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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/Q1202, Version 3.0**
**NSQF Level 3**

## Assistant Construction Fitter

**Published by**

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

**Shri Narendra Modi**
Prime Minister of India

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# Certificate

**COMPLIANCE TO**

**QUALIFICATION PACK- NATIONAL OCCUPATIONAL STANDARDS**

is hereby issued by the

CONSTRUCTION SKILL DEVELOPMENT COUNCIL OF INDIA

for

**SKILLING CONTENT:PARTICIPANT HANDBOOK**

Complying to National Occupational Standards of

Job Role/Qualification Pack:'Assistant Construction Fitter'

QP No.'CON/Q1202, Version 3.0 NSQF Level 3'

Date of Issuance: August 22nd 2019
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*Valid up to the next review date of the Qualification Pack or the 'Valid up' date mentioned above(whichever is earlier)

Authorised Signatory
(Construction Skill Development Council)

## Acknowledgements

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

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

## About this book

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

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

The handbook details the relevant activities to be carried out by an Assistant Construction Fitter. After studying this handbook, job holders will be adequately skilled in carrying out their duties according to the applicable quality standards. The handbook is aligned with the following National Occupational Standards (NOS) detailed in the latest and approved version of Assistant Construction Fitter QP:

- **CON/N1203:** Identify and mark structural steel elements to assist in fit-up of the same
- **CON/N1204:** Identify, use various tools, tackles and handle heavy materials used in fit-up of
- fabricated components
- **CON/N1205:** Assist in preparatory activities, edge reparation and positioning of steel sections for fit-up
- **CON/N8001:** Work effectively in a team to deliver desired results at a construction site
- **CON/N9001:** Work according to personal health, safety and environment protocols at construction site
- **DGT/VSQ/ N0101:** Employability Skills (30 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


Exercise


Notes


Unit Objectives


Activity

# Table of Contents



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

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# 1. Introduction to Construction Industry

Unit 1.1 – Introduction to Construction Industry

Unit 1.2 – Role and Responsibilities of an Assistant Construction Fitter

## Key Learning Outcomes

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

- Describe the role and responsibilities of an assistant construction fitter.
- Explain general hierarchy of fabrication occupation
- Discuss future possible progression and career options for assistant construction fitter
- Explain trade terminologies like orientation, alignment etc. used in fabrication occupation

# Unit 1.1 Introduction to Construction Industry

## Unit Objectives

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

- Give an overview of the construction industry.

## 1.1.1. Construction Industry

The construction industry is the oldest and one of the largest in the world, with a market size of over 10 trillion dollars. Construction has traditionally been a contracting sector, and the industry consists of a huge number of small businesses. Currently, the building industry is one of the main economic sectors. It contributes significantly to the national economy and employs a substantial number of people.

**Construction Industry in India**

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

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

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

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

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

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

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

## 1.1.2. Types of Construction

The following are the types of construction:

**a. Building construction:**

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

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

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

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

**b. Industrial Construction:**

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

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

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

Large-scale building projects necessitate the completion of several jobs by a large number of individuals. Different jobs are provided to different teams. For instance, a Project Manager is responsible for Project management,

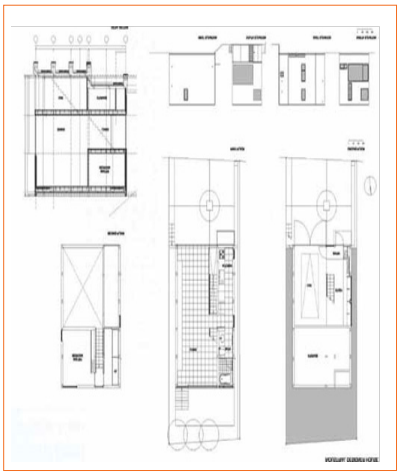

*Fig. 1.1.1 Industrial Construction Site Plan*

while a Construction Manager oversees Project construction. Additional examples include Design engineer, Project architect, and Financial Advisor. If a project is to be conducted successfully, the following must be ensured: Effective planning, successful scheduling, budgeting, construction site safety, availability of building materials, and logistics are essential for a successful construction project (that is transport of raw materials, etc).

**c. Infrastructure Construction**

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

*Fig. 1.1.2 Under Construction Bridge*

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

## 1.1.3. Market Segment of Construction Industry

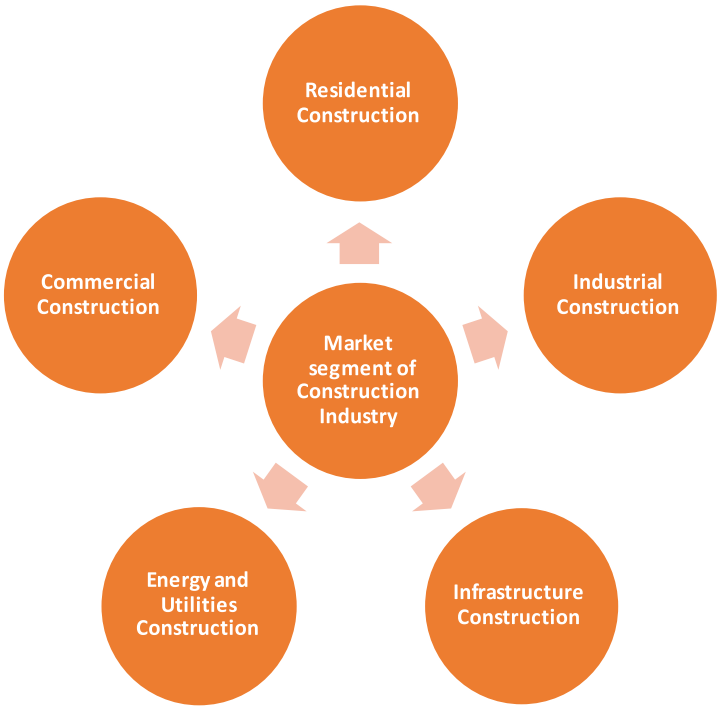


*Fig. 1.1.3 Market segment of construction industry*

## 1.1.4. Fabrication

Fabrication is the process of assembling products from separate components using at least one of a variety of procedures and materials such as metal, laminates, wood, and other solid surface materials. In metal fabrication, the steps can include stamping, welding, cutting, bending, and putting together. The technique often produces manufactured materials, such as steel, that may be assembled into bigger metal constructions. In addition, fabrication includes the production of components for engines, machineries, tools, and home appliances.

**Types of metal fabrication**

Choosing a metal fabrication method for a given project depends on the shape of the parts, the product's intended use, and the materials used to make it. The following are typical metal fabrication methods:

**Casting:** Casting is the process of pouring molten metal into a mould or die and waiting for it to cool and harden into the desired shape. With the use of the same mould to produce identical products, the metal fabrication process is perfect for mass production of parts. There are many different ways to cast, such as die casting, mould casting, sand casting, etc.

**Cutting:** The cutting of a workpiece to divide it into smaller sections is a very common type of metal fabrication. Sawing is the oldest way to cut, but today there are also ways to cut with a laser, waterjet, power scissors, and a plasma arc. Cutting can be done by hand, with power tools, or with computer numerical computer (CNC) cutters. Cutting could be the first step in a longer fabrication process, or it could be the only step.

**Drawing:** When metal is drawn, a tapered die is used to pull the metal into and through it. The die thins out the metal by pulling it into a different shape. Most drawing is done at room temperature, which is called "cold drawing." However, the metal piece can be heated to reduce the amount of force needed.

When the finished product has a depth that is equal to or greater than its radius, this is called "deep drawing." To transform sheets into hollow cylindrical or box-shaped vessels, it is typically used in conjunction with sheet metal fabrication.

**Folding:** This metal fabrication process works by manipulating metal to bend at an angle. The most common way is to use a brake press, which pinches the metal to make folds. The piece to be folded is held between a punch and a die, and pressure from the punch makes it fold. Most of the time, this method is used to shape sheet metal. You can also fold something by hammering it until it bends, or you can use a folder, which is a machine for folding. The machine has a flat surface where the flat sheet metal is placed, a clamping bar that holds the workpiece in place, and a front panel that lifts up and makes the metal over it bend.

**Forging:** Forging is a way to shape metal by putting pressure on it. The workpiece is hit with a hammer or die until it takes the shape that is wanted. Cold forging is the process of making something from metal that can be done when the metal is at room temperature. Warm forging is when the metal is heated to a temperature between above room temperature and below the recrystallization temperature. The process is called "hot forging" when the metal is heated to its recrystallization temperature, which is different for each metal. Blacksmiths used forging hundreds of years ago, making it one of the oldest types of metal fabrication.

**Extrusion:** The workpiece is forced through or around an open or closed die during the extrusion manufacturing process. When a piece of work is forced through an open or closed die, its diameter is reduced to the size of the die's cross-section. When a workpiece is pressed around a die, a hole is made in it. In both of these processes, the workpiece is usually a metal slug or cylinder (called a billet), and the impact operation is done with a ram. Most of the time, the cylindrical item that comes out of this process is wire or pipe. Extrusion can be done in a continuous way to make long pieces, or it can be done in a semi-continuous way to make many shorter pieces.

**Machining:** The process of shaping metal by taking away the unwanted material is referred to as machining in the metal fabrication industry. This process can be done in a number of different ways. There are a lot of different ways to machine, such as drilling, turning, and milling.

**Punching:** On a punch press, the metal is pushed through or into a die by turrets with different shapes. This makes holes. The final product can be a piece of metal with holes for fastening, or it can be the pieces of metal that have been cut away and shaped. This is called the blanking. Most punch presses are powered by machines, but smaller, simpler ones can be powered by hand.

**Shearing:** In this type of metal fabrication, two tools are used together to make one long, straight cut. One tool is above the metal and the other is below it to apply pressure. The metal breaks where the moving upper blade pushes down on the still lower blade. The crack then spreads inward until the two pieces are completely apart. Most of the time, the cut edges are rough. Since the blades can be set up at an angle to reduce the force needed, it is great for cutting things that are shorter or have different shapes.

**Stamping:** Similar to punching, this metal fabrication process produces an indentation rather than a hole in the metal. The turret doesn't push the metal all the way through the die. Instead, it just raises it. Stamping is a way to make shapes, letters, or pictures in a sheet or panel of metal. Stamping presses can be either mechanical or hydraulic. Metal stamping machines can cast, punch, cut, and shape metal sheets. Shapes and sizes are made by moulding sheets that are up to 1/4 inch thick.

**Welding:** Welding is a way to join two or more pieces of metal together by using heat and pressure. This method is popular because the metal pieces can be any size or shape. Stick or Arc Welding, MIG Welding, TIG Welding, and Flux Cored Arc Welding are four common ways to weld.

## 1.1.5. Steel Fabrication

Steel Fabrication refers to the process of shaping, cutting, and assembling steel-made components. Other than machinery and metal furniture, industries in the fabricated steel industry turn steel into intermediate or final items, as well as treat metals and metal-formed products fabricated elsewhere. Key steel fabrication processes include forging, stamping, bending, shaping, and machining, which are used to shape individual pieces of metal; and welding and assembly, which are used to combine distinct parts.

Structural steel is extensively used in the construction of industrial structures as well as in high-rise commercial buildings.

**Key Advantages of Steel**

- **Strength and Robustness:** Steel is commonly employed in commercial structures, in part because of its resistance to the effects of weather. Most other building materials, including concrete, cannot compare to its strength. Steel has a long lifespan and frequently comes with a warranty, which is another advantage.
- **Constructability:** Structural steel structures are quickly and easily put together. Building steel frames may be quickly constructed. Typically, construction projects disrupt the adjacent roads and buildings. This is diminished by quick construction, which also results in cost savings for site preparation.
- **Easily Fabricated:** Steel is easily fabricated and produced in large quantities. It is possible to manufacture steel components off-site at shop floors and then assemble them on-site. This shortens the construction process and makes it more effective overall.
- **Flexibility:** Steel for structures is exceedingly malleable. Compared to other building materials, structural steel is reasonably priced. It is extremely robust. Structures made of structural steel may withstand external forces including cyclones, thunderstorms, and earthquakes. If properly maintained, a well-built steel structure can survive up to 30 years.

## 1.1.6 Role of Fabrication in the Construction Industry

In terms of revenue, the worldwide structural steel fabrication market was estimated to be worth US$ 132.17 Bn in 2017. It is anticipated to grow at a CAGR of 4.24% from 2018 to 2026. The global expansion of the automotive and construction industries as well as the rise in manufacturing facilities are the main drivers propelling the structural steel fabrication market.

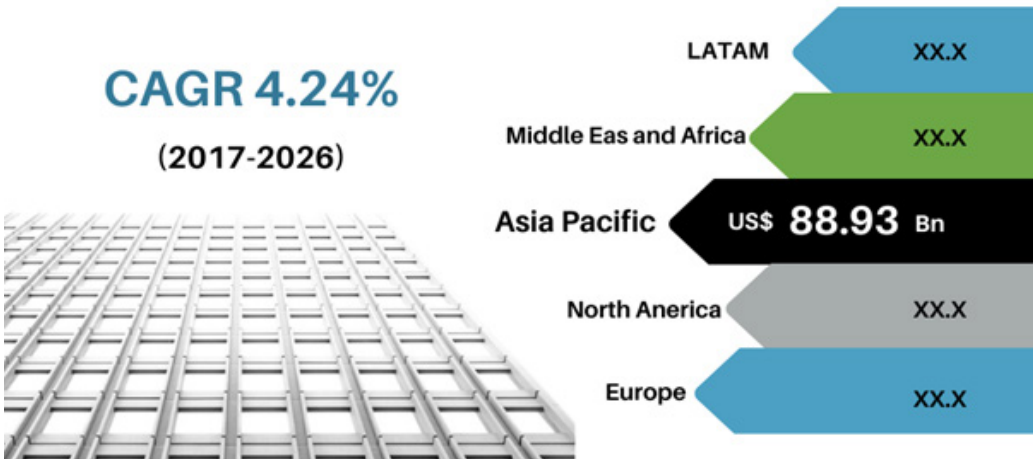


*Fig. 1.1.4 Structural Steel Fabrication Market Value, By Region, 2018 (US$ Bn)*

Other industries have also developed as significant end-users of structural steel fabrication, thus its use is not solely limited to the building industry. In recent years, the automobile industry has emerged as a major consumer of structural steel, and this development has significantly fueled the expansion of the worldwide structural steel fabrication market.

Over the past few years, the steel fabrication sector in India has advanced significantly from the remote traditional welding of some structures to the production of fully designed and inventive sheet metal for a variety of direct uses. Technology advancements in this field have aided in the accurate and leak-proof construction of the structure as well as the reduction of delivery times.

In fact, the fabrication sector has seen many new players enter this market with automated machinery for a variety of purposes. This industry was previously thought of as a perennial one, with new generations automatically taking over from the preceding one.

## Notes

## Scan the QR code to watch the video

https://youtu.be/nndLyZrGfWc

Construction Industry

https://youtu.be/1WVzo2UFyo8

Types of Construction

https://youtu.be/wi0uRrI_yz8

Fabrication

# Unit 1.2 Role and Responsibilities of an Assistant Construction Fitter

## Unit Objectives

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

- Describe the role and responsibilities of an assistant construction fitter.
- Explain general hierarchy of fabrication occupation
- Discuss future possible progression and career options for assistant construction fitter
- Explain trade terminologies like orientation, alignment etc. used in fabrication occupation

## 1.2.1. Assistant Construction Fitter

Assistant Construction Fitter provides assistance in fitup activities by placing, positioning and fixing different components after conducting proper measurements, markings and edge preparation under the supervision of trade senior. Assistant Construction Fitter should have the knowledge of:

- Using different tools and equipment
- Standard procedures for moving and lifting heavy things
- Basic idea of working principle of jacks
- Different hand and power tools available in the market for fabrication.

## 1.2.2. Role and Responsibilities of an Assistant Construction Fitter

An Assistant Construction Fitter is responsible for his own work up to a certain limit and works closely with the trade senior to complete tasks on time and well, following standard working procedures and safety rules. The responsibilities include:

- Identifying materials based upon instructions
- Measuring and marking structural steel elements as per instructions and hand sketches
- Operating a bevelling machine for edge preparations
- Preparing platforms for fitup
- Placing and fixing elements as per instruction
- Assisting in shifting of heavy materials under supervision

## 1.2.3. Personal Attributes required by an Assistant Construction Fitter

An Assistant Construction Fitter should be:

- Physically fit, mentally alert, and safety-minded
- Able to work in different places with different weather and site conditions
- Ideally, not suffering from any breathing problems, vision problems, or skin allergies caused by light and heat
- Able to work well as part of a team
- Able to use different tools and materials for fabrication

## 1.2.4. Career Progression of an Assistant Construction Fitter

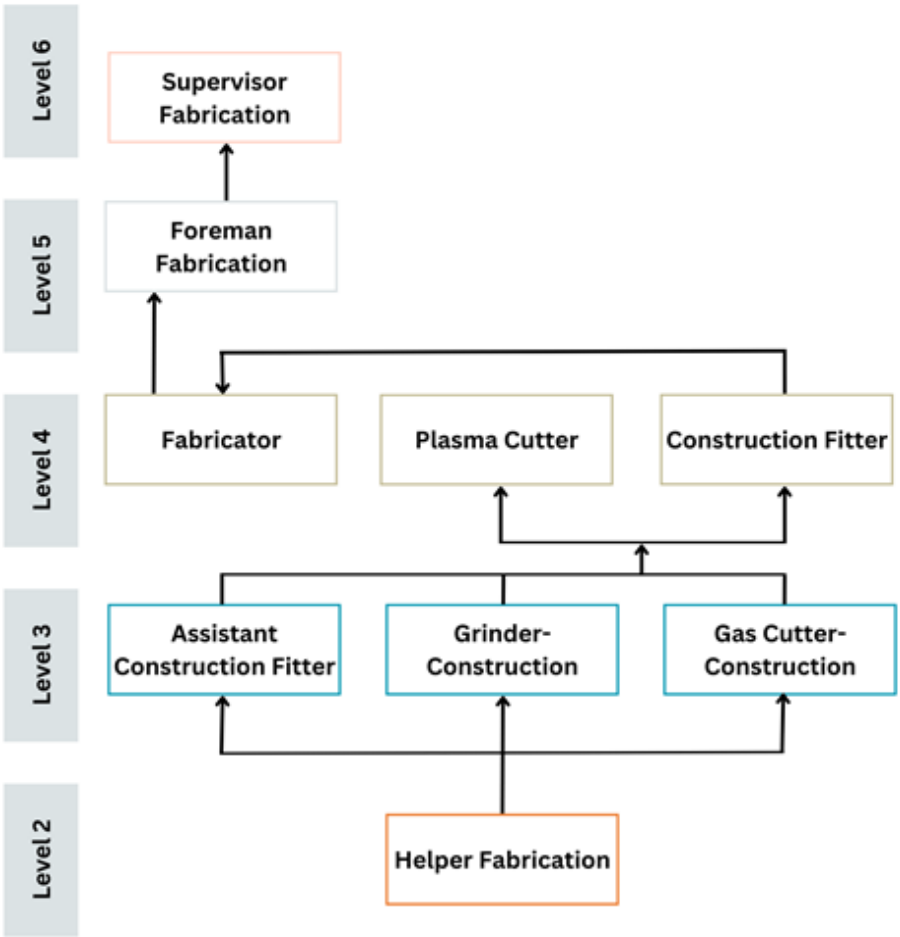


*Fig. 1.2.1 Career Progression of an Assistant Construction Fitter*

## Exercise

1. Show the career path of an Assistant Construction Fitter.
2. What are role and responsibilities of an Assistant Construction Fitter?
3. State few personal attributes required by Assistant Construction Fitter.
4. What are the different types of fabrication? Name them.

## Notes

## Scan the QR code to watch the video

https://youtu.be/F4s_QE8mRWA

Assistant Construction Fitter

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# 2. Identify and Mark Structural Elements

Unit 2.1 - Identify and mark structural elements

CON/N1203

## Key Learning Outcomes

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

- Compute dimensions of structural elements by interpreting hand sketches and simple drawings.
- Determine the location and orientation of sections for marking by interpreting the sketches
- Explain the process of measuring and marking structural steel
- Categorize materials used in fit up based upon the weight (light, medium and heavy materials)
- Describe the ergonomics involved in material shifting
- Explain various methods of shifting and stacking heavy materials
- Explain undulations and their effect on the quality of overall output.
- Identify various sections on basis of shapes
- Differentiate between sheet and plate sections based on size
- Identify the sections (I, C, H, UC) from the hand sketches or fabrication shop drawings.
- Demonstrate measuring and marking on steel sections specifying location of components (plate sections, bar section, rolled sectioned.)

# Unit 2.1 Identify and mark structural elements

## Unit Objectives

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

- Compute dimensions of structural elements by interpreting hand sketches and simple drawings.
- Determine the location and orientation of sections for marking by interpreting the sketches
- Explain the process of measuring and marking structural steel
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- Differentiate between sheet and plate sections based on size
- Identify the sections (I, C, H, UC) from the hand sketches or fabrication shop drawings.
- Demonstrate measuring and marking on steel sections specifying location of components (plate sections, bar section, rolled sectioned.)

## 2.1.1. Structure Steel Fabrication

Structural steel fabrication is the process of bending, cutting, and forming steel structures to make beams, columns, and steel members. Fabricators of structural steel erect and supply well-made steel parts and buildings. Structural steel is a low-cost, long-lasting, and extremely stable construction material.

To produce steel structures for constructing dependable structures, structural steel fabricators collaborate closely with designers, architects, shop employees, project managers, detailers, machine operators, inspectors, and engineers.

The fact that structural steel is recyclable reduces the cost of acquiring or generating new materials, making it the most popular metal in the construction sector. It is advisable to recycle and reuse any previously used structural steel components rather than throwing them away.

The most environmentally friendly structural building material, structural steel actively contributes to lowering emissions, improving energy efficiency, and other environmental issues. Recycled structural steel beams and columns make up the majority of recycled structural steel. Our goal is to offer top-notch recycled structural steel products that use less energy, emit less carbon dioxide, and promote environmental preservation.

Depending on what is being made and from what materials, the manufacturing process may involve a variety of distinct phases. Yet, design comes first in every fabrication process. Although while hand-drawn diagrams can be used for simpler work, computer-aided design (CAD) software can be used to produce and test more intricate or complicated designs. Prototyping, which assists with visualising and testing iterations of the product, is frequently used in more sophisticated fabrications.

**Anatomy of a Steel Structure**

- Beams
- Columns
- Floors
- Bracing systems-- which is very important for higher rise cases
- Foundation
- Connections

## 2.1.2. Types of Structural Steel

Structural steel is a steel-based building material that is created in a particular shape and chemical composition to meet the required criteria. There is a vast variety of steel sections that may be utilised as structural components, ranging in size, form, and other characteristics.

**Rolled Steel Sections:** Rolled structural steel sections are the steel sections that are made in rolling mills and utilised as structural elements. The names of the steel sections reflect their cross-sectional forms. The forms of sections are determined by the sorts of members that are created and, to some extent, by the erection method. Many steel parts are easily accessible and in high demand on the market. These portions of steel are referred to as normal steel sections. Some steel pieces are rarely employed. These parts are created upon special request and are referred to as special sections.

The various types of rolled structural steel sections manufactured and used as structural members are as follows:

1. **Rolled Steel I-sections (Beam sections):** The BIS(IS : 808-1989) classifies rolled steel beams into the following four series:

   a. Indian Standard Joist/junior Beams-ISJB
   b. Indian Standard Light Beams- ISLB
   c. Indian Standard Medium Weight Beams- ISMB
   d. Indian Standard Wide Flange Beams- ISWB

The BIS (IS: 808-1989) classifies rolled steel columns/heavy weight beams into the two series listed below:

a. Indian Standard Column Sections ISSC
b. Standard Indian Heavy Weight Beams ISHB

The segment of the beam consists of a web and two flanges. Fillet refers to the juncture between the flange and the web. These pieces of hot-rolled steel beam have sloping flanges. The outer and inner sides are inclined and intersect at an angle ranging from 1.5 to 8 degrees, depending on the section and rolling mill procedure. I-sections are utilised as columns and beams. It excels in resisting bending moment and shearing force.

*Fig. 2.1.1 Beam Section*

2. **Rolled Steel Channel Sections:** ISI classifies the rolled steel Channel sections into four categories:

a. Indian Standard Joist/Junior Channels- ISJC
b. Indian Standard Light Channels- ISLC
c. Indian Standard Medium Weight Channels- ISMC
d. Indian Standard Medium Weight Parallel Flange Channels- ISMCP

The segment of the channel is composed of a web and two flanges. Fillet refers to the juncture between the flange and the web. The designation of rolled steel channels is based on the series to which each channel segment belongs. The use of channels as beams and columns. Due to its design, a channel member enables the attachment of an angle to its web. For columns, constructed channels are particularly convenient. In bridge trusses, double channel members are frequently employed.

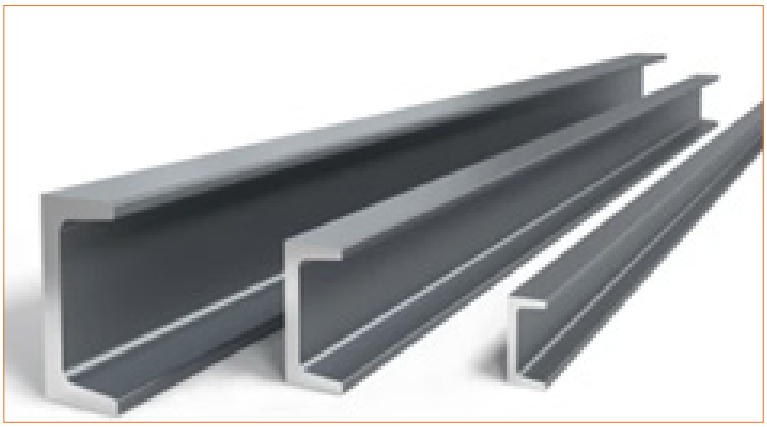

*Fig. 2.1.2 Channel Section*

3. **Rolled Steel Tee Sections:** As per ISI rolled steel tee sections are classified into the following five series:

   a. Indian Standard Normal Tee Bars- ISNT
   b. Indian Standard Wide flange Tee Bars- ISHT
   c. Indian Standard Long Legged Tee Bars- ISST
   d. Indian Standard Light Tee Bars- ISLT
   e. Indian Standard Junior Tee Bars- ISJT

The tee part has a web and flange. Fillet refers to the juncture between the flange and the web. The rolled steel tee sections are identified by the series to which they belong (abbreviated reference symbols), followed by the section's depth in millimetres and weight in kilogrammes per metre of length.

As per IS 808 (part II) 1978, the H beam parts have been eliminated.

*Fig. 2.1.3 Tee*

4. **Rolled Steel Angles Sections:** The rolled steel angle sections are divided into the three series shown below:

   a. Indian Standard Equal Angles- ISA
   b. Indian Standard Unequal Angles- ISA
   c. Indian Standard Bulb Angles- ISBA

Angles have several fabrication uses. As purlins, angle sections comprising of one, two, or four angles designed to withstand axial forces (tension and compression) and transverse forces are utilised. Angles can be utilised as connecting components to join structural elements such as sheets or plates or to create a built-up section. Like beam seats, stiffening ribs, and cleat angles, angle sections are also utilised to link beams to columns and purlins to chords of trusses. The bulb angles are utilised in ship design.

*Fig. 2.1.4 A Structure Angle*

5. **Rolled Steel Bars:** The rolled steel bars are divided into the two series listed below:

   a. Indian Standard Round Bars ISRO
   b. Indian Standard Square Bars ISSQ

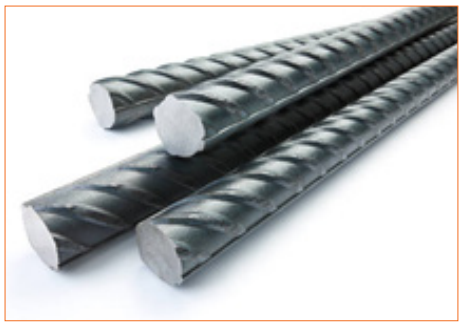

*Fig. 2.1.5 Round Bar*

The rolled steel bars are utilised as braces and ties. Cross sections of steel bars that have been rolled. The rolled steel bars are denoted by the reference symbol RO followed by the diameter for round bars and ISSQ followed by the side width for bar sections. As tension members, the bars with threaded or looped ends are employed.

6. **Rolled Steel Tubes:** In tubular trusses, the rolled steel tubes serve as columns, compression members, and tension members. The rolled steel tubes are effective compression members for use as structural sections. The gyration radius of the steel tube sections is same in all directions.

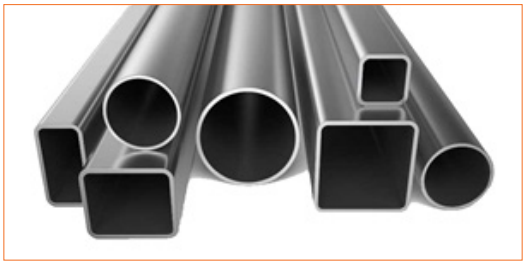

*Fig. 2.1.6 Steel Tubes (HSS)*

7. **Rolled Steel Flats:** Flats of rolled steel are used for lacing components in constructed parts, such as columns, and as ties. The designation for rolled steel flats is the width in millimetres of the section followed by the letters (abbreviated reference symbol) F and the thickness in millimetres, e.g. 50 F 8. This indicates a 50 mm wide and 8 mm thick flat. Flats of rolled steel are used as lattice bars to connect the elements of constructed columns. Flats of rolled steel are utilised as tension members and stays.

*Fig. 2.1.7 Steel Flats*

8. **Rolled Steel Sheets and Strips:** The reference symbol for the rolled steel sheet is SH followed by the sheet's length in millimetres x width in millimetres x its thickness in millimetres. ISST is followed by the width and thickness of the rolled steel strip, e.g., SH 2000 x 600 x 8 and ISST 250 x 2.

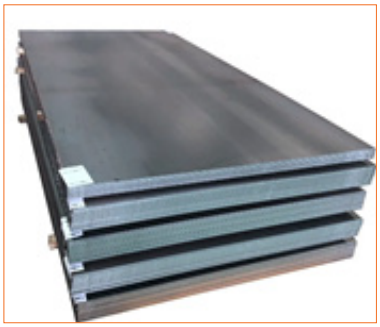

*Fig. 2.1.8 Sheets*

9. **Rolled Steel Plates:** The designation for rolled steel plates is the shortened reference symbol PL followed by the length in millimetres x breadth in millimetres x thickness in millimetres of the plates, e.g. PL 2000 x 1000 x 6.

Steel sheets and plates are utilised extensively in construction. By riveting or welding the individual plates, any section with the specified dimensions, thickness, and configuration may be manufactured. The rolled plates are utilised in the web and flanges of plate girders, plated beams and chord members, as well as the web members of truss bridge girders. Special plate constructions, such as shells, rectangular and circular steel tanks, and steel chimneys, utilise the rolled steel plates.

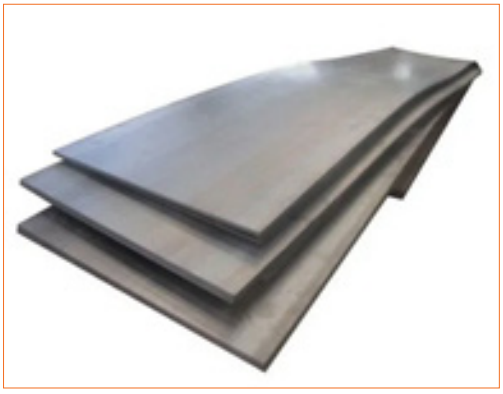

*Fig. 2.1.9 Plates*

Steel sheet metal is metal that is thicker than foil but not as thick as a plate. When metal foil turns into metal sheet and metal sheet turns into metal plate, the difference is based on the gauge or thickness. So, sheet metal must be at least 0.5 mm thick and no more than 6 mm thick to be considered sheet metal.

Steel plate metal is a sheet of metal that is at least 6 mm thick. Inches are used to measure steel plate, while gauges are used to measure sheet metal. There are low carbon steel plates, medium carbon steel plates, and high carbon steel plates. When there is more carbon in something, it gets stronger and harder.

## 2.1.3. Drawings of Steel Structure

Layout, general, fabrication, erection, and false work drawings are only few of the many kinds of blueprints used in the fabrication and erection of steel buildings.

**Layout Drawings**

General plans and profile drawings are other names for layout drawings. These show where the building will go, how it will be oriented, and how high the building's main components will be above ground. Important information, such as the kind of soil below the surface or the proximity of buildings and highways, may also be gleaned from these maps. Written specifications provide further guidance and detail to these diagrams.

**General Plans**

The size, kind, and composition of all major elements, as well as their position and method of connection, as well as the attachment of additional parts, may all be found in the general designs. Factors like building size and kind, as well as the intricacy of daily operations, will influence the amount of general plan drawings provided. Plan views, elevations, and sections of the building and its components make up the general plans. The number and placement of sections and altitudes are determined by the quantity of data being collected.

**Fabrication Drawings**

Fabrication drawings, also known as shop drawings, include the dimensions, shape, material, and connection and attachment points for each component. With this data, a fabricator in the shop or yard may purchase the necessary materials and begin working on the member in question. The fabrication design includes the component parts of the members, together with measurements and assembly markings.

**Erection Drawings**

Erection drawings, also known as erection diagrams, display where all of the building's components should be after construction is complete. Those on the front lines of the erection will find them very helpful. Erection drawings, for instance, include useful information like the approximate weight of heavy sections, the number of pieces, and other specifications.

**False Work Drawings**

False work is a phrase for the temporary timber or steel supports needed for major construction projects. Construction drawings, like the general and detail drawings mentioned above, may be given to guide building of complicated fake work. In the case of elementary forgeries, a few drawings drawn in the field might suffice.

## 2.1.4. Shop Drawings

Shop drawings (also referred to as fabrication drawings) are detailed designs depicting the designer's objective. They provide fabricators with the necessary information for manufacturing, fabricating, assembling, and installing all structural components. Instructions for assembly, installation, and erection are included, along with the necessary materials and specifications. Engineers, steel detailers, steel modellers, and fabricators are frequently responsible for creating shop drawings. Normally, the following information is provided:

- Information essential for fabrication, including dimensions, special instructions, and connection standards.
- Relevant construction specifications
- Details for installation and assembly
- Measurements needing site-specific verification
- Comparisons to the construction documents for the architect's or engineer's approval
- Comments on revisions to the construction documentation for the architect's or engineer's approval

**How to Interpret Designs for Structural Steel Fabrication?**

Every engineer and fabricator needs to be able to read fabrication drawings, comprehend the many components of the drawing, and understand the symbols and dimensions.

While stainless steel fabrication is only one type of material used in this design, it is essential to understand that the same rules apply to other fabrication drawings.

With enough study and effort, though, one may acquire a talent that will be essential. An Overview of Reading Structural Steel Fabrication Drawings:

1. Identify the various components of the drawing: It's crucial to recognise the various components of a fabrication drawing before attempting to comprehend it. There are several components that make up a typical set of fabrication drawings, including:

   a. **Cover Sheet:** The drawing's first page will provide general details about the project, including the date, the client's name, and the scope of the work.

   b. **General Notes:** Notes concerning the project, such as required surface finishes and tolerances, will be included in this section. It's crucial to carefully study this section to make sure you comprehend all of the project's requirements.

   c. **Bill of Materials:** The materials necessary for the project are listed in this section, along with any potential fabrication needs for stainless steel.

   d. **Detail Drawings:** These designs offer thorough schematics of each component that has to be manufactured. These offer the measurements, angles, and cutouts needed to finish the project.

   e. **Assembly Drawings:** An assembly-fitting diagram is included in this kind of drawing. It's crucial to pay attention to these sketches since they provide a general idea of what the final result will look like.

Understanding the various components of the fabrication drawing will help in better comprehension of what has to be done to finish the project.

2. Understand the meaning of the symbols

The symbols used in fabrication drawings can initially appear intimidating when trying to interpret them. Yet, one can readily interpret them once familiar with the various types of symbols and what they stand for.

Fabrication drawings are typically made up of symbols and lines representing the shapes and sizes of the material being fabricated.

- Lines, circles, rectangles, arcs, and arrows are all common shapes in these drawings.
- There are also different symbols for different materials, like the fabrication of stainless steel. These symbols tells about the kind of material and its thickness.
- In some cases, the drawings also include symbols that represent special features, like a hole or a slot. It is important to read these symbols correctly to see how the part should look when it is done.
- It is also important to know that fabrication drawings may use different symbols to show the same shape or feature.
- For example, a line could stand for a bolt and a circle could stand for a washer. To figure out what the drawing means, one needs to know what each symbol means and where it fits in.

3. Be able to figure out the dimensions

- It is important to understand the dimensions when reading fabrication drawings. These show the exact size and shape of the pieces of stainless steel that need to be made.
- Most drawings show measurements in millimetres or inches, but other units of measure may also be shown.
- On the fabrication drawing, the sizes are written in different places. These include the main body of the drawing, which shows the overall shape of the part, as well as smaller details like flanges and holes.
- It's also important to pay attention to any angles that may be shown. For stainless steel fabrication to go well, you have to know how to read the measurements correctly.
- To help understand the sizes on fabrication drawings, it can be helpful to look at a sample drawing and get used to the different symbols and measurements.
- By doing this, onre can learn what each symbol means and how to read it right. Also, practise is very important. The more one read fabrication drawings, the better they will get at figuring out the sizes.

## 2.1.5. Computing Dimensions of Structural Elements by Interpreting Drawings

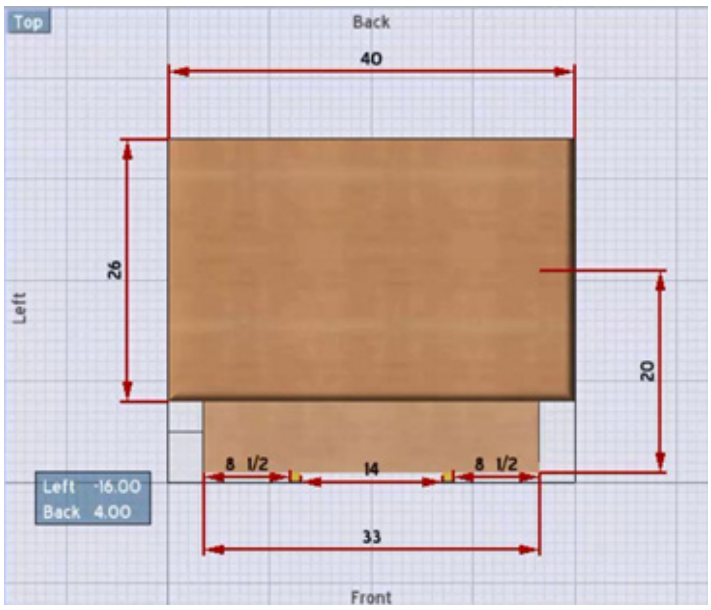


*Fig. 2.1.10 A shop drawing with dimensions*

Working with fabrication drawings can be a challenge, especially when it comes to computing the dimensions of structural elements. However, with the right set of tools, it can be done efficiently and accurately.

- The first step is to read the fabrication drawings and understand the design intent. This includes looking at the type of material, the connection details, and any other annotations on the drawing. Once the design intent is clear, it's time to measure the dimensions of the structural element. Doing so requires careful attention to detail and accuracy.
- The dimensions can be measured directly from the drawings or by using a combination of measuring tools, such as a ruler, calipers, and a protractor. It's also important to consider any additional annotations on the drawing that may affect the measurements and the overall design.
- Once the measurements are complete, the dimensions should be double-checked for accuracy. This is especially important for complex designs or parts with multiple pieces. After that, the measured dimensions can be compared with the original drawings to ensure that nothing has been overlooked and the design intent has been met.

Having a proper understanding of the fabrication drawings and a set of reliable measuring tools is key to computing the dimensions of structural elements accurately and efficiently. By following these steps, the dimensions can be determined quickly and accurately, enabling a smooth workflow and faster production cycle.

## 2.1.6. Measuring Out Structural Steel

Measuring out structural steel requires a high level of accuracy and precision to ensure the pieces are cut properly and fit together without any issues.

The process usually requires the use of specialized tools, such as a tape measure, level, and steel square.

Additionally, it is important to ensure the measurements are taken from the appropriate spot, usually from the center of the piece. Once the measurements are taken, they should be recorded and double-checked for accuracy.

Finally, the steel can be marked and cut to the desired size. With the proper tools and attention to detail, measuring out structural steel can be a straightforward process.

## 2.1.7. Marking Structural Steel

Structural steel fabrication is a process that involves the cutting, shaping, and forming of steel materials into desired shapes and sizes. In order to ensure quality, accuracy, and safety in the fabrication process, it is important to use effective methods of marking structural steel.

There are several ways to mark structural steel in fabrication. One of the most common methods is the use of heat-sensitive inks. Heat-sensitive inks are applied to the steel through a metal stamping process and become visible after the steel has been heated. This method is useful for quickly marking the steel with a unique identifier or lettering.

Laser marking is another popular method of marking structural steel in fabrication. This method uses laser etching to burn the desired marks into the steel surface. Laser marking is more time-consuming than heat-sensitive inks, but provides a permanent mark.

Another method of marking structural steel in fabrication is through the use of permanent markers. This method is relatively quick and easy, but the marks can easily be removed or obscured with further fabrication.

Finally, scribing is a traditional method of marking structural steel in fabrication. Scribing involves using a sharpened metal tool to manually mark the steel. This method offers greater precision than the other methods, but it is relatively slow and laborious.

No matter which method is used, marking structural steel in fabrication is an essential step for ensuring quality and safety in the fabrication process.

## 2.1.8. Fit up of Structural Steel

Structural steel is a highly versatile and reliable material that is used for many building projects, from bridges and tall buildings to smaller structures like sheds and garages. It is especially important to ensure that the fit up of structural steel is done correctly, since this is the key to achieving a building that is safe and structurally sound.

The fit up of structural steel includes making sure that all the components of a building are cut to the right size and shape and that they fit together properly. This includes checking the angle and position of the pieces of steel and making sure that they are level and aligned properly. It also involves ensuring that there are no gaps between the pieces of steel that could compromise the structural integrity of the building.

Another important aspect of fit up is welding, as this is what holds the pieces of steel together. Welders must ensure that all the pieces of steel are joined securely and that they are properly aligned. It is also important to check the quality of the welds, as any defects can lead to structural failure.

Finally, fit up also includes making sure that the structural steel is properly protected from the environment. This is done by applying a protective coating to the steel that will prevent it from rusting or being damaged by environmental elements. In addition, the coating may also be used to make the steel look aesthetically pleasing.

Overall, the fit up of structural steel is incredibly important to ensure the safety and structural integrity of any building. It is essential that all components are cut correctly, joined securely, and properly protected from the environment in order to ensure that the building is safe and reliable.

## 2.1.9. Material Handling

The word “material handling” is commonly used in the construction business to refer to the process of delivering, moving, storing, and maintaining control of various materials and goods. This is an essential component of the project’s logistical management.

For the purpose of material handling on the construction site, many kinds of plant equipment, such as hydraulic excavators, telescopic handlers, cranes, forklift trucks, lifting devices, and conveyor systems, among others, are utilised.

To ensure that everyone at the location is aware of how the material handling system functions at every stage, beginning with the arrival and inspection of items and continuing through storage, assembly, and usage, the system should be well-coordinated and organised. When working with materials, protecting one’s health and safety should be your top priority. It is essential to perform pre-start inspections, load restrictions should not be exceeded, method statements should be adhered to, and a banksman may be required to direct material movements throughout the site.

While building a material handling system for a construction project, it is critical to adhere to the rules established for the best practises in the industry.

One of the most common causes of injuries sustained on the job is improper manual handling. This may be due to the following factors:

- The total mass of the thing that is being moved.
- The manner in which the movement is performed repeatedly.
- The amount of space that is being covered while moving the item.
- Where the item is going and where it is coming from during the journey.
- The stance or position taken by the individual.
- Any position that requires twisting, bending, stretching, or other unpleasant movements could make the condition worse.

## 2.1.10. Ergonomics in Material Handling

Ergonomics is the study of people in the workplace with the goal of reducing the amount of physical stress and the injuries that are a direct result of that stress. These injuries can include overuse injuries, poor posture, and more serious musculoskeletal illnesses. The goal of ergonomics is to cut down on accidents like these by creating working environments, tools, activities, and pieces of machinery that contribute to the well-being of workers.

The provision of a secure working environment for workers, as well as the enhancement of their capabilities and levels of comfort, are all among the goals of ergonomics. Also, it may enhance the effectiveness of one's task.

Domains of specialisation indicate deeper competencies in ergonomics within a given workplace. These fields of specialisation are elaborated upon below:

- Ergonomics refers to the study of how factors such as an individual's anatomy, anthropometry, physiology, and biomechanics influence their performance in a given task. Physical ergonomics focuses specifically on how these factors interact with one another.
- Cognitive Ergonomics refers to the study of mental processes, such as insights, memory, analysis, and motor reaction, and how these activities influence the linkages between employees and other components of a system.
- Organisational Ergonomics refers to a branch of ergonomics that combines aspects of both physical and cognitive ergonomics and incorporates the most recent research in these subfields. This subfield focuses on improving not only social and technical systems but also their organisational structures and the policies that govern them.

The goal of ergonomics is to ensure that human needs for productive and risk-free work are taken into account during the planning and construction of organisational structures. It is possible to greatly lower the risk of suffering an injury on the job by having an evaluation of the workplace performed or by receiving training in ergonomic procedures.

## 2.1.11. Shifting and Stacking Heavy Materials

Heavy materials can be shifted using a variety of methods. For example, a forklift or crane can be used to move large objects, while a dolly can be used to move smaller items. When using a crane, it is important to ensure that the ground where the crane is standing is stable, and that the crane's lifting capacity is sufficient to handle the weight of the load. Additionally, ensure that the crane is operated by a qualified professional to minimize the risk of any accidents. For lighter materials, a trolley or pallet jack can be used. These are often easier to maneuver and allow for a greater degree of precision when moving the materials. If the materials are too large to move, it may be necessary to enlist the help of a professional moving service.

Heavy materials can be safely stacked properly by following several methods.

- The most popular approach is the "Toe-to-Toe" stacking technique, which involves positioning each layer of materials at an angle of 45 degrees from the previous layer, thus creating a stable base. This technique is especially useful for large and heavy objects.
- Another common stacking method is the "Stacking" approach, which involves positioning each layer of material flat on top of the previous layer, thus forming a cube-like structure. This technique is ideal for stacking small and lightweight materials, such as wooden boards, sheets of paper, and other lightweight items.
- The "Staircase" method is a unique approach to stacking heavy materials, which involves placing each layer of material at an angle of 45 degrees from the previous layer, then gradually increasing the angle of each layer until the desired height is reached. This technique is ideal for taller objects, and provides a very secure base.
- Finally, the "Cross-Stacking" method involves positioning each layer of material at right angles to the previous layer. This method is ideal for lightweight materials, as it creates a secure base while minimizing the risk of materials slipping or shifting while they are being stacked.

## 2.1.12. Undulations and Bends

Undulations refer to the slight variations in the output of a manufacturing process or machine. During the measurement of a steel structure, it is important to identify any undulations or bends that may have been present. It is important to note that undulations and bends in steel can weaken the structure and should be reported to the superiors to ensure the safety of those working with the structure.

In order to properly manage the bends encountered during the measurement of steel structures, several steps should be taken.

- Firstly, make sure to measure the steel structure accurately, as bends can occur due to incorrect measurements. When measuring, use the correct tools, such as a tape measure or a straight edge, and take into account any possible obstructions or objects that could cause the steel structure to bend.
- Secondly, check for any weak points in the steel structure that could lead to bending. Look out for any corrosion or welds that could be weakening the structure and causing it to bend.
- Thirdly, check the surrounding conditions to make sure there are no external factors that could be causing the steel structure to bend. If there is any risk of wind, vibration, or other environmental factors causing the structure to bend, take the necessary steps to prevent it.
- Finally, inspect the structure regularly for any signs of bending. If any bends are found, take corrective measures to fix it as soon as possible.

Undulations in steel structures can be difficult to measure, but there are a few techniques that can help.

- First, when measuring a steel structure, it is important to identify any undulations in the surface. This can usually be done with a straight edge or tape measure. It is important to note any vertical variations, as these can have a considerable effect on the accuracy of the measurements.
- Once any undulations have been identified, they should be marked or flagged. This can be done with tape, a marker, or any other flagging system. This will make the undulations more visible and allow measurements to be taken more accurately.
- If the undulations are minor, they can be compensated for in the measurements. This is done by averaging the lengths of the two closest adjacent points. The two points should be as close as possible to the undulation while still being parallel. This technique is known as ‘averaging of the undulation’.
- If the undulation is too large to be compensated for, the steel structure should be re-leveled. This can be done by using shims, wedges, or jacks to raise or lower the structure until it is level.
- Finally, all measurements should be taken twice and at least two people should be present when the measurements are taken. This will help to ensure that the measurements are accurate and consistent.

## Exercise

1. What is structure steel fabrication?
2. List the different types of structural steel.
3. What are fabrication drawings? Explain in brief the process of interpreting fabrication drawings.
4. Describe the methods of marking structural steel.
5. What is Ergonomics? Explain its importance.

## Notes

## Scan the QR code to watch the video

https://youtu.be/9-yd1QGwng4
Structure Steel Fabrication

https://youtu.be/UEOOcK2UovI
Types of Structural Steel

https://youtu.be/hVQoohvbvNI
Drawings of Steel Structure

https://youtu.be/1uMf4Ky0nyM
Material Handling

Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

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

# 3. Tools and Heavy Materials used in Fit-Up of Fabricated Components

Construction Skill Development Council

Unit 3.1 - Tools and Instrument used in Construction Fitting

CON/N1204

# Unit 3.1 Tools and Instrument used in Construction Fitting

## Unit Objectives

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

- Identify the various tools and instruments used for marking, measuring, anchoring (holding and tightening), cutting and striking, lifting and shifting.
- Explain the areas of application of each instrument.
- List major equipment manufacturers, the models, cost and specifications of instruments and equipment used for fabrication
- Use various tools and tackles required for performing lifting and shifting of heavy materials
- Apply various do's and don'ts while performing lifting and shifting of heavy materials
- Apply safe working practices while lifting and shifting heavy materials
- Demonstrate visual checks carried out for serviceability of hand tools
- Demonstrate checks performed for ensuring no obstruction of load
- Describe process of controlling the position of suspended load
- Demonstrate anchoring and control position of suspended object during lifting
- Demonstrate material shifting as per standard practices.
- Demonstrate safe stacking of heavy materials as per standard practices.

## 3.1.1. Fabrication

Fabrication is a broad term that can refer to various manufacturing processes in different industries. The instruments and equipment used for fabrication can vary depending on the specific materials being used and the methods employed. Here are some examples of common instruments and equipment used in fabrication:

- **Cutting tools:** This includes saws, drills, and laser cutters used to cut or shape materials such as metal, wood, or plastic.
- **Welding equipment:** Welding machines, torches, and filler materials are used to join two or more pieces of metal together.
- **Forming equipment:** This includes bending brakes, rollers, and presses used to shape materials into different forms, such as sheet metal or tubing.
- **3D printers:** These machines are used to create three-dimensional objects from a digital model, by adding layers of material.

- **CNC machines:** Computer numerical control (CNC) machines are used to automate fabrication processes, such as cutting or drilling, by following programmed instructions.
- **Finishing tools:** This includes sanders, grinders, and polishers used to smooth and refine the surface of the fabricated item.
- **Measuring and testing equipment:** This includes tools such as calipers, micrometers, and gauges used to measure the accuracy of the fabrication process and ensure the finished product meets specifications.

Overall, the instruments and equipment used for fabrication will depend on the specific project and requirements.

## 3.1.2. Marking out Tools and Instruments

Marking out tools are commonly used in fitting and construction to accurately mark out the location of various components and features on a workpiece. By using these marking out tools correctly, the Assistant Construction Fitter can achieve accurate and precise cuts, which is essential for successful fitting in construction. Some common marking out tools used in fitting in construction include:

1. **Scriber:** It is a round, hardened steel piece that is between 3 and 5 mm in diameter and between 150 and 300 mm in length. It has a sharp pointed one end and a similarly sharp pointed but bent other end. The bent end is used to scratch lines in locations inaccessible to the straight end.

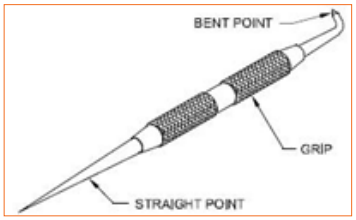


*Fig. 3.1.1 Scriber*

**Use of Scriber in Construction:**

Scribers are not typically used in construction as much as they are in metalworking or woodworking. However, they can still be useful in some construction applications where precise marking is necessary.

Here are some examples of where a scriber might be used in construction:

- **Masonry:** When working with bricks or blocks, a scriber can be used to mark the precise location where a cut is needed, such as for a window or door opening. This can help ensure that the opening is the correct size and shape.
- **Carpentry:** In carpentry, a scriber can be used to mark the location of joints, such as for a mortise and tenon joint, or to transfer the shape of one piece of wood to another. This can help ensure that the pieces fit together correctly.
- **Metalworking:** In construction projects that involve metalworking, a scriber can be used to mark the location of holes or to scribe lines for cutting. This can help ensure that the metal is cut and drilled accurately.

- Welding: In welding, a scriber can be used to mark the location where two pieces of metal will be joined. This can help ensure that the weld is placed in the correct location.

  Overall, while scribers are not as commonly used in construction as they are in other industries, they can still be a useful tool in certain situations where precise marking is necessary.

2. **Punch:** A punch is a marking instrument used in bench work and is referred to as a centre punch. Typically, it is manufactured from 10 mm octagonal cast steel measuring 100 mm in length. One end of the punch bears a point ground to an included angle of 90° and is tempered to a pale straw colour while the other end is slightly chamfered to prevent it from burring. The body is knurled for improved handhold.

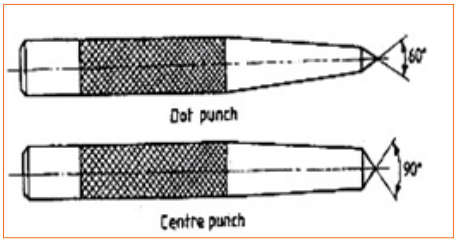


*Fig. 3.1.2 Centre and Dot Punch*

It is used for marking the ends of work to be centred for turning in lathe as well as for all centres of holes for drilling. The Prick or Dot Punch is a smaller version of a centre punch. It is manufactured from 6 mm diameter cat steel with a sharper point of 60°. Marking the position of lines and the centres of circles to be drawn with dividers.

**Use of Punch in Construction:**

In construction, a punch can be used in various ways, including:

- **Marking:** Punches can be used to mark the location of a hole or other features on a metal surface. The punch is used to create a small indentation, which can be used as a guide for drilling or cutting.
- **Alignment:** Punches can also be used to align metal parts during assembly. By punching a small hole on one piece and a corresponding mark on the other, the two pieces can be aligned correctly before they are secured in place.
- **Fastening:** Punches can be used to create a small hole in a metal surface, which can then be used to fasten two pieces together using a screw or other fastener.
- **Finishing**: In metalworking, punches can be used to create a decorative pattern or texture on a metal surface. This technique is known as “punching” and can be used to create designs on metal sheets, pipes, or other components.

- **Demolition:** In demolition work, punches can be used to create holes in concrete, brick, or other materials. This can be useful for creating an opening or for breaking up a large piece of material into smaller, more manageable pieces.

Overall, punches are a versatile tool that can be used in many different construction applications, from metalworking to demolition. They are an essential tool for anyone working with metal or other materials that require precision marking or alignment.

3. **Divider:** A divider is an indispensable tool for marking work. It resembles callipers, except its legs have pointed ends. The dividers are used for measuring the distance between two points, dividing a given length in a specific proportion, drawing circles and arcs, and transferring measurements from scales to objects.

*Fig. 3.1.3 Divider*

**Uses of a Divider in Construction:**

A divider is a tool that is commonly used in construction to make accurate measurements, mark lines, and create circles or arcs. Here are some specific ways that a divider can be used in construction:

- **Marking and measuring distances:** Dividers can be used to mark and measure distances between two points on a construction site. This can be useful for laying out foundations, framing walls, or installing fixtures.

- **Creating circles or arcs:** Dividers can also be used to create circles or arcs on a surface. This can be useful for cutting or shaping materials such as wood, metal, or plastic.

- **Transferring measurements:** Dividers can be used to transfer measurements from one surface to another. For example, a divider can be used to measure the distance between two points on a blueprint and then transfer that measurement to the actual construction site.

- **Checking for squareness:** Dividers can be used to check for squareness and make sure that corners are at a perfect 90-degree angle. This can be useful for ensuring that walls, windows, and doors are properly aligned.

Overall, dividers are a versatile tool that can be used for a variety of tasks in construction. They can help ensure accuracy and precision in the construction process and are an important tool for many construction professionals.ses of Divider in Construction

4. **Calipers:** Calipers are used with a steel rule to measure the exterior and inside of an object. They are characterised by their maximal length. Sizes range from 100 mm to 300 mm.

*Fig. 3.1.4 Calipers*

Two types of calliper exist: (a) Outer Calipers (b) Interior Caliper

Outside Calipers are used to measure the outer diameter of round objects as well as their breadth and depth.

Inside Calipers are utilised for setting internal dimensions, transferring them to work, and verifying compliance with requirements.

**Uses of Calipers in Construction**

Calipers can be used in construction for a variety of applications that require precise measurements of length, width, or thickness. Here are some examples:

- **Measuring thickness:** Calipers can be used to measure the thickness of materials such as drywall, insulation, or metal sheets. This can be important when installing materials to ensure that they meet the required specifications.

- **Checking dimensions:** Calipers can be used to check the dimensions of building materials such as lumber or pipes. This can be important to ensure that the materials are the correct size and will fit properly in the construction project.

- **Measuring angles:** Calipers with a protractor attachment can be used to measure angles in construction, such as the angle of a roof or the slope of a ramp.

- **Checking clearances:** Calipers can be used to check the clearance between objects, such as the distance between a door and its frame, or the gap between two pieces of piping. This can be important to ensure that the building components are properly installed and will function as intended.

- **Measuring distances:** Calipers with a depth gauge attachment can be used to measure distances between objects, such as the distance between a window and a wall or the distance between two studs.

Overall, calipers are versatile tools that can be used in many different applications in construction. They are especially useful for tasks that require precise measurements or the verification of dimensional accuracy.

## 3.1.3. Linear Measurements Tools and Instruments

The gap between the leftmost and rightmost ends is another way to define linear measurement, which is the measurement of the separation between two points or objects. Measurements that are inversely proportional to the distance travelled down the axis of the measurement are referred to as linear measures. Examples of linear measurements include, for instance, the width of a doorway, the height of a chair, and the length of your dining table.

Here are a few of the fundamental instruments used for linear measurements:

1. **Rulers:** Rulers come in conventional sizes of 15 and 30 cm and are marked with mm, cm, and inches on top and bottom, respectively. The rulers used in construction industry are made up of steel.

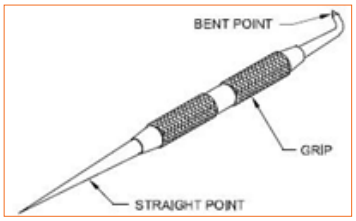


*Fig. 3.1.5 Steel Rulers*

**Uses of Steel Rulers in Construction:**

Steel rulers are a common measuring tool used in construction because they are durable, precise, and can withstand the wear and tear of a construction site. Here are some common uses of steel rulers in construction:

- **Measuring length and width:** Steel rulers are used to measure the length and width of building materials, such as lumber, drywall, and steel beams. They are commonly used to determine the dimensions of walls, floors, and ceilings during the construction process.
- **Measuring angles:** Steel rulers can also be used to measure angles in construction. They can be used to determine the angle of a roof pitch, the angle of a wall, or the angle of a cut in a building material.
- **Layout work:** Steel rulers can be used for layout work, such as marking lines and angles on building materials for cutting, drilling, or other operations.
- **Checking flatness:** Steel rulers can also be used to check the flatness of a surface. They can be placed on a surface to check for any gaps or bumps that need to be addressed before construction work can proceed.
- **Measuring clearance:** Steel rulers can be used to measure the clearance between two objects, such as the distance between a window frame and a wall or the distance between a door and a floor.

Overall, steel rulers are an essential measuring tool in construction due to their durability, precision, and versatility in measuring and layout work.

2. **Measuring Tape:** Longer items like walls, rolls of cloth, and tiles are more frequently measured with a measuring tape. A measuring tape features both metric and American-style markings, and there are various types of tapes for various uses. Similar to how tailors use foldable smooth tape and builders use steel tape.

*Fig. 3.1.6 Measuring Tape*

**Uses of Measuring Tape in Construction:**

A measuring tape is an essential tool in construction and is used for a variety of purposes. Here are some examples of where a measuring tape can be used in construction:

- **Measuring distances:** A measuring tape is commonly used to measure the distance between two points on a workpiece, such as the length of a board or the distance between two walls.
- **Measuring heights:** Measuring tape can be used to measure the height of walls, windows, or other features in a building. This is important for accurate installation of things like shelving, lighting fixtures, or window treatments.
- **Marking layouts:** Measuring tape can be used to mark out the layout of a room or other space, such as for the placement of studs, electrical outlets, or other features.
- **Measuring angles:** Measuring tape can be used to measure angles, such as the pitch of a roof or the slope of a ramp.
- **Measuring depth:** Measuring tape can be used to measure the depth of holes or other features, such as for installing anchors or fasteners.
- **Checking dimensions:** Measuring tape can be used to double-check the dimensions of a workpiece to ensure it is cut to the correct size.

Overall, a measuring tape is a versatile tool that can be used in many different ways in construction. It is an essential tool for any builder, contractor, or DIY enthusiast who wants to ensure accuracy and precision in their work.

## 3.1.4. Angular Measurements Tools and Instruments

Angular measurement tools and instruments are devices that are used to measure angles in a variety of applications, such as construction, engineering, and manufacturing. These tools can provide precise measurements of angles, which are typically expressed in degrees, minutes, and seconds.

Here are some common types of angular measurement tools and instruments:

1. **Angle Gauge:** An angle gauge is a measuring device for angular measurement. It is a device comprised of a dense and sturdy block of steel. The steel block is roughly 75 millimetres in height and 1 millimetre in width. The width comprises of two flat, lapping working faces. They are positioned at a precise angle to one another. Angle gauges are the blocks of steel that are almost often found in sets. These steel blocks can be joined together to form the necessary angle. Typically, gauges are delivered as a single set of thirteen steel blocks.

*Fig. 3.1.7 Angle Gauge*

**Uses of Angle Gauge in Construction:**

An angle gauge, also known as an angle finder, is a tool used to measure and set angles in construction. It can be used to determine the angle of a slope, to measure the angle of a cut, or to set the angle of a joint.

Here are some specific applications where an angle gauge may be used in construction:

- **Roofing:** When installing a new roof, an angle gauge can be used to measure the slope of the roof and ensure that it is pitched correctly.
- **Flooring:** When installing hardwood or tile flooring, an angle gauge can be used to measure and mark the angle of the cuts needed to fit the pieces around corners and edges.
- **Framing:** When framing a wall or other structure, an angle gauge can be used to set the angle of the joints and ensure that they are correctly aligned.
- **Staircase installation:** When installing a staircase, an angle gauge can be used to measure and mark the angles of the risers and treads, ensuring that the stairs are level and safe to use.
- **Window and door installation:** An angle gauge can be used to ensure that windows and doors are installed at the correct angle, preventing air leaks and ensuring proper operation.

Overall, an angle gauge is a versatile tool that can be used in many different applications in construction. Its ability to accurately measure angles makes it an essential tool for many tasks, ensuring that structures are properly aligned and safe to use.

2. **Protractor:** A protractor is a simple tool that is used to measure angles. It typically consists of a flat, circular disk with markings that indicate the degrees of an angle. A protractor is a tool used for drawing and measuring angles. It is denoted with degrees ranging from 0 to 180. It can directly measure any angle between 0 and 360 degrees. 0 to 180 degrees from right to left and vice versa are used to measure the angles.

*Fig. 3.1.8 Protector*

**Uses of Protractor in Construction:**

A protractor is a tool used to measure angles, and it can be useful in a variety of applications in construction. Here are a few examples:

- **Measuring roof pitch:** When constructing a roof, it is important to know the pitch or angle of the roof. A protractor can be used to measure the angle of the roof and ensure that it meets the required specifications.
- **Marking angles for cuts:** When making angled cuts in wood or other materials, a protractor can be used to mark the angle on the material and ensure that the cut is accurate.
- **Setting up stairs:** When constructing stairs, it is important to ensure that the treads are level and the risers are consistent in height. A protractor can be used to measure the angle of the stairs and ensure that they are level.
- **Aligning walls:** When constructing a building, it is important to ensure that the walls are straight and level. A protractor can be used to measure the angle of the walls and ensure that they are aligned correctly.
- **Checking for level or plumb:** A protractor can be used in conjunction with a level to check whether a surface is level or plumb, which is important in many aspects of construction.

Overall, a protractor is a versatile tool that can be used in many different ways in construction to ensure accurate measurements and angles.

## 3.1.5. Holding and Tightening Metal Pieces Tools and Instruments

There are various metal pieces tools used in construction fitting for holding and tightening different types of connections, such as bolts, nuts, screws, and pipes. Some of the most common holding and tightening metal pieces tools used in construction fitting include:

1. **Wrenches:** Wrenches come in different shapes and sizes and are used to tighten or loosen nuts and bolts. Some common types of wrenches include adjustable wrenches, combination wrenches, socket wrenches, and torque wrenches.

*Fig. 3.1.9 Wrenches*

**Uses of Wrenches in Construction**

Wrenches are essential tools used in construction for tightening and loosening bolts and nuts. They are used in various applications to ensure that bolts are secure and to prevent loosening or over-tightening, which can result in safety hazards.

Here are some common uses of wrenches in construction:

- **Assembling and disassembling scaffolding**: Scaffolding is a temporary structure used in construction, and wrenches are used to tighten the bolts and nuts that hold the scaffolding together.
- **Installing and repairing plumbing:** Wrenches are commonly used in plumbing to tighten and loosen various fittings, such as nuts, bolts, and pipes.
- **Assembling and disassembling machinery:** Wrenches are used to tighten and loosen bolts and nuts on machinery, such as engines, pumps, and conveyors.
- **Building and repairing furniture:** Wrenches are used to tighten bolts and nuts in furniture, such as beds, chairs, and tables.
- Installing and repairing electrical systems: Wrenches are used to tighten and loosen the bolts and nuts that secure electrical panels, junction boxes, and other electrical components.

Overall, wrenches are used in many aspects of construction, from large-scale projects to smaller tasks. There are many different types of wrenches available, each designed for specific applications, such as adjustable wrenches, combination wrenches, socket wrenches, and torque wrenches.

2. **Pliers:** Pliers are used to grip and hold objects firmly in place. They come in different types, such as locking pliers, needle-nose pliers, and slip-joint pliers.

*Fig. 3.1.10 Pliers*

**Uses of Pliers in Construction**

Pliers are versatile hand tools that can be used in various construction fitting tasks. Here are some examples:

- **Cutting and shaping wires:** Pliers with a cutting edge or wire cutter can be used to cut and shape wires to fit in electrical fittings, such as switches and sockets.
- **Bending and shaping metal:** Pliers with a flat jaw or a round nose can be used to bend and shape metal sheets and wires to fit in ductwork and plumbing systems.
- **Holding and pulling objects:** Pliers with a long nose or needle nose can be used to hold and pull small objects or to reach into tight spaces.
- **Clamping and crimping:** Pliers with a crimping tool can be used to crimp connectors on electrical cables or to clamp fittings on pipes and hoses.
- **Gripping and twisting:** Pliers with a locking jaw or slip joint pliers can be used to grip and twist nuts and bolts, or to loosen and tighten screws.
- **Cutting and stripping insulation:** Pliers with a wire stripper can be used to cut and strip insulation from electrical cables.

Overall, pliers are a versatile tool that can be used in a wide range of construction fitting tasks, from electrical and plumbing work to metal fabrication and woodworking.

3. **Clamps:** Clamps are used to hold objects securely in place while they are being worked on. They can be used for a wide range of applications, such as welding, woodworking, and metalworking.

*Fig. 3.1.11 Clamps*

Uses of Clamps in Construction

Clamps are commonly used in construction and fitting to hold materials in place while they are being worked on. Here are some examples of where clamps might be used in construction and fitting:

- **Woodworking:** Clamps are used extensively in woodworking to hold pieces of wood together while glue dries, or to hold a piece of wood in place while it is being cut or drilled.
- **Metalworking:** Clamps can be used in metalworking to hold metal sheets or pieces together while they are being welded, or to hold a piece of metal in place while it is being cut or drilled.
- **Plumbing:** Clamps can be used to hold pipes in place while they are being joined or while they are being cut to size.
- **Electrical:** Clamps can be used to hold cables and wires in place while they are being installed, or to hold electrical components in place while they are being worked on.

- **Masonry:** Clamps can be used in masonry work to hold bricks or stones in place while mortar is being applied.
- **Construction:** Clamps can be used to hold building materials together during construction, such as holding a wall frame together while it is being assembled.

Overall, clamps are versatile tools that can be used in many different applications in construction and fitting. They are particularly useful for holding materials in place while they are being worked on, which can help to ensure accuracy and precision in the finished product.

4. **Vices:** Vices or Vises are used to hold objects firmly in place while they are being worked on. They are often used in metalworking and woodworking applications.

*Fig. 3.1.12 Vices*

**Uses of Vices in Construction**

Vices, or vises, are a versatile tool that can be used in construction and fitting work to hold materials securely in place while they are being worked on. Here are some examples of where vices can be used in construction fitting:

- **Welding:** A welding vice can be used to hold metal pieces together while they are welded, providing a stable base that allows for precise welding.
- **Plumbing:** In plumbing, a vice can be used to hold pipes while they are being cut, threaded, or joined together, ensuring accuracy and preventing the pipes from moving during the process.
- **Woodworking:** In woodworking, a vice can be used to hold a piece of wood securely while it is being sawed, drilled, or sanded. It can also be used to hold a workpiece in place while glue dries, ensuring a strong bond.
- **Metalworking:** In metalworking, a vice can be used to hold metal pieces securely while they are being cut, drilled, or shaped. It can also be used to hold tools, such as files or grinders, in place while they are being used.
- **Electrical work:** In electrical work, a vice can be used to hold wires while they are being stripped, crimped, or soldered. This ensures that the wires are held securely in place, preventing damage or errors during the process.

In construction fitting, vices can be used to hold a wide range of materials, including metal pipes, wood planks, electrical wires, and more. They provide a secure base that allows for precise and accurate work, while also preventing materials from moving or shifting during the process.

5. **Pipe wrenches:** Pipe wrenches are designed specifically for tightening and loosening pipes and pipe fittings. They have a jaw that can be adjusted to fit different sizes of pipes.

*Fig. 3.1.13 Pipe Wrenches*

**Uses of Pipe Wrenches in Construction**

Pipe wrenches are commonly used in construction and plumbing fittings to tighten or loosen pipe connections. These wrenches have a hook-shaped jaw that is designed to grip around the pipe, providing a secure hold for turning the pipe.

Some common uses of pipe wrenches in construction fittings include:

- **Installing or removing pipes:** Pipe wrenches are used to install or remove pipes, particularly in plumbing or gas fitting. They can be used to tighten or loosen pipe fittings or to connect pipes to valves or other components.
- **Tightening or loosening nuts and bolts:** In addition to pipes, pipe wrenches can also be used to tighten or loosen nuts and bolts in construction fittings, particularly in areas that are difficult to reach with other wrenches.
- **Removing rusted or stuck components:** Pipe wrenches can be particularly useful for removing rusted or stuck components, such as pipes, fittings, or valves. The strong grip of the pipe wrench can help to break loose the rust or corrosion that may be holding the component in place.
- **Straightening bent pipes:** Pipe wrenches can also be used to straighten bent pipes, particularly in cases where the pipe cannot be easily replaced. The wrench can be used to grip the pipe and apply pressure to straighten it back into shape.

Overall, pipe wrenches are a versatile tool in construction fittings and can be used in a variety of applications where a secure grip is needed. It's important to choose the right size of wrench for the job, to ensure that the wrench can grip the pipe securely without slipping or causing damage.

## 3.1.6 Cutting and Striking Tools and Instruments

Cutting and striking tools are an essential part of construction work, and they help in performing various tasks such as cutting, shaping, and fastening materials. Below are some of the most commonly used cutting and striking tools in construction:

1. **Saw:** A saw is a tool with a long, sharp blade used for cutting through wood, metal, plastic, and other materials. It is available in different types, including hand saws, circular saws, and jigsaws.

*Fig. 3.1.14 Hand Saw*

**Uses of Saws in Construction**

Saws are used extensively in construction fitting for cutting and shaping various materials. Here are a few examples of where different types of saws may be used in construction fitting:

- **Hand saws:** Hand saws are used for a variety of cutting tasks in construction fitting, such as cutting lumber, trimming framing, or cutting PVC pipes. There are several types of hand saws, including crosscut saws, rip saws, back saws, and coping saws, each designed for a specific type of cut.
- **Circular saws:** Circular saws are power tools that are commonly used in construction fitting for cutting large sheets of plywood, cutting framing lumber, or cutting composite decking materials. They are fast, efficient, and can make precise cuts.
- **Jig saws:** Jig saws are versatile power tools that can make both straight and curved cuts in a variety of materials, such as wood, metal, and plastic. They are often used in construction fitting for cutting out intricate shapes or patterns.

2. **Hammer:** A hammer is a striking tool used for driving nails and other fasteners into wood, metal, or concrete. It has a handle and a heavy head made of metal or other hard materials.

*Fig. 3.1.15 Hammer*

**Uses of Hammers in Construction:**

Hammers are one of the most basic and versatile hand tools used in construction fitting. They are used to drive and extract nails, to break or chisel materials, and to shape or form metal objects. Here are some common uses of hammers in construction fitting:

- **Framing:** In construction, hammers are commonly used to frame walls, roofs, and floors. They are used to drive framing nails into wood and other materials to hold them together and create a sturdy structure.
- **Finishing:** Hammers are also used for finishing work, such as driving finish nails into wood trim or molding. This helps to create a clean and polished look.

- **Demolition:** Hammers can be used to break apart and remove old structures or materials, such as removing a wall or breaking up concrete.
- **Concrete:** For concrete work, a sledgehammer or a masonry hammer may be used to break apart concrete or to drive rebar into the ground.
- **Sheet metal work:** Hammers can also be used in sheet metal work to shape, bend, and cut metal.
- **Electrical work:** In electrical work, hammers may be used to drive electrical boxes or to attach conduit to a wall.

There are many types of hammers available, each with its own specific use. For example, claw hammers are used for driving and extracting nails, while sledgehammers are used for heavy-duty demolition work. The choice of hammer depends on the specific task at hand and the material being worked on.

3. **Chisel:** A chisel is a cutting tool used for carving or cutting materials such as wood, stone, and metal. It has a sharp, flat blade and a handle, and it is available in various sizes and shapes.

*Fig. 3.1.16 Chisel*

**Uses of Chisel in Construction:**

Chisels are a type of hand tool that can be used in various construction and fitting applications. Here are some examples of where chisels can be used in construction fitting:

- **Carpentry:** In carpentry, chisels are commonly used for cutting, shaping, and finishing wood. They can be used to make mortises and tenons, to create recesses for hinges and locks, and to carve decorative details into the surface of the wood.
- **Masonry:** Chisels are also used in masonry work to cut and shape stone, brick, and concrete. They can be used to create precise cuts for door and window openings, to shape the edges of decorative stonework, and to cut channels for plumbing and electrical conduits.
- **Metalworking:** Chisels can be used in metalworking to cut and shape metal. They can be used to remove excess metal from a casting, to cut and shape sheet metal, and to create decorative designs on the surface of metal objects.
- **Plumbing:** In plumbing, chisels can be used to cut and shape pipes, as well as to remove old fittings and fixtures.

Overall, chisels are versatile tools that can be used in a variety of construction and fitting applications. They are especially useful for tasks that require precision and control, as well as for tasks that involve cutting and shaping hard materials like wood, stone, and metal.

4. **Hacksaw:** A hacksaw is a handheld tool used for cutting through various materials, such as metal, plastic, and wood. It consists of a metal frame, a handle, and a thin blade with fine teeth. The blade is inserted into the frame, and the handle is used to hold and move the saw back and forth to cut the material.

*Fig. 3.1.17 Hacksaw*

**Uses of Hacksaw in Construction:**

Here are some specific applications where a hacksaw can be used in construction fitting:

- **Cutting pipes:** Hacksaws are commonly used to cut metal pipes to the required length. This is especially useful when installing plumbing or heating systems.
- **Trimming metal components:** When working with metal components such as bolts, screws, and brackets, a hacksaw can be used to trim them to the desired length.
- **Removing damaged parts:** In construction fitting, it is often necessary to remove damaged or worn parts from metal structures. A hacksaw can be used to cut through these parts, allowing them to be replaced.
- **Making precise cuts:** Hacksaws are ideal for making precise cuts on smaller metal components. This can be especially useful in construction and fitting applications where accuracy is critical.
- **Cutting metal studs:** In construction framing, metal studs are often used as a substitute for wooden studs. A hacksaw can be used to cut metal studs to the required length.

Overall, the versatility and precision of a hacksaw make it a useful tool in many construction and fitting applications, especially when working with metal components.

5. **Metal File:** A metal file is a hand tool used for shaping and smoothing metal or other hard materials. It consists of a hardened steel rod with a series of parallel ridges or teeth cut into its surface. When the file is drawn over a workpiece, the ridges remove small amounts of material, leaving behind a smooth, even surface. Metal files come in a variety of shapes and sizes, each designed for specific tasks, such as removing rough edges, creating curves, or sharpening blades.

*Fig. 3.1.18 Metal File*

**Uses of Metal File in Construction:**

Metal files are commonly used in construction and fitting applications for shaping and finishing metal surfaces. Here are some specific examples of where metal files can be used:

- **Filing down rough edges:** Metal files can be used to smooth out rough edges on metal surfaces, such as sharp edges on metal sheets, pipes, or bars.
- **Preparing surfaces for welding or soldering:** Metal files can be used to clean and shape the edges of metal pieces to be joined by welding or soldering.
- **Shaping metal parts:** Metal files can be used to shape metal parts into specific sizes and shapes, such as to make a bolt or screw fit into a specific hole or to create a customized metal part for a specific application.
- **Deburring:** Metal files can be used to remove burrs, which are small metal fragments that can be left behind after cutting or drilling metal.
- **Refining surfaces:** Metal files can be used to refine the surface of a metal part, creating a smooth and polished finish. This can be important for parts that will be visible or for parts that need to move smoothly, such as in mechanical or automotive applications.

Overall, metal files are versatile tools that can be used in a wide variety of construction and fitting applications.

## 3.1.7. Lifting and Shifting of Heavy Materials

Lifting and shifting of heavy materials in construction and fitting require various tools and tackles to ensure safe and efficient handling. The selection of tools and tackles will depend on the specific lifting and shifting tasks and the weight and size of the materials being handled. It is important to ensure that the equipment is properly maintained and operated by trained personnel to ensure safe and efficient lifting and shifting operations. Some of the commonly used tools and tackles are:

1. **Cranes:** Cranes are heavy-duty machines that use cables and pulleys to lift and move heavy materials. They come in various types such as tower cranes, mobile cranes, and crawler cranes, each designed for specific lifting and shifting tasks.

*Fig. 3.1.19 Cranes*

2. **Hoists:** Hoists are mechanical devices that lift and lower loads using a chain or wire rope. They are commonly used in construction sites for lifting materials like steel beams and concrete blocks.

*Fig. 3.1.20 Hoists*

3. **Forklifts:** Forklifts are powered industrial trucks that are designed to move and lift heavy materials using two forks attached to the front of the vehicle. They are commonly used in construction sites for moving heavy pallets, steel plates, and other large materials.

*Fig. 3.1.21 Forklifts*

4. **Slings:** Slings are used to suspend loads and transfer the weight to a crane or hoist. They come in various materials such as wire rope, chain, and synthetic fibers.

*Fig. 3.1.22 Chain Slings*

5. **Shackles:** Shackles are used to connect slings to the lifting equipment or the load being lifted. They come in various sizes and types such as screw pin shackles and bolt-type shackles.

*Fig. 3.1.23 Shackles*

6. **Trolleys:** Trolleys are used to move heavy loads horizontally along a track or beam. They come in various types such as hand-operated and motorized trolleys.

*Fig. 3.1.24 Troylleys*

7. **Rollers:** Rollers are used to reduce the friction when moving heavy loads. They are commonly used in construction sites for moving heavy pipes and steel plates.

*Fig. 3.1.25 Rollers*

## 3.1.8. Do's and Don'ts for Heavy Lifting

Performing lifting and shifting of heavy materials in construction fitting can be a hazardous activity. To ensure safety and prevent accidents, here are some do's and don'ts to keep in mind:

**Do's:**

- Inspect the materials to be lifted for any damage or defects before starting the lifting process.
- Use the appropriate lifting equipment and make sure it is in good condition.
- Have a clear plan in place for the lifting and shifting process, including communication signals and designated positions for workers involved.
- Wear appropriate personal protective equipment (PPE), such as hard hats, safety glasses, and gloves.
- Use proper lifting techniques, such as bending at the knees and keeping the back straight, and avoid lifting with your back.
- Ensure the load is stable and balanced before lifting.
- Check the weight limit of the equipment being used and do not exceed it.
- Communicate effectively with other workers involved in the lifting process.

**Don'ts:**

- Do not lift heavy materials manually without proper equipment.
- Do not overload the equipment being used beyond its capacity.
- Do not lift materials above other workers or obstruct walkways or passages.
- Do not lift materials in adverse weather conditions, such as high winds or heavy rain.
- Do not rush the lifting process or take shortcuts.
- Do not stand under a suspended load or in the path of moving materials.
- Do not use damaged or defective lifting equipment.

In addition to these do's and don'ts, it's important to receive proper training and certification before engaging in lifting and shifting activities. Always prioritize safety and follow all necessary protocols to avoid accidents and injuries.

## 3.1.9. Safe Practices while Heavy Lifting

Lifting and shifting heavy materials can be hazardous if not done safely. It is important to follow safe working practices to prevent injury to yourself or others. Here are some safe working practices to follow when lifting and shifting heavy materials:

1. **Assess the load:** Before lifting any heavy materials, make sure you know the weight, shape, and size of the load. Determine if it is too heavy to lift manually or if you need equipment such as a forklift.
2. **Use proper lifting techniques:** Always lift with your legs, not your back. Keep your back straight and your feet shoulder-width apart. Bend your knees and lift the load close to your body.
3. **Get help:** If a load is too heavy or awkward to lift on your own, get help from a colleague or use mechanical equipment to assist with the lift.
4. **Wear proper personal protective equipment (PPE):** Wear the appropriate PPE such as gloves, steel-toed boots, and a back support belt to reduce the risk of injury.
5. **Plan the route:** Plan the route you will take when moving heavy materials to avoid obstacles, narrow passages, or uneven surfaces.
6. **Maintain clear visibility:** Make sure you can see where you are going and that others can see you when you are lifting or shifting heavy materials. Use a spotter if necessary.
7. **Store materials safely:** When storing materials, make sure they are stored in a secure and stable location, and that they are not at risk of falling or rolling.

## 3.1.10. Checking for Obstruction of Load

Before lifting or moving any load, it is important to ensure that there are no obstructions in the path of the load. Here are some checks that can be performed to ensure there are no obstructions:

1. **Inspect the area:** Before moving any load, inspect the area for any potential obstructions. Look for any obstacles, such as people, equipment, or objects that may be in the way.
2. **Plan the route:** Plan the route you will take when moving the load. Ensure that the route is clear of any potential obstructions, including low-hanging objects, doorways, and tight corners.
3. **Use spotters:** If the load is large or obstructs your view, use a spotter to guide you through the area and ensure that the path is clear.
4. **Check for overhead hazards:** If the load is being moved overhead, check for overhead hazards such as low-hanging wires, pipes, or other obstructions.
5. **Clear the path:** Before moving the load, clear the path of any debris or objects that may cause tripping hazards or get caught under the load.
6. **Check the load:** Before lifting the load, inspect it for any obstructions such as protruding objects or loose materials that may fall off during transport.

By performing these checks, you can help ensure that the path is clear of any obstructions, reducing the risk of accidents and injuries when lifting or moving a load.

## 3.1.11. Controlling the Position of Suspended Load

Controlling the position of a suspended load is important to prevent accidents, damage to the load, and damage to the lifting equipment. The process of controlling the position of a suspended load involves several steps, including:

1. **Proper Rigging:** The first step is to ensure that the load is rigged correctly. This involves selecting the appropriate lifting equipment, such as slings, chains, or hooks, and attaching them securely to the load. The rigging should be inspected to make sure it is in good condition and capable of handling the weight of the load.
2. **Pre-Lift Inspection:** Before lifting the load, it is important to conduct a pre-lift inspection to identify any potential hazards. This includes checking the lifting equipment, the load, and the lifting area to ensure that they are free from obstructions, defects, or any other hazards that could interfere with the lifting operation.
3. **Lifting the Load:** Once the pre-lift inspection is complete, the load can be lifted. The operator should use the lifting equipment to control the speed and direction of the lift. The load should be lifted slowly and steadily to avoid swinging or bouncing, which can cause the load to lose control.
4. **Positioning the Load:** Once the load is in the air, the operator can use the lifting equipment to control the position of the load. This involves using the lifting equipment to move the load in the desired direction, while keeping it steady and under control.

5. **Lowering the Load:** When the load is in the correct position, it can be lowered to the ground. The operator should use the lifting equipment to control the speed and direction of the descent, making sure that the load is lowered slowly and steadily to avoid any sudden movements.
6. **Post-Lift Inspection:** Finally, after the load has been lowered, it is important to conduct a post-lift inspection to ensure that the lifting equipment and the load are in good condition, and that there is no damage or defects that could affect future lifting operations.

Overall, controlling the position of a suspended load requires careful planning, attention to detail, and proper use of lifting equipment. By following proper procedures, operators can ensure that lifting operations are conducted safely and efficiently.

## 3.1.12. Stacking of Heavy Materials

Stacking heavy materials can be hazardous if not done safely. Here are some standard practices to follow when stacking heavy materials:

1. **Assess the load:** Before stacking any heavy materials, make sure you know the weight, shape, and size of the load. Determine if it is safe to stack and if you need equipment such as a forklift.
2. **Choose a suitable location:** Choose a suitable location to stack the materials that is level, stable, and away from any hazards such as power lines or uneven surfaces.
3. **Follow the manufacturer's recommendations:** Follow the manufacturer's recommendations for stacking the specific material you are handling. These recommendations may include guidelines for maximum stack height, weight capacity, and placement of the materials.
4. **Use proper lifting techniques:** Always lift with your legs, not your back. Keep your back straight and your feet shoulder-width apart. Bend your knees and lift the load close to your body.
5. **Stack materials uniformly:** Stack materials uniformly so that the load is evenly distributed. This will help prevent the stack from tipping over.
6. **Stabilize the stack:** Stabilize the stack by placing heavier items on the bottom and lighter items on top. Use a pallet or other supporting device if necessary.
7. **Leave a safety zone:** Leave a safety zone around the stack to prevent injury to others. The safety zone should be clearly marked and free of obstacles.
8. **Store materials safely:** When storing materials, make sure they are stored in a secure and stable location, and that they are not at risk of falling or rolling.

By following these standard practices, you can help prevent injury when stacking heavy materials.

## 3.1.13. Visual Checks of Hand Tools

Visual checks are an important aspect of maintaining the serviceability of hand tools. By conducting regular visual checks, you can identify any defects or issues with the tool that need to be addressed. Here are the steps for a visual check of a hand tool:

- **Inspect the handle:** Check the handle of the tool for any signs of damage, such as cracks or splits. Make sure the handle is secure and not loose.
- **Check the blade or head:** Inspect the blade or head of the tool for signs of wear or damage, such as chips or cracks. Make sure the blade or head is securely attached to the handle.
- **Examine the cutting edge:** If the tool has a cutting edge, such as pliers or wire cutters, check the edge for sharpness and signs of wear. A dull or damaged cutting edge can make the tool less effective and more dangerous to use.
- **Look for rust or corrosion:** Check the tool for any signs of rust or corrosion, which can weaken the tool and make it more likely to fail.
- **Verify any movable parts:** If the tool has movable parts, such as an adjustable wrench or pliers, check that they move smoothly and are not loose or damaged.
- **Check any locking mechanisms:** If the tool has a locking mechanism, such as a locking pliers or adjustable wrench, check that it engages properly and holds the tool securely.
- **Test the tool:** After conducting the visual check, test the tool to ensure it is working properly. This can include opening and closing pliers or using a wrench to tighten or loosen a bolt.

## Exercise

1. Explain fabrication and name some common instruments and equipment used in fabrication.
2. List the marking out tools and instruments in construction fitting.
3. Explain the usage of angular gauge in construction.
4. List the tools and instrument used for cutting and striking in construction fitting.
5. What are the do’s and don’ts for heavy lifting in construction fitting?

## Notes

## Scan the QR code to watch the video

https://youtu.be/w83NMv9c4I4

Marking out Tools and Instruments

https://www.youtube.com/live/SncFKAqRy50?feature=share

Linear Measurements Tools and Instruments

https://youtu.be/Smi2jX18IFc

Angular Measurements Tools and Instruments

https://youtu.be/b4wXRrfKQ2c

Do's and Don'ts for Heavy Lifting

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# 4. Edge Preparation and Positioning of Steel Sections for Fit-Up

Construction Skill Development Council

Unit 4.1 -Edge Preparation and Positioning of Steel Sections for Fit-Up

CON/N1205

# Unit 4.1 Edge Preparation and Positioning of Steel Sections for Fit-Up

## Unit Objectives

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

- Explain fit-up, its role and purpose and common trade terminologies
- Describe fabrication platform, its preparation and use
- Explain scrap and its disposal
- Describe and use the anchoring devices, explain their operation and purpose
- Introduction to various types of jacks
- Interpret the drawings/ hand sketches to obtain relevant details like dimensions, orientation, alignment etc. for edge preparation.
- Use equipment and tools for edge preparation
- Demonstrate operation of bevelling machine to obtain required edge preparation as per the drawings, following standard safety parameters
- Perform measurements of the edge preparation to confirm its dimensional correction, following standard safety parameters
- Carryout marking on the structural steel sections from the hand sketches provided
- Describe the procedure for placing and fixing the structural steel sections on the fabrication platform
- Demonstrate the procedure for placing and fixing the structural steel sections on the fabrication platform

## 4.1.1. Fit-Up

Fit-up refers to the process of aligning and positioning two or more components to be joined together in a construction project. The purpose of fit-up is to ensure that the components fit together correctly and securely, and that the resulting joint is strong and durable. The fit-up process typically involves measuring, cutting, grinding, and welding or bolting the components together.

## 4.1.2. Common Terminologies

Fit-up is a critical component of construction fitting, and it is essential to ensure that the fit-up process is carried out with precision and attention to detail in order to achieve a strong and durable final result.

In construction fitting, there are several common trade terminologies used to describe fit-up. Some of these include:

1. **Beveling:** This refers to the process of cutting a sloping edge or angle on a component, usually for welding purposes.
2. **Jigging:** Jigging involves the use of a specialized tool or fixture to hold components in the correct position during fit-up.
3. **Tacking:** Tacking involves temporarily securing two components together with small welds or bolts in order to hold them in place during fit-up.
4. **Gap:** A gap is the space between two components that are being fit together. The size of the gap can affect the strength and durability of the resulting joint.
5. **Chamfer:** A chamfer is a beveled edge or angle that is cut into the edge of a component, usually to facilitate fit-up with another component.
6. **Alignment:** Alignment refers to the process of ensuring that two components are properly positioned and in the correct orientation to be joined together.

## 4.1.3. Fabrication Platforms

A fabrication platform is a specially designed area or space where various construction fittings and components are assembled and manufactured. It is a flat surface, typically made of steel or concrete that provides a stable and secure base for the construction process.

Preparation of a fabrication platform involves several steps, including selecting an appropriate location, clearing and levelling the ground, and installing a reinforced steel frame. The platform is then filled with concrete to create a sturdy base that can support the weight of heavy machinery and materials.

Once the fabrication platform is prepared, it can be used to construct various fittings and components, such as beams, columns, and trusses. Skilled technicians and engineers utilize advanced machinery and tools to cut, shape, and weld the steel into the desired shapes and sizes.

The fabricated components are then transported to the construction site, where they are assembled into the final structure. The use of a fabrication platform can greatly speed up the construction process and reduce costs, as it allows for more precise and efficient manufacturing of complex components.

## 4.1.4. Scrap Disposal

Scrap refers to the leftover or unused material generated during the construction fitting process, such as metal, wood, plastic, or concrete debris. Proper disposal of scrap is essential in the construction industry as it ensures the safety and environmental sustainability of the worksite. Proper disposal of scrap in construction fitting involves collecting, segregating, and disposing of the materials in an environmentally responsible manner. This process helps to reduce waste and conserve resources while maintaining a safe and sustainable worksite.

The following are the steps that should be taken for the disposal of scrap in construction fitting:

1. Collect and segregate the scrap materials according to their types, such as wood, metal, plastic, and concrete.
2. Sort the materials into those that can be reused or recycled, and those that are not recyclable.
3. Store the reusable materials separately and send them to the recycling centers for further processing.
4. Dispose of the non-recyclable scrap by burying it in a designated landfill or sending it to an incinerator.
5. Ensure that the scrap materials are disposed of in compliance with the local, state, and federal regulations to avoid any legal consequences.

## 4.1.5. Anchoring Devices

Anchoring devices are used in construction fitting to provide a secure and stable connection between various building components. They are commonly used to attach beams, columns, and other structural elements to walls, floors, and other surfaces. Anchoring devices come in various shapes and sizes, including bolts, screws, nails, and dowels. Some common anchoring devices are:

- **Anchor Bolt:** This device is a threaded rod that is used to anchor a building component to a concrete surface. Anchor bolts are commonly used to secure steel structures to concrete foundations. The bolt is inserted into a pre-drilled hole in the concrete and then tightened with a nut, providing a secure and stable connection.

*Fig. 4.1.1 Anchor Bolt*

- **Screw Anchor:** This device is designed to be used in hollow or solid walls and is used to secure light to medium-weight loads. A screw anchor works by expanding as the screw is tightened, creating a strong hold within the wall. They are commonly used to attach items such as shelves, brackets, and light fixtures.

*Fig. 4.1.2 Screw Anchor*

- **Dowels:** Dowels are another type of anchoring device that are used to connect concrete components. They are made of steel and are typically used to connect concrete slabs or beams. Dowels are inserted into pre-drilled holes in the concrete and then grouted into place, providing a strong connection between the two components.

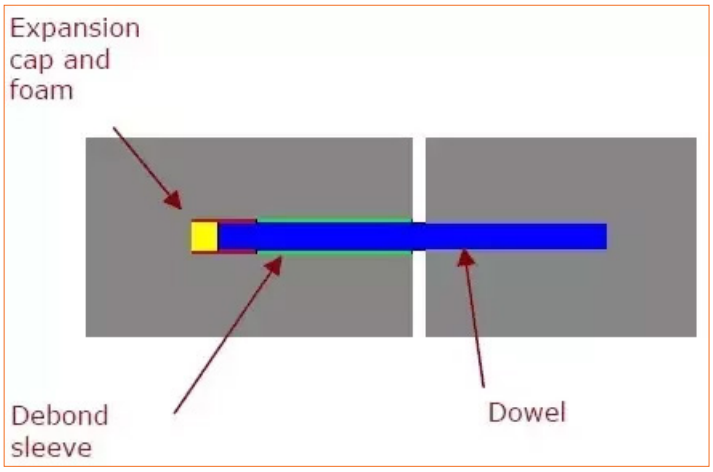


*Fig. 4.1.3 Placing of Dowels*

The purpose of anchoring devices in construction fitting is to provide a secure and stable connection between building components. This helps to ensure the safety and stability of the building, as well as the durability of the structure. Anchoring devices are designed to withstand high loads and to resist the effects of environmental factors such as wind and earthquakes. By using the appropriate anchoring devices in construction fitting, builders can ensure that the building is safe and structurally sound.

## 4.1.6. Jacks

Jacks are an essential tool in construction fitting that is used for lifting and supporting heavy loads. There are various types of jacks available in the market, each designed for specific purposes. By using the right type of jack, construction workers can improve efficiency, safety, and productivity on the job site. Here are some of the commonly used jacks in construction fitting:

1. **Hydraulic Jack:** Hydraulic jacks use hydraulic pressure to lift heavy loads. These jacks are commonly used in automobile repairs, construction works, and industrial maintenance.

*Fig. 4.1.4 Hydraulic Jack*

2. **Screw Jack:** Screw jacks are used for lifting and holding loads in a vertical position. These jacks use a threaded rod that is rotated using a lever to lift the load.

*Fig. 4.1.5 Screw Jack*

3. **Bottle Jack:** Bottle jacks are a type of hydraulic jack that has a compact and portable design. These jacks are commonly used for lifting vehicles, equipment, and heavy machinery.

*Fig. 4.1.6 Bottle Jack*

4. **Floor Jack:** Floor jacks are used to lift and hold vehicles in a raised position for maintenance or repair. These jacks have a low profile design and can easily fit under vehicles.

*Fig. 4.1.7 Floor Jack*

5. Scissor Jack: Scissor jacks are commonly used for lifting and holding loads in a horizontal position. These jacks have a compact design and are often used for lifting trailers and caravans.

*Fig. 4.1.8 Scissor Jack*

6. Toe Jack: Toe jacks are designed to lift heavy loads in a horizontal position. These jacks have a flat base and a movable toe that can be positioned under the load.

*Fig. 4.1.9 Toe Jack*

## 4.1.7. Edge Preparation

Edge preparation is the process of modifying or shaping the edges of a material or workpiece to make it ready for fitting into a construction project. The purpose of edge preparation is to ensure that the edges of the material are smooth, clean, and fit for joining with other materials.

In construction fitting, edge preparation is an essential step that involves cutting, grinding, or sanding the edges of the material to make them even and free from any roughness, burrs, or sharp edges. The edge preparation can be done by using hand tools or power tools, depending on the material and the required finish.

The edge preparation process ensures that the materials fit together tightly and precisely, which helps to create strong and durable joints. This is particularly important in high-stress areas of construction, such as in bridges, buildings, and other structures.

## 4.1.8. Tools and Equipment used in Edge Preparation

The tools and equipment used for edge preparation in construction fittings are:

1. **Hand Files:** Hand files are used for deburring and smoothing the edges of materials like metals, wood, and plastics. They come in different shapes and sizes, such as flat, round, half-round, and triangular.
2. **Grinders:** Grinders are used for shaping and smoothing the edges of materials like metals, concrete, and stone. They come in various sizes and types, such as angle grinders, bench grinders, and die grinders.
3. **Sandpaper and Sanding Blocks:** Sandpaper and sanding blocks are used for smoothing and preparing the edges of materials like wood and metal. They come in different grit sizes and types, such as aluminium oxide, silicon carbide, and diamond.
4. **Chamfering Machines:** Chamfering machines are used for creating a bevelled edge on materials like metals and plastics. They come in various sizes and types, such as manual and automatic chamfering machines.
5. **Deburring Tools:** Deburring tools are used for removing the burrs and sharp edges from materials like metal and plastic. They come in different types, such as hand-held deburring tools, deburring machines, and deburring brushes.
6. **Cutting Tools:** Cutting tools like shears, saws, and cutters are used for cutting and shaping materials like metals, wood, and plastics. They come in different shapes and sizes, such as circular saws, jigsaws, and bolt cutters.
7. **Welding Equipment:** Welding equipment is used for welding and joining materials like metals and plastics. They come in various types, such as MIG welders, TIG welders, and stick welders.
8. **Drill Bits and Drill Machines:** Drill bits and drill machines are used for drilling holes in materials like metals, wood, and plastics. They come in different sizes and types, such as twist drills, step drills, and core drills.

## 4.1.9. Interpretation of Drawings for Edge Preparation

Interpreting the drawing/hand sketch requires careful observation and understanding of the object, dimensions, orientation, alignment, material, and any special requirements. These details are essential for accurate edge preparation.

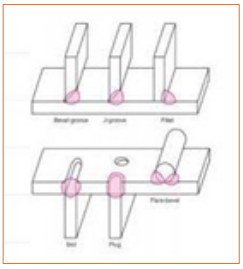

*Fig. 4.1.10 Edge Preparation Drawing used for Welding Joints*

The interpretation of the drawings/hand sketches to obtain relevant details for edge preparation:

1. **Understand the purpose of the drawing/sketch:** The first step is to understand the reason behind the drawing/sketch. What is the object that is being drawn? What is the purpose of the object? This understanding will help you to identify the relevant details required for edge preparation.

2. **Identify the dimensions:** Look for the dimensions in the drawing/sketch. This information is critical for edge preparation. You need to know the length, width, and thickness of the material to prepare the edges accurately.

3. **Look for orientation:** The orientation of the object is vital to edge preparation. Identify the direction of the object in the drawing/sketch. This information will help you to determine the correct angles for the edges.

4. **Check for alignment:** Check if the object is aligned with any other object in the drawing/sketch. This information will help you to determine the correct positioning of the edges.

5. **Identify the material:** Look for information on the material to be used. Different materials require different edge preparation techniques.

6. **Identify any special requirements:** Look for any special requirements, such as bevelled edges or chamfers, in the drawing/sketch.

## 4.1.10. Bevelling Machine for Edge Preparation

A bevelling machine is a tool used to create the required edge preparation on a workpiece. It is a mechanical device that cuts, shapes and smoothes the edge of a material, such as metal, wood, or plastic. The machine is designed to produce a precise bevel angle, chamfer, or radius on the edge of the material, which is necessary for various applications such as welding, brazing, and soldering.

*Fig. 4.1.11 Bevelling Machine*

The operation of a bevelling machine is relatively simple. The workpiece is clamped onto the machine and is brought into contact with a rotating cutting tool or a grinding wheel. The cutting tool or grinding wheel is adjustable to the required angle and depth of cut. The operator then moves the workpiece along the machine, allowing the tool to remove the necessary amount of material and create the desired edge preparation.

Bevelling machines come in a variety of sizes and types, including handheld machines, bench-mounted machines, and large industrial machines. Some machines are designed for specific materials or applications, while others are more versatile and can handle a range of materials and thicknesses.

The steps for operating a bevelling machine safely to obtain the required edge preparation as per the drawings:

1. Wear appropriate personal protective equipment (PPE) such as safety glasses, gloves, and hearing protection.
2. Familiarize yourself with the operating manual of the bevelling machine, ensuring that it is in good working condition and properly maintained.
3. Set the machine to the required angle and depth, according to the drawings.
4. Secure the workpiece in place using clamps or other appropriate methods, ensuring that it does not move during the operation.
5. Turn on the machine and adjust the speed as necessary, based on the type of material and the desired edge finish.
6. Move the workpiece smoothly and steadily along the machine, ensuring that the bevelling tool makes contact with the material at the required angle and depth.
7. Keep your hands away from the moving parts of the machine, and do not lean over the workpiece while it is in motion.
8. Once the bevelling operation is complete, turn off the machine and wait for it to come to a complete stop before removing the workpiece.
9. Inspect the finished edge to ensure that it meets the required specifications and make any necessary adjustments if required.
10. Clean up the work area and return the machine to its proper storage location.

## 4.1.11. Measurements of the Edge Preparation

The steps and maintaining standard safety parameters, one can confirm the dimensional correction of edge preparation and ensure the quality and safety of the finished product.

General steps for confirming the dimensional correction of edge preparation while adhering to standard safety parameters:

1. Verify the material specifications and required edge preparation dimensions from the technical documentation or industry standards.
2. Use appropriate personal protective equipment (PPE) such as gloves, safety glasses, and earplugs to prevent injuries during the measurement process.
3. Use calibrated measuring tools such as a micrometer or a Vernier caliper to accurately measure the edge preparation dimensions.
4. Measure the edge preparation dimensions at multiple points to ensure consistency and accuracy.
5. Compare the measured dimensions with the required specifications and tolerance limits to confirm the dimensional correction of the edge preparation.
6. Document the measurements and results for future reference and quality control.

## 4.1.12. Marking on the Structural Steel Sections from the Hand Sketches

It is important to follow the established procedures and guidelines for marking structural steel sections to ensure the safety, quality, and compliance of the construction project. Some general steps that may be involved:

1. Obtain the hand sketches of the structural steel sections and review them carefully to understand the dimensions, shapes, and labelling.
2. Determine the required markings based on the project specifications, engineering drawings, and industry standards. This may include identification marks, fabrication marks, weld symbols, bolt hole marks, cut lines, etc.
3. Use suitable marking tools such as soapstone, chalk, or paint markers to mark the sections as per the design requirements. The marking should be clear, visible, and accurate.
4. Take necessary safety precautions such as wearing appropriate PPE, using a stable platform, and securing the sections properly.
5. Check the marked sections for any errors or omissions and make necessary corrections before proceeding with further fabrication or erection.

## 4.1.13. Placing and Fixing the Structural Steel Sections on the Fabrication Platform

placing and fixing structural steel sections on the fabrication platform involves planning, preparing the platform, lifting the sections, aligning and securing them, checking for compliance, and finally, welding or bolting the sections together to create the finished structure. General guidelines that are followed in placing and fixing structural steel sections on the fabrication platform.

1. **Planning:** The first step is to plan the location and orientation of the steel sections on the fabrication platform. This is done by reviewing the design drawings and coordinating with the construction team to ensure that the sections are placed in the correct location.
2. **Preparing the platform:** The fabrication platform must be cleared of any debris or obstructions, and levelled to ensure a smooth surface for placing the steel sections.
3. **Lifting the sections:** The steel sections are lifted onto the platform using cranes or other lifting equipment. Care must be taken to ensure that the sections are not damaged during the lifting process.
4. **Aligning and securing the sections:** The sections are aligned and secured in their correct position using clamps, welding, or bolting. The sections must be aligned accurately to ensure that they fit together properly when assembled.
5. **Checking for compliance:** Once the sections are secured in place, the team checks that the steel sections comply with the design drawings, local building codes, and safety standards.
6. **Welding and bolting:** The final step is to weld or bolt the sections together to create the finished structure. The welding and bolting must be done carefully to ensure that the structure is stable and secure.

### Scan the QR code to watch the video

https://youtu.be/F4s_QE8mRWA
Fit-Up

https://youtu.be/VJWnFGBVbSg
Fabrication Platforms

## Exercise

1. What do you understand by Fit-Up?
2. How to place and fix the structural steel sections on the fabrication platform?
3. Explain why jacks are an essential tool in construction fitting.
4. What are Anchoring Devices? Name a few commonly used in construction.
5. Explain edge preparation in details.

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# 5. Work Effectively in a Team

Unit 5.1 Work effectively in a team

(CON/N8001)

## Key Learning Outcomes

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

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

# Unit 5.1 Effective Interaction and Communication

## Unit Objectives

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

- Demonstrate effective communication skills while interacting with co-workers, trade seniors and others during the assigned task.
- Interpret work sketches, formats, permits, protocols, checklists and work-related requirements which are to be conveyed to other team members
- Handle material/ tools by adhering to instructions or consulting with seniors
- Demonstrate effective reporting to seniors as per applicable organisational norms
- Explain effects and benefits of timely actions relevant to fabrication works with examples
- Explain importance of team work and its effects relevant to fabrication works with examples
- Demonstrate team work skills during assigned task.

## 5.1.1. Effective Communication

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

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

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

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

**Communication Process**

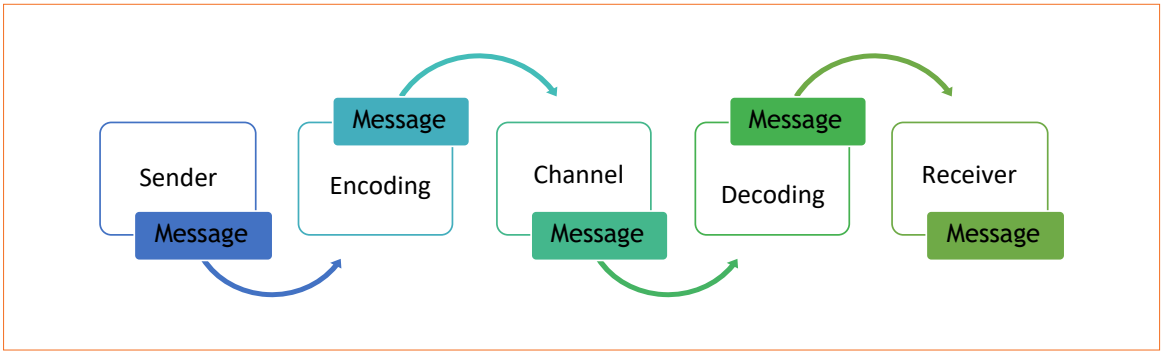


*Fig 5.1.1 Effective Communication Process*

- Sender: The person or entity starting the communication.
- Message: The information that the sender wishes to share.
- Encoding: Choosing the medium to send a message.
- Channel: The medium used to send a message.
- Receiver: The person or entity to whom the message is sent.
- Decoding: Understanding the message received.
- Feedback: The receiver's response to the message.

## 5.1.2. Workplace Communication

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

**Effective Communication with Stakeholders**

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

**1. Establish a Communication Chain of Command**

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

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

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

**2. Select an Appropriate Communication Method**

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

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

**3. Be an Active Listener**

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

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

**4. Prevent Confusion, Be Clear and Concise**

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

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

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

**5. Keep Written Communication Always Professional**

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

**6. Stick to the Facts**

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

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

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

## 5.1.3. Adverse Effects of Poor Communication

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

The following issues are faced due to poor communication:

**Creating Confusion**

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

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

**Unnecessary Delays**

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

**Budget/Cost Overruns**

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

**Injuries and Safety Issues**

Poor safety communication is frequently attributable to three frequent causes:

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

**Issues with Stakeholders**

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

## 5.1.4. Teamwork at Workplace

Teamwork is when people of an organisation collaborate to achieve a common objective or set of objectives. In the modern workplace, teamwork can take place in-person or (increasingly) online.

It is important to note that modern teams are vastly different from those of the past. Today's teams, for instance, are more varied and dynamic, with specialised skill sets that present new problems and opportunities. Consequently, any team-based initiative can also serve as an opportunity for personal and professional development.

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

**Advantages of Teamwork**

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

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

## 5.1.5. 5 C's of Teamwork

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

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

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

**Co-operation**

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

**Compromise**

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

**Communication**

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

**Confidence**

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

**Commitment**

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

## 5.1.6. Enhancing Teamwork in the Workplace

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

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

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

**2. Communicate Explicitly**

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

**3. Delegate and believe**

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

**4. Establish shared aims and objectives**

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

**5. Recognize and honour the achievements of others.**

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

**6. Conquer a conflict with success**

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

**7. Build a diverse group**

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

**8. Believe in Team Building**

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

## 5.1.7. Importance of Teamwork in Fabrication works

An assistant construction fitter works under a supervisor and aids them with fabrication tasks. Under the supervision of a supervisor, an assistant construction fitter helps with fabrication work. He has to do what they tell him, report problems, and let them know how things are going. The supervisor has to give out tasks and keep an eye on how the team is doing. This way of talking in a team makes sure that tasks are done quickly and safely. Teams can finish complicated projects and spot potential problems more easily when they work together. Having a group of people with different perspectives and areas of expertise helps make sure that any problems are dealt with quickly and that solutions are found quickly.

Teamwork also helps to reduce stress, as tasks are shared amongst team members. Working together to complete tasks reduces the amount of work each individual must complete. This benefit is especially important for fabrication works, where projects may require long hours and difficult tasks.

## 5.1.8. Time Management

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

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

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

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

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

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

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

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

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

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

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

**Time Management for Assistant Construction Fitter**

Fabrication process that requires careful planning and effective time management in order to produce quality results. To ensure the work is done efficiently, it is important to have a plan and to prioritize tasks.

Begin by assessing the project and the space that needs to be worked on. This helps in determining the skill set needed and the best way to approach the installation. Once the assessment is complete, determine the timeline and how long the installation should take.

When it comes to time management, it is important to break the project down into smaller tasks that can be completed in a reasonable amount of time. This keeps the work on track and allows focusing on one task at a time.

Additionally, it is a good idea to designate a certain amount of time to each task so that you can stay focused and complete it as quickly and accurately as possible.

The following steps should be followed for effective time management:

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

## 5.1.9. Construction Reporting

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

**Objective of Construction Reporting**

Construction reports are a way to comprehend the activities occurring on construction sites. In order

to provide an accurate depiction of the project's state, construction reporting utilises a number of methods to collect and combine project data.

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

**Types of Construction Reports**

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

**1. Materials Report**

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

**2. Trend Report**

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

**3. Cost Report**

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

4. Progress Report or Daily Report

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

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

## 5.1.10. Handle material/ tools by adhering to instructions or consulting with seniors

The poor handling of tools and materials leads to numerous health and safety incidents as well as material loss. In this sense, the construction sector is a high-risk one. To do any task in these industries safely, a high level of ability and competence is required.

Seniors must make sure and instruct that equipment that is made available to workers and employees is handled responsibly. Also, it is their duty to guarantee that the workers are qualified and capable of performing the work in a safe manner.

The workers in return are liable to adhere to the instructions laid by the supervisors for handling materials and tools. The importance of it is as follows:

- To maximise space utilisation by properly storing materials/tools and thereby reduce storage and handling costs,
- to minimise accidents during handling,
- to reduce overall cost by improving handling,

## Exercise

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

## Notes

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# 6. Work According to Personal Health, Safety and Environment Protocol

Construction Skill Development Council

Unit 6.1 - Workplace Hazards
Unit 6.2 - Fire Safety
Unit 6.3 - Safety Measures at Workplace

CON/N9001

## Key Learning Outcomes

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

- Explain the types of hazards at the construction sites
- Identify the hazards specific to the fabrication works
- Recall the safety control measures and actions to be taken under emergency situations
- Explain the classes of fire and types of fire extinguishers
- Demonstrate the operation of fire extinguisher
- Demonstrate different methods involved in providing first aid to the affected person.
- Explain the importance of worker participation in safety/mock drills
- Demonstrate the use of all Personal Protective Equipment (PPE) like helmet, safety shoe, safety belt, safe jackets and other safety equipment relevant to fabrication works requirement
- Explain the reporting procedures adopted during emergency situations
- Describe the standard procedure for handling, storing and stacking of material, tools, equipment and accessories
- Explain different types of wastes produced at a construction site including their disposal method
- Explain the purpose and importance of vertigo test at construction site
- Demonstrate vertigo test
- List out basic medical tests required for working at construction site
- Explain the types of ergonomic principles adopted while carrying out specific task at the construction
- Explain the benefits of basic ergonomic principles used at construction sites.
- Explain the importance of housekeeping works
- Demonstrate housekeeping practice followed after construction fitter works.

# Unit 6.1 – Workplace Hazards

## Unit Objectives

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

- Explain the types of hazards at the construction sites
- Identify the hazrds specific to the fabrication works
- Recall the safety control measures and actions to be taken under emergency situation.
- Explain the reporting procedures adopted during emergency situations.
- Describe the standard procedure for handling, storing and stacking of material, tools, equipment and accessories.
- Explain the types and benefits of basic ergonomic principles, which should be adopted while carrying out specific task at the construction sites.
- Demonstrate the use of all Personal Protective Equipment (PPE) like helmet, safety shoe, safety belt, safe jackets and other safety equipment relevant to fabrication works requirement.

## 6.1.1. Workplace Safety

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

The benefits of workplace safety are:

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

**Workplace Safety at Construction Site**

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

**1. Always wear PPE**

All personnel and visitors on the construction site must wear the required PPE to reduce their exposure

to potential hazards. Goggles, helmets, gloves, ear muffs or plugs, boots, and high visibility vests and suits are typical PPEs.

**2. Pay attention and obey signs**

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

**3. Provide precise directions**

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

**4. Keep site tidy**

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

**5. Organize and store equipment**

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

**6. Use the proper tools for the correct job**

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

**7. Have an emergency response plan**

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

**8. Set up protections**

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

**9. Perform pre-inspection of tools and equipment.**

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

**10. Report problems immediately**

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

## 6.1.2. Workplace Hazards

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

**Common Workplace Hazards**

The common workplace hazards are:

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

**Workplace Hazard at Construction Site**

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

- **Working at Heights:** Working at heights is the leading cause of fatal workplace injuries. All personnel working at height must receive adequate training in operating on various equipment, and such work must be carefully organised.

- **Moving Objects:** A building site is a constantly-evolving environment with numerous objects in constant motion, frequently on uneven ground. Delivery vehicles, large plant gear, and overhead lifting equipment pose a threat to workers and operators on the job site. Sites should always be designed to manage plant-to-pedestrian contact when physical barriers and enough segregation are present.

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

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

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

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

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

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

**Workplace Hazards Analysis**

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

**Control Measures of Workplace Hazards**

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

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

## 6.1.3. Hazard Identification and Risk Assessment (HIRA)

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

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

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

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

**Procedure for HIRA:**

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

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

HIRA Process it consist of four steps as follows:

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

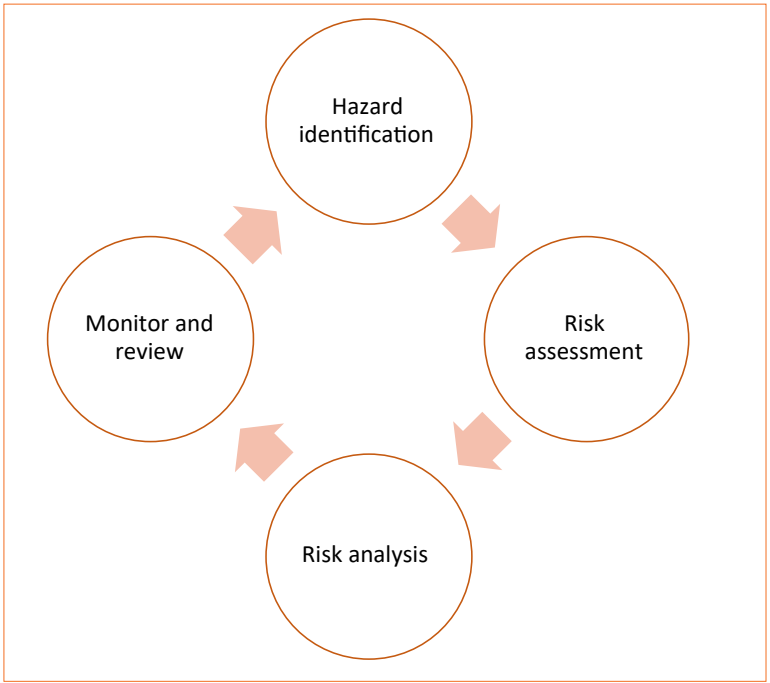


*Fig. 6.1.1 HIRA Process*

## 6.1.4. Workplace Warning Signs

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

There are four different types of safety signs:

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

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


*Fig. 6.1.2. Prohibition Warning Signs*

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


*Fig. 6.1.3. Mandatory Signs*

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


*Fig. 6.1.4. Warning Signs*

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

*Fig. 6.1.5. Emergency Signs*

## 6.1.5. Personal Protective Equipment

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

PPE used for protection from the following injuries are:

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

| Injury Protection | Protection | PPE |
|---|---|---|
| **Protection against Hearing Loss** | Hearing protection can be obtained by wearing earplugs or earmuffs. High noise levels can result in permanent hearing loss or damage, as well as physical and mental stress. Self -forming earplugs composed of foam, waxed cotton, or fibreglass wool usually fit well. Workers should be fitted for moulded or prefabricated earplugs by a specialist. |  |
| **Hand Injury Protection** | Hand protection will aid workers who are exposed to dangerous substances by skin absorption, serious wounds, or thermal burns. Gloves are a frequent protective clothing item. When working on electrified circuits, electricians frequently use leather gloves with rubber inserts. When stripping cable with a sharp blade, Kevlar gloves are used to prevent cuts. |  |
| **Whole Body Protection** | Workers must protect their entire bodies from risks such as heat and radiation. Rubber, leather, synthetics, and plastic are among the materials used in whole -body PPE, in addition to fire -retardant wool and cotton. Maintenance staff who operate with high -power sources such as transformer installations and motor -control centres are frequently obliged to wear fire -resistant clothes. |  |

*Table 6.1.1 . Personal protective equipment*

## 6.1.6. Basic Ergonomic Principles

The basic ergonomic principles for construction are:

**1. Work in neutral space.**

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

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

**2. Reduce the necessity for excessive force.**

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

**3. Keep materials easily accessible.**

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

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

**4. Work at the appropriate height.**

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

**5. Reduce needless movements.**

Manual repetition can result in overuse injuries, thus it is essential to consider the motions you repeat throughout the day and identify solutions to prevent excessive motion. Is it conceivable, for instance,

to replace a screwdriver with a drill, so eliminating the need for manual motion? Additionally, you might seek for possibilities to alter your position or the arrangement of your workspace in order to operate in a more ergonomic manner.

**6. Reduce fatigue resulting from static stress.**

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

**7. Minimize contact stress.**

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

**8. Leave adequate clearance.**

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

**9. Stay active and flexible throughout the day.**

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

**10. Keep your atmosphere comfortable.**

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

## 6.1.7. Emergency Response Plan for Construction Site

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

The Emergency Response Plan must address the following factors:

**1. Statutory Obligations**

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

Incorporate applicability and compliance status into the Emergency Response Plan.

**2. Emergency Preparedness**

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

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

**3. Measures for Emergency Mitigation**

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

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

**4. Measures for Emergency Preparedness**

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

**5. Disaster Recovery Procedures**

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

**6. Organization and Responsibilities during Emergencies**

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

**7. Resources for Emergency Management**

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

    a. Fire and gas detection system
    b. Fire protection and firefighting system (Active and Passive)
    c. Ambulance facility on-site; if not, on urgent call basis.
    d. Rescue facilities and personal protective equipment (PPEs)
    e. First aid stations.
    f. Medical facility on-site or affiliation with a local hospital or medical centre
    g. Internal and External Communication Facilities as well as a Notification System
    h. Gathering places
    i. Escape route and evacuation zones

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

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

**8. Emergency Recovery Method**

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

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

## Notes

# Unit 6.2 – Fire Safety

## Unit Objectives

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

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

## 6.2.1. Fire and its Classes

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

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

There are five distinct classes of fire:

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

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

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

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

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

## 6.2.2. Fire Safety

Fire safety is a set of actions aimed at reducing the amount of damage caused by fire. Fire safety procedures include both those that are used to prevent an uncontrolled fire from starting and those that are used to minimise the spread and impact of a fire after it has started. Developing and implementing fire safety measures in the workplace is not only mandated by law but is also essential for the protection of everyone who may be present in the building during a fire emergency.

The basic Fire Safety Responsibilities are:

- To identify risks on the premises, a fire risk assessment must be carried out.
- Ascertain that fire safety measures are properly installed.
- Prepare for unexpected events.
- Fire safety instructions and training should be provided to the employees.

**Prevention of a Workplace Fire**

- Workplace fire drills should be conducted regularly.
- If one has a manual alarm, one should raise it.
- Close the doors and leave the fire-stricken area as soon as possible. Ensure that the evacuation is quick and painless.
- Turn off dangerous machines, and don't stop to get personal items.
- Assemble at a central location. Ascertain that the assembly point is easily accessible to the employees.
- If one's clothing catches fire, one shouldn't rush about it. They should stop, descend on the ground, and roll to smother the flames if their clothes catch fire.

## 6.2.3. Fire Extinguisher

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

Types of fire extinguishers are:

There are five main types of fire extinguishers:

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

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

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


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


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

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

## Notes

# Unit 6.3 Safety Measures at Workplace

## Unit Objectives

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

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

## 6.3.1. Safety, Health and Environment at Work Place

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

## 6.3.2. Good Housekeeping

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

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

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

**1. Make a separate area for trash and waste.**

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

**2. Safely stack and store materials.**

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

**3. Maintain a safe working environment.**

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

**4. Maintain clear access routes.**

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

**5. Place tools at designated place after use.**

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

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

**6. If something is broken, fix it.**

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

**7. Avoid tripping over cables.**

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

**8. Avoid fire hazards.**

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

**9. Inform others.**

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

## 6.3.3. Safety Drills at Construction Site

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

**Safety in Excavation and Trenching**

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

**Fall Prevention and Safety Measures**

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

**Hazard Communication**

On a daily basis, construction workers are exposed to hazardous materials and chemicals at their work sites. A worker's health and safety may be compromised by repeated exposure to such substances. Training on hazard communication includes the numerous types of chemicals used in

the workplace as well as methods for minimising worker exposure. In addition, employees are taught how to read material safety data sheets and identify product labels.

**Crane Hazards Management**

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

**Construction Industry OSHA Course**

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

## 6.3.4. Medical Examination for Construction Workers

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

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

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

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

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

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

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

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

List of Recommended Medical Tests under the Factories Act:

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

## 6.3.5. Vertigo Test

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

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

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

**Diagnostic Procedures Typically Employed for Vertigo**

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

**Dix-Hallpike Maneuver**

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

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

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

**Head Impulse Test**

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

**Romberg Test**

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

**Fukuda-Unterberger Test**

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

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

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

**Rotation Test**

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

## 6.3.6. First Aid

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

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

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

**Need for First Aid at the Workplace**

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

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

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

**Treating Minor Cuts and Scrapes**

Steps to keep cuts clean and prevent infections and scars:

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

## 6.3.7. Waste Management

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

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

**Waste and Debris Management on the Construction Site**

On the construction site, one must be mindful of how they handle waste and garbage. Having a plan for managing these goods is necessary to protect the safety of both workers and the general public. Here are some waste management strategies:

- Before disposing of them in the dumpster, place any hand tools in containers with lids.
- Place empty paint cans in the trash instead than spilling them down drains or onto pavements.
- Rinse disposable cups and other food containers before placing them in a recycling bin. This will help prevent litter from being blown onto the property during windy or rainy weather.
- Recycle equipment and other metal objects by utilising a magnet or air compressor to remove all non-metal components, such as nails, screws, nuts, bolts, electrical wiring, etc. These are then segregated by category prior to proper recycling.

- Insulation should be disposed of in the garbage as opposed to being poured down drains or onto pavements, as it can clog sewer systems.
- Use a tarp to pile dirt, rocks, bricks, and other heavy things into the bed of a truck before hauling them away when the work is complete. This will make future clean-up easier.
- Instead of discarding excess lumber, wrap it in plastic to prevent it from becoming wet and infected with termites.
- Use a leak-proof container or urn to transfer hazardous liquids away for proper disposal; this will keep the workers and others on-site dry and healthy.
- Regularly cleaning up will reduce the amount of debris.
- Using trash cans with lids to prevent rubbish from falling to the ground.
- On your site, provide workers with safety vests for simple identification and protection from concealed threats such as electrical cables and sharp instruments.
- Ensure that there is a designated space for recyclable materials such as glass, plastic, cardboard, and metal containers so that they may be sorted later.

It is necessary to have a plan for waste management on construction sites, which are typically untidy places.

## Exercise

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

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# 7. Employability Skills (30 Hours)

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

**Scan the QR code below to access the eBook**

DGT/VSQ/N0101

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

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

**The scope covers the following :**

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

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

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

# Annexure-1

**Annexure of QR Codes for Assistant Construction Fitter**

| Chapter Name | Unit Name | Topic Name | URL | Page no. | QR Code |
|---|---|---|---|---|---|
| Chapter 1: Introduction to Construction Industry | Unit 1.1: Introduction to Construction Industry | Construction Industry | https://youtu.be/nndLyZrGfWc | 10 | Construction Industry |
| | | Types of Construction | https://youtu.be/1WVzo2UFyo8 | | Types of Construction |
| | | Fabrication | https://youtu.be/wi0uRrI_yz8 | | Fabrication |
| | Unit 1.2: Role and Responsibilities of an Assistant Construction Fitter Exercise | Assistant Construction Fitter | https://youtu.be/F4s_QE8mRWA | 15 | Assistant Construction Fitter |

| Chapter Name | Unit Name | Topic Name | URL | Page no. | QR Code |
|---|---|---|---|---|---|
| Chapter 2: Identify and Mark Structural Elements | Unit 2.1: Identify and mark structural elements | Structure Steel Fabrication | https://youtu.be/9-yd1QGwng4 | 37 | Structure Steel Fabrication |
| | | Types of Structural Steel | https://youtu.be/9-yd1QGwng4 | | Types of Structural Steel |
| | | Drawings of Steel Structure | https://youtu.be/hVQoohvbvNI | | Drawings of Steel Structure |
| | | Material Handling | https://youtu.be/1uMf4Ky0nyM | | Material Handling |
| Chapter 3: Tools and Heavy Materials used in Fit-Up of Fabricated Components | Tools and Instrument used in Construction Fitting | Marking out Tools and Instruments | https://youtu.be/w83NMv9c4I4 | 63 | Marking out Tools and Instruments |
| | | Linear Measurements Tools and Instruments | https://www.youtube.com/live/qRy50?feature=share | | Linear Measurements Tools and Instruments |

| Chapter Name | Unit Name | Topic Name | URL | Page no. | QR Code |
|---|---|---|---|---|---|
| | | Angular Measurements Tools and Instruments | https://youtu.be/Smi2jX18IFc | 63 | Angular Measurements Tools and Instruments |
| | | Do's and Don'ts for Heavy Lifting | https://youtu.be/b4wXRrfKQ2c | | Do's and Don'ts for Heavy Lifting |
| Chapter4: Edge Preparation and Positioning of Steel Sections for Fit-Up | Unit 4.1: Edge Preparation and Positioning of Steel Sections for Fit-Up | Fit-Up | https://youtu.be/F4s_QE8mRWA | 76 | Fit-Up |
| | | Fabrication Platforms | https://youtu.be/VJWnFGBVbSg | | Fabrication Platforms |

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