UNIT 4

PRODUCTION COST ESTIMATION

Content 1:

Estimation of Different Types of Jobs:

COST ESTIMATION IN FOUNDRY SHOP

Foundry is a metal casting process in which the metal is melted and poured into the moulds to get the components in desired shape and size. Castings are obtained from a foundry shop.

Generally a foundry shop has the following sections:

1. Pattern Making Section

In this section the patterns for making the moulds are manufactured. The machines involved in making the patterns are very costly and small foundries may not be able to afford these machines. In such cases the pattern are not made for outside parties who are specialists in pattern making. Patterns are made either fromwood or from a metal.

2. Sand-mixing Section

In this section raw sand is washed to remove clay etc., and various ingredientsare added in the sand for making the cores and moulds.

3. Core-making Section

Cores are made in this section and used in moulds to provide holes or cavitiesin the castings.

4. Mould Making Section

This is the section where moulds are made with the help of patterns. The moulds may be made manually or with moulding machines.

5. Melting Section

Metal is melted in the furnace and desired composition of metal is attained by adding various constituents. Metal may be melted in a cupola or in an induction or inan arc furnace. In some cases pit furnace is also used for melting the metals.

6. Fettling Section

The molten metal after pouring in the moulds is allowed to cool and the casting is then taken out of mould. The casting is then cleaned to remove sand and extra material and is shot blasted in fettling section. In fettling operation risers, runners and gates are cut off and removed.

7. Inspection Section

The castings are inspected in the inspection section before being sent out of the factory.

ESTIMATION OF COST OF CASTINGS

The total cost of manufacturing a component consists of following elements:

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1. Material cost.
2. Labour cost.
3. Direct other expenses.
4. Overhead expenses.

Material Cost

(a) Cost of material required for casting is calculated as follows:

(*i*) From the component drawing, calculate the volume of material required for casting.

This volume multiplied by density of material gives the net weight of the casting.

(ii) Add the weight of process scrap *i.e.* weight of runners, gates and risers and other material consumed as a part of process in getting the casting.

(iii) Add the allowance for metal loss in oxidation in furnace, in cutting the gates and runners and over runs etc.

Note: The casting drawing is made by adding various allowances like shrinkage, draft and machining allowance, etc., to the dimensions of finished component.

(a)In addition to the direct material, various other materials are used in the process of manufacture of a casting. Some of the materials are:

(*i*) Materials required in melting the metal, *i.e.*, coal, limestone and other fluxes etc. The cost of these materials is calculated by tabulating the value of material used on per tonne basis and then apportioned on each item.

(*ii*) Material used in core shop for making the cores, *i.e.*, oils, binders and refractories etc.

The cost of core materials is calculated depending upon the core size and method of making the core. Similarly the cost of moulding sand ingredients is also calculated.

Labour Cost

Labour is involved at various stages in a foundry shop. Broadly it is divided into two categories:

(i) The cost of labour involved in making the cores, baking of cores and moulds is based on the time taken for making various moulds and cores.

(ii) The cost of labour involved in firing the furnace, melting and pouring of the metal.

Cleaning of castings, fettling, painting of castings etc., is generally calculated on the basis of per kg of cast weight.

Direct Other Expenses

Direct expenses include the expenditure incurred on patterns, core boxes, cost of using machines and other items which can be directly identified with a particular product. The cost of patterns, core boxes etc., is distributed on per item basis.

Overhead Expenses

The overheads consist of the salary and wages of supervisory staff, pattern shop staff and inspection staff, administrative expenses, water and electricity charges etc. The overheads are generally expressed as percentage of labour charges.

The cost of a cast component is calculated by adding the above constituents.

COST ESTIMATION IN WELDING SHOP

Gas welding:

The most commonly used gas welding is oxy-acetylene welding. The high temperature required for welding is obtained by the application of a flame from mixture of oxygen and acetylene gas.

The filler material is used to fill the gap between the parts to be welded. The welding technique used may be leftward welding or rightward welding.

Leftward welding : In this method, welding is started from right hand side of the joint and proceeds towards left. This method is used for welding plates upto 5 mm thick. No edge preparation is required in case of the plates of thickness upto 3 mm

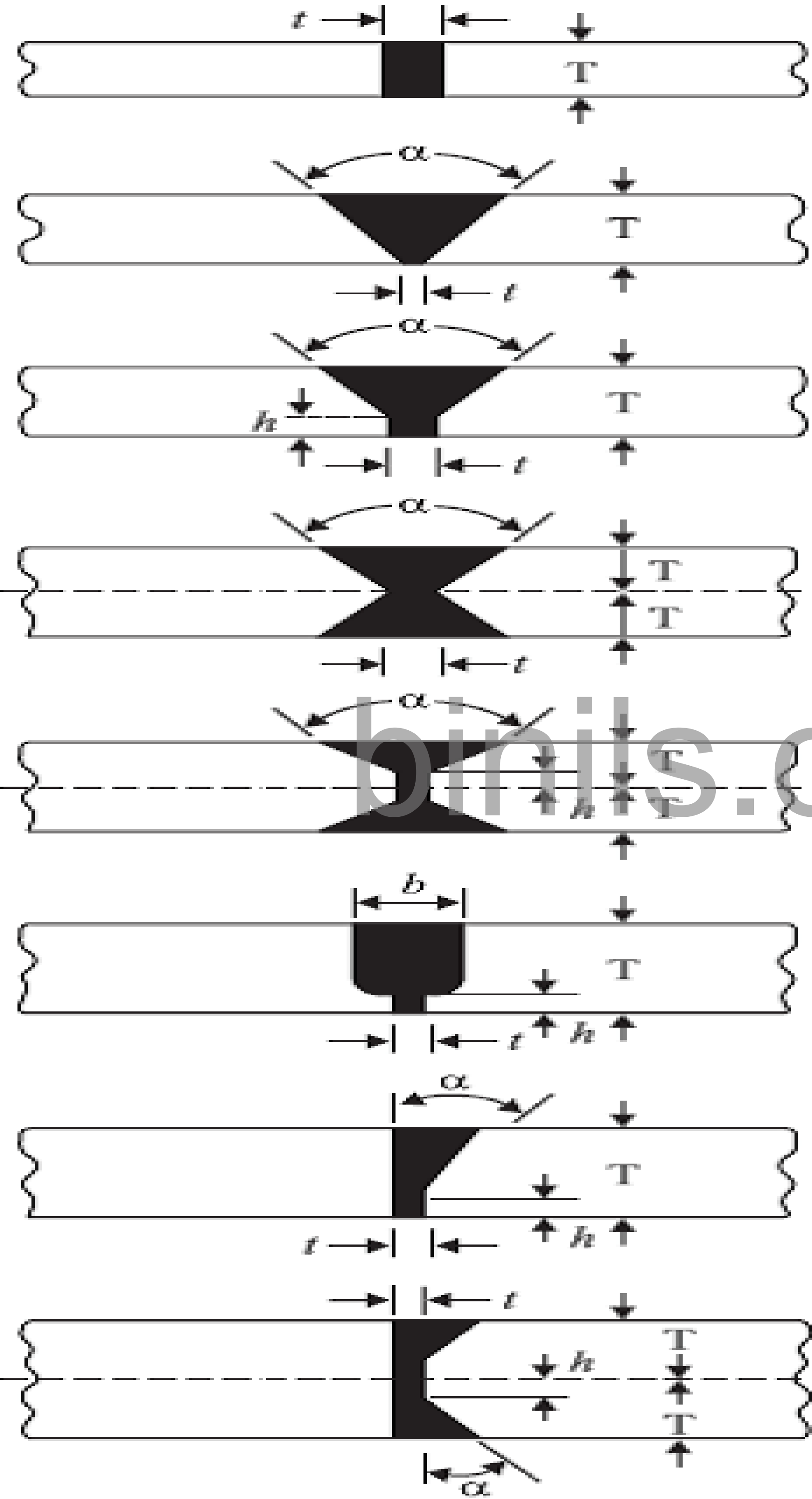


Fig. 5.3. Types of Welded Joints.

Estimation of Cost in Welding

The total cost of welding consists of the following elements:

1. Direct material cost.
2. Direct labour cost.
3. Direct other expenses.
4. Overheads.

1. Direct Material Cost

The direct material cost in a welded component consists of the following:

(i) Cost of base materials to be welded *i.e.*, sheet, plate, rolled section, casting or forging. This cost is calculated separately.

(ii) Cost of electrodes/filler material used. The electrode consumption can be estimated by using the charts supplied by the suppliers. Another way to find the actual weight of weld metal deposited is to weigh the component before and after the welding and making allowance for stub end and other losses during welding.

Also the weight of weld metal = Volume of weld × Density of weld material

2. Direct Labour Cost

The direct labour cost is the cost of labour for preparation, welding and finishing operations.

Preparation or pre-welding labour cost is the cost associated with preparation of job for welding, *i.e.*, the edge preparation, machining the sections to be welded etc. If gas is used in cutting/preparation of edges, its cost is also taken care of.

Cost of labour in actual welding operation is calculated considering the time in which arc is actually in operation.

The cost of labour for finishing operation is the cost of labour involved in grinding, machining, sand or shot blasting, heat treatment or painting of welded joints.

3. Direct Other Expenses

The direct other expenses include the cost of power consumed, cost of fixtures used for a particular job etc.

Cost of power: The cost of power consumed in arc welding can be calculated from the following formula:

$$\text{Power cost} = \frac{V \times A}{1{,}000} \times \frac{T}{60} \times \frac{1}{E} \times \frac{1}{r} \times C$$

Where,

V = Voltage

A = Current in Amperes

t = Welding time in minutes

E = Efficiency of the welding machine

= 0.6 for welding transformer

= 0.25 for welding generator

r = Ratio of operating time to connecting time taken by the operator

C = Cost of electricity per kWh *i.e.*, Unit.

In case of gas welding, the cost of gas consumed is calculated by taking the values from Tables 5.1 and 5.2. Cost of welding fixtures is apportioned on the total number of components that can be manufactured using that fixture.

4. Overheads

The overheads include the expenses due to office and supervisory staff, lighting charges of office and plant, inspection, transport, cost of consumables and other charges. The cost of equipment is also apportioned to the individual components in the form of depreciation.

COST ESTIMATION IN FORGING SHOP

Forging is the process of forming a metal into desired shape and size by the application of localized compressive forces. The component may be forged in cold or hot condition. In case of hot forging the metal is heated to a high temperature below its melting point and is pressed into shape by the application of compressive forces by manual or power hammers, presses or special forging machines.

Forging Processes

Forging processes can be divided into following categories:

1. Smith forging: In smith forging, also known as hand forging, the component is made by hammering the heated material on an anvil. The hammering may be done by hand or machine.

2. Drop forging: The forging is done by using the impressions machined on a pair of die blocks. The upper half of the die is raised and allowed to drop on the heated metal placed over the lower half of the die. The metal is thus squeezed into required shape.

3. Press forging: In this method the metal is squeezed into desired shape in dies using presses. Instead of rapid impact blows of hammer, pressure is applied slowly. This method is used for producing accurate forgings.

4. Machine forging or Upset forging: In machine forging or upset forging the metal is shaped by making it to flow at right angles to the normal axis. The heated bar stock is held between two dies and the protruding end is hammered using another die. In upset forging the cross-section of the metal is increased with a corresponding reduction in its length.

5. Roll forging: Roll forging is used to draw out sections of bar stock, *i.e.*, reducing the cross-section and increasing the length. Special roll forging machines, with dies of decreasing cross-section are used for roll forging.

The material equal to the product of thickness of sawing blade and cross-section of bar is lost for each cut. Similarly, if the small pieces left at the end are not of full length, these also go as waste. Shear loss is generally taken as 5 percent of net weight.

(i) Tonghold loss: Drop forging operations are performed by holding the stock at one end with the help of tongs. A small length, about 2.0 – 2.5 cm and equal to diameter of stock is added to the stock for holding.

Tonghold loss = Area of X-section of bar × Length of tonghold

(ii) Scale loss: As the forging process is performed at very high temperature, the Oxygen from air forms iron oxide by reacting with hot surface. This iron oxide forms a thin film called scale, and falls off from surface at each stroke of hammer. Scale loss is taken as 6 percent of net weight.

(iii) Flash loss: When dies are used for forging, some metal comes out of the die at the parting line of the top and bottom halves of the die. This extra metal is called flash. Flash is generally taken as 20 mm wide and 3 mm thick. The circumference of component at parting line multiplied by cross-sectional area of flash gives the volume of flash. The flash loss in weight is then calculated by multiplying the volume of flash by density of the material.

(iv)Sprue loss: When the component is forged by holding the stock with tongs, the tonghold and metal in the die are connected by a portion of metal called the sprue or runner. This is cut off when product is completed. Sprue loss is taken as 7 percent of net weight.

4.2 Estimation of Cost of Forgings

The cost of a forged component consists of following elements:

1. Cost of direct materials.
2. Cost of direct labour.
3. Direct expenses such as cost of dies and cost of press.
4. Overheads.

1. Cost of Direct Material

Cost of direct material used in the manufacture of a forged component is calculated as follows:

(i) **Calculate the net weight of forging:** Net weight of the forged component is calculated from the drawings by first calculating the volume and then multiplying it by the density of material used.

Net weight = Volume of forging × Density of material

(ii) **Calculate the gross weight:** Gross weight is the weight of forging stock required to make the forged component. Gross weight is calculated by adding material lost due to various factors discussed above, to the net weight.

Gross weight = Net weight + Material loss in the process

In case of smith or hand forging, only scale loss and shear loss are to be added to net weight but in case of die forging all the losses are taken into account and added to net weight.

(iii) **Diameter and length of stock:** The greatest section of forging gives the diameter of stock to be used, and

$$\text{Length of stock} = \frac{\text{Gross weight}}{\text{X-sectional area of stock} \times \text{Density of material}}$$

(iv) The cost of direct material is calculated by multiplying the gross weight by price of the raw material

Direct material cost = Gross weight × Price per kg

2. Cost of Direct Labour

Direct labour cost is estimated as follows:

Direct labour cost = $t \times l$

where

t = time for forging per piece (in hours)

l = labour rate per hour.

It is very difficult to estimate the exact time to forge a component. In practice the forging time per component is estimated based on the total production of eight hours or a day.

3. Direct Expenses

Direct expenses include the expenditure incurred on dies and other equipment, cost of using machines and any other item, which can be directly identified with a particular product. The method of apportioning die cost and machine cost is illustrated below: *Apportioning of Die Cost*

Let cost of Die = Rs. X

No. of components that can be produced using this die (*i.e.,* die life) = Y components Cost of die/component = Rs. X/Y

Apportioning of Machine (Press) Cost

Let cost of press = Rs. A

Life of press = n years

= $n \times 12 \times 4 \times 5 \times 8 = 1920\, n$ hours

(Assuming 8 hours of working per day, 5 days a week and 4 weeks a month in 12months of year).

Hourly cost of press $= \frac{A}{1920\,n}$

No. of components produced per hour = N

Cost of using press per component = Rs. $\frac{A}{1920\,n\,N}$

This excludes cost of power consumed and cost of consumables, if any.

4. Overheads

The overheads include supervisory charges, depreciation of plant and machinery, consumables, power and lighting charges, office expenses etc. The overheads are generally expressed as percentage of direct labour cost.

The total cost of forging is calculated by adding the direct material cost, directlabour cost, direct expenses and overheads.

UNIT IV

PRODUCTION COST ESTIMATION

Content 2:

COST ESTIMATION IN FOUNDRY SHOP

Example 1 : Calculate the total cost of CI (Cast Iron) cap shown in Fig, from the following data :

Cost of molten iron at cupola spout = Rs. 30 per kg
Process scrap = 17 percent of net wt. of casting
Process scrap return value = Rs. 5 per kg
Administrative overhead charges = Rs. 2 per kg of metal poured.
Density of material used = 7.2 gms/cc
The other expenditure details are:

Process	*Time per piece*	*Labour charges per hr*	*Shop overheads per hr*
Moulding and pouring	10 min	Rs. 30	Rs. 30
Casting removal, gate cutting etc.	4 min	Rs. 10	Rs. 30
Fettling and inspection	6 min	Rs. 10	Rs. 30

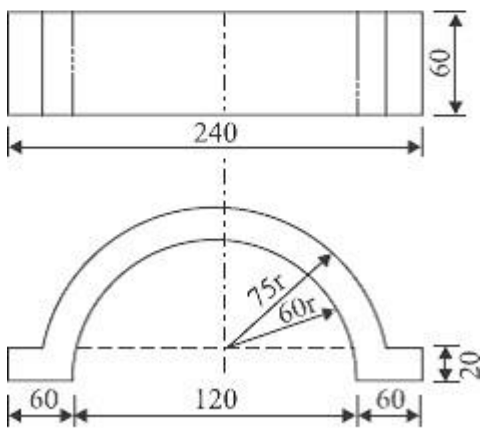


Fig. 5.1. All dimensions are in mm.

Solution: To calculate material cost :

Volume of the component = $(2 \times 6 \times 2 \times 6) + \frac{1}{2} \times p\,[(7.5^2 - 6^2]\,6$

= 335 cc

Net weight of the casting = 335 × 7.2

= 2,412 gms

= 2.4 kgs

Process scrap = 2.4 × 0.17 = 0.4 kg

Metal required per piece = 2.4 + 0.4 = 2.8 kgs

Material cost/piece = 2.8 × 30 = Rs. 84

Process return = 0.4 × 5 = Rs. 2

Net material cost per piece = 84 – 2 = Rs. 82

(ii) Calculate Labour Cost and Overheads

Process	*Time per piece*	*Labour charges per piece (Rs.)*	*Shop overheads per piece (Rs.)*
Moulding and pouring	10 min	$\frac{10}{60} \times 30 = 5$	$\frac{30 \times 10}{60} = 5$
Casting removal, gate cutting etc.	4 min	$\frac{4}{60} \times 10 = 0.67$	$\frac{30 \times 4}{60} = 2$
Fettling and inspection	6 min	$\frac{6}{60} \times 10 = 1$	$\frac{30 \times 6}{60} = 3$
Total		Rs. 6.67	Rs. 10

Labour charges = Rs. 6.67 per piece

Shop overheads = Rs. 10 per piece

Administrative overheads = 2 × 2.8 = Rs. 5.6

Total cost per piece = 82 + 6.67 + 10 + 5.6

= Rs. 104.27

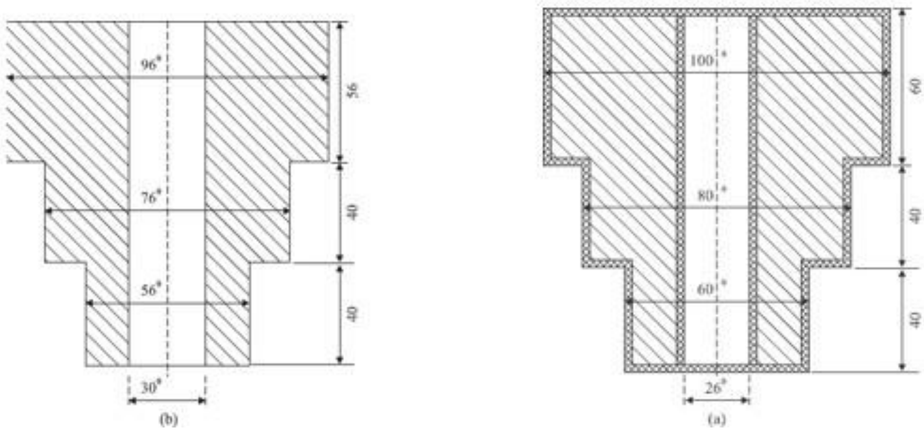
Example 2: A cast iron component is to be manufactured as per Fig. 5.2. Estimate the selling price per piece from the following data:

Density of material = 7.2 gms/cc
Cost of molten metal at cupola spout = Rs. 20 per kg
Process scrap = 20 percent of net weight
Scrap return value = Rs. 6 per kg
Administrative overheads = Rs. 30 per hour
Sales overheads = 20 percent of factory cost
Profit = 20 percent of factory cost
Other expenditures are:

Operation	*Time (min)*	*Labour cost/hr (Rs.)*	*Shop overheads/hr (Rs.)*
Moulding and pouring	15	20	60
Shot blasting	5	10	40
Fettling	6	10	40

The component shown is obtained after machining the casting. The pattern which costs
Rs. 5,000 can produce 1,000 pieces before being scrapped. The machining allowance is to be taken as 2 mm on each side.

Solution: Fig. 5.2 (*b*) shows the component in finished condition. Fig. 5.2 (*a*) has been drawn by adding the machining allowance of 2 mm on each side.



(i) Material cost:

Net volume of cast component $= \frac{\pi}{4}(10^2 \times 6 + 8^2 \times 4 + 6^2 \times 4 - 2.62^2 \times 14)$

$= 711$ cc

Net weight of cast component = 711 × 7.2 = 5117 gm
= 5.117 kg
Process scrap = 20 percent of 5.117 kg
= 0.2 × 5.117 = 1.02 kg
Total metal required per component = 5.12 + 1.02 = 6.14 kg
Cost of metal poured = 6.14 × 20 = Rs. 122.8
Process return value = 1.02 × 6 = Rs. 6.12
Material cost per component = 122.8 – 6.1 = Rs. 116.7

(ii) Labour cost and factory overheads:

Labour cost = Rs. 6.83
Shop overheads = Rs. 22.33

Process	*Time per piece (Minutes)*	*Labour cost per piece (Rs.)*	*Shop overheads per piece (Rs.)*
Melting and pouring	15	5.00	15.00
Shot blast	5	0.83	3.33
Fettling	6	1.00	4.00
Total	**26 min**	**6.83**	**22.33**

(iii) Factory cost per component = 116.70 + 6.83 + 22.33 = Rs. 145.86

(*iv*)Administrative overheads $= \frac{30 \times 26}{60}$
= Rs. 13
(*v*)Sales overheads = 0.2 × 145.86 = Rs. 29.17
(*vi*) Profit = 0.2 × 145.86 = Rs. 29.17
Selling price per component = Factory cost + Administrative overheads
+ Sales overheads + profit
= 145.86 + 13 + 29.17 + 29.17
= Rs. 217.2

UNIT IV

PRODUCTION COST ESTIMATION

Content 3:

COST ESTIMATION IN WELDING SHOP

A lap welded joint is to be made as shown in Fig.

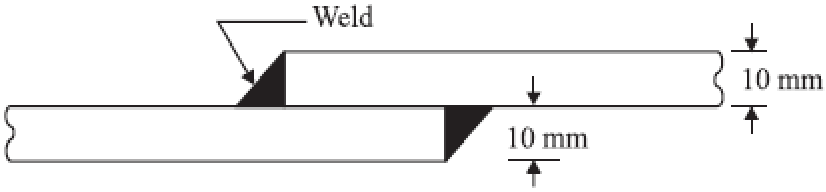


Fig. 5.4. Lap joint

Estimate the cost of weld from the following data:

Thickness of plate	= 10 mm
Electrode diameter	= 6 mm
Minimum arc voltage	= 30 Volts
Current used	= 250 Amperes
Welding speed	= 10 meters/hour
Electrode used per meter of weld	= 0.350 kg
Labour rate	= Rs. 40 per hour
Power rate	= Rs. 3 per kWh
Electrode rate	= Rs. 8.00 per kg
Efficiency of welding m/c	= 50 percent
Connecting ratio	= 0.4
Overhead charges	= 80 percent of direct charges
Labour accomplishment facto r	= 60 percent

Solution :

Time per meter run of weld = $\frac{1}{10}$ hrs = 6 minutes.

Cost of power consumed per meter run of weld = $\frac{30 \times 250}{1,000} \times \frac{6}{60} \times \frac{1}{0.5} \times \frac{1}{0.4} \times$

= Rs. 11.25

Cost of labour per meter of weld length

$$= \frac{\text{Cost of labour per hour}}{\text{Welding speed in m/hr}} + \frac{1}{\text{Labour accomplishment factor}}$$

$$\text{Cost of labour} = \frac{4}{10} \times \frac{100}{60}$$

= Rs. 6.66/meter of weld length

Cost of electrodes per meter of weld = 0.350 × 8
= Rs. 2.80

Total direct cost per meter of weld = Rs. 11.25 + 6.66 + 2.80
= Rs. 20.71

Overhead charges per meter of weld = Rs. $\frac{20.71 \times 80}{100}$

= Rs. 16.60

Total charges for welding one meter length of joint = Rs. 20.71 + 16.60
= Rs. 37.31

As this is a double fillet weld, lap joint length of weld = 1.5 × 2 = 3 meters

Total charges of making the welded joint = Rs. 37.31 × 3
= Rs. 112

Example 2: Calculate the welding cost from the following data:

Plate thickness	= 12 mm
Form of joint	= 60°V
Root gap	= 2 mm
Length of joint	= 2 meters
Electrode diameters	= 3.5 mm and 4.0 mm
Electrode length	= 350 mm
Electrodes required per meter weld For 100 per cent efficiency and 50 mm stub length	= 10 nos. of 3.5 mm dia and 24 nos. of 4 mm dia
Average deposition	= 80 percent
Melting time per electrode	= 1.3 minutes for 3.5 mm dia 1.50 minutes for 4 mm dia electrode
Connecting ratio	= 2
Hourly welding rate	= Rs. 40
Overhead charges	= 40 percent of welding cost.

Solution:

(*i*) No. of 3.5 mm dia electrodes required per meter length of weld with 100 percent deposition efficiency and 50 mm stub length = 10 nos.

Electrodes required for 2 meter length of weld with 80 percent deposition efficiency and 50 mm stub length

$$= \frac{2 \times 10 \times 100}{80}$$

= 25 nos.

(*ii*) No. of 4 mm dia electrodes required for 2 meter weld length with 80 percent deposition efficiency and 50 mm stub length

$$= \frac{2 \times 24 \times 100}{80}$$

= 60 nos.

(iii) Time required melting 25 electrodes of 3.5 mm dia and 60 electrodes of 4 mm dia and with connecting ratio of 2

$= 2 \times (25 \times 1.3 + 1.5 \times 60)$

= 245 minutes

(*iv*) Welding cost @ Rs. 40 per hour

$$= \frac{245}{60} \times 40$$

= Rs. 163

Overhead charges = 40 percent of direct charges

$= \text{Rs. } 163 \times 0.4$

= Rs. 65

Total cost of welding = 163 + 65

= Rs. 228

Example2 : Work out the welding cost for a cylindrical boiler drum $2\frac{1}{2}$ m×1m diameter which is to be made from 15 mm thick m.s plates. Both the ends are closed by arc welding of circular plates to the drum. Cylindrical portion is welded along the longitudinal seam and welding is done both in inner and outer sides. Assume the following data:

(i) Rate of welding = 2 meters per hour on inner side and 2.5 meters per hour on outer side

(iii) Cost of electrode =Rs. 0.60 per meter
(iv) Power consumption =4 kWh/meter of weld
(v) Power charges =Rs. 3/kWh
(vi) Labour charges =Rs. 40/hour
(vii) Other overheads =200 percent of prime cost
(viii) Discarded electrodes =5 percent
(ix) Fatigue and setting up time =6 percent of welding time.

Solution:

Diameter of drum = 1 meter
Length of drum = 2.5 meter

As the cylindrical portion is welded on both sides and both the ends are closed by welding circular plates, the welding on circular plates being on one side only.

Length of weld = 2 × p × dia of drum + (2 × length of drum)
= 2 × p × 1 + (2 × 2.5)
= 11.28 meters (11.3 meters.)

***(i)* To calculate direct material cost:** In this example the cost of electrodes is the direct materiel cost.

Length of electrode required = 1.5 m/m of weld
Net electrode length required for 11.3 meters weld length = 1.5 × 11.3
= 16.95 meters

Discarded electrode = 5 percent

Total length of electrodes required = $16.95 + \frac{5 \times 16.95}{100}$

= 17.8 meters

Cost of electrodes = 0.6 × 17.8
= Rs. 10.68.

(*ii*) To calculate direct labour cost :

To calculate the labour charges, first we have to calculate the time required for making the weld (assuming that side plates have single side welding and longitudinal seam is welded on both sides).

Length of weld on inside of drum = 2.5 meter
Length of weld on outside of drum = 2 × p × 1 + (2.5)
= 8.8 meters

Time taken for inside weld = $\frac{2.5 \times 1}{2}$

= 1.25 hrs

Time taken for outside weld $= \frac{8.8 \times 1}{2.5}$

$= 3.5$ hrs

Net time required for welding $= 1.25 + 3.5$

$= 4.75$ hrs

Fatigue and setting up allowances $= 4.75 \times 0.06$

$= 0.28$ hrs

Total time required $= 4.75 + 0.28$

$= 5$ hrs

Direct labour cost $= 40 \times 5$

= Rs. 200

ii) To calculate cost of power consumed

Power consumption $= 4 \times 11.3$

$= 45.2$ kWh

Cost of power consumed $= 45.2 \times 3$

= Rs. 135.6

v) To calculate the overhead charges:

Prime cost = Direct material cost + Direct labour cost + Direct other expenses

Prime cost

$= 10.68 + 200 + 135.60$

= Rs. 346

Overheads $= \frac{200}{100} \times 346$

= Rs. 692

(v) Total cost of making boiler drum $= 10.68 + 200 + 135.6 + 692$

= Rs. 1038

Example 3: A container open on one side of size 0.5 m × 0.5 m × 1 m is to befabricated from 6
mm thick plates Fig. 5.5. The plate metal weighs 8 gm/cc. If the joints are to bewelded, make calculations for the cost of container.
The relevant data is:

Cost of plate =Rs. 10 per kg
Sheet metal scarp (wastage) =5 percent of material
Cost of labour =10 percent of
sheet metal costCost of welding material =Rs. 20 per
meter of weld.

Solution:

(*i*) To calculate material cost:

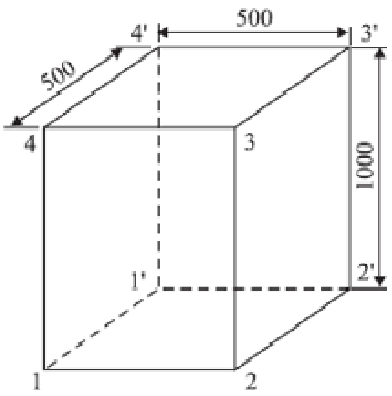


Fig. 5.5. Welded water tank

Net volume of material used = (4 × 50 × 100 × 0.6) + (50 × 50 × 0.6)
= 13,500 cc

Net weight of container = Volume × density of material
= 13,500 × 8
= 1,08,000 gm
= 108 kgs

Sheet metal scrap = 5 percent of net weight

$= \frac{108 \times 05}{100}$

= 5.40 kg

Total weight of sheet metal required for fabrication of one container
= 108 + 5.4
= 113.4 kg

Cost of sheet metal per container = 113.4 × 10
= Rs. 1134

(*ii*) To calculate labour charges:

Cost of labour = 10 percent of sheet metal cost

$= \frac{10}{100} \times 1134$

= Rs. 113

(iii) To calculate cost of welding material:

Length to be welded = (4 × 50) + (4 × 100)
= 600 cm = 6 meters

Cost of welding material = 6 × 20
= Rs. 120

(iv)Cost of container = Cost of sheet metal material + Cost of labour
+ Cost of welding material
= 1134 + 113 + 120
= Rs. 1367

Example 4: Calculate the cost of welding two pieces of mild steel sheets 1 meter long and 7 mm thick. A 60° V is prepared by means of gas cutting before welding is to the commenced. The cost of Oxygen is Rs. 7/cu meter and of acetylene is Rs. 4/cu meter. The filler metal costs Rs. 20 per kg. The following data is also available:

For gas cutting (For 10 mm thick plate)

Cutting speed =20 m/hr
Consumption of Oxygen =2 cu meter/hr
Consumption of acetylene =0.2 cu meter/hr

Data for Rightward Welding (For 7 mm thick plate)

Consumption of Oxygen =0.8 cu meter/hr
Consumption of acetylene =0.8 cu meter/hr
Dia of filler rod used =3.5 mm
Filler rod used per meter of weld =3.4 meters
Rate of welding =3 meters/hr
Density of filler metal =8 gm/cc

Solution: Cost of V preparation:

Time taken to cut two plates of one meter length each for edge preparation 2 × 1

$= \frac{2\times1}{20} = 0.1$ hr

Consumption of oxygen for cutting = 2 × 0.1
= 0.2 cu meters

Cost of oxygen for cutting = 0.2 × 7
= Rs. 1.4

Consumption of acetylene for cutting = 0.2 × 0.1
= 0.02 cu meter

Cost of acetylene for cutting = 4 × 0.02
= Re. 0.08

Total cost of gases for cutting = 1.40 + 0.08
= Rs. 1.48

Cost of welding

(i) Cost of filler rod :

Length of weld = 1 meter
Length of filler rod used = 3.4 × 1== 3.4 meters = 340 cms

Weight of filler rod used = $= \frac{\pi}{4}\left(\frac{3.5}{10}\right)^2 \times 340 \times 8$

= 261.8 gms = 0.262 kgs

Cost of filler rod used = 0.262 × 20
= Rs. 5.24

(*ii*) Cost of gases:

Time taken for welding $= \frac{1}{3} \times 1 = \frac{1}{3}$ hr

Volume of oxygen consumed for welding $= \frac{1}{3} \times 0.8 = 0.26$ cu meter

Cost of oxygen consumed for welding = 0.26 × 7 = Rs. 1.82

Volume of acetylene consumed for welding $= \frac{1}{3} \times 0.8 = 0.26$ cu meters

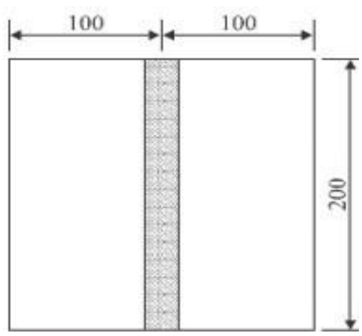
Cost of acetylene consumed for welding = 0.26 × 4 = Rs. 1.04
Cost of gases for welding = 1.82 + 1.04 = Rs. 2.86
Total cost of making the weld = 1.48 + 5.24 + 2.86
= Rs. 9.58

Example 5 : Calculate the cost of welding two plates 200 mm × 100 mm × 8 mm thick to obtain a piece 200 mm × 200 mm × 8 mm approximately using rightward welding technique Fig. 5.6. The following data is available:

Cost of filler material =Rs. 60 per kg
Cost of oxygen =Rs. 700 per 100 cu meters
Cost of acetylene =Rs. 700 per 100 cu meters
Consumption of oxygen =0.70 cu m/hr
Consumption of acetylene =0.70 cu m/hr
Diameter of filler rod =4 mm
Density of filler material =7.2 gms/cc
Filler rod used per meter of weld =340 cm
Speed of welding =2.4 meter/hr

Labour is paid Rs. 20 per hour and overheads may be taken as 100 percent of labour cost.

Solution:



Total length of weld = 200 mm

Filler rod used = $\frac{200}{1000} \times 340$
= 68 cm

Volume of filler rod used = X-sectional area of rod × length of rod π
$= \frac{\pi}{4} (0.4)^2 \times 68$

= 8.5 cm^3
Weight of filler rod = 8.5 × 7.2 = 61.2 gms
60
Cost of filler material $= 61.2 \times \frac{60}{1000}$
= Rs. 3.67

Time to weld 200 mm length = $\frac{200}{1,000 \times 2.4}$
= 0.08 hrs

Oxygen consumed = 0.08 × 0.7 = 0.056 cu m
Acetylene consumed = 0.08 × 0.7 = 0.056 cu m

700
Cost of oxygen consumed $= 0.056 \times \frac{700}{100}$
= Rs. 0.40

Cost of acetylene consumed $= 0.056 \times \frac{700}{100}$
= Rs. 0.40

Labour cost

Time to weld = 0.08 hours

Add 80 percent of time to weld for edge preparation, finishing and handling time.

Total labour time = 0.08 × 1.8 hrs
= 0.144 hrs
Labour cost = 0.144 × 20 = Rs. 3
Overheads = 100 percent of labour cost
= Rs. 3
Cost of making the joint = 3.67 + 0.40 + 0.40 + 3.00 + 3.00
= Rs. 10.50

UNIT IV

PRODUCTION COST ESTIMATION

Content 4:

COST ESTIMATION IN FORGING SHOP

Example 1: Calculate the net weight and gross weight for the component shown in Fig. 5.7.
Density of material used is 7.86 gm/cc. Also calculate:

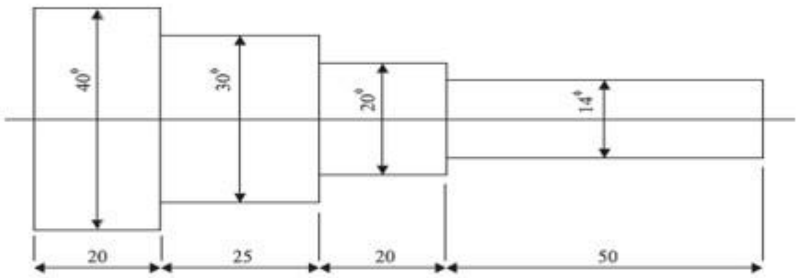


Fig. 5.7

(i) Length of 14 mm dia bar required to forge one component.
(ii) Cost of forging/piece if:

Material cost = Rs. 80 per kg
Labour cost = Rs. 5 per piece
Overheads = 150 percent of labour cost.

Solution:

Net volume of forged component = $\{\frac{\pi}{4} \times 4^2 \times 2 + 3^2 \times 2.5 + 2^2 \times 2 + 1.4^2 \times 5\}$

= 56.76 cc

Net weight = 56.76 × 7.86 = 446 gms

Losses:

Shear loss = 5 percent of net weight

$= \frac{5}{100} \times 446$

= 22.30 gm

Scale loss = 6 percent of net weight

$= \frac{6}{100} \times 446$

= 26.76 gm

Taking flash width = 20 mm

Flash thickness = 3 mm

Flash loss = (periphery of parting line) × 2 × 0.3 × 7.86

$= [2 (2 + 2.5 + 2 + 5) + 1.4 + (2 – 1.4) + (3 – 2) + (4 – 3) + 4] \times 2 \times 0.3 \times 7.86$

$= 31.0 \times 2 \times 0.3 \times 7.86 = 146$ gm

Tonghold loss = 2 × Area of cross-section of bar × 7.86

$= 2 \times \frac{\pi}{4} \times 1.4^2 \times 7.86$

$= 24.22$ gm

Sprue loss = 7 percent of net weight

$= \frac{7}{100} \times 446$

$= 31.22$ gms

Total material loss = 22.3 + 26.8 + 146 + 24.22 + 31.22

= 250 gms

Gross weight = Net weight + Losses

= 446 + 250 = 696 gm

(*i*) New length of 14 mm f bar required per piece

$= \frac{\text{Volume of forging}}{\text{Area of X – Section of bar}} = \frac{56.76}{\frac{\pi}{4} \times 1.4^2} = 36.86 \text{ cm}$

Direct material cost $= \frac{696}{1000} \times 8$

= Rs. 5.57

Direct labour cost = Rs. 5 per piece

Overheads = 150 percent f labour cost

= 1.5 × 5 = Rs. 7.5

Cost per piece = 5.57 + 5 + 7.5

= Rs. 18

Example 2: 150 components, as shown in Fig. are to be made by upsetting an f20 mm bar.

Calculate the net weight, gross weight and length of f 20 mm bar required. Thedensity of material may be taken as 7.86 gm/cc.

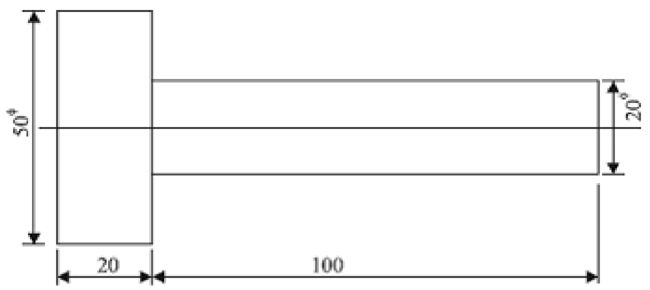


Fig. 5.8

Solution:

Net volume of material $= \frac{\pi}{4}\{5^2 \times 2 + 2^2 \times 10\}$

$= 70.72$ cm3

Net weight per component = 70.72 × 7.86 = 556 gms

Net weight for 150 components = 556 × 150 = 83,400 gms

= 83.4 kg

Losses :

Shear loss = 5 percent of net weight

$= \frac{5}{100} \times 556$

= 27.8 gm

Scale loss = 6% of net weight

$= \frac{6}{100} \times 556$

= 33.4 gm

Gross weight/component = 556 + 27.8 + 33.4

= 617 gm

Gross weight for 150 components = 617 × 150 = 92,550 gm

= 92.550 kg

Length of 20 mm f bar required $= \frac{92550}{\frac{\pi}{4} \times 2^2 \times 7.86}$

= 3744 cm = 37.44 meters.