Skill India
कौशल भारत-कुशल भारत

सत्यमेव जयते
GOVERNMENT OF INDIA
MINISTRY OF SKILL DEVELOPMENT
& ENTREPRENEURSHIP

N·S·D·C
National
Skill Development
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Construction Skill Development Council

Participant Handbook

Sector
Construction

Sub-Sector
Real Estate and Infrastructure Construction

Occupation
Fabrication

Reference ID: **CON/Q1206, Version 1.0, NSQF Level 4**

Fabricator

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Certificate

COMPLIANCE TO QUALIFICATION PACK – NATIONAL OCCUPATIONAL STANDARDS

is hereby issued by the

CONSTRUCTION SKILL DEVELOPMENT COUNCIL OF INDIA

for the

SKILLING CONTENT: PARTICIPANT HANDBOOK

Complying to National Occupational Standards of
Job Role/Qualification Pack: **'Fabricator'** QP No. **'CON/Q1206 NSQF Level 4'**

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(Construction Skill Development Council of India)

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National Skill Development Corporation (NSDC) working with the object of developing unskilled and semi-skilled labour force into productive and skilled labour through Sector Skill Councils (SSCs) and Assessment agencies has entrusted the responsibility of developing participant handbooks with National Instructional Media Institute (NIMI).

NIMI, set up by the Government of India to develop instructional material for the overall improvement in the standard of training in ITIs and skill development programmes is happy to widen the scope of its outreach by developing content for NSDC.

NIMI sincerly acknowledges the co-operation rendered by the media developers and their sponsoring organisations to bring out the participant handbook under Construction Sector for Qualification Pack for Fabrication.

This book is the outcome of teamwork by Construction Skill Development Council and experts from the Fabrication and Construction Industry.

NIMI thanks the media development committee members, data entry operators, CADD personnel and all others for their dedicated and continued support.

About this book

Construction industry is the second largest employer in India. As one of the leading avenues for employment in the country, the role played by this industry in the economic development of India is pivotal. However, despite its vast potential, the construction industry faces challenge of shortage of skilled manpower. This hampers the progress of the industry, as the quality of fabricated and constructed structure is poor and most projects fail to be completed in the stipulated time.

There is a vast difference between the required skill sets and available skills amongst workers in the industry today. To reduce the skill gap, appropriate skilling of the workforce is of paramount importance. It will not only empower the worker, but also benefit the construction framework.

This participant handbook is developed to impart skill training with appropriate and relevant knowledge required to work as an Fabricator in the Construction industry. It is designed based on Fabricator Qualification Pack under the National Skill Qualifications Framework. It comprises the following NOS/topics:

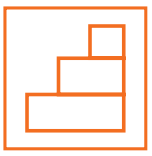
	NOS code	Major function/Task
1.	CON/N1210:	Inspect and check the fabrication materials and their preparation
2.	CON/N1211:	Oversee fabrication activites
3.	CON/N0717	Erect structural steel assemblies at construction sites
4.	CON/N8001:	Work effectively in a team to deliver desired results at the workplace
5.	CON/N9001:	Work according to personal health, safety and environment protocol at construction site

This book is designed considering the lower educational background of the construction worker. Therefore, special efforts have been taken to explain the concepts required for the job with ample visual support and illustrations.

Units and symbols used in the book have been listed below:

Symbols Used


Key Learning Outcomes


Steps


Unit Objectives


Notes


Tips


Exercise


Practical

Table of Contents

Skill India
कौशल भारत-कुशल भारत

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MINISTRY OF SKILL DEVELOPMENT
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1. Inspect and Check the Fabrication Materials and their Preparation

Unit 1.1 Introduction

Unit 1.2 Identify and Shift Proper Materials

Unit 1.3 Oversee Surface Preparation of Identified Materials

CON/N1210

Key Learning Outcomes

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

1. practice on use of PPE
2. read and interpret drawings and work procedure
3. receive and segregate the materials
4. check the materials for any physical damage
5. carry out cleaning of the surface of materials
6. carry out measuring and marking as per drawing
7. identify consumables, tools and equipment for the edge preparation
8. select suitable method for the edge preparation
9. identify suitable drilling equipment and accessories.

UNIT 1.1 Introduction

Unit Objectives

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

1. identify the purpose of the training
2. state National Occupation Standards and Qualification Pack
3. explain the benefits of skill training.

1.1.1 Introduction to the Training Programme

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

1. describe the scope of the training programme
2. determine the benefit of the training programme
3. define the role and responsibilities of fabricators.

1.1.1.1 Introduction

This training is developed to impart specific skills to individuals who wish to work as a fabricator. This training programme is based on the qualification pack of fabricator. The construction industry in India has grown very rapidly in the last few decades. Construction of new structures like residential towers. housing societies, schools, colleges, etc., has given rise to the demand for good skilled workers. There are very few skilled workers available for the construction works in India. The purpose of this training is to impart skill to the construction workers as per the set National Standards. This will give them good career opportunities and growth in the construction sector. The quality of construction work will greatly improve with the induction of skilled workforce.

1.1.1.2 Mode and Duration of the Training Programme

The training for the job role of fabricator is to provide through classroom and practical sessions. The total duration of the training programme as recommended in the qualification pack is 12-16 weeks.

Fig. 1.1.1 Classroom Session

Fig. 1.1.2 Practical Session

The training programme will enable an individual to:

- use hand tools, power tools and equipment used in fabrication
- interpret drawings, identify the components and fabrication symbols
- recognise the use of different structural elements
- carryout fabrication activities. Such as measuring, marking, punching, cutting, beveling, cleaning, drilling, bolting, welding, torqueing and tensioning
- carryout repair of fabricated components
- carryout erection of the fabricated structure in the work site
- work effectively in a team to deliver the desired results at the work site.
- work according to personal health and safety, environment protocol in the site.

1.1.1.3 Personal Attributes: The individual is expected to be physically fit and mentally alert. This will help to work across various locations and heights. It will also help to withstand the extreme weather conditions while working. Fabricators should have good communication skills, and be able to work in a team and handle various tools, instruments and materials.

1.1.1.4 National skill qualification frame work - NSQF:

Through the National policy on Skill development 2009 India recognized the need for development of a National qualification framework. The national skill qualification framework NSQF came into being as per the Gazette Notification no 8/06/2013 dated 27th Dec. 2013. NSQF is a quality assurance framework.

It is an outcome based approach and each level in the NSQF is defined and described in terms of competency levels that would need to be achieved. The National Skill Qualification Framework is composed of 10 levels, each represents a different level of competency with level 1 representing the lowest competency and level 10 highest competency. Competence means the proven ability to use acquired knowledge, skills and personal and social abilities in the discharge of responsibility of a job role. It is important to note that the NSQF levels are not directly related to years of study.

NSQF organizes qualifications according to a series of levels of knowledge, skills and aptitude. These levels are defined in terms of learning outcomes which the learner must possess regardless of whether they were acquired through formal, non-formal or informal learning.

Each level of NSQF is described by a statement of learning outcomes in five domains known as level descriptors. These five domains are:

1. Process
2. Professional knowledge
3. Professional skill
4. Core Skill
5. Responsibility

The level mentioned below in the career progression chart corresponds to NSQF level - 4.

The Fabricator is assigned level - 4 based on the above five criterias.

1.1.1.5 Introduction to QP and NOS

Introduction to QP and NOS: This program is based on Qualification Pack called “Fabricator”. The Qualification Pack is also called a QP. The code for Fabricator Trade is CON/1206. A QP consists of a set of National Occupational Standards (NOS). NOS specifies the standard competency a worker must achieve when carrying out a function in the workplace. Under the fabricator QP, there are five NOS. which provide a detailed account of the functions to be performed in the work site.

NOS Code		Major Function/Track
1. CON/N1210	:	Inspect and Check the Fabrication Materials and their Preparation
2. CON/N1211	:	Oversee the Fabrication Activities
3. CON/N0717	:	Erect Structural Steel Assemblies at Constructions Sites
4. CON/N8001	:	Work Effectively in a Team to Deliver the Desired Result at the Work Place
5. CON/N9001	:	Work According to Personal Health, Safety and Environment Protocol in the Constrution Site

1.1.1.6 Benefits of the Training Programme

After completion of the training programme, trainees will be assessed through a theory and practical test.

1. On successful passing of the assessments, a certificate will be awarded by the Construction Skill Development Council of India (CSDCI).
2. The certificate will help the trainees to get a job with better wages in the construction sector.
3. The skills acquired along with the certificate will also help the trainees to have career progression and growth.

Fig. 1.1.3 Theoritical Session

Exercise

I. Answer the following questions.

1. What does QP consist of?

---

2. What does NOS specify?

---

3. Name any two NOS under Fabricator

---

4. Mention any two benefits of this training programme?

II. State whether the following statements are True or False.

1. This certificate will help you to get a job and earn better wages in the construction sector.
   True ☐ False ☐
2. The skill acquired along with the certificate will also help you to grow in your career.
   True ☐ False ☐
3. The assessment after the training will have only practical examination.
   True ☐ False ☐

Notes

1.1.2 An Overview of the Construction Sector

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

1. identify aspects of the construction sector in India
2. identify urban and rural construction
3. define the features of modernization in construction sector
4. list out major occupations in the construction sector.

1.1.2.1 Introduction

Construction refers to building of different types of structures. The sector comprises of small, medium and large industries or companies. The companies involve in different types of projects. They create a diverse, but the specific requirement of workmen.

The construction sector can be broadly classified into two sub sectors: real estate and infrastructure construction, rural construction.

1. **Real estate and infrastructure construction:** This sub sector comprises all the works that are required for construction of all types of infrastructure and real estate projects. Infrastructure projects are those that directly or indirectly affect the growth of the Nation. For example, roads, airports, railway bridges, dams, power plants, metros, industries, etc. Real estate projects are those which mainly focus on providing residential and commercial workplaces to all categories of people. For example, residential towers, independent houses, malls, sports complex, etc.

Fig. 1.1.4 Industrial Building Construction

2. **Rural construction:** This sub sector focuses on the constructional requirements of rural India. It includes construction of rural households, warehouses, village roads, etc.

Fig. 1.1.5 Rural Infrastructure roads and flyovers

1.1.2.2 Modernization in Construction

From the early ages to the present day, the construction sector has generated substantial employment. It has also undergone extensive modernization, from raw material to the use of heavy equipment. The use of modern equipment and technique has increased the speed of construction work. It has enhanced the quality of finished structures. Further, by modernization of construction, it is now possible to construct buildings in under water as well as in very high altitudes. Modernization has helped to build hi-tech buildings and atomic power generation plants.

Fig. 1.1.6 Old bridge

Fig. 1.1.7 Modern bridge

Fig. 1.1.8 Old construction equipment

Fig. 1.1.9 Modern construction equipment

1.1.2.3 Job Roles in Construction

Construction is the second largest employment generating sector in India after agriculture. There are many job roles in construction. Depending on the nature of work, some job roles cater to the employment needs of maximum number of workmen and are more prominent than others.

The following jobs are very common in most of the fabrication and construction projects

- Helper fabrication
- Assistant construction fitter
- Construction fitter
- Fabricator
- Tack welder
- Welders
- Grinder construction
- Gas cutter construction

1. Fabrication

Metal fabrication is the creation of metal structure by marking, cutting, bending, forming, grinding fitting, assembling, welding and painting processes. Fabrication is one of the value added process involved in the creation of machine parts. Industrial building structures bridge girders, column beam structure from various raw materials.

2. Welding

Welding is the art of fabrication technique used for joining the metallic component parts through the application of heat to a suitable temperature with or without the application of pressure and with or without the use of a filler material

Fig. 1.1.10 Fabrication Activities

Fig. 1.1.11 Welding Activities

3. Drilling

Drilling is the process of cutting holes in solid material using a rotating cutting tool

4. Bolting

Bolted joints are one of the most common elements in steel structures, fabrication assembly and erection. Bolting consists of fasteners that capture and join other parts and are secured with the help of screw threads

5. Steel structure erection and alignment

The erection of steel structure consists of the assembly of steel components into a frame at site. The process involves lifting and placing components in position then connecting them together through bolting and some time welding is used

Alignment work consists of lining, levelling and plumbing.

Fig. 1.1.12 Drilling

Fig. 1.1.13 Bolting

Fig. 1.1.14 Structural Steel Erection

6. Scaffolding

Scaffolding is a temporary support structure. The materials used are bamboo, timber or steel. This support structure helps during construction activities. Scaffolding is made for workmen to do their work safely and to keep their tools and materials.

Few job roles under Scaffolding are as follows:

1. Assistant Scaffolder – System
2. Assistant Scaffolder – Conventional
3. Scaffolder – Conventional
4. Scaffolder – System.

Fig. 1.2.15 Scaffolding

7. Construction painting

Painting is a vital of the overall finishing work of a construction project. Application of paint adds aesthetic value to a constructed structure. This may also involve decorative painting of basic designs and patterns.

Few job roles under Construction painting are as follows:

5. Assistant Construction Painter and Decorator
6. Construction Painter and Decorator
7. Charge hand – Painting and Decorating.

Fig. 1.2.16 Painting work by a painter

Exercise

I. Answer the following questions.

1. What are the sub sectors in construction?

---

2. What does rural construction focus on?

---

3. How has the construction sector been modernised?

---

4. Mention 4 job roles that are common in construction projects.

---

5. What are the main objectives of Fabricator?

---

6. What is Fabrication?

II State whether the following statements are True are False.

1. Real estate projects focus on the construction of roads, airports, dams and power plants.

   True ☐ False ☐

2. Modern equipment has helped to construct under water and in high altitudes.

   True ☐ False ☐

3. Scaffolding is done using bricks and concrete.
   True ☐ False ☐
4. Repairing of Fabricator structure is done by Experienced Fabricator.
   True ☐ False ☐

Notes

1.1.3 Fabricator Job Role and Responsibilities

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

1. list the job roles and responsibilities of fabricator.

Fabricators should be able to:

- read and interpret organization procedure for obtaining approvals and indent materials
- interpret drawings
- perform all the fabrication work in sequence. For example, forming, cutting, grinding, beveling, drilling, fitting and tack welding of small parts and finished products
- use instruments and equipment
- identify and distinguish measurement units
- verify the final dimensions of fabricated components
- install fabricated components in the construction site.

Exercise

I. Answer the following questions.

1. Explain the fabricator job role in construction sector.

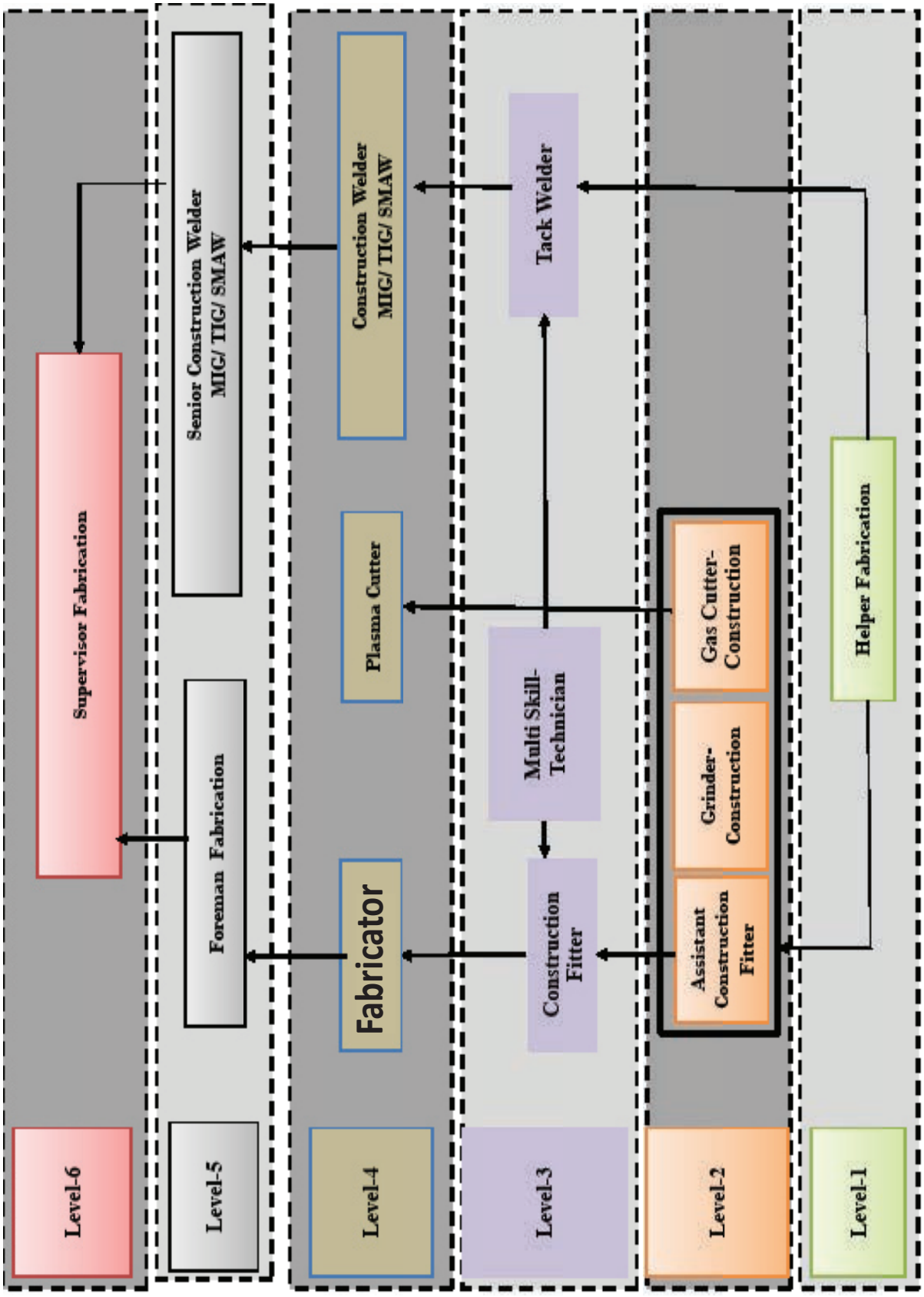
   ---

2. Draw a simple carrer progression chart for the fabrication occupation.

II. State whether the following statements are True or False.

1. The fabricator carries out grinding and filing work individually.
   True ☐ False ☐
2. There is a huge requirement for skilled workforce in the construction sector.
   True ☐ False ☐
3. A fabricator hands over the tool and materials to the store after the days work.
   True ☐ False ☐

Notes


Level-6
Supervisor Fabrication
Level-5
Senior Construction Welder MIG/ TIG/ SMAW
Foreman Fabrication
Level-4
Construction Welder MIG/ TIG/ SMAW
Plasma Cutter
Fabricator
Level-3
Tack Welder
Multi Skill-Technician
Construction Fitter
Level-2
Gas Cutter-Construction
Grinder-Construction
Assistant Construction Fitter
Level-1
Helper Fabrication

UNIT 1.2 Identify and Shift Materials

Unit Objectives

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

1. read and interpret drawings, and material specifications
2. identify the names of components and assembly
3. recognise the concept of stamping and heat number.

1.2.1 Fabrication Mathematical Applications

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

1. perform unit conversions
2. refresh basic knowledge in mathematics – Arithmetic, algebra and geometry
3. calculate area, volume, angles and length.

Metric System & Inch System Units

1. Metric System Units

- Most countries use the metric system. The metric system uses the meter and linear units based on the meter, gram as its standards of measure and prefixed by kilo, centi and milli etc . All multiplies and subdivisions of the meter are directly related to the meter by a factor of ten. This makes it easy to use the decimal system for calculations involving metric units. The more often used abbreviations for linear measurement are Decimeter “dm”, the Centimeter “cm” and Millimeter “mm”.

a. Kilometer (km), 1 km = 1,000 meter

b. Meter (m), 1 m = 10 dm = 100 cm = 1,000 mm

c. Decimeter (dm), 1 dm = 10 cm = 100 mm

d. Centimeter (cm), 1 cm = 10 mm

2. Inch System (Imperial System) Units

Inch system is mostly used in USA, where things are measured in feet, inches and pounds.

- The smallest linear measurement unit in the Inch System is the inch “in”. 1/1000 of inch is called ‘Thou’. Other units are the feet “ft” and the yard “yd”.

a. 1 yd = 3 ft = 36 in

b. 1 ft = 12 in

c. 1 m = 39.37 inches

3. Units Conversion

- Example for Inch to Inch Fraction conversion: 1/16” = 1 divided by 16 = 0.0625”
- Example for Inch Fraction to mm conversion : 0.0625” x 25.4 mm = 1.58 mm
- 1000 litre = 1 m^3.
- 1 yd = 0.9144 m
- 1 ft = 0.30480 m
- 1 in = 25.4 mm

Arithmetic and its Applications

Arithmetical calculation knowledge is needed in all areas of fabrication works. Fabricator shall be able to perform arithmetic calculations related to fabrication. Fabricator requires to calculate length, diameter, perimeter (circumference), bending angles, elevation, coordinates etc. Sometimes, pipes and cones may be required to be fabricated from plates. Hence Fabricator shall be able to mark the required development sizes in the plate so as to cut and roll the pipe or cones etc.

The four basic arithmetic operations to be performed in fabrication works are addition, subtraction, multiplication, and division.

If Pipe outside diameter (OD) and inside diameter (ID) are given, then pipe thickness will be

½ (OD-ID). If pipe OD and Thickness (t) are given , then pipe ID will be OD- 2t.

Example 3.1-If Pipe OD is 508 mm and pipe ID is 480 mm, then pipe thickness is ½ (OD-ID) = ½ (508-480) = 14 mm

Example 3.2- If pipe OD is 610 mm and wall thickness is 20 mm , then pipe ID will be OD- 2t = 610-40 = 570 mm.

Algebra and its Applications

Basic Algebraic formulas applicable for fabrication include

- $(a-b)^2 = a^2 - 2ab + b^2$

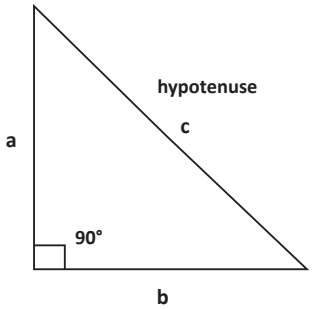


Fig 1.2.1 Right Angle Triangle - side dimension calculation

The above formulas will be applicable while calculating coordinates and elevations and third side of right angle triangle.

In a right angle triangle, if one side 'b' and hypotenuse 'c' dimensions are given, the other side can be calculated as below.

a. $a^2 + b^2 = c^2$

b. $a^2 = c^2 - b^2$

c. $a^2 = (c+b)(c-b)$

d. $a = \sqrt{(c+b)(c-b)}$

Example 3.3: In the above triangle hypotenuse dimension is 13 cm and one side is 5 cm, calculate the other side dimension.

By applying the above formula $a = \sqrt{(c+b)(c-b)}$,

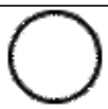
$$a = \sqrt{18x8)} = \sqrt{144} = 12$$

The other side dimension is 12 cm.

Geometry and its Applications

Geometrical knowledge is essential for fabricator to perform structure fabrication and installation.

A circle is a geometric form of which every point on the outside of the circle is the same distance away from the center. The distance around the edge of the circle is called the circumference. The distance from one side of the circle to the other, going through the center of the circle, is the diameter. Two times the radius is the diameter of the circle.

Shape	Formulas for Area (A) and Circle Circumference (C)
Triangle 	A = ½bh = ½ x base x height
Square 	A = a x a = a^2 Where 'a' is side dimension of the Square
Rectangle 	A = lw = length x width
Trapezoid 	A = ½ (b_1 + b_2)h = ½ x sum of bases x height
Parallelogram 	A = bh = base x height
Circle 	($A = \pi r^2 = \frac{\pi d^2}{4}$) ('π' value is 3.1416 or 3.142)

1. Formulas for Area of Circle, Circumference Calculation

Important formulas for area and circle circumference calculations are as tabulated below:

Example 3.4: Calculate the area of trapezium shape support foundation when bottom width of foundation is 600 mm, top width trench is 400 mm and foundation depth is 350 mm.

- Formula for trapezium area is A = ½ (b_1 + b_2)h = ½ x sum of bases x height
- Applying the given values, foundation area is ½ (400 + 600) x 350 =175 000 mm^2 = 0.175 m^2

Table 3.1 - Formula for calculating area and circumference

2. Perimeter / Circumference Calculation

a. Perimeter of a square: s + s + s + s, where 's' is length / size of one side

b. Perimeter of a rectangle: l + w + l + w, where 'l' is length &'w' is width

c. Perimeter of a triangle: a + b + c, a, b, and c are size / lengths of the 3 sides

d. area of circle = πr^2 (R-Radious)

e. circumference = 2πR

3. Volume Calculation:

a. Volume of a cube: s × s × s where 's' is length / size of one side (All sides are equal in cube)

b. Volume of a rectangular box: l × w × h, where 'l' is length & 'w' is width and 'h' is dimension of height

c. Volume of a sphere: (4/3) × π × r^3, where 'r' is radius of sphere and π value is 3.1416

d. Volume of a cylinder: π × r^2 × h, where 'r' is radius of the circle of the base and 'h' is height of the cylinder.

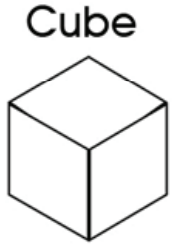


Fig 1.2.2 Cube

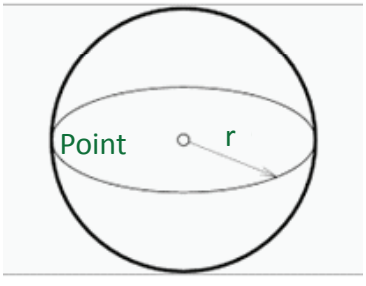


Fig 1.2.3 Sphere

Fig 1.2.4 Cylinder