry & RCC Structure (CON/N0111) | Unit 10.1: Plastering Internal and External Surfaces | How To Plaster A Brick Wall (Float & Set Plastering For Beginners) | https://youtu.be/gqJplphsRdg | 327 |  How To Plaster A Brick Wall (Float & Set Plastering For Beginners) | 0:15:53 |
| Chapter 11: Process of carrying out VDF (Vacuum Dewatered Floor) Flooring (CON/N0148) | Unit 11.1: Vacuum Dewatered Flooring (VDF) | Methodology for VDF Flooring Full process of Trimix Flooring | https://youtu.be/DNfAN381h2U | 346 |  Methodology for VDF Flooring Full process of Trimix Flooring | 0:08:17 |
| Chapter 12: Process of Building Structures using Random Rubble Masonry (CON/N0113) | Unit 12.1: Introduction to Rubble Masonry | Stone Masonry/ Coursed Rubble Masonry | https://youtu.be/kEDDMfmFoLY | 374 |  Stone Masonry/ Coursed Rubble Masonry | 0:07:33 |





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