Example-9 : A 140 × 10 mm plate of grade Fe 410 steel is connected to a gusset plate with four high strength bolts of 20 mm diameter, in drilled holes as shown below. Determine the design strength of plate.

Solution :

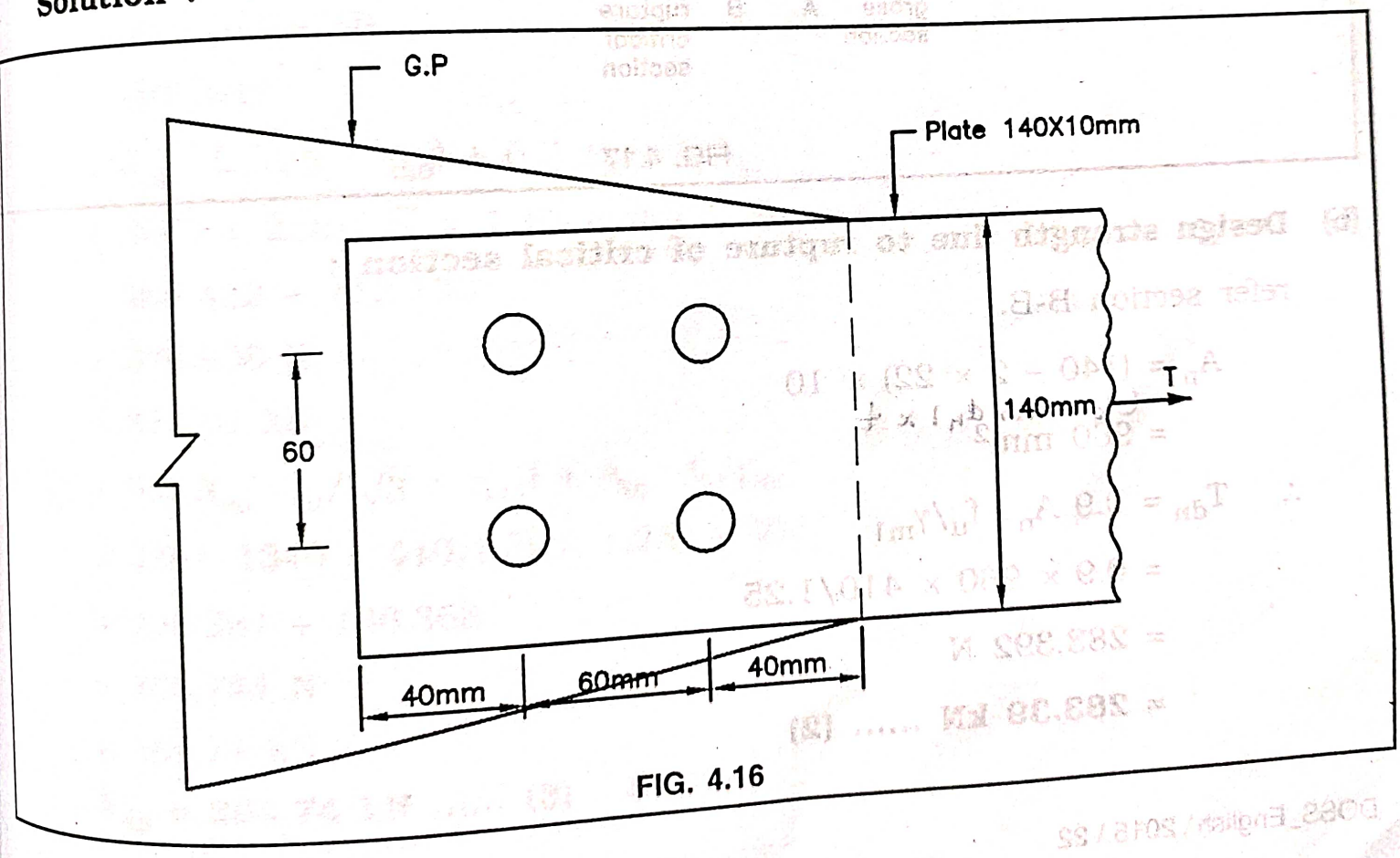

FIG. 4.16

$d = 20$ mm

$d_h = 20 + 2 = 22$ mm

(a) Design strength due to yielding of gross section :

Refer section A-A.

$T_{dg} = A_g \cdot f_y/\gamma_{mo}$

$= (140 \times 10) \times 250/1.10$

$= 318182$ N

$= 318.18$ kN ..... (1)

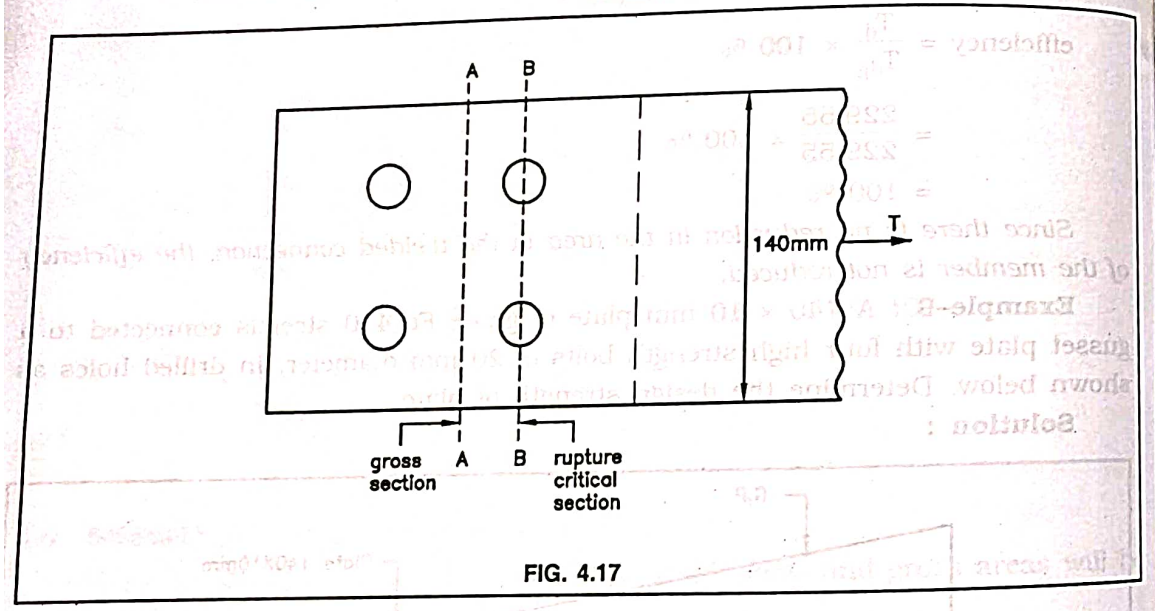

FIG. 4.17

(b) Design strength due to rupture of critical section :

refer section B-B.

$A_n = (140 - 2 \times 22) \times 10$

$= 960$ mm^2

$\therefore \quad T_{dn} = 0.9\ A_n \cdot f_u/\gamma_{m1}$

$= 0.9 \times 960 \times 410/1.25$

$= 283{,}392$ N

$= 283.39$ kN ..... (2)

(c) Design strength due to block shear :

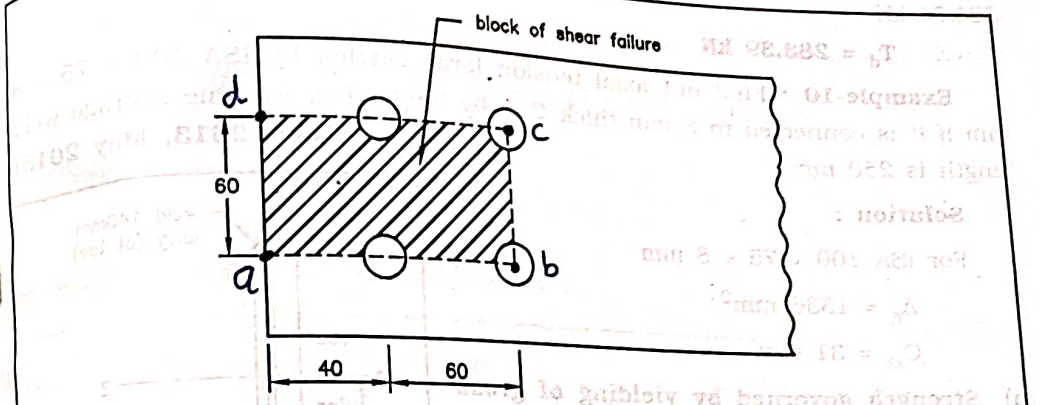

FIG. 4.18

$A_{vg} = 2 \times (40 + 60) \times 10$

$= 2000$ mm^2

$A_{vn} = 2 \times (40 + 60 - 1.5 \times 22) \times 10$

$= 1340$ mm^2

$A_{tg} = 60 \times 10 = 600$ mm^2

$A_{tn} = (60 - 22) \times 10$

$= 380$ mm^2

$T_{db1} = A_{vg} \cdot f_y/(\sqrt{3} \cdot \gamma_{mo}) + 0.9\ A_{tn} \cdot f_u/\gamma_{m1}$

$= 2000 \times 250/(\sqrt{3} \times 1.10) + 0.9 \times 380 \times 410/1.25$

$= 262{,}432 + 112{,}176$

$= 374{,}608$ N

$= 374.61$ kN

$T_{db2} = 0.9\ A_{vn} \cdot f_u/(\sqrt{3} \times \gamma_{m1}) + A_{tg} \cdot f_y/\gamma_{mo}$

$= 0.9 \times 1340 \times 410/(\sqrt{3} \times 1.25) + 600 \times 250/1.10$

$= 228{,}381 + 136{,}363$

$= 364{,}744$ N

$= 364.74$ kN

$\therefore$ **$T_{db} = 364.74$ kN ..... (3)** Smaller of T_{ab1} and T_{ab2}

The design strength (T_d) is the smaller of the 318.18 kN 283.39 kN and 364.74 kN

$\therefore$ **T_d = 283.39 kN**

Example-10 : Find out axial tension force carried by ISA 100 × 75 × 8 mm if it is connected to 8 mm thick G.P. by longer leg. Assume average weld length is 250 mm. **(Sept. 2013, May 2015)**

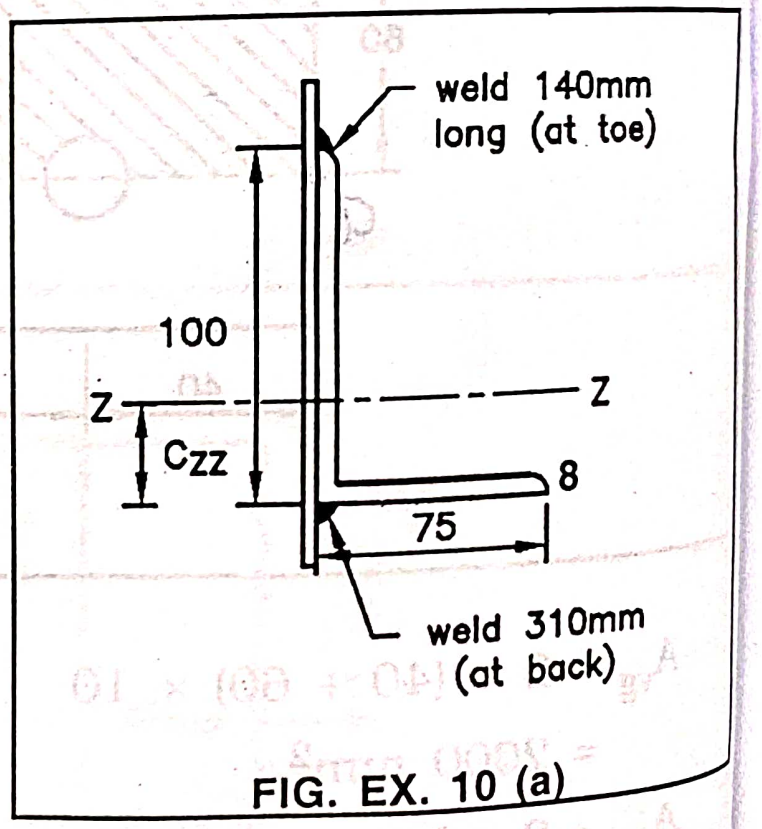

FIG. EX. 10 (a)

Solution :

For ISA 100 × 75 × 8 mm

A_g = 1336 mm^2

C_{zz} = 31 mm

(a) Strength governed by yielding of gross section :

$$T_{dg} = \frac{A_g \cdot f_y}{\gamma_{mo}}$$

$$= \frac{1336 \times 250}{1.10}$$

IS : 800

cl. 6.2