

17-04-2020

# INTRODUCTION - Structural Drawing.

## R.C.C Drawing

- Computation of amount of steel is done in order to prepare <sup>bar</sup> bending schedule.
- Drawing must be prepared by taking an appropriate scale in order to adjust both drawing, bar bending schedule & calculation in a single sheet.
- Most of the weightage of question is on detailing of drawing.
- Common Grades of concrete - M20, M25, M30..
- Steel Grades used Fe 250, Fe 415, Fe 500..

Reinforcing bars are available in sizes-

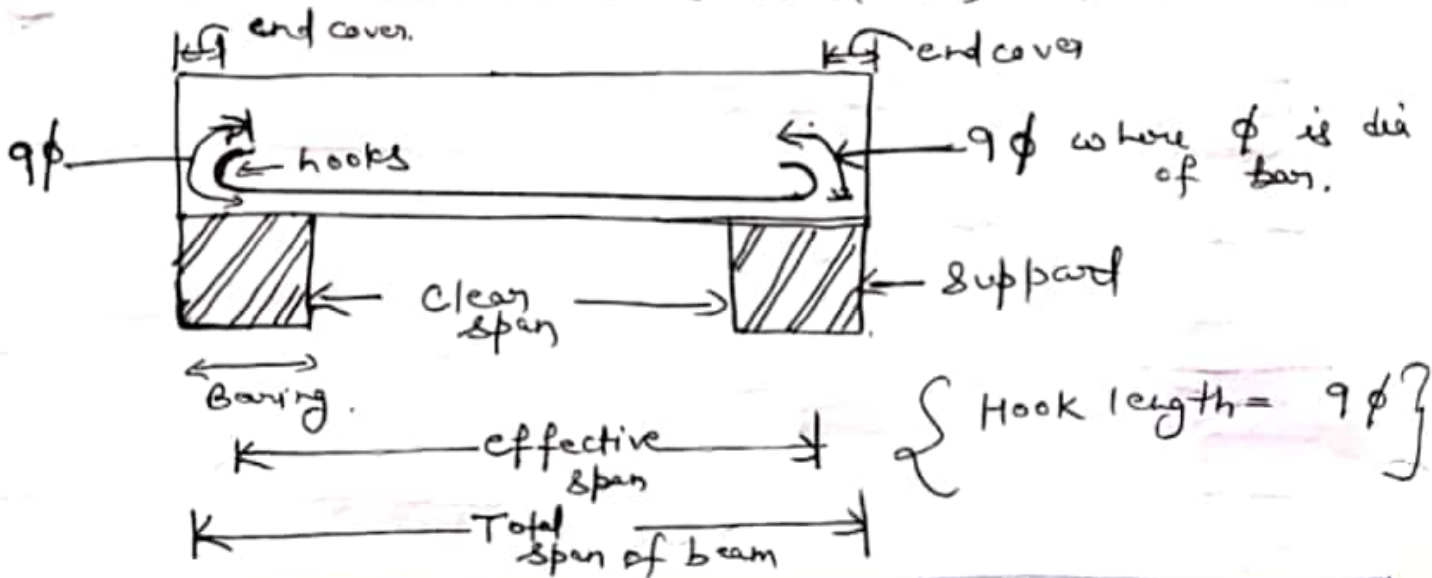
4mm, 5mm, 6mm, 8mm, 10mm, 12mm, 16mm, 20mm, 25mm, 28mm, 32mm, 36mm, 40mm.

Bearing  $\rightarrow$  The portion of beam on slab which is supported on wall.

# Calculation of length of steel bars for 2/23

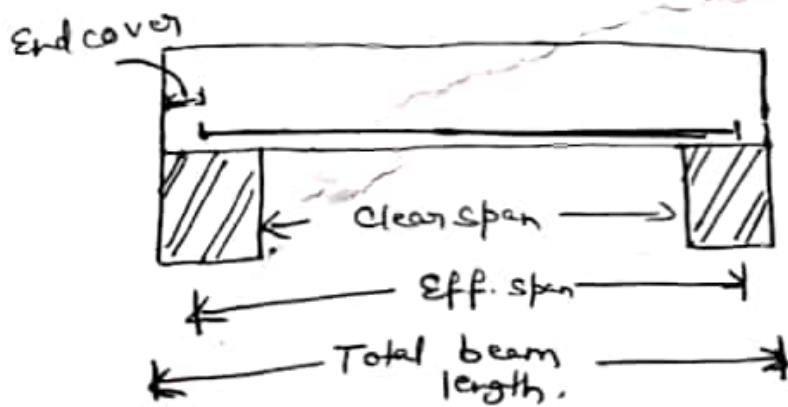
## 1. Straight bars.

a) In case of Mild steel is used as Main steel



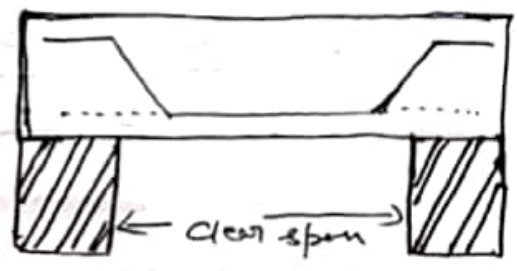
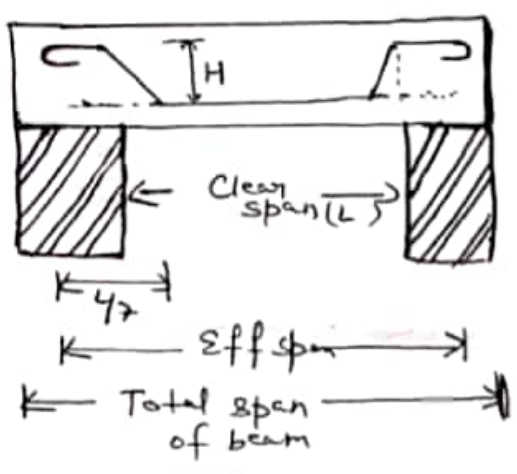
So length of bar = Total span or length of beam  
- 2 x End cover + 2 x 9φ

b) In case of <sup>(MSD)</sup> or deformed bars used as Main steel.  
no hooks are required for grip



So length of bar = Total length of beam - 2 x End cover

2. Bent up bars



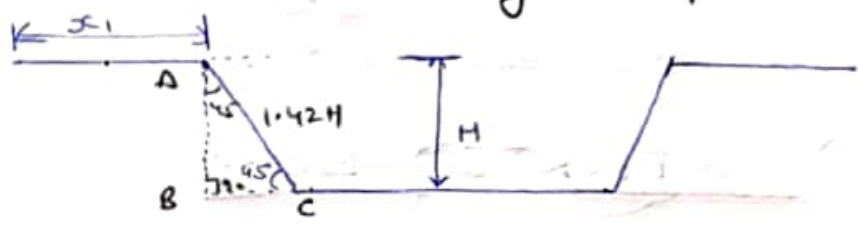
~~MILD~~ MILD STEEL

MYS D Steel.

$L_B = \text{Length of straight bar} + 2 \times 0.42H$

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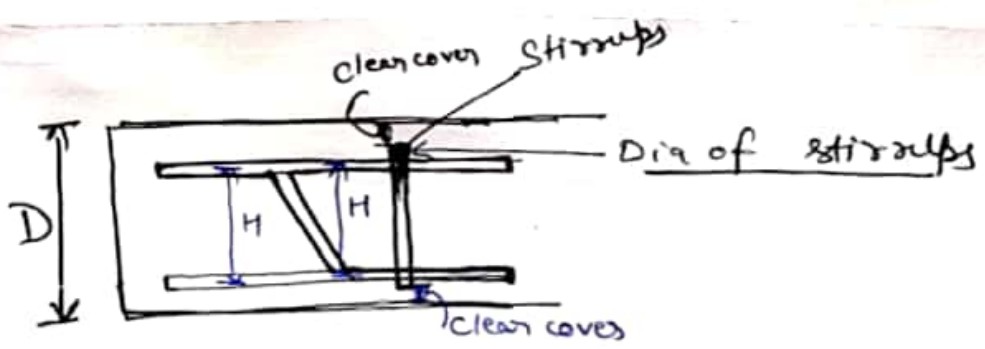
To calculate  $H = \text{Height of bend}$



$\angle A = \angle C \therefore AB = BC = H$

$AC = \sqrt{H^2 + H^2} = 1.42H$

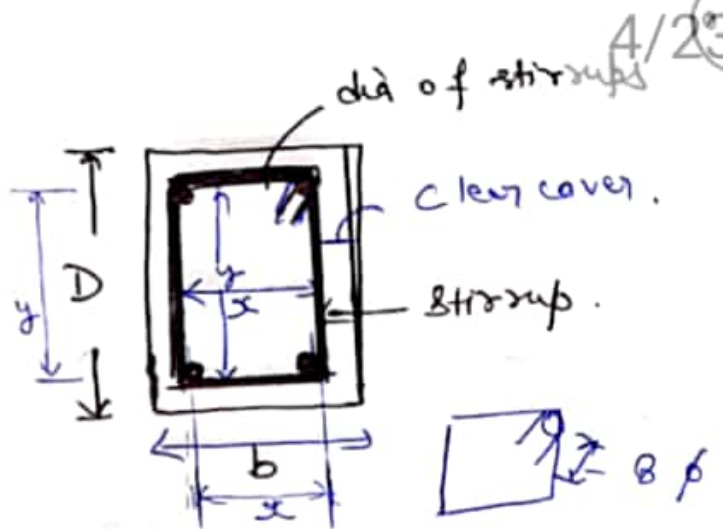
extra dis travelled by bent up bar =  $AC - BC = 1.42H - H = 0.42H$   
 than straight bar on each side



(i) for Beams  $H = D - 2 \times \text{clear cover} - 2 \times \text{dia of bar of stirrup} - \text{Dia of one bent up bar}$

(ii) for slab  $H = D - 2 \times \text{clear cover} - \text{Dia of bent up bar}$

3. Shear Stirrups



$$x = b - 2 \times \text{clear cover} - 2 \times \text{dia of bar of stirrups}$$

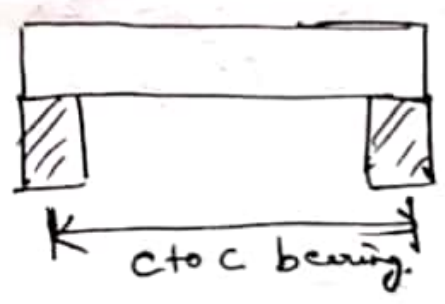
$$y = D - 2 \times \text{clear cover} - 2 \times \text{dia of bar of stirrups}$$

So. Length of bar for one stirrup =

$$2(x+y) + 8\phi + 8\phi$$

$$L_s = 2(x+y) + 16\phi$$

$$4. \text{ No. of stirrups} = \frac{\text{c to c of bearing}}{\text{Spacing of stirrups}} + 1$$



R.C.C. Beams

- > Beams are flexural members
- > Clear cover = 20 mm
- > Steel provided in tension side are singly reinforced beam
- > Steel provided on both side is doubly reinforced beam
- > Steel grades used are Fe 250 (mainly for stirrups) Fe 415, Fe 450, Fe 500
- > Minimum grade of conc - M20

SIMPLY SUPPORTED BEAM

Q1. A simply supported R.C.C beam has:-

Size of beam = 300 x 500 mm

clear span = 4.6 m

Bearing on walls = 300 mm

Thickness of walls = 400 mm

Main reinforcement = 3 - 20 mm  $\phi$  HYSD bars (one bent up bar at  $\frac{l}{4}$  from centre of support)

Vertical stirrups = 8 mm  $\phi$  2 legged @ 200 mm c/c

Anchor bars = 2 - 12 mm  $\phi$

Draw to a suitable scale the longitudinal section & two cross sections (one at mid & other at support)

UPCP Also prepare bar bending schedule.

Teacher's Sign .....

Soln: Assume necessary data as

i) Clear cover = 20 mm

2) End cover = 20 mm

3) hooks length of stirrups =  $8\phi + 8\phi = 16\phi$  5/23

Clear span = 4.6 m = 4600 mm

Calculation for bar bending schedule.

So, Total length of beam = Clear span + Bearing on both sides

$$= 4600 + 300 + 300 = 5200 \text{ mm}$$

MYSB bars used

(i) Length of main straight bar =

Total length of beam - 2 x End cover =

$$L = 5200 - 2 \times 20 = 5160 \text{ mm}$$

(ii) Length of anchor bars = Length of straight bars

$$L_a = 5160 \text{ mm}$$

Height of bend  $H = D - 2 \times \text{clear cover} - 2 \times \text{dia of stirrups} - \text{Dia of bent up bar}$ ,

$$= 500 - 2 \times 20 - 2 \times 8 - 20$$

$$= 424 \text{ mm}$$

(iii) Length of bent up bar = Length of straight bar + 2 x 0.42 H

$$= 5160 + 2 \times 0.42 \times 424$$

$$L_b = 5516 \text{ mm}$$

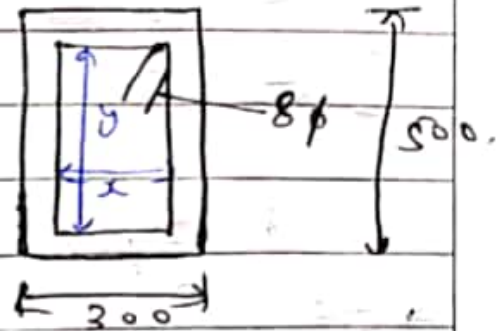
UPCP

Teacher's Sign

$$x = 300 - 2 \times \text{clear cover} - 2 \times \text{dia of stirrup}$$

$$x = 300 - 2 \times 20 - 2 \times 8$$

$$x = 244 \text{ mm}$$



$$y = 500 - 2 \times 20 - 2 \times 8$$

$$y = 444 \text{ mm}$$

(iv) Length of one stirrup =  $2(x+y) + 16\phi$   $\phi$  = dia of stirrup

$$= 2(244 + 444) + 16 \times 8$$

$$L_s = 1504 \text{ mm}$$

(v) Length of stirrup




(vi) No. of stirrups =  $\frac{\text{c/c bearing}}{\text{Spacing of stirrups}} + 1$

$$\text{c/c bearing or eff. span} = 4600 + \frac{300}{2} + \frac{300}{2}$$

$$= 4900$$

$$N = \frac{4900}{200} + 1 = 25.5 \approx 26$$

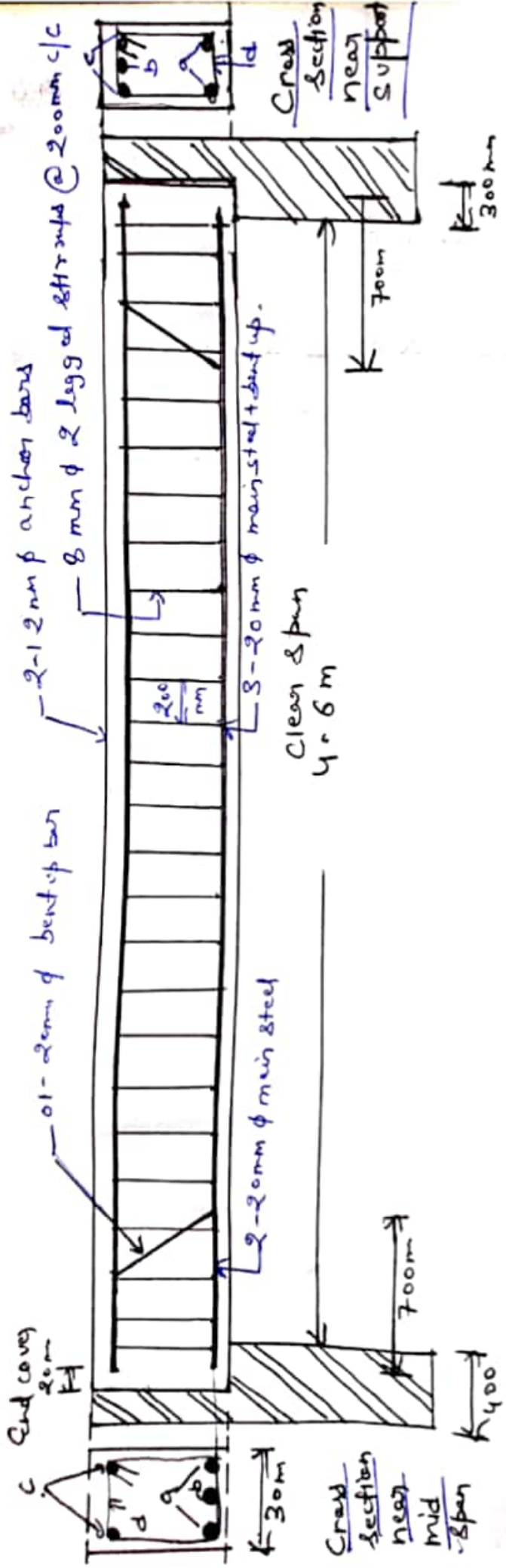
## Bar bending Schedule

Sno	Type of bar	Diameter	Shape	No.	Length (cm)	Total Length (cm)	Weight per m (kg/m)	Total weight (kg)
1.	Main bar	20mm		2	5160	10.32	$w = \frac{D^2}{162}$ D → dia of bar	25.49
				1	5516	5.516		13.63
				2	5160	10.32		25.49
2.	Anchor bar (c)	12mm		2	5160	10.32	$w = \frac{D^2}{162}$ D → dia of bar	9.19
				26	1504	39.10		15.25
				26	1504	39.10		15.25
3.	Stirrups (d)	8mm		26	1504	39.10	0.39	15.25

Add 5% wastage =  $\frac{5 \times 63.56}{100} = 3.18$

Gross wt. of steel =  $63.56 + 3.18 = 67 \text{ kg.}$





effective span = 4.9m

Longitudinal Section

bars bent up from  $\frac{L}{7}$  left from center of supports

$$= \frac{4900}{7} = 700\text{mm}$$

- a → main steel
- b → Bent up
- c → anchor bar
- d → stirrups

Note:- Drawing is required to be prepared in drawing sheet with a suitable scale

Q2. A simply supported R.C.C beam has  
Size of beam = 300 mm x 500 mm

Clear span = 4.6 m

Bearing = 300 mm, wall thickness = 400 mm

Main reinforcement = 3-20 mm  $\phi$  bars of mild steel  
(out of which one bar is bent up at  $\frac{l}{7}$  from  
centre of support.)

Vertical stirrups = 8 mm  $\phi$  2 legged @ 200 mm c/c

Anchor bars = 2-12 mm  $\phi$

Draw to a suitable scale the longitudinal section &  
two cross sections.

Soln → Clear cover = 20 mm = End cover

10/23

$$\begin{aligned} \text{Total length of beam} &= \text{Clear span} + \text{Bearing} + \text{Bearing} \\ &= 4600 + 300 + 300 \\ &= 5200 \text{ mm} \end{aligned}$$

$$\text{(i) Length of straight bar} = \text{Total length} - 2 \times \text{End cover} + 2 \times 9 \phi \quad (\text{for hooks in both sides steel})$$

$$\begin{aligned} &= 5200 - 2 \times 20 + 2 \times 9 \times 20 \\ &= 5520 \text{ mm} \end{aligned}$$

$$\text{(ii) Length of anchor bar} = \text{Total length of beam} - 2 \times \text{End cover}$$

$$\begin{aligned} \text{(Hooks not provided in anchor bars)} \quad \updownarrow &= 5200 - 2 \times 20 \\ &= 5160 \text{ mm} \end{aligned}$$

$$H = D - 2 \times \text{Clear cover} - 2 \times \text{dia of stirrup} - \text{Dia of bent up bar}$$

$$= 500 - 2 \times 20 - 2 \times 8 - 20$$

$$H = 424 \text{ mm}$$

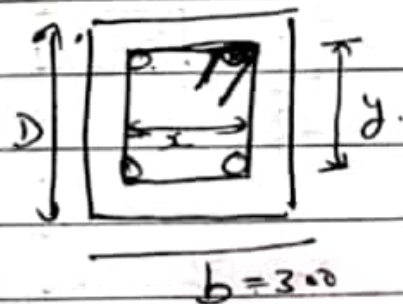
(iii) Length of Bent up bar = Length of straight bar +  $2 \times 0.42H$

$$= 5520 + 2 \times 0.42 \times 424 = 5876 \text{ mm}$$

$$x = b - 2 \times \text{clear cover} - 2 \times \text{dia of stirrup}$$

$$= 300 - 2 \times 20 - 2 \times 8$$

$$= 244$$



$$y = D - 2 \times \text{clear cover} - 2 \times \text{dia of stirrup}$$

$$= 500 - 2 \times 20 - 2 \times 8$$

$$= 444 \text{ mm}$$

(iv) Length of one stirrup

$$= 2(x+y) + 16 \phi \text{ (dia of stirrups)}$$


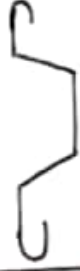


$$= 2(244+444) + 16 \times 8$$

$$= 1504 \text{ mm}$$

(v) No of stirrups =  $\frac{\text{c/c beam} + 1}{\text{Spacing}}$

$$= \frac{4900}{200} + 1 = 26$$

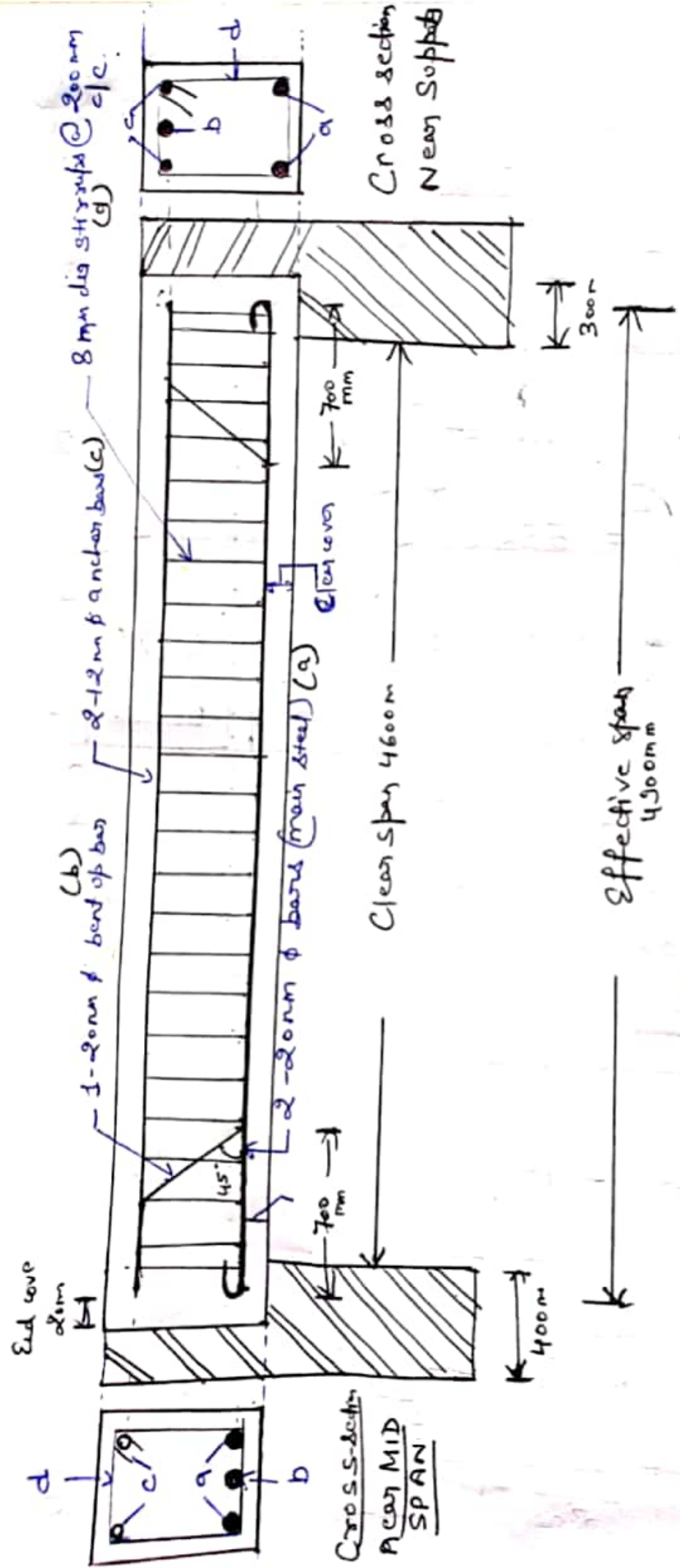
# Bar-bending schedule

S.No	Type of bar	Diameter (mm)	Shape of bar	No	Length (mm)	(P) Total length (m)	(Q) w/m $\frac{D^2}{162}$ m/kg (D = dia. of bar)	Total wt (P x Q) kg
1.	Main Steel (i) Straight bar	20		2	5520	11.04	$\frac{20^2}{162} = 2.47$	27.27
	(ii) Bent up	20		1	5876	5.876	$\frac{20^2}{162} = 2.47$	14.51
2.	Anchor bar	12		02	5160	10.32	$\frac{12^2}{162} = 0.89$	9.18
3.	Steel Stirrup	8		26	1504	39.10	$\frac{8^2}{162} = 0.39$	15.25
								66.21 kg

Total wt = 66.21 kg.

Add 5% wastage = 3.31 kg

Total wt = 69.52 kg



- a - Main steel
- b - Bent up bars
- c - Ancho~~r~~ bar
- d - Shear Stirrups