DESIGN OF WELDED PLATE GIRDERS

5.2 Design for plate girder with thick web

Example 2

Design a welded plate girder of 20m span to support a uniformly distributed love load of 70KN/m over the span using the following data. Yield stress of steel is 250 N/mm^2, top flange restrained laterally. Design the cross sectional details of the plate girder to confirm to the specifications of IS 800-2007

Given data

effective span of girder = 20 m

Distributed live load = 75KN/m

Yield stress of steel = 250 N/mm^2

Step 1 : Load on plate girder

load on girder = (1.5 x 70 x 20)

= 2100KN

Assume self weight = (total load / 200)

= 10KN/ m

Total factored load = 70 + 10

= 80 KN/m

Step 2 : Bending moments and shear force

Md = (WL^2 / 8)

= (80 x 20^2 / 8)

= 4000KN

Vd = (WL / 2)

= (80 x 20 / 2)

= 800KN

Step 3 : Cross section of girder

Is 800 2007 , page no. 63, 64

depth of plate girder

D = [√(MK / fy)]^0.33

K = (d / tw) < 200 €

d = depth of web

tw = thickness of web

Yield stress ration

€ = (250 / fy)

= (250 / 250)

= 1

K = 200 €

= 200 x 1

= 200

D = [√(4000 x 10^6 x 200 / 250)]^0.33

= 1500mm

adopt overall depth D = 1500mm

Allowing for 40mm flange plates

Depth of web d = 1500 – 80

= 1420 mm

Thickness of web

(d / tw) = 200 €

Tw = d / 200 x 1

= 1420 / 200

= 7.1 mm

(d / tw) = 67 €

Tw = d / 67 x 1

= 1420 / 67

= 21.2 mm

adopt 20mm thick and 1420mm deep web

Width of flange

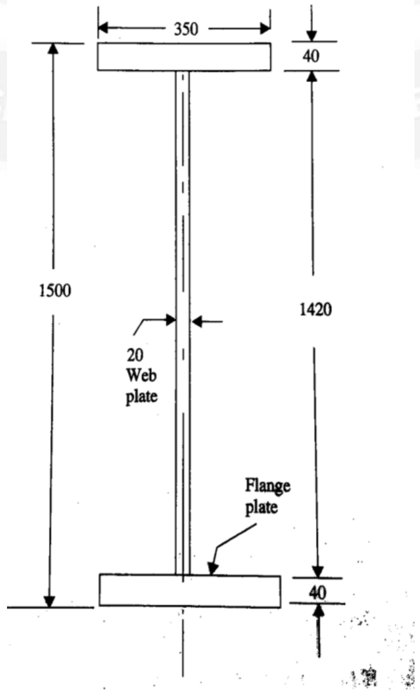
Width of flange = 0.2 d to 0.3 d

= 0.2 x 1420 to 0.3 x 1420

= 288 to 426

= 350 mm

adopt width of flange is 350mm



Check for plastic and compact section, the ratio

$b / t_f < 9.4€$

€ = 1

t_f = 40mm

b_f = 350mm

350 / 40 = 8.7

The ratio of satisfies the plastic section

Step 4 : Moment capacity

The moment capacity of the plate girder is

Is 800 2007 , page no. 53

$M_d = [(\beta_b \times Z_p \times f_y) / \gamma_{mo}]$

$\beta_b = 1$

$Z_p = [(2 \times b_f \times t_f (D - t_f) / 2) + (t_w \times d^2) / 4]$

$= [(2 \times 350 \times 40 (1500 - 40) / 2) + (20 \times 1420^2) / 4]$

$= 30.52 \times 10^6$ mm^3

$M_d = [(1 \times 30.52 \times 10^6 \times 250) / 1.1]$

= 6936 KNm > 4000KNm

Hence the section is safe

Step 5 : Shear capacity

Is 800 2007 , page no. 59

$V < V_d$

Design shear strength

$V_d = V_n / \gamma_{mo}$

Vn = Vp

Vp = [(Av x fyw) / √3]

Av = d x tw

= 1420 x 20

= 28400mm^2

Vp = [(Av x fyw) / √3]

= [(28400 x 250) / √3]

= 4099186 N

Vd = Vp / γmo

= 4099186 / 1.1

= 3726533

= 3726.5 KN > 800 KN

Hence the section is safe

Step 6 : Check for bearing stiffeners

Is 800 2007 , page no. 67

Fw = (b1 + n2) tw (fy / γmo)

Minimum stiffeners bearing length

b1 = bf / 2

= 350 / 2

= 175mm

n2 = 2.5 x 40

= 100mm

Fw = (b1 + n2) tw (fy / γmo)

= (175 + 100) x 20 x (250 / 1.1)

= 1250 x 10^3 KN > 800 KN

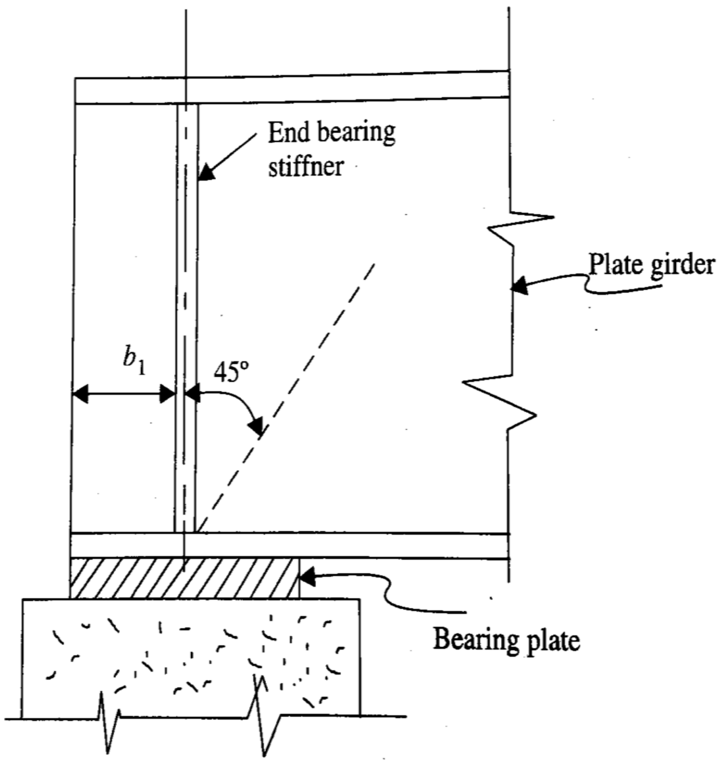


Fig.5.1 Bearing stiffener