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Participant Handbook

Sector
Construction Skill Development Council of India

Sub-Sector
Real Estate and Infrastructure Construction

Occupation
Construction Painting

Reference ID: **CON/Q0502, Version 3.0**
NSQF Level 3

Assistant Construction Painter & Decorator

Option: Varnishing and Polishing

Published by

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Shri Narendra Modi
Prime Minister of India

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QUALIFICATION PACK- NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

CONSTRUCTION SKILL DEVELOPMENT COUNCIL OF INDIA

for

SKILLING CONTENT:PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role/Qualification Pack:'Assistant Construction Painter & Decorator'

QP No.'CON/Q0502, Version 3.0 NSQF Level 3'

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Authorised Signatory
(Construction Skill Development Council)

Acknowledgements

This participant's handbook meant for Assistant Construction Painter & Decorator 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 Construction Painting. 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 an Assistant Construction Painter & Decorator. Its content has been aligned with the latest Qualification Pack (QP) prepared for the job role. With a qualified trainer's guidance, the participants will be equipped with the following for working efficiently in the job role:

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

The handbook details the relevant activities to be carried out by an Assistant Construction Painter & Decorator. 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 Assistant Construction Painter & Decorator QP:

- **CON/N0502:** Carry out preparation of all type of basic surfaces for painting works
- **CON/N0101:** Erect and dismantle temporary scaffold up to 3.6 meter height
- **CON/N0503:** Apply paints to masonry, metal and wood surfaces for obtaining plain finishes
- **CON/N8001:** Work effectively in a team to deliver desired results at the workplace
- **CON/N9001:** Work according to personal health, safety and environment protocols at construction site
- **DGT/VSQ/ N0101:** Employability Skills (30 Hours)

Participants can also elect to learn the varnishing and polishing of:

Option1: **CON/N0504:** Carry out varnishing and polishing of doors, windows partitions and other wooden surfaces under supervision

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	Module and Units	Page No
1.	**Role and Responsibilities of an Assistant Construction Painter & Decorator**	1
	Unit 1.1. Introduction to Construction	3
	Unit 1.1 - Role and Responsibilities of an Assistant Construction Painter & Decorator	8
	Exercise	10
2.	**Preparation of Basic Surface for Painting Works (CON/N0502)**	13
	Unit 2.1 Introduction to Surface Preparation	15
	Unit 2.2 Methods of Surface Preparation	28
	Exercise	38
3.	**Erect and Dismantle Scaffold (CON/N0101)**	41
	Unit 3.1 Erect and Dismantle Scaffold	43
	Exercise	55
4.	**Application of Paints to Different Surfaces (CON/N0503)**	57
	Unit 4.1 Basics of Paints	59
	Unit 4.2 Application of Paints to Different Surfaces	77
	Exercise	90
5.	**Interact and Communicate Effectively (CON/N8001)**	93
	Unit 5.1 Effective Interaction and Communication	95
	Exercise	108
6.	**Follow Safety Norms at Workplace (CON/N9001)**	111
	Unit 6.1 – Workplace Hazards	113
	Unit 6.2 – Fire Safety	130
	Unit 6.3 – Safety Measures at Workplace	134
	Exercise	144
7.	**Employability Skills (30 Hours) (DGT/VSQ/N0101)**	147
8.	**Demonstrate Varnishing and Polishing (Option 1 CON/N0504)**	151
	Unit 7.1 Varnishing and Polishing on Wooden Surfaces	152
	Exercise	170

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

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1. Role and Responsibilities of an Assistant Construction Painter & Decorator

Unit 1.1 - Introduction to Construction Industry
Unit 1.1 - Role and Responsibilities of an Assistant Construction Painter & Decorator

Key Learning Outcomes

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

- Explain the role and responsibilities of Assistant construction painter and decorator.
- Identify the career progression options for Assistant construction painter and decorator.

Unit 1.1. Introduction to Construction Industry

Unit Objectives

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

- Overview of construction industry.

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.

Construction Industry in India

During the forecast period, India's construction market is expected to grow at a CAGR greater than 10%. (2022–2027). As COVID-19 spread over the country in April 2020, the Indian construction sector, which was already struggling with poor management and a lack of labour force tracking, totally lost its central grip, bringing an end to the business. COVID-19 caused havoc on all levels and scales of the value chain.

- The availability of building supplies and the rate of price rise were major concerns. The lack of timely implementation due to lockdowns led to cost overruns, significant delays, and even the cancellation of projects.

- Many MSMEs were compelled to close their doors or restrict their activities as a direct result of the cancellation and postponement of projects. This was a major concern because the majority of construction firms and design studios are small and specialize in a certain style of structure.

- Despite the impact of COVID-19 restrictions and lockdowns on construction activity, India experienced 45 million square feet of new supply in 2020, with 36 million square feet coming from tier I cities and 8.9 million square feet from tier II and III cities.

- The 3PL and e-commerce sectors, which accounted for 62 percent of total absorption in 2020, continued to drive warehouse demand in 2021, with the manufacturing sector accounting for 14 percent. Delhi-NCR had the highest absorption rate among India's major cities in 2021, at 18%, followed by Pune at 15%. 14 percent and 11 percent absorption rates were recorded in Mumbai and Bangalore, respectively, with 20 percent in tier II and tier III cities.

- In 2021, industrial and logistics sector investments surpassed USD 1.5 billion, making it the second-largest receiver of such money after the office sector. This asset category has maintained its popularity due to its strong growth rate and regular returns.

The commercial real estate subsector is poised for growth as individuals return to the workplace and organizations adopt hybrid work arrangements. As more companies send their employees back to work, the demand for commercial office space gradually increases.

1.1.2 Types of Construction

The following are the types of construction:

a. Building construction:

Building construction is the act of adding a structure to 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 (will be explained in detail later).

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,

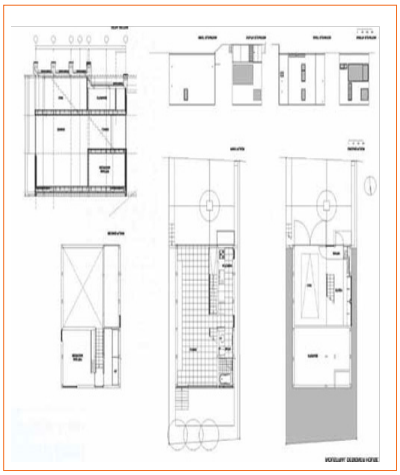

Fig. 1.1.1 Industrial Construction Site Plan

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. 1.1.2 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.

1.1.3 Construction Project Categories

Each sort of construction project necessitates a specialised team for planning, design, building, and maintenance. There are typically three basic categories of construction projects:

1. Residential projects

Residential projects involve residences, housing developments, structures, and garages. Individual landowners (self-build), expert house-builders, property developers, general contractors, and suppliers of public or social housing can all engage in residential construction (eg: local authorities, housing associations). Local building authority laws and codes of practise must be complied with by residential construction techniques, technologies, and materials.

2. Non-residential/ Commercial Projects

These projects involve the construction of large and small commercial structures, such as businesses, churches, schools, and hospitals. Depending on the type of building, a diverse variety of private and public entities, including local authorities, educational and religious bodies, transit undertakings, shops, hotels, property developers, and financial institutions, can procure non-residential building construction. The majority of building in these industries is performed by general contractors.

3. Engineering projects

Construction of bridges, roads, reservoirs, big public works, dams, motorways, trains, water or wastewater, and utility distribution are examples of engineering projects. Civil engineering include the planning, building, and upkeep of such massive enterprises.

1.1.4 Market Segment of Construction Industry

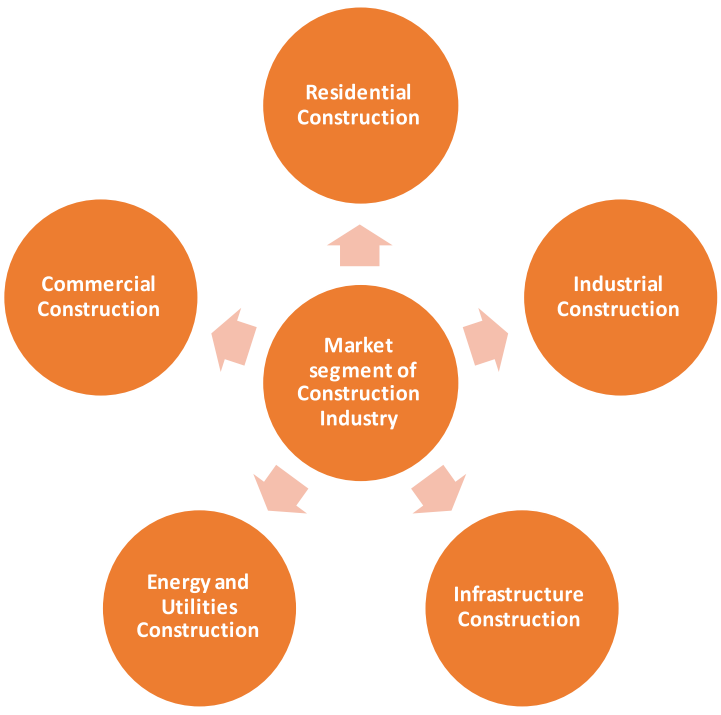

Fig. 1.1.3 Market segment of construction industry

Notes

Scan the QR code to watch the video

https://youtu.be/nndLyZrGfWc

Construction Industry

https://youtu.be/1WVzo2UFyo8

Types of Construction

Unit 1.2: Role and Responsibilities of an Assistant Construction Painter & Decorator

Unit Objectives

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

- Define personal attributes required in the construction painting occupation.
- Recall the basic terms used in construction painting works.
- Describe the role and responsibilities of an Assistant construction painter and decorator.
- Explain the career progression options of an Assistant construction painter and decorator.

1.2.1 Assistant Construction Painter & Decorator

Painter and decorator is the basic trade in the construction industry. It is the same for all types of construction, but there are differences based on specialization and the needs of the project.

An Assistant Construction Painter & Decorator has to work as a semi-skilled tradesman and do tasks under the instruction and close supervision of superiors. He is expected to shift objects, utilize tools, and mix colours and paints. Including identifying, preparing the surface, and keeping the work area clean. He should make sure that the environment, health, and safety rules that apply to his trade are followed.

1.2.2 Role and Responsibilities of an Assistant Construction Painter & Decorator

This job role is responsible for identifying and preparing paints and all kinds of basic surfaces, mixing colours and paints and applying them to get a smooth finish, setting up and taking down temporary scaffolding, and varnishing and polishing doors and windows.

- Using brushes, rollers, or spray equipment to put on paint or other materials like stains, lacquer, or varnish
- Getting surfaces ready and cleaning them
- Taking down old paint and wallpaper
- Cracks and holes in walls need to be fixed.
- Mixing and Thinning Paint
- Putting wallpaper or fabric on walls by measuring, cutting, and putting it up.

- Putting up scaffolding and building it
- Guiding customers in choosing colours and wall coverings
- Providing cost estimates
- Reading specifications to find out what materials are needed
- Assistant construction painters and decorators are trained to work safely and take precautions to avoid injury.

1.2.3 Personal Attributes required by an Assistant Construction Painter & Decorator

This job requires the individual to work on site as an Assistant Painter & Decorator, where they should have good colour perception and writing skills. Additionally, they should be physically fit to withstand working in a difficult and demanding construction environment while also responding to the needs and requirements of the tasks. Work as a Painter and Decorator might take place either indoors or outdoors, independently or in conjunction with a group of other building specialists. The task can be strenuous on the body because it requires one to stand for extended periods of time, frequently with the arms lifted over their head.

1.2.4 Career Path of an Assistant Construction Painter & Decorator

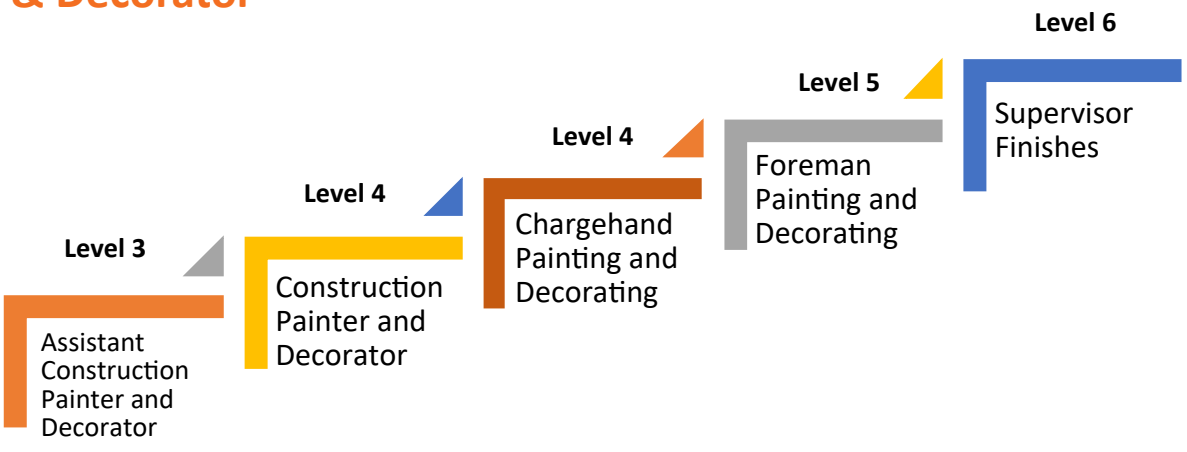

Fig. 1.2.1 Career path of an Assistant Construction Painter & Decorator

Exercise

1. Show the career path of an Assistant Construction Painter & Decorator.
2. What are role and responsibilities of an Assistant Construction Painter & Decorator?
3. State the personal attributes required by an Assistant Construction Painter & Decorator.
4. What are the types of construction? Name them.

Notes

Scan the QR code to watch the video

https://youtu.be/WCIgEL0Fv2E

Role and Responsibilities of an Assistant Construction Painter & Decorator

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2. Preparation of Basic Surface for Painting Works

Construction Skill Development Council

Unit 2.1 Introduction to Surface Preparation

Unit 2.2 Methods of Surface Preparation

CON/N0502

Key Learning Outcomes

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

- Select materials, tools and equipment for preparing basic masonry, steel and wooden surfaces for painting.
- Demonstrate preparation of masonry, metal and wood surfaces for painting works.

Unit 2.1 Introduction to Surface Preparation

Unit Objectives

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

- List different types of materials such as putties, stoppers, solvents, filler, mordant solutions & stabilizing solutions required for surface preparation.
- List the various tools required for surface preparation such as scraper, putty knife, chisel knife, knotting brush, nail punch, hammer, dusting brush, dust masks, wire brushes, goggles, filling knife, filling board, gloves & buckets.
- List the different type of abrasives such as glass, sand paper, sanders and their use.
- List the different types of cleaning agents used for surface preparation.
- Describe the different type of fillers used in painting works including their use.
- Select different types of materials, abrasives, cleaning agents required for surface preparation.
- Demonstrate filling and levelling of voids and undulations using appropriate fillers as per specifications/instructions.

2.1.1 Surface Preparation

The term “surface preparation” refers to the variety of approaches that can be taken to prepare the top layer of material before applying a coating, using adhesives, or carrying out any other processes. Surface preparation is required for preparing steel and other substrates to paint, coat, or line them before surface preparation begins.

Surface preparation can be carried out using either chemical or mechanical methods to remove any pre-existing coatings, residue, surface defects, organic matter, oxidation, and other pollutants from the surface.

Many surface preparation procedures are utilized when preparing substrate materials, such as aluminium, concrete, plastic, steel and other alloys, and wood. Some of these materials include:

Surface preparation techniques may vary depending on the type of material being worked with or the application being carried out. Still, they often involve a series of processes in sequential order.

Numerous general stages must be followed properly to successfully prepare a surface for adhesion, painting, welding, or any other procedures.

These include:

Step 1. Surface Condition Assessment

It is critical to evaluate the state of the surface in its entirety before beginning any preparation. Using standards, such as BS EN ISO 8501-1, which offers information on rust grades ranging from A to D for steel surfaces, can assist with this evaluation. These grades could be used to help determine whether or not the surface preparation will be successful, as well as the procedures that will be necessary. Surface profilometry can also help determine whether the existing surface can provide the required mechanical key for the subsequent processing steps; however, some surface preparation will generally be necessary for most instances. This can be determined by determining whether the existing surface can provide this mechanical key.

Step 2. Remove Old Coatings

Before applying a new coating, it is standard practice to strip surfaces of any previous coatings that may be present. If applying a new coating on top of an old one that has failed, you will allow pre-existing issues such as bubbling, flaking, or peeling to remain even after the covering layer has been applied. Coatings should be stripped down until there is a clean surface, such as white metal. This will help prevent problems such as corrosion and increase the assets' lifespan.

Step 3. Remove Oils, Acids, Chlorides, and Other Surface Contaminants

It is not just necessary to remove old coatings from a material's surface. Industrial environments expose numerous surfaces to oils, grease, and other lubricants, all of which must be thoroughly cleaned before a new coating is applied to avoid interfering with adhesion.

Chlorides can build on the surface of a material as they travel through the air. This is very common near the ocean and other aquatic areas. This phenomenon is known as chloride-induced corrosion. Chlorides can accelerate the rate of oxidation in metals, hence accelerating corrosion damage.

Due to the fact that certain types of surface contaminants may be invisible to the naked eye, it may be necessary to conduct tests to determine their existence.

Step 4. Remove Loose Parts of the Surface

The material's surface must also be cleaned of loose particles that may flake or crumble. This can be accomplished using procedures such as abrasive blasting, which effectively removes rust, mill scale, and other loose particles from the substrate's surface.

Step 5. Profile the Surface

After loose material and other contaminants have been removed from the surface, it is necessary to profile the surface. New coatings may necessitate a different surface profile than their predecessors. Improved adhesion and mechanical bonding will result from a surface that has been suitably contoured and adapted to the coating method or substance.

Step 6. Dry the Surfaces

Dry surfaces are ideal for coating application. During the curing process, wet surfaces can cause pinholes to form as moisture evaporates between the surface and the coating, generating microscopic holes. Moisture can also adversely affect drying times, even though some coatings use a second layer to conceal these pinholes. When moisture is present on bare metal surfaces, flash corrosion can also occur; this corrosion can continue beneath a freshly applied coating. Additionally, humidity might be a problem, thus it is important to determine whether a coating can be placed at the humidity level of the area. Typically, the requirements are specified in the applicable coating and application standards.

By adhering to these six fundamental guidelines, the likelihood of effectively applying a coating, utilizing an adhesive, or producing a strong weld is increased.

2.1.2 Purpose of Surface Preparation

Surface preparation ensures that a material is suitable for receiving a coating, adhering to another material, and other similar purposes. A surface that is unclean, greasy, flaking, or otherwise compromised can drastically limit the efficacy of a fresh coating, lead to adhesion failure, or otherwise compromise a process.

Surface preparation helps to provide the highest quality mechanical bonding, adhesion, or welds, while also mitigating future issues like as corrosion and mechanical damage.

2.1.3 Importance of Surface Preparation before Coating

Surface preparation is time-consuming, yet skipping it would not benefit the painting process as a whole. Before applying a coat of paint, the surface must be thoroughly and meticulously prepared to ensure its longevity. The surface must be uniform and smooth. Any cracks, holes, or other defects prevent the paint from adhering properly to the surface. The majority of paint failures are caused by improper surface preparation.

Techniques for surface preparation differ depending on the type of surface. Even interior and exterior surfaces cannot be treated identically. Similarly, it would change based on whether it was freshly painted or repainted. In the event of repainting, it is not required to remove the entire existing layer of paint, but only loose flakes. Painting over the shattered parts may cause the old paint to peel off along with the new paint.

Wall Cleaning: Although exterior walls may appear clean from the exterior, every wall contains dirt, dust, and black stains. Fungi develop on walls that retain moisture or are poorly maintained. Despite the fact that these contaminants may not be apparent, they are typically present on the wall. They inhibit the coating's ability to adhere completely to the wall. Therefore, cleaning the walls prior to painting is a necessary step.

Fixing Wall Dampness: Another essential step is to inspect the wall for dampness. Wet and discoloured wall areas indicate the presence of moisture. In surface abnormalities such as gaps, hairline fractures, and tiny holes, bacteria thrive. These bacteria present on the wall contaminate the air in the room and can cause serious health problems. Therefore, the spaces must be filled and polished with sandpaper.

Priming: Primer helps to conceal dark surfaces and imperfections. Priming the surface makes it appear more homogeneous in tone. In addition, priming extends the life of paint by facilitating its adhesion to the surface.

Cleaning, fixing, patching, sanding, masking, and priming constitute the entirety of the wall surface preparation process. Each surface preparation process is utilized for unique reasons and carries its own significance. Applying each step thoroughly will result in a well-prepared surface and a painting work of superior quality.

2.1.4 Types of Materials required for Surface Preparation

The following materials are used for surface preparation:

a. **Wall Putty:** Wall putty is a white, cement-based, polymer- and mineral-based powder that makes the wall appear smoother. Primarily, it is used to fill cracks and holes in walls and prepare a smooth surface for painting. Your walls will be more protected against stains, mould, and cracks if you use wall putty.

   Wall putty is a versatile compound that may be used on any wall, including precast walls, concrete walls, and rendered walls, and provides the optimum finish for paint and wall coverings. Wall putt, also known as paint putty, is typically placed prior to painting the walls because it helps cover up cracks and holes that could otherwise impede the smooth application of wall paints. Depending on the surface, it may require 1-2 coats of painting putty and sanding to prepare it for new paint.

Fig.2.1.1 Wall Putty

Types of Wall Putty

There are two types of wall putty:

- **Cement Wall Putty:** Cement-based putties or cement putty are primarily used for repairing concrete and masonry surfaces. They come in powder form and must be combined with water before to usage. The texture should resemble peanut butter (i.e., not too runny or overly thick). The compound must then be applied with a putty knife and allowed to dry for approximately one day before painting the wall.

- **Acrylic Wall Putty:** Acrylic-based putties or acrylic putty can be utilised on both plaster and drywall surfaces and is available in both ready-to-use and powder forms. They typically have a smooth finish and can be tinted, allowing you to match the colour of your wall paint. They are not as resilient as cement putties and may chip or shatter with time.

Each of these wall putties has certain advantages that make them more suitable for particular uses. Cement-based putties, for instance, dry to a surface that is often tougher than those of other types. Conversely, acrylic latex-based putties are renowned for being user-friendly and quick-drying.

Steps to follow when applying wall putty:

Guidelines to follow when applying wall putty paint:

i. Sand the surface prior to beginning. This will help the putty adhere to the wall more effectively and produce a smoother surface.

ii. Use a screwdriver or thin wire to remove any dirt or debris from any holes or cracks before filling them with putty.

iii. Begin on one corner and work outward. This method of applying the putty will prevent bubbles and creases from appearing on the surface.

iv. Ensure that the putty is uniformly applied. Ensure that the putty is spread evenly and there are no lumps or bumps by using a trowel or spatula.

v. If required, apply a second layer to assist eliminate any bubbles or wrinkles.

vi. Ensure that the blade knife is sharp when applying putty so that it glides evenly across the surface.

vii. Allow it to dry for a minimum of 24 hours before painting. It is vital to let the paint dry completely so that it does not flake off over time.

viii. Before applying paint, the surface must be sanded again to smooth it.

b. Waterproofing Chemical or Stopper: Waterproofing is the process of making a structure watertight or water-resistant in order to prevent it from being impacted by water and to strengthen its resistance to water in various conditions. The waterproofing of structures reduces humidity inside the home and minimises water-related damage. According to experts, waterproofing is also essential for increasing the building's durability. The following chemicals are used as stopper:

- Grout and epoxy
- Vinyl ester resin
- Polyurethane
- Polyurea
- Bituminous
- Poly acrylic

Rainfall-caused moisture can cause considerable damage to a home's walls. Mixing waterproof plaster with mortar provides a cost-effective approach. Plastering is an efficient approach for protecting walls. It helps make the walls stronger and improves their appearance.

Polyurethane is a common chemical used to waterproof exposed surfaces, such as roofs.

Polyurea is one of the most effective waterproofing chemicals in India and can be used to waterproof concrete seams and surfaces.

c. **Solvents:** A solvent is a substance capable of dissolving a solute into a solution. Solvents are often liquids, although they can also be solids, gases, or supercritical fluids. Temperature affects the amount of solute that can dissolve in a given volume of solvent. Organic solvents are frequently used in dry cleaning (e.g., tetrachloroethylene), as paint thinners (e.g., toluene, turpentine), as nail polish removers and glue solvents (acetone, methyl acetate, ethyl acetate), as spot removers (e.g., hexane, petrol ether), in detergents (citrus terpenes), and in perfumes (ethanol). Water is a solvent for polar molecules and the most prevalent solvent used by living organisms; all ions and proteins within a cell are dissolved in water. Solvents have multiple uses in the chemical, pharmaceutical, oil, and gas sectors, including chemical synthesis and purification.

   Depending on their volatility, most organic solvents are flammable or extremely flammable. Certain chlorinated solvents, such as dichloromethane and chloroform, constitute an exception. Explosions can occur in solvent vapour and air mixtures. Solvent vapours are denser than air, thus they sink and can travel great distances almost undiluted. The presence of solvent vapours in ostensibly empty drums and cans poses a risk of flash fire; thus, empty containers of volatile solvents should be stored open and upside down.

d. **Fillers:** Wall fillers are one of those incredibly handy products with multiple applications. It can be used to fill in holes caused by frame hangers, patch small cracks caused by the "shifting" of the furniture and fixtures, and fix other sorts of surface damage. Indeed, the most effective wall fillers are designed to conceal imperfections in walls and ceilings, leaving a smooth surface for painting.

   On the market, there are a range of fillers, including fine surface filler, interior filler, exterior filler, and multipurpose filler. These are available as either a powder or a pre-blended paste. While a paste is certainly simpler than a powder, a powder filler will last longer and won't dry out like a paste filler.

Types of fillers:

The following are important categories of fillers:

- **Fine surface fillers:** These fillers are used to conceal flaws such as microscopic cracks and scratches. It works well on fine scratches up to a depth of 2 mm.

- **Interior fillers:** Interior fillers are used to fix holes, fissures, and other imperfections measuring 2mm to 1cm. Occasionally, they can be utilised on larger holes while working with drill holes.

- **Exterior fillers:** These materials are used to patch up clefts in exterior walls. They are appropriate for a variety of surfaces, including masonry, concrete, stone, and brick, and provide a smooth, paintable surface.

- **Multipurpose fillers:** Multipurpose (also known as all-purpose) fillers can be used for both fine cracks and bigger gaps.

- **Specialist fillers:** There are also numerous specialised fillers available, such as those designed for outdoor use. Some of the more prevalent ones include:

    - **Moisture-resistant fillers:** Constructed to withstand moist settings, such as kitchens and bathrooms.

    - **Masonry repair fillers:** These are formulated for outdoor use, have great mechanical strength, and are resistant to the environment.

    - **Wood fillers:** These are often composed of wood fibres to make them appropriate for wood restorations.

Steps to follow when applying wall fillers:

i. Remove any loose particles and dust from the wall by cleaning it with sugar soap.

ii. Apply the filler to the cavity using a filling knife. Apply gently from multiple directions to provide an even coating, and don't forget to check for air bubbles.

iii. Once filled, smooth out the filler by running the knife around the surface in various directions, beginning in the centre. Repeat until the surface is smooth.

iv. Upon drying, one can apply a second layer if necessary. Alternately, use sandpaper to completely smooth the filler and then paint over it for a seamless finish.

e. Mordant Solution: A pre-treatment chemical called Mordant Solution is used to clean up galvanised metal surfaces before topcoats are applied. For the purpose of ensuring coating adhesion, it changes the surface's natural properties.

f. Stabilizing Solution: A very sticky liquid known as stabilising solution is applied on crumbling or chalky masonry prior to painting. The concept is straightforward: it penetrates deeply into the surface and ties together any loose material to form a solid foundation.

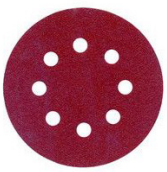
2.1.5 Types of Cleaning Agents required for Surface Preparation

Cleaners are composed of a wide variety of chemicals and substances. They can be divided into various categories based on their consistency and purpose.

- **Strong alkali cleaners** are extremely caustic solutions used to dissolve greases and protein deposits and to kill microorganisms, making them suitable for sanitation and cleaning. Sodium hydroxide and potassium hydroxide are examples.
- **Medium alkali cleaners** are moderately caustic solutions utilised to eliminate fats, oils, and some paints and lacquers. Carbonate of sodium, popularly known as washing soda, is an example.
- **Mild alkali cleaners** are slightly basic solutions used to soften water and for light cleaning. Sodium bicarbonate is an example.
- **Strong acids** are very corrosive acids used to dissolve mineral deposits on the surface of the earth. Sulfuric and hydrofluoric acids are examples.
- **Mild acids** are acids that are used to soften water and prevent mineral buildup. Examples include acetic and gluconic acid.
- **Solvents** consist of a number of noncorrosive compounds utilised to dissolve grease and oil. In solution, solvent cleaners contain chemicals such as alcohols, chlorinated hydrocarbons, and terpenes (either added or as the base). Examples are acetone and d-limonene.
- **Soaps and detergents** are commonly used as domestic cleaners and to emulsify fats, oils, and greases. Soaps are created spontaneously via fatty acid and basic salt interactions. Detergents are synthetically generated basic salts.

2.1.6 Types of Abrasives required for Surface Preparation

The type of abrasives used in surface preparation are:

Abrasives	Usage	Image
Cut Off Wheels	A self-sharpening abrasive is sometimes known as cut off wheels. The majority of the time, cut-off wheels are utilised for hard materials like metal, stone, concrete, etc. It is renowned for its quick cutting capabilities, precision, and extended lifespan. For processing, maintaining, repairing, and other industrial uses involving metals, these wheels are perfect.	
Mounted Points	Mounted Points Abrasives consist of small grinding wheels bonded to a mandrel. It is available in a variety of sizes and forms, containing abrasive granules, rubberized plastic, and felt. In the manufacturing process, mounted point abrasives are predominantly utilised for deburring. It is great for detailing and finishing in cramped locations, including machine gears. It is combined with a die grinder, straight shaft grinder, or hand-held rotary tools.	
Sand-Paper Sheets	Sandpaper is also considered to be glasspaper. It eliminates material from wood, metal, and other surfaces, leaving them smooth and ready for staining and polishing. Sandpaper can be used to remove old oil paint and adhesive. You may use the sandpaper sheets for both industrial and do-it-yourself uses. They are appropriate for both hand and power sanding. Emery, Zirconium Alumina, Ceramic Alumina, Aluminum oxide, and garnet are the most prevalent types of sanding paper.	
Grinding Wheels	The Grinding Wheel is composed of an abrasive material utilised for grinding, abrasive cutting, and abrasive machining. It is designed primarily for grinding machines. The material of grinding wheels is either aluminium or solid steel. Common types of grinding wheel include the straight wheel, cylinder ring, tapered type, dish cup, diamond type, cut-off type, and saucer type. In the machine, abrasive grains are held together using various bonding agents such as resinoid, silicate, rubber, and metal.	
Sanding Disc	The sanding disc is a circular sanding disc ideal for removing material, mild defects, corrosion, paint, and rust from wood, metal, and plastic surfaces. Its coarse grain facilitates the removal of metal welds, wood mill traces, and even edges.	

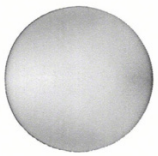
Abrasives	Usage	Image
Fibre Disc	A fibre disc is a grinding wheel constructed from vulcanised fibre and backing. One side is coated with resin and abrasive granules. It is equipped with a backing pad and a right-angle grinder. The fibre disc is commonly used for metal machining.	
PVA Sponges	PVA sponges are made from a synthetic polymer that is resistant to both mildew and mould. PVA sponge is superior to ordinary sponges or sheets for absorption. Due to its great absorption capacity, the drying process is quick and effective. On all surfaces, water spots are eliminated. The PVA sponge stretches while absorbing liquid and becomes dry when compressed.	

Table 2.1.1 Types of Abrasives

2.1.7 Tools required for Surface Preparation

The various tools used in surface preparation are:

Tool	Description	Image
Scraper	A wall scraper is an efficient instrument for scraping old wall covering and flaking paint from the surface of walls.	
Putty Knife	A putty knife is a specialised tool used to apply putty on walls. A skilled painter will manually apply putty and then smooth it with a knife.	
Chisel Knife	The chisel knife has been designed and manufactured specifically for mending cracks and holes in wood and plaster.	
Knotting Brush	The strong impact action of knotted wire brushes makes them perfect for weld cleaning, heavy deburring, and other heavy-duty tasks.	

Tool	Description	Image
Nail Punch	In woodworking, a nail set, also known as a nail punch, is used to sink the nail beneath the surface for a smooth finish.	
Hammer	A hammer is a tool with a heavy metal head placed at a right angle to a handle, used for tasks such as shattering objects and driving nails.	
Dusting Brush	Dusting brushes are the solution for preparing or finishing surfaces by removing excess dust or paint fragments, since they are the best tool for careful dusting.	
Dust Masks	A dust mask is a flexible paper pad secured over the nose and mouth with elastic or rubber straps for personal protection against non-toxic nuisance dusts.	
Wire Brushes	The wire brush is essentially an abrasive tool used for rust removal and paint removal. It is also used to clean surfaces and provide a more conductive surface for establishing electrical connections, such as those between car battery posts and their connectors if they have a build-up of filth and dirt.	
Goggles	Goggles or safety glasses are forms of protective eyewear that often enclose or shield the area around the eye to prevent particles, liquids, or chemicals from entering the eye.	
Filling Knife	Although a filling knife resembles a scraper somewhat, the key distinction is its flexible blade. This makes it perfect for squeezing filler into wall gaps and crevices.	

Tool	Description	Image
Filling Board	Filler Boards are manufactured as a basic, low-cost, pre-moulded expansion joint filler for all types of civil engineering and building construction projects. They are recommended for the protection of various materials, particularly waterproofing below-grade where sharp and abrasive backfill material could pierce or otherwise damage the waterproofing.	
Gloves	Gloves are garments that cover the hands and wrists and contain separate parts for each finger. Gloves are worn to keep the hands warm, dry, and protected. Ideally a painting glove should be used.	
Buckets	Buckets are used in preparing mixture of wall putty, fillers, etc. A lid bucket is essential to keep the mixture from air drying.	

Table 2.1.2 Types of Tools required in Surface Preparation

Notes

Scan the QR code to watch the video

https://youtu.be/24jZ03d1jxg

Surface Preparation

https://youtu.be/0Q2fk5YrS6I

Purpose of Surface Preparation

https://youtu.be/_RR-_J-n-6k

Types of Abrasives required for Surface Preparation

Unit 2.2 Methods of Surface Preparation

Unit Objectives

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

- Explain the methodology for preparation of different surfaces like masonry, RCC, wood and metal by wet and dry abrading, degreasing, knotting, priming, filling, rust removal of paint system and removal of wall coverings and other similar processes.
- Demonstrate visual checks performed to assess the surface for type of preparation method.
- Demonstrate selection of appropriate preparation process as per the type of surface such as plastered masonry and RCC surface, metal surface and wood surface.
- Demonstrate various surface preparation methods such as washing, stripping/ scarping, abrading, keying, and brushing and other similar methods as per specifications/instructions.
- Demonstrate preparation of metal surface by degreasing, solvent wiping and abrading using appropriate tools as per specifications/instructions.
- Demonstrate preparation of wood surface by scraping, solvent wiping and abrading using appropriate tools as per specifications/instructions.

2.2.1 Surface Preparation for Masonry Work

For a painting exercise to be effective, there needs to be enough planning, which should be started well in advance to account for situations like weather, examinations, weddings, etc. Before beginning the actual painting process, preparation work like masonry work, crack filling, water proofing, etc. should ideally be completed. This is also required to ensure that the final paint layer lasts as long as possible by choosing the right brushes and rollers and conducting careful preparation for colour scheme.

Because freshly laid Portland cement renderings and cement plastered surfaces are highly alkaline, solvent-based paints used to them are susceptible to saponification and bleaching. Additionally, efflorescence damage is a possibility. Solvent-based paints should not be applied to such surfaces until the substance has dried for several months; however, Portland cement paints or silicate paints may be used for earlier ornamentation.

The background drying measures listed below should be carefully followed because they will have a big impact on how well the finish works.

- **In case of New Plaster Surface**

Surface Dryness: To allow the plastered surface to carbonate, harden, and properly dry, it should ideally be left unpainted for the first few months. If it is not possible to leave the plaster exposed, a non-washable soft distemper or a layer of lime may be used as a temporary decoration. The plastered surfaces of fresh brickwork, concrete, or building blocks should not even be attempted to be painted with solvent-based paint (particularly gloss finishes) before they are completely dry.

Cleaning & Treatment: To ensure that the paint adheres well to the surface, it must be thoroughly brushed to remove all debris and any remnants of loose or powered materials. It is not advised to treat the surface with an acid or salt solution, such as zinc sulphate, as this may promote efflorescence and not significantly lessen the likelihood of an alkali attack.

- **In case of Old Unpainted Plaster Surface**

Dryness of Surface: Painting should wait until the plaster has dried. Remove any sources of moisture from ceilings and walls. In order to prevent excessive water absorption and subsequent filling shrinkage, any significant cracks or flaws in the plaster should be cut out in a V-shape and repaired. Cement mortar can be used for little repairs. It is possible to prime fine cracks before filling them using a putty comprised of enamel, water, and whiting powder that has the right consistency.

Cleaning & Treatment: Use a wire brush to thoroughly scrub any fungus or algae growth before washing it with water to eliminate it completely. Applying a wash of ammoniacal copper solution should be used to eradicate any large-scale growths of vegetative matter that are unable to eliminate by brushing. On the top of awnings, sunshades, parapets, and other horizontal surfaces where water is likely to collect during monsoon, this treatment should be carried out with more caution.

- **In case of previously painted Plaster Surface**

Surface Dryness: Any old paint that is excessively flaking, bleaching, or saponifying (yellow soapy runs present) should be scraped off and washed, and the surface should be given time to properly dry.

  - Prior to repainting, dry stains and lime wash should be completely removed. In rare cases, wetting the surface first may be necessary before scraping. Before applying any priming layers, this should not be overdone and all surfaces should be completely dry.
  - Surfaces that have been previously painted with oil should be properly sanded to eliminate loose particles and make them dull and matte for improved adhesion.
  - Exterior rough surfaces that have been painted with cement paint should be wire-brushed, thoroughly washed with water, and then allowed to dry. Make sure the surface is free of chalking before painting.

- There shouldn't be any wetness on the outside surface or persistent moisture.
- If painting during rain, the surface must thoroughly dry for two to three days in direct sunlight before painting can begin.

Cleaning & Treatment: Use a bristle brush and sand paper to scrape and thoroughly rub down the surface to get rid of any mould or fungus that may already be present. Clean water should be applied to the surface, and it should then be given time to dry. The next step is to apply a coat of fungicidal wash and let it dry before applying a second coat and letting it dry completely for a while.

Localized areas of fault should be addressed one at a time by removing any loose or softened paint and bringing treated areas forward with primer and undercoating before re-coating the entire region. The gloss or shine of coatings of oil or synthetic emulsion paints; if not in excellent condition, must be removed by thorough sanding. In case of repainting, prior coating of lime wash or powder distemper must be properly scraped off.

Priming Coat: Some ceiling and wall surfaces may show minor fractures. Use at least two coats of any of the primers for the paint system to be used after entirely removing the old paint systems and if the lime plaster has fully cured and dried. When using solvent-based paint, the primer must at the very least be alkali-resistant. The usage of limefast pigments is required.

If identical coatings are to be applied in the new paint system, water-based paint or washable distemper, if in a clean, sound condition, need not be removed. The surface can be cleansed with a moderate detergent and then lightly sanded before being ready for a new coat (with spot priming if required).

2.2.2 Surface Preparation for Metal Surfaces

Any substrate must be in a fit condition to accept paint, regardless of whether it has been painted before or not. A surface must be clean, dry, sound, and, to the extent possible, it must also have attained a stable state in order to be suitable for painting. The best results are obtained from pre-treating and priming ferrous and non-ferrous metals under regulated manufacturing settings, hence it is advised to use this approach whenever it is practical.

The correct surface preparation of the metals before painting is the single most crucial component, since the presence of rust, oil, grease, and debris under the paint film can lead to its failure.

In order to assure the paint film's adherence, the surface must be clean, dry, free of impurities, and sufficiently rough. Any of the following approaches, alone or in combination, can be used to achieve this.

- **Manual hand cleaning:** During routine maintenance, rust, scale, or old coatings can be removed with emery paper, wire brushes, scrapers, etc.
- **Surface washing:** Use lukewarm water with 1% to 2% detergent to remove salt stains and grime. The surface should then be dried, softly wire-brushed, and sanded. This is helpful when the primary coat of paint is sufficiently in good condition but only the finishing coat of paint exhibits signs of deterioration.
- **Blasting cleaning:** Using high-velocity abrasive impact to remove old paint, oxidised mill scale, and rust (sand & grit). It is the surface preparation technique that works the best.
- **Cleaning with power-driven tools:** It is necessary to get rid of oil, grease, mill scales, heavy scale, and rust and leftover rust.
- **Flame cleaning:** Rust can be cleaned using wire brushes after the application of an oxy-acetylene flame. But it shouldn't be done on plates that are 10 mm thick or less.
- **Temporary coatings:** Linseed oil applied equally and thinly (one third litre on 10 sqm area) or prefabrication primers will be used to apply temporary coatings when painting cannot be done immediately after surface preparation.

2.2.3 Surface Preparation for Wood Surfaces

The main elements affecting the longevity of paint coats and the longevity of substrates are sunlight (ultraviolet radiation), moisture, and heat (wood, plastics, etc.). Although each component might cause deterioration on its own, the combined effect of the three is significantly more severe than the effects of the individual causes. When the resin disintegrates, the colour is removed (washed off the surface) and fading takes place. In some cases, touching the surface of the painted surface with a cloth or your hand will remove a white powder (chalking).

Unprotected wood can get negatively affected by solar exposure in as little as 3 to 4 weeks of exposure. Weather permitting, wood surfaces should be painted as soon as feasible. After the prime coat has been exposed to the field for two weeks, top coats should be applied.

Surface Preparation

Wood absorbs moisture, thus it needs to be properly prepared before being painted. The wooden surfaces should be checked for fungus and insects, which are typically present in soft, porous woods. Before starting the painting project, it must be ensured that any problems that are likely to develop during surface preparation are corrected.

The process of preparing a surface for painting, which involves making it smooth, free of surface flaws, and completely clear of any dust and grime.

For a new wood surface

The wood needs to be well-seasoned, dried, and cleaned of scales, smoke, and oil before being smoothed out by sandpapering the entire surface along the grains. In order to effectively cure knots that are releasing resin into the wood and causing cracking, peeling, and brown discoloration, do the following:

- **Lime knotting:** After 24 hours, remove a layer of heated lime off of it. Apply a coat of knotting varnish after the red lead and hot glue primer has dried. Deodar and other resinous woods are suitable.
- **Ordinary size knotting:** Apply a first primer coat of red lead and hot glue, and when it has dried, follow it up with a second coat of red lead ground in oil and thinned with boiled oil and turpentine.
- **Patent knotting:** Use two coats of a varnish made of 250 g of pure shellac, 1 l of methylated spirit, and 25 g of red lead.

For old wood surface

If the original paint on an ancient wood surface is still strong and firm and removal is not necessary, the surface should be wiped with sandpaper to remove any dust and loose paint after it has been thoroughly cleaned of all grease and smoke. Grease must, if necessary, be removed by rinsing with water after washing with lime or washing soda. If the original surface is severely blistered or peeled, it should be fully removed with a sharp glass piece or stripping knife, sand paper, and one of the following:

- **Patent paint remover:** Remover solution is applied using a brush, and when the paint film wrinkles and lifts, it is thoroughly scraped off. Turpentine must be used to clean the surface after the paint has been removed.
- **Caustic soda solution:** (1 part soda to 48 parts water) this is applied with a brush and vigorously scraped off when the paint coating lifts and wrinkles. After removal, the surface should be cleaned with several rounds of clean water that contains only a small amount of acetic acid or vinegar.
- **Blowlamp:** A small amount of flame is sent over the paint covering to soften it without charring it or the surrounding area. The scraping knife/glass piece totally removes the softened paint. On a vertical surface, burning off must be done moving upward from the bottom. When there is a possibility of damaging adjacent materials or when the surface is thin, carved, or undercut, blowlamp should not be utilised.

2.2.4 Surface Preparation for RCC

For concrete repair (RCC) projects, surface preparation is a crucial stage in ensuring a strong bond between the old and new concrete. For the purpose of preparing the surface for concrete restoration work, a number of techniques are employed, including chemical cleaning, acid etching, mechanical preparation, and abrasive treatment. Many times, all that is needed to complete the planned repair is to simply clean the concrete surface, expose the coarse or fine aggregate, or remove a thin layer of damaged concrete. Each sort of surface preparation is necessary for a certain repair material, but generally speaking, the concrete surface shouldn't be excessively smooth, rough, or uneven.

Remember these things points when preparing the surface for concrete repair:

- Surface contaminants and any currently applied coatings must be eliminated.
- Scarification, brushing or grinding, abrasive blasting, shot-blasting, and flame cleaning are among methods of preparation.
- Prior to applying the surface treatment, any dust or debris created during the surface preparation process must be cleaned up. Surface contamination may make it difficult for the protective layer to adhere to the substrate.
- After preparation, the surface must be sound, dry, and to the engineer's approval.
- Repairing shallow delaminations, surface scaling, aggregate popouts, smoothing off rough surfaces, and treating any other surface flaws necessary to ensure the product performs as intended are all part of the preparation process.
- For the majority of liquid-applied membranes and other thin coatings, surfaces should be rather smooth.
- However, liquid coatings cannot be used to conceal minor surface flaws like trowel grade materials can. The substrate's pH level needs to be appropriate for the product being installed.
- When a cement, concrete, or mortar repair needs to be completed, the surfaces are cleaned, wet, and then brought to the point of being completely dry before the new material is affixed. To ensure saturation, the surfaces must be kept wet for a number of hours.
- Just prior to applying the repair material, the surface must be covered with a thin coat of mortar that is no thicker than 3 mm and has the same proportions as the repair concrete matrix.
- Slush should not be used if dry packing material is being used.
- When employing dry packing, a little dry brush is used to lightly dust the moist surfaces with cement. Dry cement should not be sticking to the surfaces.

2.2.5 Methods of Surface Preparation

Chemical or mechanical techniques can be used to prepare surfaces, including the use of solvents, abrasive blasting media, heat, acids, and water jets. There are other older methods that employ manual or power tools.

There are various types of abrasive blasting, often known as grit blasting [MR1], which is widely regarded as the most effective and adaptable surface preparation technique. However, depending on the needs of the preparation and the state of the material being prepared, solvent cleaning is another essential surface preparation procedure.

The methods are:

1. Abrasive Blast Cleaning

An abrasive spray of particles in compressed air removes contaminants, mill scale, old paint, and rust from the surface. It removes oxide corrosion well and is used in shipbuilding and maintenance. Before thermal sprayed coatings, it is utilised in aerospace, medical, and other industries.

Centrifugal impellers with spinning radial bladed wheels can throw abrasive material onto the surface to be cleaned. Wheel size and velocity affect impact force.

Aluminum oxides, metallic grit like cold iron, and other plastic, ceramic, and natural abrasives are available for different substrate materials and applications. Fine grades are good for new surfaces and coarser grades for badly corroded surfaces. Aerospace and medical industry use high-purity alumina blast media. Abrasive grades may be mixed. Separator screens recycle abrasives.

Dust and debris following blast cleaning must be removed. Sweeping, vacuuming, air blowers, or water or chemical washing can do this.

Abrasive blast cleaning ranges from light to white metal, the highest grade. Industrial/application standards define requirements:

- **Light Blast Cleaning / Sweep Blast Cleaning / Brush Off:** This gentle blast cleaning removes loose coatings, mill scale, and rust and roughens surfaces before painting. This does not remove strongly adherent compounds and is used for short-lived coatings like ship hull antifouling. It is also utilised in mild, non-corrosive situations with little damage.

- **Industrial Blast Cleaning:** Industrial blast cleaning removes 90% of securely adherent debris, leaving mill scale, old coatings, and rust shadows, streaks, and stains. This abrasive blasting works best on thin, well-adhered coatings that are compatible with the new coating.

- **Commercial Blast Cleaning:** Commercial blast cleaning removes 100% of tightly adhering materials but leaves shadows, streaks, and stains on 33%. This approach cleans goods well in non-corrosive conditions.

- **Near-White Blast Cleaning:** Near white blast cleaning removes all securely adherent particles, shadows, streaks, and stains from at least 95% of the surface. This method is cheaper than white metal blast cleaning and utilised for high-performance coatings on steel subjected to harsh environmental conditions. It is often required for offshore platforms, shipyards, and other marine settings.

- **White Metal Blast Cleaning:** This high-grade abrasive blast cleaning removes all shadows, streaks, stains, coatings, dirt, dust, grease, mill scale, oil, rust, oxides, corrosion products, and other foreign matter. High temperatures, pressures, and corrosive conditions require this approach. Nuclear reactors, chemical tanks, submarines, and crucial turbines use the most efficient method of abrasive blast cleaning since coating failure is costly.

2. Wet Abrasive Blast Cleaning

When removing lead-based paint or water-soluble pollutants, water can be added to an abrasive blast stream to help reduce dust. Conventionally, the water is supplied behind the nozzle, atomized, and accelerated through the nozzle along with the air and abrasive ingredient, while maintaining the same pressure as with dry blasting. Alternately, the water can be poured in measured quantities at the bottom of the blast pot before being mixed with the air and abrasive as they move through the blast pipe. Water can alternatively be injected into the air stream using a device operating at a lower pressure. The water then envelops the mixture of abrasive and air to prevent particles from escaping the stream. However, due to the low pressures, small abrasive particles might stay on the surface and must be removed by washing. In some cases, inhibitors are included in the wet abrasive process to prevent corrosion of the cleaned surface. In these circumstances, it is important to ensure that any remaining remnants of the inhibitors are compatible with the subsequent coating. Alternately, after wet abrasive cleaning, surface rust can be removed with moderate dry blasting. Before coating, it should be emphasised that the substrate must be dry.

3. Hand and Power Tool Cleaning

Hand or power tools can also be used for surface preparation. Hand tool cleaning, such as with a wire brush or sander, can be used to remove mill scale, rust, or old paint that is weakly adherent. However, manual cleaning tends to leave a layer of coatings or rust that adheres closely to the surface. Power equipment, such as rotary wire brushes, sanding discs, and needle guns, provide more efficient and less labor-intensive cleaning, including cleaning to bare metal. Although these procedures do not provide the same amount of cleaning as abrasive blasting, they may be the only viable alternatives in certain situations.

4. Flame Cleaning

Flame cleaning involves passing an oxygen/gas flame across the surface, generating differential expansion between the surface and rust scales. This causes the scales to flake off, but it is not very successful in removing all of the rust and must often be used in conjunction with other treatments, such as hand tool cleaning, to remove any rust or particles that have become free. Flame cleaning can also cause damage to coatings on the reverse side of the object being treated.

5. Acid Pickling

This process is immersing your material (often steel) in an acid bath that dissolves or removes mill scale and rust without damaging the exposed steel surface. This can be 100% successful, but is normally only used ahead of hot-dip galvanising for structural steels.

6. Ultra-High Pressure Water Jetting

Although combinational pressure fresh water cleaning is used to remove salts, fouling, loose coatings, paint, and other impurities after other surface preparation techniques, ultra-high pressure water jetting is gaining favour as a surface preparation technique in and of itself. Ultra-high pressure water jetting may remove significant percentages of soluble salts from steel surfaces without producing spent abrasives, which can be expensive to dispose of.

The greater the applied pressure, the less water is required. The technique warms the treated surface, allowing the water to evaporate rapidly without creating enough heat to induce thermal stresses in steel surfaces. In addition to removing soluble salts, this eco-friendly method also removes rust, old paint, and coatings from a surface. Small amounts of abrasive can be added to the water stream to provide a rougher surface profile; however, this might raise operating expenses.

7. Solvent Cleaning

As stated previously, abrasive blasting cannot be used for all surface preparation needs, and solvent-based cleaning is required to remove oil, grease, dirt, and other random stains or filth. This procedure, often known as chemical cleaning, employs organic solvents or detergents. Using soap and water with a rag to wipe the surface clean is the simplest method of solvent cleaning. However, this is also the least effective method, as the rag might spread the chemical across the surface of the object. Soap can prevent coating adherence and other processes; therefore, it must be carefully removed.

2.2.6 Visual Checks for Surface Preparation

Visual Checks keep vital importance while preparing different surfaces. The following need to be checked while the inspection:

- Check the method for preparing different surfaces like masonry, RCC, wood and metal.
- Check for welds and cut edges. Welds and cut edges can have defects that provide varying surface profiles, uneven surfaces, or sharp projections that cause coating difficulties. Weld quality inspections rarely include coating needs, therefore welds can have pinholes, projections, severe undercutting, spatter, or residual slag that degrade coating quality. Welds, cut edges, and other unit areas can be ground or filed to promote coating adhesion.
- Surface cleanliness is essential at all phases of coating, particularly prior to the application of subsequent coatings on painted surfaces. Before painting, surfaces must be thoroughly cleaned, as they might acquire dust, concrete grout leaks, blast cleaning agents, and welding and bolting residues.
- In certain instances, residual blast media embedded in the substrate material can be detrimental to the performance of the coating. To minimise the effects of embedded grit on coating performance in service, it is crucial to select the optimum blast media / substrate combination and blasting settings.

Exercise

1. List the different types of materials required for surface preparation.
2. Name the various tools required for surface preparation.
3. Explain the methodology for preparation of masonry surfaces.
4. Name the various surface preparation methods.
5. Why are the visual checks performed to assess the surface for type of preparation method?

Notes

Scan the QR code to watch the video

https://youtu.be/HhydIbOdj8I

Surface Preparation for Masonry Work

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3. Erect and Dismantle Scaffold

Unit 3.1 Erect and Dismantle Scaffold

CON/N0101

Key Learning Outcomes

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

- Identify different components of scaffold.
- List tools, materials components required for erection of 3.6 meter scaffold.
- Erect and dismantle scaffold up to 3.6 metres height.
- Stack all the components of the scaffold after dismantling.

Unit 3.1 Erect and Dismantle Scaffold

Unit Objectives

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

- Explain scaffolding and its purpose.
- List the common materials and tools used for erection of scaffolding (pipe, cup lock (vertical and ledgers), H- frames, bamboo and balli.
- List the functions of different hand tools like hammer, spanner, pulleys, hooks, ropes, etc., used for erection/ dismantling of scaffolds.
- List the visual checks to be carried out on the scaffolding components to ascertain their usability.
- Explain the functions of materials, components and accessories used in scaffolding.
- Explain the methods adopted during the erection of the scaffold to ensure its safety.
- Explain various checks to be done on completion of erection of scaffolds, such as verticality check, stability check and so on.
- Explain the sequence and standard procedure to, dismantle the whole scaffold and stack their components.
- Select different components used in temporary scaffolding such as base, toe board, guard rails, platform, walkways and ladder.
- Demonstrate preparation of scaffolding base for a scaffold up to 3.6 m height.
- Demonstrate erection of a scaffold (up to 3.6 m height) using pipes and couplers/ cup lock system/ H frame using appropriate hand tools.
- Demonstrate the process of conducting verticality check, stability check and rigidity check.
- Demonstrate the dismantling and stacking of scaffold.

3.1.1 Scaffolding

A scaffold, also known as scaffolding or staging, is a temporary construction that provides a sturdy platform for working at height or in difficult-to-access areas.

These temporary constructions are frequently used to support work crews and materials during the construction, maintenance, or repair of buildings, bridges, and other man-made structures.

The benefits of scaffolding

Scaffolding has been used for thousands of years for a reason: it works. Scaffolding continues to be one of the most useful and efficient means of working at height.

Here are the principal benefits of use scaffolding for work at height:

- **Access.** Scaffolding can provide unobstructed, stable access to virtually any region of a structure.
- **Balance.** Scaffolds provide workers with stable footing, allowing them to maintain balance in a variety of operating situations.
- **Construction ease.** Scaffolding is generally simple to assemble and remove, and may be erected and dismantled quickly.
- **Long-lasting.** Whether they're composed of wood or steel, most scaffolding may last for an extremely long time.
- **Safety.** Safety is one of the most essential benefits of scaffolding, as it provides a stable working platform for personnel. The best option for work at height, however, is to reduce or even eliminate the requirement for a person to be there; in the final portion of this guide, we will discuss how drones can assist inspectors lessen their need to work at height.
- **Functions as a bridge.** A variety of construction tasks necessitate that workers take circuitous paths to reach specific areas, which is a major time waster. By shortening the distance that employees must go, bridging points on scaffolding can aid in solving this issue.

3.1.2 Uses of Scaffold

Nowadays, scaffolding is utilized for a variety of purposes. Here are some of the most prevalent applications for scaffolding:

- **Cleaning:** Workers frequently use scaffolding to clean windows and other components of tall structures.
- **Construction:** Scaffolding is essential for construction because it allows employees to stand on a secure surface at heights. This is notably true for skyscrapers and other high-rise structures, but it is also a typical practise for ground-level construction projects.
- **Occupational inspections:** Scaffolding is commonly used for inspections because it enables inspectors to reach inaccessible regions to conduct visual inspections and other NDT testing. Inspectors frequently employ internal scaffolding or other temporary structures for both internal and external inspections, such as those performed inside enormous industrial boilers or pressure vessels. Regardless of the type of inspection, the scaffolding serves the same purpose: to enable inspectors to stand at height and conduct a variety of tests to satisfy inspection criteria.
- **Maintenance:** Typically, inspections are the initial stage in a maintenance procedure, as they identify areas that may require maintenance. After these faults are discovered by inspectors, maintenance personnel will address them while standing on scaffolding.
- **Other uses:** Different types of scaffolding are also employed for:
    - Theatrical stages
    - Installations of art
    - Exhibition displays
    - Observation platforms
    - Observation stand seating
    - Shoring Ski ramps

3.1.3 Scaffolding Components

Here are all the scaffolding components:

- **Standards.** This structure comprises of vertical elements supported on the ground, on drums, or by ground anchors.
- **Ledgers.** The length of a scaffold bay is defined by tubes with a case wedge fixing device positioned horizontally between two standards and defining the length of the scaffold bay.
- **Braces.** The braces are attached to the standards diagonally.
- **Putlogs.** A putlog connects the wall under construction to the ledger. A putlog hole is drilled into the side of a structure to accommodate a putlog.
- **Transoms.** A transom is a sort of ledger putlog that both ledgers support.
- **Bridle.** Bridles are used to bridge an opening in a wall by supporting one end of the putlog that is used to build the wall.
- **Boarding.** Boarders function as horizontal platforms for supporting workers and materials throughout the construction process.
- **Guard railings.** A rail installed at the same height as the ledger.
- **Toeboard.** A parallel arrangement of boards supported by putlogs that provides protection at the level of the working platform.
- **Ladder scaffolding.** Using scaffolding ladders, employees can simply mount and descend the erected structure.
- **Scaffolding wheels.** Wheels at the base of the scaffold that facilitate its mobility from one location to another.
- **Cup-lock:** Cup-lock Scaffolding is a temporary framework utilized to support a slab, work crew, and materials during the construction, maintenance, and repair of buildings, bridges, and all other man-made structures. Cup-lock is a galvanized or painted, multipurpose steel scaffolding system that is excellent for giving general access and supporting vertical loads. All vertical standards and ledgers tubes are 48.3mm diameter with 3.00 or 3.20 mm thickness.
- **H Frames:** Due to its features, H-frame scaffolding guarantees significant labour and time savings. Essentially, the system consists of interconnected frames. One H frame is 2 metres high, whereas the length between two H frames is 2.5 metres. In addition, auxiliary factors are utilized in this system:

    - Metal plank
    - Stairs with or lacking a landing
    - Adjustable base jack
    - Adjustable support

- Inclined floors are levelled with the aid of screws with a variable length. Steel work platforms improve the safety and durability of scaffolding. Passageways between floors are secure inside scaffolding with some applications such as staircase or access ladder. The use of a scaffolding clamp in jacketing operations improves scaffold safety and facilitates its deployment.

- **Pipes:** Galvanized scaffolding pipes are the most durable type of steel scaffold tubes. There are three distinct variations of galvanized steel scaffolding pipes. Include E-galvanized scaffolding pipes, GI pipes, and hot-dip galvanized steel pipes. HDG scaffold tubes are another term for hot-dip galvanized scaffolding pipe.

- **Bamboo:** In China and Hong Kong, bamboo scaffolding has replaced steel for numerous reasons. In reality, bamboo has a higher tensile strength than steel. It is also considerably less expensive and fully eco-friendly.

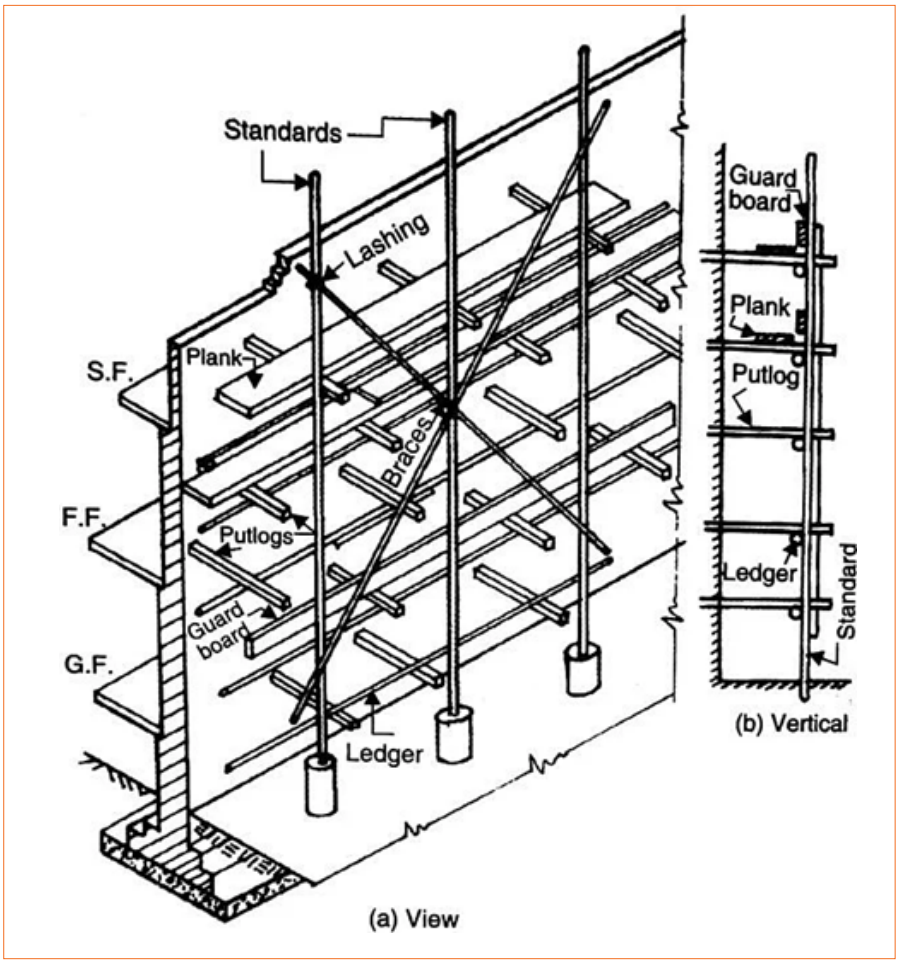

Fig. 3.1.1 Components of Scaffolding

3.1.4 Scaffolding Materials

Here are three of the most prevalent materials used to construct scaffolding:

- **Aluminum scaffolding.** Aluminum is commonly used for scaffolding because it is lightweight, sturdy, and highly corrosion-resistant.
- **Bamboo skeletons.** Since it is sturdy, flexible, lightweight, easy to work with, and abundant in certain places of the world, bamboo is an excellent alternative to steel. In Hong Kong, for example, bamboo is the most prevalent material used for scaffolding, and it is frequently repurposed from other applications to reduce waste.
- **Iron scaffolding.** Steel scaffolding is one of the most prevalent scaffolding materials. Although it is more expensive than bamboo or aluminium, it is quite sturdy and long-lasting, making it a perfect material for urban construction.

3.1.5 Scaffolding Erection and Dismantle

The erection and disassembly of scaffolding remains a hazardous task, not just for those performing the work, but also for other workers and the general public. The measures outlined in this guidance must be considered by everyone engaged in such activities. It is intended not only for scaffolding sector workers, but also for clients, planning supervisors, and general contractors. Listed below are a number of important considerations you must make to ensure the safety of scaffolding activities.

Scaffold Licenses

Before a scaffold can be placed on a public motorway, a permit from the local authority is required. Typically, an additional licence is required to instal a protective fan. A licence may stipulate lighting or painting requirements for a scaffold, or the maximum height at which a fan may be installed. For further guidance you should contact your local highway authority.

Protection of the public

During scaffolding activities, the public must be separated from both the work area and a suitable buffer zone.

- Obtaining a temporary pavement or street closure whilst operations are carried out;
- Carrying out operations during “quiet” hours, i.e. early morning, late evening, or weekends;
- Incorporating fans, crash decks, and “tunnels” as early as possible into a scaffold;
- Erecting barriers and signs and diverting the public away from operations;
- Storing scaffold clips and other loose material safely on the scaffold; and
- Not raising or lowering the scaffold during

Also remember that disabled individuals require proper access along scaffold-covered sidewalks.

3.1.6 Scaffolding Erection

Scaffolding is frequently required for building and home maintenance. Set up scaffolding correctly to ensure your safety and the safety of those utilizing the equipment. A lapse in scaffolding erection could result in a serious accident. The use of scaffolding is an alternative to ladders. In comparison to a ladder, scaffolding provides a bigger working space and greater manoeuvrability. It provides a walking surface and a place to set your tools. This significantly reduces work hours.

Here is a summary of the processes necessary to construct scaffolding:

- **Establish the foundation.** The scaffolding should be constructed on flat, stable ground. Attach the scaffolding to base plates or mud sills for stability; if you are on an uneven surface, you may need to dig down to level the soil.
- **Level it.** Ensure the scaffolding is level by adjusting the screws. If the terrain is steeply sloping, you may need leg extensions.
- **Consider casting devices.** If you intend to move the scaffolding from one location to another, it should incorporate wheels. Ensure that the casters are locked before installing the item.
- **Guarantee good assembly.** The scaffolding ends must be constructed correctly. First, raise one end portion, then connect the upper cross brace. To attach the upper cross brace of the second end piece, you must support the end by lifting the far end of this brace. Finally, secure the ends of the cross braces to the bottom of the opposing end frame.
- **Place the planks.** Place the planks over the scaffold bar and secure them in place using the provided hardware.
- **Identify access.** Consider accessibility when constructing a scaffold. If ladders are used for access, ensure that they are suited for the exact scaffold you are using and do not offer any other safety risks.
- **Mount guardrails.** Due to the height of the equipment and the risk of falling, guardrails must be installed on all scaffolds. Additionally, you should think about fall prevention measures, such as tie-offs.
- **Observe it**. Inspect the scaffolding thoroughly to ensure that it is safe for use. Ensure that all scaffolding components are secure by reviewing the setup properly. After leaving and returning to the site, always verify the scaffolding to ensure that it is still safe.

3.1.7 Hand Tools used in Erection/Dismantle

The following hand tools are used in erecting or dismantling the scaffold:

1. Hammer: A hammer is intended to deliver a large amount of force in a compact area. It is a long wooden stick connected to a metal block. The hammer is circular on one side and sharp on the other. The hammer is your closest friend whether you need to hammer something into place or smash something. However, ensure that the weight is appropriate for the user. When selecting a hammer, one must carefully consider the available sizes and weights.

Fig. 3.1.2 Hammer

2. Spanner/Wrench: A spanner is utilized to grasp and rotate items. Aside from plumbing, these instruments can also be used to assemble furniture or repair bicycles by loosening or tightening nuts and bolts. There are numerous types of spanners, including those with closed ends, open ends, and adjustable ends.

Fig. 3.1.3 Spanner/Wrench

3. Pulleys: A pulley is a simple machine composed of a rope and a wheel with grooves. The rope fits into the wheel's groove, and pulling on the rope causes the wheel to rotate. Generally, pulleys are used to raise objects, particularly heavy ones. The item lifted by a pulley is referred to as the load.

Fig. 3.1.4 Pulley

4. Hooks: A double-action aluminium scaffold hook typically used in conjunction with a fall arrest safety lanyard for rapid attachment to scaffolding or steel structures.

Fig. 3.1.5 Hooks

5. Ropes: Bundles of scaffolding rope coir yarn. In shapes such as bales, spools, dholls, and ropes. Cut to lengths suitable for both industrial and agricultural applications. Material used in the production of PVC-tufted pile carpets and mats, wall-to-wall carpets, and doormats. Support for hop plants and scaffolding erection for construction operations. Depending on the twist of the yam and the type of fibre used, a variety of characteristics suitable for various applications are available.

Fig. 3.1.6 Scaffolding rope

3.1.8 Safety Checks

1. Vertical Safety Check: Checking verticality would be required at various stages of building construction, such as when constructing vertical column formwork and transferring levels up consecutive floors of multi-story constructions. Several ways for controlling or inspecting verticality work in building construction are discussed.

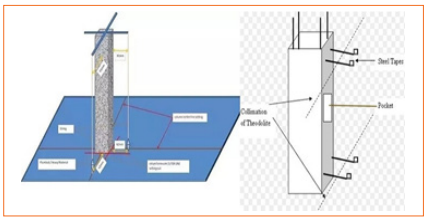

Fig. 3.1.7 Vertical Scaffolding Check

Methods used to check or control verticality works include:

a. Plumb-bob technique
b. Spirit level
c. Theodolite
d. Optical plummet

a. Plumb-Bob Technique

As depicted in the illustration below, a plum-bob consists of a weight with a pointy tip attached to the end of a string. The heavy object will hang under the force of gravity and provide an exact vertical line, known as a plumb line.

Fig. 3.1.8 Plum Bob Technique

This method is used for verifying or controlling the vertical alignment of structural elements, particularly inside, such as lift shafts. In addition, it controls the verticality of the foundation, walls, and columns.

The plumb line or vertical line of a plumb-bob will lose its accuracy and precision when subjected to wind force. Small to moderate lateral movement of the plumb-bob can be effectively minimized by soaking it in oil or water. If the height of the structural member is high, it is conceivable to replace the string with a long wire, but substantial precautions must be taken to avoid endangering the workers below.

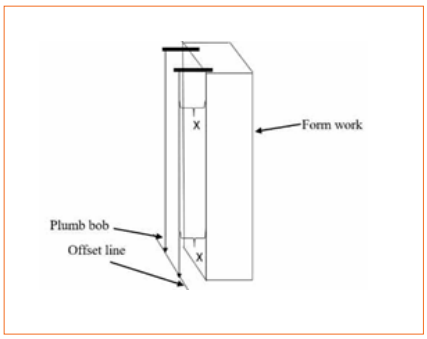

Fig. 3.1.9 Checking Verticality of Columns

b. Spirit Level Method

This device is suitable for managing the verticality of small-scale construction projects, such as examining door frames and formwork. If a spirit level is used for approximate inspections, then a more precise technique must be used to evaluate the verticality.

Fig. 3.1.10 Spirit Level

c. Theodolite Method

The theodolite is an extremely potent equipment that may be used to check the verticality of construction projects with high precision and accuracy. It is appropriate for verifying or managing the verticality of towers, walls, foundations, and columns as depicted in Figure 3.1.10, particularly a large number of columns along a single grid line. Using a Theodolite in conjunction with a tape, it is possible to measure the slope of the member's out-of-plumb line. The process for verifying column verticality comprises:

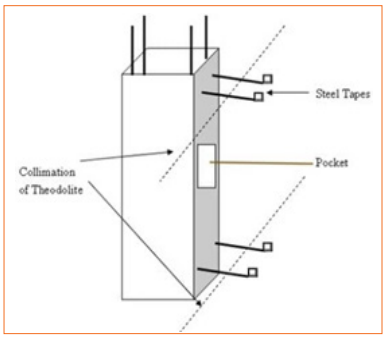

Fig. 3.1.11 Checking Verticality Using Theodolite

Install the digital Theodolite so that it is positioned on a peg that is 500 mm from the column grid.

After Theodolite has been precisely positioned, the laser beam will be activated and focused on the steel tape that is attached to the formwork.

Put the steel tape's reading via the telescope.

Take the readings of two spots at the same level on both the upper and lower formwork levels. By taking two measurements at the same level, any surface curvature can be determined. The figure below illustrates these steps.

d. Optical Plummet Method

It is a device that can look directly up or directly down. In comparison to previous methods utilized for managing verticality, the optical plummet's automatic compensator substantially improves its accuracy.

Fig. 3.1.12 Optical Plummet

2. Stability Check: Under each foot's contact with the ground, stabilize the scaffolding with solid, flat wood planks. This will prevent your scaffolding from becoming uneven and sinking into muck. Add weight and bracing to prevent the device from toppling.

3.1.9 Safety Check before Dismantling

Safety must always come first in scaffolding and the construction business. Because disassembling a scaffold is just as tough as assembling one. Therefore, one must first devise a plan for disassembling your scaffold. Before dismantling a scaffold, one should always begin by doing a comprehensive inspection. One may continue as follows:

One may continue as follows:

Step 1: Check the stability and statics of the scaffolding. All scaffolding components should continue to be firmly attached to one another. If individual components have been removed or badly damaged throughout the scaffold's service life, they must be replaced for safe dismantlement.

Step 2: Check whether the scaffolding decks are still firmly in place.

Step 3: Verify the stability of all anchors and fasteners on the scaffold.

Step 4: Check the type of fall protection required during disassembly and install it.

Step 5: Ensure that no unsecured building materials or tools remain on the scaffolding. In the worst-case scenario, these could fall during disassembly and injure those below.

All of these stages are fundamental to a proper scaffold inspection.

3.1.10 Dismantling the Scaffold

Once the scaffold has passed all safety inspections, then can begin disassembling it. Again, one should continue methodically:

Step 1: Make space for the disassembled scaffolding components.

Create a nearby storage area for the disassembled scaffolding components. During disassembly, individual scaffold components should be taken off the scaffold and set away for subsequent inspection. In addition, there must be an access route for the vehicle that will transfer the scaffolding materials away from the construction site.

Step 2: Put safety equipment

Wear the appropriate protective clothes. This comprises PPE, such as safety shoes, a helmet, and gloves, as well as any other safety equipment necessary by the project.

Step 3: Remove scaffolding components from the top to the bottom

Logic dictates that disassembly should occur in the reverse sequence of assembly, from top to bottom. Before disassembling the scaffold decks, remove the tubes and safety railings first. During disassembly, scaffolding components should not be stored on the scaffold, but rather transferred immediately to the ground. This can be accomplished by reaching down to a colleague or by carefully lowering using a rope system or similar device.

Step 4. Remove scaffolding anchors

Stability must also be maintained at all times during scaffold disassembly. Therefore, remove the anchors only after disassembling the complete platform.

Step 5: Check the scaffolding components

After disassembling all scaffolding components, properly inspect them. Defective scaffolding components may cause injury, so any components that cannot be fixed must be set aside for disposal. All undamaged or reparable scaffolding components must be stored properly for transfer off-site.

Scan the QR code to watch the video

https://youtu.be/96shGh3rfXw

Scaffolding

https://youtu.be/5Vj-MosphpY

Uses of Scaffold

https://youtu.be/OKawvyUhUkA

Scaffolding Erection and Dismantle

https://youtu.be/AoDWOZE8Wb4

Safety Checks

Exercise

1. Explain scaffolding and its uses.
2. Name any 5 scaffolding components.
3. Explain the steps required for dismantling the scaffold.
4. Name the hand tools used in erection or dismantling of scaffold.

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4. Application of Paints to Different Surface

Unit 4.1 Basics of Paints

Unit 4.2 Application of Paints to Different Surfaces

CON/N0503

Key Learning Outcomes

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

- Demonstrate preparation of paint mix using various constituents as per instructions.
- Demonstrate application of paint to produce film of uniform thickness on masonry, wood and metal surfaces as per specifications and instructions.

Unit 4.1 Basics of Paints

Unit Objectives

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

- List different painting tool such as brushes, rollers, painting bucket, stirrers, scrapers, sand papers, putty blades and others used for application of paint.
- Interpret sketches/ specifications related to painting works.
- List the various painting and finishing material and mixing ingredients such as scrape, primer, base colour, tint base, colorants, varnishes, enamel and other painting ingredients.
- List the various adhesives used binding coats of paint such as oil, turpentine, mildew remover or other preparations.
- Describe the standard procedure used for effective mixing and dilution of paints.
- Select and mix paint ingredients in correct proportion following specifications and as per requirement.
- Select different types of tools such as brushes, rollers, stirrers, scrappers as per the painting surface requirement
- Demonstrate mixing, pouring and dilution of paints and painting material as per specifications/ instructions.
- Describe the method followed to protect the adjacent surface prior to painting.
- Demonstrate proper cleaning, maintenance and upkeep of painting tools and equipment before and after use.

4.1.1. Paints

When thin coats of paint are applied to a surface, they dry to produce a solid film that gives the surface a beautiful finish. Paints are liquid compositions of pigments and binders. Paints shield the surface from the atmosphere's impact on deterioration. They stop metal from corroding and wood from decomposing.

Characteristics of an Ideal Paint

An ideal paint should

- Have good spreading power, which means that a small amount of paint should cover a large area of the surface.
- Be reasonably priced and cost-effective.
- Be designed in such a way that it can be easily and freely applied to the surface.
- Make sure it dries in a reasonable amount of time and not too quickly.
- Make it so that its colour lasts a long time.
- Create a hard and long-lasting surface.
- Weathering actions of the atmosphere have no effect on it.
- Have an appealing and pleasing appearance.
- When the paint dries, there should be no visible cracks.
- Create a uniformly thin film.

4.1.2. Types of Paints

Paints are used for a variety of purposes. The most common paints are listed below:

a. Aluminium Paint

Depending on the application, extremely finely powdered aluminium is suspended in either a fast-drying spirit varnish or a slow-drying oil varnish. The spirit or oil evaporates, leaving a thin layer of aluminium on the top.

Advantages of Aluminium Paint:

- It is visible in the dark.
- It resists heat to some extent.
- This paint protects iron and steel surfaces from corrosion better than any other paint.
- It has a large covering capacity. A litre of paint can cover approximately 200 square metres.
- It gives the surface an attractive aspect.
- It is resistant to dampness.
- It has a significant electrical resistance.
- The aluminium paint is commonly used for painting gas tanks, hot water pipes, naval piers, oil storage tanks, and radiators, among other things.

b. Anticorrosive Paint

This paint comprises primarily of oil and a potent drying agent. After combining a pigment such as chromium oxide, lead, red lead, or zinc chrome with a small amount of very fine sand, the pigment is added to the paint.

Advantages of Anticorrosive Paint:

- It is low-cost.
- It lasts for a very long period.
- The paint has a black appearance.

c. Asbestos Paint

This is a very unusual kind of paint, and it is used to cover surfaces that are subjected to acidic gases and steam.

d. Bituminous Paint

Asphalt, mineral pitches, or vegetable bitumen can be used to make this paint. It is made by dissolving these materials in any form of oil or petroleum. The paint has the appearance of being black, and it is utilised for painting ironwork while it is submerged in water.

e. Cellulose Paint

This paint is made from nitro-cotton, celluloid sheets, photographic films, and other materials. Normal paint hardens by oxidation. The drying of cellulose paint is caused by the evaporation of a thinning agent. Therefore, it hardens rapidly. It is slightly more expensive, but its surface is flexible, durable, and smooth. Additionally, surfaces painted with cellulose paint can be readily cleaned and washed. The cellulose paint is unaffected by hot water and can withstand high temperatures of cold and heat.

f. Cement Paint

This paint contains white cement, pigment, an accelerator, and additional ingredients. It is accessible as a dry powder. Cement paint is available in a wide range of hues and has an attractive ornamental aspect. It is waterproof and long-lasting. It is beneficial for surfaces that are damp at the time of painting or surfaces that are prone to become damp after painting. For external finish on cement-plastered walls, it is instantly mixed with water prior to application. It is preferable to apply cement paint on a rough surface as opposed to a smooth surface due to its poor adherence on smooth surfaces.

For painting surfaces such as corrugated iron sheets, etc., cement paint is combined with linseed oil that has been boiled. During use, the mixture is continuously mixed.

g. Colloidal Paint

This type of paint does not contain any inert substance of any kind. It takes a longer period of time to settle, and during the process of settling, it breaks through the surface of the ground. It is suitable for use on walls both inside and outside of buildings.

h. Emulsion Paint

There are various emulsion paints available. It contains binders such as polyvinyl acetate and synthetic resins, among others. This paint is simple to apply and dries within one to two hours. The paint retains its colour for an extended duration. The paint's surface is resilient and may be washed with water. The paint is odourless and resistant to alkalis to an exceptional degree.

Emulsion paint can be applied using either a paintbrush or a spray gun. It is recommended to apply two coats of emulsion paint for good service life. To smooth a rough cement plastered surface, a thin coat of cement paint might be placed first. For emulsion paint to adhere well, a solid surface is required.

i. Enamel Paint

This paint is offered in a variety of colours to choose from. White lead or zinc white, oil, petroleum spirit, and resinous materials are all components of this substance. It dries slowly, forming a surface that is both hard and long-lasting. This paint creates a surface that is impervious to the effects of acids, alkalies, gas fumes, hot and cold water, steam, and other elements such as these. It is suitable for usage on both the inside and exterior of buildings.

Before applying the coat of enamel paint, it is recommended to apply a coat of titanium white that has been diluted in pale linseed oil first. This will help improve the appearance.

j. Graphite Paint

The paint has a dark black appearance, and it is used to coat iron surfaces that are exposed to corrosive elements such as ammonia, chlorine, sulphur gases, and others. In addition, it finds application in the construction of mines and underground railways.

k. Inodorous Paint

This paint does not contain any turpentine at all. On the other hand, zinc white or white lead is combined with methylated spirit. When white lead or zinc white is ground in oil, the result is a white powder. Methylated alcohol is used to dissolve shellac, which also contains a certain amount of linseed oil and castor oil. Although the paint doesn't last very long, it dries really quickly. After the methylated spirit evaporates, a shellac layer is left behind on the surface of the surface.

l. Luminous Paint

In addition to varnish, this paint is made with calcium sulphide. After the light source has been turned off, the surface that has had luminous paint put to it will radiate a glow similar to that of radium dials on timepieces. It is recommended that the paint be applied on surfaces that are free of corrosion as well as any other kind of lead paint.

m. Oil Paint

This is the common paint, which is often applied in three layers of different composition. They are referred to as primers, undercoats, and topcoats, respectively. This paint is inexpensive, simple to apply, and opaque with a low sheen.

It should be kept in mind that oil paint should not be applied when the weather is wet and damp. The presence of moisture on a wall surface significantly reduces the durability of oil paint application. Only fresh oil paint should be used to repaint surfaces that have been completed with oil paint. The coating of old oil paint acts as a base for new paint.

n. Plastic Paint

This paint comprises the appropriate assortment of polymers and is marketed under many brand names. It is possible to apply plastic paint using either a paintbrush or a spray gun. This paint has a nice appearance and is a lovely hue. This paint is commonly used in exhibition halls, auditoriums, etc.

o. Silicate Paint

This paint is made by combining calcined, finely-ground silica with resinous ingredients. When cured, the paint forms a durable, hard surface. It can withstand high temperatures and sticks strongly to masonry. It is resistant to alkalies. This paint does not have any chemical effect on metals. The drier used with this paint must be of the silicate variety.

On surfaces of brick, plaster, or concrete, silicate paint can be applied directly. These surfaces must be made wet prior to the application of paint. Two or three coats of silicate paint are advised, but a primary coat is not required. After using a tool to apply silicate paint, it must be cleaned promptly with water. In warm weather, surfaces should not be painted with silicate paint.

p. Synthetic Rubber Paint

The paint is formulated using resins. Its main advantages are:

- It provides water resistance and is unaffected by severe rainfall.
- It dries promptly.
- This paint maintains a uniform hue when applied to the surface.
- It is not significantly affected by weather or sunlight.
- It can be used to surfaces that are not totally dry, such as freshly poured concrete.
- It is reasonably priced and covers a huge area.
- It is simple to apply to a surface.

4.1.3. Tools required for Application of Paints

Sr. No.	Tools and Equipment	Purpose/Use
1.	**Knives**	
	a) Putty Knife	Used for applying putty to cover dents, undulation, cracks, knots in wooden surfaces.
	b) Scrapping Knife	Used for removing old paints and hard materials from surface and not to use on oily or greasy surface directly.
	c) Chisel Knife	Used for cutting hard old thick paint.
	d) Moulding Knife or Contour Knife	Used for scraping or rubbing on peculiarly shaped/contours like statue, ornamental carving, curved portions etc.
	e) Pallet Knife	Used for mixing the paint in drums.
	f) Stencil Knife	Used for cutting stencils.

Sr. No.	Tools and Equipment	Purpose/Use
2.	**Brushes**	
	a) Flat Brush	Used for painting generally flat wooden and metal surfaces.
	b) Round Brush	Used for painting very large areas quickly for preparatory application.
	c) Curve Brush	Used for painting curved surfaces of irregular design.
	d) Taper Brush	Used for white washing covering large area of contact
	e) Wall Brush or ground brush	Used for painting walls.
	f) White wash Brush	Used for white washing.
	g) Calcimine Brush	Used for applying calcimine or water paint to ceiling and walls and not used for applying oil paints.
	h) Dust Brush	Used for removing dust, dirt before painting.
	i) Wire Brush	Used for removing tightly adhering rust on metal surfaces.
	j) Stencil Brush	Used for stencil work.
	k) Artist Brush	Used for lettering/arts.
	l) Stippler Brush	Used for painting on very rough surfaces.
3.	Pallet board	Used for mixing various colours by artists.
4.	Plumb ball	Used for drawing vertical lines.
5.	Emery sheets available in four types: Sand paper, Cloth emery, Water proof emery, Abrasive stones.	a) Used for removing unwanted materials b) Used for creating surface roughness
6.	Shade card	Used for choosing shades of a single colour.
7.	Stencil paper	Used for cutting or making stencil.

Sr. No.	Tools and Equipment	Purpose/Use
8.	Viscosity	Used for measuring the consistency or flow of paint.
9.	Elcometer	Used for measuring dry film thickness (DTF) of paint in microns and this works on electromagnetic principle. (1micron=0.001mm).
10.	Gloss meter	Used for measuring gloss value of dry paint film.
11.	Wet flatting machine	Used for flattening the putty applied areas.
12.	Drop sheet	Available in the form of paper, gunny bag, polythene paper etc. to protect flooring and furniture from paint particularly used for ceiling and interior works.
13.	Ladder	Essentially used for painting ceiling, side walls etc.
14.	Masking tape	Used for covering areas which are not to be painted.
15.	Paint bucket	Used for containing paints for painting.
16.	Straight edge/Ruler	Used for drawing straight line bands, border line etc.
17.	Strainer	Used for filtering the paint to remove dust, dirt and other insoluble materials before applying paint on the surface.
18.	Brush holder	Used for keeping brushes after completing the painting.
19.	Rubber block	Used for flatting small, curved areas where wet flatting machine cannot be used.
20.	Spray Gun	Used for painting the surfaces by mode of spraying.

Table 4.1.1 Tools required for Application of Paints

4.1.4. Good Quality Paint Brushes and Rollers

a. Paint Brush

Brushes are an essential painting equipment that come in a variety of sizes and shapes for different types of artwork. The market offers a variety of brush sizes, including 38mm, 50mm, 60mm, and 75mm. Since most homes utilise water-based or oil-based paints, a high-quality synthetic brush may be the best option for painting the surfaces. The quality of the brush used has a direct impact on the quality of the finished product and the controllability of the paint.

The properties of a high-quality paintbrush are as follows:

- It has a dense, complete texture, holds more paint, and covers a larger surface area.
- It has tapering filaments that gently, uniformly, and smoothly release paint.
- It has bristles that are 'tipped' and 'flagged' for improved paint collection, more coverage, and simpler application.
- It has high-quality filaments for painting faster and more evenly, regardless of the painting surface.

b. Roller

- A roller frame and roller of superior quality will provide the best paint coverage and surface finish. Choose a roller cover made of the proper fabric for the paint and surface being painted.
- Selecting a Roller Frame
- Rollers and frames are available in three standard sizes: 180mm, 230mm, and 270mm. The sizes between 180 mm and 230 mm cover less surface area, but are lighter and easier to manipulate.
- Select a sturdy roller frame that cannot be bent easily and a cage assembly that is tight and spins freely.
- Ensure that the handle is aligned with the centre of the cage and has a comfortable grip for increased stability and uniform pressure delivery.
- Each end of the roller frame should have a cap to prevent paint from gathering inside the cover and to ensure that the roller rolls smoothly.
- The handle of the frame should be ergonomic and include a threaded end to accommodate an extension pole.

Selecting the Appropriate Roller Covers

- A high-quality roller cover should have a phenolic core that is impervious to water and resistant to all paint solvents.
- Roller coverings are manufactured in a variety of thicknesses, each suited for a particular surface texture. A thickness or nap of 6 mm is for surfaces that are extremely smooth, 12 mm for surfaces that are slightly uneven, and 20 mm for surfaces that are extremely rough.

Selecting a Roller

- Foam, synthetic fibres, and lambswool can be used to create rollers, each of which has distinct advantages.

i. Foam:

- Because they are seamless, these rollers provide a uniform, colourless layer of paint.
- Due to the fact that paint can be applied more quickly and without brush strokes with a foam roller, trim and edge foam rollers are great for reaching into corners and neighbouring walls and ceilings.
- Since foam itself does not absorb paint, foam rollers are easily cleaned with water if latex paint is used or the appropriate solvent if other paints are used.

ii. Synthetic or Synthetic/Lamb's Wool blend Rollers

- Recommended for the trade
- Due to the synthetic fibre, they are extremely durable and able to withstand regular commercial use.
- Denser cloth absorbs more paint during loading. To release the paint, a more robust roller action is required.

iii. Lamb's Wool and Mohair

- As a natural animal fibre, it possesses intrinsic resilience and will withstand the test of time.
- The natural oils make it easier to clean than conventional synthetic fibres, thereby extending the lifespan of the roller.
- The fine wool fibres of the mohair rollers provide a highly specialist mirror finish, and can be used for all gloss paints, varnishes, epoxies, enamels, and polyurethane clear coatings.
- The "nap" of a roller refers to the thickness of its surface. The ideal nap for flat walls and ceilings is 6 mm. 12mm nap for surfaces with minor flaws and 20mm nap for surfaces with roughness.

4.1.5. Painting and Finishing Material and Mixing Ingredients

Sr. No.	Painting and finishing material and mixing ingredients	Purpose/Use
1	Scrape	Acetone, toluene, and methanol are commonly combined compounds used in paint scrapers; they evaporate rapidly and are highly combustible.
2	Primer	A primer is a base layer used before painting. Priming and painting involve brushing a material onto a surface. Primers bond paint to surfaces and are applied with a brush. Primers prevent paint from soaking into the surface and creating an uneven top coat. It fills surface gaps. Primers strengthen paint-substrate bonds. Lacquer, enamel, and water-base primers are available. It works on metal, lead, and plastic when thinned.
3	Base colour	Base is the primary component that makes up the majority of paint. It forms the paint's body. Typically, the base is composed of white lead, red lead, zinc oxide (zinc white), iron oxide, titanium white, aluminium powder, and lithophone.
4	Tint base/ Pigments	One of the primary components of paint is pigment. Pigments are utilised to conceal surface flaws and give the desired colour. In general, for white, black, and extremely dark hues, the foundation itself functions as the pigment. When light or bright colours are needed, white paint is mixed with pigment to achieve the appropriate hue.
5	Colorants	Colorants are primarily synthetic or natural additives, including pigments and dyes that are used for imparting colours or masking the power of a product or item. Colorants are pigments or dyes that are utilised in a variety of industries.
6	Varnishes	Varnish is a clear, hard, protective finish or coating that is usually used for wood finishing but can also be applied to other substances. Traditionally, varnish is composed of a drying oil, a resin, and a thinner or solvent. Varnish finishes are typically glossy, although "flatting" agents can be added to achieve satin or semi-gloss sheens.

Sr. No.	Painting and finishing material and mixing ingredients	Purpose/Use
7	Enamel	Enamel is a glassy, vitreous, and typically opaque substance used as a protective or decorative coating on metal, glass, and ceramic objects. The use of enamel in varnishes, paints, and coatings is possible. After drying, it forms a firm, glossy surface.Enamel provides corrosion protection for materials. Enamel coatings have the potential to effectively protect steel from corrosion.
8	Inert Filler or Extender	Fillers are used to add physical features other than colour, such as opacity or roughness, or to improve the handling of paint. They not only make the paint more durable, but they also reduce the expensive paint base, making the paint more affordable.
9	Binder	A binder is also known as the adhesive or resin that holds paint together. Additionally, it bonds the paint to the applied surface. Additionally, this component permits the paint to spread evenly.
10	Solvent or Thinner	Solvent or thinner boosts the paint's fluidity. It improves the workability of paint by improving its spreading capability. Thinner facilitates paint's penetration into porous surfaces, making it smooth and easier to apply.
11	Additives	Additives are typically applied in minute amounts to various types of paints used in construction and building. It alters the characteristics of paint. In addition, they are added to improve the paint's qualities, such as opacity, pigment dispersion, and stability.

Table 4.1.2 Painting and finishing material and mixing ingredients

4.1.6. Adhesives used for Binding Coats of Paint

Adhesion of a coating is the strong bond between the coating and the substrate of a substance. Adhesion is one of the most important features in the paints and coatings industry, as it ensures that the coating (or paint film) adheres to the surface for an extended period of time, especially in hostile environments. Durability and quality of a coating are directly proportional to adhesion characteristics.

Few important Adhesives used are:

Sr. No.	Adhesives	Purpose/Use
1	Oil	Paint Adhesive Oil is widely used to process resins and water-based dispersions in paints and coatings. Utilized in the production of paints, coatings, and adhesives, these cutting-edge, high-performance materials are of the most recent generation.
2	Turpentine	Turpentine is an industrially useful compound. Turpentine is the conventional paint thinner for the majority of oil-based paints, enamels, and varnishes, as it is both very effective and naturally produced. It facilitates the paint in bonding, covering, and penetrating any type of wooden surface.
3	Mildew Remover	Mold and mildew on paint are unsightly and can damage walls and cause allergies and respiratory issues if left untreated. Moisture on painted surfaces breeds mould in warm, wet situations without airflow. Hydrogen peroxide eliminates mould on clothes, floors, bathroom fixtures, walls, and appliances. Pour 3% concentration hydrogen peroxide into a spray bottle. Spray the moldy surface completely to saturate the area with hydrogen peroxide.
4	Sand Rough Spots	The purpose of sanding is to remove flaws from walls, ceilings, furniture, floors, etc. It is also used to roughen surfaces too shiny for paint or filler product to adhere easily. The most often used abrasive materials for this function are steel wool and sandpaper. Sanding can be conducted by hand or with electric tools.

Table 4.1.3 Adhesives used for Binding Coats of Paint

4.1.7. Mixing and Dilution of Paint

To achieve the proper mixing ratio, various components are required. Each paint manufacturer offers information on the optimum mixing ratio for their product's correct hardness and behaviour. It should be noted that the quantities and types of each component may change according on variables like as room temperature, type of finish, etc. After determining the amount of product to be mixed, add the various components according to the manufacturer-recommended mixing ratio.

Always observe the following mixing ratios in the following order:

1. Component A (Paint /Clear Coat)
2. Component B (Hardener).
3. Component C (Thinner).

Include Component A or Filler Paint

Adjust the amount of component A according to the regulation indicated on the container. In this situation, 240 ml.

Include Component B or a Hardener

Component B, the hardener, is poured. For a 4:1 mixing ratio, 60 ml should be poured. Stir the mixture with a stick until it is uniform and uniformly mixed.

Mix in the Dilution

Pour 30 ml, or 10% of the whole mixture (base + hardener). Stir the mixture one more. Use a paper filter to remove any contaminants from the mixture if you are not utilising a single-use application system.

4.1.8. Interpreting Construction Drawings

The most important aspect of civil engineering is the drawings. It includes detailed measurements (dimensions, height, and location) as well as a detailed section of each part of the structure. A painter and decorator can prepare project estimates, work schedules, construction bills, and other documents if they know how to read drawings.

It is necessary for painters and decorators to interpret blueprints and construction site specifications. By interpreting these drawings, painters and decorators can determine the surface area of walls and ceilings to be painted.

There are three parts to every Construction drawing.

1. Plan
2. Section
3. Elevation

Types of drawings used in construction site

Architectural Drawings

- Site Plan (layout Plan)
- Floor Plan
- Working Plan
- Section Drawings
- Elevation Drawings

Structural Drawings

- General Note
- Excavation Drawing
- Column Layout
- Plinth Beam Layout
- Lintel Beam Layout
- Roof Beam and Shuttering Layout
- Roof Slab Layout
- Framing Plans

Plumbing, Electrical and Finishing Drawings

- Electrical Drawings
- Plumbing Drawings
- Fire Fighting Drawings
- HVAC Drawings

4.1.8. Interpreting Construction Drawings

Painter's tape is a masking tape with a mild adhesive used to cover objects that should not be painted. Perfect for smooth surfaces such as freshly painted woodwork, it prevents drips and over painting on trim, baseboards, mouldings, casings, and windows.

Fig. 4.1.1 Painter's Tape

Here are some benefits of using painter's tape as opposed to regular masking tape:

- No adhesive residue upon removal;
- Clean removal without peeling;
- No paint bleed;
- Easy to tear.

Using Painter's Tape.

First, remove debris and dust from the trim so the adhesive tape will adhere properly. Attach a small amount of painter's tape to the surface and roll it out approximately six inches. Keep the tape close to the wall and push the edges to create a seal.

Using a smooth-glide applicator is another method for applying painter's tape. The tape is applied in one continuous strip, saving time and reducing hand fatigue. Once the tape has been applied, use a flexible putty knife to check that there are no gaps between the tape and the surface. Start painting once everything has been masked (even with the putty knife). Ideally the tape should be removed while the paint is still wet. If left to dry, portions of the wall's paint may peel off along with the tape. Additionally, it is useful for creating wall designs.

4.1.10. Cleaning Painting Tools

Painting is not complete immediately after completion. Cleaning up after painting is an integral part of the overall painting procedure. An equally vital step is cleaning the painting instruments, as a clean and organised brush can survive for many more painting tasks. Whether the paint is oil-based or water-based, there are correct methods for cleaning painting instruments.

The cleaning procedure begins immediately following use. Techniques for cleaning depend on the type of equipment and paint used for a painting project. Getting the paintbrush as free of paint as possible expedites the cleaning procedure as a whole. Cleaning a paintbrush with a solvent or water shortly after use might harm the bristle. It is difficult to clean paintbrushes that are used for both oil-based and water-based paints; therefore, it is more efficient to use separate painting sets for each type of paint.

1. Cleaning Oil-Based Paint

- **Paint Brush:** Oil-based paint must be cleaned with paint thinner. A paintbrush with less paint adhering to the bristles requires less cleaning solvent. The initial stage in the cleaning procedure is soaking the brush in solvent thinner. By washing the bristles with one's hands (while wearing gloves), the sticking paint is removed from the brush. The brush and roller spinner rotates the brush and removes paint particles from it. If paint remains on the brush, repeating the same process removes the remaining paint. By dipping the paintbrush in a clean lacquer thinner, any leftover paint residue can be removed. Washing the brush with soapy water, working the bristles for a few seconds, and drying the brush prepares it for another painting task.

- **Paint Roller:** The simplest approach to clean a paint roller is to quickly submerge it in water after painting has been completed. Cleaning paint rollers with soapy water is effective.

2. Cleaning Water-Based Paint

- **Paint Brush:** The fact that water-based paint may be cleaned without extra thinner is its best feature. The most obvious and vital step in cleaning is to scrape off any excess paint. The most quantity of paint is removed when the bristles are washed with soapy water using bare hands or a brush comb. The residual paint and water are eliminated by spinning the brush in the pail. Brushes can be thoroughly cleaned by rinsing them in a second pail of clean water. Drying the paintbrush makes it suitable for further use.

- **Paint Roller:** Roller washers are incredibly user-friendly and save a great deal of time. Simply rotating the roller in the roller washer thoroughly cleans the roller.

3. Storage of Paint Equipment

Store brushes on their sides or on a hook. Never store brushes standing on their bristles, since this may cause them to lose their shape and make them more difficult to use in the future.

Keep rollers upright on their ends. If storing them horizontally, a flat patch will form on the roller, which will show through the next time using it.

Notes

Scan the QR code to watch the video

https://youtu.be/AucnsOoJPKc

Paints

https://youtu.be/9i1a80ZHwQ4

Types of Paints

https://youtu.be/Je3cSDj55cg

Tools required for Application of Paints

https://youtu.be/g2K6PXxtyB4

Adhesives used for Binding Coats of Paint

Unit 4.2 Application of Paints to Different Surfaces

Unit Objectives

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

- Describe standard method of painting internal and external surfaces.
- Explain different type of surfaces and their required finish.
- Explain the ratio and proportion of paint and painting additives used for preparation of paint.
- Describe the method used for adjusting viscosity of painting mix.
- Describe the method of application of primer.
- Demonstrate preparation of paint surfaces as per instructions/specifications prior to painting works.
- Select different type of painting, finishing material for masonry, wood and metal surfaces
- Demonstrate application of primer coat to the finished surface as per instructions.
- Demonstrate application of main coat and final coat on masonry, wood and metal surfaces as per specifications and instructions.

4.2.1. Process for Interior Wall Painting

Choosing the right paint colour can be difficult. It is difficult to specify a paint colour and finish because there are so many options.

The tips include -

1. Collect paint samples when planning a space, but refrain from making final decisions until the room's overall colour scheme has been determined. Paint is available in a virtually unlimited variety of colours and is the most adaptable, cheapest, and simplest aspect of interior design. After rugs, wallpaper, and fabrics have been finalised, make the ultimate decision.

2. Coordinate Samples of Decorating: Always maintain a collection of fabric, carpet, tile, wallpaper, and trim samples before to actual buying.

3. Really Examine the Colors: A complete sample strip of matched colours will provide hints about the underlying tones of various tints of a colour. Even if you have no intention of employing a darker tone, examine each colour carefully. Determine if the colour family is the path you intend to take with your colour decision.

4. Choose the Appropriate Paint Finish: Consider the optimal paint finish for the project. Matte or flat coatings conceal wall flaws, but glossy finishes reflect more light.

5. Create a painting schedule: Together with the painter, survey all areas to be painted, examine and assess all requirements. The goal is to clear sufficient space at once to cycle surface preparation, priming, painting, and drying time. Painting should be avoided during rainy and windy circumstances, and rooms should be adequately aired throughout the entire process.

6. A paint job is essentially a three-step process, with drying time between each step:

   - Surface Preparation - which differs for previously untreated and previously painted surfaces
   - Priming - this stage is primarily protective and crucial to the long-term performance of paint systems
   - Application of Paint – the penultimate phase in which the finishing coats are applied.

7. When selecting colours and determining a budget, one must remember:

   - Different surfaces require paints that have been created expressly for that surface type.
   - Painting requires at least two components, a paint and a primer, and occasionally a third, a thinner. To get the intended results, the specified primer must be used. With water-based paints, water serves as the solvent. For solvent-based paints, the appropriate thinner is required.
   - There are both water-based and solvent-based primers available.
   - Paints, primers, tools, and accessories account for only a portion (typically half) of your total painting expenses; the other portion, which varies from location to location, is the cost of labour. Armed with this information, one may confidently select a painter, evaluate his knowledge, his cost estimate for the task, and his personnel adequacy.

The following process are followed for painting an interior wall:

Pre Painting Process

- Ensure that the walls have been adequately cured. Minimum 7-21 days.
- Examine the surface for leaks or wetness.
- Before beginning to paint, correct any such issues that may have discovered. Allow them to dry
- Fill up any cracks. It should be addressed with the suggested crack filling method.
- Fill any nail holes with primer and then sand the switch box.
- Ensure that all movables are removed from the room. Place it in the centre of the room and cover them if you cannot move it.
- Ensure that the flooring is covered.

Surface Preparation

- Cleaning - Scrub the wall region. It must be devoid of dust.
- Ensure that all previous paints and loose plaster are removed When painting an existing wall surface.
- Using sandpaper, achieve a dry finish.
- Cover all surfaces of the structure that must remain paint-free, including doors, windows, switch boxes, furniture, etc.

Painting

- Caulking - Fill any door and window sidewall cracks with caulking.
- Apply a single coat of Primer. We have already emphasised the importance of primer.
- Putty - Apply a single layer of putty. The putty paint will give the wall a smooth finish and correct any surface irregularities. Caution: putty is extremely pricey. If the wall has more undulations, your wallet will be severely damaged.
- After finishing the putty, request that the electricians fix the switch box. Once switch boxes have been installed, they must be covered to prevent paint splatters. Apply two layers of paint.

4.2.2. Process for Exterior Wall Painting

Over time, houses' exteriors will require general upkeep, such as painting. The home's exterior features siding, trim, a pergola, deck work, fencing, and brick foundations. Because these areas are all exposed to the elements, it is necessary to choose exterior paint that can withstand a variety of weather situations.

The tips include:

1. Determine which outside areas of the home will be painted. The area to be painted will determine whether exterior paint or stain should be purchased.

2. Determine the area's surface to be painted. Different surfaces demand different exterior paint varieties. Consequently, the sort of exterior paint that will best cover a particular surface will depend on the surface's composition. On glossy surfaces, alkyd paints can be used. Typically, latex paints can be utilised on various surfaces.

3. Choose a colour or kind of stain for the exterior.

4. Select the exterior paint finish. Exterior finishes for wood grains include flat, semi-gloss, gloss, and clear finishes. The selection relies on the subject matter. For hardboard siding, vinyl or aluminium siding, brick, block, stucco, and concrete, latex treatments are available, whereas galvanised or ferrous metals require an alkyd finish. Both materials can be utilised for wood or plywood siding and wood trim.

The following process are followed for painting an exterior wall:

Pre Painting Process

- Ensure that there are no wall leaks.
- Ensure that the walls are free of cracks. If you discovered any cracks, fill them using the prescribed method. Allow them sufficient time to dry.
- Ensure that the entire procedure of plastering the exterior walls has been completed. There are no batch operations.
- Be sure to begin painting the wall at the top.
- Ensure that all requirements for staging are met.
- Ensure the protection of painters.
- Avoid transporting any materials during the painting process.

Surface Preparation

- Ensure that the wall had ample time to cure. 35 -50 days.
- Make sure the wall is completely dry. Avoid painting walls that are moist.
- Ensure that all drainage pipe apertures and scaffolding gaps are sealed.
- Cover the doors and windows to prevent paint from splattering on them.

Painting

- Apply one application of the recommended external wall primer when priming exterior walls.
- Applying two coats of paint. Allow four to six hours between coatings.

4.2.3. Building Finishes

Plastering, varnishing, distempering, whitewashing, colouring, etc. serve primarily two purposes, as outlined in the following section.

They give the surfaces a protective coating that shields them from weather conditions such as rain, frost, and heat, and they produce ornamental features that enhance the appearance of the surfaces and the structure as a whole.

Types of Building Finishes

1. **Plastering:** This is the process of coating various surfaces of a structure with a polymeric material, such as cement mortar, lime mortar, composite mortar, etc., in order to achieve a surface that is uniform, smooth, regular, clean, and durable. Plastering covers low-quality materials and shoddy craftsmanship, as well as providing a protective coating against the impacts of the environment. In addition, it serves as a foundation for other decorative finishes such as painting, whitewashing, etc.

2. **Pointing:** This is the finishing technique for mortar joints in exposed brick or stone masonry, which involves two operations. First, masonry joints in brick or stone are raked out to a depth of approximately 15 mm, and these spaces are then filled with a suitable mortar of a richer mix. Pointing gives the brickwork an attractive appearance and prevents water from entering the wall.

3. **Painting:** This is the process of applying paint as a final finish to all surfaces, including walls, ceilings, woodwork, metalwork, etc., in order to preserve them from weathering effects to avoid decay of wood and corrosion in metal, and to obtain a clean, colourful, and aesthetically beautiful surface.

4. **Varnishing:** This is the procedure of adding varnish to wooden and painted surfaces to enhance their appearance and preserve them from the effects of the environment.

5. **Dis-Tempering:** This is the method of applying distemper to plastered surfaces more simply and at a lower cost than paints and varnishes, in order to protect them from weather and enhance their appearance. A distemper as water paint consists of whiting (i.e., powdered chalk), a binder such as glue or casein, and proper amounts of pigments that dry quickly. Distempers are widely accessible in sealed tins as a stiff paste or dry powder in a number of distinct hues.

6. **White Washing:** In the first step of this procedure, a mixture of pure fat-slaked lime and adequate water is created. It is then sieved through coarse cloth and a mixture of cooked gum and rice is added in certain proportions. The resulting solution, known as white-wash, is then applied with brushes in a predetermined number of coats, typically three.

7. **Colour Washing:** It is comparable to whitewashing, with the addition of a colouring pigment of the appropriate hue and nature unaffected by lime. The application of colour washing is limited to one or two coats.

4.2.4. Paint Additives

Additives are used to improve the performance of paints, and the most commonly used are:

- **Thickening agents:** They give the paint more "viscosity" or thickness so it can be applied correctly; they also enable better "flow and levelling," and they prevent a splatter effect when rolling out the paint.
- **Surfactants:** Surfactants, often known as soaps, are substances that give paint stability so that it won't separate and maintain the pigments spread in the liquid for improved concealment and added guarantee of colour fidelity.
- **Biocides:** They are used in latex paints in two different ways: as a preservative to prevent the growth growth of bacteria and as a mildewcide to prevent the growth of mildew.
- **Defoamers:** They offer a technique to eliminate bubbles that form during the manufacture of paint, during the shaking of paint at the tint centre, and during the application of paint to a surface.
- **Co-solvents:** These substances add more liquid to the water so that it can help the binders make a nice film when used in cold weather. They also help with brushing abilities so that paint can be applied before drying.

Additives are minute quantities of various chemical ingredients that improve or alter the paint's qualities. Its benefits are:

- Added to a paint in levels between 0.001% and 5% can have a significant impact on the paint's physical and chemical qualities.
- Prevent the accumulation of pigments.
- Surfactants such as polyoxyethylene ethers of dodecyl alcohol, e.g. C12H25O (CH2. CH2.O)6H, are added to a paint solution to provide compatibility between diverse materials.
- Driers accelerate the drying (hardening) of paint by stimulating the binder's oxidation.
- Plasticisers (liquids with a higher molecular weight than solids used to reduce volatility) boost the paint's flexibility, durability, and compatibility, and reduce film cracking.
- Fungicides, biocides, and insecticides inhibit the development and assault of fungi, bacteria, and insects. (prevent paint from spoiling in storage owing to bacterial development)
- Flow control agents enhance flow characteristics.
- Defoamers prevent the production of trapped air bubbles in coatings.
- Emulsifiers are wetting agents that improve the colloidal stability of liquid paints.
- UV stabilizer offer paints with ultraviolet light stability.
- Anti-skinning chemicals inhibit the production of a can skin.

- Adhesion promoters enhance the coating's adhesion to the substrate.
- Corrosion inhibitors reduce the substrate's corrosion rate.
- Texturizers impart coatings with textures.
- Antifreeze protects against exposure.
- Pigment stabilisers boost pigment stability
- Fire retardant properties
- Anti-settling

4.2.5. Paint Viscosity

The ability of a liquid to resist spilling is known as viscosity. This difficulty in moving is caused by the friction between the molecules of the substance, which move at various rates and collide, making motion difficult.

It is possible to think of viscosity as the reverse of fluidity. In this view, the liquid's viscosity decreases as fluidity increases. Although the Pascal-second (Pas) is the unit of measurement in the International System (SI), the Poise has a conversion factor of 1 Poise to 0.1 Pa.

With regard to the Poise, the centipoise (cP), which is its multiple, is used more frequently. This is primarily due to the reference fluid, water, having a viscosity of 1.002 cP at 20 °C. From an equivalence standpoint, 1 cps is equivalent to 1 mPas.

Since has been said in the case of water, the measurement temperature must be taken into account when determining the viscosity of paint (and that of any fluid), as it greatly affects the outcome. Viscosity is typically tested at a temperature of 25°C.

There are numerous tools available for measuring viscosity. The most popular tools in the market for paints and related goods are:

Orifice Viscometers: Ford, Zahn and Gardner cup

Orifice viscometers, like the Ford, Zahn, or BYK-Gardner cups, are instruments with cups-like shapes with orifices that can vary in size (No. 3, No. 4, etc.) They also come with a container for the liquid.

These viscometers' measuring methodology is based on the idea of "flow time," or the length of time it takes for a specific amount of liquid to pass through a capillary or aperture.

Fig 4.2.1 Orifice Viscometers

This duration, expressed in seconds, is proportional to the fluid's viscosity. To test viscosity, the cup number is tabulated.

It is an instrument for measuring viscosity that is simple to use and manage. They are frequently used in the production of paint, ink, and adhesives, although it is not recommended to use them with non-Newtonian fluids (whose viscosity varies with the temperature and shear stress applied to them).

Stormer Viscometer

A standardised mixer with two blades that are submerged in the fluid and operated by applying weight makes up the Stormer viscometer.

The time required for the blades to spin 100 times for a specific weight is determined using a stopwatch. With the help of an ASTM D562 table, the viscosity is calculated and given in Krebs units.

Fig 4.2.2 Stormer Viscometers

Brookfield Viscometer

Rotational viscometry is the foundation of the Brookfield Viscometer. It determines the torque necessary to rotate a needle immersed in the fluid being examined at a constant speed in order to assess viscosity.

Depending on the paint's consistency, the gadget has a mixer with spindle sizes that can rotate at various speeds. Centipoises is the unit of measurement (cps).

It is vital to consistently take the reading at the same time after beginning mixing in order to measure viscosity appropriately. Since a thixotropic product is being examined, keep in mind that the viscosity may change over time.

Fig 4.2.3 Brookfield Viscometers

4.2.6. Primer

Priming is advised for practically all painting operations, regardless of whether the surface to be painted is new drywall, old wood, bare metal, previously painted masonry, or any other material. Primers are essentially flat, sticky paint that is intended to cling well and serve as a stable foundation for subsequent layers of paint. Without priming a surface first, you will probably need more coats of paint to get an acceptable coverage, and the paint may not adhere to the original surface as well as it would to the primer. There are several primer formulations made for various surfaces.

A primer:

- Covers faults such as portions of the wall that have been repaired or mended.
- Blocks and covers stains, preventing them from bleeding through freshly painted surfaces.
- Offers a consistent surface for paint to adhere to. (Better adherence equals a more durable paint job.)
- Creates a homogenous base for a seamless, uniform paint application, allowing painters to complete the job with fewer coats.
- Neutralizes the surface's hue so that when new paint is applied, the truest, brightest colour is revealed.

The advantages of a primer coat:

Primers protect newly created surfaces, preventing paint from soaking into them and necessitating additional coats. Additionally, primer minimises bleed-through from knots and other natural flaws and colours in the naked wood while helping to conceal faults or seams on new drywall. Mold stains and other discolorations are covered by primer with stain-blocking characteristics to keep them from showing through the finish coats of paint. For the paint work to adhere properly to brick, metal, and many wood surfaces, primer must be used.

Although it can be other neutral hues, primer is often white. In order to ensure that paint colours display accurately, this neutral surface is provided. The primer itself doesn't need to be coloured, but some paint shops may add a tiny amount of pigment to the primer to make it more similar to the colour of your final coat of paint. When the final colour is significantly lighter than the surface's initial hue, this is a good idea.

Oil-Based Primers

For surfaces that are likely to be touched, like doors, windows, and cabinets, an oil-based primer is frequently advised. Mineral spirits are required to thin and clean up oil-based primers. They work great for covering troublesome woods, including cedar. Smoke stains, crayon, and oil-based adhesives are just a few of the surfaces that shellac-based primers are made to cover.

Water-Based Primers

Water-based, or "latex," primers are excellent at preventing stains, and they work much better when the surface has paste-filled gaps. They are advised for use on freshly installed drywall and bare wood because they produce a fantastic flexible finish with high crack resistance. Test a water-based primer in a discrete area to ensure that it won't increase the wood grain before using it on bare wood. Depending on the formulation, many water-based primers can also be applied to painted metal, masonry, plaster, and brick. In general, higher-quality water-based primers are more expensive and employ 100% acrylic resins instead of formulae of lower quality.

Paint-and-Primer-in-One

One coat of a paint and primer-in-one solution is intended to seal and cover surfaces. These substances can offer respectable coverage in a single application and perform best when applied to freshly painted or drywalled surfaces. But rather than being primers, they are designed more like thick paint. This implies that they might not always function as well as a proper primer. A paint-and-primer product is not advised for surfaces that require the high-performance bond, stain-blocking, or sealing capabilities of genuine primer.

Usage of Paint Primer

A primer coat prior to applying paint for a professional-quality finish is recommended. Priming first enables the richest, most authentic colour to emerge. We refer to it as the ideal foundation for vibrant colour. In most cases, a single coat of primer will suffice, however in the following instances, one will need to apply two coats:

- When transitioning from a finish with a higher sheen to one with a lower sheen, such as from semi-gloss to eggshell.
- Changing from a dark to a lighter colour.
- When your walls have been fixed or mended.
- If youa painter is painting a humid space, such as a bathroom, which is more vulnerable to mildew and leaching, then should use a mildew-resistant paint.
- If the wall contains stains that you wish to conceal, use a stain blocker (like water spots from a bathroom leak or smoke damage from a fire in a kitchen).
- When painting unfinished wood trim or other very porous surfaces.

Steps for Priming a Surface

The following steps should be followed for priming a wall:

1. **Picking the Primer:** For painting interior walls, either a water-based or oil-based primer can be used. It is advisable to use an oil-based primer to prevent stains and cover porous surfaces. For concealing dark colours, a tinted primer is required. Most primers can be tinted to provide adequate coverage, and The Paint Shed will custom-blend any primer to your specifications. Ensure that the primer is sufficient to cover the entire area.

2. **Preparing the Surface**: Prepare the wall by removing any shelving and hardware (outlet covers, light switch covers etc.) Caulk any holes, dents, or imperfections, then use a putty knife to apply and remove any excess. Before sanding using fine 220 grit paper and wiping clean with a moist towel, allow the surface to dry fully.

3. **Protect the Surroundings:** Before priming, remove all furniture and allow adequate ventilation. Protect any remaining items from paint splatters by covering them with a drop cloth. Use painter's tape to mask off ceilings, mouldings, fittings, and trimmings.

   Before painting, we recommend moistening the roller or paintbrush so the primer is evenly absorbed. For water-based primers, water will suffice, whereas oil-based primers will require a paint thinner or mineral spirit. Squeeze away extra liquid before using your primer. Safety glasses should be used during this step and when priming the wall.

4. **Cut In and Spot Prime:** First, Primer should be applied to the wall's corners and edges before moving on to the regions requiring special attention. Cut into corners with a 2 to 3 inch brush. Next, apply spot primer to any visible stains, wood, drywall, or plaster.

5. **Roll on the Primer:** After addressing any faults, proceed to the bigger areas of the wall. Utilize a 9-inch roller for a speedy and uniform application. Start by pouring your primer into a paint tray, then apply primer to the entire roller and roll off any excess on the ridged portion of the paint tray.

   Paint a vertical stripe at the mitered corner, then apply the primer from top to bottom as you move around the space. Reload the roller as needed and always overlap wet priming regions. If a second coat of priming is necessary, allow the first coat to dry completely before proceeding.

6. **Sand Primer:** The final step is to lightly sand the primed wall using fine-grit sandpaper to help level the surface for painting.

4.2.7. Painting Different Surfaces

1. Painting Internal & External Plastered Surface

a. The surface to be painted must be free of dust, filth, and plaster splashes, as well as clean and dry.

b. Any efflorescence must be eliminated by cleaning with a dry coarse cloth and then a damp cloth.

c. The surface must be completely dry prior to painting. A metre can measure the degree of dryness/humidity.

d. Any cracks or other flaws must be repaired with a suitable mortar/cement combination. Before painting, patchwork must be allowed to dry properly.

e. A single plastered outside surface.

f. Next, apply two coats of an acceptable type of premium emulsion paint to all internal plastered surfaces and two coats of an approved type of cement paint to all external plastered surfaces.

g. Allow a minimum of four (4) hours between the completion of the first coat and the application of the second.

2. Painting Wood Surface

Priming Wood Works

a. The required primer must comply with either BS 5082 or BS 5358.

b. The surface to be primed and painted must be properly cleaned to eliminate filth, grease, etc., then rubbed down and sanded to a smooth finish.

c. Any cracks and repairs on the wood surface must be filled with certified fillers, and the surface must be sanded to a uniform, smooth finish.

d. To avoid bleeding, any knots in the woodwork must be treated with a shellac solution. Large or loose knots must be removed, replaced with solid wood, or trimmed back, and the surface must be repaired with fillers.

e. Timbers arriving on site that are dry and unprimed must be primed immediately, with the end grain receiving two coats. On-site priming must be accomplished with a paintbrush.

f. Woodwork shall not be left without a new primer or undercoat and gloss for more than six (6) months.

g. All joinery timbers must be primed before to assembly and installation.

Painting

a. Paint the primed surfaces with two (2) undercoats and one (1) finishing layer of high-gloss enamel.

b. Each undercoat must be rubbed down with fine glass paper until completely dry before the next coat is applied.

c. Unpainted wood surfaces must be sealed with an authorised filler and coloured to match the wood colour. The surface shall next be sanded with fine glass paper to an eggshell finish, stained with two (2) layers of an authorised stain, and varnished flat.

3. Painting Metal Surface

Priming Metal Works

a. Prior to priming, all metal works must be meticulously cleaned to eliminate any filth, grease, scale, and rust by means of wire brushing, scraping, grit abrasion, pickling, or other methods.

b. The surface must then be promptly prepared with an appropriate metallic primer.

c. As soon as rust forms on primed steel, a second primer or protective coating must be applied.

d. Galvanized metal surfaces to be painted must be etched with a chemical solution or primed with a special primer, such as zinc-chromate or another approved product, according to the manufacturer's guidelines.

Painting

a. Once the primer has completely dried, two (2) undercoats and one (1) finishing coat of high-gloss enamel paint must be applied to the surface of the metal.

b. Once the primer has completely dried, one undercoat and one topcoat of high-gloss enamel paint shall be applied to galvanised metal surfaces.

c. For all types of metals, a minimum of 24 hours (1 day) of drying time under normal weather conditions is required between coat applications.

Exercise

1. Explain the process for interior wall painting.
2. Name few tools required for application of paints.
3. How to select an appropriate roller covers?
4. State some types of building finishes.
5. Explain the process of priming.

Notes

Scan the QR code to watch the video

https://youtu.be/-zvbiV1XBh4
Process for Interior Wall Painting

https://youtu.be/ox8dFf_BBmA
Process for Exterior Wall Painting

https://youtu.be/9UTzIyfkAaA
Building Finishes

Skill India
कौशल भारत - कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

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

5. Interact and Communicate Effectively

Unit 5.1 Effective Interaction and Communication

CON/N8001

Key Learning Outcomes

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

- Demonstrate effective communication with co-workers, superiors and sub-ordinates across different teams
- Provide support to co-workers, superiors and sub-ordinates within the team and across interfacing teams to ensure effective execution of assigned task.

Unit 5.1 Effective Interaction and Communication

Unit Objectives

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

- Explain effect and benefit of timely actions relevant to construction painting works with examples.
- Explain importance of team work and its effects relevant to construction painting works with examples.
- Explain importance of proper and effective communication and its adverse effects in case of failure of proper communication.
- Demonstrate effective communication skills while interacting with co-workers and trade seniors during the assigned task.
- Demonstrate effective reporting to seniors as per applicable organisational norms.
- Instruct subordinates in a clear and precise manner with respect to construction painting works.
- Demonstrate team work during assigned task.
- Interpret work sketches construction painting works formats, permits, protocols, checklists etc.
- Interpret scope of construction painting works.

5.1.1 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.

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.

The benefits of time management skills to both for the person and the company are:

1. **Enhanced productivity and performance:** Poor time management causes employees to feel overwhelmed, whereas excellent time management leads to increased efficiency, which in turn improves performance.

2. **Providing work on schedule:** This is the most visible advantage of excellent time management, but it is also one of the most crucial. Time management enables workers to meet deadlines, which is essential for meeting client expectations.

3. **Less anxiety and stress:** When employees are stressed and anxious, not only do they miss deadlines and produce subpar work, but it also negatively affects their health. As an employer, you are responsible for ensuring that the mental health of your employees is a top priority. Stressed employees are more prone to take sick days and seek alternative jobs.

4. **Better-quality work:** With effective time management, employees have the necessary time to produce work that is not only completed on time but also of a superior quality.

5. **Boosts confidence:** When employees are on top of their responsibilities, it boosts their confidence and enables them to believe in their own talents. In turn, this reduces tension and anxiety because the body produces dopamine.

6. **Reduces procrastination and wasted time:** Knowing how to prioritise decreases procrastination and promotes a "eat the frog" mentality among staff. This saves downtime and increases productivity.

7. **Enhances the work-life balance:** An effective work-life balance When an employee is well-rested and has the opportunity to re-energize, they are in the best position possible to produce their finest work.

8. **Make better decisions:** When employees have time to concentrate and work thoroughly, they are not required to make decisions under duress. Instead, individuals can make selections based on all the necessary information to make the greatest choice.

Time Management for Painters

Similar to other businesses, painters have a full workday. If not careful, anyone will blink and the "short task" will consume half of the day. Too many days like this will rapidly cause you to fall behind on everything, which could be detrimental to your bottom line. There are certain responsibilities that every business must fulfil, and then there are responsibilities that are unique to the painting industry.

The following steps should be followed by painters for effective time management:

1. Keep the project schedule at the forefront
2. Prioritize the task list
3. Delegate tasks as needed
4. Conduct actionable meetings
5. Communicate clearly and effectively
6. Use the right tools

5.1.2. Effective Communication

Effective communication is the process of sending and receiving messages from sender to receiver properly and successfully. The information is passed by signs and signals, speaking, writing or using some other medium and means. The objectives of effective communication are:

1. Sending, receiving and understanding the message or information.
2. Development of Interpersonal Skills.
3. To express effectively & with maximum efficiency.

Effective communication requires one to follow basic principles of communication, i.e., 7Cs:

- 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

Communication Process

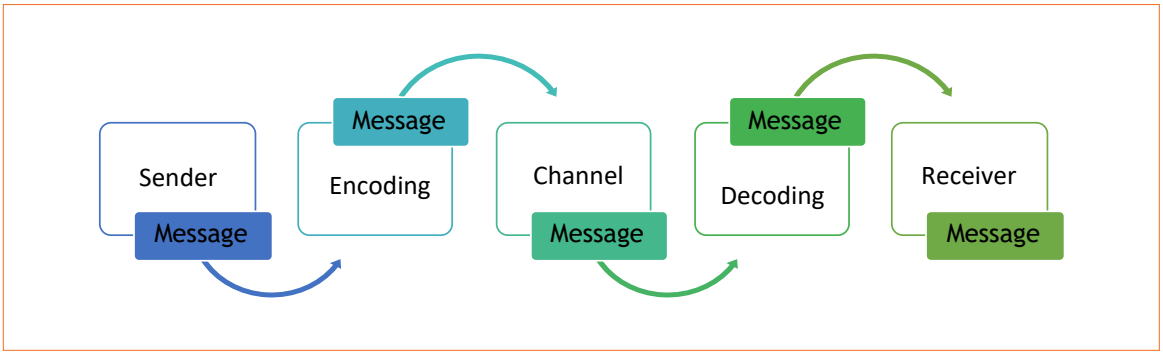

Fig 5.1.1 Effective Communication Process

- 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.

5.1.3. Workplace Communication

Every workplace organisation requires communication for day-to-day business, regardless of size, location, goals, etc. It forms a bridge between people to exchange ideas, inform, express their feelings, influence others, etc. Communication is required to communicate within the organisation with managers and employees, etc. and outside with suppliers, buyers, etc.

Effective Communication with Stakeholders

The key factors to establishing effective communication in the construction industry are:

1. Establish a Communication Chain of Command

Construction projects need a communication chain. The contract documents usually require the owner and general contractor to communicate through the architect.

The architect communicates with consultants and the general contractor with suppliers and subcontractors. The general contractor usually contacts the project superintendent.

Contract documents—drawings, specifications, change order forms, and requests for information—form the basis for construction communication. Any direct communication not in the contract documents must be authorised, and any scope or schedule modifications must be documented and reported.

2. Select an Appropriate Communication Method

We communicate vocally and nonverbally daily, and construction communication is no different. We text, talk on the phone and in person, send emails, and some of us still use fax machines inexplicably in this digital era. We communicate on the building site with signs, drawings, hand gestures, and meetings. We write daily reports, take photographs, generate information requests (RFIs), and examine modification orders.

There are benefits and drawbacks to each way of communication. Selecting the appropriate mode of communication can facilitate and expedite the transmission of information.

3. Be an Active Listener

One should be an active listener when engaging in oral communication, whether in person or by phone. At best, it is passive listening to sit there and absorb the information like a digital recorder. Try to comprehend what the speaker is trying to convey from their perspective.

Take notes on significant points, rather than transcribing every word they say, and jot down information that may require clarification. Maintain eye contact and use nonverbal cues such as head nods to demonstrate attentive listening.

4. Prevent Confusion, Be Clear and Concise

When communicating in the construction industry, you want your message to be understood the first time you convey it. Avoid jargon and unfamiliar phrases when interacting with others. Your communication should be concise and direct. Keep it as brief and clear as possible.

Focus on one project at a time if you are working on multiple projects with the same owner or architect to avoid misunderstanding. The real difficulty lies in attempting to be as descriptive as possible while using as few words as possible.

It takes practice to be concise yet comprehensive in your construction communications. Before sending any written communication, proofread it to determine if it may be shortened without affecting its meaning or omitting vital details.

5. Keep Written Communication Always Professional

Avoid using profanity and allowing your emotions to influence your message. If your feelings are running high, wait 24 hours before sending the email so that you can examine and make any necessary modifications. If a quick answer is required, read the message aloud or have another person review it for a second opinion.
Separate huge data pieces into smaller paragraphs. People tend to scan rather than read emails; thus, dividing the content into smaller bits facilitates processing. Use numbered or bulleted lists when delivering numerous details or posing innumerable questions.

6. Stick to the Facts

One should solely care about presenting or obtaining facts. In all communications, do not overcomplicate or provide irrelevant details. Keep the personal ideas and feelings about a project to yourself unless asked.

However, you must offer your professional thoughts on a project when you believe they could contribute to its practical completion. Your company's expertise contributed to its selection for the project, so don't be shy.

- Communicate effectively with the plant operator; Lower all ground engagement tools and/or implements to the ground.
- Disengage the plant controls so that they cannot be accidentally activated by the operator or by any other means;
- Visibly remove their hands from the controls of the powered mobile plant; and cease all movement of the plant.

5.1.4. Adverse Effects of Poor Communication

There is poor workplace communication when there is a disconnect between what is said and what is heard, whether between co-workers or between an employee and management. Specifically, there is a lack of mutual understanding between two parties when the recipient of your communication misunderstands it.

The following issues are faced due to poor communication:

Creating Confusion

In building, a lack of communication is problematic. Miscommunications can also have a negative effect on a project by causing misunderstandings among significant stakeholders, construction professionals, and field personnel. Inconsistent reporting, incomplete reporting, inaccurate reporting, and delayed reporting can all contribute to errors that result in project delays and cost overruns on the construction site and the office.

Clear and straightforward messages prevent confusion. Keep messages brief, concise, and to the point.

Unnecessary Delays

Poor communication is a primary cause of project delays in the construction sector. It can manifest in various ways, including delays in the flow of information, communication directed to the wrong person or location, and confusing communication that leads to misunderstanding or incorrect interpretation. Any of these inefficient communication elements can result in errors and cause delays. Ordering unsuitable material, omitting a step in the construction process, or misallocating labour can all result in project delays.

Budget/Cost Overruns

According to the Project Management Institute (PMI), inefficient communications and improper time management of project communications account for more than half of all project budget risks. Poor or erroneous communication frequently results in greater expenditures. Adding a zero to a significant number can wreak havoc on a budget.

Injuries and Safety Issues

Poor safety communication is frequently attributable to three frequent causes:

- Workers lack familiarity with the safety training vocabulary. This is particularly true for trainees who are fresh to safety training. They can disconnect more quickly at this moment.
- Workers are scared to speak out when they find a safety hazard. They may fear judgement if they alert a colleague or supervisor to a potential danger. It is simpler to avoid risk.
- Workers frequently regard safety communication as unfavourable. Typically, only negative situations are discussed or emphasised, while the positive aspects of their behaviour are neglected.

Issues with Stakeholders

Multiple parties are involved in every construction project, including owners, designers, investors, general contractors, project managers, subcontractors, and labourers. Effective and thorough communication among a project's stakeholders is essential to its success. It can lead to increased project expenses, delays, and stakeholder disputes. Poor project data and miscommunications between project stakeholders account for nearly 48% of all project rework.

5.1.5. Teamwork at Workplace

Teamwork is when people of an organisation collaborate to achieve a common objective or set of objectives. In the modern workplace, teamwork can take place in-person or (increasingly) online.
It is important to note that modern teams are vastly different from those of the past. Today's teams, for instance, are more varied and dynamic, with specialised skill sets that present new problems and opportunities. Consequently, any team-based initiative can also serve as an opportunity for personal and professional development.

As technology continues to dominate the workplace, digital literacy, or the ability to use information and communication technologies, has become increasingly vital in team settings.

Advantages of Teamwork

There is no stronger tool in a business' armoury than a strong staff. Effective teams can increase efficiency by tackling more complex tasks (think "two heads are better than one"), improve communication by fostering open discussion and cooperation among team members, maximise output by leveraging each team member's strengths, provide opportunities for personal growth, and serve as a support mechanism for staff.

Unsurprisingly, cooperation in the workplace has also been demonstrated to boost invention and creativity by allowing team members to contribute their own unique perspectives. Effective cooperation supports organisational growth and improves performance and success by capitalising on the unique talents and characteristics of each employee.

Importance of Teamwork for Painters

It is necessary for a construction painter to maintain constant communication with the team. It is of the utmost importance to maintain clear lines of communication and cooperate productively with them in order to accomplish the tasks. The painters require that the entire team maintain the same rate of work.

5.1.6. 5 C's of Teamwork

It is crucial for organisations and corporations to continuously seek ways to increase their productivity and competitiveness. It has been discovered how to make work teams more unified and effective. In other words, work as a team. For this reason, a great number of specialists have sought out the most efficient method for fostering teamwork.

Tom Peters, who is regarded by many as the "father" of modern management, investigated the variables necessary for teams to achieve high performance. His research established the five C's of teamwork, which are essential for achieving high performance.

5 C's of Teamwork				
Co-operation	**Communication**	**Confidentiality**	**Competence**	**Courage**

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.

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.

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.

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.

Commitment

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

5.1.7. Enhancing Teamwork in the Workplace

Working in a team can be complicated due to the fact that we are all unique individuals with varying mental states. Improving teamwork relies heavily on the role of the team's leader. Here are some recommendations that can assist them in achieving greater teamwork:

1. Concentrate more on "us" than "me"

A minor step is to begin speaking in the plural, so that all members feel as though they are a part of the effort. The greater our involvement, the harder we work to obtain the finest results.

2. Communicate Explicitly

Communication is the fundamental prerequisite. We must create an atmosphere in which team members are free to share their thoughts. It is advisable to make an effort to prevent such misunderstandings.

3. Delegate and believe

When working in a team, each assignment symbolises a problem that can be readily overcome via teamwork. Team leaders should be aware of the abilities and qualities of their team members and assign them jobs where they may demonstrate their value. For this, they must feel at ease while working and have confidence that their bosses have faith in them.

4. Establish shared aims and objectives

It is crucial to establish a unified business objective and effectively communicate it to team members.

5. Recognize and honour the achievements of others.

This attitude strengthens the team's trust and teamwork, which will inspire them to achieve the following objectives.

6. Conquer a conflict with success

Workplace conflicts are prevalent, and people with conflict management abilities are in high demand.Learn this talent if you still lack it.

7. Build a diverse group

People with varied origins, personalities, and experiences can be a source of innovative ideas. Through intelligent reading, we will recognise that we have the opportunity to maximise each individual's qualities.

8. Believe in Team Building

It's been said that teams that have fun remain together, thus establishing personal relationships in the workplace is a fantastic way to boost teamwork.

5.1.8 Construction Reporting

Construction reporting is the preparation of official records that provide stakeholders with information on significant events, project phases, and processes. Typically, these reports are written documents containing data. They can also describe the condition of particular project components or the budget. Construction reports should be short and written in straightforward language. Additionally, they should be simple to navigate and contain only the essential information. Additionally, they should not be replicated in other reports. Reporting on construction gives the project team excellent visibility and comprehension of what should be done. Inaccurate reporting can have significant effects on project costs and deadlines.

Objective of Construction Reporting

Construction reports are a way to comprehend the activities occurring on construction sites. In order to provide an accurate depiction of the project's state, construction reporting utilises a number of methods to collect and combine project data.

Creating reports improves comprehension of current activities and minimises the likelihood of project delays and cost overruns. The information flow from construction reporting keeps stakeholders informed and provides psychological comfort as they enjoy a project's efficient operation. Construction reports can reduce safety concerns because problems are identified and documented before they escalate.

Types of Construction Reports

There are numerous types of construction reports that detail various project operations. The majority of construction reports fall under many categories, as illustrated below.

1. Materials Report

Technological advancements have produced new construction technologies that contractors can utilise. Consequently, material reports provide construction organisations with information regarding materials that offer greater cost savings and a longer lifespan. These construction material reports are provided by a variety of organisations, and construction enterprises must enlist in order to receive their services.

2. Trend Report

Standard in the building business, trend reports provide information on various construction styles and whether their market usage is expanding or diminishing. To have access to such information, contractors must subscribe to the websites that publish studies on building industry trends. The majority of these papers are published annually and provide excellent overviews of the most recent trends and industry dynamics.

3. Cost Report

These are construction reports that tell the client and other interested parties on the expected and actual expenditures of a project. Typically, cost consultants such as quantity surveyors or contractors produce cost reports. The project is then constructed in accordance with the client-presented cost estimate. These reports are periodically updated to monitor the project's expenses. Throughout the lifecycle of a project, cost reports are in a state of ongoing evolution. Consequently, the amount of detail and precision improves as the project progresses and more information becomes available.

4. Progress Report or Daily Report

Daily reports are an integral component of project management. A daily report describes the actions of a project on a daily basis. Daily reports augment a contract by recording and confirming project progress.

These report describe the site's specifics and keep stakeholders updated. In the event of any delays, daily reports clarify the underlying causes, thereby eliminating the time wasted disputing over the surrounding minutiae. The daily report is typically prepared by the construction manager or foreman.

5.1.9. Instructions to Sub-Ordinates

Giving clear, understandable directions is one of those tasks that sounds simple but may be difficult in practise, particularly in a construction setting. Because of mixed signals, assumptions, and various possibilities, the message received may differ from what we intended.

Consider the consequences of a poor communication system on a construction project to determine the significance of communication in construction. When there is a breakdown in communication, the budget and schedule differ dramatically. Communication failures have the potential to have catastrophic repercussions on the safety of project personnel. Communication boosts the efficiency of a project as a result.

Communication breakdowns are the major source of construction disputes. In the absence of an open and transparent documentation procedure, conflicts are probable. Transparent and truthful documentation is the most effective method for avoiding building disputes. There cannot be proper documentation if the owner, contractor, and other parties do not communicate.

It is important to provide Clear and Concise instructions to sub-ordinates. When sending a message in the construction industry, one should make every effort to ensure that it is understood. To clarify the message to the stakeholders, please make it brief and to the point. It is wise for a contractor with multiple projects to focus on a single job to avoid misunderstanding.

Before sending any communications, one should proofread and update them without changing or omitting vital details. Certain sector-specific terms are difficult for others outside the field to comprehend. Eliminating unnecessary jargon will ensure that everyone on the project is on the same page. The time the team spends attempting to understand what is comprehended will be reduced.

5.1.10. Interpreting Scope of Construction Painting Works

Painting contractors are responsible for a variety of property care projects involving the painting of floors, ceilings, buildings, and walls, and may also bid on and manage these projects. To become a painting contractor, proficiency in commercial and residential painting procedures and an aptitude for project management may be required.

Understanding how to become a painting contractor will enable you to practise the necessary abilities for the position. This article examines the six steps necessary to become a painting contractor and the ideal duties associated with this position.

5.1.11. Interpreting Painter Essentials

The ability to read and understand plans, sketches, formats, permits, protocols, checklists etc. as well as the requirements of construction sites is essential for painters and decorators. Painters and decorators are able to calculate the total surface area of walls and ceilings that need to be painted by reading and understanding these designs. They may have to further deal with authorities and stake holders, where they are required to be well informed.

Exercise

1. What are the 7 Cs of effective communication?
2. State some Adverse Effects of Poor Communication.
3. What do you understand by Workplace Communication?
4. How to enhance teamwork in the workplace?
5. Explain importance of time management.

Notes

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6. Follow Safety Norms at Wokplace

Unit 6.1 – Workplace Hazards

Unit 6.2 – Fire Safety

Unit 6.3 – Safety Measures at Workplace

CON/N9001

Key Learning Outcomes

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

- Identify various hazards at construction site.
- Use PPE's relevant to electrical works.
- Perform safe waste disposal at construction site.
- Demonstrate the activities to check the spread of infection as per medical/ organizational guidelines.

Unit 6.1 – Workplace Hazards

Unit Objectives

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

- Explain the types of hazards at the construction sites and identify the hazards specific to the domain related works.
- Describe the standard procedure for handling, storing and stacking of material, tools, equipment and accessories.
- Use PPEs as per work requirements during construction painting job.
- Recall the safety control measures and actions to be taken under emergency situation.
- Explain the reporting procedure to the concerned authority in case of emergency situations.
- Explain the types and benefits of basic ergonomic principles, which should be adopted while carrying out specific task at the construction sites.

6.1.1. Workplace Safety

Workplace safety is important to be established for creating a safe and secure working for the workers. The workplace has to be administered as per the rules of the Occupational Safety and Health Administration (OSHA). It refers to monitoring the working environment and all hazardous factors that impact employees' safety, health, and well-being. It is important to provide a safe working environment to the employees to increase their productivity, wellness, skills, etc.

The benefits of workplace safety are:

- Employee retention increases if they are provided with a safe working environment.
- Failure to follow OSHA's laws and guidelines can result in significant legal and financial consequences.
- A safe environment enables employees to stay invested in their work and increases productivity.
- Employer branding and company reputation can both benefit from a safe working environment.

Workplace Safety at Construction Site

To avoid injuries, accidents, and other health issues on a building site, the following safety guidelines must be followed:

1. Always wear PPE

All personnel and visitors on the construction site must wear the required PPE to reduce their exposure to potential hazards. Goggles, helmets, gloves, ear muffs or plugs, boots, and high visibility vests and suits are typical PPEs.

2. Pay attention and obey signs

Employees and visitors can be warned and made more aware of health and safety hazards through the use of safety signs. When necessary, strategically position them throughout the facility. Workers should be aware with construction site safety advice and various signs, including prohibition signs, required signs, warning signs, safe condition signs, and fire fighting equipment signs.

3. Provide precise directions

There should be a site induction or contractor induction on the job site. This will familiarise new employees with site operations. Additionally, toolbox presentations are an effective means of communicating health and safety instructions to the employees. On a daily or more frequent basis, a pre-work inspection is performed.

4. Keep site tidy

Ensure that excavation debris, dust, loose nails, and stagnant water are not lying about the site. For the prevention of slips and trips, the building site must be cleaned everyday and kept decluttered.

5. Organize and store equipment

Ensure that there are no tools laying around, and unplug all lights and power tools. The observance of building site regulations will prevent tools from becoming damaged or perhaps causing worker injury. Putting them in their proper location will help facilitate navigation.

6. Use the proper tools for the correct job

Frequently, accidents occur due to improper usage of a tool or piece of equipment. Avoid using homemade tools. Use the proper tool to complete the task more quickly and safely.

7. Have an emergency response plan

An emergency response plan instructs employees on what to do in the event of emergencies such as natural disasters, fire, hazardous material spills, and other catastrophes. Have a team committed to addressing emergency situations, answering queries, and reporting potential risks, quality issues, and near misses.

8. Set up protections

Installation of engineering controls, such as barriers, fences, and safeguards, is one method for ensuring site safety. These will aid in isolating individuals from hazardous places like high-voltage electricity or harmful chemicals.

9. Perform pre-inspection of tools and equipment.

Ensure that the tools and equipment to be utilised are free of defects or damage before beginning work.

10. Report problems immediately

Train employees to immediately report flaws and near-misses on the job site. Problems can only be resolved when management is made aware of them. The sooner problems are identified, the less likely they are to worsen and cause accidents or additional damage.

6.1.2. Workplace Hazards

A workplace is a situation that has the potential to cause harm or injury to the workers and damage the tools or property of the workplace. Hazards exist in every workplace and can come from a variety of sources. Finding and removing them is an important component of making a safe workplace.

Common Workplace Hazards

The common workplace hazards are:

- **Biological:** The threats caused by biological agents like viruses, bacteria, animals, plants, insects and also humans, are known as biological hazards.
- **Chemical:** Chemical hazard is the hazard of inhaling various chemicals, liquids and solvents. Skin irritation, respiratory system irritation, blindness, corrosion, and explosions are all possible health and physical consequences of these dangers.
- **Mechanical:** Mechanical Hazards comprise the injuries that can be caused by the moving parts of machinery, plant or equipment.
- **Psychological:** Psychological hazards are occupational hazards caused by stress, harassment, and violence.
- **Physical:** The threats that can cause physical damage to people is called physical hazard. These include unsafe conditions that can cause injury, illness and death.
- **Ergonomic:** Ergonomic Hazards are the hazards of the workplace caused due to awkward posture, forceful motion, stationary position, direct pressure, vibration, extreme temperature, noise, work stress, etc.

Workplace Hazard at Construction Site

Working on a construction site entails working with or alongside massive, functioning plant machinery and tools and working at heights and in potentially hazardous settings.
The following are a few hazards of a construction site:

- **Working at Heights:** Working at heights is the leading cause of fatal workplace injuries. All personnel working at height must receive adequate training in operating on various equipment, and such work must be carefully organised.
- **Moving Objects:** A building site is a constantly-evolving environment with numerous objects in constant motion, frequently on uneven ground. Delivery vehicles, large plant gear, and overhead lifting equipment pose a threat to workers and operators on the job site. Sites should always be designed to manage plant-to-pedestrian contact when physical barriers and enough segregation are present.

- **Slips, Trips, and Falls:** Slips, trips, and falls can occur in practically any environment, but they occur less frequently in the construction industry than in other sectors. Unsurprisingly, slips, trips, and falls are major hazards on construction sites due to the often uneven ground and ever-changing typography.

- **Noise:** Exposure to loud, excessive, and repetitive noise can result in long-term hearing issues, including deafness. Noise can also be a risky distraction, diverting a worker's attention from the task at hand, which can lead to mishaps. A full noise risk assessment should be conducted if the risk assessment identifies a noise hazard associated with the proposed work.

- **Hand Arm Vibration Syndrome:** HAVS is a painful and debilitating condition affecting the blood vessels, nerves, and joints. It is often brought on by the repeated use of hand-held power tools, such as vibrating power tools and ground-working equipment. HAVS is avoided if construction projects are structured to minimise exposure to vibration during work and if personnel utilising vibrating tools and equipment are monitored and properly protected.

- **Material Handling - Manual and with Equipment:** On construction sites, materials and equipment are continuously lifted and transported, either manually or with equipment. Handling always carries a degree of danger.

- **Excavations:** On construction sites, incidents frequently occur within excavations, such as an unsupported excavation collapse with employees inside.

- **Electricity:** Contact with overhead or subsurface power cables and electrical equipment/ machinery accounts for most of these mishaps. The standard in the construction industry is service strikes. The strikes occur when excavation is performed without a sufficient search for existing utilities. Consequently, problems can be readily averted by employing technologies such as CAT and Genny scanning equipment to scan an area, anticipate prospective services, and prevent service interruptions.

Workplace Hazards Analysis

A workplace hazard analysis is a method of identifying risks before they occur by focusing on occupational tasks. It focuses on the worker’s relationship with the task, the tools, and the work environment. After identifying the hazards of the workplace, organisations shall try to eliminate or minimize them to an acceptable level of risk.

Control Measures of Workplace Hazards

Control measures are actions that can be taken to reduce the risk of being exposed to the hazard. Elimination, Substitution, Engineering Controls, Administrative Controls, and Personal Protective Equipment are the five general categories of control measures.

- **Elimination:** The most successful control technique is to eliminate a specific hazard or hazardous work procedure or prevent it from entering the workplace.
- **Substitution:** Substitution is the process of replacing something harmful with something less hazardous. While substituting the hazard may not eliminate all of the risks associated with the process or activity, it will reduce the overall harm or health impacts.
- **Engineering Controls:** Engineered controls protect workers by eliminating hazardous situations or creating a barrier between the worker and the hazard, or removing the hazard from the person.
- **Administrative Controls:** To reduce exposure to hazards, administrative controls limit the length of time spent working on a hazardous task that might be used in combination with other measures of control.
- **Personal Protective Equipment:** Personal protective equipment protects users from health and safety hazards at work. It includes items like safety helmets, gloves, eye protection, etc.

6.1.3. Hazard Identification and Risk Assessment (HIRA)

Hazard Identification and Risk Assessment (HIRA) is conducted to identify undesired events that can lead to a hazard, analyse the hazard of this undesirable event, and estimate its scope, magnitude, and possibility of detrimental effects. Within the industry, it is commonly acknowledged that the various risk assessment approaches contribute significantly to improving the safety of complex processes and equipment.

This analysis of hazards and risks aims to identify and assess hazards, the event sequences that lead to hazards, and the risk associated with hazardous occurrences. There are numerous strategies for identifying and analysing dangers, ranging from simple qualitative procedures to advanced quantitative methods. Multiple methodologies for hazard analysis are advised because each has its objective, strengths, and weaknesses.

To manage risk, risks must first be identified, and then the risk must be assessed and its acceptability established.

The earlier an effective risk analysis is conducted in the life cycle, the more cost-effective the future safe operation of the process or activity is expected to be. Most of the facility's other process safety management tasks are based on understanding the risk obtained via these studies. An inaccurate perception of risk at any time could result in inefficient use of scarce resources or the unwitting acceptance of hazards that exceed the genuine tolerance of the organisation or community.

Procedure for HIRA:

At each stage of the work life cycle, a review team questions process specialists about potential hazards and evaluates the risk of any detected hazards. There are numerous typical ways to evaluate a design, ranging from straightforward qualitative checklists to extensive quantitative fault tree analysis. Typically, the results of the review process are recorded on a worksheet whose level of information varies according to the stage of the job and the evaluation method employed. Typically, risk evaluations on operational processes are regularly updated or revalidated.

This work's objective is to detect hazards and risks by assessing each step involved in various building activities and to provide recommendations to remove or reduce the risk assessment (HIRA). The industry achieves success by satisfying production objectives and ensuring high employee satisfaction by meeting workplace safety criteria. Regularly, hazards and risk assessments should be performed, and steps should be taken to reduce the risk to an acceptable level.

HIRA Process it consist of four steps as follows:

i. Hazard identification
ii. Risk assessment
iii. Risk analysis
iv. Monitor and review

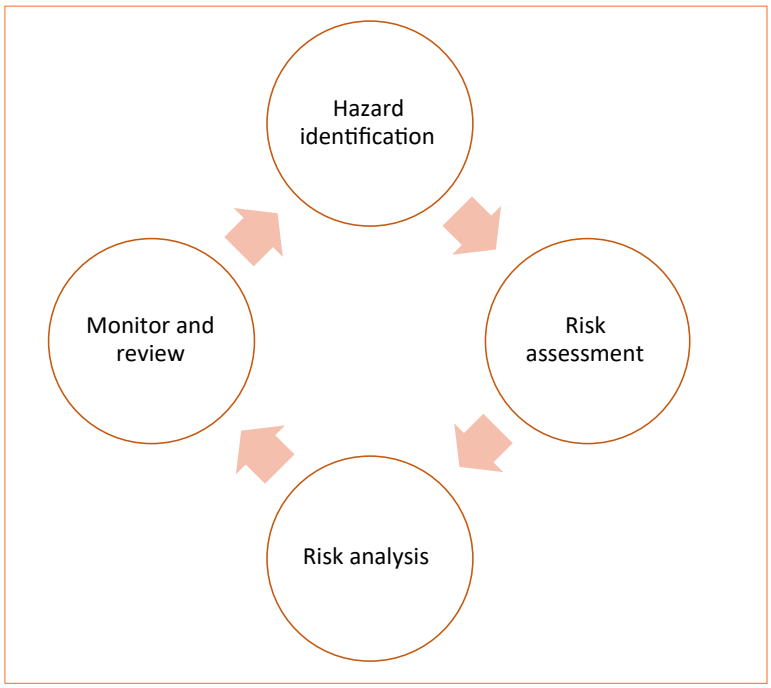

Fig. 6.1.1 HIRA Process

6.1.4. Workplace Warning Signs

A Hazard sign is defined as 'information or instruction about health and safety at work on a signboard, an illuminated sign or sound signal, a verbal communication or hand signal.'

There are four different types of safety signs:

- Prohibition / Danger Alarm Signs
- Mandatory Signs
- Warning Signs
- And Emergency

1. **Prohibition Signs:** A "prohibition sign" is a safety sign that prohibits behaviour that is likely to endanger one's health or safety. The colour red is necessary for these health and safety signs. Only what or who is forbidden should be displayed on a restriction sign.

Fig. 6.1.2. Prohibition Warning Signs

2. **Mandatory Signs:** Mandatory signs give clear directions that must be followed. The icons are white circles that have been reversed out of a blue circle. On a white background, the text is black

Fig. 6.1.3. Mandatory Signs

3. **Warning Signs:** Warning signs are the safety information communication signs. They are shown as a 'yellow colour triangle'.

Fig. 6.1.4. Warning Signs

4. **Emergency Signs:** The location or routes to emergency facilities are indicated by emergency signs. These signs have a green backdrop with a white emblem or writing. These signs convey basic information and frequently refer to housekeeping, company procedures, or logistics.

Fig. 6.1.5. Emergency Signs

6.1.5. Personal Protective Equipment

Personal protective equipment, or "PPE," is equipment worn to reduce exposure to risks that might result in significant occupational injuries or illnesses. Chemical, radiological, physical, electrical, mechanical, and other job dangers may cause these injuries and diseases.

PPE used for protection from the following injuries are:

Injury Protection	Protection	PPE
Head Injury Protection	Falling or flying objects, stationary objects, or contact with electrical wires can cause impact, penetration, and electrical injuries. Hard hats can protect one's head from these injuries. A common electrician's hard hat is shown in the figure below. This hard hat is made of nonconductive plastic and comes with a set of safety goggles.	
Foot and Leg Injury Protection	In addition to foot protection and safety shoes, leggings (e.g., leather) can guard against risks such as falling or rolling objects, sharp objects, wet and slippery surfaces, molten metals, hot surfaces, and electrical hazards.	 
Eye and Face Injury Protection	Spectacles, goggles, special helmets or shields, and spectacles with side shields and face shields can protect against the hazards of flying fragments, large chips, hot sparks, radiation, and splashes from molten metals. They also offer protection from particles, sand, dirt, mists, dust, and glare.	
Protection against Hearing Loss	Hearing protection can be obtained by wearing earplugs or earmuffs. High noise levels can result in permanent hearing loss or damage, as well as physical and mental stress. Self -forming earplugs composed of foam, waxed cotton, or fibreglass wool usually fit well. Workers should be fitted for moulded or prefabricated earplugs by a specialist.	

Injury Protection	Protection	PPE
Hand Injury Protection	Hand protection will aid workers who are exposed to dangerous substances by skin absorption, serious wounds, or thermal burns. Gloves are a frequent protective clothing item. When working on electrified circuits, electricians frequently use leather gloves with rubber inserts. When stripping cable with a sharp blade, Kevlar gloves are used to prevent cuts.	
Whole Body Protection	Workers must protect their entire bodies from risks such as heat and radiation. Rubber, leather, synthetics, and plastic are among the materials used in whole - body PPE, in addition to fire -retardant wool and cotton. Maintenance staff who operate with high -power sources such as transformer installations and motor - control centres are frequently obliged to wear fire -resistant clothes.	

Table 6.1.1 Personal protective equipment

6.1.6. Basic Ergonomic Principles

The basic ergonomic principles for construction are:

1. Work in neutral space.

Whether working seated or standing and moving throughout the day, it is essential to maintain a neutral posture. Several parts of the body are typically affected by this principle. The foremost is the rear. A healthy spine has an S-curve, and it is essential to maintain this curve when working to prevent back pain. When working in a seated position, lumbar support is essential. When standing stationary, it can be advantageous for those who stand or move around a facility to rest one foot on a footrest, and when lifting, it is important to lift using your legs rather than your back.

Neck, elbows, and wrists are additional parts of the body that may be misaligned. To lessen tension on these areas and maintain their alignment, try modifying your equipment or work position so that your muscles remain in a relaxed state.

2. Reduce the necessity for excessive force.

Imagine a time when you had to move an object using your entire body weight. This is what the principle refers to. Heavy pushing, pulling, and lifting can strain your joints, potentially leading to weariness or injury. Instead of employing unnecessary force, look for equipment or methods that can lighten the load you must move. It may be as easy as using a cart or hoist to transport heavy objects, or you may need to modify your workflow to reduce the distance you must go or the number of objects you must transport.

3. Keep materials easily accessible.

Try extending your arms in front of you and drawing a half-circle with them. This is your reach envelope, and you should keep goods you use regularly within this semicircle at your desk. To accommodate your reach envelope, you may need to rearrange your space so that you no longer have to reach for often used goods. Adjusting your seat and armrests can help alleviate fatigue by bringing machine controls within reach.

Also applies while reaching into boxes or containers. Before reaching into a box, tilt it or lay it on a lower surface instead than straining your shoulders to reach higher.

4. Work at the appropriate height.

A work surface that is either too high or too low might cause back, neck, and shoulder strain. Standing or sitting, the majority of normal tasks should be performed at elbow height. Nonetheless, if you work with heavy instruments, you may need to change your position to work below elbow height. On the other hand, precision work may necessitate working at heights above the elbow.

5. Reduce needless movements.

Manual repetition can result in overuse injuries, thus it is essential to consider the motions you repeat

throughout the day and identify solutions to prevent excessive motion. Is it conceivable, for instance, to replace a screwdriver with a drill, so eliminating the need for manual motion? Additionally, you might seek for possibilities to alter your position or the arrangement of your workspace in order to operate in a more ergonomic manner.

6. Reduce fatigue resulting from static stress.

There may be tasks at work that need you to maintain the same position for a lengthy period of time. This is known as static load. Static load can impact various regions of the body, including the legs while standing for an extended period of time and the shoulders when holding the arms overhead for more than a few seconds. These types of tasks might create muscle fatigue and discomfort that persists long after the work is completed. You may be able to prevent the weariness generated by static load by altering the orientation of your work area, repositioning your body, or using tool extenders.

7. Minimize contact stress.

When a tool or surface repeatedly comes into contact with the same part of your body, contact stress occurs. Sometimes referred to as pressure points, these places of contact can be painful. When you habitually squeeze a tool, such as pliers, or hold a heavy object, such as a nail gun, that exerts pressure on a portion of your hand, this is an example of contact stress. Adding padding, wearing gloves, or selecting equipment with a padded grip can be beneficial. Consider adding anti-fatigue mats to standing surfaces to reduce heel contact stress.

8. Leave adequate clearance.

This idea is straightforward: you must have adequate space for your head, knees, and feet. Adjust your seat to allow sufficient legroom if you perform your duties while seated. Remove above obstacles to avoid head injuries. Visibility also plays a role in this scenario. It is essential to have a clear perspective of your surroundings regardless of where you are working or what equipment you are employing.

9. Stay active and flexible throughout the day.

Sitting or standing in one posture for too long is unhealthy for the human body. Take time to stretch and exercise your muscles. If you are sedentary for an extended amount of time, take frequent breaks to walk around. If you are on your feet all day, wear supportive shoes and rest during your breaks. And if your profession is physically demanding on specific sections of your body, it may be beneficial to stretch before to undertaking tough duties.

10. Keep your atmosphere comfortable.

Depending on your sector and position, work conditions vary widely, but lighting, temperature, vibration, and noise are a few common factors you may want to consider. Consider strategies to reduce glare or improve lighting in dimly lit places. Whenever feasible, maintain a pleasant temperature in the workplace, and when working outside, dress appropriately for the weather. And if the tools produce excessive noise or vibration, give hearing protection and seek methods to attenuate the vibrations.

6.1.7 Emergency Response Plan for Construction Site

Construction projects are commonly recognised as one of the most accident-prone activities. It must be realised that the size and complexity of a project determines the associated dangers and risks. In the majority of cases, poor response, a lack of resources, or the absence of trained staff on a building site will result in chaos. In order to reduce human suffering and financial losses, it is strongly suggested that the emergency response plan be developed prior to project launch.

The Emergency Response Plan must address the following factors:

1. Statutory Obligations

The entity must comply with all applicable Central and State Rules and Regulations, such as The Building and Other Construction Workers' Act of 1996, the Environment (Protection) Act of 1986, the Factories Act of 1948, the Inflammable Substances Act of 1952, the Motor Vehicles Act of 1988, the Public Liability Insurance Act of 1991, the Petroleum Act of 1934, the National Environment Tribunal Act of 1995, and the Explosives Act of 1874, etc.

Incorporate applicability and compliance status into the Emergency Response Plan.

2. Emergency Preparedness

a. The process of hazard identification and risk assessment entails a thorough review of construction activities such as Excavation, Scaffolding, Platforms & Ladders, Structural Work, Laying of Reinforcement & Concreting, Road Work, Cutting /Welding, Working in Confined Space, Proof/Pressure Testing, Working at Heights, Handling & Lifting Equipment, Vehicle Movement, Electrical, Demolition, Radiography, Shot blasting

b. Listing On-Site (Level I & II) and Off-Site (Level III) Emergency Scenarios in accordance with their effects and available resources.

3. Measures for Emergency Mitigation

To ensure safety during construction activities, the business must have an appropriate Health, Safety, and Environment Management System in place.

a. Health, Safety, and Environment (HSE) Policy;
b. Duties and Responsibilities of Contractor/Executing Agency;
c. Site planning and layout;
d. Deployment of Safety Officer/Supervision;
e. Safety committees with fair participation of workers;
f. Safety audits and inspections shall be conducted using prescribed checklists.
g. Work permit system h) PPE I Safety awareness and training, etc.

4. Measures for Emergency Preparedness

a. Emergency Drill and Exercise on Identified Scenarios and Evaluations b) Emergency Response Training

b. Mutual Aid

5. Disaster Recovery Procedures

The entity must develop well-planned and documented response procedures. The action plan may be documented for both On-site and Off-site disaster scenarios.

6. Organization and Responsibilities during Emergencies

The entity must create an organisation chart (emergency action flowchart) and specify the roles and duties of key individuals in order to properly handle an emergency scenario on the project site. Clause 14.0 of the PNGRB (ERDMP) Regulations may be consulted in order to establish the emergency organisation and responsibilities.

7. Resources for Emergency Management

1. The following emergency control systems and facilities must be provided on the project/ construction site: -

   a. Fire and gas detection system

   b. Fire protection and firefighting system (Active and Passive)

   c. Ambulance facility on-site; if not, on urgent call basis.

   d. Rescue facilities and personal protective equipment (PPEs)

   e. First aid stations.

   f. Medical facility on-site or affiliation with a local hospital or medical centre

   g. Internal and External Communication Facilities as well as a Notification System

   h. Gathering places

   i. Escape route and evacuation zones

2. Internal and External Emergency contact information for police, fire, hospitals, mutual assistance industry, factory inspectors, Board, State Pollution Control Board, Petroleum and Explosive Safety Organization (PESO), etc.

3. Addresses and Telephone Directory of Technical Support Services and Professional Emergency Responders

8. Emergency Recovery Method

Following the emergency, the following tasks must be completed in detail.

a. Information to legal authorities (Refer to Clause 23.0 for Incident Reporting to PNGRB).
b. Incident examination.
c. Damage evaluation.
d. Product salvage, decontamination, clean-up, and restoration.
e. A comprehensive report shall be compiled based on the complete incident experience, including restorations, restrictions, and lessons learned.

Notes

Unit 6.2 – Fire Safety

Unit Objectives

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

- Explain the classes of fire and types of fire extinguishers.
- Demonstrate the operating procedure of the fire extinguishers.

6.2.1. Fire and its Classes

Fires can be catastrophic. Burning, hurting, and even murdering people. causing property and equipment damage. Disrupting corporate operations. Fire may take lives and destroy businesses.

Fire prevention is the most effective technique to prevent fire from affecting you or your organisation. In addition to preventing fires from starting, you should also have a plan in place for responding to flames if they occur.

There are five distinct classes of fire:

Class A: Ordinary solid combustibles, including paper, wood, fabric, and certain polymers.

Class B: Flammable liquids such as alcohol, ether, oil, gasoline, and grease that should be smothered.

Class C: Electrical equipment, appliances, and wiring where applying a nonconductive extinguishing chemical minimise electrical shock-related injuries. Don't use water.

Class D: Certain combustible metals, including sodium and potassium. These items are not often found at the Medical Center.

Class K: Flames caused especially by cooking fat or oil.

6.2.2. 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.

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.

6.2.3. Fire Extinguisher

Fire extinguishers are portable devices used to put out small flames or minimise their damage until fire-fighters arrive. These are maintained on hand in locations such as fire stations, buildings, workplaces, public transit, and so on. The types and quantity of extinguishers that are legally necessary for a given region are determined by the applicable safety standards.

Types of fire extinguishers are:

There are five main types of fire extinguishers:

1. Water.
2. Powder.
3. Foam.
4. Carbon Dioxide (CO2).
5. Wet chemical.

1. **Water:** Water fire extinguishers are one of the most common commercial and residential fire extinguishers on the market. They're meant to be used on class-A flames.

2. **Powder:** The L2 powder fire extinguisher is the most commonly recommended fire extinguisher in the Class D Specialist Powder category, and is designed to put out burning lithium metal fires.

3. **Foam:** Foam extinguishers are identified by a cream rectangle with the word "foam" printed on it. They're mostly water-based, but they also contain a foaming component that provides a quick knock-down and blanketing effect on flames. It suffocates the flames and seals the vapours, preventing re-ignition.

4. **Carbon Dioxide (CO2):** Class B and electrical fires are extinguished with carbon dioxide extinguishers, which suffocate the flames by removing oxygen from the air. They are particularly beneficial for workplaces and workshops where electrical fires may occur since, unlike conventional extinguishers, they do not leave any toxins behind and hence minimize equipment damage.

5. **Wet Chemical:** Wet chemical extinguishers are designed to put out fires that are classified as class F. They are successful because they can put out extremely high-temperature fires, such as those caused by cooking oils and fats.

Notes

Unit 6.3 – Safety Measures at Workplace

Unit Objectives

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

- Explain the importance of housekeeping works.
- Demonstrate safe housekeeping practices.
- Explain the importance of participation of workers in safety drills.
- Explain the purpose and importance of vertigo test at construction site.
- List out basic medical tests required for working at construction site.
- Demonstrate vertigo test.
- Demonstrate different methods involved in providing First aid to the affected person
- Demonstrate safe waste disposal practices followed at construction site.
- Explain different types of waste at construction sites and their disposal method.

6.3.1. Safety, Health and Environment at Work Place

The Indian Constitution gives explicit standards for people's rights and the Directive Principles of State Policy, which offer a framework for the acts of the government. The government is dedicated to regulating all economic activities for the management of safety and health risks at workplaces and to implementing steps to provide safe and healthy working conditions for every man and woman in the country. This commitment is supported by both these Directive Principles and international instruments. The government recognises that worker health and safety contribute to both economic growth and worker output.

6.3.2. Good Housekeeping

Good housekeeping on construction sites refers to the practice of keeping your site clean and tidy. After all, construction work is messy, and cleaning up now will only result in more mess later.

A clean work environment reduces the likelihood of accidents and improves fire safety. There are fewer things to trip you up if there are no materials, waste, or discarded tools.

Following are some housekeeping rules for a clean site. Implement these, and you should see a decrease in slip and fall accidents and near misses among your employees.

1. Make a separate area for trash and waste.

Make a waste disposal area. After all, if you want your workspace to be free of waste materials, you'll need a place to store them. Depending on the amount of waste, this could be a skip or another waste disposal bin. Segregating waste types for reuse, recycling, or landfill is a best practice solution.

2. Safely stack and store materials.

Poorly stacked materials can obstruct access routes or topple over, resulting in crushing injuries or property damage. You will need materials and tools throughout your project; store them safely to avoid them becoming hazardous.

3. Maintain a safe working environment.

On a construction site, your job will almost certainly generate daily waste. Whether it's packaging, demolition, or leftovers. Check and clean up your work area regularly throughout the day. If trip hazards and clutter are beginning to accumulate, address them as soon as possible.

4. Maintain clear access routes.

A safe working environment includes access and egress. It is how you arrive at work and how you leave. Leave no materials/tools/benches in gangways/corridors where they could obstruct someone's escape or cause a trip hazard (it might be you or a colleague who needs to get out in a hurry).

5. Place tools at designated place after use.

Put away tools and equipment after you've finished using them. It's easy to leave items lying around, but if you won't need them again soon, store them. If it's not in use, it should be out of sight, or at the very least out of your way!

It is not your responsibility simply because it is not yours. If you see anything lying on the floor, stairwell, or passageway that could cause people to trip and fall, pick it up and put it somewhere safe - don't wait for someone else to move it; the next person could be the one who gets hurt.

6. If something is broken, fix it.

Fix it or get rid of it. Good housekeeping also entails keeping things in working order on-site. Damaged tools or equipment must be removed from service so that they can be repaired or replaced.

7. Avoid tripping over cables.

Equipment trailing leads and cables are common trip hazards, especially when using portable equipment. You may not have a socket nearby, but make sure the lead is routed away from walkways or access routes. Cables should be routed so that they do not present a tripping hazard to you or others.

8. Avoid fire hazards.

Make sure that waste or material storage does not accumulate in fire escapes, as you may need to use these escapes at some point. Clearing up and removing waste is also a good way to keep fires at bay on the job site. Because fire requires fuel, do not store waste materials near sources of ignition. If all garbage is collected on a regular basis and placed in a skip, the danger is contained and more easily dealt with in the event of a fire.

9. Inform others.

Everyone must work together to keep the workplace clean. Use our free good housekeeping toolbox talk to raise awareness on your site. If everyone follows the same good housekeeping routines, you will be well on your way to a clean and safe site for everyone.

6.3.3. Safety Drills at Construction Site

Construction is a hazardous field in which employees must become proficient. Fortunately, safety training can reduce workplace injuries while informing employees of necessary precautions to take. Here are five types of construction industry safety training you should be aware of.

Safety in Excavation and Trenching

Training on excavation and trenching safety emphasises the dangers associated with working in excavation sites and confined spaces. The training enables workers to navigate these areas safely in order to prevent falls and fatalities. In addition, the programme emphasises preplanning and protective systems (which fall under OSHA-compliant safety material). Workers will be educated on the various excavation methods and techniques in order to perform their duties safely.

Fall Prevention and Safety Measures

Fall prevention and protection training is another type of safety training that all construction workers must receive. Falls are one of the leading causes of death in the industry; therefore, it is essential that workers protect themselves. Fall prevention programmes illustrate fall protection principles, fall arrest system components, and fall hazard recognition. Moreover, demonstrations familiarise workers with fall protection equipment.

Hazard Communication

On a daily basis, construction workers are exposed to hazardous materials and chemicals at their work sites. A worker's health and safety may be compromised by repeated exposure to such substances. Training on hazard communication includes the numerous types of chemicals used in the workplace as well as methods for minimising worker exposure. In addition, employees are taught how to read material safety data sheets and identify product labels.

Crane Hazards Management

Cranes pose a distinct hazard in the construction industry because of the diverse causes of these injuries. For instance, improper placement of loads, contact with overhead electricity lines, and structural failures can result in injuries and fatalities. Nevertheless, crane hazard management develops a grasp of OSHA compliance rules, which enhances job site safety and decreases the likelihood of employee accident.

Construction Industry OSHA Course

OSHA courses for the construction sector equip novice and seasoned workers with a general understanding of diverse construction sites. In addition to an introduction to OSHA, employees will receive training on issues including material handling, ergonomics, access into restricted spaces, and site-specific policies. This course is designed to cover industry-wide themes and handle safety issues.

6.3.4 Medical Examination for Construction Workers

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

The type of medical examination varies according to an employee's job description or the nature of the industrial process in which he is involved. For instance, if an employee works in the food business, their hands are routinely inspected for skin disorders. If someone is involved in a hazardous manufacturing process, chest X-rays may be part of the medical checkup.

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

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

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

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

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

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

List of Recommended Medical Tests under the Factories Act:

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

6.3.5. 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.

Diagnostic Procedures Typically Employed for Vertigo

Following a discussion of your symptoms, a review of your medical history, and a general physical examination, your physician may recommend one or more of the following tests:

Dix-Hallpike Maneuver

If your doctor suspects you have benign paroxysmal positional vertigo (BPPV), the most frequent type of vertigo, he or she may employ the Dix-Hallpike manoeuvre. This procedure can also assist your doctor in determining if your vertigo is caused by an inner ear disorder or something in your head.

The physician will rotate your head 45 degrees to one side. Then, you will immediately lie on your back with your head off the edge of the table for at least 30 seconds. Your physician will examine your eyes and inquire whether you feel dizzy. The process is repeated on the opposite side.

You should be aware that this examination could induce vertigo. If you experience symptoms during this examination, your physician will conclude that you have vertigo.

Head Impulse Test

The head impulse test examines the coordination between your eyes and inner ears. It is frequently utilised when vestibular neuritis is suspected. Your doctor will quickly twist your head to search for rapid eye movements and reflexes that may indicate a problem with the semicircular canals of the inner ear.

Romberg Test

The Romberg test requires that you stand with your feet together. You will then close your eyes. Your doctor will evaluate the degree to which you wobble or fall to establish the cause of your vertigo.

Fukuda-Unterberger Test

The Fukuda-Unterberger test consists of a blindfolded march. To determine which side of your body is afflicted by vertigo, your doctor will evaluate how your body deviates from the midline.

Electronystagmography (ENG) or Videonystagmography (VNG)

Electronystagmography (ENG) and Videonystagmography (VNG) are used to identify aberrant eye movements and assess if vertigo symptoms are caused by an inner ear condition.

ENG employs electrodes and VNG uses small cameras to monitor eye movements while the head is put in various postures or while the subject is requested to track specific visual targets. Air or water may also be utilised to regulate the temperature of the ear canal. Typically administered in a dark setting, these examinations may induce jerking eye movements.

Rotation Test

To determine how well the eyes and inner ear work together, rotation tests are administered. Eye movements are analysed while the head is slowly moved from side to side. Different types of rotation tests exist. You may be required to sit in a chair that swivels or to look at a stationary target while moving your head back and forth or up and down.

6.3.6. First Aid

First aid is the treatment or care given to someone who has sustained an injury or disease until more advanced care can be obtained or the person recovers.

The aim of first aid is to:

- Preserve life
- Prevent the worsening of a sickness or injury
- If at all possible, relieve pain
- Encourage recovery
- Keep the unconscious safe.

First aid can help to lessen the severity of an injury or disease, and in some situations, it can even save a person's life.

Need for First Aid at the Workplace

In the workplace, first aid refers to providing immediate care and life support to persons who have been injured or become unwell at work.

Many times, first aid can help to lessen the severity of an accident or disease.

It can also help an injured or sick person relax. In life-or-death situations, prompt and appropriate first aid can make all the difference.

Treating Minor Cuts and Scrapes

Steps to keep cuts clean and prevent infections and scars:

- **Wash Hands:** Wash hands first with soap and water to avoid introducing bacteria into the cut and causing an infection. One should use the hand sanitiser if one is on the go.
- **Stop the bleeding:** Using a gauze pad or a clean towel, apply pressure to the wound. For a few minutes, keep the pressure on.
- **Clean Wounds:** Once the bleeding has stopped, clean the wound by rinsing it under cool running water or using a saline wound wash. Use soap and a moist washcloth to clean the area around the wound. Soap should not be used on the cut since it may irritate the skin. Also, avoid using hydrogen peroxide or iodine, as these may aggravate the wound.
- **Remove Dirt:** Remove any dirt or debris from the area. Pick out any dirt, gravel, glass, or other material in the cut with a pair of tweezers cleaned with alcohol.

6.3.7. Waste Management

The disorderly nature of construction sites can make it difficult for workers to remain productive. By applying waste management methods from the outset of the project, one will aid in maintaining order and keeping everyone focused on their jobs.

- **Avoid Accidents:** To prevent accidents, the workers must ensure that waste and debris are properly disposed of. Ensure that they are aware of which objects are hazardous in the event of a fire or an object being thrown into machinery.
- **Reduce Cost:** Managing garbage on-site can assist decrease costs by minimising the cost of removal, in addition to improving safety.
- **Maintain a wholesome working atmosphere:** To maintain a healthy building site, workers will need a variety of equipment and supplies, such as wheelbarrows for transporting dirt and pallets for storing bricks and other heavy items. Ensure that there are always sufficient rubbish bins available so that the workers may dispose of the trash without difficulty.
- **Keeping Material Records:** All building materials must be accounted for at all times to prevent their accidental disposal. This contributes to cost control and time management. If using Reo mesh for wall stability, one would not want to waste such a valuable resource. This occurs frequently on construction sites and may be controlled with simple procedures. This can be as easy as choosing various colours for waste piles or maintaining a log. Materials that are no longer required should never be discarded until they have reached the end of their functional life on the site; in other words, until nothing can be salvaged from them.
- **Environmentally Responsible:** Waste management is also essential since it ensures the environmental friendliness of a project. If garbage is not disposed of in an environmentally responsible manner, it can negatively impact the local ecology and nearby places by contaminating streams and contributing to air pollution.

Waste and Debris Management on the 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.

Exercise

1. Name the types of fire extinguishers.
2. Explain PPE in brief.
3. Explain importance of workplace safety at construction site.
4. What do you understand by good housekeeping?
5. Why is safety drills at construction site importance?

Notes

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7. Employability Skills (30 Hours)

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Employability skills can be defined as those soft skills which employers look for in a potential employee. These skills equip the employees to carry out their role to the best of their ability and client satisfaction. For example, the ability to explain what you mean in a clear and concise way through written and spoken means, helps to build a better relationship with the client or the customer. Similarly, handling stress that comes with deadlines for finishing work and ensuring that you meet the deadlines can be done through effective self-management training. It can also be done by working well with other people from different disciplines, backgrounds, and expertise to accomplish a task or goal. In today's digital age, employers expect that the employees should be able to make use of elementary functions of information and communication technology to retrieve, access, store, produce, present and exchange information in collaborative networks via the Internet. Students need to develop entrepreneurial skills, so that they can develop necessary knowledge and skills to start their own business, thus becoming job creators rather than job seekers. Potential employees need to develop green skills, which are the technical skills, knowledge, values and attitudes needed in the workforce to develop and support sustainable social, economic and environmental outcomes in business, industry and the community. Thus, students are expected to acquire a range of skills so that you can meet the skill demands of the organisation that you would work for or to set up and run your own business.

This chapter is about employability skills, Constitutional values, becoming a professional in the 21st Century, digital, financial, and legal literacy, diversity and Inclusion, English and communication skills, customer service, entrepreneurship, and apprenticeship, getting ready for jobs and career development.

The scope covers the following :

- Introduction to Employability Skills
- Constitutional values – Citizenship
- Becoming a Professional in the 21st Century
- Basic English Skills
- Career Development & Goal Se ng
- Communication Skills
- Diversity & Inclusion
- Financial and Legal Literacy
- Essential Digital Skills
- Entrepreneurship
- Customer Service
- Gettng ready for Apprenticeship & Jobs

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8. Demonstrate Varnishing and Polishing (Option 1)

Unit 8.1 Varnishing and Polishing on Wooden Surfaces

CON/N0504

Unit 8.1 Varnishing and Polishing on Wooden Surfaces

Unit Objectives

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

- List different types of varnishes, polishes pigments and mixtures used in wood polishing.
- Explain surface preparation method adopted for wooden surfaces.
- Explain the ratio and proportion of paint and painting additives used for preparation of paint.
- Describe the method used for adjusting viscosity of paint mix.
- Describe the method of application of primer.
- List the various adhesives used in binding coats of paint such as oil, turpentine, mildew remover or other preparations.
- Describe the standard procedure used for effective mixing and dilution of paints.
- List various tools and equipment used in painting such as brushes, rollers, painting bucket, stirrers, scrapers, sand papers, putty blades and other painting tools.
- Explain methodology involved in application of different types of varnishing and polishing of doors, window partitions and other wooden surfaces.
- Explain the importance of applying bleaching agents on wood surface.
- Describe the application of finishes, varnishes, putty, primer, sealants, toners, and other relevant finishing materials.
- Select different types of tools and equipment required for varnishing and polishing of wooden surfaces.
- Demonstrate preparation of wooden surface using standard surface preparation methods prior to painting.
- Select appropriate finishing ingredients such as paint, stain, lacquer, shellac, or varnish as per specification/instructions.
- Demonstrate mixing of paint and additives following standard procedures as per specification/ instructions.
- Demonstrate application of primer coat to the finished wooden surface as per instructions.
- Demonstrate sanding of surface using appropriate tools as per instructions, for application of next coat.
- Demonstrate application of main coat and final coat on wood surfaces as per required finish and specification.

8.1.1. Wooden Surfaces

Wood is valuable for both structural and decorative applications. Wood has origins in plants. Timber refers to the timber used for building construction. Forests provide a tremendous amount of timber. Wood is composed of cellulose, hemicellulose, lignin, and other compounds. Woods contain aliphatic chemicals, phenols, lipids, waxes, terpenes, terpenoids, etc. Woods contain stilbenes, tannins, flavonoids, and lignanas as phenolic chemicals.

Wooden surfaces are made of the following types of wood:

1. Hardwood
2. Softwood
3. Heartwood
4. Sapwood
5. Springwood
6. Summerwood.

Painting on Wooden Surfaces

When applying paint to wooden surfaces, the primary goal is to provide a smooth protective cover of the desired colour while also improving the aesthetic appearance of the wood structure. A painting of high quality makes the woodwork more durable, more decorative with a smooth finish, and free from the formation of bacteria and fungus, both of which are unhygienic and give the appearance of being ugly.

There are numerous kinds of paints available on the market that can be used to create an opaque coating. Enamel paints, on the other hand, are extremely popular due to the superior surface finish and durability that they offer.

8.1.2. Surface Preparation of Wooden Surfaces

The wooden surfaces are prepared to receive an application of paint. The surface that is going to receive the paint should be smooth, free of surface imperfections, and thoroughly clean of any dust and dirt that may be present. The following are the essential details that must be kept in mind:

A. Concerns of a General Nature: Across the Entire Surface

i. For new wood surface: If the wood is going to be used for a new wood surface, it needs to be properly aged, dried, and cleaned of any scales, smoke, or grease.

- To achieve a smooth finish, the entire surface must be sandpapered in the direction of the grains.

- Cracking, peeling, and a brown discoloration in the wood are all caused by knots in the wood that excrete resin. They will receive appropriate treatment by:

  – Lime knotting involves applying a coat of hot lime, letting it sit for 24 hours, and then scraping the surface. The next step is to apply a primer of red lead, followed by one coat of hot glue, and finally one coat of knotting varnish. Appropriate for use with deodar as well as other types of resinous wood.

  Or

  – For knotting of an ordinary size, apply a first primer coat of red lead and hot glue. Once this coat has dried, apply a second coat of red lead grounded in oil and thinned with boiled oil and turpentine.

  Or

  – To complete the patent knotting technique, apply two coats of varnish made from 250 grammes of pure shellac, one litre of methylated spirit, and 25 grammes of red lead.

ii. For old wood surfaces: If the old paint is still sound and firm and its removal is considered to be unnecessary, the surface must be rubbed down with sandpaper to remove all dust and loose paint after it has been cleaned of all smoke and grease. This should be done after the surface has been thoroughly cleaned of all smoke and grease. In the event that it is necessary, grease should be removed by first washing with lime or washing soda and then rinsing with water.

If the old surface is severely blistered or flaked, it should be removed entirely using a sharp glass piece or stripping knife, sand paper, and either:

  – **Patent paint remover:** Remover solution is applied with a brush, and once the paint film lifts and wrinkles, it is scraped thoroughly. After the paint has been removed, the surface must then be washed down with turpentine.

  Or

  – **Caustic soda solution:** A solution of caustic soda would consist of 1 part soda and 48 parts water. The soda solution is painted on with a brush, and once the paint film has been lifted and wrinkled, it is thoroughly scrapped. After the substance has been removed, the surface should be washed with several fresh changes of clean water, and the final rinses should include a small amount of acetic acid or vinegar.

  Or

  – **Blowlamp:** A flame is moved over the paint coating in order to soften it without charring the paint or the background. This is accomplished by moving the flame just the right amount. Using a scraping knife or a piece of glass, the paint is completely removed after it has been softened. On a vertical surface, the burning off process should proceed from the bottom up towards the top. Blowlamps are not allowed to be used on surfaces that are too narrow, have been carved or undercut, or where there is a risk of damaging the material that is adjacent.

B. Special Attention:

- Any surface flaws must be smoothed out by applying wood filler with a putty knife or a muslin cloth pad in a circular motion and applying enough pressure to force the filler into the pores of the material. This must be done before the next step. It is necessary to remove the excess filler using strokes that follow the grain pattern.

- Allow the wood filler to dry for at least two to three hours before sanding it and applying additional coats.

8.1.3. Primer Coating on Wooden Surfaces

Primer Coating is used to seal wood's pores and establish adherence between the paint coat and surface. It makes the surface smoother, less absorbent, and boosts the paint's spreading capacity. It shall not contain turpentine, as it reduces the paint's hardness. Primers must be manufactured on-site, or approved brand/manufacturer-approved paint must be used.

- **First Priming Coat:** After preparing the surface and thoroughly drying the wood, the first priming coat must be applied.

- **Stopping & Filling:** After the priming coat has been applied, the holes and indentations on the surface must be filled using glazier's putty (1 part white lead + 3 parts fine powdered chalk + boiling linseed oil to produce a firm paste) or a putty of a reputable brand. Stopping shall not be used prior to the application of the priming coat, as the wood will absorb the oil in the stopping and cause it to fracture.

- **Second Primer Coat:** Since painting directly on putty results in a patchy look, the second priming coat is used to sandwich putty between two primer coats.

8.1.4. Wood Filler and Wood Putty

A. **Wood Filler:** Wood filler consists of wood particles, such as sawdust, plus a hardening binder. The binder is composed of either water or petroleum. One may need to add water to a water-based filler in order to reach the correct consistency. The smoother texture of a wood filler derived from petroleum makes it easier to work with. However, petroleum-based fillers must be cleaned with a chemical solvent, whereas water-based fillers can be cleaned with soap and water.

Uses of wood filler include:

- Unfinished furniture should be repaired for dents, gouges, and gashes.
- Repair damaged wood flooring.
- Before installing unfinished trim, cover any imperfections such as scratches or cracks.

B. **Wood Putty:** Wood putty is an oil-based product including natural or synthetic additives. It is suitable for woodwork that expands and shrinks when exposed to humidity, such as in bathrooms and basements. However, wood putty will not absorb stain in the same manner as wood and will finish a different hue, making the blemish obvious. Therefore, it is suited for stained or varnished wood.

Uses of wood putty:

- Fix dents and cracks and patch minor holes in wood furniture, flooring, and interior trim.
- Patch cracks and holes in woodwork that may expand or compress as a result of exposure to moisture.

8.1.5. Application of Paint on Wooden Surfaces

A. **Preparation of Mix:** The paint mix should be made of only enamel paint of a good brand that conforms to IS Specification and is of the required colour/tone shall be used. The supplied paint must be used for painting. If necessary, mineral turpentine oil can be used to thin the paint to the degree advised by the manufacturer (between 5 and 10 percent).

B. **Paint Coats:** Generally, one coat is sufficient for previous work, and two coats (excluding the primer coat) are required for new work to get the desired finish and colour. If the previous paint colour is much darker than the new colour, a second coat of paint is advised.

C. Procedure of Paint Application:

- Paint must be applied using an appropriate paintbrush. The paint shall be applied uniformly and smoothly by crossing and laying off, the latter in the direction of the wood's grain. Crossing and laying off entails coating the area with paint, vigorously brushing the surface twice or three times in different directions, and then lightly brushing in a direction perpendicular to the grain. In this technique, there shall be no brush marks remaining when the laying off is complete. One coat will encompass the entire process of crossing and laying off.

- Subsequent coatings shall not be applied until the prior coat has completely dried. Before applying the second coat, the previous coat must be lightly sanded with sandpaper and cleared of dust.

- The surface finish must be smooth and homogeneous, with no brush marks.

8.1.6. Viscosity

In an oversimplified sense, viscosity is the thickness of a fluid. The viscosity of a liquid will alter as its temperature changes. This is a basic idea for the application of industrial coatings. Consider a freshly-made milkshake to illustrate this concept. Consider how much simpler it is to consume this milkshake after it has melted for one minute. However, why? At no other time in its existence will it be as cold or as dense as it is at the time of its conception. Temperature and viscosity are inextricably linked, as fluid mechanics teaches us. When a liquid cools, its viscosity increases. As the milkshake warms or melts, its consistency begins to decrease, making it easier to draw through the straw.

Viscosity's Effect on Coatings

Coatings are fluids subject to the same scientific principles as milkshakes. As coatings are heated, their viscosity naturally decreases. When coatings are cold, however, they are thick or highly viscous. This concept explains why materials held overnight at a construction site during cold-weather months may be more difficult to apply in the morning until they thaw. It may be difficult for the applicator to move the paint through their equipment, even to the point of starving the tip, resulting in an incomplete or, worse, nonexistent fan design.

On the other hand, a material with a higher temperature may offer some application benefits. Applying coatings with a lower viscosity results in lower spray pressures, improved atomizing properties, and an improved final appearance. Thinner is often utilised in coatings for all of these reasons and more. Due to the impact of temperature on viscosity, recommendations for thinner are supplied in ranges. For example, an applicator in Texas during the summer may not require as much thinner as a Canadian using the same coating at the same time.

Utilizing Heat to Reduce Coating Viscosity

When thinning is inappropriate, it is usual to practise for applicators to use heat to lessen the material's viscosity. If cold materials are being applied with negative consequences, heat may be the remedy. Remember that heat can be your ally by boosting the workability of a coating, but it can also substantially reduce the pot life. The use of heat in this manner can be a useful tool, but as with other tools, it must be utilised properly.

\If heat is utilised to reduce the material's viscosity, numerous things must be considered. First, viscosity is not the only coating property impacted by heat. Additionally, pot life can be dramatically affected. In a single-leg application, heat should not be utilised to reduce the viscosity of a substance with a short pot life. In contrast, practically all multicomponent spraying processes involve the application of heat to increase the coatings' viscosity. This change in viscosity makes the product sprayable and gives it an aesthetically pleasing finish.

Refer to topic 4.2.5 to understand about types of Viscosity Measuring Instruments.

8.1.7. Types of Wood Polish and Finishes for Wooden Surfaces

Even while paint and varnish are necessary for enhancing the endurance of wooden objects, it is essential to complete their ornamentation with a wood polish that protects the coating and imparts a long-lasting sheen.

- **Surface wood finish:** This polish does not penetrate the wood's interior. However, it leaves behind a dense, hard, and sturdy covering on the wood's surface. Consequently, harmful or detrimental substances and moisture will not touch the timber surface directly. This buffering layer may also include lacquer, wax, varnish, polyurethane, and shellac, among other substances.

- **Penetrating timber finish:** An oil-based chemical penetrates deep within the wood's surface and structure. In addition to linseed and tung oil, the penetrating wood polishes also contain flaxseed oil. These oils may also permeate the timber floor and harden it. The application of these penetrating finishes is simple and convenient.

Wood Polish Types

The following are the most popular types of wood polishes now in demand in both residential and commercial settings. The characteristics or benefits of these wood polishes are listed below so that you may apply them appropriately.

a. Water-soluble Wood Polish

The water-based wood polish and finish can be utilised on unique sorts of wood surfaces. These include painted, bare, and stained surfaces. The finish no longer requires a yellow hue with time, as the oil-based polish or finish does. This finish, which offers beautiful wood products, handicrafts, and articles a sophisticated look that does not degrade over time, can be applied to them. Because the water-based oil wood finish may also leave brush marks, it should only be applied by skilled wood polishers. Additionally, the durability of the finish is uncertain.

b. Lacquer Wood Polish

As one of the outstanding varieties of wood polish, lacquer wood polish is also an all-purpose polish. The coating provides more floor protection and also dries more quickly. It can also increase the wood's durability and give it a luxurious appearance. A lacquer wooden finish is also simple to remove, and a new wood polish and finish can be applied to the wood floor whenever desired. The lacquer finish dries quickly; hence, spraying may also be a viable application method. The end is extremely sensitive to heat, so the possibility of a fire exists. Additionally, some lacquer finishes may release vapours.

c. Polyurethane Polish

The polyurethane wood polish (PU polish) is great for kitchen cabinets, cupboards, doors, windows, and practically all types of furniture and flooring. This is the case due to its waterproof qualities. Additionally, the PU varnish is robust and greatly impacts the longevity of your wooden products. Sold in distinct varieties, you can use the polyurethane wooden polishes comprising sheen, gloss, shine, and even the satin and natural aesthetics and look to the wood.

The 2K Polyurethane varnish is resistant to water, dampness, and UV light. In contrast to other polishes, 2K PU polish will not become yellow in the presence of sunshine following exposure. This is the most effective polish for outdoor furniture.

d. Varnish Polish

Varnish with the warmest wood finish can be applied to stained and unfinished wood. Additionally, the long-lasting finish comes in a variety of unique sheen types. Before applying any varnish or wood polish, the surface must be thoroughly cleaned. When applied to a damp surface, varnish has the potential to damage it further. Therefore, caution is recommended.

e. Shellac Polish

The shellac finish can dry without issue and in significantly less time and provides a tough finish. In addition to being a stain remover and sealer, it is suitable for use on both drywall and cured plaster. Because finishes are available in a variety of hues, it is also possible to refinish furniture or wooden objects to make them more suitable for interior design. French polish is among the most popular uses for wood polish and finishing cloth. It consists of a combination of mineral spirit and shellac.

The inability of the shellac end to resist moisture is one of its disadvantages. Therefore, using this finish on outdoor furniture and other wooden objects is no longer recommended.

f. Oil-based or penetrating wood polish

The furnishings of the living room and other homes/businesses, as well as wooden handicrafts, may demand a satin-like appearance and finish. The oil-based or penetrating finish may also contribute to its lustre, sheen, and sophistication. The polish/finish also can cover the nicks and scratches and may be applied effortlessly. It is necessary to wear eye protection when applying oil-based wood polish. The end can also dry up slowly, which may be inconvenient in some instances.

g. Wax based Wood Polish

Wax coatings for wooden surfaces are available in both paste and liquid forms. They can be acquired from various plants, minerals, and animal sources. In addition to protecting the wood from moisture and other damaging elements, the surface end may also prolong and enhance the wood's life. Before application, the wax may additionally require diluting in oil or water (as per instructions). As demonstrated, specialised wood polishes offer unique advantages and can be adapted to diverse applications. Choose the proper wood polish or finish to ensure the quality of your work. And to protect the wood surface from a variety of hazardous and damaging agents.

8.1.8. Varnish

Varnish is a resin-based solution applied to wooden surfaces to give a protective, transparent, and durable layer. The majority of varnishes consist of resin, driers, and solvents. Varnish application to surfaces is referred to as varnishing.

Varnish is exclusively applied to wooden surfaces. Varnish is essential for finishing the wooden surfaces of doors, windows, floors, and other items. This page discusses the various types of the varnish used on wood.

Purpose of Varnish

- It provides the painted surface brightness.
- It shields the surface from damaging atmospheric influences.
- It boosts the paint coating's longevity.
- It beautifies the hardwood surface without concealing the wood's unique textures.

Requirements of a Good Varnish

- Following the curing, the varnish shouldn't contract or crack.
- The thin varnish coating must be strong and lasting.
- The varnish must dry quickly.
- It ought to render the surface shiny.
- It should impart a uniform hue and an attractive aspect to the finished surface.
- It should not conceal the wood's original grains.
- When the finished surface is exposed to the atmosphere, the natural colour of the varnish should not fade.
- The varnish should be durable.

Types of Varnish

Varnish can come in a variety of types, depending on the solvent used to make it:

1. **Oil Varnish**: Hard resins, such as amber and copal, are dissolved in linseed oil to form these types of varnish. Small amounts of turpentine can also be used to thin the varnish and make it workable. Oil varnishes dry slowly and create a durable, hard layer on the surface.

2. **Spirit Varnish:** This type of varnish is created by dissolving resins such as shellac or lac in methylated spirit. A suitable pigment can be added to the varnished surface to achieve the desired hue. Spirit varnish dries rapidly and is susceptible to the effects of weathering. It is typically used for wooden furniture.

3. **Turpentine Varnish:** In turpentine, gum dammer, mastic, and rosin-like resins are dissolved to create this form of varnish. These varnishes are transparent and quick-drying. However, turpentine varnishes are softer and less durable than oil varnishes.

4. **Asphalt Varnish:** This form of varnish is created by dissolving asphalt in linseed oil. Occasionally, the appropriate amount of turpentine or petroleum spirit is added to thin this varnish. Typically, asphalt varnish is utilised to varnish iron and steel goods.

5. **Water Varnish:** This varnish is made by dissolving shellac in boiling water. Shellac is not easily soluble in water. To facilitate rapid dissolution, ammonia, potash, soda, or borax are added to water. These varnishes are used for painting portraits, posters, and maps.

6. **Flat Varnish:** It is an ordinary sort of varnish. This varnish contains materials such as wax, finely divided silica, and metallic soaps to minimise the glossiness of the varnished surface. Typically, it imparts a dreary aspect to the surface.

7. **Spar Varnish:** This varnish is typically applied to spars and other exposed ship elements. Extremely weather-resistant flat varnish is unsuitable for interior application.

8.1.9. Process of Varnishing

The following is the procedure for varnishing wooden surfaces:

1. **Preparing the Surface:** The surface must be carefully smoothed and cleaned of dirt and dust using sandpaper.

2. **Knotting:** All knots should be coated with a hot mixture of lead and glue.

3. **Stopping:** Following knotting, the wooded surface is ended. This is achieved with a hot, weak adhesive. This coating fills the surface's pores. One kilogramme of glue typically yields ten litres of glue. If glue is unavailable, two layers of boiling linseed oil may be used as a substitute. After pausing when the surface gets dry, sandpaper is applied again.

4. **Applying Varnish:** When the stopping process is complete, it is time to add extremely thin coats of varnish to the surface. Use a varnishing brush with fine hair to apply varnish. After the first coat has dried, the second coat should be applied. Thus concludes the discussion of varnish types and their application procedures. I hope you have sufficient knowledge about it now. If you have any questions, please post them here.

Varnishing Doors/Windows

The steps for varnishing doors are as follows:

- **Remove Door Hardware & Prepare the Area:** Protect the ground from any stray varnish by laying down a tarp or laminated dustsheet. Keep the windows open for ventilation purposes. Unscrew and remove the door/window handles, hooks, and other hardware with a screwdriver.

- **Sand Door:** For optimal results, the door/ window should be stripped down to its bare wood or as close as possible to it. Any paint or varnish flaking must be removed. If there are any deep scratches, holes, or missing moulding, fill them with a matching-colour plastic wood filler. Then, using fine sandpaper and working with the wood grain, smooth the surface.

- **Clean Door:** Wipe the door/window with a damp cloth and let it dry completely.

- **Plan Varnish Application:** It is sufficient to begin varnishing at the top and work your way down on a flush door.

- **Apply Varnish:** Wearing protective gloves, evenly apply the first coat of varnish with a paintbrush. Allow each coat to dry, then rub the door with fine sandpaper between coats to remove any varnish bubbles or rough spots. This will also aid the adhesion of the subsequent coat. Before applying the next coat, wipe away dust with a damp cloth and allow it to dry. Depending on the desired finish, two to three layers of varnish should be sufficient.

- **Reattach Hardware:** Reattach the door handles and other hardware after the varnish has dried completely.

8.1.10. Sanding

Sanding is performed to create a smooth surface and improve the appearance of wood. Sanding can be time-consuming, but every project benefits from the process. Sanding is the process of removing small amounts of wood's surface material with an abrasive. The sanding of woodwork can be done by hands or power tools.

Steps for Sanding Woodwork are:

- Prepare your workspace and wear dust protection while sanding.
- Select various sandpaper grits. I typically use sandpaper with 80, 120, and 220 grit.
- Beginning with a coarse sandpaper grit, such as 80 grit, sand the wood. This will require the most time and remove the most material.
- Use sandpaper with a medium grit, such as 120 or 150 grit, to begin smoothing the wood's surface.
- Using finer grit sandpaper, such as 220 grit, sand the wood until it is touchably smooth.
- Using a soft bristled brush, remove sawdust from the wood by sweeping off the majority of the sawdust. Then, wipe the surface with a tack or damp cloth.

Sanding between Finish Coats

The majority of skilled painters apply two or even three coats of varnish or oil to a wooden surfaces. Between coats, the surfaces should be lightly sanded with silicon carbide sandpaper of 320 or 400 grit. Before applying the next coat, thoroughly clean the surfaces.

Some painters complete the best finishes by wet-sanding the final dried topcoat with silicon-carbide wet-dry sandpaper. Use mineral spirits or water as a lubricant, and thoroughly dry the surface after use. A final polishing with a non-woven synthetic pad will produce a uniformly glossy surface.

8.1.11. Bleaching Woodworks

Bleaching chemically degrades the wood's influencing oils, thereby lightening the wood or removing the colour entirely. Bleaching woodwork gives it a clean, bright appearance by lightening the wood's overall hue. Bleaching is not intended to remove stains, but it will lighten them proportionally and diminish their visual impact. Bleaching woodworks to help restore its fresh, natural appearance prior to coating or staining with a clear finish.

Methods to Bleach Woodworks

Choose a mild, moderate, or strong bleaching agent for the woodworks, such as laundry bleach, oxalic acid, or two-part bleach.

- **Laundry Bleach:** It is possible to bleach wood with laundry bleach at full strength. Laundry bleach, the mildest option, will only minimally lighten wood on the first pass, necessitating multiple applications.

- **Oxalic Acid:** Oxalic acid, an organic compound, is a powder or crystal that, when combined with hot water, produces an effective bleaching solution for wood. Oxalic acid can also be combined with a small amount of water to create a paste for removing blemishes and stains.

- **Two-Part Bleach (A/B):** Two-part bleach, also known as A/B bleach, combines sodium hydroxide and hydrogen peroxide to form a highly concentrated solution. Two-part bleaches are effective on heavily tannic woods, dark woods that require lightening, and heavily stained or damaged woods.

Equipment / Tools used for Bleaching

- Synthetic-bristle paint brush
- Latex gloves
- Paint scraper or five-in-one tool
- Oscillating sander
- Putty knife
- Cotton rags
- Plastic dropcloth
- Tack cloth
- Sponge
- Glass container
- Breathing and eye protection
- 120-grit sandpaper

Materials

- Bleaching agent (Bleach, oxalic acid, or two-part bleach)
- Natural paint stripper
- White vinegar

Steps for Bleaching Woodworks

1. Prepare the Work Site

Work only in areas with adequate ventilation. Working outside in the sun accelerates the bleaching process and helps the wood dry between coats more quickly. Place plastic under the woodworks.

2. Use PPE

Toxic substances, including paint strippers and bleaching agents, are used to bleach woodworks. Wear waterproof latex or latex-substitute gloves, eye protection, and respiratory protection.

3. Remove all Coatings and Paint from Wooden Works

Paint, stain, and other coatings prevent the bleaching agent from lightening the wood. Try removing the coatings with non-toxic, less caustic citrus- or soy-based natural paint strippers, or by scraping the wood while using a heat gun, instead of using toxic paint strippers.

4. Sand Furniture

To remove all coatings, sand the wood thoroughly with 120-grit sandpaper. Embedded stains and paints that were not eliminated by the paint stripper must be eliminated using sandpaper.

5. Eliminate Wood Dust

Using a tack cloth, wipe the furniture of wood dust.

6. Prepare Bleaching Solution

- **Laundry bleach:** Utilize laundry bleach at full strength and undiluted. Pour the liquid into a glass or plastic container, not a metal one.
- **Oxalic acid:** In a gallon of hot water, dissolve 12 ounces of oxalic acid. Dissolve 3 ounces of oxalic acid in 32 ounces of hot water for smaller quantities. Since oxalic acid clumps will lighten the wood in blotches, stir thoroughly.
- **Two-part bleaches:** In a container made of glass or plastic, combine one part sodium hydroxide (Part A) with three parts hydrogen peroxide (Part B) (Part B). Do not add water.

7. Apply Bleaching Solution

Avoid overlapping. Keep the brush in constant motion. Apply the solution uniformly to the entirety of the piece. Do not apply a greater weight to one section than to others. On vertical surfaces, work from the bottom upwards.

8. Apply Rinse

Laundry bleach and oxalic acid: Apply a solution of one part white vinegar and one part cool water using a sponge to neutralise the solution between coats.

Two-part bleaches: Between coats, rinse with cool water using a sponge.

9. Apply Multiple Coats

To achieve the desired degree of wood lightness, multiple applications of bleaching agent are interspersed with neutralizer or rinse. It may take five or more applications of laundry bleach to begin lightening wood.

10. Sand Wood

Sand one last time with 120-grit paper, then switch to sandpaper with a finer grit, such as 220 grit paper.

Avoid extensive sanding after bleaching the wood, as this will remove the bleached wood cells and expose the darker wood layers beneath.

8.1.12. Adhesives used for Binding Coats of Paint

A coating's adhesion to a substrate is strong. The paints and coatings industry relies on adhesion to keep coatings and paint films on surfaces, especially in harsh environments. Adhesion determines coating durability and quality. There are few important adhesives used for binding coats of paint are oil, turpentine, mildew remover, sanding, etc.

Refer to topic 4.1.6 for more details about these adhesives.

8.1.13. Finishing Materials

Finishing material refers to a coating applied to woodwork. Varnishes, putty, priming, sealants, toners, highlights, glazes or shades, lacquers and sealers are the materials used in woodwork painting, varnishing and polishing.

1. **Varnish:** Varnishes protect wood, paintings, and decorative objects. Varnish preserves and beautifies wood floors, panelling, trim, and furniture. The earliest varnishes were solutions of natural resins, which are the secretions of plants.

2. **Putty:** Wood putty, sometimes known as plastic wood, is a product used to fix flaws in wood prior to finishing, such as nail holes. It is frequently formed of wood dust coupled with a binder that dries and a diluent (thinner), and, sometimes, colour.

3. **Primer:** Wood primer is the undercoat of the preliminary coating that is applied to wood before painting. Utilizing a wood primer boosts the endurance of the paint job, improves the paint's adhesion to the surface, and protects the wood being painted.

4. **Sealants:** Transparent coatings, such as wood sealer, are used to prevent damage to wood surfaces. Wood sealer is a form of clear coating.

5. **Toners:** A wood toner is a transparent finish that has dye or pigment applied to it. The finish is typically lacquer, but it can also be shellac, water-based varnish, or varnish.

6. **Glazes or Shades:** Wood glazes are materials that are applied over stained or painted wood to create an aged appearance. These products are thicker than paint and have a longer working period to assist painters get the desired effect. A glaze can be put over varnish, lacquer, shellac, or water-based finishes. The exceptions include oil and oil-varnish mixtures.

7. **Lacquers:** Lacquer is a contemporary wood treatment that is frequently applied to high-end woodwork. It dries quickly, is water-resistant, and retains its transparency as it ages. Lacquer finishes are popular because they don't yellow with age, protect well against liquids, and require very little upkeep.

8.1.14. Tools and Equipment

There are various tools and equipment used in painting such as brushes, rollers, painting bucket, stirrers, scrapers, sand papers, putty blades and other painting tools. These tools are discussed in details in topic 4.1.3.

Tools for Woodworking include the following:

- Hand saws
- Power saws
- Planes
- Sanders
- Files
- Hammer
- Mallet
- Drill
- Screw Gun
- Tape Measure
- Square
- Sawhorses
- Workbench

The Tools and Equipment used for Varnishing and Polishing are:

- Rubber gloves
- Natural-bristle paintbrush
- Paint stirrer
- Paint mixing and measuring cup
- Paint thinner
- Respirator mask
- Bucket
- Rollers
- Varnish Sprayer
- Lint or Dust Pickers

Exercise

1. Name types of varnishes used for woodworks.
2. Explain surface preparation method adopted for wooden surfaces.
3. How is Primer Coating done on Wooden Surfaces?
4. Explain in brief wood filler and wood putty.
5. Give examples of wood polishes.

Annexure-2

Annexure of QR Codes for Assistant Construction Painter and Decorator

Chapter Name	Unit Name	Topic Name	URL	Page no.	QR Code
Chapter 1: Role and Responsibilities of an Assistant Construction Painter & Decorator"	Unit 1.1: Introduction to Construction Industry	Construction Industry	https://youtu.be/nndLyZrGfWc	7	Construction Industry
		Types of Construction	https://youtu.be/1WVzo2UFyo8		Types of Construction
	Unit 1.2: Role and Responsibilities of an Assistant Construction Painter & Decorator	Role and Responsibilities of an Assistant Construction Painter & Decorator	https://youtu.be/WCIgEL0Fv2E	11	Role and Responsibilities of an Assistant Construction Painter & Decorator
Chapter 2: Preparation of Basic Surface for Painting Works	Unit 2.1: Introduction to Surface Preparation	Surface Preparation	https://youtu.be/24jZ03d1jxg	27	Surface Preparation
		Purpose of Surface Preparation	https://youtu.be/0Q2fk5YrS6I		Purpose of Surface Preparation
		Types of Abrasives required for Surface Preparation	https://youtu.be/_RR-_J-n-6k		Types of Abrasives required for Surface Preparation

Chapter Name	Unit Name	Topic Name	URL	Page no.	QR Code
	Unit 2.2 Methods of Surface preparation	Surface Preparation for Masonry Work	https://youtu.be/HhydIbOdj8I	39	Surface Preparation for Masonry Work
Chapter 3: Erect and Dismantle Scaffold	Unit 3.1: Erect and Dismantle Scaffold	Scaffolding	https://youtu.be/96shGh3rfXw	54	Scaffolding
		Uses of Scaffold	https://youtu.be/5Vj-MosphpY		Uses of Scaffold
		Scaffolding Erection and Dismantle	https://youtu.be/OKawvyUhUkA		Scaffolding Erection and Dismantle
		Safety Checks	https://youtu.be/AoDWOZE8Wb4		Safety Checks

Chapter Name	Unit Name	Topic Name	URL	Page no.	QR Code
Chapter 4: Application of Paints to Different Surface	Unit 4.1: Basics of Paints	Paints	https://youtu.be/AucnsOoJPKc	76	Paints
		Types of Paints	https://youtu.be/9i1a80ZHwQ4		Types of Paints
		Tools required for Application of Paints	https://youtu.be/Je3cSDj55cg		Tools required for Application of Paints
		Adhesives used for Binding Coats of Paint	https://youtu.be/g2K6PXxtyB4		Adhesives used for Binding Coats of Paint
	Unit 4.2: Application of Paints to Different Surfaces	Process for Interior Wall Painting	https://youtu.be/-zvbiV1XBh4	91	Process for Interior Wall Painting
		Process for Exterior Wall Painting	https://youtu.be/ox8dFf_BBmA		Process for Exterior Wall Painting
		Building Finishes	https://youtu.be/9UTzIyfkAaA		Building Finishes

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