

A book for Civil Engineers

Hi, I am a civil engineer and content creator passionate about helping engineers learn practical construction skills. After working on multiple projects and managing site teams, I realized that many engineers struggle to connect **theory with real site work** — especially in areas like estimation, billing, and quantity surveying.

To bridge this gap, I started creating **easy-to-understand ebooks, Excel tools, and video tutorials** that teach civil engineers how to work confidently on-site using real project examples.

WELCOME AND ROCK IN YOUR CAREER

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My mission is simple:

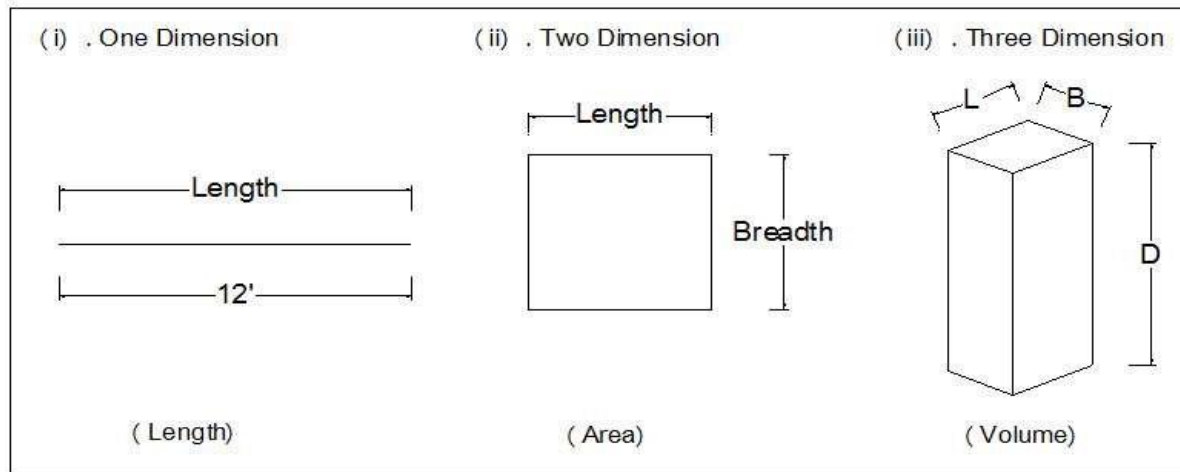
☞ To make every civil engineer *industry-ready* with real, practical knowledge — not just theory.

If you're serious about learning quantity surveying, estimation, or billing — this ebook is the best place to start your journey.



UNIT CONVERSION

- (i). One dimension calculation = length calculation
- (ii). Two dimension calculation = area calculation
- (iii). Three dimension calculation = volume calculation



Types of units :-

1. M.K.S Units (Metre-Kilogram/Sec) : Metres, Centimetres & Millimetres (Scales used).

These units are practically called as Engineering Unit.

2. F.P.S Units (Foot-Pound/Sec) : Feets, Inches and Yards (scales used).

These units are practically called as Architectural Unit.

S.no.	Scale	One-Dimension	Two-Dimension	Three-Dimension
		Length	Area	Volume
1	Metre	M	m x m = m ² / square metre	m x m x m = m ³ / cum
2	Centimeter	CM	cm x cm = cm ² / sq. centimetre	cm x cm x cm = cm ³ / cucm
3	Millimeter	MM	mm x mm = mm ² /sq. millimetre	mm x mm x mm = mm ³ /cumm
4	Feet	FT	Ft x Ft = Ft ² / square feet	Ft x Ft x Ft = Ft ³ /cft
5	Inch	INCH	inch x inch = inch ² / square inch	inch x inchx inch = inch ³ /cuinch
6	Yard	YD	Yd x Yd = Yd ² / square yard	Yd x Yd x Yd = Yd ³ /cuyd

Scales :-

1 metre = 1000mm

1 metre = 100cm

1 cm = 10mm

1 metre = 1.0936 yd

1 metre = 3.28 Ft

1 yd = 36"

1 yd = 3'

1 yd² = 9 Ft²

1 Acre = 4840 yd²

1 Hectare = 2.47 Acre

1 Feet = 12"

1 inch = 2.54cm

1 inch = 25.4mm

1 metre = 39.37"

S.no	One-Dimension	Two-Dimension	Three-Dimension
	Length	Area	Volume
1	6m = ? Mm	6m ² = ? Mm ²	6m ³ = ? Mm ³
	Since 1m = 1000mm	Since 1m = 1000mm	Since 1m = 1000mm
	6 x 1000 = 6000mm	6 x 1000 ² = 6000000mm ²	6 x 1000 ³ = 6000000000mm ³
2	25m = ? Cm	25m ² = ? Cm ²	25m ³ = ? Cm ³
	Since 1m = 100cm	Since 1m = 100cm	Since 1m = 100cm
	25 x 100 = 2500cm	25 x 100 ² = 250000cm ²	25 x 100 ³ = 25000000cm ³
3	60m = ? Yd	60m ² = ? Yd ²	60m ³ = ? Yd ³
	Since 1m = 1.0936yd	Since 1m = 1.0936yd	Since 1m = 1.0936yd
	60 x 1.0936 = 65.616yd	60 x 1.0936 ² = 71.757yd ²	60 x 1.0936 ³ = 78.474yd ³
4	0.20m = ? Ft	0.20m ² = ? Ft ²	0.20m ³ = ? Ft ³
	Since 1m = 3.28Ft	Since 1m = 3.28Ft	Since 1m = 3.28Ft
	0.20 x 3.28 = 0.656Ft	0.20 x 3.28 ² = 2.151Ft ²	0.20 x 3.28 ³ = 7.057Ft ³
5	55m = ? Inch	55m ² = ? Inch ²	55m ³ = ? Inch ³
	Since 1m = 39.37"	Since 1m = 39.37"	Since 1m = 39.37"
	55 x 39.37 = 2165.35"	55 x 39.37 ² = 85249.829 ² "	55 x 39.37 ³ = 3356285.787 ³ "
6	9000mm = ? M	9000mm ² = ? M ²	9000mm ³ = ? M ³
	Since 1m = 1000mm	Since 1m = 1000mm	Since 1m = 1000mm
	9000/1000 = 9.0m	9000/1000 ² = 0.009m ²	9000/1000 ³ = 9.0x10 ⁻⁶ m ³
7	2500mm = ? Cm	2500mm ² = ? Cm ²	2500mm ³ = ? Cm ³
	Since 1 cm = 10mm	Since 1 cm = 10mm	Since 1 cm = 10mm
	2500/10 = 250cm	2500/10 ² = 25cm ²	2500/10 ³ = 2.5cm ³
8	600mm = ? Inch	600mm ² = ? Inch ²	600mm ³ = ? Inch ³
	Since 1" = 25.4mm	Since 1" = 25.4mm	Since 1" = 25.4mm
	600/25.4 = 23.622"	600/25.4 ² = 0.93 ² "	600/25.4 ³ = 0.0366 ³ "
9	2800mm = ? Ft	2800mm ² = ? Ft ²	2800mm ³ = ? Ft ³
	Since 1" = 25.4mm	Since 1" = 25.4mm	Since 1" = 25.4mm
	2800/25.4 = 110.236"	2800/25.4 ² = 4.34 ² "	2800/25.4 ³ = 0.170 ³ "
	Since 1Ft = 12inch	Since 1Ft = 12inch	Since 1Ft = 12inch

S.no	One-Dimension	Two-Dimension	Three-Dimension
	Length	Area	Volume
	110.236/12 = 9.186 Ft	4.34/12 ² = 0.030 Ft ²	0.170/12 ³ = 9.83x10 ⁻³ Ft ³
10	3500mm = ? Yd	3500mm ² = ? Yd ²	3500mm ³ = ? Yd ³
	Since 1" = 25.4mm	Since 1" = 25.4mm	Since 1" = 25.4mm
	3500/25.4 = 137.795"	3500/25.4 ² = 5.425" ²	3500/25.4 ³ = 0.213" ³
	Since 1yd = 36inch	Since 1yd = 36inch	Since 1yd = 36inch
	137.795/36 = 3.827yd	5.425/36 ² = 4.18x10 ⁻³ yd ²	0.213/36 ³ = 4.57x10 ⁻⁶ yd ³
11	10cm = ? Mm	10cm ² = ? Mm ²	10cm ³ = ? Mm ³
	Since 1cm = 10mm	Since 1cm = 10mm	Since 1cm = 10mm
	10 x 10 = 100mm	10 x 10 ² = 1000mm ²	10 x 10 ³ = 10000mm ³
12	560cm = ? M	560cm ² = ? M ²	560cm ³ = ? M ³
	Since 1m = 100cm	Since 1m = 100cm	Since 1m = 100cm
	560/100 = 5.6m	560/100 ² = 0.056m ²	560/100 ³ = 5.6x10 ⁻⁴ m ³
13	650cm = ? Inch	650cm ² = ? Inch ²	650cm ³ = ? Inch ³
	Since 1inch = 2.54cm	Since 1inch = 2.54cm	Since 1inch = 2.54cm
	650/2.54 = 255.905"	650/2.54 ² = 100.75" ²	650/2.54 ³ = 39.665" ³
14	5206cm = ? Yd	5206cm ² = ? Yd ²	5206cm ³ = ? Yd ³
	Since 1inch = 2.54cm	Since 1inch = 2.54cm	Since 1inch = 2.54cm
	5206/2.54 = 2049.606"	5206/2.54 ² = 806.931" ²	5206/2.54 ³ = 317.689" ³
	Since 1yd = 36inch	Since 1yd = 36inch	Since 1yd = 36inch
	2049.606/36 = 56.933yd	806.931/36 ² = 0.622yd ²	317.689/36 ³ = 6.8x10 ⁻³ yd ³
15	950cm = ? Ft	950cm ² = ? Ft ²	950cm ³ = ? Ft ³
	Since 1" = 2.54cm	Since 1" = 2.54cm	Since 1" = 2.54cm
	950/2.54 = 374.0157"	950/2.54 ² = 147.25" ²	950/2.54 ³ = 57.972" ³
	Since 1Ft = 12"	Since 1Ft = 12"	Since 1Ft = 12"
	374.0157/12 = 31.167Ft	147.25/12 ² = 1.02Ft ²	57.972/12 ³ = 0.0335Ft ³
16	0.25Ft = ? Mm	0.25Ft ² = ? Mm ²	0.25Ft ³ = ? Mm ³
	Since 1ft = 12"	Since 1ft = 12"	Since 1ft = 12"
	0.25 x 12 = 3"	0.25 x 12 ² = 36" ²	0.25 x 12 ³ = 432" ³

S.no	One-Dimension	Two-Dimension	Three-Dimension
	Length	Area	Volume
	Since 1inch = 25.4mm	Since 1inch = 25.4mm	Since 1inch = 25.4mm
	$3 \times 25.4 = 76.2\text{mm}$	$36 \times 25.4^2 = 23225.76\text{mm}^2$	$432 \times 25.4^3 = 7079211.648\text{mm}^3$
17	60Ft = ? cm	60Ft ² = ? cm ²	60Ft ³ = ? cm ³
	Since 1' = 12"	Since 1' = 12"	Since 1' = 12"
	$60 \times 12 = 720"$	$60 \times 12^2 = 8640''^2$	$60 \times 12^3 = 103680''^3$
	Since 1" = 2.54cm	Since 1" = 2.54cm	Since 1" = 2.54cm
	$720 \times 2.54 = 1828.8\text{cm}$	$8640 \times 2.54^2 = 55741.824\text{cm}^2$	$103680 \times 2.54^3 = 1699010.7\text{cm}^3$
18	56Ft = ? Inch	56Ft ² = ? Inch ²	56Ft ³ = ? Inch ³
	Since 1Ft = 12"	Since 1Ft = 12"	Since 1Ft = 12"
	$56 \times 12 = 672"$	$56 \times 12^2 = 8064''^2$	$56 \times 12^3 = 96768''^3$
19	12Ft = ? M	12Ft ² = ? M ²	12Ft ³ = ? M ³
	Since 1m = 3.28ft	Since 1m = 3.28ft	Since 1m = 3.28ft
	$12/3.28 = 3.658\text{m}$	$12/3.28^2 = 1.115\text{m}^2$	$12/3.28^3 = 0.34\text{m}^3$
20	355Ft = ? Yd	355Ft ² = ? Yd ²	355Ft ³ = ? Yd ³
	Since 1yd = 3ft	Since 1yd = 3ft	Since 1yd = 3ft
	$355/3 = 118.333\text{yd}$	$355/3^2 = 39.444\text{yd}^2$	$355/3^3 = 13.148\text{yd}^3$
21	25yd = ? M	25yd ² = ? M ²	25yd ³ = ? M ³
	Since 1m = 1.0936yd	Since 1m = 1.0936yd	Since 1m = 1.0936yd
	$25/1.0936 = 22.860\text{m}$	$25/1.0936^2 = 20.903\text{m}^2$	$25/1.0936^3 = 19.114\text{m}^3$
22	2yd = ? Cm	2yd ² = ? Cm ²	2yd ³ = ? Cm ³
	Since 1yd = 36"	Since 1yd = 36"	Since 1yd = 36"
	$2 \times 36 = 72"$	$2 \times 36^2 = 2592''^2$	$2 \times 36^3 = 93312''^3$
	since 1" = 2.54cm	since 1" = 2.54cm	since 1" = 2.54cm
	$72 \times 2.54 = 182.88\text{cm}$	$2592 \times 2.54^2 = 16722.547\text{cm}^2$	$93312 \times 2.54^3 = 1529109.71\text{cm}^3$
23	5.0 yd = ? Mm	5.0 yd ² = ? Mm ²	5.0 yd ³ = ? Mm ³
	Since 1yd = 36"	Since 1yd = 36"	Since 1yd = 36"
	$5 \times 36 = 180"$	$5 \times 36^2 = 6480''^2$	$5 \times 36^3 = 233280''^3$
	since 1" = 25.4mm	since 1" = 25.4mm	since 1" = 25.4mm

S.no	One-Dimension	Two-Dimension	Three-Dimension
	Length	Area	Volume
	$180 \times 25.4 = 4572\text{mm}$	$6480 \times 25.4^2 = 4180636.8\text{mm}^2$	$23380 \times 25.4^3 = 3822774290\text{mm}^3$
24	$2\text{yd} = ? \text{ Inch}$	$2\text{yd}^2 = ? \text{ Inch}^2$	$2\text{yd}^3 = ? \text{ Inch}^3$
	Since $1\text{yd} = 36"$	Since $1\text{yd} = 36"$	Since $1\text{yd} = 36"$
	$2 \times 36 = 72"$	$2 \times 36^2 = 2592''^2$	$2 \times 36^3 = 93312''^3$
25	$25\text{yd} = ? \text{ Ft}$	$25\text{yd}^2 = ? \text{ Ft}^2$	$25\text{yd}^3 = ? \text{ Ft}^3$
	Since $1\text{yd} = 3\text{ft}$	Since $1\text{yd} = 3\text{ft}$	Since $1\text{yd} = 3\text{ft}$
	$25 \times 3 = 75\text{Ft}$	$25 \times 3^2 = 225\text{Ft}^2$	$25 \times 3^3 = 675\text{Ft}^3$
26	$20" = ? \text{ Mm}$	$20''^2 = ? \text{ Mm}^2$	$20''^3 = ? \text{ Mm}^3$
	Since $1" = 25.4\text{mm}$	Since $1" = 25.4\text{mm}$	Since $1" = 25.4\text{mm}$
	$20 \times 25.4 = 508\text{mm}$	$20 \times 25.4^2 = 12903.2\text{mm}^2$	$20 \times 25.4^3 = 327741.28\text{mm}^3$
27	$15" = ? \text{ Cm}$	$15''^2 = ? \text{ Cm}^2$	$15''^3 = ? \text{ Cm}^3$
	Since $1" = 2.54\text{cm}$	Since $1" = 2.54\text{cm}$	Since $1" = 2.54\text{cm}$
	$15 \times 2.54 = 39.1\text{cm}$	$15 \times 2.54^2 = 96.774\text{cm}^2$	$15 \times 2.54^3 = 245.805\text{cm}^3$
28	$260" = ? \text{ M}$	$260''^2 = ? \text{ M}^2$	$260''^3 = ? \text{ M}^3$
	since $1\text{m} = 39.37"$	since $1\text{m} = 39.37"$	since $1\text{m} = 39.37"$
	$260/39.37 = 6.604\text{m}$	$260/39.37^2 = 0.167\text{m}^2$	$260/39.37^3 = 4.26 \times 10^{-3}\text{m}^3$
29	$20" = ? \text{ Yd}$	$20''^2 = ? \text{ Yd}^2$	$20''^3 = ? \text{ Yd}^3$
	Since $1\text{yd} = 36"$	Since $1\text{yd} = 36"$	Since $1\text{yd} = 36"$
	$20/36 = 0.555\text{yd}$	$20/36^2 = 0.015\text{yd}^2$	$20/36^3 = 4.28 \times 10^{-4}\text{yd}^3$
30	$6" = ? \text{ Ft}$	$6''^2 = ? \text{ Ft}^2$	$6''^3 = ? \text{ Ft}^3$
	Since $1' = 12"$	Since $1' = 12"$	Since $1' = 12"$
	$6/12 = 0.5\text{Ft}$	$6/12^2 = 0.0416\text{Ft}^2$	$6/12^3 = 3.47 \times 10^{-3}\text{Ft}^3$
31	$6'6" = ? \text{ Ft}$		
	Since $1' = 12"$		
	$6/12 = 0.5'$	---	---
	$6' + 0.5' = 6.5'$		

S.no	One-Dimension	Two-Dimension	Three-Dimension
	Length	Area	Volume
32	9'9" = ? Inch		
	Since 1ft = 12"		
	9 x 12 = 108"	---	---
	108" + 9" = 117"		
33	6'5" = ? Cm		
	Since 1' = 12"		
	6 x 12 = 72"		
	72 + 5" = 77"	---	---
	77" = ? Cm		
	Since 1" = 2.54cm		
	77 x 2.54 = 195.58cm		
34	9'1/4" = ? Yd		
	1/4 = 0.25 "		
	9'0.25" = ? Yd		
	Since 1' = 12"	---	---
	9 x 12 = 108"		
	108" + 0.25" = 108.25"		
	108.25" = ? Yd		
	Since 1yd = 36"		
	108.25/36 = 3.006yd		
35	10'3/4" = ? M		
	3/4 = 0.75"		
	10'0.75" = ? M		
	Since 1' = 12"	---	---
	10 x 12 = 120"		
	120" + 0.75" = 120.75"		
	120.75" = ? M		
	Since 1m = 39.37"		
	120.75/39.37 = 3.067m		



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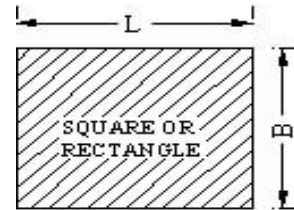
LENGTH AND AREA CALCULATION FORMULAS

Formulas:

1. Square or Rectangle

(i) Area = $A = L \times B$

(ii) Peripheral Length = $L = (L+B) \times 2$

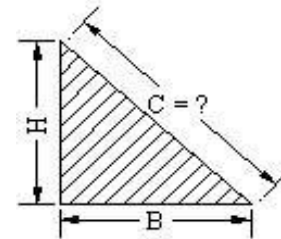


2. Pythagoras theorem

this theorem is used to find out any inclined length

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

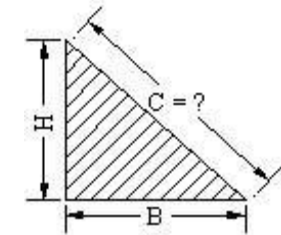
$$c = \sqrt{a^2 + b^2}$$



3. Tri-angle

(i) Area = $A = \frac{1}{2} \times B \times H$

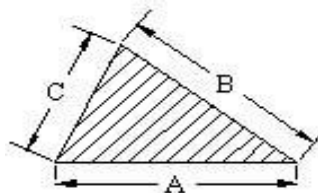
(ii) Peripheral Length = $L = B + H + C$



4. Irregular Tri-angle

(i) Area = $A = \sqrt{s(s-a)(s-b)(s-c)}$
where $s = (a + b + c) / 2$

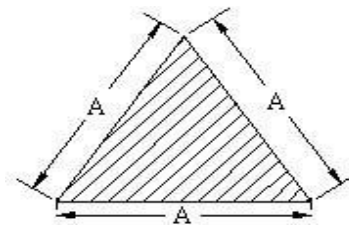
(ii) Peripheral Length = $L = a + b + c$



5. Equilateral Tri-angle

(i) Area = $A = \frac{a^2}{4} \times \sqrt{3}$

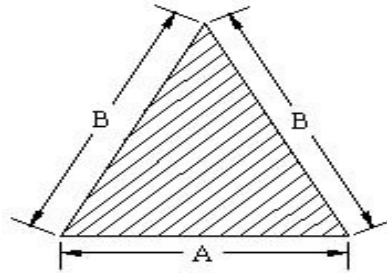
(ii) Peripheral Length = $L = a + a + a = 3a$



6. Isosceles Tri-angle

(i) Area = $A = \frac{a}{4} \times \sqrt{4b^2 - a^2}$

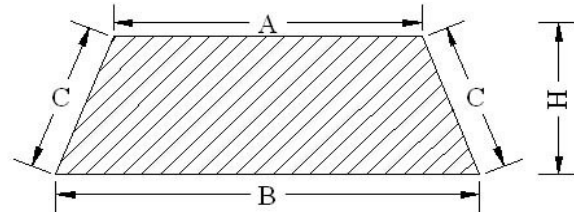
(ii) Peripheral Length = $L = a + b + b = a + 2b$



7. Trapezoidal

(i) Area = $A = \frac{1}{2} (a + b) \times h$

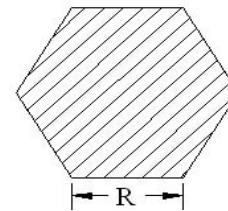
(ii) Peripheral Length = $L = a + b + c + c$



8. Hexagon

(i) Area = $A = (0.5 \times r \times 0.5 \times r \times \tan 60) \times 6$

(ii) Peripheral Length = $L = 6r$



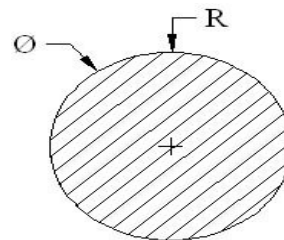
9. Circle

(i) Area = $A = \frac{\pi}{4} \times d^2$

where d = diameter of circle ; $\pi = 3.14$

(ii) Peripheral Length = $L = 2 \times \pi \times r$

where r = radius of circle



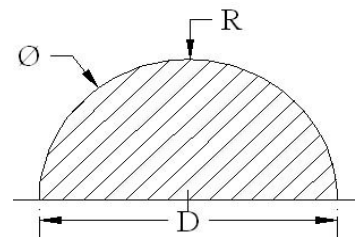
10. Semi-Circle

(i) Area = $A = \frac{\pi}{4} \times d^2 \times 0.50$

where d = diameter of circle ; $\pi = 3.14$

(ii) Peripheral Length = $L = 2 \times \pi \times r \times 0.50$

where r = radius of circle



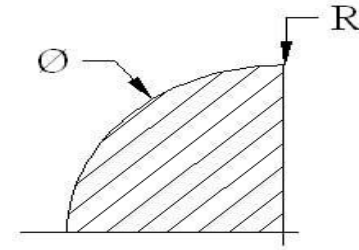
11. Quarter Circle

(i) Area = $A = \pi/4 \times d^2 \times 0.25$

where d = diameter of circle ; $\pi = 3.14$

(ii) Peripheral Length = $L = 2 \times \pi \times r \times 0.25$

where r = radius of circle



12. Segmental Arc

(i) Area = $A = (2/3 \times D \times H) + (H^3/2D)$

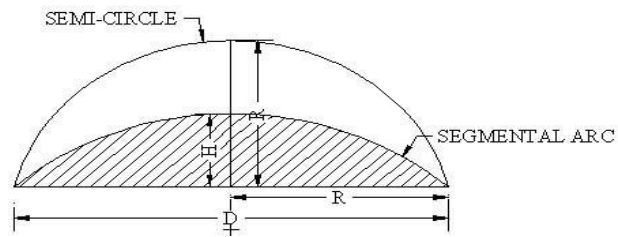
where d = diameter of circle

H = height of arc

(ii) Arc Length = $L = (8b - 2r)/3$

where 'r' = radius of circle

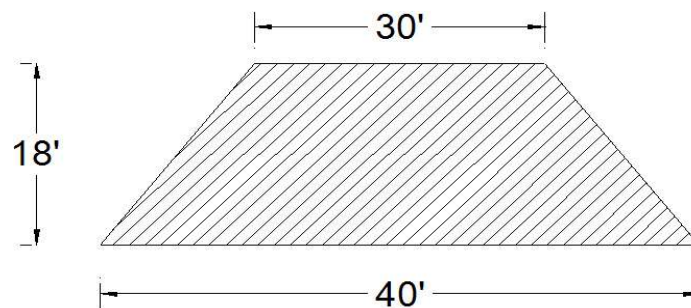
$$b' = \sqrt{r^2 + h^2}$$



PLOT AREA CALCULATION

Problem-1:

find area of plot = ?



Solution: the area of plot can be find out by using

trapezoidal area formula i. e

$$\text{area} = 1/2 \times [a + b] \times h$$

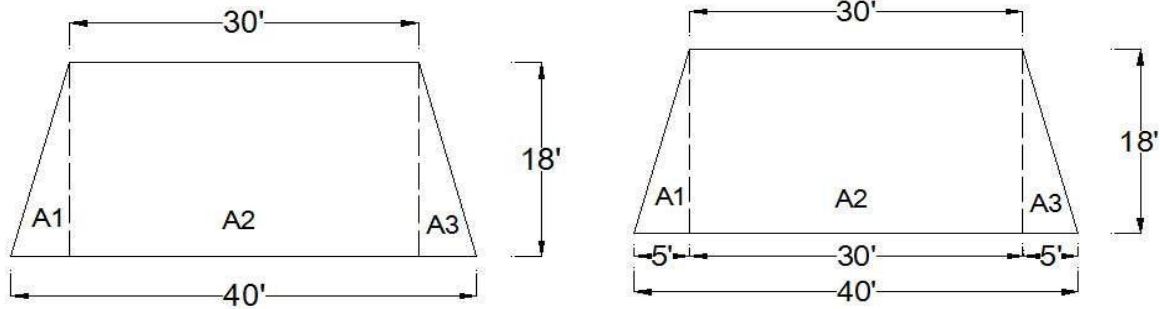
$$\text{area} = 0.5 \times [30 + 40] \times 18$$

$$\text{area} = 630.0 \text{ Ft}^2$$

Method - ii :

Area of plot can be found out by using thumb rule i.e.

dividing area in to parts



$$A1 = \text{Area-1} = 0.5 \times 5 \times 18 \quad . = 45.0 \text{ Ft}^2$$

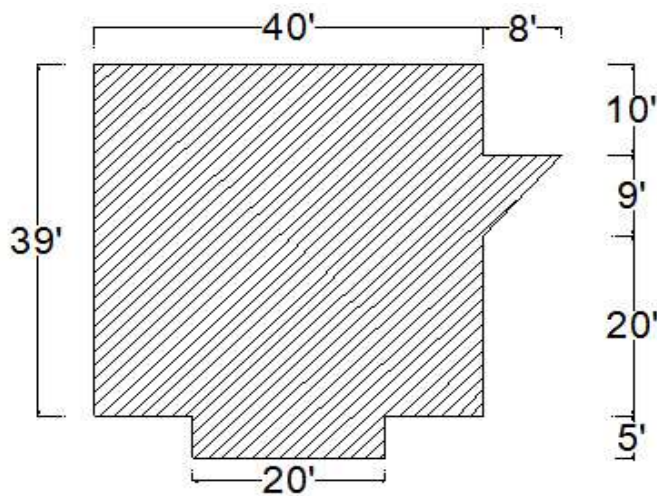
$$A2 = \text{Area-2} = 30 \times 18 \quad . = 540.0 \text{ Ft}^2$$

$$A3 = \text{Area-3} = 0.5 \times 5 \times 18 \quad . = 45.0 \text{ Ft}^2$$

$$\text{total area of plot} \quad . = 630.0 \text{ Ft}^2$$

Problem-2:

find area of plot = ?



PLAN OF PLOT

Solution:

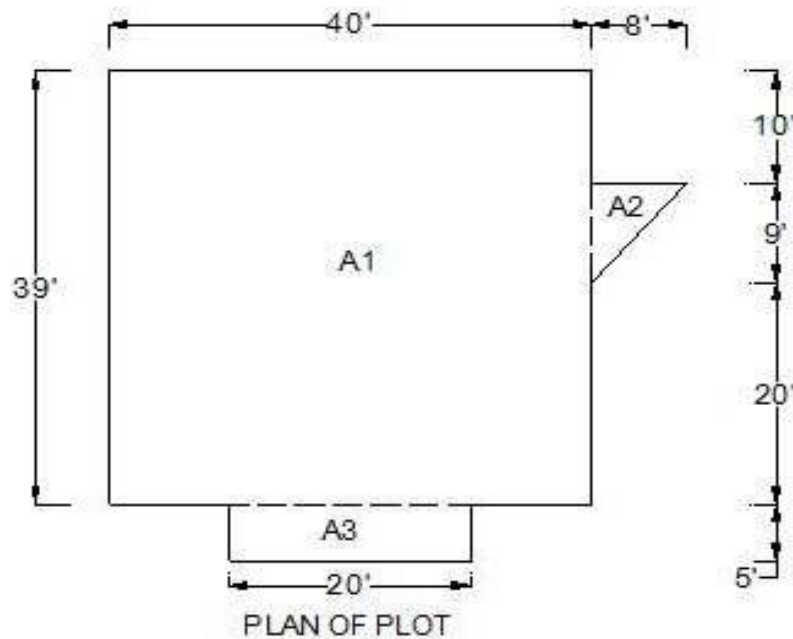
Area of plot can be found out by using thumb rule i.e. dividing area into parts.

$$A1 = \text{Area-1} = 40 \times 39 \quad . = 1560.0 \text{ Ft}^2$$

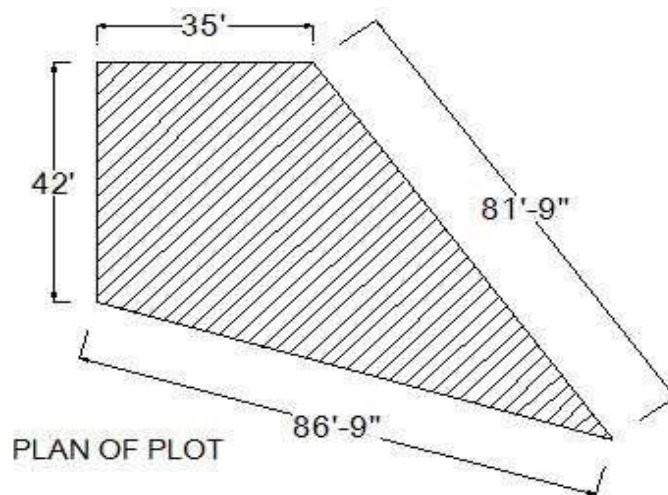
$$A2 = \text{Area-2} = 0.5 \times 8 \times 9 \quad . = 36.0 \text{ Ft}^2$$

$$A3 = \text{Area-3} = 20 \times 5 \quad . = 100.0 \text{ Ft}^2$$

$$\text{total area of plot} \quad . = 1696.0 \text{ Ft}^2$$

**Problem-3:**

find area of plot = ?

**Solution:** Area of plot can be found out by using thumb rule i.e. dividing area in to parts

$$A1 = \text{Area-1} = 0.5 \times 35 \times 42 = 735.0 \text{ Ft}^2$$

By pythagorous theorem

$$A2 = \text{Area-2} = \sqrt{s(s-A)}(s-B)(s-C)$$

$$C = \sqrt{a^2 + b^2}$$

$$\text{where } s = (a + b + c) / 2$$

$$C = \sqrt{35^2 + 42^2}$$

$$C = 54.671$$

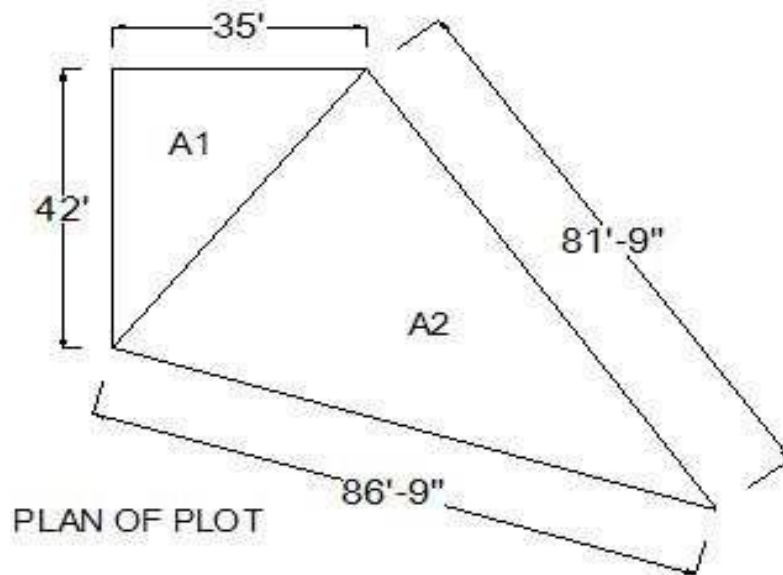
$$S = (86.75 + 81.75 + 54.671) / 2$$

$$S = 111.585$$

$$A2 = \text{Area-2} = \sqrt{111.585(111.585-86.75)(111.585-81.75)(111.585-54.671)}$$

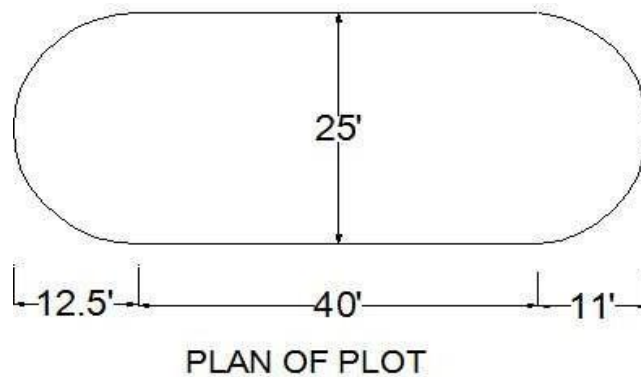
$$A2 = \text{Area-2} = 2169.239 \text{ Ft}^2$$

$$\text{Total area of plot} = A1 + A2 = 2904.239 \text{ Ft}^2$$

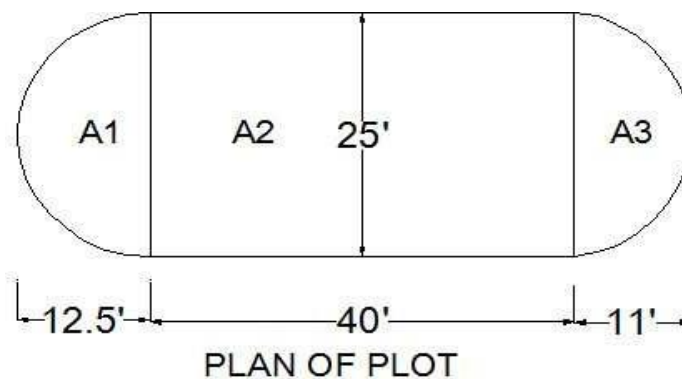


Problem-4 :

find area of plot = ?



Solution: Area of plot can be found out by using thumb rule i.e. dividing area in to parts



Area-1 = A1 = area of semi-circle = $\pi/4 \times d^2 \times 0.50 = \pi/4 \times 25^2 \times 0.50 = 245.436 \text{ Ft}^2$

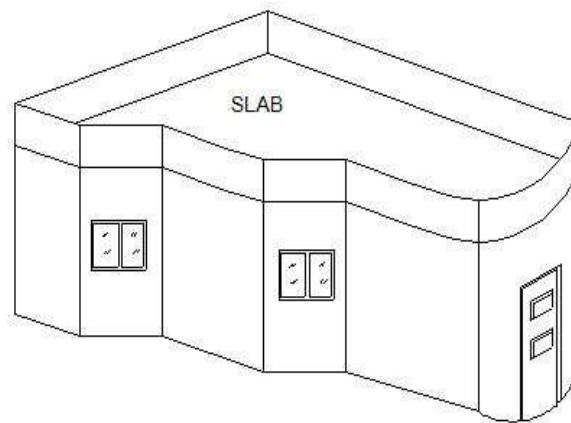
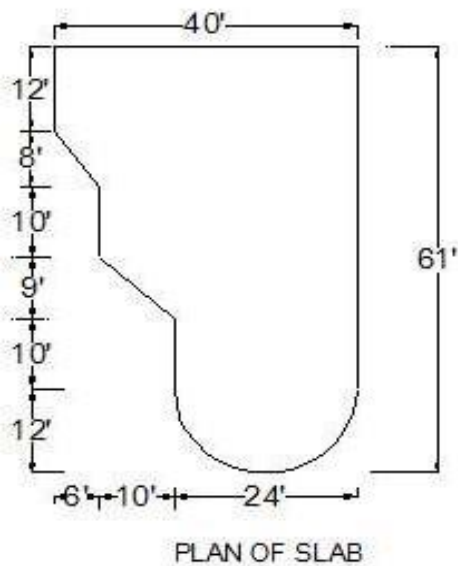
Area-2 = A2 = area of rectangle = $L \times B = 40 \times 25 = 1000 \text{ Ft}^2$

Area-3 = A3 = area of segmental arc = $(2/3 \times D \times H) + (H^3/2D)$
 $\therefore (2/3 \times 25 \times 11) + (11^3 / 2 \times 25)$
 $\therefore 183.333 + 26.62$
 $\therefore 209.953 \text{ Ft}^2$

Total area of plot = $A1 + A2 + A3 = 1455.389 \text{ Ft}^2$

Problem-5:

find area of Slab = ?



Solution: Area of slab can be found out by using thumb rule i.e. dividing area in to parts

Area-1 = A1 = area of rectangle = $L \times B = 40 \times 12 = 480.0 \text{ Ft}^2$

Area-2 = A2 = area of triangle = $0.5 \times L \times B = 0.5 \times 8 \times 6 = 24.0 \text{ Ft}^2$

Area-3 = A3 = area of rectangle = $L \times B = 34 \times 18 = 612.0 \text{ Ft}^2$

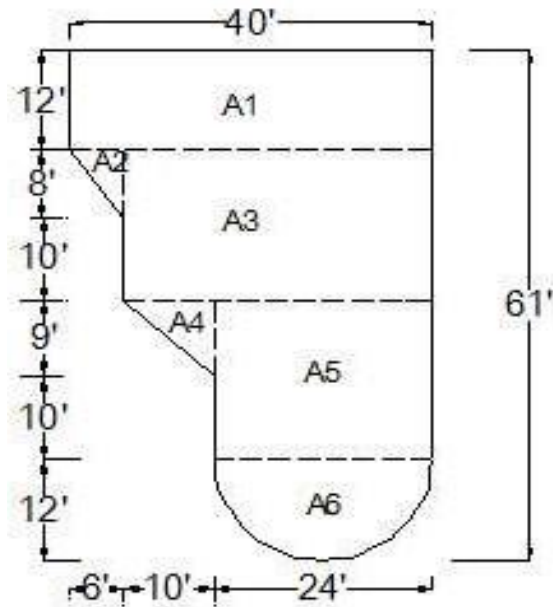
Area-4 = A4 = area of triangle = $0.5 \times L \times B = 0.5 \times 9 \times 10 = 45.0 \text{ Ft}^2$

Area-5 = A5 = area of rectangle = $L \times B = 24 \times 19 = 456.0 \text{ Ft}^2$

Area-6 = A6 = area of semi-circle = $\pi/4 \times d^2 \times 0.50 = \pi/4 \times 24^2 \times 0.50 = 226.194 \text{ Ft}^2$

Total area of Slab = $A1 + A2 + A3 + A4 + A5 + A6$

$\therefore 1843.194 \text{ Ft}^2$



PLAN OF SLAB

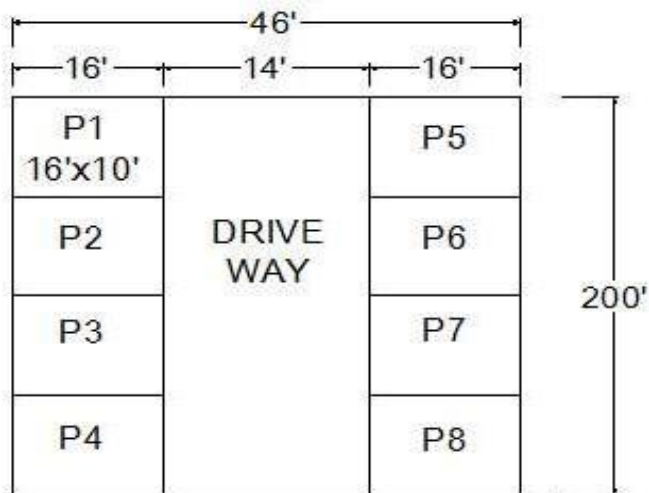
Problem-6:

From the given figure find no. of car-parking space

If size of plot = 46' x 200' and

size of each car park space = 16' x 10'

Size of Drive-way = 14' x 200'



PLAN OF CAR PARKING AREA

Solution :-

1. Plot area = $46' \times 200' = 9200 \text{ Ft}^2$

2. Drive-way area = $14' \times 200' = 2800.0 \text{ Ft}^2$

3. Car-parking space = Plot area - Drive-way area

$\therefore 9200 - 2800$

$\therefore 6400 \text{ Ft}^2$

4. Area of each Car-park space = $16' \times 10' = 160 \text{ Ft}^2$

5. No. of Car-park space to be provided = Car-park space / area of each Car-park space

$\therefore 6400 / 160$

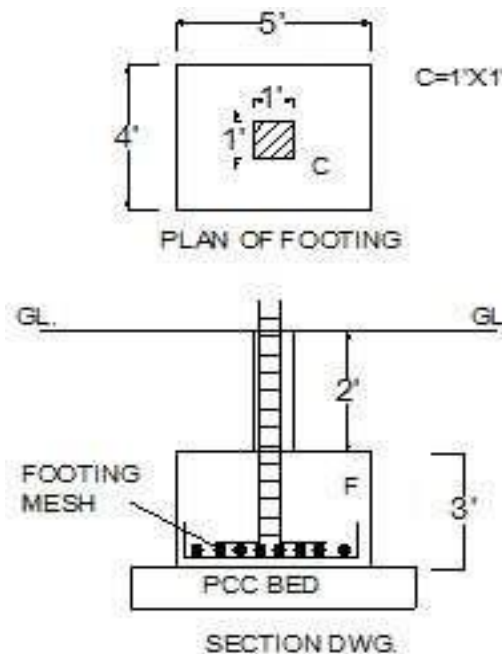
$\therefore 40 \text{ Car-park space can be provided}$

CENTERING AND SHUTTERING AREA CALCULATION

Problem-1:

find area of Centering and Shuttering for footing = ?

If size of footing = $5' \times 4' \times 3'$



Solution:**Note:**

area will be counted for wooden shuttering and as well as for laying footing steel mesh.

Centering and Shuttering area = Side area + Bottom area

. = Peripheral Length x Depth + Bottom area

. = $(L + B) \times 2 \times D + L \times B$

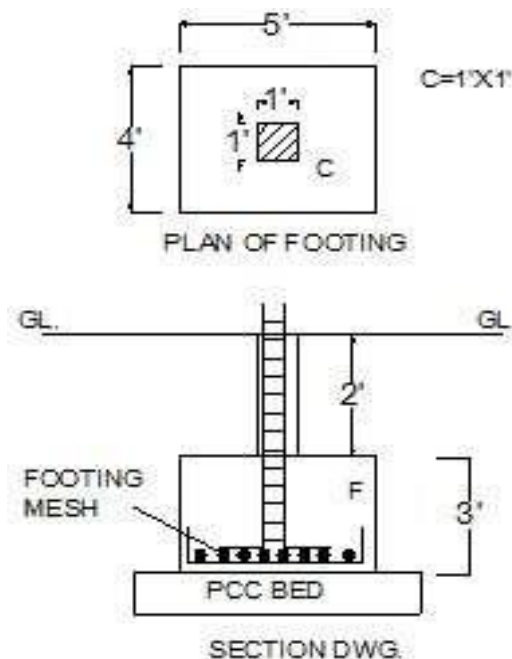
. = $(5 + 4) \times 2 \times 3 + 5 \times 4$

. = 74.0 Ft²

Problem-2:

find area of Centering and Shuttering for Neck Column = ?

If size of neck column = 1' x 1' x 2' and size of footing = 5' x 4' x 3'

**Solution:****Note:**

area will be counted for wooden shuttering and as well as for laying neck column steel.

Depth of Neck column shall be considered up to footing mesh, as steel bars of neck column rests on footing mesh.

Centering and Shuttering area = Side area

. = Peripheral Length x Depth

. = $(L + B) \times 2 \times D$

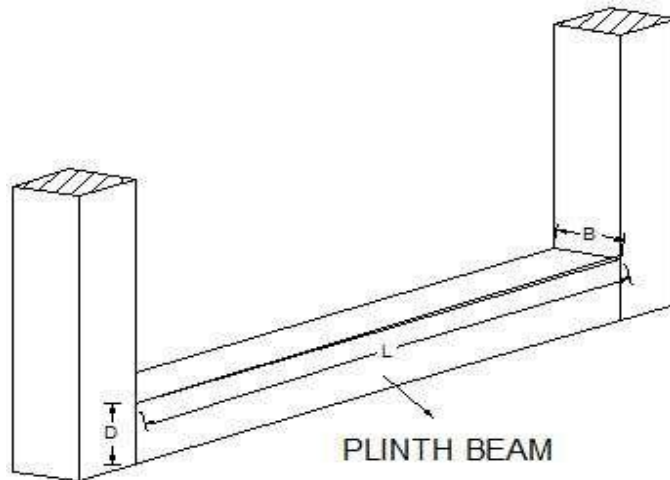
. = $(1 + 1) \times 2 \times 5$

. = 20.0 Ft²

Problem-3:

Find area of Centering and Shuttering for Plinth beam = ?

If size of Plinth beam = 12' x 0.75' x 1'

**Solution:**

Note:

area will be counted for wooden shuttering and as well as for laying Plinth beam steel.

Centering and Shuttering area = Side area + Bottom area

$$.= L \times D \times 2 + L \times B$$

$$.= 12 \times 1 \times 2 + 12 \times 0.75$$

$$.= 33.0 \text{ Ft}^2$$

Problem-4 :-

Find area of Centering and Shuttering for Floor Column = ?

If size of Floor Column = 1' x 1' x 10'

Solution:

Note: area will be counted for wooden shuttering and as well as for tying Floor Column steel. Height of Floor column shall be considered up to Ceiling height.

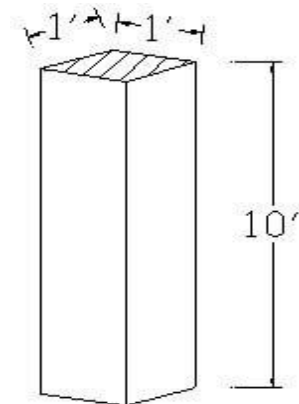
Centering and Shuttering area = Surface area of column

$$.= \text{Peripheral Length} \times \text{Depth}$$

$$.= (L + B) \times 2 \times D$$

$$.= (1 + 1) \times 2 \times 10$$

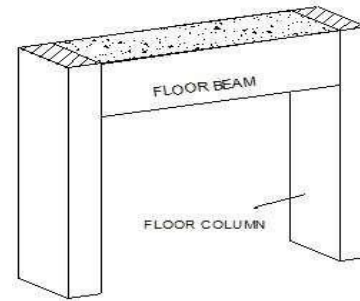
$$.= 40.0 \text{ Ft}^2$$



Problem-5:

Find area of Centering and Shuttering for Floor Beam = ?

If size of Floor beam = 12' x 0.75' x 1'

**Solution:**

Centering and Shuttering area = Side area + Bottom area

$$.= L \times D \times 2 + L \times B$$

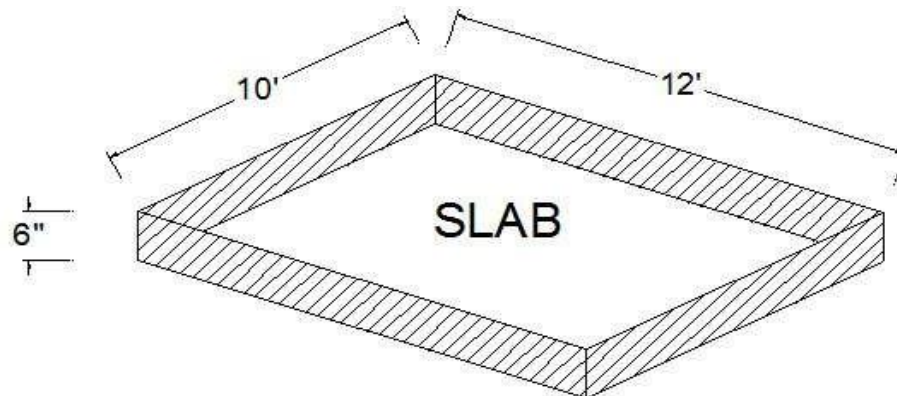
$$.= 12 \times 1 \times 2 + 12 \times 0.75$$

$$.= 33.0 \text{ Ft}^2$$

Problem-6:

Find area of Centering and Shuttering for the given Floor Slab = ?

If size of Floor Slab = 10' x 12' x 0.5'

**Solution:**

Centering and Shuttering area = Side area + Bottom area

$$.= \text{Peripheral Length} \times \text{Depth} + \text{Bottom area}$$

$$.= (L + B) \times 2 \times D + L \times B$$

$$.= (10 + 12) \times 2 \times 0.5 + 10 \times 12$$

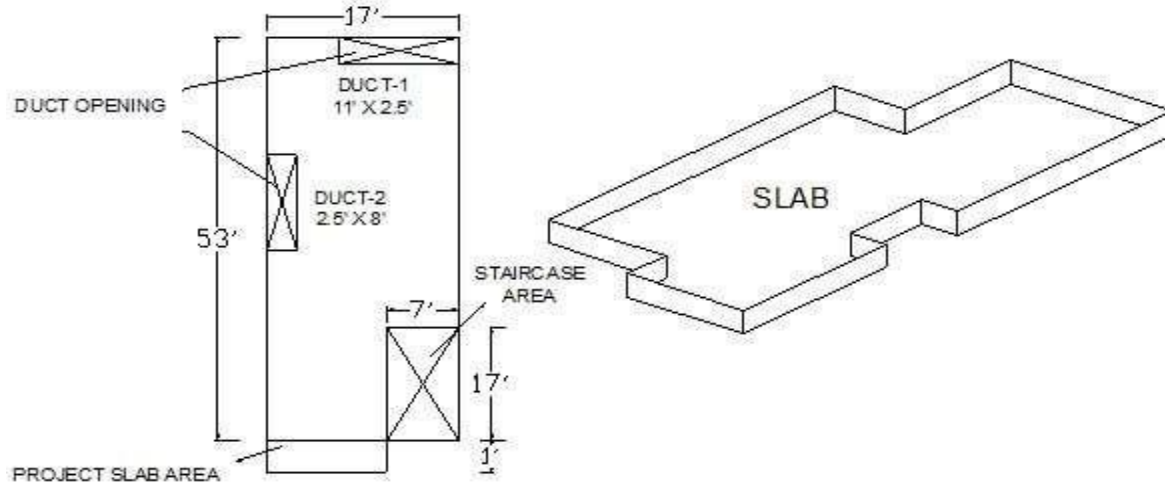
$$.= 142.0 \text{ Ft}^2$$

Problem-7:

Find area of Centering and Shuttering for the given Floor Slab = ?

If size of Floor Slab = 17' x 53' x 0.5' ; size of stair case = 7' x 17'

size of Duct-1 = 11' x 2.5' ; size of Duct-2 = 2.5' x 8'

**Solution:**

$$\begin{aligned}
 \text{Centering and Shuttering area} &= \text{Side area} + \text{Bottom area} \\
 &= \text{Peripheral Length} \times \text{Depth} + \text{Bottom area} \\
 &= 147.0 \times 0.5 + 744.50 \\
 &= 818.0 \text{ Ft}^2
 \end{aligned}$$

(I). Peripheral length of slab = 17 + 53 + 17 + 1 x 2 + 53 + 2.5 x 2 = 147.0 Ft.

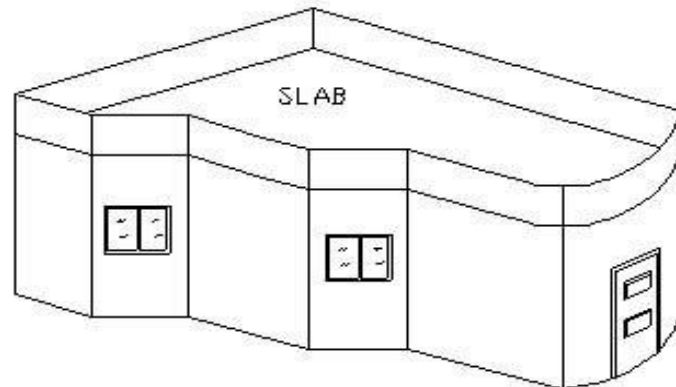
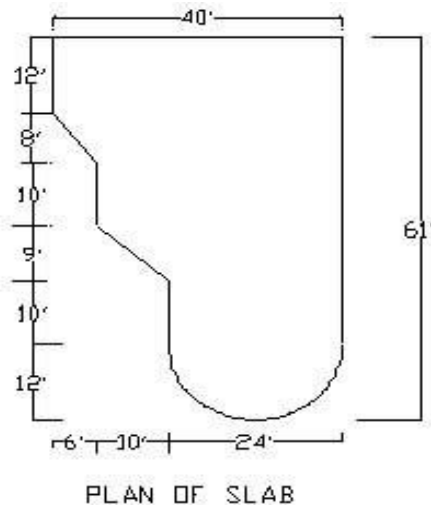
Thickness of slab = 6" = 0.5'

$$\begin{aligned}
 \text{Bottom area of Slab} &= 17 \times 53 + 1 \times 10 \text{ (projected slab area)} = 911.0 \text{ Ft}^2 \\
 \text{Deduction of openings:-} & \quad \text{Duct-1} = 11.0 \times 2.5 = -27.50 \text{ Ft}^2 \\
 & \quad \text{Duct-2} = 2.5 \times 8.0 = -20.0 \text{ Ft}^2 \\
 & \quad \text{Staircase area} = 7 \times 17 = -119.0 \text{ Ft}^2 \\
 \text{Total bottom area of slab after deduction} &= 744.50 \text{ Ft}^2
 \end{aligned}$$

Problem-8:

Find area of Centering and Shuttering for Floor Slab = ?

if thickness of slab = 6" = 0.5'

**Solution:**

Centering and Shuttering area = Side area + Bottom area

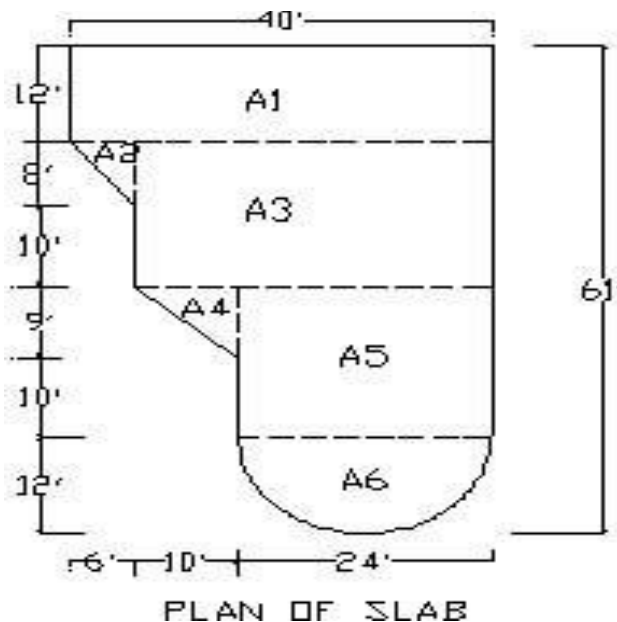
= Peripheral Length x Depth + Bottom area

= 182.152 x 0.5 + 1843.194

= 1934.27 Ft²

(I). Peripheral length of slab = $40 + 49 + 2 \times \pi \times 12 \times 0.50 + 10 + 13.453 + 10 + 10 + 12$
 = 182.152 Ft

Thickness of slab = 6" = 0.5'



Using Pythagoras theorem to find inclined length

$$c = \sqrt{a^2 + b^2}$$

$$c = \sqrt{10^2 + 9^2} = 13.453 \text{ Ft}$$

$$c = \sqrt{6^2 + 8^2} = 10.0 \text{ Ft}$$

Bottom Area of Slab can be found out by using thumb rule i.e. dividing area in to parts

$$\text{Area-1} = A1 = \text{area of rectangle} = L \times B = 40 \times 12 = 480.0 \text{ Ft}^2$$

$$\text{Area-2} = A2 = \text{area of triangle} = 0.5 \times L \times B = 0.5 \times 8 \times 6 = 24.0 \text{ Ft}^2$$

$$\text{Area-3} = A3 = \text{area of rectangle} = L \times B = 34 \times 18 = 612.0 \text{ Ft}^2$$

$$\text{Area-4} = A4 = \text{area of triangle} = 0.5 \times L \times B = 0.5 \times 9 \times 10 = 45.0 \text{ Ft}^2$$

$$\text{Area-5} = A5 = \text{area of rectangle} = L \times B = 24 \times 19 = 456.0 \text{ Ft}^2$$

$$\text{Area-6} = A6 = \text{area of semi-circle} = \pi/4 \times d^2 \times 0.50 = \pi/4 \times 24^2 \times 0.50 = 226.194 \text{ Ft}^2$$

$$\text{Total Bottom area of Slab} = A1 + A2 + A3 + A4 + A5 + A6 = 1843.194 \text{ Ft}^2$$

Problem-9:

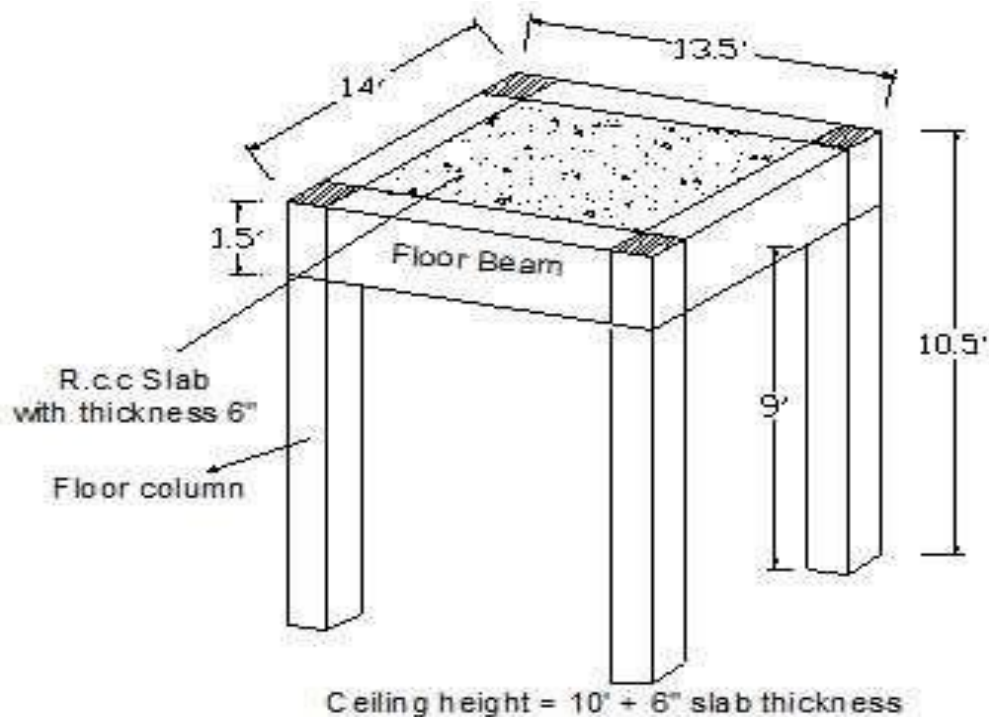
Find Area of Centering and Shuttering for Floor Column, Floor Beam and Floor Slab = ?

if size of column = 12" x 9"

Height of Ceiling = 10' and Slab thickness = 6" = 0.5'

Size of beam along horizontal axis = 12' x 9" x 1'

Size of beam along vertical axis = 12' x 9" x 1'



Solution:

size of slab =

$$L = 13.5' - 9'' - 9'' = 12'$$

$$B = 14' - 1' - 1' = 12'$$

$$D = 6'' = 0.5'$$

therefore beam lengths =

$$L = 13.5' - 9'' - 9'' = 12'$$

$$L = 14' - 1' - 1' = 12'$$

1. Floor Column:

Centering and Shuttering area = Peripheral length x Depth x no. of Columns

$$.= (L + B) \times 2 \times D \times \text{no.s}$$

$$.= (1 + 0.75) \times 2 \times 10 \times 4$$

$$.= 140.0 \text{ Ft}^2$$

Note: while doing shuttering calculation for floor column, height of floor column shall be considered up to ceiling height only. (i.e., given ceiling height = 10')

2. Floor Beam along horizontal axis :

Centering and Shuttering area = (Side area of beam + bottom area of beam)x no. of beams

$$L = 13.5' - 9'' - 9''$$

$$.= (L \times D \times 2 + L \times B) \times \text{no. of beams}$$

$$L = 12'$$

$$.= (12 \times 1 \times 2 + 12 \times 0.75) \times 2 = 66.0 \text{ Ft}^2$$

3. Floor Beam along vertical axis :

Centering and Shuttering area = (Side area of beam + bottom area of beam)x no. of beams

$$L = 14' - 1' - 1'$$

$$.= (L \times D \times 2 + L \times B) \times \text{no. of beams}$$

$$L = 12'$$

$$.= (12 \times 1 \times 2 + 12 \times 0.75) \times 2 = 66.0 \text{ Ft}^2$$

4. Floor Slab :

Centering and Shuttering area = Side area of Slab + Bottom area of Slab

$$.= \text{Peripheral length} \times \text{Depth} + \text{Bottom area of Slab}$$

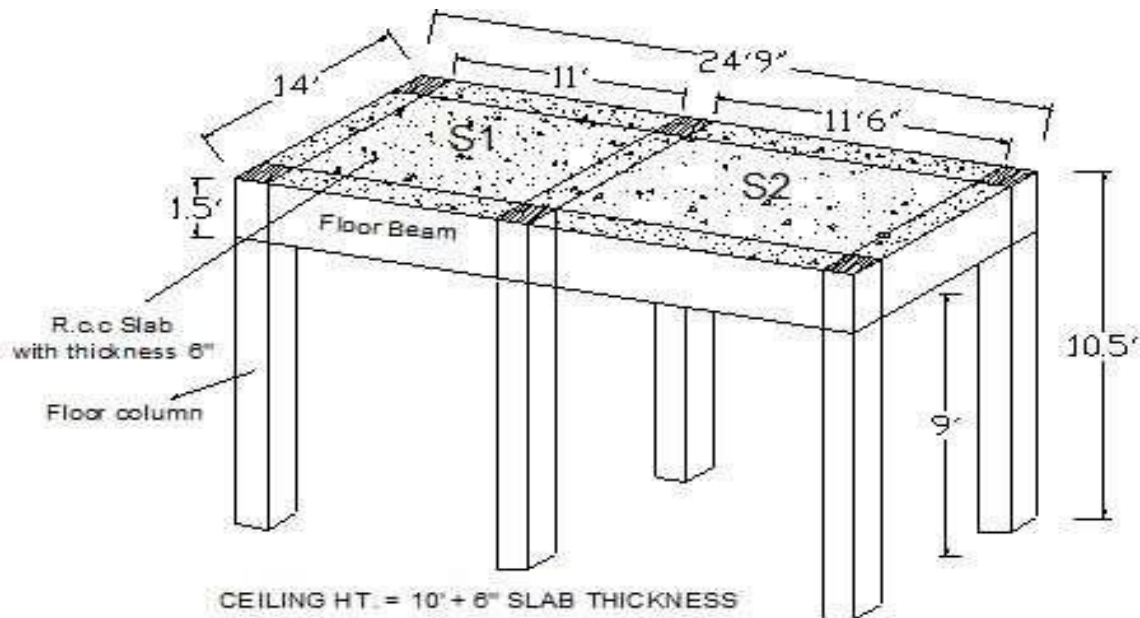
$$.= (L + B) \times 2 \times D + L \times B$$

$$.= (13.5 + 14) \times 2 \times 0.5 + 13.5 \times 14$$

$$.= 216.50 \text{ Ft}^2$$

Problem-10 :

Find Area of Centering and Shuttering for Floor Column, Floor Beam and Floor Slab = ?



If size of column = 12" x 9"

Height of Ceiling = 10' and Slab thickness = 6" = 0.5'

Breadth of beam = 9" ; Depth of Beam = 12"

Solution:**1. Floor Column:**

Centering and Shuttering area = Peripheral length x Depth x no. of Columns

$$.= (L + B) \times 2 \times D \times \text{no.s}$$

$$.= (1 + 0.75) \times 2 \times 10 \times 6$$

$$.= 210.0 \text{ Ft}^2$$

Note: while doing shuttering calculation for floor column, height of floor column shall be considered up to ceiling height only. (i.e., given ceiling height = 10')

2. Floor Beam along horizontal axis :

Centering and Shuttering area = (Side area of beam + bottom area of beam) x no. of beams

$$L = 11' + 11.5' \quad . = (L \times D \times 2 + L \times B) \times \text{no. of beams}$$

$$L = 22.5' \quad . = (22.5 \times 1 \times 2 + 22.5 \times 0.75) \times 2 = 123.75 \text{ Ft}^2$$

3. Floor Beam along vertical axis :

Centering and Shuttering area = (Side area of beam + bottom area of beam) x no. of beams

$$L = 14' - 1' - 1' \quad . = (L \times D \times 2 + L \times B) \times \text{no. of beams}$$

$$L = 12' \quad . = (12 \times 1 \times 2 + 12 \times 0.75) \times 3 = 99.0 \text{ Ft}^2$$

4. Floor Slab :

Centering and Shuttering area = Side area of Slab + Bottom area of Slab

$$. = \text{Peripheral length} \times \text{Depth} + \text{Bottom area of Slab}$$

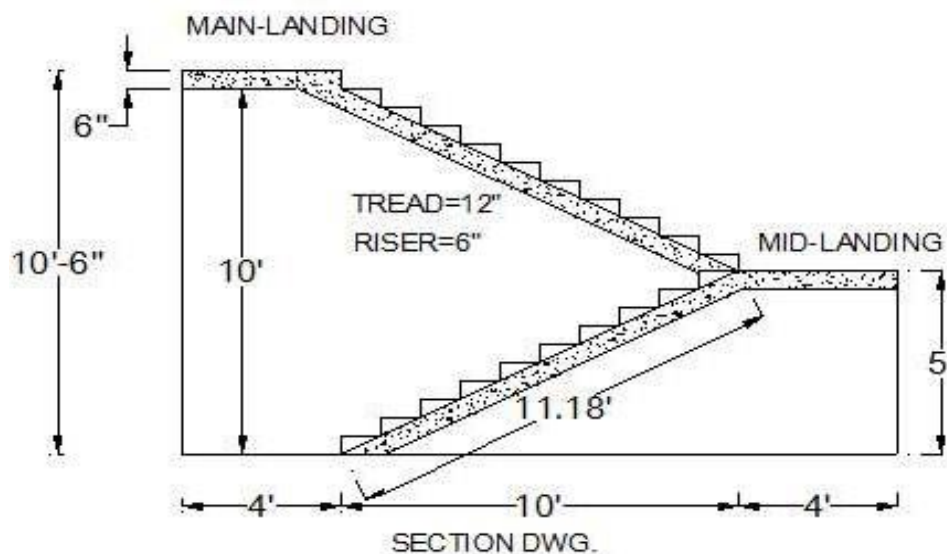
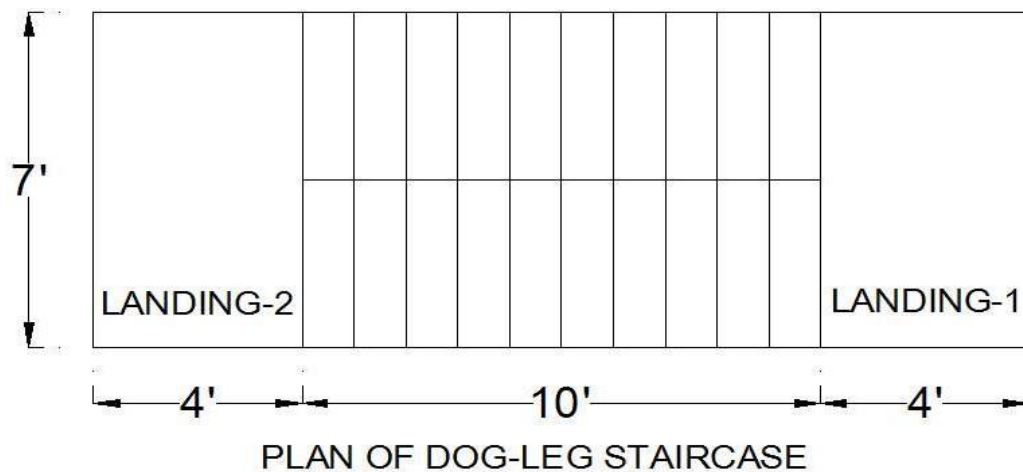
$$. = (L + B) \times 2 \times D + L \times B$$

$$. = (24.75 + 14.0) \times 2 \times 0.5 + 24.75 \times 14.0$$

$$. = 385.25 \text{ Ft}^2$$

Problem-11 :

Find Area of Centering and Shuttering for Stair-case = ?



Solution :**1. Waist Slab : S1 & S2**

Centering and Shuttering area = (Side area of Slab + Bottom area of Slab) x no. of slabs

By Pythagoras theorem $\therefore (L \times D \times 2 + L \times B) \times \text{no. of slabs}$

$c = \sqrt{a^2 + b^2} \therefore (11.18 \times 0.5 \times 2 + 11.18 \times 3.5) \times 2$

$c = \sqrt{10^2 + 5^2} \therefore 100.62 \text{ Ft}^2$

$C = 11.18 \text{ Ft. (Inclined length)}$

2. Steps :

Centering and Shuttering area = (Side area of Step + Front area of Step) x no. of Steps

$\therefore (0.5 \times B \times H \times 2 + L \times D) \times \text{no. of Steps}$

$\therefore (0.5 \times 1 \times 0.5 \times 2 + 3.5 \times 0.5) \times 20$

$\therefore 45.0 \text{ Ft}^2$

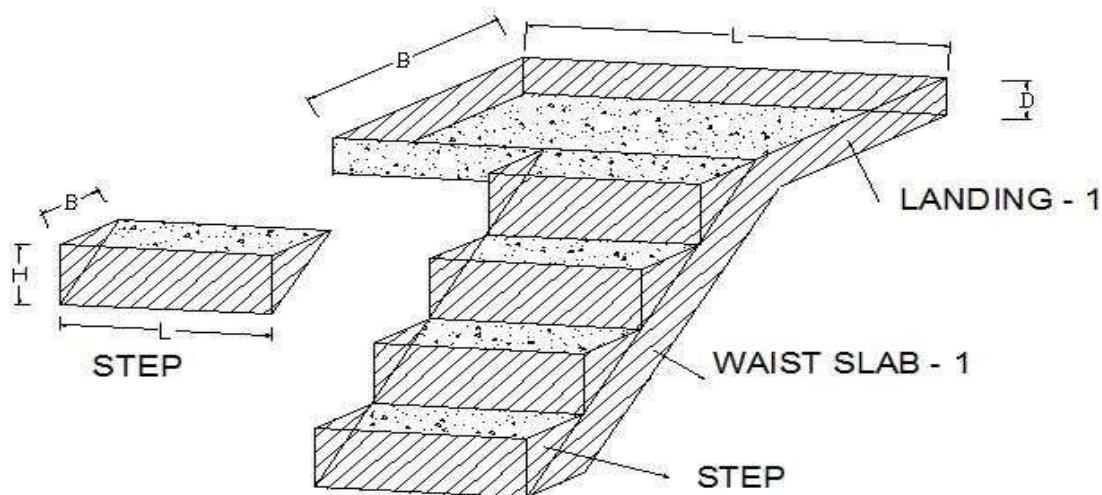
3. Landings : L1 & L2

Centering and Shuttering area = (three Side area of Landing + Bottom area of Landing) x
no. of Landings

$\therefore (B \times D \times 2 + L \times D + L \times B) \times \text{no. of Landings}$

$\therefore (4 \times 0.5 \times 2 + 7 \times 0.5 + 7 \times 4) \times 2$

$\therefore 71.0 \text{ Ft}^2$



VOLUME OF CONCRETE CALCULATION

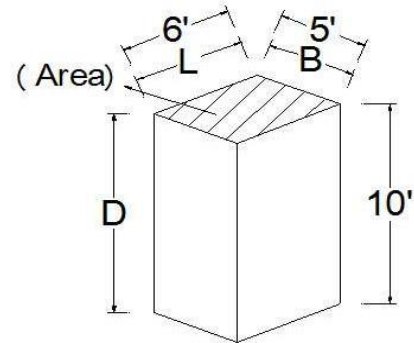
Definition :- Capacity of anything is called as Volume, the unit is Ft^3 or m^3 .

$$\text{Volume} = \text{Area} \times \text{Depth}$$

Problem-1 :- Find Volume of Concrete for a given figure

Solution :-

$$\begin{aligned} \text{Volume} &= \text{Area} \times \text{Depth} \\ &= L \times B \times D \\ &= 6' \times 5' \times 10' \\ &= 300 \text{ Ft}^3 \end{aligned}$$



Problem-2 :- Find Volume of Concrete for a given figure

Solution :-

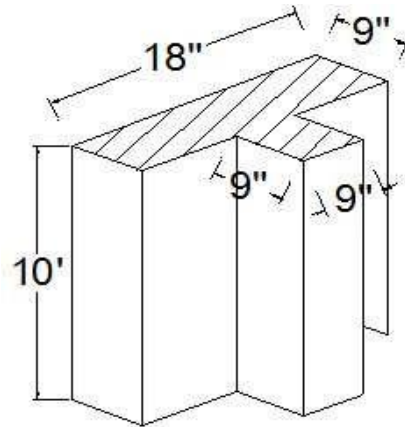
Dividing top area in to two parts to find Area

$$\text{Area-1} = 1.5' \times 0.75' = 1.125 \text{ Ft}^2$$

$$\text{Area-2} = 0.75' \times 0.75' = 0.5625 \text{ Ft}^2$$

$$\text{Total Area} = 1.6875 \text{ Ft}^2$$

$$\begin{aligned} \text{Volume} &= \text{Area} \times \text{Depth} \\ &= 1.6875 \times 10' \\ &= 16.875 \text{ Ft}^3 \end{aligned}$$



Problem-3 :- Find Volume of Concrete for a given figure

Solution :-

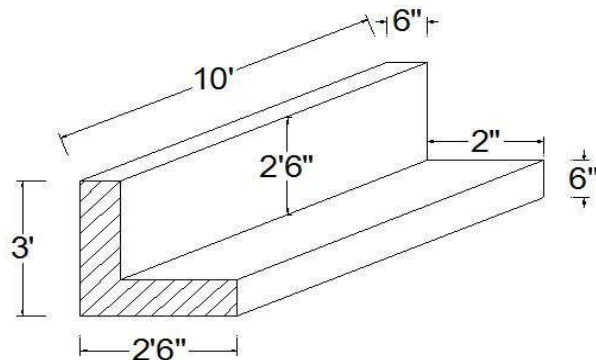
Dividing c/s area in to two parts to find Area

$$\text{Area-1} = 3' \times 0.5' = 1.5 \text{ Ft}^2$$

$$\text{Area-2} = 2' \times 0.5' = 1.0 \text{ Ft}^2$$

$$\text{Total Area} = 2.50 \text{ Ft}^2$$

$$\begin{aligned} \text{Volume} &= \text{C/S Area} \times \text{Length} \\ &= 2.50 \times 10' \\ &= 25.0 \text{ Ft}^3 \end{aligned}$$



Problem-4 :- Find Volume of Concrete for a given figure

Solution :-

Dividing c/s area in to three parts to find Area

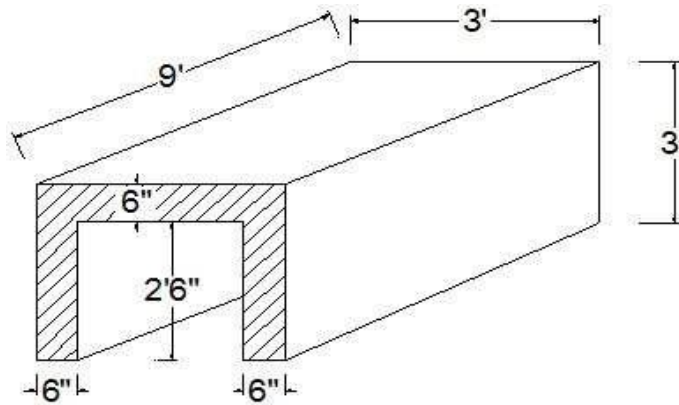
$$\text{Area-1} = 3' \times 0.5' = 1.5 \text{ Ft}^2$$

$$\text{Area-2} = 2.5' \times 0.5' = 1.25 \text{ Ft}^2$$

$$\text{Area-3} = 2.5' \times 0.5' = 1.25 \text{ Ft}^2$$

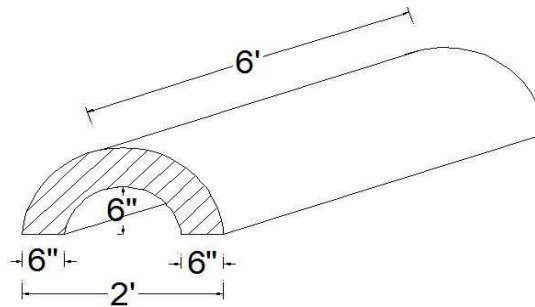
$$\text{Total Area} = 4.0 \text{ Ft}^2$$

$$\begin{aligned} \text{Volume} &= \text{C/S Area} \times \text{Length} \\ &= 4.0 \times 9' \\ &= 36.0 \text{ Ft}^3 \end{aligned}$$



Problem-5 :- Find Volume of Concrete for a given figure

Solution :-



$$\text{Arc Length} = 2 \times \pi \times r \times 0.5$$

$$\text{Inner Arc Length} = 2 \times \pi \times 0.5 \times 0.5 = 1.57 \text{ Ft}$$

$$\text{Outer Arc Length} = 2 \times \pi \times 1.0 \times 0.5 = 3.141 \text{ Ft}$$

$$\text{Average Arc Length} = (1.57 + 3.141)/2 = 2.355 \text{ Ft}$$

Therefore, Length = 6' ; Breadth = 2.355' ; Depth = 0.5'

$$\text{Volume} = L \times B \times D = 6' \times 2.355' \times 0.5' = 7.065 \text{ Ft}^3$$

Problem-6 :- Find Volume of Concrete for a given figure

Solution :-

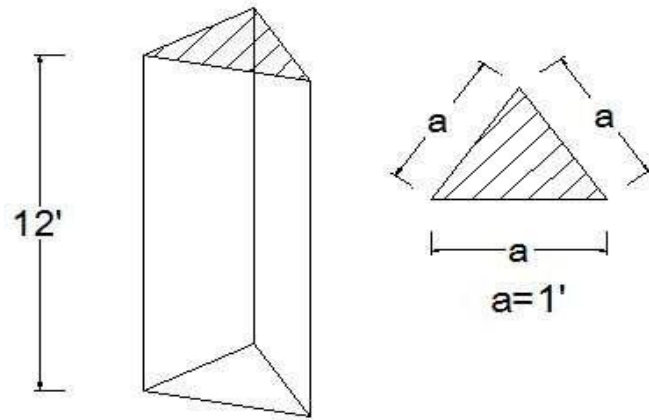
$$\text{Area of Equilateral Triangle} = (a^2/4) \times \sqrt{3}$$

$$\text{Volume} = \text{Area} \times \text{Depth}$$

$$= (a^2/4) \times \sqrt{3} \times D$$

$$= (1^2/4) \times \sqrt{3} \times 12$$

$$= 5.196 \text{ Ft}^3$$



Problem-7 :- Find Volume of Concrete for a given figure

Solution :-

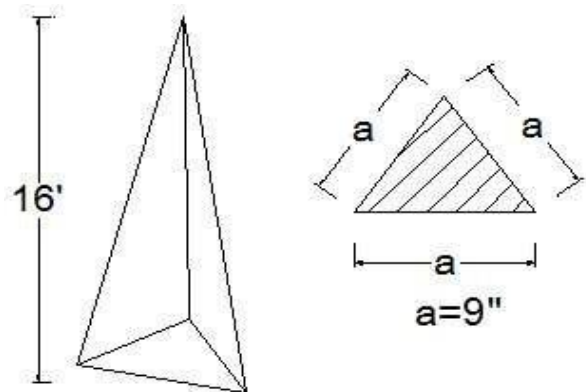
Area of Equilateral Triangle = $(a^2/4) \times \sqrt{3}$

Volume = (Area x Depth) / 3

$$.= ((a^2/4) \times \sqrt{3} \times D) / 3$$

$$.= ((0.75^2/4) \times \sqrt{3} \times 16) / 3$$

$$.= 1.299 \text{ Ft}^3$$



PYRAMID

Problem-8 :- Find Volume of Concrete for a given figure

Solution :-

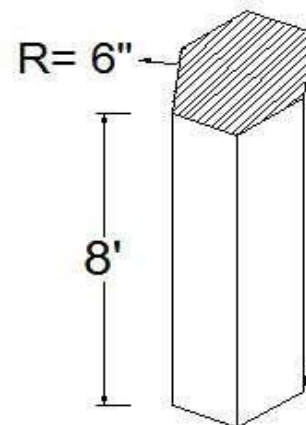
Area of Hexagon = $(0.5 \times R \times 0.5 \times R \times \text{TAN}60) \times 6$

Volume = Area x Depth

$$.= (0.5 \times 0.5' \times 0.5 \times 0.5' \times \text{TAN}60) \times 6 \times D$$

$$.= (0.5 \times 0.5' \times 0.5 \times 0.5' \times \text{TAN}60) \times 6 \times 8'$$

$$.= 5.196 \text{ Ft}^3$$



Problem-9 :- Find Volume of Concrete for a given figure

Solution :-

$$\text{Area of Circle} = (\pi/4) \times d^2$$

$$d1 = 2'$$

$$d2 = 4'$$

$$\text{Average dia} = (d1 + d2) / 2 = (2+4)/2 = 3'$$

$$\text{Volume} = \text{Area} \times \text{Depth}$$

$$.= (\pi/4) \times d^2 \times D$$

$$.= (\pi/4) \times 3^2 \times 6$$

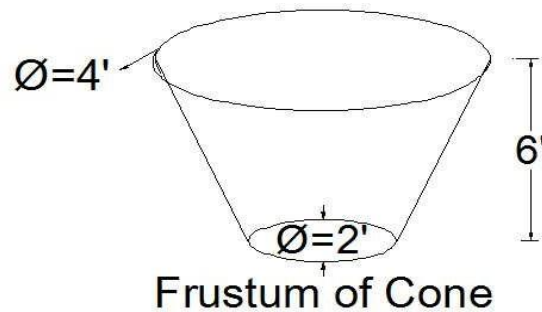
$$.= 42.411 \text{ Ft}^3$$

or

$$\text{Volume} = (\pi \times r^2 \times h)$$

$$.= (\pi \times 1.5^2 \times 6)$$

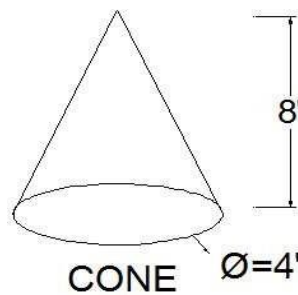
$$.= 42.411 \text{ Ft}^3$$



Problem-10 :- Find Volume of Concrete for a given figure

Solution :-

$$\text{Area of Circle} = (\pi/4) \times d^2$$



$$\text{Volume} = (\text{Area} \times \text{Depth})/3$$

$$.= ((\pi/4) \times d^2 \times D)/3$$

$$.= ((\pi/4) \times 4^2 \times 8)/3$$

$$.= 33.51 \text{ Ft}^3$$

OR

$$\text{Volume} = (\pi \times r^2 \times h)/3$$

$$.= (\pi \times 2^2 \times 8)/3$$

$$.= 33.51 \text{ Ft}^3$$

Problem-11 :- Find Volume of Concrete for a given figure

Solution :-

$$\text{Length of R.C.C wall} = (L + B) \times 2$$

$$\text{External length} = (12' + 10') \times 2 = 44 \text{ Ft}$$

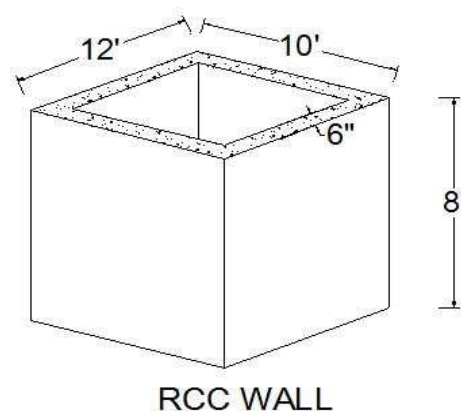
$$\text{Internal length} = (11' + 9') \times 2 = 40 \text{ Ft}$$

$$\text{Average length} = (44 + 40)/2 = 42 \text{ Ft}$$

$$\text{Volume} = L \times B \times D$$

$$.= 42' \times 0.5' \times 8'$$

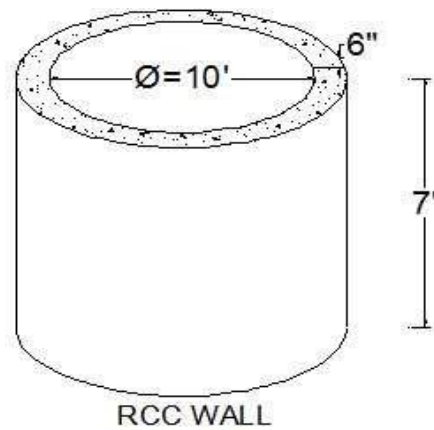
$$.= 168 \text{ Ft}^3$$



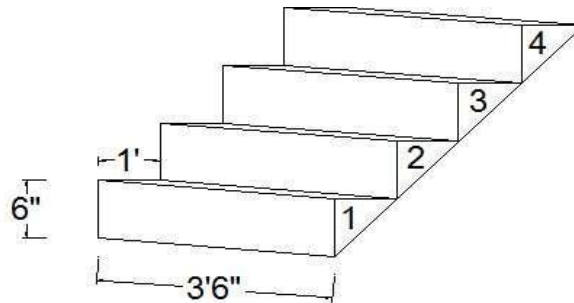
Problem-12 :- Find Volume of Concrete for a given figure

Solution :- length of Circle = $2 \times \pi \times r$
 Length of R.C.C wall = $2 \times \pi \times r$
 Internal length = $2 \times \pi \times 5 = 31.415\text{Ft}$
 External length = $2 \times \pi \times 5.5 = 34.557\text{Ft}$
 Average length = $(31.415 + 34.557)/2 = 32.986\text{Ft}$

Volume = $L \times B \times D$
 $= 32.986' \times 0.5' \times 7'$
 $= 115.451 \text{ Ft}^3$



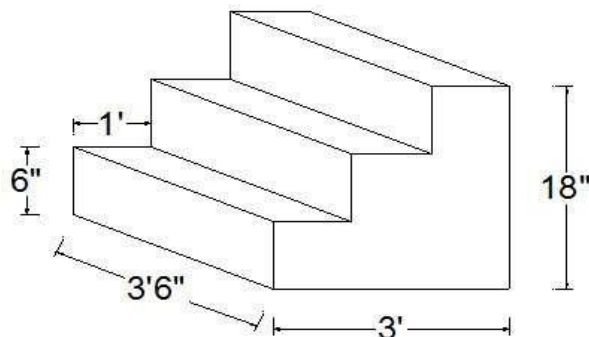
Problem-13 :- Find Volume of Concrete for a given figure



Solution :-

Volume = c/s area x length of step x No. of steps
 $= 0.5 \times B \times H \times L \times \text{No. of steps}$
 $= 0.5 \times 1' \times 0.5' \times 3.5' \times 4$
 $= 3.50\text{Ft}^3$

Problem-14 :- Find Volume of Concrete for a given figure



Solution :-

Dividing c/s area in to three parts to find Volume

Volume of Step = $L \times B \times D$

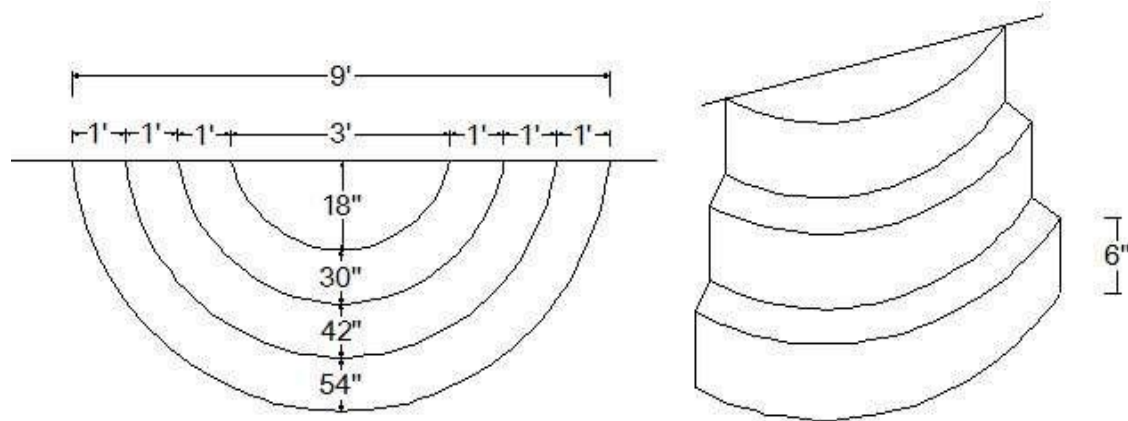
Volume of step-1 = $3.5' \times 1' \times 0.5' = 1.75 \text{ Ft}^3$

Volume of step-2 = $3.5' \times 2' \times 0.5' = 3.50 \text{ Ft}^3$

Volume of step-3 = $3.5' \times 3' \times 0.5' = 5.25 \text{ Ft}^3$

Total Volume = 10.50 Ft^3

Problem-15 :- Find Volume of Concrete for a given figure



Public Stair-case

Solution :-

Volume of Step = Top area $\times$ Depth $\times$ 0.5

$$.= (\pi/4) \times d^2 \times D \times 0.5$$

Volume of Step-1 $.= (\pi/4) \times 3'^2 \times 0.5' \times 0.5 = 1.767 \text{ Ft}^3$

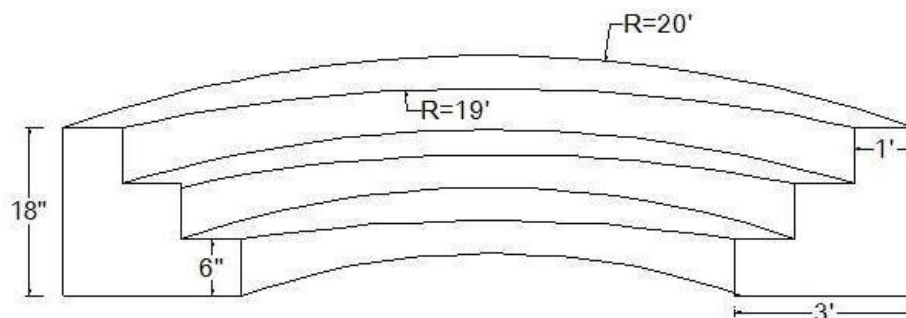
Volume of Step-2 $.= (\pi/4) \times 5'^2 \times 0.5' \times 0.5 = 4.908 \text{ Ft}^3$

Volume of Step-3 $.= (\pi/4) \times 7'^2 \times 0.5' \times 0.5 = 9.621 \text{ Ft}^3$

Volume of Step-4 $.= (\pi/4) \times 9'^2 \times 0.5' \times 0.5 = 15.904 \text{ Ft}^3$

Total volume = 32.20 Ft^3

Problem-16 :- Find Volume of Concrete for a given figure



STAIRCASE IN STADIUM

Solution :- Half-round stair-case

Arc Length of Step = $2 \times \pi \times r \times 0.5$

1. Arc Length of Step-1 = $2 \times \pi \times 19.5' \times 0.5 = 61.261 \text{ Ft}$

For Step-1 External radius = 20'

For Step-1 Internal radius = 19'

Average radius for Step-1 = $(19' + 20')/2 = 19.5'$

2. Arc Length of Step-2 = $2 \times \pi \times 19' \times 0.5 = 59.69 \text{ Ft}$

For Step-2 External radius = 20'

For Step-2 Internal radius = 18'

Average radius for Step-2 = $(18' + 20')/2 = 19'$

3. Arc Length of Step-3 = $2 \times \pi \times 18.5' \times 0.5 = 58.119 \text{ Ft}$

For Step-3 External radius = 20'

Average radius for Step-3 = $(17' + 20')/2 = 18.5'$

For Step-3 Internal radius = 17'

Volume = $L \times B \times D$

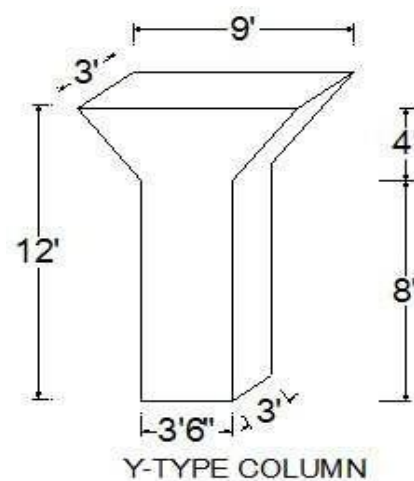
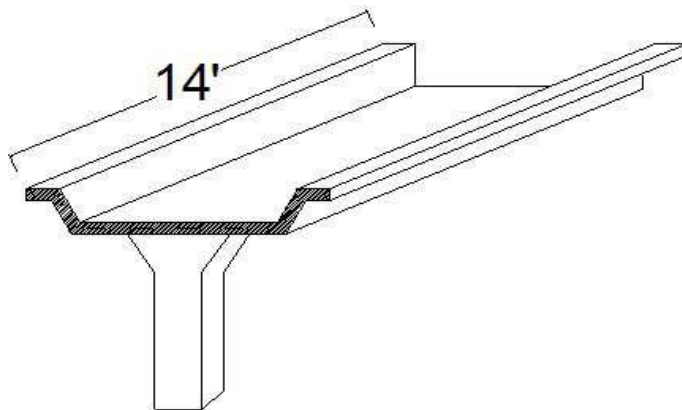
Step-1 = $61.261' \times 1' \times 0.5' = 30.630 \text{ Ft}^3$

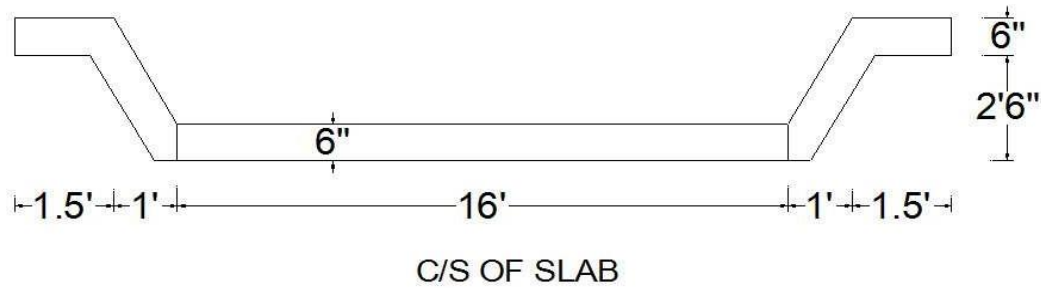
Step-2 = $59.690' \times 2' \times 0.5' = 59.69 \text{ Ft}^3$

Step-3 = $58.119' \times 3' \times 0.5' = 87.178 \text{ Ft}^3$

Total Volume = 177.498 Ft^3

Problem-17 :- Find Volume of Concrete for a given figure



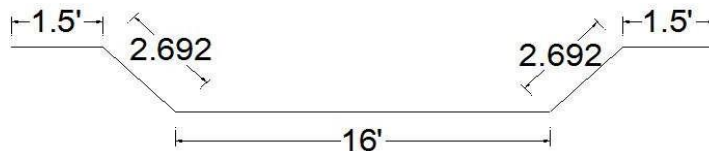
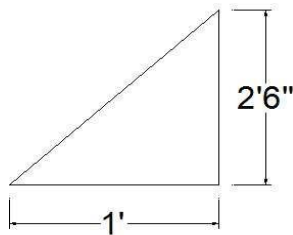


Solution :-

According to pythagoruous theorem ' $c' = \sqrt{a^2 + b^2}$

$$.= 'c' = \sqrt{1^2 + 2.5^2}$$

$$.= 2.692\text{Ft}$$



$$\text{Length} = 1.5' \times 2 + 2.692 \times 2 + 16' = 24.384\text{Ft}$$

$$\text{Breadth} = 14'$$

$$\text{Thickness} = 0.5'$$

$$\text{Volume} = L \times B \times D$$

$$1. \text{ Volume of Concrete for Bridge panel} = 24.384' \times 14' \times 0.5' = 170.688 \text{ Ft}^3$$

$$2. \text{ Volume of Concrete for 'Y' Column} = \text{Front Area of y-column} \times \text{thickness of y-Column}$$

$$.= 53' \times 3' = 159 \text{ Ft}^3$$

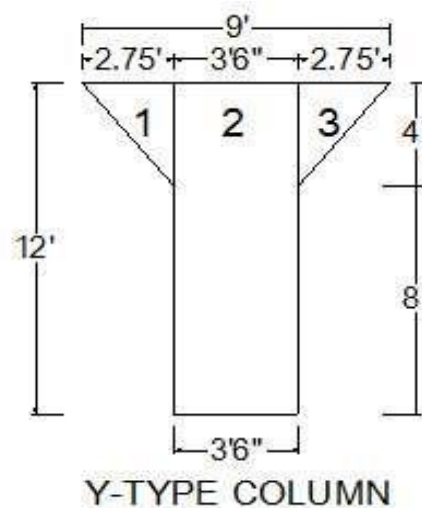
According to thumb rule dividing front area in to three parts

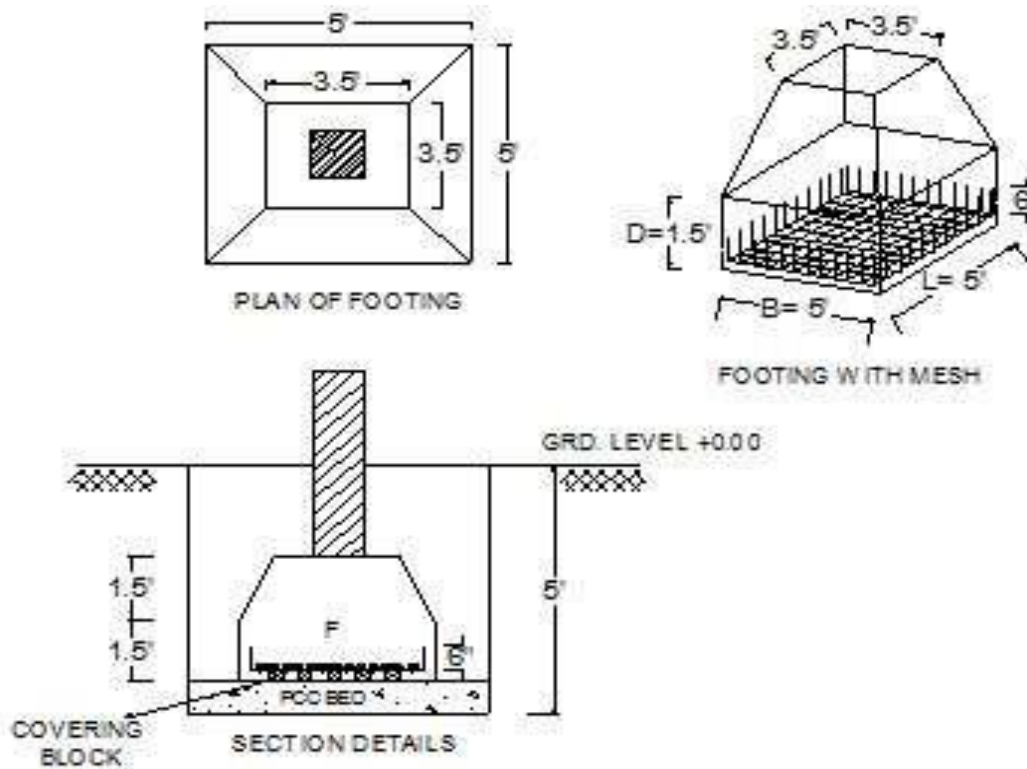
$$1. \text{ Area-1} = 0.5 \times B \times H = 0.5 \times 2.75' \times 4' = 5.5 \text{ Ft}^2$$

$$2. \text{ Area-2} = L \times B = 3.5' \times 12' = 42 \text{ Ft}^2$$

$$3. \text{ Area-3} = 0.5 \times B \times H = 0.5 \times 2.75' \times 4' = 5.5 \text{ Ft}^2$$

$$4. \text{ Total Area} = 53.0\text{Ft}^2$$



Problem-18 :- Find Volume of Concrete for a given figure

Solution :- Dividing footing in to two parts

Part-1:-

$$L1 = 5' ; L2 = 3.5' \quad \text{Average length} = (5' + 3.5') / 2 = 4.25'$$

$$B1 = 5' ; B2 = 3.5' \quad \text{Average Breadth} = (5' + 3.5') / 2 = 4.25'$$

$$D = 1.5'$$

Part=2 :-

$$L = 5' ; B = 5' ; D = 1.5'$$

$$1. \text{ Volume of Concrete for part-1} = L \times B \times D = 4.25 \times 4.25 \times 1.5 = 27.093 \text{ Ft}^3$$

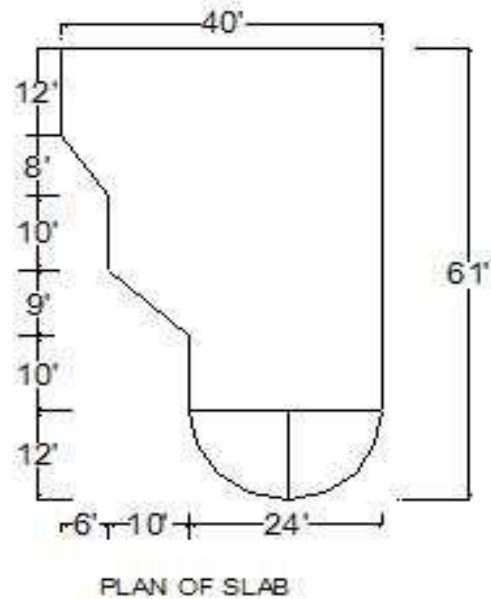
$$2. \text{ Volume of Concrete for part-2} = L \times B \times D = 5' \times 5' \times 1.5' = 37.5 \text{ Ft}^3$$

$$\text{Total Volume} = 64.593 \text{ Ft}^3$$

Problem-19 :-

Find Volume of Concrete for a Slab in a given figure

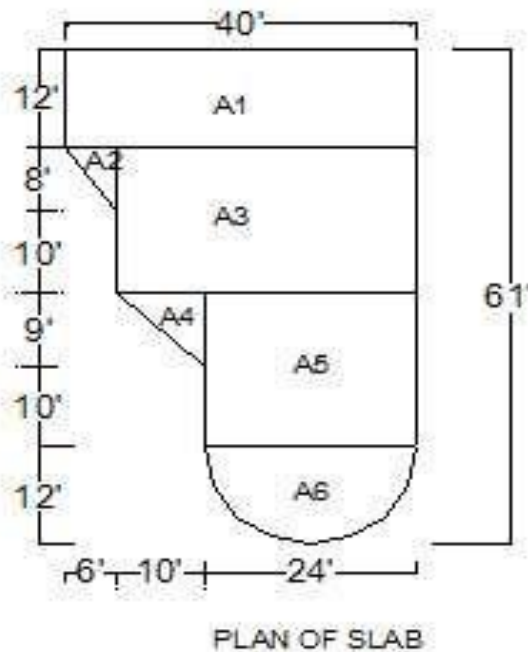
if thickness of Slab = 6"

**Solution :-**

Volume of Concrete required for slab = Area of slab x thickness of slab

$$.= 1843.194 \times 0.5'$$

$$.= 921.597 \text{ Ft}^3$$



Area of Slab can be found out by using thumb rule i.e. dividing area in to parts

$$\text{Area-1} = A1 = \text{area of rectangle} = L \times B = 40 \times 12 = 480.0 \text{ Ft}^2$$

$$\text{Area-2} = A2 = \text{area of triangle} = 0.5 \times L \times B = 0.5 \times 8 \times 6 = 24.0 \text{ Ft}^2$$

$$\text{Area-3} = A3 = \text{area of rectangle} = L \times B = 34 \times 18 = 612.0 \text{ Ft}^2$$

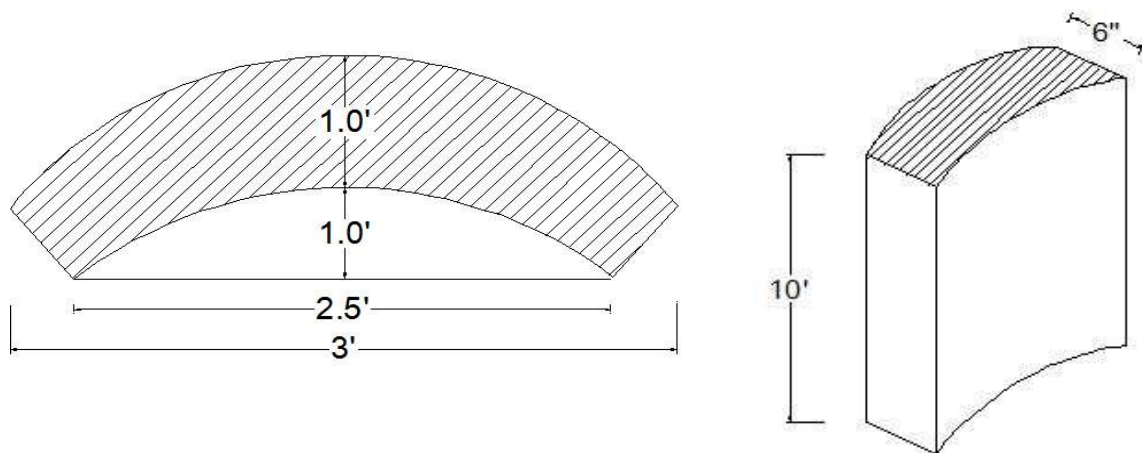
$$\text{Area-4} = A4 = \text{area of triangle} = 0.5 \times L \times B = 0.5 \times 9 \times 10 = 45.0 \text{ Ft}^2$$

$$\text{Area-5} = A5 = \text{area of rectangle} = L \times B = 24 \times 19 = 456.0 \text{ Ft}^2$$

$$\text{Area-6} = A6 = \text{area of semi-circle} = \pi/4 \times d^2 \times 0.50 = \pi/4 \times 24^2 \times 0.50 = 226.194 \text{ Ft}^2$$

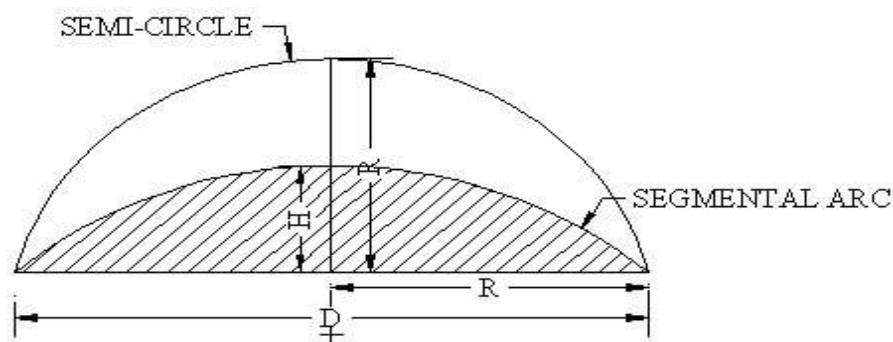
$$\text{Total area of Slab} = A1 + A2 + A3 + A4 + A5 + A6 = 1843.194 \text{ Ft}^2$$

Problem-20 :- Find Volume of Concrete from the given Arch type column



Solution: -

Segmental Arc formula :-



$$(i) \text{ Area} = A = (2/3 \times D \times H) + (H^3/2D)$$

where d = diameter of circle

H = height of arc

$$(ii) \text{ Arc Length} = L = (8b - 2r)/3$$

where r = radius of circle

$$b = \sqrt{r^2 + h^2}$$

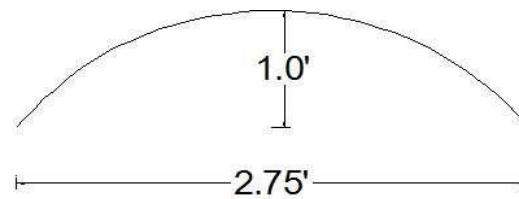
Given : $D = 2.75'$; $R = 1.375'$; $H = 1.0'$

Segmental arc length = $(8B - 2R)/3$

where ' B ' = $V(r^2 + h^2)$

$$.= V(1.375^2 + 1^2)$$

$$.= 1.70$$



$$\text{Avg. 'D'} = (3 + 2.5)/2 = 2.75'$$

$$R = 1.375'$$

Segmental arc length = $(8 \times 1.7 - 2 \times 1.375)/3$

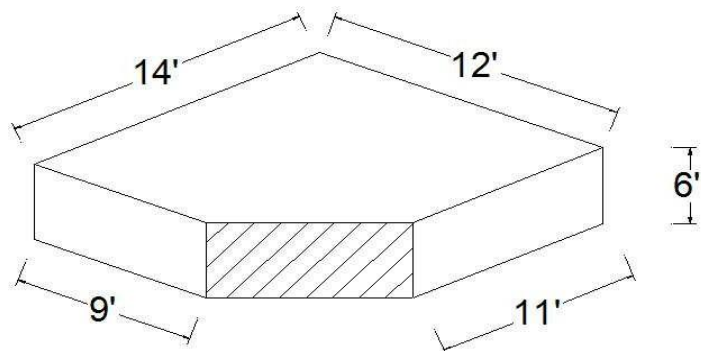
$$.= 3.616'$$

Volume of Concrete required for Arch Type column = $L \times B \times D$

Where $L = 3.616$; $B = 0.5'$; $D = 10'$

$$\text{Volume} = 3.616' \times 0.50' \times 10' = 18.08 \text{ Ft}^3$$

Problem-21 :- Find Volume of Concrete from the given Figure



Solution :-

Top Area :-

$$\text{Area-1} = L \times B = 14' \times 9' = 126.0 \text{ Ft}^2$$

$$\text{Area-2} = L \times B = 11' \times 3' = 33.0 \text{ Ft}^2$$

$$\text{Area-3} = 0.5 \times B \times H = 0.5 \times 3' \times 3' = 4.50 \text{ Ft}^2$$

$$\text{Total Area} = 163.50 \text{ Ft}^2$$

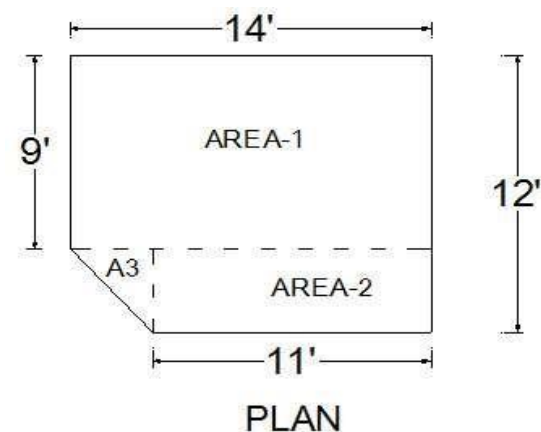
$$\text{Thickness} = 6" = 0.50'$$

Volume = Top area $\times$ Depth

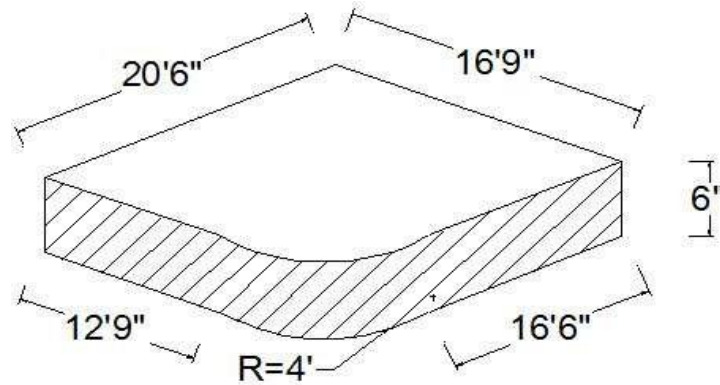
$$.= 163.50 \times 0.50$$

$$.= 81.75 \text{ Ft}^3$$

Dividing Top area in to three parts

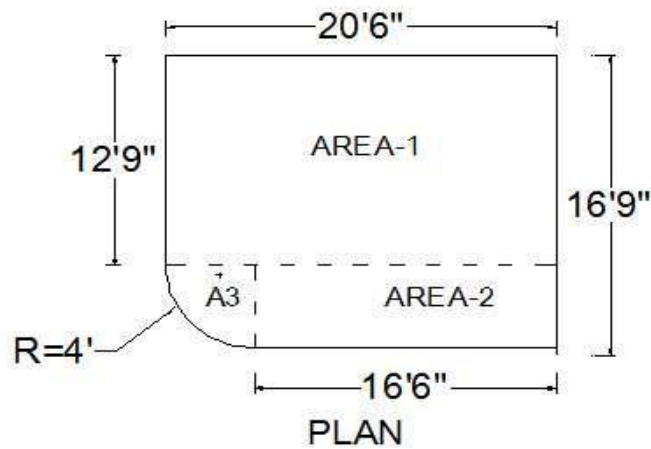


Problem-22 :- Find Volume of Concrete from the given Figure



Solution :-

Dividing Top Area in to parts :-



$$\text{Area-1} = L \times B = 20.5' \times 12.75' = 261.375 \text{ Ft}^2$$

$$\text{Area-2} = L \times B = 16.5' \times 4' = 66.0 \text{ Ft}^2$$

$$\begin{aligned} \text{Area-3} &= (\pi/4) \times d^2 \times 0.25 \\ &= (\pi/4) \times 8^2 \times 0.25 = 12.566 \text{ Ft}^2 \end{aligned}$$

$$\text{Total Area} = 339.941 \text{ Ft}^2$$

$$\text{Thickness} = 6'' = 0.50'$$

$$\begin{aligned} \text{Volume} &= \text{Top area} \times \text{Depth} \\ &= 339.941 \times 0.50 \\ &= 169.97 \text{ Ft}^3 \end{aligned}$$

CAPACITY OF WATER IN SUMP CALCULATIONS

Problem-1:-

Find capacity of Rectangular Sump (water tank below ground level)
if size of Sump = 14' x 12' x 6' and no. of water tanker required
to fill the sump if, each water tanker has capacity to carry 5000 litres.

Solution:-1. Capacity of water tank:-

Standard Specification : $1.0 \text{ Ft}^3 = 28.34 \text{ Litres}$

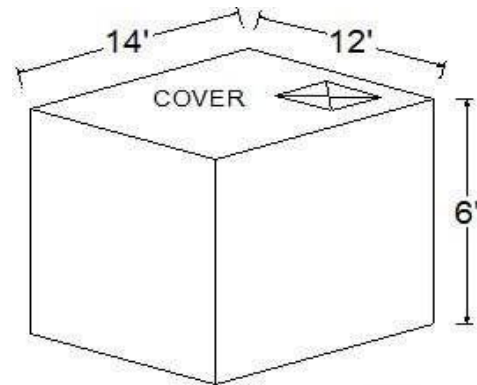
$$\begin{aligned} \text{Volume of Rectangular Sump} &= L \times B \times D \\ &= 14' \times 12' \times 6' \\ &= 1008 \text{ Ft}^3 \end{aligned}$$

$$\text{for } 1.0 \text{ Ft}^3 = 28.34 \text{ Litres}$$

$$1008 \text{ Ft}^3 = ? \text{ Litres}$$

$$= 1008 \times 28.34$$

$$\text{Total capacity} = 28,566.72 \text{ Litres}$$



RECTANGULAR SUMP

2. No. of water tank required to fill the Sump:-

$$\begin{aligned} \text{no. of water tanker required} &= \text{capacity of water in Sump} / \text{capacity of each water tanker} \\ &= 28566.72 / 5000 \\ &= 5.71 \text{ or approximately equal to 6 water tanker required.} \end{aligned}$$

Problem-2:-

Find (i). capacity of Circular Sump (water tank below ground level)
if Dia of Sump = 12' and Depth of Sump = 6'
(ii). no. of water tanker required to fill the sump if,
each water tanker has capacity to carry 5000 litres.

Solution:-1. Capacity of water tank:-

Standard Specification : $1.0 \text{ Ft}^3 = 28.34 \text{ Litres}$

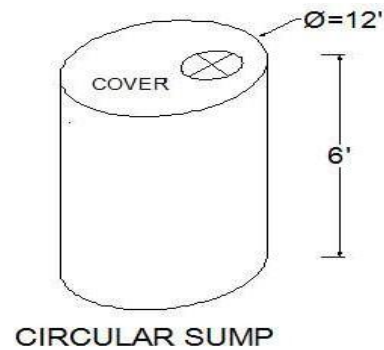
$$\begin{aligned} \text{Volume of Circular Sump} &= \text{Top area} \times \text{Depth} \\ &= (\pi/4) \times d^2 \times D \\ &= (\pi/4) \times 12^2 \times 6 \\ &= 678.584 \text{ Ft}^3 \end{aligned}$$

for $1.0 \text{ Ft}^3 = 28.34 \text{ Litres}$

$678.584 \text{ Ft}^3 = ? \text{ Litres}$

$\therefore = 678.584 \times 28.34$

Total capacity $\therefore = 19,231.07 \text{ Litres}$



2. No. of water tank required to fill the Sump:-

No. of water tanker required = capacity of water in Sump / capacity of each water tanker

$\therefore = 19,231.07 / 5000$

$\therefore = 3.846$ or approximately equal to 4 water tanker required

Problem-3:-

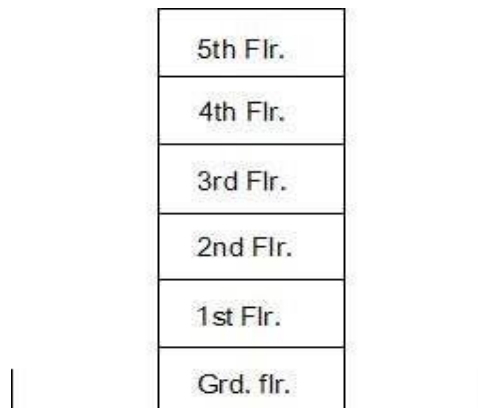
For a building of G+5 (Ground Floor + 5 Floor) with built-up area $30,000 \text{ Ft}^2$,

Design required Size of Rectangular Sump or Circular Sump, so that the water stored in sump should be sufficient for the occupant who lives in building.

Solution:-

1. Total Built-up area = $30,000 \text{ Ft}^2$

2. No. of Floors = 6



SECTION DWG. OF BUILDING

3. Area of each Floor = Total built-up area for G+5 floor / no. of floors

$\therefore = 30,000 / 6$

$\therefore = 5000 \text{ Ft}^2$

4. Area of each flat = 1000 Ft^2

2BHK = Two bed room, Hall and kitchen, is generally

built-up on an area of $100 \text{ yd}^2 = 900 \text{ Ft}^2$

with an additional area = 100 Ft^2 common area

Total area of 2BHK = $900 + 100 = 1000 \text{ Ft}^2$

common area includes, Stair-case area + Lift area + Corridor area

4. No. of Flats on each Floor = Area of each floor / area of each Flat
 $\therefore = 5000 / 1000$
 $\therefore = 5$ Flats on each Floor

5. Total Flats in building = No. of Floors x No. of Flats on each Floor
 $\therefore = 5 \times 5$
 $\therefore = 25$ Flats in building

Note:-

Ground Floor will be used for Car-parking and Occupant will start living from 1st Floor

6. No. of Occupant live in each Flat = 8 (common practice)
 (Father, Mother, four children and their grand Father and grand Mother)

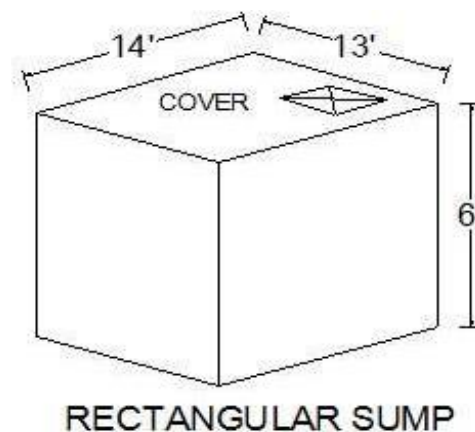
7. Total no. of Occupants live in building = no. of Occupant x no. of Flats
 $\therefore = 8 \times 25$
 $\therefore = 200$ people

8. Usage of water by each Human being / day = 100 litres
 other utensils (kitchen, laundry room, etc) = 50 liters
 Total = 150 litres

9. Water required for the building = usage of water by each Human being / day x no.
 of Occupants
 $\therefore = 150 \times 200$
 $\therefore = 30,000$ Litres

10. Capacity of water for $1.0 \text{ Ft}^3 = 28.34$ litres

$28.34 \text{ litres} = 1.0 \text{ Ft}^3$
 $30,000 \text{ litres} = ? \text{ Ft}^3$
 $\therefore = (30,000 / 28.34) \times 1$
 $\therefore = 1058.57 \text{ Ft}^3$



Case-I :- If Rectangular Sump to be designed then required dimension of Sump,

Required Size of Rectangular Sump = 14' x 13' x 6'

Volume = $L \times B \times D$

$$.= 14' \times 13' \times 6' = 1092 \text{ Ft}^3$$

there should be some surplus water

Case-II :- If Circular Sump to be designed then required dimension of Sump,

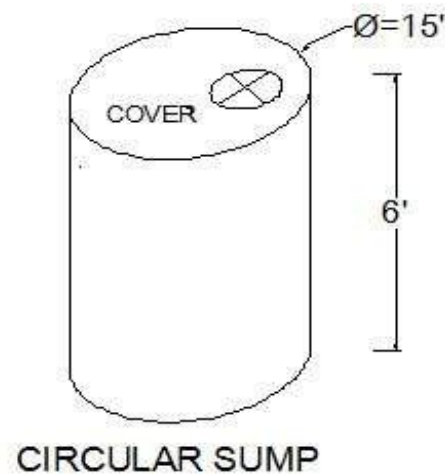
Required Size of Circular Sump: Dia = 15' : Depth = 6'

Volume = $(\pi/4) \times d^2 \times D$

$$.= (\pi/4) \times 15^2 \times 6$$

$$.= 1060.28 \text{ Ft}^3$$

there should be some surplus water



FINISH WORK CALCULATION



Most commonly used brick in India, is Indian red brick

size of each Indian red brick = 9" x 4" x 3"

size of each over-seas brick = 0.40m x 0.20m x 0.20m

C : M required for 1.0m ³ of Brick Work					
S.no.	Ratio or Dry proportion	Sand in m ³	Cement in kgs	Cement in bags	Cement in m ³
1	1:06	0.20	48.00	0.96	0.033
2	1:05	0.20	57.60	1.152	0.04
3	1:04	0.20	72.00	1.44	0.05
4	1:03	0.20	96.00	1.92	0.066



For 1.0m^3 of Brick work quantity of sand and cement:-

(i). Sand = $1.0\text{m}^3 = 0.20\text{m}^3$ Constant

(ii). Cement = $1.0\text{m}^3 = (0.20 \times 1440) / \text{last digit of ratio}$

C:M required for 1.0m^3 of brick work with ratio 1:6

(i). Sand = for $1.0\text{m}^3 = 0.20\text{m}^3$ constant

(ii) Cement in kgs = for $1.0\text{m}^3 = (0.20 \times 1440) / 6$

$$= 48.0 \text{ kgs}$$

(a). each bag of cement = 50.0 kgs

$$\text{No. of bags required} = 48.0 / 50.0$$

$$= 0.96 \text{ bag}$$

(b). cement in m^3 : -

$$1440 \text{ kgs} = 1.0\text{m}^3$$

weight of cement/ $\text{m}^3 = 1440\text{kgs}$

$$48\text{kgs} = ? \text{M}^3$$

$$48 / 1440 = 0.333\text{m}^3$$

BRICK WORK CALCULATIONS

Note:-

Volume of Cement : Mortar shall be deducted from Volume of Brick work because there will be lot of wastage while executing brick work.

if you still want to deduct the volume of C:M from volume of brick work then, the quantity of c:m shall be deducted as **20 %** of brick work.

Brick work calculation can be done by means of Volume of wall or Area of wall.

Problem-1 (with volume) :-

For an area 1200 Ft^2 of brick work find no. of bricks and cement : mortar required with ratio 1 : 6 , if size of brick = $9'' \times 4'' \times 3''$; wall thickness = $4''$;
Height of Ceiling = $10'$

Solution :-

(i). Volume of Brick work	= Area of wall x thickness of wall	$4'' = ? \text{ Ft}$
	.= 1200×0.333	since $1' = 12''$
	.= 399.6 Ft^3	$4/12 = 0.333 \text{ Ft}$

(ii). Volume of each Brick	= $L \times B \times D$	$108''^3 = ? \text{ Ft}^3$
	.= $9'' \times 4'' \times 3''$	since $1' = 12''$
	.= $108''^3$	.= $108 / 12^3$
	.= 0.0625 Ft^3	.= 0.0625 Ft^3

(iii). No. of Bricks required	= Volume of brick work required / Volume of each brick
	.= $399.6 / 0.0625$
	.= 6393.6 bricks
	.= or approximately equal to 6394 bricks

(iv). C:M required for brick work with ratio 1:6

Volume of brick work = 399.6 Ft^3	$399.6 \text{ Ft}^3 = ? \text{ m}^3$
.= 11.324 m^3	since $1.0\text{m} = 3.28 \text{ Ft}$
	.= $399.6 / 3.28^3$

(a). Sand = for $1.0\text{m}^3 = 0.20 \text{ m}^3$	.= 11.324 m^3
$11.324 \text{ m}^3 = ?$	
.= 11.324×0.20	
.= 2.264 m^3	

$$\begin{aligned}
 \text{(b). Cement} &= \text{For } 1.0\text{m}^3 &= (0.20 \times 1440) / \text{last digit of ratio} \\
 & &.= (0.20 \times 1440) / 6 \\
 & &.= 48.0 \text{ kgs}
 \end{aligned}$$

$$\text{for } 1.0\text{m}^3 = 48.0 \text{ kgs}$$

$$11.324 \text{ m}^3 = ?$$

$$.= 11.324 \times 48$$

$$.= 543.552 \text{ kgs}$$

$$\text{each bag of cement} = 50.0 \text{ kgs}$$

$$\text{No. of bags} = 543.552 / 50.0$$

$$.= 10.87 \text{ bags}$$

$$.= \text{or approximately equal to 11 bags}$$

Problem-2 (with Area) :-

For an area 2000 Ft^2 of brick work find no. of bricks and cement : mortar required

with ratio 1: 5 , if size of brick = $9'' \times 4'' \times 3''$

; wall thickness = $4''$;

Height of Ceiling = $10'$

Solution :-

$$\text{(i). Area of Brick work} = 2000 \text{ Ft}^2$$

$$27''^2 = ? \text{ Ft}^2$$

$$\text{since } 1' = 12''$$

$$\text{(ii). Area of each brick} = 9'' \times 3''$$

$$27/12^2 = 0.1875 \text{ Ft}^2$$

$$.= 27''^2$$

$$.= 0.1875 \text{ Ft}^2$$

$$\text{(iii). No. of bricks required} = \text{Area of brick work} / \text{Area of each brick}$$

$$.= 2000 / 0.1875$$

$$.= 10666.66 \text{ bricks}$$

$$.= \text{or approximately equal to } 10667 \text{ bricks}$$

(iv). C:M required for brick work with ratio 1:5

Volume of brick work = Area of brick work x wall thickness

$$.= 2000 \times 0.333$$

$$.= 666 \text{ Ft}^3$$

$$.= 18.873 \text{ m}^3$$

$$666 \text{ Ft}^3 = ? \text{ m}^3$$

$$\text{since } 1.0\text{m} = 3.28 \text{ Ft}$$

$$.= 666 / 3.28^3$$

$$.= 18.873 \text{ m}^3$$

$$\text{(a). Sand} = \text{for } 1.0\text{m}^3 = 0.20 \text{ m}^3$$

$$18.873 \text{ m}^3 = ?$$

$$.= 18.873 \times 0.20$$

$$.= 3.774 \text{ m}^3$$

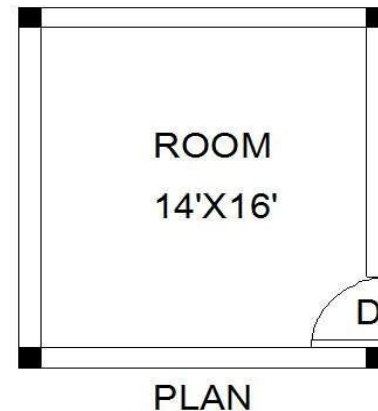
$$\begin{aligned}
 \text{(b). Cement} &= \text{For } 1.0\text{m}^3 &= (0.20 \times 1440) / \text{last digit of ratio} \\
 & &= (0.20 \times 1440) / 5 \\
 & &= 57.6 \text{ kgs}
 \end{aligned}$$

$$\begin{aligned}
 \text{for } 1.0\text{m}^3 &= 57.6 \text{ kgs} \\
 18.873 \text{ m}^3 &= ? \\
 &= 18.873 \times 57.6 \\
 &= 1087.084 \text{ kgs}
 \end{aligned}$$

$$\begin{aligned}
 \text{each bag of cement} &= 50.0 \text{ kgs} \\
 \text{No. of bags} &= 1087.084 / 50.0 \\
 &= 21.741 \text{ bags} \\
 &= \text{or approximately equal to 22 bags}
 \end{aligned}$$

Problem - 3 :-

Find (i) No. of bricks required to construct this room
(ii) C:M required for brick work with ratio 1:6,
if size of brick is 9" x 4" x 3" and Height of Ceiling is 10'
size of door = 3' 6" x 7'
size of column = 1' x 1'
thickness of wall = 8"



Solution:-

Length of four walls after deduction of length of column = $14' \times 2 + 16' \times 2 = 60 \text{ Ft.}$

$$\begin{aligned}
 \text{(I). Volume of Brick work} &= L \times B \times D & 8'' = ? \text{ Ft} \\
 &= 60' \times 0.666' \times 10' & \text{since } 1' = 12'' \\
 &= 399.6 \text{ Ft}^3 & 8/12 = 0.666\text{Ft}
 \end{aligned}$$

(ii). Deductions of openings:-

(a). Door Deduction :-

$$\begin{aligned}
 \text{Vol. of Door} &= L \times B \times D \\
 &= 3.5' \times 0.666' \times 7' = 16.317 \text{ Ft}^3
 \end{aligned}$$

(b). Lintel Deduction :-

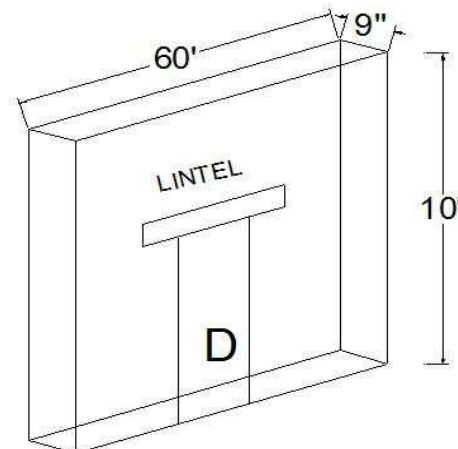
$$\begin{aligned}
 \text{Length of Lintel} &= 3.5' + 0.333' + 0.333' \\
 &= 4.166 \text{ Ft}
 \end{aligned}$$

Note:-

Provide 4" bearings on each side of

Doors and Windows for each lintel.

Height of lintel = 4" = 0.333 Ft



Vol. of Lintel	$= L \times B \times D$	$4'' = ? \text{ Ft}$
	$= 4.166 \times 0.666' \times 0.333'$	since $1' = 12''$
	$= 0.923 \text{ Ft}^3$	$4/12 = 0.333\text{Ft}$

(iii). Total volume of brick work = $399.6 \text{ Ft}^3 - 16.317 \text{ Ft}^3 - 0.923 \text{ Ft}^3 = 382.36 \text{ Ft}^3$

(iv). Vol. of each Brick = $L \times B \times D$	$108''^3 = ? \text{ Ft}^3$
$= 9'' \times 4'' \times 3''$	since $1' = 12''$
$= 108''^3$	$= 108 / 12^3$
	$= 0.0625 \text{ Ft}^3$

(v). No. of Bricks required = Volume of Brick work / Volume of each Brick

$$= 382.36 / 0.0625$$

$$= 6117.76 \text{ bricks}$$

$$= \text{approximately equal to } 6118 \text{ bricks}$$

(vi). C:M required for Brick work with ratio 1:6

(a). Sand = $1.0 \text{ M}^3 = 0.20 \text{ M}^3$	volume of brick work = 382.36 Ft^3
$10.835 \text{ m}^3 = ?$	$382.36 \text{ Ft}^3 = ? \text{ M}^3$
$= 10835 \times 0.20$	since $1.0 \text{ m} = 3.28 \text{ Ft}$
$= 2.167 \text{ m}^3$	$= 382.36 / 3.28^3$
	$= 10.835 \text{ m}^3$

Sand in terms of weight :-

$$\text{weight of sand} / \text{m}^3 = 1.75 \text{ tons}$$

$$1.0 \text{ m}^3 = 1.75 \text{ tons}$$

$$2.167 \text{ m}^3 = ?$$

$$1.75 \times 2.167 = 3.792 \text{ tons (Sand in terms of weight)}$$

(b). Cement required for brick work :-

$$1.0 \text{ m}^3 = (0.20 \times 1440) / \text{last digit of ratio}$$

$$= (0.20 \times 1440) / 6$$

$$= 48.0 \text{ kgs}$$

$$1.0 \text{ m}^3 = 48 \text{ kgs}$$

$$10.835 \text{ m}^3 = ?$$

$$= 10.835 \times 48$$

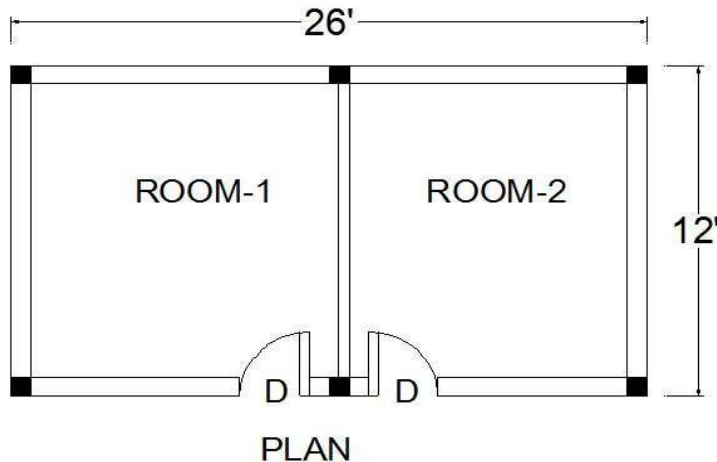
$$= 520.08 \text{ kgs}$$

$$\text{Each bag of cement} = 50 \text{ kgs}$$

$$\text{no. of bags required} = 520.08 / 50$$

$$= 10.40 \text{ bags}$$

$$= \text{approximately equal to } 11 \text{ bags}$$

Problem - 4 :-

Find (i) No. of bricks required to construct these rooms

(ii). C:M required for brick work with ratio 1:6,

if size of brick is 9" x 4" x 3" and Height of Ceiling is 10'

size of door = 3' 6" x 7'

size of column = 1' x 1' and depth of drop beam is 1'

External wall thickness = 8"

internal wall thickness = 4"

Solution:-

Length of four external walls = $26' \times 2 + 12' \times 2 = 76 \text{ Ft.}$

Deduction for length of column (horizontally) = $1' \times 6 = 6'$

Deduction for length of column (vertically) = $1' \times 4 = 4'$

Total length of external wall = $76' - 6' - 4' = 66 \text{ Ft}$

(i). Volume of external wall :- $\therefore L \times B \times D$

external wall thickness = 8" $\therefore 66 \times 0.666 \times 9'$

$\therefore 0.666 \text{ Ft} \quad \therefore 395.604 \text{ Ft}^3$

Height of Ceiling = 10'

Depth of Drop beam = 1'

Total height of wall = $10' - 1' = 9 \text{ Ft}$

(ii). Deduction of openings :-

(a). Volume of Doors = $L \times B \times D \times \text{No.s}$

$\therefore 3.5' \times 0.666' \times 7' \times 2$

$\therefore 32.634 \text{ ft}^3$

(b). Volume of Lintels = $L \times B \times D \times \text{Nos.}$

$$L = 3'6'' + 8 = 4.1666 \times 0.666 \times 0.333$$

$$\text{add } 4'' \text{ bea.} = 0.924 \text{ Ft}^3$$

each side of door

$$\begin{aligned} \text{(iii) Total volume of Brick work for external wall} &= 395.604 - 32.634 - 0.924 \\ &= 362.046 \text{ Ft}^3 \end{aligned}$$

$$\begin{aligned} \text{(iv). Volume of internal wall} &= L \times B \times D & \text{Length of internal wall} &= 12' - 1' - 1' = 10' \\ &= 10' \times 0.333 \times 9' & \text{wall thickness} &= 4'' = 0.333 \text{ Ft} \\ &= 29.97 \text{ Ft}^3 \end{aligned}$$

$$\text{(v). Total Volume of Brick work} = 362.046 + 29.97 = 392.016 \text{ Ft}^3$$

$$\begin{aligned} \text{(vi). Vol. of each Brick} &= L \times B \times D & 108''^3 &= ? \text{ Ft}^3 \\ &= 9'' \times 4'' \times 3'' & \text{since } 1' &= 12'' \\ &= 108''^3 = 0.0625 \text{ Ft}^3 & &= 108 / 12^3 \\ & & &= 0.0625 \text{ Ft}^3 \end{aligned}$$

$$\begin{aligned} \text{(vii). No. of Bricks required} &= \text{Volume of Brick work} / \text{Volume of each Brick} \\ &= 392.016 / 0.0625 \\ &= 6272.256 \text{ bricks} \\ &= \text{approximately equal to } 6273 \text{ bricks} \end{aligned}$$

(viii). C:M required for Brick work with ratio 1:6

$$\begin{aligned} \text{(a). Sand} &= 1.0 \text{ M}^3 = 0.20 \text{ M}^3 & \text{volume of brick work} &= 392.016 \text{ Ft}^3 \\ 11.109 \text{ m}^3 &= ? & 392.016 \text{ Ft}^3 &= ? \text{ M}^3 \\ &= 11.109 \times 0.20 & \text{since } 1.0 \text{ m} &= 3.28 \text{ Ft} \\ &= 2.221 \text{ m}^3 & &= 392.016 / 3.28^3 \\ & & &= 11.109 \text{ m}^3 \end{aligned}$$

Sand in terms of weight :-

$$\text{weight of sand} / \text{m}^3 = 1.75 \text{ tons}$$

$$1.0 \text{ m}^3 = 1.75 \text{ tons}$$

$$2.221 \text{ m}^3 = ?$$

$$1.75 \times 2.221 = 3.886 \text{ tons}$$

(b). Cement required for brick work :-

$$1.0\text{m}^3 = (0.20 \times 1440) / \text{last digit of ratio}$$

$$.= (0.20 \times 1440) / 6$$

$$.= 48.0 \text{ kgs}$$

$$1.0\text{m}^3 = 48 \text{ kgs}$$

$$11.109 \text{ m}^3 = ?$$

$$.= 11.109 \times 48$$

$$.= 533.232 \text{ kgs}$$

Each bag of cement = 50kgs

$$\text{no. of bags required} = 533.232 / 50$$

$$.= 10.664 \text{ bags}$$

$$.= \text{approximately equal to 11 bags}$$

PLASTERING CALCULATIONS



Plastering is done in two coats

- (i). 1st coat or rough coat with thickness of plaster = 12mm
- (ii). 2nd coat of plaster with thickness of plaster = 8mm

Total thickness of plaster = 20mm

Cement : Mortar required for 1.0m ³ of Plastering					
S.no.	Ratio or Dry Proportion	Sand in m ³	Cement in kgs	Cement in bags	Cement in m ³
1	1:06	1.25	300	6	0.208
2	1:05	1.25	360	7.2	0.25
3	1:04	1.25	450	9	0.312
4	1:03	1.25	600	12	0.416



C:M required for 1.0m^3 of Plastering

(i). Sand = for $1.0\text{m}^3 = 1.25\text{m}^3$ constant

(ii). Cement in kgs = for $1.0\text{m}^3 = (1.25 \times 1440) / \text{last digit of ratio}$

C:M required for 1.0m^3 of Plastering with ratio 1:6

(i). Sand = for $1.0\text{m}^3 = 1.25\text{m}^3$ constant

(ii). Cement in kgs = for $1.0\text{m}^3 = (1.25 \times 1440) / 6$
 $= 300 \text{ kgs}$

Each bag of cement = 50kgs

No. of cement bags = $300/50 = 6$ bags

weight of cement/ $\text{m}^3 = 1440\text{kgs}$

$$1440\text{kgs} = 1.0\text{m}^3$$

$$300\text{kgs} = ? \text{M}^3$$

$$.= 300/1440 = 0.208\text{m}^3$$

Problem-1 :-

For an Area of 1600 Ft^2 for plastering find C:M required with ratio 1:6 and 1:3

Solution:-

$$\begin{aligned} \text{Area of plaster} &= 1600 \text{ Ft}^2 \\ &.= 148.72 \text{ m}^2 \end{aligned}$$

$$\begin{aligned} 1600 \text{ Ft}^2 &= ? \text{M}^2 \\ \text{since } 1\text{m} &= 3.28\text{Ft} \\ &.= 1600/3.28^2 \\ &.= 148.72\text{m}^2 \end{aligned}$$

(i). Cement : Mortar required for 1st coat of Plaster with ratio 1:6 :-

note: thickness of plaster for 1st coat = $12\text{mm} = 0.012\text{m}$

$$\begin{aligned} \text{Volume of Plaster} &= \text{Area of Plaster} \times \text{Thickness of Plaster} \\ &.= 148.72 \times 0.012 & T = 12\text{mm} = 0.012\text{m} \\ &.= 1.784\text{m}^3 \end{aligned}$$

(a). Sand = for $1.0\text{m}^3 = 1.25\text{m}^3$

$$1.784\text{m}^3 = ?$$

$$.= 1.784 \times 1.25$$

$$.= 2.23 \text{ m}^3$$

(b). Cement in kgs = for $1.0\text{m}^3 = (1.25 \times 1440) / 6 = 300\text{kgs}$
 for $1.0\text{m}^3 = 300\text{kgs}$
 $1.784\text{m}^3 = ?$
 $\therefore = 1.784 \times 300$
 $\therefore = 535.2 \text{ kgs}$

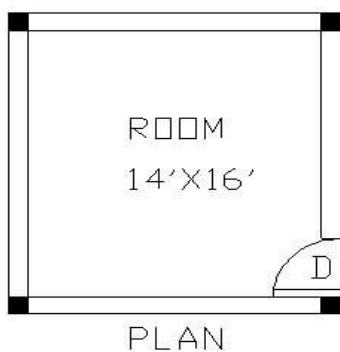
(ii). Cement : Mortar required for 2nd coat of Plaster with ratio 1:3 :-
 note: thickness of plaster for 2nd coat = $8\text{mm} = 0.008\text{m}$

Volume of Plaster = Area of Plaster x Thickness of Plaster
 $\therefore = 148.72 \times 0.008$
 $\therefore = 1.189\text{m}^3$

(a). Sand = for $1.0\text{m}^3 = 1.25\text{m}^3$
 $1.189\text{m}^3 = ?$
 $\therefore = 1.189 \times 1.25$
 $\therefore = 1.486 \text{ m}^3$

(b). Cement in kgs = for $1.0\text{m}^3 = (1.25 \times 1440) / 3$
 $\therefore = 600\text{kgs}$
 for $1.0\text{m}^3 = 600\text{kgs}$
 $1.189\text{m}^3 = ?$
 $\therefore = 1.189 \times 600 = 713.4 \text{ kgs}$

Problem - 2 :-



Find (i). Internal and External plaster area
 (ii). C:M required with ratio 1:6 and 1:3
 if height of Ceiling = $10'$
 Slab thickness = $6''$
 size of door = $3'6'' \times 7'$
 wall thickness = $9''$
 Depth of Drop beam = $1'$

Solution :-

(i). Internal Plaster area :-

(a). Ceiling Plaster area :- $L \times B = 14 \times 16 = 224 \text{ Ft}^2$

(b). Wall Plaster area :- $L \times D = 60 \times 10 = 600 \text{ Ft}^2$

Length of four walls = $(14 + 16) \times 2 = 60\text{Ft}$

Height of Ceiling = $10'$

(c). Deduction of Door = $L \times D = 3.5' \times 7' = -24.5 \text{ Ft}^2$

Total internal plaster area = $224 + 600 - 24.5 = 799.5 \text{ Ft}^2$

(ii). External Plaster area :-

(a). Length of four walls = $(15.50 + 17.50) \times 2 = 66.0 \text{ Ft}$

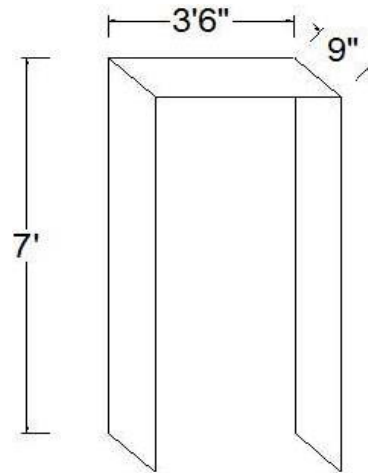
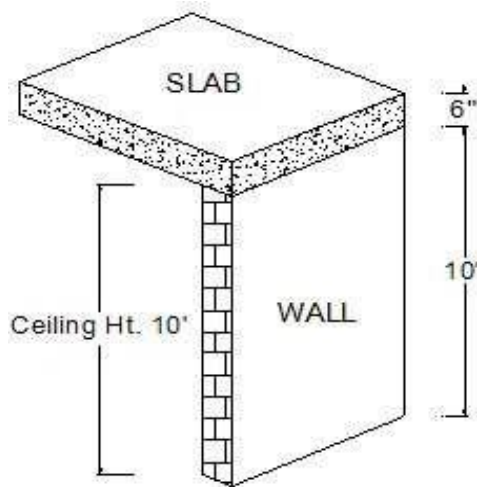
$L = 14' + 0.75 + 0.75 = 15.50 \text{ Ft}$

$B = 16' + 0.75 + 0.75 = 17.50 \text{ Ft}$

$9'' = ? \text{ Ft}$

since $1' = 12''$

$8/12 = 0.75 \text{ Ft}$



External Plaster area = $L \times D = 66' \times 10.5' = 693.0 \text{ Ft}^2$

Height of Ceiling = $10'$

Slab thickness = $6'' = 0.5'$

Total Height of external wall including slab thickness = $10.5'$

(b). Internal plaster area for Door = $L \times B = 17.5 \times 0.75 = 13.125 \text{ Ft}^2$

Size of Door = $3'6'' \times 7'$

Length of Door = $3.5' + 7' + 7' = 17.5 \text{ Ft}$

thickness of wall = $9'' = 0.75 \text{ Ft}$

(c). Deduction of Door from external wall = $L \times D = 3.5' \times 7' = -24.5 \text{ Ft}^2$

(d). Total external Plaster area = $693.0 + 13.125 - 24.5 = 681.625 \text{ Ft}^2$

(iv). Total Plaster area = internal + external

$= 799.5 + 681.625$

$= 1481.125 \text{ Ft}^2$

(v). Cement : Mortar required for 1st coat of Plaster with ratio 1:6

:- Volume of Plaster = Area of Plaster x Thickness of Plaster

$$.= 137.671 \times 0.012$$

$$.= 1.652 \text{ m}^3$$

note: thickness of plaster for 1st coat = 12mm = 0.012m

$$1481.125 \text{ Ft}^2 = ? \text{ M}^2$$

(a). Sand = for $1.0\text{m}^3 = 1.25\text{m}^3$

since $1\text{m} = 3.28\text{Ft}$

$$1.642 \text{ m}^3 = ?$$

$$.= 1481.125 / 3.28^2$$

$$.= 1.652 \times 1.25$$

$$.= 137.671 \text{ m}^2$$

$$.= 2.065 \text{ m}^3$$

(b). Cement in kgs = for $1.0\text{m}^3 = (1.25 \times 1440) / 6$

$$.= 300\text{kgs}$$

$$\text{for } 1.0\text{m}^3 = 300\text{kgs}$$

$$1.652 \text{ m}^3 = ?$$

$$.= 1.652 \times 300$$

$$.= 495.6 \text{ kgs}$$

(vi). Cement : Mortar required for 2nd coat of Plaster with ratio 1:3 :-

Volume of Plaster = Area of Plaster x Thickness of Plaster

$$.= 137.671 \times 0.008$$

$$.= 1.101\text{m}^3$$

note: thickness of plaster for 2nd coat = 8mm = 0.008m

(a). Sand = for $1.0\text{m}^3 = 1.25\text{m}^3$

$$1.101.\text{m}^3 = ?$$

$$.= 1.101 \times 1.25$$

$$.= 1.376 \text{ m}^3$$

(b). Cement in kgs = for $1.0\text{m}^3 = (1.25 \times 1440) / 3$

$$.= 600\text{kgs}$$

$$\text{for } 1.0\text{m}^3 = 600\text{kgs}$$

$$1.101\text{m}^3 = ?$$

$$.= 1.101 \times 600$$

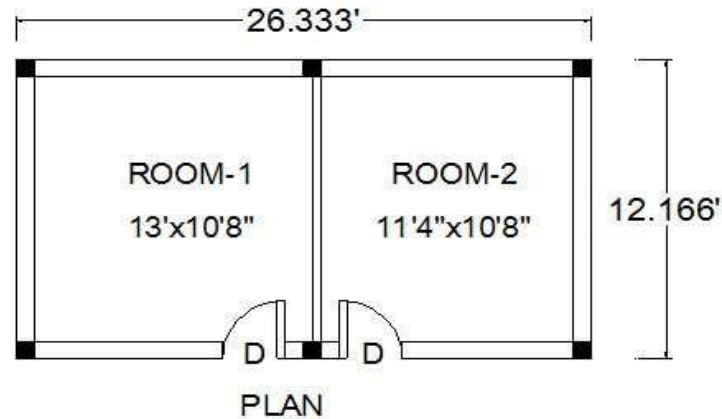
$$.= 660.6 \text{ kgs}$$

Problem-3 :-

Find (i). Internal and External plaster area (ii). C:M required with ratio 1:6 and 1:3

if height of Ceiling = 10' Slab thickness = 6" ; size of door = 3'6" x 7'

External wall thickness = 9" ; internal wall thickness = 6" ; Depth of Drop beam = 1'

**Solution :-**

(i). Internal Plaster area :-

$$8'' = ? \text{ Ft}$$

$$\text{since } 1' = 12''$$

$$8/12 = 0.666\text{Ft}$$

$$4'' = ? \text{ Ft}$$

$$\text{since } 1' = 12''$$

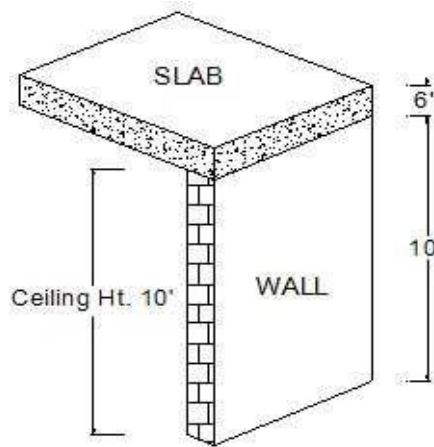
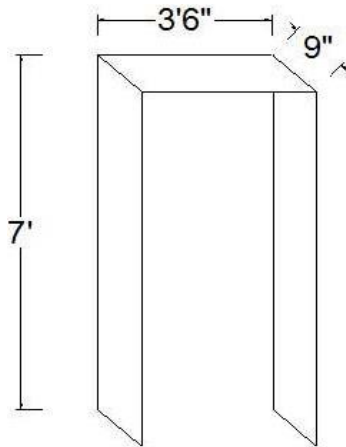
$$4/12 = 0.333\text{Ft}$$

(a). Ceiling Plaster area :-

$$1. \text{ Room-1} = L \times B = 13 \times 10.666 = 138.658 \text{ Ft}^2$$

$$2. \text{ Room-2} = L \times B = 11.333 \times 10.666 = 120.877 \text{ Ft}^2$$

$$\text{Total Ceiling Plaster area} = 138.658 + 120.877 = 259.535 \text{ Ft}^2$$



(b). Wall Plaster area :-

$$1. \text{ Room-1} = L \times D = 47.332 \times 10 = 473.32 \text{ Ft}^2$$

$$\text{Length of four walls} = (13 + 10.666) \times 2 = 47.332\text{Ft}$$

$$\text{Height of Ceiling} = 10'$$

$$2. \text{ Room-2} = L \times D = 43.998 \times 10 = 439.98 \text{ Ft}^2$$

$$\text{Length of four walls} = (11.333 + 10.666) \times 2 = 43.998 \text{ Ft}$$

$$\text{Height of Ceiling} = 10'$$

$$(c). \text{ Deduction of Door} = L \times D \times \text{No.s} = 3.5' \times 7' \times 2 = -49.0 \text{ Ft}^2$$

Total internal plaster area = Ceiling plaster area + Wall plaster area

$$= 259.535 + 473.32 + 439.98 - 49 = 1123.835 \text{ Ft}^2$$

(ii). External Plaster area :-

$$(a). \text{ Length of four external walls} = (26.333 + 12.166) \times 2 = 76.998 \text{ Ft}$$

$$6'' = ? \text{ Ft}$$

$$\text{since } 1' = 12''$$

$$6/12 = 0.5 \text{ Ft}$$

$$\text{External Plaster area} = L \times D = 76.998' \times 10.5' = 808.479 \text{ Ft}^2$$

$$\text{Height of Ceiling} = 10'$$

$$\text{Slab thickness} = 6'' = 0.5'$$

$$\text{Total Height of external wall including slab thickness} = 10' + 0.5' = 10.5'$$

$$(b). \text{ Internal plaster area for Door} = L \times B \times \text{No.s} = 17.5 \times 0.75 \times 2 = 26.25 \text{ Ft}^2$$

$$\text{Size of Door} = 3'6'' \times 7'$$

$$\text{Length of Door} = 3.5' + 7' + 7' = 17.5 \text{ Ft}$$

$$\text{thickness of wall} = 9'' = 0.75 \text{ Ft}$$

$$(c). \text{ Deduction of Door from external wall} = L \times D \times \text{No.s} = 3.5' \times 7' \times 2 = -49.0 \text{ Ft}^2$$

$$(d). \text{ Total external Plaster area} = 808.479 + 26.25 - 49.0 = 785.729 \text{ Ft}^2$$

(iv). Total Plaster area = internal + external

$$= 1123.835 + 785.729$$

$$= 1909.564 \text{ Ft}^2$$

$$1909.564 \text{ Ft}^2 = ? \text{ M}^2$$

$$\text{since } 1\text{m} = 3.28\text{Ft}$$

$$= 1909.564 / 3.28^2$$

$$= 177.495 \text{ m}^2$$

(v). Cement : Mortar required for 1st coat of Plaster with ratio 1:6

:- Volume of Plaster = Area of Plaster x Thickness of Plaster

$$= 177.495 \times 0.012$$

$$= 2.129 \text{ m}^3$$

note: thickness of plaster for 1st coat = 12mm = 0.012m

$$\begin{aligned}
 \text{(a). Sand} &= \text{for } 1.0\text{m}^3 = 1.25\text{m}^3 \\
 2.129 \text{ m}^3 &= ? \\
 &= 2.129 \times 1.25 \\
 &= 2.661 \text{ m}^3
 \end{aligned}$$

$$\begin{aligned}
 \text{(b). Cement in kgs} &= \text{for } 1.0\text{m}^3 = (1.25 \times 1440) / 6 \\
 &= 300\text{kgs}
 \end{aligned}$$

$$\begin{aligned}
 \text{for } 1.0\text{m}^3 &= 300\text{kgs} \\
 2.129 \text{ m}^3 &= ? \\
 &= 2.129 \times 300 \\
 &= 638.7 \text{ kgs}
 \end{aligned}$$

(vi). Cement : Mortar required for 2nd coat of Plaster with ratio 1:3 :-

$$\begin{aligned}
 \text{Volume of Plaster} &= \text{Area of Plaster} \times \text{Thickness of Plaster} \\
 &= 177.495 \times 0.008 \\
 &= 1.419 \text{ m}^3
 \end{aligned}$$

note: thickness of plaster for 2nd coat = 8mm = 0.008m

$$\begin{aligned}
 \text{(a). Sand} &= \text{for } 1.0\text{m}^3 = 1.25\text{m}^3 \\
 1.419 \text{ m}^3 &= ? \\
 &= 1.419 \times 1.25 \\
 &= 1.773 \text{ m}^3
 \end{aligned}$$

$$\begin{aligned}
 \text{(b). Cement in kgs} &= \text{for } 1.0\text{m}^3 = (1.25 \times 1440) / 3 \\
 &= 600\text{kgs}
 \end{aligned}$$

$$\begin{aligned}
 \text{for } 1.0\text{m}^3 &= 600\text{kgs} \\
 1.419 \text{ m}^3 &= ? \\
 &= 1.419 \times 600 \\
 &= 851.4 \text{ kgs}
 \end{aligned}$$

Problem-4 :-

From the given plan find

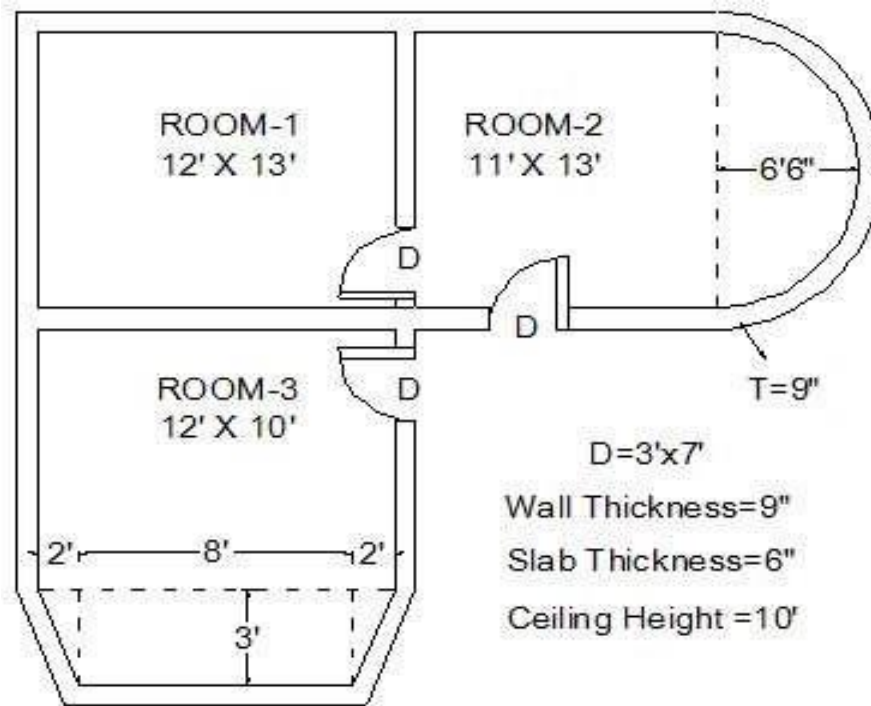
(i). Internal and External Plastering Area and (ii). C:M required with ratio 1:6 and 1:3

if height of Ceiling = 10'

Slab thickness = 6" size of door = 3' x 7'

wall thickness = 9"

Depth of Drop beam = 1'



PLAN OF THREE ROOMS

Solution :-

(i). Internal Plaster area :-

(a). Ceiling Plaster area :-

1. Room-1 = $L \times B = 12' \times 13' = 156 \text{ Ft}^2$

$$9'' = ? \text{ Ft}$$

$$\text{since } 1' = 12''$$

$$9/12 = 0.75 \text{ Ft}$$

2. Room-2 :-

Part-1 = $L \times B = 11' \times 13' = 143 \text{ Ft}^2$

Part-2 = $(\pi/4) \times d^2 \times 0.5 = (\pi/4) \times 13^2 \times 0.5 = 66.366 \text{ Ft}^2$

3. Room-3 :-

Part-1 = $L \times B = 12' \times 10' = 120 \text{ Ft}^2$

Part-2 = $0.5 \times (a+b) \times h = 0.5 \times (8'+12') \times 3' = 30.0 \text{ Ft}^2$

Total Ceiling Plaster area = $156 + 143 + 66.366 + 120 + 30 = 515.366 \text{ Ft}^2$

(b). Wall Plaster area :-

1. Room-1 = $L \times D = 50' \times 10' = 500 \text{ Ft}^2$

Length of four walls = $(12 + 13) \times 2 = 50.0 \text{ Ft}$

Height of Ceiling = $10'$

2. Room-2 = $L \times D = 55.42 \times 10 = 554.2 \text{ Ft}^2$

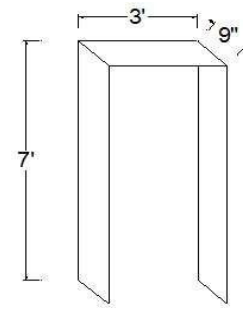
Peripheral Length of walls = $(11' + 2 \times \pi \times 6.5' \times 0.5 + 11' + 13) = 55.42 \text{ Ft}$

Height of Ceiling = $10'$

3. Room-3 = $L \times D = 47.21' \times 10' = 472.1 \text{ Ft}^2$

Peripheral Length of walls = $(12' + 10' + 3.605 + 8' + 3.605' + 10') = 47.21 \text{ Ft}$

Height of Ceiling = $10'$



According to pythagorous theorm inclined length = $V(a^2 + b^2)$
 $= V(2^2 + 3^2)$
 $= 3.605 \text{ Ft}$

$9'' = ? \text{ Ft}$
 since $1' = 12''$
 $9/12 = 0.75 \text{ Ft}$

Total wall plaster area = $500 + 554.2 + 472.1 = 1526.3 \text{ Ft}^2$

(c). Deduction of Door = $L \times D \times \text{No.s} = 3' \times 7' \times 4 = -84.0 \text{ Ft}^2$

Total internal plaster area = Ceiling plaster area + Wall plaster area - Door area

$= 515.366 + 1526.3 - 84 = 1957.666 \text{ Ft}^2$

(ii). External Plaster area :-

(a). Length of external walls =

$= (99'' + 12' + 9'' + 11' + 2 \times \pi \times r \times 0.5 + 11' + 10' + 4.65' + 8' + 4.65' + 10' + 9'' + 13' + 9'')$

$= (0.75' + 12' + 0.75' + 11' + 2 \times \pi \times 7.25' \times 0.5 + 11' + 10' + 4.65' + 8' + 4.65' + 10' + 0.75' + 13' + 0.75') = 110.076 \text{ Ft}$

According to pythagorous theorm inclined length = $V(a^2 + b^2)$

$= V(2.75^2 + 3.75^2)$

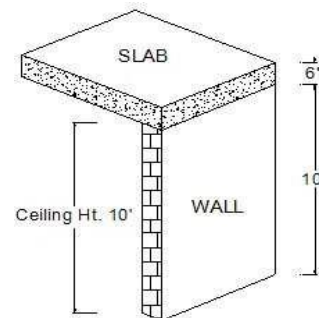
$= 4.65 \text{ Ft}$

External Plaster area = $L \times D = 110.076' \times 10.5' = 1155.798 \text{ Ft}^2$

Height of Ceiling = $10'$

Slab thickness = $6'' = 0.5'$

Total Height of external wall including slab thickness = $10' + 0.5' = 10.5'$



(b). Internal plaster area for Door = $L \times B \times \text{No.s} = 17 \times 0.75 \times 3 = 38.25 \text{ Ft}^2$

Size of Door = $3' \times 7'$

Length of Door = $3' + 7' + 7' = 17 \text{ Ft}$

thickness of wall = $9'' = 0.75 \text{ Ft}$

(c). Deduction of Door from external wall = $L \times D \times \text{No.s} = 3' \times 7' \times 2 = - 42.0 \text{ Ft}^2$

(d). Total external Plaster area = $1155.798 + 38.25 - 42.0 = 1152.048 \text{ Ft}^2$

(iv). Total Plaster area = internal + external

$$.= 1957.666 + 1152.048$$

$$.= 3109.714 \text{ Ft}^2$$

$$3109.714 \text{ Ft}^2 = ? \text{ M}^2$$

$$\text{since } 1\text{m} = 3.28\text{Ft}$$

$$.= 3109.714 / 3.28^2$$

$$.= 289.049 \text{ m}^2$$

(v). Cement : Mortar required for 1st coat of Plaster with ratio 1:6

:- Volume of Plaster = Area of Plaster x Thickness of Plaster

$$.= 289.049 \times 0.012$$

$$.= 3.468 \text{ m}^3$$

note: thickness of plaster for 1st coat = $12\text{mm} = 0.012\text{m}$

(a). Sand = for $1.0\text{m}^3 = 1.25\text{m}^3$

$$3.468 \text{ m}^3 = ?$$

$$.= 3.468 \times 1.25$$

$$.= 4.335 \text{ m}^3$$

(b). Cement in kgs = for $1.0\text{m}^3 = (1.25 \times 1440) / 6$

$$.= 300\text{kgs}$$

$$\text{for } 1.0\text{m}^3 = 300\text{kgs}$$

$$3.468 \text{ m}^3 = ?$$

$$.= 3.468 \times 300$$

$$.= 1040.4 \text{ kgs}$$

(vi). Cement : Mortar required for 2nd coat of Plaster with ratio 1:3 :-

Volume of Plaster = Area of Plaster x Thickness of Plaster

$$.= 289.049 \times 0.008$$

$$.= 2.312 \text{ m}^3$$

note: thickness of plaster for 2nd coat = 8mm = 0.008m

(a). Sand = for $1.0\text{m}^3 = 1.25\text{m}^3$

$$2.312 \text{ m}^3 = ?$$

$$.= 2.312 \times 1.25$$

$$.= 2.89 \text{ m}^3$$

(b). Cement in kgs = for $1.0\text{m}^3 = (1.25 \times 1440) / 3$

$$.= 600\text{kgs}$$

$$\text{for } 1.0\text{m}^3 = 600\text{kgs}$$

$$2.312 \text{ m}^3 = ?$$

$$.= 2.312 \times 600$$

$$.= 1387.2 \text{ kgs}$$

FLOORING AND SKIRTING CALCULATIONS



Various types of Flooring :-

1. Marble Flooring
2. Vetrified Tiles Flooring
3. Inter-lock Tiles Flooring etc.

Problem-1 :-

For a Room of size 40' x 30' with Floor Area of 1200 Ft² find,

- (i). no. of floor tiles required for flooring and Skirting,
if size of each floor tile = 12" x 12" and Height of Skirting = 4"
- (ii). Cement : Mortar required for laying Floor tiles with ratio 1:10
- (iii). Cement required for sticking Skirting to walls

Solution :-

(i). Floor Tiles required for Flooring and Skirting :-

1. Total Floor area = 1200 Ft²
2. Area of each tile = 12" x 12"
 .= 1' x 1'
 .= 1.0Ft²

3. Required no. of Floor tiles = Total floor area / area of each tile
 .= 1200/1.0
 .= 1200 tiles

4. Skirting calculation will be done in running feet:

- (a). Peripheral Length of Room = (L + B) x 2
 .= (40' + 30') x 2
 .= 140 Ft

- (b). Height of Skirting = 4" = 0.333Ft

- (c). Area of Skirting = L x D = 140.0 x 0.333 = 46.62 Ft²

- (d). No. of tiles required for Skirting = Area of Skirting / Area of each tile

Given area of each tile = 1' x 1' = 1.0Ft²

$$.= 46.62 / 1.0$$

$$.= 46.62 \text{ or approximately equal to } 47 \text{ tiles}$$

(ii). Cement : Mortar required for laying Floor tiles with ratio 1:10 :-



Area of Flooring = 1200Ft²

thickness of C : M layer = 2" = 0.166Ft

Volume of C : M required for laying floor tiles = Area of Flooring x thickness of C : M layer

$$.= 1200 \times 0.166$$

$$.= 199.20 \text{ Ft}^3$$

$$199.20 \text{ Ft}^3 = ? \text{ M}^3$$

$$\text{Since } 1.0\text{m} = 3.28\text{Ft}$$

$$.= 199.20 / 3.28^3$$

$$.= 5.645\text{m}^3$$

Standards :-

(a). Quantity of Sand required : for 1.0m³ of C:M = 1.25m³ Constant value

(b). Quantity of Cement required : for 1.0m³ of C:M = (1.25 x 1440) / last digit of c:m ratio

(1). Quantity of Sand required : for 1.0m³ = 1.25m³

$$5.645\text{m}^3 = ?$$

$$.= 5.645 \times 1.25$$

$$.= 7.056\text{m}^3$$

(2). Quantity of Cement required : for 1.0m³ = (1.25 x 1440) / 10

$$.= 180.0\text{kgs}$$

$$5.645\text{m}^3 = ?$$

$$.= 5.645 \times 180.0$$

$$.= 1016.10 \text{ kgs}$$

each bag of cement = 50 kgs

no. of cement bags required = 1016.10 / 50 = 20.322 or approximately equal to 21 bags

(iii). Cement required for sticking Skirting to walls :-

Area of Skirting = 46.62 Ft²

thickness of Cement layer = 4mm = 0.0131 Ft

4mm = ? Ft

Since 1" = 25.4mm

∴ 4/25.4

∴ 0.1574"

since 1' = 12"

∴ 0.1574/12

∴ 0.0131 Ft

Volume of Cement required = Area of Skirting x thickness of cement layer

∴ 46.62 x 0.0131

∴ 0.610 Ft³

∴ 0.0172m³

Standard weight of cement/m³ = 1440kgs

1.0m³ = 1440kgs

0.0172m³ = ? Kgs

∴ 0.0172 x 1440

∴ 24.768kgs

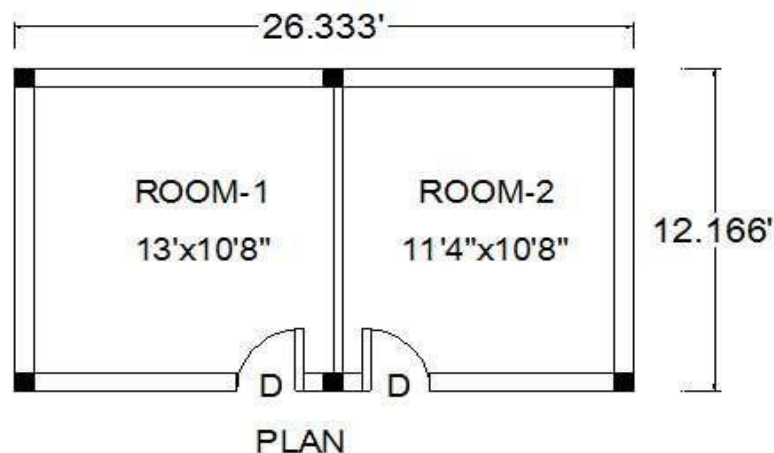
each bag of cement = 50 kgs

no. of cement bags required = 24.764 / 50 = 0.495 or approximately equal to 1 bags

Problem-2 :-

From the given plan of two rooms find,

- (i). No. of Floor tiles required for Flooring & Skirting, if size of each tile = 18" x 30" and Height of Skirting = 6" (ii). Cement : Mortar required for laying Floor tiles with ratio 1:8 (iii). Cement required for sticking Skirting to walls.



Solution :-(i). Floor Tiles required for Flooring and Skirting :-Floor Area:-

1. Room-1 = L x B

.= 13' x 10'8"

.= 13' x 10.666'

.= 138.658 Ft²

2. Room-2 = L x B

.= 11'4" x 10'8"

.= 11.333' x 10.666'

.= 120.877 Ft²

Total Floor area = 138.658 + 120.877 = 259.535 Ft²

2. Area of each tile = 18" x 30"

.= 1.5' x 2.5'

.= 3.75Ft²

3. Required no. of Floor tiles = Total floor area / area of each tile

.= 259.535 / 3.75

.= 69.20 tiles or approximately equal to 70 tiles

4. Skirting calculation will be done in running feet:

(a). Peripheral Length of Room-1 = (L + B) x 2

.= (13' + 10'8") x 2

.= (13' + 10.666') x 2

.= 47.332 Ft

(b). Peripheral Length of Room-2 = (L + B) x 2

.= (11'4" + 10'8") x 2

.= (11.333' + 10.666') x 2

.= 43.998 Ft

(c). Total length of Skirting = 47.332 + 43.998 = 91.33 Ft

(d). Height of Skirting = 6" = 0.50Ft

(c). Area of Skirting = L x D = 91.33 x 0.50 = 45.665 Ft²

(d). No. of tiles required for Skirting = Area of Skirting / Area of each tile

Given area of each tile = 1.5' x 2.5' = 3.75Ft²

.= 45.665 / 3.75

.= 12.177 or approximately equal to 13 tiles

(ii). Cement : Mortar required for laying Floor tiles with ratio 1:8 :-



Area of Flooring = 259.535Ft²

thickness of C : M layer = 2" = 0.166Ft

Volume of C : M required for laying floor tiles = Area of Flooring x thickness of C : M layer

$$.= 259.535 \times 0.1666$$

$$.= 43.238 \text{ Ft}^3$$

$$43.238 \text{ Ft}^3 = ? \text{ M}^3$$

$$\text{Since } 1.0\text{m} = 3.28\text{Ft}$$

$$.= 43.238 / 3.28^3$$

$$.= 1.225\text{m}^3$$

Standards :-

(a). Quantity of Sand required : for 1.0m³ of C:M = 1.25m³ Constant value

(b). Quantity of Cement required : for 1.0m³ of C:M=(1.25 x 1440) / last digit of c:m ratio

(1). Quantity of Sand required : for 1.0m³ = 1.25m³

$$1.225\text{m}^3 = ?$$

$$.= 1.225 \times 1.25$$

$$.= 1.531\text{m}^3$$

(2). Quantity of Cement required : for 1.0m³ = (1.25 x 1440) / 8

$$.= 225.0\text{kgs}$$

$$1.225\text{m}^3 = ?$$

$$.= 1.225 \times 225.0$$

$$.= 275.625 \text{ kgs}$$

each bag of cement = 50 kgs

no. of cement bags required = 275.625 / 50 = 5.51 or approximately equal to 6 bags

(iii). Cement required for sticking Skirting to walls :-

Area of Skirting = 45.665 Ft²

thickness of Cement layer = 4mm = 0.0131 Ft

Volume of Cement required = Area of Skirting x thickness of cement layer

$$.= 45.665 \times 0.0131$$

$$.= 0.598 \text{ Ft}^3$$

$$.= 0.0169 \text{ m}^3$$

Standard weight of cement/m³ = 1440kgs

$$1.0 \text{ m}^3 = 1440 \text{ kgs}$$

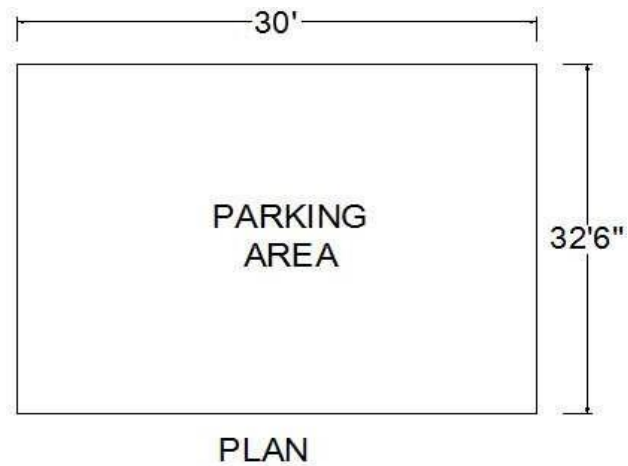
$$0.0169 \text{ m}^3 = ? \text{ Kgs}$$

$$.= 0.0169 \times 1440$$

$$.= 24.336 \text{ kgs}$$

each bag of cement = 50 kgs

no. of cement bags required = 24.336 / 50 = 0.486 or approximately equal to 1 bags

Problem-3:-

From the given figure, Find

- (i). No. of inter-lock tiles to be layed in Parking Area with Inter-lock tile specification that, an area of 12.0Ft² will cover 30 no. of tiles.
- (ii). C:M required for laying Inter-lock tiles in parking area with ratio 1 : 10

Solution :-(i). Required no. of Inter-lock tiles:-

Area of Parking = L x B = 30' x 32'6"

$$.= 30' \times 32.5'$$

$$.= 975.0 \text{ Ft}^2$$

Given specification for Inter-lock tiles = 30 tiles will cover 12.0Ft² area

$$12.0 \text{ Ft}^2 = 30 \text{ tiles}$$

$$975.0 \text{ Ft}^2 = ? \text{ Tiles}$$

$$.= (975.0 / 12.0) \times 30$$

$$.= 2437.5 \text{ tiles or approximately equal to 2438 tiles}$$

(ii). C:M required for laying Inter-lock tiles in parking area with ratio 1 : 10:-

Area of Inter-lock tiles = 975.0Ft²

thickness of C : M layer = 2" = 0.166Ft

Volume of C : M required for laying floor tiles = Area of Inter-lock tiles x thickness of
C : M layer

$$.= 975.0 \times 0.1666$$

$$.= 162.435 \text{ Ft}^3$$

$$162.435 \text{ Ft}^3 = ? \text{ M}^3$$

$$\text{Since } 1.0\text{m} = 3.28\text{Ft}$$

$$.= 162.435 / 3.28^3$$

$$.= 4.603\text{m}^3$$

Standards :-

(a). Quantity of Sand required : for 1.0m³ of C:M = 1.25m³ Constant value

(b). Quantity of Cement required : for 1.0m³ of C:M=(1.25 x 1440) / last digit of c:m ratio

(1). Quantity of Sand required : for 1.0m³ = 1.25m³

$$4.603\text{m}^3 = ?$$

$$.= 4.603 \times 1.25$$

$$.= 5.753\text{m}^3$$

(2). Quantity of Cement required : for 1.0m³ = (1.25 x 1440) / 10

$$.= 180.0\text{kgs}$$

$$4.603\text{m}^3 = ?$$

$$.= 4.603 \times 180.0$$

$$.= 828.54 \text{ kgs}$$

each bag of cement = 50 kgs

no. of cement bags required = 828.54 / 50 = 16.57 or approximately equal to 17 bags

WALL TILE CALCULATIONS

Ceramic Tile or Vitrified Tiles for walls :-



Problem-1 :-

From the given plan of Toilet, Find

(i). Required no. of wall tiles, if size of each wall tile = 9" x 12"

wall tiles shall be provided up to Ceiling height

Height of Ceiling = 10'

Size of Door = 2'6" x 7'

Size of Ventilator = 3' x 2'

(ii). Cement required for sticking wall tiles



Solution:-

(i). Required no. of wall tiles :-

$$1. \text{ Wall Tile area} = L \times D = 30' \times 10' = 300.0 \text{ Ft}^2$$

Where,

L = Peripheral length of four wall

D = Ht. of Ceiling = 10' given

$$L = (L + B) \times 2$$

$$L = (7' + 8') \times 2 = 30 \text{ Ft}$$

2. Deduction of openings i.e., Door area & Ventilator area

$$\text{Door area} = L \times D = 2'6'' \times 7' = 17.5 \text{ Ft}^2$$

$$\text{Ventilator area} = L \times D = 3' \times 2' = 6.0 \text{ Ft}^2$$

$$\text{Total area} = 23.50 \text{ Ft}^2$$

3. Wall Tile area after deductions = $300.0 - 23.50 = 276.50 \text{ Ft}^2$ $108''^2 = ? \text{ Ft}$
Since $1' = 12''$
 4. Area of each wall tile = $L \times D = 9'' \times 12'' = 108''^2 = 0.75 \text{ Ft}^2$ $= 108 / 12^2$
 $= 0.75 \text{ Ft}$
 5. No. of Wall Tiles required = Total wall tile area / area of each wall tile
 $= 276.50 / 0.75$
 $= 368.666$ or approximately equal to 369 wall tiles

(ii). Cement required for sticking wall tiles :-

Area of Wall tiles = 276.50 Ft^2

Thickness of Cement layer = $4\text{mm} = 0.0131 \text{ Ft}$

Volume of Cement required = Area of wall tiles x thickness of Cement layer

$$= 276.50 \times 0.0131$$

$$= 3.622 \text{ Ft}^3$$

$$= 0.102 \text{ m}^3$$

$$4\text{mm} = ? \text{ Ft}$$

$$\text{Since } 1'' = 25.4\text{mm}$$

$$= 4/25.4$$

$$= 0.1574''$$

$$0.1574'' = ? \text{ Ft}$$

$$\text{Since } 1' = 12''$$

$$= 0.1574 / 12$$

$$= 0.0131 \text{ Ft}$$

$$3.622 \text{ Ft}^3 = ? \text{ M}^3$$

$$\text{Since } 1\text{m} = 3.28\text{Ft}$$

$$= 3.622 / 3.28^3$$

$$= 0.102 \text{ m}^3$$

Standard weight of Cement / $\text{m}^3 = 1440\text{kgs}$

$$\text{for } 1.0\text{m}^3 = 1440 \text{ kgs}$$

$$0.102 \text{ m}^3 = ? \text{ Kgs}$$

$$= 0.102 \times 1440$$

$$= 146.88 \text{ kgs}$$

$$\text{each bag of cement} = 50.0 \text{ kgs}$$

$$\text{No. of Cement bags required} = 146.88 / 50$$

$$= 2.93 \text{ or approximately equal to 3 bags of cement}$$

Problem-2 :-

From the given plan of Toilet, Find

(i). Required no. of wall tiles, if size of each wall tile = 24" x 12"

wall tiles shall be provided up to Door Sill level

Height of Ceiling = 10'

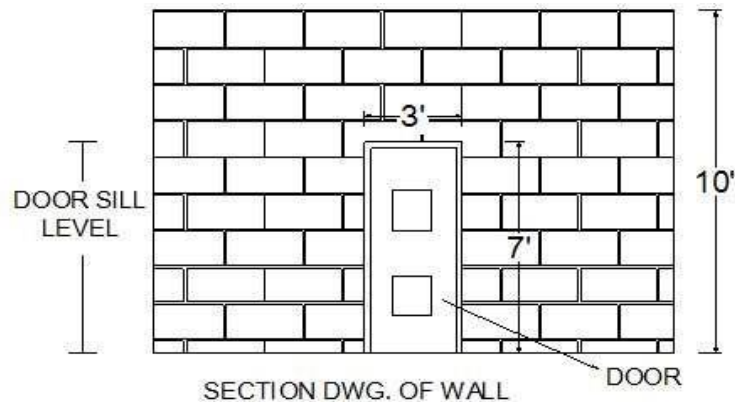
Size of Door = 2'6" x 7'

Size of Ventilator = 3' x 2'

(ii). Cement required for sticking wall tiles



PLAN OF TOILET



SECTION DWG. OF WALL

Solution:-

(i). Required no. of wall tiles :-

Sill level = Door height = 7'

$$1. \text{ Wall Tile area} = L \times D = 32.5' \times 7' = 227.5 \text{ Ft}^2$$

Where,

L = Peripheral length of four wall

D = Height up to Door Sill level = 7'

$$L = (L + B) \times 2$$

$$L = (7'6" + 8'9") \times 2 = 32.50 \text{ Ft}$$

2. Deduction of openings i.e., Door area & Ventilator area

$$\text{Door area} = L \times D = 2'6" \times 7' = 17.5 \text{ Ft}^2$$

$$\text{Ventilator area} = L \times D = 3' \times 2' = 6.0 \text{ Ft}^2$$

$$\text{Total area} = 23.50 \text{ Ft}^2$$

$$3. \text{ Wall Tile area after deductions} = 227.50 - 23.50 = 204.0 \text{ Ft}^2$$

$$4. \text{ Area of each wall tile} = L \times D = 24" \times 12" = 288" = 2.0 \text{ Ft}^2$$

$$288" = ? \text{ Ft}$$

$$\text{Since } 1' = 12"$$

$$.= 288 / 12^2$$

$$.= 2.0 \text{ Ft}$$

$$\begin{aligned}
 5. \text{ No. of Wall Tiles required} &= \text{Total wall tile area} / \text{area of each wall tile} \\
 &= 204.0 / 2.0 \\
 &= 102 \text{ wall tiles required}
 \end{aligned}$$

(ii). Cement required for sticking wall tiles :-

$$\text{Area of Wall tiles} = 204.0 \text{ Ft}^2$$

$$\text{Thickness of Cement layer} = 4\text{mm} = 0.0131 \text{ Ft}$$

$$\text{Volume of Cement required} = \text{Area of wall tiles} \times \text{thickness of Cement layer}$$

$$= 204.0 \times 0.0131$$

$$= 2.672 \text{ Ft}^3$$

$$= 0.0757 \text{ m}^3$$

$$4\text{mm} = ? \text{ Ft}$$

$$\text{Since } 1" = 25.4\text{mm}$$

$$= 4/25.4$$

$$= 0.1574"$$

$$0.1574" = ? \text{ Ft}$$

$$\text{Since } 1' = 12"$$

$$= 0.1574 / 12$$

$$= 0.0131 \text{ Ft}$$

$$2.672 \text{ Ft}^3 = ? \text{ M}^3$$

$$\text{Since } 1\text{m} = 3.28\text{Ft}$$

$$= 2.672 / 3.28^3$$

$$= 0.0757 \text{ m}^3$$

$$\text{Standard weight of Cement} / \text{m}^3 = 1440\text{kgs}$$

$$\text{for } 1.0\text{m}^3 = 1440 \text{ kgs}$$

$$0.0757 \text{ m}^3 = ? \text{ Kgs}$$

$$= 0.0757 \times 1440$$

$$= 109.008 \text{ kgs}$$

$$\text{each bag of cement} = 50.0 \text{ kgs}$$

$$\text{No. of Cement bags required} = 109.008 / 50$$

$$= 2.18 \text{ or approximately equal to 3 bags of cement}$$

Problem-3 :-

From the given plan of Kitchen, Find

(i). Required no. of wall tiles, if size of each wall tile = 18" x 12"

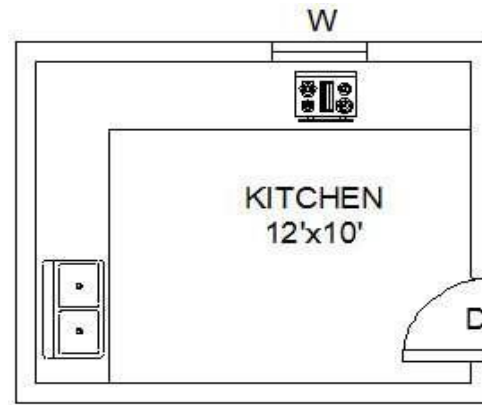
wall tiles shall be provided up to height 2'9" above kitchen platform.

Height of Ceiling = 10'

Size of Door = 3' x 7'

Size of Window = 3' x 3'

(ii). Cement required for sticking wall tiles



PLAN OF KITCHEN

Solution:-

(i). Required no. of wall tiles :-

$$1. \text{ Wall Tile area} = L \times D = 22' \times 2.75' = 60.50 \text{ Ft}^2$$

Where,

L = length of two diagonal wall

D = Height of wall tiles to be provided above kitchen platform i.e., 2'9" given

$$L = 12' + 10' = 22'$$

$$D = 2'9"$$

2. Deduction of openings i.e., Window area

$$\text{Window area} = L \times D = 3' \times 3' = 9.0 \text{ Ft}^2$$

$$3. \text{ Wall Tile area after deductions} = 60.50 - 9.0 = 51.50 \text{ Ft}^2$$

$$4. \text{ Area of each wall tile} = L \times D = 18" \times 12" = 216"{}^2 = 1.50 \text{ Ft}^2$$

$$4\text{mm} = ? \text{ Ft}$$

$$\text{Since } 1" = 25.4\text{mm}$$

$$.= 4/25.4$$

$$.= 0.1574"$$

$$0.1574" = ? \text{ Ft}$$

$$\text{Since } 1' = 12"$$

$$.= 0.1574 / 12$$

$$.= 0.0131 \text{ Ft}$$

$$216"{}^2 = ? \text{ Ft}$$

$$\text{Since } 1' = 12"$$

$$.= 216 / 12^2$$

$$.= 1.50 \text{ Ft}$$

$$0.674 \text{ Ft}^3 = ? \text{ M}^3$$

$$\text{Since } 1\text{m} = 3.28\text{Ft}$$

$$.= 0.674 / 3.28^3$$

$$.= 0.0191 \text{ m}^3$$

$$\begin{aligned}
 5. \text{ No. of Wall Tiles required} &= \text{Total wall tile area} / \text{area of each wall tile} \\
 &= 51.50 / 1.50 \\
 &= 34.333 \text{ or approximately equal to 35 wall tiles required.}
 \end{aligned}$$

(ii). Cement required for sticking wall tiles :-

$$\text{Area of Wall tiles} = 51.50 \text{ Ft}^2$$

$$\text{Thickness of Cement layer} = 4\text{mm} = 0.0131 \text{ Ft}$$

$$\text{Volume of Cement required} = \text{Area of wall tiles} \times \text{thickness of Cement layer}$$

$$= 51.50 \times 0.0131$$

$$= 0.674 \text{ Ft}^3$$

$$= 0.0191 \text{ m}^3$$

$$\text{Standard weight of Cement} / \text{m}^3 = 1440\text{kgs}$$

$$\text{for } 1.0\text{m}^3 = 1440 \text{ kgs}$$

$$0.0191 \text{ m}^3 = ? \text{ Kgs}$$

$$= 0.0191 \times 1440$$

$$= 27.504 \text{ kgs}$$

$$\text{each bag of cement} = 50.0 \text{ kgs}$$

$$\text{No. of Cement bags required} = 27.504 / 50$$

$$= 0.55 \text{ or approximately equal to 1 bags of cement}$$

FALSE CEILING CALCULATIONS

False Ceiling :

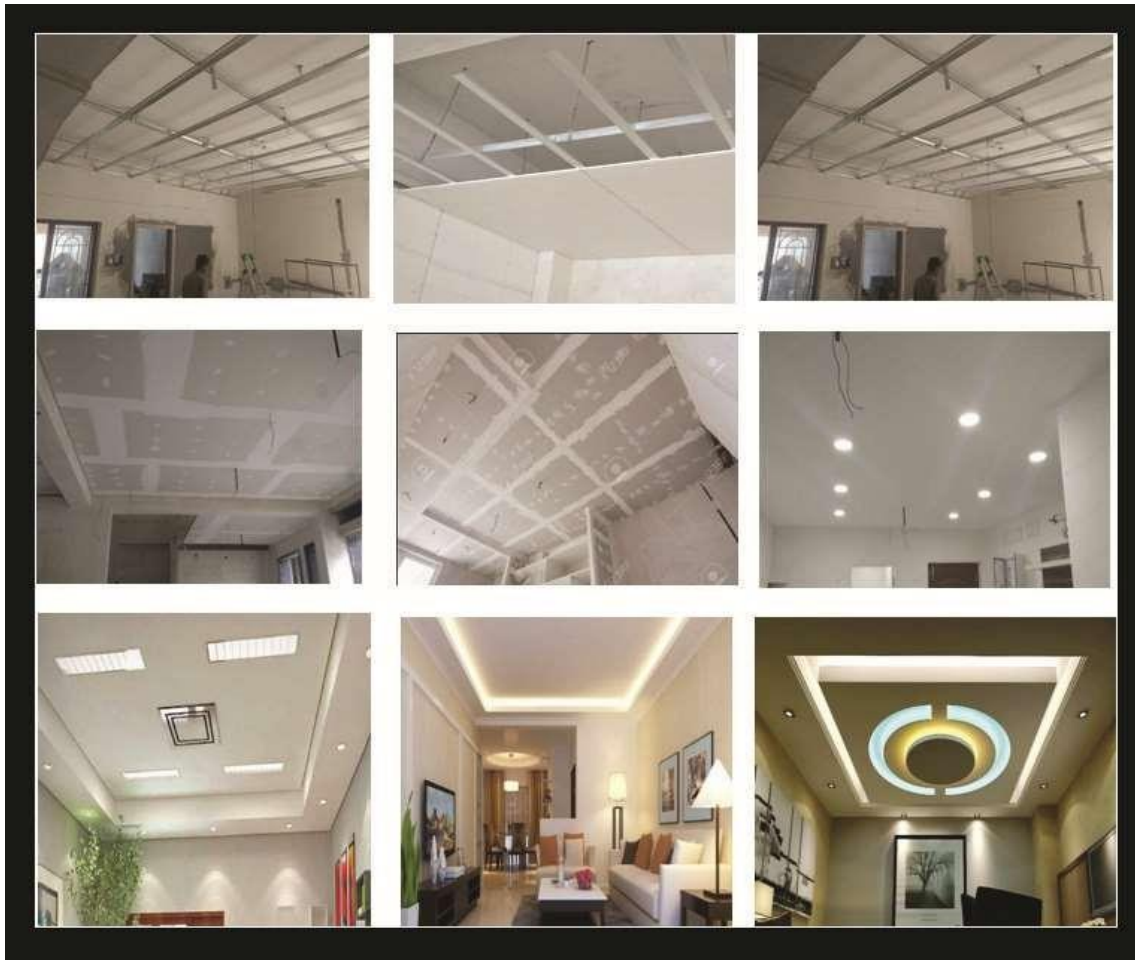
The Ceiling provided under the True Ceiling is Called as False Ceiling.

It is generally provided to have more interior look with eliminated florescent lights and also to hide Drop beams and HVAC Ducting (Heat, ventilation and air conditioning). False Ceiling is done by means of material gypsum board and pop board (plaster of Paris). Generally gypsum board is bit expensive then pop board.

The calculation of False Ceiling is done in terms of Area Calculation

Ceiling border Calculation is done in Running Feet

Extra money has to pay if Ceiling has offset design.



Problem-1 :-

Find Cost amount of False-Ceiling for a Room of size 15' x 18' with plain design along with the Ceiling border, by means of Gypsum board and Provide 20 no. of round Ceiling light. If, 1. Rate/SFt for Ceiling = 60.0 rupees, along with material and installation.
 2. Rate/ running feet for Ceiling border = 35.0 rupees along with material and installation.
 3. Rate/each round ceiling light = 650.0 rupees

Solution :-

Size of room = 15' x 18'

Area of False Ceiling = 15' x 18' = 270Ft²

Length of Ceiling border = Peripheral length "L" = (L+B) x 2 = (15'+18') x 2 = 66Ft

1. Cost amount for Ceiling = Area of Ceiling x Rate/Ft² for Ceiling
 . = 270 x 60
 . = 16,200.0 rupees
2. Cost amount for Ceiling border = length of Ceiling border x Rate/ running feet
 . = 66 x 35
 . = 2310 rupees
3. Cost of Ceiling lights = Rate/each light x no. of lights
 . = 650 x 20
 . = 13,000 rupees
4. Total Cost = 16,200 + 2,310 + 13,000 = 31,510.0 rupees

Problem-2 :-

Find Cost amount of False-Ceiling for a Room of size 20' x 30' with 1Ft off-set plain design along with the Ceiling border, by means of Gypsum board and Provide 30 no. of round Ceiling light. If,

1. Rate/SFt for Ceiling = 60.0 rupees, along with material and installation.
2. Rate/SFt for Ceiling off-set = 60.0 rupees, along with material and installation.
3. Rate/ running feet for Ceiling border = 35.0 rupees along with material and installation.
4. Rate/each round ceiling light = 350.0 rupees

Solution :-

Size of room = 20' x 30'

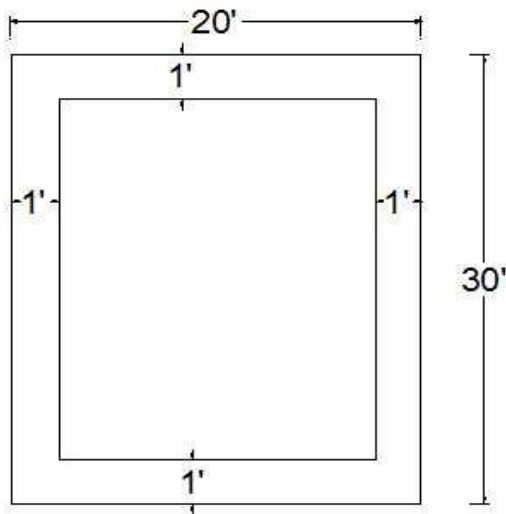
Area of False Ceiling = 20' x 30' = 600 Ft²

Length of False Ceiling off-set = (20' + 28') x 2 = 96.0Ft

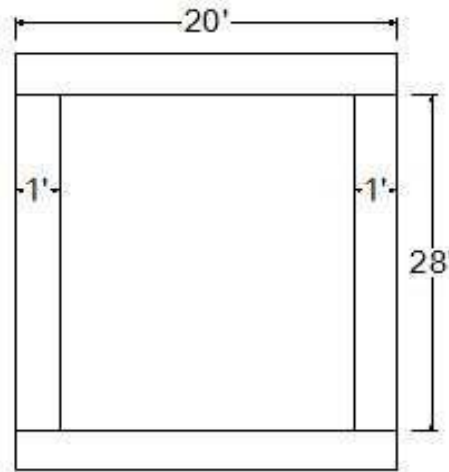
Area of False Ceiling off-set = L x B = 96' x 1' = 96.0 Ft²

Length of Ceiling border :-

Peripheral length "L" = (L+B) x 2 = (20'+30') x 2 = 100 Ft



PLAN OF FALSE CEILING



PLAN OF FALSE CEILING

$$L = 20' \times 2 + 28' \times 2 = 96 \text{ FT}$$

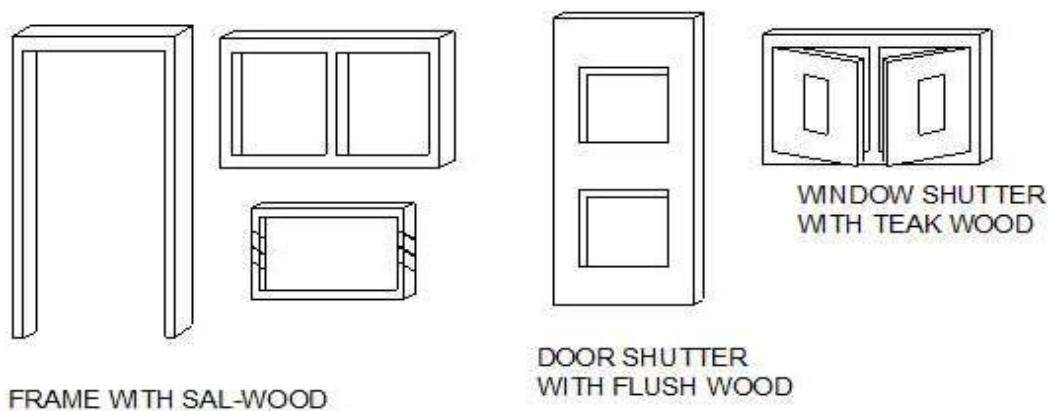
1. Cost amount for Ceiling = Area of Ceiling x Rate/Ft² for Ceiling
 . = 600 x 60
 . = 36,000 rupees
2. Cost amount for Ceiling Off-set = Area of Ceiling off-set x Rate/Ft² for Ceiling
 . = 96.0 x 60
 . = 5760.0 rupees
3. Cost amount for Ceiling border = length of Ceiling border x Rate/ running feet
 . = 100 x 35
 . = 3500 rupees
4. Cost of Ceiling lights = Rate/each light x no. of lights
 . = 350 x 30
 . = 10,500 rupees
5. Total Cost = 36,000 + 5760 + 3500 + 10500 = 55,760 rupees

Note :- If any Ceiling to be design with heavy decoration with expensive light then, the calculation of False-Ceiling will be done interms of Ceiling area only but the rate/Ft² will be more than normal rates

WOOD CALCULATIONS FOR DOORS AND WINDOWS

Types of Wood:

- | | | |
|---|-------------|---|
| 1 | Teak Wood | Very expensive - Used for Doors and windows |
| 2 | Sal-wood | Economical- Used for Door Frames |
| 3 | Flush wood | Cheaper- Used for Door Shutters |
| 4 | Plywood | Economical Used for Wardrobes, Shelves and Cup-board |
| 5 | Nova pan | Cheaper- used for Tables and Chairs [with dust partials of wood] |
| 6 | Rubber wood | Cheaper- but not recommended, as it has expansion and contraction due to weather conditions |



In olden days people used to measure the quantity of wood required to make Doors & Windows and according to measurement they would buy the wood from the market and let the carpenter make Doors & Windows on Site. Presently Doors & Windows are available in ready-made to save the time and to get rid of man-power.

Problem -1:-

Find Cost of Doors, of Size 3'6" x 7' along with Door shutter and Door frame if,
 no. of Doors = 6 and section of Door frame = 3"x3"
 Rate / Door frame = 2600 rupees and for Door shutter Rate / ft² = 110.0 rupees

Solution:-

1. Door Frames :

Given rate for each Door frame of size 3'6" x 7' with section of frame 3"x3" = 2600 rupees

No. of Door frames = 6

Cost for Door frames = 2600 x 6 = 15,600/-

2. Door Shutters :

Given size of Door = 3'6" x 7'
 . = 42" x 84"

Size of Door shutter area = L x H = 36" x 81" = 2916"² = 20.25 Ft²

length of Door shutter = 42" - 3" - 3" = 36"

Height of Door Shutter = 84" - 3" = 81"

2916"² = ? Ft²

Since 1Ft = 12"

. = 2916 / 12²

. = 20.25 Ft²

For Door Shutter given rate / Ft² = 110.0 rupees

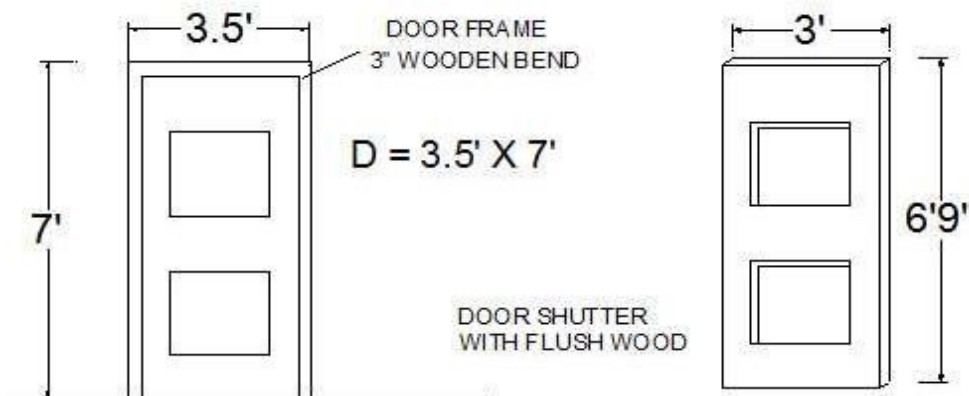
No. of Shutters = 6

Cost for Door Shutters = 110.0 x 20.25 x 6

. = 13,365/- rupees

Total cost for 6 Door Frames & Door Shutters = 15600 + 13365 = 28,965/-

Door shutters will be selling interms of area.

**Problem -2:-**

Find Cost of Windows, of Size 3' x 4' along with Window shutter and Window frame if,

no. of Windows = 4 and section of window frame = 3"x3"

Rate / Window frame = 2800 rupees and for Window shutter Rate / Window Shutter =

900.0 rupees

Solution:-1. Window Frames :

Given rate for each Window frame of size 3' x 4' with section of frame 3"x3"=3200 rupees

No. of window frames = 4

Cost for window frames = 2800 x 4 = 11200/-

2. Window Shutters :

size of each window shutter = 13.5" x 42"

length of Window shutter = 36" - 3" - 3" - 3" = 27"

providing two shutter panels . = 27 / 2

in each window . = 13.5"

Height of Window Shutter = 48" - 3" - 3" = 42"

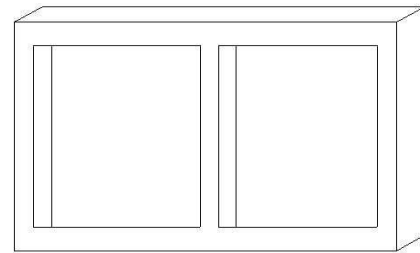
Given Rate/each window shutter = 900.0

No. of Shutters = 2 in each window

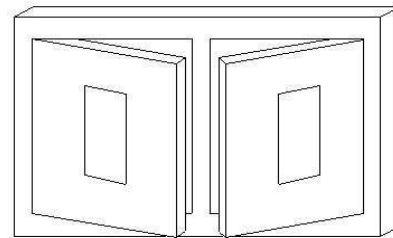
No. of Windows = 4

Cost for Window Shutters = 900 x 2 x 4

. = 7200/- rupees



WINDOW FRAME



WINDOW SHUTTER

Total cost for 4 Window Frames & Window Shutters = 11200 + 7200 = 18,400/-

WALL PUTTY CALCULATIONS



Wall Putty :- (Available in a form of Powder or Paist provided on Walls and Ceilings).
 Wall putty is provided on walls and ceiling to reduce the friction and to have smooth surface. it is provided in two coats and rub with San-paper. Thickness of wall putty layer
 . = 3mm. water is added to wall putty powder to make paste out of it, and paste will be
 pasted on walls. Standard weight of wall putty / m^3 = 849.0kgs
 it is available in bags of 5kg, 10kg, 20kg and 40kgs

Problem-1 :-

Find no. of wall putty bag required and cost amount for the given details,

wall surface area = 1200 Ft^2

Ceiling area = 800 Ft^2

Rate/bag = 1200 rupees (for 40kg bag)

Also find labour charges if rate/ ft^2 = 5.0/- rupees

Solution :-

1. Area of wall putty = wall surface area + ceiling area

$$.= 1200 + 800$$

$$.= 2000 \text{ Ft}^2$$

$$.= 185.901 \text{ m}^2$$

2. Thickness of wall putty layer = 3mm = 0.003m

3. Volume of wall putty = area of wall putty x thickness of wall putty

$$.= 185.901 \times 0.003$$

$$.= 0.557 \text{ m}^3$$

4. Standard weight of wall putty/ m^3 = 849.0kgs

$$1.0\text{m}^3 = 849.0\text{kgs}$$

$$0.557\text{m}^3 = ? \text{ Kgs}$$

$$.= 0.557 \times 849$$

$$.= 472.893 \text{ kgs}$$

5. No. of wall putty bags required = $472.893/40$

$$.= 11.822 \text{ or approximately equal to 12 bags}$$

6. Rate/bags = 1200/- rupees

7. Cost amount required = $1200 \times 12 = 14400/-$ rupees.

8. Labour charges:-

Rate/ $\text{Ft}^2 = 5.0/-$ rupees

wall putty area = 2000 Ft^2

Total Labour charges = $5.0 \times 2000 = 10,000/-$ rupees.

PAINT CALCULATIONS

Primer Paint :- (white wash)

Primer paint (white wash) is applied to plastered area before applying Emulsion paint to walls. so that the paint shall have required good looking view.

Standard :-

1.0 litre of Primer paint will cover 40.0 Ft^2 area



Problem-1 :-

For an Area of 6500.0 Ft^2 (plastered surface area), Find how many litres of white Primer is required.

Solution :-

According to standard, 1.0 litre of Primer paint will cover 40.0 Ft^2 area.

$$40.0 \text{ Ft}^2 = 1.0 \text{ litre}$$

$$6500.0 \text{ Ft}^2 = ? \text{ Litre}$$

$$.= 6500 / 40$$

$$.= 162.5 \text{ litres}$$

Each bucket of Primer paint is of 20.0 litre

Cost of each bucket = 3000/- rupees

No. of Primer Bucket required = required primer in litres / primer in each bucket

$$.= 162.5/20$$

.= 8.125 or approximately equal to 9 Primer Bucket required.

Cost amount required = Rate/bucket x no. of bucket

$$.= 3000 \times 9$$

$$.= 27,000/- \text{ rupees}$$

Emulsion and Enamel Paint :-

Types of Paints:

1. Emulsion Paint or Water Bond Paint ----- used for Plastering area
2. Enamel Paint or Oil Bond Paint ----- used for Doors and Windows

Standards for Double coat of Paint:

1. 1.0 Litre of Emulsion paint will cover 4.2 m^2 area or 45 Ft^2 area
2. 1.0 Litre of Enamel paint will cover 4.5 m^2 area or 50 Ft^2 area

[a]. Price of External Emulsion paint is expensive, as it is expose to Sun rays but never get fade out, also expose to rain water but never get wash out. Emulsion paint will works as rain-coat to building.

[b]. Price of Internal paint is economical, as it is not expose to Sun-rays and Rain water.



Problem-1 :-

From the given plan of two rooms find Internal Emulsion paint required & External Emulsion paint required in litres, and Enamel paint required in litres for Doors,

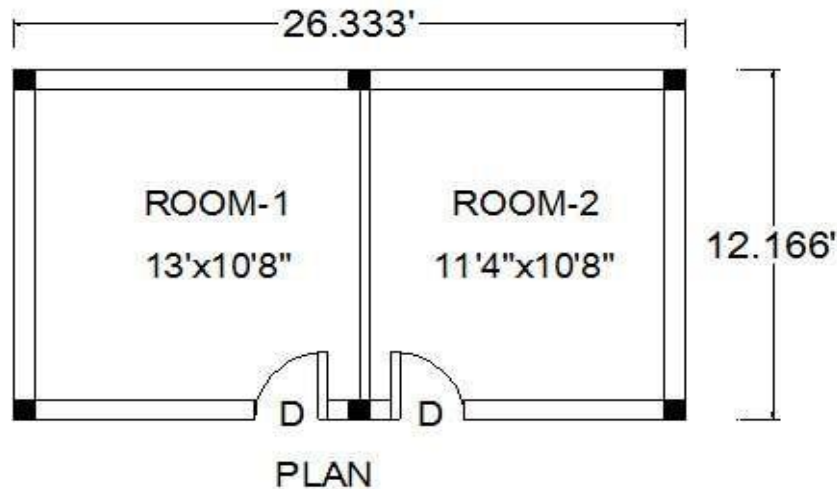
if thickness of Slab = 6"

Height of Ceiling = 10'

Size of Door = 3'6" x 7'

External wall thickness = 9"

Internal wall thickness = 6"



Solution :-

(i). Internal Emulsion paint :-

1. Ceiling area:

$$\begin{aligned} \text{(a). Room-1} &= L \times B = 13' \times 10'8'' \\ &= 13' \times 10.666' \\ &= 138.658 \text{ Ft}^2 \end{aligned}$$

$$\begin{aligned} \text{(b). Room-2} &= L \times B = 11'4'' \times 10'8'' \\ &= 11.333' \times 10.666' \\ &= 120.877 \text{ Ft}^2 \end{aligned}$$

2. Wall surface area :-

$$\begin{aligned} \text{(a). Room-1} &= L \times D = 47.332' \times 10' \\ &= 473.32 \text{ Ft}^2 \end{aligned}$$

D = Height of Ceiling = 10'

Peripheral length of wall 'L' = (L+B) x 2

$$= (13' + 10.666') \times 2$$

$$= 47.332 \text{ Ft}$$

$$(b). \text{ Room-2} = L \times D = 43.998' \times 10'$$

$$.= 439.98 \text{ Ft}^2$$

$$D = \text{Height of Ceiling} = 10'$$

$$\text{Peripheral length of wall 'L'} = (L+B) \times 2$$

$$.= (11.333' + 10.666') \times 2$$

$$.= 43.998 \text{ Ft}$$

$$3. \text{ Deduction of Door area} = L \times D \times \text{no.s}$$

$$.= 3'6'' \times 7' \times 2$$

$$.= 3.5' \times 7' \times 2$$

$$.= 49.0 \text{ Ft}^2$$

$$4. \text{ Total internal paint area} = 138.658 + 120.877 + 473.32 + 439.98 - 49.0 = 1123.835 \text{ Ft}^2$$

According to Standards 1.0 litre of Emulsion paint will cover 45.0 Ft² area

$$45.0 \text{ Ft}^2 = 1.0 \text{ litre}$$

$$1123.835 \text{ Ft}^2 = ? \text{ Litre}$$

$$.= 1123.835 / 45$$

$$.= 24.974 \text{ or approximately equal to 25 litres}$$

$$\text{Rate/litre} = 160/- \text{ rupees}$$

$$\text{Cost amount required} = 160 \times 25 = 4000/- \text{ rupees}$$

(li). External Emulsion paint :-

$$1. \text{ External paint area} = L \times D$$

$$.= 76.998' \times 10.5'$$

$$.= 808.479 \text{ Ft}^2$$

$$\text{External Peripheral length of wall 'L'} = (L+B) \times 2$$

$$.= (26.333' + 12.166') \times 2$$

$$.= 76.998 \text{ Ft}$$

$$D = \text{Height of Ceiling} = 10'$$

$$\text{Slab thickness} = 6'' = 0.50'$$

$$2. \text{ Deduction of Door area} = L \times D \times \text{no.s}$$

$$.= 3'6'' \times 7' \times 2$$

$$.= 3.5' \times 7' \times 2$$

$$.= 49.0 \text{ Ft}^2$$

$$3. \text{ Total External paint area} = 808.479' - 49.0' = 759.479 \text{ Ft}^2$$

According to Standards 1.0 litre of Emulsion paint will cover 45.0 Ft² area

$$45.0\text{ft}^2 = 1.0 \text{ litre}$$

$$759.479 \text{ Ft}^2 = ? \text{ Litre}$$

$$.= 759.479 / 45$$

$$.= 16.877 \text{ or approximately equal to 17 litres}$$

Rate/litre = 180/- rupees

Cost amount required = 180 x 17 = 3060/- rupees

(iii). Enamel paint for Doors :-

Size of Door = 3'6" x 7'

No. of Doors = 2

Enamel paint Area = L x D x 2 x no. of Doors

$$.= 3'6" \times 7' \times 2 \times 2$$

$$.= 3.5' \times 7' \times 2 \times 2$$

$$.= 98.0 \text{ Ft}^2$$

According to Standards 1.0 litre of Enamel paint will cover 50.0 Ft² area

$$50.0\text{ft}^2 = 1.0 \text{ litre}$$

$$98.0 \text{ Ft}^2 = ? \text{ Litre}$$

$$.= 98.0 / 50$$

$$.= 1.96 \text{ or approximately equal to 2 litres}$$

Rate/litre = 170/- rupees

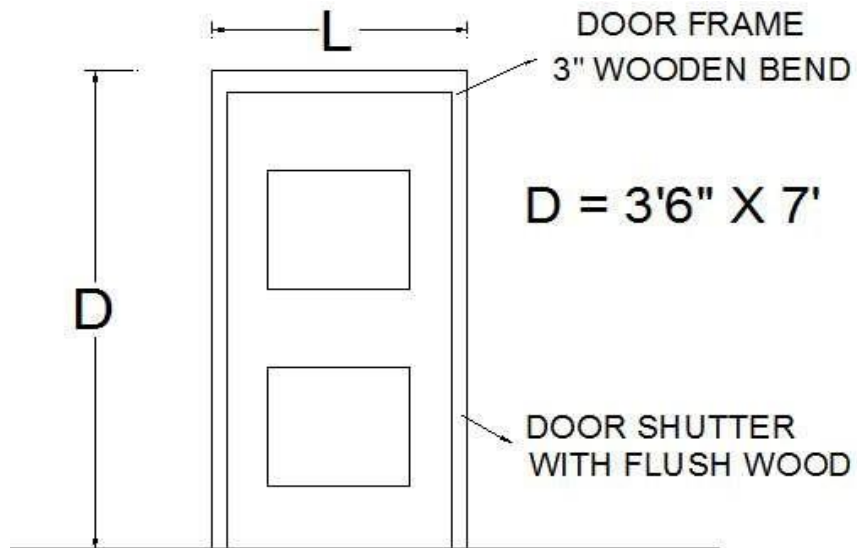
Cost amount required = 170 x 2 = 340.0/- rupees

Note:-

To find area of Enamel paint for Doors, Front and back surface area of Door should be added, and side area shall not be added, because the oil paint or Enamel paint will be thick in nature, which will be harder to apply on the surface of Door. To make it thin, Turpentine (thinner) shall be added so that the paint brush will play softly.

Turpentine will make thick Enamel paint to thin Enamel paint, which increases the quantity of paint and this increased quantity of paint will cover internal and side area of Doors.

Surface Area of Door = $L \times D$ (front area) + $L \times D$ (back area)
. $= L \times D \times 2$



REINFORCEMENT CALCULATIONS

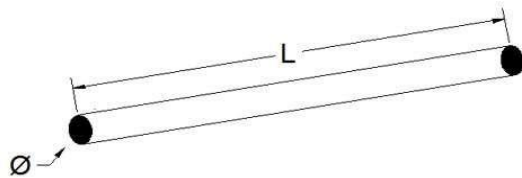
The dia for Steel bar or Reinforcement bar comes between 6mm to 40mm.

(Re-bars = Reinforcement bars = Steel-bars)

Types of Steel :

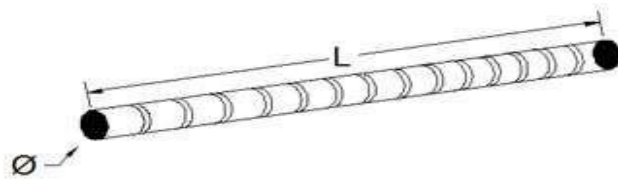
1. Mild- Steel (Plain steel bar)

Available dia of bar = 6mm and 8mm



2. Tor- Steel (Twisted steel bar which has anchorage on it)

Available dia of bar = 8mm, 10mm, 12mm, 16mm, 20mm up to 40mm



General Practice:

- (i). The diameter of Steel bar used for Main and Distribution bars are above 8mm but in India for Slabs, Dia 8mm bar can be used.
- (ii). The diameter of Steel bar used for Stirrups are 6mm and 8mm.

3. Meaning or Full form of equation:

- (i). $12\varnothing 16\text{mm}$ = 12 steel bars of diameter 16mm
- (ii). $\varnothing 16\text{mm}@150\text{mm}$ = diameter of steel bar is 16mm at an spacing of 150mm
(clear spacing)
- (iii). $\varnothing 20\text{mm}@200\text{mm c/c}$ = diameter of steel bar is 20mm at an spacing of 200mm
(centre to centre).

4. Types of Footing meshes commonly used :-

- a. Plain Footing mesh
- b. Mesh with hooks
- c. Mesh with up-projection
- d. Raft mesh

5. For G+2 or G+3 building, Diameter of Steel-Bar commonly used for the following :

- a. Footings : $\varnothing 8\text{mm}$ and $\varnothing 10\text{mm}$ commonly used for Footing Meshes in India.
- b. Columns : $6\varnothing 12\text{mm}$ (main bars) and $\varnothing 8\text{mm}@100\text{mm}$ or 4"
- c. Plinth Beams : $6\varnothing 10\text{mm}$ (main bars) and $\varnothing 8\text{mm}@100\text{mm}$ or 4"
- d. Floor Beams : $6\varnothing 12\text{mm}$ (main bars) and $\varnothing 8\text{mm}@100\text{mm}$ or 4"
- e. Floor Slab : $\varnothing 8\text{mm}@100\text{mm}$ or 4" or $\varnothing 10\text{mm}@100\text{mm}$ or 4" (mesh in both direction)
- f. Stair-case : Waist slab mesh $\varnothing 10\text{mm}@100\text{mm}$ and Handrail mesh $\varnothing 8\text{mm}@100\text{mm}$
- g. water tank below ground level : Bottom & top slab mesh $\varnothing 8\text{mm}@100\text{mm}$
Shear wall mesh : $\varnothing 10\text{mm}@100\text{mm}$
- h. Over head water tank on roof level : Bottom & top slab mesh $\varnothing 10\text{mm}@100\text{mm}$
Shear wall mesh : $\varnothing 12\text{mm}@100\text{mm}$

BAR BENDING SCHEDULE (B.B.S)

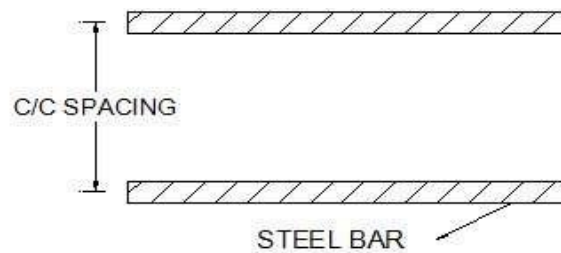
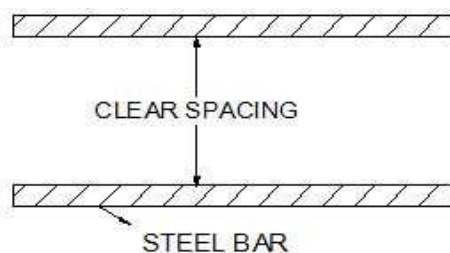
1. Standard length of each Steel bar all over the world = 12.0 m or 40 Ft.



2. Spacing :-

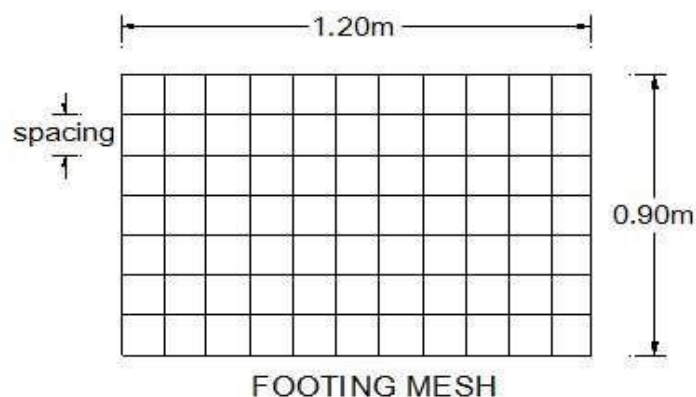
The distance between two steel bar is called as Spacing

- (i). Clear Spacing = The distance from face of steel bar to another face of Steel bar
- (ii). Centre to Centre Spacing = The distance from centre of steel bar to another centre of steel bar



3. No. of bars = (opposite length / spacing) + 1

Problem-1 ;- Find no. of x-bars and y-bars with spacing 0.10m for a given footing mesh

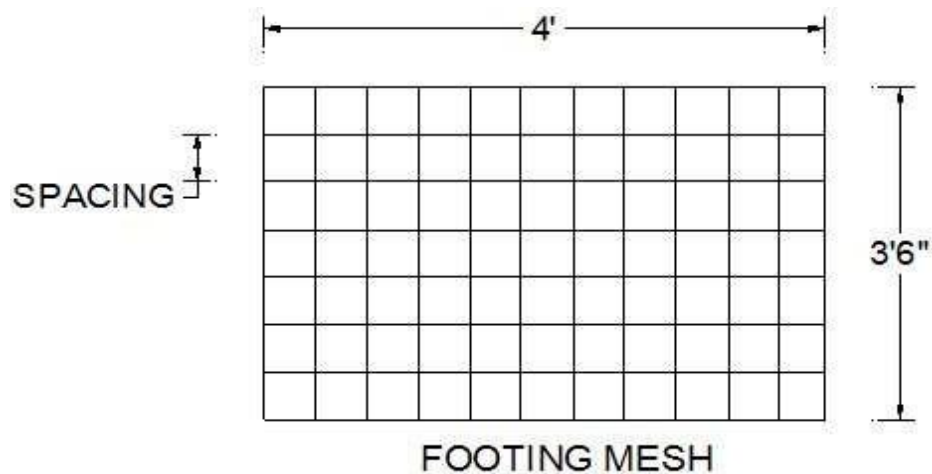


Solution : The Steel bars provided in x-direction is called as x-bars and
The Steel bars provided in y-direction is called as y-bars

$$\begin{aligned} \text{(i). No. of x-bars} &= (\text{opposite length} / \text{spacing}) + 1 \\ &= (0.90 / 0.10) + 1 \\ &= 10 \text{ bars in x-direction} \end{aligned}$$

$$\begin{aligned} \text{(ii). No. of y-bars} &= (\text{opposite length} / \text{spacing}) + 1 \\ &= (1.2 / 0.10) + 1 \\ &= 13 \text{ bars in y-direction} \end{aligned}$$

Problem-2 ; - Find no. of x-bars and y-bars with spacing 4 inch for a given footing mesh



Solution : The Steel bars provided in x-direction is called as x-bars and
The Steel bars provided in y-direction is called as y-bars

$$\begin{aligned} \text{(i). No. of x-bars} &= (\text{opposite length} / \text{spacing}) + 1 \\ &= (42'' / 4'') + 1 \\ &= 11.5 \text{ bars} \\ &= \text{approximately equal to 12 bars in x-direction} \end{aligned}$$

$$\begin{aligned} 3.5' &= ? \text{ Inches} \\ \text{Since } 1' &= 12'' \\ &= 3.5 \times 12 \\ &= 42'' \end{aligned}$$

$$\begin{aligned} \text{(ii). No. of y-bars} &= (\text{opposite length} / \text{spacing}) + 1 \\ &= (48'' / 4'') + 1 \\ &= 13 \text{ bars in y-direction} \end{aligned}$$

$$\begin{aligned} 4' &= ? \text{ Inches} \\ \text{Since } 1' &= 12'' \\ &= 4 \times 12 \\ &= 48'' \end{aligned}$$

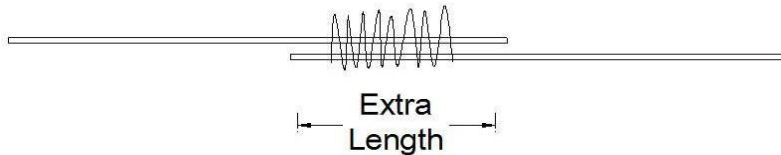
4. Over-lap length :-

Each over-lap length = $50d$ (Practically)

where d = dia of bar

(over-lap length means Joining to steel bar with extra length of Steel bar)

Extra Length = Over-lap Length

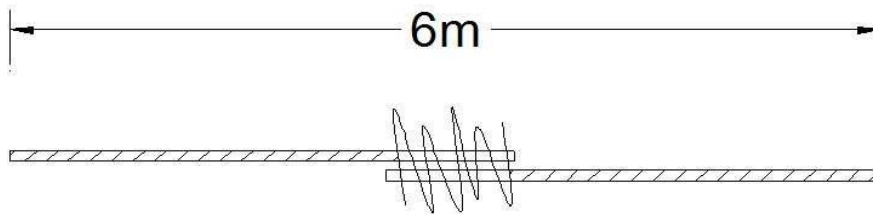


Theoretical Standards for Over-lap length:-

1. For Compressive member (vertical member) Standard over-lap length = $40d$
(Vertical over-lap)
2. For Tensile member (Horizontal member) Standard over-lap length = $50d$
(Horizontal over-lap)

Problem -1 :- Find length of steel bars including over-lap length from the given figure

if dia of bars are:- 12mm, 16mm and 20mm



Solution:- Length of steel bar = Total length + over-lap length

$$\text{Length of steel bar} = L + 50D$$

1. Length of bar, if dia of bar = 12mm = $L + 50D = 6.0\text{m} + 50 \times 0.012\text{m} = 6.60\text{m}$
2. Length of bar, if dia of bar = 16mm = $L + 50D = 6.0\text{m} + 50 \times 0.016\text{m} = 6.80\text{m}$
3. Length of bar, if dia of bar = 20mm = $L + 50D = 6.0\text{m} + 50 \times 0.020\text{m} = 7.00\text{m}$

12mm = ? m

Since 1m = 1000mm

$$.= 12/1000$$

$$.= 0.012\text{m}$$

16mm = ? m

Since 1m = 1000mm

$$.= 16/1000$$

$$.= 0.016\text{m}$$

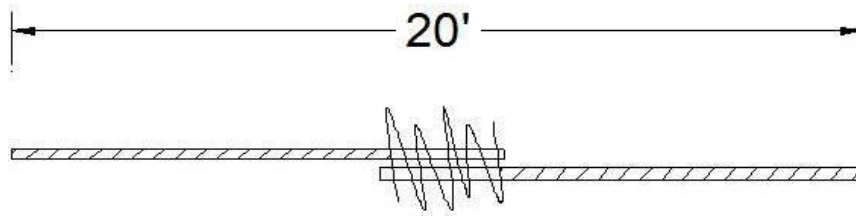
20mm = ? m

Since 1m = 1000mm

$$.= 20/1000$$

$$.= 0.020\text{m}$$

Problem -2 :- Find length of steel bars including over-lap length from the given figure
if dia of bars are:- 12mm, 16mm and 20mm



Solution:- Length of steel bar = Total length + over-lap length

$$\text{Length of steel bar} = L + 50D$$

$$12\text{mm} = ? \text{ Ft}$$

$$\text{Since } 1" = 25.4\text{mm}$$

$$.= 12/25.4$$

$$.= 0.472"$$

$$0.472" = ? \text{ Ft}$$

$$\text{Since } 1\text{ft} = 12"$$

$$.= 0.472/12$$

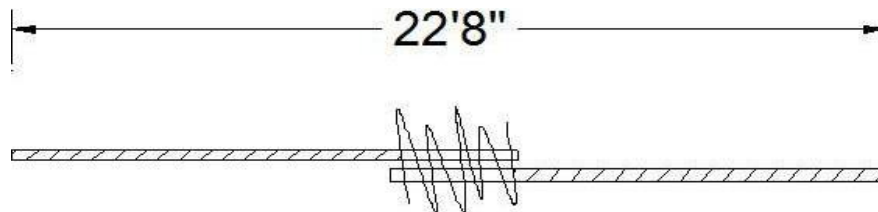
$$.= 0.0393 \text{ Ft}$$

$$1. \text{ Length of bar, if dia of bar} = 12\text{mm} = L + 50D = 20' + 50 \times 0.0393' = 21.965 \text{ Ft}$$

$$2. \text{ Length of bar, if dia of bar} = 16\text{mm} = L + 50D = 20' + 50 \times 0.0524' = 22.62 \text{ Ft}$$

$$3. \text{ Length of bar, if dia of bar} = 20\text{mm} = L + 50D = 20' + 50 \times 0.0656' = 23.28 \text{ Ft}$$

Problem -3 :- Find length of steel bars including over-lap length from the given figure
if dia of bars are:- 12mm, 16mm and 20mm



Solution:- Length of steel bar = Total length + over-lap length

$$\text{Length of steel bar} = L + 50D$$

$$8" = ? \text{ Ft}$$

$$\text{Since } 1\text{ft} = 12"$$

$$.= 8/12$$

$$.= 0.666 \text{ Ft}$$

$$12\text{mm} = ? \text{ Ft}$$

$$\text{Since } 1" = 25.4\text{mm}$$

$$.= 12/25.4$$

$$.= 0.472"$$

$$0.472" = ? \text{ Ft}$$

$$\text{Since } 1\text{ft} = 12"$$

$$.= 0.472/12$$

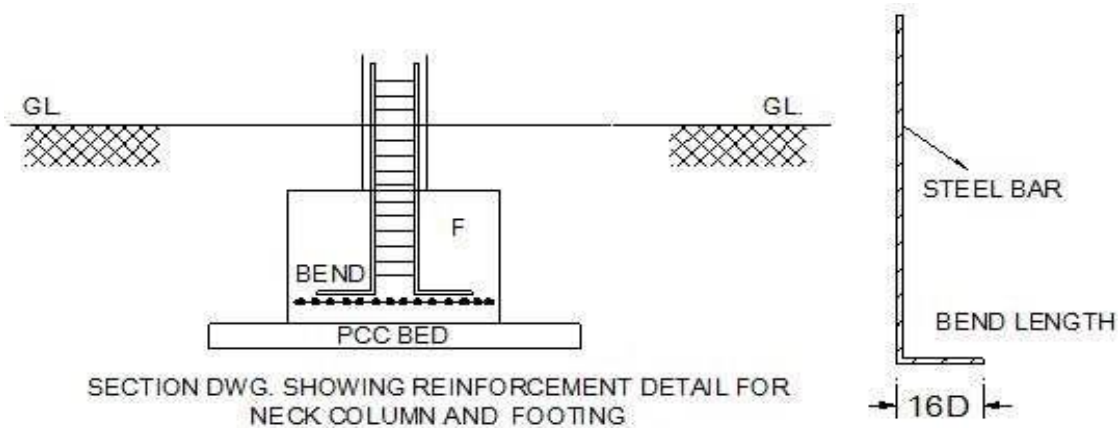
$$.= 0.0393 \text{ Ft}$$

1. Length of bar, if dia of bar = 12mm = $L + 50D = 22.666' + 50 \times 0.0393' = 24.631 \text{ Ft}$
2. Length of bar, if dia of bar = 16mm = $L + 50D = 22.666' + 50 \times 0.0524' = 25.286 \text{ Ft}$
3. Length of bar, if dia of bar = 20mm = $L + 50D = 22.666' + 50 \times 0.0656' = 25.946 \text{ Ft}$

5. Bend Length :-

Each Bend length = $16d$ (Practically)

where d = dia of bar



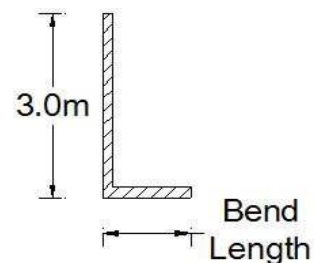
Problem -1 :-

Find length of steel bars including Bend length from given the figure

if dia of bars are:- 12mm, 16mm and 20mm

Solution:- Length of steel bar = Total length + Bend length

$$\text{Length of steel bar} = L + 16D$$



12mm = ? M

Since 1.0m = 1000mm

$$.= 12/1000$$

$$.= 0.012\text{m}$$

16mm = ? M

Since 1.0m=1000mm

$$.= 16/1000$$

$$.= 0.016\text{m}$$

20mm = ? M

Since 1m = 1000mm

$$.= 20/1000$$

$$.= 0.020\text{m}$$

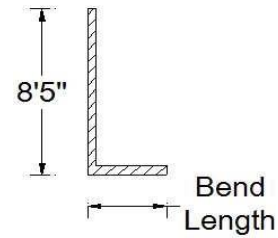
1. Length of bar, if dia of bar = 12mm = $L + 16D = 3.0 + 16 \times 0.012 = 3.192\text{m}$
2. Length of bar, if dia of bar = 16mm = $L + 16D = 3.0 + 16 \times 0.016 = 3.256\text{m}$
3. Length of bar, if dia of bar = 20mm = $L + 16D = 3.0 + 16 \times 0.020 = 3.32\text{m}$

Problem -2 :-

Find length of steel bars including Bend length from the given figure
if dia of bars are:- 12mm, 16mm and 20mm

Solution:- Length of steel bar = Total length + Bend length

$$\text{Length of steel bar} = L + 16D$$



$$5'' = ? \text{ Ft}$$

$$\text{Since } 1\text{ft} = 12''$$

$$.= 5/12$$

$$.= 0.416 \text{ Ft}$$

$$12\text{mm} = ? \text{ Ft}$$

$$\text{Since } 1'' = 25.4\text{mm}$$

$$.= 12/25.4$$

$$.= 0.472''$$

$$0.472'' = ? \text{ Ft}$$

$$\text{Since } 1\text{ft} = 12''$$

$$.= 0.472/12$$

$$.= 0.0393 \text{ Ft}$$

$$1. \text{ Length of bar, if dia of bar} = 12\text{mm} = L + 16D = 8.416' + 16 \times 0.0393' = 9.044 \text{ Ft}$$

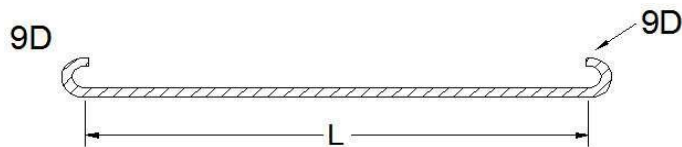
$$2. \text{ Length of bar, if dia of bar} = 16\text{mm} = L + 16D = 8.416' + 16 \times 0.0524' = 9.254 \text{ Ft}$$

$$3. \text{ Length of bar, if dia of bar} = 20\text{mm} = L + 16D = 8.416' + 16 \times 0.0656' = 9.465 \text{ Ft}$$

6. Hook Length :-

Each Hook length = 9D

where d = dia of bar



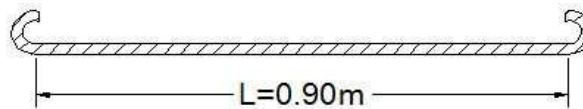
Total length of steel bar including Hook lengths = $L + 9D + 9D$

$$.= L + 18D$$

Problem -1 :-

Find length of steel bars including Hook length

from the given figure if dia of bars are:- 6mm, 8mm and 10mm



Solution:- Length of steel bar = Total length + Bend length

$$\text{Length of steel bar} = L + 18D$$

$$6\text{mm} = ? \text{ M}$$

$$\text{Since } 1.0\text{m} = 1000\text{mm}$$

$$.= 6/1000$$

$$.= 0.006\text{m}$$

$$8\text{mm} = ? \text{ M}$$

$$\text{Since } 1.0\text{m} = 1000\text{mm}$$

$$.= 8/1000$$

$$.= 0.008\text{m}$$

$$10\text{mm} = ? \text{ M}$$

$$\text{Since } 1.0\text{m} = 1000\text{mm}$$

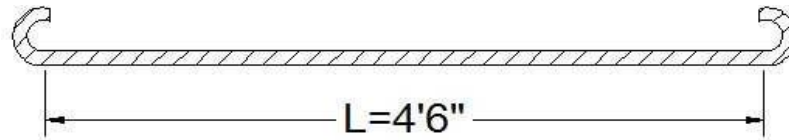
$$.= 10/1000$$

$$.= 0.010\text{m}$$

1. Length of bar, if dia of bar = 6mm = $L + 18D = 0.90 + 18 \times 0.006 = 1.008\text{m}$
2. Length of bar, if dia of bar = 8mm = $L + 18D = 0.90 + 18 \times 0.008 = 1.044\text{m}$
3. Length of bar, if dia of bar = 10mm = $L + 18D = 0.90 + 18 \times 0.010 = 1.080\text{m}$

Problem -2 :-

Find length of steel bars including Hook length
from the given figure if dia of bars are:- 6mm, 8mm and 10mm



Solution:- Length of steel bar = Total length + Bend length

$$\text{Length of steel bar} = L + 18D$$

$$6\text{mm} = ? \text{ Inch}$$

$$\text{Since } 1" = 25.4\text{mm}$$

$$.= 6/25.4$$

$$.= 0.236"$$

$$0.236" = ? \text{ Ft}$$

$$\text{Since } 1 \text{ Ft} = 12"$$

$$.= 0.236/12$$

$$.= 0.0196 \text{ Ft}$$

$$6" = ? \text{ Ft}$$

$$\text{Since } 1 \text{ Ft} = 12"$$

$$.= 6/12$$

$$.= 0.50 \text{ Ft}$$

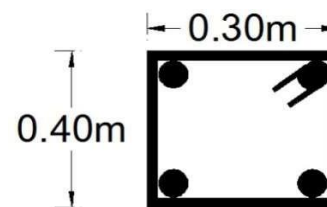
$$1. \text{ Length of bar, if dia of bar} = 6\text{mm} = L + 18D = 4.5' + 18 \times 0.0196' = 4.852'$$

$$2. \text{ Length of bar, if dia of bar} = 8\text{mm} = L + 18D = 4.5' + 18 \times 0.0262 = 4.971'$$

$$3. \text{ Length of bar, if dia of bar} = 10\text{mm} = L + 18D = 4.5' + 18 \times 0.0328 = 5.090'$$

Problem-3 :-

Find length of Stirrup from the given figure
if dia of Stirrup = 6mm and 8mm



Solution :-

$\emptyset = 6\text{mm} \text{ \& } 8\text{mm}$ for Stirrup or Tie

$$(i). \text{ Length of Stirrup or tie} = L + 18D \quad \text{where 'L' } = (L + B) \times 2$$

$$.= 1.40 + 18 \times 0.006$$

$$.= 1.508\text{m}$$

$$.= (0.30+0.40) \times 2$$

$$.= 1.40\text{m}$$

$$6\text{mm} = ? \text{ M}$$

$$\text{Since } 1.0\text{m} = 1000\text{mm}$$

$$.= 6/1000$$

$$.= 0.006\text{m}$$

$$8\text{mm} = ? \text{ M}$$

$$\text{Since } 1.0\text{m} = 1000\text{mm}$$

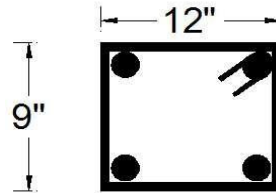
$$.= 8/1000$$

$$.= 0.008\text{m}$$

$$\begin{aligned}
 \text{(ii). Length of Stirrup or tie} &= L + 18D & \text{where 'L'} &= (L + B) \times 2 \\
 &= 1.40 + 18 \times 0.008 & &= (0.30 + 0.40) \times 2 \\
 &= 1.544\text{m} & &= 1.40\text{m}
 \end{aligned}$$

Problem-4 :-

Find length of Stirrup from the given figure
if dia of Stirrup = 6mm and 8mm



Solution :- Given $\varnothing$ = 6mm & 8mm for Stirrup or Tie

$$\begin{aligned}
 6\text{mm} &= ? \text{ inch} & 8\text{mm} &= ? \text{ inch} \\
 \text{Since } 1" &= 25.4\text{mm} & \text{Since } 1" &= 25.4\text{mm} \\
 &= 6/25.4 & &= 8/25.4 \\
 &= 0.236" & &= 0.314"
 \end{aligned}$$

$$\begin{aligned}
 \text{(i). Length of Stirrup or tie} &= L + 18D & \text{where 'L'} &= (L + B) \times 2 \\
 &= 42" + 18 \times 0.236" & &= (9" + 12") \times 2 \\
 &= 46.248" & &= 42" \\
 &= 46.248/12 & & \\
 &= 3.854 \text{ Ft} & &
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii). Length of Stirrup or tie} &= L + 18D & \text{where 'L'} &= (L + B) \times 2 \\
 &= 42" + 18 \times 0.314" & &= (9" + 12") \times 2 \\
 &= 47.652" & &= 42" \\
 &= 47.652/12 & & \\
 &= 3.971 \text{ Ft} & &
 \end{aligned}$$

7. Concrete Cover:-

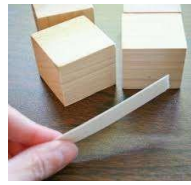
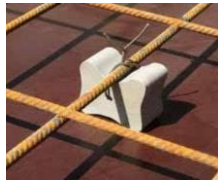
The gap or distance between Steel bar and shuttering is called as Concrete Cover. Concrete Cover is provided in concrete to give strength to the concrete and to safe reinforcement from atmospheric temperature, Rain water and Rust (Corrosion).

Condition:-

- (i). If the length or width of item is less than or equal to 0.3m or 12" then cover=25mm or 1"
- (ii). If the length or width of item is between 0.4m to 0.5m or 16" to 20" then cover=50mm or 2"
- (iii). If the length or width of item is greater than or equal to 0.6m or 24" then cover=100mm or 4"

Types of Covering block :-

(1). Steel covering block (2). Wooden block (3). C:M block (4). PVC block (5). Piece of Stones



Problem -1 :-

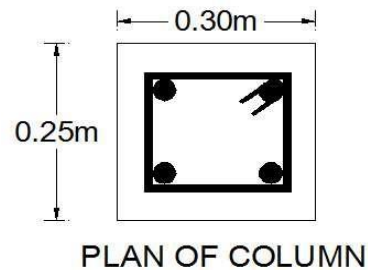
From the given figure find

(i). Length of Stirrups

(ii). No. of Stirrups

if Height of Column = 2.70m ; spacing = 0.10m

dia of stirrup = 8mm



Solution :-

(i). According to condition, deduction of Concrete Cover from four sides of Column

if Length or width of item is less than or equal to 0.30m then cover = 1"=25mm = 0.025m

$$L = 0.30 - 0.025 - 0.025 = 0.25\text{m}$$

$$B = 0.25 - 0.025 - 0.025 = 0.20\text{m}$$

$$L = (L+B) \times 2$$

$$L = (0.25 + 0.20) \times 2 = 0.90\text{m}$$

$$\text{Length of Tie or Stirrup} = L + 18D$$

$$= 0.90 + 18 \times 0.008$$

$$= 1.044\text{m}$$

(ii). No. of Stirrups = (Height of Column / spacing) + 1

$$= (2.7 / 0.10) + 1$$

$$= 28 \text{ ties or stirrups}$$

Problem -2 :-

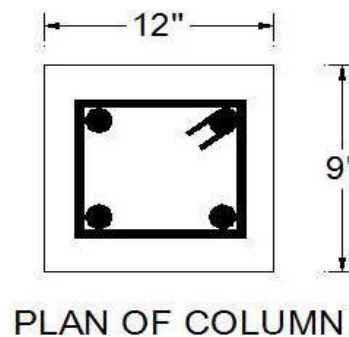
From the given figure find

(i). Length of Stirrups

(ii). No. of Stirrups

if Height of Column = 9 Ft ; spacing = 4"

dia of stirrup = 8mm



Solution :-

(i). According to condition, deduction of Concrete Cover from four sides of Column

if Length or width of item is less than or equal to 1.0 Ft then cover = 1" = 25mm = 0.025m

$$\begin{aligned}
 L &= 12'' - 1'' - 1'' = 10'' & \text{Length of Tie or Stirrup} &= L + 18D \\
 B &= 9'' - 1'' - 1'' = 7'' & &= 34'' + 18 \times 0.314 \\
 L &= (L+B) \times 2 & &= 39.652'' \\
 L &= (10'' + 7'') \times 2 = 34'' & &= 39.652 / 12 \\
 & & &= 3.304 \text{ Ft}
 \end{aligned}$$

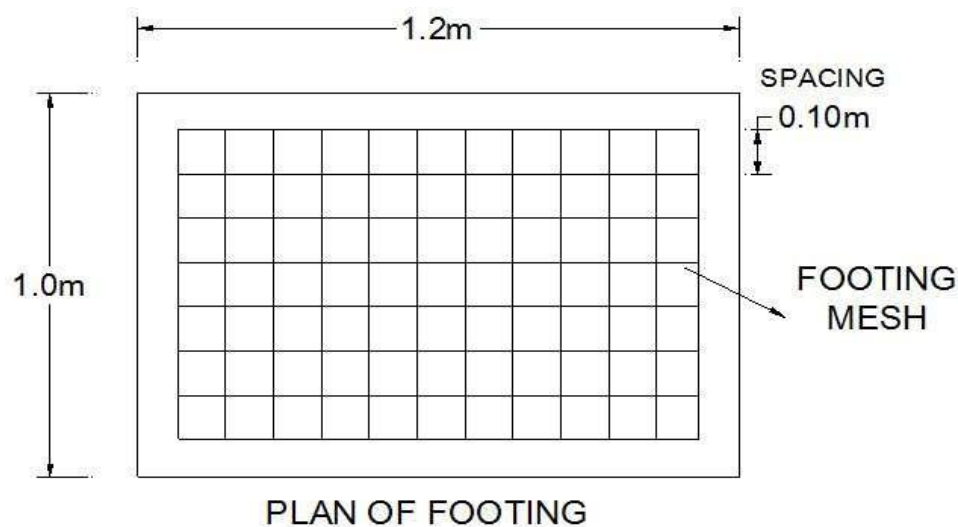
$$\begin{aligned}
 8\text{mm} &= ? \text{ Inch} & 4'' &= ? \text{ Ft} \\
 \text{Since } 1'' &= 25.4\text{mm} & \text{Since } 1' &= 12'' \\
 &= 8/25.4 & &= 4/12 \\
 &= 0.314'' & &= 0.333 \text{ Ft}
 \end{aligned}$$

$$\begin{aligned}
 \text{(ii). No. of Stirrups} &= (\text{Height of Column} / \text{spacing}) + 1 \\
 &= (9' / 0.333) + 1 \\
 &= 28.02 \text{ ties or stirrups} \\
 &= \text{approximately equal to 28 ties}
 \end{aligned}$$

Problem -3 :-

From the given figure find

- (i). Length of x-bar and y-bar (ii). No. of x-bar and y-bar
if spacing = 0.10m

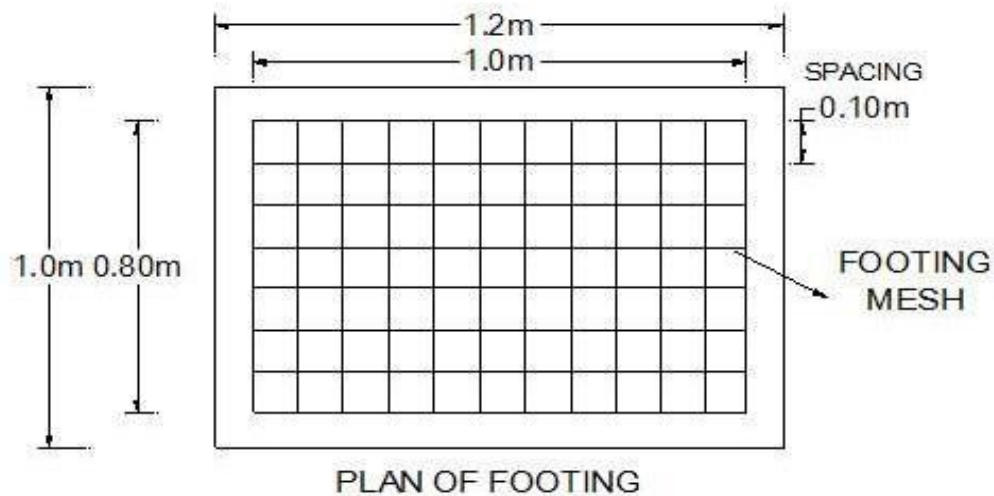


Solution :-

(i). According to condition, deduction of Concrete Cover from four sides of footing
if Length or width of item is less than or equal to 0.60m then cover = 4" = 100mm = 0.10m

1. Length of x-bar = $1.20 - 0.10 - 0.10 = 1.0\text{m}$

2. Length of y-bar = $1.0 - 0.10 - 0.10 = 0.80\text{m}$



(ii). No. of x and y bars

(a). No. of x-bar = (opposite length / spacing) + 1

$$.= (0.80/0.10) + 1$$

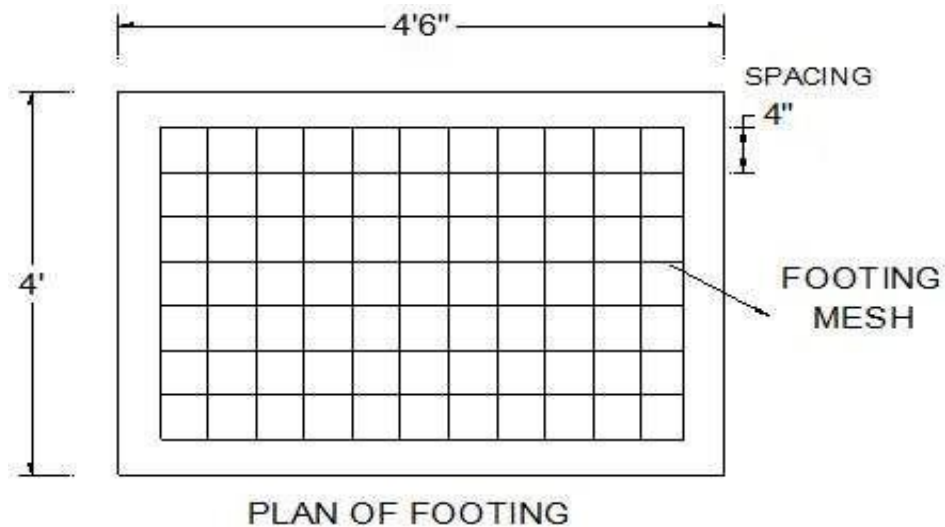
$$.= 9 \text{ bars}$$

(b). No. of y-bar = (opposite length / spacing) + 1

$$.= (1.0/0.10) + 1$$

$$.= 11 \text{ bars}$$

Problem -4 :-



From the given figure find

(i). Length of x-bar and y-bar

(ii). No. of x-bar and y-bar

if spacing = 4"

Solution :-

(i). According to condition, deduction of Concrete Cover from four sides of footing

if Length or width of item is less than or equal to 0.60m then cover = 4" = 100mm=0.10m

1. Length of x-bar = 4'6" - 4" - 4" = 3'10"

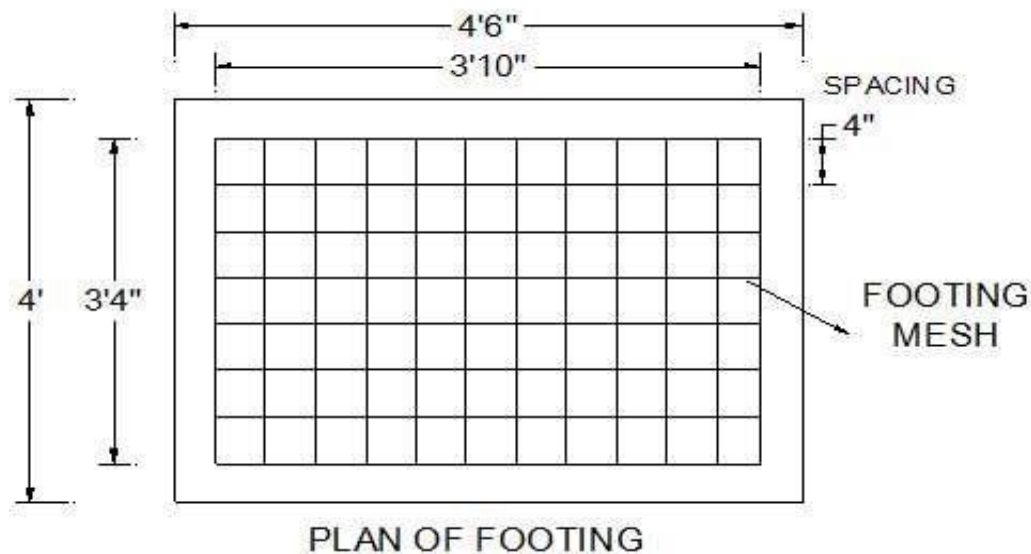
2. Length of y-bar = 4' - 4" - 4" = 3'4"

(ii). No. of x and y bars

(a). No. of x-bar = (opposite length / spacing) + 1

$$.= (40''/4'') + 1$$

$$.= 11 \text{ bars}$$



(b). No. of y-bar = (opposite length / spacing) + 1

$$.= (46''/4'') + 1$$

$$.= 12.5 \text{ bars}$$

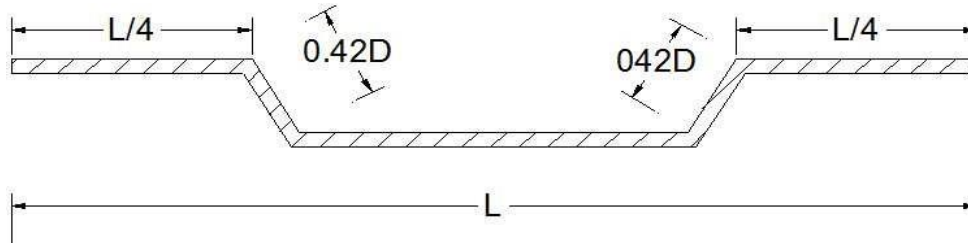
$$.= \text{approximately equal to } 13 \text{ bars}$$

8. Crank Bar :-

each crank length = $0.42D$

where D = Depth of Slab or Beam - Top & Bottom cover

Mostly Cranking is done in Slab and Beams.



$$\begin{aligned}\text{Length of Crank bar} &= L + 0.42D + 0.42D \\ &= L + 0.84D\end{aligned}$$

where D = Depth of Slab or Beam - Top & Bottom cover

There are three types of bars :-

- (i). Straight Bar : Steel bar which is linear (straight) in length is called as straight bar.
- (ii). Crank Bar : Steel bar which is bent up at an angle of 45 degree is called as Crank bar.
- (iii). Extra Bar : Steel bar which is provide under each crank is called as Extra bar.

Conditions for providing Crank bar:-

- (1). If the span between two columns supporting the Slab is less than or equal to 4.0 m or 12 Ft then straight bar is enough to carry the load of Slab.
- (2). If the span between two columns supporting the Slab is greater than 4.0 m or 12 Ft then Crank bar is provided in the Slab to balance the load and stresses developing at the corner of Slab. Cranking should be done at a distance of $L/4$ from corner of Slab.

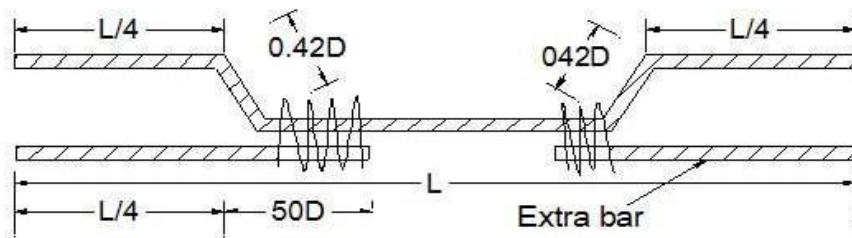
9. Extra bar

The length of each Extra bar = $(L/4) + 50D$

where D = dia of bar; L = length of Crank bar including crank length

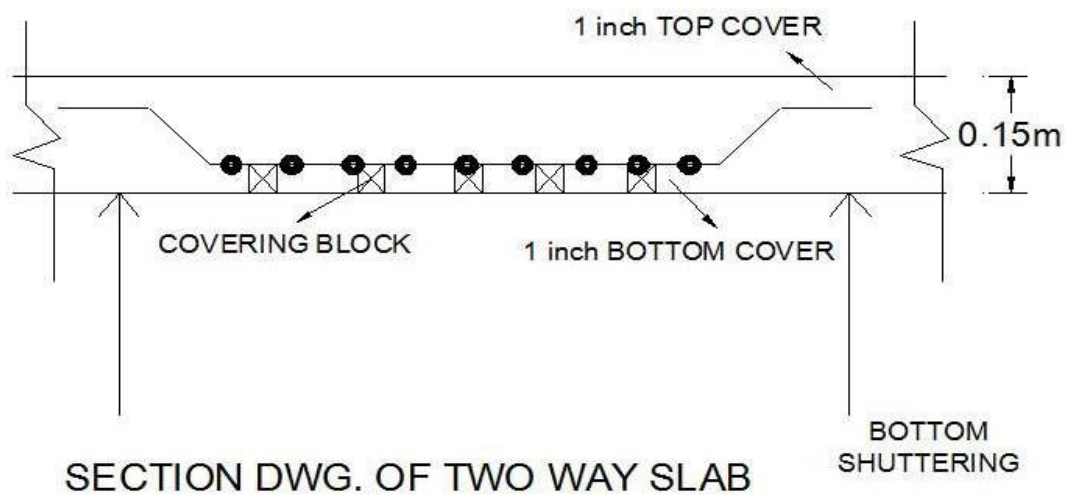
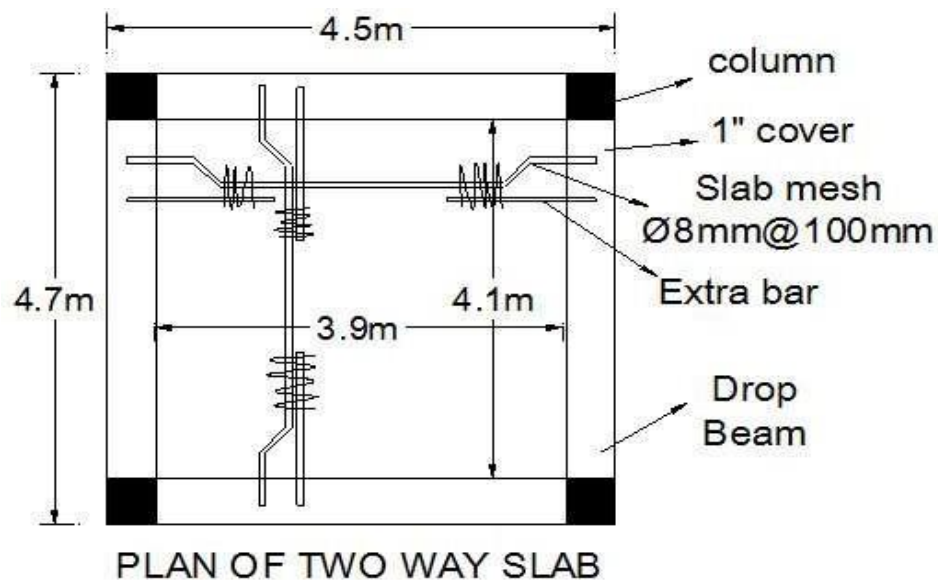
$L/4$ is 1/4th length of slab

$50D$ is over-lap length

**Problem-1 :-**

From the given figure find,

- (i). Length of x-bar and y-bar; (ii). No. of x-bars and y-bars
- (iii). Length of Extra bar in x & y-direction ; (iv). No. of Extra bar



Solution :-

According to conditions, 1 inch concrete cover shall be deducted from four sides of Slab

(i). Length of x-bar and y-bar

$$1" = 25\text{mm} = 0.025\text{m}$$

(a). Length of x-bar = length of slab + crank length - concrete cover from both side of slab

$$.= L + 0.42D + 0.42D - 1" - 1"$$

$$.= L + 0.84D - 0.025 - 0.025$$

$$.= 4.5\text{m} + 0.84D - 0.025\text{m} - 0.025\text{m}$$

$$.= 4.5 + 0.84 \times 0.10 - 0.025 - 0.025$$

$$.= 4.534\text{m}$$

D = Depth of Slab - top cover - bottom cover

$$D = 0.15 - 0.025 - 0.025$$

$$D = 0.10\text{m}$$

$$1" = 25\text{mm} = 0.025\text{m}$$

(b). Length of y-bar = breadth of slab + crank length - concrete cover from both side of slab

$$.= L + 0.42D + 0.42D - 1" - 1"$$

$$.= L + 0.84D - 0.025 - 0.025$$

$$.= 4.7\text{m} + 0.84D - 0.025\text{m} - 0.025\text{m}$$

$$.= 4.7 + 0.84 \times 0.10 - 0.025 - 0.025$$

$$.= 4.734\text{m}$$

D = Depth of Slab - top cover - bottom cover

$$D = 0.15 - 0.025 - 0.025$$

$$D = 0.10\text{m}$$

(ii). No. of x-bar and y-bars

$$\text{Given spacing} = 100\text{mm} = 0.10\text{m}$$

(a). No. of x-bars = (opposite length / spacing) + 1

$$.= (4.1/0.1) + 1$$

$$.= 42 \text{ bars}$$

(b). No. of y-bars = (opposite length / spacing) + 1

$$.= (3.9/0.1) + 1$$

$$.= 40 \text{ bars}$$

(iii). Length of Extra-bar in x and y direction

(a). The length of each Extra bar in x-direction = $(L/4) + 50D$

where D = dia of bar; L = length of Crank bar including crank length

$$\text{Given dia of bar} = 8\text{mm} = 0.008\text{m}$$

$$.= (4.534/4) + 50 \times 0.008$$

$$.= 1.533\text{m}$$

(b). The length of each Extra bar in y-direction = $(L/4) + 50D$

where D = dia of bar; L = length of Crank bar including crank length

$$\begin{aligned} \text{Given dia of bar} &= 8\text{mm} = 0.008\text{m} & . &= (4.734/4) + 50 \times 0.008 \\ & & . &= 1.583\text{m} \end{aligned}$$

(iv). No. of Extra-bars in x and y-direction

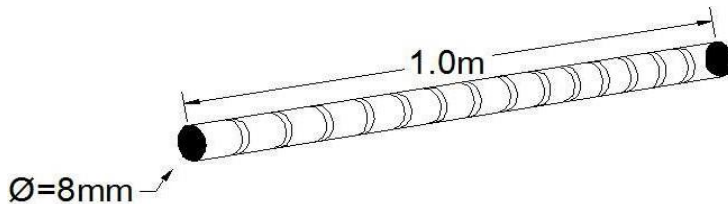
$$\begin{aligned} \text{(a). No. of Extra-bar in x-direction} &= \text{no. of x-bars} \times 2 \\ &= 42 \times 2 = 84 \text{ bars} \end{aligned}$$

$$\begin{aligned} \text{(b). No. of Extra-bar in y-direction} &= \text{no. of y-bars} \times 2 \\ &= 40 \times 2 = 80 \text{ bars} \end{aligned}$$

WEIGHT OF STEEL BAR CALCULATIONS

(a). Density of Steel = 7850 kgs/m³

(b). Density of Steel = 0.00785 kgs/mm³



Formulas :-

There are four formulas to find weight of Steel bar in kgs/m, which ever is convenient, can be used.

$$\begin{aligned} \text{1. Weight of Steel bar in kgs / m} & . = \text{Area of Steel bar} \times \text{Density of Steel} \\ \text{where d = dia of bar in mm} & . = \pi/4 \times d^2 \times \text{Density of Steel} \\ \text{If dia} = 8\text{mm} & \\ \text{Weight of Steel bar in kgs / m} & . = \pi/4 \times 8^2 \times 0.00785 \\ & . = 0.39 \text{ kgs/m} \end{aligned}$$

$$\begin{aligned} \text{2. Weight of Steel bar in kgs / m} & = \text{Volume of Steel bar} \times \text{Density of Steel} \\ \text{where d = dia of bar in metres} & . = \text{Area of Steel bar} \times \text{length of bar} \times \text{Density of Steel} \\ & . = \pi/4 \times d^2 \times L \times \text{Density of Steel} \\ \text{If dia} = 8\text{mm} & . = \pi/4 \times d^2 \times L \times \text{Density of Steel} \\ \text{Weight of Steel bar in kgs / m} & . = \pi/4 \times 0.008^2 \times 1.0 \times 7850 \\ & . = 0.39 \text{ kgs/m} \end{aligned}$$

3. According to Thumb Rule :-

Weight of Steel bar in kgs / m $\therefore d^2/162$

where d = dia of bar in mm

and 162 is constant value

If dia = 8mm

Weight of Steel bar in kgs / m $\therefore 8^2/162$
 $\therefore 0.39 \text{ kgs/m}$

4. According to Mohammed Haroon's Rule :-

Weight of Steel bar in kgs / m $\therefore \text{Area of Steel bar} / 127$

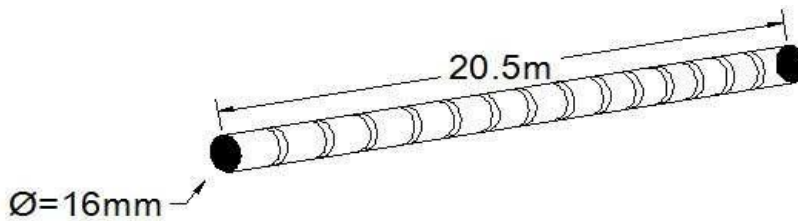
where d = dia of bar in mm $\therefore (\pi/4 \times d^2) / 127$

If dia = 8mm

Weight of Steel bar in kgs / m $\therefore (\pi/4 \times 8^2) / 127$
 $\therefore 0.39 \text{ kgs/m}$

Problem -1 :-

Find weight of Steel bar from given diagram

**Solution :-**

According to Thumb Rule :-

Weight of Steel bar in kgs / m $\therefore d^2/162$

where d = dia of bar in mm

and 162 is constant value

If dia = 16mm

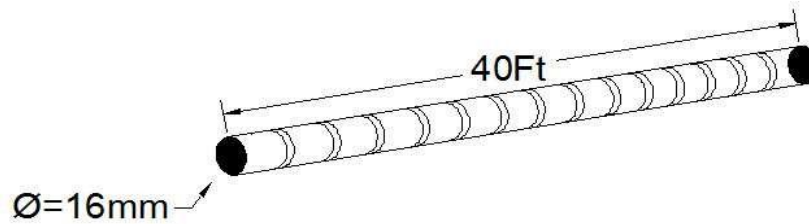
Weight of Steel bar in kgs / m $\therefore 16^2/162$
 $\therefore 1.58 \text{ kgs/m}$

Given length of bar = 20.5m

weight of steel bar = weight of steel bar/m x length of bar
 $\therefore 1.58 \times 20.5$
 $\therefore 32.39 \text{ kgs}$

Problem -2 :-

Find weight of Steel bar from given diagram

**Solution :-**

According to Thumb Rule :-

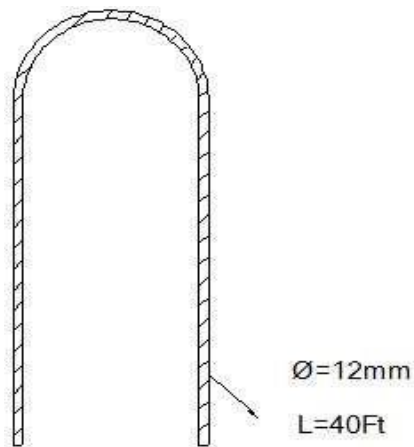
Weight of Steel bar in kgs / m	$= d^2/162$
where d = dia of bar in mm	$= 16^2/162$
and 162 is constant value	$= 1.58 \text{ kgs/m}$

Weight of Steel bar in kgs / Ft	$= d^2/531.36$
Since 1.0m = 3.28Ft	$= 16^2 / 531.36$
$162 \times 3.28 = 531.36$	$= 0.481 \text{ kgs/Ft}$
or $0.481 \times 3.28 = 1.58 \text{ kgs/m}$	

Given length of steel bar = 40Ft

Weight of Steel bar	$= \text{Weight / Ft} \times \text{length of steel bar}$
	$= 0.481 \times 40$
	$= 19.24 \text{ kgs}$

Problem -3 : On a site about 55 no. of Steel bars of dia 12mm have been unloaded from Truck, Find (i). weight of Steel bars and (ii). Required amount to pay the bill, if Rate of Steel/kg = 48.0 rupees.



Solution :-

Note: Standard length of Steel bar all over the world = 12.0m or 40 Ft.

Given dia of bar = 12mm ; Standard length of each bar = 40 Ft

$$\begin{aligned}\text{Weight of Steel bar in kgs / Ft} &= d^2/531.36 \\ &= 12^2/531.36 \\ &= 0.27 \text{ kgs/Ft}\end{aligned}$$

$$\begin{aligned}\text{(i). Weight of Steel bar} &= \text{Weight / Ft} \times \text{length of steel bar} \times \text{no. of bars} \\ &= 0.27 \times 40 \times 55 \\ &= 594.0 \text{ kgs}\end{aligned}$$

$$\begin{aligned}\text{(ii). Amount required} &= \text{weight of steel bars in kgs} \times \text{Rate / kgs} \\ &= 594.0 \times 48 \\ &= 28,512.0 \text{ rupees}\end{aligned}$$

Problem -4 :-

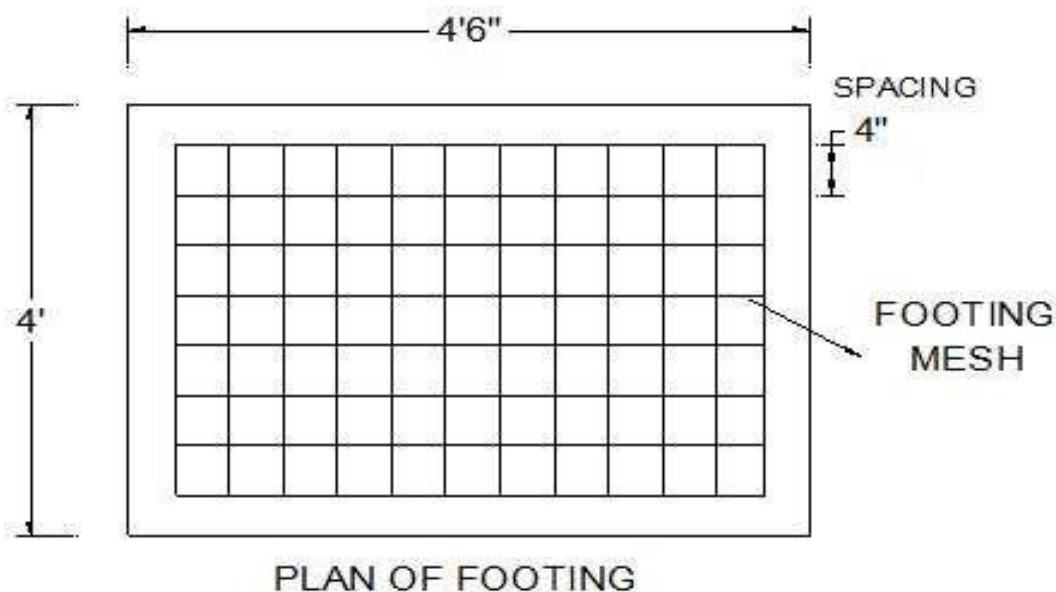
For a given plan of footing find

(i). Weight of Steel required for making plain footing meshes if, spacing = 4"

Footing mesh details: 11 $\varnothing$ 12mm in x-direction; 13 $\varnothing$ 16mm in y-direction
and no. of footings = 12

(ii). No. of Steel bars required, of length 40Ft

(iii). Bill of Quantities for Footing Reinforcement if Rate of steel /kg = 48.0 rupees.



Solution :-

According to condition, deduction of Concrete Cover from four sides of Footing
if Length or width of item is greater than or equal to 0.60m then cover = 4" = 100mm

(i). x-bar calculation:- = 0.10m

1. Length of x-bar = 4'6" - 4" - 4" = 3'10"

2. No. of x-bars = 11

3. Total length of x-bar = 11 x 3'10" (no. of x-bars X length of each x-bar)

$$.= 11' \times 3.833$$

$$.= 42.163\text{Ft}$$

4. Given dia of x-bar = 12mm:

5. Weight of Steel bar in kgs / Ft .= $d^2/531.36$

$$.= 12^2 / 531.36$$

$$.= 0.27 \text{ kgs/Ft}$$

6. Total weight of Steel required = weight/Ft x Total length of x-bar x no. of footings

$$.= 0.27 \times 42.163 \times 12$$

$$.= 136.608 \text{ kgs steel required of } \varnothing 12\text{mm}$$

(ii). y-bar calculation:-

1. Length of y-bar = 4' - 4" - 4" = 3'4"

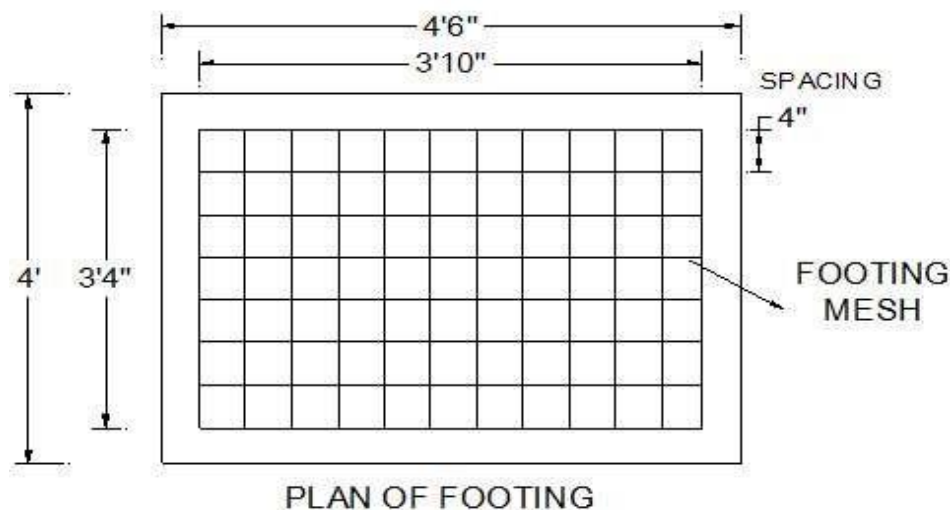
2. No. of y-bars = 13

3. Total length of y-bar .= no. of y-bars x length of each y-bar

$$.= 13 \times 3'4"$$

$$.= 13' \times 3.333$$

$$.= 43.329\text{Ft}$$



4. Given dia of y-bar = 16mm

$$\begin{aligned} \text{5. Weight of Steel bar in kgs / Ft.} &= d^2/531.36 \\ &= 16^2 / 531.36 \\ &= 0.481 \text{ kgs/Ft} \end{aligned}$$

$$\begin{aligned} \text{6. Total weight of Steel required} &= \text{weight/Ft} \times \text{Total length of y-bar} \times \text{no. of footings} \\ &= 0.481 \times 43.329 \times 12 \\ &= 250.094 \text{ kgs steel required of } \varnothing 16\text{mm} \end{aligned}$$

(iii). Total weight of steel required for 12 footing meshes of $\varnothing 12\text{mm}$ & $\varnothing 16\text{mm}$

$$\begin{aligned} \text{weight of x-bars required} &= 136.608 \text{ kgs for } \varnothing 12\text{mm} \\ \text{weight of y-bars required} &= 250.094 \text{ kgs for } \varnothing 16\text{mm} \end{aligned}$$

(iv). No. of Steel bars required of length 40Ft.

(a). $\varnothing 12\text{mm}$

1. Standard length of each steel bar = 40 Ft.

2. Dia of steel bar for x-bar = 12mm

$$\begin{aligned} \text{3. Weight of Steel bar in kgs / Ft} &= d^2/531.36 \\ &= 12^2 / 531.36 \\ &= 0.27 \text{ kgs/Ft} \end{aligned}$$

$$\text{4. weight of each steel bar of length 40'} = 0.27 \times 40 = 10.8 \text{ kgs}$$

$$\begin{aligned} \text{5. No. of Steel bars of length 40' required} &= \text{weight of steel required} / \text{weight of each} \\ \text{of } \varnothing 12\text{mm} &= 136.608 / 10.8 \quad \text{steel bar} \\ &= 12.648 \text{ or approximately equal to 13 bars of} \\ &\quad \varnothing 12\text{mm required.} \end{aligned}$$

For 12.648 steel bars the required weight of steel = 136.608 (required weight of steel)

For 13 Steel bars the required weight of steel = $10.8 \times 13 = 140.4$ kgs (Actual weight of steel)

(b). $\varnothing 16\text{mm}$

1. Standard length of each steel bar = 40 Ft.

2. Dia of steel bar for y-bar = 16mm

$$\begin{aligned} \text{3. Weight of Steel bar in kgs / Ft} &= d^2/531.36 \\ &= 16^2 / 531.36 \\ &= 0.481 \text{ kgs/Ft} \end{aligned}$$

4. weight of each steel bar of length 40' = $0.481 \times 40 = 19.24\text{kgs}$

5. No. of Steel bars of length 40' required = wt. of steel required / wt. of each Steel bar of $\varnothing 12\text{mm}$
 $= 250.094 / 19.24$

$= 12.998$ or approximately equal to 13 bars of $\varnothing 16\text{mm}$ required.

For 12.998 steel bars the required weight of steel = 250.094 (required weight of steel)

For 13 Steel bars the required wt of steel = $19.24 \times 13 = 250.12\text{ kgs}$ (Actual wt. of steel)

(iv). Bill of Quantities for Footing reinforcement:-

BILL OF QUANTITIES FOR FOOTING REINFORCEMENT							
S.no.	Description	Unit	Rate/unit	Total Quantity		Total Amount	Remark
	Dia of bar	Kgs	in Rupees	Actual weight of	Required	in	
				Steel required	bars of	Rupees	
				in kgs	40' length		
1	$\varnothing 12\text{mm}$	Kgs	48.00	140.400	13	6739.200	
2	$\varnothing 16\text{mm}$	Kgs	48.00	250.120	13	12005.760	
					Total	18744.960	
				Add 10% wastage		1874.496	
				Add 5% Contingencies		937.248	
					Total	21556.704	

Contingencies mean : Expenses which is likely to happen in future, which may happen or may not happen.

Problem-2:-

For a given plan of footing find

(i). Weight of Steel required for making footing meshes with hooks

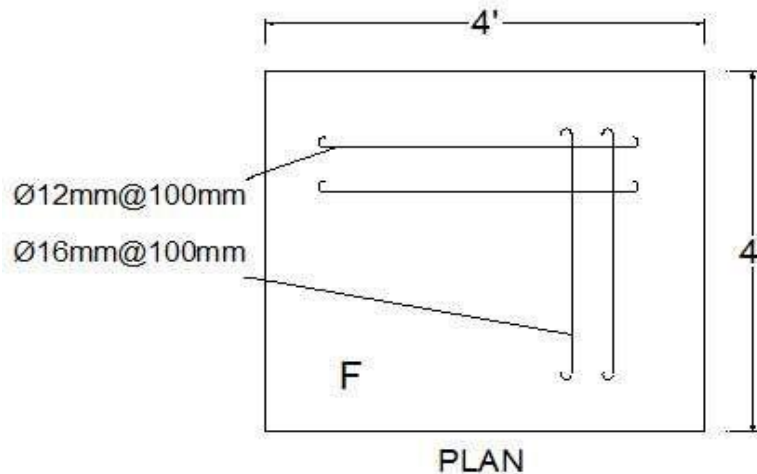
(ii). No. of Steel bars required, of length 40Ft

(iii). Bill of Quantities for Footing Reinforcement

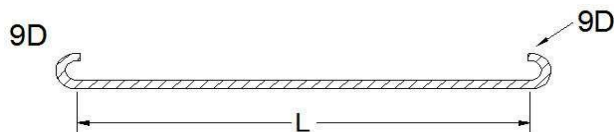
Footing mesh details:

Ø12mm@100mm or 4" in x-direction and Ø16mm@100mm or 4" in y-direction

no. of footings = 8 spacing = 4" and Rate of steel/kg = 48.0 rupees.

**Solution :-**

(i). x-bar calculation:-



Total length of bar $\therefore L + 9D + 9D$

$\therefore L + 18D$

where D= dia of bar

According to condition, deduction of Concrete Cover from four sides of Footing

if Length or width of item is greater than or equal to 0.60m or 2' then cover=4"=100mm

" L" = 4' - 4" - 4" = 3'4" = 3.333'

dia of x-bar = 12mm = 0.0393'

1. Length of x-bar = L + 18D

$\therefore 3.333' + 18 \times 0.0393'$

$\therefore 4.04'$

12mm=? Ft

since 1"=25.4mm

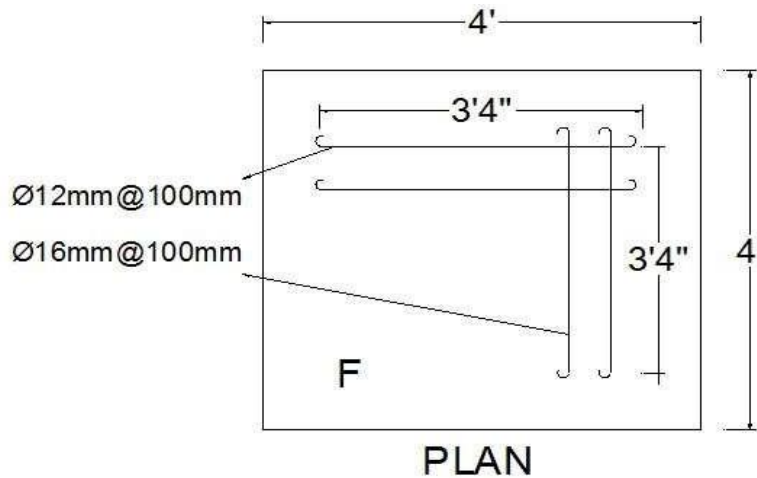
$\therefore 12/25.4$

$\therefore 0.472" = ? \text{ Ft}$

since 1ft = 12"

$\therefore 0.472/12$

$\therefore 0.0393\text{ft}$



2. No. of x-bar = (opposite length / spacing) + 1

$$.= (40''/4'') + 1$$

$$.= 11 \text{ bars}$$

3. Total length of x-bar = no. of x-bars x length of each x-bar

$$.= 11 \times 4.04'$$

$$.= 44.44'$$

4. Given dia of x-bar = 12mm

5. Weight of Steel bar in kgs / Ft $.= d^2/531.36$

$$.= 12^2 / 531.36$$

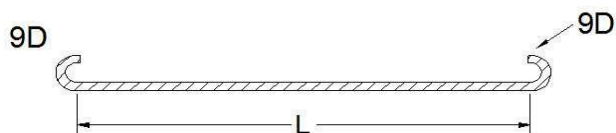
$$.= 0.27 \text{ kgs/Ft}$$

6. Total weight of Steel required = weight/Ft x Total length of x-bar x no. of footings

$$.= 0.27 \times 44.44 \times 8$$

$$.= 95.99 \text{ kgs steel required of } \varnothing 12\text{mm}$$

(ii). y-bar calculation:-



Total length of bar $.= L + 9D + 9D$

$$.= L + 18D$$

where D= dia of bar

According to condition, deduction of Concrete Cover from four sides of Footing
if Length or width of item is greater than or equal to 0.60m or 2' then cover = 4"

$$L = 4' - 4'' - 4'' = 3'4'' = 3.333'$$

$$\text{dia of y-bar} = 16\text{mm} = 0.0524'$$

$$1. \text{ Length of y-bar} = L + 18D$$

$$.= 3.333' + 18 \times 0.0524'$$

$$.= 4.276'$$

$$16\text{mm} = ? \text{ Ft}$$

$$\text{since } 1'' = 25.4\text{mm}$$

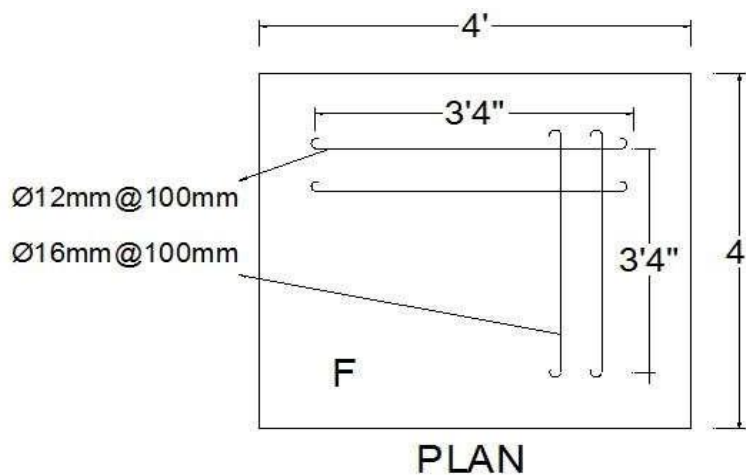
$$.= 16/25.4$$

$$.= 0.629'' = ? \text{ Ft}$$

$$\text{since } 1\text{ft} = 12''$$

$$.= 0.629/12$$

$$.= 0.0524\text{ft}$$



$$2. \text{ No. of y-bar} = (\text{opposite length} / \text{spacing}) + 1$$

$$.= (40''/4'') + 1$$

$$.= 11 \text{ bars}$$

$$3. \text{ Total length of y-bar} = \text{no. of y-bars} \times \text{length of each y-bar}$$

$$.= 11 \times 4.276'$$

$$.= 47.036'$$

$$4. \text{ Given dia of y-bar} = 16\text{mm}$$

$$5. \text{ Weight of Steel bar in kgs / Ft} \quad . = d^2/531.36$$

$$.= 16^2/531.36$$

$$.= 0.481 \text{ kgs/Ft}$$

$$6. \text{ Total weight of Steel required} = \text{weight/Ft} \times \text{Total length of y-bar} \times \text{no. of footings}$$

$$.= 0.481 \times 47.036 \times 8$$

$$.= 180.994 \text{ kgs steel required of } \varnothing 16\text{mm}$$

(iii). Total weight of steel required for 8 footing meshes of Ø12mm & Ø16mm

weight of x-bars required = 95.99 kgs for Ø12mm

weight of y-bars required = 180.994 kgs for Ø16mm

(iv). No. of Steel bars required of length 40Ft.

(a). Ø12mm

1. Standard length of each steel bar = 40 Ft.

2. Dia of steel bar for x-bar = 12mm

3. Weight of Steel bar in kgs / Ft . $= d^2/531.36$
 . $= 12^2 /531.36$
 . $= 0.27 \text{ kgs/Ft}$

4. weight of each steel bar of length 40' = $0.27 \times 40 = 10.8 \text{ kgs}$

5. No. of Steel bars of length 40' required = wt of steel required / wt of each steel bar
 of Ø12mm . $= 95.99 / 10.8$
 . $= 8.88$ or approximately equal to 9 bars of Ø12mm required.

For 8.88 steel bars the required weight of steel = 95.99 (required weight of steel)

For 9 Steel bars the required weight of steel = $10.8 \times 9 = 97.2 \text{ kgs}$ (Actual weight of steel)

(b). Ø16mm

1. Standard length of each steel bar = 40 Ft.

2. Dia of steel bar for y-bar = 16mm

3. Weight of Steel bar in kgs / Ft . $= d^2/531.36$
 . $= 16^2 /531.36$
 . $= 0.481 \text{ kgs/Ft}$

4. weight of each steel bar of length 40' $= 0.481 \times 40 = 19.24 \text{ kgs}$

5. No. of Steel bars of length 40' required = wt. of steel required /wt of each steel bar
 of Ø16mm . $= 180.994 / 19.24$
 . $= 9.407$ or approximately equal to 10 bars of Ø16mm required.

For 9.407 steel bars the required weight of steel = 180.994 (required weight of steel)

For 10 Steel bars the required wt of steel = $19.24 \times 10 = 192.4 \text{ kgs}$ (Actual wt. of steel)

(iv). Bill of Quantities for Footing reinforcement:-

BILL OF QUANTITIES FOR FOOTING REINFORCEMENT							
S.no.	Description	Unit	Rate/unit	Total Quantity		Total Amount	Remark
	Dia of bar	Kgs	in Rupees	Actual weight of	Required	in	
				Steel required	bars of	Rupees	
				in kgs	40' length		
1	Ø12mm	Kgs	48.00	97.200	9	4665.600	
2	Ø16mm	Kgs	48.00	192.400	10	9235.200	
					Total	13900.800	
				Add 10% wastage		1390.080	
				Add 5% Contingencies		695.040	
					Total	15985.920	

Contingencies mean : Expenses which is likely to happen in future, which may happen or may not happen.

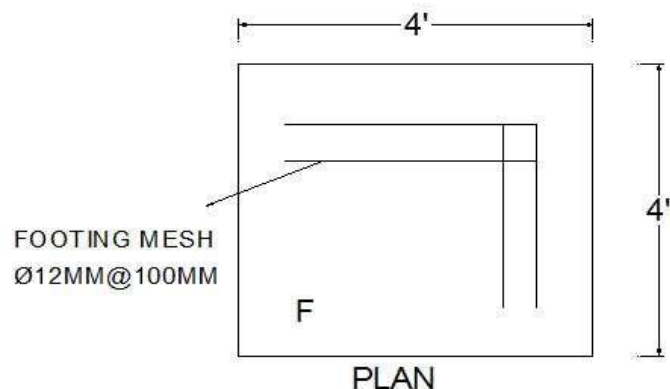
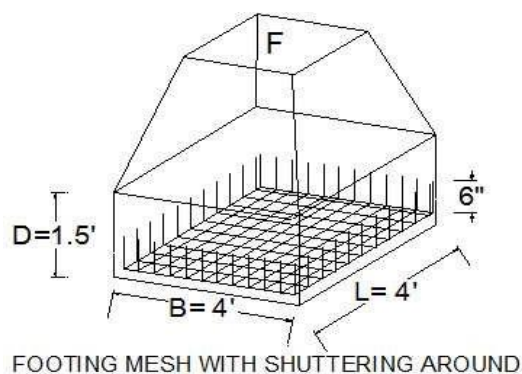
Problem-3:-

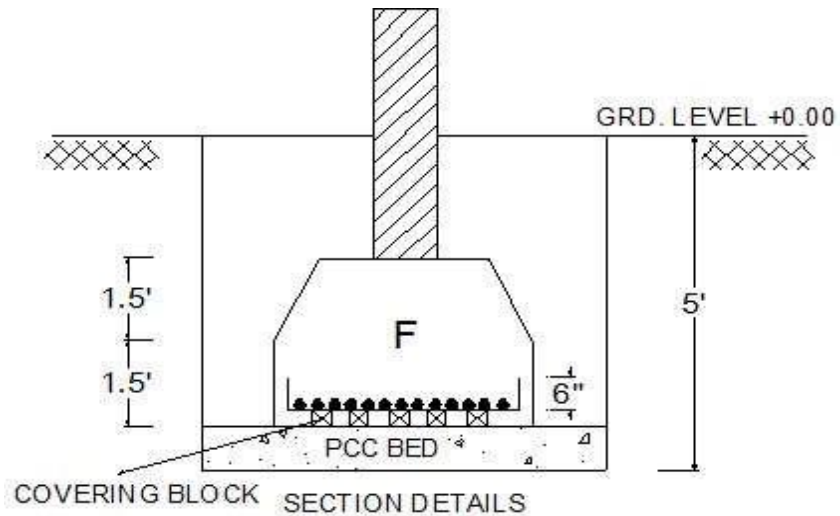
For a given plan of footing find

- Weight of Steel required for making footing meshes
- No. of Steel bars required, of length 40Ft
- Bill of Quantities for Footing Reinforcement

Footing mesh details: Ø12mm@100mm or 4" in x-direction & y-direction

if no. of footings = 14 ; spacing = 4" and Rate of steel /kg = 48.0 rupees.



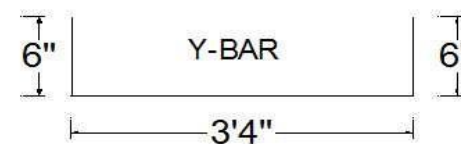
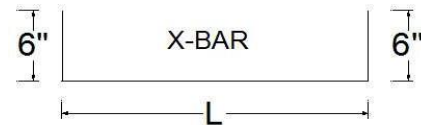
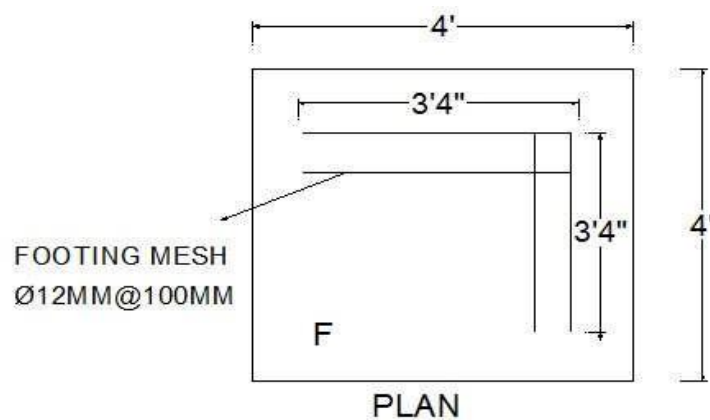
**Solution:-**

Total length of bar = $L + 6'' + 6''$

$$.= L + 12''$$

L' = length of x & y bar after deduction of concrete cover

6" = Given Projection of Steel bar for footing mesh

**(i). x-bar calculation:-**

According to condition, deduction of Concrete Cover from four sides of Footing

if Length or width of item is greater than or equal to 0.60m or 2' then cover=4"=100mm

$$" L" = 4' - 4" - 4" = 3'4" = 3.333'$$

$$1. \text{ Length of x-bar} = L + 6'' + 6''$$

$$.= L + 12''$$

$$.= 3.333' + 1'$$

$$.= 4.333'$$

$$\begin{aligned}
 2. \text{ No. of x-bar} &= (\text{opposite length} / \text{spacing}) + 1 \\
 &= (40'' / 4'') + 1 \\
 &= 11 \text{ bars}
 \end{aligned}$$

$$\begin{aligned}
 3. \text{ Total length of x-bar} &= \text{no. of x-bars} \times \text{length of each x-bar} \\
 &= 11 \times 4.333' \\
 &= 47.663'
 \end{aligned}$$

$$4. \text{ Given dia of x-bar} = 12\text{mm}$$

$$\begin{aligned}
 5. \text{ Weight of Steel bar in kgs / Ft} &= d^2 / 531.36 \\
 &= 12^2 / 531.36 \\
 &= 0.27 \text{ kgs/Ft}
 \end{aligned}$$

$$\begin{aligned}
 6. \text{ Total weight of Steel required} &= \text{weight/Ft} \times \text{Total length of x-bar} \times \text{no. of footings} \\
 &= 0.27 \times 47.663' \times 14 \\
 &= 180.166 \text{ kgs steel required of } \phi 12\text{mm}
 \end{aligned}$$

(ii). y-bar calculation:-

According to condition, deduction of Concrete Cover from four sides of Footing
if Length or width of item is greater than or equal to 0.60m or 2' then cover=4''=100mm

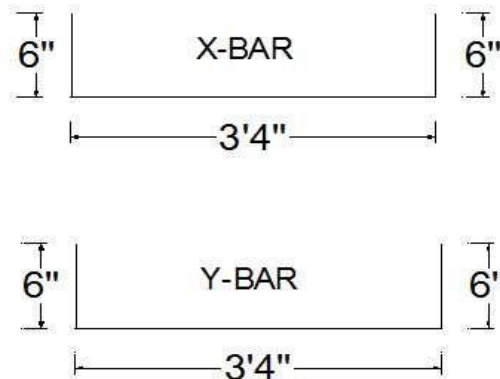
$$L = 4' - 4'' - 4'' = 3'4'' = 3.333'$$

$$\begin{aligned}
 1. \text{ Length of y-bar} &= L + 6'' + 6'' \\
 &= L + 12'' \\
 &= 3.333' + 1' \\
 &= 4.333'
 \end{aligned}$$

$$\begin{aligned}
 2. \text{ No. of y-bar} &= (\text{opposite length} / \text{spacing}) + 1 \\
 &= (40'' / 4'') + 1 \\
 &= 11 \text{ bars}
 \end{aligned}$$

$$\begin{aligned}
 3. \text{ Total length of y-bar} &= \text{no. of y-bars} \times \text{length of each y-bar} \\
 &= 11 \times 4.333' \\
 &= 47.663'
 \end{aligned}$$

$$4. \text{ Given dia of y-bar} = 12\text{mm}$$



$$\begin{aligned}
 5. \text{ Weight of Steel bar in kgs / Ft} &= d^2/531.36 \\
 &= 12^2 / 531.36 \\
 &= 0.27 \text{ kgs/Ft}
 \end{aligned}$$

$$\begin{aligned}
 6. \text{ Total weight of Steel required} &= \text{weight/Ft} \times \text{Total length of y-bar} \times \text{no. of footings} \\
 &= 0.27 \times 47.663' \times 14 \\
 &= 180.166 \text{ kgs steel required of } \varnothing 12\text{mm}
 \end{aligned}$$

(iii). Total weight of steel required for 14 footing meshes of $\varnothing 12\text{mm}$

$$\begin{aligned}
 \text{weight of x-bars required} &= 180.166 \\
 \text{weight of y-bars required} &= 180.166
 \end{aligned}$$

Total required weight of ste.= 360.332 kgs

(iv). No. of Steel bars required of length 40Ft.

1. Standard length of each steel bar = 40 Ft.

2. Dia of steel bar for x-bar & y-bar = 12mm

$$\begin{aligned}
 3. \text{ Weight of Steel bar in kgs / Ft} &= d^2/531.36 \\
 &= 12^2 / 531.36 \\
 &= 0.27 \text{ kgs/Ft}
 \end{aligned}$$

$$4. \text{ weight of each steel bar of length 40'} = 0.27 \times 40 = 10.8 \text{ kgs}$$

$$\begin{aligned}
 5. \text{ No. of Steel bars of length 40' required} &= \text{wt of steel required} / \text{wt of each steel bar} \\
 &= 360.332 / 10.8 \\
 &= 33.36 \text{ or approximately equal to 34 bars of } \varnothing 12\text{mm required.}
 \end{aligned}$$

For 33.36 steel bars the required weight of steel = 360.332 (required weight of steel)

For 34 Steel bars the required wt of steel = $10.8 \times 34 = 367.20$ kgs (Actual wt of steel)

(iv). Bill of Quantities for Footing reinforcement:-

BILL OF QUANTITIES FOR FOOTING REINFORCEMENT							
S.no.	Description	Unit	Rate/unit	Total Quantity		Total Amount	Remark
	Dia of bar	Kgs	in Rupees	Actual weight of	Required	in	
				Steel required	bars of	Rupees	
				in kgs	40' length		
1	Ø12mm	Kgs	48.00	367.200	34	17625.600	
					Total	17625.600	
				Add 10% wastage		1762.560	
				Add 5% Contingencies		881.280	
					Total	20269.440	

Contingencies mean : Expenses which is likely to happen in future, which may happen or may not happen.

Problem-4 :-

For a given plan of Neck Column find

(i). Weight of Steel required for Main bars and Stirrups.

(ii). No. of Steel bars required, of length 40Ft

(iii). Bill of Quantities for Neck Column Reinforcement if Rate of steel /kg = 48.0 rupees.

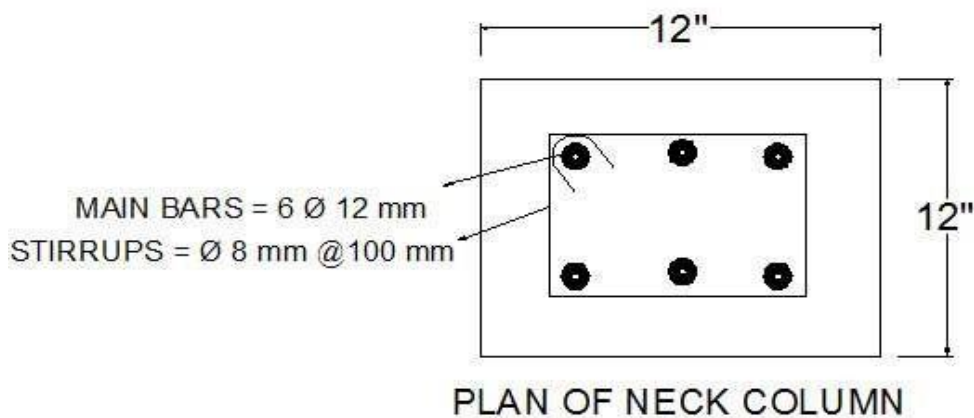
If no. of Columns = 12 size of column = 12" x 12" Height of CRS above G.L = 1.0Ft.

Depth of excavation = 5Ft

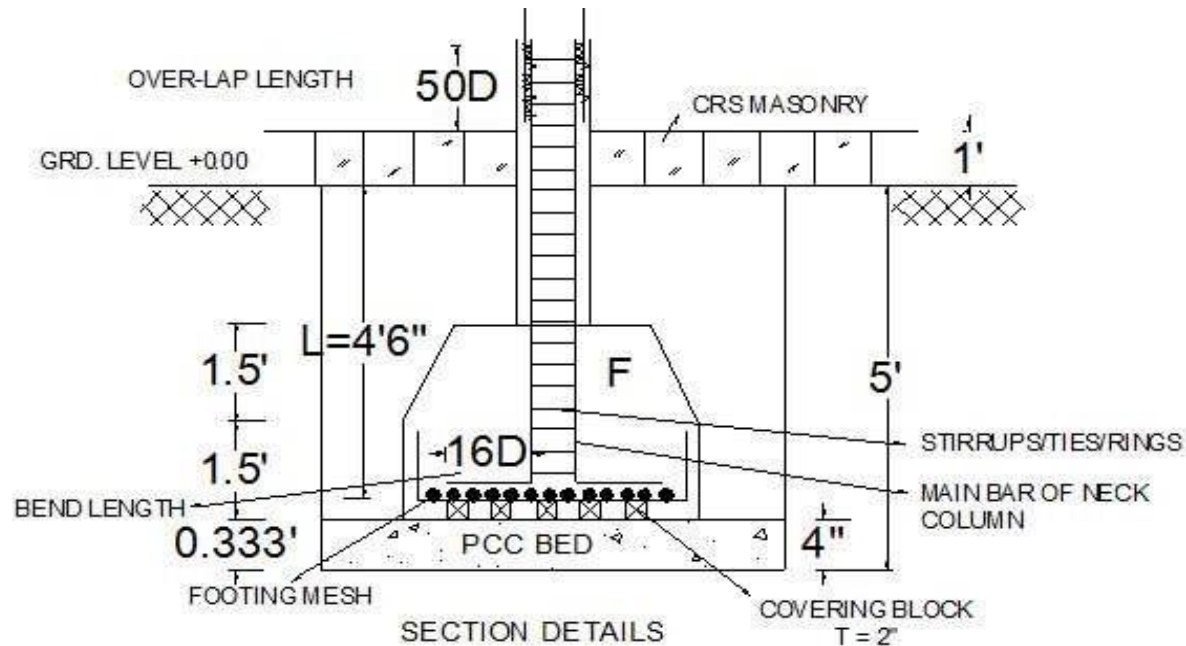
Depth of footing = 3Ft Thickness of pcc bed 4"

Reinforcement details for Neck column :-

(a). Main bars = 6 Ø 12mm (b). Stirrups = Ø 8mm @ 100mm or 4"



Solution :-



(i). Neck Column Main bars calculations:-

"L" = Depth of Excavation - thickness of pcc bed - thickness of Covering block

$$L = 5' - 4'' - 2''$$

$$L = 5' - 6''$$

$$L = 4.5'$$

Dia of Main bar = 12mm = 0.0393 Ft

Bend length = 16D : Over-lap length = 50D

1. The length of each Main bar = L + 16D + 50D + Ht. of CRS

$$.= L + 66D + \text{Ht. of CRS}$$

$$.= 4.5' + 66 \times 0.0393 + 1'$$

$$.= 8.093 \text{ Ft}$$

2. No. of Main bars = 6

3. Total length of Main bar = length of each main bar x no. of main bars

$$.= 8.093' \times 6$$

$$.= 48.558'$$

4. Dia of Main bar = 12mm

$$12\text{mm} = ? \text{ Ft}$$

$$\text{since } 1'' = 25.4\text{mm}$$

$$.= 12/25.4$$

$$.= 0.472'' = ? \text{ Ft}$$

$$\text{since } 1\text{ft} = 12''$$

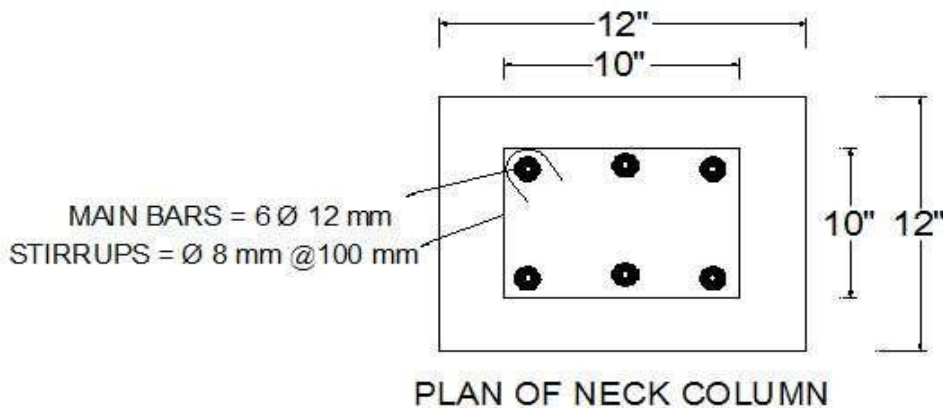
$$.= 0.472/12$$

$$.= 0.0393\text{ft}$$

$$\begin{aligned}
 3. \text{ Weight of Steel bar in kgs / Ft} &= d^2/531.36 \\
 &= 12^2/531.36 \\
 &= 0.27 \text{ kgs/Ft}
 \end{aligned}$$

$$\begin{aligned}
 6. \text{ weight of Steel required} &= \text{wt./Ft} \times \text{Total length of Main-bar} \times \text{no. of Neck columns} \\
 &= 0.27 \times 48.558' \times 12 \\
 &= 157.327 \text{ kgs steel required of } \phi 12\text{mm}
 \end{aligned}$$

(ii). Neck Column Stirrups or Ties calculations:-



Hook length = 9D

Two Hook length = 9D x 2 = 18D

where D = dia of bar

Length of each Tie = L + 18D

L = length of Tie after deduction of 1" Concrete Cover from four sides of Column with out hook length.

$$L = (L+B) \times 2$$

$$L = (10'' + 10'') \times 2$$

$$L = 40'' = 3.333\text{Ft}$$

$$D = \text{dia of Stirrup} = 8\text{mm} = 0.0262 \text{ Ft}$$

$$8\text{mm} = ? \text{ Ft}$$

$$\text{since } 1'' = 25.4\text{mm}$$

$$= 8/25.4$$

$$= 0.3149'' = ? \text{ Ft}$$

$$\text{since } 1\text{ft} = 12''$$

$$= 0.3149/12$$

$$= 0.0262\text{ft}$$

$$1. \text{ Length of Tie} = L + 18D$$

$$= 3.333' + 18 \times 0.0262$$

$$= 3.804'$$

$$2. \text{ No. of Ties} = (\text{Ht. of neck column} / \text{spacing}) + 1$$

$$= (5.5' / 0.333') + 1$$

$$= 17.51 \text{ or approximately equal to 18 stirrups}$$

Given spacing = 4" = 0.333Ft

Ht. of neck column = Depth of excavation - thickness of pcc - thickness
of covering block + Ht. of CRS

$$.= 5' - 4" - 2" + 1'$$

$$.= 5' - 0.5' + 1'$$

$$.= 5.5\text{ft}$$

3. Total length of Stirrup = length of each Stirrup x no. of Stirrups

$$.= 3.804' \times 18$$

$$.= 68.472 \text{ Ft}$$

4. Dia of Stirrup = 8mm

3. Weight of Steel bar in kgs / Ft . = $d^2/531.36$

$$.= 8^2 / 531.36$$

$$.= 0.1204 \text{ kgs/Ft}$$

6. Weight of Steel required = weight/Ft x Total length of Stirrup x no. of Neck columns

$$.= 0.1204 \times 68.472' \times 12$$

$$.= 98.928 \text{ kgs steel required of } \varnothing 8\text{mm}$$

(iii). Total weight of steel required for 12 no. of Columns of $\varnothing 12\text{mm}$ & $\varnothing 8\text{mm}$

weight of Main bars required . = 157.327 kgs

weight of Stirrups required . = 98.928 kgs

(iv). No. of Steel bars required of length 40Ft.

(a). $\varnothing 12\text{mm}$

1. Standard length of each steel bar = 40 Ft.

2. Dia of steel bar for Main bar = 12mm

3. Weight of Steel bar in kgs / Ft . = $d^2/531.36$

$$.= 12^2 / 531.36$$

$$.= 0.27 \text{ kgs/Ft}$$

4. weight of each steel bar of length 40' = $0.27 \times 40 = 10.8$ kgs

5. No. of Steel bars of length 40' required = wt. of steel required / wt. of each steel bar
 $\therefore = 157.327 / 10.8$
 $\therefore = 14.56$ or approximately equal to 15 bars of $\varnothing 12$ mm required.

For 14.56 steel bars the required weight of steel = 157.327 (required weight of steel)

For 15 Steel bars the required wt. of steel = $10.8 \times 15 = 162.0$ kgs (Actual wt. of steel)

(b). $\varnothing 8$ mm

1. Standard length of each steel bar = 40 Ft.

2. Dia of steel bar for Stirrups = 8mm

3. Weight of Steel bar in kgs / Ft $\therefore = d^2/531.36$
 $\therefore = 8^2/531.36$
 $\therefore = 0.1204$ kgs

4. weight of each steel bar of length 40' = $0.1204 \times 40 = 4.816$ kgs

5. No. of Steel bars of length 40' required = wt of steel required / wt of each steel bar
 $\therefore = 98.928 / 4.816$
 $\therefore = 20.54$ or approximately equal to 21 bars of $\varnothing 8$ mm required.

For 20.54 steel bars the required weight of steel = 98.928 (required weight of steel)

For 21 Steel bars the required wt. of steel = $4.816 \times 21 = 101.136$ kgs (Actual wt. of steel)

(v). Bill of Quantities for Neck column reinforcement:-

BILL OF QUANTITIES FOR NECK COLUMN REINFORCEMENT							
S.no.	Description	Unit	Rate/unit	Total Quantity		Total Amount	Remark
	Dia of bar	Kgs	in Rupees	Actual weight of	Required	in	
				Steel required	bars of	Rupees	
				in kgs	40' length		
1	$\varnothing 12$ mm	Kgs	48.00	162.000	15	7776.000	
2	$\varnothing 8$ mm	Kgs	48.00	101.136	21	4854.528	
					Total	12630.528	
				Add 10% wastage		1263.053	
				Add 5% Contingencies		631.526	
					Total	14525.107	

Contingencies mean : Expenses which is likely to happen in future, which may happen or may not happen.

Problem-5 :-

For a given plan of Plinth beam find

- (i). Weight of Steel required for Main bars and Stirrups.
- (ii). No. of Steel bars required, of length 40Ft
- (iii). Bill of Quantities for Plinth beam Reinforcement if Rate of steel /kg = 48.0 rupees.

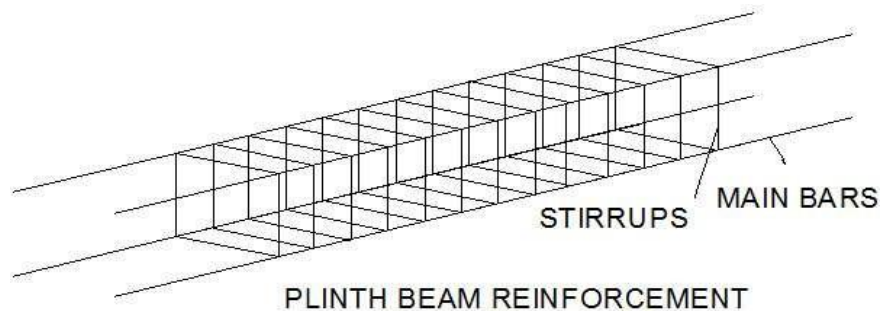
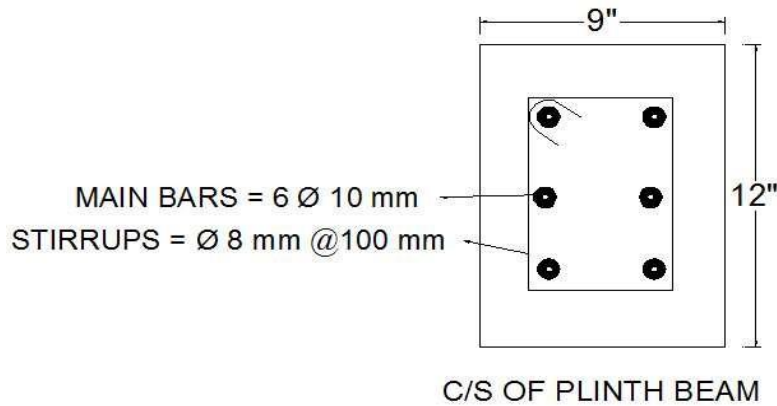
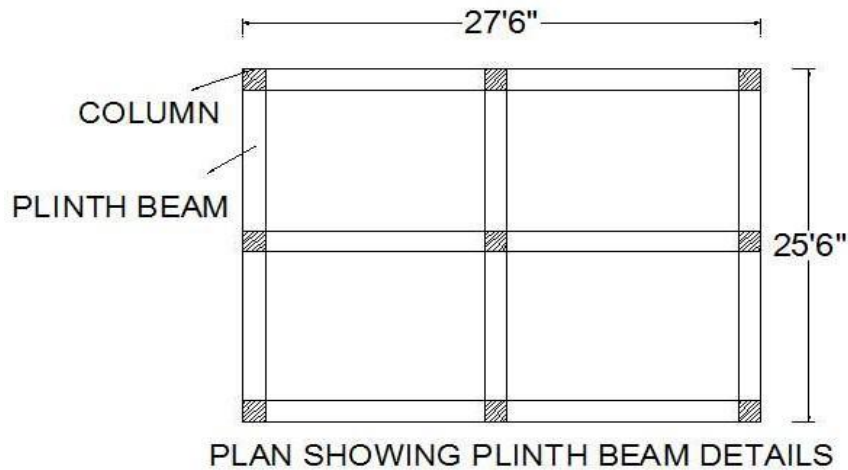
size of Plinth beam = 9" x 12"

size of column = 9" x 12"

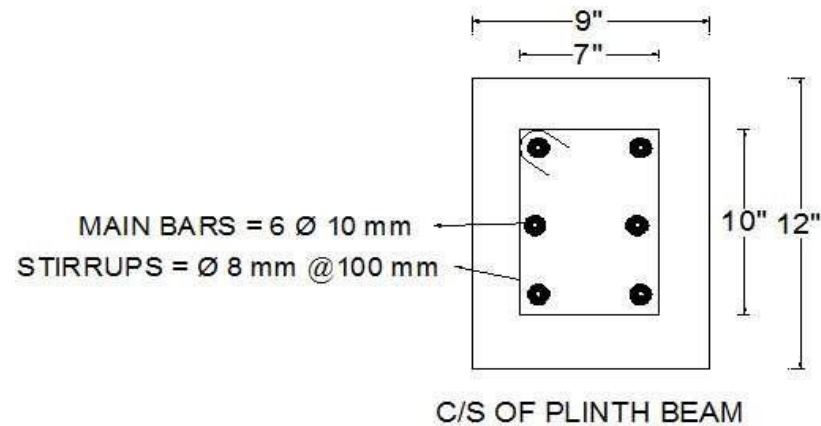
Reinforcement details for Plinth beams :-

(a). Main bars = 6 $\varnothing$ 10mm

(b). Stirrups = $\varnothing$ 8mm @ 100mm or 4"



Solution :-



(i). Plinth beam main bar calculations:-

(a). Plinth beam along horizontal axis"

Given size of Column = 9" x 12"

No. of Plinth beams along horizontal axis = 3

Length of Plinth beam including column length = 27'6"

1. Length of each Main bar = 27'6" - 1" - 1"

. = 27'4" (Deduction of 1" concrete cover from both side)

. = 27.333'

2. No. of Main bars = 6

3. Total length of Main bars

. = length of each Main bar x no. of Main bars x
no. of Plinth beams

. = 27.333' x 6 x 3

. = 491.994'

(b). Plinth beam along vertical axis"

Given size of Column = 9" x 12"

No. of Plinth beams along vertical axis = 3

Length of Plinth beam including Column length = 25'6"

1. Length of each Main bar = 25'6" - 1" - 1"

. = 25'4" (Deduction of 1" concrete cover from both side)

. = 25.333'

2. No. of Main bars = 6

3. Total length of Main bars $\therefore$ length of each Main bar x no. of Main bars x
no. of Plinth beams
 $\therefore 25.333' \times 6 \times 3$
 $\therefore 455.994'$

	<u>Total</u>
length of Main bars along horizontal and vertical axis :- length of	
steel bar along horizontal axis	$\therefore 491.994'$
length of steel bar along vertical axis	$\therefore 455.994'$
Total length of Main bars	$\therefore 947.988'$

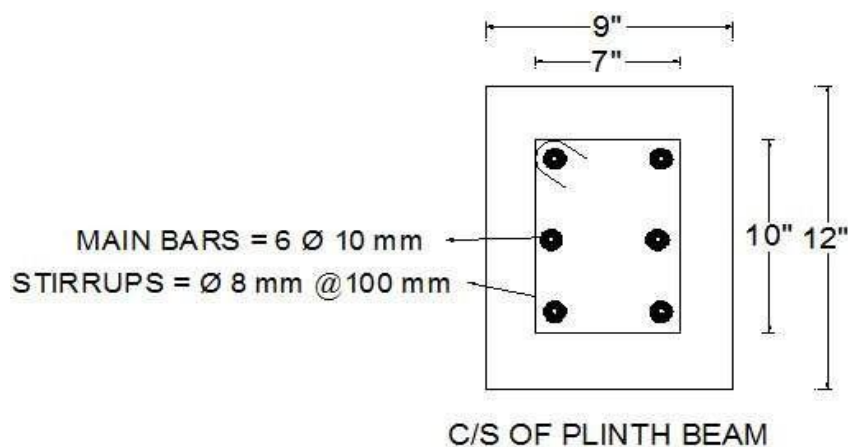
(d). Weight of steel required for Main bars :-

- Total length of Main bars = 947.988 Ft
- Dia of Main bar = 10mm
- Weight of Steel bar in kgs / Ft $\therefore d^2/531.36$
 $\therefore 10^2/531.36$
 $\therefore 0.1881 \text{ kgs/Ft}$
- Total weight of Steel required = weight/Ft x Total length of Main bars
 $\therefore 0.1881 \times 947.998$
 $\therefore 178.316 \text{ kgs steel required of } \varnothing 10\text{mm}$

(ii). Plinth beam -Stirrups calculations:-

Stirrups are provided in plinth beam up to Plinth beam length, excluding Columns

Size of Column = 9" x 12"



- Length of Plinth beam along horizontal axis $\therefore 27'6'' - 9'' - 9'' - 9''$
excluding Column length $\therefore 27.5' - 0.75' - 0.75' - 0.75'$
 $\therefore 25.25'$

No. of Plinth beam along horizontal axis $\therefore 3$

Length of Plinth beam along vertical axis
excluding Column length

$$= 25'6'' - 12'' - 12'' - 12''$$

$$= 25.5' - 1' - 1' - 1'$$

$$= 22.5'$$

No. of Plinth beam along vertical axis

$$= 3$$

Total length of Plinth beam

$$= 25.25' \times 3 + 22.5' \times 3$$

$$= 143.25\text{Ft}$$

Length of each Stirrup $= L + 18D$
where 'L' = length of stirrup after deduction of 1" concrete cover
'D' = dia of Stirrup = 8mm = 0.0262 Ft

$L = (L + B) \times 2$
 $= (7'' + 10) \times 2$
 $= 34''$
 $= 2.833 \text{ Ft}$

$8\text{mm} = ? \text{ Ft}$
since $1'' = 25.4\text{mm}$
 $= 8/25.4$
 $= 0.3149'' = ? \text{ Ft}$
since $1\text{ft} = 12''$
 $= 0.3149/12$
 $= 0.0262\text{ft}$

1. Length of each Stirrup $= L + 18D$
 $= 2.833 + 18 \times 0.0262$
 $= 3.304'$

2. No. of Stirrups $= (\text{length of Plinth beam} / \text{spacing}) + 1$
Given spacing = 100mm $= (143.25 / 0.333) + 1$
 $= 4'' = 0.333 \text{ Ft}$ $= 431.18$ or approximately equal to 432 Ties

3. Total length of Stirrups $= \text{length of each Tie} \times \text{no. of Ties}$
 $= 3.304 \times 432$
 $= 1427.328 \text{ Ft}$

4. Dia of Stirrup $= 8\text{mm}$

5. Weight of Steel bar in kgs / Ft $= d^2/531.36$
 $= 8^2/531.36$
 $= 0.1204 \text{ kgs/Ft}$

6. Total weight of Steel required = weight/Ft x Total length of stirrup
 $= 0.1204 \times 1427.328'$
 $= 171.850 \text{ kgs steel required of } \varnothing 8\text{mm}$

(v). Bill of Quantities for Plinth beam reinforcement:-

BILL OF QUANTITIES FOR PLINTH BEAM REINFORCEMENT							
S.no.	Description	Unit	Rate/unit	Total Quantity		Total Amount	Remark
	Dia of bar	Kgs	in Rupees	Actual weight of	Required	in	
				Steel required	bars of	Rupees	
				in kgs	40' length		
1	Ø10mm	Kgs	48.00	180.576	24	8667.648	
2	Ø8mm	Kgs	48.00	173.376	36	8322.048	
					Total	16989.696	
				Add 10% wastage		1698.970	
				Add 5% Contingencies		849.485	
					Total	19538.150	

Contingencies mean : Expenses which is likely to happen in future, which may happen or may not happen.

Problem-6 :-

From the given plan and section Dwg. of Floor Column Find

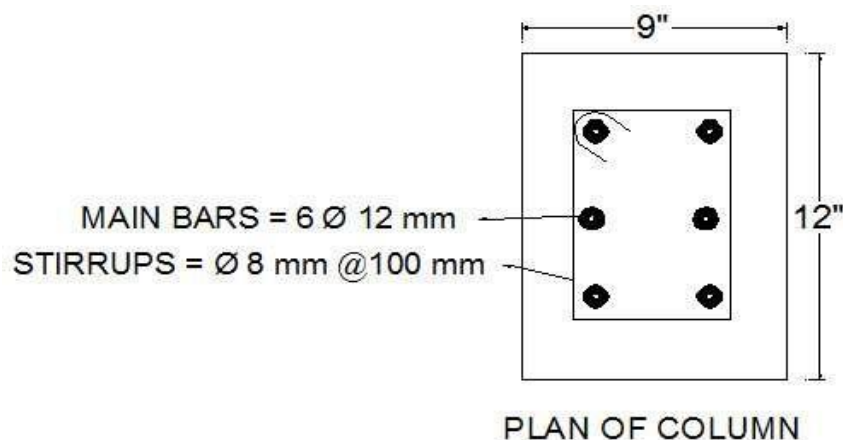
- (i). Weight of Steel required for Main bars and Stirrups.
- (ii). No. of Steel bars required, of length 40Ft
- (iii). Bill of Quantities for Floor Column Reinforcement if Rate of steel /kg = 48.0 rupees.

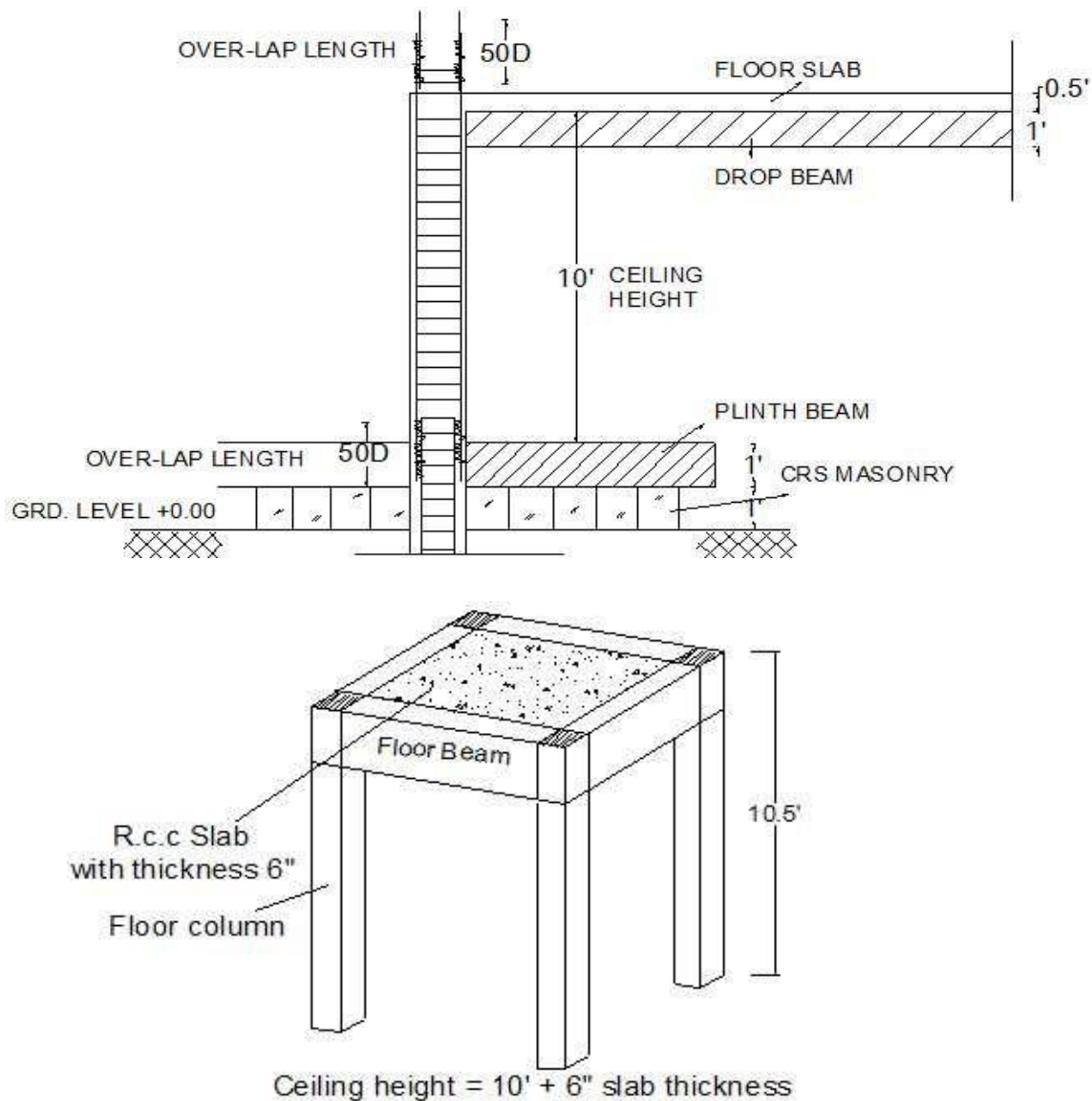
size of Column = 9" x 12" ; height of Ceiling = 10'

No. of Floor Columns = 6 and Thickness of Floor Slab = 6"

Reinforcement Details for Floor Columns :

- (a). Main bars = 6 Ø12mm (b). Stirrups = Ø8mm@100mm or 4"



**Solution :-****(i). Floor Column Main bars calculations:-****1. Length of each Main bar :-**

"L" = Height of Ceiling + Thickness of Floor Slab + Over-lap length

$$L = 10' + 6'' + 50D$$

$$12\text{mm} = ? \text{ Ft}$$

$$L = 10' + 0.5' + 50 \times 0.0393'$$

$$\text{since } 1'' = 25.4\text{mm}$$

$$L = 12.465'$$

$$= 12/25.4$$

$$\text{Dia of Main bar} = 12\text{mm} = 0.0393 \text{ Ft}$$

$$= 0.472'' = ? \text{ Ft}$$

$$\text{Over-lap length} = 50D$$

$$\text{since } 1\text{ft} = 12''$$

$$= 0.472/12$$

$$= 0.0393\text{ft}$$

2. No. of Main bars = 6

3. Total length of Main bar = length of each main bar x no. of main bars

$$.= 12.465' \times 6$$

$$.= 74.79'$$

4. Dia of Main bar = 12mm

3. Weight of Steel bar in kgs / Ft $. = d^2 / 531.36$

$$.= 12^2 / 531.36$$

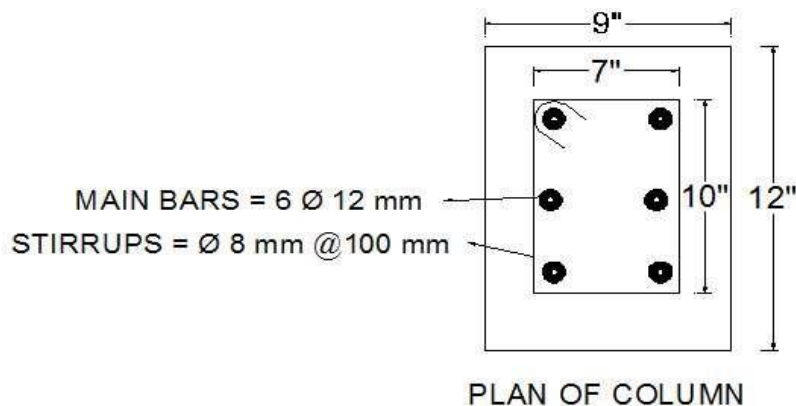
$$.= 0.27 \text{ kgs/Ft}$$

6. Total wt of Steel required = wt/Ft x Total length of Main-bar x no. of Floor columns

$$.= 0.27 \times 74.79' \times 6$$

$$.= 121.159 \text{ kgs steel required of } \varnothing 12\text{mm}$$

(ii). Floor Column Stirrups or Ties calculations:-



Hook length = 9D

Two Hook length = 9D x 2 = 18D

where D = dia of bar

Length of each Tie = L + 18D

L = length of Tie after deduction of 1" Concrete Cover from four sides of Column with-

$$L = (L+B) \times 2$$

out hook length

$$L = (7" + 10") \times 2$$

$$L = 34" = 2.833\text{Ft}$$

D = dia of Stirrup = 8mm = 0.0262 Ft

8mm=? Ft

since 1"=25.4mm

$$.= 8/25.4$$

$$.= 0.3149" = ? \text{ Ft}$$

since 1ft = 12"

$$.= 0.3149/12$$

$$.= 0.0262\text{ft}$$

1. Length of Tie = L + 18D

$$.= 2.833' + 18 \times 0.0262$$

$$.= 3.304'$$

2. No. of Ties = (Ht. of Ceiling / spacing) +1

$$.= (10' / 0.333') +1$$

$$.= 31.03 \text{ or approximately equal to 31 stirrups}$$

Given spacing = 4" = 0.333Ft

Note: Stirrups shall be provided up to ceiling height only.

3. Total length of Stirrup = length of each Stirrup x no. of Stirrups

$$.= 3.304' \times 31$$

$$.= 102.424 \text{ Ft}$$

4. Dia of Stirrup = 8mm

3. Weight of Steel bar in kgs / Ft $.= d^2/531.36$

$$.= 8^2 / 531.36$$

$$.= 0.1204 \text{ kgs/Ft}$$

6. Total wt of Steel required = wt/Ft x Total length of Stirrup x no. of Floor Columns

$$.= 0.1204 \times 102.424' \times 6$$

$$.= 73.991 \text{ kgs steel required of } \varnothing 8\text{mm}$$

(iii). Total weight of steel required for 6 no. of Columns of $\varnothing 12\text{mm}$ & $\varnothing 8\text{mm}$

weight of Main bars required $.= 121.159 \text{ kgs}$

weight of Stirrups required $.= 73.991 \text{ kgs}$

(iv). No. of Steel bars required of length 40Ft.

(a). $\varnothing 12\text{mm}$

1. Standard length of each steel bar = 40 Ft.

2. Dia of steel bar for Main bar = 12mm

3. Weight of Steel bar in kgs / Ft $.= d^2/531.36$

$$.= 12^2 / 531.36$$

$$.= 0.27 \text{ kgs/Ft}$$

4. weight of each steel bar of length 40' = $0.27 \times 40 = 10.8 \text{ kgs}$

5. No. of Steel bars of length 40' required = wt of steel required / wt of each steel bar

$$.= 121.159 / 10.8$$

$$.= 11.21 \text{ or approximately equal to 12 bars of } \varnothing 12\text{mm required.}$$

For 11.21 steel bars the required weight of steel = 121.159 (required weight of steel)

For 12 Steel bars the required wt of steel = $10.8 \times 12 = 129.6 \text{ kgs}$ (Actual wt of steel)

(b). $\varnothing$ 8mm

1. Standard length of each steel bar = 40 Ft.

2. Dia of steel bar for Stirrups = 8mm

3. Weight of Steel bar in kgs / Ft $\therefore = d^2/531.36$
 $\therefore = 8^2 / 531.36$
 $\therefore = 0.1204$ kgs

4. weight of each steel bar of length 40' = $0.1204 \times 40 = 4.816$ kgs

5. No. of Steel bars of length 40' required = wt of steel required / wt of each steel bar
 $\therefore = 73.991 / 4.816$
 $\therefore = 15.36$ or approximately equal to 16 bars of $\varnothing$ 8mm required.

For 15.36 steel bars the required weight of steel = 73.991 (required weight of steel)

For 16 Steel bars the required wt of steel = $4.816 \times 16 = 77.056$ kgs (Actual wt of steel)

(v). Bill of Quantities for Floor Columns reinforcement:-

BILL OF QUANTITIES FOR FLOOR COLUMNS REINFORCEMENT							
S.no.	Description	Unit	Rate/unit	Total Quantity		Total Amount	Remark
	Dia of bar	Kgs	in Rupees	Actual weight of	Required	in	
				Steel required	bars of	Rupees	
				in kgs	40' length		
1	$\varnothing$ 12mm	Kgs	48.00	129.600	12	6220.800	
2	$\varnothing$ 8mm	Kgs	48.00	77.056	16	3698.688	
					Total	9919.488	
				Add 10% wastage		991.949	
				Add 5% Contingencies		495.974	
					Total	11407.411	

Contingencies mean : Expenses which is likely to happen in future, which may happen or may not happen.

Problem-7 :-

For a given plan & Section Dwg. of Floor beams find

- (i). Weight of Steel required for Main bars and Stirrups.
- (ii). No. of Steel bars required, of length 40Ft
- (iii). Bill of Quantities for Floor beam Reinforcement if Rate of steel /kg = 48.0 rupees.

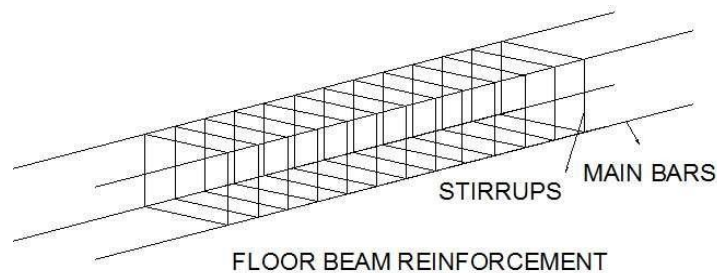
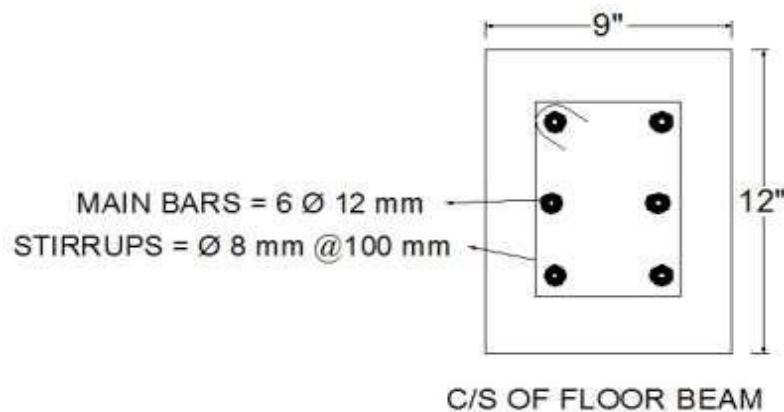
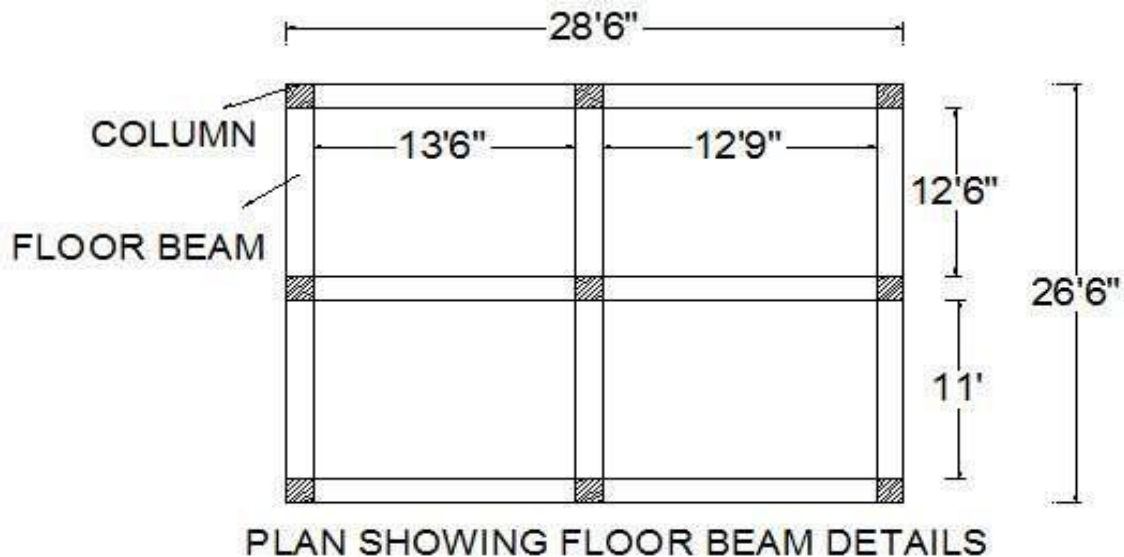
Floor beam details: size of Floor beam = 9" x 12"

size of column = 9" x 12"

Reinforcement details for Floor beams :-

(a). Main bars = 6 $\varnothing$ 12mm

(b). Stirrups = $\varnothing$ 8mm @ 100mm or 4"



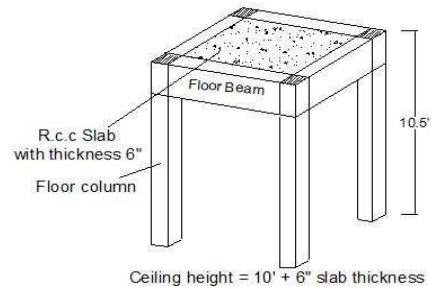
Solution :-**(i). Floor beam main bars calculations:-**

(a). Floor beam along horizontal axis"

Given size of Column = 9" x 12"

No. of Floor beams along horizontal axis = 3

Length of Floor beam including column length = 28'6"



1. Length of each Main bar = 28'6" - 1" - 1"

.= 28'4" (Deduction of 1" concrete cover from both side)

.= 28.333'

2. No. of Main bars = 6

3. Total length of Main bars = length of each Main bar x no. of Main bars x

no. of Floor beams

.= 28.333' x 6 x 3

.= 509.994'

(b). Floor beam along vertical axis"

Given size of Column = 9" x 12"

No. of Floor beams along vertical axis = 3

Length of Floor beam including Column length = 26'6"

1. Length of each Main bar = 26'6" - 1" - 1"

.= 26'4" (Deduction of 1" concrete cover from both side)

.= 26.333'

2. No. of Main bars = 6

3. Total length of Main bars = length of each Main bar x no. of Main bars x

no. of Floor beams

.= 26.333' x 6 x 3

.= 473.994'

(c). Total length of Main bars along horizontal and vertical axis :-

length of steel bar along horizontal axis . = 509.994

length of steel bar along vertical axis . = 473.994'

Total length of Main bars . = 983.988'

(d). Weight of steel required for Main bars :-

1. Total length of Main bars = 983.988 Ft
2. Dia of Main bar = 12mm
3. Weight of Steel bar in kgs / Ft

$$.= d^2/531.36$$

$$.= 12^2 / 531.36$$

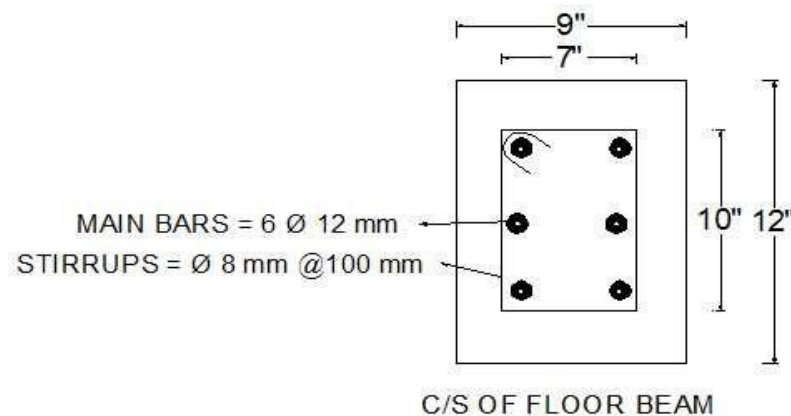
$$.= 0.27 \text{ kgs/Ft}$$
4. Total weight of Steel required = weight/Ft x Total length of Main bars

$$.= 0.27 \times 983.998$$

$$.= 265.679 \text{ kgs steel required of } \varnothing 12\text{mm}$$

(ii). Floor beam -Stirrups calculations:-

Stirrups are provided in Floor beam up to Floor beam length, excluding Column length.
Size of Column = 9" x 12"



- | | |
|---|--|
| Length of Floor beam along horizontal axis
excluding Column length | $.= 28'6" - 9" - 9" - 9"$ $.= 28.5' - 0.75' - 0.75' - 0.75'$ $.= 26.25'$ |
| No. of Floor beam along horizontal axis | $.= 3$ |
| Length of Floor beam along vertical axis
excluding Column length | $.= 26'6" - 12" - 12" - 12"$ $.= 26.5' - 1' - 1' - 1'$ $.= 23.5'$ |
| No. of Floor beam along vertical axis | $.= 3$ |
| Total length of Floor beam | $.= 26.25' \times 3 + 23.5' \times 3$ $.= 149.25\text{Ft}$ |

Length of each Stirrup $\therefore L + 18D$

where 'L' = length of stirrup after deduction of 1" concrete cover

'D' = dia of Stirrup = 8mm = 0.0262 Ft

$L = (L + B) \times 2$

$\therefore (7" + 10) \times 2$

$\therefore 34"$

$\therefore 2.833 \text{ Ft}$

8mm=? Ft

since 1"=25.4mm

$\therefore 8/25.4$

$\therefore 0.3149" = ? \text{ Ft}$

since 1ft = 12"

$\therefore 0.3149/12$

$\therefore 0.0262 \text{ ft}$

1. Length of each Stirrup $\therefore L + 18D$

$\therefore 2.833 + 18 \times 0.0262$

$\therefore 3.304'$

2. No. of Stirrups $\therefore (\text{length of Floor beam} / \text{spacing}) + 1$

Given spacing = 100mm $\therefore (149.25 / 0.333) + 1$

$\therefore 4" = 0.333 \text{ Ft} \therefore 449.198$ or approximately equal to 450 Ties

3. Total length of Stirrups $\therefore \text{length of each Tie} \times \text{no. of Ties}$

$\therefore 3.304 \times 450$

$\therefore 1486.8 \text{ Ft}$

4. Dia of Stirrup $\therefore 8 \text{ mm}$

5. Weight of Steel bar in kgs / Ft $\therefore d^2/531.36$

$\therefore 8^2/531.36$

$\therefore 0.1204 \text{ kgs/Ft}$

6. Total weight of Steel required = weight/Ft x Total length of stirrup

$\therefore 0.1204 \times 1486.8$

$\therefore 179.01 \text{ kgs}$ steel required of $\varnothing 8 \text{ mm}$

(iii). Total weight of steel required for Floor beams of $\varnothing 12 \text{ mm}$ & $\varnothing 8 \text{ mm}$

weight of Main bars required $\therefore 265.679 \text{ kgs}$

weight of Stirrups required $\therefore 179.01 \text{ kgs}$

(iv). No. of Steel bars required of length 40Ft.

(a). $\varnothing 12 \text{ mm}$

1. Standard length of each steel bar = 40 Ft.

2. Dia of steel bar for Main bar = 12mm

3. Weight of Steel bar in kgs / Ft $= d^2/531.36$
 $= 12^2 / 531.36$
 $= 0.27 \text{ kgs/Ft}$

4. weight of each steel bar of length 40' $= 0.27 \times 40 = 10.8 \text{ kgs}$

5. No. of Steel bars of length 40' required = wt of steel required / wt of each steel bar
 $= 265.679 / 10.8$
 $= 24.59$ or approximately equal to 25 bars of $\varnothing 12\text{mm}$ required.

For 24.59 steel bars the required wt of steel = 265.679 kgs (required wt of steel)

For 25 Steel bars the required wt of steel = $10.8 \times 25 = 270.0 \text{ kgs}$ (Actual wt of steel)

(b). $\varnothing 8\text{mm}$

1. Standard length of each steel bar = 40 Ft.

2. Dia of steel bar for Stirrups = 8mm

3. Weight of Steel bar in kgs / Ft $= d^2/531.36$
 $= 8^2 / 531.36$
 $= 0.1204 \text{ kgs}$

4. weight of each steel bar of length 40' $= 0.1204 \times 40 = 4.816 \text{ kgs}$

5. No. of Steel bars of length 40' required = wt of steel required / wt of each steel bar
 $= 179.01 / 4.816$
 $= 37.16$ or approximately equal to 38 bars of $\varnothing 8\text{mm}$ required.

For 37.16 steel bars the required weight of steel = 179.01 kgs (required weight of steel)

For 38 Steel bars the required wt of steel = $4.816 \times 38 = 183.008 \text{ kgs}$ (Actual wt of steel)

(v). Bill of Quantities for Floor beam reinforcement:-

BILL OF QUANTITIES FOR FLOOR BEAMS REINFORCEMENT							
S.no.	Description	Unit	Rate/unit	Total Quantity		Total Amount	Remark
	Dia of bar	Kgs	in Rupees	Actual weight of	Required	in	
				Steel required	bars of	Rupees	
				in kgs	40' length		
1	Ø12mm	Kgs	48.00	270.000	25	12960.000	
2	Ø8mm	Kgs	48.00	183.008	38	8784.384	
					Total	21744.384	
				Add 10% wastage		2174.438	
				Add 5% Contingencies		1087.219	
					Total	25006.042	

Contingencies mean : Expenses which is likely to happen in future, which may happen or may not happen.

Problem-8 :-

For a given plan & Section Dwg. of Floor Slab find

(i). Weight of Steel required for Main bars and Extra bars

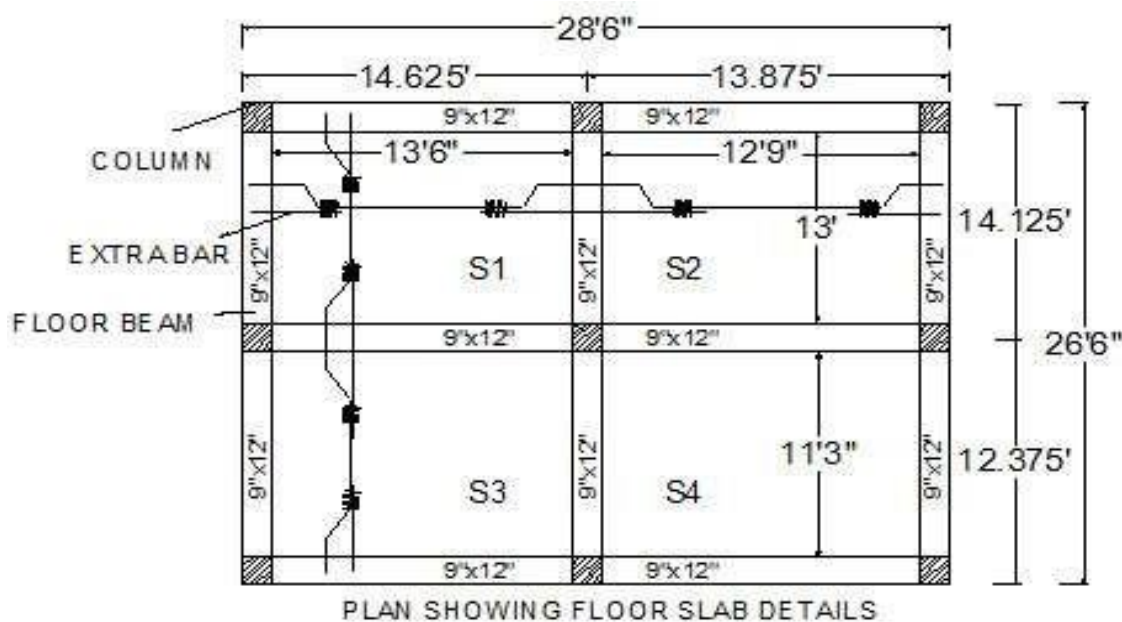
(ii). No. of Steel bars required, of length 40Ft

(iii). Bill of Quantities for Floor Slab Reinforcement if Rate of steel /kg = 48.0 rupees.

size of Floor beam = 9" x 12" size of column = 9" x 12" Slab thickness = 6"

Reinforcement details for Floor Slabs :-

(a). Slab mesh = Ø 10mm@100mm or 4(b). Extra bar = Ø 8mm@ 100mm or 4"



Solution :-

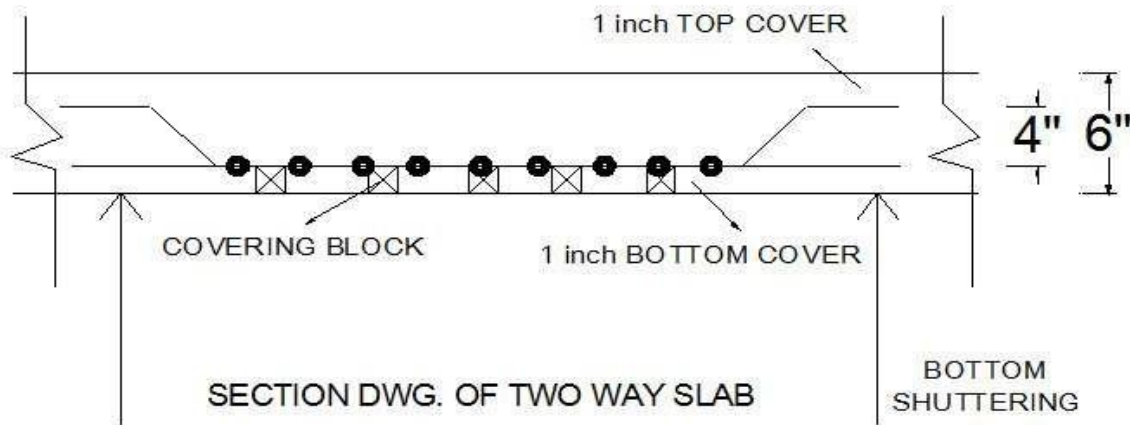
According to conditions, 1 inch concrete cover shall be deducted from 4 sides of Slab

SLAB-1:-**(i). Main bar and Distribution bar calculation (Slab-1) :-**

$$\begin{aligned}
 1. \text{ Length of x-bar} &= L + 0.42D + 0.42D - 1'' \\
 &= L + 0.84D - 1'' \\
 &= 14.625' + 0.84D - 1'' & 1'' = 0.0833' \\
 &= 14.625' + 0.84 \times 4'' - 1'' & 4'' = 0.333' \\
 &= 14.625' + 0.84 \times 0.333 - 0.0833' \\
 &= 14.821'
 \end{aligned}$$

D = Depth of Slab - top cover - bottom cover

$$D = 6'' - 1'' - 1'' = 4''$$



$$\begin{aligned}
 2. \text{ Length of y-bar} &= L + 0.42D + 0.42D - 1'' \\
 &= L + 0.84D - 1'' \\
 &= 14.125' + 0.84D - 1'' \\
 &= 14.125' + 0.84 \times 4'' - 1'' & 1'' = 0.0833' \\
 &= 14.125' + 0.84 \times 0.333 - 0.0833' & 4'' = 0.333' \\
 &= 14.321'
 \end{aligned}$$

$$\begin{aligned}
 3. \text{ No. of x-bars} &= (\text{opposite length} / \text{spacing}) + 1 \\
 &= (13' / 4'') + 1 \\
 &= (156'' / 4'') + 1 & \text{Opp. length} = \text{internal breadth of Slab} \\
 &= 40 \text{ bars} & \text{Given spacing} = 4''
 \end{aligned}$$

$$\begin{aligned}
 4. \text{ No. of y-bars} &= (\text{opposite length} / \text{spacing}) + 1 \\
 &= (13'6'' / 4'') + 1 & \text{Opp. length} = \text{internal length of Slab} \\
 &= (162'' / 4'') + 1 & \text{Given spacing} = 4'' \\
 &= 41.5 \text{ bars or approximately equal to 42 bars}
 \end{aligned}$$

5. Total length of x-bar & y-bar = length of x-bar x no. of x-bars + length of y-bar x no. of y-bars

$$.= 14.821 \times 40 + 14.321 \times 42$$

$$.= 1194.322 \text{ Ft}$$

(ii). Extra- bar calculation (Slab-1) :- Extra bar = $\varnothing$ 8mm@ 100mm or 4"

1. The length of each Extra bar in x-direction = $(L/4) + 50D$

where D = dia of bar; L = length of Crank bar including crank length

Given dia of bar = 8mm = 0.0262'
$$.= (14.821'/4) + 50 \times 0.0262'$$

$$.= 5.015'$$

2. The length of each Extra bar in y-direction = $(L/4) + 50D$

where D = dia of bar; L = length of Crank bar including crank length

Given dia of bar = 8mm = 0.0262'
$$.= (14.321'/4) + 50 \times 0.0262'$$

$$.= 4.89'$$

8mm=? Ft

since 1"=25.4mm

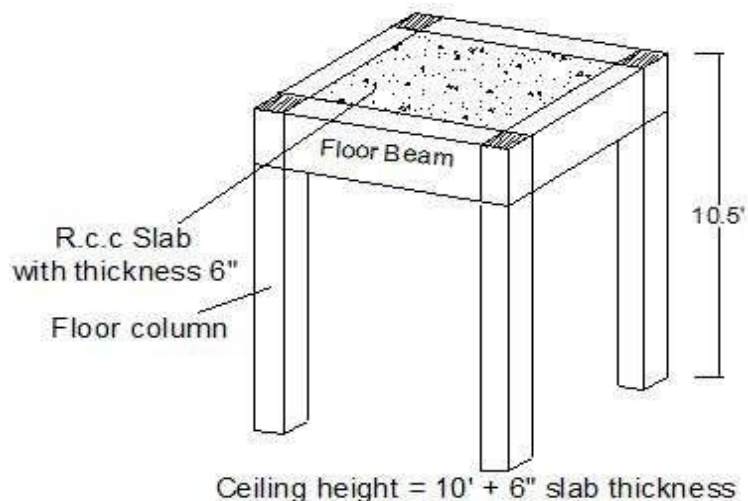
$$.= 8/25.4$$

$$.= 0.3149" = ? \text{ Ft}$$

since 1ft = 12"

$$.= 0.3149/12$$

$$.= 0.0262 \text{ ft}$$



3. No. of Extra-bar in x-direction = no. of x-bars x 2

$$.= 40 \times 2 = 80 \text{ bars}$$

4. No. of Extra-bar in y-direction = no. of y-bars x 2

$$.= 42 \times 2 = 84 \text{ bars}$$

5. Total length of Extra bar = length of each Extra bar in x-direction x no. of Extra bar in x-direction + length of each Extra bar in y-direction x no. of Extra bar in y-direction

$$.= 5.015' \times 80 + 4.88 \times 84$$

$$.= 785.92 \text{ Ft}$$

SLAB-2:-**(i). Main bar and Distribution bar calculation (Slab-2) :-**

$$\begin{aligned}
 1. \text{ Length of x-bar} &= L + 0.42D + 0.42D - 1'' \\
 &= L + 0.84D - 1'' \\
 &= 13.875' + 0.84D - 1'' \\
 &= 13.875' + 0.84 \times 4'' - 1'' \\
 &= 13.875' + 0.84 \times 0.333 - 0.0833' \\
 &= 14.071'
 \end{aligned}$$

D = Depth of Slab - top cover - bottom cover

1" = 0.0833'

D = 6" - 1" - 1"

4" = 0.333'

D = 4"

$$\begin{aligned}
 2. \text{ Length of y-bar} &= L + 0.42D + 0.42D - 1'' \\
 &= L + 0.84D - 1'' \\
 &= 14.125' + 0.84D - 1'' \\
 &= 14.125' + 0.84 \times 4'' - 1'' \\
 &= 14.125' + 0.84 \times 0.333 - 0.0833' \\
 &= 14.321'
 \end{aligned}$$

$$\begin{aligned}
 3. \text{ No. of x-bars} &= (\text{opposite length} / \text{spacing}) + 1 \\
 &= (13' / 4'') + 1 \\
 &= (156'' / 4'') + 1 && \text{Opp. length = internal breadth of Slab} \\
 &= 40 \text{ bars} && \text{Given spacing = 4''}
 \end{aligned}$$

$$\begin{aligned}
 4. \text{ No. of y-bars} &= (\text{opposite length} / \text{spacing}) + 1 \\
 &= (12'9'' / 4'') + 1 && \text{Opp. length = internal length of Slab} \\
 &= (153'' / 4'') + 1 && \text{Given spacing = 4''} \\
 &= 39.25 \text{ bars or approximately equal to 40 bars}
 \end{aligned}$$

$$\begin{aligned}
 5. \text{ Total length of x-bar \& y-bar} &= \text{length of x-bar} \times \text{no. of x-bars} + \text{length of y-bar} \times \text{no. of y-bars} \\
 &= 14.071 \times 40 + 14.321 \times 40 \\
 &= 1135.68 \text{ Ft}
 \end{aligned}$$

(ii). Extra- bar calculation (Slab-2) :- Extra bar = $\emptyset$ 8mm@ 100mm or 4"

1. The length of each Extra bar in x-direction = $(L/4) + 50D$

where D = dia of bar; L = length of Crank bar including crank length

$$\begin{aligned}\text{Given dia of bar} &= 8\text{mm} = 0.0262' & . = (14.071'/4) + 50 \times 0.0262' \\ & & . = 4.827'\end{aligned}$$

2. The length of each Extra bar in y-direction = $(L/4) + 50D$

where D = dia of bar; L = length of Crank bar including crank length

$$\begin{aligned}\text{Given dia of bar} &= 8\text{mm} = 0.0262' & . = (14.321'/4) + 50 \times 0.0262' \\ & & . = 4.89'\end{aligned}$$

3. No. of Extra-bar in x-direction = no. of x-bars x 2

$$. = 40 \times 2 = 80 \text{ bars}$$

4. No. of Extra-bar in y-direction = no. of y-bars x 2

$$. = 40 \times 2 = 80 \text{ bars}$$

5. Total length of Extra bar = length of each Extra bar in x-direction x no. of Extra bar
in x-direction + length of each Extra bar in y-direction x
no. of Extra bar in y-direction

$$\begin{aligned}& . = 4.827' \times 80 + 4.89 \times 80 \\ & . = 777.36 \text{ Ft}\end{aligned}$$

SLAB-3:-

(i). Main bar and Distribution bar calculation (Slab-3) :-

$$\begin{aligned}\text{1. Length of x-bar} & . = L + 0.42D + 0.42D - 1'' \\ & . = L + 0.84D - 1'' \\ & . = 14.625' + 0.84D - 1'' \\ & . = 14.625' + 0.84 \times 4'' - 1'' \\ & . = 14.625' + 0.84 \times 0.333 - 0.0833' \\ & . = 14.821'\end{aligned}$$

D = Depth of Slab - top cover - bottom cover

$$1'' = 0.0833'$$

D = 6" - 1" - 1"

$$4'' = 0.333'$$

D = 4"

2. Length of y-bar $. = L + 0.42D + 0.42D - 1''$
 $. = L + 0.84D - 1''$
 $. = 12.375' + 0.84D - 1''$
 $. = 12.375' + 0.84 \times 4'' - 1''$
 $. = 12.375' + 0.84 \times 0.333 - 0.0833'$
 $. = 12.571'$
3. No. of x-bars $= (\text{opposite length} / \text{spacing}) + 1$
 $. = (11'3'' / 4'') + 1$ Opp. length = internal breadth of Slab
 $. = (135'' / 4'') + 1$ Given spacing = 4"
 $. = 34.75$ bars or approximately equal to 35 bars
4. No. of y-bars $= (\text{opposite length} / \text{spacing}) + 1$
 $. = (13'6'' / 4'') + 1$ Opp. length = internal length of Slab
 $. = (162'' / 4'') + 1$ Given spacing = 4"
 $. = 41.5$ bars or approximately equal to 42 bars
5. Total length of x-bar & y-bar = length of x-bar x no. of x-bars + length of y-bar x no. of y-bars
 $. = 14.821 \times 35 + 12.571 \times 42$
 $. = 1046.717 \text{ Ft}$

(ii). Extra- bar calculation (Slab-3) :- Extra bar = $\emptyset$ 8mm@ 100mm or 4"

1. The length of each Extra bar in x-direction $= (L/4) + 50D$
 where D = dia of bar; L = length of Crank bar including crank length
 Given dia of bar = 8mm = 0.0262' $. = (14.821' / 4) + 50 \times 0.0262'$
 $. = 4.705'$
2. The length of each Extra bar in y-direction $= (L/4) + 50D$
 where D = dia of bar; L = length of Crank bar including crank length
 Given dia of bar = 8mm = 0.0262' $. = (12.571' / 4) + 50 \times 0.0262'$
 $. = 4.452'$
3. No. of Extra-bar in x-direction = no. of x-bars x 2
 $. = 35 \times 2 = 70$ bars
4. No. of Extra-bar in y-direction = no. of y-bars x 2
 $. = 42 \times 2 = 84$ bars

5. Total length of Extra bar = length of each Extra bar in x-direction x no. of Extra bar
in x-direction + length of each Extra bar in y-direction x
no. of Extra bar in y-direction

$$.= 4.705' \times 70 + 4.452 \times 84$$

$$.= 703.318 \text{ Ft}$$

SLAB-4:-**(i). Main bar and Distribution bar calculation (Slab-4) :-**

1. Length of x-bar
$$.= L + 0.42D + 0.42D - 1''$$

$$.= L + 0.84D - 1''$$

$$.= 13.875' + 0.84D - 1''$$

$$.= 13.875' + 0.84 \times 4'' - 1''$$

$$.= 13.875' + 0.84 \times 0.333 - 0.0833'$$

$$.= 14.071'$$

D = Depth of Slab - top cover - bottom cover

1" = 0.0833'

D = 6" - 1" - 1"

4" = 0.333'

D = 4"

2. Length of y-bar
$$.= L + 0.42D + 0.42D - 1''$$

$$.= L + 0.84D - 1''$$

$$.= 12.375' + 0.84D - 1''$$

$$.= 12.375' + 0.84 \times 4'' - 1''$$

$$.= 12.375' + 0.84 \times 0.333 - 0.0833'$$

$$.= 12.571'$$

3. No. of x-bars = (opposite length / spacing) + 1

$$.= (11'3'' / 4'') + 1$$

Opp. length = internal breadth of Slab

$$.= (135'' / 4'') + 1$$

Given spacing = 4"

$$.= 34.75 \text{ bars or approximately equal to 35 bars}$$

4. No. of y-bars = (opposite length / spacing) + 1

$$.= (12'9'' / 4'') + 1$$

Opp. length = internal length of Slab

$$.= (153'' / 4'') + 1$$

Given spacing = 4"

$$.= 39.25 \text{ bars or approximately equal to 40 bars}$$

5. Total length of x-bar & y-bar = length of x-bar x no. of x-bars + length of y-bar x
no. of y-bars

$$.= 14.071 \times 35 + 12.571 \times 40$$

$$.= 995.325 \text{ Ft}$$

(ii). Extra- bar calculation (Slab-4) :- Extra bar = $\varnothing$ 8mm@ 100mm or 4"

1. The length of each Extra bar in x-direction = $(L/4) + 50D$

where D = dia of bar; L = length of Crank bar including crank length

$$\begin{aligned} \text{Given dia of bar} &= 8\text{mm} = 0.0262' \\ &= (14.071'/4) + 50 \times 0.0262' \\ &= 4.827' \end{aligned}$$

2. The length of each Extra bar in y-direction = $(L/4) + 50D$

where D = dia of bar; L = length of Crank bar including crank length

$$\begin{aligned} \text{Given dia of bar} &= 8\text{mm} = 0.0262' \\ &= (12.571'/4) + 50 \times 0.0262' \\ &= 4.452' \end{aligned}$$

3. No. of Extra-bar in x-direction = no. of x-bars x 2

$$= 35 \times 2 = 70 \text{ bars}$$

4. No. of Extra-bar in y-direction = no. of y-bars x 2

$$= 40 \times 2 = 80 \text{ bars}$$

5. Total length of Extra bar = length of each Extra bar in x-direction x no. of Extra bar
in x-direction + length of each Extra bar in y-direction x
no. of Extra bar in y-direction

$$\begin{aligned} &= 4.827' \times 70 + 4.452 \times 80 \\ &= 694.05 \text{ Ft} \end{aligned}$$

(a). Total length of Main & Distribution bar for all Slabs :-

$$\text{Slab-1} \quad = 1194.322 \text{ Ft}$$

$$\text{Slab-2} \quad = 1135.68 \text{ Ft}$$

$$\text{Slab-3} \quad = 1046.717 \text{ Ft}$$

$$\text{Slab-4} \quad = 995.325 \text{ Ft}$$

Total	= 4372.044 Ft
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(b). Total length of Extra- bar for all Slabs :-

$$\text{Slab-1} \quad = 785.92 \text{ Ft}$$

$$\text{Slab-2} \quad = 777.36 \text{ Ft}$$

$$\text{Slab-3} \quad = 703.318 \text{ Ft}$$

$$\text{Slab-4} \quad = 694.05 \text{ Ft}$$

Total	= 2960.648 Ft
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Weight of Steel required for Slab Mesh :

1. Given Dia of Slab Mesh = 10mm Slab mesh = $\varnothing$ 10mm@100mm or 4"

$$\begin{aligned} 2. \text{ Weight of Steel bar in kgs / Ft} &= d^2/531.36 \\ &= 10^2/531.36 \\ &= 0.1881 \text{ kgs/Ft} \end{aligned}$$

$$\begin{aligned} 3. \text{ Total weight of Steel required} &= \text{weight/Ft} \times \text{Total length main bars} \\ &= 0.1881 \times 4372.044 \\ &= 822.381 \text{ kgs steel required of } \varnothing 10\text{mm} \end{aligned}$$

No. of Steel bars required of length 40Ft. :

1. Standard length of each steel bar = 40 Ft.

2. Dia of steel bar = 10mm

$$\begin{aligned} 3. \text{ Weight of Steel bar in kgs / Ft} &= d^2/531.36 \\ &= 10^2/531.36 \\ &= 0.1881 \text{ kgs/Ft} \end{aligned}$$

$$4. \text{ weight of each steel bar of length 40'} = 0.1881 \times 40 = 7.524 \text{ kgs}$$

$$\begin{aligned} 5. \text{ No. of Steel bars of length 40' required} &= \text{wt of steel required} / \text{wt of each steel bar} \\ &= 822.381 / 7.524 \\ &= 109.301 \text{ or approximately equal to 110 bars of } \varnothing 10\text{mm required.} \end{aligned}$$

For 109.301 steel bars the required wt of steel = 822.381 kgs (required wt of steel)

For 110 Steel bars the required wt of steel = $7.524 \times 110 = 827.64$ kgs (Actual wt of steel)

Weight of Steel required for Extra-bar :

1. Given Dia of Extra-bar = 8mm Extra-bar = $\varnothing$ 8mm@100mm or 4"

$$\begin{aligned} 2. \text{ Weight of Steel bar in kgs / Ft} &= d^2/531.36 \\ &= 8^2/531.36 \\ &= 0.1204 \text{ kgs/Ft} \end{aligned}$$

$$\begin{aligned} 3. \text{ Total weight of Steel required} &= \text{weight/Ft} \times \text{Total length of Extra-bar} \\ &= 0.1204 \times 2960.648' \\ &= 356.462 \text{ kgs steel required of } \varnothing 8\text{mm} \end{aligned}$$

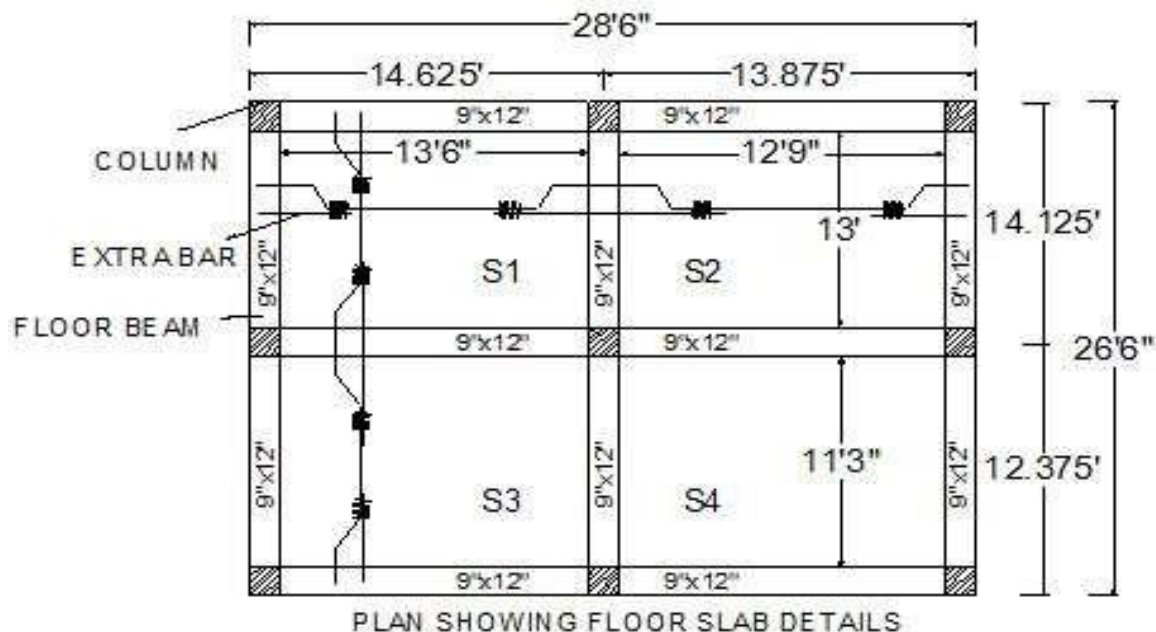
No. of Steel bars required of length 40Ft. :

1. Standard length of each steel bar = 40 Ft.
2. Dia of steel bar = 8mm
3. Weight of Steel bar in kgs / Ft
$$.= d^2/531.36$$
$$.= 8^2 / 531.36$$
$$.= 0.1204 \text{ kgs/Ft}$$
4. weight of each steel bar of length 40' = $0.1204 \times 40 = 4.816 \text{ kgs}$
5. No. of Steel bars of length 40' required = $\text{Wt of steel required} / \text{wt of each steel bar}$
$$.= 356.462 / 4.816$$
$$.= 74.016 \text{ or approximately equal to 74 bars of } \varnothing 8\text{mm required.}$$

Bill of Quantities for Floor Slab reinforcement:-

BILL OF QUANTITIES FOR FLOOR SLAB REINFORCEMENT							
S.no.	Description	Unit	Rate/unit	Total Quantity		Total Amount	Remark
	Dia of bar	Kgs	in Rupees	Actual weight of	Required	in	
				Steel required	bars of	Rupees	
				in kgs	40' length		
1	Ø10mm	Kgs	48.00	827.640	110	39726.720	
2	Ø8mm	Kgs	48.00	356.462	74	17110.176	
					Total	56836.896	
				Add 10% wastage		5683.690	
			Add 5% Contingencies			2841.845	
					Total	65362.430	

Contingencies mean : Expenses which is likely to happen in future, which may happen or may not happen.

METHOD - 2 FOR SLAB REINFORCEMENT CALCULATIONS

(a). Slab mesh calculations :-

$$\begin{aligned}
 1. \text{ length of x-bar} &= L - 1'' - 1'' + 0.42D \times 4 \\
 &= 28'6'' - 1'' - 1'' + 1.68D \\
 &= 28'4'' + 1.68D \\
 &= 28'4'' + 1.68 \times 4'' \\
 &= 28.333' + 1.68 \times 0.333 \\
 &= 28.892 \text{ Ft}
 \end{aligned}$$

D = Depth of Slab - top cover - bottom cover

$$1'' = 0.0833'$$

$$D = 6'' - 1'' - 1''$$

$$4'' = 0.333'$$

$$D = 4''$$

$$\begin{aligned}
 2. \text{ length of y-bar} &= L - 1'' - 1'' + 0.42D \times 4 \\
 &= 26'6'' - 1'' - 1'' + 1.68D \\
 &= 26'4'' + 1.68D \\
 &= 26'4'' + 1.68 \times 4'' \\
 &= 26.333' + 1.68 \times 0.333 \\
 &= 26.892 \text{ Ft}
 \end{aligned}$$

Opp. Length = breadth of Slab - width of Floor beams

$$\text{Opp.length} = 26'6'' - 9'' \times 3 = 24.25'$$

$$\begin{aligned}
 3. \text{ No. of x-bars} &= (\text{Opp.length} / \text{spacing}) + 1 \\
 &= (24.25/0.333) + 1 \\
 &= 73.82 \text{ or approximately equal to 74 bars}
 \end{aligned}$$

Opp. Length = Length of Slab - width of Floor beams

$$\text{Opp.length} = 28'6'' - 9'' \times 3 = 26.25'$$

$$\begin{aligned}
 4. \text{ No. of y-bars} &= (\text{Opp.length} / \text{spacing}) + 1 \\
 &= (26.25/0.333) + 1 \\
 &= 79.82 \text{ or approximately equal to 80 bars}
 \end{aligned}$$

$$5. \text{ Total length of x-bar \& y-bar} = 28.892 \times 74 + 26.892 \times 80 = 4289.368 \text{ Ft}$$

$$\begin{aligned}
 6. \text{ Weight of Steel bar in kgs / Ft} &= d^2/531.36 \\
 \text{Dia of Slab Mesh} = 10\text{mm} &= 10^2/531.36 \\
 &= 0.1881 \text{ kgs/Ft}
 \end{aligned}$$

$$7. \text{ Weight of Steel required for Slab Mesh} = 0.1881 \times 4289.368 = 806.830 \text{ kgs}$$

$$8. \text{ weight of each steel bar of length } 40' = 0.1881 \times 40 = 7.524 \text{ kgs}$$

$$\begin{aligned}
 9. \text{ No. of Steel bars of length } 40' \text{ required} &= \text{wt of steel required} / \text{wt of each steel bar} \\
 &= 806.830 / 7.524 \\
 &= 107.234 \text{ or approximately equal to 108 bars of } \varnothing 10\text{mm required.}
 \end{aligned}$$

For 107.234 steel bars the required weight of steel = 806.830 kgs (required wt of steel)

For 108 Steel bars the required wt of steel = $7.524 \times 108 = 812.592$ kgs (Actual wt of steel)

(b). Extra-bar calculations :-

$$\begin{aligned}
 8\text{mm} &= ? \text{ Ft} &= 0.3149'' = ? \text{ Ft} \\
 \text{since } 1'' &= 25.4\text{mm} &\text{since } 1\text{ft} = 12'' \\
 &= 8/25.4 &= 0.3149/12 \\
 &= 0.3149'' &= 0.0262\text{ft}
 \end{aligned}$$

$$\begin{aligned}
 1. \text{ length of each Extra-bar in x-direction} &= (L/2) + 50D \times 4 \\
 &= (28.892/2) + 50 \times 0.0262 \times 4 \\
 &= 19.686 \text{ Ft}
 \end{aligned}$$

$$\begin{aligned}
 2. \text{ length of each Extra-bar in y-direction} &= (L/2) + 50D \times 4 \\
 &= (26.892/2) + 50 \times 0.0262 \times 4 \\
 &= 18.686 \text{ Ft}
 \end{aligned}$$

$$3. \text{ No. of Extra-bar in x-direction} = 74$$

$$4. \text{ No. of Extra-bar in y-direction} = 80$$

$$5. \text{ Total length of Extra-bar} = 19.686 \times 74 + 18.686 \times 80 = 2951.644 \text{ Ft.}$$

$$6. \text{ Weight of Steel bar in kgs / Ft} \quad = d^2/531.36$$

$$\text{Dia of Extra-bar} = 8\text{mm} \quad = 8^2/531.36$$

$$= 0.1204 \text{ kgs/Ft}$$

$$7. \text{ Weight of Steel required for Extra-bar} = 0.1204 \times 2951.644 = 355.377 \text{ kgs}$$

$$8. \text{ weight of each steel bar of length 40'} = 0.1204 \times 40 = 4.816 \text{ kgs}$$

$$\begin{aligned}
 9. \text{ No. of Steel bars of length 40' required} &= \text{wt of steel required} / \text{wt of each steel bar} \\
 &= 355.377 / 4.816
 \end{aligned}$$

$$= 73.79 \text{ or approximately equal to 74 bars of } \varnothing 8\text{mm required.}$$

For 73.79 steel bars the required weight of steel = 355.377 kgs (required wt of steel)

For 74 Steel bars the required wt of steel = $4.816 \times 74 = 356.384$ kgs (Actual wt of steel)

(c). Bill of Quantities for Floor Slab reinforcement:-

BILL OF QUANTITIES FOR FLOOR SLAB REINFORCEMENT							
S.no.	Description	Unit	Rate/unit	Total Quantity		Total Amount	Remark
	Dia of bar	Kgs	in Rupees	Actual weight of	Required	in	
				Steel required	bars of	Rupees	
				in kgs	40' length		
1	$\varnothing 10\text{mm}$	Kgs	48.00	812.592	108	39004.416	
2	$\varnothing 8\text{mm}$	Kgs	48.00	356.384	74	17106.432	
					Total	56110.848	
				Add 10% wastage		5611.085	
				Add 5% Contingencies		2805.542	
					Total	64527.475	

Contingencies mean : Expenses which is likely to happen in future, which may happen or may not happen.

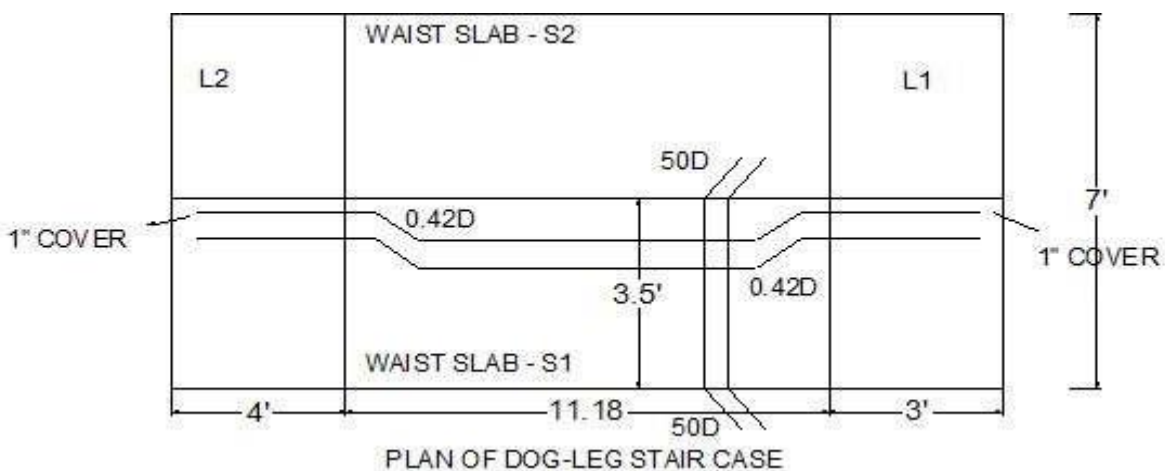
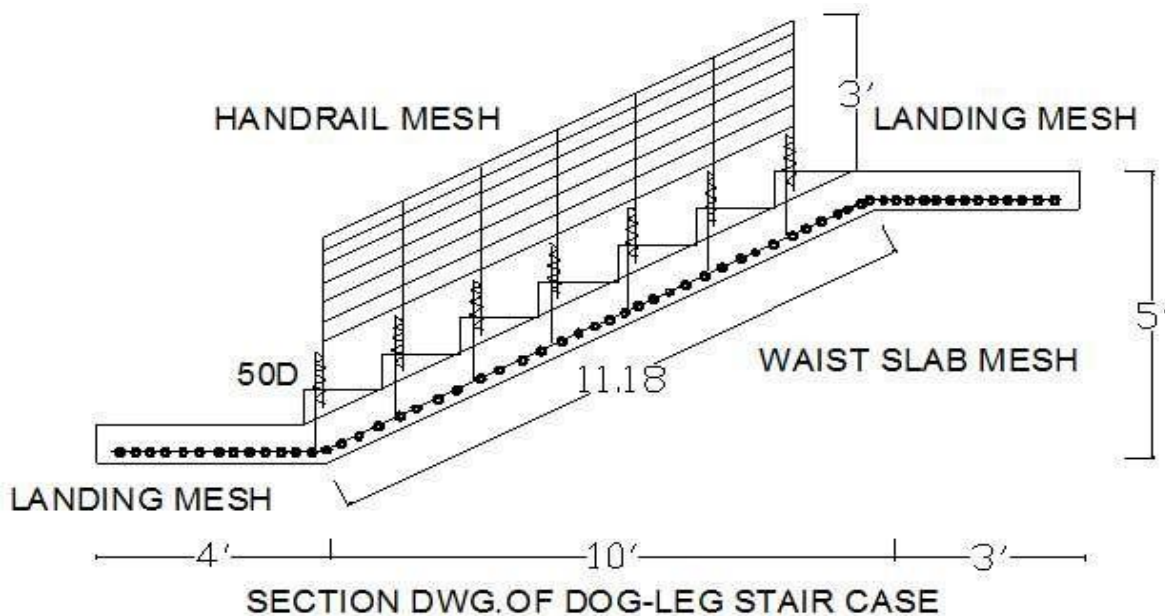
Problem-9 :-

For a given plan & Section Dwg. of Dog-leg Stair-case find

- Weight of Steel required for Main bars, Distribution bars, Extra bars and Hand Rail mesh. Thickness of Waist Slab and Landing = 6"
- No. of Steel bars required, of length 40Ft
- Bill of Quantities for Stair-case Reinforcement if Rate of steel /kg = 48.0 rupees.

Reinforcement details :-

- Waist Slab mesh = $\varnothing$ 10mm@100mm or 4"
- Landing mesh = $\varnothing$ 10mm@100mm or 4"
- Extra bar = $\varnothing$ 8mm@ 100mm or 4"
- Handrail mesh = $\varnothing$ 8mm@ 100mm or 4"



(i). Waist Slab (S1&S2) :-

Note:-

(a). while providing Steel mesh in waist slab , 1" concrete cover shall be deducted from each side of waist slab's x-bar and add over-lap length of 50D on each side of y-bar to join hand-rail mesh

(b). Each Crank Length = $0.42D$

where D = Depth of Slab -Top and Bottom concrete cover

$D = 6" - 1" - 1" = 4"$ or 0.333 Ft

(c). formula used to find, no. of bars = [opposite length / spacing] + 1

Given dia of main bar = 10mm

$$10\text{mm} = ? \text{ Ft} \quad . = 0.3937" = ? \text{ Ft}$$

$$. = 10 / 25.4 \quad . = 0.3937 / 12$$

$$. = 0.3937" \quad . = 0.0328 \text{ Ft}$$

$$\begin{aligned} 1. \text{ length of x-bar} & . = 4' + 11.18' + 3' + 0.42D \times 2 - 1" - 1" \\ & . = 4' + 11.18' + 3' + 0.42 \times 0.333 \times 2 - 0.1666 \\ & . = 18.293 \text{ Ft} \end{aligned}$$

$$\begin{aligned} 2. \text{ length of y-bar} & . = 3.5' + 50D \times 2 \\ & . = 3.5' + 50 \times 0.0328 \times 2 \\ & . = 6.78' \text{ Ft} \end{aligned}$$

$$\begin{aligned} 3. \text{ No. of x -bar} & . = [3'4" / 4"] + 1 & L = 3'6" - 1" - 1" = 3'4" \\ & . = [3.333' / 0.333'] + 1 \\ & . = 11 \text{ bars} \end{aligned}$$

$$\begin{aligned} 4. \text{ No. of y -bar} & . = [11.01' / 4"] + 1 & L = 11.18' - 1" - 1" = 11.01' \\ & . = [11.01' / 0.333'] + 1 \\ & . = 34.06 \\ & . = \text{approximately equal to 34 bars} \end{aligned}$$

$$\begin{aligned} 5. \text{ Total Length of Steel -bars} & = \text{length of x -bar} \times \text{no. of x -bars} + \text{length of y -bar} \times \\ & \quad \text{no. of y -bars} \\ & . = 18.293 \times 11 + 6.78 \times 34 = 431.743 \text{ Ft} \end{aligned}$$

6. Dia of bar for waist slab mesh in both direction = 10 mm

According to thumb rule :-

$$[i]. \text{ weight of steel bar in kgs / m} = d^2 / 162 \quad . = 10^2 / 162 = 0.617 \text{ kgs / m}$$

$$[ii]. \text{ weight of steel bar in kgs / Ft} = d^2 / 531.48 \quad . = 10^2 / 531.48 = 0.188 \text{ kgs / Ft}$$

$$\begin{aligned} 8. \text{ Total weight required} & . = \text{weight / Ft} \times \text{Total length} \times \text{no. of waist slab} \\ & . = 0.188 \times 431.743 \times 2 \\ & . = \mathbf{162.335 \text{ kgs}} \end{aligned}$$

(ii). Extra bar Calculations :

Extra bar = $\varnothing$ 8mm @ 100mm / 4"

$$\begin{aligned} 8\text{mm} & = ? \text{ Ft} \quad . = 0.3149 = ? \text{ Ft} \\ . & = 8 / 25.4 \quad . = 0.3149 / 12 \\ . & = 0.3149" \quad . = 0.0262 \text{ Ft} \end{aligned}$$

Note:- Extra bar is provided at a distance of L / 4 from corner of Slab

where L = length of x-bar including crank length

$$\begin{aligned} \text{Length of each extra bar} & . = [L / 4] + \text{over-lap length} \\ & . = [L / 4] + 50 D \end{aligned}$$

$$\begin{aligned} 1. \text{ Length of each extra bar in x-direction} & . = [11.459 / 4] + 50 \times 0.0262 \\ L & = 11.18 + 0.42D \times 2 \quad . = 4.174 \text{ Ft} \\ L & = 11.18 + 0.42 \times 0.333 \times 2 \\ L & = 11.459 \text{ Ft} \end{aligned}$$

$$\begin{aligned} 2. \text{ No. of Extra bar in x-direction} & . = \text{No. of main bar in x-direction} \times 2 \\ & . = 11 \times 2 = 22 \end{aligned}$$

$$\begin{aligned} 3. \text{ Total length of Extra- bar in x- direction} & = \text{length of Extra-bar} \times \text{no. of Extra-bars} \\ & . = 4.174 \times 22 = 91.828 \text{ Ft} \end{aligned}$$

4. Dia of Extra bar in x- direction = 8 mm ; Extra bar = $\varnothing$ 8mm @ 100mm / 4"

According to thumb rule :-

$$[i]. \text{ weight of steel bar in kgs / m} = d^2 / 162 \quad . = 8^2 / 162 = 0.395 \text{ kgs / m}$$

$$[ii]. \text{ weight of steel bar in kgs / Ft} = d^2 / 531.48 \quad . = 8^2 / 531.48 = 0.1204 \text{ kgs / Ft}$$

$$\begin{aligned} 5. \text{ Total weight required for Extra -bar} & = \text{weight / Ft} \times \text{Total length} \times \text{no. of Waist Slabs} \\ & . = 0.1204 \times 91.828 \times 2 \\ & . = \mathbf{22.112 \text{ kgs}} \end{aligned}$$

(iii). Landing mesh (L1&L2) :-

Note:- while doing calculation of Reinforcement for Landing, no need to find length of x-bar as it has already added with waist slab x-bar length. All is need is to find length of y bar only.

$$\begin{aligned} 1. \text{ length of y-bar} &= 7' - 1'' - 1'' \\ &= 7' - 0.1666' \\ &= 6.983' \text{ Ft} \end{aligned}$$

$$\begin{aligned} 2. \text{ No. of y-bar} &= [6.8333 / 4''] + 1 \\ \text{width of landing-1} &= 3' &= [6.8333 / 0.333] + 1 \\ \text{width of landing-2} &= 4' &= 21.52 \text{ or approximately equal to 22 bars} \\ \text{Total width} &= 3' + 4' = 7' \\ &= 7' - 1'' - 1'' [\text{concrete cover}] \\ &= 6.8333 \text{ Ft} \end{aligned}$$

$$\begin{aligned} 3. \text{ Total Length of y-bar} &= \text{length of y-bar} \times \text{no. of y-bars} \\ &= 6.983 \times 22 = 153.626 \text{ Ft} \end{aligned}$$

According to thumb rule :-

$$\begin{aligned} [i]. \text{ weight of steel bar in kgs / m} &= d^2 / 162 &= 10^2 / 162 = 0.617 \text{ kgs / m} \\ [ii]. \text{ weight of steel bar in kgs / Ft} &= d^2 / 531.48 &= 10^2 / 531.48 = 0.188 \text{ kgs / m} \end{aligned}$$

$$\begin{aligned} 4. \text{ Total weight required for y-bar} &= \text{weight / Ft} \times \text{Total length} \\ &= 0.188 \times 153.626 \\ &= \mathbf{28.881 \text{ kgs}} \end{aligned}$$

(iv). Hand-Rail mesh :-

$$\begin{aligned} 1. \text{ length of x-bar} &= 11.18' - 1'' - 1'' \\ &= 11.18' - 0.1666' \\ &= 11.013 \text{ Ft} \end{aligned}$$

$$\begin{aligned} 2. \text{ length of y-bar} &= 3' - 1'' - 1'' \\ &= 3' - 0.1666' \\ &= 2.833 \text{ Ft} \end{aligned}$$

$$\begin{aligned} 3. \text{ No. of x-bar} &= [2'10'' / 4''] + 1 &L=3'-1''-1''=2'10'' \\ &= [2.8333 / 0.333'] + 1 \\ &= 9.508 \text{ bars or approximately equal to 10 bars} \end{aligned}$$

$$\begin{aligned}
 4. \text{ No. of y-bar} &= [11.01 / 4"] + 1 & L = 11.18' - 1" - 1" = 11.01 \\
 &.= [11.01 / 0.333] + 1 \\
 &.= 34.06 \\
 &.= \text{approximately equal to 34 bars}
 \end{aligned}$$

$$\begin{aligned}
 5. \text{ Total Length of Steel bar} &= \text{length of x-bar} \times \text{no. of x-bars} + \\
 &\quad \text{length of y-bar} \times \text{no. of y-bars} \\
 &.= 11.013 \times 10 + 2.833 \times 34 = 206.452 \text{ Ft}
 \end{aligned}$$

6. Dia of bar for Hand Rail mesh in both direction = 8 mm

According to thumb rule :-

$$\begin{aligned}
 [i]. \text{ weight of steel bar in kgs / m} &= d^2 / 162 & . = 8^2 / 162 = 0.395 \text{ kgs / m} \\
 [ii]. \text{ weight of steel bar in kgs / Ft} &= d^2 / 531.48 & . = 8^2 / 531.48 = 0.1204 \text{ kgs / Ft}
 \end{aligned}$$

$$\begin{aligned}
 \text{Total weight of steel required} &. = \text{weight / Ft} \times \text{Total length} \times \text{no. of Handrails} \\
 &.= 0.1204 \times 206.452 \times 4 \\
 &.= \mathbf{99.427 \text{ kgs}}
 \end{aligned}$$

Total weight of steel required:

1. S1&S2	10mm	162.335
2. landing 1&2	10mm	57.763
	Total	220.098
3. Extra bar	8mm	22.112
4. Handrail	8mm	99.427
	Total	121.539

No. of Steel bars required of length 40Ft. :

(a). $\phi=10\text{mm}$ Required wt. of steel = 220.098kgs

1. Standard length of each steel bar = 40 Ft.

2. Dia of steel bar = 10mm

$$\begin{aligned}
 3. \text{ Weight of Steel bar in kgs / Ft} &. = d^2 / 531.36 \\
 &.= 10^2 / 531.36 \\
 &.= 0.1881 \text{ kgs/Ft}
 \end{aligned}$$

$$4. \text{ weight of each steel bar of length 40'} = 0.1881 \times 40 = 7.524 \text{ kgs}$$

5. No. of Steel bars of length 40' required = wt of steel required / wt of each steel bar

$$= 220.098 / 7.524$$

$$= 29.25 \text{ or approximately equal to 30 bars of } \varnothing 10\text{mm required.}$$

For 29.25 steel bars the required weight of steel = 220.098 kgs (required wt of steel)

For 30 Steel bars the required wt of steel = $7.524 \times 30 = 225.72$ kgs (Actual wt of steel)

(b). $\varnothing = 8\text{mm}$ Required wt. of steel = 121.539kgs

1. Standard length of each steel bar = 40 Ft.

2. Dia of steel bar = 8mm

3. Weight of Steel bar in kgs / Ft
$$= d^2 / 531.36$$

$$= 8^2 / 531.36$$

$$= 0.1204 \text{ kgs/Ft}$$

4. weight of each steel bar of length 40' = $0.1204 \times 40 = 4.816$ kgs

5. No. of Steel bars of length 40' required = wt of steel required / wt of each steel bar

$$= 121.539 / 4.816$$

$$= 25.23 \text{ or approximately equal to 26 bars of } \varnothing 8\text{mm required.}$$

For 25.23 steel bars the required weight of steel = 121.539 kgs (required wt of steel)

For 26 Steel bars the required wt of steel = $4.816 \times 26 = 125.216$ kgs (Actual wt of steel)

Bill of Quantities for Stair-case reinforcement:-

BILL OF QUANTITIES FOR STAIR-CASE REINFORCEMENT							
S.no.	Description	Unit	Rate/unit	Total Quantity		Total Amount	Remark
	Dia of bar	Kgs	in Rupees	Actual weight of	Required	in	
				Steel required	bars of	Rupees	
				in kgs	40' length		
1	$\varnothing 10\text{mm}$	Kgs	48.00	225.720	30	10834.560	
2	$\varnothing 8\text{mm}$	Kgs	48.00	125.216	26	6010.368	
					Total	16844.928	
				Add 10% wastage		1684.493	
				Add 5% Contingencies		842.246	
					Total	19371.667	

Contingencies mean : Expenses which is likely to happen in future, which may happen or may not happen.

Problem-10 :-

For a given plan & Section Dwg. of Kitchen Room find

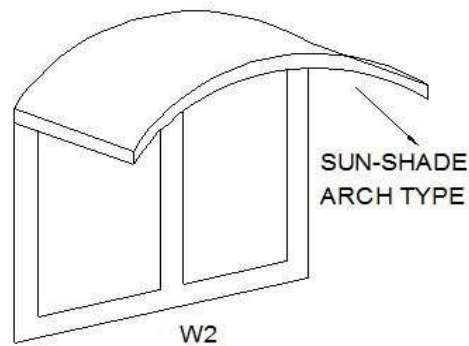
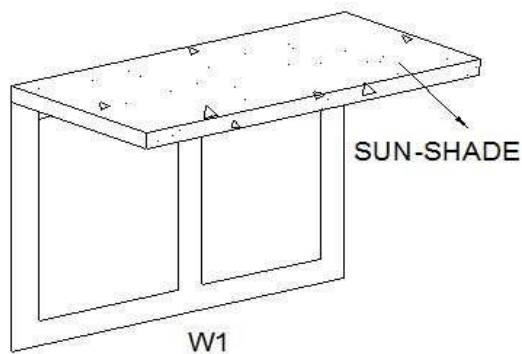
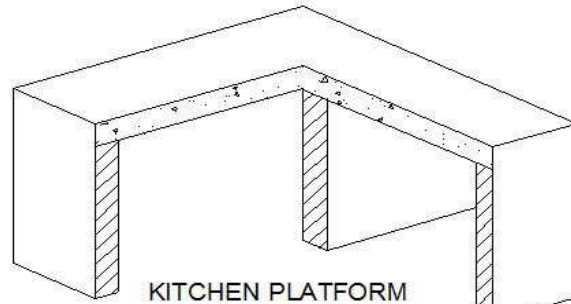
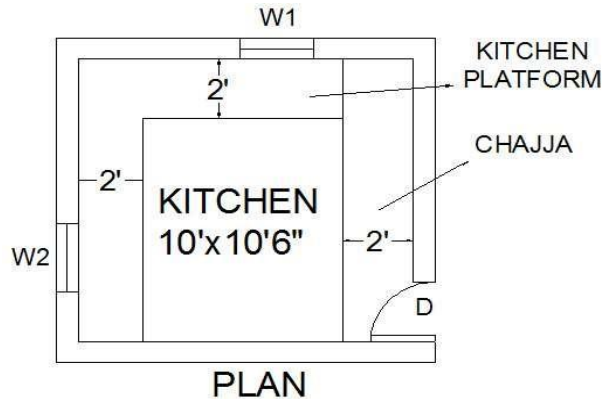
- (i). Weight of Steel required for Kitchen Platform, Room Chajja, and Window sun-shade (arch type) (ii). No. of Steel bars required, of length 40ft and (iii). Bill of Quantities for Miscellaneous item Reinforcement.

if Rate of steel /kg = 48.0 rupees.

Reinforcement details :- Miscellaneous item mesh = ϕ 8mm@100mm or 4"

Thickness = 4" for all Slabs

wall thickness = 4"



Size of window-1 = 4' x 4'

Size of window-2 = 4'6" x 4' (Arch Type)

Size of door = 3' x 7'

Size of Chajja = 10'6" x 2'

Solution :-

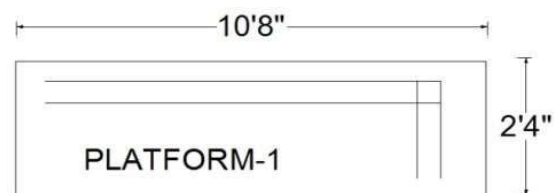
Note :- Dividing kitchen platform in to two parts and with each part add 4" bearing i.e., thickness of wall. Also deduct 1" concrete cover from both ends.

(a). Kitchen Platform :- Part-1:

1. length of x-bar = length of platform + wall thickness from both end - 1" concrete cover from both side

$$= 10' + 4" + 4" - 1" - 1"$$

$$= 10'6" = 10.5'$$



2. length of y-bar . = Breadth of platform + wall thickness - 1" concrete cover from both side

$$.= 2' + 4" - 1" - 1"$$

$$.= 2'2" = 2.166'$$

3. No. of x-bars . = (Opp.length / spacing) + 1

$$.= (2.166'/0.333') + 1$$

. = 7.504 or approximately equal to 8 bars

4. No. of y-bars . = (Opp.length / spacing) + 1

$$.= (10.5'/0.333') + 1$$

. = 32.531 or approximately equal to 33 bars

5. Total length of bar = $10.5' \times 8 + 2.166' \times 33 = 155.478 \text{ Ft}$

Part-2:

1. length of x-bar . = length of platform + wall thickness - 1" concrete cover from both side

$$.= 2' + 4" - 1" - 1"$$

$$.= 2'2" = 2.166'$$

2. length of y-bar . = Breadth of platform + wall thickness from both end - 1" concrete cover from both side

$$.= 10'6" + 4" + 4" - 1" - 1"$$

$$.= 11'$$

3. No. of x-bars . = (Opp.length / spacing) + 1

$$.= (11'/0.333') + 1$$

. = 34.03 or approximately equal to 34 bars

4. No. of y-bars . = (Opp.length / spacing) + 1

$$.= (2.166'/0.333') + 1$$

. = 7.504 or approximately equal to 8 bars

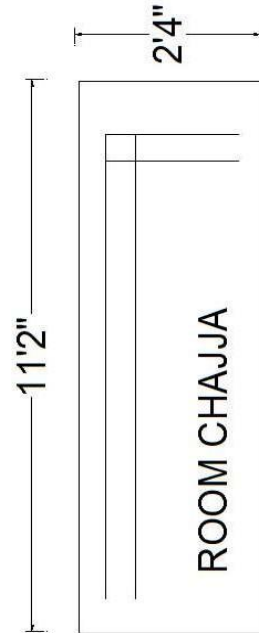
5. Total length of bar = $2.166' \times 34 + 11' \times 8 = 161.644 \text{ Ft}$



Total length of part-1 and part-2: = $155.478' + 161.644' = 317.122'$

(b). Room chajja :-

1. length of x-bar .= length of Chajja + wall thickness - 1" concrete cover from both side
 .= $2' + 4'' - 1'' - 1''$
 .= $2'2'' = 2.166'$
2. length of y-bar .= Breadth of Chajja + wall thickness from both end - 1" concrete cover from both side
 .= $10'6'' + 4'' + 4'' - 1'' - 1''$
 .= $11'$
3. No. of x-bars .= (Opp.length / spacing) + 1
 .= $(11' / 0.333') + 1$
 .= 34.03 or approximately equal to 34 bars
4. No. of y-bars .= (Opp.length / spacing) + 1
 .= $(2.166' / 0.333') + 1$
 .= 7.504 or approximately equal to 8 bars
5. Total length of x-bar & y-bar = $2.166' \times 34 + 11' \times 8 = 161.644 \text{ Ft}$

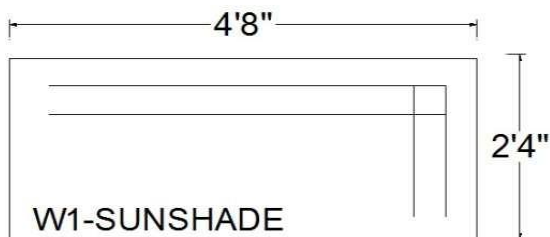
**(c). Window Sun-shades :-**

window-1: size = $4' \times 4'$

Note:- Add 4" bearing with length of window i.e., thickness of wall ,

Also deduct 1" concrete cover from both ends.

1. length of x-bar .= length of window + wall thickness from both end - 1" concrete cover from both side
 .= $4' + 4'' + 4'' - 1'' - 1''$
 .= $4'6'' = 4.5'$
2. length of y-bar .= projection length of sunshade + wall thickness - 1" concrete cover from both side
 .= $2' + 4'' - 1'' - 1''$
 .= $2'2'' = 2.166'$



3. No. of x-bars $\therefore (\text{Opp.length} / \text{spacing}) + 1$
 $\therefore (2.166' / 0.333') + 1$
 $\therefore 7.504$ or approximately equal to 8 bars
4. No. of y-bars $\therefore (\text{Opp.length} / \text{spacing}) + 1$
 $\therefore (4.5' / 0.333') + 1$
 $\therefore 14.51$ or approximately equal to 15 bars
5. Total length of bar $= 4.5' \times 8 + 2.166 \times 15 = 68.49 \text{ Ft}$

window-2: size = 4'6" x 4'

Note:- Add 4" bearing with length of window i.e., thickness of wall, Also deduct 1" concrete cover from both ends.

linear length of window $= 4'6" + 4" + 4" = 5'2"$

Height of arch always 1Ft

Segmental Arc Length $= L = (8B - 2R) / 3$

where 'R' = radius of circle

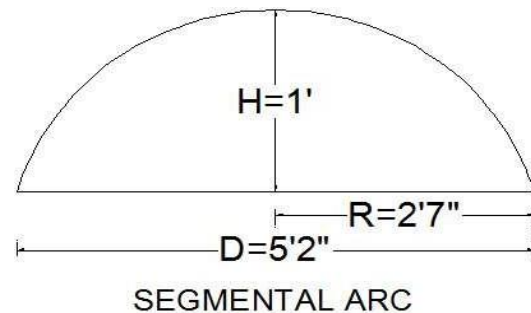
$$B' = \sqrt{R^2 + H^2}$$

$$"B' = \sqrt{(2.583^2 + 1^2)}$$

$$\therefore 2.769$$

$$"L = (8 \times 2.769 - 2 \times 2.583) / 3$$

$$\therefore 5.662 \text{ Ft}$$

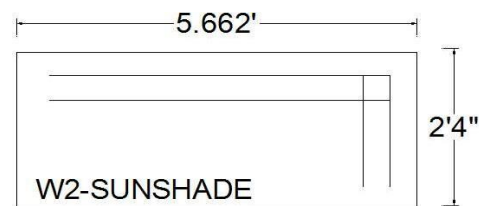


1. length of x-bar $\therefore$ length of window - 1" concrete cover from both side
 $\therefore 5.662 - 1" - 1"$
 $\therefore 5.662 - 0.166 = 5.496'$

2. length of y-bar $\therefore$ projection length of sunshade - 1" concrete cover from both side
 $\therefore 2' + 4" - 1" - 1"$
 $\therefore 2'2" = 2.166'$

3. No. of x-bars $\therefore (\text{Opp.length} / \text{spacing}) + 1$
 $\therefore (2.166' / 0.333') + 1$
 $\therefore 7.504$ or approximately equal to 8 bars

4. No. of y-bars $\therefore (\text{Opp.length} / \text{spacing}) + 1$
 $\therefore (5.496' / 0.333') + 1$
 $\therefore 17.504$ or approximately equal to 18 bars



$$5. \text{ Total length of bar} = 5.496' \times 8 + 2.166 \times 18 = 82.956 \text{ Ft.}$$

$$\text{Total length for both window W1\&W2} = 68.49 + 82.956 = 151.446 \text{ Ft.}$$

(d). Total length for miscellaneous item :-

1. Kitchen platform	. = 317.122
2. Room Chajja	. = 161.644
3. Sun-shade	. = 151.446
Total	. = 630.212 Ft.

Dia of bar for Miscellaneous item mesh in both direction = 8 mm

According to thumb rule :-

[i]. weight of steel bar in kgs / m = $d^2 / 162$	. = $8^2 / 162$ = 0.395 kgs / m
[ii]. weight of steel bar in kgs / Ft = $d^2 / 531.48$	. = $8^2 / 531.48$ = 0.1204 kgs / Ft

Total weight of steel required	. = weight / Ft x Total length
	. = 0.1204 x 630.212
	. = 75.877 kgs

No. of Steel bars required of length 40Ft. :

Required wt. of steel = 75.877kgs

1. Standard length of each steel bar = 40 Ft.

2. Dia of steel bar = 8mm

3. Weight of Steel bar in kgs / Ft	. = $d^2/531.36$
	. = $8^2 / 531.36$
	. = 0.1204 kgs/Ft

4. weight of each steel bar of length 40'	= 0.1204 x 40 = 4.816 kgs
---	---------------------------

5. No. of Steel bars of length 40' required = wt of steel required / wt of each steel bar
. = 75.877 / 4.816
. = 15.75 or approximately equal to 16 bars of Ø8mm required.

For 15.75 steel bars the required weight of steel = 75.877 kgs (required wt of steel)

For 16 Steel bars the required wt of steel = 4.816 x 16 = 77.056 kgs (Actual wt of steel)

Bill of Quantities for Miscellaneous item reinforcement:-

BILL OF QUANTITIES FOR MISCELLANEOUS ITEM REINFORCEMENT							
S.no.	Description	Unit	Rate/unit	Total Quantity		Total Amount	Remark
	Dia of bar	Kgs	in Rupees	Actual weight of	Required	in	
				Steel required	bars of	Rupees	
				in kgs	40' length		
2	Ø8mm	Kgs	48.00	77.056	16	3698.688	
					Total	3698.688	
				Add 10% wastage		369.869	
				Add 5% Contingencies		184.934	
					Total	4253.491	

Contingencies mean : Expenses which is likely to happen in future, which may happen or may not happen.

Problem-11 :-

For a given plan & Section Dwg. of Sump (water tank below ground level) find

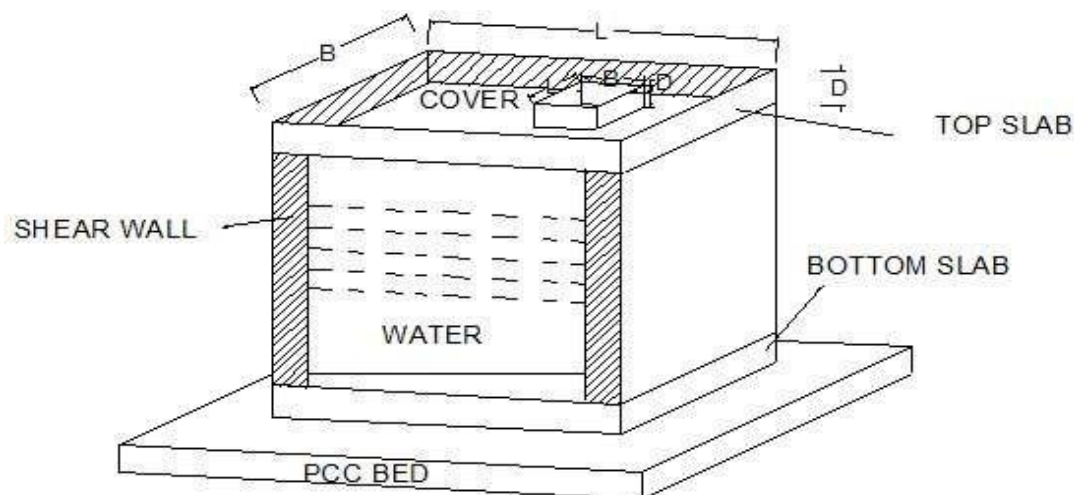
- (i). Weight of Steel required
- (ii). No. of Steel bars required, of length 40Ft
- (iii). Bill of Quantities for Rectangular Sump Reinforcement if Rate of steel /kg=48.0 rupees.

Reinforcement Details :

Bottom and Top Slab mesh = Ø10mm@100mm

Shear Wall mesh = Ø12mm@100mm

Size of Sump = 10' x 8' x 6'6" Thickness of bottom and top slab = 6"

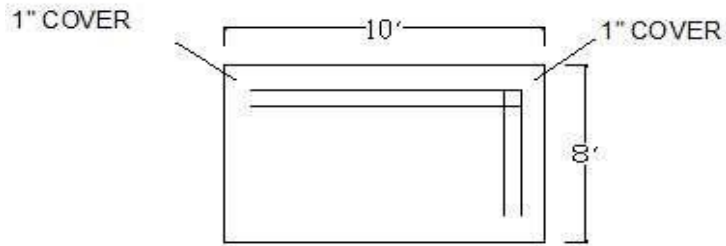


Solution :-**(i). Bottom and Top Slab mesh Calculations :-**

Note:- while providing Steel mesh in bottom and top slab , 1" concrete cover shall be deducted from each side of Slab.

$$\begin{aligned} 1. \text{ Length of x-bar} &= 10' - 1'' - 1'' \\ &= 10' - 0.166' \\ &= 9.833 \text{ Ft} \end{aligned}$$

$$\begin{aligned} 2. \text{ Length of y-bar} &= 8' - 1'' - 1'' \\ &= 8' - 0.1666' \\ &= 7.833 \text{ Ft} \end{aligned}$$



PLAN OF BOTTOM AND TOP SLAB

$$\begin{aligned} 3. \text{ No. of x-bars} &= [7.833 / 0.333] + 1 \\ &= 24.52 \text{ approximately } 25 \end{aligned}$$

$$\begin{aligned} 4. \text{ No. of y-bars} &= [9.833 / 0.333] + 1 \\ &= 30.52 \text{ approximately } 31 \end{aligned}$$

formula used to find, no. of bars = [opposite length / spacing] + 1

Note:- End bars will not be deducted from each side of cover i.e., $7 - 2 = 5$ bars shall be considered.

$$5. \text{ Total length of x-bar and y-bar} = 9.833 \times 25 + 7.833 \times 31 = 488.648 \text{ Ft}$$

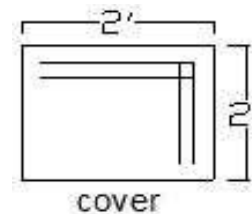
Deduction of Cover from top slab mesh :-

$$\text{Length of x-bar} = 2'$$

$$\text{Length of y-bar} = 2'$$

$$\begin{aligned} \text{No. of x-bars} &= [2' / 0.333] + 1 \\ &= 7 \end{aligned}$$

$$\begin{aligned} \text{No. of y-bars} &= [2' / 0.333] + 1 \\ &= 7 \end{aligned}$$



$$\text{Total length of Steel bar for cover} = 2 \times 5 + 2 \times 5 = 20 \text{ Ft}$$

$$\text{Total length of Steel bar required} = 488.648 - 20 = 468.648 \text{ Ft}$$

6. Dia of bar for Bottom and Top Slab mesh = 10 mm

According to thumb rule :- Slab mesh: ϕ 10mm @ 100mm / 4"

[i]. weight of steel bar in kgs / m = $d^2 / 162$.= $10^2 / 162 = 0.617$ kgs / m

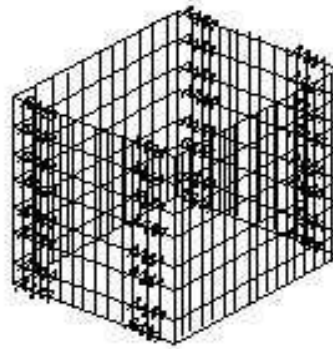
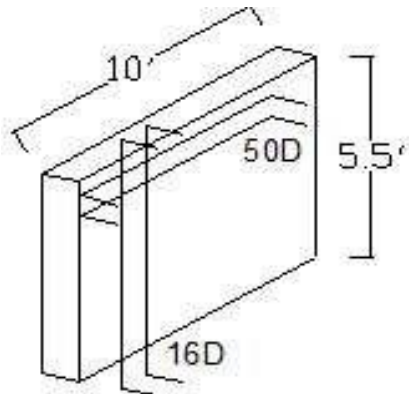
[ii]. weight of steel bar in kgs / Ft = $d^2 / 531.48$.= $10^2 / 531.48 = 0.188$ kgs / Ft

7. wt required for bottom and top slab mesh = weight / Ft x Total length x no. of Slabs

.= $0.188 \times 468.648 \times 2$

.= 176.211 kgs

(ii). Shear Wall along horizontal axis :-



shear wall along horizontal axis

1. Length of x-bar	.= $10' - 1'' - 1'' + 50D \times 2$	12mm = ? Ft
	.= $10' - 0.1666' + 50 \times 0.03937 \times 2$	.= $12 / 25.4$
	.= 13.77 Ft	.= 0.472"

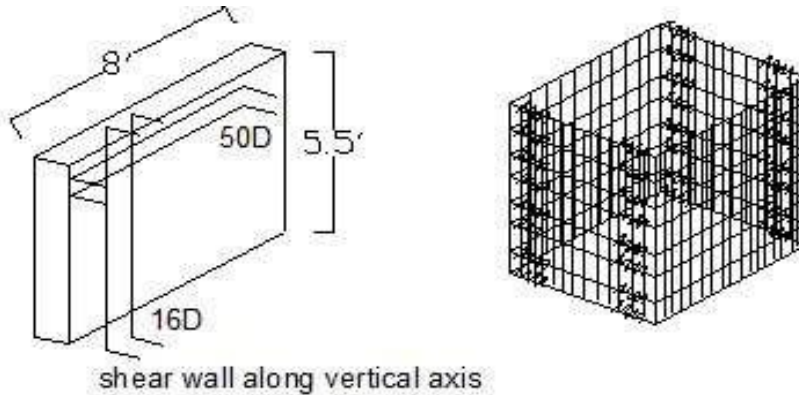
.= $0.472 / 12$

2. Length of y-bar	= $5.5' + 3'' + 3'' + 16D \times 2$	.= 0.03937Ft
	.= $5.5 + 0.5' + 16 \times 0.03937 \times 2$	
	.= 7.259 Ft	

3. No. of x-bars	= $[5.333 / 0.333] + 1$
L=5.5'- 1" - 1"	.= 17.015 approximately 17
L= 5.333Ft	

4. No. of y-bars	= $[9.833 / 0.333] + 1$
L=10'-1"-1"	.= 30.52 approximately 31
L= 9.833Ft	

5. Total length of Steel bar = $13.77 \times 17 + 7.259 \times 31 = 459.119$ Ft

(iii). Shear wall along vertical axis:-

$$\begin{aligned}
 1. \text{ Length of x-bar} &= 8' - 1'' - 1'' \\
 &= 8' - 0.1666' \\
 &= 7.833 \text{ Ft}
 \end{aligned}$$

$$\begin{aligned}
 2. \text{ Length of y-bar} &= 5.5' + 3'' + 3'' + 16D \times 2 & 12\text{mm} = ? \text{ Ft} \\
 &= 5.5 + 0.5' + 16 \times 0.03937 \times 2 & = 12 / 25.4 \\
 &= 7.259 \text{ Ft} & = 0.472'' \\
 & & = 0.472 / 12 \\
 & & = 0.03937 \text{ Ft}
 \end{aligned}$$

$$\begin{aligned}
 3. \text{ No. of x-bars} &= [5.333 / 0.333] + 1 \\
 L=5.5' - 1'' - 1'' &= 17.015 \text{ approximately } 17 \\
 L= 5.333 \text{ Ft}
 \end{aligned}$$

$$\begin{aligned}
 4. \text{ No. of y-bars} &= [7.833 / 0.333] + 1 \\
 L=8'-1''-1'' &= 24.52 \text{ approximately } 25 \\
 L= 7.833 \text{ Ft}
 \end{aligned}$$

$$5. \text{ Total length of x-bar} = 7.833 \times 17 + 7.259 \times 25 = 314.636 \text{ Ft}$$

Total length of Steel bars =

$$\begin{aligned}
 &= \text{Shear wall along horizontal axis} + \text{shear wall along vertical axis} \\
 &= 459.119 + 314.636 = 773.755 \text{ Ft}
 \end{aligned}$$

6. Dia of bar for Shear wall mesh = 12 mm

According to thumb rule :-

$$[i]. \text{ weight of steel bar in kgs / m} = d^2 / 162 \quad = 12^2 / 162 = 0.888 \text{ kgs / m}$$

$$[ii]. \text{ weight of steel bar in kgs / Ft} = d^2 / 531.48 \quad = 12^2 / 531.48 = 0.271 \text{ kgs / Ft}$$

$$\begin{aligned}
 7. \text{ Total weight required} &= \text{weight / Ft} \times \text{Total length} \times \text{no. of walls} \\
 &= 0.271 \times 773.755 \times 2 \\
 &= 419.375 \text{ kgs}
 \end{aligned}$$

No. of Steel bars required of length 40Ft. :**(a). $\phi = 10\text{mm}$**

Required wt. of steel = 176.839 kgs

1. Standard length of each steel bar = 40 Ft.

2. Dia of steel bar = 10mm

3. Weight of Steel bar in kgs / Ft $= d^2/531.36$
 $= 10^2 / 531.36$
 $= 0.1881 \text{ kgs/Ft}$

4. weight of each steel bar of length 40' = $0.1881 \times 40 = 7.524 \text{ kgs}$

5. No. of Steel bars of length 40' required = wt of steel required / wt of each steel bar
 $= 176.839 / 7.524$
 $= 23.503$ or approximately equal to 24 bars of $\phi 10\text{mm}$ required.

For 23.503 steel bars the required weight of steel = 176.839 kgs (required wt of steel)

For 24 Steel bars the required wt of steel = $7.524 \times 24 = 180.576 \text{ kgs}$ (Actual wt of steel)**No. of Steel bars required of length 40Ft. :****(b). $\phi = 12\text{mm}$**

Required wt. of steel = 419.375 kgs

1. Standard length of each steel bar = 40 Ft.

2. Dia of steel bar = 12mm

3. Weight of Steel bar in kgs / Ft $= d^2/531.36$
 $= 12^2 / 531.36$
 $= 0.271 \text{ kgs/Ft}$

4. weight of each steel bar of length 40' = $0.271 \times 40 = 10.84 \text{ kgs}$

5. No. of Steel bars of length 40' required = wt of steel required / wt of each steel bar
 $= 419.375 / 10.84$
 $= 38.68$ or approximately equal to 39 bars of $\phi 12\text{mm}$ required.

For 38.68 steel bars the required weight of steel = 419.375 kgs (required wt of steel)

For 39 Steel bars the required wt of steel = $10.84 \times 39 = 422.76 \text{ kgs}$ (Actual wt of steel)

Bill of Quantities for Sump reinforcement:-

BILL OF QUANTITIES FOR SUMP REINFORCEMENT							
S.no.	Description	Unit	Rate/unit	Total Quantity		Total Amount	Remark
	Dia of bar	Kgs	in Rupees	Actual weight of	Required	in	
				Steel required	bars of	Rupees	
				in kgs	40' length		
1	Ø10mm	Kgs	48.00	180.576	24	8667.648	
2	Ø12mm	Kgs	48.00	422.760	39	20292.480	
					Total	28960.128	
				Add 10% wastage		2896.013	
				Add 5% Contingencies		1448.006	
					Total	33304.147	

Contingencies mean : Expenses which is likely to happen in future, which may happen or may not happen.

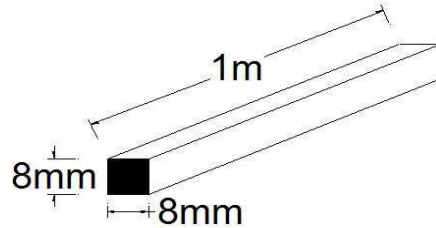
STEEL STRUCTURES CALCULATION

Density of Steel = 7850 kgs/m

Density of Steel = 0.00785 kgs/mm

Problem-1 :-

Find weight of Solid Square bar



Solution :-

Standard formulas :-

$$\begin{aligned}
 \text{1. weight of Square Steel bar in kgs/m} &= \text{volume of steel bar} \times \text{Density of steel} \\
 \text{dimension in metres} &= 0.008 \times 0.008 \times 1.0 \times 7850 \\
 &= 0.5024 \text{ kgs/m}
 \end{aligned}$$

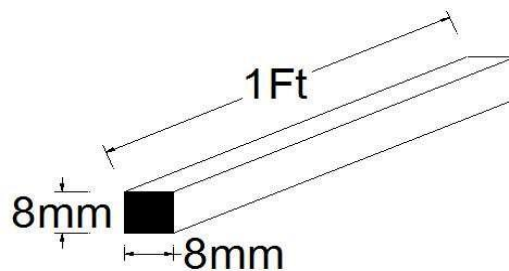
$$\begin{aligned}
 \text{2. weight of Square Steel bar in kgs/m} &= \text{area of bar} \times \text{Density of steel} \\
 \text{dimension in mm} &= 8 \times 8 \times 0.00785 \\
 &= 0.5024 \text{ kgs/m}
 \end{aligned}$$

According to thumb rule :

$$\begin{aligned}
 \text{3. weight of Square Steel bar in kgs/m} &= \text{Area of bar} / 127 \\
 \text{dimension in mm} &= (8 \times 8) / 127 \\
 &= 0.503 \text{ kgs/m}
 \end{aligned}$$

Problem-2 :-

Find weight of Solid Square bar

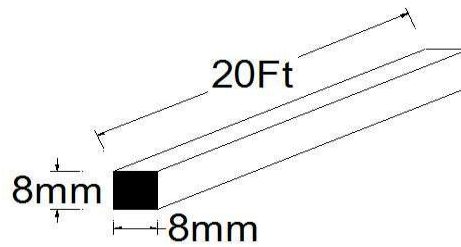


Solution :-

$$\begin{aligned}
 \text{weight of Square Steel bar in kgs/Ft} &= \text{Area of bar} / 416.56 \\
 &= (8 \times 8) / 416.56 \\
 &= 0.1536 \text{ kgs/ Ft}
 \end{aligned}$$

Problem-3 :-

Find weight of Solid Square bar

Solution :-

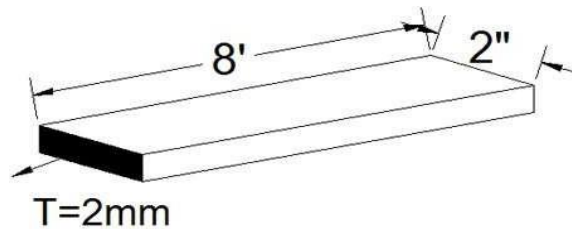
$$\begin{aligned} \text{weight of Square Steel bar in kgs/Ft} &= \text{Area of bar} / 416.56 \\ &= (8 \times 8) / 416.56 \\ &= 0.1536 \text{ kgs/ Ft} \end{aligned}$$

length of solid square bar = 20'

Weight of Solid square bar = $0.1536 \times 20' = 3.072 \text{ kgs}$ **Problem-4 :-**

Find weight of Flat plate

$$\begin{aligned} \text{Solution :-} \quad &\text{since } 1'' = 25.4\text{mm} \\ &25.4 \times 2 = 50.8\text{mm} \end{aligned}$$



section of Flat plate = 50.8mm x 2mm

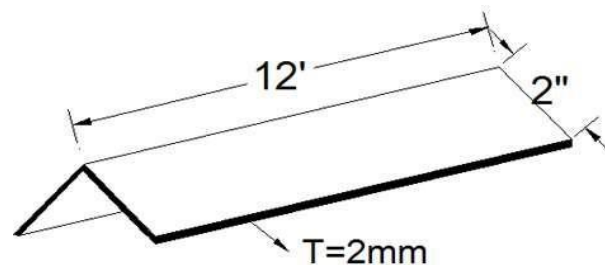
$$\begin{aligned} \text{weight of Steel bar in kgs/Ft} &= \text{Area of bar} / 416.56 \\ &= (50.8 \times 2) / 416.56 \\ &= 0.243 \text{ kgs/ Ft} \end{aligned}$$

length of Flat plate = 8'

Weight of Flat plate = $0.243 \times 8' = 1.944 \text{ kgs}$ **Problem-5 :-**

Find weight of angle plate

$$\begin{aligned} \text{Solution :-} \quad &\text{since } 1'' = 25.4\text{mm} \\ &25.4 \times 4 = 101.6\text{mm} \end{aligned}$$



section of Flat plate = 101.6mm x 2mm

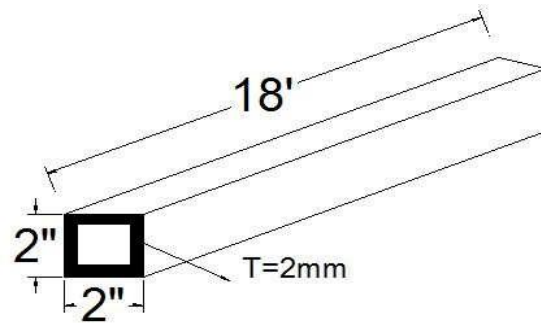
$$\begin{aligned} \text{weight of Steel bar in kgs/Ft} &= \text{Area of bar} / 416.56 \\ &= (101.6 \times 2) / 416.56 \\ &= 0.487 \text{ kgs/ Ft} \end{aligned}$$

length of Angle plate = 12'

Weight of Angle plate = $0.487 \times 12' = 5.844 \text{ kgs}$

Problem-6 :-

Find weight of Hollow square pipe

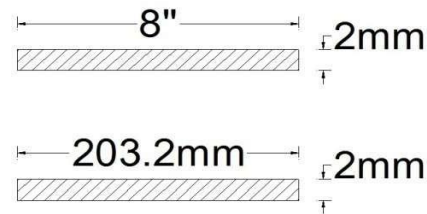
**Solution :-**

$$L = (L+B) \times 2 = (2+2) \times 2 = 8"$$

since 1" = 25.4mm

$$8 \times 25.4 = 203.2\text{mm}$$

Thickness of pipe = 2mm



Section Dwg.

section of Flat plate = 203.2mm x 2mm

weight of Steel bar in kgs/Ft

$$.= \text{Area of bar} / 416.56$$

$$.= (203.2 \times 2) / 416.56$$

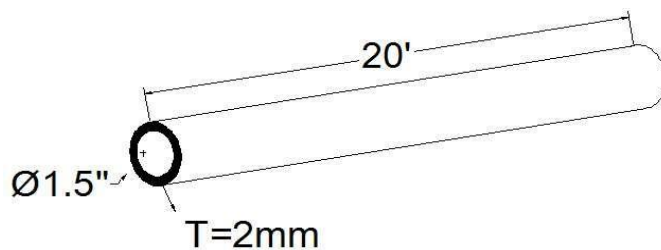
$$.= 0.975 \text{ kgs/ Ft}$$

length of Hollow square pipe = 18'

$$\text{Weight of Hollow square pipe} = 0.975 \times 18' = 17.55 \text{ kgs}$$

Problem-7 :-

Find weight of Hollow round pipe

**Solution :-**

since 1" = 25.4mm

$$1.5" = 25.4 \times 1.5 = 38.1\text{mm}$$

$$D = 38.1\text{mm}$$

$$R = 19.05\text{mm}$$

$$L = 2 \times \pi \times r = 2 \times \pi \times 19.05 = 119.69\text{mm}$$

Thickness of pipe = 2mm

section of Flat plate = 119.69mm x 2mm



weight of Steel bar in kgs/Ft

$$.= \text{Area of bar} / 416.56$$

$$.= (119.69 \times 2) / 416.56$$

$$.= 0.574 \text{ kgs/ Ft}$$

length of Round Hollow pipe = 20'

$$\text{Weight of Round Hollow pipe} = 0.574 \times 20' = 11.48 \text{ kgs}$$

Problem-8 :-

Find weight of i-Beam

Solution :-

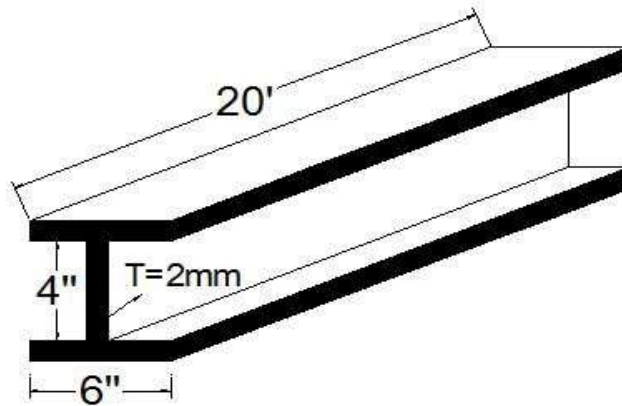
$$1" = 25.4\text{mm}$$

$$6" = ?$$

$$6 \times 25.4 = 152.4\text{mm}$$

$$4" = ?$$

$$4 \times 25.4 = 101.6\text{mm}$$



Dividing c/s of i-beam in three parts

$$\text{Area-1} = 152.4\text{mm} \times 2\text{mm} = 304.8\text{mm}^2$$

$$\text{Area-2} = 101.6\text{mm} \times 2\text{mm} = 203.2\text{mm}^2$$

$$\text{Area-3} = 152.4\text{mm} \times 2\text{mm} = 304.8\text{mm}^2$$

$$\text{Total area} = 812.8\text{mm}^2$$

1. weight of i-beam in kgs/Ft

$$.= \text{Area of bar} / 416.56$$

$$.= 812.8 / 416.56$$

$$.= 1.951 \text{ kgs/ Ft}$$

2. weight of i-beam in kgs/ft

Area in mm^2

$$.= \text{Area of bar} \times \text{Density of steel}$$

$$.= 812.8 \times 0.00785$$

$$.= 6.38\text{kgs/m}$$

$$.= 6.38 / 3.28$$

$$.= 1.945 \text{ kg/Ft}$$

3. weight of i-beam in kgs/ft

Area in m^2

$$.= 812.8/1000^2$$

$$.= 0.0008128 \text{ m}^2$$

$$.= \text{Area of bar} \times \text{Density of steel}$$

$$.= 0.0008128 \times 7850$$

$$.= 6.38\text{kgs/m}$$

$$.= 6.38 / 3.28$$

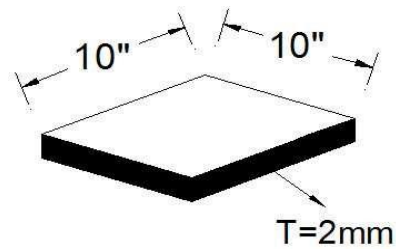
$$.= 1.945 \text{ kg/Ft}$$

length of i-beam = 20'

$$\text{Weight of i-beam} = 1.951 \times 20 = 39.02 \text{ kgs}$$

Problem-9 :-

Find weight of Square plate

Solution :-

Weight of Square plate in kgs

Dimension in metres

$$1" = 25.4\text{mm}$$

$$10" = 25.4 \times 10 = 254\text{mm}$$

$$254\text{mm} = 0.254\text{m}$$

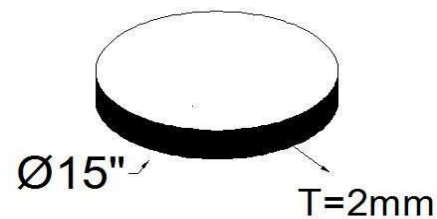
$$.= \text{Volume of plate} \times \text{Density of steel}$$

$$.= 0.254 \times 0.254 \times 0.002 \times 7850$$

$$.= 1.01\text{kgs}$$

Problem-10 :-

Find weight of Round plate

**Solution :-**

Weight of Round plate in kgs

Dimension in metres

$$1" = 25.4\text{mm}$$

$$15" = 25.4 \times 15 = 381\text{mm}$$

$$381\text{mm} = 0.381\text{m}$$

$$.= \text{Volume of plate} \times \text{Density of steel}$$

$$.= \text{Area of plate} \times \text{thickness of plate} \times \text{Density of steel}$$

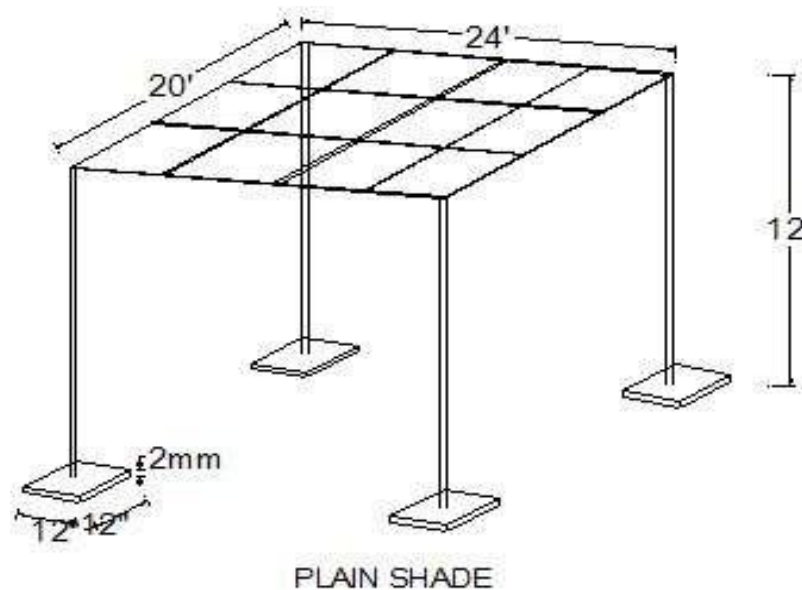
$$.= (\pi/4) \times d^2 \times \text{thickness of plate} \times \text{density of steel}$$

$$.= (\pi/4) \times 0.381^2 \times 0.002 \times 7850$$

$$.= 1.789\text{kgs}$$

Problem-11 :-

From the given figure find



- (i). Weight of Steel structure for pipes and square plates and
- (ii). No. of pipes required to make this frame.

Section of pipe 2"x2"

Thickness of pipe = 2mm

Square plate = 12" x 12" x 2mm

Solution :-

(a). Frame calculation:-

1. length of pipe in horizontal direction = 24'

No. of pipes of length = 4

2. length of pipe in vertical direction = 20'

No. of pipes of length = 5

3. Height of Column = 12'

No. of pipes = 4

4. Total length = 24' x 4 + 20' x 5 + 12' x 4 = 244 Ft

Section of pipe = 2"x2"

$L = (2''+2'') \times 2 = 8'' = 203.2\text{mm}$

Thickness = 2mm

$L = (L+B) \times 2 = (2''+2'') \times 2 = 8''$

since 1" = 25.4mm

$8 \times 25.4 = 203.2\text{mm}$

Thickness of pipe = 2mm

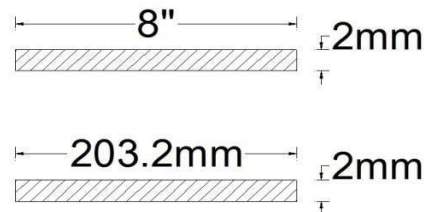
section of Flat plate = 203.2mm x 2mm

weight of Steel bar in kgs/Ft

$\therefore \text{Area of bar} / 416.56$

$\therefore (203.2 \times 2) / 416.56$

$\therefore 0.975 \text{ kgs/ Ft}$



5. Total length of Hollow square pipe = 244'

Weight of Hollow square pipe required = $0.975 \times 244' = 237.9 \text{ kgs}$

6. No. of pipes required = Total length required / length of each pipe

Standard length of Square pipe = 20'

$\therefore 244 / 20$

$\therefore 12.2 \text{ pipes}$

(b). Square Plate :-

Size of Square plate = 12" x 12" x 2mm

No. of Square plate = 4

Weight of Square plate in kgs

$\therefore \text{Volume of plate} \times \text{Density of steel} \times \text{No. of plates}$

Dimension in metres

$\therefore 0.304 \times 0.304 \times 0.002 \times 7850 \times 4$

1" = 25.4mm

$\therefore 5.803 \text{ kgs}$

12" = $25.4 \times 12 = 304.8\text{mm}$

$304.8\text{mm} = 0.304\text{m}$

(c). Total weight of Steel required = Weight of frame + Weight of Square plate

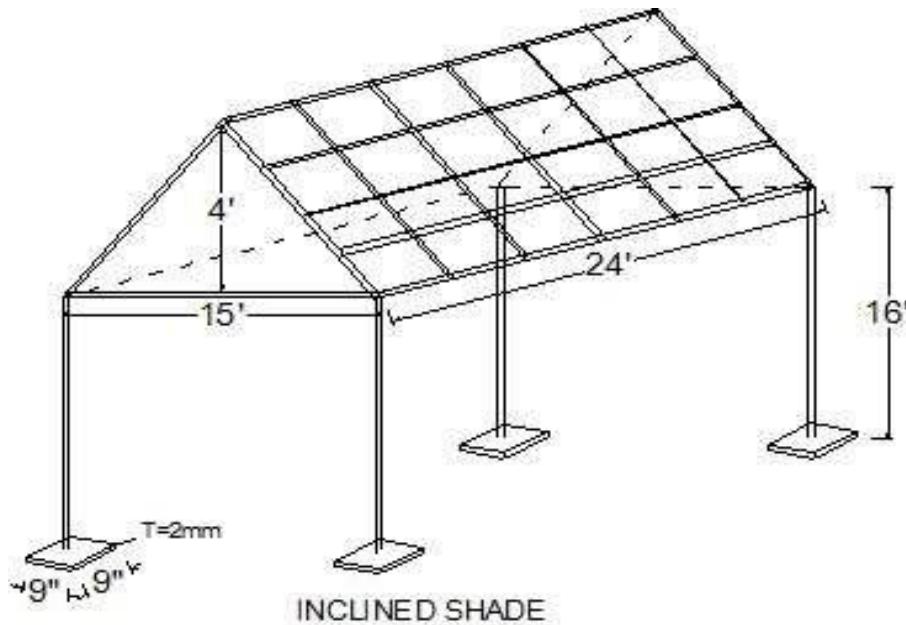
$$= 237.9 + 5.803$$

$$= 243.703 \text{ kgs}$$

Problem-11 :-

From the given figure find

- (i). Weight of Steel structure for pipes and square plates and
- (ii). No. of pipes required to make this frame.



Detail Section of pipe 1.5"x1.5"

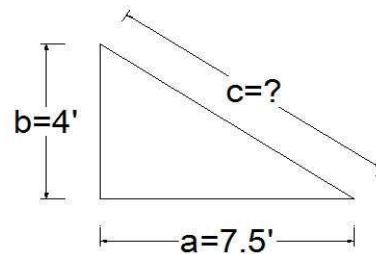
Thickness of pipe = 2mm

Square plate = 9" x 9" x 2mm

Solution :-

(a). Frame calculation:-

1. length of pipe in horizontal direction = 15'
No. of pipes of length = 2
2. length of pipe in vertical direction = 24'
No. of pipes of length = 9
3. Height of Column = 16'
No. of pipes = 4
4. length of inclined pipe = $8.5 \times 2 = 17'$
No. of pipes = 7



$$c = \sqrt{a^2 + b^2}$$

$$c = \sqrt{7.5^2 + 4^2}$$

$$c = 8.5$$

5. Total length = $15' \times 2 + 24' \times 9 + 16' \times 4 + 17 \times 7 = 429.0 \text{ Ft}$

Section of pipe = 1.5" x 1.5"

$$L = (L+B) \times 2$$

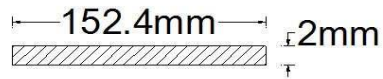
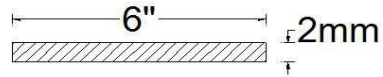
$$L = (1.5" + 1.5") \times 2 = 6" = 152.4\text{mm}$$

$$\text{since } 1" = 25.4\text{mm}$$

$$6 \times 25.4 = 152.4\text{mm}$$

$$\text{Thickness of pipe} = 2\text{mm}$$

$$\text{section of Flat plate} = 152.4\text{mm} \times 2\text{mm}$$



$$\text{Thickness of pipe} = 2\text{mm}$$

$$\text{weight of Steel bar in kgs/Ft} \quad . = \text{Area of bar} / 416.56$$

$$. = (152.4 \times 2) / 416.56$$

$$. = 0.731 \text{ kgs/ Ft}$$

$$6. \text{ Total length of Hollow square pipe} = 429'$$

$$7. \text{ Weight of Hollow square pipe required} = 0.731 \times 429 = \mathbf{313.599 \text{ kgs}}$$

$$8. \text{ No. of pipes required} = \text{Total length required} / \text{length of each pipe}$$

$$\text{Standard length of Square pipe} = 20'$$

$$. = 429 / 20$$

$$. = 21.45 \text{ pipes}$$

(b). Square Plate :-

$$\text{Size of Square plate} = 9" \times 9" \times 2\text{mm}$$

$$\text{No. of Square plate} = 4$$

$$\text{Weight of Square plate in kgs} \quad . = \text{Volume of plate} \times \text{Density of steel} \times \text{No. of plates}$$

$$\text{Dimension in metres} \quad . = 0.2286 \times 0.2286 \times 0.002 \times 7850 \times 4$$

$$1" = 25.4\text{mm} \quad . = \mathbf{3.281 \text{ kgs}}$$

$$9" = 25.4 \times 9 = 228.6\text{mm}$$

$$228.6\text{mm} = 0.2286\text{m}$$

(c). Total weight of Steel required = Weight of frame + Weight of Square plate

$$. = 313.599 + 3.281$$

$$. = 316.88 \text{ kgs}$$

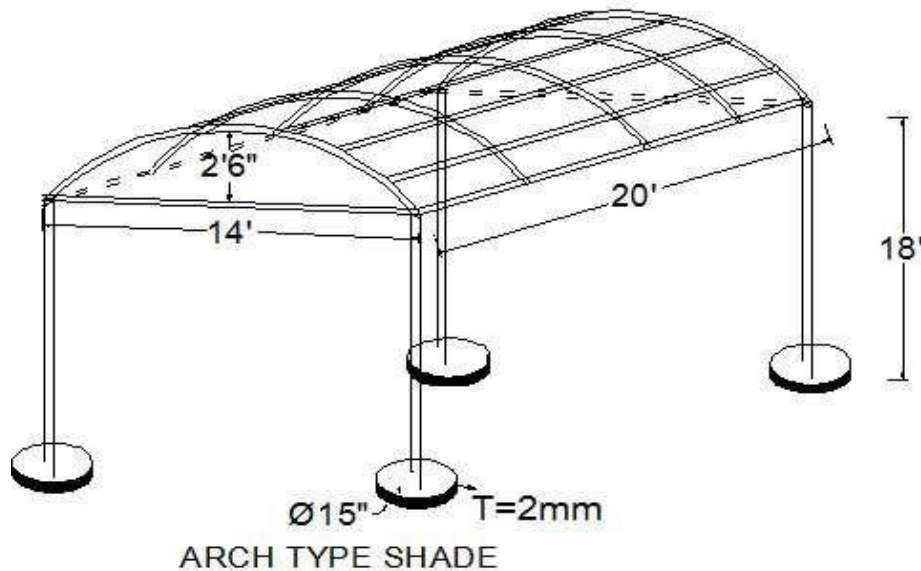
Problem-12 :- From the given figure find

- (i). Weight of Steel structure for pipes and square plates and
- (ii). No. of pipes required to make this frame.

Dia of pipe = 2"

Thickness of pipe = 2mm

Dia of round plate = 15" thickness of plate = 2mm



Solution :-

(a). Frame calculation:-

1. length of pipe in horizontal direction = 14'

No. of pipes of length = 2

2. length of pipe in vertical direction = 20'

No. of pipes of length = 9

3. Height of Column = 18'

No. of pipes = 4

4. length of Arch pipe = 15.154'

No. of pipes = 5

Segmental Arc Length = $L = (8B - 2R)/3$

where 'R' = radius of circle

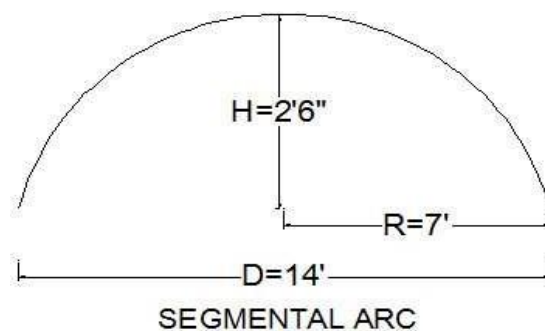
$$B' = \sqrt{R^2 + H^2}$$

$$"B' = \sqrt{7^2 + 2.5^2}$$

$$.= 7.433'$$

$$"L" = (8 \times 7.433 - 2 \times 7) / 3$$

$$.= 15.154' \text{ Ft}$$



$$5. \text{ Total length} = 14' \times 2 + 20' \times 9 + 18' \times 4 + 15.154 \times 5 = 355.77 \text{ Ft}$$

$$\text{Dia of pipe} = 2" = 50.8\text{mm} \quad \text{Radius} = 25.4\text{mm}$$

$$L = 2 \times \pi \times r = 2 \times \pi \times 25.4 = 159.59\text{mm}$$

$$\text{Thickness of pipe} = 2\text{mm}$$

$$\text{section of Flat plate} = 159.59\text{mm} \times 2\text{mm}$$

$$\begin{aligned} \text{weight of Steel bar in kgs/Ft} &= \text{Area of bar} / 416.56 \\ &= (159.59 \times 2) / 416.56 \\ &= 0.766 \text{ kgs/ Ft} \end{aligned}$$

$$6. \text{ Total length of Round Hollow pipe} = 355.77'$$

$$7. \text{ Weight of Round Hollow pipe required} = 0.766 \times 355.77 = \mathbf{272.519 \text{ kgs}}$$

$$8. \text{ No. of pipes required} = \text{Total length required} / \text{length of each pipe}$$

$$\text{Standard length of Round pipe} = 20'$$

$$= 355.77 / 20$$

$$= 17.78 \text{ pipes}$$

(b). Round Plate :-

$$\text{Dia of Round plate} = 15" ; T = 2\text{mm}$$

$$\text{No. of Round plate} = 4$$

$$\text{Weight of Round plate} = \text{Volume of plate} \times \text{Density of steel} \times \text{No. of plates}$$

$$\text{Dimension in metres} = \text{Area of plate} \times \text{thickness of plate} \times \text{Density of steel} \times \text{no.s}$$

$$1" = 25.4\text{mm} \quad = (\pi/4) \times d^2 \times \text{thickness of plate} \times \text{density of steel} \times \text{no.s}$$

$$15" = 25.4 \times 15 = 381\text{mm} \quad = (\pi/4) \times 0.381^2 \times 0.002 \times 7850 \times 4$$

$$381\text{mm} = 0.381\text{m} \quad = \mathbf{7.159 \text{ kgs}}$$

(c). Total weight of Steel required = Weight of frame + Weight of Round plate

$$= 272.519 + 7.159$$

$$= 279.678 \text{ kg}$$

Hi, I'm a civil engineer and content creator passionate about helping engineers learn practical construction skills. After working on multiple projects and managing site teams, I realized that many engineers struggle to connect **theory with real site work** — especially in areas like estimation, billing, and quantity surveying.

To bridge this gap, I started creating **easy-to-understand ebooks, Excel tools, and video tutorials** that teach civil engineers how to work confidently on-site using real project examples.

THANK YOU BEST OF LUCK