Plate Girders - Behavior Of Components

5.1 Design for plate girder with thick web

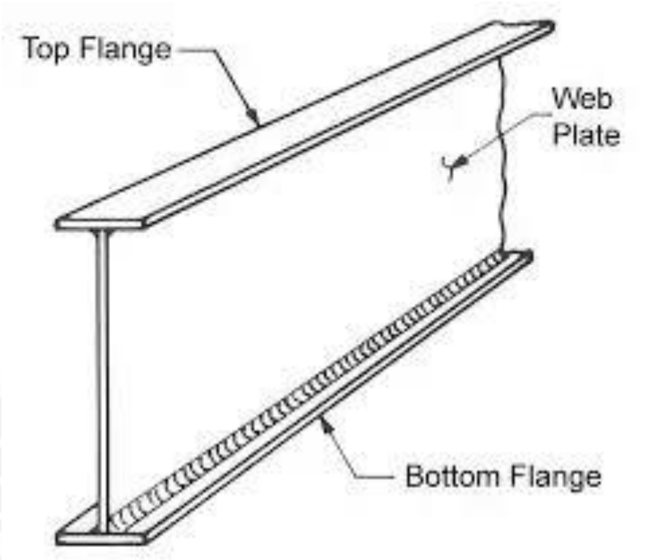

Fig 5.1 Plate girder

Design for plate girder with thick web

Example 1

Design a welded plate girder of 30m span to support a uniformly distributed love load of 100KN/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 = 30 m

Distributed live load = 100KN/m

Yield stress of steel = 250 N/mm^2

Step 1 : Load on plate girder

load on girder = (1.5 x 100 x 30)

= 4500KN

Assume self weight = (4500 / 200)

= 22.5KN/ m

Total factored load = 100 + 22.5

= 122.5 KN/m

Step 2 : Bending moments and shear force

Md = (WL^2 / 8)

= (122.5 x 30^2 / 8)

= 13781KNm

Vd = (WL / 2)

= (122.5 x 30 / 2)

= 1837.5KN

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 = [(13781 x 10^6 x 200 / 250)]^0.33

= 2060mm

adopt overall depth D = 2000mm

Allowing for 50mm flange plates

Depth of web d = 2000 – 100

= 1900 mm

Thickness of web

(d / tw) = 200 €

Tw = d / 200 x 1

= 1900 / 200

= 9.5 mm

(d / tw) = 67 €

Tw = d / 67 x 1

= 1900 / 67

= 28.3 mm

adopt 25mm thick and 1900mm deep web

Width of flange

Width of flange = 0.2 d to 0.3 d

= 0.2 x 1900 to 0.3 x 1900

= 380 to 570

= 450 mm

adopt width of flange is 450mm

Check for plastic and compact section, the ratio

b / tf < 9.4€

€ = 1

tf = 50mm

bf = 450mm

450 / 50 = 9

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

Md = [(βb x Zp x fy) / γmo]

βb = 1

Zp = [(2 x bf x tf (D - tf) / 2) + (tw x d^2) / 4]

= [(2 x 450 x 50 (2000 - 50) / 2) + (25 x 1900^2) / 4]

= 66.43 x 10^6 mm^3

Md = [(1 x 66.43 x 10^6 x 250) / 1.1]

= 15097 KNm > 13781KNm

Hence the section is safe

Step 5 : Shear capacity

Is 800 2007 , page no. 59

V < Vd

Design shear strength

Vd = Vn / γmo

Vn = Vp

Vp = [(Av x fyw) / √3]

Av = d x tw

= 1900 x 25

= 47500mm^2

Vp = [(Av x fyw) / √3]

= [(47500 x 250) / √3]

= 68560.03x 10^3 N

Vd = Vp / γmo

= 4099186 / 1.1

= 6232.75 KN > 1837.5 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

= 450 / 2

= 225mm

n2 = 2.5 x 50

= 125mm

Fw = (b1 + n2) tw (fy / γmo)

= (225 + 125) x 25 x (250 / 1.1)

= 1988.63 x 10^3 KN > 1837 KN

Hence safe

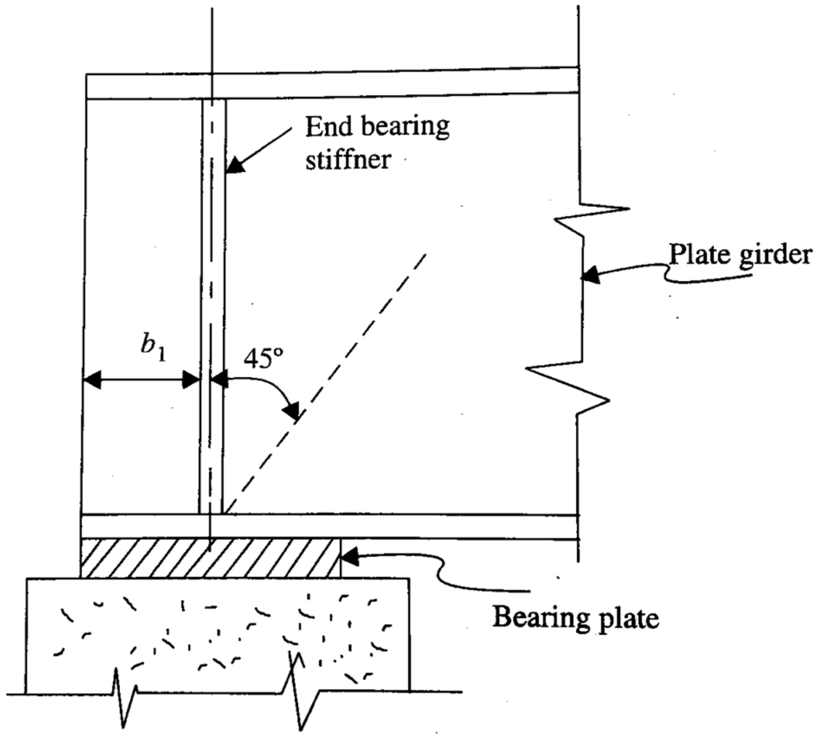

Fig.5.2 Stiff bearing