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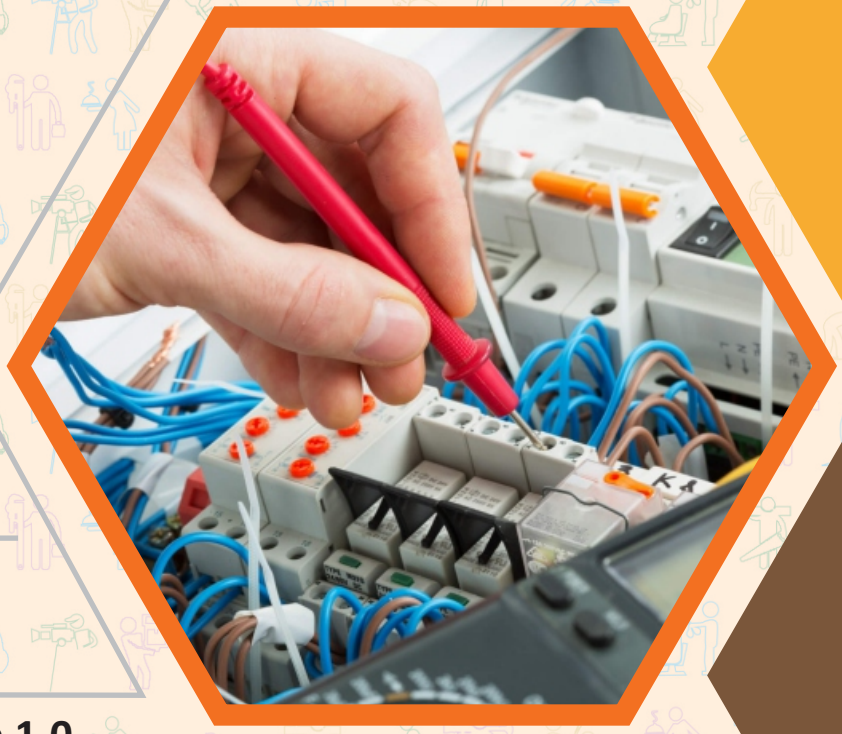
Participant Handbook



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Industrial Automation

Occupation
Engineering-I&A

Reference ID: **ELE/Q7104, Version 1.0**
NSQF Level 5

Building Management System Service Engineer

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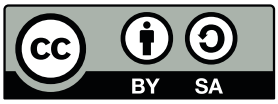

> Skilling is building a better India. If we have to move India towards development then Skill Development should be our mission.

Shri Narendra Modi
Prime Minister of India

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Certificate

COMPLIANCE TO
QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

ELECTRONICS SECTOR SKILL COUNCIL OF INDIA

for

SKILLING CONTENT : PARTICIPANT HANDBOOK

Complying to National Occupational Standards of

Job Role/Qualification Pack

"Building Management System Service Engineer" QP No. **"ELE/Q7104, NSQF Level 5"**

Date of Issuance: February 24th, 2022
Valid up to*: June 2nd, 2025

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

Authorized Signatory
Electronics Sector Skill Council of India

Acknowledgments

This participant's handbook meant for Building Management System Service Engineer 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. We'd also like to thank all the experts and organizations who have helped us by reviewing the content and providing their feedback to improve its quality.

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

About this book

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

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

The handbook details the relevant activities to be carried out by a Building Management Service Engineer. After studying this handbook, job holders will be adequately skilled to carry out their duties efficiently according to the applicable quality standards. The handbook is aligned with the following National Occupational Standards (NOS) detailed in the Building Management Service Engineer QP:

- ELE/N7205: Prepare for installing the BMS
- ELE/N7206: Carry out the installation of BMS
- ELE/N7208: Carry out commissioning and testing of BMS
- ELE/N7207: Carry out repair and maintenance of BMS
- ELE/N9905: Work effectively at the workplace
- ELE/N1002: Apply health and safety practices at the workplace

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. We sincerely hope that participants will obtain enhanced knowledge and skills after studying this handbook and make career progress in the relevant and senior job roles.

Symbols Used


Key Learning Outcomes


Exercise


Notes


Unit Objectives

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1. Introduction

Unit 1.1 - Overview of the Electronics Industry

Unit 1.2 - Job Responsibilities and Career Opportunities for a BMS Service Engineer

Key Learning Outcomes

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

1. Discuss the Electronics industry and its sub-sectors.
2. Discuss the job role of a BMS Service Engineer.

UNIT 1.1: Introduction to the Electronics Sector in India

Unit Objectives

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

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

1.1.1 Size and Scope of the Electronics Industry and Its Sub-Sectors

The Indian Electronics System Design & Manufacturing (ESDM) industry is one of the vital sectors of the Indian economy. The country has witnessed a substantial spike in demand for electronic products in the last few years. Today, India is positioned as the second-largest mobile phone manufacturer globally, with a surging internet penetration rate.

The ESDM sector is playing a vital role in the Indian government's goal of generating US$ 1 trillion of economic value from the digital economy by 2025. With several government initiatives aiming to boost domestic manufacturing, India is witnessing increased production and assembly activities across products, such as consumer electronics and mobile phones.

Market Size

- The Indian electronics manufacturing industry is projected to reach US$ 520 billion by 2025.
- In FY22 (until October 2021), imports of electronics goods stood at US$ 28.59 billion, whereas exports stood at US$ 7.89 billion.
- The demand for electronic products is expected to rise to US$ 400 billion by 2025 from US$ 33 billion in Fy20.
- The electronics market has witnessed a growth in demand, with market size increasing from US$ 145 billion in FY16 to US$ 215 billion in FY19—the market witnessed a growth of 14% CAGR from 2016-19.
- India's exports of electronic goods were valued at US$ 11.7 billion in FY21.
- Smartphone shipments in India increased by ~82% YoY to reach 33.0 million units in the second quarter of 2021.
- The Electronics System Design & Manufacturing (ESDM) is broadly segregated into—electronics system and electronics design.
- The electronics system market is expected to witness 2.3x demand of its current size (FY19) to reach US$ 160 billion by FY25.

- Electronics design segment, growing at 20.1%, was 22% of the ESDM market size in FY19; it is anticipated to be 27% of the ESDM market size in FY25.
- India's consumer electronics and appliances industry is expected to become the 5th largest globally by 2025.
- According to the Department for Promotion of Industry and Internal Trade, from April 2000 to June 2021, Foreign Direct Investment (FDI) equity inflows stood at US$ 3,176.29 million.

1.1.2 Sub-Sectors of the Electronics System Design & Manufacturing (ESDM) Industry

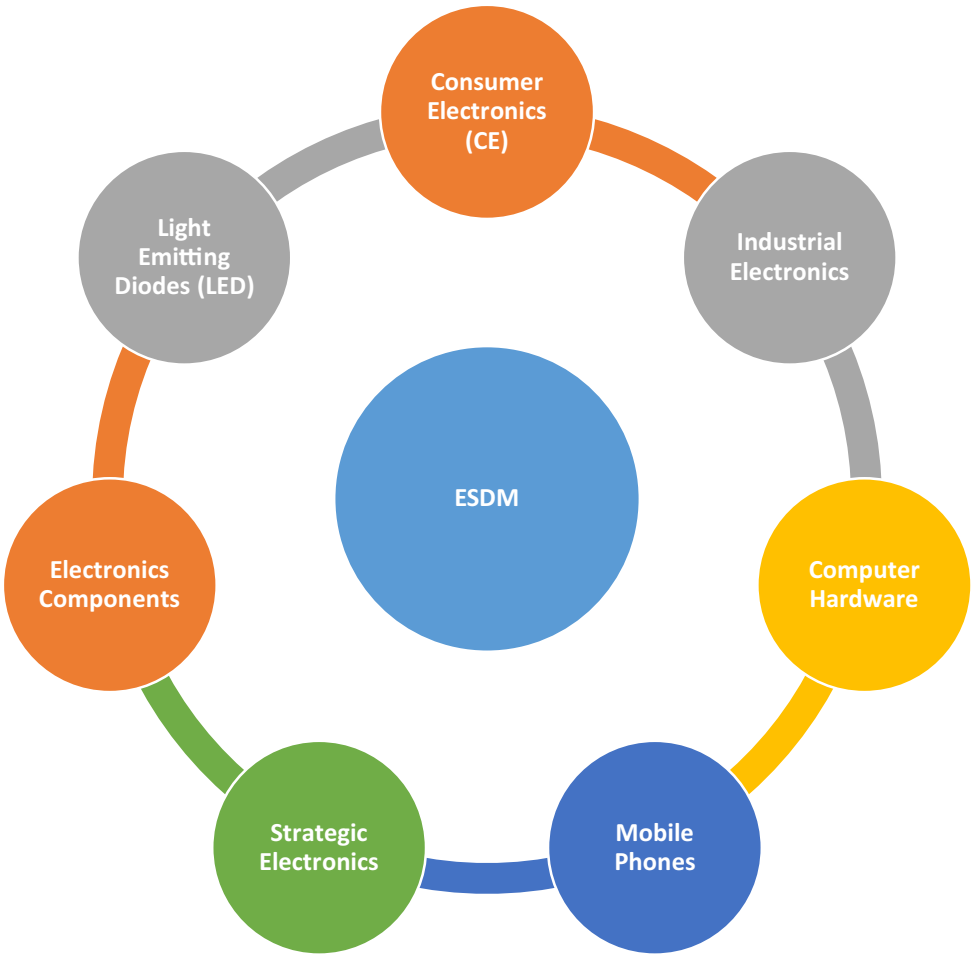

Fig. 1.1.1 Sub-sectors of the Electronics System Design & Manufacturing (ESDM) Industry

Notes

Scan the QR Code to watch the related videos

https://www.youtube.com/watch?v=JgLu40JBa-c
Electronic Industry overview

https://www.youtube.com/watch?v=eod1cID3aUQ
Building Management System (BMS)

UNIT 1.2: Job Responsibilities and Career Opportunities for a BMS Project Manager

Unit Objectives

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

1. Discuss the role and responsibilities of a BMS Service Engineer.
2. Explain the personal attributes required in a BMS Service Engineer.
3. Identify the career progression opportunities for a BMS Service Engineer.

1.2.1 Job Responsibilities of a BMS Service Engineer

A Building Management System (BMS) Service Engineer has the following primary job responsibilities:

- Preparing for the installation of BMS, which includes the following activities:
  - ❖ Checking the availability of required resources
  - ❖ Checking and testing the received resources
  - ❖ Preparing for installing the BMS
- Carrying out the installation of BMS, which includes the following activities:
  - ❖ Installing conduits and carrying out wiring
  - ❖ Installing the Direct Digital Controller (DDC) with field devices
  - ❖ Installing the central peripherals
  - ❖ Installing the motion sensors
  - ❖ Installing the duct air temperature sensor and duct temperature/ humidity sensor
  - ❖ Installing the water differential pressure sensor
  - ❖ Installing the air differential pressure sensor
  - ❖ Installing the immersion water temperature sensor
  - ❖ Installing the smoke detectors in AC ducts
  - ❖ Installing the butterfly valves

- Carrying out commissioning and testing of BMS, which includes the following activities:
  - ❖ Carrying out pre-commissioning of BMS
  - ❖ Carrying out commissioning of DDC panels
  - ❖ Carrying out commissioning of the Fan Coil Unit (FCU)
  - ❖ Testing the digital and analogue inputs and outputs
  - ❖ Testing the communication link, printer and alarms
  - ❖ Testing the third-party system interface connectivity
- Carry out repair and maintenance of BMS, which includes the following activities:
  - ❖ Carrying out repair and maintenance of BMS field devices
  - ❖ Carrying out repair and maintenance of electrical panels
  - ❖ Managing the BMS helpdesk, complaints and requests
  - ❖ Maintaining the records
- Working effectively at the workplace, which includes the following activities:
  - ❖ Communicating effectively at the workplace
  - ❖ Working effectively
  - ❖ Maintaining and enhancing professional competence
  - ❖ Working in a disciplined and ethical manner
  - ❖ Upholding social diversity in the workplace
- Following health and safety practices at the workplace, which includes the following activities:
  - ❖ Dealing with workplace hazards
  - ❖ Applying fire safety practices
  - ❖ Following emergencies, rescue and first-aid procedures
  - ❖ Following effective waste management/recycling practices

1.2.2 Personal attributes of a BMS Service Engineer

A BMS Service Engineer should have some critical personal attributes for performing various tasks effectively. The individual should be in good health with the appropriate stamina to work for long durations with concentration. The person should have attention to detail and problem-solving skills to quickly identify and resolve any issues with the building management system.

The individual often works in a team environment that requires him/her to work in coordination with others to achieve the work objectives. This involves appropriate communication skills and amenable behaviour, which help form professional and interpersonal relationships while working in a group. Good communication and strong organizational skills are other essential attributes required in this job role.

1.2.3 Career progression for a BMS Service Engineer

As a BMS Service Engineer gains knowledge and experience, the individual may progress into different job roles, such as:

The immediate job role one can progress into is the BMS Project Manager. With adequate experience as per industry standards, one may take the role of a Mechanical, Electrical and Plumbing (MEP) General Manager.

Alternatively, one can become an Area Sales Officer and later progress into the job role of a Project Manager Electronics and subsequently into the role of a Quality Manager Electronics.

Exercise

1. List down three sub-sectors of the Electronics System Design & Manufacturing (ESDM) Industry.
2. Identify two job roles that a BMS Service Engineer can move into for career progress.

Notes

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2. Process of Preparing for Installing the BMS

Unit 2.1 - Introduction to Building Management System (BMS)

Unit 2.2 - Checking and Preparing the BMS Equipment for Installation

ELE/N7205

Key Learning Outcomes

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

1. Describe the process of checking the availability of required resources.
2. Describe the process of checking and testing the received resources.
3. Demonstrate the process of preparing for installing the BMS.

UNIT 2.1: Process of Preparing for Installing the BMS

Unit Objectives

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

1. Explain what a BMS is.
2. Explain the benefits and features of BMS.
3. Describe the structure of BMS.

2.1.1 Building Management System

A Building Management System (BMS), also known Building Automation System (BAS), is a control system that monitors and manages a building's mechanical, electrical, and electromechanical services. These services include power, heating, ventilation, air conditioning, physical access control, pumping stations, elevators, and lighting.

Fig. 2.1.1 Building Management System

A basic BMS is made up of the relevant software, a server with a database, and smart sensors that are linked to an Internet-capable network. Smart sensors placed throughout the building collect data and transmit it to the BMS, to be recorded in a database. If a sensor sends data outside of pre-defined parameters, the BMS will raise an alarm. In a data centre, for example, when the temperature in a server rack exceeds the permitted limits, the BMS may sound an alarm.

Depending on the system, BMS software can be installed as a standalone application or integrated with other monitoring tools. A more sophisticated BMS may monitor and control a wide range of building services across many platforms and protocols, enabling the building administrators and facility management to get a unified and shared view of the facility's operations.

Building Management Systems are typically used in large projects with complex mechanical, HVAC, and electrical systems.

BMS is often linked to access control, i.e. turnstiles and access doors to control who is permitted to enter and exit a building. Other security systems are also employed to control a building's internal environment, e.g. Closed-Circuit Television (CCTV) cameras and motion detectors. BMS can also monitor fire alarm systems, elevators and escalators. With an advanced BMS – in case of fire, the fire alarm panel may close dampers in the ventilation system to stop smoke from spreading, shut down the air handlers, and start the smoke evacuation fans. It may also send all elevators to the ground level and park them to prevent anyone from using them during a fire.

To safeguard structures from earthquakes, building management systems have also included disaster-response measures (such as base isolation).

2.1.2 BMS Apparatus

BMS is a micro-processor-based system which centralizes and simplifies:

- Controlling
- Monitoring
- Operation and management of heating, air-conditioning, ventilation and other building services to achieve a safe and comfortable working environment, energy-saving and efficient operation at reduced time and cost.

BMS provides a comfortable and safe environment in a building by controlling:

- Air Handling Units
- Fan Coil Units
- Chillers
- Pumps
- Boilers
- Variable Frequency Drives (VFDs), etc.

2.1.3 Components of BMS

- Centralized Workstation Computer – It comes with dedicated software and is used for everyday building operations.
- DDC Controllers – These are micro-processor based and are pre-configured/ freely programmable. These control the HVAC equipment of a building.
- Field devices - Temperature, humidity, and pressure sensors. These also include valves and actuators.

2.1.4 Features of BMS

1. **Machine interface**
   - Interact with the connected technical building equipment.
   - User friendly for operators, engineers and building managers
2. **System security**
   - To prevent unauthorized use
   - Password protection
   - Operator specific access
   - Operator log summary
3. **User-friendly data presentation**
   - Coordination of the flow of information through the system by implementing customized graphics.
   - Floor plans of the building
   - Graphical representation of the equipment
4. **Alarm management**
   - The presentation in the sequence of importance and time of the alarm
   - Potentially dangerous situations
   - Process value deviations
   - Guiding the operator to take appropriate action through audible and visual indications
   - Email and SMS
   - Alarm summary
   - Time, date, priority and description

5. **Data logging**
   - The automatic gathering and storage of data from the field equipment for later analysis and reporting
   - Dynamically or historical
   - Customized charts and graphs
   - Tabular reports
6. **Time scheduling**
   - Time-based start/stop of the equipment
   - Saves energy cost and efficient operation
   - Effective for lighting, occupancy control
   - Can be as daily, weekly, for holidays or events
7. **Event recording**
   - Automatic logging of operator activities and commands
   - Processes related to connected devices
   - Workstations and printers
8. Remote connectivity
   - Provide remote access to the system with full functionality through the local area network and internet via a web browser.

2.1.4 Features of BMS

1. **Machine interface**
   - Interact with the connected technical building equipment.
   - User friendly for operators, engineers and building managers
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   - Password protection
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   - Operator log summary

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- Floor plans of the building
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- The presentation in the sequence of importance and time of the alarm
- Potentially dangerous situations
- Process value deviations
- Guiding the operator to take appropriate action through audible and visual indications
- Email and SMS
- Alarm summary
- Time, date, priority and description

5. Reporting

- Present customized subsets of data.
- The actual or historical state.
- Export as a word or excel document or to a printer.

2.1.5 Benefits of BMS

1. Improved indoor environment quality

- Comfortable living and working environment – domestic or commercial
- Better temperature and humidity control
- Good air quality

2. Faster response to

- Occupant needs
- End-user complaints
- Trouble conditions

3. Maintenance Savings

- Efficient control puts less wear and strain on mechanical equipment.
- Provides longer life
- Runtime monitoring alerts about the timely maintenance of equipment
- And avoids expensive failures

4. Energy Savings

- Eliminates unnecessary system operation.
- Accurate energy usage information
- Helps you to take steps to reduce energy consumption like Optimum-Start, Night-Purging
- Time-Scheduling

5. Consolidated facility control

- One point centralized operation
- Simpler operation
- Reduces time and resources

6. Reduced operator training

- On-screen instructions
- User-friendly graphic displays
- Simpler operation programmed for routine and repetitive operation

7. Improved management reporting

- Provides valuable real-time data
- Creates reports and charts
- Critical information immediately sent to printers, emailed or sent via SMS

8. Timely and effective control

- Alerts your employees when your facility is not operating correctly
- Reduce troubleshooting and downtime
- Remote access connectivity without site visits

9. Performance Benchmarking

- Facilitates the overall system performance measurement
- Comparison with set benchmarks

2.1.5 Benefits of BMS

Centralized Workstation Computer

It is used to monitor and control the functions of the BMS. It receives data from field devices enabling it to monitor the building's environment. Based on the data received, the BMS operator can control the building's environment.

Fig. 2.1.2 Centralized Workstation Computer

Direct Digital Controller (DDC)

DDC is a controller which uses the analogue or digital signals from various devices of a field sensor and actuators and then controls the system based on the programme written in the controllers. A DDC can send the information to another controller or DDC.

Fig. 2.1.3 Direct Digital Controller

Temperature Sensor

It records the temperature in the building, allowing the operator to monitor and control the temperature.

Fig. 2.1.4 Temperature Sensor

Structure of a BMS

A basic Building Management System is made up of a software, a server containing a database, and smart sensors linked to an Internet-capable network. Data collected by the smart sensors installed around a building is sent to the BMS, where it is recorded in a database. BMS will raise an alarm if a sensor delivers data outside the pre-defined parameters/conditions. For example, if the temperature of a server rack in a database centre is reported above the permitted limits, BMS may trigger an alarm to make the relevant personnel aware. It can potentially help avoid serious damage to equipment and the resulting disruption in service provided by the server.

BMS software can be installed as a standalone application or integrated with other monitoring tools, depending on the system. Advanced building management systems can monitor and manage a wide range of building services across numerous platforms and protocols, allowing facility administrators a single and shared view of the facility's operations.

2.1.3 BMS Architecture

The BMS architecture chiefly consists of three sections:

1. **Operator Control Room -** It's important to BMS and consists of the following for its effective monitoring and control:

   - **Workstations -** It is used to design & develop the control system.
   - **Servers -** These are used to monitor & control the control system.
   - **Clients -** These are used to monitor the control system.

The total number of workstations, servers and clients at a particular site totally depends on the size of the BMS. A BMS operator sits in the BMS control room and controls its functioning. The operator control room is also equipped with a drive for data storage and a printer for printing. In recent trends, companies have started maintaining data on the cloud for data security purposes.

2. **Control Operation Units -** Automation or instrumentation is central to building management systems. Control operation units help in achieving automation. These units help maintain the environmental conditions in a building.

   - **Air Handling Unit (AHU) -** The AHU is installed either in the basement of a building or on the rooftop to maintain the quality of air. It consists of ducts for the supply of air.
   - **Chiller unit –** It is used to extract heat from a liquid medium and works on the principle of the refrigeration cycle. There are two main types of chillers, i.e. Air Cooled Chillers and Water Cooled Chillers.
   - **Fan Coil Unit (FCU) –** It is a subset of the air handling unit. It consists of a fan, coil, and controller. It is typically used in dedicated areas of a building.
   - **Boilers -** Boilers are used to generate steam which is then used for different purposes, e.g. temperature control in the BMS. There are different types of boilers, e.g. fire tube boilers, water tube boilers, etc.
   - **Pumps -** Submersible pumps are usually used in the basement of a building to pump water to the top for various purposes.
   - **Drives -** The ducting units in the BMS consist of huge air blowers. The blower drive, known as Variable Frequency Drives (VFD), generates air for the air conditioning system.

3. **Management Operations Units**

   These are the operations in addition to the control operation units and include:

   - **Fire Alarm System –** It consists of devices that can detect smoke, fire, and gases, such as Carbon Monoxide and other hazardous gases. It is a safety system that warns of any abnormal conditions in the building.

- **Energy Management System (EMS) -** The energy management system is mainly used to improve the overall efficiency and save cost by analyzing the trends for energy usage and transmission.
- **Elevators and Escalators -** Large buildings, such as shopping malls, are provided with elevators and escalators. These are monitored and controlled using the BMS.
- **Energy Meters -** The energy meters are provided to improve energy accountability, cost-saving and easy monitoring of energy levels.
- **Water Meters –** These days, under 24x7 water facilities, water meters are installed to improve water accountability. The user is charged on a monthly basis depending on the meter reading.
- **Closed Circuit Television (CCTV) Cameras –** It's a safety system provided in BMS for Intruder Detection & Alarm Generation. CCTV cameras record the data for up to several months, storing it on digital hard disks or saved/ backed up on a cloud server. The data is utilized for security investigations.
- **Wastewater Management -** The wastewater generated in a building is recycled or processed using a water management system to reutilize for various purposes, such as gardening, sanitation, etc.

Notes

Scan the QR Code to watch the related videos

https://www.youtube.com/watch?v=eod1cID3aUQ
Building Management System (BMS)

https://youtu.be/iIlCOZoIZVs
BMS Architecture

UNIT 2.2: Checking and Preparing the BMS Equipment for Installation

Unit Objectives

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

1. Explain the apparatus required for the installation of BMS, such as Direct Digital Controller (DDC), sensors, actuators, relevant types of cables, Human Machine Interface (HMI) display, computer, server, etc.
2. List the necessary tools, equipment, and Personal Protective Equipment (PPE) required for BMS installation.
3. Explain the importance of ensuring that trained personnel assist with the BMS installation process.
4. Describe the process of examining the BMS apparatus before installation to ensure no physical damage or malfunctions.
5. List the applicable documentation requirements.
6. Explain the importance of ensuring all the civil works are completed in the building and necessary approval/ clearance is obtained before starting the installation process.
7. Elaborate how to prepare the circuit diagram/ shop drawing/ as-built drawings for the installation of BMS in the building.
8. Explain the importance of ensuring all the outlets related to BMS are accessible and not covered by Mechanical, Electrical and Plumbing (MEP) services.
9. Explain the importance of ensuring the work area is ready and safe to start the installation of BMS systems.
10. Describe the process of assembling various BMS equipment such as access control, video surveillance, fire alarms, HVAC control, programmable lighting and electric power management for installation.

2.2.1 Checking and Storing the BMS Equipment and Accessories

A BMS Service Engineer is responsible for coordinating with the relevant company personnel/ third-party supplier to ensure timely delivery of all the necessary apparatus for the installation of BMS, such as Direct Digital Controller (DDC), sensors, actuators, relevant types of cables, Human Machine Interface (HMI) display, computer, server, etc.

On receipt of the BMS equipment and accessories, the necessary precautions as given below should be taken:

- When the BMS apparatus is delivered, it is important to check that all the components are delivered as per the order. All packages for the complete set of BMS systems, should be identified as per the package list.

- If the accessories are shipped separately/loose, they should be identified and checked against the dispatch documents.
- One should also examine the BMS equipment and accessories to ensure they are not physically damaged.
- The supplier should be contacted immediately for any missing items or for the replacement of faulty/damaged items.
- One should pay special attention to the instruments and monitoring devices supplied loose.
- All received materials should be inspected and ensured that the materials are as per the approved material submittal, shop drawing and single line diagram.
- For the BMS equipment, it is essential to conduct the necessary tests to ensure their correct functioning.
- Any discrepancies should be reported promptly to the relevant authority for further action. It is important to ensure that the materials used at the site is free from any damage.
- It is critical to ensure the availability of all the equipment and accessories before the installation of BMS.
- All equipment and installation material should be stored in a safe and dust-free storage.

2.2.2 Preparation for the Installation of BMS and General Requirements

- One should arrange the necessary tools, equipment, and Personal Protective Equipment (PPE) for the installation and trained personnel to assist with the installation process. It is important to ensure the availability of trained personnel for the installation process to minimize health and safety incidents and ensure the quality of work.
- One should ensure all civil works are completed for the area to carry out the installation, and the required clearance/approval is obtained from respective authorities to proceed further.
- Prior to starting the installation, one should refer to the approved shop drawings related to the area of installation and ensure that required materials are available at the site as per the approved material submittals.
- One should ensure the materials are stored safely and there is no mark of damage or deformity of any kind before taking the material for installation from the site store.
- A BMS Service Engineer is often required to prepare the circuit diagram/ shop drawing/ as-built drawings for the installation of BMS in the building.

- All shop drawings and riser diagrams must be approved by the supplier for all installation methods and details.
- One should check and ensure that all the outlets related to BMS are accessible and not covered by Mechanical, Electrical and Plumbing (MEP) services
- One should ensure that the work area is ready and safe to start the installation of BMS Systems. It includes identifying any health and safety hazards and taking appropriate preventive measures.
- One should ensure that as-built drawings showing all changes are ready before the false ceiling is finished.
- The installation process should be thoroughly planned to ensure timely completion as per the client's requirement.
- One should coordinate with the Heating, Ventilation and Air-conditioning (HVAC) installation technician for the installation of HVAC equipment as per the BMS installation plan and client requirements.
- Appropriate locations should be identified for the installation of various BMS equipment/ devices such as access control, video surveillance, fire alarms, HVAC control, programmable lighting and electric power management as per the BMS installation plan.
- The BMS equipment, such as access control, video surveillance, fire alarms, HVAC control, programmable lighting and electric power management equipment, should be prepared/assembled for installation as per the manufacturers' instructions.
- It is critical to ensure the installation of BMS systems and accessories is carried out according to the manufacturers' installation recommendations, requirements of applicable standards, applicable industrial practices, and project specifications to ensure that installation complies with the applicable requirements.

2.2.3 Tools Required for the Installation

- Standard's electrician and wireman's tools
- A toolbox containing portable hand tools
- Spirit Level/ Level Threads
- Digital multimeter
- Material handling tools

Exercise

1. Explain two benefits of BMS.
2. Identify the components of BMS.
3. Identify the three sections of BMS architecture.
4. List three tools required for the installation of BMS.

Notes

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3. Process of Carrying Out the Installation of BMS

Unit 3.1 - Conduiting and Cabling

Unit 3.2 - Installation of BMS Equipment

ELE/N7206

Key Learning Outcomes

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

1. Dramatize the process of installing conduits and carrying out the wiring.
2. Demonstrate the process of installing the Direct Digital Controller (DDC) with field devices.
3. Dramatize the process of installing the central peripherals.
4. Demonstrate the process of installing the motion sensors.
5. Demonstrate the process of installing the duct air temperature sensor and duct temperature/ humidity sensor.
6. Dramatize the process of installing the water differential pressure sensor.
7. Demonstrate the process of installing the air differential pressure sensor.
8. Demonstrate the process of installing the immersion water temperature sensor.
9. Dramatize the process of installing the smoke detectors in AC ducts.
10. Demonstrate the process of installing the butterfly valves.

UNIT 3.1: Conduiting and Cabling

Unit Objectives

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

1. Describe the process of installing (PVC)/ (GI) conduits and carrying out cabling to connect all the BMS equipment/ devices.

3.1.1 Conduiting and Cabling

It involves Polyvinyl Chloride (PVC) conduiting/ Galvanized Iron (GI) conduiting, or trunking is done as per the approved shop drawing to pull control wires for all field devices and control panels.

For conduiting and cabling, following equipment/ tools should be arranged:

- Bending machine
- Die sets
- Measuring tape
- Screw driver
- Chalk mate thread
- Oil
- Drill machine
- Screw driver

Fig. 3.1.1 Conduits

3.1.2 GI Conduit Installation

One should take the following drawings approved for construction.

- GI conduits layout complete with section details.
- MEP coordination drawing complete with section details.
- Architectural Drawing

Fig. 3.1.2 GI conduits on a wall

Procedure for GI Conduit Installation

- Check the route of GI conduiting to make sure that it is free from debris and obstruction of any other activity.
- Arrange scaffolding of sufficient height, which is checked by the scaffolding inspector/ safety officer before using the same for installation.
- Mark the reference points on the wall/ column as per civil architectural drawing.
- Identify the circuit start point and end points to mark the conduit route as per approved drawings.
- Make a hole in wall/concrete using a drill machine for the rawal plug, fix the rawal plug inside the hole and then fix the base of the saddle by screwing at every 2-meter span.
- Use recommended and approved GI conduiting & bends as per site condition and drawing.
- Remove the sharp edge of the cut length of the conduit by filing.
- Install conduits and all accessories as per the approved shop drawing and tight with saddle and screw, make joints using threaded fittings.
- Installation of GI conduits should be checked by the internal quality engineer as per drawings and quality of installation before offering consultant/client for inspection.
- Conduits are not to cross pipe shafts, vents or openings.
- Additional threaded cuts on GI conduits are to be painted with a zinc-based coating resistant to corrosion.
- Approved clamps to be used for the supports.
- Maximum spacing of supports for different conduit sizes to be clarified.
- Conduits on walls are to be run neatly, horizontally or vertically.
- Conduits are to be used for exposed installations over false ceilings when the false ceiling is used as a return plenum.
- Conduits are to be used for all installation in the elevator machine room and shafts, electrical equipment rooms, parking floor, solid waste rooms, etc.
- All works on site will be as per electrical specifications and as per applicable electrical wiring regulations.

3.1.3 PVC Conduit Installation in Concrete Slab

Following tools should be arranged before starting the job.

- Pipe Bender (20 and 25 mm diameter)
- Mini Hacksaw Frame with Blades
- Choke Lime Powder with sufficient length of Thread
- 500 gm Hammer
- Measuring Tape
- End Cutter

Procedure for PVC Conduit Installation in Slab

- Ensure that the civil works team finishes ply/post-tension work on the slab.
- Arrange the approved shop drawings for the area of installation.
- Mark first the wall location for the lower floor in the slab as per the latest Architecture layout so that it will be easy to locate the drops for the switch, thermostat and any other drops required for the electrical system.
- Mark the opening size in Electrical Room and Telephone room as per the approved electrical drawing.
- Mark the Electrical points on the slab as per the approved Electrical Layout and fix the proper shape and size of the Circular Box with the help of a nail/mess in case of plywood slab, and provide steel bar chairs for fixing the box in case of the post-tension slab.
- Just after completing the first layer of steel, start PVC conduiting work with different sizes of conduit based on electrical system requirements and as per drawings.
- Always loop the two-way switches with 20 mm conduit as the number of wires will be more, and only the switch drop pipe will not be sufficient for pulling all these wires.
- Try to avoid the overlapping of conduits and keep some distance between the conduits for low current and power/Lights.
- Just after completing the work, tighten the conduits with binding wire and mark the circuit numbers. Identification for the raised pipe in slab for the upper slab to be done for power, TV and telephone systems and closing of the mouth of pipe with the help of masking tape.
- The site Engineer/Foreman should check the proper size of conduit and circular box, opening size in both Electrical and Telephone room and be sure the work is completed as per the approved Electrical shop drawing.
- Before the concrete pouring, the PVC conduit installation is to be inspected and approved by the consultant/client/contractor.
- During concrete pouring, keep electricians for taking care of conduit to avoid any damage by others or dislocation of joints.

3.1.4 GI Box and GI/PVC Conduit Installation in Walls

Following tools should be arranged before starting the job.

- 9" Grinder with cutting disc
- Mini Hacksaw Frame with Blades
- White chalk /Marker
- 1 Kg Hammer
- Measuring Tape
- Sprit Level
- Water Level Pipe
- Point and Flat Chisels
- Trowel
- Pipe Bender

Procedure for Conduit Installation inside the Wall – PVC

- Ensure that the civil works team has finished the block wall and clearance is given to proceed with electrical works.
- Check the required reference markings are available for FFL (finished floor levels).
- Mark the location of switch/socket and conduit route on proper height based on approved shop drawing.
- Ensure the box size and accordingly cut a bit larger size of the box in marked place of block wall with sufficient depth.
- Start cutting the marked place for conduit run with the help of a grinder and chip with a hammer after cutting.
- Fix the GI Metal box of appropriate size and level with the help of spirit level.
- The bottom portion of the box should match the marked level as per consultant approved height for switch/ socket and/or as per local applicable wiring regulation requirements.
- Apply cement filler to fix the box properly and leave to set. Insert the required lengths of conduits on their paths and don't connect with boxes until the next day.
- After setting the box, connect the dropped conduits for the switch/socket to the box.
- Make sure the conduits are not visible from outside their route, which could lead to improper plastering.
- Before the plastering work, issue the inspection requests for the client so that approval can be taken.

3.1.5 BMS Electrical Wiring and Connection Installation

- Install raceways, boxes, and cabinets according to approved shop drawings and using the approved material.
- Install lv, signal and communication wires and cables as per approved electrical drawings and specifications.
- Conceal cable, except in mechanical rooms and areas where other conduit and piping are exposed.
- Install exposed cable in the raceway.
- Install concealed cable in the raceway.
- Bundle and harness multi-conductor instrument cable in place of single cables where several cables follow a common path.
- Fasten flexible conductors, bridging cabinets and doors, along hinge side; protect against abrasion. Tie and support conductors.
- Number-code or colour-code conductors for future identification and service of the control system, except local individual room control cables.
- Install wire and cable with sufficient slack and flexible connections to allow for vibration of piping and equipment.
- Connect manual-reset limit controls independent of manual-control switch positions. Automatic duct heater resets may be connected to the interlock circuit of power controllers.
- Connect hand-off-auto selector switches to override automatic interlock controls when the switch is in hand position.

Notes

UNIT 3.2: Installation of BMS Equipment

Unit Objectives

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

1. Describe the process of installing (PVC)/ (GI) conduits and carrying out cabling to connect all the BMS equipment/ devices.
2. Elaborate on how to install and terminate the temperature sensor, humidity sensor, and motorized damper actuators for HVAC equipment.
3. Elaborate on how to install and terminate the CHW temperature sensor, pressure sensor and flow sensors for CHW pipes.
4. Describe the process of connecting all the field devices as per the approved BMS point schedule, wiring schedule and schematic diagrams.
5. Explain how to install the field devices such as the outside air humidity sensor, water level sensor, and staircase pressurisation sensor as per the approved BMS system.
6. Describe the process of installing the VFDs inside AHU control panels as per the approved schematic diagrams.
7. Describe the process of installing conduits and carrying out the wiring for plumbing systems such as water booster pump sets, fire pump sets, water calorifier and pumps from the DDC panel as per the system requirements.
8. Describe the process of carrying out terminations at field ends and control cabling for DDC control panels as per approved shop drawings and schematic drawings.
9. Describe the process of installing the central peripherals such as the computer, printer, and monitor as per the approved BMS system and shop drawings.
10. Describe the process of installing the motion sensors and connecting them for BMS digital control.
11. Elaborate on how to install the duct air temperature sensor and duct temperature/ humidity sensor.
12. Explain how to install the water differential pressure sensor.
13. Describe the process of installing an air differential pressure sensor.
14. Describe the process of installing an immersion water temperature sensor.
15. Elaborate on how to install smoke detectors in AC ducts.
16. Describe the process of installing butterfly and two-port valves.

3.2.1 BMS Installation Procedure

The installation of BMS consists of the following stages:

- Installation of VAV and FCU Controllers
- Installation of control valves and actuators
- Installation of DDC panels and field devices

Variable Air Volume (VAV), Fan Coil Unit (FCU) Controllers with Field Devices

- The controllers, transformers and relays are delivered by the system supplier.
- Controllers should be mounted with an enclosure with the control transformer attached to the VAV control assembly.
- Two-port valves with actuators are installed in the chilled water pipe at FCU as per the approved shop drawings.
- Control wires are installed between the VAV, FCU's controllers and thermostats, and two-port valves as per the approved wiring drawings.
- Terminations at the VAV controller are carried out following the approved method.
- The thermostats are installed and terminated. The thermostat unit is fixed with an inbuilt jack, and the laptop connection can be made with the existing control cable wiring.

3.2.2 Installation and Integration of Direct Digital Controller (DDC) with Field Devices

- DDC Control panels with controllers, modules, transformers, and relays are provided by the system supplier.
- The control panel is installed with the required power supply on the wall as per the approved shop drawings and coordinated with other services.
- Conduiting/ trunking is installed between the field devices and the control panel.
- For HVAC equipment, field devices pertaining to ducting, such as the temperature sensor, humidity sensor, and motorized damper actuators, are to be installed and terminated as per manufacturers' recommendations.
- Field devices pertaining to Chilled Water (CHW) pipes like CHW temperature sensor, pressure sensor and flow sensors are to be installed and terminated as per manufacturers' recommendations.
- Wiring and connections for all field devices are made as per the approved BMS point schedule, wiring schedule and schematic diagrams.

- Field devices, such as outside air humidity sensor, water level sensor, and staircase pressurization sensor, are installed and connected as per the approved BMS system.
- VFDs are fixed inside AHU control panels, and required cable connections should be made as per approved schematic diagrams.
- Conduiting and wiring for plumbing systems, such as water booster pump sets, fire pump sets, water calorifier, and pump to be carried out from the DDC panel as per system requirements.
- Terminations at field ends should be carried out as per the approved manufacturers' recommendations.
- For DDC control panels, control cabling is done through GI conduit or GI trunking above the false ceiling as per the approved shop drawings, and schematic drawings and all control wires should be dressed properly with related identifications and connected as per the approved data point schedule.

3.2.3 Central Peripherals and Integration

- Bus loop wiring is to be carried out from the Central Controller to all the VAVs and DDC as per the approved schematic drawings.
- The pre-assembled peripherals with controller hubs are installed in the BMS control room.
- Wiring between the central peripherals and the low current systems is carried out as per the approved shop drawings.
- Installation of central peripherals such as the computer, printer, and monitor should be installed as per the approved BMS system and approved shop drawings.

3.2.4 Procedures for the Installation of Field Devices for HVAC Equipment

Installation of duct air temperature sensor

- The installation of the duct air temperature sensor should be as per the approved shop drawings and the manufacturer's recommendations.
- The location of the duct air temperature sensor should be marked as per the approved shop drawings.
- A hole of 20 mm diameter is made using a hole saw cutter, and the mounting flange is fitted.
- The temperature sensor should then be inserted and installed on the mounting flange.
- The sensing element should be diagonally bent across the cross-section of the duct, and the end of the element should be fitted using the collar provided with the sensor.
- It should be ensured that the sensing element is not touching the duct wall.

Installation of duct temperature or humidity sensor

- The installation of the duct air temperature or humidity sensor should be as per approved shop drawings and the manufacturer's recommendations.
- The location of the duct air temperature or humidity sensor should be marked as per the approved shop drawings.
- It should be ensured that the sensor is mounted in the middle of the duct wall.
- A hole of 22mm diameter should be made using a hole saw cuter, and the mounting flange should be fitted.
- The temperature or humidity sensor should then be inserted and installed on the mounting flange.
- The sensor should be installed in such a way as to have electricity cable entry from the downside.

Installation of water differential pressure sensor

- The installation of the water differential pressure sensor should be as per approved shop drawings and the manufacturer's recommendations.
- The location of the water pressure sensor should be as per the approved shop drawings, and it should be below the pressure measuring points.
- The pressure sensor should be installed using the GI mounting bracket provided with the sensor.
- The surface of the installation of the sensor should be vibration-free, i.e. not on the surface of any equipment with moving parts.
- Holes of 5mm diameter should be drilled at the bottom of the pipes for pressure tapping, and standard fittings supplied with the sensor should be used for connections.
- The tapping point should be connected to the sensor using the copper capillary tube supplied along with the sensor.

Installation of air differential pressure sensor

- The installation of the air differential pressure sensor should be done as per the approved shop drawings and the manufacturer's recommendations.
- The location of the air differential pressure sensor should be as per the approved shop drawings.
- The air differential pressure sensor should be mounted on the duct wall using fasteners supplied with the sensor.
- The sensors should be installed using GI mounting bracket provided with the sensor.
- Two duct probes should be installed, one in the suction and the other on the discharge side of the fans.
- The probes should be connected to the pressure sensor using the plastic tubing provided with the sensor.

Installation of immersion water temperature sensor

- Thermo well should be installed first in the chilled water pipeline, and a temperature sensor should be installed inside the thermo well suitably.
- The installation of the immersion water temperature sensor should be as per approved shop drawings and the manufacturer's recommendations.
- The sensor should be installed in such a way that the stem length is completely immersed in chilled water as per the manufacturer's recommendations.
- The sealing of the socket and the sensor threads should be made using Teflon tape.
- It should be ensured that the cable entry to the sensor is not from the top of the sensor.

Installation of smoke detectors in AC ducts

- The installation of smoke detector duct housing should be as per the approved shop drawing or manufacturer recommendations.
- Mounting holes should be drilled for duct housing and also holes made to insert air sampling and exhaust tubes as per the manufacturer's recommendations.
- Wiring should be as done for detector connection as per approved shop drawings.
- The smoke detector is then installed with the base unit inside the smoke chamber using the adopter plates as shown in the installation instructions.

Installation of butterfly valves

- The installation of butterfly valves should be as per approved shop drawings and manufacturers' recommendations.
- The butterfly valves should be installed in a sandwiched position using appropriate flanges.
- Upon completion of installation and insulation of the valves, the actuators are installed.
- It should be installed that the valve actuators are not installed upside down in any case.
- All the other actuator orientations are acceptable as per the manufacturer's recommendations.

Installation of two-port valves

- The installation of two-port valves should be as per the approved shop drawings and manufacturer's recommendations.
- The valves should be connected to the piping using threaded fittings or flanges depending on the pipe diameter.
- Upon completion of installation and insulation of the valves, the actuators are installed.
- It should be ensured that the valve actuators are not installed upside down in any case.
- All the other actuator orientations are acceptable as per the manufacturer's recommendations.

Installation of immersion water temperature sensor

- Thermo well should be installed first in the chilled water pipeline, and a temperature sensor should be installed inside the thermo well suitably.
- The installation of the immersion water temperature sensor should be as per approved shop drawings and the manufacturer's recommendations.
- The sensor should be installed in such a way that the stem length is completely immersed in chilled water as per the manufacturer's recommendations.
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Installation of two-port valves

- The installation of two-port valves should be as per the approved shop drawings and manufacturer's recommendations.
- The valves should be connected to the piping using threaded fittings or flanges depending on the pipe diameter.
- Upon completion of installation and insulation of the valves, the actuators are installed.
- It should be ensured that the valve actuators are not installed upside down in any case.
- All the other actuator orientations are acceptable as per the manufacturer's recommendations.

Exercise

1. List three equipment/ tools required for BMS conduiting and cabling.
2. Explain the stages of BMS installation.
3. Briefly explain the process of installing smoke detectors in AC ducts.

Notes

Scan the QR Code to watch the related videos

https://youtu.be/2S4j3qW-g9s

Conducting and Cabling

https://youtu.be/lC7vhxwLiJc

GI Conduit Installation

https://youtu.be/agtnyfZY8SI

BMS Electrical Wiring and Connection Installation

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4. Process of Carrying out Commissioning and Testing of BMS

Unit 4.1 - Commissioning and Testing of BMS

ELE/N7208

Key Learning Outcomes

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

1. Demonstrate the process of carrying out pre-commissioning of BMS.
2. Demonstrate the process of carrying out the commissioning of DDC panels.
3. Demonstrate the process of carrying out the commissioning of the Fan Coil Unit (FCU).
4. Dramatize the process of testing the digital and analogue inputs and outputs.
5. Dramatize the process of testing the communication link, printer and alarms.
6. Dramatize the process of testing the third-party system interface connectivity.

UNIT 4.1: Commissioning and Testing of BMS

Unit Objectives

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

1. Describe the process of pre-commissioning a BMS.
2. Explain the importance of ensuring that all peripheral devices are mounted and connected.
3. Explain the importance of checking the mechanical installations for the correct location and application.
4. Elaborate on how to check if all the cables are connected correctly inside the control panels/ DDC controllers and to the peripheral devices.
5. Describe the process of checking the control panel input terminals for interference voltages with the use of an AC range voltmeter.
6. Elaborate on how to check if the Fan Coil Unit (FCU) controllers are installed and connected via the communication bus.
7. Explain the importance of ensuring the installation of all the sensors, DP switches, and valves are completed both mechanically and electrically.
8. Elaborate on the use of a multimeter to test all control cables.
9. Describe the process of commissioning DDC panels, including the installation of relevant DDC controller application software.
10. Describe the process of testing the digital input/ output and analogue input/ output.
11. Describe the process of commissioning the Fan Coil Unit (FCU).
12. Explain the importance of checking the network communication between the BMS servers, workstations, DDC Panels, LON to IP converters (LIP) and Building Automation and Control Network (BACnet) controllers.
13. Describe the process of testing the sequence of operation according to changes in the field devices.
14. Describe the process of checking the printer and alarms for the correct functioning.
15. Elaborate on how to check that the communication link is up between the servers/ workstations and printers.
16. Elaborate on how to check the third-party system interface connectivity.

4.1.1 BMS Building Management System Testing & Commissioning Method

Below is a list of some necessary tools and instruments. Calibration certificates of the testing equipment should be produced during testing and commissioning.

- Laptop with Ethernet cross cable
- Multi-meter. (A valid test/calibration certificate will be available for inspection)
- General toolbox comprising screw-drivers, pliers, etc.

All the above equipment, tools, and safety wear should be suitably sized and designed to meet the project's specifications and be in good and safe working order within the acceptable parameters of the applicable Environment Health and Safety Management System.

4.1.2 Pre-commissioning Procedure for Building Management System BMS

- One should conduct a visual inspection to ensure that all DDC panels, sensors, actuators and other system devices are installed as per the approved points list, schematic drawings and specifications.
- Check that the wiring of field devices with the DDC panel is correct and complete.
- Set the MAC address in the Controller using the DIP switch.
- Supply power to the DDC controller.
- Connect the DDC controllers to the BMS PC through the MSTP network. Assign software addresses to the DDC controllers.
- Save the DDC controllers & their properties to the BMS PC (Database)
- Check all field device inspections are approved and copy attached with the commissioning documentation file.
- Check the calibration certificate of all measuring and testing instruments for validity.

4.1.3 BMS Testing & Commissioning Sequence & Procedure

1. Fan Coil Unit (FCU) Commissioning

- **General:** The unit will be installed in the space without ducting. Each fan coil unit consists of a three-speed fan and chilled water cooling coil with a two-way modulating valve. The DDC controller will be mounted next to the unit. Three-speed fan and valve actuator will be wired from this controller. Also, the room thermostat will be wired to a DDC controller.
- **Fan control:** The start/stop of the three-speed supply fan will be based on the speed selection from the room thermostat, and also this fan control can be overridden from BMS for auto operation.
- **Temperature control:** Under normal conditions, based on space temperature, the DDC controller will modulate the cooling valve to achieve desired temperature set point. This temperature set point can be adjusted from the BMS.

Commissioning Procedure:

- Configure the input/output settings in the DDC program.
- Down load the DDC program to the DDC
- Verify supply and return air temperature readings between sensors and BMS graphics and record them in the test report.
- Override the three speeds through BMS graphics. Verify the actual speed changes with the fan itself and status indication in BMS graphics.
- Confirm the correct operation (Open/Close) of the valve actuator with respect to the temperature set point changes.
- Complete Testing and Commissioning report.

2. Air Handling Unit AHU Commissioning

General Requirements

The system consists of a filter section, chilled water cooling coils with Pressure independent control valve, supply fan with VSD, associated Relief fan with VSD, modulating outside air I return Air dampers, ON/OFF Relief Air dampers, combination space temperature/humidity.

Sensors and thermal dispersion airflow measuring stations.

- Run status via a differential pressure switch mounted across the fan.
- Fresh & Return air damper Modulating control & feedback
- Return air damper open-close Command & Status.

Chilled water cooling with a two-way modulating valve controlled by BMS according to the cooling demand.

Filter section status will be monitored by BMS through an air differential pressure transmitter across the following filters.

Pre and bag filter: If the pressure exceeds the pre-determined setpoint, then the dirty alarm will be established by the controller.

Sensors will be mounted:

- Supply, Space & Return air duct Temperature/ Humidity
- Supply & Return Pressure
- Supply Smoke Detector
- Cooling coil Immersion Temperature (Supply & return)

The fire alarm signal will be connected to the starter panel to switch off the fan in case of fire.

3. AHU Start-Up and Fan Operation

The unit can be started and stopped locally through the HOA switch on the starter panel.

When this switch is in AUTO, the fan can be started and stopped remotely through the BMS, provided the following conditions are met:

- The motor starter is not in a trip state.
- There is no extant (un-reset) air-flow failure alarm.
- Fresh-Return Dampers are open.

Once the supply fan has started, the differential pressure switch installed across the supply fan will verify the run status of the supply fan and enable temperature control.

The return fan will start independently, and the differential pressure switch across the return fan will verify the run status of the return fan.

Dampers Position: Fresh & Return Air Dampers will be maintained at full Open position.

Temperature Control

When the unit is OFF, the two-way cooling valve will be fully closed. After airflow is established, which is confirmed by the closing of the airflow switch, temperature control will be enabled.

A PI control loop is used to generate a Space Temperature Control Signal which is then used to modulate the cooling valve as required to maintain the Space Air Temperature at the Set point (adjustable from BMS graphics).

Under normal conditions, on-demand for cooling, which is based on Space air temperature with respect to the temperature setpoint, the cooling valve will modulate to open. Once the required temperature is achieved, the cooling valve starts to modulate to closed.

4. Static Pressure Control

Depending on the static pressure setpoint, present pressure will be matched with the setpoint by ramping down and ramping up VFD speed.

Shutdown Operation: The following actions occur during the shutdown sequence:

- The chilled water valve is commanded to close.
- The supply fan is switched OFF.
- The return fan is switched OFF.
- The fresh air damper is closed (100 %.)

5. Fan Alarm Condition

Fan run status will be monitored by the BMS through a differential switch installed across the fan. If no air flow is sensed by the differential pressure switch while the fan is commanded to run by BMS, a failure alarm will be generated after a time delay (adjustable). The following happens when an alarm occurs:

- The alarm will be displayed in the BMS graphics.
- A pop-up window will appear with a description of the alarm. The alarm will be printed.
- The unit will be automatically shut down.
- The cooling valve will be commanded to a fully closed position.

After fault rectification, the alarm point has to be reset at the BMS/HOA before the unit can be brought back into automatic operation.

6. Fire/Smoke Alarm Condition

- Smoke Detector on Supply Duct should stop the fans in case of smoke on the duct.
- Upon receipt of a Fire Alarm signal, Return & Relief Dampers should be opened fully, and Relief Fan should be on at the same time.
- Fresh Air Dampers should be closed as well as Supply fan should be off.
- The Supply fan motor is turned OFF by a hardwired link between the Fire Control Panel and the starter control panel).
- When the Fire Alarm has been reset, the unit will return by resetting HOA/BMS operation.

Commissioning Steps

- Configure the input/output settings in the DDC program.
- Download the DDC program to the DDC controller.
- Verify the readings for all inputs between the field and BMS graphics and record them in the test report.
- Activate outputs such as fan control and cooling valve from BMS Graphics and verify the actual operation in the field.
- Confirm the operation of modulating valve with respect to the temperature setpoint.
- Observe and verify the start-up and shutdown sequence of the unit with BMS mentioned above

- Check the sequence of operation of AHU during normal conditions.
- Check and verify the shutdowns, including fire conditions.
- Perform the functional tests, which include airflow fail, alarm reset and manual override.
- Complete Testing and Commissioning report.

7. Commissioning of Chilled Water System

The sequence of Operation Chilled Water Pump Lead/Lag/Standby Selection

- Provide a lead/lag/standby manual command on the chilled water system graphical display for each chilled water pump.
- Lead selection should allow the BAS to start the pump and modulate speed to maintain the differential pressure set
- Lag selection should allow the BAS to enable the pump when the lead pump is near full capacity.
- Standby selection should allow the BAS start the pump when the lead or lag pump shows a run status failure alarm or VSD fault alarm
- Display run time total hours for each pump. The BAS should automatically rotate the lead, lag, and standby pumps every week (adj.). Provide the option to manually switch the lead, lag, and standby pump status from the OWS.

Heat Exchanger Sequence of Operation

- Depending on the heat exchanger outlet temperature (secondary side), setpoint (5.8 C, adj.),
- Lead Heat Exchanger Isolation Valve Opens (secondary side)
- The primary side Modulating valve will be modulated up to 100%.
- If there is further demand, then the second Exchanger Isolation valve opens, and Modulating valve will modulate up to 50%, and the lead Exchanger modulating Valve will be modulated at 50% simultaneously.
- If there is a further command, then both Modulating valves will be modulated at 100%.
- If there is a further demand, then the third Exchanger Isolation valve opens, and Modulating valve will modulate up to 50%, and the other Exchangers modulating valve will be modulated at 50% simultaneously.
- If there is a further command, then three Modulating valves will be modulated at 100%.
- If there is no demand, then the reverse order of the sequence mentioned above will occur.

Chilled Water Differential Pressure Control

- The BAS should use the differential pressure sensor that has a reading furthest below the setpoint for control of the chilled water pump(s).
- The chilled water differential pressure sensor should modulate the speed of the enabled chilled water pump(s) to maintain a chilled water system differential pressure setpoint of 1 bar (adj).
- The actual set point should be field determined by the balancer and programmed by the BMS contractor.

Chilled Water Pumps Staging Control

- Upon chilled water system enable, the lead pump should be enabled upon confirmation of the lead heat exchanger isolation valve open status.
- The heat exchanger should operate as described above to maintain the system differential pressure.
- If the lead pump VSD remains above 70% speed (adj.) for an adjustable time period (15 minutes, adj.) The lag pump should be enabled.
- The lead pump VSD speed should be reduced to 35%, and the lag pump VSD should be increased to 3.5%.
- After an adjustable time period (5 minutes, adj.), both pumps should operate at the same speed control signal and should ramp up and down in unison to maintain the pressure set point.
- If both pumps' VSD speed drops below 30% for an adjustable time period (15 minutes, adj.), the lag pump should be disabled.
- The standby pump should be enabled upon failure of either the lead or lag pump.

8. Monitoring of Chilled Water Pumps

In addition to the input points mentioned in the above sequence of operations, the following points are also monitored by the BMS.

1. Pump H-0-A switch status
2. Pump trip alarm
3. VFD trip indication
4. VFD Feedback

9. Chilled Water Pump Commissioning

- Configure the input/output settings in the DDC program.
- Download the DDC program to the DDC controller.
- Verify input status to the BMS by switching units on and off and simulating faults.
- Obtain all input readings of the sensors through the Graphics and note them down in the test report.
- Verify the start-up and shutdown sequence of the unit with BMS.
- Observe the response of VFD by changing the pressure set point with respect to the DPT reading.
- Simulate a maximum demand condition in each circuit by opening all cooling valves and operating the chilled water pump with maximum efficiency to obtain the pressure setpoint.
- Check and confirm the change over a sequence of pumps in cases of failure, run hours and manual override.
- Complete Testing and Commissioning report.

Chilled Water Pressurization Unit, Chemical Dosing System and Air separation System

BMS will monitor the Unit Run and trip status for the Pressurization Unit. BMS will monitor Unit Power On/Off Status as well as Common fault status for Chemical Dosing Unit.

BMS will monitor Unit run, Common Fault & Trip status for the Air separation system.

Commissioning Procedure

- Configure the input settings in the DDC program.
- Download the DDC program to the DDC controller.
- •Verify status input signals to the BMS by switching units on and off and simulating faults.
- Complete Testing and Commissioning report.

10. Booster Fans BMS Commissioning

- The system consists of a supply fan with VSD & Pressure Sensor.
- Run status via a differential pressure switch mounted across the fan.

Supply Pressure sensor: A fire alarm signal will be connected to the starter panel to switch off the fan in case of fire.

11. Start-Up and Fan Operation

The unit can be started and stopped locally through the HOA switch on the starter panel. When this switch is in AUTO, the fan can be started and stopped remotely through the BMS, provided the following conditions are met:

- The motor starter is not in a Trip state.
- There is no extant (un-reset) air-flow failure alarm.

Once the supply fan has started, the differential pressure switch installed across the supply fan will verify the run status of the supply fan.

Control Sequence

Fan on P1, which is interlocked with Garage FCUs. Once the controller receives run status from corresponding FCUs, VFD Speed will be regulated at Constant pressure with a pre-determined setpoint.

Loading Dock Exhaust Fan

The system consists of an Exhaust Fan. Run status via a differential pressure switch mounted across the fan. The gas detection controller should provide relays for monitoring points on the BAS, including zone warning, zone alarm, zone sensor failure and high CO/NO2 reading.

The fire alarm signal will be connected to the starter panel to switch off the supply fan in case of fire.

Start-Up and Fan Operation

- The unit can be started and stopped locally through the HOA switch on the starter panel. When this switch is in AUTO, the fan can be started and stopped remotely through the BMS, provided the following conditions are met:
- The motor starter is not in a Trip state.
- There is no extant (un-reset) air-flow failure alarm.
- The Dock area CO/NO2 level should be monitored by the BAS through the gas detection controller.
- If CO/NO2 from the gas detection controller exceeds the above-designed warning level (via volt-free contact), then the Exhaust fan will be enabled; otherwise will be disabled.
- A fan failure alarm should be generated at the OWS whenever the run status of the fan does not match the current command state.
- Once the supply fan has started, the differential pressure switch installed across the supply fan will verify the run status of the supply fan.

Staircase and Elevator Pressurization Fan

- The system consists of a pressurization fan with VSD as well as a differential air pressure sensor.
- Run status via a differential pressure switch mounted across the fan.
- Fire alarm signal and Outside air dampers/Fire Dampers.

Control Sequence

- The stair and elevator pressurization fans should be enabled upon Fire alarm signal- Fire dampers - Outside Dampers.
- Fire Status will be interlocked with relevant fire dampers and outside air dampers by the fire alarm system.
- Only upon receiving Fan run status (via Differential Pressure Switch) Control sequence of Fans will be initiated by BMS.
- BMS can only maintain the differential pressure in the shaft/pit as per the designed set point of Pressure. Fan command sequence will be executed by the Fire alarm system (via signal and dampers).
- A fan failure alarm should be generated at the OWS whenever the run status of the fan does not match the current command state.
- The differential pressure switch installed across the supply fan will verify the run status of the supply fan.

Transformer Room Exhaust Fan

- The system consists of two Exhaust Fans (Duty/Standby) with a space Temperature sensor.
- Run status via a differential pressure switch mounted across the fans.
- The fire alarm signal will be connected to the starter panel to switch off the supply fan in case of fire.

Start-Up and Fan Operation

The unit can be started and stopped locally through the HOA switch on the starter panel. When this switch is in AUTO, the fan can be started and stopped remotely through the BMS, provided the following conditions are met:

- The motor starter is not in a Trip state.
- There is no extant air-flow failure alarm.
- A fan failure alarm should be generated at the OWS whenever the run status of the fan does not match the current command state.
- Once the supply fan has started, the differential pressure switch installed across the supply fan will verify the run status of the supply fan.

Control Sequence

If the space temperature exceeds 30 degrees, then the duty exhaust fan will be on; otherwise, off. If the Duty exhaust fan fails to run, then standby will be on.

Fan Alarm Condition

Fan run status will be monitored by the BMS through a differential switch installed across the fan. If no air flow is sensed by the differential pressure switch while the fan is commanded to run by BMS, a failure alarm will be generated after a time delay (adjustable).

The following happens when an alarm occurs:

- The alarm will be displayed in the BMS graphics.
- A pop-up window will appear with a description of the alarm.
- The alarm will be printed.
- The unit will be automatically shutdown.

After fault rectification, the alarm point has to be reset at the BMS/HOA before the unit can be brought back into automatic operation.

Commissioning Procedure

- Configure the input/output settings in the DDC program.
- Download the DDC program to the DDC controller.
- Verify the readings for all inputs between the field and BMS graphics and record them in the test report.
- Activate outputs such as fan control and cooling valve from BMS Graphics and verify the actual operation in the field.
- Observe and verify the start-up and shutdown sequence of the unit with the BMS mentioned above.
- Check and verify the shutdowns, including fire conditions.
- Perform the functional tests, which include airflow fail, alarm reset and manual override.
- Complete Testing and Commissioning report.

Toilet Exhaust Fan

- The system consists of an Exhaust Fan with VFD & pressure sensor
- Run status via a differential pressure switch mounted across the fans.
- The fire alarm signal will be connected to the starter panel to switch off the supply fan in case of fire.

Start-Up and Fan Operation

The unit can be started and stopped locally through the HOA switch on the starter panel. When this switch is in AUTO, the fan can be started and stopped remotely through the BMS, provided the following conditions are met:

- The motor starter is not in a Trip state.
- There is no extant (un-reset) air-flow failure alarm.
- A fan failure alarm should be generated at the OWS whenever the run status of the fan does not match the current command state.
- Once the supply fan has started, the differential pressure switch installed across the supply fan will verify the run status of the supply fan.

Control Sequence

Duct Pressure will be maintained at the designed balancing pressure set point by modulating the VFD Speed.

Battery Room/ATS room Exhaust Fan

- The system consists of an Exhaust Fan.
- Run status via a differential pressure switch mounted across the fan.
- The Hydrogen detection controller should provide relays for monitoring points on the BAS for high Hydrogen readings.

Start-Up and Fan Operation

The unit can be started and stopped locally through the HOA switch on the starter panel. When this switch is in AUTO, the fan can be started and stopped remotely through the BMS, provided the following conditions are met:

- The motor starter is not in a Trip state.
- There is no extant (un-reset) air-flow failure alarm.
- A fan failure alarm should be generated at the OWS whenever the run status of the fan does not match the current command state.
- Once the supply fan has started, the differential pressure switch installed across the supply fan will verify the run status of the supply fan.

Alarm Condition

Fan run status will be monitored by the BMS through a differential switch installed across the fan. If no air flow is sensed by the differential pressure switch while the fan is commanded to run by BMS, a failure alarm will be generated after a time delay (adjustable). The following happens when an alarm occurs:

- The alarm will be displayed in the BMS graphics.
- A pop-up window will appear with a description of the alarm.
- The alarm will be printed.
- The unit will be automatically shutdown.

After fault rectification, the alarm point has to be reset at the BMS/HOA before the unit can be brought back into automatic operation.

Commissioning Procedure

- Configure the input/output settings in the DDC program.
- Download the DDC program to the DDC controller.
- Verify the readings for all inputs between the field and BMS graphics and record them in the test report.
- Activate outputs such as fan control and cooling valve from BMS Graphics and verify the actual operation in the field.
- Observe and verify the start-up and shutdown sequence of the unit with the BMS mentioned above.
- Check and verify the shutdowns, including fire conditions.
- Perform the functional tests, which include airflow fail, alarm reset and manual override.
- Complete Testing and Commissioning report.

Exercise

1. Write four steps of the BMS pre-commissioning procedure.
2. Briefly explain the process of commissioning Fan Coil Unit (FCU).

Notes

Scan the QR Code to watch the related videos

https://youtu.be/lXw_6anGWFY

Pre-commissioning Procedure for Building Management System BMS

https://youtu.be/2WRUAquvuUY

BMS Testing & Commissioning Sequence & Procedure

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5. Process of Carrying Out Repair and Maintenance of BMS

Unit 5.1 - Repair and Maintenance of BMS

ELE/N7207

Key Learning Outcomes

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

1. Demonstrate the process of carrying out repair and maintenance of BMS field devices.
2. Dramatize the process of carrying out repair and maintenance of electrical panels.
3. Describe the process of managing the BMS helpdesk, complaints and requests.
4. Demonstrate the process of maintaining the records.

UNIT 5.1: Repair and Maintenance of BMS

Unit Objectives

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

1. Describe the process of testing the valve actuators, damper actuator, sensors, transducers, high-low limit thermostats, frost thermostats, pressure switches, control valve, relays, emergency stop button and fire/ smoke shut-down, the shut-off operation of spring return actuators and Digital Input and Output (I/O) for the correct functioning.
2. Explain the importance of ensuring the field devices are not worn out or damaged.
3. Elaborate on how to check the BMS is connected with the control system and is online.
4. Elaborate on how to identify the repair and maintenance needs of the BMS control system.
5. Elaborate on how to check if the motion sensors are working as expected and replace them if required.
6. Describe the process of cleaning the valve actuators, damper actuators and sensors.
7. Describe the process of re-calibrating all sensors, transducers, valve start points and actuator travel times.
8. Describe the process of replacing worn-out or damaged field devices.
9. Explain how to check settings, ratings and operation of protective devices such as overloads, residual current devices, circuit breakers and fuses.
10. Elaborate signs of overheating of components such as contactors, cables, connectors and internal temperature within the electrical panels.
11. Describe the process of re-torqueing the busbar nuts and bolts.
12. Elaborate on how to check if the electrical panel is earth-bonded correctly.
13. Elaborate on how to check if the main door electrical isolator is engaged and operational.
14. Explain the importance of ensuring ventilation fans and grilles are functional and clean.
15. Explain the importance of ensuring isolators, relays, contactors and starters are functioning correctly and free from pitting.
16. Explain the importance of ensuring incoming power supply voltages are within the prescribed limits.
17. Explain the importance of ensuring status indicators on all panels are functional.
18. Explain the importance of ensuring the closure of BMS-related requests/ complaints with timely resolution.
19. Explain the importance of directing the BMS complaints requiring vendor attention to the concerned vendor promptly and escalating the unresolved complaints to the relevant authority as per the escalation matrix.
20. List various records to be maintained regarding the BMS operations.

5.1.1 Maintenance of BMS Controllers

- Visually inspect electronic control components & PCB conditions.
- Make back up of any resident software Power-down control system, and Test battery back-up.
- Test power supply level and calibration of low voltage power settings.
- Check controller settings and record all values.
- Check time and date settings.
- Check system parameters.
- Check security of all electrical connections.
- Check earthing to control system.
- Check screening on out-going cables.
- Confirm controls operate in-line with design specification.
- View alarm messages and record.
- Check plant start-up sequence.
- Check output command relays.
- Check plant shut-down sequence.
- Check plant fire shut-down operation.
- Check operation of all panel lamps.
- Check motor overload for setting and operation.
- Check operation of contactors Check all Frost protection programs and function.

5.1.2 Maintenance of BMS Field Devices

- Test operation of all valve actuators and check general cleanliness.
- Test operation of all damper actuators and check general cleanliness.
- Test operation of all sensors and check general cleanliness.
- Test operation of all transducers.
- Check operation of all digital inputs and outputs.
- Check relay operation and condition.
- Re-calibrate all sensors (as necessary) and record on report.
- Re-calibrate all transducers (as necessary) and record on report.

- Re-calibrate valve start points and actuator travel times and record on report.
- Test shut-off operation of spring return actuators.
- Test operation of high-low limit thermostats.
- Test operation of frost thermostats and record settings.
- Test operation of pressure switches.
- Check control valve operation (let-by, shut-off & leakage).
- Test emergency stop button operation (providing it is safe to do so).
- Test Fire/Smoke Shut-down operation (providing it is safe to do so).

5.1.3 Maintenance of Central Computer

- Check computer, monitor and printer operation
- Check the setup and operation of interface software
- Identify the need to update/upgrade the virus checker and perform the update/upgrade.
- Perform backup of computer hard drive.
- Check operation of the USB and any other backup device.
- Power down, remove covers and vacuum out all dust from the keyboard, mouse and monitor screen.
- Check the operation of power supply and processor cooling fan.
- Inspect all power connections for security.
- Check all serial and parallel connection points.
- Remove all temporary files.
- Check the remaining disk space and record.
- Free up space on the hard disk.
- Re-start and check the time and date.
- Check communication to the Building Management System network.

5.1.4 Energy usage Check

- Compare occupancy times against actual times.
- Make use of free energy by modifying control programmes.
- Set-up normal and energy modes for each plant.
- Assess the actual energy usage versus the original control system design.
- Undertake point of control routine maintenance of systems.
- Set the cooling and heating setpoints to the recommended temperature.
- Modify software to give a wider free energy zone (no heating or cooling).
- Include optimum stop of plant.
- Reduce the optimum start period to limit the pre-heat times.
- Allow optimum start target temperature to be lower than day setpoint.
- Allow optimum stop temperature to be lower than day setpoint.
- Disable chiller plant prior to the end of occupancy.
- Shut down plant between set temperatures, e.g. 20 and 24 °C.
- Analyse the historical data from graphs plotted on BMS.
- Enable free cooling (night purge) during non-occupancy period.

5.1.5 Maintenance of Supervisory Panels

- Perform diagnostic checks, report problems.
- Test network communications.
- Review alarm and trend data, diagnose and initiate corrective action to correct problems.
- Check network interlocks and network programming.
- Review and adjust weekly and holiday schedules with building personnel.
- Upgrade panels to current firmware revision.

5.1.6 Maintenance of Air Systems

- Test and adjust operating sequences for fans, dampers, heating and cooling.
- Review temperature and ventilation operating set points against design criteria.
- Initiate changes to control loops, monitor controls reaction, and adjust tuning parameters to achieve stable and accurate control.
- Review the physical operation of equipment.
- Report and maintenance requirements operation or maintenance issues.

5.1.7 Maintenance of Geo-Thermal, Heating & DHW Systems

- Test and adjust operating sequences for boilers, pumps, valves.
- Review seasonal temperature operating set points against design criteria.
- Initiate changes to control loops, monitor controls reaction, and adjust tuning parameters to achieve stable and accurate control.
- Check outside air temperature interlocks.
- Review the physical operation of equipment.
- Report equipment failures, repair and maintenance requirements.

5.1.8 Maintenance of Room Temperature Controls

- Check controls operation of force flow and unit heaters.
- Check controls operation of Fan Coils.
- Check controls operation for radiant panel heating and reheat coils.

5.1.9 Maintenance of Gas Detection Systems

- Check controls operation
- Annual calibration of sensors
- Test and adjust operations

5.1.10 Maintenance of Chilled Water Controls

- Check BMS controls operation of chiller, chiller pumps and system.
- Check calibration of sensors, verify operational sequence.

5.1.11 Maintenance of Reporting

- Review with site personnel the current operating conditions of the systems
- Review any changes in the operating system with the building operator and record them
- Prepare a written report documenting the site visit

Exercise

1. Mention four steps undertaken for the maintenance of BMS controllers.
2. Mention five steps undertaken for the maintenance of BMS controllers.

Notes

Scan the QR Code to watch the related videos

https://youtu.be/KtV7J_YQq7k
Maintenance of Air Systems

https://youtu.be/ZDRiYEoskoM
Maintenance of Geo-Thermal, Heating & DHW Systems

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6. Soft Skills and Work Ethics

Unit 6.1 - Effective Communication and Coordination at Work

Unit 6.2 - Working Effectively and Maintaining Discipline at Work

Unit 6.3 - Maintaining Social Diversity at Work

ELE/N9905

Key Learning Outcomes

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

1. State the importance of work ethics and workplace etiquette.
2. State the importance of effective communication and interpersonal skills.
3. Explain ways to maintain discipline in the workplace.
4. Discuss the common reasons for interpersonal conflict and ways of managing them effectively.

UNIT 6.1: Effective Communication and Coordination at Work

Unit Objectives

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

1. Work effectively at the workplace.
2. Demonstrate practices related to gender and PwD sensitization.

6.1.1 Importance of Work Ethics and Workplace Etiquette

Workplace ethics are a set of moral and legal guidelines that organizations follow. These guidelines influence the way customers and employees interact with an organization. Workplace ethics essentially guide how an organization serves its clients and treats its employees.

For example, if a company seeks to fulfil the promises it makes, it may develop processes and set up a robust support system to address this policy and build customer/client loyalty. To achieve this goal, the company may implement specific incentive programs for employees to encourage them to produce high-quality work and ensure the organization fulfils the promises it makes to its clients/ customers.

Many organizations, often the large ones, set detailed ethical codes to guide their operations and control how the organizational processes impact the stakeholders. These ethics usually help organizations maintain certain standards of responsibility, accountability, professionalism and among others, as they navigate through different challenges and day-to-day circumstances. By following these guidelines, organizations often experience several benefits that improve the lives of stakeholders, such as customers, employees, leaders, etc.

Examples of Common Workplace Ethics

Fig. 6.1.1 Examples of Common Workplace Ethics

Workplace ethics are essential for a successful organization with a satisfied and loyal team. High ethical standards help in ensuring all stakeholders, such as customers, investors, employees, and other individuals involved in the workplace operations, feel the organization is safeguarding their interests. By creating and implementing ethical guidelines, organizations can keep the best interests of their employees in mind while maintaining a positive influence on those they impact through their processes.

As a result, employees maintain the organization's best interests by being ethical in their daily work duties. For example, fairly-treated employees of an organization who understand the organization's commitments to environmental sustainability are usually less likely to behave in a manner that causes harm to the environment. Thus, they help maintain a positive public image of the organization. It means that workplace ethics help in maintaining reciprocal relationships that benefit organizations at large and the individuals associated with and influenced by the organizational policies.

Benefits of Workplace Ethics

There are various benefits of implementing workplace ethics. When organizations hold themselves to high ethical standards, leaders, stakeholders, and the general public can experience significant improvements. Following are some of the key benefits of employing ethics in the workplace:

Fig. 6.1.2 Benefits of Workplace Ethics

6.1.2 Interpersonal Communication

Interpersonal communication is a process that involves sharing ideas and emotions with another person, both - verbally and non-verbally. It is essential to interact effectively with others in both personal and professional lives. In professional life or the workplace, strong interpersonal skills play a crucial role in achieving effective collaboration with colleagues.

Interpersonal Skills

Interpersonal skills, in other terms, are known as people skills, which are used to communicate and interact with others effectively. These are soft skills one uses to communicate with others and understand them. One uses these skills in daily life while interacting with people.

Examples of Interpersonal Skills

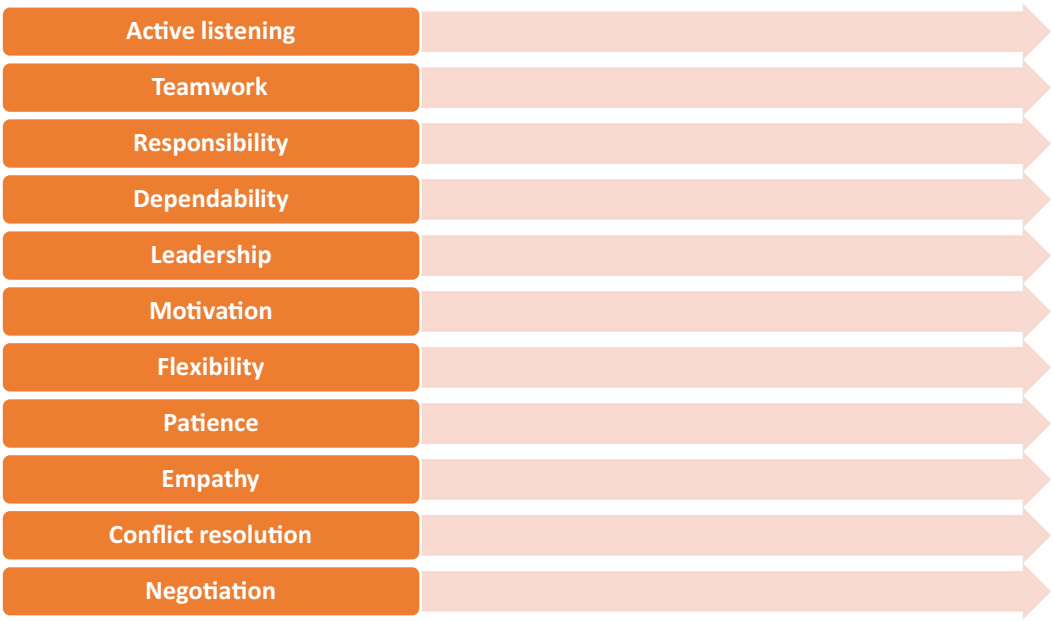


Fig 6.1.3 Examples of Interpersonal Skills

Numerous interpersonal skills involve communication. Communication can be verbal, such as persuasion or tone of voice — or non-verbal, such as listening and body language.

Importance of Interpersonal Skills

Interpersonal skills are essential for communicating and collaborating with groups and individuals in both personal and professional life. People with strong interpersonal skills often are able to build good relationships and also tend to work well with others. Most people often enjoy working with co-workers who have good interpersonal skills.

Among other benefits of good interpersonal skills is the ability to solve problems and make the best decisions. One can use the ability to understand others and good interpersonal communication skills to find the best solution or make the best decisions in the interest of everyone involved. Strong interpersonal skills help individuals work well in teams and collaborate effectively. Usually, people who possess good interpersonal skills also tend to be good leaders, owing to their ability to communicate well with others and motivate the people around them.

Interpersonal communication is the key to working in a team environment and working collectively to achieve shared goals. Following are the interpersonal communication skills that vital for success at work:

Verbal Communication

The ability to speak clearly, appropriately and confidently can help one communicate effectively with others. It is vital to select the appropriate vocabulary and tone for the target audience.

For example – one should speak formally and professionally in the work environment, while informal language is acceptable in an intimate environment with close friends and family. Also, one should avoid using complex or technical language while communicating with an audience that may not be familiar with it. Using simple language in a courteous tone helps achieve better communication, irrespective of the audience.

Active Listening

Active listening is defined as the ability to pay complete or undivided attention to someone when they speak and understand what they are saying. It is important for effective communication because without understanding what the speaker is saying, it becomes difficult to carry forward a conversation. One should ensure to use appropriate verbal and non-verbal responses, e.g. eye contact, nodding, or smiling, to show interest in what the speaker says. Active listening is also about paying attention to the speaker's body language and visual cues. Asking and answering questions is one of the best ways to demonstrate an interest in conversing with the other person.

Active listening is critical for communicating effectively without ambiguity. It helps one understand the information or instructions being shared. It may also encourage co-workers to share their ideas, which ultimately helps achieve collaboration.

Body Language

One's expression, posture, and gestures are as important as verbal communication. One should practice open body language to encourage positivity and trust while communicating. Open body language includes - maintaining eye contact, nodding, smiling and being comfortable. On the other hand, one should avoid closed body language, e.g. crossed arms, shifting eyes and restless behaviour.

Empathy

Empathy is the ability to understand the emotions, ideas and needs of others from their point of view. Empathy is also known as emotional intelligence. Empathetic people are good at being aware of others' emotions and compassionate when communicating with them. Being empathetic in the workplace can be good to boost the morale of employees and improve productivity. By showing empathy, one can gain the trust and respect of others.

Conflict Resolution

One can use interpersonal communication skills to help resolve disagreements and conflicts in the workplace. This involves the application of negotiation and persuasion skills to resolve arguments between conflicting parties. It is also important to evaluate and understand both sides of the argument by listening closely to everyone involved and finding an amicable solution acceptable to all.

Teamwork

Employees who communicate and work well in a team often have better chances of achieving success and common goals. Being a team player can help one avoid conflicts and improve productivity. One can do this by offering to help co-workers when required and asking for their feedback and ideas. When team members give their opinions or advice, one should positively receive and react to the opinions/advice. One should be optimistic and encouraging when working in groups.

Improving Interpersonal Skills

One can develop interpersonal skills by practising good communication and setting goals for improvement. One should consider the following tips to improve their interpersonal skills:

- One should ask for feedback from co-workers, managers, family or friends to figure out what needs improvement concerning their interpersonal skills.
- One can identify the areas of interpersonal communication to strengthen by watching others.
- One can learn and improve interpersonal skills by observing co-workers, company leaders and professionals who possess good interpersonal skills. This includes watching and listening to them to note how they communicate and the body language used by them. It is vital to note their speed of speaking, tone of voice, and the way they engage with others. One should practice and apply such traits in their own interactions and relationships.
- One should learn to control their emotions. If stressed or upset, one should wait until being calm to have a conversation. One is more likely to communicate effectively and confidently when not under stress.
- One can reflect on their personal and professional conversations to identify the scope of improvement and learn how to handle conversations better or communicate more clearly. It helps to consider whether one could have reacted differently in a particular situation or used specific words or positive body language more effectively. It is also vital to note the successful and positive interactions to understand why they are successful.
- One should practice interpersonal skills by putting oneself in positions where one can build relationships and use interpersonal skills. For example, one can join groups that have organized meetings or social events. These could be industry-specific groups or groups with members who share an interest or hobby.
- Paying attention to family, friends and co-workers and making efforts to interact with them helps a lot. One should complement their family, friends and co-workers on their good ideas, hard work and achievements. Trying to understand someone's interests and showing interest in knowing them can help one build strong interpersonal skills. Offering to help someone, especially in difficult situations, helps build stronger and positive workplace relationships.
- One should avoid distractions, such as a mobile phone, while interacting with someone. Giving someone full attention while avoiding distractions helps achieve a clear exchange of ideas. By listening with focus, one can understand and respond effectively.

- One can attend appropriate courses on interpersonal skills or sign up for workshops at work to improve interpersonal skills. One can find many resources online also, such as online videos.
- For personal mentoring, one can approach a trusted family member, friend, co-worker, or current/former employer. A person one looks up to with respect and admires is often a good choice to be selected as a mentor. One can even hire a professional career or communication coach.

Interpersonal communication skills often help one boost their morale, be more productive in the workplace, complete team projects smoothly and build positive and strong relationships with co-workers.

Good conflict resolution skills can help one contribute to creating a collaborative and positive work environment. With the ability to resolve conflicts, one can earn the trust and respect of co-workers.

Notes

UNIT 6.2: Working Effectively and Maintaining Discipline at Work

Unit Objectives

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

1. Discuss the importance of following organizational guidelines for dress code, time schedules, language usage and other behavioural aspects.
2. Explain the importance of working as per the workflow of the organization to receive instructions and report problems.
3. Explain the importance of conveying information/instructions as per defined protocols to the authorised persons/team members.
4. Explain the common workplace guidelines and legal requirements on non-disclosure and confidentiality of business-sensitive information.
5. Describe the process of reporting grievances and unethical conduct such as data breaches, sexual harassment at the workplace, etc.
6. Discuss ways of dealing with heightened emotions of self and others.

6.2.1 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:

All employees follow the same rules which helps establish uniformity and equality in the workplace

Managers and supervisors have defined guidelines on what action to take while initiating disciplinary action

With well-defined and enforced disciplinary rules, an organization can avoid various safety, security, rupational risks

Fig 6.2.1 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:

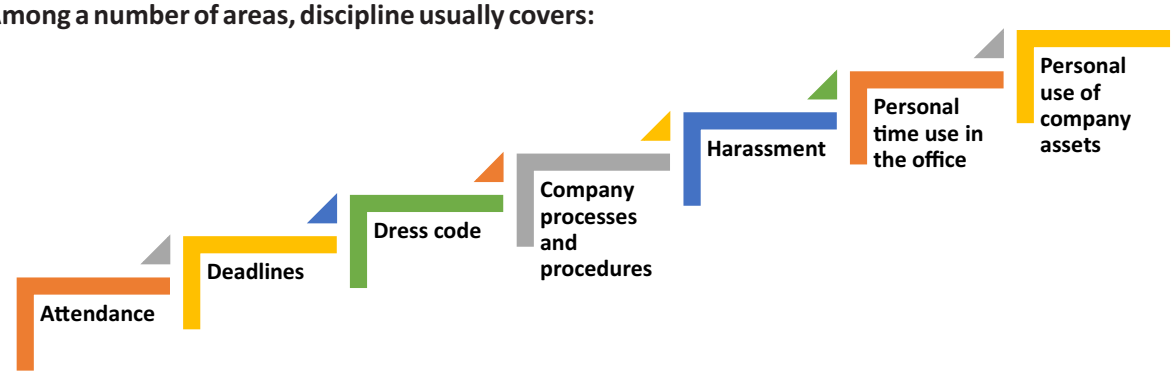


Fig 6.2.2 Examples of Workplace Discipline

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.

6.2.2 Employee Code of Conduct

The employee code of conduct manual serves as a guide for employees to inform them regarding the behaviour expected from them at work. It helps create a good work environment with consistent behaviour from employees. The manual should list examples of acceptable and not acceptable behaviours at work. The code of conduct should be discussed with employees so that they have the clarifications required.

For example, an organization may create guidelines concerning the conduct with clients to ensure no contact is made with them except for business purposes, also prescribing the use of appropriate means of communication.

Employees should have a clear understanding concerning their job responsibilities and the behaviour expected from them with all stakeholders, e.g. company personnel, clients and associated third parties. It is critical to have documented guidelines for employees to follow concerning all aspects of work.

It should also document the disciplinary action to be followed in case of non-compliance, e.g. verbal and then written warning, temporary suspension or eventual termination of service in case of repeated non-compliance with the employee code of conduct. Employees should know what the company rules are and what will happen if they break the rules. However, disciplinary action should be initiated only when reasonably required to avoid its misuse for employee harassment.

There should also be an effective mechanism for employees to raise their concerns/ grievances and have them addressed while maintaining privacy, as required, e.g. raising concerns regarding the behaviour of a co-worker.

The employee code of conduct manual must be duly reviewed and approved by the concerned stakeholders, such as the Human Resources (HR) department and company executives.

6.2.3 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:

1. **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.

2. **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.

3. **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.

4. **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.

6.2.4 Importance of Following Organizational Guidelines

Policies and procedures or organizational guidelines are essential for any organization. These provide a road map for the operations of the organization. These are also critical in ensuring compliance with the applicable laws and regulations by guiding the decision-making process and business operations.

Organizational guidelines help bring uniformity to the operations of an organization, which helps reduce the risk of unwanted and unexpected events. These determine how employees are supposed to behave at work, which ultimately helps the business achieve its objectives efficiently.

However, organizational guidelines are ineffective and fail to serve their purpose if they are not followed. Many people don't like the idea of following and abiding by specific guidelines. Such people should be made to understand the benefits of following the organizational guidelines. Some of the key benefits are given below:

With well-defined organizational guidelines in place, no individual can act arbitrarily, irrespective of their position in the organization. All individuals will know the pros and cons of taking certain actions and what to expect in case of unacceptable behaviour. Benefits of following organizational guidelines:

- **Consistent processes and structures:** Organization guidelines help maintain consistency in operations, avoiding any disorder. When all employees follow the organizational guidelines, an organization can run smoothly. These ensure that people in different job roles operate as they are supposed to, knowing what they are responsible for, what is expected of them, and what they can expect from their supervisors and co-workers. With clarity in mind, they can do their jobs with confidence and excellence. With every person working the way intended, it's easy to minimise errors.

  With all the staff following organizational guidelines, the organization has a better scope of using time and resources more effectively and efficiently. This allows the organization to grow and achieve its objectives.

- **Better quality service:** By following organizational guidelines, employees perform their duties correctly as per the defined job responsibilities. It helps enhance the quality of the organization's products and services, helping improve the organization's reputation. Working with a reputable organization, employees can take pride in their work and know they are contributing to the reputation.

- **A safer workplace:** When all employees follow organizational guidelines, it becomes easy to minimise workplace incidents and accidents. It reduces the liabilities associated with risks for the organization and limits the interruptions in operations. Employees also feel comfortable and safe in the workplace, knowing their co-workers are ensuring safety at work by following the applicable guidelines.

Different organizations may have different guidelines on dress code, time schedules, language usage, etc. For example – certain organizations in a client-dealing business requiring employees to meet clients personally follow a strict dress code asking their employees to wear formal business attire. Similarly, organizations operating in specific regions may require their employees to use the dominant regional language of the particular region to build rapport with customers and serve them better. Certain organizations, such as banks, often give preference to candidates with knowledge of the regional language during hiring.

Working hours may also differ from one organization to another, with some requiring employees to work extra compared to others. One should follow the organizational guidelines concerning all the aspects of the employment to ensure a cohesive work environment.

6.2.5 Workflow

Workflow is the order of steps from the beginning to the end of a task or work process. In other words, it is the way a particular type of work is organised or the order of stages in a particular work process.

Workflows can help simplify and automate repeatable business tasks, helping improve efficiency and minimise the room for errors. With workflows in place, managers can make quick and smart decisions while employees can collaborate more productively.

Other than the order that workflows create in a business, these have several other benefits, such as:

- **Identifying Redundancies:** Mapping out work processes in a workflow allows one to get a clear, top-level view of a business. It allows one to identify and remove redundant or unproductive processes.

Workflow gives greater insights into business processes. Utilizing such useful insights, one can improve work processes and the bottom line of the business. In many businesses, there are many unnecessary and redundant tasks that take place daily. Once an organization has insight into its processes while preparing workflow, it can determine which activities are really necessary.

Identifying and eliminating redundant tasks creates value for a business. With redundant tasks and processes eliminated, an organization can focus on what's important to the business.

- **Increase in Accountability and Reduction in Micromanagement:** Micromanagement often causes problems in a business setting as most employees don't like being micromanaged, and even many managers don't like the practice. Micromanagement is often identified as one of the reasons why people quit their job.

However, the need for micromanagement can be minimized by clearly mapping out the workflow. This way, every individual in a team knows what tasks need to be completed and by when and who is responsible for completing them. This makes employees more accountable also.

With clearly defined workflow processes, managers don't have to spend much time micromanaging their employees, who don't have to approach the manager to know what the further steps are. Following a workflow, employees know what is going on and what needs to be done. This, in turn, may help increase the job satisfaction of everyone involved while improving the relationships between management and employees.

- **Improved Communication:** Communication at work is critical because it affects all aspects of an organization. There are instances when the main conflict in an organization originates from miscommunication, e.g. the management and employees disagreeing on an aspect, despite pursuing the same objectives. Poor communication is a common workplace issue that is often not dealt with.

This highlights why workflow is important. Workplace communication dramatically can increase with the visibility of processes and accountability. It helps make the daily operations smoother overall.

- **Better Customer Service:** Customers or clients are central to a business. Therefore, it is imperative to find and improve ways to improve customer experience. Relying on outdated manual systems may cause customer requests or complaints to be overlooked, with dissatisfied customers taking their business elsewhere. However, following a well-researched and defined workflow can help improve the quality of customer service.

By automating workflows and processes, an organization can also reduce the likelihood of human error. This also helps improve the quality of products or services over time, resulting in a better customer experience.

6.2.6 Following Instructions and Reporting Problems

All organizations follow a hierarchy, with most employees reporting to a manager or supervisor. For organizational success, it is vital for employees to follow the instructions of their manager or supervisor. They should ensure they perform their duties as per the given instructions to help achieve the common objectives of the organization and deliver quality service or products. This consequently helps maintain the reputation of the organization.

It is also important to be vigilant and identify problems at work or with the organizational work processes. One should deal with the identified within their limits of authority and report out of authority problems to the manager/ supervisor or the concerned person for a prompt resolution to minimise the impact on customers/clients and business.

6.2.7 Information or Data Sharing

Information or data is critical to all organizations. Depending on the nature of its business, an organization may hold different types of data, e.g. personal data of customers or client data concerning their business operations and contacts. It is vital to effective measures for the appropriate handling of different types of data, ensuring its protection from unauthorized access and consequent misuse.

One should access certain data only if authorised to do so. The same is applicable when sharing data which must be shared only with the people authorised to receive it to use it for a specific purpose as per their job role and organizational guidelines. For example – one should be extra cautious while sharing business data with any third parties to ensure they get access only to the limited data they need as per any agreements with them. It is also critical to monitor how the recipient of the data uses it, which should strictly be as per the organizational guidelines. It is a best practice to share appropriate instructions with the recipient of data to ensure they are aware of the purpose with which data is being shared with them and how they are supposed to use and handle it. Any misuse of data must be identified and reported promptly to the appropriate person to minimise any damage arising out of data misuse.

These days most organizations require their employees and business partners or associated third parties to sign and accept the relevant agreement on the non-disclosure of business-sensitive information. In simple terms, business-sensitive information is confidential information. It is proprietary business information collected or created during the course of conducting business, including information about the business, e.g. proposed investments, intellectual property, trade secrets, or plans for a merger and information related to its clients. Business-sensitive information may sometimes also include information regarding a business's competitors in an industry.

The release of business: Sensitive information to competitors or the general public poses a risk to a business. For example, information regarding plans for a merger could be harmful to a business if a competitor gets access to it.

6.2.8 Reporting Issues at Work

Most organizations have defined guidelines on appropriate reporting processes to be followed for reporting different types of issues. For example – one can report any grievances or dissatisfaction concerning co-workers to their manager/supervisor, e.g. data breaches or unethical conduct. If the concern is not addressed, then the employee should follow the organizational guidelines and hierarchy for the escalation of such issues that are not addressed appropriately.

For example: Any concern related to sexual harassment at the workplace should be escalated to the concerned spokesperson, such as Human Resources (HR) representative, and if not satisfied with the action taken, it should be reported to the senior management for their consideration and prompt action.

6.2.9 Dealing with Heightened Emotions

Humans are emotional beings. There may be occasions when one is overwhelmed by emotions and is unable to suppress them. However, there may be situations when one must manage emotions well, particularly at work.

Stress in one's personal and professional life may often cause emotional outbursts at work. Managing one's emotions well, particularly the negative ones, is often seen as a measure of one's professionalism. Anger, dislike, frustration, worry, and unhappiness are the most common negative emotions experienced at work.

Ways to manage negative emotions at work:

- **Compartmentalisation:** It's about not confining emotions to different aspects of one's life. For example, not letting negative emotions from personal life affect work-life and vice versa. One should try to leave personal matters and issues at home. One should train their mind to let go of personal matters before reaching work. Similarly, one can compartmentalise work-related stresses so that negative emotions from work don't affect one's personal life.

- **Deep breathing and relaxation:** Deep breathing helps with anxiety, worry, frustration and anger. One should take deep breaths, slowly count to ten - inhaling and exhaling until one calms down. One can also take a walk to calm down or listen to relaxing music. Talking to someone and sharing concerns also helps one calm down.
- **The 10-second rule:** This is particularly helpful in controlling anger and frustration. When one feels their temper rising, they should count to 10 to calm down and recompose. If possible, one should move away to allow temper to come down.
- **Clarify:** It is always good to clarify before reacting, as it may be a simple case of misunderstanding or miscommunication.
- **Physical activity:** Instead of losing temper, one should plan to exercise, such as running or going to the gym, to let the anger out. Exercise is also a great way to enhance mood and release any physical tension in the body.
- **Practising restraint:** One should avoid replying or making a decision when angry, not allowing anger or unhappiness to cloud one's judgement. It may be best to pause any communication while one is angry, e.g. not communicating over email when angry or upset.
- **Knowing one's triggers:** It helps when one is able to recognise what upsets or angers them. This way, one can prepare to remain calm and plan their reaction should a situation occur. One may even be able to anticipate the other party's reaction.
- **Be respectful:** One should treat their colleagues the same way one would like to be treated. If the other person is rude, one need not reciprocate. It is possible to stay gracious, firm and assertive without being aggressive. Sometimes, rude people back away when they don't get a reaction from the person they are arguing with.
- **Apologise for any emotional outburst:** Sometimes, one can get overwhelmed by emotions, reacting with an emotional outburst. In such a case, one should accept responsibility and apologise immediately to the affected persons without being defensive.
- **Doing away with negative emotions:** It is recommended to let go of anger, frustration and unhappiness at the end of every workday. Harbouring negative emotions affects one emotionally, affecting their job performance also. Engaging in enjoyable activities after work is a good stress reliever.

Notes

UNIT 6.3: Maintaining Social Diversity at Work

Unit Objectives

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

1. Explain the concept and importance of gender sensitivity and equality.
2. Discuss ways to create sensitivity for different genders and Persons with Disabilities (PwD).

6.3.1 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 6.3.1 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 coffee farming households.
- Assist in making a work environment that is healthy, safe, and free from discrimination.

Bridging Gender Differences

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

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

In order to bridge the gap, one should:

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

Ways to reduce Gender Discrimination

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

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.

6.3.2 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 three examples of workplace ethics.
2. List down three examples of interpersonal skills.
3. Identify two reasons for workplace conflicts.
4. Identify two ways of resolving interpersonal conflicts.
5. List down two ways of dealing with heightened emotions at work.
6. List down two types of non-verbal communication.4. Basic Health and Safety Practices.

Notes

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

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

ESSCI
Skilling India in Electronics

7. Basic Health and Safety Practices

Unit 7.1 - Workplace Hazards

Unit 7.2 - Fire Safety

Unit 7.3 - First Aid

Unit 7.4 - Waste Management

ELE/N1002

Key Learning Outcomes

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

1. Discuss job-site hazards, risks and accidents.
2. Explain the organizational safety procedures for maintaining electrical safety, handling tools and hazardous materials.
3. Describe how to interpret warning signs while accessing sensitive work areas.
4. Explain the importance of good housekeeping.
5. Describe the importance of maintaining appropriate postures while lifting heavy objects.
6. List the types of fire and fire extinguishers.
7. Describe the concept of waste management and methods of disposing of hazardous waste.
8. List the common sources of pollution and ways to minimize them.
9. Elaborate on electronic waste disposal procedures.
10. Explain how the administer appropriate first aid to victims in case of bleeding, burns, choking, electric shock, poisoning and also administer first aid to victims in case of a heart attack or cardiac arrest due to electric shock.

UNIT 7.1: Workplace Hazards

Unit Objectives

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

1. Discuss job-site hazards, risks and accidents.
2. Explain the organizational safety procedures for maintaining electrical safety, handling tools and hazardous materials.
3. Describe how to interpret warning signs while accessing sensitive work areas.
4. Explain the importance of good housekeeping.
5. Describe the importance of maintaining appropriate postures while lifting heavy objects.
6. Explain safe handling of tools and Personal Protective Equipment to be used.

7.1.1 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.

7.1.2 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 Hazards Analysis

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

Control Measures of Workplace Hazards

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

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

7.1.3 Risk for a Drone Technician

A drone technician may require to repair the propeller, motor and its mount, battery, mainboards, processor, booms, avionics, camera, sensors, chassis, wiring and landing gear. A technician may face some risks while repairing the drones' equipment.

- The technician is susceptible to being physically harmed by propellers.
- Direct contact with exposed electrical circuits can injure the person.
- If the skin gets in touch with the heat generated from electric arcs, it burns the internal tissues.
- Major electrical injuries can occur due to poorly installed electrical equipment, faulty wiring, overloaded or overheated outlets, use of extension cables, incorrect use of replacement fuses, use of equipment with wet hands, etc.

7.1.4 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. 7.1.1. 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. 7.1.2. Mandatory signs

3. Warning Signs

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

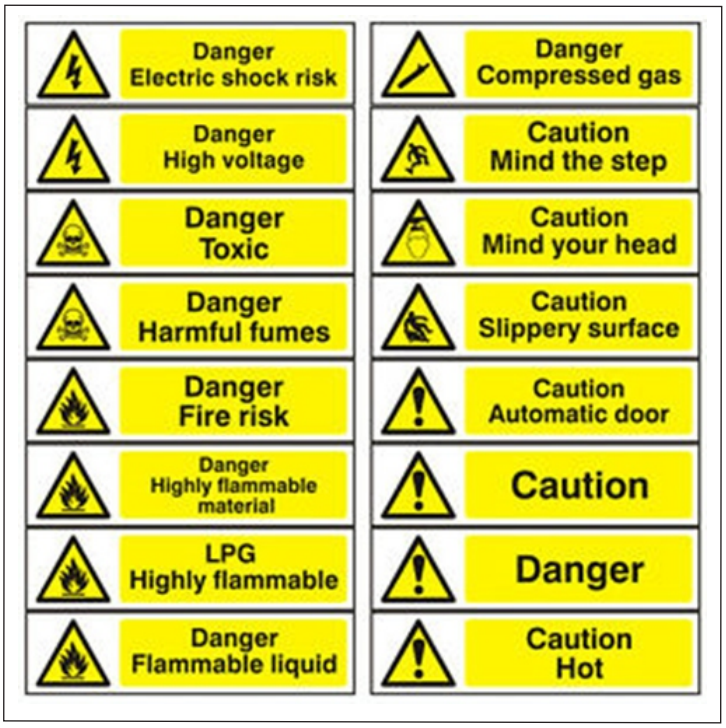


Fig. 7.1.3. Warning signs

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. 7.1.4. Emergency signs

7.1.5 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.

7.1.6 Lifting and Handling of Heavy Loads

Musculoskeletal Injuries (MSIs), such as sprains and strains, can occur while lifting, handling, or carrying objects at work. When bending, twisting, uncomfortable postures and lifting heavy objects are involved, the risk of injury increases. Ergonomic controls can help to lower the risk of injury and potentially prevent it.

Types of injuries caused while lifting heavy objects:

- Cuts and abrasions are caused by rough surfaces.
- Crushing of feet or hands.
- Strain to muscles and joints.

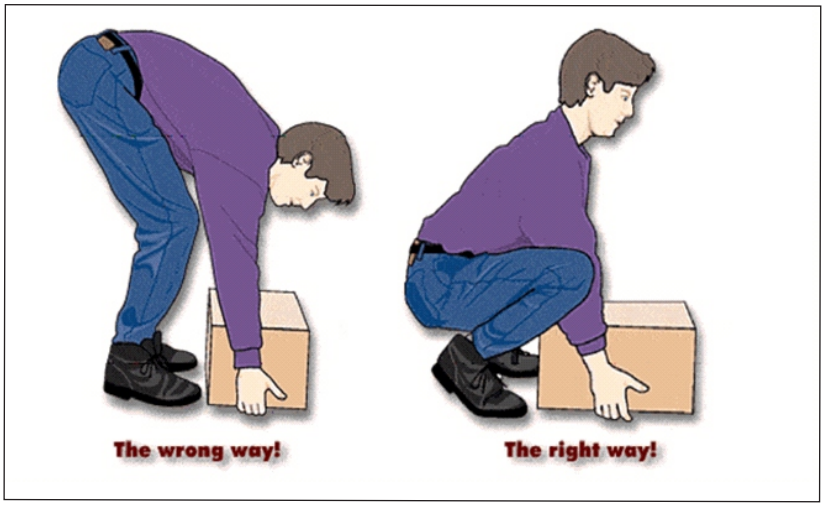


Fig. 7.1.5. Lifting loads technique

Preparing to Lift

A load that appears light enough to bear at first will grow increasingly heavier as one carries it further. The person carrying the weight should be able to see over or around it at all times.

The amount of weight a person can lift, depends on their age, physique, and health.

It also depends on whether or not the person is used to lifting and moving hefty objects.

Common Causes of Back Injuries

The Most Common Causes of Back Injuries are:

1. **Inadequate Training:** The individual raising the load receives no sufficient training or guidance.
2. **Lack of awareness of technique:** The most common cause of back pain is incorrect twisting and posture, which causes back strain.
3. **Load size:** The load size to consider before lifting. If the burden is too much for one's capacity or handling, their back may be strained and damaged.
4. **Physical Strength:** Depending on their muscle power, various persons have varied physical strengths. One must be aware of their limitations.
5. **Teamwork:** The operation of a workplace is all about working together. When opposed to a single person lifting a load, two people can lift it more easily and without difficulty. If one of two people isn't lifting it properly, the other or both of them will suffer back injuries as a result of the extra strain.

Technique	Demonstration
1. Ensure one has a wide base of support before lifting the heavy object. Ensure one's feet are shoulder-width apart, and one foot is slightly ahead of the other at all times. This will help one maintain a good balance during the lifting of heavy objects. This is known as the Karate Stance.	
2. Squat down as near to the object as possible when one is ready to lift it, bending at the hips and knees with the buttocks out. If the object is really heavy, one may wish to place one leg on the floor and the other bent at a straight angle in front of them.	

4. By straightening one's hips and knees, slowly elevate the thing (not the back). As one rises, they should extend their legs and exhale. Lift the heavy object without twisting the body or bending forward.	
5. Do not lift bending forward.	
6. Hold the load close to the body.	
7. Never lift heavy objects above the shoulder	

7. Never lift heavy objects above the shoulder	
8. Use the feet (not the body) to change direction, taking slow, small steps.	
9. Set down the heavy object carefully, squatting with the knees and hips only.	

Table 7.1.1 Techniques for lifting heavy objects[1]

[1]*Source:https://www.braceability.com/blogs/articles/7-proper-heavy-lifting-techniques*

7.1.7 Safe Handling of Tools

Workers should be trained on how to use tools safely. When tools are misplaced or handled incorrectly by workers, they can be dangerous. The following are some suggestions from the National Safety Council for safe tool handling when they are not in use:

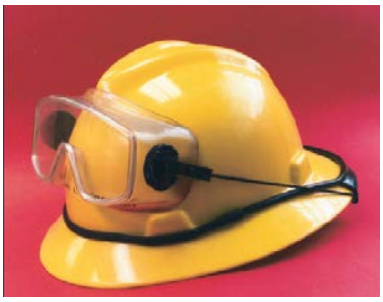
- Never carry tools up or down a ladder in a way that makes it difficult to grip them. Instead of being carried by the worker, tools should be lifted up and down using a bucket or strong bag.
- Tools should never be tossed but should be properly passed from one employee to the next. Pointed tools should be passed with the handles facing the receiver or in their carrier.
- When turning and moving around the workplace, workers carrying large tools or equipment on their shoulders should pay particular attention to clearances.
- Pointed tools such as chisels and screwdrivers should never be kept in a worker's pocket. They can be carried in a toolbox, pointing down in a tool belt or pocket tool bag, or in hand with the tip always held away from the body.

- Tools should always be stored while not in use. People below are put in danger when tools are left sitting around on an elevated structure, such as a scaffold. In situations when there is a lot of vibration, this risk increases.

7.1.8 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.	
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 7.1.2 Personal protective equipment

Notes

UNIT 7.2: Fire Safety

Unit Objectives

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

1. List the types of fire and fire extinguishers.

7.2.1 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.

7.2.2 Respond to a Workplace Fire

- Workplace fire drills should be conducted on a regular basis.
- If one has a manual alarm, they 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 and descend on the ground and roll to smother the flames if their clothes catch fire.

7.2.3 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 soon. The types and quantity of extinguishers that are legally necessary for a given region are determined by the applicable safety standards.

Types of fire extinguishers are:

There are five main types of fire extinguishers:

1. Water.
2. Powder.
3. Foam.
4. Carbon Dioxide (Co2).
5. Wet chemical.

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

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

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

4. **Carbon Dioxide (Co2):** Class B and electrical fires are extinguished with carbon dioxide extinguishers, which suffocate the flames by removing oxygen from the air. They are particularly beneficial for workplaces and workshops where electrical fires may occur since, unlike conventional extinguishers, they do not leave any toxins behind and hence minimise 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 7.3: First Aid

Unit Objectives

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

1. Explain how the administer appropriate first aid to victims in case of bleeding, burns, choking, electric shock, poisoning.
2. Explain how to administer first aid to victims in case of a heart attack or cardiac arrest due to electric shock.

7.3.1 First Aid

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

The aim of first aid is to:

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

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

7.3.2 Need for First Aid at the Workplace

- In the workplace, first aid refers to providing immediate care and life support to persons who have been injured or become unwell at work.
- Many times, first aid can help to lessen the severity of an accident or disease.
- It can also help an injured or sick person relax. In life-or-death situations, prompt and appropriate first aid can make all the difference.

7.3.2 Need for First Aid at the Workplace

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

7.3.3 Treating Minor Cuts and Scrapes

Steps to keep cuts clean and prevent infections and scars:

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

7.3.4 Heart Attack

When the blood flow carrying oxygen to the heart is blocked, a heart attack occurs. The heart muscle runs out of oxygen and starts to die.

Symptoms of a heart attack can vary from person to person. They may be mild or severe. Women, older adults, and people with diabetes are more likely to have subtle or unusual symptoms.

Symptoms in adults may include:

- Changes in mental status, especially in older adults.
- Chest pain that feels like pressure, squeezing, or fullness. The pain is most often in the centre of the chest. It may also be felt in the jaw, shoulder, arms, back, and stomach. It can last for more than a few minutes or come and go.
- Cold sweat.
- Light-headedness.
- Nausea (more common in women).
- Indigestion.

- Vomiting.
- Numbness, aching or tingling in the arm (usually the left arm, but the right arm may be affected alone, or along with the left).
- Shortness of breath.
- Weakness or fatigue, especially in older adults and in women.

First Aid for Heart Attack

If one thinks someone is experiencing a heart attack, they should:

- Have the person sit down, rest, and try to keep calm.
- Loosen any tight clothing.
- Ask if the person takes any chest pain medicine, such as nitro-glycerine for a known heart condition, and help them take it.
- If the pain does not go away promptly with rest or within 3 minutes of taking nitro-glycerine, call for emergency medical help.
- If the person is unconscious and unresponsive, call 911 or the local emergency number, then begin CPR.
- If an infant or child is unconscious and unresponsive, perform 1 minute of CPR, then call 911 or the local emergency number.

Notes

UNIT 7.4: Waste Management

Unit Objectives

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

1. Describe the concept of waste management and methods of disposing of hazardous waste.
2. List the common sources of pollution and ways to minimize them.
3. Elaborate on electronic waste disposal procedures.

7.4.1. 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.

7.4.2 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.

- **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.
- **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.

7.4.3 Recyclable, Non-Recyclable and Hazardous Waste

1. **Recyclable Waste:** The waste which can be reused or recycled further is known as recyclable waste.
2. **Non-recyclable Waste:** The waste which cannot be reused or recycled is known as non-recyclable waste. Polythene bags are a great example of non-recyclable waste.
3. **Hazardous Waste:** The waste which can create serious harm to the people and the environment is known as hazardous waste.

7.4.4 Sources of Pollution

Pollution is defined as the harm caused by the presence of a material or substances in places where they would not normally be found or at levels greater than normal. Polluting substances might be in the form of a solid, a liquid, or a gas.

- **Point source of pollution:** Pollution from a point source enters a water body at a precise location and can usually be identified. Effluent discharges from sewage treatment plants and industrial sites, power plants, landfill sites, fish farms, and oil leakage via a pipeline from industrial sites are all potential point sources of contamination.

  Point source pollution is often easy to prevent since it is feasible to identify where it originates, and once identified, individuals responsible for the pollution can take rapid corrective action or invest in longer-term treatment and control facilities.

- **Diffuse source of pollution:** As a result of land-use activities such as urban development, amenity, farming, and forestry, diffuse pollution occurs when pollutants are widely used and diffused over a large region. These activities could have occurred recently or in the past. It might be difficult to pinpoint specific sources of pollution and, as a result, take rapid action to prevent it because prevention often necessitates significant changes in land use and management methods.

Pollution Prevention

Pollution prevention entails acting at the source of pollutants to prevent or minimise their production. It saves natural resources, like water, by using materials and energy more efficiently.

Pollution prevention includes any practice that:

- Reduces the amount of any hazardous substance, pollutant, or contaminant entering any waste stream or otherwise released into the environment (including fugitive emissions) prior to recycling, treatment, or disposal;
- Reduces the hazards to public health and the environment associated with the release of such substances, pollutants, or contaminants (these practices are known as "source reduction");
- Improved efficiency in the use of raw materials, energy, water, or other resources, or Conservation is a method of safeguarding natural resources.
- Improvements in housekeeping, maintenance, training, or inventory management; equipment or technology adjustments; process or method modifications; product reformulation or redesign; raw material substitution; or improvements in housekeeping, maintenance, training, or inventory control.

7.4.5 Electronic Waste

Lead, cadmium, beryllium, mercury, and brominated flame retardants are found in every piece of electronic waste. When gadgets and devices are disposed of illegally, these hazardous compounds are more likely to contaminate the earth, pollute the air, and leak into water bodies.

When e-waste is dumped in a landfill, it tends to leach trace metals as water runs through it. The contaminated landfill water then reaches natural groundwater with elevated toxic levels, which can be dangerous if it reaches any drinking water bodies. Despite having an environmentally benign approach, recycling generally results in international shipment and dumping of the gadgets in pits.

Some eco-friendly ways of disposing of e-waste are:

- Giving back the e-waste to the electronic companies and drop-off points.
- Following guidelines issued by the government.
- Selling or donating the outdated technology-based equipment.
- Giving e-waste to a certified e-waste recycler.

Exercise

1. Name all five types of fire extinguishers.
2. Explain PPE in brief.
3. List the common workplace hazards.
4. Fill in the Blacks:
   i. A "_____ sign" is a safety sign that prohibits behaviour that is likely to endanger one's health or safety.
   ii. _____ entails acting at the source of pollutants to prevent or minimise their production.
   iii. _____ is the treatment or care given to someone who has sustained an injury or disease until more advanced care can be obtained or the person recovers.
   iv. The threats caused by biological agents like viruses, bacteria, animals, plants, insects and also humans, are known as _____.
   v. The workplace has to be administered as per the rules of the _____.

Notes

Annexure of QR Codes for Building Management System Service Engineer

Chapter Name	Unit Name	Topic Name	URL	Page No.	QR Code	Video Duration
Chapter 1: Introduction to the Electronics Sector in India	Unit 1.1: Introduction of Electronic Sector	1.1 Electronic Industry overview	https://www.youtube.com/watch?v=JgLu40JBa-c	5	Electronic Industry overview	00:06:05
		1.2.2 Building Management System (BMS)	https://www.youtube.com/watch?v=eod1clD3aUQ	10	Building Management System (BMS)	00:20:37
Chapter 2: Process of Preparing for Installing the BMS	Unit 2.1: Process of Preparing for Installing the BMS	2.1.1: Building Management System (BMS)		24	Building Management System (BMS)	00:20:37
		2.1.3: BMS Architecture	https://youtu.be/illCOZoIZVs	24	BMS Architecture	00:07:17
Chapter 3: Process of Carrying out the Installation of BMS	Unit 3.1 Conduiting and Cabling	3.1.1: Conducting and Cabling	https://youtu.be/2S4j3qW-g9s	38	Conducting and Cabling	00:07:58
		3.1.2: GI Conduit Installation	https://youtu.be/lC7vhxwLiJc	38	GI Conduit Installation	00:05:01
		3.1.5: BMS Electrical Wiring and ConnectIon Installation	https://youtu.be/agtnyfZY8SI	38	BMS Electrical Wiring and ConnectIon Installation	00:10:15
Chapter 4: Process of Carrying out Commissioning and Testing of BMS	Unit 4.1: Commissioning and Testing of BMS	4.1.2 Pre-commissioning Procedure for Building Management System BMS	https://youtu.be/lXw_6anGWFY	64	Pre-commissioning Procedure for Building Management System BMS	00:14:25
		4.1.3 BMS Testing & Commissioning Sequence & Procedure	https://youtu.be/2WRUAquvuUY	64	BMS Testing & Commissioning Sequence & Procedure	00:12:56

Chapter Name	Unit Name	Topic Name	URL	Page No.	QR Code	Video Duration
Chapter 5: Process of Carrying Out Repair and Maintenance of BMS	Unit 5.1 - Repair and Maintenance of BMS	5.1.6 Maintenance of Air Systems	https://youtu.be/KtV7J_YQq7k	75	Maintenance of Air Systems	00:08:51
		5.1.7 Maintenance of Geo-Thermal, Heating & DHW Systems	https://youtu.be/ZDRiYEoskoM	75	Maintenance of Geo-Thermal, Heating & DHW Systems	00:16:32

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