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MINISTRY OF SKILL DEVELOPMENT
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Construction Skill Development Council

Participant Handbook

Sector
Construction Skill Development Council of India

Sub - Sector
Real Estate and Infrastructure Construction

Occupation
Fabrication

Reference ID: **CON/Q1206, Version 3.0**

NSQF Level 4

Fabricator

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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

Construction Skill Development Council of India

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for

SKILLING CONTENT: PARTICIPANT HANDBOOK

Complying to National Ocupational Standards of

Job Role/Qualification Pack: **'Fabricator'** QP No. **'CON/Q1206, Version 3.0 NSQF Level 4'**

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Acknowledgements

This participant's handbook meant for Fabricator is a sincere attempt to ensure the availability of all the relevant information to the existing and prospective job holders in this job role. We have compiled the content with inputs from the relevant Subject Matter Experts (SMEs) and industry members to ensure it is the latest and authentic. We express our sincere gratitude to all the SMEs and industry members who have made invaluable contributions to the completion of this participant's handbook.

This handbook will help deliver skill-based training in the Fabricator. 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 Fabricator. 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 Fabricator. After studying this handbook, job holders will be adequately skilled in carrying out their duties according to the applicable quality standards. The handbook is aligned with the following National Occupational Standards (NOS) detailed in the latest and approved version of Fabricator QP:

- **CON/N1210:** Inspect the fabrication materials and conduct their surface cleaning
- **CON/N1211:** Conduct joint preparation, connection activities and repair work in fabricated assemblies
- **CON/N0717:** Erect structural steel assemblies at construction sites
- **CON/N8001:** Work effectively in a team to deliver desired results at the workplace
- **CON/N9001:** Work according to personal health, safety and environment protocols at construction site
- **DGT/VSQ/N0102:** Employability Skills (60 Hours)

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

Symbols Used

Key Learning Outcomes

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1. Introduction of Construction Sector and Fabricator Job Role

Construction Skill Development Council

Bridge Module

Key Learning Outcomes

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

1. Explain role description/ functions of the job role- fabricator.
2. Define the personal attributes required in fabrication occupation.
3. Explain future possible progression for role of fabricator.

UNIT 1.1: Construction Industry in India

Unit Objectives

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

1. Describe the size and scope of the construction industry and its sub-sectors
2. Compare urban and rural construction
3. Observe and outline modernization of construction
4. Know about major occupations in the construction sector

1.1.1 Overview of Construction Sector in India

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

Fig. 1.1.1 Construction Industry

The construction sector in India, following agriculture, is the second-largest employment generator, encompassing a wide spectrum of enterprises, ranging from small and medium-sized businesses to large corporations.

These entities engage in a myriad of projects, including infrastructure, residential, and commercial developments, resulting in a multifaceted demand for a diverse workforce with various skills and expertise to meet the nation's growing construction needs.

Some examples of Infrastructure are:

Buildings	
Bridges	
Dams	
Power Plants	
Railway Bridges	

Hotels	
Airports	
Buildings	

Table 1.1.1 Various infrastructure related to Construction

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

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

Real Estate & Infrastructure Construction

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

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

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

Fig. 1.1.3 Bridge Construction

Fig. 1.1.2 Township Construction

Government Initiatives under Urban Development

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

Fig. 1.1.4 Building Construction Site

Fig. 1.1.5 Industrial Building Construction Site

Some of the key government initiatives include:

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

Rural Construction

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

Fig. 1.1.6 Rural Roads

Fig. 1.1.7 Rural House

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

Government Initiatives under Rural Development

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

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

"Bharat Nirman"

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

Fig. 1.1.8 Bharat Gramin Yojna for improving Rural Infrastructure

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

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

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

1.1.2 Major occupations in Construction Sector

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

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

The basic objectives of masonry work include:

- Building of structure by laying material such as bricks, blocks, tiles and other construction materials, and bonding them by mortar.
- Constructing, altering, repairing and maintaining walls, sidewalks, street curbs, floors, sink counters, partitions, manholes, and other related structures or surfaces.
- Carry out structural finishes like tiling, grit wash, cement wash, POP, plastering, stone cladding etc. on finished masonry surface to impart an aesthetic appeal to the finished structure.

Fig. 1.1.9 Brick work

Fig. 1.1.10 Plastering Work

Few job roles under masonry occupation are:

- Helper Mason
- Assistant Mason
- General Mason
- Mason Tiling
- Mason Concrete
- Mason marble, granite & stone; and
- Mason Special Finishing
- Mason Form Finishes & Special concrete.

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

Fig. 1.1.11 Bar bending

Few job roles under bar bending occupation are:

- Helper bar bender & steel fixer;
- Assistant bar bender & steel fixer;
- Bar bender & steel fixer; and
- Reinforcement fitter.

Fig. 1.1.12 Reinforcement bars fixed at site

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

Fig. 1.1.13 Conventional formwork

Fig. 1.1.14 System formwork

Few job roles under shuttering carpentry occupation are:

- Helper shuttering carpenter;
- Assistant shuttering carpenter;
- Shuttering carpenter – system; and
- Shuttering carpenter – conventional.

Fig. 1.1.11 Bar bending

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

Few job roles under scaffolding occupation are:

- Assistant scaffold – system; and;
- Assistant scaffold – conventional.;
- Scaffolder-System
- Scaffolder-Conventional.
- Chargehand Scaffolding –System
- Foreman Scaffolding

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

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

Fig. 1.1.16 Welding

Few job roles under Fabrication occupation are:

- Grinder Construction;
- Construction fitter;
- Construction welder;
- Fabricator; and
- Plasma cutter.

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

Fig. 1.1.17 Rigging work at site

Few job roles under rigging occupation are:

- Khalasi;
- Rigger structural erection;
- Rigger precast erection; and
- Rigger piling.

1.1.3 Typical Layout of a Construction Site

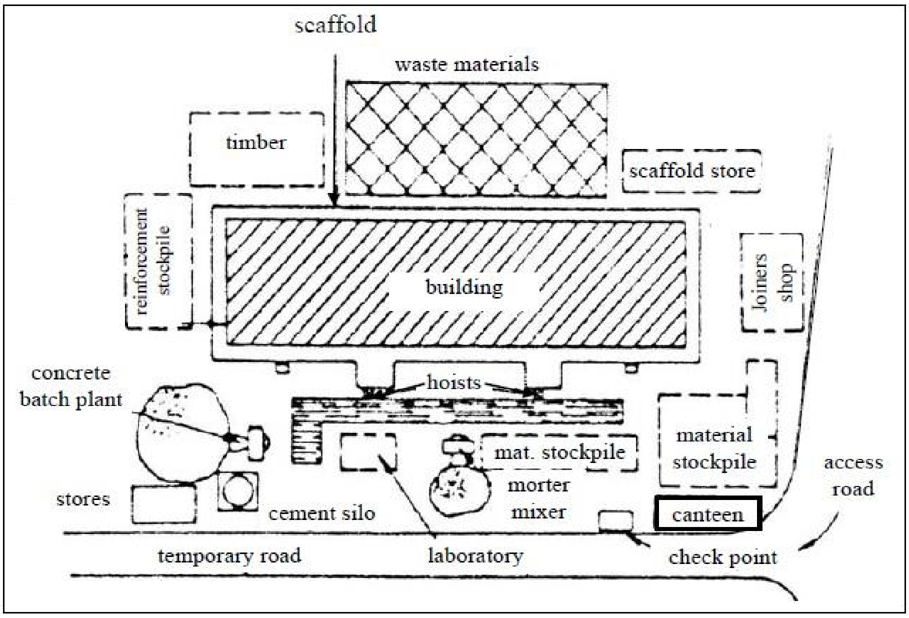

Fig. 1.1.18 Layout of a construction site

Notes

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QR Codes

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Overview of Construction Sector in India

UNIT 1.2: About Fabrication Occupation

Unit Objectives

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

1. Explain role description/ functions of the job role- fabricator.
2. Define the personal attributes required in fabrication occupation.
3. Explain future possible progression for role of fabricator.

1.2.1 About Fabrication in Construction Industry

In the construction industry, fabrication refers to the process of creating and assembling structural components, building materials, or architectural elements in a controlled environment, typically a fabrication shop or factory, before transporting them to the construction site for installation. This approach offers several advantages, including increased precision, quality control, and efficiency.

Here are few examples of fabrication in the construction industry:

1. **Structural Steel Fabrication:**
   - **Example:** Fabricating steel beams and columns.
   - **Process:** Structural steel components, such as beams and columns, are fabricated in a dedicated shop. Skilled fabricators cut, weld, and assemble steel pieces according to engineering specifications and architectural plans. This process ensures that the steel components are precise and meet strength requirements.
   - **Advantages:** Fabricating structural steel off-site reduces construction time, minimizes on-site welding, and improves the overall structural integrity of the building.

Fig. 1.2.1 Structural steel fabrication

2. **Prefab Wall Panels:**

- **Example:** Prefabricated wall panels with insulation and exterior finishes.
- **Process:** Wall panels are manufactured in a controlled environment, with insulation, sheathing, and exterior cladding installed. These panels are then transported to the construction site and assembled into the building's structure. Electric wiring and plumbing can also be pre-installed.
- **Advantages:** Prefabricated wall panels accelerate construction, enhance insulation performance, and maintain consistent quality. They also reduce waste and labor costs.

Fig. 1.2.2 Prefab wall panels

3. **Modular Construction:**

- **Example:** Modular housing units.
- **Process:** Entire building modules, such as apartment units or hotel rooms, are constructed off-site in a factory. These modules include interior finishes, fixtures, and even appliances. Once completed, they are transported to the construction site and stacked or connected to form the final building.

Fig. 1.2.3 Modular construction

- **Advantages:** Modular construction speeds up project timelines significantly, improves quality control, and reduces on-site disruptions. It's often used in projects where speed is crucial, such as affordable housing or hotels.

4. **Custom Millwork and Cabinetry:**

- **Example:** Custom-made cabinets and architectural millwork for interior spaces.
- **Process:** Skilled craftsmen create custom cabinetry, millwork, and architectural details in a workshop. This includes items like kitchen cabinets, built-in shelving, and decorative woodwork. These custom pieces are then transported to the construction site for installation.
- **Advantages:** Custom millwork and cabinetry enhance the interior aesthetics and functionality of a building. Fabricating these items off-site allows for precision and customization that might be difficult to achieve on-site.

Fig. 1.2.4 Custom millwork and cabinetry

In all these examples, fabrication in the construction industry allows for greater efficiency, quality control, and faster project completion. By creating components or structures in a controlled environment, construction professionals can mitigate many of the challenges and uncertainties associated with on-site construction, ultimately delivering better results to clients.

1.2.2 About Fabricator Job Role

The fabricator is responsible for conducting various activities such as surface cleaning, edge/ joint preparation, and connection of the components/ steel sections, etc., as well as carrying out the erection of these assemblies.

The fabricator is expected to be physically fit to work across various locations with varied environmental conditions. The individual should preferably not be suffering from any respiratory disorder, vision defects, and skin allergies. The person should be organized, diligent, methodical, safety-conscious, and a prompt decision-maker. In addition to being a team player, the individual should have good communication skills.

Fig. 1.2.5 Fabricator performing duties

1.2.3 About Role Description/ Functions of the Fabricator

A fabricator in the construction sector is a skilled tradesperson responsible for creating and assembling various structural and architectural components used in construction projects. Their role is crucial in ensuring that the fabricated parts meet design specifications, quality standards, and safety regulations.

Fig. 1.2.6 Functions of the fabricator

Here are the role description and functions of a fabricator in the construction sector:

- **Reading and Interpreting Blueprints:** Fabricators start by studying architectural and engineering drawings, blueprints, and plans to understand the specific requirements of the construction project. This includes interpreting dimensions, materials, and assembly instructions.

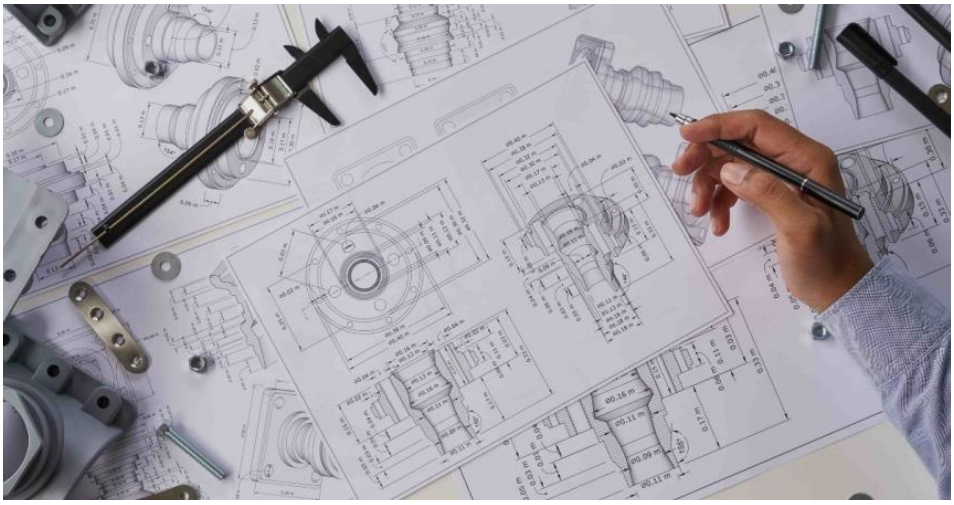


Fig. 1.2.7 Reading and interpreting blueprints

- **Material Selection:** Fabricators select the appropriate materials based on the project's specifications and design requirements. This includes choosing the right type of metal, wood, or other construction materials.

Fig. 1.2.8 Material selection

- **Cutting and Shaping:** Fabricators use a variety of tools and machinery to cut and shape materials to the required dimensions. This may involve using saws, shears, plasma cutters, or CNC (Computer Numerical Control) machines to achieve precision.

Fig. 1.2.9 Cutting and shaping

- **Welding and Joining:** Fabricators are often skilled welders, responsible for joining metal components together securely. They use welding techniques such as MIG, TIG, and stick welding to create strong and durable connections.

Fig. 1.2.10 Welding and joining

- **Assembly:** Fabricators assemble various components, such as structural steel frames, staircases, railings, and architectural features. They ensure that all parts fit together correctly and securely, using fasteners, welding, or adhesives.

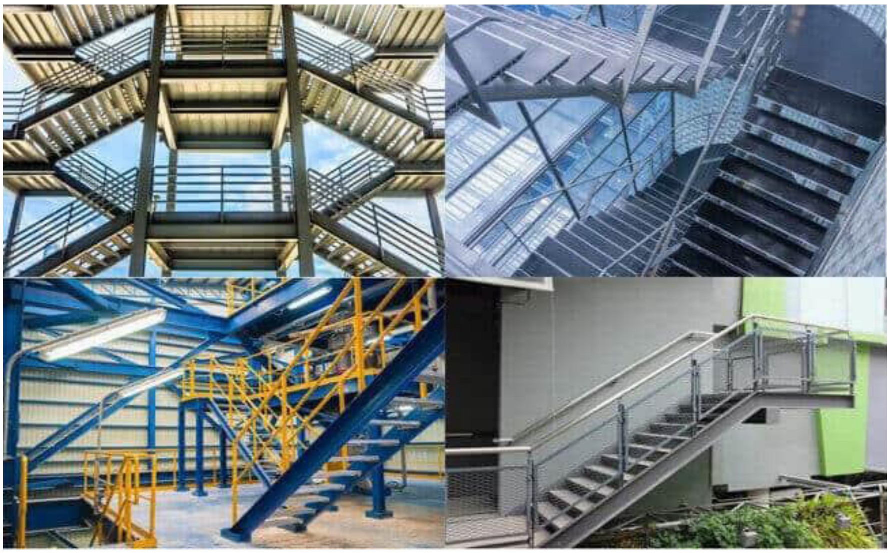


Fig. 1.2.11 Assembling various components

- **Quality Control:** Fabricators are responsible for inspecting their work at various stages to ensure that it meets quality standards and specifications. This includes checking for accurate dimensions, weld quality, and overall structural integrity.

Fig. 1.2.12 Quality control

- **Safety Compliance:** Fabricators must adhere to strict safety protocols to prevent accidents and injuries. They use personal protective equipment (PPE) and follow safety procedures when working with heavy machinery, sharp tools, and potentially hazardous materials.

Fig. 1.2.13 Safety compliance

- **Problem Solving:** Fabricators often encounter challenges during fabrication, such as material defects or design discrepancies. They need to troubleshoot problems, make adjustments, and find practical solutions to ensure the project progresses smoothly.
- **Communication:** Effective communication is essential for fabricators, as they need to collaborate with architects, engineers, project managers, and other construction professionals. They provide progress updates, discuss design changes, and address any construction-related issues.
- **Documentation:** Fabricators maintain records of materials used, work hours, and quality control checks. These records help track progress and ensure that the project complies with regulations and specifications.

Fig. 1.2.14 Tracking progress

- **Equipment Maintenance:** Fabricators are responsible for the maintenance and upkeep of their tools and equipment. Regular maintenance ensures that machinery operates efficiently and safely.

Fig. 1.2.15 Equipment maintenance

- **Adaptability:** Fabricators may work on a wide range of construction projects, from residential buildings to commercial structures and industrial facilities. They must adapt to different project requirements and materials.
- **Continuous Learning:** To stay current in their field, fabricators may need to learn new fabrication techniques, work with evolving materials, and understand the latest safety regulations and construction standards.

In summary, fabricators in the construction sector play a pivotal role in creating and assembling components that form the backbone of construction projects. They work with precision, adhere to safety regulations, and ensure that the fabricated parts meet quality standards, contributing to the successful completion of construction projects.

1.2.4 Personal Attributes required in the Fabrication Occupation

Personal attributes required in the fabrication occupation in the construction sector include:

- **Precision:** Fabricators must work with accuracy to ensure components fit perfectly.
- **Attention to Detail:** Identifying flaws and ensuring quality is crucial in fabrication.

- **Problem-Solving Skills:** Ability to troubleshoot and find solutions when issues arise.
- **Physical Stamina:** The job often involves lifting heavy materials and standing for extended periods.
- **Safety Consciousness:** Prioritizing safety and following safety protocols at all times.
- **Communication:** Effective communication for collaboration with the team.
- **Adaptability:** Being open to learning new techniques and materials.
- **Time Management:** Meeting project deadlines and managing tasks efficiently.
- **Mechanical Aptitude:** Understanding how tools and machinery work.
- **Teamwork:** Collaborating with architects, engineers, and other construction professionals.

Fig. 1.2.16 Fabrication occupation in the construction

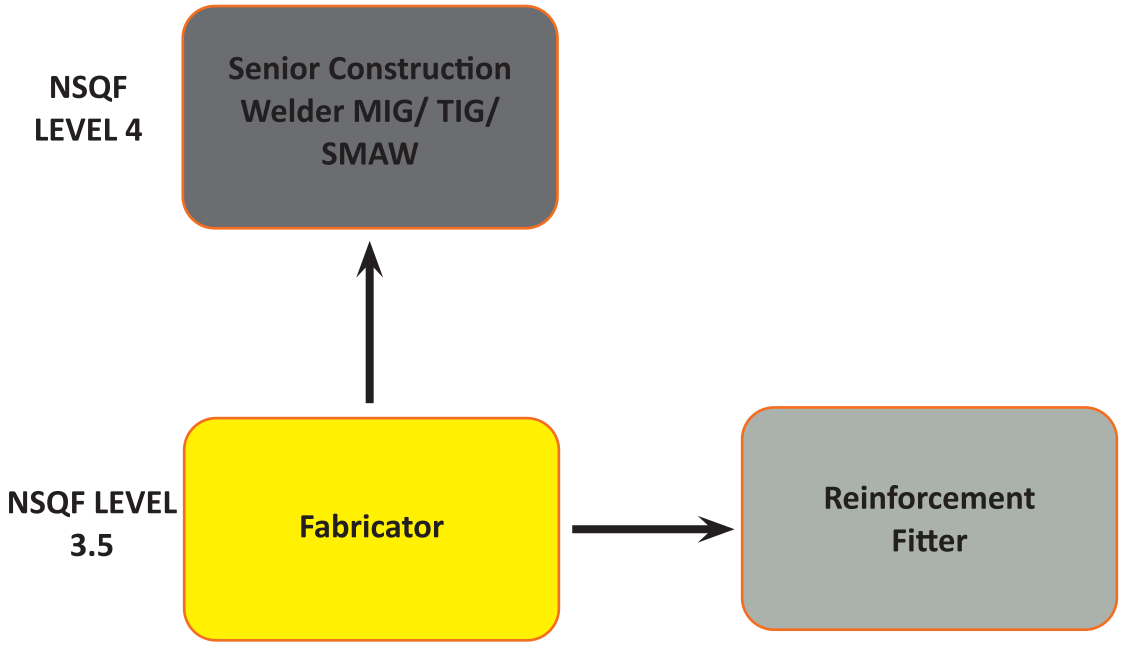
These attributes ensure success and safety in the fabrication role within the construction sector.

1.2.5 Future Possible Progression for Role of Fabricator

The role of a fabricator can progress in various ways, depending on an individual's skills, experience, and career goals.

The progression in the role of a fabricator can vary widely based on individual career aspirations and opportunities within the construction and manufacturing sectors. Continuous learning, gaining certifications, and building a strong professional network are key factors in advancing one's career as a fabricator.

Career Progression Map:



Exercise

Answer the following questions:

Questions:

1. What is the conversion factor between meters and millimeters?
2. What is the sum of the interior angles of a triangle?
3. How many sides does a hexagon have?
4. What is the relationship between the sides in a Pythagorean triple?
5. What is the tangent of an acute angle in a right triangle?

Fill-in-the-Blanks:

1. 1000 millimeters are equal to ________ meter(s).

   a. 0.001 meter(s). b. 1 meter(s).

2. A triangle with all sides of different lengths is called a ________ triangle.

   a. An isosceles triangle. b. A scalene triangle.

3. A circle is defined as the set of all points ________ from a given point.

   a. Equidistant from a given point. b. Concentric to a given point.

4. The Pythagorean theorem is named after the ancient Greek mathematician ________.

   a. Archimedes. b. Pythagoras.

5. The angle of 90 degrees is called a ________ angle.

   a. An acute angle. b. A right angle.

True/False:

1. **True/False:** A Celsius temperature can never be lower than a Fahrenheit temperature.
2. **True/False:** The sum of the angles in any triangle is 180 degrees.
3. **True/False:** The Pythagorean theorem has applications in fields like navigation and engineering.
4. **True/False:** The tangent of a right angle is undefined.
5. **True/False:** In a right triangle, the side opposite the larger acute angle is longer than the side opposite the smaller acute angle.

Notes

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Responsibilities of Fabricator

2. Generic Mathematical Skills

Unit 2.1 - Unit Conversion and Measurement

Unit 2.2 - Basic Geometrical Shapes and its Properties

Key Learning Outcomes

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

1. Explain brief on metric system of measurement;
2. Explain briefly inch system of measurement;
3. Perform basic arithmetic calculations;
4. Know about basic geometrical shapes;
5. Calculate area, volume and perimeter of different shapes;

UNIT 2.1: Unit Conversion and Measurement

Unit Objectives

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

- Explain brief on metric system of measurement; and
- Understanding inch system of measurement.

2.1.1 Different System of Measurement

There are two systems of measurement used are:

- Metric MKS system; and
- Inch/FPS system.

Metric System	Inch System
1. It is based on meter as the standard unit of measurement.	1. It is based on the foot as the standard unit of measurement.
2. A meter contains 10 equal parts called decimeter.	2. A foot is divided into 12 similar parts called inches.
3. Decimeter is divided into 10 parts called centimeters and centimeter is divided into 10 parts called millimeters.	3. Inch system does not have decimal based benefit of the Metric System.
4. Most usually used system of measurement in the world.	4. Fractions of foot cannot be written as decimal inches.
--	5. For example, in the metric system 5 millimeters = 0.5 centimeters = 0.05 decimeters = 0.005 meters. But 5 inches = 0.416667 which is feet = 0.138889 yards and so on.

Table 2.1.1: Metric system and Inch system

2.1.2 Metric System

This system is much easier. It consists of a series of basic units corresponding to mass, distance and volume and utilizes prefixes to denote multiples of unit being used.

Basic Unit	Measuring
Metre/meter	Distance
Kilogram	Mass
Litre/liter	Volume

Table 2.1.2: Basic metric system units

The prefixes and what they mean are:

Prefix	Symbol	Number
Giga-	G	1,00,00,00,000
Mega-	M	10,00,000
Kilo-	K	1,000
Hecto	H	100
Deca-	D	10
(none)		1
Deci-	D	0.1
Centi-	C	0.01
Milli-	M	0.001

Table 2.1.3: Metric system units' prefix and their meaning

2.1.3 Inch System

Length or distance

Lengths and distances are measured in inches, feet, yards and miles:

- 12 inches = 1 foot
- feet = 1 yard
- 1760 yards = 1 mile

2.1.4 Conversion between metric and inch systems

There are various approximations used for conversion of units. For example:

- 1 meter is approximately equal to 1 yard.
- 1 mile is approximately equal to 1.5 KM's and a KM is approximately equal to 2/3 of a mile.
- pounds (lb) make up 1Kg.)

Weight, mass, length, volume, and temperature used for measurement conversions.

Metric to Imperial Conversion chart		
Convert	To	Multiply by
Kilometers	Miles	0.62
Kilometers	Feet	3280.8
Meters	Feet	3.28

Centimeters	Inches	0.39
Millimeters	Inches	0.039
Liters	Quarts	1.057
Liters	Gallons	0.264
Milliliters	Ounces	0.0338
Celsius	Fahrenheit	(Temperature (C) + 32) * 9/5
Kilogram	Tons	0.0011
Kilogram	Pounds	2.2046
Grams	Ounces	0.035
Grams	Pounds	0.002205
Milligrams	Ounces	0.000035

Table 2.1.4: Conversion from metric to imperial system

Imperial to Metric Conversion chart		
Convert	**To**	**Multiply by**
Fahrenheit	Celsius	(Temperature (F) - 32) * 5/9
Inches	Meters	0.0254
Inches	Centimeters	2.54
Inches	Millimeters	25.4
Feet	Meters	0.3
Yards	Meters	0.91
Yards	Kilometers	0.00091
Miles	Kilometers	1.61
Tons	Kilograms	907.18

Table 2.1.5: Conversion from imperial to metric system

Notes

QR Codes

Scan the QR code to watch the video

https://youtu.be/H1xo5UVJKVo

Different System of Measurement

UNIT 2.2: Basic Geometrical Shapes and its Properties

Unit Objectives

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

1. Perform basic arithmetic calculations;
2. Know about basic geometrical shapes; and
3. Calculate area, volume and perimeter of different shapes.

2.2.1 Basic Mathematical Calculations

The same thing can be explained by the use of basic mathematics

Symbol	Words Used
+	Addition, Plus, Sum, Increase
−	Subtraction, Minus, Less, Decrease, Difference, Deduct
×	Multiplication, Product
÷	Division, Quotient

Table 2.1.1: Metric system and Inch system

Addition

To make a new total by bringing two or more numbers (or things) together. “Addends” are the numbers which are to be added together:

$$8 + 3 = 11$$

Subtraction

It involves taking one digit away from another digit.

$$8 - 3 = 5$$

Multiplication

In its simplest form, it is repeated addition.

Below we see 3+3+3 (three 3s) make 9:

$$6 \times 3 = 18$$

We can also multiply by fractions or a decimal, which is also repetitive addition:

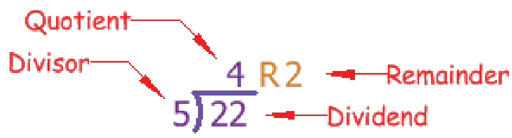
Example: 3.5 × 5 = 17.5

which is 3.5 lots of 5, or 5 lots of 3.5

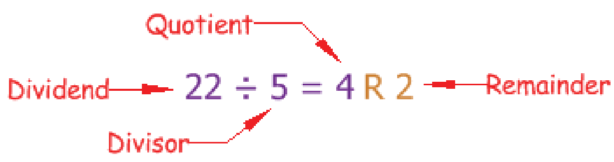
Division

Division is also the splitting into equivalent parts or groups. Division is the result of "fair sharing". It has its own singular words to remember.

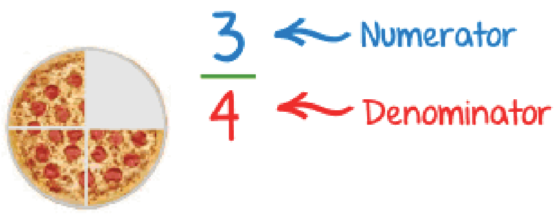
For example, take the simple query of dividing 22 by 5. By 2 left over and the answer is 4. See the important words:



Which is the same as:

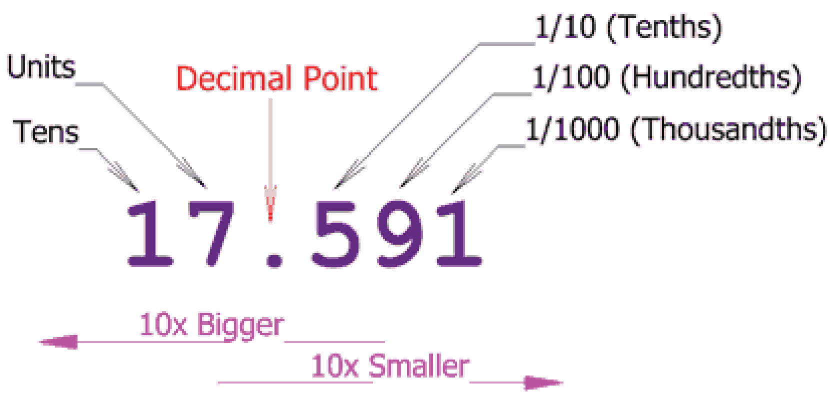


Fraction is part of a whole.



It is written with the lowest portion (the denominator) telling how many parts the whole is separated into, and the top portion (the numerator) telling how many portion we have.

A Decimal Point contain in a Decimal Number.



Part of per 100 is called a Percentage. The symbol is % Example: 25 per 100 is called 25% (25% of this pattern is green).

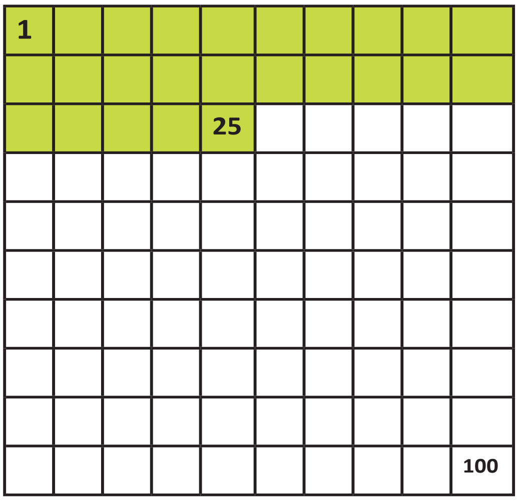


Fig. 2.2.1: Part percentage

Average (Mean) is the total divided by the sum.

We analyze the average by adding up all the figure and then split by how many figure.

Example: What is the average of 9, 2, 12 and 5?

Add up all the values: 9 + 2 + 12 + 5 = 28

How many values are required to divide (there are four of them): 28 ÷ 4 = 7

So the average is 7.

2.2.2 Basic Geometrical Shapes

The common shapes comprise of square, triangle and rectangle.

Basic Shapes

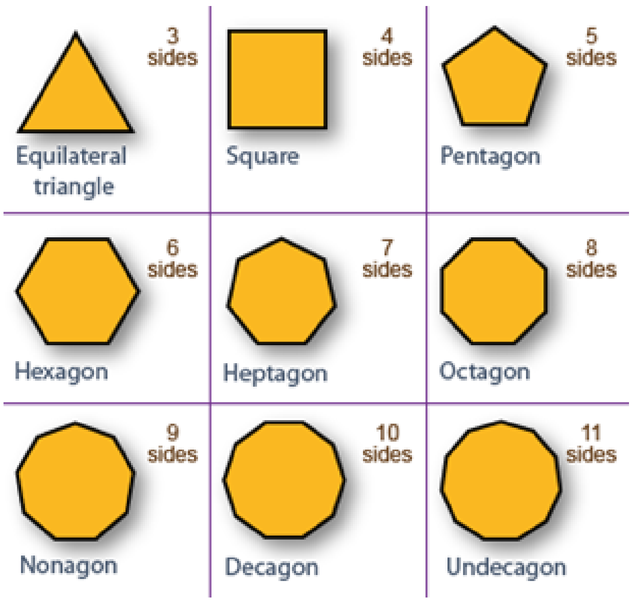


Fig. 2.2.2: Basic shapes

Curved Shapes

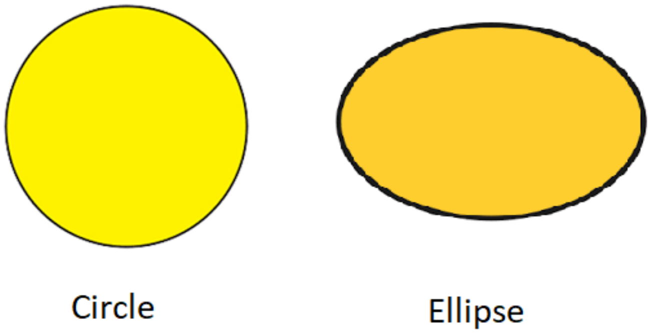


Fig. 2.2.3: Curved shapes

Other Shapes

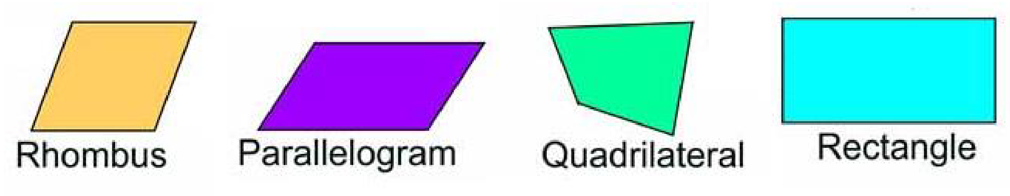


Fig. 2.2.4: Other shapes

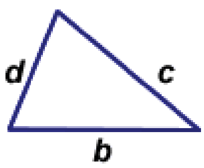
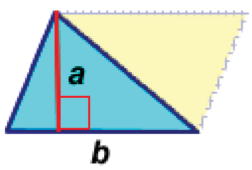
2.2.3 Area, volume and perimeter of geometrical shapes

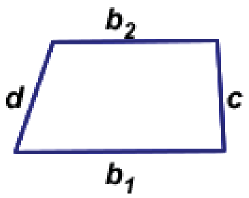
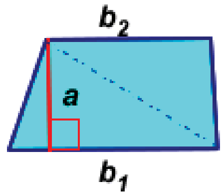
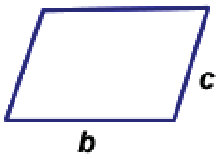
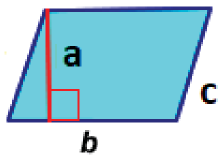
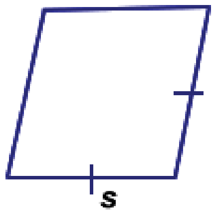
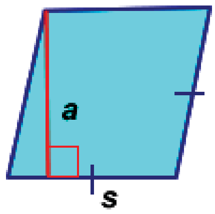
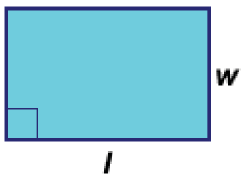
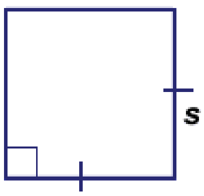
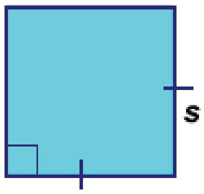
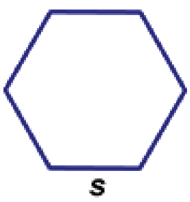
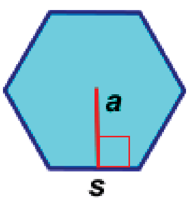
The common shapes comprise of square, triangle and rectangle.

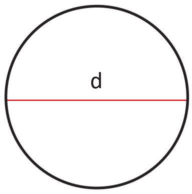
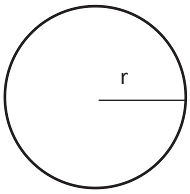
Basic Shapes

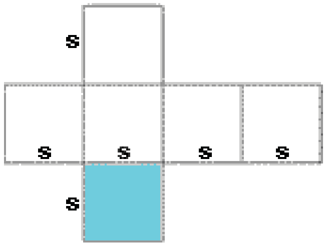
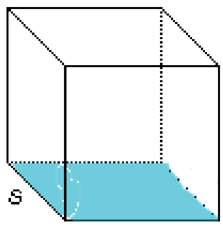
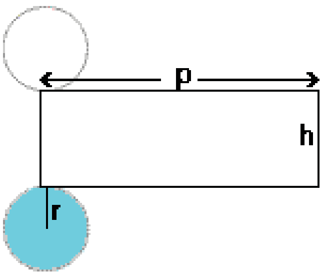
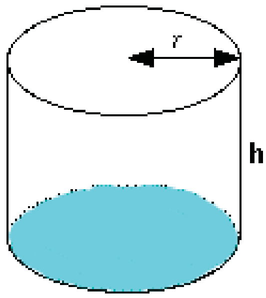
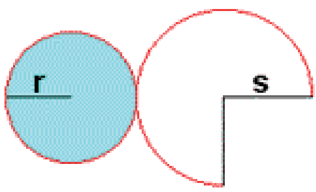
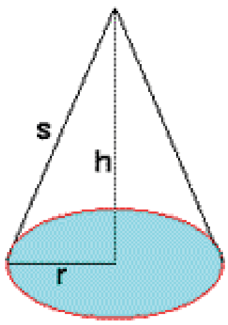
Units	Perimeter	cm	m	ft.
	Area	cm2	m2	Sq. ft
	Volume	cm3	m3	Cub. ft

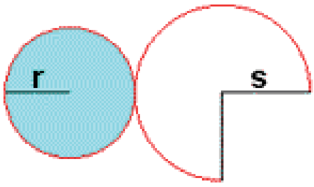
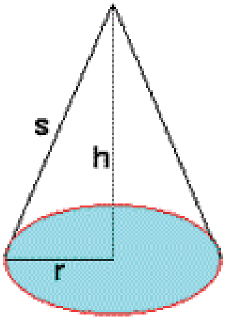
Table 2.2.2: Area, volume and perimeter units

Polygon / Circle	Perimeter (P)	Area (A)	Sides
Triangle	P = b + c + d 	A = 1/2ab 	a=altitude b=base c, d=sides

Trapezoid	P = b1 + b2 + c + d 	Area = 1/2a (b1 + b2) 	a= altitude b1, b2=base c, d=sides
Parallelogram	P= 2b + 2c 	Area = b x h 	a= altitude b=base c= side
Rhombus	P = 4s 	A= a x s 	a= altitude s=side
Rectangle	P = 2l + 2w 	A = l x w 	l=length w=width
Square	P = 4s 	A= s2 	s= side length
Regular polygon pentagon has five sides hexagon has six sides heptagon has seven sides octagon has eight sides nonagon has nine sides decagon has ten sides	P = ns  P=5s P=6s P=7s P=8s P=9s P=10s	A= 0.5a x n x s  A=2.5 a x s A= 3.0 a x s A= 3.5 a x s A= 4.0 a x s A=4.5 a x s A=5.0 a x s	a = length s = side length n = No. of sides n=5 n=6 n=7 n=8 n=9 n=10

Circle	C = Circumference C = πd 	A = Area A = πr2 	r=radius d= Diameter

Geometric Shape	Surface Area	Volume	Sides
Cube	A = 2B + Ph SA = 2(s2) + (4s)s = 6s2 	Volume = Bh Volume = s3 	s = side length B = area of the base P = perimeter of the base h = height
Cylinder	SA = 2(π r2) + (2πr) h 	V = Bh V = π r2h 	B = area of base P = perimeter of base r = radius of circle h = height
Cone	SA = πr 2 + πrs 	V = 0.33 Bh V = 0.33 πr2h 	B = area of base r = radius of circle h = height s= slant height

Sphere	SA = 4πr2 	 V = 1.33πr3	r = radius of circle

Exercise

Answer the following questions:

Short Questions:

1. What is the base unit for measuring length in the metric system?
2. Which metric unit is commonly used for measuring mass?
3. In the metric system, what unit is used for measuring volume?
4. In the inch system, what is the equivalent of 1 foot in inches?
5. How do you calculate the volume of a rectangular prism?

Fill-in-the-Blanks:

1. In the metric system, the base unit for temperature is Celsius, while in the inch system, it's _________________.
   a) Fahrenheit b) Kelvin
2. The metric system uses the prefix "kilo" to represent _________________.
   a) 10 b) 1,000
3. The inch system uses the unit "pound" for measuring _________________.
   a) Mass b) Volume
4. In the inch system, there are _________________ inches in a yard.
   a) 12 b) 36
5. True/False: 0 is considered an even number.
   a) True b) False

True/False Questions:

1. **True/False:** The metric system is widely used in most countries around the world.
2. **True/False:** The inch system is based on the decimal system.
3. **True/False:** A triangle has four sides.
4. **True/False:** The perimeter of a square is four times the length of one of its sides.
5. **True/False:** The inch system is commonly used in the United States.

Notes

QR Codes

Scan the QR code to watch the video

https://youtu.be/OhTubw4C0to

Area, volume and perimeter of geometrical shapes

3. Inspect the Fabrication Materials and Conduct their Surface Cleaning

Unit 3.1 - Blueprint Interpretation and Material Identification

Unit 3.2 - Material Handling and Quality Control

Unit 3.3 - Surface Cleaning and Preparation

CON/N1210

Key Learning Outcomes

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

1. Read and interpret blueprints/ working drawings/shop drawings/ specification details related to the fabrication activities
2. Identify different components/ sections like columns, I-beams, girders, trusses, channels, angles, plates, hollow section and other mild steel (MS) components/ accessories required in the steel fabrication work with respect to the specifications/ drawings
3. Locate the appropriate sections based on sizes, dimensions, and design in the warehouse/ storing yard for further processing which may involve grinding, wielding, cutting, bending, drilling, punching, burning or melting
4. Ensure that there are correct identity marks/heat number on the structural sections as per the organizational norms
5. Confirm that quality inspection has been conducted by the quality department for the required materials
6. Ensure the fabrication material has no physical damage like distortion, bending, cracks etc.
7. Ensure that the materials are loaded, shifted and unloaded to the fabrication yard/ workshop safely, following standard practices
8. Inspect the surface of the materials/ sections to determine the types of impurities on it
9. Obtain approval for employing different methods of surface cleaning from the concerned authority
10. Estimate the quantities of the materials required for the surface cleaning purpose
11. Initiate indent procedures for the required cleaning materials as per the organizational norms
12. Ensure appropriate surface cleaning procedures like heating, chemical cleaning, scrubbing, water jet, abrasion etc. are adopted as per the requirements/ instructions
13. Confirm the compliance of prepared clean surface with technical details or instructions

UNIT 3.1: Blueprint Interpretation and Material Identification

Unit Objectives

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

1. Read and interpret blueprints, working drawings, shop drawings, and specification details related to fabrication activities.
2. Identify different components and sections like columns, I-beams, girders, trusses, channels, angles, plates, hollow sections, and other mild steel (MS) components and accessories required in steel fabrication work based on specifications and drawings.

3.1.1 Introduction to Blueprint Interpretation

Blueprint interpretation is a foundational skill that plays a vital role in the construction sector, particularly for fabricators.

In construction, blueprints are the essential roadmaps that guide the creation of structures and components. They are detailed visual representations that provide fabricators with precise instructions on how to produce the various steel components and structures needed for construction projects.

Fig. 3.1.1 Blueprint interpretation

As a fabricator in the construction sector, your ability to read and interpret blueprints is paramount. Blueprints contain critical information such as measurements, dimensions, material specifications, welding details, and assembly instructions.

These details are crucial for ensuring that fabricated steel components meet design requirements, adhere to safety standards, and fit seamlessly into the overall construction project.

3.1.2 Types of Drawings in Fabrication

Understanding various types of drawings is essential for fabricators, as they're the roadmap for creating precise and safe components and structures in the construction sector.

Here's a concise and structured list of the types of drawings in fabrication tailored for the Fabricator occupation in the Construction Sector:

- **Architectural Plans:** These provide an overall view of the building's design. Fabricators may refer to these for the big picture.
  - **Example:** An architectural plan for a building layout showing room placement, doors, and windows.

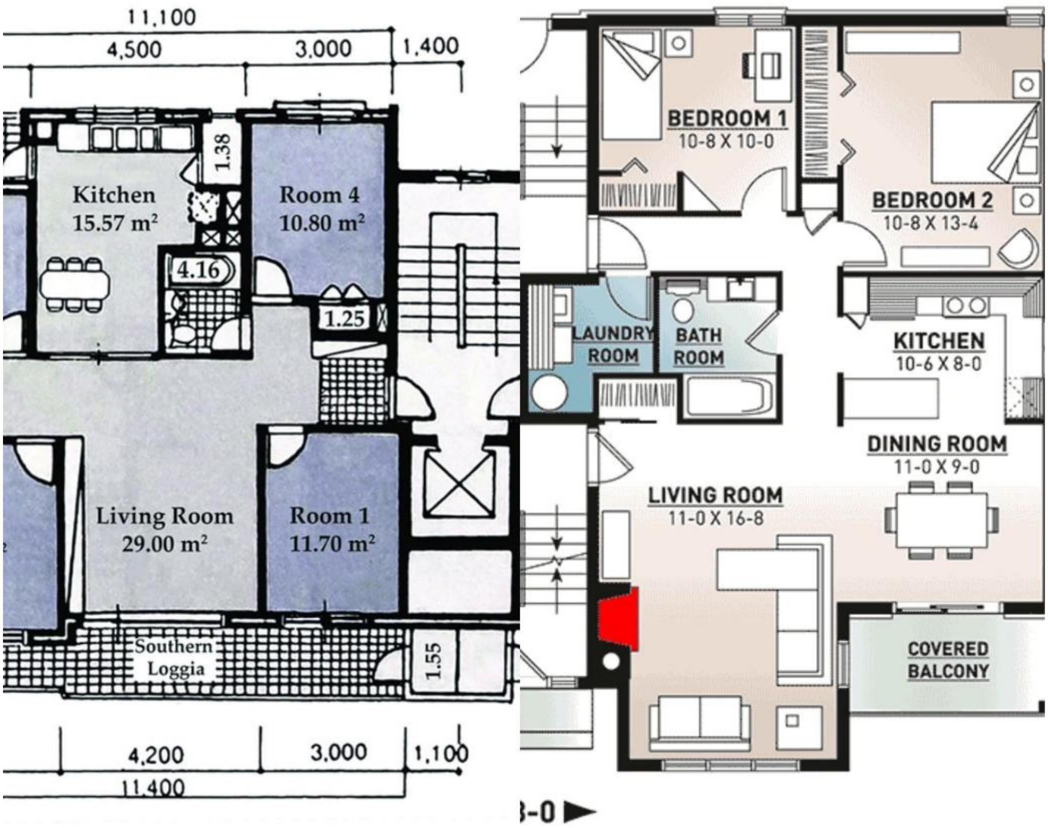


Fig. 3.1.2 Architectural plans

- **Structural Drawings:** These are the backbone of our work, offering detailed information on dimensions and specs for key structural elements like beams and columns.
  - **Example:** Detailed structural drawings indicating the dimensions and specifications of steel beams and columns for a bridge.

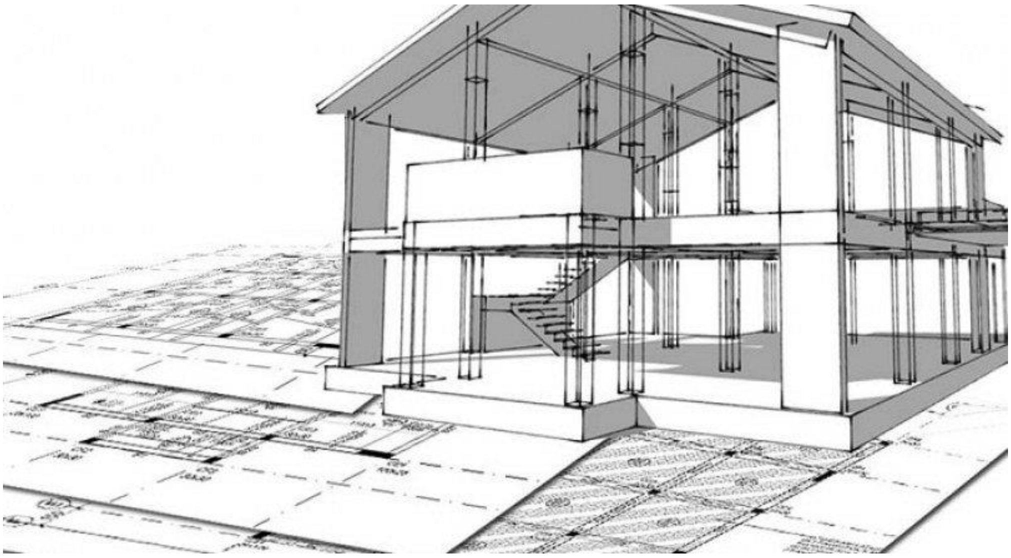


Fig. 3.1.3 Structural drawings

- **Fabrication Shop Drawings:** Prepared by us, these drawings contain specifics for creating individual components, including materials and assembly details.
    - **Example:** Shop drawings outlining the precise measurements and assembly instructions for a steel staircase.

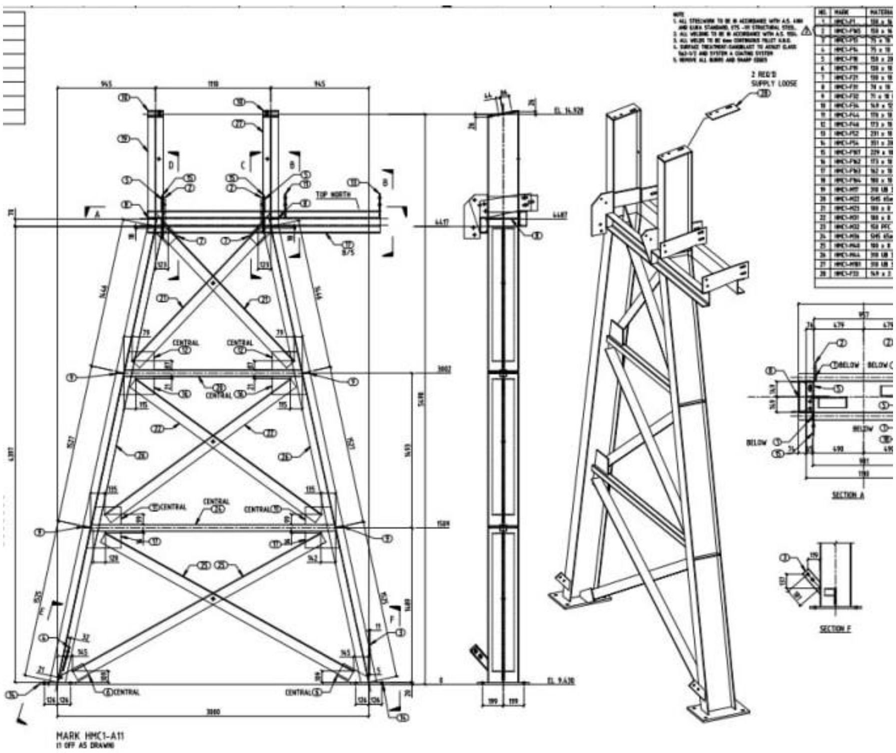


Fig. 3.1.4 Fabrication shop drawings

- **Assembly Diagrams:** These illustrate how different parts come together, ensuring everything fits and aligns correctly.
    - ♦ **Example:** An assembly diagram illustrating how various steel components come together to form a large structural frame.

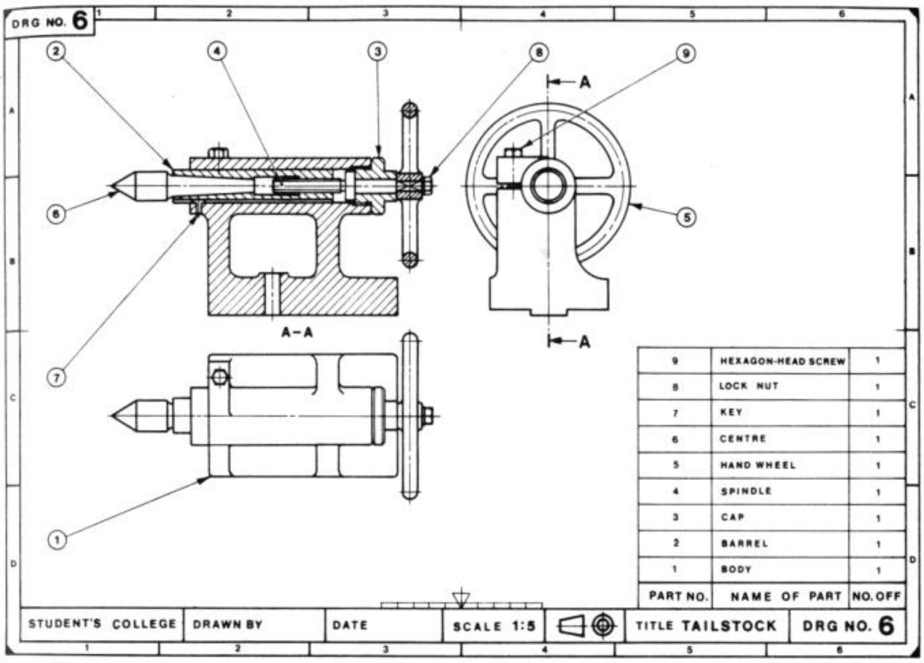


Fig. 3.1.5 Assembly diagrams

- **Welding Plans:** Vital for us, these drawings specify where and how welding should be done, including weld types and techniques.
    - ♦ Example: Welding plans specifying the type of welds, positions, and dimensions for joining steel plates in a fabrication project.

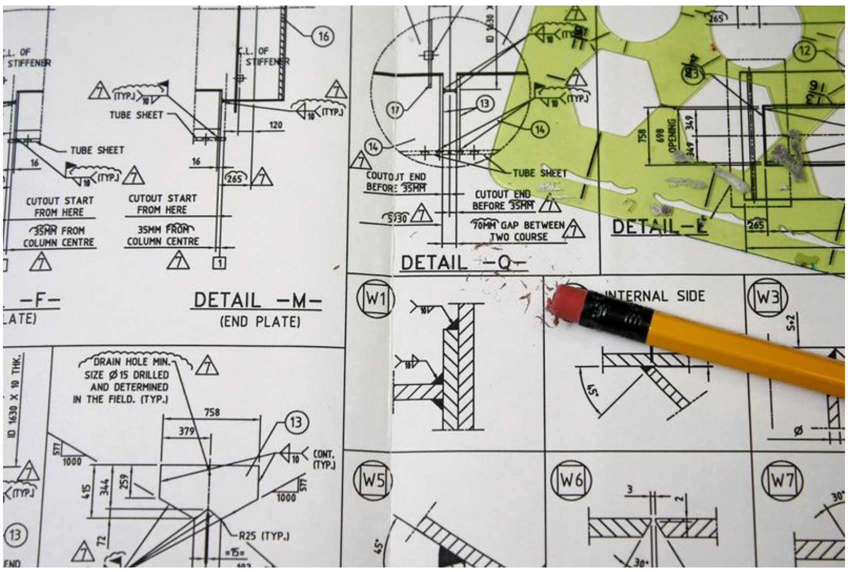


Fig. 3.1.6 Welding plans

3.1.3 Blueprint Elements and Symbols

Here's a table showing common blueprint elements and symbols for fabricators in the Construction Sector:

Blueprint Element / Symbol	Description and Use
Dimensions and Measurements	Represented with numerical values and arrows for length, width, and height measurements.
Material Specifications	Symbols and notations indicating the type and quality of materials required for fabrication (e.g., steel grades, thickness).
Welding Symbols	Specify the type, size, and location of welds needed for joining steel components.
Geometric Shapes	Include circles, squares, triangles, etc., to indicate specific features or cut-outs in steel components.
Notations	Notes or labels providing additional details or instructions for fabrication.
Section and Elevation Views	Show cross-sections and elevations of the structure, aiding in 3D visualization.
Arrows and Lines	Arrows indicate view directions, while lines represent edges, cuts, and breaks in the material.
Key/Legend	Explains the meaning of symbols, abbreviations, and notations used throughout the blueprint.
Title Block	Contains project information such as project name, drawing number, date, and names of individuals involved.

Table 3.1.1 Blueprint elements and symbols

3.1.4 Scale and Dimension Reading Techniques

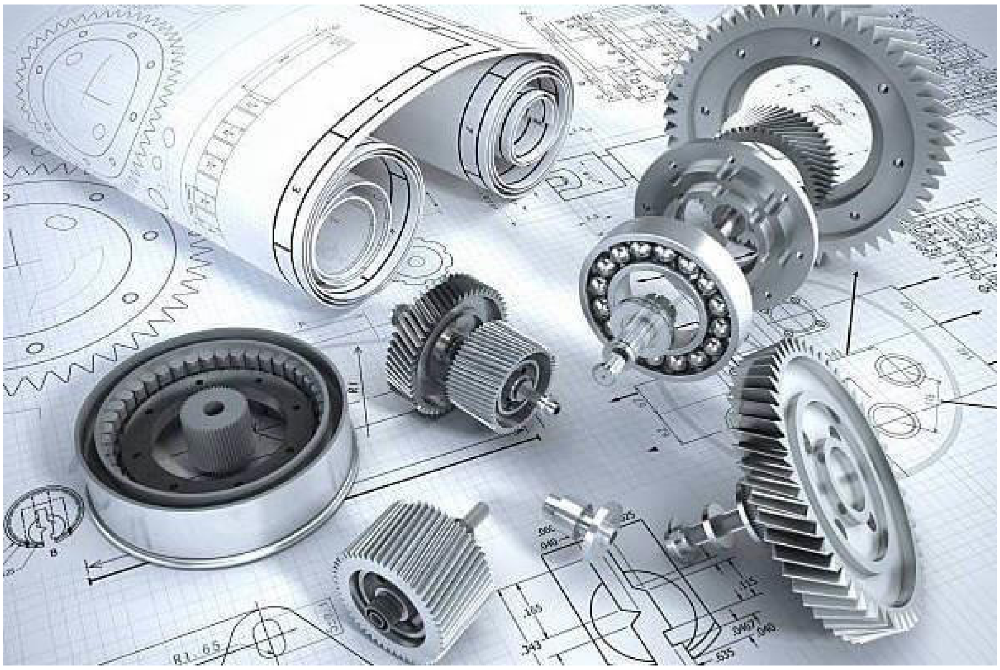


Fig. 3.1.7 Blueprints

1. **Understanding Scale:** Blueprints often use scales to represent large structures or components on standard-sized paper. For instance, a 1:100 scale means that 1 unit on the blueprint represents 100 units in real life. Pay close attention to the scale used and use it to calculate actual measurements.

2. **Measuring Tools:** Fabricators rely on measuring tools like calipers, tape measures, and rulers to verify dimensions on the blueprint. Ensure your measuring tools are accurate and well-maintained.

3. **Conversion Skills:** In some cases, you may need to convert between different units of measurement (e.g., from inches to millimeters). Familiarity with unit conversions is valuable.

4. **Coordinate Grids:** Blueprint drawings may include coordinate grids to locate specific points. Learn how to read these grids to pinpoint the exact placement of features or components.

5. **Dimension Lines and Tolerances:** Dimension lines indicate the extent of a measurement, while tolerances specify allowable variations. Pay attention to these to ensure precision in fabrication.

6. **Scaling Software:** Some fabrication tasks involve computer-aided design (CAD) software that allows you to input blueprint measurements and visualize the final product. Familiarity with CAD tools can be advantageous.

7. **Spot Checks:** Regularly perform spot checks to verify dimensions during the fabrication process, ensuring that components align with the blueprint specifications.

8. **Double-Checking:** Always double-check your measurements and calculations to minimize errors and ensure the accuracy of fabricated components.

9. **Quality Control:** Collaborate with quality control teams to ensure that fabricated components meet the specified dimensions and tolerances.

Mastering these scale and dimension reading techniques is crucial for fabricators in the Construction Sector. It ensures that fabricated components align precisely with the design specifications, contributing to the overall quality and safety of construction projects.

3.1.5 Practical Application of Blueprint Interpretation

Imagine you're a fabricator tasked with creating steel beams for a bridge construction project. You're provided with blueprints that detail the required dimensions, welding specifications, and materials.

Fig. 3.1.8 Dimensions, welding specifications, and materials

Here's how blueprint interpretation applies in this scenario:

- **Component Fabrication:** The blueprint outlines the precise measurements and specifications for the steel beams. You use your blueprint interpretation skills to understand these requirements, ensuring that the beams are cut and shaped to the exact dimensions specified.
- **Welding and Joining:** Welding symbols on the blueprint indicate where welds are needed to join different parts of the beams. Accurate interpretation ensures that you perform the correct type of welds in the specified locations, ensuring the structural integrity of the beams.
- **Material Selection:** The blueprint specifies the type of steel and its quality requirements. You rely on your interpretation skills to choose the appropriate steel grades and thickness to meet these specifications.
- **Quality Control:** Throughout the fabrication process, you work closely with quality control teams. Your interpretation of blueprint dimensions and tolerances is crucial to ensure that the fabricated

beams meet the project's quality standards.

- **Efficiency and Cost Control:** By following the blueprint's guidance accurately, you minimize material waste and reduce the need for rework. This efficient fabrication process helps control costs and ensures that resources are used effectively.
- **Problem Solving:** If you encounter unexpected challenges, such as a design adjustment or material availability issue, your ability to adapt while staying within the blueprint's parameters is essential. It allows you to find practical solutions that keep the project on track.
- **Communication:** You frequently communicate with engineers and project managers to discuss blueprint details and address any concerns. Your ability to articulate how you're interpreting the blueprints ensures that everyone is on the same page.
- **Safety Compliance:** Blueprint interpretation helps you identify safety requirements, such as load-bearing capacities and material strengths. This ensures that the fabricated beams comply with safety standards, guaranteeing the bridge's long-term stability.

Fig. 3.1.9 Safety compliance

- **Project Success:** Accurate fabrication based on blueprint interpretation ensures that the steel beams you create fit seamlessly into the bridge's construction. The entire project's success depends on these well-fabricated components, making your role indispensable.

In this example, your proficiency in blueprint interpretation directly contributes to the successful fabrication of steel beams, which are critical components of the bridge construction project. Your attention to detail, precision, and adherence to blueprint specifications play a vital role in ensuring the safety and structural integrity of the final bridge.

Fig. 3.1.10 Well-fabricated components

3.1.6 Introduction to Steel Components in Fabrication

Steel components form the backbone of countless structures in the construction industry. Fabricators play a pivotal role in transforming raw steel into precision-crafted components that are essential for buildings, bridges, industrial facilities, and more.

Understanding the various steel components and their significance in fabrication is fundamental for fabricators in the construction sector.

Fig. 3.1.11 Steel components in fabrication

Steel components encompass a wide range of parts and structures, including:

1. **Beams:** Steel beams are horizontal load-bearing elements that support the weight of structures like buildings and bridges. They come in various shapes and sizes, such as I-beams, H-beams, and box beams, each designed for specific applications.
2. **Columns:** Steel columns are vertical structural elements that provide support and stability to buildings. They vary in size and shape, with circular, square, and rectangular columns being common options.
3. **Trusses:** Trusses are assemblies of steel members arranged in triangular patterns to distribute loads efficiently. They are commonly used in roofing systems and bridges to provide strength and stability.
4. **Channels and Angles:** Steel channels and angles are versatile components used for framing, support, and bracing in construction projects. They come in various profiles and sizes to suit different applications.
5. **Plates:** Steel plates are flat sheets of steel used for various purposes, such as base plates for columns, shear plates for connections, and floor plates.
6. **Hollow Sections:** Hollow steel sections, including rectangular, square, and circular shapes, are used in the construction of columns, beams, and frameworks, offering strength while minimizing weight.
7. **Pipes and Tubes:** Steel pipes and tubes are essential for plumbing, drainage, and structural applications, providing a reliable conduit for fluids and gases.
8. **Fasteners:** Fasteners like bolts, nuts, screws, and rivets are crucial for connecting steel components securely, ensuring structural integrity.
9. **Accessories:** Accessories such as brackets, cleats, and connectors play a supporting role in assembly and reinforcement, enhancing the stability and functionality of steel structures.

Steel components are chosen based on their specific properties, including strength, durability, and corrosion resistance. Fabricators must interpret blueprints accurately, select the appropriate materials, and employ various techniques like cutting, welding, bending, and drilling to shape these components according to design specifications.

In the construction sector, fabricators are the artisans who transform steel into meticulously crafted components, ensuring they meet safety standards and design requirements.

Their expertise in working with steel components is indispensable in the creation of robust and enduring structures that define our built environment.

3.1.7 Classification of Mild Steel Components

Mild steel components can be classified into various categories based on their shapes, functions, and applications.

Fig. 3.1.12 Mild steel components

Here's a classification of mild steel components commonly used in fabrication:

1. **Structural Components:**
   - **Beams:** Including I-beams, H-beams, and box beams used for load-bearing in buildings and bridges.
   - **Columns:** Vertical members providing support and stability to structures.
   - **Trusses:** Assemblies of steel members arranged in triangular patterns to distribute loads efficiently.
2. **Supporting Elements**:
   - **Channels:** U-shaped steel components used for framing, bracing, and support.
   - **Angles:** L-shaped steel sections employed for reinforcement, framing, and corner bracing.
   - **Plates: Flat steel sheets used as base plates, shear plates, and floor plates in construction.**
3. **Hollow Sections:**
   - **Rectangular Sections:** Hollow steel sections with rectangular shapes, used in columns and beams.
   - **Square Sections:** Hollow steel sections with square shapes, employed in various structural applications.

- **Circular Sections:** Hollow steel sections with circular shapes, often used in pole and pipe applications.

4. **Pipes and Tubes:**
   - **Steel Pipes:** Used for conveying fluids and gases in plumbing and industrial applications.
   - **Steel Tubes:** Employed in structural and mechanical applications, offering versatility in shapes and sizes.
5. **Fasteners and Connectors:**
   - **Bolts and Nuts:** Essential for securing steel components together.
   - **Screws:** Used for connecting and fastening steel parts.
   - **Rivets:** Commonly used in structural connections for their load-bearing capacity.
6. **Accessories:**
   - **Brackets:** Support and reinforcement elements, often used in shelving and framing.
   - **Cleats:** Secure steel components together, ensuring stability.
   - **Connectors:** Various connectors and fittings are used for joining steel elements in construction.
7. **Miscellaneous Components:**
   - **Anchors:** Used to secure steel components to concrete or masonry structures.
   - **Plates and Flanges:** Employed as connectors and reinforcements in various applications.
   - **Bars and Rods:** Solid steel bars and rods are used in construction for specific purposes.

The classification of mild steel components helps fabricators and construction professionals better understand the types and functions of these elements. Each category serves a specific purpose in building and structural projects, and selecting the right component is crucial to ensure safety and structural integrity.

3.1.8Reading Component Specifications

Reading component specifications is a fundamental skill for fabricators and construction professionals. Specifications provide detailed information about the materials, dimensions, quality standards, and other critical details necessary for the fabrication and assembly of components. Here's a guide on how to read component specifications effectively:

1. Understand the Purpose: Begin by understanding why you need to read the specifications. Is it for selecting materials, ensuring compliance with design requirements, or meeting safety standards? Knowing the purpose will guide your reading.
2. **Identify Key Information:**
   - **Material:** Check for the type of material specified (e.g., mild steel, stainless steel) and its

quality or grade (e.g., ASTM A36).

- **Dimensions:** Look for dimensions such as length, width, height, thickness, and tolerances. Ensure you understand the units of measurement (e.g., inches, millimeters).
- **Quality Standard**s: Specifications may reference industry standards or codes (e.g., ASTM, ANSI) that the component must meet. Familiarize yourself with these standards.
- **Surface Finish:** Some specifications may require specific surface finishes or treatments (e.g., galvanized, painted).
- **Testing and Inspection:** Understand any testing or inspection requirements specified to ensure the component's quality and performance.

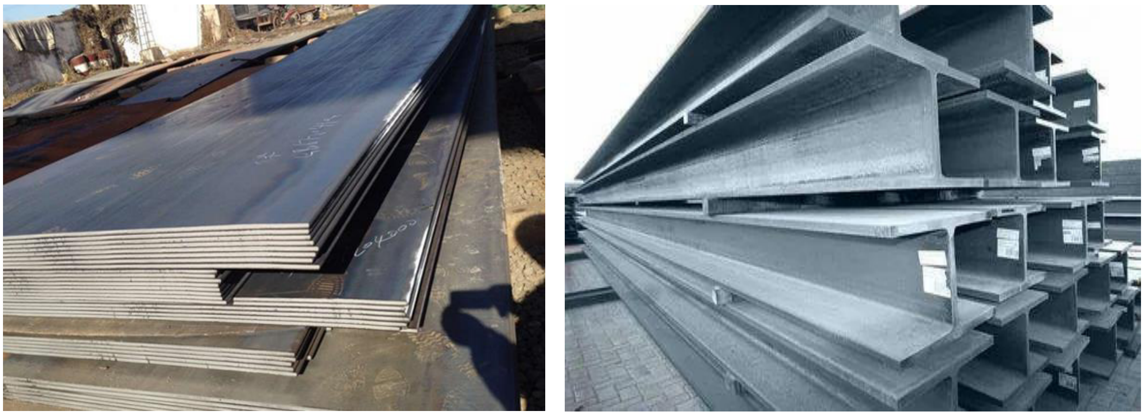


Fig. 3.1.13 Material related quality standards

3. **Review Drawings:** If available, review accompanying drawings or blueprints that illustrate the component's shape, dimensions, and assembly instructions. The drawings often complement written specifications.
4. **Pay Attention to Tolerances:** Tolerances are critical. They indicate the allowable variations in dimensions or properties. Exceeding tolerances can lead to non-compliance with the specifications.
5. **Check for Special Requirements:** Look for any special requirements or notes in the specifications. These may include unique fabrication processes, handling instructions, or specific treatments.
6. **Verify Compliance:** Ensure that the materials you plan to use and the methods you intend to employ align with the specifications. If any deviations are necessary, seek approval from the relevant authorities.
7. **Clarify Ambiguities:** If you encounter unclear or ambiguous information in the specifications, seek clarification from the project engineer, designer, or project manager. It's crucial to have a clear understanding of what's expected.
8. **Document and Communicate:** Keep records of the specifications for reference throughout the fabrication process. Communicate the specifications to your team or colleagues involved in the project to ensure everyone is on the same page.

9. **Quality Control:** During and after fabrication, perform quality control checks to ensure that the components meet the specified requirements. This includes measuring dimensions, conducting inspections, and testing as necessary.
10. **Document Compliance:** Maintain records of compliance with the specifications. This documentation is essential for quality assurance and for providing evidence that the components meet the project requirements.

Effective reading of component specifications is critical for fabricators to produce components that meet design standards, safety regulations, and quality expectations in construction projects. It ensures that the fabricated components fit seamlessly into the overall structure and contribute to the project's success.

3.1.9 Blueprint Symbols for Components

Blueprint symbols for components are graphical representations used on construction and engineering drawings to convey information about the various elements and components that make up a structure. These symbols are essential for accurately interpreting blueprints and communicating design intent.

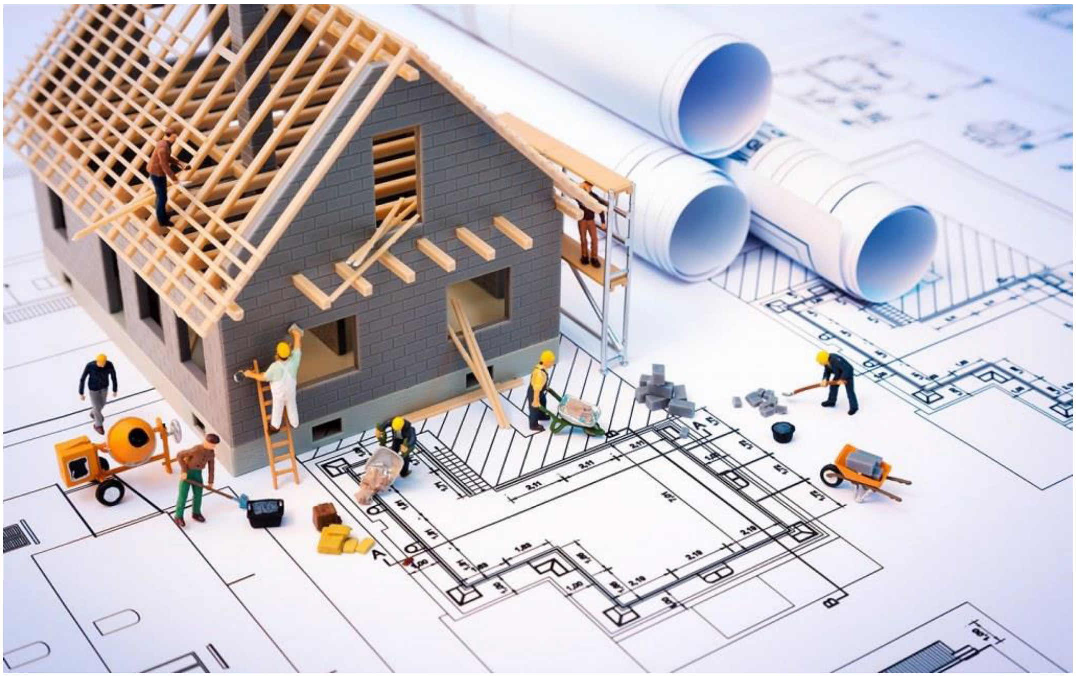


Fig. 3.1.13 Material related quality standards

Here are some common blueprint symbols for components:

Component	Blueprint Detail & Symbol
I-Beam	Represented by a vertical line with horizontal lines at the top and bottom, resembling the shape of an "I." It signifies the presence of I-beams or structural steel beams in the construction.
H-Beam	Similar to the I-beam symbol but with an extra horizontal line in the middle, forming an "H." It indicates the presence of H-beams in the structure.
Column	Depicted as a vertical line with two short horizontal lines at the top and bottom, resembling a column. It represents the presence of columns or vertical supports.
Truss	Represented as a series of diagonal lines connected by horizontal and vertical lines. It signifies the use of trusses in the construction.
Channel	Displayed as a C-shaped figure with a horizontal line in the middle. It denotes the presence of steel channels in the structure.
Angle	Shown as an L-shaped figure, representing steel angles used for framing and bracing.
Plate	Depicted as a rectangular shape, it signifies the use of steel plates in the construction.
Pipe	Represented as a circle or oval with a line inside, indicating the presence of pipes or tubing in the design.
Tube	Similar to the pipe symbol but often with thicker lines, denoting the use of steel tubes.
Fastener	Typically shown as a hexagonal shape or with a specific design to represent bolts, nuts, screws, or other fasteners used for assembly.
Weld	Consists of a series of lines and symbols indicating the location, type, and size of welds required for joining components.
Brace	Depicted as diagonal lines connecting two structural elements, indicating the presence of braces for reinforcement.
Plate with Holes	A plate symbol with small circles or dots inside it, representing steel plates with holes for bolts or fasteners.
Foundation	Shown as a solid rectangle or square at the base of a column or wall, indicating the foundation or footing of a structure.
Concrete Block	A symbol resembling a series of rectangular blocks stacked together, signifying the use of concrete blocks in construction.

Electrical Outlet	Represented as a circle with two or more short lines extending from it, indicating electrical outlets or fixtures.
Window	Typically depicted as a rectangle with horizontal lines inside, representing windows in the structure.
Door	Shown as a rectangle with an arc or lines indicating the swing direction, signifying doors in the design.

Table 3.1.2 Common blueprint symbols for components

3.1.10 Component Identification and Examples

Component identification is a crucial skill for fabricators and construction professionals. It involves recognizing and understanding various components used in construction and fabrication.

Here are common components, along with examples:

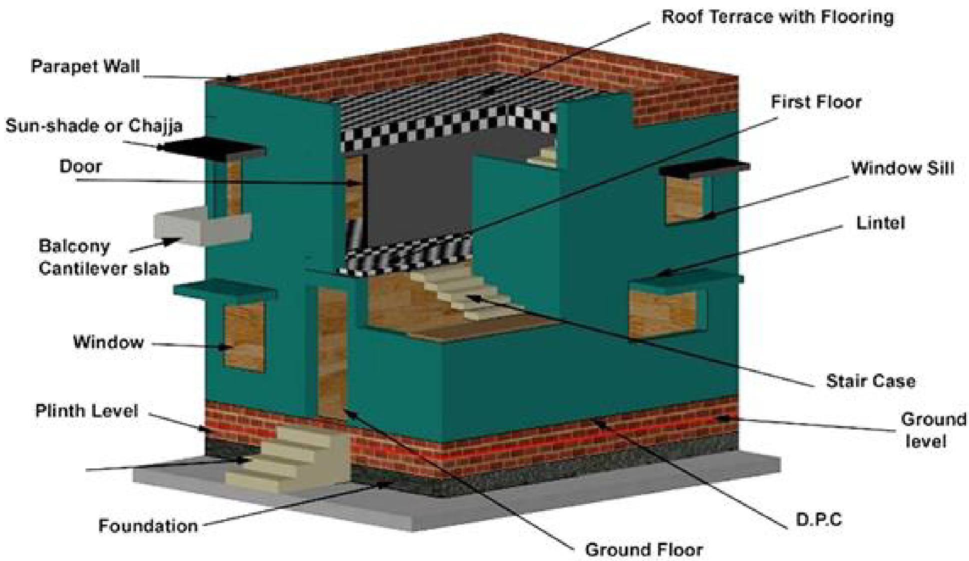


Fig. 3.1.15 Component identification

1. Beams:
   - Example: Steel I-beams used as horizontal supports in building frames.
2. Columns:
   - Example: Reinforced concrete columns supporting the structure of a high-rise building.
3. **Trusses:**
   - **Example:** Wooden trusses in a residential roof system.

4. **Channels:**
   - **Example:** Steel U-channels used as lintels above doorways.
5. **Angles:**
   - **Example:** L-shaped steel angles reinforcing corners of structural elements.
6. **Plates:**
   - **Example:** Steel base plates anchoring columns to concrete foundations.
7. **Hollow Sections:**
   - **Example:** Rectangular hollow steel sections used as structural beams.
8. **Pipes:**
   - **Example:** PVC pipes for plumbing and drainage systems.
9. **Tubes:**
   - **Example:** Aluminium tubes in the framework of a bicycle frame.
10. **Fasteners:**
    - **Example:** Bolts and nuts used to connect steel beams in construction.
11. **Brackets:**
    - **Example:** Metal shelf brackets supporting wall-mounted shelves.
12. **Cleats:**
    - **Example:** Wooden cleats used to secure panels to a wall.
13. **Connectors:**
    - **Example:** Metal connectors joining wooden beams in roof framing.
14. **Anchors:**
    - **Example:** Expansion anchors securing heavy equipment to a concrete floor.
15. **Plates with Holes:**
    - **Example:** Steel plates with holes used as gussets in truss assemblies.
16. **Foundation Components:**
    - **Example:** Concrete footings supporting the base of a residential house.
17. **Concrete Bloc**ks:
    - **Example:** Concrete blocks forming the walls of a commercial building.
18. **Electrical Outlets:**
    - **Example:** Wall-mounted electrical outlets in a residential home.
19. **Windows:**
    - Example: Double-hung windows providing ventilation and natural light.
20. **Doors:**

- **Example:** Solid wood entry door with decorative glass panels.

These examples represent a wide range of components used in construction and fabrication, from structural elements like beams and columns to fasteners, connectors, and architectural features like doors and windows. Identifying these components is essential for professionals in the construction sector to understand and interpret blueprints accurately, select appropriate materials, and ensure the successful completion of projects.

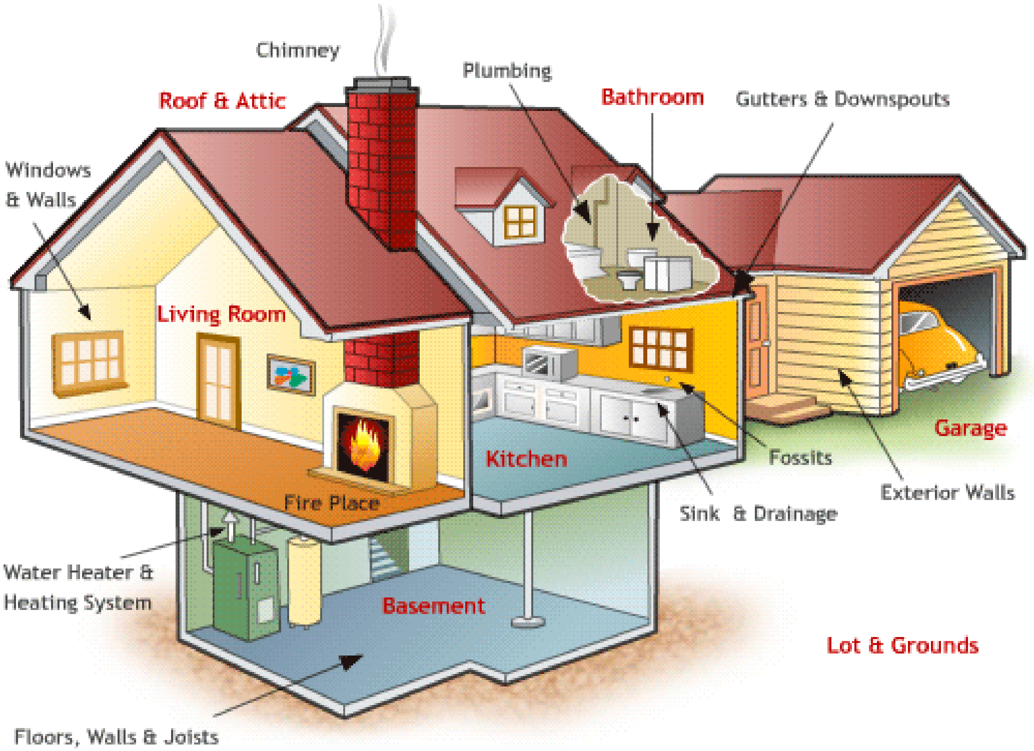


Fig. 3.1.16 Components of a residential project

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QR Codes

Scan the QR code to watch the video

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Types of Drawings in Fabrication

UNIT 3.2: Material Handling and Quality Control

Unit Objectives

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

1. Locate the appropriate sections in the warehouse or storing yard based on sizes, dimensions, and design for further processing, which may involve grinding, welding, cutting, bending, drilling, punching, burning, or melting.
2. Ensure that there are correct identity marks and heat numbers on the structural sections as per organizational norms.
3. Confirm that quality inspection has been conducted by the quality department for the required materials.
4. Ensure that the fabrication material has no physical damage like distortion, bending, cracks, etc.
5. Safely load, shift, and unload materials to the fabrication yard/workshop following standard practices.

3.2.1 Introduction to Material Handling

Material handling is a critical aspect of fabrication within the construction industry. It encompasses the processes and techniques used to move, transport, store, and manage various materials and components required for construction projects. Effective material handling is essential for ensuring the smooth flow of materials from their source to the fabrication yard or construction site.

Fig. 3.2.1 Material handling

Here's an overview of material handling in the context of the fabrication occupation in the construction industry:

1. **Importance of Material Handling:**
   - Efficient material handling is crucial to meet project timelines and budget constraints.
   - Proper handling minimizes the risk of damage to materials, ensuring quality and structural integrity.
   - It contributes to a safer work environment by reducing the potential for accidents and injuries.
2. **Types of Materials:**
   - Materials in construction fabrication can vary widely, including steel sections, pipes, concrete, and more.
   - Each material has unique handling requirements based on its size, weight, and fragility.
3. **Handling Equipment:**
   - Material handling often involves the use of specialized equipment such as cranes, forklifts, conveyors, and hoists.
   - These machines assist in lifting, moving, and positioning materials safely and efficiently.


Fig. 3.2.1 Material handling

4. **Storage and Organization:**
   - Materials need to be stored in an organized manner to facilitate easy retrieval and prevent damage.
   - Proper storage systems, such as racks and shelves, are used in warehouses and storing yards.
5. **Transportation and Logistics:**
   - Effective transportation systems are essential for delivering materials to the fabrication yard or construction site.
   - Logistics planning ensures materials are at the right place and time when needed.
6. **Safety Considerations:**
   - Material handlers must follow safety protocols to prevent accidents and injuries.

- Training and certification for equipment operators are critical to maintaining a safe work environment.

7. **Quality Control:**
   - Material handlers may be responsible for inspecting materials for damage or defects upon delivery.
   - Ensuring the quality of materials is vital to the overall quality of the construction project.
8. **Environmental Impact:**
   - Sustainable material handling practices are becoming increasingly important to reduce the environmental footprint of construction projects.
   - Recycling and responsible disposal of materials are considerations in material handling.
9. **Efficiency and Productivity:**
   - Efficient material handling processes contribute to increased productivity and cost savings in fabrication and construction.
10. **Integration with Fabrication:**
    - Material handling is closely integrated with the fabrication process, as materials need to be in the right place for processing.
    - Fabricators must coordinate with material handlers to ensure a seamless workflow.

Understanding material handling principles and practices is essential for fabricators in the construction industry. It ensures that materials are handled safely, efficiently, and in a manner that supports the successful completion of construction projects.

3.2.2 Selecting Sections for Processing

Selecting sections for processing is a critical step in the fabrication process within the construction industry. It involves choosing the right materials and components for further processing, such as cutting, welding, bending, or drilling, to meet the project's specifications and design requirements.

Fig. 3.2.3 Cutting, welding, bending, or drilling

Here's an overview of the process of selecting sections for processing:

1. **Blueprint and Design Review:**
    - Fabricators begin by reviewing blueprints, working drawings, and design specifications to understand the structural requirements of the project.
    - This step ensures that fabricators have a clear understanding of the components needed and their dimensions.
2. **Material Selection:**
    - Fabricators must select the appropriate materials for each component based on the project's specifications.
    - Materials may include steel sections, concrete forms, or other construction materials.
3. **Dimensional Considerations:**
    - Fabricators need to pay close attention to the dimensions specified in the design.
    - This includes the length, width, thickness, and tolerances of the sections to be processed.
4. **Quality Standards:**
    - Materials selected for processing must meet the quality standards and codes relevant to the construction industry.
    - Fabricators ensure that the chosen sections comply with industry norms.
5. **Material Availability:**
    - Fabricators assess the availability of materials in their inventory or from suppliers.
    - This step ensures that materials can be procured in a timely manner to avoid project delays.
6. **Compatibility with Processing Techniques:**
    - Fabricators consider how selected sections will be processed (e.g., cutting, welding).
    - Compatibility with processing techniques and equipment is essential.
7. **Handling and Transportation:**
    - Logistics and material handling play a role in selecting sections, as materials need to be transported to the fabrication yard or workshop safely.
8. **Budgetary Constraints:**
    - Fabricators must consider budgetary constraints when selecting materials, striving to balance quality with cost-effectiveness.
9. **Sustainability:**
    - Increasingly, fabricators consider sustainable materials and practices to reduce the environmental impact of construction projects.
10. **Documentation and Records**:
    - Proper documentation of material selection is essential for quality control and project records.

- Records should include details of materials, suppliers, and quality certifications.

11. **Communication with Design Team:**
    - Effective communication with the design team is crucial to address any design changes or clarifications related to material selection.
12. **Quality Assurance:**
    - Before processing begins, fabricators may conduct initial quality inspections to ensure the selected sections meet the required standards.

Selecting sections for processing is a decision-making process that requires careful evaluation of project requirements, materials, quality standards, and logistical considerations. It ensures that the fabrication process proceeds smoothly and that the constructed components meet design specifications and quality expectations in the construction industry.

3.2.3 Processing Techniques i.e. Grinding, Welding, Cutting, etc.

Processing techniques are a fundamental aspect of fabrication within the construction industry. Fabricators use various methods to shape, join, and finish materials to create the components needed for construction projects.

Fig. 3.2.4 Processing techniques i.e. grinding, welding and cutting etc.

Here's an overview of essential processing techniques commonly employed in fabrication:

1. **Cutting:**
   - **Purpose:** Cutting involves the removal of excess material or shaping sections to specific dimensions.
   - **Methods:** Fabricators use tools such as saws, plasma cutters, laser cutters, and waterjet cutters.
   - **Applications:** Cutting is used to create precise lengths, angles, and shapes in materials like steel, concrete, and wood.
2. **Welding:**
   - **Purpose:** Welding joins two or more pieces of material, typically metals, to form a strong and permanent bond.
   - **Methods:** Common welding techniques include arc welding, MIG welding, TIG welding, and spot welding.
   - **Applications:** Welding is used to assemble structural components, such as beams and columns, and to create sturdy connections.
3. **Grinding:**
   - **Purpose:** Grinding is used to smooth rough surfaces, remove burrs, and achieve precise dimensions on fabricated components.
   - **Methods:** Fabricators use angle grinders, bench grinders, and abrasive wheels for grinding.
   - **Applications:** Grinding improves the finish and quality of fabricated parts and ensures they meet design specifications.
4. **Bending:**
   - **Purpose:** Bending involves shaping materials, especially metal, to achieve specific angles or curves.
   - **Methods:** Fabricators use machines like press brakes and rollers for precise bending.
   - **Applications:** Bending is used to create curved components such as arches, brackets, and pipe bends.
5. **Drilling:**
   - **Purpose:** Drilling creates holes in materials to accommodate fasteners, electrical components, or plumbing fixtures.
   - **Methods:** Fabricators use drills, drill presses, and core drills for various hole sizes.
   - **Applications:** Drilling is essential for attaching components, routing wires or pipes, and providing access points.
6. **Punching:**
   - **Purpose:** Punching creates holes or shapes in materials using a punching press or machine.

- **Methods:** Punches and dies are used to cut holes or form specific shapes.
- **Applications:** Punching is common in structural steel fabrication for bolted connections and clearances.

7. **Burning or Melting:**
   - **Purpose:** Burning or melting techniques use heat to cut, shape, or fuse materials.
   - **Methods:** Oxy-fuel cutting, plasma cutting, and melting with electric arcs are examples.
   - **Applications:** These methods are used to cut thick steel sections and create intricate shapes in metal fabrication.

8. **Finishing:**
   - **Purpose:** Finishing processes, such as sanding, painting, and coating, enhance the appearance and protect fabricated components from corrosion.
   - **Methods:** Fabricators employ abrasive materials, paints, and specialized coatings.
   - **Applications:** Finishing ensures the longevity and aesthetic appeal of fabricated structures.

These processing techniques are essential skills for fabricators in the construction industry. Depending on project requirements, fabricators select the most suitable methods to transform raw materials into finished components that meet design specifications and quality standards.

3.2.4 Importance of Identity Marks

Identity marks play a crucial role in the fabrication process within the construction industry. These marks, which include heat numbers and unique identifiers, are used to track, identify, and ensure the quality of materials and components.

Here's an overview of the importance of identity marks in fabrication for the construction sector:

1. **Traceability:**
   - Identity marks enable the traceability of materials from their source to the fabrication yard and eventually to the construction site.
   - Fabricators can track the origin, specifications, and history of each material, ensuring accountability throughout the supply chain.

2. **Quality Assurance:**
   - Identity marks provide a reference for quality control and inspection processes.
   - Quality control teams can verify that materials meet the required standards by cross-referencing identity marks with specifications.

3. **Compliance with Specifications:**
   - Construction projects often have strict design and material specifications.

- Identity marks help fabricators confirm that selected materials match the project's requirements, reducing the risk of errors.

4. **Material Certification:**
   - Many materials come with certification documents that include identity marks.
   - Fabricators rely on these marks to validate that materials meet industry standards and have undergone necessary testing and quality checks.
5. **Component Identification:**
   - In a construction project, numerous components, such as beams, columns, and brackets, are fabricated and assembled.
   - Identity marks aid in identifying and differentiating each component, preventing mix-ups during assembly.
6. **Structural Integrity:**
   - Identity marks contribute to the structural integrity of the final construction.
   - Fabricators can verify that the materials used have the required strength and durability for their intended use.
7. **Maintenance and Repairs:**
   - In the long term, identity marks help with maintenance and repairs.
   - When a construction project is complete, the marks assist maintenance teams in identifying and sourcing replacement components.
8. **Project Documentation:**
   - Identity marks are included in project documentation and records.
   - These records serve as a historical reference for future projects and provide insights into material usage and performance.
9. **Material Accountability:**
   - Accurate tracking of materials with identity marks enhances accountability.
   - Fabricators and project managers can quickly identify the source of any issues or defects that may arise during fabrication or construction.
10. **Risk Management:**
    - Identity marks help manage risks associated with materials and components.
    - Fabricators can identify any potential recalls or issues with specific batches of materials, reducing project risks.
11. **Legal Compliance:**
    - Certain construction projects may require adherence to legal and regulatory standards.
    - Identity marks demonstrate compliance with these standards and serve as documentation in case of audits or inspections.

Fig. 3.2.5 Identity marks on material

Identity marks are an integral part of material management and quality control in the construction industry. They ensure that materials are used correctly, conform to specifications, and contribute to the safety and structural integrity of construction projects.

3.2.5 Marking Procedures and Standards

Marking procedures and adhering to industry standards are vital components of construction fabrication. These procedures involve labelling materials and components with specific identification marks, ensuring materials are correctly organized, tracked, and utilized.

Here's a detailed look at marking procedures and standards and their importance:

1. **Identification Marks:**
    - Identification marks, like heat numbers, serial numbers, barcodes, or QR codes, are assigned to materials.
    - These marks offer a distinct identity to each material, allowing easy tracking and reference.
2. **Methods of Marking:**
    - Various methods are employed to mark materials, including stamping, engraving, laser marking, or attaching labels.
    - The chosen method depends on factors such as material type, size, and durability requirements.

3. **Mark Location:**
   - Marks are strategically placed on materials or components to ensure visibility and accessibility.
   - Standardized locations simplify the identification process.
4. **Compliance with Specifications:**
   - Marking procedures must align with industry specifications and standards.
   - Adherence guarantees that markings are legible, durable, and compliant with regulations.
5. **Heat Numbers:**
   - In steel fabrication, heat numbers are critical marks.
   - They trace materials back to specific production batches or heat treatment processes, aiding in quality control and compliance.
6. **Traceability:**
   - Effective marking allows for traceability across the supply chain, from material procurement to fabrication and construction.
   - Traceability enhances accountability and quality assurance.
7. **Quality Control:**
   - Marks serve as references during quality control procedures.
   - Inspectors cross-reference marks with specifications to confirm material quality and compliance.
8. **Material Certification:**
   - Material certification documents often reference marking standards.
   - Fabricators rely on these certifications to verify that materials meet the necessary standards.
9. **Safety Information:**
   - Marks may convey safety-related information, such as load-bearing capacities or weight limits.
   - Such markings ensure the safe handling and use of materials and components.
10. **Documentation and Records:**
    - All marking procedures and standards should be documented as part of project records.
    - Proper documentation aids in material management, audits, and project accountability.
11. **Effective Communication:**
    - Effective communication among fabricators, suppliers, and construction teams is essential to ensure that marking procedures are well-understood and consistently applied.
    - Clear communication minimizes errors and discrepancies.
12. **Adherence to Codes:**
    - Construction projects typically adhere to specific codes and standards.
    - Marking procedures must align with these codes to ensure legal and regulatory compliance.

13. **Environmental Considerations:**
    - Fabricators may need to consider environmentally friendly marking methods and materials to align with sustainability objectives.

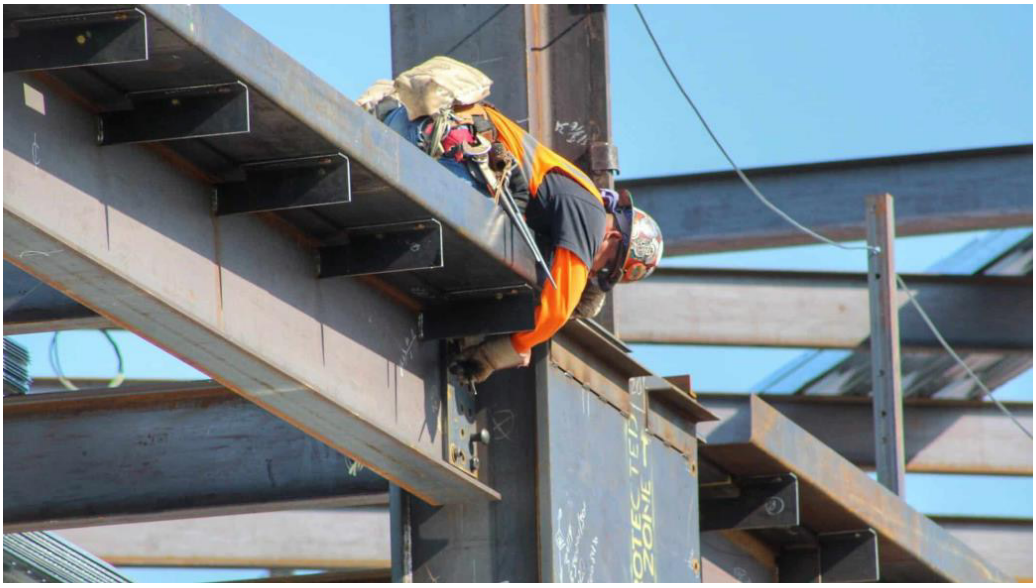

Fig. 3.2.6 Marking procedures and standards

Marking procedures and standards are critical for efficient material management, quality control, and traceability in construction fabrication. They promote effective project execution, confirm material compliance, and enhance safety and accountability throughout fabrication and construction processes.

3.2.6 Quality Assurance in Fabrication

Quality assurance is a fundamental aspect of fabrication in the construction industry. It encompasses a systematic approach to ensuring that materials, components, and processes meet specified standards and project requirements.

Here's an overview of the importance and key elements of quality assurance in construction fabrication:

1. **Project Specifications:**
    - Quality assurance begins with a thorough understanding of project specifications and design requirements.
    - Fabricators must align their work with these specifications to ensure that the end product meets the intended purpose.
2. **Material Inspection:**
    - Quality assurance involves rigorous material inspection.
    - Materials are examined for compliance with industry standards, such as size, composition, strength, and certification.

3. **Traceability:**
    - Materials and components are marked with unique identifiers for traceability.
    - This traceability ensures that materials can be tracked from procurement through fabrication and into the construction phase.
4. **Quality Control:**
    - Quality control processes are implemented at various stages of fabrication.
    - Inspections and tests verify that components are produced to the required standards and specifications.
5. **Documented Procedures:**
    - Fabricators follow documented procedures and work instructions.
    - These procedures detail every step of fabrication and quality control, providing a clear framework for consistency.
6. **Testing and Inspection:**
    - Rigorous testing and inspection protocols are employed.
    - These include destructive and non-destructive testing methods to assess material properties and weld integrity.
7. **Certifications and Compliance:**
    - Fabrication processes should adhere to industry codes and standards.
    - Fabricators often hold certifications that validate their ability to meet these standards.
8. **Training and Competence:**
    - Quality assurance relies on skilled and trained personnel.
    - Fabricators invest in workforce training and ensure that employees are competent in their roles.
9. **Documentation and Records:**
    - Detailed records are maintained throughout the fabrication process.
    - Records include material certifications, inspection reports, test results, and as-built drawings.
10. **Non-Conformance Management:**
    - A robust system for managing non-conformances is in place.
    - Any deviations from specifications are documented, investigated, and corrected to maintain quality.
11. **Quality Audits:**
    - Regular internal and external quality audits are conducted.
    - Audits assess the effectiveness of quality assurance processes and identify areas for improvement.

12. **Continuous Improvement:**
    - Fabricators strive for continuous improvement in quality assurance.
    - Lessons learned from previous projects are applied to enhance future processes and outcomes.
13. **Client Satisfaction:**
    - Ultimately, quality assurance aims to achieve client satisfaction.
    - Fabricated components should meet or exceed client expectations in terms of quality, safety, and performance.


Fig. 3.2.7 Quality assurance in fabrication

Quality assurance in construction fabrication is essential for delivering safe and reliable structures. It ensures that materials and components meet the necessary standards and that construction projects are completed successfully, meeting design specifications and industry regulations.

3.2.7 Inspection Procedures and Criteria

Inspection procedures and criteria are vital components of construction fabrication. These processes involve systematic checks and assessments to verify that materials, components, and workmanship meet specified standards and project requirements.

Fig. 3.2.8 Vital components of construction fabrication

Here's a detailed look at inspection procedures and criteria and their importance in the construction fabrication industry:

1. **Material Inspection:**
   - Inspection begins with a thorough examination of raw materials.
   - Materials are checked for compliance with industry standards, including size, composition, strength, and certification.
2. **Visual Inspection:**
   - Visual inspections assess the external appearance of materials, components, and welds.
   - Fabricators look for signs of defects, such as cracks, corrosion, or improper welding.

Fig. 3.2.9 Signs of defects

3. **Dimensional Inspection:**
   - Dimensional checks ensure that fabricated components meet specified dimensions and tolerances.
   - Instruments like calipers, micrometers, and laser scanners are used to measure accuracy.
4. **Non-Destructive Testing (NDT):**
   - NDT methods include techniques like ultrasonic testing, radiographic testing, magnetic particle testing, and dye penetrant testing.
   - These tests assess material properties and weld integrity without damaging the components.
5. **Destructive Testing:**
   - Destructive tests, such as tensile tests or impact tests, are conducted on sample materials to assess their mechanical properties.

- Results help validate material quality.

6. Weld Inspection:
   - Weld inspection evaluates the quality of welds, ensuring they meet design specifications and are free from defects.
   - Visual inspection and NDT methods are commonly used for weld assessment.
7. Paint and Coating Inspection:
   - Inspections for paint and coating applications involve checking thickness, adhesion, and coverage.
   - Coatings are assessed for uniformity and protection against corrosion.

Fig. 3.2.10 Paint and coating inspection

8. **Fit-Up and Alignment Inspection:**
   - Fit-up and alignment checks ensure that components are properly positioned before welding or assembly.
   - Proper alignment is crucial for structural integrity.
9. **Bolted Connection Inspection:**
   - Bolted connections are inspected to verify correct torque, fastener type, and alignment.
   - Properly tightened bolts are essential for load-bearing capacity.

Fig. 3.2.11 Bolted connection inspection

10. **Documentation Review:**
    - Inspectors review documentation, including material certificates, welder qualifications, and work instructions.
    - Documentation should align with project specifications and standards.
11. **Acceptance Criteria:**
    - Inspection criteria are based on industry codes, standards, and project specifications.
    - Components must meet these criteria to be accepted.
12. **Non-Conformance Reporting:**
    - Any non-conformances or deviations from specifications are documented and reported.
    - Corrective actions are taken to address non-conformities.
13. **Quality Control Audits:**
    - Quality control audits assess the effectiveness of inspection procedures.
    - Audits may be conducted by internal teams or third-party inspectors.
14. **Client Inspection and Acceptance:**
    - In some cases, clients may conduct their inspections to ensure project compliance.
    - Fabricated components must pass client acceptance criteria.
15. **Continuous Improvement:**
    - Fabricators strive for continuous improvement in inspection processes.
    - Feedback from inspections is used to enhance procedures and prevent future defects.

Fig. 3.2.12 Maintaining quality and safety in construction fabrication

Inspection procedures and criteria are essential for maintaining quality and safety in construction fabrication. They ensure that materials and components meet the necessary standards, adhere to design specifications, and comply with industry regulations. Rigorous inspections contribute to the successful execution of construction projects, minimizing the risk of defects and ensuring the durability and reliability of structures.

3.2.8 Identifying and Reporting Damage

Identifying and reporting damage is a critical aspect of construction fabrication.

It involves recognizing any defects, flaws, or issues in materials, components, or equipment and promptly reporting them to ensure that corrective actions are taken.

Fig. 3.2.13 Identifying and reporting damage

Here's an overview of the process of identifying and reporting damage in construction fabrication:

1. **Visual Inspection:**
   - Visual inspections are conducted at various stages of fabrication.
   - Fabricators and quality control personnel visually examine materials, components, welds, and equipment for any visible damage or defects.
2. **Material Damage:**
   - Material damage can include dents, scratches, corrosion, or signs of mishandling during transport or storage.
   - Damaged materials are segregated, and their condition is documented.
3. **Component Inspection:**
   - Components, such as beams, columns, and plates, are checked for cracks, bends, or misalignment.
   - Welds are inspected for proper fusion, cracks, and irregularities.
4. **Non-Destructive Testing (NDT):**
   - NDT methods, like ultrasonic testing or radiographic testing, are used to detect internal defects in materials and welds.
   - Results help identify hidden damage.

Fig. 3.2.14 Non-destructive testing (NDT)

5. **Coating and Paint Damage:**
   - Coatings and paint applications are inspected for peeling, chipping, or inadequate coverage.
   - Damaged coatings can lead to corrosion.

6. **Fit-Up and Alignment Issues:**
   - Fit-up and alignment issues are identified during the assembly of components.
   - Incorrect fit-up and alignment can compromise structural integrity.
7. **Bolted Connection Issues:**
   - Bolted connections are inspected to ensure that bolts are properly torqued and aligned.
   - Loose or misaligned bolts can result in damage.

Fig. 3.2.15 Bolted connection issues

8. **Documentation Review:**
   - Material certificates and quality control documentation are reviewed for accuracy and compliance.
   - Inaccurate or incomplete documentation can lead to misunderstandings and errors.
9. **Non-Conformance Reporting:**
   - Any identified damage or non-conformance is documented in non-conformance reports (NCRs).
   - NCRs include details of the damage, location, and severity.
10. **Reporting Procedures:**
    - Fabricators and quality control personnel follow established reporting procedures.
    - Damaged materials or components are reported to supervisors, project managers, and quality control teams.
11. **Corrective Actions:**
    - Upon receiving damage reports, corrective actions are initiated.

- These actions may involve repairing, replacing, or refurbishing damaged materials or components.

12. **Preventive Measures:**
    - Fabrication facilities implement preventive measures to reduce the risk of damage.
    - These measures include proper handling, storage, and transport procedures.
13. **Quality Control Audits:**
    - Quality control audits may assess the effectiveness of damage identification and reporting processes.
    - Audits help identify areas for improvement.
14. **Client Communication:**
    - If damage affects materials or components destined for a client's project, clear communication with the client is essential.
    - Clients should be informed of any damage and the proposed corrective actions.
15. **Documentation Retention:**
    - All damage reports, NCRs, and related documentation should be retained for reference and audits.

Identifying and reporting damage is crucial for maintaining the quality and integrity of fabricated components in construction. Early detection and swift reporting ensure that corrective measures are taken promptly, preventing defects from compromising the safety and functionality of construction projects.

3.2.9 Prevention and Handling Practices

Prevention and handling practices are essential in construction fabrication to minimize damage, defects, and safety risks. These practices encompass a range of measures and procedures aimed at preventing issues and effectively managing them when they occur.

Here are key prevention and handling practices in construction fabrication:

Prevention Practices:

1. **Proper Handling:**
    - Employees are trained in safe handling practices for materials and components to prevent physical damage or deformation.
2. **Storage Guidelines:**
    - Materials and components are stored according to industry guidelines to prevent corrosion, distortion, or contamination.

3. **Transport Protocols:**

   - Safe transport procedures are followed to avoid damage during transit, including securing materials and using appropriate packaging.

4. **Quality Control:**

   - Rigorous quality control processes are in place to catch defects and deviations from specifications early in the fabrication process.

5. **Welding Procedures:**

   - Certified welders follow proper welding procedures to ensure strong, defect-free welds.

6. **Coating and Paint Application**:

   - Skilled technicians apply coatings and paint according to manufacturer specifications to prevent corrosion.

7. **Bolted Connections:**

   - Proper torque and fastener selection are ensured during the assembly of bolted connections to prevent issues.

8. **Material Certification:**

   - Materials are procured with appropriate certification to guarantee compliance with industry standards.

9. **Documentation:**

   - Accurate and detailed documentation is maintained throughout the fabrication process to reduce errors.

Fig. 3.2.16 Prevention practices in construction fabrication

Handling Practices:

1. **Identification of Damage:**
   - Regular visual inspections are conducted to identify damage or defects in materials, components, and equipment.
2. **Non-Destructive Testing (NDT):**
   - NDT methods are employed to detect hidden defects, such as ultrasonic testing, radiographic testing, and magnetic particle testing.
3. **Documentation Review:**
   - Material certificates and inspection records are reviewed for accuracy and compliance with project requirements.
4. **Reporting Procedures:**
   - Established reporting procedures are followed when damage or defects are identified, including documenting the extent and location of issues.
5. **Non-Conformance Reporting (NCR):**
   - NCRs are generated to formally document and address identified non-conformities and deviations from specifications.
6. **Corrective Actions:**
   - Prompt corrective actions are initiated to address damage, including repair, replacement, or refurbishment of materials and components.
7. **Preventive Measures:**
   - Measures are put in place to prevent the recurrence of similar issues, such as improving handling or storage practices.
8. **Client Communication:**
   - Clients are informed of any damage or defects that may affect their project, with clear communication about proposed solutions.
9. **Quality Control Audits:**
   - Periodic quality control audits assess the effectiveness of prevention and handling practices and identify areas for improvement.
10. **Documentation Retention:**
    - All documentation related to damage identification, reporting, and corrective actions is retained for future reference and audits.

Fig. 3.2.17 Handling practices in construction fabrication

Prevention and handling practices are integral to ensuring the quality and safety of fabricated components in construction. By proactively preventing issues and efficiently addressing them when they arise, construction fabricators contribute to the successful execution of projects and the durability of structures.

3.2.10 Material Handling Safety

Material handling safety is of paramount importance in construction fabrication to prevent accidents, injuries, and damage to materials and components. It involves adhering to strict safety protocols and best practices when lifting, moving, and manipulating materials within fabrication facilities.

Fig. 3.2.18 Material handling safety

Here's an overview of material handling safety in the context of construction fabrication:

1. **Training and Education:**
    - Fabrication workers receive comprehensive training on safe material handling practices.
    - They are educated about potential hazards, proper lifting techniques, and equipment operation.
2. **Personal Protective Equipment (PPE):**
    - Workers are equipped with appropriate PPE, including safety gloves, steel-toed boots, hard hats, and eye protection.
    - The use of PPE is mandatory during material handling tasks.
3. **Equipment Inspection:**
    - Material handling equipment, such as forklifts, cranes, and hoists, undergo regular inspections for safety and functionality.
    - Any defects or malfunctions are promptly addressed.
4. **Load Capacity:**
    - Equipment operators are trained to know the load capacity of the machinery they operate.
    - Loads should never exceed the equipment's specified capacity.
5. **Proper Lifting Techniques:**
    - Workers are trained in proper lifting techniques to avoid strains and injuries.
    - This includes bending at the knees, keeping the back straight, and using leg muscles to lift.
6. **Secure Packaging:**
    - Materials are securely packaged to prevent shifting or falling during transport.
    - Straps, chains, or other securing methods are used as needed.
7. **Material Inspection:**
    - Before handling, materials are inspected for damage or defects.
    - Damaged materials are not used until they are repaired or replaced.
8. **Clear Pathways:**
    - Work areas are kept free of clutter and obstructions to ensure clear pathways for material handling equipment.
9. **Communication:**
    - Effective communication among workers is essential.
    - Hand signals or radios are often used to coordinate movements when handling materials.
10. **Slow and Controlled Movements:**
    - Equipment operators are trained to make slow and controlled movements when lifting and

moving materials.

- Abrupt manoeuvres are avoided.

Fig. 3.2.19 Lifting, moving, and manipulating materials within fabrication facilities

11. **Emergency Procedures:**
    - Workers are familiar with emergency procedures, including what to do in case of equipment malfunctions or accidents.
    - First-aid supplies and personnel are readily available.
12. **Material Placement:**
    - Materials are placed in designated areas and stored securely to prevent tipping or falling.
    - Heavy items should be stored at lower levels to avoid overloading shelving.
13. **Housekeeping:**
    - Regular housekeeping practices are followed to maintain a clean and organized workspace.
    - This reduces trip hazards and ensures a safe environment.
14. **Equipment Operation Training:**
    - Only trained and authorized personnel are allowed to operate material handling equipment.
    - Certification may be required for specific equipment.
15. **Continuous Improvement:**
    - Fabrication facilities regularly review and improve material handling safety procedures.
    - Lessons learned from incidents or near-misses are used to enhance safety.

Fig. 3.2.20 Material handling safety

Material handling safety is an ongoing commitment in construction fabrication, with the aim of preventing accidents, injuries, and material damage. By prioritizing safety, fabrication facilities create a secure working environment for their employees and contribute to the successful and accident-free execution of construction projects.

3.2.11 Standard Practices and Equipment

Standard practices and equipment play a crucial role in ensuring efficiency, safety, and quality in construction fabrication. These practices encompass established procedures, tools, and machinery that are essential for fabricating components and structures.

Here's an overview of standard practices and equipment used in construction fabrication:

Standard Practices:

1. **Blueprint Interpretation:**
   - Fabricators read and interpret blueprints, working drawings, and specifications to understand project requirements.
2. **Material Identification:**
   - Identifying and selecting the correct materials, such as steel sections and components, based on project specifications.
3. **Material Handling:**
   - Safe handling, transportation, and storage of materials and components to prevent damage and ensure accessibility.

4. **Welding and Joining:**
   - Proper welding techniques and procedures to create strong and reliable connections between materials.
5. **Cutting and Shaping:**
   - Precision cutting and shaping of materials using tools like saws, plasma cutters, and shears.
6. **Assembly and Fit-Up:**
   - Precise assembly and fit-up of components according to design specifications, ensuring proper alignment.
7. **Surface Preparation:**
   - Cleaning and preparing material surfaces through methods like sandblasting or chemical treatments before painting or coating.
8. **Quality Control:**
   - Rigorous quality control processes, including inspections and testing, to ensure compliance with standards and specifications.
9. **Safety Protocols:**
   - Implementation of safety protocols and procedures to protect workers from hazards during fabrication activities.
10. **Documentation and Records:**
    - Maintaining accurate documentation of materials, inspections, and work procedures for traceability and compliance.

Equipment:

1. **Welding Machines:**
   - Various types of welding machines, such as arc welders, MIG welders, and TIG welders, for joining materials.

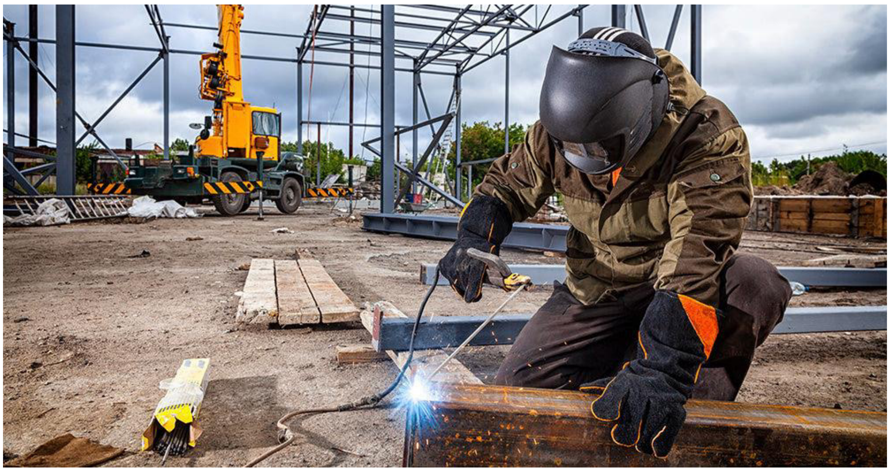

Fig. 3.2.21 Welding machines

2. Cutting Tools:

   - Tools like circular saws, plasma cutters, and oxy-fuel torches for cutting materials to size.

Fig. 3.2.22 Cutting tool i.e. circular saws

3. Material Handling Equipment:

   - Equipment like forklifts, cranes, and hoists for moving heavy materials and components.

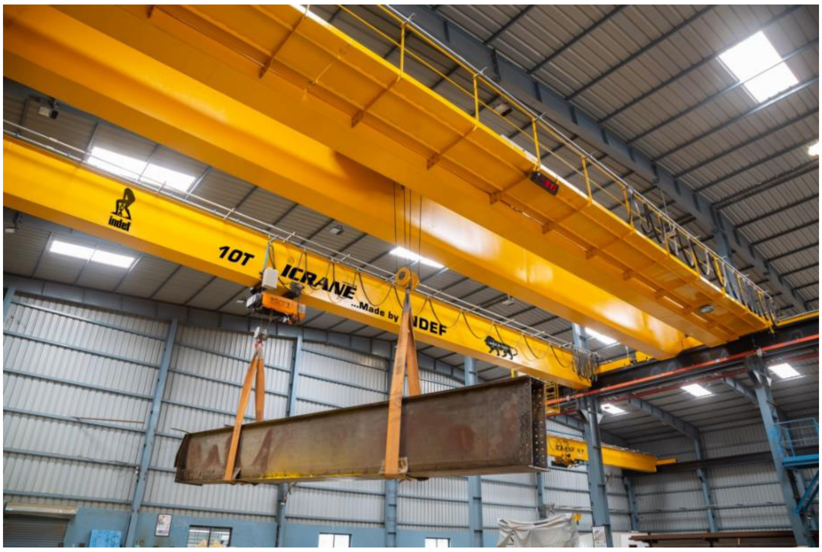

Fig. 3.2.23 Hoist for material handling

4. Grinding and Polishing Tools:

   - Tools for grinding and polishing materials to achieve smooth surfaces and precise dimensions.

Fig. 3.2.24 Grinding & polishing tool

5. Measuring and Layout Tools:

    - Instruments like tape measures, calipers, squares, and levels for accurate measurements and layout.

Fig. 3.2.25 Measuring & layout tool

6. Surface Preparation Equipment:

   - Equipment such as sandblasting machines and chemical applicators for surface cleaning and preparation.

Fig. 3.2.25 Measuring & layout tool

7. Painting and Coating Equipment:

   - Tools and machinery for applying protective coatings and paint to materials and structures.

Fig. 3.2.27 Painting & coating equipment

8. Safety Gear:

   - Personal protective equipment (PPE) like helmets, gloves, safety glasses, and respirators for worker safety.

Fig. 3.2.28 Safety gear i.e. PPEs

9. Quality Inspection Tools:

   - Tools for conducting inspections, including non-destructive testing (NDT) equipment like ultrasonic testers and X-ray machines.

Fig. 3.2.29 Quality inspection tools

10. Lifting and Rigging Equipment:
    - Hardware and accessories like slings, shackles, and hooks for lifting and securing materials.

Fig. 3.2.30 Lifting & rigging equipment

11. Material Storage Systems:
    - Storage racks, shelves, and pallets for organized material storage and easy access.

Fig. 3.2.31 Material storage system

12. Documentation Software:
    - Computer software for managing documentation, records, and project data.

Standard practices and equipment are the backbone of construction fabrication, ensuring that materials are processed efficiently, safely, and in compliance with project requirements and industry standards. These practices and tools are essential for producing high-quality components and structures in the construction industry.

Notes

QR Codes

Scan the QR code to watch the video

https://youtu.be/PXmQX4rw7rM

Cutting, Filing, Grinding and Fitting Metal for Welding

UNIT 3.3: Surface Cleaning and Preparation

Unit Objectives

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

1. Inspect the surface of the materials/sections to determine the types of impurities present.
2. Obtain approval for employing different methods of surface cleaning from the concerned authority.
3. Estimate the quantities of the materials required for the surface cleaning purpose.
4. Initiate indent procedures for the required cleaning materials as per organizational norms.
5. Ensure appropriate surface cleaning procedures like heating, chemical cleaning, scrubbing, water jet, abrasion, etc., are adopted as per the requirements/instructions.
6. Confirm the compliance of the prepared clean surface with technical details or instructions.

3.3.1 Inspecting Surface Impurities in Construction Fabrication

Inspecting the surface of materials and sections to determine the types of impurities is a critical step in construction fabrication. Surface impurities can compromise the quality and integrity of fabricated components and structures.

Fig. 3.3.1 Types of impurities

Here's a detailed look at this important aspect of the fabrication process:

1. **Visual Inspection:**
   - Fabricators begin by visually examining the surface of materials and sections.
   - They look for any visible impurities, such as dirt, rust, oil, paint, or debris.
2. **Surface Cleaning:**
   - Before inspection, the surface may be cleaned using appropriate methods.
   - Cleaning methods include brushing, wiping, washing, or using solvents to remove loose contaminants.
3. **Types of Impurities:**
   - Fabricators identify various types of impurities that can be present on surfaces:
     - **Dirt and Dust:** Common contaminants that can be easily removed.
     - **Rust:** Surface corrosion, which can affect the material's structural integrity.
     - **Oil and Grease: Lubricants or residues from previous handling or processing.**
     - **Paint or Coatings:** Previous paint layers that may need to be stripped.
     - **Weld Spatter:** Splatter from welding processes that can affect appearance and quality.
     - **Scale:** Oxide layers formed during heating or manufacturing processes.
4. **Inspection Tools:**

   Inspection may involve the use of various tools and equipment, including:
   - **Visual Inspection:** Standard lighting and the naked eye for initial assessment.
   - **Magnifying Glasses:** For closer examination of small or intricate areas.
   - **Ultraviolet (UV) Lights:** Used to detect certain types of contaminants, such as fluorescent dyes.

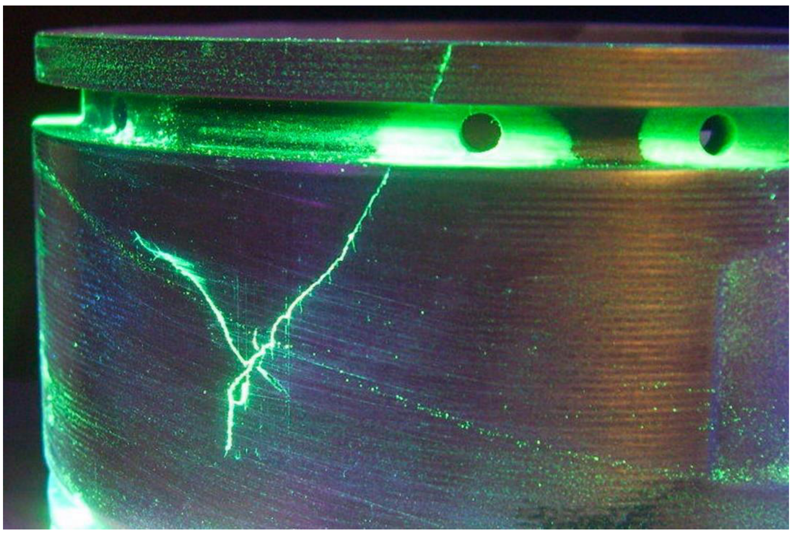

Fig. 3.3.2 Ultraviolet (UV) lights

5. **Importance of Surface Inspection:**
   Identifying surface impurities is crucial for several reasons:
   - Ensures the quality and safety of fabricated components.
   - Helps determine the appropriate surface preparation methods.
   - Guides decisions on whether to clean, remove, or treat specific impurities.
   - Affects the adhesion of coatings and paints if applied.
6. **Documentation:**
   - Inspection findings are documented, including the type and location of impurities.
   - Documentation helps in determining the appropriate cleaning or treatment procedures.
7. **Surface Preparation:**
   Once impurities are identified, fabricators decide on the appropriate surface preparation methods:
   - **Cleaning:** Removing dirt, oil, grease, and loose contaminants.
   - **Abrasion:** Using abrasive methods like sandblasting to remove rust and scale.
   - **Chemical Treatment:** Applying chemicals to remove specific impurities.
   - **Coating Removal:** Stripping old paint or coatings for reapplication.
8. **Compliance with Standards:**
   - Surface inspection and preparation must comply with industry and project-specific standards.
   - Compliance ensures that fabricated components meet quality and safety requirements.
9. **Continuous Monitoring:**
   - Regular inspections and monitoring throughout the fabrication process are essential to maintain surface quality.

Inspecting surface impurities is a fundamental part of construction fabrication. It ensures that materials and components are free from contaminants that could compromise their structural integrity, appearance, and functionality. Effective surface inspection and preparation contribute to the overall quality and longevity of fabricated structures in the construction industry.

3.3.2 Obtaining Approval for Surface Cleaning Methods

Obtaining approval for employing different methods of surface cleaning is a crucial step in construction fabrication to ensure that the chosen cleaning methods are safe, effective, and compliant with industry standards and project requirements.

Fig. 3.3.3 Surface cleaning methods

Here's how this process typically works:

1. **Method Selection:**
   - Fabricators evaluate the specific cleaning requirements based on the type of material, the nature of impurities, and project specifications.
   - They consider various cleaning methods, such as mechanical abrasion (e.g., sandblasting), chemical cleaning, water jetting, or heat treatment.
2. **Risk Assessment:**
   - Fabricators conduct a risk assessment to identify potential hazards associated with each cleaning method.
   - Hazards may include exposure to chemicals, dust, noise, or high-pressure equipment.
3. **Safety Precautions:**
   - Based on the risk assessment, fabricators develop safety protocols and precautions for each cleaning method.
   - These precautions may involve the use of personal protective equipment (PPE), ventilation, or containment measures.
4. **Regulatory Compliance:**
   - Fabricators ensure that the chosen cleaning methods comply with local, regional, and national regulations and standards.

- Compliance may involve meeting environmental, health, and safety regulations.

5. **Documentation:**
    - Fabricators document their proposed cleaning methods, safety measures, and risk assessments.
    - Detailed documentation is prepared to provide a clear understanding of the chosen method's safety and effectiveness.
6. **Approval Process:**
    - The documented proposal is submitted to the concerned authority responsible for approving fabrication processes.
    - The authority may be an internal safety department, an external regulatory agency, or the client's quality control team.
7. **Review and Evaluation:**
    - The authority reviews the submitted proposal, assessing its compliance with safety and quality standards.
    - They may request additional information or clarification as needed.
8. **Approval or Feedback:**
    - The authority provides either approval or feedback on the proposed cleaning methods.
    - If approved, fabricators can proceed with the chosen cleaning method.
    - If feedback is provided, fabricators make necessary adjustments and resubmit the proposal for approval.
9. **Implementation:**
    - Once approval is granted, fabricators implement the approved cleaning method.
    - Safety measures and precautions are strictly followed during the cleaning process.
10. **Continuous Monitoring:**
    - Fabricators continuously monitor the cleaning process to ensure that safety and quality standards are maintained.
11. **Record Keeping:**
    - Detailed records of the cleaning process, including safety measures and results, are maintained for documentation and future reference.
12. **Reporting:**
    - Any incidents or deviations from the approved cleaning process are promptly reported to the concerned authority.

Obtaining approval for surface cleaning methods is an essential part of ensuring safety, compliance, and quality in construction fabrication. By following a structured approval process and adhering to safety protocols, fabricators can effectively clean materials and components while minimizing risks and meeting project requirements.

3.3.3 Estimate the Quantities of the Materials required for the Surface Cleaning Purpose

Estimating the quantities of materials required for surface cleaning purposes in construction fabrication is essential for planning and executing cleaning activities efficiently. Proper estimation ensures that an adequate amount of cleaning materials is available while minimizing waste.

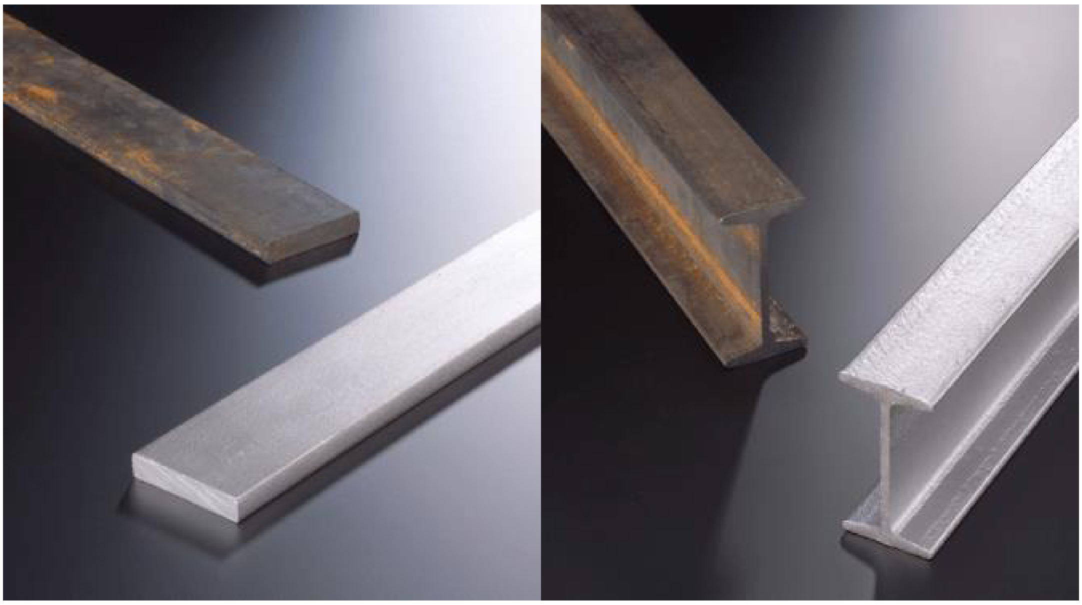

Fig. 3.3.4 Surface cleaning purposes in construction fabrication

Here's a step-by-step guide on how this process is typically carried out:

1. **Assessment of Surface Area:**
   - Fabricators start by assessing the surface area that needs to be cleaned. This includes identifying the dimensions and specifications of the materials or components to be cleaned.
2. **Determination of Cleaning Method:**
   - The choice of cleaning method (e.g., abrasive blasting, chemical cleaning, water jetting) is made based on the type of material, the nature of impurities, and project requirements.

Fig. 3.3.5 Cleaning method (e.g., abrasive blasting, chemical cleaning, water jetting)

3. **Material Consumption Rate:**
   - Fabricators refer to industry standards or guidelines to determine the average material consumption rate per square meter or square foot for the chosen cleaning method.
   - Material consumption rates can vary depending on factors like the cleaning material used and the extent of surface contamination.
4. **Calculation:**
   - The estimated surface area is multiplied by the material consumption rate to calculate the quantity of cleaning material required.
   - The formula typically used is:

     Quantity of Cleaning Material = Surface Area (in square meters or square feet) × Material Consumption Rate (in liters, kilograms, or gallons per unit area)
5. **Safety Margin:**
   - Fabricators often add a safety margin to the estimated quantity to account for potential variations in the cleaning process.
   - The safety margin helps ensure that there is an adequate supply of cleaning material available to handle unexpected situations or variations in surface conditions.
6. **Storage and Handling:**
   - Fabricators consider storage and handling requirements for the cleaning materials.
   - Materials should be stored in appropriate containers and conditions to prevent contamination or degradation.
7. **Procurement Planning:**
   - Once the estimated quantity is determined, fabricators plan the procurement of cleaning materials.
   - Orders are placed with suppliers to ensure that the required materials are available when needed.
8. **Quality Assurance:**
   - Fabricators may conduct quality checks on the cleaning materials to ensure they meet specified standards.
   - This includes checking for proper labelling, batch numbers, and compliance with safety regulations.
9. **Inventory Management:**
   - An inventory management system may be implemented to track the quantities of cleaning materials on hand and reorder as needed to maintain adequate stock levels.
10. **Waste Management:**
    - Proper disposal procedures for used or waste cleaning materials are established to comply with environmental regulations.

11. **Documentation:**

- All estimations, procurement records, and quality assurance documentation related to cleaning materials are maintained for project records and future reference.

Fig. 3.3.6 Cleaning equipment & material

Accurate estimation of cleaning material quantities is a vital aspect of construction fabrication, ensuring that cleaning activities are carried out effectively and efficiently while maintaining quality and safety standards.

3.3.4 Initiating Indent Procedures for Cleaning Materials in Construction Fabrication

In the context of construction fabrication and procurement, an "indent procedure" refers to the formal process of requesting and procuring materials, equipment, or supplies needed for a specific project or task. It is a systematic approach used by organizations to ensure that the necessary items are obtained efficiently and in accordance with established protocols.

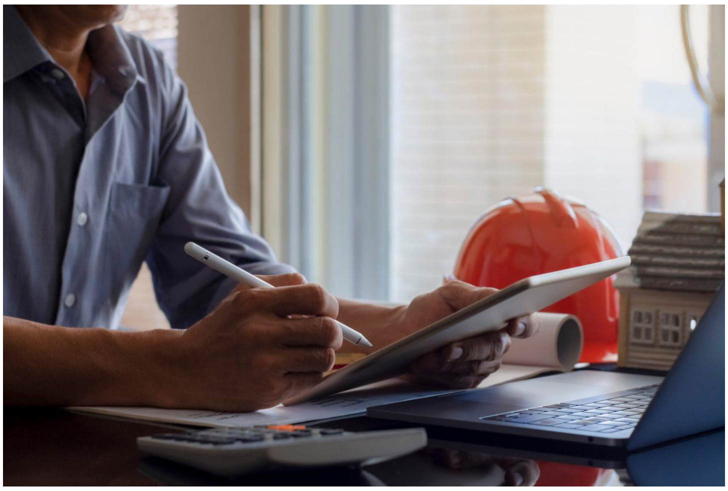

Fig. 3.3.7 Construction fabrication and procurement

Indent procedures are essential for requesting and procuring the required cleaning materials efficiently and in compliance with organizational norms in construction fabrication. Here's how the process typically works:

1. **Material Requirement Assessment:**
   - Fabricators assess the cleaning materials needed based on the type of surface cleaning method selected and the estimated quantities calculated.
2. **Indent Preparation:**
   - An **"indent"** is essentially a formal request or requisition for materials. Fabricators prepare the indent document, specifying the details of the required cleaning materials. This document typically includes:
     - The type and quantity of cleaning materials needed.
     - Specifications or standards that the materials must meet.
     - Project or job details, including the location and expected start date of cleaning activities.
     - Any specific brand preferences or special requirements.
3. **Authorization and Approval:**
   - The indent document is typically submitted to the appropriate authority within the organization for approval.
   - Approval ensures that the request aligns with project needs and budgetary constraints.
4. **Procurement Process:**
   - Once the indent is approved, it initiates the procurement process.
   - The procurement department or responsible personnel use the approved indent to procure the specified cleaning materials from suppliers or vendors.
5. **Vendor Selection:**
   - The organization may have approved vendors or suppliers for specific types of cleaning materials.
   - Vendors are selected based on factors like quality, price, reliability, and delivery timelines.
6. **Purchase Order:**
   - A purchase order is issued to the selected vendor, detailing the quantity, type, specifications, and delivery instructions for the cleaning materials.
7. **Delivery and Inspection:**
   - Upon receipt of the cleaning materials, they are inspected for compliance with the specified requirements.
   - This may include checking for correct quantities, quality, labelling, and conformity to safety and environmental standards.

8. **Storage and Handling:**
   - The received cleaning materials are stored in designated areas following proper storage and handling guidelines.
   - This ensures that the materials remain in good condition until they are used.
9. **Reconciliation:**
   - The organization reconciles the received materials with the purchase order to verify that the correct materials and quantities were delivered.
10. **Document Retention:**
    - All indent documents, purchase orders, delivery receipts, and inspection reports are retained for documentation and audit purposes.
11. **Accounting and Payment:**
    - The organization's accounting department processes payments to vendors based on the invoices and receipts.
12. **Utilization:**
    - The cleaning materials are used for their intended purpose in surface cleaning activities as per the project schedule.
13. **Continuous Monitoring:**
    - Throughout the project, the organization may continuously monitor the consumption of cleaning materials to ensure adequate stock levels.

Fig. 3.3.8 Material requisitions in construction fabrication

Initiating indent procedures is a structured way to manage material requisitions in construction fabrication. It helps ensure that the required cleaning materials are obtained in a timely and organized manner, facilitating smooth and efficient surface cleaning processes.

3.3.5 Ensuring Appropriate Surface Cleaning Procedures in Construction Fabrication

In construction fabrication, ensuring that the right surface cleaning procedures are adopted is crucial to achieving the desired quality and finish of fabricated components. Different methods such as heating, chemical cleaning, scrubbing, water jetting, and abrasion may be employed based on specific project requirements and instructions.

Here's how this process is typically carried out:

1. **Reviewing Project Requirements:**
   - Fabricators begin by thoroughly reviewing project specifications, blueprints, and quality standards to understand the specific cleaning requirements for each component or structure.
2. **Selecting the Cleaning Method:**

   Based on the project requirements and the nature of surface impurities, fabricators choose the appropriate cleaning method from available options, which may include:
   - **Heating:** Used for removing certain contaminants through controlled heating or burning.
   - **Chemical Cleaning:** Involves the use of chemicals to dissolve or remove specific impurities.
   - **Scrubbing:** Manual or mechanical scrubbing using brushes or abrasive pads.
   - **Water Jetting:** High-pressure water jets for removing loose contaminants or coatings.
   - **Abrasion:** The use of abrasive materials or sandblasting to remove rust, scale, or old coatings.
3. **Compliance with Safety Standards:**
   - Fabricators ensure that the selected cleaning procedure aligns with safety regulations and standards.
   - They assess potential hazards associated with the chosen method and implement safety measures accordingly.
4. **Equipment and Material Preparation:**
   - Depending on the selected cleaning method, fabricators prepare the necessary equipment, materials, and tools.
   - For example, if chemical cleaning is chosen, the appropriate chemicals and protective gear are procured.
5. **Procedure Execution:**
   - Fabricators execute the chosen cleaning method following specific procedures and guidelines.
   - For instance, if abrasion is selected, they control the blasting process to achieve the desired surface finish without damaging the material.
6. **Monitoring and Quality Control:**
   - During the cleaning process, fabricators closely monitor the progress to ensure that impurities are effectively removed and the surface is prepared as required.
   - Quality control checks may involve visual inspections or the use of instruments to measure

surface cleanliness.

7. **Compliance with Instructions:**
    - Fabricators strictly adhere to any specific instructions provided in the project documents.
    - This may include temperature and pressure requirements, chemical concentrations, or surface roughness standards.
8. **Documentation:**
    - Detailed records are maintained of the cleaning procedures followed, including any deviations from the initial plan.
    - Documentation helps in traceability and ensures that the cleaning process aligns with project requirements.
9. **Reporting and Communication:**
    - Any issues, challenges, or deviations from the plan are reported to the relevant authorities or project stakeholders.
    - Communication ensures that corrective actions can be taken promptly.
10. **Post-Cleaning Inspection:**
    - After the cleaning process is completed, a final inspection is conducted to verify that the surface meets the required standards.

Fig. 3.3.9 Post cleaning inspection

11. **Continual Improvement:**
    - Lessons learned from the cleaning process are used to continually improve surface cleaning procedures in future projects.

Ensuring the adoption of appropriate surface cleaning procedures is essential for achieving the desired quality and integrity of fabricated components in construction fabrication. By following a structured approach and complying with project requirements and safety standards, fabricators can consistently deliver high-quality results.

3.3.6 Confirming Compliance of Prepared Clean Surfaces in Construction Fabrication

After the surface cleaning process is completed in construction fabrication, it is crucial to confirm that the cleaned surfaces comply with technical details and instructions outlined in project specifications and quality standards.

Here's how this confirmation process typically works:

1. **Inspection and Assessment:**
   - Trained inspectors or quality control personnel are responsible for assessing the cleaned surfaces.
   - They compare the actual condition of the surface to the technical details and instructions provided in the project documents.
2. **Reference to Technical Details:**
   - The inspectors refer to the project's technical drawings, blueprints, specifications, and any specific instructions related to surface cleanliness.
   - They use these references as benchmarks for evaluation.
3. **Measurement and Testing:**
   - Inspectors may use various tools and instruments to measure and test the prepared surface. This may include:
     - ♦ **Visual Inspection:** A visual examination to identify any visible contaminants, residues, or defects.
     - ♦ **Surface Roughness Measurement:** Using instruments to measure the surface texture or roughness.
     - ♦ **Adhesion Testing:** Assessing the adhesion strength of coatings or paint applied to the surface.
     - ♦ **Chemical Testing:** Confirming that the surface is free from chemical residues, if applicable.
     - ♦ **Thickness Measurement:** Verifying the thickness of coatings, if specified.

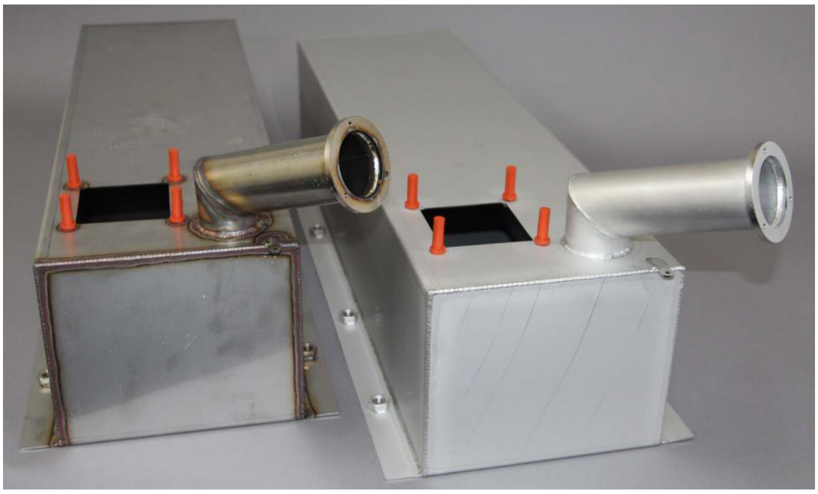

Fig. 3.3.10 Surface cleaning process

4. **Compliance Evaluation:**
   - Inspectors evaluate the measured data and observations against the project requirements.
   - They check for compliance with cleanliness levels, surface finish specifications, and any other relevant criteria.
5. **Non-Conformance Identification:**
   - If any non-conformities or discrepancies are identified during the inspection, they are documented and reported.
   - Non-conformances may include insufficient cleanliness, deviations from specified roughness, or other surface defects.
6. **Corrective Actions:**
   - If non-conformities are detected, corrective actions are initiated.
   - The responsible parties, such asa the cleaning crew or surface preparation team, may be required to rectify the issues.
7. **Verification and Re-inspection**:
   - After corrective actions are taken, a verification process is conducted to confirm that the issues have been addressed.
   - Re-inspection may involve repeating the measurements or tests that initially identified non-conformities.
8. **Documentation and Records:**
   - Detailed records are maintained of the inspection results, including compliance findings and any corrective actions taken.
   - Documentation provides a clear history of the surface condition and verification steps.

9 **Final Acceptance**:
   - Once the prepared surface is confirmed to comply with technical details and instructions, it is accepted for further construction or coating applications.

Fig. 3.3.11 Stacking and storing

10. Reporting:

- A final compliance report may be generated, summarizing the inspection findings and confirming that the surface meets the required standards.
- This report is often shared with project stakeholders and may be required for regulatory or contractual compliance.

11. Quality Assurance:

- Quality assurance processes are implemented to ensure that the prepared surface remains compliant throughout the project's construction phases.

12. Continuous Improvement:

- Lessons learned from the compliance confirmation process are used to improve surface cleaning procedures and adherence to project instructions in future projects.

Confirming compliance of prepared clean surfaces is essential for maintaining the structural integrity and durability of fabricated components in construction fabrication. It ensures that surfaces are ready for subsequent processes such as coating, welding, or assembly and helps deliver a quality end product.

Fig. 3.3.12 Maintaining the structural integrity and durability of fabricated components

Exercise

Answer the following questions:

Short Questions:

1. What is the primary purpose of reading and interpreting blueprints in steel fabrication?
2. Why is it important to confirm the compliance of a clean surface with technical details or instructions?
3. What are the typical methods used for identifying different steel components in fabrication?
4. Why is it essential to locate appropriate sections in the storing yard based on size and design?
5. What is the role of quality inspection in the fabrication process?

Fill-in-the-Blanks:

1. Identifying different components in steel fabrication is crucial for aligning the work with ____________ (specifications / design) requirements.
2. Surface cleaning procedures may include heating, chemical cleaning, scrubbing, water jetting, or ____________ (abrasion / painting).
3. The compliance of a prepared clean surface with technical details ensures adherence to project ____________ (standards / specifications).
4. To estimate the quantities of materials required for surface cleaning, fabricators must consider project ____________ (scope / requirements).
5. Initiation of indent procedures is essential to procure necessary ____________ (cleaning / construction) materials for cleaning.

True/False Questions:

1. True or False: Identifying steel components in fabrication is not necessary if the materials are standardized.
2. True or False: Quality inspection is only required for the final product, not for raw materials.
3. True or False: Surface cleaning methods like heating and chemical cleaning can be chosen without approval.
4. True or False: Estimating cleaning material quantities is a one-time process and does not require ongoing monitoring.
5. True or False: Compliance with technical details is only necessary for aesthetic purposes and does not affect structural integrity

Notes

QR Codes

Scan the QR code to watch the video

https://youtu.be/xzW5VxmpV70

Blast Cleaning of Steel as part of Automatic Steel Fabrication

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National
Skill Development
Corporation
Transforming the skill landscape

4. Conduct Joint Preparation, Connection Activities and Repair Work in Fabricated Assemblies

Construction Skill Development Council

Unit 4.1 - Fabrication Fundamentals

Unit 4.2 - Fabrication Bed and Equipment Preparation

Unit 4.3 - Quality Control and Repair

CON/N1211

Key Learning Outcomes

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

1. Explain common terminologies, drawings, and symbols relevant to fabrication work.
2. Explain requirements for preparation of fabrication bed/platform.
3. Demonstrate clamping and anchoring of the sections/work piece to the platform/bed as per standard practices.
4. Describe the parts and components of welding equipment and their functions.
5. Explain welding and bolting methods and their applications.
6. Explain the different welding parameters and their correlations.
7. Explain positions and patterns of welding.
8. Describe consumables used in welding, their selection, and storage.
9. Explain the concept of customisation of jigs and fixtures.
10. Discuss the procedures involved in edge/joint preparation during the fabrication of a steel structure.
11. Interpret fabrication blueprints/shop drawings and specifications for details required for edge/joint preparation.
12. Explain the concept of root gaps and how to include them in measurement.
13. Explain the concept of shrinkage of material and adjusting shrinkage into measurement.
14. Explain the various types of defects arising in the components of various shapes and sizes, their causes, and effects.
15. Explain the various methods for rectification of various defects along with the sequence of each activity.
16. Explain the use of various tools, equipment, and consumables required for repair work and their basic maintenance.
17. Prepare a sample estimate of the quantities of consumables, tools, and equipment required for edge/joint preparation.
18. Demonstrate the methods to measure and mark the sections for edge preparation as per provided technical details and standard procedures.
19. Demonstrate the process of edge preparation of a work piece/section as per requirements.
20. Demonstrate welding/bolting method to connect two components/assemblies as per drawings and specifications.
21. Inspect the proposed component/assemblies for distortions, change in dimensions, or other defects.
22. Prepare an estimate of the time, materials, tools, manpower required for repair work of a given component/assemblies.
23. Demonstrate the application of corrective operations like grinding, welding, heating, jacking, etc., to repair given defective component/assemblies.

UNIT 4.1: Fabrication Fundamentals

Unit Objectives

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

1. Explain common terminologies, drawings, and symbols relevant to fabrication work.
2. Describe the parts and components of welding equipment and their functions.
3. Explain welding and bolting methods and their applications.
4. Explain the different welding parameters and their correlations.
5. Explain positions and patterns of welding.
6. Describe consumables used in welding, their selection, and storage.
7. Explain the concept of customisation of jigs and fixtures.
8. Discuss the procedures involved in edge/joint preparation during the fabrication of a steel structure.
9. Interpret fabrication blueprints/shop drawings and specifications for details required for edge/ joint preparation.

4.1.1 Terminologies, Drawings, and Symbols relevant to Fabrication Work

In the context of fabrication work, understanding common terminologies, drawings, and symbols is crucial for effective communication and accurate execution of tasks.

Fig. 4.1.1 Fabrication work

Here are some key terminologies, drawings, and symbols relevant to fabrication work:

Terminologies:

- **Welding:** The process of joining metals or thermoplastics through fusion, often using heat and pressure.
- **Bolting:** The method of fastening two or more components together using bolts and nuts.
- **Fabrication:** The process of building or assembling metal structures or components from raw materials.
- **Blueprint:** A detailed technical drawing or plan that provides instructions for fabrication.
- **Weld Joint:** The specific area where two metal pieces are joined together by welding.
- **Welding Parameters:** Variables such as voltage, current, and travel speed that affect the welding process.
- **Jigs and Fixtures:** Devices used to hold and position workpieces during fabrication.
- **Edge/ Joint Preparation:** The process of cleaning and shaping the edges of metal components before welding.
- **Root Gap:** The distance between the edges of two metal pieces to be welded together.
- **Shrinkage:** The reduction in size or volume of a material during the cooling process after welding.

Drawings and Symbols:

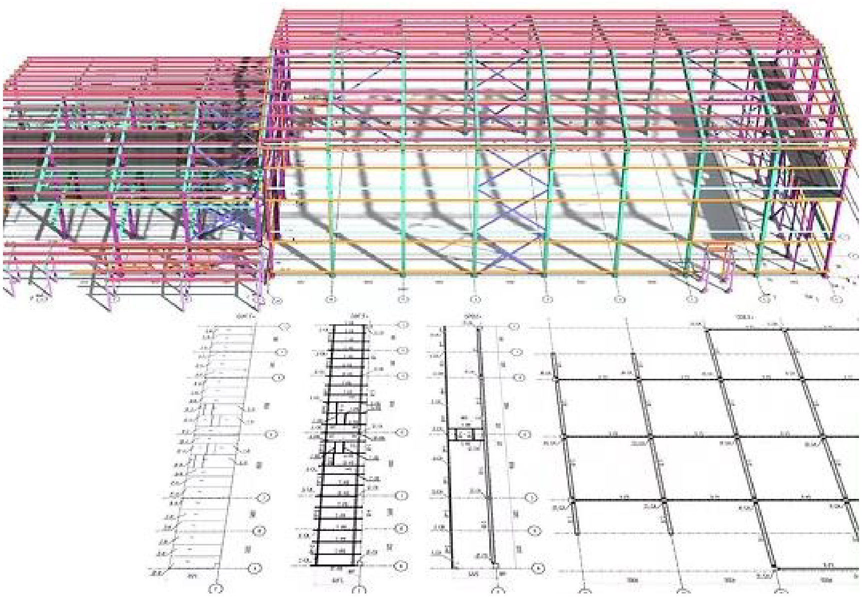

Fig. 4.1.2 Drawing and symbols

- **Isometric Drawing:** A three-dimensional representation of an object that shows all three axes in a single view.
- **Orthographic Projection:** A two-dimensional representation of an object with multiple views (front, top, side, etc.) to provide detailed information.
- **Welding Symbol:** A graphical symbol on a drawing that indicates the type, location, and dimensions of welds to be used.
- **Surface Finish Symbol:** A symbol that specifies the required surface finish on a metal component.
- **Dimension Lines:** Lines on a drawing that indicate the size or length of a feature.
- **Arrowheads:** Symbols used to indicate the direction or extent of a dimension or tolerance.
- **Bill of Materials (BOM):** A list of all the materials and components needed for a fabrication project.
- **Cutting Symbol:** A symbol that indicates where material should be cut or removed.
- **Welding Process Symbol:** A symbol that specifies the welding process to be used, such as arc welding or gas welding.
- **Surface Roughness Symbol:** A symbol that defines the surface texture or roughness required for a component.

Understanding these terminologies, drawings, and symbols is essential for fabricators, welders, and anyone involved in the fabrication process to ensure precision, quality, and adherence to project specifications.

4.1.2 Parts and Components of Welding Equipment and their Functions

In the context of fabrication in construction, it's important to understand the various parts and components of welding equipment and their functions. Welding equipment is crucial for joining metal components in construction projects.

Here are the key parts and components of welding equipment and their functions:

1. **Welding Power Source:**
   - **Function:** Provides the electrical power required for the welding process.
   - **Types:** Transformer, inverter, engine-driven, and resistance welding power sources.
2. **Electrode Holder (or Welding Torch):**
   - **Function:** Holds the welding electrode (rod or wire) and conducts the electrical current to create the welding arc.
   - **Types:** Manual electrode holder, MIG gun, TIG torch.

Fig. 4.1.3 Electrode holder

3. Ground Clamp (or Work Clamp):
   - Function: Provides a connection between the workpiece and the welding power source to complete the electrical circuit.

Fig. 4.1.4 Ground clamp

4. Welding Electrode (or Filler Material):
   - Function: The consumable material that is melted to form the weld joint.
   - Types: Electrodes vary depending on the welding process, such as stick electrodes for SMAW,

wire for MIG welding, and tungsten for TIG welding.

Fig. 4.1.5 Welding electrode

5. **Shielding Gas (for MIG and TIG):**
    - Function: Protects the weld area from atmospheric contamination by creating a stable environment during welding.
    - Types: Argon, CO2, helium, or a mixture, depending on the welding process and material being welded.
6. **Welding Cables:**
   Function: Conducts electrical current from the power source to the electrode holder and ground clamp.
7. **Welding Helmet (or Welding Mask):**
   Function: Protects the welder's eyes and face from intense light, sparks, and UV radiation generated during welding.

Fig. 4.1.6 Welding helmet

8. Welding Gloves and Protective Clothing:
   Function: Protects the welder from heat, sparks, and molten metal during welding.

Fig. 4.1.7 Welding gloves

9. Welding Table or Workbench:
   Function: Provides a stable and secure surface for positioning and welding workpieces.

Fig. 4.1.8 Welding table

10. **Welding Curtains/Screen:**
    Function: Used to isolate the welding area and protect others from welding hazards like sparks and UV radiation.

11. Gas Regulator (for gas welding):

Function: Controls the flow of shielding gas to the welding torch in gas welding processes.

Fig. 4.1.9 Gas regulator

12. **Wire Feeder (for MIG welding):**

    Function: Supplies the welding wire from a spool to the welding torch at a consistent rate.

13. **Foot Pedal or Remote Control (for TIG welding):**

    Function: Allows the welder to control the welding current and heat input while welding.

14. **Cooling System (for high-amperage applications):**

    Function: Prevents overheating of welding equipment, such as water-cooled torches or coolers for TIG welding.

15. **Welding Machine Cart or Trolley:**

    Function: Provides mobility for the welding equipment, making it easier to move around the construction site.

Fig. 4.1.10 Welding machine cart

Understanding these parts and components, as well as their functions, is essential for welders and fabricators in construction to ensure safe and effective welding operations, which are crucial for the structural integrity of buildings and infrastructure projects.

4.1.3 Welding and Bolting Methods and their Applications

Welding:

- Description: Welding is a process of joining two or more metal pieces by melting them at the joint and allowing them to cool and fuse together. It creates a strong and permanent bond.

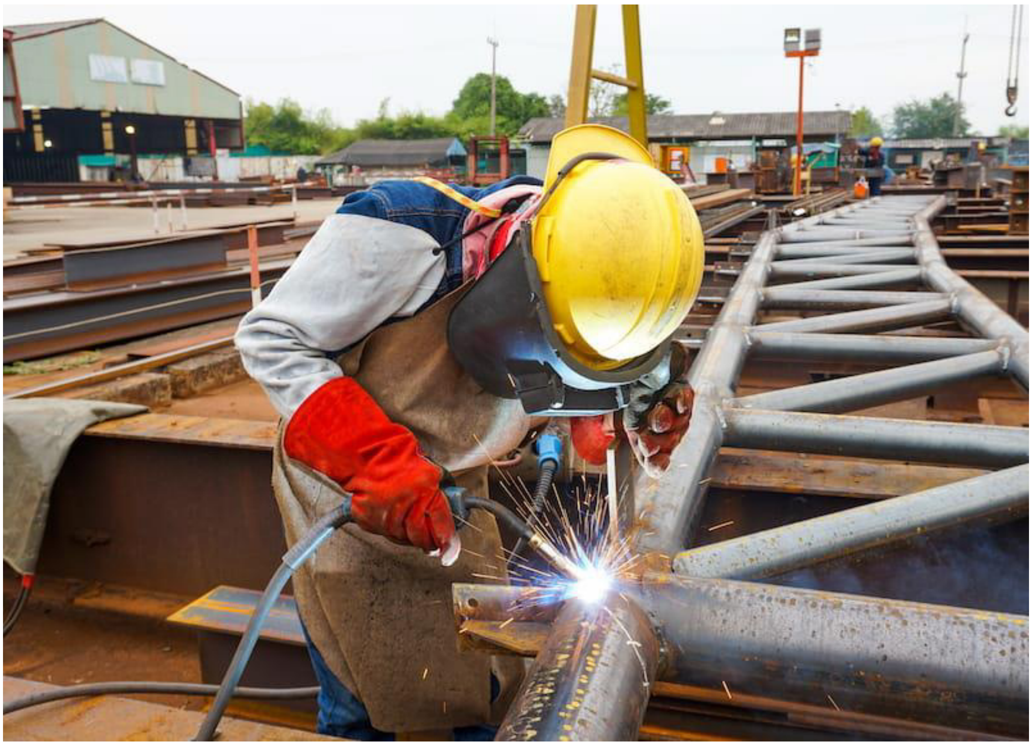

Fig. 4.1.11 Welding method

- **Applications in Construction:**
  - **Structural Steel Fabrication:** Used to join steel beams, columns, and other structural components in buildings and bridges.
  - **Pipeline Construction:** Welding is essential for joining pipes in plumbing and gas distribution systems.
  - **Metal Fabrication:** Used for manufacturing various metal components and equipment.
  - Repair Work: Welding is often employed to repair damaged metal structures.

Bolting:

- Description: Bolting involves fastening two or more components together using bolts, nuts, and washers. It creates a secure, removable connection.

Fig. 4.1.12 Bolting method

- **Applications in Construction:**
    - **Steel Frame Construction:** Bolting is common in the assembly of steel frames for commercial and industrial buildings.
    - **Wooden Structures:** Bolts are used to join wooden beams and columns in residential and light commercial construction.
    - **Mechanical Equipment:** Bolting is used to assemble machinery and equipment on construction sites.
    - **Temporary Structures:** Bolting is ideal for assembling temporary structures like scaffolding.

Both welding and bolting play essential roles in construction, and the choice between them depends on factors such as the type of materials being joined, the structural requirements, and whether the connection needs to be permanent or removable.

4.1.4 Different Welding Parameters and their Correlations

Welding parameters are critical variables that influence the quality, strength, and integrity of welded joints in various applications, including construction.

Fig. 4.1.13 Welding in fabrication process

Understanding the relationships between these parameters is essential for welders to produce reliable and structurally sound welds.

Below are the different welding parameters and their correlations in the context of fabrication in construction

Welding Parameter	Description	Correlations in Construction
Voltage	Voltage in welding refers to the electrical potential difference between the welding electrode and the workpiece.	• Joint Penetration: Higher voltage can lead to deeper penetration, which is crucial for thicker materials in structural welding. • Heat Input: Voltage affects the heat generated during welding. Controlling voltage helps manage heat input, critical for avoiding distortion in structural components.
Current	Current represents the flow of electricity during welding, measured in amperes (A).	• Welding Speed: Higher current levels allow for faster welding speeds, important in construction for efficiency. • Penetration Depth: Increased current can lead to greater penetration, useful when joining heavy structural elements.

Polarity	Polarity refers to the direction of current flow, which can be direct current (DC) or alternating current (AC).	• Electrode Selection: Polarity affects the choice of welding electrodes. DC electrode positive (DCEP) is often used for construction welding with certain electrode types. • Arc Stability: Proper polarity selection contributes to stable arc formation, important for consistent weld quality.
Arc Length	Arc length is the distance between the tip of the welding electrode and the workpiece.	• Control of Weld Bead: Maintaining a consistent arc length helps control the size and shape of the weld bead. • Avoiding Arc Flare: Correct arc length prevents the electrode from sticking to the workpiece, reducing downtime in construction projects.
Travel Speed	Travel speed is the rate at which the welder moves the electrode along the joint.	• Heat Input Control: Adjusting travel speed helps manage heat input, which is crucial for preventing distortion in structural components. • Weld Quality: Proper travel speed ensures the desired weld bead shape and quality, important for structural integrity.
Electrode Type	Electrode type refers to the composition and coating of the welding electrode.	• Material Compatibility: The choice of electrode type must match the base metal being welded, ensuring compatibility in construction projects. • Weld Quality: Different electrode types produce varying weld characteristics, affecting joint strength and integrity.
Shielding Gas	Shielding gas is used in some welding processes (e.g., MIG and TIG) to protect the weld area from atmospheric contamination.	• Weld Quality: Proper selection of shielding gas is critical for achieving clean and defect-free welds in construction. • Material Compatibility: The type of shielding gas must be compatible with the welding process and materials being used.

Table 4.1.1 Welding parameter and correlation in construction

4.1.5 Positions and Patterns of Welding

Welding positions and patterns are fundamental aspects of welding techniques employed in construction projects.

Welders must have a solid grasp of these positions and patterns, as they significantly influence the quality and integrity of welded joints in various structural components.

Below is the different positions and patterns of welding:

Welding Position	Description	Applications in Construction
Flat Position	In the flat position, the weld is performed on the upper side of the joint, and gravity helps hold the molten metal in place.	• Horizontal Fillet Welds: Common in the construction of buildings and bridges, especially for connecting steel plates and beams. • Plate Welding: Used for joining flat steel plates in various construction components. • Pipe Welding: Suitable for welding pipes when they are in a horizontal orientation.
Horizontal Position	In the horizontal position, the weld is made along the joint, and the molten metal flows slightly downward due to gravity.	• Horizontal Groove Welds: Used for welding joints in structural steel components where the joint is oriented horizontally. • Pipeline Construction: Relevant for welding pipe joints when the pipes are positioned horizontally.
Vertical Position	In the vertical position, the weld is performed from bottom to top, and the molten metal requires more control to prevent sagging or spattering.	• Vertical Groove Welds: Important for welding vertical joints in steel structures. • Column Fabrication: Used to join column sections in construction projects.
Overhead Position	In the overhead position, the weld is made against gravity, and molten metal tends to flow downward. It demands precise control to prevent drips.	• **Ceiling Welds:** Necessary for welding structural components on the ceiling or upper portions of construction projects. • Pipe Welding: Relevant when welding pipes positioned overhead.

Table 4.1.2 Welding positions

Welding Pattern	Description	Applications in Construction
Stringer Bead	The stringer bead is a straight-line welding pattern where the electrode moves in a straight path along the joint.	• **Tack Welding:** Commonly used for tack welds to temporarily hold components in position before full welding. • **Root Pass:** Often used for the root pass in groove welds to ensure proper penetration and alignment.
Weave Bead	The weave bead involves a side-to-side motion of the electrode while moving forward along the joint. It creates a wider weld bead.	• **Filler Welds:** Applied to fill in the groove and create a wider, stronger weld for structural components. • **Multi-Pass Welding:** Used for multiple passes over a groove weld to build up the required weld size.
Circular Bead	The circular bead pattern involves moving the electrode in a circular or semi-circular motion, creating a round or semi-circular weld bead.	• **Pipe Welding:** Commonly used for welding pipes, especially for root passes and filling in gaps in pipe joints. • **Joint Reinforcement:** Applied to reinforce circular joints and connections in construction.

Table 4.1.3 Welding patterns

4.1.6 Consumables used in Welding, their Selection, and Storage

Proper selection of welding consumables is essential to ensure the quality and integrity of welds in construction.

Additionally, the correct storage practices help prevent contamination and maintain the effectiveness of these consumables, ultimately contributing to the success of fabrication projects.

Welding Consumable	Description	Selection Criteria	Storage Guidelines
Electrodes	Electrodes are used in shielded metal arc welding (SMAW) and flux-cored arc welding (FCAW). They consist of a metal core with a flux coating that provides protection to the weld pool.	• **Electrode Type:** Select electrodes with the appropriate composition for the base metal being welded. • **Diameter:** Choose the electrode diameter based on the required welding current and joint thickness.	• Store electrodes in a dry environment to prevent moisture absorption, which can lead to hydrogen-induced cracking. • Use rod ovens or storage containers to maintain low humidity levels. • Keep electrodes off the ground and away from contaminants.

Welding Wire	Welding wire is used in gas metal arc welding (GMAW or MIG) and flux-cored arc welding (FCAW). It is a continuous wire electrode used with a welding gun.	• **Wire Type:** Select wire with the appropriate composition for the base metal and welding process (e.g., solid wire or flux-cored wire). • **Wire Diameter:** Choose the wire diameter based on the welding current and joint thickness.	• Store welding wire in a dry, temperature-controlled environment to prevent moisture absorption and rust. • Keep wire spools covered to protect them from dust and contaminants. • Use wire feeders to maintain consistent wire feeding and prevent kinks or tangles.
Shielding Gas	Shielding gases, such as argon, carbon dioxide, or a mixture, are used in gas tungsten arc welding (GTAW or TIG) and gas metal arc welding (GMAW or MIG) to protect the weld pool from atmospheric contamination.	• **Gas Type:** Choose the shielding gas based on the welding process and the material being welded. • **Flow Rate:** Set the appropriate gas flow rate to ensure effective shielding.	• Store gas cylinders in a well-ventilated, dry area away from direct sunlight and heat sources. • Secure cylinders to prevent tipping or falling. • Regularly inspect cylinders for leaks and damage.
Flux	Flux is used in submerged arc welding (SAW) and some types of FCAW. It is a granular or powder-like material that shields the weld pool and provides additional alloying elements.	• **Flux Type:** Select flux with the right composition for the base metal and welding process. • **Flux Grain Size:** Choose the appropriate grain size for the required weld appearance and penetration.	• Store flux in a dry location to prevent moisture absorption, which can cause porosity in welds. • Keep flux containers tightly sealed when not in use. • Use flux hoppers or feeders to control the flux flow during welding.

Table 4.1.4 Proper selection of welding consumables

4.1.7 Concept of Customisation of Jigs and Fixtures

The concept of customization of jigs and fixtures in fabrication for construction represents the practice of designing and adapting specialized tools to meet the unique requirements of each construction project.

These tools, often made of metal, wood, or other materials, play a crucial role in securing and positioning workpieces during welding, cutting, assembly, and other fabrication processes.

By tailoring these tools to fit specific tasks, construction fabricators can achieve higher precision, efficiency, and quality in their work, ultimately contributing to the successful completion of diverse construction projects.

Fig. 4.1.14 Jigs and fixtures in fabrication for construction

Key Aspects of Customization:

- **Geometry and Dimensions:** Customized jigs and fixtures are designed to precisely match the size, shape, and dimensions of the workpieces involved in the construction project. This ensures that components are securely held in the correct orientation, reducing the likelihood of errors and rework.
- **Flexibility and Versatility:** While customization provides specificity, it also allows for adaptability. Fabricators can design jigs and fixtures with adjustable features, enabling them to accommodate variations in workpiece sizes and configurations.
- **Accuracy and Alignment:** The primary objective of customization is to achieve high levels of accuracy and alignment during fabrication processes. Custom jigs and fixtures enable consistent positioning, reducing the risk of weld defects, misalignments, or inaccuracies in the final product.
- **Efficiency and Productivity:** Tailored tools optimize fabrication efficiency by streamlining processes. Workers can work more quickly and with greater confidence when using fixtures that are precisely suited to the task, ultimately reducing production time and costs.
- **Quality Control:** Customized fixtures often incorporate features for quality control, such as alignment indicators, measuring gauges, or inspection points. This ensures that fabricated

components meet the required standards and specifications.

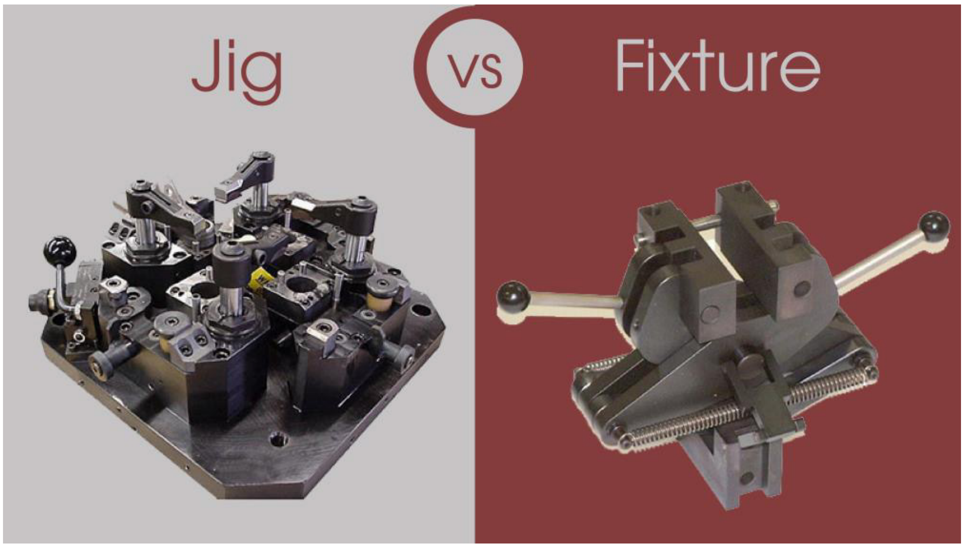

Fig. 4.1.15 Jig and fixture in fabrication

Applications in Construction Fabrication:

Customization of jigs and fixtures finds widespread applications in construction fabrication, including:

- **Structural Steel Fabrication:** Customized fixtures are crucial for aligning and securing steel beams, columns, and other structural components during welding and assembly in construction projects.
- **Pipe Fabrication:** In pipeline construction, custom fixtures are used to position and secure pipes for accurate welding, ensuring precise alignment and joint quality.
- **Sheet Metal Work:** Custom jigs and fixtures assist in shaping and cutting sheet metal for architectural and structural applications, maintaining precision in the process.
- **Welding and Assembly:** Customized tooling is essential for the precise alignment of various components, including brackets, connectors, and joints, in construction projects, contributing to the overall structural integrity.

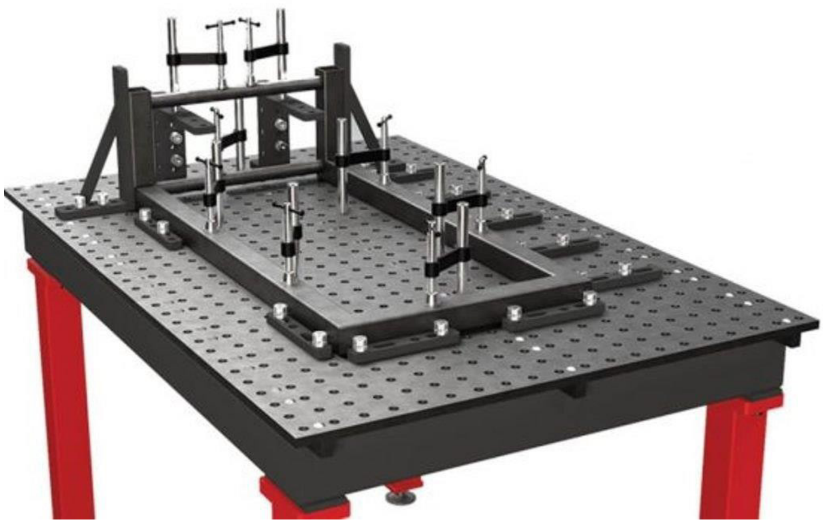

Fig. 4.1.16 Welding and assembly

In essence, the concept of customization of jigs and fixtures in construction fabrication serves as a cornerstone for achieving high-quality, efficient, and precise assembly of structural and architectural elements, ultimately ensuring the success and safety of construction projects.

4.1.8 Procedures involved in Edge/Joint Preparation during the Fabrication of a Steel Structure

The preparation of edges and joints is a critical step in the fabrication of steel structures. Proper edge and joint preparation ensures that the welded connections are strong, durable, and meet structural requirements.

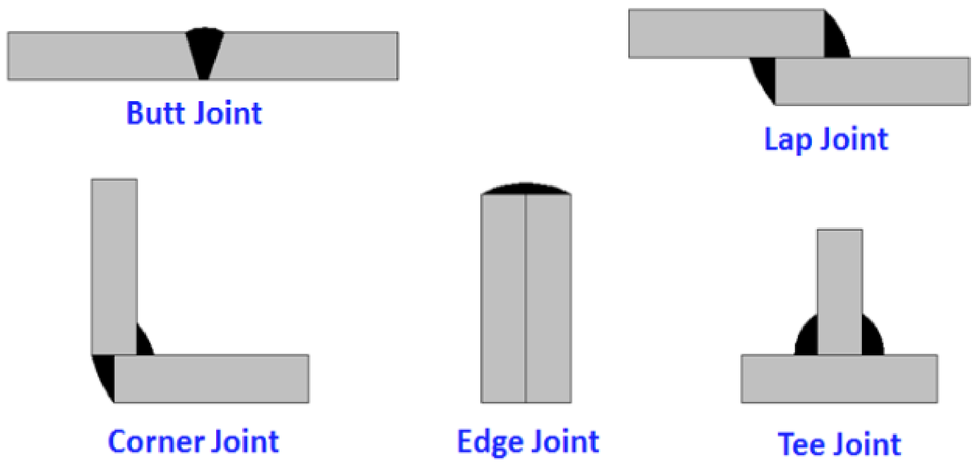

Fig. 4.1.17 Preparation of edges and joints

Here are the key procedures involved in edge/joint preparation during the fabrication of a steel structure:

1. **Material Selection and Inspection:**
   - Choose the appropriate steel material based on project specifications, including type, grade, and thickness.
   - Inspect the steel for any defects, such as cracks, corrosion, or surface contaminants, and address them before proceeding.
2. **Layout and Marking:**
   - Use layout tools and measurements to mark the location of the joints and edges on the steel components.
   - Ensure accurate positioning and alignment of the components based on construction drawings and plans.
3. **Cutting and Shaping:**
   - Employ cutting techniques like shearing, sawing, or thermal cutting (e.g., oxy-fuel or plasma

cutting) to trim the steel to the required size and shape.

- Achieve precise angles, bevels, and contours as specified in the design.

4. **Edge Preparation:**

- Depending on the welding process and joint type, prepare the edges of the steel components. Common edge preparations include:
    - **Bevelling:** Creating an angled edge on the steel to facilitate full penetration welds, commonly used for butt joints.
    - **J-groove or U-groove:** Creating a J or U-shaped groove to enhance weld penetration and strength.
    - **V-groove:** Forming a V-shaped groove for thicker materials or high-stress areas.
- Remove any sharp edges, burrs, or irregularities to ensure smooth and clean surfaces for welding.

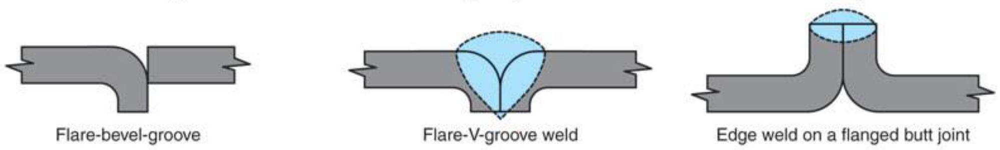

Fig. 4.1.18 Welding joint type

5. **Cleaning and Surface Preparation:**

- Thoroughly clean the prepared edges and surfaces to remove rust, scale, dirt, and contaminants using wire brushes, grinders, or abrasive materials.
- Apply an appropriate pre-weld cleaning method, such as mechanical cleaning or chemical cleaning, to achieve a surface suitable for welding.

6. **Fit-Up and Alignment:**

- Ensure precise fit-up and alignment of the components to be joined, maintaining the specified gap and orientation.
- Use jigs, fixtures, clamps, or tack welds to hold the components securely in place during welding.

7. **Welding Procedure:**

- Follow the approved welding procedure specifications (WPS) for the specific joint and welding process.

- Apply the appropriate welding method, such as shielded metal arc welding (SMAW), gas metal arc welding (GMAW), or submerged arc welding (SAW), as per project requirements.

Fig. 4.1.19 Welding procedure

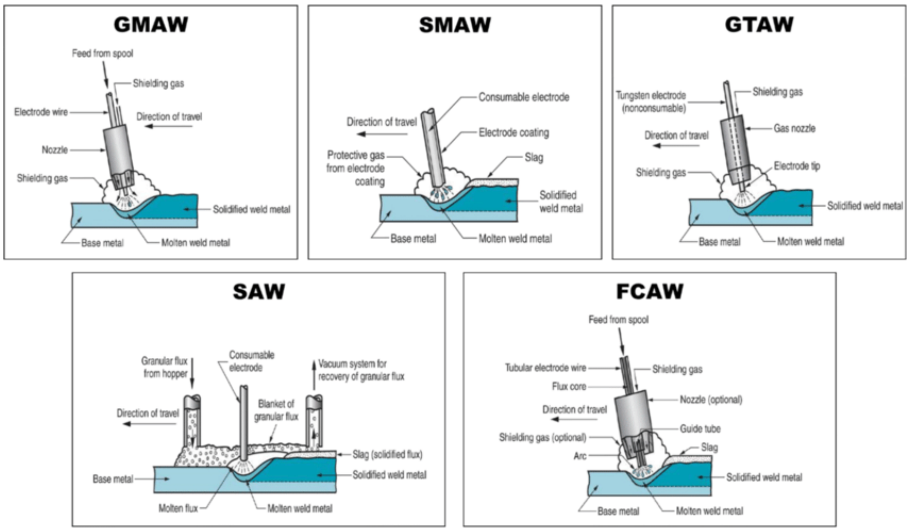

Fig. 4.1.20 Welding methods

8. **Quality Control and Inspection:**

   - Inspect the welded joint for weld defects like porosity, cracks, incomplete fusion, and under-cut.
   - Use non-destructive testing (NDT) methods, such as radiographic testing or ultrasonic testing, to assess the quality of the weld.

Fig. 4.1.21 Non-destructive testing (NDT)

9. **Post-Weld Treatment:**
   - Depending on the project's requirements, conduct post-weld treatments like stress relieving or heat treatment to reduce residual stresses and improve weld properties.
10. **Finish and Coating:**
    - After completing welding and inspections, apply the necessary finish or protective coatings to prevent corrosion and enhance the appearance of the steel structure.

Proper edge and joint preparation are essential for ensuring the structural integrity and longevity of steel structures in construction projects. Adhering to industry standards and best practices at each step of the process is crucial to achieving high-quality welds and reliable connections.

4.1.9 Interpret Fabrication Blueprints/Shop Drawings and Specifications for details required for Edge/Joint Preparation

Understanding fabrication blueprints and specifications is crucial in construction to ensure proper edge and joint preparation.

Here's how to interpret these documents:

1. **Blueprint Review:**
   - **Identify Relevant Sections:** Begin by identifying the blueprint sections or drawings that pertain to the specific components requiring edge and joint preparation. These sections often include details about welding, connections, and joints.
   - **Focus on Welding Symbols:** Pay close attention to welding symbols, which indicate the type

of joint, weld size, and preparation requirements. Symbols like "V," "J," or "U" indicate the required groove shape, while dimensions specify the size of the groove.

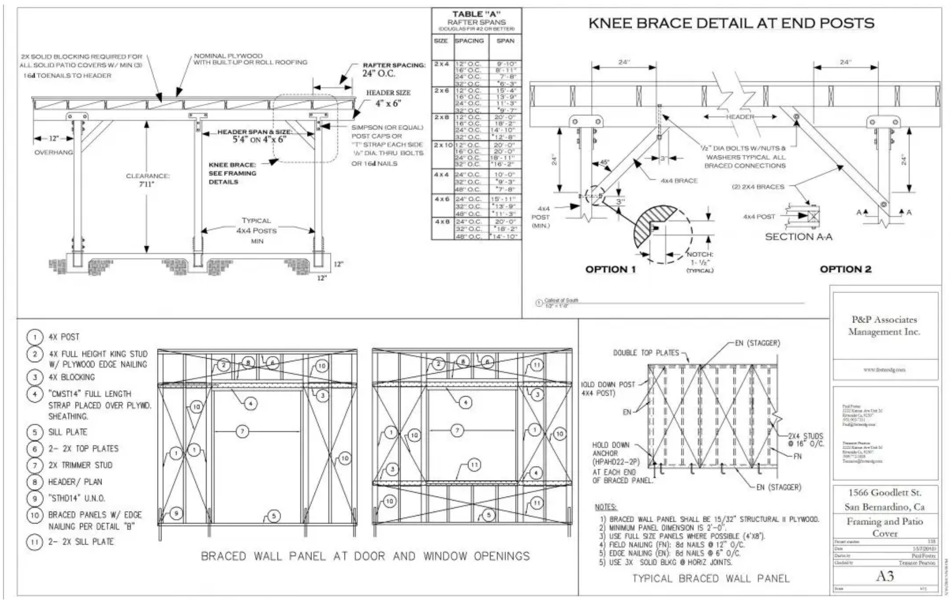

Fig. 4.1.22 Blueprint review

2. **Specification Examination:**

   - **Material Specifications:** Check the specifications for the type and grade of steel material being used. This information helps determine the appropriate welding procedures and edge preparations required for that material.

   - **Welding Procedure Specifications (WPS):** Review the WPS to understand the approved welding methods, parameters, and edge preparation details. The WPS provides essential guidance on joint configurations and welding techniques.

   - **Preparation Details:** Look for specific instructions related to edge and joint preparation. This may include details on bevel angles, groove dimensions, root gaps, and the desired quality of the weld.

3. **Joint Type and Design:**

   - Determine the type of joint specified in the blueprint, such as butt joints, lap joints, or fillet joints. Different joint types require varying degrees of edge preparation.

   - Assess the joint design, including whether it's a single-V, double-V, or other configuration. The blueprint should indicate the precise geometry of the joint and groove angles.

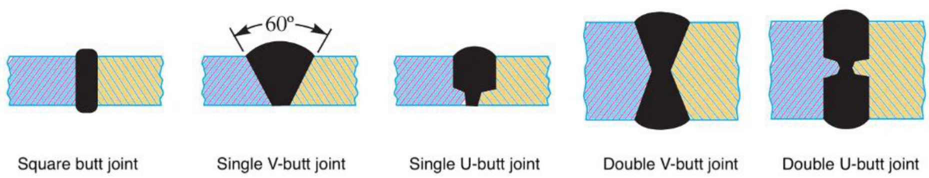

Fig. 4.1.23 Joint type and design

4. **Welding Symbols:**

   - Pay attention to welding symbols on the blueprint. These symbols often include additional information like weld size, welding processes, and any special requirements, such as back gouging or post-weld heat treatment.

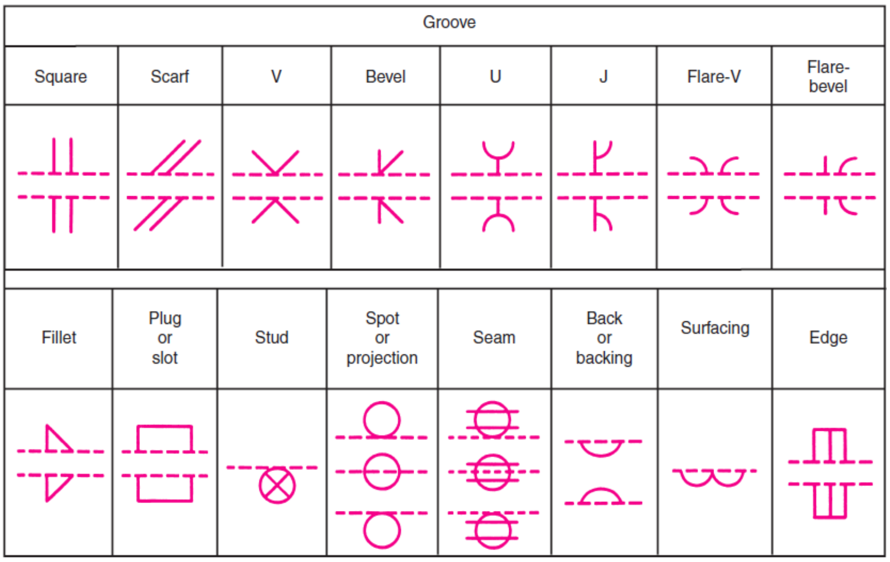

Fig. 4.1.24 Welding symbols

5. **Tolerances and Dimensions:**

   - Review the blueprint for tolerances and dimensions related to the edge and joint preparation. Ensure that the components are within the specified size and alignment requirements.

6. **Notes and Callouts:**

   - Check for notes, callouts, or special instructions related to edge preparation. These may provide further guidance on specific tasks, such as removing mill scale or ensuring a particular surface finish.

7. **Consult with Engineers or Supervisors:**

   - If any details are unclear or if there are conflicting instructions, consult with engineers, supervisors, or project managers for clarification. It's essential to ensure that edge and joint preparation align with the project's structural requirements and safety standards.

Fig. 4.1.25 Consult with engineer or supervisor

8. **Document and Record:**

   - Document the edge and joint preparation details from the blueprint and specifications. This documentation is crucial for tracking compliance and quality control throughout the fabrication process.

Interpreting fabrication blueprints and specifications accurately is a fundamental aspect of successful construction fabrication. By following these steps, fabricators can ensure that edge and joint preparation align with project requirements, leading to high-quality welds and reliable structural connections.

Notes

QR Codes

Scan the QR code to watch the video

https://youtu.be/B4jqkbKqS0s

Welding Fabrication Basics

UNIT 4.2: Fabrication Bed and Equipment Preparation

Unit Objectives

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

1. Explain requirements for preparation of fabrication bed/platform.
2. Demonstrate clamping and anchoring of the sections/work piece to the platform/bed as per standard practices.
3. Prepare a sample estimate of the quantities of consumables, tools, and equipment required for edge/joint preparation.
4. Demonstrate the methods to measure and mark the sections for edge preparation as per provided technical details and standard procedures.
5. Demonstrate the process of edge preparation of a work piece/section as per requirements.
6. Demonstrate welding/bolting method to connect two components/assemblies as per drawings and specifications.
7. Inspect the proposed component/assemblies for distortions, change in dimensions, or other defects.

4.2.1 Requirements for the Preparation of Fabrication Bed /Platform in Construction

In construction and fabrication, the preparation of a suitable bed or platform is a fundamental step that sets the foundation for the entire fabrication process. This critical groundwork involves creating a stable, level, and secure surface on which various components and structures will be assembled and fabricated.

Fig. 4.2.1 Preparation of fabrication bed/platform in construction

Proper preparation ensures precision, safety, and efficiency in the construction and fabrication of a wide range of projects, from structural steel assemblies to intricate metalwork and welding tasks.

To ensure a solid foundation for the fabrication process in construction, certain requirements must be met when preparing the fabrication bed or platform:

1. **Adequate Space and Layout:**
   - Ensure that the fabrication area provides ample space for manoeuvring and assembly of large components.
   - Designate clear pathways for material handling, equipment movement, and worker access to prevent congestion.
2. **Load-Bearing Capacity:**
   - Determine the maximum weight and size of the components to be fabricated and ensure that the bed/platform has the necessary load-bearing capacity to support them.
   - Verify that the bed/platform is designed to distribute loads evenly and prevent overloading.
3. **Level and Flat Surface:**
   - The bed/platform must be level and flat to prevent distortion or misalignment of fabricated components.
   - Use levelling equipment and precision measurements to achieve the desired flatness.
4. **Material Compatibility:**
   - Ensure that the material used for the bed/platform construction is compatible with the welding and fabrication processes to prevent contamination or adverse reactions.
   - Common materials include steel, concrete, or composite materials.
5. **Secure Anchoring:**
   - Securely anchor the bed/platform to the foundation to prevent movement or shifting during fabrication.
   - Proper anchoring enhances stability and safety during welding and assembly.
6. **Adequate Ventilation and Safety Measures:**
   - Implement adequate ventilation to disperse welding fumes and maintain a safe working environment.
   - Install safety features like guardrails, handrails, and non-slip surfaces to protect workers.

Fig. 4.2.2 Ventilation and safety measures

7. **Accessibility to Utilities:**

   - Ensure that the fabrication bed/platform is conveniently located near utilities such as power sources, welding equipment, compressed air, and water supply for cooling and cleaning processes.

8. **Compatibility with Lifting Equipment:**

   - If overhead lifting equipment (cranes or hoists) is required, ensure that the bed/platform is designed to accommodate these tools safely and efficiently.

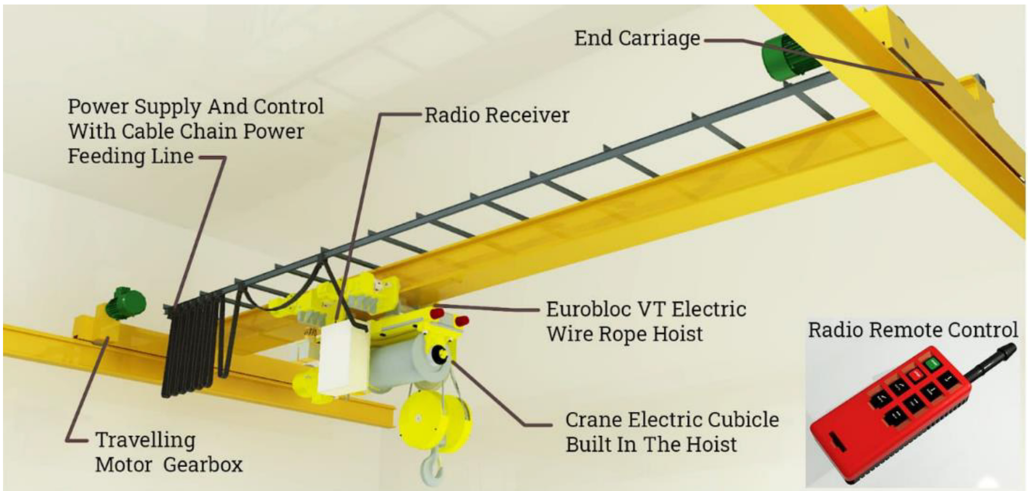

Fig. 4.2.3 Overhead lifting equipment (hoist)

9. **Environmental Considerations**:

   - Assess environmental factors like weather conditions and exposure to the elements. Implement protective measures if the fabrication bed/platform is located outdoors.

10. **Compliance with Regulations:**
    - Comply with local building codes, safety regulations, and industry standards to ensure the bed/platform's structural integrity and safety.
11. **Maintenance Plan:**
    - Develop a maintenance plan to inspect and maintain the fabrication bed/platform regularly. This includes checking for wear and tear, addressing any damage promptly, and keeping the surface clean and free from debris.
12. **Safety Training:**
    - Provide safety training to personnel working on or around the fabrication bed/platform, emphasizing safe practices and hazard awareness.
13. **Documentation and Records:**
    - Maintain detailed records of bed/platform construction, inspections, maintenance, and safety protocols to ensure accountability and traceability.

A well-prepared fabrication bed/platform forms the foundation for safe and efficient construction fabrication processes. Meeting these requirements ensures that the fabrication environment is conducive to producing high-quality components while safeguarding the well-being of workers and the structural integrity of the project.

4.2.2 Demonstrating Clamping and Anchoring of Sections/ Workpieces to the Fabrication Platform/Bed

Properly securing workpieces during construction fabrication is essential for accurate and safe assembly. To secure workpieces effectively during fabrication in construction, follow these steps to demonstrate clamping and anchoring as per standard practices:

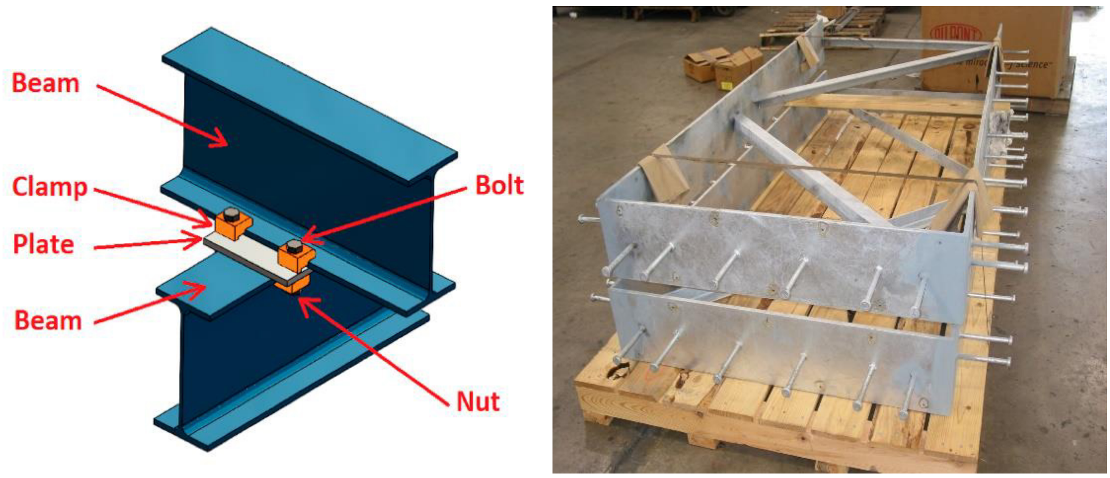

Fig. 4.2.4 Clamping and anchoring

1. **Assessment of Workpiece and Platform Compatibility:**
    - Begin by assessing the workpiece's size, weight, and shape, as well as the fabrication platform/bed's design and load-bearing capacity.
    - Ensure that the platform is clean, level, and prepared for anchoring.
2. **Selecting Appropriate Clamping and Anchoring Equipment:**
    - Choose the right clamps, fixtures, and anchor points based on the workpiece's dimensions and geometry.
    - Verify that the selected equipment can securely hold the workpiece in the desired position.
3. **Positioning the Workpiece:**
    - Carefully position the workpiece on the fabrication platform, aligning it with the intended fabrication marks and dimensions.
    - Ensure that the workpiece is centered and level for accurate assembly.
4. **Clamping:**
    - Use clamps or fixtures designed for the specific task to hold the workpiece in place.
    - Apply clamps evenly along the edges or critical points of the workpiece to distribute clamping forces uniformly.
5. **Tacking or Tack Welding:**
    - In some cases, tack welds may be used to temporarily secure the workpiece to prevent movement during final welding.
    - Apply tack welds at strategic points, ensuring they are strong enough to hold but easy to remove later.
6. **Verification and Alignment Checks:**
    - Verify the alignment and positioning of the workpiece by using measuring tools, levels, and alignment gauges.
    - Adjust the clamps or fixtures as needed to achieve the correct orientation and dimensions.
7. **Anchor Points Installation:**
    - Locate suitable anchor points on the fabrication platform/bed, ensuring they are securely anchored to the foundation or structure.
    - Anchor points may include bolts, anchors, or other fastening devices designed for heavy-duty applications.
8. **Anchoring the Workpiece:**
    - Securely anchor the workpiece to the fabrication platform/bed using the selected anchor points.
    - Apply the necessary torque or tension to ensure a tight and stable connection.
9. **Secondary Clamping and Support:**
    - Depending on the complexity of the workpiece and the welding process, consider adding secondary clamps or support structures to prevent distortion or movement during welding.

10. **Welding and Assembly:**

    - Once the workpiece is securely clamped and anchored, proceed with the welding and assembly processes as specified in the fabrication plans and welding procedures.

11. **Inspection and Quality Control:**

    - After welding, inspect the welds and joints for quality, ensuring they meet the required standards and specifications.

12. **Removal of Clamps and Anchors:**

    - Carefully remove clamps, fixtures, and tack welds as needed, taking care not to damage the workpiece or the platform/bed.

13. **Documentation:**

    - Maintain records of the clamping and anchoring process, including details of equipment used, torque values, and inspection results.

Demonstrating proper clamping and anchoring techniques is crucial to ensure the accuracy, stability, and safety of the fabrication process in construction. Following standard practices and guidelines helps achieve high-quality welds and reliable structural connections.

4.2.3Estimation of the Quantities of Consumables, Tools, and Equipment required for Edge/Joint Preparation

Estimating the quantities of consumables, tools, and equipment needed for edge/joint preparation is vital to ensure a smooth fabrication process.

This involves careful planning and consideration of various factors.

Here is a step-by-step guide on how to perform this estimation:

1. **Review Project Specifications:**

    - Begin by thoroughly reviewing the project specifications, construction drawings, and welding procedure specifications (WPS). These documents will provide essential details about the joint type, material, thickness, and welding process.

2. **Understand Joint Requirements:**

    - Identify the type of joint to be prepared (e.g., butt joint, lap joint, T-joint) and the required joint configuration (e.g., single-V groove, double-V groove).

    - Determine any specific requirements for edge preparation, including bevel angle, groove dimensions, and root gap.

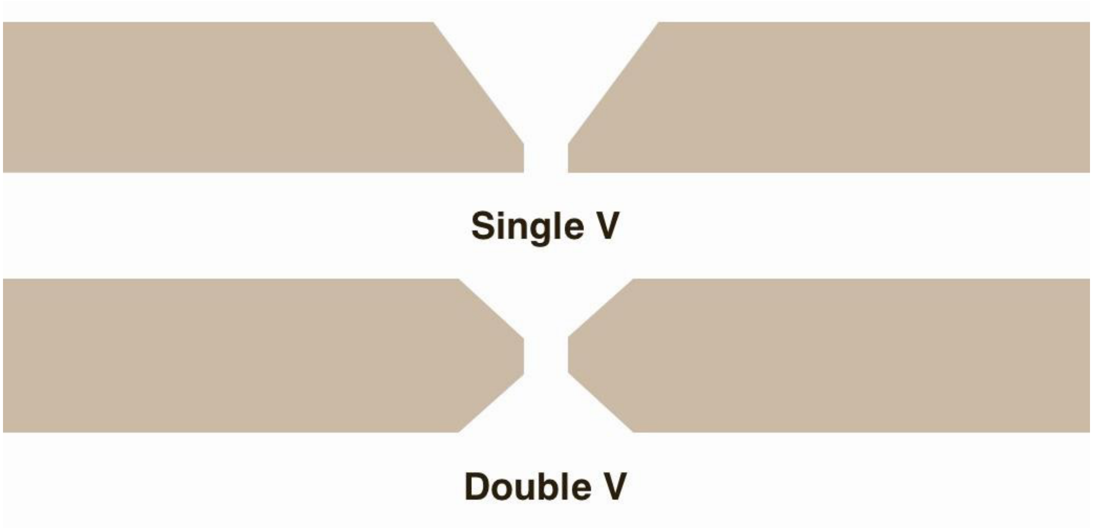

Fig. 4.2.4 Clamping and anchoring

3. **Calculate Material Quantities:**
   - Calculate the quantity of steel material to be prepared based on the project's design. This includes the length, width, and thickness of the components that require edge/joint preparation.
4. **Estimate Consumables:**
   - Select the appropriate welding consumables (electrodes, flux-cored wire, shielding gas) based on the welding process specified in the WPS.
   - Estimate the quantity of consumables required per meter or per joint, considering factors like weld size, deposition rate, and any wastage (typically 5-10%).

Fig. 4.2.6 Welding consumables

5. **List Tools and Equipment:**
   - Identify the necessary tools and equipment for edge/joint preparation. This includes angle grinders, cutting torches, magnetic base drills, clamps, measuring tools, and safety equipment.

- Determine the quantity of each tool or equipment item required based on the project's size and complexity.

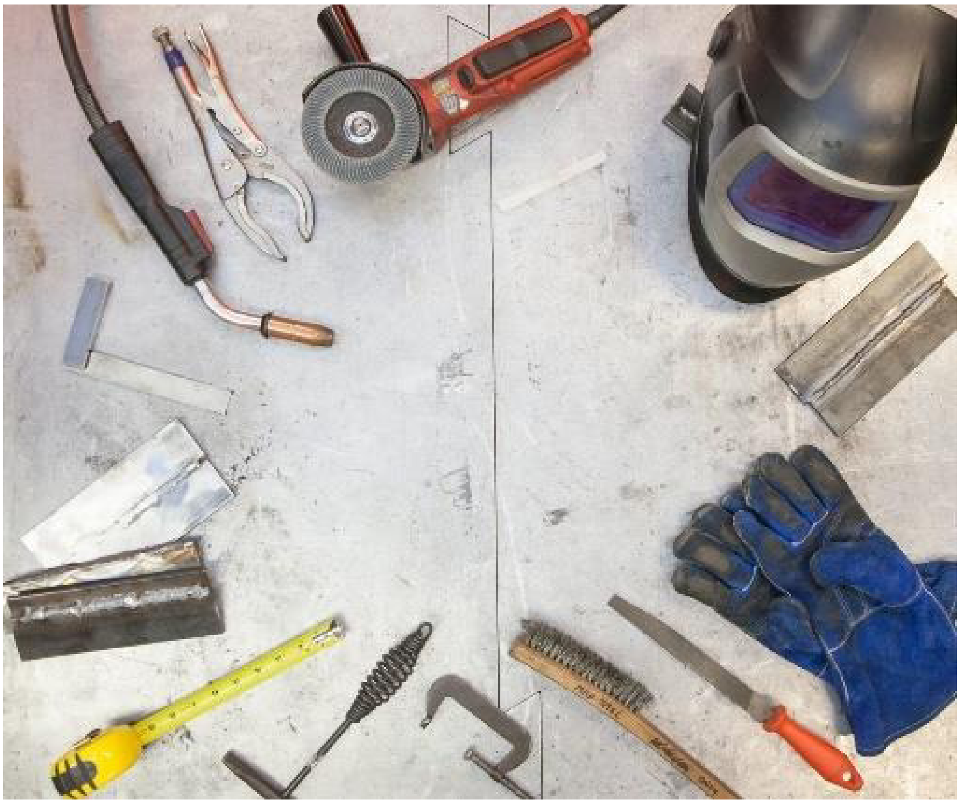

Fig. 4.2.7 Tools for edge/joint preparation

6. Consider Redundancy:
   - Account for redundancy in tools and consumables. Having backup tools and extra consumables on hand is essential to prevent delays due to equipment breakdowns or unexpected needs.
7. Consult Welding Procedures:
   - Refer to the WPS to understand the recommended or required consumable specifications, such as electrode diameter or flux-cored wire type.
   - Ensure that the selected consumables match the welding process and are suitable for the material being used.
8. Factor in Safety Equipment:
   - Include personal protective equipment (PPE) for welders, such as welding helmets, gloves, safety glasses, and flame-resistant clothing.
   - Calculate the quantity of PPE needed for the welding team.

Fig. 4.2.8 PPE for welders

9. **Create a Detailed List:**
   - Create a comprehensive list that includes all consumables, tools, and equipment, along with their estimated quantities.
   - Organize the list by category for clarity and ease of procurement.
10. **Review and Validate:**
    - Have the list reviewed by experienced welders or fabrication supervisors to ensure that all necessary items have been considered.
    - Validate the estimates against similar past projects if available.
11. **Adjust for Contingencies:**
    - Include a contingency factor (e.g., 10%) to account for unexpected changes, additional requirements, or unforeseen circumstances during the fabrication process.
12. **Procurement and Monitoring:**
    - Procure the estimated consumables, tools, and equipment in advance of the fabrication work.
    - Continuously monitor and manage inventory throughout the project to ensure that supplies are adequate and replacements are ordered as needed.

Fig. 4.2.9 Monitor and manage inventory throughout the project

13. Documentation:

    - Maintain accurate records of all consumables, tools, and equipment used during the fabrication process to track consumption and manage costs effectively.

By following this systematic approach, you can estimate the quantities of consumables, tools, and equipment required for edge/joint preparation accurately, ensuring a smooth and efficient construction fabrication process.

4.2.4 Prepare a Sample Estimate of the Quantities of Consumables, Tools, and Equipment required for Edge/ Joint Preparation

Here's a sample estimate:

Project Details:

- **Construction Project:** Steel Structural Fabrication
- **Type of Joint:** Single-V groove butt joint
- **Material:** Mild Steel (ASTM A36)
- **Thickness:** 10 mm

Consumables:

1. **Welding Electrodes:**
   - **Electrode Type:** E6013
   - **Estimated Quantity:** 30 kg (based on 5% wastage)
2. **Flux-Cored Wire (for Submerged Arc Welding, if applicable):**
   - **Wire Type:** E71T-1
   - **Estimated Quantity:** 25 kg (based on 5% wastage)

Tools and Equipment:

3. **Angle Grinder:**
   - **Quantity:** 2
   - **Purpose:** Grinding and bevelling edges
   - **Accessories:** Grinding discs, wire brushes
4. **Oxy-Fuel Cutting Torch:**
   - **Quantity: 1**
   - **Purpose:** Cutting steel plates to size and shape
5. **Magnetic Base Drill:**
   - **Quantity:** 1
   - **Purpose:** Drilling holes for temporary fasteners or anchors
6. **Clamps and Fixtures:**
   - C-clamps, quick clamps, and welding fixtures for securing workpieces during edge preparation
7. **Grinding and Bevelling Jigs:**
   - Custom jigs designed for maintaining precise bevel angles
8. **Measuring and Layout Tools:**
   - Steel rules, squares, protractors, and chalk lines for accurate measurements and layout marking
9. **Welding Machine:**
   - **Welding Process:** Shielded Metal Arc Welding (SMAW)
   - **Quantity:** 1
   - Electrode Holder and Ground Clamp included
10. **Personal Protective Equipment (PPE):**
    - Welding helmets, welding gloves, safety glasses, and flame-resistant clothing for operator safety

11. **Ventilation and Exhaust System:**
    - Local exhaust ventilation system to remove welding fumes
12. **Welding Inspection Tools:**
    - Inspection gauges and tools for checking groove dimensions and angles

Fig. 4.2.10 Steel Structural Fabrication

Safety Equipment:

13. **Fire Extinguishers:**
    - **Quantity:** As per safety regulations
    - **Purpose:** Fire safety in the welding area
14. **First Aid Kit**:
    - **Quantity:** As per safety regulations
    - **Purpose:** Immediate response to injuries
15. **Eye Wash Station:**
    - **Quantity:** 1
    - **Purpose:** Emergency eye rinsing in case of chemical exposure
16. **Safety Barriers and Signage**:
    - To demarcate the welding area and provide safety instructions

Fig. 4.2.11 Safety equipment

Note: This estimate serves as a general guideline and may vary based on project specifics, such as the scope of work, material type, joint design, and welding process. Always consult project plans, welding procedures, and safety regulations for precise requirements.

4.2.5 Demonstrating Methods for Measuring and Marking Sections for Edge Preparation

Accurate measurement and marking of sections for edge preparation are crucial in construction fabrication. Follow these steps to demonstrate the process:

Tools and Materials:

- Steel rule or tape measure
- Combination square
- Chalk or soapstone marker
- Straight edge or ruler

- Protective equipment (safety glasses, gloves)

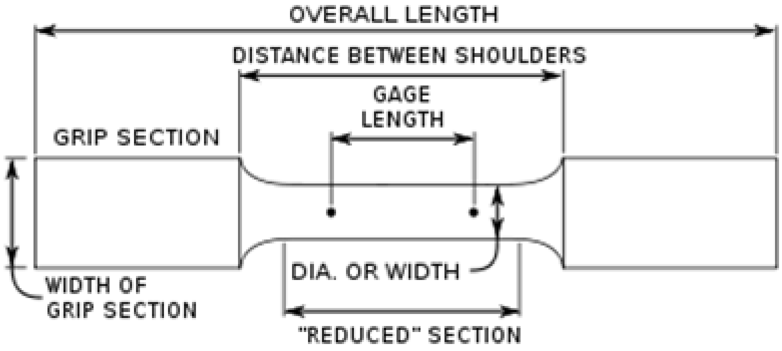

Fig. 4.2.12 Edge preparation for construction fabrication

Procedure:

1. **Review Technical Details:**
   - Begin by reviewing the provided technical details, construction drawings, and specifications to understand the required edge preparation dimensions and angles.
2. **Prepare the Work Area:**
   - Ensure the work area is clean, well-lit, and free from obstructions.
   - Wear appropriate personal protective equipment (PPE), including safety glasses and gloves.
3. **Measure the Section:**
   - Identify the section of steel that requires edge preparation.
   - Use a steel rule or tape measure to measure the length of the section accurately. Record the **measurement.**
4. **Mark the Starting Point:**
   - Select a reference point on the section where the edge preparation will begin.
   - Mark this point clearly with chalk or a soapstone marker.
5. **Determine the Edge Preparation Dimension**s:
   - Refer to the provided technical details or welding procedure specifications to determine the required bevel angle, groove dimensions, and root gap.
6. **Set the Combination Square:**
   - Adjust the combination square to the specified bevel angle.
   - Ensure the square is securely locked at the desired angle.

Fig. 4.2.13 Combination square

7. **Mark the Edge Preparation Line:**
   - Align the combination square along the edge of the section, starting from the reference point.
   - Use the square to mark a straight and continuous line along the length of the section. This line represents the edge preparation boundary.
8. **Measure and Mark Groove Dimensions:**
   - Measure the distance from the edge preparation line to the outer edge of the section, following the specified groove dimensions.
   - Mark additional lines parallel to the edge preparation line to indicate the groove boundaries.
9. **Mark the Root Gap:**
   - Measure and mark the specified root gap distance from the edge preparation line toward the center of the section.

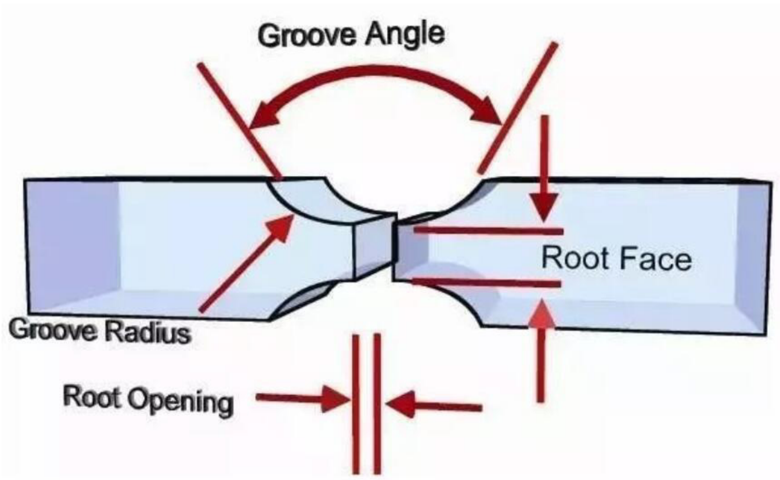

Fig. 4.2.14 Root gap

10. **Verify Accuracy:**
    - Double-check all measurements and marks for accuracy, especially the bevel angle and groove dimensions.
11. **Record Details:**
    - Document the edge preparation details, including measurements, angles, and dimensions, for quality control and reference.
12. **Proceed with Edge Preparation:**
    - After accurate measurement and marking, proceed with the edge preparation process, which may involve cutting, grinding, or bevelling the marked section to the required specifications.
13. **Quality Inspection:**

- Inspect the edge preparation to ensure it meets the specified requirements before welding or further fabrication.

By following these steps, you demonstrate the proper methods for measuring and marking sections for edge preparation in construction fabrication, ensuring precision and compliance with technical details and standard procedures.

4.2.6 Demonstrating the Process of Edge Preparation in Construction Fabrication

Edge preparation is a critical step in ensuring strong and reliable welds. Here, we demonstrate the process of edge preparation for a workpiece/section according to specified requirements:

Tools and Materials:

- Steel section to be prepared
- Angle grinder with appropriate cutting or grinding disc
- Magnetic square or clamps
- Chalk or soapstone marker
- Safety equipment (safety glasses, gloves, ear protection)
- Dust mask or respirator (if required)
- Measuring tools (combination square, ruler)

Fig. 4.2.15 Process of edge preparation in construction fabrication

Procedure:

1. **Review Specifications:**
   - Start by reviewing the construction drawings and specifications to understand the required edge preparation details, including bevel angle, groove dimensions, and root gap.
2. **Safety Precautions:**
   - Put on the necessary safety equipment, including safety glasses, gloves, and ear protection. If working in a dusty environment, wear a dust mask or respirator.
3. **Marking:**
   - Use a chalk or soapstone marker to mark the section where the edge preparation will be performed. Ensure the marks are clearly visible and follow the specified measurements and angles.
4. **Secure the Workpiece:**
   - Use a magnetic square or clamps to secure the workpiece in a stable position, ensuring it doesn’t move during the preparation process.
5. **Select the Angle Grinder:**
   - Choose the angle grinder with the appropriate cutting or grinding disc based on the material type and thickness and the specified bevel angle.

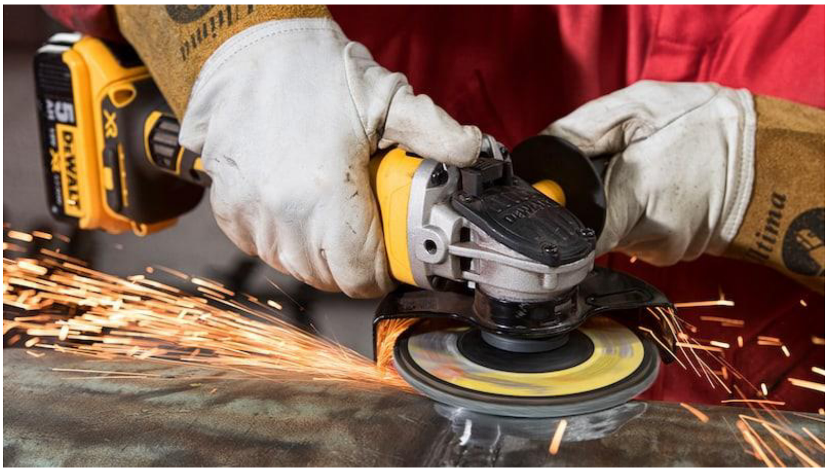

Fig. 4.2.16 Angle grinder

6. Setting the Bevel Angle:
   - Adjust the angle grinder to the required bevel angle according to the specifications. Ensure it is securely locked in place.
7. **Cutting/Grinding:**
   - Start the angle grinder and carefully cut or grind along the marked lines. Follow the bevel angle, groove dimensions, and root gap as specified.
   - Maintain a steady hand and move the grinder smoothly to create a clean and precise edge preparation.
8. **Inspect the Preparation:**
   - After completing the edge preparation, inspect the groove for compliance with the specifications. Ensure that the bevel angle, groove dimensions, and root gap are within tolerance.
9. **Clean the Surface:**
   - Use a wire brush or abrasive pad to remove any slag, debris, or contaminants from the prepared edge. This ensures a clean surface for welding.
10. **Quality Assurance:**
    - Verify the edge preparation's quality and adherence to the requirements before proceeding with welding or further fabrication.
11. **Documentation:**
    - Maintain records of the edge preparation process, including measurements, angles, and dimensions, for quality control and documentation purposes.
12. **Proceed with Welding:**
    - Once the edge preparation is verified and meets the specifications, proceed with the welding process according to the project's requirements.

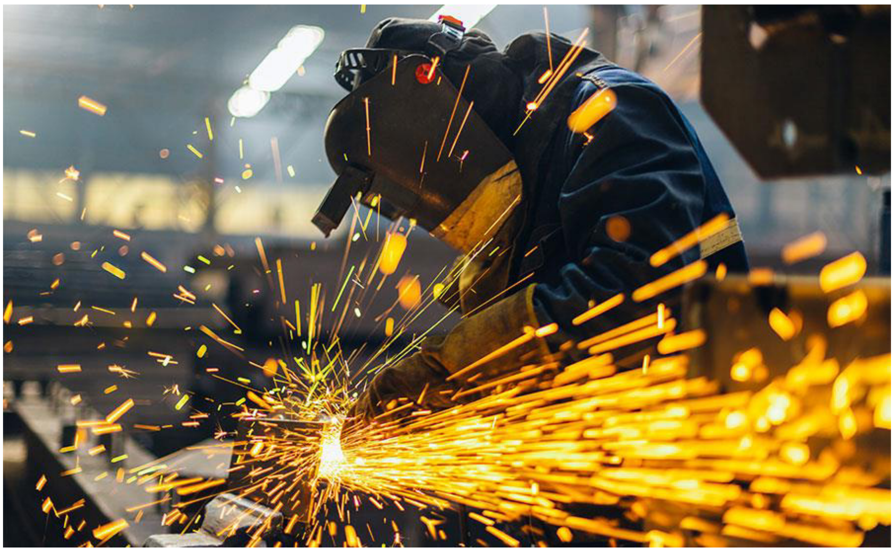

Fig. 4.2.17 Process of welding

By following this process, you demonstrate the correct methods for edge preparation in construction fabrication, resulting in welds that meet the required standards and specifications.

4.2.7 Demonstrating Welding/Bolting to Connect Two Components/Assemblies in Construction Fabrication

Welding and bolting are common methods to join components in construction fabrication. Here, we demonstrate both processes for connecting two components/assemblies as per drawings and specifications.

Fig. 4.2.18 Welding versus Bolting

Tools and Materials:

- Two steel components/assemblies
- Welding machine (for welding method)
- Electrodes suitable for the material and welding process (for welding method)
- Fasteners (bolts, nuts, washers) and a wrench or socket set (for bolting method)
- Measuring tools (ruler or tape measure)
- Square and level (for alignment)
- Safety equipment (welding helmet, gloves, safety glasses)

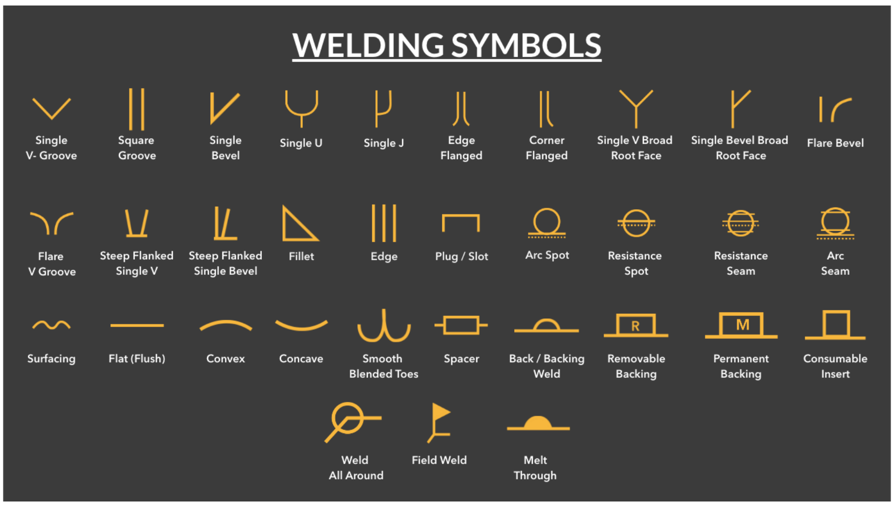

Fig. 4.2.19 Welding symbols

Procedure - Welding Method:

1. **Review Drawings and Specifications:**
   - Begin by reviewing the construction drawings and specifications to understand the welding requirements, including weld type, size, and location.
2. **Preparation:**
   - Ensure that both components/assemblies to be joined are clean and free from contaminants, rust, and paint. Remove any debris or obstacles from the work area.
3. **Alignment:**
   - Use a square and level to ensure that the components/assemblies are properly aligned according to the drawings. Correct any misalignment as necessary.
4. **Welding Setup:**
   - Select the appropriate welding process (e.g., shielded metal arc welding, gas metal arc welding) and set up the welding machine with the recommended settings based on the material and welding procedure specifications.
5. **Welding:**
   - Weld along the designated weld line as per the drawings and specifications. Follow the welding procedure to ensure proper bead formation and penetration.
6. **Quality Inspection:**
   - After welding, visually inspect the weld for any defects, such as cracks or incomplete fusion. Ensure it meets the specified weld size and quality.
7. **Cooling and Post-Weld Treatment:**
   - Allow the weld to cool naturally or follow any specified post-weld treatment procedures, such as stress relieving or heat treatment.

Procedure - Bolting Method:

1. **Review Drawings and Specifications:**
   - Start by reviewing the construction drawings and specifications to understand the bolting requirements, including the type, size, and location of fasteners.
2. **Preparation:**
   - Ensure that both components/assemblies to be joined are clean and free from contaminants, debris, and obstacles.
3. **Alignment:**
   - Use measuring tools, a square, and a level to ensure proper alignment of the components/assemblies according to the drawings. Adjust as needed.
4. **Fastener Selection:**

- Choose the appropriate fasteners (bolts, nuts, washers) based on the specifications, including size, material, and strength grade.

5. **Insert Fasteners**:
   - Insert the selected fasteners through the pre-drilled holes in the components/assemblies. Place washers and nuts on the opposite side.

6. **Tightening:**
   - Use a wrench or socket set to tighten the nuts on the bolts according to the specified torque values. Ensure uniform tightening to achieve proper clamping force.

7. **Quality Inspection:**
   - Inspect the bolted connection for proper alignment, secure fastening, and compliance with the specifications.

8. **Final Checks:**
   - Verify that all fasteners are securely tightened and that the joint is stable and free from any misalignment.

Fig. 4.2.20 Bolting versus Welding

By following these procedures, you demonstrate the welding and bolting methods to connect two components/assemblies in construction fabrication while ensuring compliance with drawings and specifications.

4.2. Inspecting Proposed Component/Assemblies in Construction Fabrication

Inspecting components and assemblies for distortions, dimensional changes, and defects is crucial to ensure the quality and integrity of the construction fabrication process.

Fig. 4.2.21 Proposed component/assemblies in construction fabrication

Here's how to perform the inspection:

1. **Review Specifications:**
   - Understand required tolerances, dimensions, and inspection criteria from drawings and specifications.
2. **Visual Inspection:**
   - Check for visible defects, including weld spatter, surface irregularities, cracks, or distortions.
   - Use a flashlight or magnifying glass for detailed examination.
3. **Dimensional Inspection:**
   - Measure critical dimensions using appropriate tools.
   - Compare measurements to specifications for any discrepancies.
4. **Alignment and Squareness:**
   - Ensure components meet specified tolerances for angles and joints.
   - Correct misalignments if necessary.
5. **Weld Inspection:**
   - If welding is involved, check weld size, throat thickness, and penetration with inspection gauges.
   - Inspect welds for defects, such as porosity, undercut, or incomplete fusion.

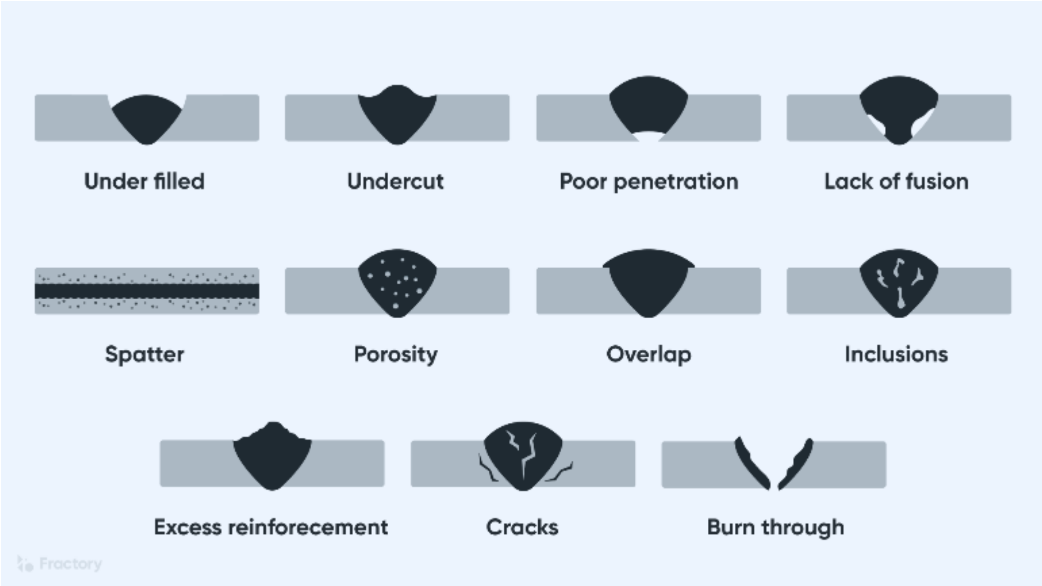

Fig. 4.2.22 Weld inspection

6. **Distortion Check:**
   - Examine for signs of distortion, warping, or twisting.
   - Measure flatness with a straight edge to identify deviations.
7. **Quality Control Plan Compliance:**
   - Align the inspection process with the established quality control plan.
   - Follow specified acceptance criteria.
8. **Documentation:**
   - Maintain detailed records of inspection, including measurements, observations, and identified defects.
   - Document corrective actions taken for defects or dimensional variations.
9. **Final Evaluation:**
   - Assess overall component or assembly condition against required quality standards.
   - Address any defects or discrepancies through appropriate corrective actions.
10. **Quality Assurance:**
    - Conduct a final quality assurance check to ensure compliance with project quality and safety requirements.

Using this checklist format, you can systematically inspect proposed components/assemblies in construction fabrication, ensuring that all relevant aspects are considered and addressed effectively.

Notes

QR Codes

Scan the QR code to watch the video

https://youtu.be/9-yd1QGwng4

Structural Steel Fabrication

UNIT 4.3: Quality Control and Repair

Unit Objectives

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

1. Explain the concept of root gaps and how to include them in measurement.
2. Explain the concept of shrinkage of material and adjusting shrinkage into measurement.
3. Explain the various types of defects arising in the components of various shapes and sizes, their causes, and effects.
4. Explain the various methods for rectification of various defects along with the sequence of each activity.
5. Explain the use of various tools, equipment, and consumables required for repair work and their basic maintenance.
6. Prepare an estimate of the time, materials, tools, manpower required for repair work of a given component/assemblies.
7. Demonstrate the application of corrective operations like grinding, welding, heating, jacking, etc., to repair given defective component/assemblies.

4.3.1 Concept of Root Gaps in Joint Preparation

In the context of conducting joint preparation, understanding the concept of root gaps is essential. Root gaps play a significant role in welding and are the spaces intentionally left between the edges of two components to be joined.

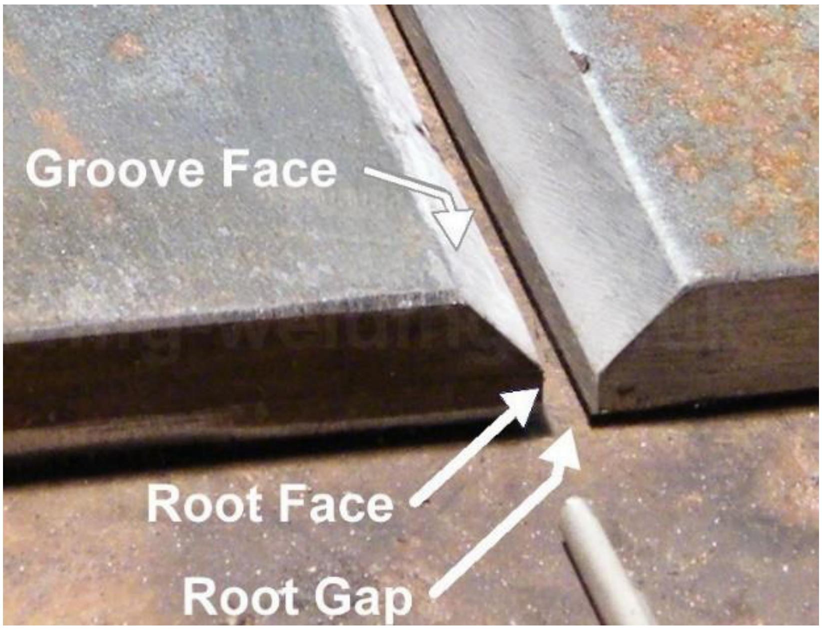

Fig. 4.3.1 Root gaps in joint preparation

These gaps are critical for several reasons:

- Weld Penetration: Root gaps allow the welding filler material to penetrate the joint fully, ensuring a strong and uniform weld on both the front and back sides of the joint.
- Preventing Lack of Fusion: Insufficient root gap can lead to a lack of fusion, where the welding material does not fuse properly with the base metal. This can result in weak or defective welds.
- Avoiding Welding Defects: Inadequate root gaps can lead to welding defects like incomplete penetration, underfill, or undercut, which compromise the integrity of the joint.
- Control of Weld Size: Root gaps also influence the size of the weld bead. A larger root gap typically results in a larger weld bead, which may be necessary for specific joint configurations.

Including Root Gaps in Measurement

To include root gaps in measurement during joint preparation, follow these steps:

Fig. 4.3.2 Welding procedure specifications

- **Determine Gap Size:** Refer to the welding procedure specifications (WPS) or project specifications to determine the required root gap size for the joint. This information should be provided in the welding documentation.
- **Mark the Components:** Mark the components or workpieces where the joint will be prepared, indicating the starting and ending points of the root gap. Use a chalk or soapstone marker for clear visibility.
- **Measure the Gap:** Use measuring tools, such as a gap gauge or feeler gauge, to measure the actual root gap. Ensure that the gap matches the specified size.
- **Adjust if Necessary:** If the measured root gap differs from the specified size, make necessary

adjustments. This may involve separating the components slightly to achieve the correct gap size or closing the gap if it's too wide.

- **Maintain Consistency:** Ensure that the root gap size is consistent along the entire length of the joint, as variations can lead to uneven welds.
- **Document Measurements:** Keep records of the root gap measurements for quality control and documentation purposes. This information is crucial for welding inspectors and quality assurance teams.
- **Proceed with Joint Preparation:** Once the root gap is correctly measured and adjusted, proceed with the joint preparation process, which may involve bevelling, cleaning, and other necessary steps.

By including root gaps in your measurement and adhering to the specified size, you ensure that the welding process produces strong, defect-free, and uniform joints in fabricated assemblies, contributing to the overall quality and integrity of the construction project.

4.3. Concept of Material Shrinkage in Welding

Material shrinkage is a fundamental concept in welding, especially in the context of conducting joint preparation, connection activities, and repair work in fabricated assemblies. When metals are subjected to high temperatures during welding, they expand.

However, as they cool and solidify, they undergo contraction or shrinkage. This shrinkage can lead to several significant considerations:

- **Dimensional Changes:** Welded joints and fabricated assemblies may experience dimensional changes as they cool. These changes can affect the overall fit, alignment, and tolerances of the components.
- **Residual Stresses:** Shrinkage-induced stresses can result in residual stresses within the welded joint. These stresses may lead to distortion, warping, or even cracking if not properly managed.
- **Distortion:** Material shrinkage can cause the welded components to deform or distort from their original shape. This distortion can be undesirable, especially in precision applications.
- **Quality Implications:** Failure to account for material shrinkage can result in welding defects, reduced structural integrity, or the need for costly rework.

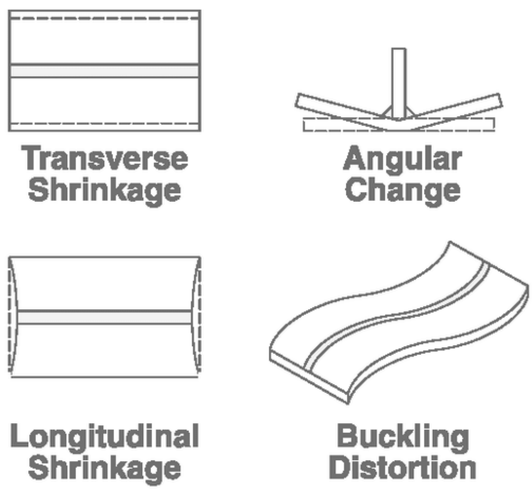

Fig. 4.3.3 Material shrinkage in welding

Adjusting Shrinkage into Measurement

To account for material shrinkage and adjust it into measurements during joint preparation and fabrication, follow these steps:

1. **Pre-Weld Measurements:**

   Before welding, take precise measurements of the components or assemblies, including dimensions, angles, and clearances. Document these measurements as the initial "assembled" state.

2. **Calculate Shrinkage:**

   Consult welding procedure specifications (WPS) or engineering guidelines to estimate the expected shrinkage for the specific materials and welding process being used. Shrinkage factors can vary based on material type, welding method, and temperature.

3. **Adjust Measurements:**

   Subtract the estimated shrinkage values from the initial measurements to determine the "post-weld" or "final" dimensions and clearances. These adjusted measurements account for the anticipated shrinkage during cooling.

4. **Tolerance Consideration:**

   Ensure that the adjusted measurements still fall within the acceptable tolerances and requirements specified in the project's engineering drawings and specifications.

5. **Alignment and Fixturing:**

   Use appropriate fixturing and clamping techniques to maintain proper alignment and prevent distortion during welding. Proper fixturing can help compensate for shrinkage-induced forces.

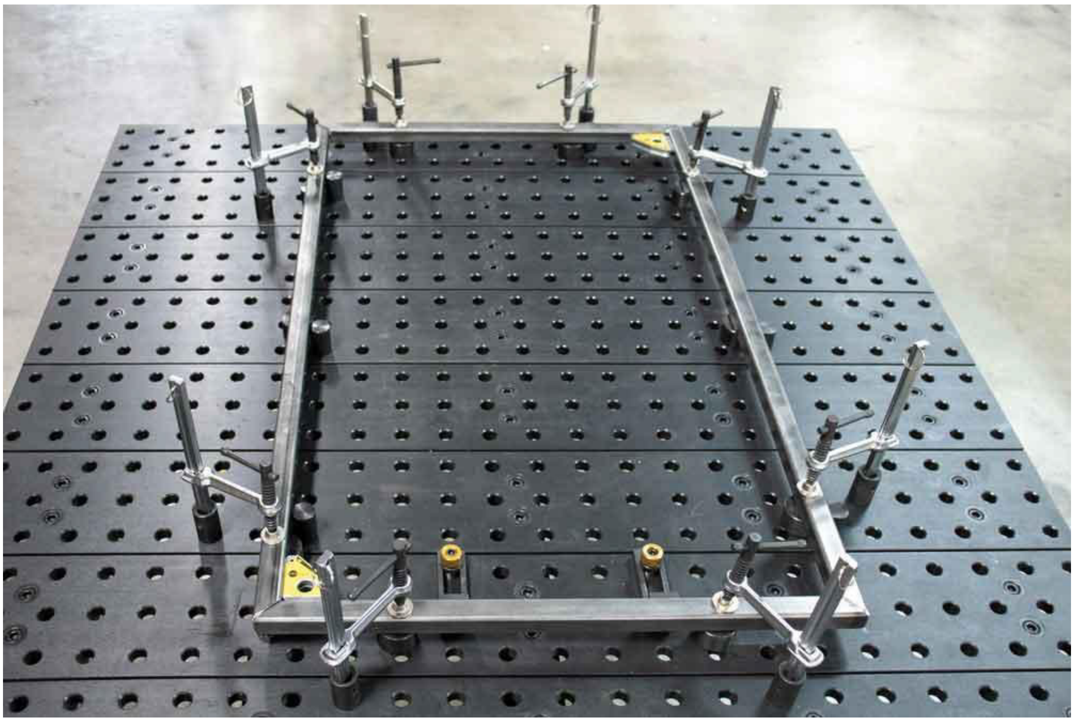

Fig. 4.3.4 Alignment and fixturing

6. **Quality Control:**

   Throughout the welding process, employ quality control measures such as visual inspections and non-destructive testing to verify that the final dimensions and clearances meet the specified requirements.

7. **Post-Weld Corrections:**

   If necessary, make post-weld corrections, such as machining or grinding, to achieve the desired final dimensions and clearances while considering the material's properties.

By adjusting for material shrinkage in measurements and carefully managing the welding process, you can ensure that the fabricated assemblies maintain the required dimensions, tolerances, and structural integrity, ultimately contributing to the success and safety of the construction project.

4.3.3 Various Types of Defects in Fabricated Components

Defects can occur in fabricated components of various shapes and sizes, compromising their quality and performance. These defects may arise from different causes and have varying effects on the final product.

Here are some common types of defects, their causes, and effects:

1. **Welding Defects:**

- Incomplete Penetration:
  - Cause: Insufficient heat or improper welding technique.
  - Effect: Weak joint, reduced load-bearing capacity.
- Porosity:
  - Cause: Trapped gas or moisture during welding.
  - Effect: Reduced strength, potential for cracks.
- Cracking:
  - Cause: High stresses, improper cooling.
  - Effect: Structural weakness, failure risk.
- Undercut:
  - Cause: Excessive welding current or improper technique.
  - Effect: Reduced cross-sectional area, weaker joint.

Fig. 4.3.5 Welding defects

2. **Dimensional Deviations:**

- **Oversize/Undersize:**
  - **Cause:** Incorrect machining, measurement errors.
  - **Effect:** Fitment issues, misalignment.
- **Out-of-Roundness:**
  - **Cause:** Machining or forming errors.
  - **Effect:** Poor sealing, decreased strength.

- **Warpage:**
  - **Cause:** Uneven cooling, welding stresses.
  - **Effect:** Fitment problems, aesthetic issues.

3. **Surface Imperfections:**

- **Surface Cracks:**
  - **Cause: Stress, material defects.**
  - **Effect:** Structural weakness, corrosion risk.
- **Surface Roughness:**
  - **Cause:** Poor machining or finishing.
  - **Effect:** Reduced aesthetics, friction.
- **Pitting:**
  - **Cause:** Corrosion, material contamination.
  - **Effect:** Weakened surface, reduced lifespan.

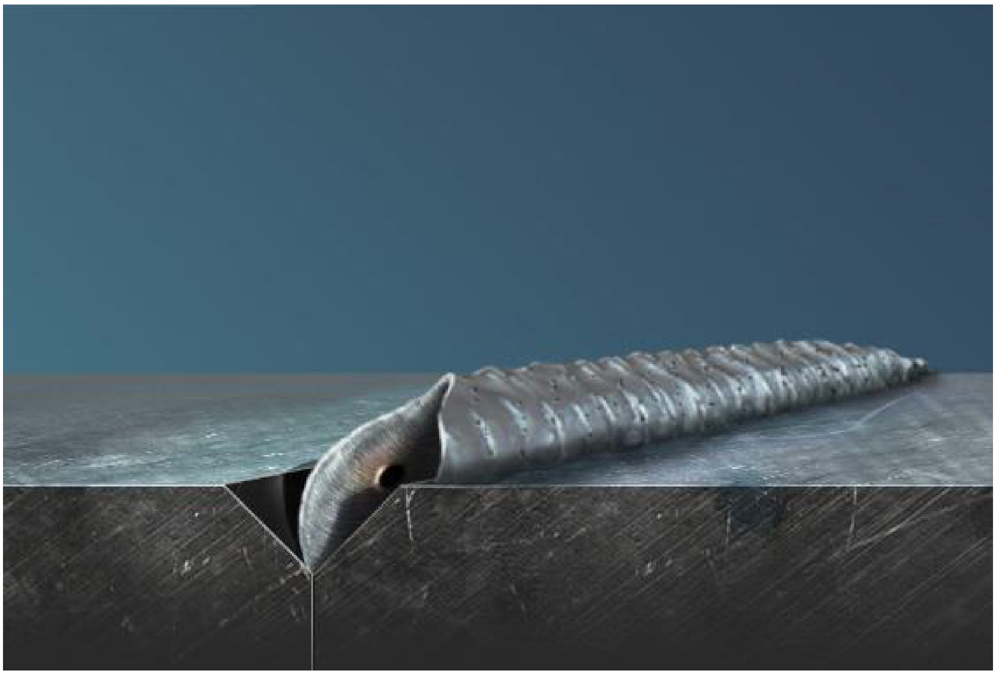

Fig. 4.3.6 Surface imperfections

4. **Contamination:**

- **Foreign Material Inclusion:**
  - **Cause:** Contaminants during fabrication.
  - **Effect:** Weakened structural integrity, potential for defects.

- **Oxidation:**
  - **Cause:** Exposure to oxygen during welding.
  - **Effect:** Weakened material properties, reduced corrosion resistance.

Fig. 4.3.7 Contamination

5. **Material Defects:**

- **Inclusions:**
  - **Cause:** Foreign particles in the material.
  - **Effect:** Structural weaknesses, reduced material properties.

- **Segregation:**
  - **Cause:** Non-uniform distribution of alloying elements.
  - **Effect:** Inconsistent material properties, reduced strength.

Fig. 4.3.8 Material defects

6. **Misalignment:**
    - **Cause:** Incorrect assembly or welding.
    - **Effect:** Reduced structural integrity, potential for failure.

- **Addressing Defects:**
    - Detect and address defects through visual inspection, non-destructive testing (NDT), and quality control processes.
    - Corrective actions may include rework, grinding, welding repairs, or component replacement.

  Prevention through proper welding techniques, quality materials, and precise measurements is key to minimizing defects and ensuring the quality of fabricated components.

4.3.4 Methods for Rectifying Defects in Fabricated Assemblies

Rectifying defects in fabricated assemblies is essential to ensure the final product meets quality standards. The specific method chosen for rectification depends on the type of defect and its severity.

Here are various methods for rectifying defects, along with the sequence of activities:

1. **Weld Repair for Welding Defects:**
    a. **Sequence:**
        - **Identify Defect:** Inspect the welded joint to identify the defect (e.g., incomplete penetration, cracks, porosity).
        - **Remove Defective Material:** Grind or cut out the defective portion to expose clean, defect-free metal.
        - **Preheat:** If necessary, preheat the area to reduce the risk of cracking during welding.
        - **Weld Repair:** Apply proper welding techniques to fill the gap, ensuring complete fusion and proper bead formation.
        - **Post-Weld Heat Treatment:** Perform post-weld heat treatment if specified to relieve residual stresses.
        - **Re-Inspection:** Inspect the repaired weld to ensure it meets quality standards.

Fig. 4.3.7 Contamination

2. **Machining for Dimensional Deviations:**

   a. **Sequence:**

   - **Measure Deviation:** Determine the extent of dimensional deviation from the specified dimensions.
   - **Setup and Fixturing:** Secure the component in a machining setup or fixture.
   - **Machining:** Use appropriate machining tools (e.g., lathe, milling machine) to remove excess material or correct the dimension.
   - **Measure Again:** Measure the component after machining to verify that it now meets the specified dimensions.
   - **Surface Finishing:** Finish the machined surface to achieve the desired surface quality.

Fig. 4.3.10 Machining for dimensional deviations

3. **Surface Treatment for Surface Imperfections:**

   a. **Sequence:**

   - **Identify Imperfection:** Identify the type and extent of surface imperfection (e.g., surface crack, roughness, pitting).
   - **Preparation:** Prepare the surface by cleaning and removing any contaminants or loose material.
   - **Surface Treatment:**

     1. **For surface cracks:** Grind out the crack and weld to fill the gap.
     2. **For roughness:** Use abrasive methods (e.g., grinding, sanding) to smoothen the surface.
     3. **For pitting:** Remove the pitted material and fill the depressions with appropriate

filler material.

- **`Inspect and Verify: I**nspect the treated surface to ensure the imperfection is rectified and meets quality requirements.

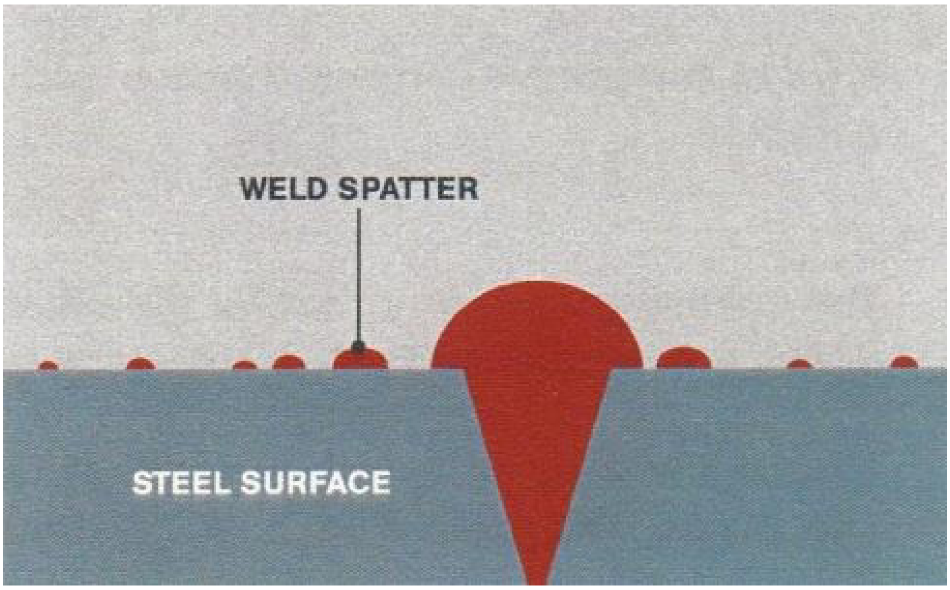

Fig. 4.3.11 Surface imperfections due to weld spatter

4. Material Replacement for Severe Defects:

a. Sequence:

- **Assess Severity:** Evaluate the defect's severity and whether it compromises the component's integrity.
- **Cut Out Defective Portion:** If the defect is severe, cut out the entire defective portion.
- **Prepare Replacement:** Fabricate a replacement piece or component that matches the required specifications.
- **Weld or Join Replacement:** Weld or join the replacement piece into the assembly.
- **Post-Weld Finishing:** Perform post-weld finishing and inspections to ensure the repair is seamless and meets quality standards.

Fig. 4.3.12 Post-weld finishing

5. **Alignment Correction for Misalignment:**

   a. **Sequence:**

   - **Assessment:** Assess the misalignment by measuring the deviation from the desired position.
   - **Disassemble if Needed:** If the misalignment is significant, disassemble the components.
   - **Realign:** Correct the misalignment through adjustments, which may involve repositioning, shimming, or reassembly.
   - **Reassemble:** Reassemble the components in the corrected position.
   - **Inspection:** Inspect the alignment to ensure it meets specified tolerances.

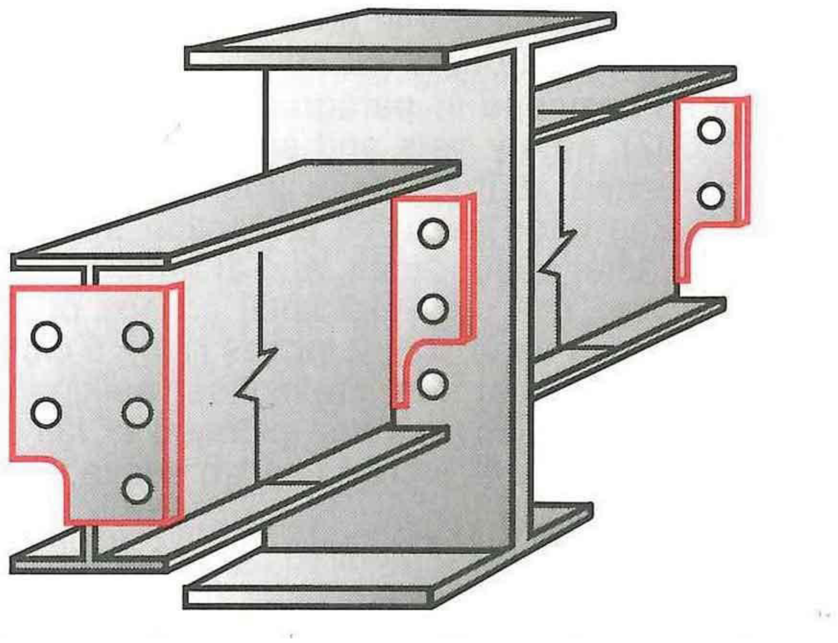

Fig. 4.3.13 Alignment correction for misalignment

The choice of rectification method and sequence of activities depend on factors such as the defect type, severity, material, and project requirements.

It's crucial to follow proper quality control procedures and ensure that the rectification process results in a safe and compliant final product.

4.3.5 Use of Tools, Equipment, and Consumables in Repair Work

Repair work in fabricated assemblies often requires specific tools, equipment, and consumables to rectify defects or make adjustments.

Understanding their use and performing basic maintenance is crucial for efficient and effective repair processes.

Fig. 4.3.14 Welding processes (MIG/TIG/Stick)

Here's an overview:

Tools and Equipment:

- **Grinders and Cutting Tools:** These tools are used for removing defects, excess material, or preparing surfaces for welding. They include angle grinders, cutting torches, and plasma cutters.
- **Welding Machines:** Various welding processes (e.g., MIG, TIG, stick) may be employed for repair. Welding machines generate the necessary heat and electrical current for welding.
- **Machining Tools:** Tools like lathes, milling machines, and drilling machines may be used to reshape or correct components with dimensional defects.
- **Measurement Tools:** Calipers, micrometers, gauges, and levels are used to measure and ensure precise dimensions and alignment.
- **Clamps and Fixtures:** These hold components in place during welding or machining to prevent movement and maintain alignment.
- **Safety Equipment:** Safety gear such as welding helmets, gloves, safety glasses, and respirators is essential for protection during repair work.

Consumables:

- **Welding Electrodes and Wire:** Different welding processes require specific electrodes or wire for creating welds. These should be compatible with the base material.
- **Filler Material:** Used to fill gaps, holes, or areas with defects during welding. The type and composition depend on the materials being joined.
- **Abrasive Materials:** Grinding wheels, sandpaper, and abrasive pads are used for preparing surfaces, removing defects, and smoothing welds.
- **Coolants and Lubricants:** These are essential for cooling and lubricating machining tools during repair work.

Basic Maintenance:

- **Regular Inspection:** Routinely inspect tools and equipment for wear, damage, or loose parts. Address any issues promptly.
- **Cleaning:** Keep tools and equipment clean and free from debris or contaminants that could affect their performance.
- **Lubrication:** Apply appropriate lubricants to moving parts of machines and equipment to reduce friction and prevent wear.
- **Electrode Storage:** Store welding electrodes in a dry, temperature-controlled environment to prevent moisture absorption and deterioration.
- **Safety Equipment Maintenance:** Ensure that safety equipment is in good condition and replace any damaged or expired components.
- **Sharpening and Calibration:** Maintain sharpness and accuracy in cutting and measuring tools by sharpening and calibrating them as needed.
- **Training:** Provide training to personnel on the proper use and maintenance of tools, equipment, and consumables.

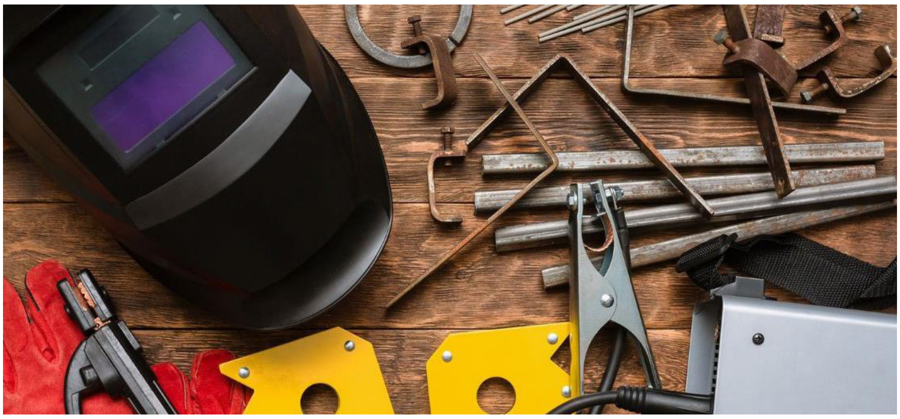

Fig. 4.3.15 Maintenance of tools, equipment, and consumables

Proper maintenance of tools, equipment, and consumables not only extends their lifespan but also ensures the safety and quality of repair work in fabricated assemblies. Regular inspections and adherence to manufacturer guidelines are essential for effective maintenance practices.

4.3.6 Estimate for Repair Work on a Given Component/ Assembly

Estimating the time, materials, tools, and manpower required for repair work on a specific component or assembly is essential for project planning and resource allocation. Here's a general outline to create such an estimate:

1. **Define the Scope of Repair:**
    - Identify the component or assembly requiring repair.
    - Determine the nature and extent of the repair (e.g., welding defects, dimensional corrections).
2. **Time Estimate:**
    - Assess the repair complexity and size to estimate the time needed.
    - Consider factors like preparation, welding, machining, cooling, and inspection time.
    - Add extra time for unexpected issues that may arise.
3. **Materials Estimate:**
    - Identify the materials required for repair, including:
        - ♦ Welding consumables (electrodes, wire, filler material).
        - ♦ Replacement parts (if any).
        - ♦ Abrasive materials (grinding wheels, sandpaper).
        - ♦ Coolants or lubricants (if machining is involved).
4. **Tools and Equipment Estimate:**
    - List the tools and equipment necessary for repair, such as:
        - ♦ Welding machines and accessories.
        - ♦ Grinders, cutting tools, or machining equipment.
        - ♦ M
        - ♦ C

Fig. 4.3.16 Tools and equipment necessary for repair

5. **Manpower Estimate:**
   - Determine the number of skilled workers needed for each repair task (e.g., welders, machinists, inspectors).
   - Consider the expertise and experience required.
6. **Contingency Planning:**
   - Allocate a contingency factor to account for unforeseen challenges or additional tasks.
   - Typically, a contingency of 10-15% of the estimated time and resources is advisable.
7. **Cost Estimate:**
   - Calculate the costs associated with materials, tools, and labor based on local rates and prices.
   - Include overhead costs and any subcontracting expenses.
8. **Documentation:**
   - Create a detailed estimate document that includes all the above information.
   - Use tables or spreadsheets to present the estimates clearly.
9. **Review and Approval:**
   - Review the estimate with project stakeholders, such as project managers or engineers.
   - Obtain approval and make necessary adjustments if required.
10. **Execution and Monitoring:**
    - Implement the repair work according to the approved estimate.
    - Monitor progress, costs, and timelines to ensure adherence to the estimate.

Remember that the accuracy of your estimate relies on a clear understanding of the repair scope and tasks involved. Regular updates and communication with the project team are crucial to ensure that the repair work proceeds smoothly and within the estimated parameters.

4.3.7 Demonstration of Corrective Operations for Repairing a Defective Component/Assembly

In this demonstration, we will show how to apply corrective operations like grinding, welding, heating, and jacking to repair a defective metal component. Suppose we have a steel beam with a crack that needs repair.

Tools and Equipment Needed:

- Angle Grinder with Grinding Wheel
- Welding Machine (appropriate for steel welding)
- Electrodes or Welding Wire
- Oxy-acetylene Torch for Heating
- Hydraulic Jack
- Safety Gear (Welding Helmet, Gloves, Safety Glasses, etc.)

Fig. 4.3.17 Angle Grinder with grinding wheel

Procedure:

1. **Inspection:**
   - Begin by inspecting the defective component. In this case, we have a steel beam with a visible crack. Assess the extent of the damage and determine the repair approach.
2. **Safety Precautions:**
   - Ensure that you are wearing the necessary safety gear, including a welding helmet, gloves, and safety glasses, before starting any repair work.
3. **Grinding:**
   - Use the angle grinder with a grinding wheel to remove any rust, contaminants, or damaged material around the crack. Create a clean, smooth surface around the crack for welding.
4. **Welding:**
   - Set up the welding machine according to the specifications for steel welding. Ensure proper

electrode or wire selection.

- Weld along the length of the crack, filling it with the welding material. Achieve a consistent and strong weld.
- Follow the recommended welding parameters for the chosen welding process (e.g., MIG, stick, TIG).

Fig. 4.3.18 Welding process

5. **Heating (If Needed):**
   - In some cases, heating may be required to relieve residual stresses or reshape the component. Use an oxy-acetylene torch to carefully apply heat as needed. Follow safety guidelines and control the heating process.
6. **Jacking (If Needed):**
   - If the defect has caused misalignment or deformation, use a hydraulic jack to carefully apply pressure to the affected area. Jacking can help realign the component or restore its original shape.
7. **Cooling and Inspection:**
   - Allow the welded area to cool naturally or use controlled cooling methods if specified. Proper cooling prevents the formation of additional stresses.
   - Inspect the repaired area for any visual defects, such as cracks, porosity, or incomplete penetration.
8. **Post-Processing:**
   - Perform any necessary post-processing tasks, such as grinding or smoothing the welded area to achieve the desired finish.
9. **Final Inspection:**
   - Conduct a final inspection to ensure that the repair meets quality standards and is safe for use.

10. Documentation:

    - Maintain records of the repair process, including details of the corrective operations performed, welding parameters, and inspection results.

Safety Note: Always prioritize safety when conducting corrective operations. Follow safety guidelines for each tool and operation, and use appropriate personal protective equipment.

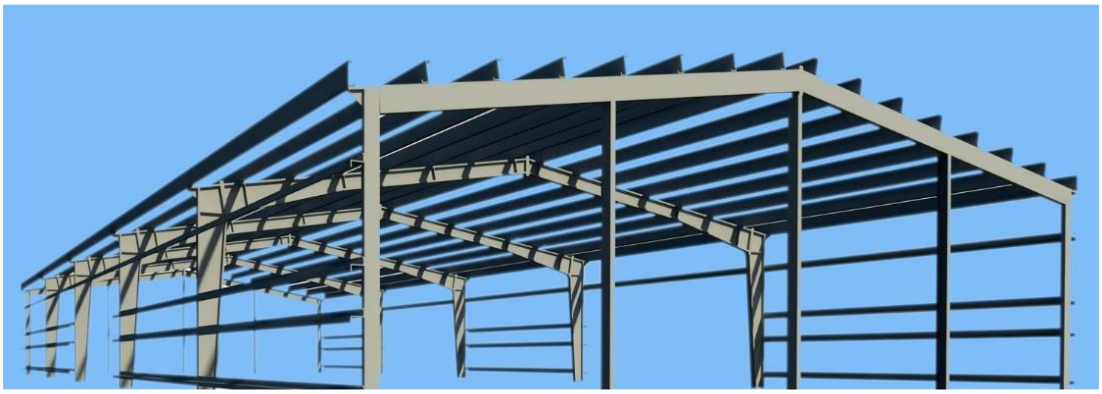

Fig. 4.3.19 Corrective operations for perfect component or assembly

This demonstration illustrates how corrective operations like grinding, welding, heating, and jacking can be applied to repair a defective component or assembly effectively. It's essential to have the right tools, equipment, and skills to ensure a successful repair while adhering to safety protocols.

Exercise

Answer the following questions:

Short Questions:

1. What is the primary purpose of interpreting fabrication blueprints and shop drawings in construction fabrication?
2. Why is it important to understand common terminologies, drawings, and symbols in fabrication work?
3. What are the key considerations when selecting consumables for welding in construction?
4. Why is clamping and anchoring essential when working on a fabrication bed/platform?
5. In welding, what is the significance of adjusting welding parameters?

Fill-in-the-blanks Questions:

1. The _____________ of a fabrication bed/platform is crucial to ensure stability during construction.

   a. Color b. Level

2. Welding equipment consists of various components, including the welding _____________.

   a) Rod b) Machine

3. In fabrication work, the _____________ is a method used to connect two components using bolts or screws.

   a) Welding b) Bolting

4. _____________ is the process of customizing tools and workholding devices to match specific project requirements.

   a) Clamping b) Customization

5. To prepare a sample estimate for edge/joint preparation, you need to consider the quantities of _____________, tools, and equipment.

   a) Materials b) Fuel

True/False Questions:

1. **True or False:** Understanding common terminologies, drawings, and symbols is not necessary for effective fabrication work.
2. **True or False:** The primary function of clamping and anchoring in a fabrication bed/platform is to provide a comfortable resting place for workers.
3. **True or False:** Welding equipment includes components like welding machines, electrodes, and filler materials.
4. **True or False:** Welding and bolting methods have similar applications in construction fabrication.
5. **True or False:** Adjusting welding parameters has no impact on the quality of welds produced.

Notes

QR Codes

Scan the QR code to watch the video

https://youtu.be/HbL4as_wG50

Welding defects cause and remedies

Skill India
कौशल भारत - कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
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N·S·D·C
National
Skill Development
Corporation
Transforming the skill landscape

Construction Skill Development Council

5. Erect Structural Steel Assemblies at Construction Sites

CON/N0717

Key Learning Outcomes

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

1. Explain basic sketches / schematic working drawing relevant to rigging works.
2. Explain how to interpret lifting plans and schedules.
3. Describe the precautions and measures required in lifting and movement of heavy components and materials.
4. Install shoring, bracing and guying materials.
5. Demonstrate how to communicate efficiently to the signalman or operator for precise movement of assemblies.
6. Demonstrate how to place the steel assemblies/ components to its accurate location and adjustments as per erection requirement.
7. Explain applicable tolerance to respective erection job.
8. Explain sequence of erection works as per proposed work method statement.
9. Explain checks to be carried out to ensure readiness of base for erections.
10. Explain checks required for alignment and positioning of the erected elements.
11. Demonstrate how to do proper alignment of the erected steel assembly/ component.
12. Perform installation of temporary connections using appropriate tools.
13. Perform tightening of bolted connections to the specified tolerance and torque using appropriate torque wrench.

UNIT 5.1: Rigging Plans and Safety Measures

Unit Objectives

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

1. Explain basic sketches/schematic working drawings relevant to rigging works.
2. Explain how to interpret lifting plans and schedules.
3. Describe the precautions and measures required in lifting and movement of heavy components and materials.
4. Install shoring, bracing, and guying materials.

5.1.1 Basic Sketches/Schematic Working Drawings in Rigging for Structural Steel Assemblies

In the job of a fabricator involved in the erection of structural steel assemblies at construction sites, understanding basic sketches and schematic working drawings is essential for safe and efficient rigging operations.

These drawings provide vital information for planning and executing rigging tasks.

Fig. 5.1.1 Rigging for structural steel assemblies

Here's an explanation of their relevance:

1. **Identification of Components:**

   Basic sketches and drawings help identify key components of the steel assembly, including beams, columns, braces, and connection points. This information is crucial for selecting the appropriate rigging equipment and methods.

2. **Load Details:**

   They specify the weight and dimensions of the steel components to be lifted. This data guides the choice of lifting equipment, such as cranes or hoists, and determines the necessary lifting capacity.

3. **Rigging Points:**

   Drawings indicate where lifting points or attachment points are located on each steel component. Fabricators need to know these locations to ensure secure and balanced lifting.

4. **Rigging Configuration:**

   Schematic drawings often include details on the rigging configuration, such as the type of slings or shackles to be used. This ensures that the rigging is correctly assembled and load-bearing.

5. **Safety Precautions:**

   Safety information, such as load limits, working load limits (WLL), and recommended rigging angles, is often included in drawings. Fabricators must adhere to these limits to prevent accidents.

6. **Sequence of Erection:**

   Some drawings outline the recommended sequence for erecting steel components. This helps fabricators plan their actions to ensure the safe and efficient assembly of the structure.

7. **Communication:**

   Basic sketches and drawings also serve as a communication tool between different team members involved in the rigging process. Clear visuals and annotations ensure that everyone understands the plan and procedures.

8. **Compliance:**

   These drawings often include compliance with industry standards and regulations, ensuring that rigging operations meet safety and quality standards.

   In summary, basic sketches and schematic working drawings play a pivotal role in the safe and successful rigging of structural steel assemblies.

They provide essential information on load details, rigging points, configurations, safety precautions, and the sequence of erection. Fabricators rely on these drawings to execute their tasks accurately and in compliance with industry standards.

5.1.2 Interpreting Lifting Plans and Schedules in the Erection of Structural Steel Assemblies

Interpreting lifting plans and schedules in the erection of structural steel assemblies can be made more comprehensible with a visual aid. Here's a simplified example:

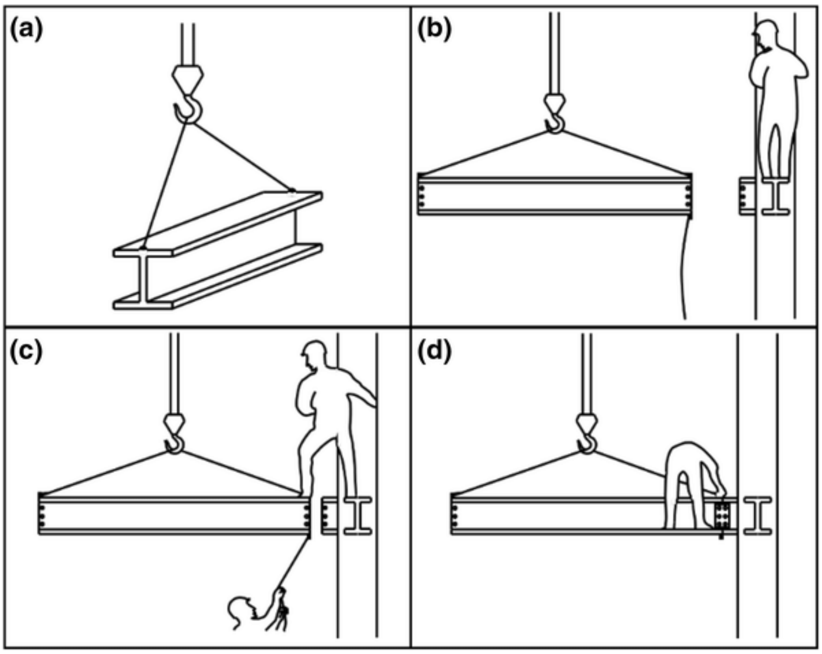

Fig. 5.1.2 Plans and schedules in erection of structural steel assemblies

Key Elements to Interpret:

Element	Description
Load Characteristics	- Weight: 10 tons
	- Dimensions: 30 ft x 5 ft x 3 ft
Rigging Points	- Four designated points marked on the steel beam for lifting.
Rigging Configuration	- Four heavy-duty steel slings attached to the lifting points.
Safety Guidelines	- Maximum Working Load Limit (WLL): 12 tons.
	- Rigging angles must not exceed 60 degrees.
Sequence of Erection	- Steel beam is the first component to be lifted and placed in position.
Compliance with Standards	- Lifting equipment and rigging comply with ANSI/ASME standards.
Weather Conditions	- Operation will be postponed in the event of high winds or heavy rain.

Table 5.1.1 Element and their description

By visually examining the lifting plan and referring to the accompanying table, fabricators can quickly grasp the essential details, including load characteristics, rigging points, safety guidelines, and sequence of erection. This approach enhances understanding and helps ensure a safe and efficient lifting operation.

5.1.3 Precautions and Measures for Lifting and Movement of Heavy Components and Materials

When involved in lifting and moving heavy components and materials in construction, taking precautions and implementing specific measures is crucial to ensure safety and prevent accidents.

Fig. 5.1.3 Lifting and moving heavy components and materials in construction

Here's a detailed overview:

1. **Rigging Inspection:**
   - Precaution: Before any lifting operation, thoroughly inspect rigging equipment, including slings, shackles, and hooks, to ensure they are in good condition.
   - Measure: Maintain a regular inspection schedule for rigging gear and document inspections to track wear and tear.
2. **Load Assessment:**
   - Precaution: Determine the weight and center of gravity of the load to select the appropriate lifting equipment and plan the lift accordingly.
   - Measure: Use load cells or weighbridges for accurate load measurement, and consider dynamic factors that may affect the load during lifting.

3. **Qualified Personnel:**
    - **Precaution:** Ensure that only trained and certified personnel operate lifting equipment and handle rigging tasks.
    - **Measure:** Provide ongoing training and certification programs for operators and riggers.
4. **Communication:**
    - **Precaution:** Establish clear and effective communication between the crane operator, signal person, and rigging team.
    - **Measure:** Use standardized hand signals or two-way radios for communication during lifting operations.
5. **Load Securement:**
    - **Precaution:** Properly secure the load to prevent shifting or falling during movement.
    - **Measure:** Use appropriate rigging techniques and securement methods, such as chains, binders, or straps.
6. **Lifting Zone Clearance:**
    - **Precaution:** Ensure the lifting zone is clear of personnel and obstacles.
    - **Measure:** Establish designated safety zones and restrict access during lifting operations.
7. **Pre-Lift Meeting:**
    - **Precaution:** Conduct a pre-lift meeting to review the lifting plan, assign roles and responsibilities, and discuss potential hazards.
    - **Measure:** Document the meeting and share safety guidelines with all involved personnel.
8. **Environmental Factors:**
    - **Precaution:** Consider environmental factors like wind, rain, or temperature that may affect the lift.
    - **Measure:** Postpone or adjust lifting operations based on weather conditions and consult with meteorological sources.
9. **Load Control:**
    - **Precaution:** Maintain control over the load at all times, avoiding sudden movements or jerks.
    - **Measure:** Use a tagline or guide rope to control load swing and maintain stability.
10. **Emergency Response Plan:**
    - **Precaution:** Develop an emergency response plan to address potential accidents or equipment failures.
    - **Measure:** Conduct regular drills and ensure all personnel are familiar with emergency procedures.
11. **Post-Lift Inspection:**
    - **Precaution:** After the lift, inspect equipment for damage and ensure proper storage.

- **Measure:** Implement a post-lift inspection checklist and promptly address any equipment issues.

12. **Documentation:**

- **Precaution:** Maintain detailed records of lifting operations, including load weights, rigging gear used, and personnel involved.
- **Measure:** Keep a comprehensive logbook and archive records for future reference.

13. **Compliance:**

- **Precaution:** Adhere to industry standards, regulations, and best practices for safe lifting operations.
- **Measure:** Regularly update procedures to align with evolving safety standards.

By diligently following these precautions and measures, construction teams can significantly reduce the risks associated with lifting and moving heavy components and materials, ensuring the safety of workers and the success of the project.

5.1.4 Install Shoring, Bracing, and Guying Materials in Structural Steel Assembly

In the job of a fabricator involved in the erection of structural steel assemblies at construction sites, the installation of shoring, bracing, and guying materials is a critical step to ensure the stability and safety of the structure. Here's how it's done:

1. Shoring Installation:

   Purpose: Shoring is used to support loads temporarily, especially during construction or repair of structures. It helps prevent structural collapse.

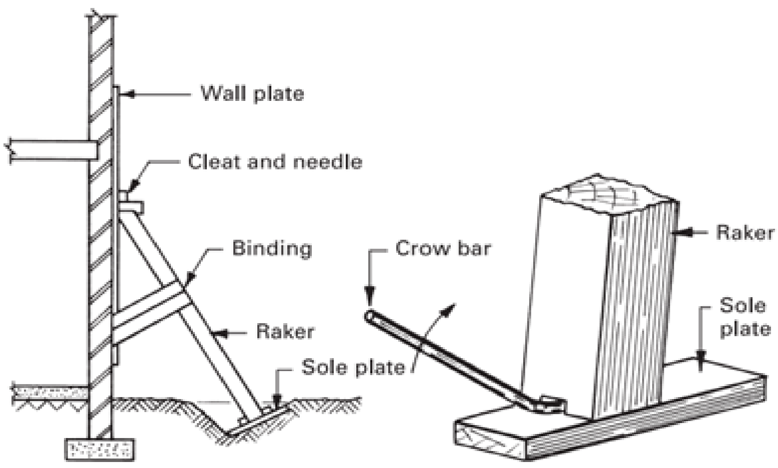

Fig. 5.1.4 Shoring installation

Steps:

a. Identify the areas that require shoring, considering the load-bearing capacity of existing supports.

b. Select appropriate shoring materials, such as steel or wood beams.

c. Install shoring materials vertically or horizontally, ensuring they make direct contact with the load to distribute weight evenly.

d. Secure shoring materials in place using strong, stable supports or braces.

e. Periodically inspect shoring to ensure it remains in place and stable.

2. Bracing Installation:

Purpose: Bracing is used to stabilize and reinforce structural components, preventing lateral movement or buckling.

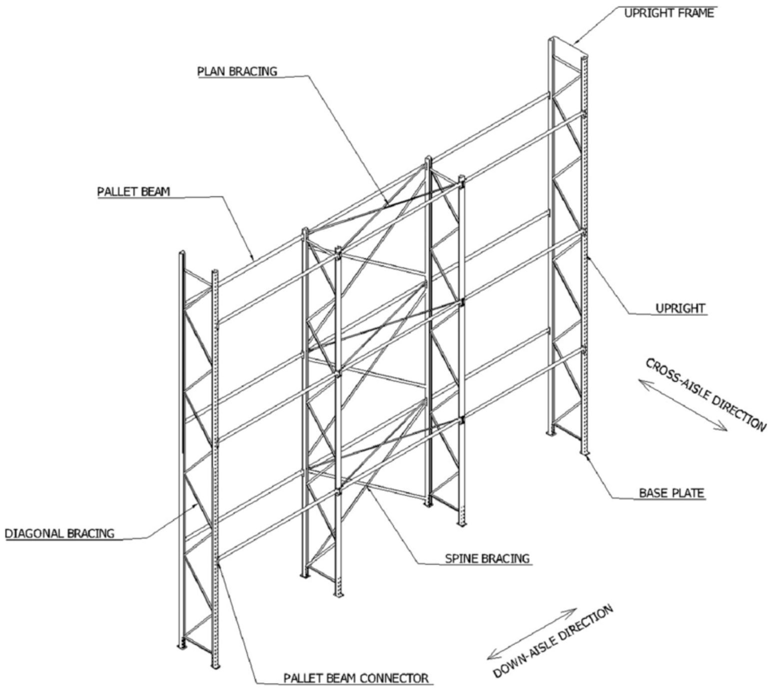

Fig. 5.1.3 Lifting and moving heavy components and materials in construction

Steps:

a. Identify the areas where bracing is needed based on the structural design and engineering calculations.

b. Choose suitable bracing materials, which can include steel rods, cables, or diagonal supports.

c. Secure one end of the brace to a structural member using appropriate fasteners.

d. Position the other end of the brace to connect to another structural member, forming a diagonal or cross-bracing pattern.

e. Tension the brace to provide the necessary stability.

f. Periodically inspect bracing to ensure it remains tight and secure.

3. **Guying Installation:**

Purpose: Guying is employed to stabilize tall or vertical structural elements, such as towers or columns, by anchoring them to the ground or other supports.

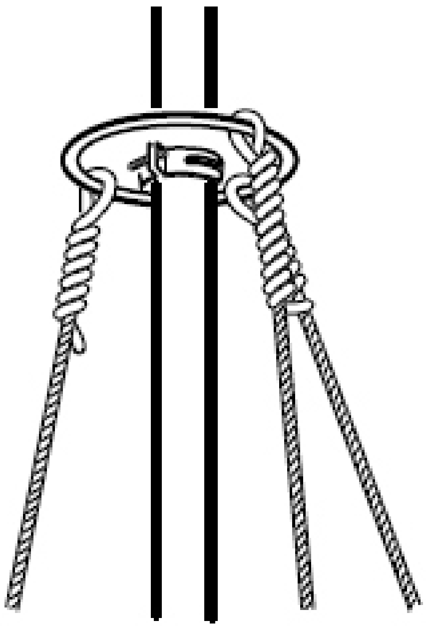

Fig. 5.1.6 Guying installation

Steps:

a. Determine the locations where guy wires are required based on structural analysis and design.

b. Select appropriate guy wire materials, typically steel cables.

c. Secure one end of the guy wire to the structural element using appropriate fasteners or attachments.

d. Position the other end of the guy wire and anchor it securely to the ground or a substantial support structure.

e. Tension the guy wire to ensure stability while avoiding over-tightening.

f. Regularly inspect guy wires to maintain proper tension and integrity.

Safety Considerations:

- Prioritize safety when installing shoring, bracing, and guying materials.
- Ensure that personnel involved in installation are trained and experienced in structural stability measures.

- Conduct regular inspections of all installed materials to identify and address any issues promptly.
- Comply with industry standards and engineering specifications for the installation of such materials.

By effectively installing shoring, bracing, and guying materials, fabricators contribute to the overall stability and safety of structural steel assemblies during construction, minimizing the risk of accidents or structural failures.

Fig. 5.1.7 Safety consideration

Notes

QR Codes

Scan the QR code to watch the video

https://youtu.be/A3v3ik3kmks

Reading Construction Drawings

https://youtu.be/fDoFkMbLFAs

Formwork, Shoring, and Bracing Requirements

UNIT 5.2: Erection Techniques and Alignment

Unit Objectives

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

1. Demonstrate how to place the steel assemblies/components accurately and make adjustments as per erection requirements.
2. Explain applicable tolerance to respective erection jobs.
3. Explain sequence of erection works as per proposed work method statement.
4. Explain checks to be carried out to ensure readiness of the base for erections.
5. Explain checks required for alignment and positioning of the erected elements.
6. Demonstrate how to do proper alignment of the erected steel assembly/component.

5.2.1 Placing Steel Assemblies/Components and Making Adjustments in Structural Steel Erection

In the job of a fabricator involved in the erection of structural steel assemblies at construction sites, accurately placing steel components and making adjustments as per erection requirements is crucial for a safe and precise assembly.

Fig. 5.2.1 Accurately placing steel components and making adjustments

Here's a step-by-step demonstration:

Step 1: Safety Precautions

- **Safety First:** Before any action, ensure that all safety measures are in place. Personal protective equipment (PPE) must be worn, and the work area should be secured.

Step 2: Positioning the Component

- **Component Inspection:** Inspect the steel component to be placed for any defects or damage that may affect its installation.
- **Lifting Equipment:** Use the appropriate lifting equipment, such as cranes or hoists, to position the component accurately.
- **Alignment Marks:** Align the component with pre-marked reference points on the supporting structure or foundation.

Step 3: Secure Placement

- **Temporary Fastening:** Use temporary fasteners, such as bolts or pins, to hold the component in its initial position.
- **Level and Plumb:** Use levelling tools and plumb bobs to ensure that the component is level and plumb as required by the design.

Step 4: Adjustment

- **Measurements:** Take precise measurements to confirm that the component is in the correct position and alignment.
- **Adjustment Tools:** Utilize tools like hydraulic jacks, shims, or wedges to make necessary adjustments.
- **Team Coordination:** Communicate with the rigging team and signalman to ensure coordinated adjustments.

Step 5: Verify Position

- **Double-Check:** Reconfirm the position and alignment of the component after adjustments are made.
- **Load Distribution:** Ensure that the load is evenly distributed across all support points.
- **Torque Bolts:** If bolts were temporarily used, torque them to the specified values as per engineering requirements.

Step 6: Welding and Permanent Fastening

- **Welding:** If welding is part of the assembly, weld the component to the supporting structure, ensuring strong and secure connections.
- **Permanent Fasteners:** Replace temporary fasteners with permanent ones, following the design specifications.

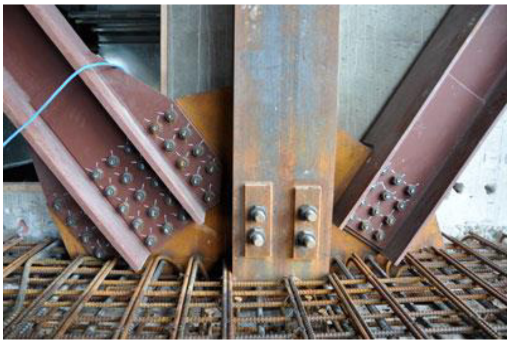

Fig. 5.2.2 Welding and permanent fastening

Step 7: Quality Check

- **Inspection:** Conduct a thorough visual and structural inspection to confirm that the component is securely in place and meets quality standards.
- **Documentation:** Document the installation process, adjustments made, and any deviations from the original plan.

Step 8: Load Testing (If Applicable)

- **Load Test:** If required, perform load testing to ensure that the installed component can handle the specified loads.

Step 9: Safety Sign-Off

- **Final Safety Check:** Ensure that all safety measures are maintained during and after the installation.
- **Sign-Off:** Once the component is correctly installed and meets all safety and quality standards, obtain the necessary sign-off from a supervisor or engineer.

This demonstration illustrates the meticulous process of placing steel assemblies/components accurately and making necessary adjustments during structural steel erection. Following these steps ensures the safe and precise assembly of structural steel elements at construction sites.

5.2.2 Understanding Applicable Tolerances in Structural Steel Erection

In the job of a fabricator involved in the erection of structural steel assemblies at construction sites, understanding and adhering to applicable tolerances is crucial to ensure the integrity and functionality of the structure.

Tolerance refers to the allowable variation or deviation from specified dimensions, positions, or alignments.

Fig. 5.2.3 Applicable tolerances in structural steel erection

Here's an explanation of applicable tolerance considerations:

1. **Dimensional Tolerance:**
   - **Purpose:** Dimensional tolerance defines the permissible variation in the size and shape of structural steel components.
   - **Applicability:** Relevant to the dimensions of steel beams, columns, girders, and other structural elements.
   - **Example:** If the design specifies a beam length of 10 meters with a tolerance of ±5 millimeters, the actual length of the erected beam can range from 9.995 meters to 10.005 meters.
2. **Positional Tolerance:**
   - **Purpose:** Positional tolerance determines how much a structural component can deviate from its specified location.
   - **Applicability:** Important when aligning and placing steel components accurately in relation to their intended positions.
   - **Example:** For a column base plate, a positional tolerance of ±3 millimeters means that the center of the column can be up to 3 millimeters off from the specified location.
3. Angular Tolerance:
   - **Purpose:** Angular tolerance allows for permissible variations in angles or slopes of structural members.
   - **Applicability:** Relevant for components requiring specific angles, such as diagonal braces or sloping beams.
   - **Example:** If a brace must be installed at a 45-degree angle with a tolerance of ±1 degree, the actual angle can vary between 44 and 46 degrees.
4. **Welding and Joint Tolerance:**
   - **Purpose:** Welding and joint tolerance defines the acceptable variations in weld size, shape, and alignment.
   - **Applicability:** Crucial for ensuring proper weld quality and alignment of structural connections.
   - Example: If the weld size must be 8 millimeters with a tolerance of ±1 millimeter, the weld size can range from 7 to 9 millimeters.
5. **Vertical and Horizontal Alignment Tolerance:**
   - **Purpose:** Vertical and horizontal alignment tolerance specifies permissible deviations from plumb (vertical) or level (horizontal) positions.
   - **Applicability:** Critical for columns, walls, and other vertical or horizontal structural elements.
   - **Example:** If a wall must be erected perfectly plumb with a tolerance of ±5 millimeters, it can

lean up to 5 millimeters from the vertical axis.

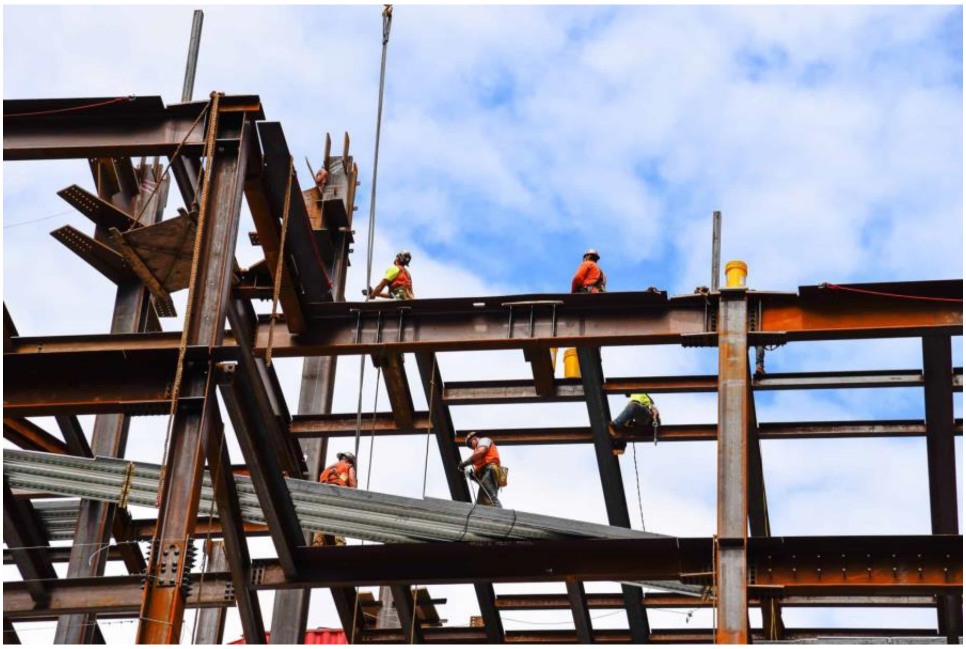

Fig. 5.2.4 Vertical and horizontal alignment tolerance

6. **Safety and Load-Bearing Tolerance:**

   - **Purpose:** Safety and load-bearing tolerance ensures that structural components can safely support the intended loads.
   - **Applicability:** Vital for structural stability and safety.
   - **Example:** If a beam must support a load of 100 tons with a tolerance of ±10%, it can safely handle loads ranging from 90 to 110 tons.

7. **Cumulative Tolerance:**

   - **Purpose:** Cumulative tolerance considers the combined effects of individual tolerances in an assembly.
   - **Applicability:** Relevant when multiple components are assembled together, and their individual tolerances can accumulate.
   - **Example:** If two beams with ±2 millimeter dimensional tolerance are joined, the cumulative tolerance could be ±4 millimeters.

Understanding and adhering to these applicable tolerances is essential to ensure that the erected structural steel assemblies meet design specifications, safety standards, and structural integrity requirements. Compliance with tolerance limits helps prevent issues like misalignment, structural instability, or costly rework during construction.

5.2.3 Sequence of Erection Works in Structural Steel Assembly

A well-defined sequence of erection works is essential for the safe and efficient assembly of structural steel components at construction sites.

Fig. 5.2.5 Erection works in structural steel assembly

Below, we present a visual infographic outlining the typical sequence of erection works as per a proposed work method statement:

1. **Mobilize Equipment and Personnel:**
    - Arrange for the arrival of cranes, lifts, and necessary equipment.
    - Ensure that the erection crew is present and briefed on safety procedures.
2. **Prepare the Work Area:**
    - Clear and level the work area.
    - Install shoring, bracing, and guying materials as needed for support.
3. **Inspect Components:**
    - Thoroughly inspect all steel components for defects or damage.
    - Confirm that components match the design specifications.
4. **Lifting Plan and Rigging:**

- Develop a lifting plan specifying crane capacities and rigging requirements.
- Rig components for safe lifting, ensuring proper slings, shackles, and spreader bars.

Fig. 5.2.6 Rig components for safe lifting

5. **Lifting and Placement:**
    - Use cranes to lift and place steel components in their designated positions.
    - Ensure accurate alignment and levelness during placement.
6. **Temporary Fastening:**
    - Temporarily fasten components in place using bolts, pins, or other fasteners.
    - Verify stability and alignment.
7. **Welding and Permanent Fastening:**
    - Weld components to create permanent connections where specified.
    - Replace temporary fasteners with permanent bolts or connections.
8. **Inspection and Quality Checks:**
    - Conduct visual and structural inspections to ensure components are properly aligned and secured.
    - Verify that welding meets quality standards.

9. Load Testing (If Applicable):

- If required, perform load tests to validate the structural integrity of connections and components.

Fig. 5.2.7 Validating the structural integrity of connections and components

10. Documentation:

- Maintain detailed records of the erection process, including any adjustments or deviations from the plan.
- Ensure all safety and quality checks are documented.

11. Safety Measures:

- Throughout the process, prioritize safety by enforcing safety protocols, PPE, and fall protection.

12. Sign-Off and Handover:

- Obtain sign-off from a supervisor or engineer confirming the successful completion of erection works.
- Hand over the assembled structure for further construction phases.

This visual infographic provides a clear overview of the sequential steps involved in erecting structural steel components at a construction site. Following this proposed work method statement ensures a systematic and safe assembly process, contributing to the successful completion of the project.

5.2.4 Ensuring Base Readiness for Structural Steel Erections

Ensuring the readiness of the base for structural steel erections is a critical step in construction. Below is a visual checklist in the form of an infographic that outlines the essential checks to be carried out before erecting steel components at a construction site:

1. **Foundation Inspection:**
   - Verify that the foundation is properly excavated and levelled.
   - Check for any loose soil, debris, or obstructions.

Fig. 5.2.8 Base readiness for structural steel erections

2. **Concrete Cure:**
   - Ensure that the concrete foundation has cured to the specified strength.
   - Verify that no cracks or voids are present.
3. **Anchor Bolt Placement:**
   - Confirm that anchor bolts or embeds are correctly positioned and aligned with the steel component layout.
   - Measure the anchor bolt projections to match design requirements.
4. **Levelness and Plumb:**
   - Use a levelling tool to check the levelness of the foundation.
   - Verify that the foundation is plumb, ensuring vertical alignment.

5. **Surface Preparation:**
   - Clean the foundation surface of any dirt, oil, or contaminants.
   - Apply any required coatings or corrosion protection.
6. **Adequate Load-Bearing Capacity:**
   - Verify that the foundation can support the anticipated loads.
   - Ensure that soil tests and engineering calculations confirm capacity.
7. **Safety Measures:**
   - Confirm that safety barriers and fall protection systems are in place.
   - Ensure that personnel are trained in safety protocols and have appropriate PPE.
8. **Accessibility:**
   - Ensure that the erection area is accessible to lifting equipment and personnel.
   - Check for any obstructions or restricted pathways.
9. **Environmental Conditions:**
   - Assess weather conditions, including wind speed and precipitation.
   - Determine if conditions are suitable for safe erection work.
10. **Communication and Coordination:**
    - Establish clear communication channels with crane operators, signalmen, and the erection team.
    - Confirm that all team members are briefed on the plan.
11. **Emergency Procedures:**
    - Develop and communicate emergency procedures for unexpected situations.
    - Ensure all team members are aware of evacuation routes and emergency contacts.
12. **Documentation:**
    - Maintain records of all base readiness checks and inspections.
    - Document any corrective actions taken if issues are identified.
13. **Engineer’s Approval:**
    - Obtain approval from a structural engineer or supervisor confirming base readiness.

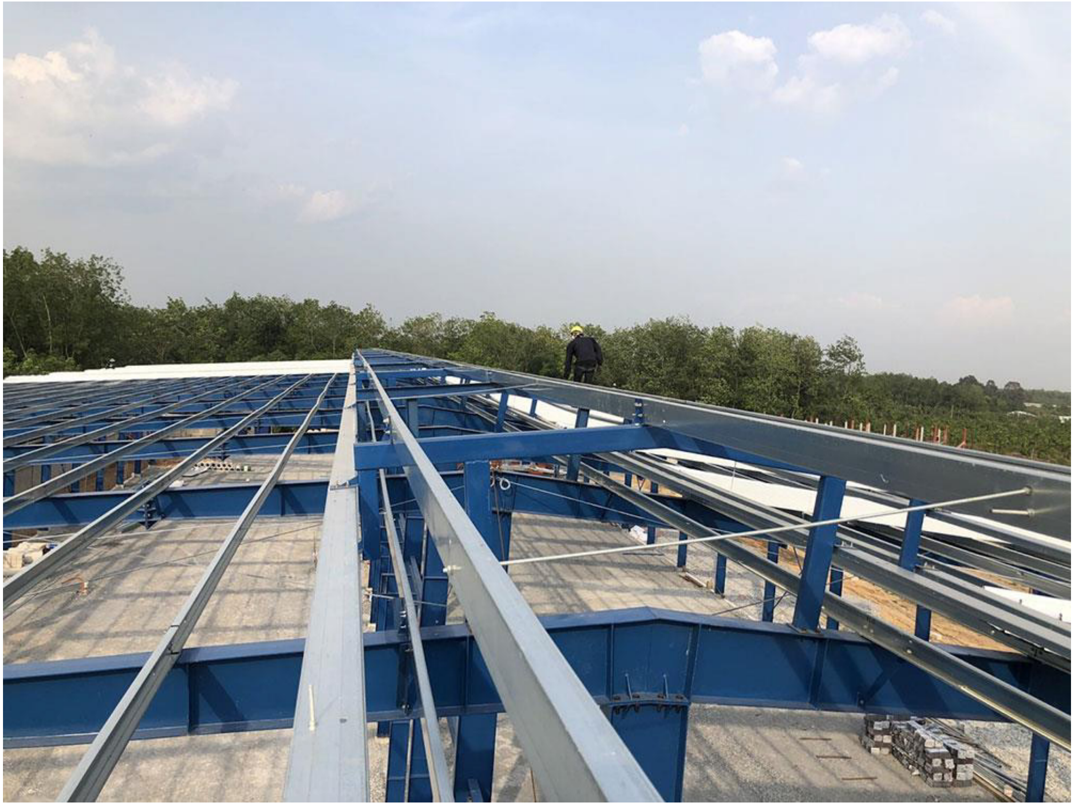

Fig. 5.2.9 Structural steel erections

By following this visual checklist, construction teams can systematically ensure that the base is fully prepared for structural steel erections. These checks contribute to the safety, stability, and quality of the erection process, ultimately leading to the successful completion of the project.

5.2.5 Alignment and Positioning Checks for Erected Elements

Proper alignment and positioning of erected elements are crucial in ensuring the structural integrity and safety of a construction project.

Here, we present a visual guide in the form of an infographic that outlines the essential checks and procedures to ensure precise alignment and positioning of structural steel components:

1. **Reference Points:**
    - Establish clear reference points on the foundation or adjacent elements.
    - These points serve as guides for accurate alignment.
2. **Laser Alignment:**
    - Use laser alignment equipment for high-precision alignment.

- Ensure the laser beam aligns with reference points.

3. **Plumb Bobs:**
    - Employ plumb bobs to confirm vertical alignment (plumb) of columns and other vertical elements.
    - Check that the plumb bob string aligns with the reference point.
4. **Levelling Instruments:**
    - Utilize levelling instruments such as spirit levels or digital levellers.
    - Verify that horizontal elements are level and not tilted.

Fig. 5.2.10 Utilizing levelling instruments

5. **Surveying Instruments:**
    - In larger projects, consider surveying instruments like total stations for accurate positioning.
    - Use survey data to confirm precise coordinates.
6. **String Lines:**
    - Stretch string lines across elements to ensure straightness and alignment.
    - Adjust elements until they align with the string.
7. **Tolerances:**
    - Refer to project specifications and engineering tolerances for allowable deviations.
    - Ensure that elements meet specified alignment and positioning criteria.
8. **Welding Checks:**
    - During welding, inspect joints for proper fit-up and alignment.

- Correct any misalignment before welding to prevent defects.

Fig. 5.2.9 Structural steel erections

9. Pre-Assembly Checks:

- For complex assemblies, pre-assemble components on the ground.
- Confirm alignment and fit before final installation.

10. Measuring Tools:

- Use measuring tools like callipers or micrometres for precision measurements.
- Check critical dimensions and alignments.

11. Engineering Approval:

- Seek approval from structural engineers or supervisors for alignment and positioning.
- Ensure compliance with design specifications.

12. Documentation:

- Maintain records of alignment and positioning checks.
- Document any corrective actions taken if alignment issues arise.

13. Safety Measures:

- Prioritize safety during alignment and positioning activities.
- Use fall protection and safety barriers as needed.

By following these alignment and positioning checks, construction teams can ensure that structural steel components are accurately placed and aligned according to design specifications. This visual guide provides a systematic approach to achieving precision in the erection process, contributing to the overall quality and safety of the construction project.

5.2.6 Demonstrating Proper Alignment of Erected Steel Assembly/Component

Achieving precise alignment of steel assemblies or components during erection is critical to ensure structural integrity and safety.

Fig. 5.2.12 Achieving precise alignment of steel assemblies or components

Here, we provide a step-by-step demonstration using an infographic to illustrate how to properly align an erected steel assembly/component:

- **Step 1:** Establish Reference Points
  - Begin by establishing reference points on the foundation or adjacent elements.
  - These points will serve as guides for alignment.
- **Step 2:** Use Laser Alignment
  - Employ laser alignment equipment for high-precision alignment.
  - Position the laser beam to align with the established reference points.
- **Step 3:** Check Vertical Alignment with Plumb Bobs
  - Confirm the vertical alignment (plumb) of columns or vertical elements.
  - Use plumb bobs and ensure that the string aligns with the reference point.
- **Step 4:** Verify Horizontal Alignment with Levelling Instruments
  - Utilize levelling instruments such as spirit levels or digital levellers.

Fig. 5.2.13 Laser alignment

    - Check that horizontal elements are level and not tilted.
- **Step 5:** Stretch String Lines for Straightness
    - To ensure straightness and alignment, stretch string lines across elements.
    - Adjust elements until they align perfectly with the string.
- **Step 6:** Adhere to Tolerances
    - Refer to project specifications and engineering tolerances for allowable deviations.
    - Ensure that the alignment meets specified criteria.
- **Step 7:** Inspect Weld Joints
    - During welding, inspect joints for proper fit-up and alignment.
    - Correct any misalignment before welding to prevent defects.
- **Step 8:** Pre-Assembly and Measurements
    - For complex assemblies, consider pre-assembling components on the ground.
    - Confirm alignment and fit before final installation.
    - Use measuring tools like callipers or micrometres for precision measurements.
- **Step 9:** Seek Engineering Approval
    - Seek approval from structural engineers or supervisors for alignment.
    - Ensure compliance with design specifications.
    - Step 10: Maintain Safety Measures
    - Prioritize safety during alignment activities.
    - Use fall protection and safety barriers as needed.
- **Step 11:** Documentation
    - Keep records of alignment checks and any corrective actions taken.
    - Document alignment measurements and adjustments made.

By following this step-by-step demonstration, construction teams can effectively achieve proper alignment of steel assemblies or components during erection, ensuring the structural integrity and safety of the construction project.

Notes

QR Codes

Scan the QR code to watch the video

https://youtu.be/CmTRThjb6mc

Master Craftsmen - Erecting Steel

UNIT 5.3: Connection and Communication

Unit Objectives

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

1. Perform installation of temporary connections using appropriate tools.
2. Perform tightening of bolted connections to the specified tolerance and torque using an appropriate torque wrench.
3. Demonstrate how to communicate efficiently with the signalman or operator for precise movement of assemblies.

5.3.1 Installation of Temporary Connections in Structural Steel Erection

In structural steel erection, temporary connections play a vital role in stabilizing components during the assembly process.

Fig. 5.3.1 Temporary connections in structural steel erection

Below, we present a visual guide in the form of an infographic that outlines the steps for performing the installation of temporary connections using appropriate tools:

- **Step 1:** Gather Required Tools and Materials

  Before starting, gather the necessary tools and materials, including bolts, nuts, washers, wrenches, and any other connection-specific components.

- **Step 2:** Identify Connection Points

  Identify the connection points where temporary connections are needed. These points are typically marked on the steel components or specified in the erection plan.

- **Step 3:** Insert Bolts

  Insert bolts through the pre-drilled holes in the steel components at the designated connection points.

- **Step 4:** Add Washers and Nuts

  Place washers over the protruding bolt ends, followed by nuts. Ensure they are finger-tightened initially.

- **Step 5:** Align Components

  Align the steel components according to the erection plan, ensuring that they fit together accurately.

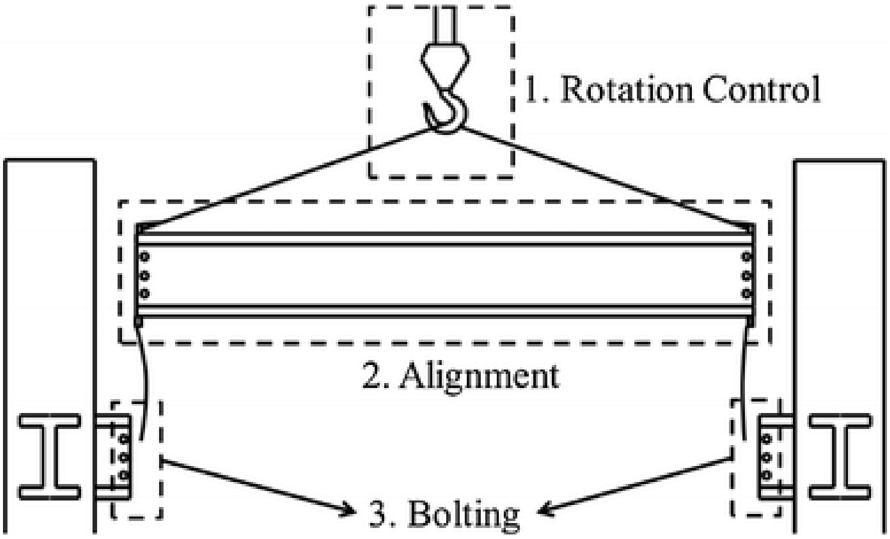

Fig. 5.3.2 Erection plan for aligning components

- **Step 6:** Tighten Nuts

  Use an appropriate wrench or torque wrench to tighten the nuts securely. Follow the specified torque values to achieve the required tension.

- **Step 7:** Check Alignment

  After tightening, verify that the components remain aligned and in the correct position. Adjust if necessary.

- **Step 8:** Repeat for Additional Connections

  Repeat the above steps for all necessary temporary connections in the assembly. Ensure consistency and precision.

- **Step 9:** Inspection and Quality Control

Inspect all temporary connections to confirm proper installation. Check for tightness, alignment, and overall stability.

- **Step 10:** Structural Stability

  Temporary connections should provide stability during the assembly process but must be designed for easy removal during the final connection phase.

Fig. 5.3.3 Structural stability

- **Step 11:** Document Temporary Connections

  Maintain detailed records of temporary connections, including their locations and torque values applied. This documentation aids in quality control and ensures proper removal later.

By following these steps and utilizing the appropriate tools and materials, construction teams can safely and effectively install temporary connections in structural steel erection. These temporary connections are crucial in maintaining stability during assembly, ultimately contributing to the successful completion of the project.

5.3.2 Tightening Bolted Connections with a Torque Wrench

Fig. 5.3.4 Torque wrench

Illustrating the process of tightening bolted connections to specified tolerance and torque using a torque wrench with a visual infographic:

- **Step 1:** Select the Correct Torque Wrench

  Choose a torque wrench suitable for the specified torque values and the size of the bolts.

- **Step 2:** Identify the Bolted Connections

  Identify the bolted connections on the steel components that need to be tightened.

- **Step 3:** Attach the Torque Wrench

  Attach the torque wrench to the bolt's nut or head, ensuring a secure fit.

- **Step 4:** Set the Torque Value

  Set the torque wrench to the specified torque value as per project requirements.

- **Step 5:** Apply Torque Gradually

  Gradually apply force to the torque wrench handle, keeping it perpendicular to the bolt. The wrench will click or provide a signal when the specified torque is reached.

- **Step 6:** Verify Tightening

  Confirm that the bolted connection is tightened to the specified tolerance by visually inspecting or using additional torque measurement tools.

Fig. 5.3.5 Tightened bolted connection

- **Step 7:** Repeat for Other Connections

  Repeat the process for all bolted connections, following the torque specifications for each.

- **Step 8:** Document Tightening

  Document the tightening process, including the torque values applied to each connection. This documentation is essential for quality control and record-keeping.

By adhering to these steps and using an appropriate torque wrench, construction teams can accurately and consistently tighten bolted connections to the specified tolerance and torque, ensuring the structural integrity of the steel assemblies.

5.3.3 Efficient Communication with a Signalman or Operator for Precise Movement of Assemblies

In construction, efficient communication between the fabricator and the signalman or operator is essential for the safe and precise movement of heavy assemblies. Here's a visual infographic demonstrating how to communicate effectively:

- Step 1: Establish Clear Signals

  Agree on a set of clear and standardized hand signals or communication methods before beginning any movement.

Fig. 5.3.6 Establish clear signals

- **Step 2:** Visual Contact

  Ensure direct visual contact with the signalman or operator at all times. Maintain eye contact to establish a strong connection.

- **Step 3:** Use Standard Signals
  Use standardized signals that both parties understand. Examples include hand signals for "start," "stop," "raise," and "lower."
- **Step 4:** Signal Demonstration
  Demonstrate the intended signal to the operator before initiating any movement. Ensure they understand and acknowledge it.
- **Step 5:** Confirm Signal Acknowledgment
  Wait for the signalman or operator to acknowledge the signal before proceeding. This confirms they are ready for the movement.
- **Step 6:** Maintain Continuous Communication
  Maintain ongoing communication during the movement. Relay any necessary adjustments or changes in direction through clear signals.
- **Step 7:** Emergency Signals
  Establish emergency signals in case immediate stoppage or action is required. These signals should be well-defined and understood by both parties.
- **Step 8:** Operator's Perspective
  Consider the operator's perspective when giving signals. Use signals that are intuitive from their viewpoint.
- **Step 9:** Verify Successful Movement
  After the movement is completed, verify with the operator or signalman that the task was executed as intended.
- **Step 10:** Debrief and Feedback
  After the task, conduct a brief debriefing to discuss any challenges or improvements in communication. Incorporate feedback to enhance future operations.

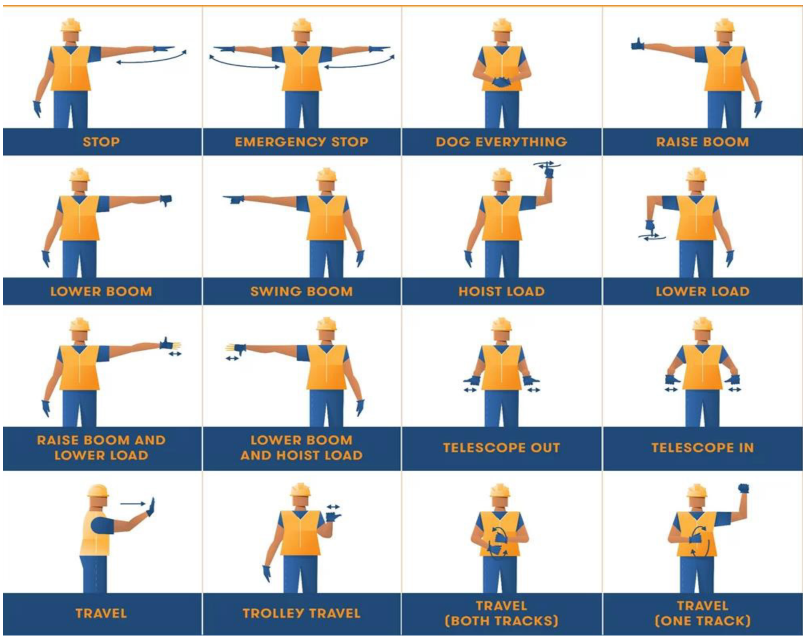

Fig. 5.3.7 Use standard signals

By following these communication practices and visual cues, fabricators can efficiently coordinate with signalmen or operators, ensuring precise and safe movement of assemblies during structural steel erection.

Exercise

Answer the following questions:

Short Questions:

1. What are the primary safety considerations when erecting structural steel assemblies at construction sites?
2. Explain the role of a signalman in the erection of steel structures.
3. What are the key steps involved in securing steel components during the erection process?
4. How does the use of temporary connections contribute to the structural integrity during erection?
5. Why is proper alignment crucial when erecting steel assemblies?

Fill-in-the-Blanks Questions:

1. The ____________ plays a crucial role in guiding crane operators during steel assembly erection.

   a. Rigger   b. Architect

2. Temporary connections are used to hold steel components together ________ during erection.

   a. Permanently   b. Temporarily

3. Erection of steel structures requires careful consideration of ________ conditions.

   a. Wind and weather   b. Paint color

4. The ________ of steel assemblies ensures that they are level and in the correct position.

   a. Alignment   b. Rotation

5. Safety helmets and ________ are essential personal protective equipment during steel assembly erection.

   a. Sunglasses   b. Harnesses

True/False Questions:

1. True or False: The signalman's role during steel assembly erection is not significant for safety.
2. True or False: Temporary connections in steel erection are meant to be permanent.
3. True or False: Weather conditions do not impact the safety of steel assembly erection.
4. True or False: Proper alignment of steel components is not crucial for structural integrity.
5. True or False: Safety helmets and harnesses are not necessary during steel assembly erection.

Notes

QR Codes

Scan the QR code to watch the video

https://youtu.be/xcUTFcjuzOk

Bolted Connection and Tightening Torque Basics

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

6. Communicate Effectively at Workplace

Unit 6.1 - Effective Communication and Teamwork

Unit 6.2 - Working Effectively and Maintaining Discipline at Work

Unit 6.3 - Maintaining Social Diversity at Work

CON/N8001

Key Learning Outcomes

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

1. Explain the effects and benefits of timely actions relevant to the task at hand with examples.
2. Explain the importance of teamwork and its effects relevant to the task at hand with examples.
3. Demonstrate teamwork skills during assigned task.
4. Explain the importance of proper and effective communication and its adverse effects in case of failure of proper communication.
5. Apply effective communication skills while interacting with co-workers, trade seniors and others during the assigned task.
6. Use appropriate writing skills and verbal communication reporting as per commonly applicable organisational norms.
7. Discuss about gender and its related concept: gender equality, gender equity (group work).
8. Discuss different types of disabilities (physical, mental, intellectual or sensory impairment).
9. Discuss the activities sensitive to the cultural diversity, disabilities and gender neutrality at the workplace.
10. Demonstrate acceptable interpersonal transactions with individuals having disabilities (physical, mental, intellectual or sensory impairment) or cultural diversity.
11. Discuss the basic rules and regulations related to gender sensitivity, disabilities, and cultural diversity, with their impact on operations of a workplace.
12. Demonstrate the process modifications required to make the workplace free from gender biases.
13. Discuss how to take initiative in resolving issues among co-workers in a given situation.
14. Discuss reporting procedure followed at the workplace.

Unit 6.1: Effective Communication and Teamwork

Unit Objectives

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

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

6.1.1 Communication at Workplace

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

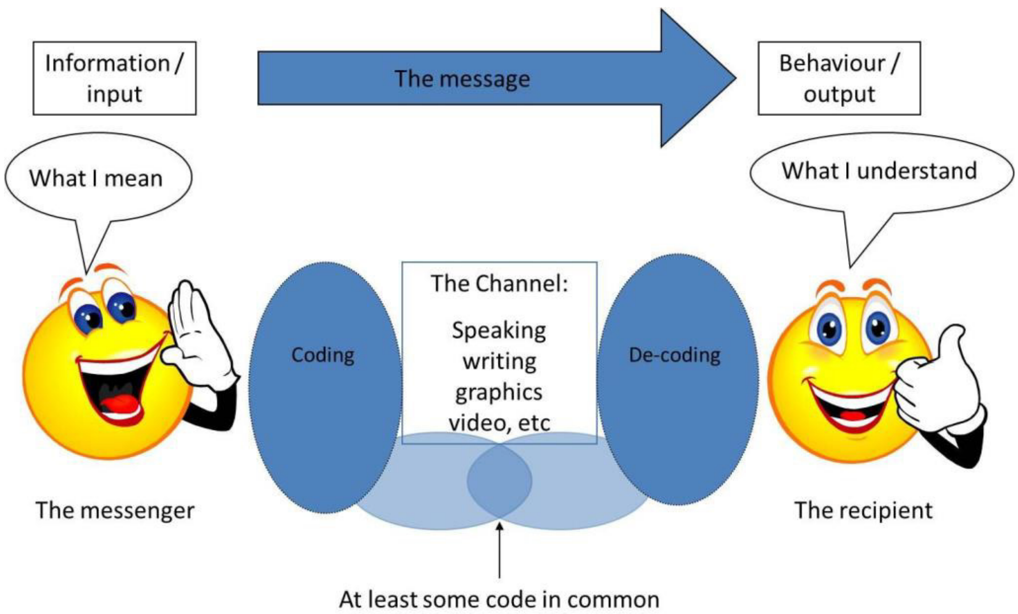

Fig. 6.1.1 Effective Communication – Two-way Process

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

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

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

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

Fig. 6.1.2 C's of Communication

6.1.2 Type of Communication at Construction Worksite

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

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

Some common communication methods include:

Fig. 6.1.3 Communication at Construction

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

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

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

Fig. 6.1.4 Coordination during Construction Work

6.1.3 Adverse Effects of Poor Communication

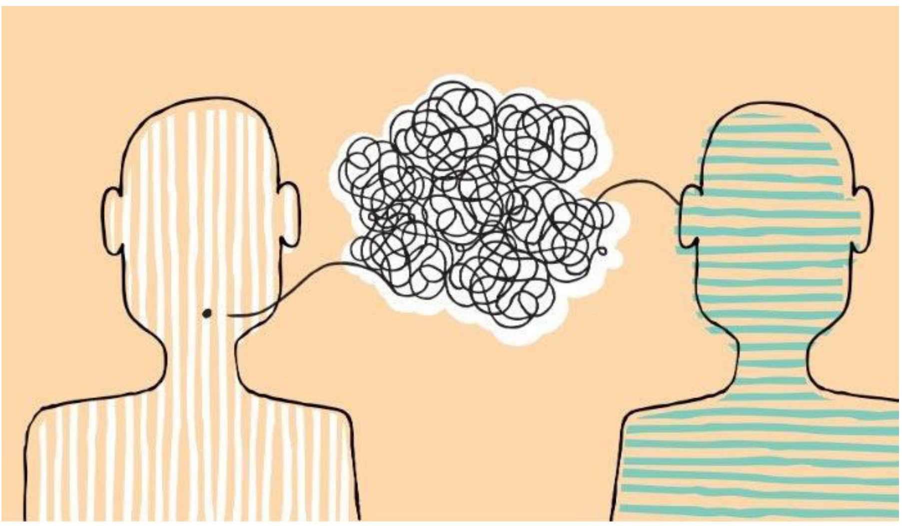

Fig. 6.1.5 Adverse Effects of Poor Communication

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

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

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

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

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

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

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

6.1.4 Teamwork at Workplace

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

Fig. 6.1.6 Teamwork at Workplace

Here are some key reasons highlighting the importance of teamwork:

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

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

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

6.1.5 The 5Cs of Teamwork

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

The 5Cs of teamwork are:

1. **Co-operation**

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

Fig. 6.1.7 Effective and Successful Collaboration

1. **Compromise**

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

2. **Communication**

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

3. **Confidence**

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

4. **Commitment**

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

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

6.1.7 Consequence of Poor Teamwork

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

Some of the key consequences of poor teamwork include:

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

Fig. 6.1.8 Poor Teamwork

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

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

Notes

Unit 6.2: Working Effectively and Maintaining Discipline at Work

Unit Objectives

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

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

6.2.1 Discipline at Work

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

Fig. 6.2.1 Discipline at Work

Here are some key aspects of discipline at work:

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

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

6.2.2 Time Management

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

By effectively managing their time, employees will meet deadlines, increase their effectiveness, become more productive, and produce superior work.

Fig. 6.2.2 Time Management

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

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

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

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

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

6.2.3 Interpersonal Conflicts at Construction by Workers

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

Some common causes of interpersonal conflicts at construction sites include:

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

Fig. 6.2.3 Interpersonal Conflicts

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

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

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

Fig. 7.2.3 Interpersonal Conflicts

Notes

Unit 6.3: Maintaining Social Diversity at Work

Unit Objectives

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

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

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.

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

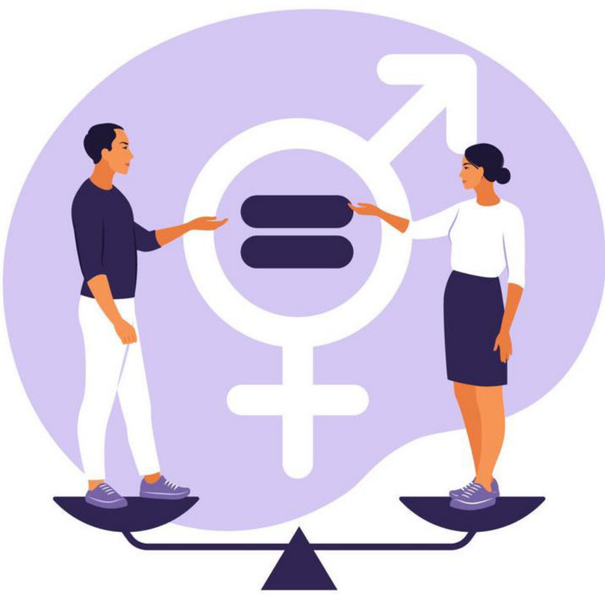

Fig. 6.3.1 Gender Equality

Important Terms

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

Fig. 6.3.2 Gender Discrimination

Strategies for Enhancing Gender Equity

To enhance gender equity, one should:

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

Bridging Gender Differences

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

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

In order to bridge the gap, one should:

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

Fig. 6.3.3 Promoting Gender Sensitivity at Workplace

Ways to Promote Gender Sensitivity in the Workplace

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

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

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.

Fig. 6.3.4 Disability-Friendly Workplace

Important Terms

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

f) Mental retardation

g) Mental illness

PwD Sensitivity

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

Ways to be PwD Sensitive

To be sensitive to PwD, one should:

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

Appropriate Verbal Communication

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

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

Appropriate Non-verbal Communication

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

- **Facial expressions -** The human face is quite expressive, capable of conveying many emotions without using words. Facial expressions must usually be maintained neutral and should change according to the situation, e.g. smile as a gesture of greeting.

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

Rights of PwD

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

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

Making Workplace PwD Friendly

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

Expected Employer Behaviour

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

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

Fig. 6.3.4 Disability-Friendly Workplace

Exercise

Answer the following questions:

Short Questions:

A. Why is effective communication important in construction job roles?

B. What are the consequences of poor teamwork on project outcomes and safety at a construction site?

C. How can you pass on work-related information clearly to your team members?

D. What are some different modes of communication used in the workplace?

E. Why is creating a healthy and cooperative work environment important among gangs of workers?

Fill-in-the-Blanks Questions:

A. ________________ (Effective / Limited) communication ensures that project goals and tasks are understood by everyone.

B. Poor teamwork can lead to delays, compromised ________________ (Quality / Efficiency), and increased safety risks.

C. To ensure clarity, it's essential to provide work-related information to team members in a ________________ (Concise / Detailed) manner.

D. Communication modes include verbal, written, visual, and ________________ (Digital / Auditory) forms.

E. Creating a cooperative work environment fosters efficient collaboration and ________________ (Unity / Isolation) among workers.

True/False Questions:

A. Effective communication is only important for supervisory roles. (True/False)

B. Poor teamwork rarely affects project timelines or safety on a construction site. (True/False)

C. Passing on work-related information is not necessary if everyone has their own tasks. (True/False)

D. Communication modes in the workplace are limited to verbal and written forms. (True/False)

E. A cooperative work environment can enhance productivity and worker morale. (True/False)

Notes

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

7. Follow Safety Norms as defined by organization, Adopt Healthy and Safe Work Practices

Construction Skill Development Council

CON/N9001

Key Learning Outcomes

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

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

Unit 7.1 - Hazards and Emergency Situations

Unit Objectives

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

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

9.1.1 Hazards at Workplace

Hazards versus Risk: A hazard possesses the potential to induce harm, whereas risk pertains to the probability of harm occurring as a result of being exposed to that hazard.

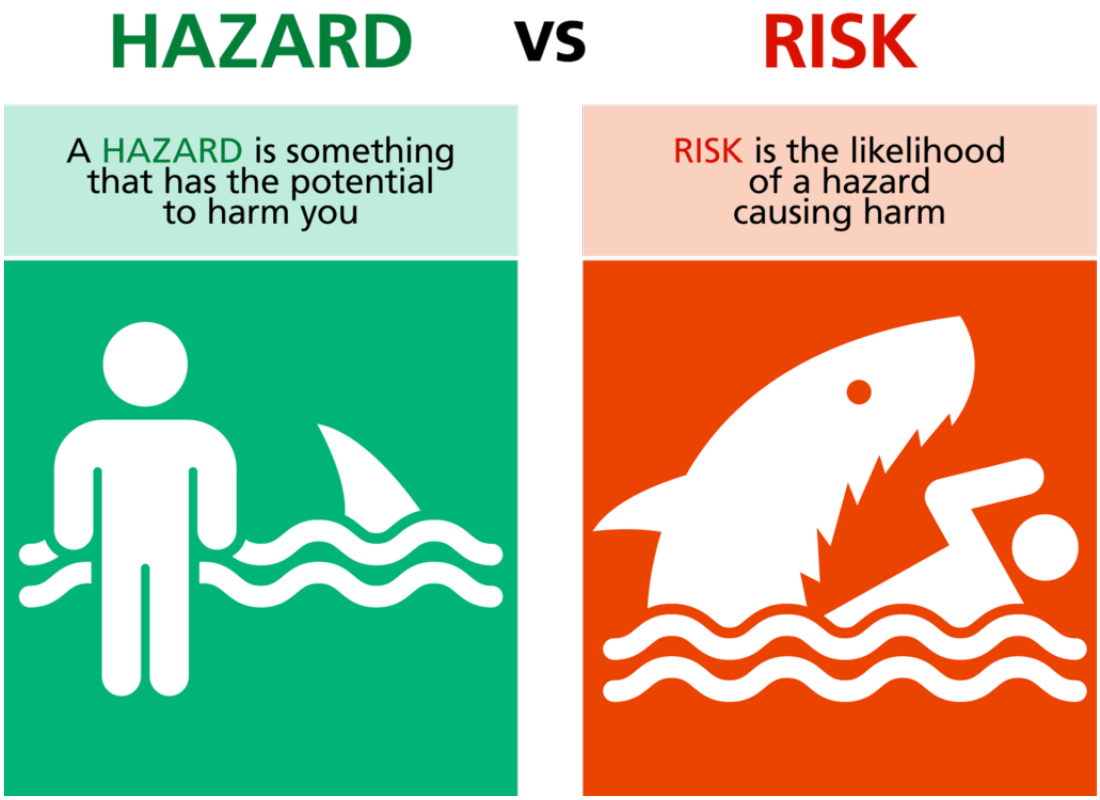

Fig. 7.1.1 Hazards versus Risk

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

Fig. 7.1.2 Workplace Hazards

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

- **Physical Hazards:**
    - Slips, trips, and falls
    - Falling objects or materials
    - Contact with moving machinery or equipment
    - Noise and vibration
    - Extreme temperatures (hot or cold)
    - Poor ergonomics leading to musculoskeletal disorders
- **Electrical Hazards:**
    - Electrical shock or electrocution
    - Short circuits or electrical fires
- **Fire and Explosion Hazards:**
    - Combustible materials
    - Electrical equipment malfunctions
    - Inadequate fire safety measures
- **Vehicle-Related Hazards:**
    - Accidents involving vehicles or heavy machinery
    - Forklift incidents in warehouses and industrial settings
- **Chemical Hazards:**
    - Exposure to toxic or hazardous substances (e.g., chemicals, fumes, gases)
    - Skin contact with irritants or corrosive materials
    - Chemical spills or leaks

- **Psychosocial Hazards:**
  - Workplace stress and pressure
  - Bullying or harassment
  - Job insecurity
  - Long working hours and inadequate rest breaks

Identifying and mitigating workplace hazards is essential to ensuring the health and safety of employees. Employers should conduct regular risk assessments and implement appropriate safety measures and training to minimize the risks associated with these hazards.

Fig. 7.1.3 Risk Associated with Hazards

7.1.2 Hazard Identification and Risk Assessment (HIRA):

Hazard Identification and Risk Assessment (HIRA) is a systematic process used to identify potential hazards in a workplace or any activity and assess the associated risks.

The primary goal of HIRA is to proactively identify and evaluate potential dangers to prevent accidents, injuries, and adverse health effects. It is a fundamental component of occupational health and safety management.

Fig. 7.1.4 Risk Assessment

The HIRA process typically involves the following steps:

- Conduct a comprehensive site survey to identify potential hazards at the construction site.
- Involve workers, supervisors, and safety personnel in the hazard identification process.
- Prioritize hazards based on their severity and likelihood of occurrence.
- Assess the risks associated with each identified hazard, considering potential consequences and exposure frequency.
- Implement appropriate control measures to reduce or eliminate the identified risks.
- Use the hierarchy of controls (elimination, substitution, engineering controls, administrative controls, and PPE) to address hazards effectively.
- Provide necessary training and awareness programs for workers on identified hazards and safety protocols.
- Regularly review and update the hazard identification and risk assessment as the construction progresses.
- Maintain proper documentation of the hazard identification and risk assessment process.
- Foster a culture of safety and encourage workers to report any new hazards or safety concerns.

Fig. 7.1.5 Risk Management Process

HIRA is an ongoing process that requires the involvement and cooperation of all stakeholders, including workers, supervisors, safety officers, and management.

It helps create a safer work environment, reduces the likelihood of accidents, and contributes to improved overall occupational health and safety.

Hazards Specific to Domain-Related Works in Construction:

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

- **Painting Hazards:** Painters may encounter risks from working at heights, using chemicals in paints, and exposure to fumes.
- **Tunneling Hazards:** Workers involved in tunnel construction face risks of collapse, flooding, and exposure to harmful gases.

Different domain-related works have their unique risks, and it's essential to tailor safety measures accordingly to ensure a safe work environment for all employees.

7.1.3 Workplace Warning Signs:

Workplace warning signs are essential visual cues used in various environments to convey important information, instructions, or potential hazards.

These signs play a crucial role in promoting safety, providing guidance, and preventing accidents.

Safety signs are essential visual cues used to convey critical safety information and promote safety awareness in various environments.

Safety Signs are generally divided into 4 Categories along with their Colour Codes:

- Red
- Blue
- Yellow
- Green

Fig. 7.1.6 Workplace Warning Signs

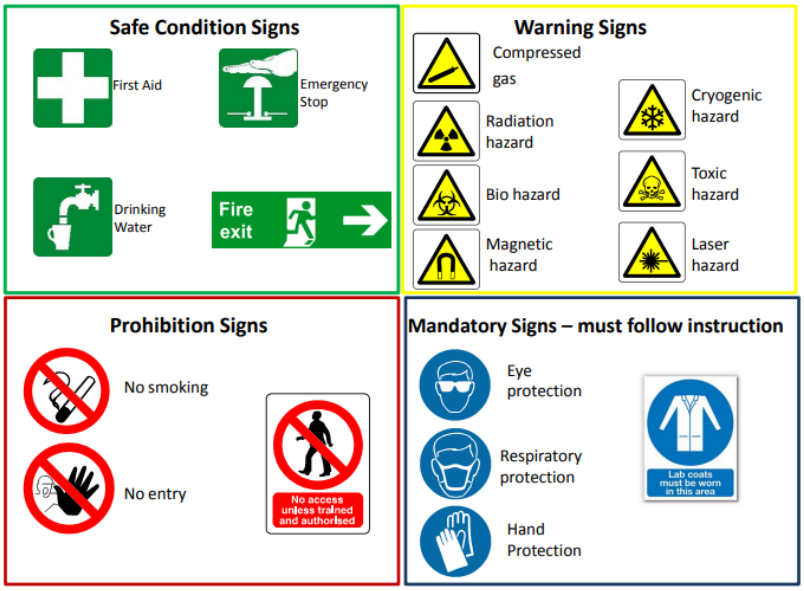

Fig. 7.1.7 Four Types of Safety Signs and their Colour

7.1.4 Emergency Response Plan (ERP)

An Emergency Response Plan (ERP) is a comprehensive document that outlines procedures, protocols, and responsibilities to be followed in the event of emergencies or critical incidents.

The ERP is designed to ensure the safety and well-being of individuals, property, and the environment during emergencies.

Fig. 7.1.8 Emergency Response Plan (ERP)

7.1.5 Reporting Emergency

Reporting procedures in case of emergency situations at a construction site play a crucial role in ensuring the safety of workers and facilitating a swift and coordinated response. The specific reporting procedure may vary depending on the construction site's policies and the type of emergency.

Fig. 7.1.10 Reporting Emergency Situations

However, here are general steps to follow when reporting an emergency situation at a construction site in India:

1. **Assess the Situation:** Quickly assess the nature and severity of the emergency while ensuring your safety and the safety of others, if possible.
2. **Activate the Alarm:** If the construction site has an alarm or emergency alert system, activate it to alert other workers and personnel about the emergency.
3. **Call Emergency Services:** Dial the appropriate emergency services number in India, which is 112, to connect to Police, Fire, and Medical emergency services.
4. **Provide Essential Information:** When calling emergency services, provide the operator with the following information:
    - The type of emergency (e.g., fire, collapse, injury).
    - The exact location of the construction site, including the address or nearby landmarks.
    - Any specific hazards or risks present at the site.
    - The number of people involved or injured (if known).
5. **Notify On-Site Personnel:** Inform the on-site supervisor, safety officer, or designated emergency response team members about the emergency.
6. **Follow the Construction Site's Emergency Response Plan:** Comply with the specific reporting procedures outlined in the construction site's Emergency Response Plan. This may involve contacting a specific individual or department responsible for handling emergencies.
7. **Cooperate with Authorities:** Once emergency services arrive at the construction site, cooperate fully with the authorities and follow any instructions provided by them.
8. **Inform Contractors or Site Management:** If the construction site involves multiple contractors or has site management, inform them about the emergency situation.
9. **Document the Incident:** After the emergency has been addressed, document the incident thoroughly, including the details of the emergency, response actions taken, and any injuries or damages incurred.
10. **Review and Improve Procedures:** After the emergency situation has been resolved, review the response and reporting procedures to identify any areas for improvement and make necessary adjustments to the Emergency Response Plan.

It is essential for all personnel working at the construction site to be familiar with the site's specific emergency response procedures and protocols. Regular training, drills, and awareness programs can help ensure that everyone knows how to respond effectively in case of emergencies, reducing the risk of injuries and minimizing damage to property.

Notes

Unit 7.2: Safety Drills, PPEs and Fire Safety

Unit Objectives

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

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

7.2.1 Fire Triangle & Fire Types

Fire is a chemical reaction that occurs when a substance combines with oxygen and releases heat, light, and various combustion products. It is a rapid oxidation process that can lead to destructive consequences if not controlled.

The fire triangle is a simple model used to illustrate the three essential components necessary for a fire to occur. These three components must be present simultaneously for a fire to ignite and sustain itself.

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

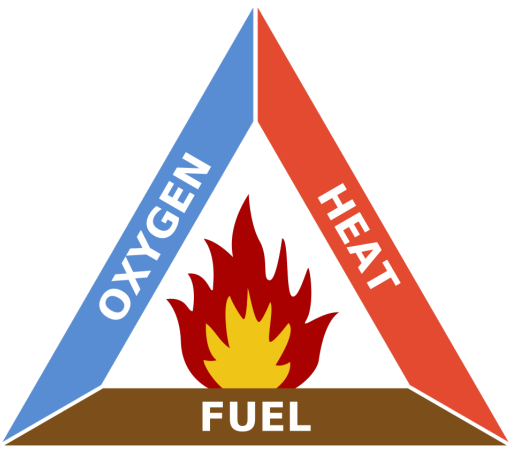

Fig. 7.2.1 Fire Triangle

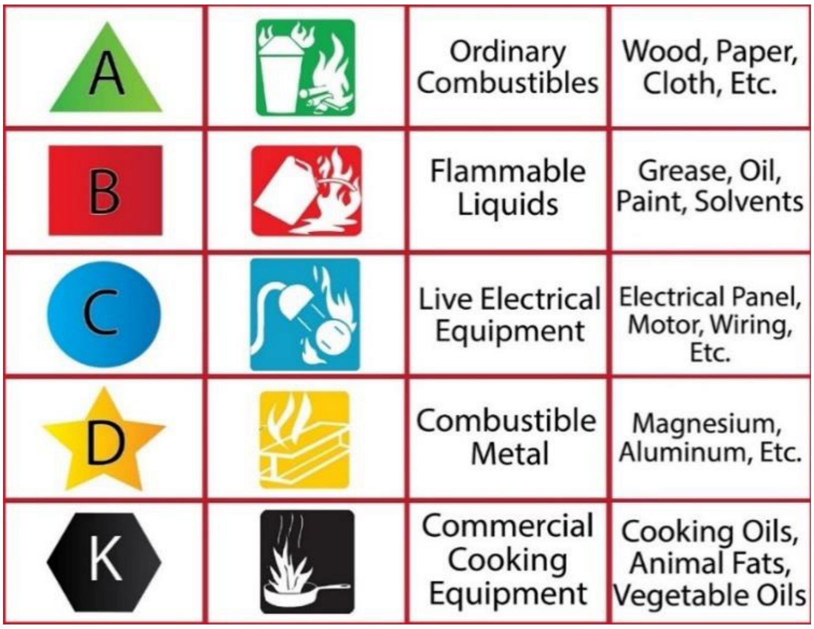

Fig. 7.2.1 Fire Triangle

It is essential to use the appropriate extinguishing agents and follow proper fire safety protocols based on the type of fire to ensure effective firefighting and minimize risks to life and property. Fire safety training and understanding the different types of fires are crucial for individuals to respond safely and efficiently in the event of a fire emergency.

7.2.2 Fire Safety

Fire safety is a set of actions aimed at reducing the amount of damage caused by fire.

Fire safety procedures include both those that are used to prevent an uncontrolled fire from starting and those that are used to minimise the spread and impact of a fire after it has started. Developing and implementing fire safety measures in the workplace is not only mandated by law but is also essential for the protection of everyone who may be present in the building during a fire emergency.

Fig. 7.2.3 Fire at Construction Site

The basic Fire Safety Responsibilities are:

- To identify risks on the premises, a fire risk assessment must be carried out.
- Ascertain that fire safety measures are properly installed.
- Prepare for unexpected events.
- Fire safety instructions and training should be provided to the employees.

Prevention of a Workplace Fire:

- Workplace fire drills should be conducted regularly.
- If one has a manual alarm, one should raise it.
- Close the doors and leave the fire-stricken area as soon as possible. Ensure that the evacuation is quick and painless.
- Turn off dangerous machines, and don't stop to get personal items.
- Assemble at a central location. Ascertain that the assembly point is easily accessible to the employees.
- If one's clothing catches fire, one shouldn't rush about it. They should stop, descend on the ground, and roll to smother the flames if their clothes catch fire.

7.2.3 Fire Extinguisher

A fire extinguisher is a portable firefighting device designed to control and extinguish small fires. It is an essential tool for fire safety, allowing individuals to respond quickly to fires before they become unmanageable.

Fire extinguishers work by discharging a firefighting agent onto the fire, either by cooling the fuel, smothering the flames, or interrupting the chemical reaction required for combustion. Each fire extinguisher is specifically designed to combat certain classes of fires.

The most common types of fire extinguishers are:

1. **Water Fire Extinguisher (Class A):**
    - Suitable for Class A fires involving ordinary combustible materials such as wood, paper, cloth, plastics, and rubber.
2. **Foam Fire Extinguisher (Class A and Class B):**
    - Effective for Class A fires (ordinary combustibles) and Class B fires (flammable liquids and gases).
3. **Dry Powder Fire Extinguisher (Class A, Class B, and Class C):**
    - Versatile extinguisher suitable for Class A, B, and C fires.

1. **Carbon Dioxide (CO2) Fire Extinguisher (Class B and Class C):**
   - Suitable for Class B fires (flammable liquids and gases) and Class C fires (energized electrical equipment).
2. **Wet Chemical Fire Extinguisher (Class K):**
   - Specifically designed for Class K fires involving cooking oils and fats.

Fig. 7.2.4 Types of Fire Extinguishers

Fire extinguishers should be placed in easily accessible locations throughout buildings, construction sites, vehicles, and other facilities. Regular maintenance, inspection, and employee training on how to use fire extinguishers properly are essential components of fire safety programs. Remember, fire extinguishers are designed for small fires only. For larger fires or situations beyond your control, evacuate the area immediately and call the appropriate emergency services.

Using Fire Extinguisher:

Using a fire extinguisher properly can be instrumental in quickly extinguishing small fires and preventing them from spreading. When using a fire extinguisher, remember the acronym “PASS,” which stands for Pull, Aim, Squeeze, and Sweep.

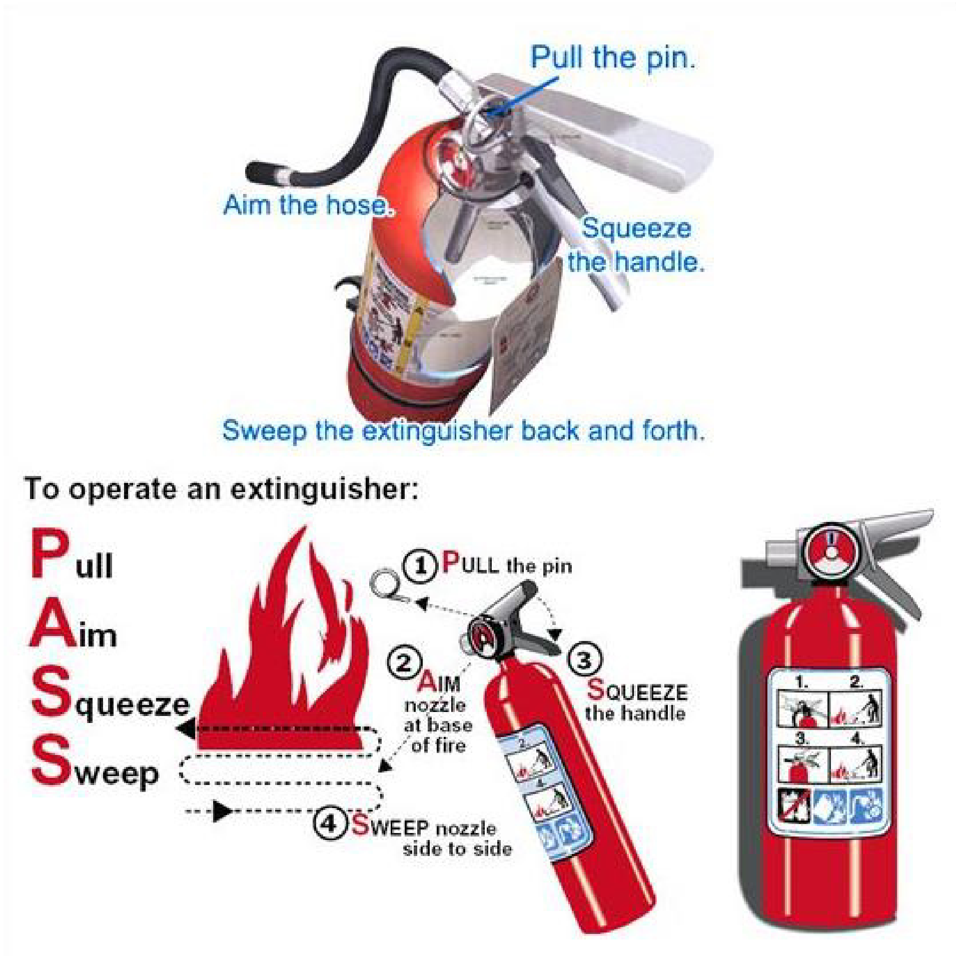

Fig. 7.2.5 Using a Fire Extinguisher

Remember the following important tips:

- Only use a fire extinguisher on small fires that are contained and not spreading rapidly.
- Make sure you are using the right type of fire extinguisher for the specific class of fire (e.g., Class A, B, C, K).
- Always maintain a safe distance from the fire and avoid getting too close to the flames.
- Never turn your back on a fire, and be prepared to evacuate if the fire becomes too large or uncontrollable.
- If the fire does not respond to the extinguisher or starts to grow rapidly, evacuate the area immediately and call the fire department.

7.2.4 Safety Drills and Its Importance for Workers

The participation of workers in safety drills at a construction site is of utmost importance to ensure a safe working environment and reduce the risk of accidents or incidents. Construction sites are inherently hazardous places, and safety drills play a crucial role in preparing workers to respond effectively to emergencies.

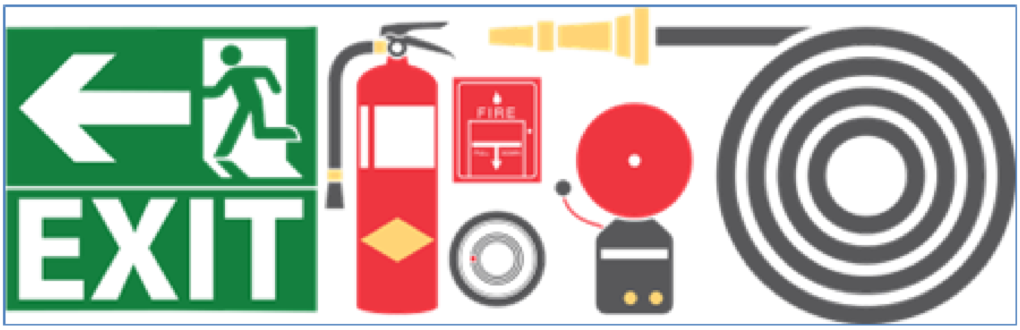

Fig. 7.2.6 Components related to Safety Drill

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

- **Familiarization with Site-Specific Procedures:** Construction sites can have unique layouts and hazards. Safety drills allow workers to become familiar with site-specific emergency procedures, such as evacuation routes, muster points, and the location of emergency equipment.
- **Practicing Response to Common Construction Hazards:** Safety drills provide an opportunity to practice responding to emergencies related to common construction hazards, such as falls, structural collapses, confined space incidents, and electrical accidents.
- **Building Muscle Memory for Critical Tasks:** By participating in safety drills, workers develop muscle memory for critical safety tasks, such as donning personal protective equipment (PPE), using fire extinguishers, or performing emergency rescues. Muscle memory helps workers react quickly and instinctively during real emergencies.
- **Testing Effectiveness of Emergency Plans:** Safety drills allow construction site managers to assess the effectiveness of the site's emergency response plans and identify any gaps or weaknesses that need to be addressed.
- **Boosting Confidence and Reducing Panic:** Regular participation in safety drills can boost workers' confidence in their ability to handle emergencies, making them less likely to panic and more likely to respond calmly and rationally.
- **Team Coordination and Communication:** Safety drills encourage teamwork and coordination among workers. It helps them practice effective communication during emergencies, which is essential for a coordinated and efficient response.
- **Compliance with Regulations:** Construction sites are subject to various safety regulations and standards. Worker participation in safety drills ensures that the construction site is compliant with safety requirements.

- **Preventing Injuries and Fatalities:** The ultimate goal of safety drills is to prevent injuries and save lives. Properly trained and prepared workers are more likely to respond effectively to emergencies, reducing the severity of incidents.
- **Emergency Response Performance Evaluation:** Safety drills provide an opportunity to evaluate how well workers respond to emergencies and identify areas that need improvement or additional training.
- **Promoting a Safety Culture:** Encouraging worker participation in safety drills sends a strong message about the importance of safety at the construction site. It fosters a safety-first culture and instills a sense of responsibility for safety among all workers.

By actively involving workers in safety drills, construction site management can significantly enhance the site's emergency preparedness, improve response capabilities, and create a safer working environment for everyone involved.

Evacuation:

Evacuation at a construction workplace/site is a crucial aspect of ensuring the safety of all workers and visitors in case of emergencies. Construction sites can be hazardous environments with various potential risks, making preparedness and efficient evacuation procedures essential.

Fig. 7.2.7 Emergency Evacuation

7.2.5 Medical Examination for Construction Workers

The government has mandated that industrial enterprises undertake annual health checkups on their employees. In accordance with the Factories Act of India from 1947, both contractual and permanent employees in manufacturing businesses are required to undergo periodic health examinations. These examinations aim to protect the health and safety of factory workers.

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

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

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

Medical Check-up Prior to Employment: A young person must have a pre-employment medical examination by a Certifying Surgeon to determine and confirm his fitness to work in a factory, according the Factories Act of 1949. The certificate of fitness is only valid for one year from the date it was issued.

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

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

Fig. 7.2.8 Medical Examination for Construction Workers

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

List of Recommended Medical Tests under the Factories Act:

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

7.2.6 Vertigo Test

Vertigo is a symptom, not a condition in and of itself. Vertigo is a sort of dizziness that is frequently described as the sensation that one is spinning or that the world is spinning around them, especially when they alter their position.

Vertigo affects people of all ages. Middle ear pathology is typically the culprit in younger patients. The danger of falls and associated sequelae necessitates a specialised assessment of the elderly. The key to arriving at a diagnosis is distinguishing vertigo from other causes of dizziness or imbalance, as well as distinguishing central causes of vertigo from peripheral causes.

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

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

Fig. 7.2.9 Vertigo Test for Construction Workers

7.2.7 Basic Ergonomic Principles

Basic ergonomic principles involve designing and arranging workspaces, equipment, and tasks to optimize efficiency, productivity, and worker well-being.

Ergonomics aims to reduce the risk of musculoskeletal disorders (MSDs) and other work-related injuries by ensuring that the work environment fits the worker's capabilities and needs.

Construction sites can be physically demanding and involve various tasks that may lead to musculoskeletal disorders (MSDs) and other injuries if not properly addressed. Here are some basic ergonomic principles to consider at a construction site:

Fig. 7.2.10 Basic Ergonomic Principles

- Proper Lifting Techniques:
  - Train workers in proper lifting techniques to avoid back injuries. Encourage the use of mechanical lifting aids, such as cranes or hoists, for heavy or awkward loads.
- Worksite Organization:
  - Arrange tools, equipment, and materials to minimize excessive reaching or bending.
  - Keep frequently used items within easy reach to reduce unnecessary movement.
- Tool Selection:
  - Provide ergonomic tools with appropriate grips and handles that reduce hand and wrist fatigue.
  - Choose tools that require less force to operate to prevent overexertion.

By applying these basic ergonomic principles at construction sites, employers can create a safer and more comfortable working environment, reduce the risk of work-related injuries, and improve the overall well-being and productivity of construction workers.

7.2.7 First Aid

First aid refers to the immediate and initial care given to an injured or ill person before professional medical help arrives. It is crucial in emergencies to stabilize the injured or sick individual and prevent their condition from worsening.

First aid aims to preserve life, alleviate pain, and promote recovery.

Here are some key points about first aid:

Fig. 7.2.11 First Aid to Injured Person

Objectives of First Aid:

- **Preserve Life:** The primary objective of first aid is to assess the situation and provide immediate care to save lives.
- **Prevent Further Harm:** First aid measures aim to prevent the injured person's condition from worsening.
- **Relieve Pain:** First aid techniques can provide pain relief to the injured or ill person.
- **Promote Recovery:** Properly administered first aid can help promote the person's recovery and reduce the severity of injuries or illnesses.

Common First Aid Procedures:

- **Assessment:** Assess the situation and the injured or ill person's condition. Ensure your safety and the safety of others.
- **CPR (Cardiopulmonary Resuscitation):** If the person is not breathing or their heart has stopped, perform CPR to maintain blood flow and provide oxygen.
- **Bleeding Control:** Apply pressure to stop bleeding from wounds and injuries.
- **Wound Care:** Clean and dress wounds to prevent infection and aid healing.
- **Fracture and Sprain Care:** Immobilize fractures and provide support for sprains to prevent further damage.
- **Burn Care:** Cool burns with running water and cover with a clean, non-stick dressing.
- **Choking Response:** Perform abdominal thrusts (Heimlich maneuver) on a choking person to clear their airway.
- **Seizure Management:** Keep the person safe during a seizure and provide comfort afterward.

First Aid Kits:

A well-stocked first aid kit is essential in homes, workplaces, and vehicles. It should contain items such as adhesive bandages, gauze pads, antiseptic wipes, adhesive tape, scissors, tweezers, CPR mask, disposable gloves, and pain relievers, among others.

Note: While first aid can be lifesaving, it is not a substitute for professional medical care. In emergencies, call for professional help (e.g., emergency services) as soon as possible, especially for serious injuries or illnesses.

It is crucial to receive formal first aid training to effectively administer first aid and respond appropriately in emergency situations. Proper training ensures that you can provide the most appropriate care and support to those in need until professional help arrives.

Fig. 7.2.12 First Aid Kit

7.2.9 Ensure Electrical Safety at Construction Sites

Electrical safety is important because hazards such as arc flash and shock can result in death if you are exposed to them.

Fortunately, the likelihood of this occurring is relatively low.

However, the control measures that prevent these hazards require careful management, attention to detail and technical competence.

Fig. 7.2.12 First Aid Kit

- Conduct regular inspections of electrical equipment and wiring to identify any potential hazards or defects.
- Ensure all electrical installations and equipment meet relevant safety standards and codes.
- Provide proper training to construction workers on electrical safety practices and procedures.
- Clearly label electrical panels, switches, and outlets for easy identification.
- Use ground fault circuit interrupters (GFCIs) to protect against electric shock in wet or damp environments.
- Avoid overloading electrical circuits and outlets by distributing loads evenly.
- Keep electrical cords and cables away from heavy machinery, sharp objects, or areas with high foot traffic.
- Store electrical tools and equipment properly when not in use to prevent damage and accidents.
- Use insulated tools and personal protective equipment (PPE) when working with electricity.
- Have a clear emergency plan in place in case of electrical accidents or incidents and ensure workers are familiar with it.

Fig. 7.2.14 Electrical Safety

7.2.10 PPE and Its Importance

Personal Protective Equipment (PPE) plays a crucial role in the construction industry to protect workers from potential hazards and ensure their safety on the job. PPE is designed to shield workers from various risks, such as falling objects, electrical hazards, chemical exposure, noise, and more.

Fig. 7.2.15 PPEs in Construction Industry

Importance of PPE in Construction Industry:

- **Hazard Protection:** PPE serves as a barrier between workers and potential workplace hazards, preventing injuries and illnesses.
- **Legal Compliance:** Regulatory authorities require the use of appropriate PPE in construction to meet safety standards and comply with regulations.
- **Injury Prevention:** PPE can significantly reduce the risk of injuries and accidents, protecting workers' health and well-being.
- **Risk Reduction:** PPE mitigates the risk of exposure to harmful substances, noise, dust, and other occupational hazards.
- **Enhanced Productivity:** When workers feel safe and protected, their confidence and efficiency increase, leading to improved productivity.

Types of PPE in Construction Industry:

Injury Protection	Description	PPE
Head Injury Protection	Head injuries can occur due to falling or flying objects, stationary objects, or contact with electrical wires. Hard hats provide protection against such injuries by shielding the head. Electrician's hard hat is commonly made of nonconductive plastic. It is accompanied by safety goggles for additional eye protection.	
Foot and Leg Injury Protection	Safety shoes, especially those made of leather, provide essential foot protection. They offer protection against various risks, including falling or rolling objects, sharp objects, wet and slippery surfaces, molten metals, hot surfaces, and electrical hazards. Proper use of safety shoes enhances safety measures for workers in hazardous environments like construction sites.	
Eye and Face Injury Protection	Spectacles and goggles provide protection against hazards like flying fragments, large chips, hot sparks, radiation, and splashes from molten metals. Special helmets or shields offer additional protection for the face and eyes in hazardous environments. Spectacles with side shields and face shields enhance eye safety by preventing exposure to various risks. These protective gears also safeguard against particles, sand, dirt, mists, dust, and glare, promoting overall eye health and safety.	

Protection against Hearing Loss	Hearing protection can be achieved through earplugs or earmuffs. Prolonged exposure to high noise can lead to permanent hearing loss, physical strain & mental stress. Self-forming earplugs made of materials like foam, waxed cotton, or fibreglass wool are commonly used as they offer a good fit. For better fit and protection, workers should be fitted with moulded or prefabricated earplugs by a specialist.	
Hand Injury Protection	Hand protection is crucial for workers exposed to hazardous substances through skin absorption, serious wounds, or thermal burns. Gloves are commonly used as protective gear for hands. Electricians often use leather gloves with rubber inserts when working on electrified circuits. Kevlar gloves are employed when stripping cable with a sharp blade to prevent cuts and injuries.	
Whole Body Protection	Full-body protection is essential for workers to safeguard against heat and radiation hazards. Whole-body PPE includes materials like rubber, leather, synthetics, plastic, fire-retardant wool, and cotton. Maintenance staff working with high-power sources like transformer installations and motor-control centers are often required to wear fire-resistant clothes for added safety.	

Table 7.2.1 PPEs for Construction Worker

Care and Maintenance of PPE:

- Regular Inspection: PPE should be inspected before each use to ensure it is in good condition and free from damage.
- Proper Storage: Store PPE in a clean, dry, and designated area away from direct sunlight and chemical exposure.
- Cleaning: Clean PPE regularly according to the manufacturer's guidelines to maintain its effectiveness.
- Replacement: PPE should be replaced when damaged, worn out, or beyond its usable life as specified by the manufacturer.
- Training: Provide training to workers on the proper use, care, and limitations of PPE.
- Comfort and Fit: Ensure that PPE fits properly and is comfortable for the worker to encourage consistent use.

PPE is essential for protecting workers from harm, but it is also the last line of defence.

Fig. 7.2.14 Electrical Safety

Care and Maintenance of Tools & Equipment:

- Regularly inspect tools and equipment for signs of damage or wear.
- Keep tools and equipment clean and free from dirt and debris after each use.
- Store tools and equipment in a dry and secure location, protected from weather elements.
- Follow manufacturer's instructions for battery-operated tools regarding charging and storage.
- Train workers on proper tool usage, care, and maintenance to ensure safe and efficient operation

7.2.11 Ladder Safety in Construction

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

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

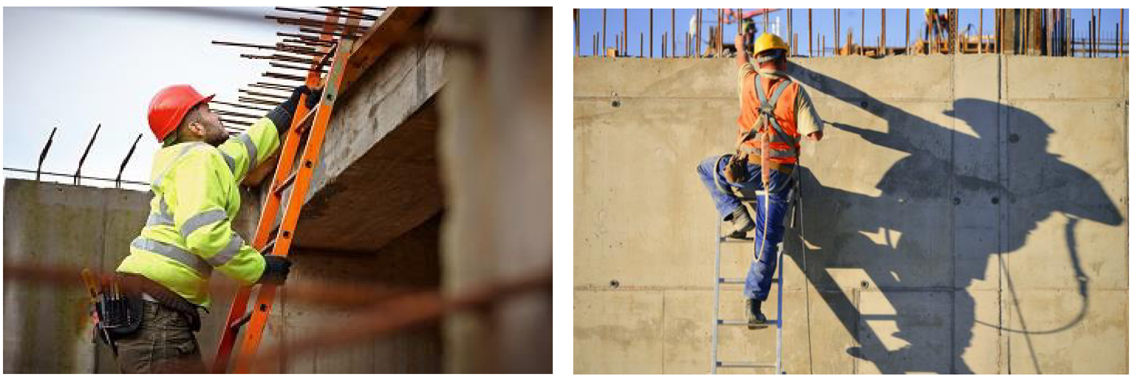

Fig. 7.2.17 Ladder safety

Notes

Unit 7.3: Hygiene and Safe Waste Disposal Practices

Unit Objectives

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

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

7.3.1 Personal Hygiene and Cleanliness

Personal hygiene and cleanliness are essential practices that involve maintaining cleanliness and taking care of one's body to prevent the spread of germs, illnesses, and maintain overall well-being. These practices are crucial for promoting good health and preventing the transmission of infectious diseases.

Fig. 7.3.1 Personal Hygiene

Here are some key aspects of personal hygiene and cleanliness:

- **Regular Bathing or Showering:** Regular bathing or showering helps to keep the body clean and remove dirt, sweat, and bacteria from the skin.
- **Handwashing:** Proper handwashing with soap and water is one of the most effective ways to prevent the spread of germs and infections.
- **Oral Hygiene:** Brushing teeth twice a day and flossing regularly help maintain good oral health and prevent dental problems.
- **Trimming Nails:** Keeping nails clean and trimmed prevents the accumulation of dirt and germs under the nails.
- **Hair Care:** Regularly washing and maintaining hair cleanliness can prevent scalp issues and promote healthy hair.
- **Wearing Clean Clothes:** Wearing clean clothes helps prevent the spread of germs and keeps the body fresh.
- **Proper Use of Personal Protective Equipment (PPE):** In certain situations, such as during a pandemic or when handling hazardous materials, using appropriate PPE like masks, gloves, and safety gear is crucial for personal protection and hygiene.
- **Handling Food Safely:** Properly handling, preparing, and storing food helps prevent food-borne illnesses.
- **Cough and Sneezing Etiquette:** Covering the mouth and nose with a tissue or elbow when coughing or sneezing helps prevent the spread of respiratory droplets containing germs.
- **Managing Menstrual Hygiene:** Properly managing menstrual hygiene is essential for women's health and well-being.
- **Cleaning and Disinfecting Surfaces:** Regularly cleaning and disinfecting frequently-touched surfaces, such as doorknobs and handles, helps prevent the spread of germs.
- **Managing Personal Waste:** Properly disposing of waste and using clean and sanitary facilities help prevent the spread of infections.

Maintaining personal hygiene and cleanliness is not only important for individual health but also for public health. It is essential for reducing the risk of contagious diseases and maintaining a hygienic living and working environment. By practicing good personal hygiene and cleanliness, individuals can contribute to a healthier and safer community.

Importance of Informing on Personal Health Issues

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

- The infectious diseases can spread and affect the health of other workers at the farm.
- The infectious diseases can be spread to the consumers if the bacteria and viruses spread through the produces.

- The injuries should be timely reported and should be taken care of immediately. If not timely reported it may worsen and may cause severe diseases and even death.

Fig. 7.3.2 Infectious Disease

7.3.2 Workplace Cleanliness and Sanitization

Workplace cleanliness and sanitization are crucial for creating a safe, healthy, and productive work environment.

Clean and sanitized workplaces not only reduce the risk of the spread of infections and illnesses but also contribute to employee well-being and morale.

Fig. 7.3.3 Workplace Cleanliness

Here are some important aspects of workplace cleanliness and sanitization:

- **Regular Cleaning Routine:** Establish a regular cleaning schedule for the workplace, including workstations, common areas, restrooms, and shared equipment. Cleaning should be done daily or as needed, depending on the nature of the workplace.

- **Surface Disinfection:** Regularly disinfect frequently-touched surfaces, such as doorknobs, light switches, keyboards, and shared equipment. Use EPA-approved disinfectants that are effective against viruses and bacteria.

- **Hand Sanitizing Stations:** Place hand sanitizing stations at convenient locations throughout the workplace to encourage employees and visitors to maintain hand hygiene.

- **Restroom Hygiene:** Maintain clean and well-stocked restrooms with proper sanitation supplies. Regularly clean and disinfect restroom surfaces to prevent the spread of germs.

- **Waste Management:** Provide clearly marked waste disposal bins and ensure proper waste segregation. Regularly empty trash bins and dispose of waste appropriately.

- **Kitchen and Break Areas:** Maintain cleanliness in kitchen and break areas by regularly cleaning countertops, sinks, and shared appliances. Encourage employees to clean up after themselves.

- **Ventilation and Air Quality:** Ensure proper ventilation to improve indoor air quality. Clean air filters regularly to remove dust and allergens from the air.

- **Personal Protective Equipment (PPE):** Provide appropriate PPE, such as masks and gloves, for employees when needed, especially during pandemics or when handling hazardous materials.

- **Educate Employees:** Educate employees about the importance of workplace cleanliness and hygiene practices. Encourage them to follow hygiene guidelines and protocols.

- **Workplace Signage:** Display hygiene-related signage, such as handwashing instructions, cough etiquette, and reminders about cleaning protocols, to reinforce good practices.

- **Cleaning and Sanitization Training:** Train cleaning staff and employees responsible for workplace cleanliness on proper cleaning and sanitization techniques and the correct use of disinfectants.

- **Workplace Wellness Initiatives:** Implement workplace wellness programs that promote good health and hygiene practices among employees.

By prioritizing workplace cleanliness and sanitization, employers can create a healthier and safer environment for their employees, clients, and visitors. Regular cleaning and sanitation efforts help prevent the spread of infections, reduce absenteeism, and foster a positive work culture focused on employee well-being and productivity.

7.3.3 Implement Good Housekeeping Practices at Construction Site

Implementing good housekeeping practices at a construction site is essential to maintain a safe, organized, and efficient working environment. Proper housekeeping helps prevent accidents, reduces the risk of injuries, and enhances productivity.

Here are some effective ways to promote good housekeeping practices at construction sites:

1. **Designate Storage Areas:** Assign specific areas for storing tools, equipment, and materials. Keep these areas organized and ensure that items are returned to their designated places after use.

Fig. 7.3.4 Designated Areas

2. **Regular Cleanup**: Schedule regular cleanup sessions throughout the workday to remove debris, waste, and hazards from the construction site. Encourage all workers to participate in keeping the site clean.

Fig. 7.3.5 Clean-up Debris and Waste

3. **Dispose of Waste Properly:** Provide clearly marked waste disposal bins and containers. Train workers to segregate waste materials correctly, including hazardous materials, to ensure safe disposal.

Fig. 7.3.6 Disposing of Waste

4. **Keep Walkways Clear:** Ensure that walkways, access routes, and emergency exits are clear of obstructions at all times. Remove trip hazards and obstacles to prevent accidents.

Fig. 7.3.7 Clear Walkways

5. **Store Flammable Materials Safely:** Store flammable materials, such as fuel, solvents, and gases, in designated storage areas away from potential ignition sources. Follow safety guidelines for their storage and handling.

Fig. 7.3.8 Store Flammable Safely

6. **Prevent Slips, Trips, and Falls:** Regularly inspect the site for slippery surfaces, loose debris, and uneven terrain. Address potential hazards promptly to reduce the risk of slips, trips, and falls.

Fig. 7.3.9 Prevent Hazards

7. **Control Dust and Debris:** Use dust control measures, such as wetting down surfaces, using dust collectors, or providing personal protective equipment (PPE), to reduce airborne dust and debris.

Fig. 7.3.10 Wetting Down Dust

8. **Proper Material Handling:** Train workers on proper material handling techniques to prevent injuries caused by lifting, carrying, or moving heavy objects.

Fig. 7.3.11 Material Handling with Safety

9. **Secure Tools and Equipment:** Ensure that tools and equipment are properly stored, secured, and maintained when not in use. Avoid leaving them unattended or in precarious positions.

Fig. 7 .3.12 Securing Tools & Equipment

10. **Inspect and Maintain Equipment:** Regularly inspect machinery, vehicles, and equipment to identify potential issues or defects. Perform maintenance and repairs promptly to ensure their safe operation.

Fig. 7.3.13 Inspect and Maintain Equipment

Remember that good housekeeping is an ongoing effort and requires the commitment and cooperation of all workers and management.

By prioritizing cleanliness and organization at the construction site, you can create a safer and more productive work environment for everyone involved.

Fig. 7.3.14 Good Housekeeping and Safety relevance

7.3.4 Handwashing

Handwashing is a simple yet highly effective practice that involves cleaning one's hands with soap and water to remove dirt, germs, and other harmful microorganisms.

Proper handwashing is one of the most important measures to prevent the spread of infectious diseases, including common colds, flu, gastrointestinal infections, and respiratory illnesses.

Proper Handwashing Technique:

- **Wet Hands:** Wet your hands with clean, running water (warm or cold).
- **Apply Soap:** Apply enough soap to cover all hand surfaces.
- **Rub Hands Together:** Rub your hands palm to palm to create lather. Continue rubbing the backs of your hands, between your fingers, and under your nails.
- **Scrub for at least 20 Seconds:** Scrub your hands for at least 20 seconds. Singing "Happy Birth-day" twice is a useful timer.
- **Rinse Thoroughly:** Rinse your hands thoroughly under clean, running water.
- Dry Hands: Dry your hands using a clean towel or air dry them. If possible, use a paper towel to turn off the faucet to avoid recontamination.

Fig. 7.3.15 Handwashing

When to Wash Hands:

- Before preparing or eating food
- After using the restroom
- After coughing, sneezing, or blowing your nose
- After touching surfaces in public places
- After handling garbage or waste
- After caring for someone who is sick
- Before and after tending to wounds or injuries

Fig. 7.3.16 Wash Hands Properly

7.3.5 Avoid Bad Habits

Avoiding bad habits like smoking, drinking alcohol, and addiction to tobacco and gutkha is essential for maintaining good health and well-being. These habits can have severe negative impacts on physical health, mental health, and overall quality of life.

Fig. 7.3.17 Avoid Bad Habits

Here are some reasons to avoid these habits:

- Understand the health risks associated with smoking, drinking alcohol, and using tobacco and gutkha.
- Seek support from family, friends, or support groups to help quit these habits.
- Replace bad habits with healthier alternatives, such as exercise, hobbies, or mindfulness practices.
- Set specific and achievable goals to gradually reduce and eliminate these habits.
- Avoid triggers or situations that may tempt you to engage in these bad habits.
- Practice stress management techniques to cope with stress without turning to harmful substances.
- Stay informed about the benefits of quitting and the negative impacts of these habits.
- Use nicotine replacement therapies or medications to aid in quitting smoking.
- Find healthy ways to socialize and relax without relying on alcohol or tobacco.
- Celebrate small milestones and successes in your journey to quit these bad habits.

7.3.6 Waste Types at Construction Sites

Construction sites generate various types of waste during the building process.

Some common types of waste found at construction sites include:

1. **Concrete and Bricks Waste:** Excess or damaged concrete, bricks, blocks, and precast elements.
2. **Wood Waste:** Includes timber offcuts, pallets, and packaging materials.
3. **Metal Waste:** Scrap metal from structural elements, reinforcement bars, and metal packaging.
4. **Plastic Waste:** Packaging materials, plastic sheets, and pipes.
5. **Cardboard and Paper Waste:** Packaging materials and documents.
6. **Glass Waste:** Broken or excess glass from windows, doors, and mirrors.
7. **Asphalt Waste:** Leftover asphalt from road or pavement construction.
8. **Paints and Chemicals:** Unused or leftover paints, solvents, adhesives, and other construction chemicals.
9. **Electrical Waste:** Old or damaged electrical components, cables, and wiring.
10. **Insulation Materials:** Unused or waste insulation materials.
11. **Hazardous Waste:** Materials containing asbestos, lead, mercury, or other hazardous substances.
12. **Packaging Waste:** Cardboard boxes, plastic wraps, and other packaging materials.

Fig. 7.3.18 Construction Wastes

Proper waste management and disposal methods are crucial to handle these various types of waste responsibly and minimize their impact on the environment. Recycling, reusing, and responsible disposal in designated landfills or waste treatment facilities are some of the ways to manage construction site waste effectively.

7.3.7 Waste Management

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

Fig. 7.3.18 Construction Wastes

The importance of waste management is:

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

7.3.8 Methods of Waste Management

Construction waste management is crucial for reducing environmental impact and promoting sustainable practices in the construction industry. The 5Rs framework offers a systematic approach to managing construction waste, focusing on reducing waste generation and maximizing resource efficiency. The 5Rs stand for: Reduce, Reuse, Recycle, Recover, and Residuals. Here's how each of these methods is applied in construction waste management:

1. **Reduce:**
    - **Design for Minimal Waste:** Employ design strategies that aim to minimize waste generation during the construction phase. This includes accurate quantity estimation, optimizing material use, and choosing construction methods that generate less waste.
    - **Prefabrication:** Prefabrication and modular construction techniques can significantly reduce on-site waste by producing components off-site with precise measurements and minimal material wastage.
    - **Waste Audits:** Conduct waste audits to identify the major sources of waste and implement measures to reduce waste generation.
2. **Reuse:**
    - **Salvage and Reuse Materials:** Salvage and reuse materials from demolition or renovation activities that are still in good condition and can be repurposed in other projects. This includes doors, windows, fixtures, and lumber.
    - **Temporary Structures:** Utilize temporary structures and materials that can be disassembled and reused in other projects to reduce waste.
3. **Recycle:**
    - **On-Site Recycling:** Set up on-site recycling facilities to process construction waste, such as concrete, wood, metal, and plastics, into reusable materials like aggregates, mulch, or recycled content products.
    - **Use Recycled Content:** Incorporate recycled content materials, such as recycled concrete aggregate or reclaimed wood, in new construction to reduce the demand for virgin resources.
4. **Recover:**
    - **Energy Recovery:** Some non-recyclable construction waste can be converted into energy through waste-to-energy processes, helping to minimize landfill disposal and generate electricity or heat.
    - **Anaerobic Digestion:** Organic waste can be processed through anaerobic digestion to produce biogas, which can be used as a renewable energy source.
5. **Residuals Management:**
    - **Landfill Diversion:** For waste that cannot be reduced, reused, recycled, or recovered, focus on diverting it from landfills and explore alternative disposal methods that have a lower environmental impact.
    - **Responsible Disposal:** Ensure that waste that ends up in landfills is disposed of responsibly, adhering to local regulations and guidelines.

Fig. 7.3.20 Waste Bin Types and their Colour

By implementing the 5Rs framework, construction companies can minimize waste generation, conserve resources, reduce environmental pollution, and move towards a more sustainable and environmentally friendly approach to construction waste management.

7.3.9 Waste Management on a Construction Site

On the construction site, one must be mindful of how they handle waste and garbage. Having a plan for managing these goods is necessary to protect the safety of both workers and the general public. Here are some waste management strategies:

- Before disposing of them in the dumpster, place any hand tools in containers with lids.
- Place empty paint cans in the trash instead than spilling them down drains or onto pavements.
- Rinse disposable cups and other food containers before placing them in a recycling bin. This will help prevent litter from being blown onto the property during windy or rainy weather.
- Recycle equipment and other metal objects by utilising a magnet or air compressor to remove all non-metal components, such as nails, screws, nuts, bolts, electrical wiring, etc. These are then segregated by category prior to proper recycling.
- Insulation should be disposed of in the garbage as opposed to being poured down drains or onto pavements, as it can clog sewer systems.

- Use a tarp to pile dirt, rocks, bricks, and other heavy things into the bed of a truck before hauling them away when the work is complete. This will make future clean-up easier.
- Instead of discarding excess lumber, wrap it in plastic to prevent it from becoming wet and infected with termites.
- Use a leak-proof container or urn to transfer hazardous liquids away for proper disposal; this will keep the workers and others on-site dry and healthy.
- Regularly cleaning up will reduce the amount of debris.
- Using trash cans with lids to prevent rubbish from falling to the ground.
- On your site, provide workers with safety vests for simple identification and protection from concealed threats such as electrical cables and sharp instruments.
- Ensure that there is a designated space for recyclable materials such as glass, plastic, cardboard, and metal containers so that they may be sorted later.

It is necessary to have a plan for waste management on construction sites, which are typically untidy places.

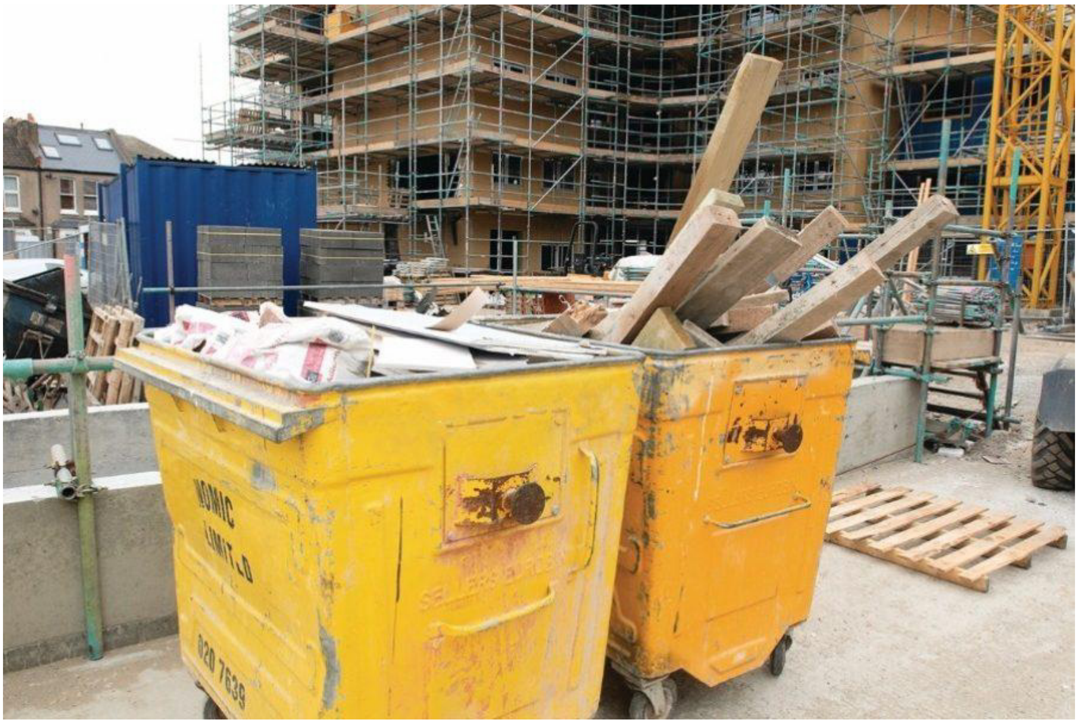

Fig. 7.3.21 Waste Management on a Construction Site

Notes

Unit 7.4: Infectious Disease and Its Cure

Unit Objectives

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

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

7.4.1 Infectious Diseases

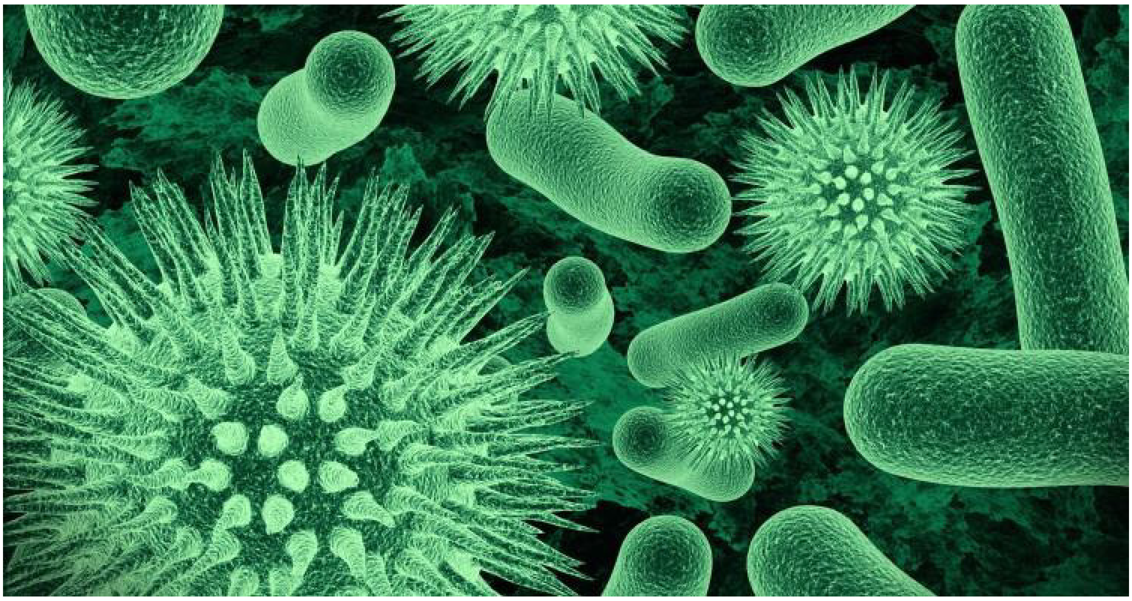

Fig. 7.3.21 Waste Management on a Construction Site

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

- Viral infections
- Bacterial infections
- Fungal infections
- Parasitic infections
- Transmissible spongiform encephalopathies (TSEs/prion diseases)

Infectious diseases are extremely common worldwide, but some are more common than others.

Some of the most common infectious diseases are listed here by type.

Common infectious diseases caused by viruses:

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

Common infectious diseases caused by bacteria:

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

Common infectious diseases caused by fungi:

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

Common infectious diseases caused by parasites:

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

7.4.2 Prevention of Infectious Diseases

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

Therefore, it is essential to have several risk-reduction behaviours.

Fig. 7.4.2 Vaccines for Infectious Diseases

Vaccines

Vaccines lessen the likelihood of contracting an infectious disease by preparing the immune system to recognise and combat dangerous invaders.

Vaccinated individuals may occasionally still get an illness, although their symptoms are typically milder than they would have been without vaccination.

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

- **Chickenpox:** Highly contagious viral infection causing itchy skin rash and fever.
- **COVID-19:** Respiratory illness caused by the novel coronavirus, leading to a wide range of symptoms from mild to severe.
- **Diphtheria, tetanus, and whooping cough (whooping cough):** Bacterial infections with symptoms like severe throat inflammation, muscle stiffness, and persistent cough.
- **Hepatitis A:** Liver infection caused by the hepatitis A virus, transmitted through contaminated food and water.
- **Hepatitis B:** Viral infection affecting the liver, transmitted through blood and body fluids, leading to acute or chronic liver disease.
- **Human papillomavirus (HPV):** Common sexually transmitted infection, linked to cervical and other cancers.
- **Influenza:** Viral respiratory infection causing fever, body aches, and respiratory symptoms.
- **Malaria:** Mosquito-borne infectious disease characterized by fever, chills, and flu-like symptoms.
- **Rubella, measles, and rubella:** Viral infections causing rashes, fever, and respiratory symptoms, with potential complications.
- **Polio:** Highly contagious viral infection affecting the nervous system, leading to paralysis in

- severe cases.
- **Rotavirus:** Common cause of severe diarrhea in young children.
- **Rabies:** Deadly viral disease affecting the nervous system, transmitted through animal bites.
- **Shingles:** Painful viral rash caused by the reactivation of the chickenpox virus.
- **Tuberculosis:** Bacterial infection primarily affecting the lungs, causing persistent cough and fatigue.

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

Other methods of infectious illness prevention:

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

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

Fig. 7.4.2 Vaccines for Infectious Diseases

7.4.3 General Health Issues and their Symptoms & Cure

General health issues like fever, cough, and cold can affect construction workers, especially when working in diverse weather conditions and exposed to various environmental factors.

Fig. 7.4.4 Symptoms of Fever, Cough and Cold

Here are their symptoms and some recommendations on what construction workers can do to manage these health issues:

- **Fever:**
  - **Symptoms:** Elevated body temperature, chills, body aches, fatigue.
  - **To-Do:**
    - Rest and avoid strenuous physical activity.
    - Stay hydrated by drinking plenty of fluids.
    - Use over-the-counter fever-reducing medications if necessary.
    - Seek medical attention if the fever persists or becomes severe.
- **Cough:**
  - **Symptoms:** Persistent coughing, irritation in the throat, chest discomfort.
  - **To-Do:**
    - Avoid exposure to irritants like dust and fumes as much as possible.
    - Stay well-hydrated to soothe the throat.
    - Use a mask or respirator to protect the airways from particles and pollutants.
    - Seek medical advice if the cough worsens or is accompanied by other symptoms.
- **Cold:**
  - **Symptoms:** Runny or stuffy nose, sneezing, sore throat, mild body aches.
  - **To-Do:**

- Rest and take sufficient breaks to recover.
- Keep warm and dress appropriately for the weather.
- Drink warm fluids like soups and herbal teas.
- Use over-the-counter cold remedies to alleviate symptoms.

General Health Tips for Construction Workers:

- Stay hydrated throughout the day, especially in hot weather.
- Wear appropriate protective gear such as safety shoes, gloves, and helmets.
- Take regular breaks and rest when needed to prevent fatigue.
- Practice proper hand hygiene to reduce the risk of infections.
- Use masks or respirators when working in dusty or polluted environments.
- Eat a balanced diet to maintain overall health and immunity.
- Get regular medical check-ups and vaccinations as recommended.

It's important for construction workers to prioritize their health and safety, as their job often involves physical exertion and exposure to potential health hazards. If any health issue persists or worsens, it is advisable for them to seek medical attention promptly.

7.4.4 Reporting an Outbreak or Hazard of any Infectious Disease or Pandemic

Reporting an outbreak or hazard of any infectious disease or pandemic is crucial for prompt action and preventing further spread of the illness. The specific reporting procedure may vary based on the organization, industry, or country. Here's a general procedure to report such incidents to the concerned authority:

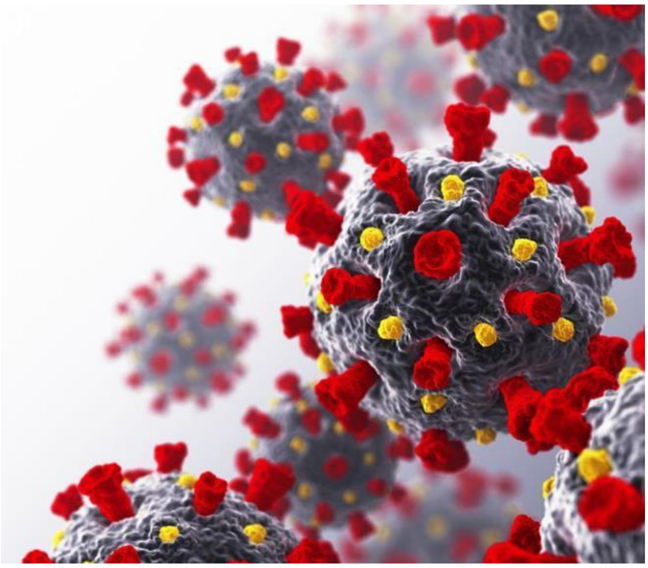

Fig. 7.4.2 Vaccines for Infectious Diseases

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

Remember that reporting an outbreak or hazard of any infectious disease or pandemic promptly is essential for quick containment and mitigation. Cooperate with healthcare professionals, follow their advice, and work together to protect the health and safety of your community and workplace.

Exercise

Answer the following questions:

A. Short Questions:

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

B. Fill-in-the-Blanks Questions:

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

C. True/False Questions:

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

Notes

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8. Employability Skills (60 Hours)

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

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9. Annexure

Annexure I - QR Codes - Video Links

Annexure-I

Annexure of QR Codes for Fabricator

Chapter Name	Unit Name	Topic Name	URL	Page no.	QR Code	Video Duration
Chapter 1: Introduction of Construction Sector and Fabricator Job Role	UNIT 1.1: Introduction to Construction Industry	Overview of Construction Sector in India	https://youtu.be/yhjDhav4Pfw	14	Overview of Construction Sector in India	0:13:24
	UNIT 1.2: About Fabrication Occupation	Responsibilities of Fabricator	https://youtu.be/EdR-jd9Deqs	27	Responsibilities of Fabricator	0:01:26
Chapter 2: Core/Generic Skills	Unit 2.1 – Numeracy Skills	Different System of Measurement	https://youtu.be/H1xo5UVJKVo	34	Different System of Measurement	0:17:17
	Unit 2.2 – Systems of Measurements	Area, volume and perimeter of geometrical shapes	https://youtu.be/OhTubw4C0to	43	Area, volume and perimeter of geometrical shapes	0:16:16
Chapter 3: Inspect the Fabrication Materials and Conduct their Surface Cleaning (CON/N1210)	Unit 3.1 – Blueprint Interpretation and Material Identification	Types of Drawings in Fabrication	https://youtu.be/YbPxawXyvYE	65	Types of Drawings in Fabrication	0:01:03

	Unit 3.2 – Material Handling and Quality Control	Cutting, Filing, Grinding and Fitting Metal for Welding	https://youtu.be/PXmQX4rw7rM	99	Cutting, Filing, Grinding and Fitting Metal for Welding	0:32:18
	Unit 3.3 – Surface Cleaning and Preparation	Blast Cleaning of Steel as part of Automatic Steel Fabrication	https://youtu.be/xzW5VxmpV70	116	Blast Cleaning of Steel as part of Automatic Steel Fabrication	0:02:49
Chapter 4: Conduct Joint Preparation, Connection Activities and Repair Work in Fabricated Assemblies (CON/N1211)	Unit 4.1 – Fabrication Fundamentals	Welding Fabrication Basics	https://youtu.be/B4jqkbKqS0s	143	Welding Fabrication Basics	0:08:57
	Unit 4.2 – Fabrication Bed and Equipment Preparation	Structural Steel Fabrication	https://youtu.be/9-yd1QGwng4	167	Structural Steel Fabrication	0:08:55
	Unit 4.3 – Quality Control and Repair	Welding defects cause and remedies	https://youtu.be/HbL4as_wG50	189	Welding defects cause and remedies	0:18:19
Chapter 5: Erect Structural Steel Assemblies at Construction Sites (CON/N0717)	Unit 5.1 – Rigging Plans and Safety Measures	Reading Construction Drawings	https://youtu.be/A3v3ik3kmks	201	Reading Construction Drawings	0:11:13

		Formwork, Shoring, and Bracing Requirements	https://youtu.be/fDoFkMbLFAs	201	Formwork, Shoring, and Bracing Requirements	0:04:02
	Unit 5.2 – Erection Techniques and Alignment	Master Craftsmen - Erecting Steel	https://youtu.be/CmTRThjb6mc	217	Master Craftsmen - Erecting Steel	0:03:06
	Unit 5.3 – Connection and Communication	Bolted Connection and Tightening Torque Basics	https://youtu.be/xcUTFcjuzOk	226	Bolted Connection and Tightening Torque Basics	0:21:11

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