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M/eng03/047

CIVIL ENGINEERING

Structural Steel Design Project

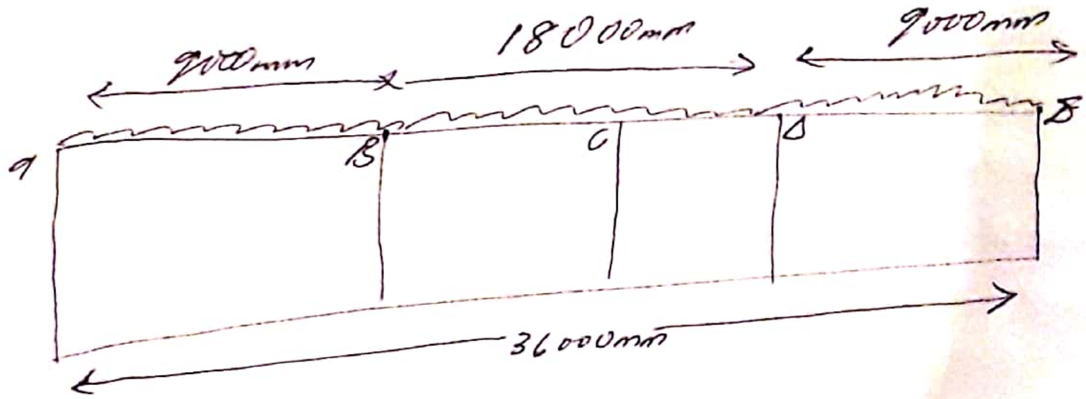
Structural Design II

① Yield stress of steel $P_y = 250N/mm^2$

Material factor for steel, $\gamma_m = 1.15$

Dead load factor, ~~for steel~~ $\gamma_{fd} = 1.35$

Imposed load factor, $\gamma_{fl} = 1.50$



Dead Load:

UDL, wd = 20kN/m (Including self weight)

Concentrated load, W1d = 200kN

Concentrated load W2d = 200kN

Live Load:

Uniformly distributed load, wl = 35kN/m

Concentrated load, W1l = 400kN

Concentrated Load W2l = 400kN

Scanned with CamScanner

Solution

Using the load factors

1·35Gk + 1·3QK

For UDL = 20 × 1·35 + 1·5 × 35 = 79·5 kN/m

For Conc Loads = 200 × 1·35 + 400 × 1·5 = 870 kN

For Conc loads = 200 × 1·35 + 400 × 1·5 = 870 kN

S.F and B.M

Calculating reactions

Moment about A = 0

O = (870 × 9) + (79·5 × 36 × 18) + (870 × 2700) = 36

E = 230kN

A = (79·5 × 36) + 870 + 870 − 2301

A = 2301 kN

Calculating shear forces

A = 2301 kN

B' = 2301 − 79·5 × 9 = 1585·5 kN

B = 2301 − (79·5 × 9) − 870 = 715·5 kN

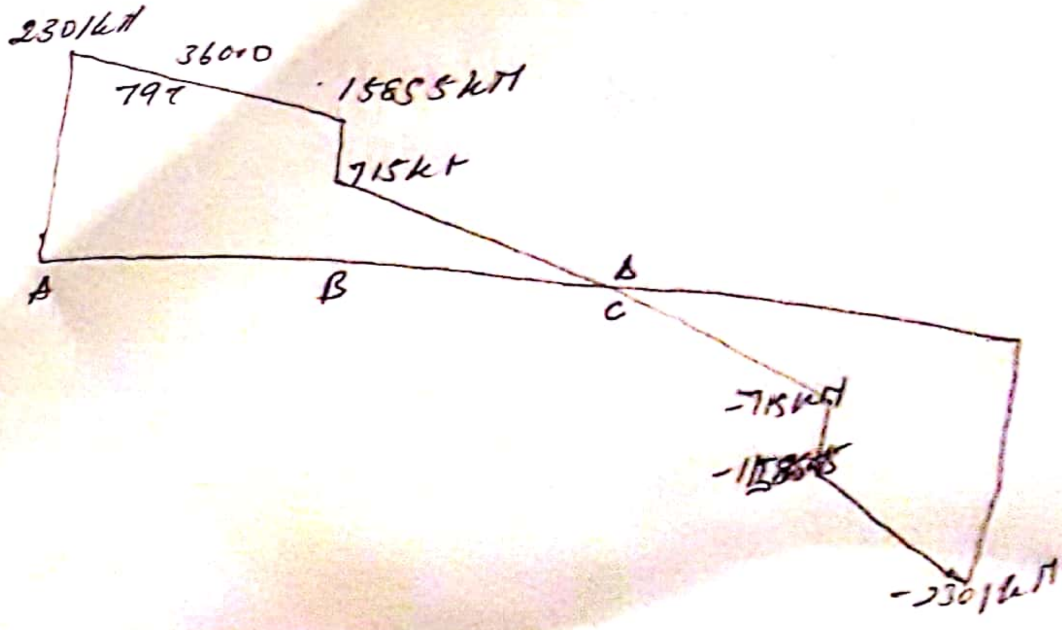
C = 715·5 − 79·5(9) = 0

D' = 0 − 79·5 × 7 = −715·5 kN

D = −715·5 − 870 = −1585·5 kN

E' = −1585·5 − (79·5 × 9) = −2301 kN

E = −2301 + 2301 kN = 0



Max Shear Force = 2501kN

Max Bending Moment (When shear force is at 0)

$= (2501 \times 18) - (79.5 \times 15^2/2) - (870 \times 2)$

$= 20709 kN/m^2$

Girder Section:

Depth of Girder = 1 to Span /15/10/12

Using 15 = $\frac{36000}{15}$ = 2400mm

Flange

$P_y = 250/1.15 = 217.4 N/mm^2$

Single Flange Area

$A_f = \frac{M_{max}}{d\,P_y} = \frac{20709 \times 10^6}{2400 \times 217.4} = 39690.7 mm^2$

Assuming Thickness of Flange as 60mm

Breadth of girder = 2400 × 0.3 = 720

Using 720mm × 60mm = 43200mm² (Area)

Web: Using 13 as thickness of web

Web size = 2400 × 13mm

Section Classification

Flange

$\varepsilon = (275/P_y)^{0.5} = (275/250)^{0.5} = 1.04$

$b = \frac{B - t}{2} = \frac{720 - 13}{2} = 353.5$

$\frac{b}{t} = 353.5 / 60 = 5.89 < 7.9\varepsilon$

Flange is Plastic

Web

$d/t = 2400/13 = 184.6 > 63\varepsilon$

Checking for Shear buckling

Checks for Web

~~check~~ Serviceability

$d/250 - 2400/250 = 9.6mm < t$

Checks is Ok

Check for Flange buckling in to web

Assumming Stiffner Spacing $a > 1.5d$

$t \geq d/294 \left(P_y/250\right)^{1/2} = \frac{2400}{294}\left(\frac{217.4}{250}\right)^{0.5}$

$= 7.6mm$

$t = 13m > 7.6mm$

Check is Ok