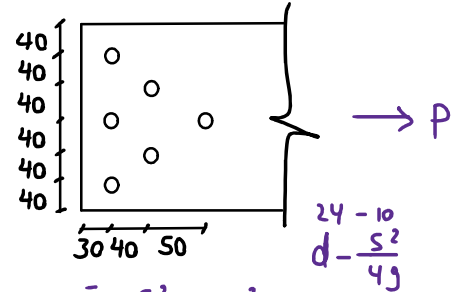
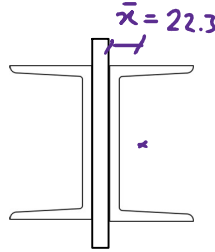
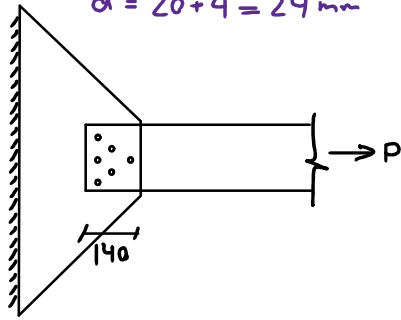


مثال: بر اساس عضو خرابی 2 UNP 240 به ورق اتصال پیچی با M20 مطابق شکل زیر استفاده شده است.

UNP 240: $A_g = 42.3 \times 10^2 \text{ mm}^2$, $t_w = 9.5 \text{ mm}$
 $d = 20 + 4 = 24 \text{ mm}$

مناسبت طراحی (ϕP_n) را بدست آورید.

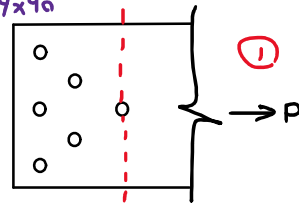


yield: $\phi P_n = 0.9 F_y A_g = 0.9 \times 235 \times 2 \times 42.3 \times 10^2 = \underline{1789 \text{ kN}}$

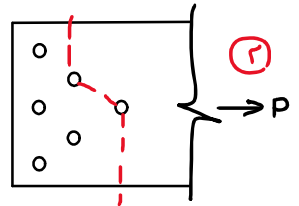
مناسبت: $\frac{5^2}{4 \times 9} = \frac{4 \times 4^2}{4 \times 40} = 10$

محاسبه سطح مقطع خالص A_n

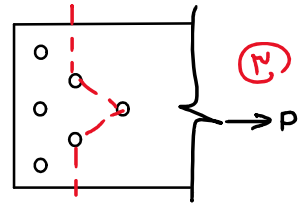
① $A_n = 42.3 \times 10^2 - (24 \times 9.5) = 40 \times 10^2 \text{ mm}^2$



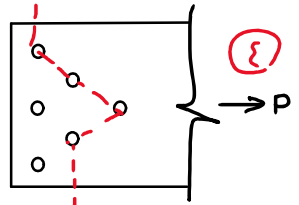
② $A_n = 42.3 \times 10^2 - 2 \times (24 \times 9.5) + \frac{50^2}{4 \times 40} \times 9.5 = 39.22 \times 10^2 \text{ mm}^2$



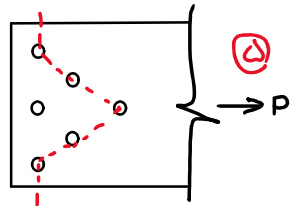
③ $A_n = 42.3 \times 10^2 - 3 \times (24 \times 9.5) + 2 \times \frac{50^2}{4 \times 40} \times 9.5 = 38.4 \times 10^2 \text{ mm}^2$



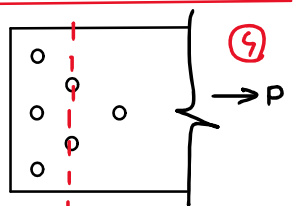
④ $A_n = 42.3 \times 10^2 - 4 \times (24 \times 9.5) + 2 \times \frac{50^2}{4 \times 40} \times 9.5 + \frac{40^2}{4 \times 40} \times 9.5 = 37.1 \times 10^2 \text{ mm}^2$



⑤ $A_n = 42.3 \times 10^2 - 5 \times (24 \times 9.5) + 2 \times \frac{50^2}{4 \times 40} \times 9.5 + 2 \times \frac{40^2}{4 \times 40} \times 9.5 = \underline{35.77 \times 10^2 \text{ mm}^2}$ ← Controls



⑥ $A_n = [42.3 \times 10^2 - 2 \times (24 \times 9.5)] \times \frac{6}{5} = 43.7 \times 10^2 \text{ mm}^2$



$$\textcircled{V} A_n = [42.3 \times 10^2 - 4(24 \times 9.5) + 2 \times \frac{40^2}{4 \times 40} \times 9.5] \times \frac{6}{5} = 42.1 \times 10^2$$

$$\textcircled{A} A_n = [42.3 \times 10^2 - 3(24 \times 9.5) + \frac{40^2}{4 \times 40} \times 9.5] \times \frac{6}{5} = 43.7 \times 10^2$$

$$\textcircled{B} A_n = [42.3 \times 10^2 - 5(24 \times 9.5) + 4 \times \frac{40^2}{4 \times 40} \times 9.5] \times \frac{6}{5} = 41.6 \times 10^2$$

$$\textcircled{C} A_n = [42.3 \times 10^2 - 3(24 \times 9.5)] \times \frac{6}{3} = 70.9 \times 10^2$$

$$U A_g > A_1$$

معاينة سطح مقطع مؤثر A_e

$$U = 1 - \frac{\bar{x}}{l} = 1 - \frac{22.3}{90} = 0.752 > \frac{A_1}{A_g} = \frac{240 \times 9.5}{42.3} = 0.539 \quad \checkmark$$

$$A_e = U A_n = 0.752 \times 43.7 \times 10^2 = 26.9 \times 10^2 \text{ mm}^2$$

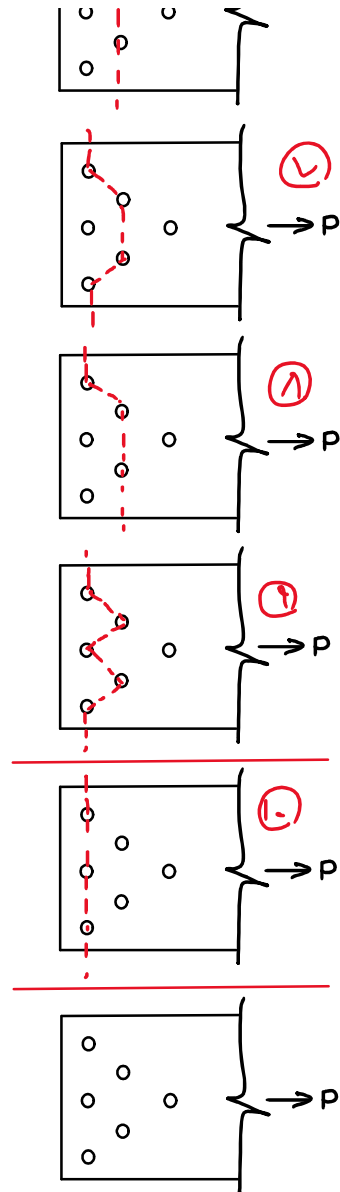
fracture $\phi P_n = 0.75 F_u A_e = 0.75 \times 360 \times (2 \times 26.9 \times 10^2) = 1452 \text{ kN}$

limit State ϕP_n for 2UM240

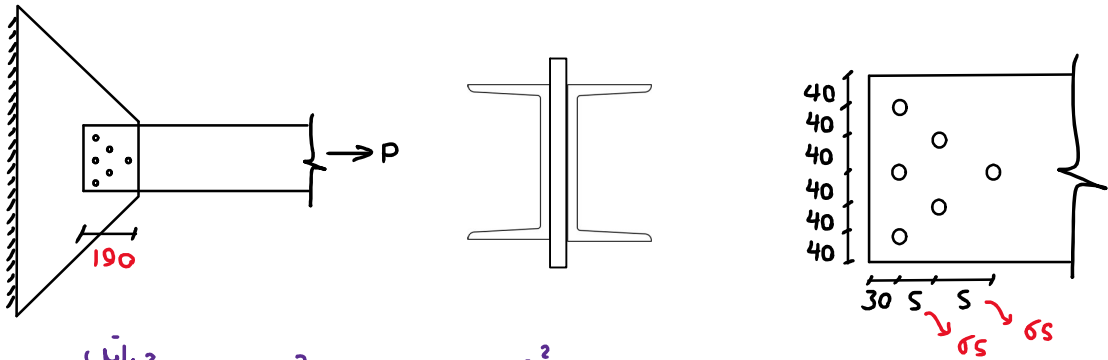
yield 1789 kN

fracture 1452 kN ← Controls

$$\phi P_n = 1452 \text{ kN}$$



مثال: در مثال فوق، حداقل فاصله انتی پیچ‌ها را به گونه‌ای پیدا کنید که مسیر ① (بر اساس یک سوراخ) حاکم شود. پس متناوبت موجود عضو را به دست آورید.



حدین $d' = d - \frac{s^2}{4g} \leq 0 \rightarrow d = \frac{s^2}{4g} \rightarrow 24 = \frac{s^2}{4 \times 40} \rightarrow s = 62 \text{ mm}$

بنابراین اگر $s > 62$ باشد، مسیر ① حاکم است.

① $A_n = 40 \times 10^2 \text{ mm}^2$

$U = 1 - \frac{\bar{x}}{l} = 1 - \frac{22.3}{130} = 0.828 > \frac{A_1}{A_g}$

$A_e = U A_n = 0.828 \times 40 \times 10^2 = 33.1 \times 10^2 \text{ mm}^2$

fracture $\phi P_n = 0.75 F_u A_e = 0.75 \times 360 \times (2 \times 33.1 \times 10^2) = \underline{1787 \text{ kN}}$

Limit State ϕP_n for 2UM7240

yield 1789 kN

fracture 1787 kN ← Controls

$\phi P_n = 1787 \text{ kN}$

با اصلاح $s = 65$ ، ظرفیت عضو افزایش قابل توجهی یافته و از منظریت (بر اساس تسلیم) با اصلاح 2UM7240 استفاده شد است.