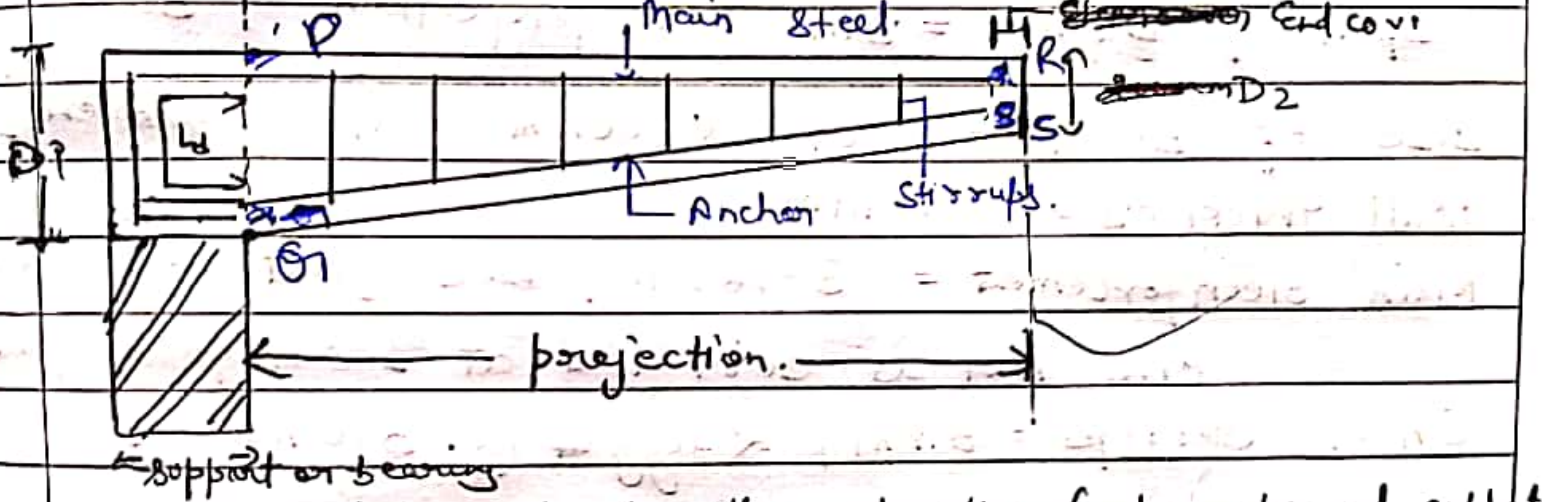
CANTILEVER BEAM

- Main steel provided in ~~bot~~ top zone.
- Tapered cross section preferred due to decrease in shear as well as bending stress at free end.
- Curtailment of bar is also done near free end.



L_d = development length = length of bar beyond supports

$$L_d = \frac{\phi \sigma_{st}}{4 \tau_{bd}}$$

Length of main steel = Projection of Cantilever − Clear cover En.

(1) Length of main steel = Projection of Cantilever − end cover of free end + L_d

(2) Anchor bar length.

∴ QS → inclined length.

$$QS = \sqrt{QT^2 + ST^2}$$

UPCP

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Length of anchor bar = Inclined length + Bearing − 2X End cover.

Q1) Draw to a suitable scale L-section & two cross-sections (one at fixed end & other near free end) of a R.C.C Cantilever beam from details given.

Span of beam = 3m (or projection of beam)
Size of beam = 300 mm X 600 mm (at fixed end)
Wall thickness = 300mm.
Main reinforcement = 3-16 mm ϕ bars (out of which one bar is curtailed at 1.8m from fixed end)
Shear Stirrups = 8 mm ϕ 2 legged @ 300 mm c/c.
Anchor bars = 2 no- 12 mm ϕ
Used HYSD & Prepare bar bending schedule.

Soln. Clear cover to stirrups = 20mm
M20 & HYSD steel

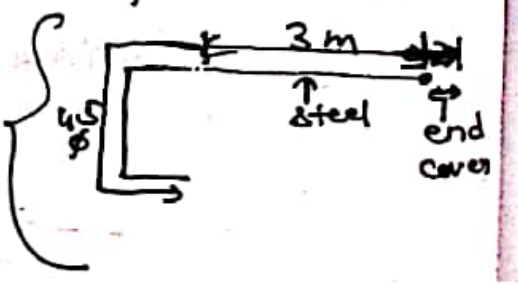
Development length $L_d = \frac{\phi \sigma_{st}}{4\tau_{bd}} = 45\phi$ { in place of W.S.M L.S.M value can be used }

1) Length of main steel bar = Projection of Cantilever − Clear cover + L_d

⇒ Projection of Cantilever = 3m

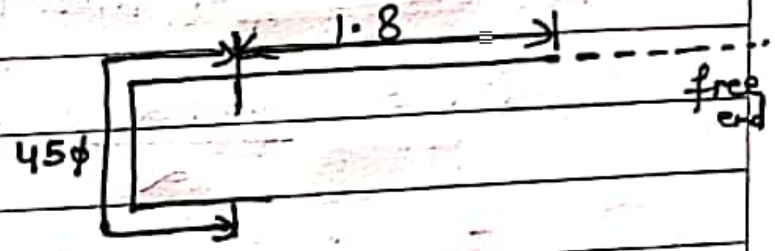
$L = 3000 - 20 + 45 \times 16$

$L = 3700mm$



2) Length of curtailed bar = Length of bar + Ld

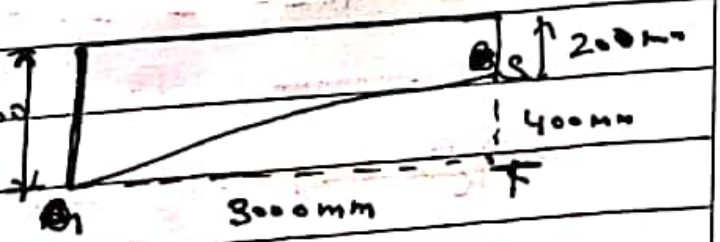
Acc. to question bar is continued upto 1.8m from fixed end



$\therefore L = 1800 + 45 \times 16$

$L = 2520$ mm.

3) Anchor bar



Inclined length = OS = $\sqrt{3000^2 + 400^2}$ = 3027 mm

Length of anchor bar = Inclined length of bar + Bearing - 2x End Cover

= 3027 + 300 - 2x20

= 3287 mm.

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1) Length of Stirrups

As depth of beam is varying so an average depth is taken for theoritical calculation.

$D_{av} = \frac{600+200}{2} = 400\,mm$

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

$= 300 - 2\times 20 - 2\times 8 = 244\,mm$

$y = D_{av} - 2 \times \text{Clear cover} - 2 \times \text{dia of stirrups}$

$= 400 - 2\times 20 - 2\times 8 = 344\,mm$

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

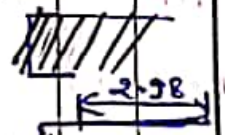
$= 2(244+344) + 16\times 8$

$= 1176 + 128 = 1304\,mm$

No. of Stirrups $= \frac{\text{Overhang of Cantilever}}{\text{c/c spacing of stirrups}} + 1$

$= \frac{3000}{300} + 1 = 11$

Bar Bending Schedule

S.No	Type of Bar	Dia	Shape	No	Length	Total length(m)	Weight per m length kg/m	Total weight kg
1.	Main L Bar							
a)	Straight	16		02	3700	7.4	.58	11.69
b)	Curtailed one at 1.8 m	16		01	2520	2.52	1.58	3.98
2.	Anchor bar (c)	12		02	3287	6.57	0.89	5.85
3	Stirrups	8		11	1304	14.34	0.39	5.60
								27.12 kg

Total weight = 27.12 kg

Add 5% wastage = 1.36 kg

Gross wt. = 29 kg

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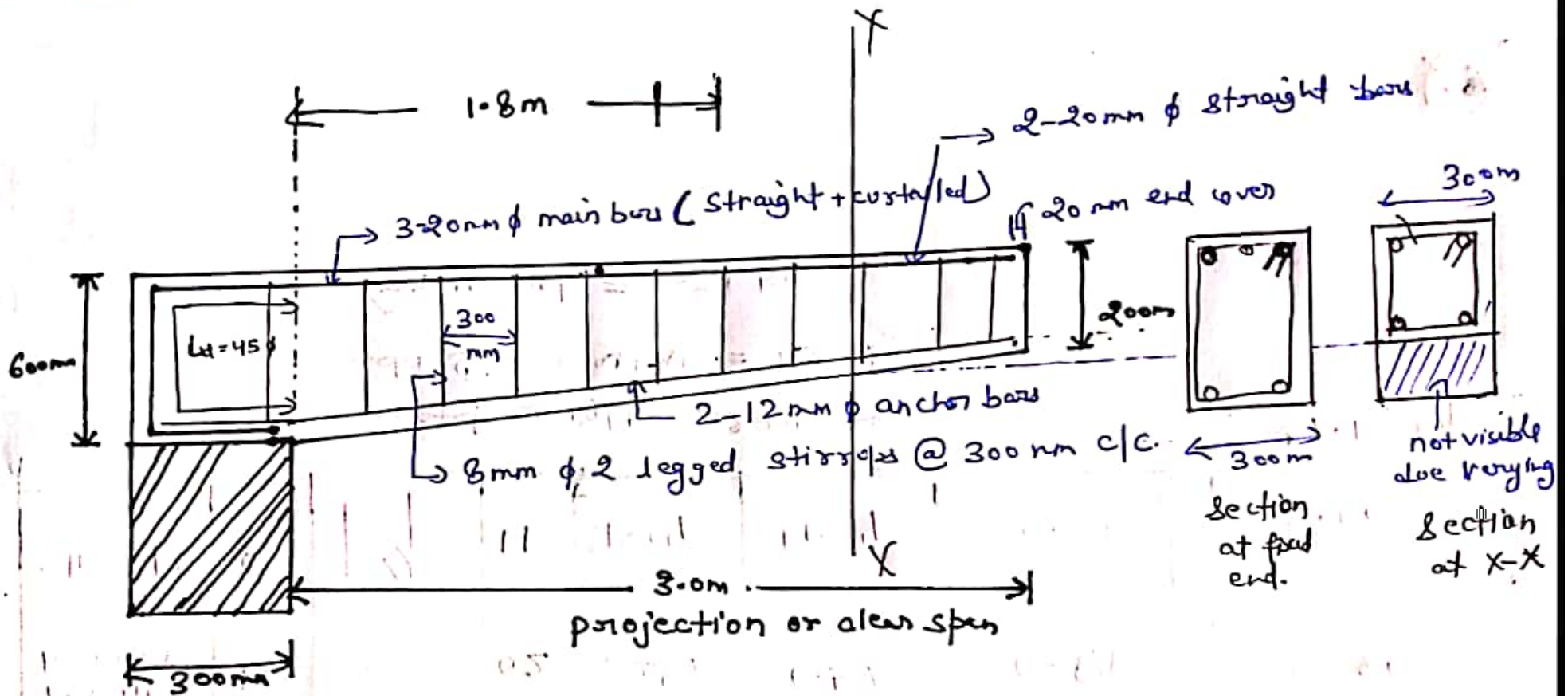

Longitudenal-Section

Note:- As the bars curtailed after 1.8m length from free end so at a section upto 1.8m main reinforment consist of 3 bars. After 1.8m, one bar is curtailed (cut) & only 2 bars are available.