Participant Handbook

Sector

Construction Skill Development Council of India

Sub-Sector

Real Estate and Infrastructure Construction

Occupation

Construction Electrical Works

Reference ID: **CON/Q0601, Version 2.0**
NSQF Level 2

Helper Electrician

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Shri Narendra Modi
Prime Minister of India

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CONSTRUCTION SKILL DEVELOPMENT COUNCIL OF INDIA

for

SKILLING CONTENT:PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role/Qualification Pack:'Helper Electrician' QP No.'CON/Q0601, Version 2.0 NSQF Level 2'

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Authorised Signatory
(Construction Skill Development Council)

Acknowledgements

This participant's handbook meant for Helper Electrician 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 Helper Electrician. 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 Helper Electrician. 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 Helper Electrician. After studying this handbook, job holders will be adequately skilled in carrying out their duties according to the applicable quality standards. The handbook is aligned with the following National Occupational Standards (NOS) detailed in the latest and approved version of Helper Electrician QP:

- CON/N0606: Handle different tools, measuring devices and materials relevant to LV(low voltage) electrical works
- CON/N0607: Carry out wall chasing and external threading on MS(mild steel) conduit
- CON/N0101: Erect and dismantle scaffold up to 3.6 meter height
- 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

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


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Unit Objectives


Activity

Table of Contents

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

1. Introduction to Helper Electrician Job Role

Unit 1.1 - Role and Responsibilities of a Helper Electrician

Key Learning Outcomes

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

- Explain the role and responsibilities of a Helper Electrician
- Discuss the career progression options for Helper Electrician

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 specialise 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 organisations 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

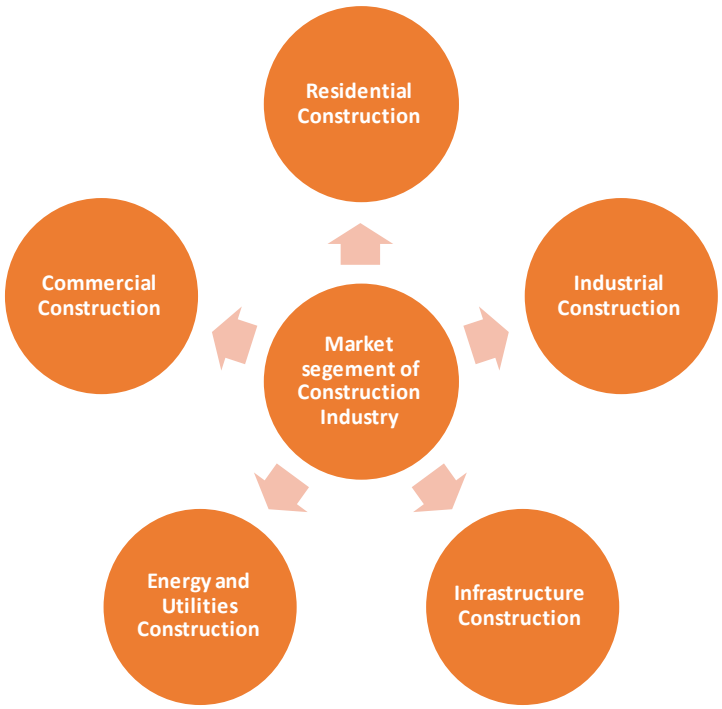


Fig. 1.1.3 Market segment of construction industry

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 a Helper Electrician

Unit Objectives

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

- Explain the roles and responsibilities of the job role of Helper Electrician.
- Define the personal attributes required in the occupation of Construction electrician works.
- Explain the possible future progression and career development options of a helper electrician.

1.2.1. Helper Electrician

A Helper Electrician assists senior electricians with the installation, repair, and maintenance of basic electrical systems. They carry out the more common activities of the electrical trade under the direction and supervision of the senior electrician. The Helper Electrician ensures that all completed work adheres to all applicable safety codes and is properly inspected.

1.2.2. Role and Responsibilities of a Helper Electrician

The job role is responsible for assisting the construction electrician and carrying out duties under close supervision.

In addition to completing preparation work prior to temporary and permanent electrical installations, the tasks also include handling the tools, devices, and materials necessary to perform electrical works.

The roles and responsibilities of a helper electrician are:

- **Electrical Installations Completion:** Assistant senior electricians work closely with their supervising electrician to complete basic electrical tasks. They instal electrical wiring, circuit breakers, and lighting fixtures, among other electrical equipment, systems, and controls.

- **Observe and Help Electrical Worker:** Electrician helpers receive guidance from experienced electricians, who rely on them to execute electrical jobs. Senior electricians will provide written or verbal directions to electrician helpers, which they will then carry out.

- **Observe Safety Procedure:** Due to the inherent dangers of the electrical trade, electrician helpers adhere to all applicable safety laws and regulations when assisting with the installation and maintenance of electrical equipment. They always wear the proper protective clothing and equipment and adhere to all job-specific safety standards.

- **Maintain Equipment and Inventory:** Senior electricians have a vast array of tools and equipment, and electrician helpers ensure that all required tools are on-site and accessible throughout the project's duration. Electrician's helpers arrange electrical components and materials and bring equipment and materials to the electrician as needed.

- **Prepare and Disinfect the Worksite:** Before the commencement of a project, electrician helpers aid in cleaning and preparing the electrician's workspace. Upon completion of a project, electricians' helpers clean and organise the workspace, removing unused supplies, dust, and dirt as necessary.

1.2.3. Personal Attributes required by a Helper Electrician

Although helper electrician helps do minor electrical installation and repair jobs under the supervision of a senior or master electrician, they also learn and use more advanced trade skills. The following competencies and qualifications are typical of a helper electrician:

- Color Vision and Depth Perception- When cutting, pulling, or installing electrical wiring, electrician helpers distinguish between different wires based on their colours. As a result, electricians' helpers can distinguish between various hues. Additionally, they have excellent depth perception and can identify and differentiate electrical elements at differing distances.
- Fine Motor Skills- A significant proportion of an electrician's assistant's duties require handling of small, difficult-to-grasp, and difficult-to-reach wires and other materials. Electrician helpers rely solely on their hands or small equipment to perform this operation.
- Clean Driving Record- electrician assistants have clean driving records and access to reliable transportation. As required, they commute to work sites and operate business cars.
- Physical Fitness- In addition to attics, basements, and rooftops, electrician assistants operate in uncomfortable and occasionally dangerous locations such as crawlspaces and basements. They frequently climb ladders and staircases and should be capable of lifting up to 50 pounds.
- Listening Skills- An electrician's helper understands and respects his or her duty as an assistant to the supervising electrician and appropriately follows directives and instructions.

1.2.4. Career Path of a Helper Electrician

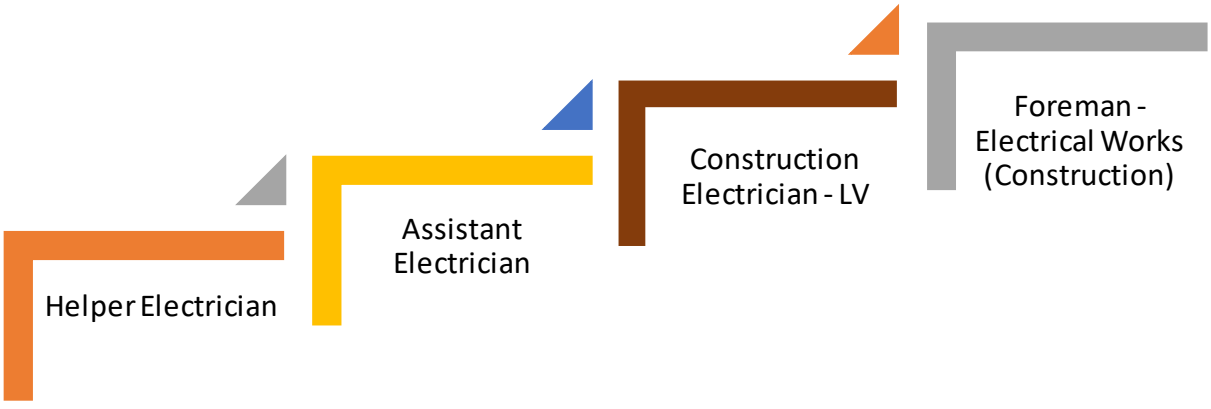


Fig. 1.2.1 Career path of a Helper Electrician

Exercise

1. Show the career path of a helper electrician.
2. What are role and responsibilities of a helper electrician?
3. State few personal attributes required by a helper electrician.
4. What are the types of construction? Name them.

Notes

Scan the QR code to watch the video

https://youtu.be/fwVndSUEeEg

Role and Responsibilities of a Helper Electrician

2. LV (Low Voltage) Electrical Works Tools, Devices and Materials Handling

Unit 2.1 Understanding Electric Current

Unit 2.2 LV Electrical Works

(CON/N0606)

Key Learning Outcomes

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

- Handle different tools, measuring devices and materials used for LV electrical work.
- Shift and stack various materials and tools used for electrical work.

Unit 2.1 Understanding Electric Current

Unit Objectives

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

- Explain basic concept of electrical current flow and factors which influence electrical flow through conductor.
- List the types of circuit breakers, starters, relays including their areas of use.

2.1.1. Electric Current

Electric current is the constant flow of charged particles in a circuit. The direction of the passage of electric current is from higher to lower electric potential. The movement of an electron in an electric current is opposite to that of the current. Below is a comparison of AC and DC current.

DC (Direct current): Here, just one direction of electric charge flow is present. Used in cell phones, torches, etc.

AC (alternating current): Unlike DC, the flow of electric charge periodically reverses direction in AC. The current supplied to offices and homes, for instance.

Fig 2.1.1 DC Voltage and AC Voltage

2.1.2. Electric Circuit

A circuit is the path along which electrons move from a voltage or current source.

Fig. 2.1.2 Electric Circuit

The location where electrons enter an electrical circuit is known as their "source." The point in an electrical circuit where electrons leave is known as the "return" or "earth ground." Because electrons always return to the source as they complete the path of an electrical circuit, the exit point is called the "return."

The portion of an electrical circuit between the electrons' starting point and the point at which they return to the source is referred to as the "load." The load of an electrical circuit can be as basic as domestic appliances such as refrigerators, televisions, and lamps, or it can be more complex, such as the load on the output of a hydroelectric power producing facility.

The two types of electrical power used in circuits are alternating current (AC) and direct current (DC) (DC). AC is typically used to power large appliances and motors and is produced by power plants. DC is used to power battery-powered cars, machines, and gadgets. Converters may switch between AC and DC. Transmission of high-voltage direct current requires large converters.

2.1.3. Parts of Electric Circuit

An electric circuit consists of four parts:

- The Energy Source
- The Conductors
- The Switch (Control Device)
- The Load

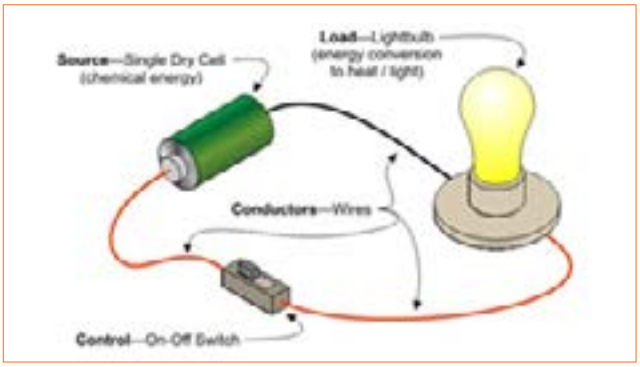


Fig. 2.1.3 Parts of an Electric Circuit

The Energy Source

In an electrical circuit, the voltage (the force that pushes electrons through a conductor — measured in volts) and current (the rate of electron movement — measured in amperes) supplied by the power source are used to energise a device connected to the circuit.

A voltage power source supplies the circuit with a consistent voltage level. Batteries, such as those in your laptop computer or car, solar panels, the alternator in your car, and the electricity from your local power plant or hydroelectric dam are examples of voltage power sources.

A current power source, also known as a constant-current source, supplies a constant current of energy independent of its voltage. Typically, constant-current circuits are incorporated into a system to protect the device supplying the circuit's electrical load. For instance, an LED requires a steady current level to prevent it from burning out or becoming damaged.

The Conductor

In an electrically powered environment with common electrical equipment, the conductor is the wire in a home or device that supplies the path of the circuit along which energy travels. The conductor (conduction) system connects all the other circuit components.

The flow of electricity is comparable to the flow of water through a pipe or hose. The conductor functions as the conduit through which electrical energy passes from its source to its load and occasionally back again. And, similar to the flow of water via a hose, the quantity of energy required on the circuit (as demanded by the load device) defines the gauge of the conductor wire.

The Switch

The switch offers the control that either shuts (continues) or opens (breaks) the circuit's electrical current flow. There are numerous types of circuit switches, such as wall switches, push buttons, key toggles, and numerous biometric devices.

A closed circuit switch may feature either continuous or transitory contact. A sustained contact, such as a light switch, maintains the circuit in a state that permits a continuous energy flow. A transitory or momentary contact only supplies electricity to a circuit while a button or similar device is pressed or engaged. The circuit is reopened when the button is released.

The Load

Any device connected to an electrical circuit that is energised by the passage of electricity to it constitutes the circuit's electrical load. The load is the quantity of electrical energy a device requires to perform its function. This electrical consumption is measured in watts, which is equal to the circuit's current (amps) multiplied by its voltage (volts). Lights, televisions, motors, and heaters are load devices that consume electricity.

2.1.4. Passive Circuit Elements

Passive Elements are elements that have the ability to regulate the flow of electrons through them. The voltage is either increased or decreased. Here are some instances of passive elements.

- A resistor opposes the flow of electrical current through it. Ohm's law applies to linear circuits, which asserts that the voltage across a resistor is directly proportional to the current flowing through it, with the resistance serving as the proportional constant.
- An inductor stores electrical energy in the form of an electromagnetic field. The voltage across an inductor is proportional to its current's rate of change.
- A capacitor stores electrical energy in the form of an electrostatic field. A capacitor's voltage is proportional to its charge.

2.1.5. Types of Electric Circuit

There are three types of electric circuits:

Series Circuit

A series circuit contains only one path for the flow of electricity between two points. The amount of electricity in the circuit is uniform across all circuit components. When electricity flows across a series circuit, the flow rate (speed) is constant. In a series circuit, the overall resistance equals the sum of the individual resistances. The greater the number of resistors in a series circuit, the more challenging it is for electrons to flow.

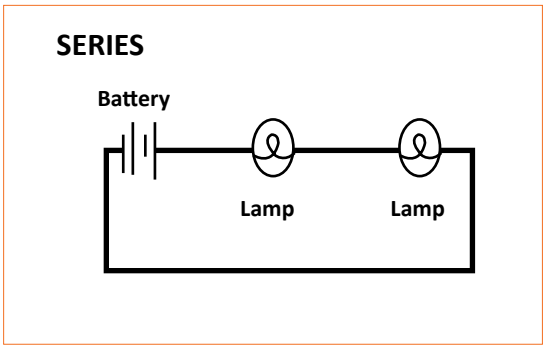


Fig. 2.1.4 Series Circuit

Parallel Circuit

A parallel circuit provides numerous routes for the passage of electricity between two points. According to website All About Circuits, "all components are connected between the same set of electrically common points." Resistors and sources are frequently connected between two sets of electrically shared locations. In a parallel circuit, electricity can flow in numerous directions horizontally and vertically. The components in a parallel circuit will have the same voltage across their ends and will have identical polarity.

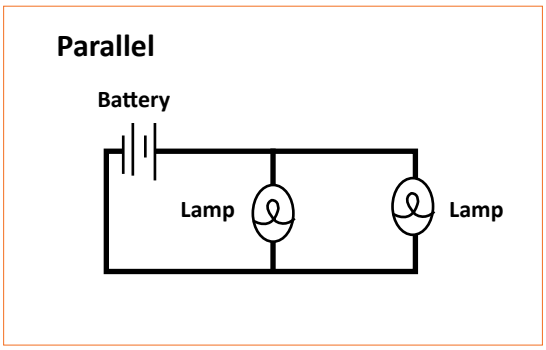


Fig. 2.1.5 Parallel Circuit

Combination Circuit

A combination circuit consists of both series and parallel pathways for the passage of electricity. It possesses a combination of the two traits. In this example, the parallel segment of the circuit functions as a subcircuit and is actually a component of a larger series circuit.

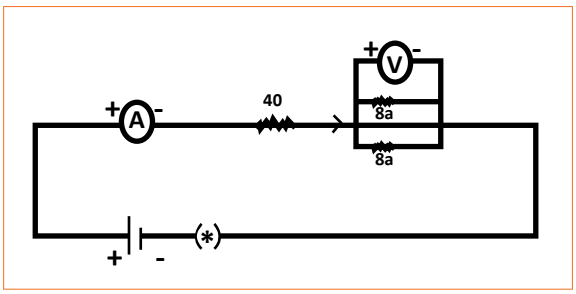


Fig. 2.1.6 Combination Circuit

2.1.6. Circuit Breaker

A circuit breaker is a switch that can be activated automatically or manually for the purpose of safeguarding and managing an electrical power supply. In the modern power system, the design of the circuit breaker has altered in response to the large working currents and to prevent arcing.

From the power distribution networks, electricity flows to homes, offices, schools, industries, and other locations, forming a huge circuit. The lines that are linked to the power plant are referred to as the hot wire, while the lines that are connected to the ground are referred to as the other end. Whenever electrical current passes between these two lines, a potential is created. The connection of loads (appliances) provides resistance to the passage of charge over the entire circuit, allowing the electrical system in a home or business to function without interruption.

They perform smoothly as long as the appliances are sufficiently resistant and do not generate any excess current or voltage. Too much charge travelling through the circuit, a short circuit, or the rapid connecting of the hot end wire to the ground wire would cause the wires to overheat and catch fire. The circuit breaker will prevent instances in which the remaining circuit is simply switched off.

Types of Circuit Breaker

Ground fault circuit interrupter (GFCI) circuit breakers interrupt the entire circuit's power supply. A current overload, short circuit, or line-to-ground fault will trigger them. When an unintended path arises between an electrical current and a grounded element, this can occur.

Fig. 2.1.7 GFCI circuit breakers

Arc fault circuit interrupter (AFCI) circuit breakers protect against an inadvertent electrical discharge that could create a fire in an electrical cable or wiring. Once the circuit breaker detects the electrical jump and irregular path, it immediately disconnects the faulty circuit before the arc can generate sufficient heat to ignite.

Fig. 2.1.8 AFCI circuit breakers

Combination arc fault circuit interrupters (CAFCI) guard against low-energy series arcing in addition to the arcs covered by AFCI. As a result of their ability to protect downstream branch circuit wiring and power cords, they are gaining popularity in households.

Fig. 2.1.9 CAFCI circuit breakers

2.1.7. Relay

Relays are straightforward electromechanical switches. While regular switches are used to manually close or open a circuit, a Relay also connects or disconnects two circuits. A relay, however, uses an electrical signal to drive an electromagnet, which connects or disconnects a second circuit.

Fig. 2.1.10 Relay

Every electromechanical relay is comprised of:

- Electromagnet
- Mechanically movable contact
- Switching points and
- Spring

The construction of an electromagnet involves winding a copper coil around a metal core. As seen, the two ends of the coil are linked to two pins of the relay. These two are used for the DC supply.

- Relay operates on the electromagnetic induction principle.
- When a current is applied to the electromagnet, a magnetic field is produced around it.
- The graphic above depicts the operation of the relay. Utilizing a switch to supply DC current to the load.
- Copper coil and iron core serve as electromagnets in the relay.
- As demonstrated, when a DC current is given to the coil, it begins to attract the contact. This is known as relay energising.
- When the supply is removed, the object returns to its initial position. This is referred to as de-energizing the relay.
- There are also relays whose contacts are initially closed and open when a power supply is present, i.e. the exact opposite of the relay depicted above.

Types of Relays

Relays can be categorised based on their functionality, construction, and application, among other factors. Here are some of the most frequent types of relays.

- Electromagnetic
- Latching
- Electronic
- Non-Latching
- Reed
- High-Voltage
- Small Signal
- Time Delay
- Multi-Dimensional
- Thermal
- Differential
- Distance
- Automotive
- Frequency
- Polarized
- Rotary
- Sequence
- Moving Coil
- Buchholz
- Safety
- Supervision
- Ground Fault

2.1.8. Starter Motor

A starter motor is an electrical device utilised to consistently start and stop a motor. Similar to a relay, the motor starter switches the power ON/OFF, but unlike a relay, it also provides safety against low voltage and overcurrent.

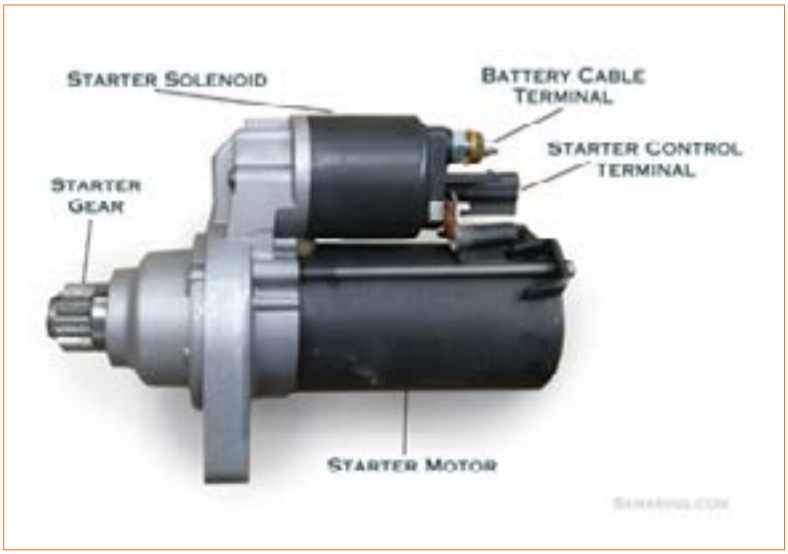


Fig. 2.1.11 Starter

A motor starter's principal duty is to safely halt a motor.

- To start a motor safely.
- To reverse the direction of the motor.
- To safeguard the gadget against low voltage and excessive current.

Types of Starter Motor

Different types of starter motors are as the below:

1. Manual Starter

This sort of starter is manually operated and requires no prior experience. A button is used to switch ON and OFF the motor that is attached to it. The mechanism that follows the button push contains a mechanical switch that interrupts the circuit or causes the motor to stop or start.

2. Magnetic Starter

Magnetic starter motors are the most common type of starter, and they are typically utilised in AC motors with high power. These starters perform electromagnetically like a relay that uses magnetism to make or break contacts.

Magnetic starters are comprised of two circuits:

- The power circuit is responsible for supplying energy to the motor. It features electrical contacts that, via an overload relay, turn ON/OFF the power provided from the line to the motor.

- Control circuit_ this circuit regulates the connections of the power circuit to either disconnect or reconnect the motor's power source. To modify the electrical connections, the electromagnetic coil is de- or re-energized. Consequently, this type offers remote control.

3. Direct Online (DOL) Starter

Direct Online Starting, also known as DOL, is the simplest motor starter that links the motor directly to the power source. A magnetic contactor connects the motor to the supply line, and an overload relay safeguards against overcurrent. There is no voltage decrease necessary for starting a motor reliably. Therefore, the engine using such starters has a horsepower rating of less than five. It contains two easy-to-use push buttons for starting and stopping the motor.

4. Stator Resistance starter

To start motors, a stator resistance starter employs the low voltage starter approach. External resistance is connected in series with all three phases of the stator of a three-phase induction motor. The role of the resistor is to reduce the line voltage (and, consequently, the starting current) linked to the stator.

5. Slip Ring or Rotor Resistance Starter Motor

This type of motor starter runs on a motor system with full voltage. It is known as a slip ring starter motor because it only runs with a slip ring induction motor.

Through the slip ring, external resistances are coupled to the rotor in a star configuration. These resistors reduce rotor current and increase torque, hence decreasing starting stator current. Additionally, it contributes to the enhancement of the power factor.

The resistors are only utilised during the motor's start-up. It is eliminated once the engine attains its calculated speed.

Notes

Scan the QR code to watch the video

https://youtu.be/kAL17fHlv4U
Electric Current

https://youtu.be/VnnpLaKsqGU
Electric Circuit

https://youtu.be/RQ3djos_LY8
Parts of Electric Circuit

https://youtu.be/V93nP6sCmsQ
Passive Circuit Elements

https://youtu.be/-K8yV1saoKQ
Circuit Breaker

https://youtu.be/5Baz70n5qhY
Relay

https://youtu.be/gXKqhFENnQc
Starter Motor

Unit 2.2 LV Electrical Works

Unit Objectives

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

- List the different materials, fixtures, tools and equipment relevant to LV electrical work.
- Explain the use of common electrical measuring devices required to undertake LV electrical tests/ inspections.
- List the common construction equipment used in other construction activities such as bar bending, concreting etc.
- Explain physical and chemical properties of good conductor, semi-conductor and bad conductor materials.
- Explain standard practice of material handling and storing at workplace.
- Demonstrate the use of different hand and power tools relevant to LV electrical works.
- Demonstrate the use of measuring and marking tools relevant to LV electrical installation work.
- Demonstrate standard procedure of shifting lights, cables, conduits, cable trays, brackets, DBs, ladders and other relevant materials.
- Demonstrate storing and stacking of electrical materials as per standard practices.
- Demonstrate standards practice of tagging materials, tools and tackles.

2.2.1. LV Wiring

Low voltage cables (LV cables) are used for electrical equipment with a voltage rating between 50 and 1000V for alternating current and between 75 and 1500V for direct current; as a result, they are not subject to excessive electric stress. They are often composed of uncoated or tinned copper, and solid or stranded aluminium, and the wire can be round, compressed, or shaped.

For this purpose, the cables can be soft or hard, and they can be wrapped in different kinds of thermoplastics. PVC, XLPE, and HFFR / LS0H are the insulation materials used for low-voltage power cables.

In the last few decades, the need for these electric power cables has steadily grown as more and more electrical equipment has been used in homes, businesses, and factories.

LV cables are used in many **applications** including:

- Infrastructures
- Automation
- Lighting
- Sound and security
- Video surveillance
- Fire alarm

2.2.2. Electrical Drawings

An electrical drawing is a component of the architectural design that depicts the electrical supply and distribution for the electrical system of the project. Electrical drawings describe in precisely what is necessary for an electrician to instal an electrical system. Electrical symbols, a sort of abbreviation for equipment and devices, indicate to the electrician which electrical items are needed and where they should be placed. Symbols are utilised to create an electrical layout that is less crowded.

Electrical contractors value electrical designs because they allow them to estimate the amount of materials and labour required. This information is used to estimate the total cost of installing the electrical system and in the bidding process. Electrical plans are an excellent documentation of the electrical system and can be reviewed if any technical problems arise.

2.2.3. Hand Tools

Any tool that is used manually rather than by a motor is referred to as a hand tool. Examples of hand tools include wrenches, pliers, cutters, hammered tools, screwdrivers, saws, drills, and knives.

The Importance of Hand Tools and Their Appropriate Application

- Injuries caused by hand tools are typically attributable to poor use or faulty maintenance. It is essential for electricians, craftsmen, and all other tool users to be familiar with recommendations for the care and safe use of hand tools. When utilising hand tools, you should consider the following information:
- Personal protection equipment (PPE) must be worn when required.
- Utilize the appropriate instrument for the task at hand. Utilizing a tool that is not suited for the task may result in severe damage and injury.
- Utilize the appropriate-sized tool.
- Use a tool only after receiving training in its fundamental safety and appropriate operation.
- inspect tools regularly to ensure they are in good shape and maintain that state.
- Maintain clean and dry tools. (Clean hand tools are more effective)
- Lubricate tools as required. (Lubrication facilitates the operation of hinged-joint instruments)
- Repair broken or damaged instruments as soon as possible, and dispose of those that cannot be fixed.
- Razor blades and utility knife blades should be disposed of in a puncture-resistant sharps container.

- Use caution when operating tools. (Only those who are trained and qualified should work on electrical lines.)
- When not in use, shop tools properly in a safe location.
- Maintain the sharpness of all cutting instruments to ensure that they move without bending or skipping.
- Maintain a firm grasp on the instrument and maintain a balanced stance to prevent slides.
- Ensure that your work place is clean, dry, well-lit, and uncluttered.

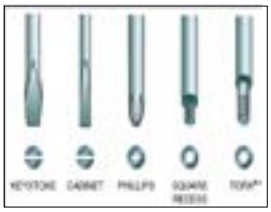
Basic Hand Tools

In the electrical industry, numerous tools are employed. A tool pouch worn on the electrician's hip fits hand tools with ease. Following list is of the most common tools used by electricians.

Tool name	Description	Image
Wrenches/ Spanner	Wrenches are frequent hand tools. Their primary use is to retain and turn nuts, bolts, cap screws, plugs, and other threaded components. Quality wrenches are designed to maintain a healthy balance between leverage and desired load. Standard spanner types with both American standard inch and metric apertures are available for the vast majority of applications and services.	
Chisel	A chisel is a tool having a distinctively formed cutting edge on its blade, used to carve or cut hard materials such as wood, stone, or metal by hand, a mallet, or mechanical force. Some varieties of chisels have handles and blades made of metal or wood with a sharp edge.	

Tool name	Description	Image
Pliers	Diverse varieties of pliers are utilised by virtually everyone who uses tools. There are several varieties and sizes. Each pair of pliers is designed for a distinct purpose, however its adaptability allows some to be used for a variety of tasks. Here are the most popular types of pliers, sometimes known as pouch tools: • Lineman • Long-nose • Diagonal cutting	
	Lineman There are two different head styles: the standard, also known as the bevel nose, and the New England, also known as the round nose. A bevel is any edge that is cut at an angle to a flat surface. Lineman pliers, also known as side-cutter pliers, are one of the most commonly used hand tools among electricians. The purpose of these pliers is to cut wires, conductors, and small screws. In addition to forming massive conductors, they are also used to pull and retain conductors. Always use the appropriate-sized pliers for the job. Typically, the length of the handles should be approximately 9 inches so that minimal hand pressure is necessary to cut the conductor or cable.	
	Long-nose Long-nose pliers, commonly known as needlenose pliers, are used to create small conductors, cut conductors, and hold and pull wires. The long-nose pliers, also known as needlenose pliers, make it easier to work in confined spaces due to its small head. Typically, electricians employ long-nose pliers with at least an 8-inch grip.	
	Diagonal cutting Diagonal cutting pliers, sometimes referred to as dikes, are used to cut cables and conductors in areas with limited working space.	

Tool name	Description	Image
Wire Cutters	Wire cutters are an instrument made specifically for cutting wire. There are various variations on the basic design, including versions with varying weights for wires of varying thicknesses. These cutters, also known as snips or diagonal pliers, are constructed similarly to pliers, but instead of grips, they include pointed edges that cut through wire. The larger and heavier the wire cutters, the larger the wire gauge they can manage. Wire cutters may also include insulated handles, which can be advantageous in some applications, and some may incorporate a wire stripper, allowing electricians to strip and cut wire with the same instrument.	
Wire Strippers	The main function of wire strippers is to strip (remove) insulation from wires. Additionally, conductors are chopped and formed with this instrument. The two types of wire strippers that electricians most frequently employ are listed below. • T-Stripper Wire Stripper • Cable ripper	
	T -Stripper Wire Stripper The nonadjustable T-Stripper Wire Stripper is the type of wire stripper that is most frequently used in domestic electrical work. Without needing to be modified for each size, the T-Stripper Wire Stripper can remove the insulation from a variety of wire sizes. The most frequent wire sizes used in household power are 10 through 18 AWG. The ideal instrument for removing insulation from cables of this size is the T-Stripper Wire Stripper.	
	Cable Ripper A non-metallic sheathed cable's exterior sheathing is removed using cable rippers. A sheathed cable is one that is shielded by a nonconductive covering, such as vinyl. Sheathing is a protective covering that wraps or surrounds something. The purpose of cable rippers is to slit the cable sheathing. The cable sheathing is then sliced off using a knife or cutting pliers.	

Tool name	Description	Image
Screwdrivers	The Keystone and Phillips screwdrivers are the two screwdriver types most frequently used in electrical work. Slot-head screws are installed and removed using the Keystone. Slot-head lugs can also be tightened and unfastened using this screwdriver. To instal and remove Phillips-head screws as well as tighten and loosen Phillips-head lugs, use Phillips-tip screwdrivers. The stubby screwdriver is a very useful tool for tightening and loosening screws in small spaces. Keystone and Phillips screwdriver designs are both available for stubby screwdrivers.	
Knife	The electrician's knife is a useful item frequently used by residential electricians. The insulation from large conductors and cables can be removed with the electrician's knife, which can also be used to open cardboard boxes housing electrical equipment. A typical electrician's knife has a cutting blade as well as a screwdriver blade. The utility knife with a retractable blade and the hawkbill knife with a curved blade are two more well-liked electrician's knives.	(A) Electrician's knife, (B) Hawkbill knife, (C) Utility knife. 
Hammer	A very helpful instrument for residential electricians is the electrician's hammer. A hammer is used to strike awls and chisels, drive and pull nails or staples, pry open boxes, and shatter wallboard. An awl is a tiny tool used for making small holes or marking surfaces. A chisel is a cutting-edge edge instrument with a flat steel blade. Long, straight claws on an electrician's hammer are ideal for making it simple to remove electrical apparatus. The electrician's hammer handle needs to be sturdy and shock-absorbing. The handles on the most common hammers are made of fibreglass. The most popular hammers among residential electricians are the 18- and 20-ounce models.	

Tool name	Description	Image
Hacksaw	Some conduit types are typically cut with a hacksaw, along with larger conductors and cables. Currently, hacksaws are made with sturdy frames that are lightweight but have enough rigidity to allow exceptional cutting control. For electricians, a hacksaw blade with 24 teeth per inch is the finest all-around option. Additionally, electrical work hacksaw blades come in tooth counts of 18 and 32 per inch. Awl, a tiny tool used for making small holes or marking surfaces. Chisel, a cutting-edge tool having a flat steel blade.	
Tape Measure	One of the most helpful items in an electrician's toolbox is the tape measure. It is a measurement device that consists of a thin strip of material (metal or cloth) marked with inches or centimetres. Typically, measurements are taken with a tape measure to establish the proper placement of electrical equipment. Standard lengths for tape measures are 12, 16, 20, and 25 feet. The 25-foot length, 1-inch-wide tape measure is the one that is most frequently used. When the tape is expanded, it may break or bend if it is too small.	
Nail	A nail consists of three fundamental parts: a point that drives into the work pieces, a shank or shaft that binds the work pieces together and provides much of the strength and holding power, and a head that allows the fastener to be driven and prevents it from tearing through the work pieces.	

Table 2.2.1 Hand Tools

2.2.4. Power Tools

Electric power tools include both those that run on 120-volt alternating current and those that run on low-voltage direct current. Double-insulated ac-powered tools with a two-prong connector are a type of electrical protection that includes two distinct insulation systems to assist protect against electrical shock caused by internal problems. All other power tools feature a grounding attachment plug with three prongs. Power is supplied by rechargeable batteries to cordless power tools. When working with power tools, remember this rule: Only use a tool after you have been educated in basic safety and correct tool use. When utilising power tools, the following guidelines should be followed:

- Wear personal protective equipment (PPE) as necessary.
- Do not use power tools in explosive environments, such as those containing flammable substances like petrol. Power tool sparks have the potential to ignite gasoline fumes.
- Bystanders should be kept away from the work area. Injuries could result from flying debris. Check that grounded tools are plugged into a grounded outlet.
- Polarized attachment plugs are used on double-insulated power tools. A polarised plug is one that has one prong that is longer than the other and can only be placed into an outlet one way. Make sure it's plugged into a properly equipped polarised receptacle.
- In rainy situations, do not use electric power tools.
- Never utilise a power tool's lead incorrectly. Never transport a tool by the lead.
- When using a power tool outside, use an extension lead labelled "W-A" or "W." These cords are intended for outdoor use.
- Never use a power tool if you are tired or on drowsy medicine.
- Wearing loose clothing or jewellery while operating a power tool is never a good idea.
- Before plugging a power tool into an outlet, make sure it is turned off.
- Before applying power, be sure that all chuck keys or other tightening wrenches are removed.
- When utilising a power tool, make sure you have solid footing.
- Always use the appropriate power instrument for the task.
- Always keep power tools in a dry and clean place, away from children and other inexperienced individuals.
- Never use a faulty or broken tool.

The types of power tools are as follows:

Tool name	Description	Image
Power Drills	A power drill fitted with an appropriate bit is used to bore holes in wood, metal, plastic, or other materials for the installation of wire lines, conduits, and other electrical equipment. Power drills are widely used by residential electricians. Power drill versions, like other power tools, are available with a power cord and socket or cordless with rechargeable batteries. The following are the primary types of power drills: • Pistol-grip • Hammer	
	Pistol-Grip Drill The most popular form of drill used nowadays is one with pistol grips. Pistol-grip drills are tiny, lightweight, and simple to operate. This drill resembles and is held in the manner of a pistol. This type of drill is commonly referred to as a variable-speed drill.	
	Hammer Drill The hammer drill is similar to a regular variable-speed drill, but it has a hammer motion for drilling masonry or concrete walls and floors.	

Tool name	Description	Image
Power Saws	Power saws are frequently used by electricians. Power saws are used to cut plywood backboards for mounting electrical equipment and to cut building structural members during electrical wiring installation. The following are two popular power saws: • Circular • Reciprocating	
	Circular Saw A circular saw is an electric saw that cuts wood, metal, or plastic depending on the blade used. Circular saws have a handle with an on/off trigger switch, an arbour nut to secure the blade, and guards to keep the operator from coming into contact with the spinning blade. A mandrel is a tool component that can be used to grip other moving tool components. The circular saw is sometimes known as a skilsaw.	
	Reciprocating Saw A reciprocating saw is a saw in which a push-and-pull reciprocating motion of the blade accomplishes the cutting action cutting action is accomplished by a push-and-pull reciprocating motion of the blade. The blade on this saw is reciprocating, which means it moves back and forth. Remember that the circular saw blade rotates in a round or round motion. A reciprocating saw is also referred to as a recipro saw, or a sabre saw.	
Wall Chaser	A wall chaser is a specialised power tool that is utilised for the purpose of cutting thin grooves in walls, for example when electrical cable is being laid.	

Table 2.2.2 Power Tools

2.2.5. Electrical Material

Electrical Materials, also known as Electrical Supplies, are key components or elements used in a construction project to link your home, business, or building to an electrical power source. Electrical components can range in size from a tiny home circuit to a sizable industrial plant.

Electrical materials can be categorised as follows based on their characteristics and areas of application:

- Conductors
- Semiconductors
- Insulating Materials
- Magnetic Materials
-

a. Conductors

Materials with a high conductivity are known as conductors. At normal temperature, a conductor has a large number of free electrons, which is the primary cause of the conductors' high conductivity. Silver, copper, gold, aluminium, etc. are some examples.

Silver is one of the good electrical conductors because it has a large amount of free electrons. The nucleus exerts very little binding force on these free valance electrons. Because of this, these electrons can readily escape from the nucleus and take part in the electrical current.

In equilibrium, a conductor exhibits the following properties:

- A conductor constantly permits electrons and ions to pass through them.
- The electric field within a conductor is zero, allowing free electron flow.
- There is no charge density within a conductor.
- Only on the conductor's surface are there no charges.
- All conductor points have the same potential.

Many metals are excellent electrical conductors. This is the reason why electrically conducting appliance components are comprised of metals. Insulator refers to the plastic covering that surrounds an electrical conductor. It safeguards us against receiving an electric shock.

b. Semiconductors

Semiconductors are substances with conductivities halfway between those of conductors and insulators. The elements of group III, group IV, and group IV are semiconductors. Materials used in semiconductors have covalent bonds. Semiconductors have very low conductivities at room temperature. The conductivity of semiconductors grows exponentially with temperature.
Examples include Germanium, Silicon, Gallium, and Arsenic.

The important properties of a semiconductor are:

- The resistivity of a semiconductor is lower than that of an insulator and greater than that of a conductor.
- Semiconductors have a temperature coefficient of resistance that is negative. The resistance of semiconductors reduces as temperature rises, and vice versa.
- At 0 Kelvin, semiconductors exhibit insulator behaviour. As the temperature rises, it conducts electricity.
- Impurities increase the conductivity of semiconductors. Doping is the process of adding impurities to semiconductors.

c. Insulating Materials

Insulating materials have relatively low conductivities. These materials are ideal for isolating the current-carrying components from earthed metallic structures because of their extremely high resistivity. The electrons and nuclei are closely bonded in insulating materials. As a result, they cannot be released for material mobility. As a result, insulating materials have very high resistance. These are known as bad conductors of electricity.
Examples include PVC, ceramics, and plastics.

i. Physical Properties

Physical characteristics include density, porosity, moisture resistance, thermal expansion coefficient, low odour level, inflammability, compactness, and surface tension. The desirable characteristics of insulated materials are as follows:

- Low density.
- It should not have its own odour and should instead absorb the odour of other particles.
- It must resist moisture penetration and not degrade when moisture accumulates.
- If it were combustible, it would be hazardous in the presence of electricity.

ii. Chemical Properties

Insulation's chemical qualities allow it to keep its own structure in adverse environments and also prevent substances from becoming corrosive. An insulation material intended for use in the chemical sector must be resistant to acid and corrosive gases.

d. Magnetic Materials

These minerals are crucial to the existence of many different electrical machines. The core is constructed using magnetic materials with high permeability to allow magnetic flux to flow along a channel with low reluctance. The following categories further categorise magnetic materials:

- Ferromagnetic substances
- Magnetic substance
- Diamagnetic substances
- Materials that are antiferromagnetic
- Ferrites

2.2.6. Various Electrical Material

The various electrical material is as follows:

Tool name	Description	Image
Electrical Conduit and Conduit Fitting	A conduit known as an electrical conduit transports electrical wire for communications or power. Rigid steel, lighter steel known as IMC or intermediate conduit, EMT or thin wall conduit, plastic or PVC, aluminium, or PVC coated, which is rigid covered with a 40 mil PVC jacket, are all used to make conduit. Electrical conduit comes in sizes ranging from 3/8" to 6".	
Electrical Wire and Cable	Electrical Copper or aluminium is pulled into wire that delivers energy across an electrical circuit. It is possible to run wire overhead, underground, through conduit or flex conduit, or openly. The design of a wire's jacket is determined by its intended use. It can also be adaptable, as with extension cords. It can range in size from as tiny as 26 gauge to as large as 2,000 MCM.	
Explosion Proof Enclosures	Explosion-Proof is the design of a product that prevents an electrical short from igniting a hazardous environment and generating an explosion. These items would be utilised at refineries, gas stations, and paint booths, among other places. They are constructed of steel or aluminium, and can also be made of fibreglass.	
Distribution Boxes	A distribution box, also known as a distribution board, panel board, breaker panel, or electric panel, ensures that electricity is distributed throughout a facility. It is the electrical distribution system of a structure or property. As a component of an electrical system, it divides electrical power into subsidiary circuits and provides a circuit breaker or fuse for each circuit. All the contact breakers, earth leakage units, doorbells, and timers are contained within a distribution box. The network provides electrical power to the building through the main feeding line. The wire is linked to the distribution board, and the secondary circuit breakers distribute electricity (lights and plugs).	

Tool name	Description	Image
Circuit Breakers	Circuit breakers are devices that block the flow of an electric current in the event of a short or overload. Multiple manufacturers, including Cutler Hammer/Westinghouse, General Electric, Square D, ITE Sieonans, and Federal Pacific, produce circuit breakers. Circuit breakers protect anything from the smallest residential circuit to the largest industrial needs.	
Electrical Connectors	Electrical Connector is a component that joins or adapts two other components. Connector sizes range from 3/8" to 6". They may be for indoor or outdoor use, corrosive-resistant, or explosion-proof.	
Electrical Box	Electrical Box is a container that serves multiple tasks, including pulling, connecting, and terminating an electrical circuit. The electrical box can be put screw or installed indoors; it can be weatherproof or installed outdoors. They may be constructed from steel, aluminium, plastic, stainless steel, or cast iron. Design requirements can include corrosion protection and explosive protection.	
Lugs	Lugs are the electrical connectors used to complete the circuit. Copper, aluminium, or bronze are used to create lugs. They are designed for wire sizes ranging from 26 gauge to 2,000 MCM. Mechanical or set screw, compression or crimp, solder or weld, or clamp-type lugs may be used. Several manufacturers of lugs include T&B, Burndy, Penn Union, Panduit, and 3M.	
Motor Control	Motor Control is a device for controlling a motor or mechanism. It can operate everything from the simplest mechanisms to the greatest turbines. There are numerous motor control manufacturers, such as Allen Bradley, Square D, Cutler Hammer, ITE Siemens, General Electric, and Westinghouse.	
Electric Light	A light bulb, lamp, or electric light is an electrical component that creates light. It is the most prevalent artificial lighting source.	

Tool name	Description	Image
Cable Trays	Cable trays are mechanical support systems that offer a robust structural structure for electrical cables, raceways, and insulated conductors used for power distribution, control, signal instrumentation, and communication. The materials galvanised steel, stainless steel, and aluminium are used to construct cable trays. The non-metallic material for cable trays is plastic bonded with glass fibres.	
Electrical Riser Brackets	Electrical riser brackets are used to elevate the electrical supply wire from the supply pole to the premises above the ground as part of the premises' electrical installation.	
Ladders	Most electricians utilise timber or fibreglass step ladders, with fibreglass typically being favoured due to its higher strength and less weight, which makes it easier to handle and transport.	

Table 2.2.3 Various Electrical Material

2.2.7. Material Handling, and Storage

Employees should seek assistance when a weight is so large that it cannot be properly grasped or lifted, when they cannot see around or above it, or when they cannot securely handle the burden.

Handles or holders should be fitted to loads to avoid the possibility of fingers being pinched or damaged. Workers should also wear suitable protection equipment. Wear gloves or other hand and forearm protection when handling loads with sharp or rough edges. Additionally, utilise eye protection to avoid eye damage. When moving big or bulky goods, the mover should also wear steel-toed safety shoes or boots to prevent foot injuries if he or she falls or loses a load.

All stacked loads must be correctly piled and, where possible, cross-tiered. When stacking and storing materials, precautions should also be observed. Materials in storage must not pose a hazard. Storage facilities must be kept clear of collected objects that could cause tripping, fires, or explosions, or that could harbour rats and other pests.

When stacking and piling materials, keep in mind the height and weight of the materials, how accessible the stored materials are to the user, and the condition of the containers where the products are stored. Non-compatible materials must be stored separately. Employees who operate with stored materials in silos, hoppers, or tanks must wear lifelines and safety belts. To prevent slipping, tumbling, or collapsing, all tied material should be piled, placed on racks, blocked, interlocked, or otherwise secured. No load may be applied on any floor of a building or other structure that is greater than that allowed by a building official. Load restrictions certified by the building inspector should be prominently displayed in all storage facilities, when relevant.

Height restrictions should be considered when stacking materials. For example, if lumber is handled manually, it must be stacked no higher than 16 feet; if a forklift is used, the maximum stacking height is 20 feet. Stripes on walls or posts can be painted to indicate maximum stacking heights for convenient reference.

Before stacking used timber, all nails must be removed. Lumber must be placed and levelled on bracing that is properly supported. The stacks must be self-supporting and stable. Stacks of loose bricks should not be taller than 7 feet. When these stacks reach 4 feet in height, they should be tapered back 2 inches for every foot above that level. When stacking masonry blocks higher than 6 feet, the stacks should be tapered back one-half block for each tier above 6 feet. To be secure, bags and bundles must be piled in interlocking rows. Stepping back the layers and cross-keying the bags at least every ten layers is required when stacking bagged items. Begin removing bags from the stack from the top row. Inside a structure, baled paper and rags must be kept at least 18 inches away from the walls, partitions, or sprinkler heads.

Boxed materials must be banded or held in place using shrink plastic fibre or cross-ties.

Drums, barrels, and kegs must be symmetrically arranged. The lower tiers must be blocked if stored on their sides to prevent rolling. Put boards, sheets of plywood dunnage, or pallets between each tier when stacking on end to provide a sturdy, flat stacking surface. To prevent moving in any direction while stacking materials two or more levels high, the bottom tier must be chocked on both sides. Consider the necessity for material availability when stacking. Materials that cannot be piled owing to their size, form, or fragility can be stored safely on shelves or in bins.

Unless in racks, structural steel, bar stock, poles, and other cylindrical components must be stacked and blocked to prevent spreading or tilting. Pipes and bars should not be housed in racks that face main aisles; this may pose a hazard to passers-by when supplies are removed.

2.2.8. Electrical Measuring Instruments

Electrical measuring instruments consist of all equipment used to measure the magnitude of an electric current for various purposes. Typical values measured with this apparatus are current, voltage, resistance, and power. Each is stated in a unique unit: amps, volts, ohms, and watts, in that order. The majority of measuring devices are portable, allowing for quick and reliable measurements.

Depending on what must be determined regarding an electrical circuit, various magnitudes can be measured:

- Voltage: Voltage is the power difference between two points of an electrically conducting element. Volt is its unit of measurement.
- Intensity: Intensity is the magnitude of the current flowing through an electrical circuit. Its measurement unit is the amp.
- Resistance: Resistance is the conductor's value relative to the flow of electrons. Ohm is its unit of measurement.
- Capacitance: Capacitance is the capacity of an element in an electrical circuit to store charge. Its unit of measurement is the amp as well.
- Electrical power: The combination of voltage (volts) and current (amps) produces electrical power (amps). Watt is the unit of measurement for this quantity.

Main Electrical Measuring Instruments

Device name	Description	Image
Galvanometer	Indicates the intensity of an electric circuit's current flow.	
Voltmeter	An instrument for measuring the potential difference between two points of a closed electrical circuit or the electromotive force of a battery. This device must have a high electrical resistance so that, when connected to the circuit, it does not generate consumption that affects the measurement result and precision.	

Device name	Description	Image
Ammeter	Measures the intensity (i.e. amps) of current in a circuit.	
Ohmmeter	Measures the electrical resistance, or ohms, in a circuit.	
Multimeter	A multimeter is a metre that combines the characteristics of different metres; it contains the tools required to measure voltages, resistances, capacitances, etc.	
Oscilloscope	An oscilloscope is a measurement equipment and graphical representation of time-varying electrical signals. This tool enables the visualisation of transient events and improves the diagnosis and investigation of the operation and potential faults of an electrical circuit.	
Spectrum analyser	A piece of measurement equipment that displays the components and spectral ranges of electrical signals originating from electromagnetic, mechanical, acoustic, or optical waves.	

Table 2.2.4 Electrical Measuring Devices

2.2.9. Equipment Tagging

Several considerations must be made when addressing equipment quantities. These include the uniqueness of the numbers, the usage of intelligent numbers, and the utilisation of equipment schematics.

First, equipment numbers must be unique. A number assigned to one piece of equipment cannot be assigned to another. Because planners will maintain separate records for each piece of equipment, each number must correspond to a single information repository. If the facility uses current numbering systems given by vendors, it must prevent unintended duplication.

Second, intelligent numbers enhance maintenance labour by facilitating equipment identification and filing or computer classification. For example, an equipment number beginning with B for all boiler equipment would allow for the organisation of all boiler-related paperwork.

A 2 3-inch tag is suitable for the majority of uses. The majority of equipment should have a tag legible at arm's length. Letters should have the same height and width as the tag. This means that following the equipment number, a 2 3-inch tag may include just two lines for the equipment name.

Scan the QR code to watch the video

https://youtu.be/IHHCT43sdYM

Electrical Drawings

https://youtu.be/rBYI10QeoRY

Hand Tools

https://youtu.be/vKKhxwn4P4o

Electrical Material

https://youtu.be/eS9nA5x0TFo

Electrical Measuring Instruments

Exercise

1. Explain the following in brief:
   a. Electric Current
   b. LV Wiring
   c. Series Circuit
   d. Circuit Breaker
2. Name the basic hand tools required in construction.
3. Electric power tools include both those that run on 120-volt alternating current and those that run on low-voltage direct current. Name 5 power tools used in construction.
4. Explain Material Handling, and Storage.
5. What are measuring devices? Explain with examples.

3. Wall Chasing and External Threading on MS (mild steel) Conduit

Unit 3.1 Electrification of Buildings

(CON/N0607)

Key Learning Outcomes

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

- Preform wall chasing work in concealed wiring work.
- Perform laying of conduits in concealed wiring work.
- Perform external threading on MS conduit.

Unit 3.1 Electrification of Buildings

Unit Objectives

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

- Explain electrical wiring methods adopted in electrification of buildings.
- Identify electrical fixtures used in electrical wiring works.
- Explain concealed electrical wiring and its use.
- Discuss the use of power tools and hand tools required for wall chasing and threading of conduits.
- Explain common accessories used for fixing of conduits
- Explain specification of conduits and their uses.
- Explain standard procedure of handling and storing of electrical materials required for wiring work.
- Demonstrate marking and measurement on the wall prior to chasing.
- Demonstrate how to chase the wall of given depth using appropriate tools.
- Perform fixing of conduit in the chased wall using appropriate accessories.
- Perform cutting and edge preparation of MS conduits.
- Demonstrate threading of MS conduits using die and tap.
- Demonstrate maintenance/ upkeep of electrical fixtures, tools and equipment.

3.1.1. Electrification of Buildings

Electrification is crucial to decarbonizing buildings, which is why it's has become crucial in construction. Decarbonization is significant because building activities account for 31% of energy-related CO2 emissions in the U.S. and nearly half of all residences use natural gas for heating.

Our long-term reliance on fossil fuels makes buildings one of the main producers of carbon dioxide (CO2) emissions, which trap heat and cause respiratory ailments from smog and air pollution. Greenhouse gases like CO2 create climate change, which causes extreme weather, drought, rising oceans, food shortages, and wildfires.

The Intergovernmental Panel on Climate Change (IPCC) warns that "rapid and deep emissions reductions across all sectors" are needed to minimise global warming to 1.5°C, the Paris agreement goal. How?

Building electrification—also called beneficial electrification or building decarbonization—replaces fossil fuels including oil, gas, and coal with electricity for heating and cooking. Solar, wind, and other zero-carbon electricity-powered buildings are the goal. These electrification technologies decarbonize since they use clean electricity.

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Benefit of Electrification

Programs for electrification offer utilities incentives to move from fossil fuels to electricity as their primary energy source. However, "beneficial" electrification demands that initiatives benefit participants, ratepayers, and the environment.

The drop in load growth that many electric utilities are currently experiencing could be greatly compensated by beneficial electrification. Other advantages for participants in electrification programmes include:

- Reduced bills
- Decreased expenditures for upkeep.
- Less noisy operations.
- Enhanced capacity to regulate temperature.
- Improved operational accuracy.

3.1.2. Electric Wiring

Electrical wiring is the process of connecting cables and wires to linked devices like fuses, switches, sockets, lights, fans, and so on to the main distribution board, a special structure attached to the utility pole that assures a steady supply of electricity.

A certain set of guidelines and laws established by a particular organisation are followed when installing the electrical wiring system. Electrical wiring must be carried out correctly and safely in accordance with the applicable laws and standards. Imagine that electrical wiring is carried out incorrectly or without according to any regulations. This may lead to short circuits, electric shocks, device or appliance damage, or gadget malfunction, all of which would shorten the life of the hardware.

Several factors need to be taken into account before installing residential, commercial, or industrial wiring. There are many things to take into account, including the building type, the ceiling, wall, and floor structures, wiring techniques, and installation requirements.

3.1.3. Types of Electric Wiring

Whether a facility is domestic (individual residences or apartments), huge commercial (office buildings), or industrial, electrical wiring is an essential component (factories). Circuits for lighting and other power sources can be wired in a number of different ways.

The type of wire used typically determines electrical wiring systems. The electrical wiring techniques that are frequently employed in home, business, industrial, and theatre contexts are as follows:

- Cleat wiring
- Casing and capping wiring
- Batten wiring (CTS or TRS)
- Conduit wiring (Surface or Concealed)
- Lead sheathed wiring

i. Cleat Wiring

Cleat wire is a temporary wiring technique that should not be used in a home. The use of cleat wiring has been discontinued.

Cleat wire refers to the compounded, braided VIR or PVC wires that are waterproofed and insulated. Typically, wood, porcelain, and plastic are used to attach the wiring to the walls or the ceiling.

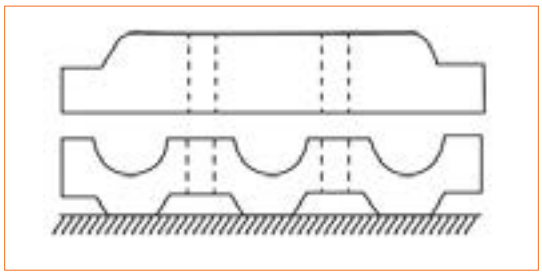

Fig. 3.1.1 Cleat with three grooves

Advantages of Cleat Wiring

- **It is an easy and inexpensive wiring design.**
- **Because the cables and wires in the cleat wiring system are outside, any cable failures may be found and fixed right away.**
- Installation of a Cleat wiring system is straightforward and easy.

- This wiring scheme makes it simple to customise something by adding or changing something.

Disadvantages of Cleat Wiring

- The exterior is not appealing.
- It is not a long-lasting wire system because of the influence of the general weather, the increased risk of fire, and wear and tear.
- Only low temperatures and 250/440 Volts are suitable for using it.
- Electric shock and fire are both always a risk.
- Use of it is prohibited in sensitive or important areas.

ii. Casing and Capping Wiring

Casing and capping wiring systems were originally widespread, but because conduit and encased wiring systems have become more ubiquitous, they are now viewed as being antiquated. This type of wiring uses VIR or PVC cables as well as any other permitted insulated wires.The cables were run through the enclosures made of wood. The enclosure is formed of a strip of wood with parallel grooves running the length of it to accommodate VIR wires. To discern between polarities, grooves were made. The wires and cables that had been inserted and fitted into the casing were covered with the capping (also made of wood).

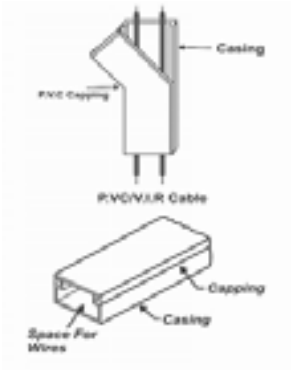

Fig. 3.1.2 Casing and Capping

Advantages of Casing and Capping Wiring

- Compared to conduit and shielded wiring systems, it is the more economical option.
- It is a reliable and durable wiring system.
- It is straightforward to customise due to the wire topology.
- It is unaffected by rain, steam, smoke, oil, or smoke.
- Electric shock is not a possibility because the wires and cables in the casing and capping are covered.

Disadvantages of Casing and Capping Wiring

- The electrical system's casing and capping provide a serious fire danger.
- It is inappropriate for situations that are acidic, alkaline, or humid.
- Repairing costs money and uses additional supplies.
- It's challenging to find material in the modern environment.
- Wood casing and capping are susceptible to harm from white ants.

iii. Batten Wiring (CTS or TRS)

In this arrangement, the straight teak battens are utilised to run insulated cables. The wooden battens are screwed and plugged into the ceilings and walls. To attach the cables to the battens, link clips made of tinned brass are used Rust-resistant nails are utilised to attach the clips to the battens. This wiring installation is less complicated, inexpensive, and time-consuming than other electrical wiring methods. These are predominantly used indoors.

Typically, Cabtyre Sheathed Wire (CTS) or Tough Rubber Sheathed Wire (TRS) is utilised as the electrical conductor in this type of wiring.

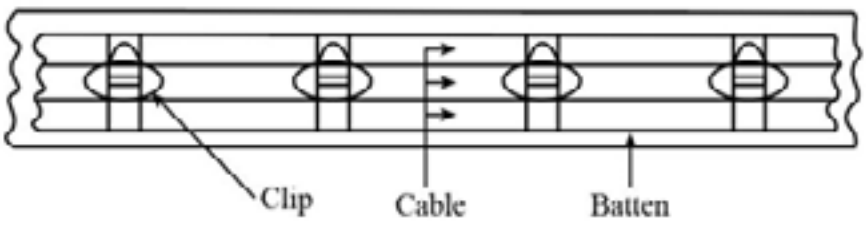

Fig. 3.1.3 Batten Wiring

Advantages of Batten Wiring

- Wiring is a straightforward and uncomplicated operation.
- A cost-effective alternative to conventional electrical wiring methods.
- It is both pleasant and attractive.
- Repairing is straightforward.
- Long-lasting and durable.
- This wire architecture permits simple customization.
- In this system's wiring, cases of current leakage are uncommon.

Disadvantages of Batten Wiring

- Moisture, chemical effects, and open, outdoor conditions are incompatible with installation.
- There is a high fire risk.
- Due to their exposure to heat, dust, steam, and smoke, these wires are not immune to weather or external wear and tear.
- In a system of batten wiring, large wires are prohibited.
- Only suitable for use under 250 V.
- There is a need for more cables and wires.

iv. Lead Sheathed Wiring

In this type of wire, conductors are covered by an outer sheath made of an alloy of lead and aluminium that contains around 95% lead. The metal wrapping protected the wires to protect them from environmental mechanical damage, moisture, and corrosion.

The entire lead sheath covering is made electrically consistent and linked to the ground at the point of entry to safeguard against electrolytic action brought on by leaking current and to ensure safety in the event that the cable sheath becomes alive. With TRS wiring, the wires are strung along a wooden batten and connected using link clips.

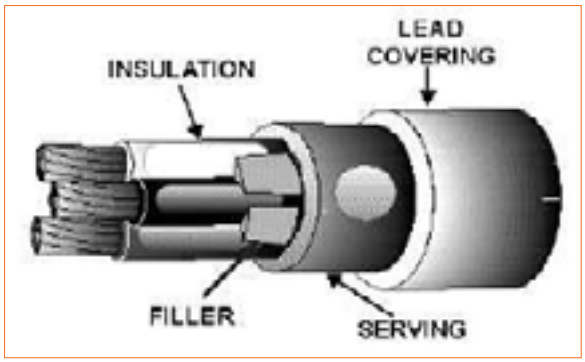

Fig. 3.1.4 Lead-Sheathed Wiring

Advantages of Lead-Sheathed Wiring

- Lead sheath has a lengthy lifespan.
- It has a pleasing aesthetic.

Disadvantages of Lead-Sheathed Wiring

- Lead sheathing is more expensive.
- Finding a defect in lead sheath wiring is difficult.

v. Conduit Wiring

Conduit wiring comes in two different varieties.

- Surface Conduit Wiring
- Concealed Conduit Wiring

a. Surface Conduit Wiring

Conduits installed on a wall or roof are referred to as surface conduits. This wiring method involves drilling holes into the wall surface at regular intervals, and then installing the conduit using rawl plugs. Surface conduit wiring is made of two different sorts of materials: metallic and non-metallic. Steel (material) is utilised in non-metallic conduit wiring systems while plastic pipes are used in metallic conduit wiring systems.

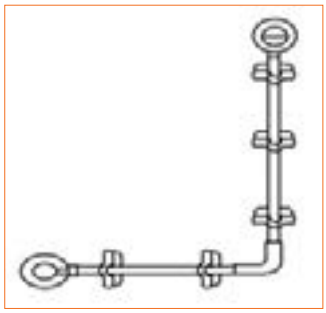

Fig. 3.1.5 Surface Conduit Wiring

b. Concealed Conduit Wiring

Concealed conduit wire is that which has slots inside the wall plasters and is often hidden. It can be inferred from this that the concealed conduits have conduits that run through the walls in structures such as floors, walls, ceilings, or tubes specifically designated for wiring. The concealed conduits are hung through the ceilings or walls of locations where the regular wiring is routinely changed, such as offices or factories, using pins or hooks.

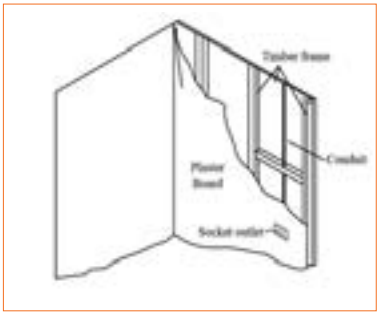

Fig. 3.1.6 Concealed Conduit

Conduits must be correctly connected and earthed by a qualified professional, it must be mentioned. PVC conduit is the most widely used type (polyvinyl chloride).

Advantages of Conduit Wiring

- It is the industry's safest wiring technique.
- It has a beautiful appearance.
- It's easy to maintain and repair your car.
- The insulation of the cables won't be affected.
- It is fire and corrosion resistant.
- It can be used in surroundings that are humidified, chemically impacted, and smokey.
- No risk of electric shock exists.
- It is a reputable and well-liked wiring system.
- a sustainable and long-lasting wiring system.

Disadvantages of Conduit Wiring

- It is an expensive wiring setup.
- It was quite difficult to find the wiring errors.
- It is not easy to instal.
- Risk of electric shock.
- Future management of additional connections will be challenging.

3.1.4. Marking Out Tools

Marking out is the preparatory process of establishing guides and centres prior to cutting and machining. The lines are rendered in 3-D and to scale. The item can then be cut or machined to the desired dimensions or forms. The following are typical tools used for outlining:

Tool Name	Description	Image
Scriber	A scriber is a tool used to scratch lines onto the workpiece. It is constructed of tool steel that has been hardened.	
Engineer's Square	Engineer's squares are manufactured from tool steel that has been hardened. It is used to examine the straightness and squareness of a piece of work. On a workpiece, it can also be used to mark perpendicular lines.	
Spring Dividers	Spring dividers are composed of tool steel that has been hardened. On a workpiece, the legs are utilised for scribing arcs or circles.	

Table 3.1.1 Marking Out Tools

3.1.5. Electrical Fixtures

Electrical Fixtures are condominium air space enhancements that belong to the unit owner. Unless the governing documents specify otherwise, it is the homeowner’s responsibility to repair, maintain, and replace electrical fixtures. Examples of electrical fixtures include light switches, outlets, bathroom ventilation fans, ceiling lights, and ceiling fans, among others. Wall-mounted wiring is either common area or exclusive use common area, depending on its intended function.

The following electrical fixtures are used commonly:

1. Switches and Its types

A switch is used to complete or interrupt an electric circuit. It must function in such a way as to make the circuit firm. At the instant the switch is closed, the current must be interrupted so that no arc forms between the switch blades and contact terminals. Arc formation harms or burns the switch contacts.

Fig 3.1.7 Switchboard

Typically, this arc is prevented by supplying a spring to a moving blade in order to have a swift action. There are four different types of switches.

- Tumbler switch
- Flush switch
- Knife switch
- I.C. Main switch

2. Lampholders

Lampholders are mechanical devices used to support and connect lamps to electrical circuits. They hold light bulbs and give power by making electrical contact. Most light sources, including incandescent, fluorescent, and compact fluorescent lamps, require lampholders (CFL).

Fig. 3.1.8 Lampholder

3. Ceiling Rose

A ceiling rose or other similar attachment shall not be utilised on a circuit whose voltage exceeds 250 volts in normal operation. Typically, only one flexible cord is permitted to be attached to a ceiling rose. A ceiling rose may not incorporate a fuse terminal as an integrated component.

Fig. 3.1.9 Ceiling Rose

4. Pin Plug

To connect a portable appliance, such as a table fan, table light, electric iron, radio, television, etc., to a socket. It could have two or three pins. At 5 or 15 amps, a two-prong plug is utilised. The third pin is the earth line pin, and it is significantly thicker than the other two pins. Also composed of bakelite. A pin-plug may alternatively be referred to as a plug-top.

Fig. 3.1.10 Pin Plug

5. Socket and Adopter

a. Socket: The socket has an insulated base with moulded terminal sleeves or a socket base with three terminal sleeves. The two thin terminal sleeves are intended for cable connection, while the terminal sleeve with the thicker cross-section is utilised for earth connection.

The cover is once more moulded and contains three holes. These are designed for loads of 5 amps and 15 amps.

b. Adapter.

Adapter is the electrical item used to take additional connections from a socket or holder.

Fig. 3.1.11 Socket and Adapter

6. Fuses

A fuse is a device that disconnects the circuit when the current exceeds a predefined value. It is the circuit's weakest link that breaks when an abnormally high current passes across it.

Fig. 3.1.12 Fuses

7. Electrical Conduits

Electrical conduits are tubes used to protect and direct electrical wire within a building or structure. Metal, plastic, fibre, or kiln-fired clay may be used to create electrical conduit. For certain applications, flexible conduit is utilised in addition to stiff conduit.

Generally, electricians build conduit at the site of electrical equipment installation. Wiring rules frequently specify its application, form, and installation specifics.

Fig. 3.1.13 Electrical conduits

Classification of conduit systems is based on wall thickness, mechanical stiffness, and tubing material. Materials may be selected based on mechanical protection, corrosion resistance, and total installation cost (labor plus material cost). Wiring regulations for electrical equipment in hazardous regions may mandate the use of specific conduit types for an acceptable installation.

- Metal Rigid metal conduit (RMC) is a thick-walled, threaded tube constructed from coated steel, stainless steel, or aluminium.
- Galvanized rigid conduit (GRC) is galvanised steel tubing with a wall thickness sufficient to permit threading. It is typically used in commercial and industrial construction.
- IMC is a steel tube that is heavier than EMT but lighter than RMC. It is threadable.
- Electrical metallic tubing (EMT), also known as thin-wall, is frequently substituted for galvanised rigid conduit (GRC) due to its lower cost and lighter weight. EMT is not threaded, although it can be used with threaded clamp-on fittings. Using clamp-type fittings, conduit lengths are linked to each other and to equipment. Similar to GRC, EMT is more prevalent in commercial and industrial applications than in residential ones. EMT is typically composed of coated steel, however it may also be made of aluminium.

8. MS Conduit Pipes

Steel Pipes are a critical requirement in infrastructure across numerous sectors. Mild Steel (MS) Conduit Pipe is utilised to protect sensitive electronic equipment that may be exposed to electromagnetic interference. The MS Conduit Pipe is constructed from high-quality steel and is highly resistant to corrosion. Galvanized rigid steel conduit is made from mild steel and is used as an electric conductor steel raceway system.

The circular cross-section is intended for the physical protection and routing of wire conductors and as a grounding conductor for equipment.

The MS Conduit Pipes are typically employed in:

- Fertilizer Plants
- Food & Beverage Sectors
- Oil, fuel, and water gas businesses
- Thermal and Nuclear Energy Station
- Chemical Processes
- Mining Sector Pharmaceutical Sector
- Platform for Oil Exploration and Offshore Operations
- Wastewater Treatment and Sewerage Facility

Fig. 3.1.14 MS Conduit Pipes

3.1.6. Electric Wall Chase

Electric wall chase refers to the technique of cutting and chiselling channels in a wall so that electricians can run their cables through them. After the cables are installed and the job is complete, the chases can be refilled and decorated to conceal the cables within the wall.

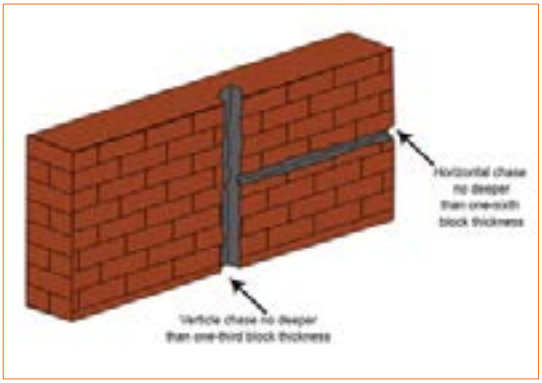

Fig. 3.1.15 Wall Chasing

The two primary ways used by electricians to protect buried wires in walls are conduit systems and situating the cables in safe zones as stipulated by wiring rules. There are many conduit systems that give varying levels of protection. The term conduit refers to the hollow tubing used by electricians to route cables.

Principal methods of protection employed in pursued walls include:

- **PVC oval shaped conduit.** This has the benefit of having a shallower oval, so the chases do not need to be as deep. This is a very common form of protection, but because it is made of plastic, it cannot withstand a drill or a nail!

- **Metal round conduit.** This is more industrial; being made of metal, it provides greater protection and was once the standard solution. However, because to the expense of materials and the time required for installation, this is rarely employed in residential properties nowadays. Another issue is that roundness necessitates deeper chases, which may not comply with contemporary building codes (more details later)

- **Plastic capping.** It is feasible to bury a cable straight against masonry and then cover it with a covering. This capping is quite thin and provides little real protection for the cable, but it facilitates plastering because we do not have to plaster straight onto the cable when we are finished.

Depth of a wall chase: The depth of a wall chase is specified by Approved Document A Section 2c of the building regulations. It specifies that vertical wall chases should be no deeper than one-third the thickness of the wall's leaf, and horizontal wall chases should be no deeper than one-sixth the thickness of the wall's leaf.

Tools required: Wall Chaser is the best tool for chasing a wall, despite its unimaginative name. It is a motorised, dust-extraction-equipped device that allows the operator to cut channels into a wall. The tool can be adjusted to maintain a uniform depth in accordance with building codes. Then, a chisel and hammer are necessary to remove the central masonry, which typically falls out with relative ease. The chasing tools required are:

- Chase cutter – blades set to single chase
- Chisel
- Lump hammer
- Large bolster
- Medium bolster

Fig. 3.1.16 Electric Wall Chaser

3.1.7. Process of Wall Chasing

The most visually appealing approach for carrying cables or pipes up (or along) a masonry wall is to bury (or chase) them in the wall surface. When chasing cables or pipes into walls, there are several guidelines to adhere to:

- Between the start and finish on the wall, chase cutouts should always be vertical or horizontal; never cut a chase at an angle between these two, nor step the channel.
- Vertical chases should be no deeper than one-third of the wall thickness – with ordinary 100mm bricks and blocks, this will be 33mm, which is already rather deep – this does not account for any plaster covering, which might be 10mm, so the maximum depth is 36mm from the plaster's front face.
- Horizontal chases should be no deeper than one sixth of the wall thickness - with typical 100mm blocks, this will be 16mm, which is generally adequate - this does not include the plaster covering.
- The chases on opposing sides of a wall should not be lined up, or "back to back."
- Any new electrical circuit must comply with Part P of the Building Regulations before it can be concealed.

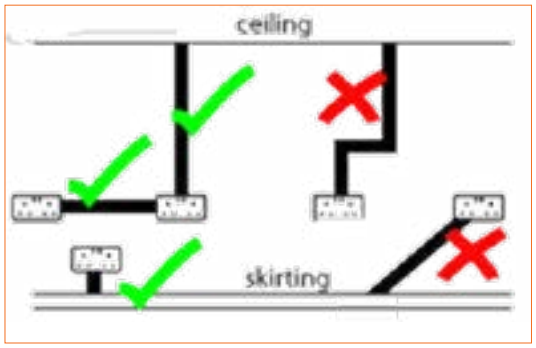

Fig. 3.1.16 Correct and incorrect ways for Wall Chasing

The reasoning behind the preceding recommendations falls into two categories:

1. The person who cuts a chase will likely not be the same person who drives in a nail to hang a painting in the future; therefore, knowing that wires/pipes have only been pursued in vertically or horizontally reduces the risk that he/she will drive a nail through them.

2. Cutting away masonry undermines a wall's structure, horizontally more so than vertically.

Chase Cutting

Chase cutting is one of the important processes after the construction of walls. Chase in general is to make a narrow and a sharp opening. Chase is the passage through which the electrical connections are made or passage for water connections or a groove made in the wall for design purposes.

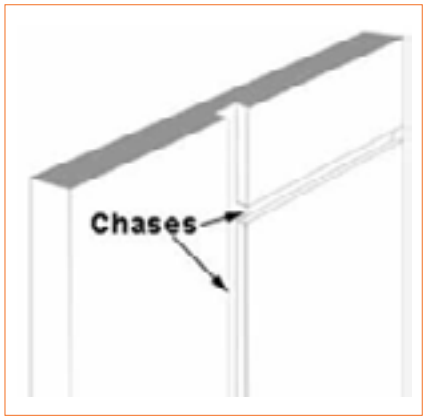

Fig. 3.1.17 Chases

The majority of skilled builders will possess a tool for cutting chases, which is essentially an angle grinder with two parallel cutting discs and a depth adjustment. The builder simply sets the depth gauge, runs the grinder up/down or across the wall to make two parallel cuts, and then uses a cold chisel to remove the waste between the cuts. Even with the standard dust extractor connected to these chase-cutting tools, they emit a considerable amount of dust, therefore, it is necessary to take steps to protect both property and person.

Mark the sides of the chase on the wall, then use a power drill to cut away most of the 'waste' by drilling many holes to the desired depth and then use a hammer and cold chisel to remove the remaining waste and trim the edges.

Chases in the wall should not be randomly cut. Simple steps are:

- The vertical chases should not be deeper than 1/3rd of the total wall thickness.
- The horizontal chases should not be deeper than 1/6th of the total wall thickness.
- The chases (either horizontal or vertical) should not be made back to back.
- Chases should be either horizontal or vertical. Diagonal chases should not be used.
- The stability of the wall will be affected if the chases are too deep.
- If the chases are found back to back, then the thickness of the wall is reduced to a greater extent and this will also affect the stability of the wall.
- A cutting tool is required for cutting the chase.
- It usually consists of two parallel blades.
- Depending on the thickness of the wall, the depth of the cut should be determined.
- Based on the depth of cut the position of the blades can be adjusted.
- Once the chase lines are cut, the middle part is removed by using a hammer and a bolster.
- Removing the middle part is easier only if the depth of cut is less.
- Once the chase is cut, the necessary wiring or piping connections are made.
- After the work is done it is again sealed by using a mixture of cement and sand in most cases.

Fig. 3.1.18 Removing middle part

Take the following necessary precautions:

- Check the wall for already-installed cables and pipes.
- Use protective eyewear and a dust mask to minimise exposure.
- If an electrician is required to use a power saw, use one with a dust collection system; even so, everything will be covered in dust.

Insert the cable or pipe into the conduit.

In a conduit – both plastic and metal conduit is available, but for a chased run, plastic oval conduit is preferable due to its tiny width and short depth, which eliminates the need to earth bond the conduit (as would be required with metal conduit).

Typically, it is most convenient to pass the cable(s) into the conduit before securing it in place. Once the cable is through the conduit, lay it at the back of the chase and secure it with a few broad head nails on both sides of the conduit. • PVC channelling is an alternative to conduit (metal channelling is available, but again should be earth bonded). Lay the cable along the rear of the pursuit, position the channelling over it, and nail the channeling's side flanges to the back of the chase.
Pipework

Due to the rigidity of copper pipe, it is typically sufficient to lay it in the chase and secure it with a few large-headed nails.

3.1.8. Safety Guidelines on the Work Site

Workers must adhere to eight safety guidelines on the work site.

1. **Personal Safety:** Personal safety should take precedence over all other safety equipment since it protects electrician or worker directly from electrical disasters. The required level of personal protection is determined by your probable exposure to electricity. Utilize electrical gloves and boots when working with electrical materials, as they give fundamental protection. Utilize additional safety precautions, such as a face shield, fire-resistant helmet, protective eyewear, and earmuffs, when working around wiring or electrical equipment.

2. **Testing equipment:** Never attempt to operate electrical wiring or equipment if one do not know how to do so. The electrical power testing equipment protects against unwanted and perhaps lethal electrical shocks. Ensure that voltage detectors, clamp metres, and receptacle testers are available on the job site.

3. **Cord protectors:** Use of safe extension cords and outlet strips is a recommended electrical safety practise. Use cable covers and cord protectors as a precautionary step. Utilize floor cable protectors for safety, and make sure they are widely visible to prevent trips on the job site.

4. **Voltage regulators and breaker switches:** They are essential safety items that prevent the situation from escalating. Always utilise a surge protector to turn off the power supply in the event of an emergency. A voltage regulator prevents equipment from becoming damaged over time or during an electrical surge.

5. **Precautions:** Electrician will be unable to prevent certain electrical risks. However, by exercising caution on the job site, the risk of electrocution can be mitigated. On a construction site, safety precautions include labelling the areas where electrical wiring is an issue and placing ground fault circuit interrupters on all receptacle outlets to prevent electrical shock.

6. **Equipment use:** The use of electrical devices in the workplace can become very natural and comfortable for employees. This may result in inappropriate tool use or the unwitting practise of unknown dangers. The correct training of the personnel will enable them to discover unknown improper shortcuts, hence reducing the risk of electrocution caused by equipment. In addition, verify that all the teammates know how to use every instrument properly, especially in direct electrical work.

7. **Identifying problems:** The hazards posed by building sites must never be disregarded. Encourage the employees to practise recognising any anomaly or electrical hazard, such as a distinct odour of burning. Create a safety checklist and include it in everyday activities. Create an environment in which employees feel at ease informing a supervisor of any problems.

8. **Risk assessments:** Before any form of work begins on the construction site, conduct an intensive and exhaustive risk assessment. This aids in identifying potential electrical hazards and ensuring that adequate control measures are in place to prevent them from posing a threat to the safety of employees. It is essential to educate oneself with the results of the risk assessment in order to recognise the dangers you must avoid.

Scan the QR code to watch the video

https://youtu.be/2i4ugBLR1KU

Electrification of Buildings

https://youtu.be/A5P-buWX-dA

Types of Electric Wiring

https://youtu.be/OdnApA_GXsk

Electrical Fixtures

Exercise

1. Explain the benefit of electrification of buildings.
2. What are the safety guidelines to be followed on the work site?
3. State the types of electric wiring.
4. Explain in brief about wall chasing.
5. What is the process of wall chasing?

4. Erect and Dismantle Scaffold

Unit 4.1 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 4.1 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.
- Discuss the functions of different hand tools like hammer, spanner, pulleys, hooks, ropes, etc., used for erection/ dismantling of scaffolds
- Describe 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 scaffold and stack their components
- Select different components used in 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
- Demonstrate the process of conducting verticality check, stability check and rigidity check
- Demonstrate the dismantling and stacking of scaffolding components.

4.1.1. 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.

4.1.2. Uses of Scaffold

Nowadays, scaffolding is utilised 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

4.1.3. 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 utilised 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 galvanised 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 utilised 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 galvanised steel scaffolding pipes. Include E-galvanized scaffolding pipes, GI pipes, and hot-dip galvanised steel pipes. HDG scaffold tubes are another term for hot-dip galvanised 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.

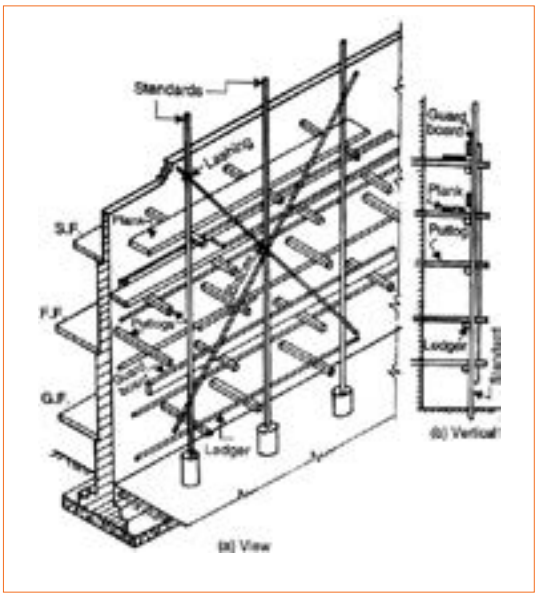

Fig. 4.1.1 Components of Scaffolding

4.1.4. 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.

4.1.5. 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.

4.1.6. Scaffolding Erection

Scaffolding is frequently required for building and home maintenance. Set up scaffolding correctly to ensure your safety and the safety of those utilising 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.

4.1.7. 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. 4.1.2 Hammer

2. Spanner/Wrench: A spanner is utilised 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. 4.1.3 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. 4.1.4 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. 4.1.5 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. 4.1.5 Scaffolding rope

4.1.8. 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.

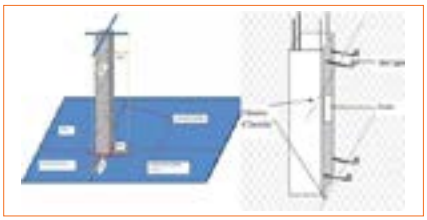

Fig. 4.1.6 Vertical Scaffolding Check

Methods used to check or control verticality works include:

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

Fig. 4.1.7 Plum Bob Technique

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.

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 minimised 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.

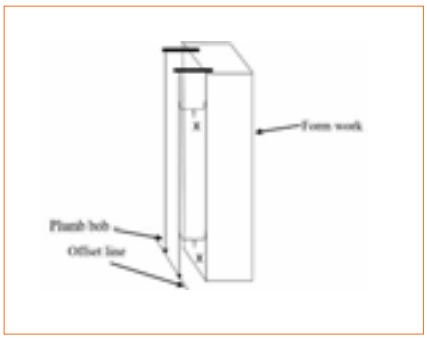

Fig. 4.1.8 Checking Verticality of Columns

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. 4.1.9 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 as depicted in Figure 4.1.9, walls, foundations, and columns as depicted in Figure 4.1.10, 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:

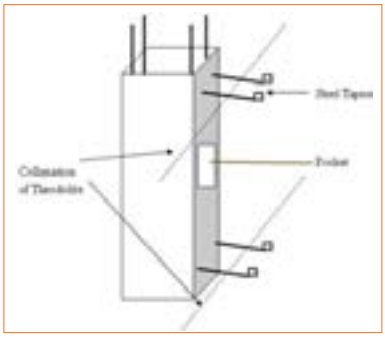

Fig. 4.1.10 Checking Verticality Using Theodolite

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 utilised for managing verticality, the optical plummet's automatic compensator substantially improves its accuracy.

Fig. 4.1.11 Optical Plummet

2. Stability Check: Under each foot's contact with the ground, stabilise 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.

4.1.9. 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: 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 instal 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.

4.1.10. 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.

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.

Notes

Scan the QR code to watch the video

https://www.youtube.com/watch?v=wdcq4EYST2c

Scaffolding Components

https://www.youtube.com/watch?v=OKawvyUhUkA

Dismantling the Scaffold

5. Team Work and Effective Communication at Workplace

Unit 5.1 – Effective Communication and Teamwork

Unit 5.2 – Working Effectively and Maintaining Discipline at Work

Unit 5.3 – Maintaining Social Diversity at Work

(CON/N8001)

Key Learning Outcomes

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

- Demonstrate effective communication with co-workers, superiors and sub-ordinates across different teams
- Provide support to co-workers, superiors and sub-ordinates within the team and across interfacing teams to ensure effective execution of assigned task.
- Demonstrate practices sensitive to disabilities (physical, mental, intellectual or sensory impairment), cultural diversity and gender neutrality.

Unit 5.1 – Effective Communication and Teamwork

Unit Objectives

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

- Explain the importance of proper and effective communication and its adverse effects in case of failure of proper communication.
- Apply effective communication skills while interacting with co-workers, trade seniors and others during the assigned task.
- Use appropriate writing skills and verbal communication reporting as per commonly applicable organisational norms.
- Demonstrate teamwork skills during assigned task.

5.1.1. 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

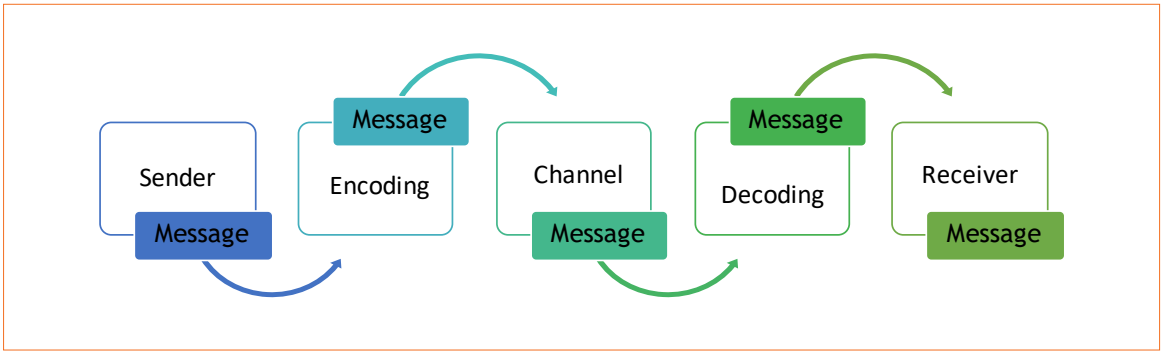

Fig 5.1.1 Effective Communication Process

- 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.

5.1.2. 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.

5.1.3. 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.

5.1.4. Effective Writing Skills in Workplace

Despite the fact that many job adverts emphasise oral and written communication abilities, both employees and employers sometimes overlook the significance of effective writing in the workplace. When an employee writes effectively, they display courtesy, attention to detail, and intelligence. In addition, personnel with strong written communication skills benefit their employer by assuring quality interactions with clients, prospects, and other external parties.

1. Creating a Positive First Impression

The classic saying that you never have a second chance to make a strong first impression is a cliche. This is true even when the initial impression is made through written communication. When an email, letter, text message, or social media post is appropriately written, organised, and grammatically correct, the reader will get a favourable impression of the author.

In contrast, misspellings, poorly structured thoughts, and grammatical faults portray the author as stupid and unprofessional. At the application or interview stage, this could result in the loss of a job offer or a lower pay offer than would otherwise be the case. Poor writing in external business communications may reflect adversely on the firm. Poor writing habits may also be observed by co-workers, which may influence their perception of the writer's competency.

2. Good Writing Demonstrates Courtesy

Excellent business writing exhibits respect for the reader's time. The reader benefits when a writer can arrange his thoughts and concerns and express them in a manner that is easy to read and comprehend.

On the other hand, poor writing causes the reader to expend time and effort to comprehend what is being said. The reader may need to ask the author for clarification in many instances. The writing demonstrates that the author values the reader's time and does not waste it.

3. Importance of Clear Communication

Effective business decisions are dependent upon effective communication. This is true for both internal and external communications. It is much simpler to coordinate internal projects and share ideas when all co-workers know the proposed ideas and methods for completing the project. When employees know what to anticipate from one another, morale typically improves.

Similarly, employees will have much more robust interactions with individuals outside the organisation if their messages are easily understood. When both sides can write coherently, coordinating meetings, establishing objectives, and negotiating contracts become much simpler.

Ways for Enhancing Business Writing

Those concerned with their business writing have multiple possibilities for enhancing their talents. Here are some things to consider:

- Take extra time: In many instances, a person can improve their writing by taking additional time to produce and then proofread messages. Workers should view business communications as projects in their own right, not as tasks to be accomplished as soon as feasible. Essential letters and emails should be written at least a few hours before they are sent so that the writer can take a break from the article and evaluate it with fresh eyes.

- Use a grammar checker: Most word processing software contains a grammar checker, but independent tools provide more thorough proofreading and feedback for greater clarity.

- Ask for feedback: After composing an especially significant letter or email, it may be prudent for an employee to request comments from his manager or a co-worker.

- Get tutoring or take a class: There are numerous educational programme options for enhancing one's writing skills, including tutoring and classes. Many business writing courses offered by community colleges and adult education programmes can be taken online.

5.1.5. Effective Verbal Communication

The utilisation of voice and words facilitates verbal communication. Words, sounds, languages, and the physical act of speaking are the primary components of verbal communication. The majority of verbal communication consists of informal interactions with others. There is a clear and intimate communication link between senders and recipients in verbal communication. Poor language, physical limitations, inadequate communication techniques, and subjective opinions are all issues that might arise during verbal communication.

Importance of Verbal Communication at the Workplace:

Correcting wrong: Assume there was a file to be saved, and you made a minor error in protecting it. The phrase "I apologise for the error" will save you. The word "Sorry" is effective since it is part of spoken communication.

Persuade someone: If you need to convince your co-worker to join a project, persuasive techniques can help. Your verbal communication talent is necessary to persuade them to join you.

Create a relationship: If you are new to a workplace, you can create a relationship by speaking with a colleague. By attempting to communicate with others, new relationships may be formed, as this is impossible without verbal communication.
Bringing clarity: There is a minor issue that has to be clarified for the other members, and you might do so by utilising correct syntax and semantics. Proper grammar will help the reader understand your message, especially in emails, memos, etc.

Increases productivity: It would be impossible to achieve maximum output without effective communication among team members. Teams with effective lateral communication and group discussion provide superior outcomes.Teams with effective lateral communication and group discussion provide superior outcomes.

Increase job satisfaction: Empowering employees through upstream and downward communication indicates enhanced job satisfaction. Through the upward flow of information in the form of employee feedback, and if their superiors respond by listening to them, this suggests that the employees are empowered.

Sharing ideas: There must be a two-way flow of ideas while communicating within a group or organisation. The organisation will undoubtedly see greater success if there is a venue for sharing ideas.

Removes barriers: Effective communication eliminates barriers between the working management and personnel. Appropriately toned and decoded words for the employees will function as a bridge. Communication that is open and honest is the key to success.

Gives motivation: Appropriately timed words of encouragement and praise from management boost the confidence of employees, which in turn increases their output. As motivation directly affects productivity, verbal communications such as emails, memos, announcements, newsletters, etc., play a significant role in providing feedback and recognising employees.

5.1.6. 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.

5.1.7. 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.

5.1.8. 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.

Unit 5.2 – Working Effectively and Maintaining Discipline at Work

Unit Objectives

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

- Explain the effects and benefits of timely actions relevant to the task at hand with examples.
- Discuss how to take initiative in resolving issues among co-workers in a given situation.
- Discuss reporting procedure followed at the workplace.

5.2.1. Discipline at Work

Discipline is essential for organizational success. It helps improve productivity, reduce conflict and prevent misconduct in the workplace. It is important to have rules concerning workplace discipline and ensure that all employees comply with them. In the absence of discipline, a workplace may experience conflicts, bullying, unethical behaviour and poor employee performance. An efficient workplace disciplinary process helps create transparency in the organization. Benefits of disciplinary standards:

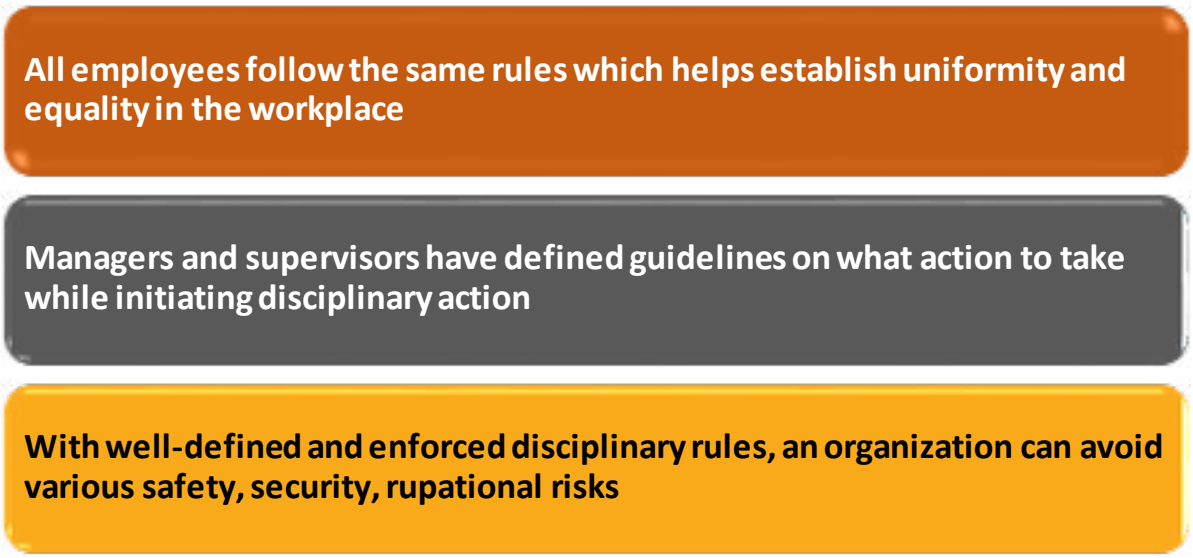

Fig 5.2.1 Benefits of Disciplinary Standards

Maintaining an organized and cohesive workforce requires maintaining discipline in both personal and professional behaviour. It is important to follow the appropriate measures to keep employees in line without affecting their morale.

Defining Discipline

The first and crucial step in maintaining workplace discipline is to define what is meant by discipline. It helps to evaluate common discipline problems and devise guidelines for handling them effectively.

Among a number of areas, discipline usually covers:

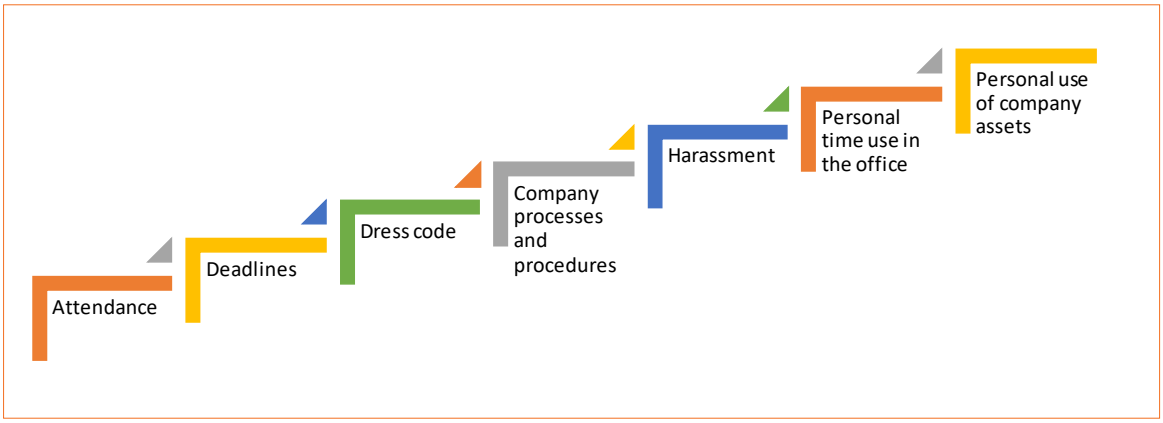

Fig 5.2.2 Examples of Workplace Discipline

According to demography and local issues, it may also include substance use and related issues.

It is vital for a workplace to have an employee handbook or company policy guide, to serve as a rulebook for employees to follow. The employee handbook/ company policy guide should be reviewed and updated periodically according to any issues or areas, or concerns identified concerning workplace discipline. Such manuals should also cover all the laws and regulations governing workplace behaviour.

Defining and documenting workplace rules aids in their implementation, ensuring little or no ambiguity. All employees in a workplace should also have easy access to the workplace guidelines so that they can refer to them to get clarity whenever required. To maintain discipline at work, it is also critical to ensure uniform application of workplace guidelines to all employees without exception.

5.2.2. Time Management

Time management is not about working harder; rather, it is about working smarter so that employees do not overburden themselves and create unnecessary strain. By effectively managing their time, employees will meet deadlines, increase their effectiveness, become more productive, and produce superior work.

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.

5.2.3. Interpersonal Conflicts

Interpersonal conflict is any type of conflict between two or more people. These are found in both - personal and professional relationships - among friends, family, and co-workers. In the workplace, interpersonal conflict is often observed when a person or group of people interfere with another person's attempts at completing assignments and achieving goals. It is critical to resolve conflicts in the workplace to boost the morale of employees, repair working relationships among them, and improve customer satisfaction.

Reasons for Workplace Conflicts

Workplace conflicts are often observed when two or more people have different points of view. This can happen between managers, co-workers, or clients and customers. In general, interpersonal conflicts are caused by a lack of communication or unclear communication.

Some of the leading reasons for workplace conflicts are:

- Difference in values
- Personality clashes
- Poor communication

Example of poor communication – if a manager reassigns a task to another employee without communicating with the employee to whom it was originally assigned, interpersonal conflict can arise among them. This may potentially make the first employee, i.e. who was originally assigned the task, feel slighted and mistrusted by the manager. It may even cause animosity in the first employee toward the employee who has now been assigned the task.

Types of Interpersonal Conflict

Following are the four types of interpersonal conflicts:

a. Policy-related interpersonal conflict

When a conflict relates to a decision or situation that involves both parties, it can be called a policy-related interpersonal conflict. Example – two people or groups working on the same project, trying to adopt different approaches. To resolve policy-related interpersonal conflicts, the parties involved should try to look for a win-win situation or make a compromise. This is especially critical to resolve trivial issues so that work is not affected and common goals are achieved.

b. Pseudo-conflicts

Pseudo-conflict arises when two people or groups want different things and cannot reach an agreement. Pseudo-conflicts usually involve trivial disagreements that tend to hide the root of the issue.

c. Ego-related interpersonal conflicts

In ego conflicts, losing the argument may hurt or damage a person's pride. Sometimes ego conflicts arise when a number of small conflicts pile up on being left unresolved. To resolve ego-related conflicts, it's best to find the root of the issue and work towards a resolution.

d. Value-related interpersonal conflicts

Sometimes conflicts may occur between people when they have different value systems. Such conflicts can be difficult to identify initially, making the people involved think the other party is being disagreeable or stubborn, wherein they just have different values. Some co-workers may highly value their personal/ family time after office that they may be unreachable to clients during non-office hours, while others may place a high value on client satisfaction and may still be available for clients during non-office hours. Conflict may arise among such people when they may be required to coordinate to help a client during after-office hours. Value-related interpersonal conflicts are often difficult to settle since neither party likes to compromise.

Resolving Interpersonal Conflicts

Conflicts are usually likely in the workplace; they can, however, be prevented. Often resolving interpersonal conflicts through open communication helps build a stronger relationship, paving the way for effective coordination and success. Some ways to resolve interpersonal conflict:

- **Communication -** A great way to resolve interpersonal conflicts is for the opposing parties to listen to one another's opinions and understand their viewpoints. Meeting in person and keeping the conversation goal-oriented is important. One can have effective communication by following some measures, e.g. staying on the topic, listening actively, being mindful of the body language, maintaining eye contact, etc.

- **Active Listening -** One should patiently listen to what the other person is saying without interrupting or talking over them. It helps one display empathy and get to the root of the issue. Asking questions to seek clarification when required helps in clear communication and conveys to the other person that one is listening to them. Practising active listening is a great way to improve one's communication skills.

- **Displaying Empathy -** Listening attentively and identifying the anxieties/ issues of co-workers is a great way to show empathy and concern. It is essential to understand their feelings and actions to encourage honesty and avoid future conflict.

- **Not Holding Grudges -** With different types of people and personalities in a workplace, it is common for co-workers to have conflicts. It is best to accept the difference in opinions and move on. Being forgiving and letting go of grudges allows one to focus on the positive side of things and perform better at work.

Work-related interpersonal conflicts can be complicated because different people have different leadership styles, personality characteristics, job responsibilities and ways in which they interact. One should learn to look above interpersonal conflicts, resolving them to ensure work goals and environment are not affected.

5.2.4. Reporting Inappropriate Behaviour in the Workplace

Every company should have a Human Resource (HR) department, which is designed to assist employees in crises. Effective HR practices safeguard the interests of employers and employees.
The lack of physical evidence in most grievances or harassing actions should not stop a victim from submitting a formal report. It is important to report workplace harassment since there may be complaints from other victims who have experienced similar acts from the same offender.

The following measures should be taken to report inappropriate behaviour in the workplace:

- Examine the Organisation Manual: Check the organisation's policies and procedures to see if the behaviour one witnessed is illegal. If one has first-hand knowledge of a clear policy breach, one's reports of unethical activity are more likely to be taken seriously.

- Submit an Anonymous Report: Employers expect one to report unethical behaviour in the workplace, such as false overtime claims, showing up for work drunk, or lying to customers. If one is worried about putting one's name on the complaint, weigh the benefits and drawbacks of reporting anonymously.

- Submit a Signed Written Report: Follow the correct processes for reporting suspected ethical violations. Instructions are usually found in the corporate handbook or a code of conduct guideline for employees. The report's credibility is enhanced by the inclusion of details. Any supporting material, such as emails, should be attached. If the unethical behaviour being reported is serious and unlawful, one should document everything in case one is questioned during an inquiry or summoned to court.

- Request a Private Meeting: Consider speaking with one's boss to express dissatisfaction with unethical actions. Bring any supporting documents, such as a suspicious expenditure report submitted by an employee who failed to attach receipts. When making claims of unethical activity, remain cool and professional.

Unit 5.3 – Maintaining Social Diversity at Work

Unit Objectives

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

- Discuss about gender and its related concept: gender equality, gender equity (group work)
- Discuss different types of disabilities (physical, mental, intellectual or sensory impairment).
- Discuss the activities sensitive to the cultural diversity, disabilities and gender neutrality at the workplace.
- Discuss the basic rules and regulations related to gender sensitivity, disabilities, and cultural diversity, with their impact on operations of a workplace.
- Demonstrate acceptable interpersonal transactions with individuals having disabilities (physical, mental, intellectual or sensory impairment) or cultural diversity.
- Demonstrate the process modifications required to make the workplace free from gender biases

5.3.1. Gender Sensitivity

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

Fig 5.3.1 Gender Equality

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

Important Terms

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

Strategies for Enhancing Gender Equity

To enhance gender equity, one should:

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

Bridging Gender Differences

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

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

- Not categorize all men and women in one way.
- Be aware of the verbal and non-verbal styles of communication of every gender to avoid any miscommunication and work better.
- Be aware of partial behaviour and avoid it.
- Encourage co-workers of different genders to make room by providing space to others.

Ways to reduce Gender Discrimination

- Effective steps against sexual harassment by the concerned authorities and general public.
- Gender stereotypes are how society expects people to act based on their gender. This can only be reduced by adopting appropriate behaviour and the right attitude.
- Objectification of females must be abolished.

Ways to Promote Gender Sensitivity in the Workplace

- Practices that promote gender diversity should be adopted and promoted.
- All genders should receive equal responsibilities, rights, and privileges.
- All genders should have equal pay for similar or the same job roles/ positions.
- Strict and effective workplace harassment policies should be developed and implemented.
- An open-minded and stress-free work environment should be available to all the employees, irrespective of their gender.
- Women should be encouraged to go ahead in every field of work and assume leadership roles.
- Follow appropriate measures for women's empowerment.
- Men should be taught to be sensitive to women and mindful of their rights.

5.3.2. PwD Sensitivity

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

Important Terms

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

  a. Blindness – Visually impaired
  b. Low Vision
  c. Leprosy Cured
  d. Hearing impairment
  e. Locomotor disability
  f. Mental retardation
  g. Mental illness

PwD Sensitivity

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

Ways to be PwD Sensitive

To be sensitive to PwD, one should:

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

Appropriate Verbal Communication

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

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

Appropriate Non-verbal Communication

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

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

- Touch - Touch is a very sensitive type of non-verbal communication. Examples are - handshakes, hugs, pat on the back or head, gripping the arm, etc. A firm handshake indicates interest, while a weak handshake indicates the opposite. One should be extra cautious not to touch others inappropriately and avoid touching them inadvertently by maintaining a safe distance.

Rights of PwD

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

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

Making Workplace PwD Friendly

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

Expected Employer Behaviour

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

- **Cooperation:** No work is successful without cooperation from the employer's side. Cooperation helps to understand the job role better and complete it within the given timeline.

- **Polite language:** Polite language is always welcomed at work. This is a basic aspect that everybody expects.

- **Positive Attitude:** Employers with a positive attitude can supervise the work of the employees and act as a helping hand to accomplish the given task. A person with a positive attitude looks at the best qualities in others and helps them gain success.

- **Unbiased behaviour:** Employers should always remain fair towards all their employees. One should not adopt practices to favour one employee while neglecting or ignoring the other. This might create animosity among co-workers.

- **Decent behaviour:** The employer should never improperly present oneself before the employee. One should always respect each other's presence and behave accordingly. The employer should not speak or act in a manner that may make the employee feel uneasy, insulted, and insecure.

Exercise

1. List down the Ways for Enhancing Business Writing.
2. Explain in short PwD Sensitivity and Gender Sensitivity.
3. State some Adverse Effects of Poor Communication.
4. Identify two ways of resolving interpersonal conflicts.
5. What do you understand by Workplace Communication?

6. Follow Safety Norms at Wokplace

(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.
- Demonstrate safety techniques to be adopted in case of accidents.
- Demonstrate use of PPEs as per work requirements.
- Demonstrate the methods to clean and disinfect all materials, tools and supplies before and after use.
- Demonstrate the procedure to report to the concerned authority regarding the outbreak/ hazard of any infectious disease/ pandemic.
- List different types of infectious disease that can spread/ originate at a construction site
- Discuss the ways of transmission of the various infectious disease.
- 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.

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

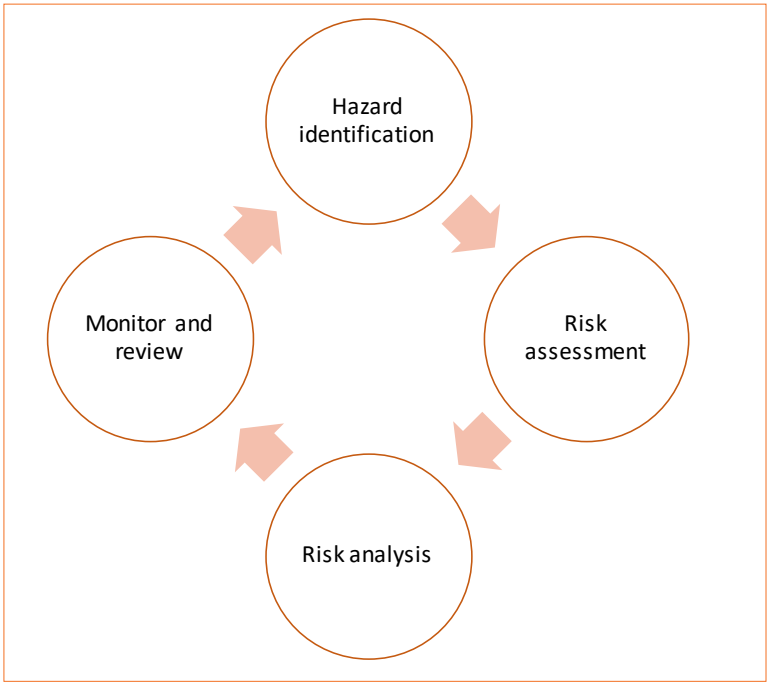

Fig. 6.1.1 HIRA Process

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. Cleanliness in the Workplace

Workplace cleanliness maintenance creates a healthy, efficient and productive environment for the employees. Cleanliness at the workplace is hindered by some elements like cluttered desks, leftover food, waste paper, etc. A tidy workplace is said to improve employee professionalism and enthusiasm while also encouraging a healthy working environment.

Benefits of cleanliness in the workplace:

1. Productivity: Cleanliness in the workplace can bring a sense of belonging to the employees, also motivating and boosting the morale of the employees. This results in increasing their productivity.
2. Employee Well-being: Employee well-being can be improved by providing a clean work environment. Employees use fewer sick days in a workplace where litter and waste are properly disposed of, and surfaces are cleaned regularly, resulting in increased overall productivity.
3. Positive Impression: Cleanliness and orderliness in the workplace provide a positive impression on both employees and visitors.
4. Cost saving: By maintaining acceptable levels of cleanliness in the workplace, businesses can save money on cleaning bills and renovations, which may become necessary if the premises are not properly kept.

Reasons for cleaning the workplace

- Cleaning of dry floors, mostly to prevent workplace slips and falls.
- Disinfectants stop bacteria in their tracks, preventing the spread of infections and illness.
- Proper air filtration decreases hazardous substance exposures such as dust and fumes.
- Light fixture cleaning improves lighting efficiency.
- Using environmentally friendly cleaning chemicals that are safer for both personnel and the environment.
- Work environments are kept clean by properly disposing of garbage and recyclable items.

6.1.6. 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.	

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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

6.1.7. Prevention of Accidents at Construction Site

Construction sites are the most hazardous of all industrial locations. Accidents occur more frequently on construction sites than at other workplaces. More frequently than other workers, construction site employees encounter hazardous safety hazards. According to a survey by the Occupational Safety and Health Administration (OSHA), one out of every five fatalities on the job is a construction worker. The vast majority of these incidents can be avoided through safe operations and basic safety procedures. By adhering to basic health and safety protocols, the likelihood of risks and dangers occurring while working on a building site can be significantly decreased. The contractors can take a number of steps to ensure that their staff are well-versed in the safety and health procedures that must be implemented to minimise the likelihood of accidents.

Here are some safety measures that can be taken to avoid accidents -

- **Enforce Constant Use of Protection Gears and Utilities -** On-site employees should be required to always wear the proper protective gear. The usage of this protective equipment considerably reduces the likelihood of accidents and incidents. This is shorthand for Personal Protective Equipment (PPE). Typical PPE includes hard helmets, gloves, safety boots, safety goggles, earplugs, high visibility clothes, etc.

- **Safety Training for All Employees Prior to Employment -** Prior to beginning work on construction projects, all employees must undertake mandatory safety training. Workers must be educated about the risks associated with their workplace. They should evaluate the health and safety policies applicable to their place of employment. They should not use any equipment unless they have received training or are otherwise qualified.

- **Periodic Worker Safety Sessions -** The safety officer should call for these meetings on a regular basis. All employees are required to attend these safety sessions in order to discuss important risks and hazards on the job site. To avoid errors, these sessions should be quick and employees should be asked to maintain concentration.

- **Plan based on existing dangers -** A construction site should be thoroughly assessed for potential dangers before to the start of the project and during its execution. This type of risk inspection and further evaluation safeguards the health and safety of workers. To lessen the impact of the dangers, preventive steps should be adopted. These dangers should be incorporated into safety training and discussions.

- **Maintenance of Equipment -** All equipment present on a construction site, whether in operation or not, should be routinely inspected. Every piece of equipment must be in proper operating order. A simple malfunction in any of the equipment might result in severe injury or even death.

- **Maintaining a Clean Workspace -** By keeping the construction site clean and clear of debris, accidents can be avoided. If the location is messy, accidents such as Slips, Trips, and Falls could occur. Materials and equipment should be kept in their right locations, as strewn objects increase the likelihood of accidents. All areas used by the workers for transportation should be kept free of debris.

- **Utilization of equipment properly -** The equipment available on the job site must be utilised according to the manufacturer's instructions. There is no assurance of safety if equipment and tools are utilised in a manner for which they were not intended.
- **Taking Frequent Breaks –** Working on construction sites for extended periods of time can be physically and mentally draining. Workers can become fatigued and lose concentration, which increases the risk of accidents. Working lengthy hours continuously should be prohibited. Shift workers should be provided with breaks so that they can remain focused and productive while performing their duties.
- **Prevent Falls -** Almost one-third of construction site fatalities are caused by falls. Falls without scaffolding are the most prevalent sort of falls that can be readily avoided by using the proper safety equipment. On-site installation of fall protection systems can increase the safety of workers.

6.1.8. Prevention of Infectious Diseases

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

Viral infections. Viruses are information (DNA or RNA) enclosed in a protective shell (capsid). Viruses are significantly smaller than human cells and are incapable of self-reproduction. They utilise the machinery within your cells to generate copies of themselves.

- **Bacterial infections.** Bacteria are unicellular organisms whose instructions are encoded on a little fragment of DNA. Bacteria are everywhere, even within our bodies and on our skin. Many bacteria are innocuous or even beneficial. However, certain bacteria produce toxins that can cause illness.
- **Fungal infections.** Like bacteria, there are numerous types of fungi. They continue to exist in your body. You can become ill if your fungi become overgrown or hazardous fungi enter your body through your mouth, nose, or a cut in your skin.
- **Parasitic infections.** Parasites utilise the bodies of other creatures for reproduction and survival. Parasites consist of worms (helminths) and particular unicellular creatures (protozoa).
- **Transmissible spongiform encephalopathies (TSEs/prion diseases).** TSEs are produced by prions, which are defective proteins that cause other proteins in the body, typically in the brain, to become defective. Your body is unable to utilise or eliminate these proteins, so they accumulate and cause illness. Prions are extremely uncommon infectious disease agents.

Infectious diseases are extremely common worldwide, but some are more common than others. Some of the most common infectious diseases are listed here by type.

Common infectious diseases caused by viruses:

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

Common infectious diseases caused by bacteria:

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

Common infectious diseases caused by fungi:

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

Common infectious diseases caused by parasites:

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

Prevention:

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

Vaccines

Vaccines lessen the likelihood of contracting an infectious disease by preparing the immune system to recognise and combat dangerous invaders. Vaccinated individuals may occasionally still get an illness, although their symptoms are typically milder than they would have been without vaccination.

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

- Chickenpox.
- COVID-19.
- Diphtheria, tetanus, and whooping cough (whooping cough).
- The virus Hepatitis A.
- The virus Hepatitis B.
- Human papillomavirus (HPV).
- Influenza.
- Malaria.
- Rubella, measles, and rubella.
- Polio.
- Rotavirus.
- Rabies.
- Shingles.
- Tuberculosis.

The CDC provides current vaccination recommendations for children, adolescents, and adults. Before you travel, ensure that you have had all of the necessary vaccines for your location.

Other methods of infectious illness prevention

In addition to immunisations and appropriate food handling procedures, you can lower your risk of contracting or transmitting an infectious disease by a few common actions.

- Hands should be washed with soap and water. Before making a meal or eating, after using the restroom, after contact with faeces (human or animal), and after gardening or dealing with dirt, it is essential to wash hands thoroughly.
- When you sneeze or cough, cover your nose and mouth.
- Sanitize regularly touched surfaces in your home and place of business.
- Avoid contact with infectiously ill individuals and the exchange of personal goods with them.
- While suffering from an infectious ailment, you should avoid contact with others.
- Do not drink or swim in potentially contaminated water.
- When sick or as recommended by the CDC, you should wear a mask in public.
- Always use a condom during sexual activity.
- To limit the risk of tick or mosquito bites, apply tick- and mosquito-approved insect repellent, cover as much exposed skin as possible with clothing, and check for ticks after spending time in wooded or grassy areas.

6.1.9. 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, cleanup, and restoration.
e. A comprehensive report shall be compiled based on the complete incident experience, including restorations, restrictions, and lessons learned.

6.1.10. 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.

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 (CO_2).
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 – Personal Hygiene and Safety Measures

Unit Objectives

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

- Demonstrate the practices to maintain personal hygiene, workplace hygiene and site/ workplace sanitization.
- 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.

6.3.1. Personal Hygiene and Cleanliness

Maintaining personal hygiene and cleanliness at work is essential for ensuring own and co-workers' wellbeing. Working in a hygienic environment helps in maintaining, even increasing productivity as employees do not fall sick often.

With the regular washing of hands and the use of recommended hand sanitiser, one can ensure that they don't transmit germs to their co-workers while shaking hands or using shared tools and equipment. Similarly, if one feels unwell after catching a cold, they should either not go to work, or use a face mask appropriately to ensure they do not transmit the infection to others through the air when they cough.

In case of a health emergency or workplace injuries/ accidents, one must inform their supervisor immediately to seek appropriate help, such as first-aid or hospitalisation.

Fig. 6.3.1 Rules of Workplace Personal Hygiene

Good hygiene is essential because it prevents you and others from contracting or transmitting infectious illnesses and germs.

Importance of Informing on Personal Health Issues

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

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

6.3.2. 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.

6.3.3. 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.

10 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.

6.3.4. Workplace Cleanliness and Sanitization

Maintaining cleanliness in the workplace not only promotes a healthier atmosphere for workers, but also tends to assist businesses in being more productive and effective. Cluttered workstations, uneaten food, and discarded paper are among the most frequent contributors to a disorganised workplace. It is stated that a clean workplace enhances the professionalism and motivation of workers and promotes a healthy working environment.

The following advantages illustrate why workplace hygiene is important:

Fig 6.3.2 Advantages of workplace cleanliness

Productivity

Provisions for a clean atmosphere may boost staff productivity. Cleanliness may increase employee motivation and morale, hence fostering a sense of belonging inside an organisation. Placing free-standing or wall-mounted trash cans around the workplace to make garbage disposal simple is one of the simplest strategies to promote this behaviour.

Well-being

Providing a clean workplace contributes to the maintenance of staff health. In a workplace where trash and garbage are properly disposed of and surfaces are routinely cleaned, workers take fewer sick days, resulting in increased overall productivity.

Impression

The workers and visitors of a firm are positively impacted by a clean and orderly workplace. Therefore, it is prudent to maintain cleanliness and hygiene not only inside but also in any outside spaces. Outdoor trash cans and ashtrays are available for purchase by businesses for outdoor and smoking areas.

Cost saving

By keeping high standards of cleanliness in the workplace, businesses may save money on cleaning expenses and renovations, which may be required if the space is not well maintained.

Best practices for workplace cleanliness are:

The following are some useful practises to introduce and urge everyone to adopt:

Normal (and correct) hand washing

This is among the most efficient methods for preventing the spread of germs. Encourage your staff to form the practise of washing their hands thoroughly, particularly before eating and after using the toilet. Place hand sanitizers or alcohol in strategic spots for use between hand washings.

Allow sick employees to work remotely

Remote work is a win-win scenario for both you and your sick employee: you can shield the rest of your staff from sickness, and your sick employee can continue to be productive and complete important tasks (assuming they don't call in sick instead).

Invest in secure and efficient cleaning products

Not all cleaning products are equivalent. Take a close look at the labels of typical cleaning products, such as cleansers, degreasers, and disinfectants, and you will discover that they include a number of dangerous substances. Choosing a choice of safe and efficient cleaning solutions protects the health of your employees. In addition, it enables your janitorial crew to clean effectively, saving you both time and money.

Establish a cleaning schedule for staff

Educate and constantly remind your employees of the significance of maintaining a clean workplace and why everyone should contribute to spot cleaning. Encourage your employees to follow a simple and straightforward cleaning routine, such as wiping down their office desks (including computer keyboards, mice, and telephones) with a sanitising spray once or twice daily; and keeping communal spaces, such as the kitchen (including microwaves, refrigerators, and sinks), clean.

6.3.5. 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.

6.3.6. 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

6.3.6. Vertigo Test

Vertigo is a symptom, not a condition in and of itself. Vertigo is a sort of dizziness that is frequently described as the sensation that one is spinning or that the world is spinning around them, especially when they alter their position. Vertigo affects people of all ages. Middle ear pathology is typically the culprit in younger patients. The danger of falls and associated sequelae necessitates a specialised assessment of the elderly. The key to arriving at a diagnosis is distinguishing vertigo from other causes of dizziness or imbalance, as well as distinguishing central causes of vertigo from peripheral causes.

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

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

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.

Unit 6.4 – Waste Management

Unit Objectives

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

- Demonstrate safe waste disposal practices followed at construction site.
- Explain different types of waste at construction sites and their disposal method.

6.4.1. Waste Management and Methods of Waste Disposal.

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

The importance of waste management is:

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

6.4.2. Methods of Waste Management

Non-biodegradable and toxic wastes, such as radioactive remains, can cause irreversible damage to the environment and human health if they are not properly disposed of. Waste disposal has long been a source of worry, with population increase and industrialisation being the primary causes. Here are a few garbage disposal options.

1. **Landfills:** The most common way of trash disposal today is to throw daily waste/garbage into landfills. This garbage disposal method relies on burying the material in the ground.

2. **Recycling:** Recycling is the process of transforming waste items into new products in order to reduce energy consumption and the use of fresh raw materials. Recycling reduces energy consumption, landfill volume, air and water pollution, greenhouse gas emissions, and the preservation of natural resources for future use.

3. **Composting:** Composting is a simple and natural bio-degradation process that converts organic wastes, such as plant remnants, garden garbage, and kitchen waste, into nutrient-rich food for plants.

4. **Incineration:** Incineration is the process of combusting garbage. The waste material is cooked to extremely high temperatures and turned into materials such as heat, gas, steam, and ash using this technology.

6.4.3. Waste Management on a Construction Site

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 know 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 and improving safety.

- **Maintain a wholesome working atmosphere:** To maintain a healthy building site, workers will need various 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 the workers can dispose of the trash easily.

- **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. What is Workplace Safety?
4. How to prevent accidents at construction site?

7.Employability Skills (30 Hours)

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

Scan the QR code below to access the eBook

DGT/VSQ/N0101

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

The details of Employability module is available on eskill India. Please find below the link.

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

Annexure-1

Annexure of QR Codes for Helper Electrician

Chapter Name	Unit Name	Topic Name	URL	Page no.	QR Code
Chapter 1: Introduction to Helper Electrician Job Role	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 a Helper Electrician	Role and Responsibilities of a Helper Electrician	https://youtu.be/fwVndSUEeEg	11	Role and Responsibilities of a Helper Electrician
Chapter 2: LV (Low Voltage) Electrical Works Tools, Devices and Materials Handling	Unit 2.1: Understanding Electric Current	Electric Current	https://youtu.be/kAL17fHlv4U	25	Electric Current
		Electric Circuit	https://youtu.be/VnnpLaKsqGU		Electric Circuit
		Parts of Electric Circuit	https://youtu.be/RQ3djos_LY8		Parts of Electric Circuit
		Passive Circuit Elements	https://youtu.be/V93nP6sCmsQ		Passive Circuit Elements
		Circuit Breaker	https://youtu.be/-K8yV1saoKQ		Circuit Breaker

Chapter Name	Unit Name	Topic Name	URL	Page no.	QR Code
		Relay	https://youtu.be/5Baz70n5qhY	25	Relay
		Starter Motor	https://youtu.be/gXKqhFENnQc		Starter Motor
	Unit 2.2: LV Electrical Works	Electrical Drawings	https://youtu.be/IHHCT43sdYM	44	Electrical Drawings
		Hand Tools	https://youtu.be/rBYI10QeoRY		Hand Tools
		Electrical Material	https://youtu.be/vKKhxwn4P4o		Electrical Material
		Electrical Measuring Instruments	https://youtu.be/eS9nA5x0TFo		Electrical Measuring Instruments
Chapter 3: Wall Chasing and External Threading on MS (mild steel) Conduit	Unit 3.1: Electrification of Buildings	Electrification of Buildings	https://youtu.be/2i4ugBLR1KU	64	Electrification of Buildings
		Types of Electric Wiring	https://youtu.be/A5P-buWX-dA		Types of Electric Wiring
		Electrical Fixtures	https://youtu.be/OdnApA_GXsk		Electrical Fixtures

Chapter Name	Unit Name	Topic Name	URL	Page no.	QR Code
Chapter 4: Erect and Dismantle Scaffold	Unit 4.1: Erect and Dismantle Scaffold	Scaffolding Components	https://www.youtube.com/watch?v=wdcq4EYST2c	81	Scaffolding Components
		Dismantling the Scaffold	https://www.youtube.com/watch?v=OKawvyUhUkA		Dismantling the Scaffold

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