

STRUKTUR BAJA I



Perhitungan
Sambungan Las

Sambungan Las

Sambungan las ada dua macam, yaitu:

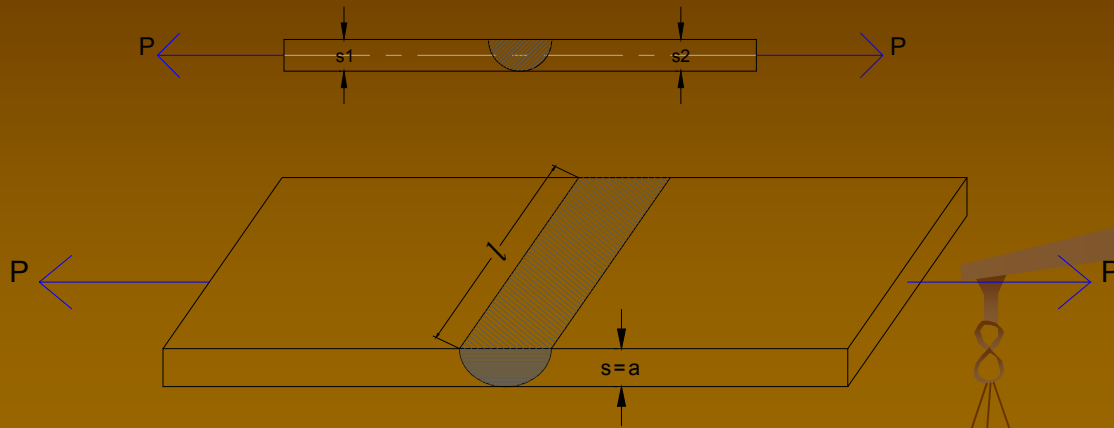
- las tumpul
- las sudut.

Tegangan:

$$\bar{\sigma}_{las} = \bar{\sigma}$$

$$\bar{\tau} = 0,6\bar{\sigma}$$

a. Las Tumpul:



Untuk $s_1 = s_2$ ---- tebal las tumpul (a) = s

Untuk $s_1 \neq s_2$ ----- tebal las tumpul (a) = S_{\min}

$F_{las} = l.a$ ---- l = panjang las neto

$$l_n = l_{br} - 3a$$

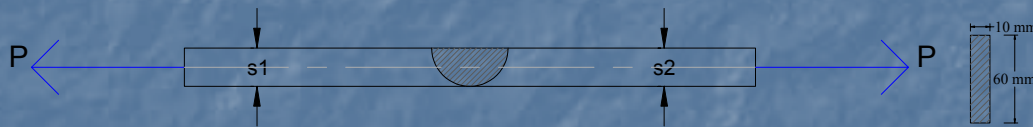
$$\sigma = \frac{P}{F_{las}} \leq \bar{\sigma}$$

Contoh 1

Dua plat akan disambung dengan las lumer bentuk tumpul, ukuran plat 1 = ukuran plat 2
→ ≠ 10/60. Menerima gaya tarik sejajar sumbu plat sebesar $P = 3000 \text{ kg}$

$$\bar{\sigma} = 1400 \text{ kg} / \text{cm}^2$$

Kontrol kekuatan las.



Penyelesaian:

$$F_{\text{las}} = l_{\text{net}} \cdot a$$

$$a = 10 \text{ mm}$$

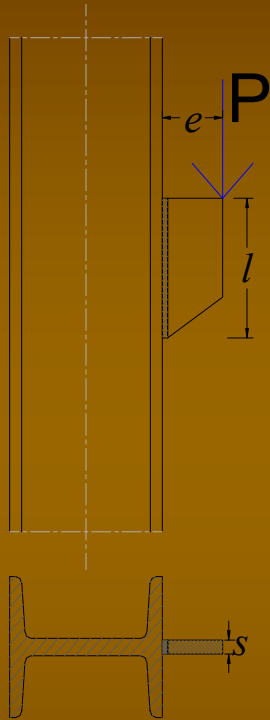
$$l_{\text{br}} = 60 \text{ mm}$$

$$l_{\text{net}} = l_{\text{br}} - 3a = 60 - 30 = 30 \text{ mm} = 3 \text{ cm}$$

$$\sigma = \frac{P}{F_{\text{las}}} = \frac{3000 \text{ kg}}{3 \text{ cm} \times 1 \text{ cm}} = 1000 \text{ kg/cm}^2 < 1400 \text{ kg/cm}^2$$

Jadi las cukup kuat menahan gaya yang bekerja pada plat yang disambung tsb.

Contoh 2



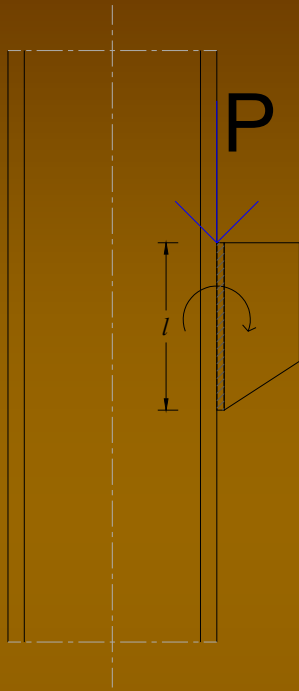
Sebuah plat tebal (s) = 8 mm, l = 300 mm, disambungkan pada tiang baja dari profil DIN dengan las tumpul. Sambungan tsb menahan gaya $P = 1000$ kg sejauh $e = 150$ mm dari las (spt gbr disamping).

$$\bar{\sigma} = 1400 \text{ kg/cm}^2$$

$$\bar{\tau} = 0,6\bar{\sigma} = 840 \text{ kg/cm}^2$$

Kontrol kekkuatan las

Penyelesaian



$$\text{Tebal las (a) = s = 0,8 cm}$$

$$l_{br} = 300 \text{ mm} = 30 \text{ cm}$$

$$l_{net} = l_{br} - 3a$$
$$= 30 - (3 \times 0,8) = 27,6 \text{ cm}$$

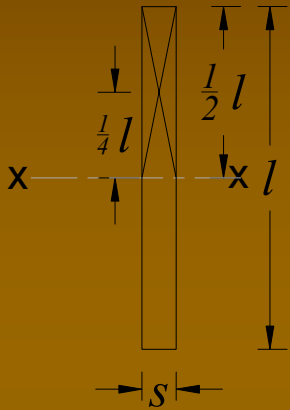
Pindahkan gaya P pada kedudukan las \rightarrow timbul momen $M = P.e$ dan gaya geser P

$$M = P.e = 1000 \text{ kg} \times 15 \text{ cm} = 15000 \text{ kgcm}$$

$$\sigma = \frac{M}{W_{las}}$$

$$W_{las} = \frac{1}{6} a l^2 = \frac{1}{6} \times 0,8 \times 30^2 = 120 \text{ cm}^3$$

$$\sigma = \frac{15000 \text{ kgcm}}{120 \text{ cm}^3} = 125 \text{ kg} / \text{cm}^2 < 1400 \text{ kg} / \text{cm}^2$$



$$\tau = \frac{D.S}{b.I}$$

dimana:

$$D = P ; S = S_{x \text{ las}}$$

$$b = a_{\text{ las}} ; I = I_{x \text{ las}}$$

$$S_x = \left(\frac{1}{2} \cdot l \cdot a\right) \times \frac{1}{4} l$$

$$S_x = (15 \times 0,8 \text{ cm}) \times 7,5 \text{ cm} = 90 \text{ cm}^3$$

$$I_x = \frac{1}{12} b \cdot h^3$$

dimana:

$$b = a$$

$$h = l$$

$$I_x = \frac{1}{12} a.l^3$$

$$I_x = \frac{1}{12} \times 0,8cm \times 30cm^3 = 1800 cm^4$$

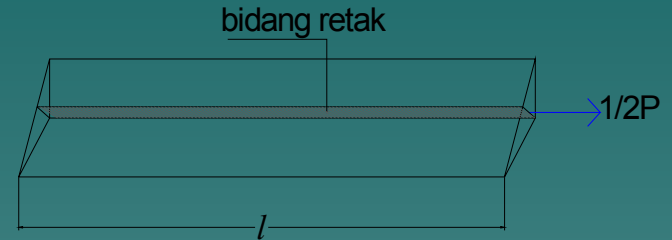
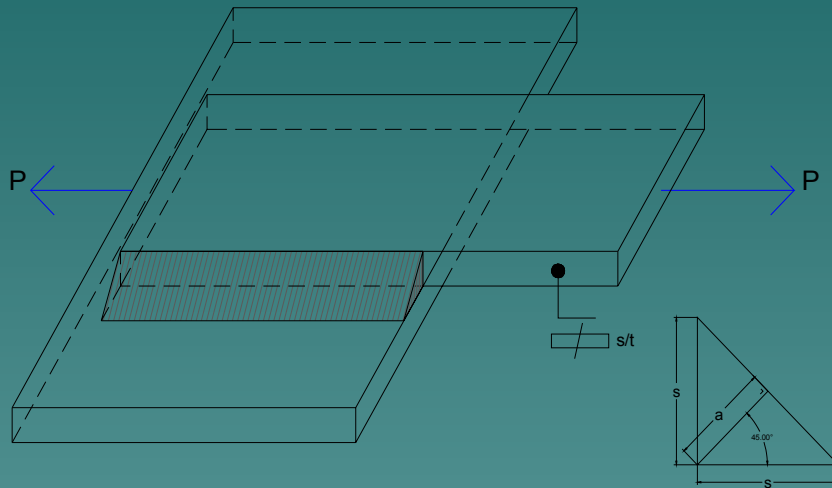
$$\tau = \frac{P.S_x}{a.I_x} = \frac{1000 kg \times 90cm^3}{0,8cm \times 1800 cm^4}$$

$$\tau = 694,44kg / cm^2 < \bar{\tau} \Rightarrow ok$$

Jadi las cukup kuat menahan gaya yang bekerja tsb.

b. Las Sudut:

- Arah gaya P // las



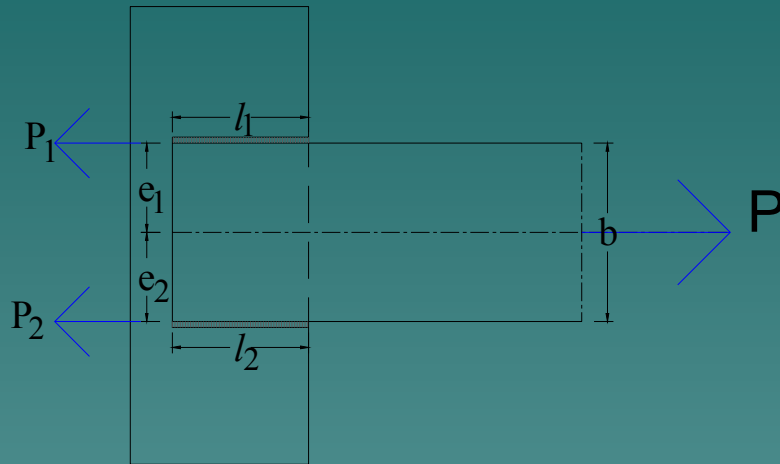
a = tebal las

$$a = s \sin 45^\circ = 0,707s$$

s = tebal plat = panjang kaki las

Bidang retak utk las sudut yang dibebani gaya P dengan arah // las, akan membuat sudut 45° dengan kaki las.

✓Las dipasang pada dua bagian



Gaya P akan ditahan oleh las atas dan bawah sebesar P_1 dan P_2 .

$$e_1 = e_2 = \frac{b}{2}$$

$$P_1 = \frac{e_2}{e_1 + e_2} \times P = \frac{1}{2} P$$

$$P_2 = \frac{e_1}{e_1 + e_2} \times P = \frac{1}{2} P$$

$$\tau_1 = \frac{P_1}{F_{gs1}} \leq \bar{\tau}$$

$$\tau_2 = \frac{P_2}{F_{gs2}} \leq \bar{\tau}$$

$$\bar{\tau} = 0,6\bar{\sigma}$$

$$F_{gs1} = a.l_{1n} = 0,707.s.l_{1n}$$

$$F_{gs2} = a.l_{2n} = 0,707.s.l_{2n}$$

$$l_n = l_{br} - 3a$$

dimana:

l_n = panjang las neto

l_{br} = panjang las bruto

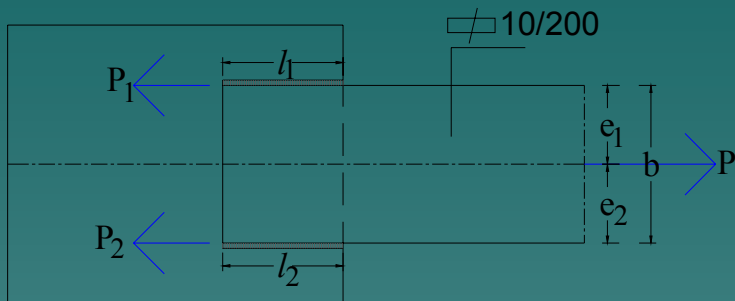
a = tebal las

note:

panjang las min (l_{min}) = 40 mm

panjang las mak (l_{mak}) = 40 a = 28,28 s

Contoh 3



Diket: Konst spt gambar.

Gaya $P = 2000$ kg; las dipasang pada dua muka.

$$\bar{\sigma} = 1400 \text{ kg/cm}^2; \bar{\tau} = 0,6\bar{\sigma} = 840 \text{ kg/cm}^2$$

Hitung panjang las

Penyelesaian:

$$s = 10 \text{ mm} = 1 \text{ cm};$$

$$a = 0,707s = 0,707 \text{ cm}$$

$$b = 200 \text{ mm} = 20 \text{ cm};$$

$$e_1 = e_2 = \frac{1}{2} b = 10 \text{ cm}$$

$$P_1 = P_2 = \frac{1}{2} P = 1000 \text{ kg};$$

$$l_1 = l_2 = l_{br}$$

$$F_{gs} = l_n \cdot a = 0,707 \text{ cm} \cdot l_n$$

$$\tau = \frac{\frac{1}{2} P}{F_{gs}} \Rightarrow F_{gs} = \frac{\frac{1}{2} P}{\bar{\tau}}$$

$$F_{gs} = \frac{1000 \text{ kg}}{840 \text{ kg/cm}^2} = 1,19 \text{ cm}^2$$

$$0,707 l_n = 1,19 \text{ cm}^2$$

$$l_n = 1,683 \text{ cm}$$

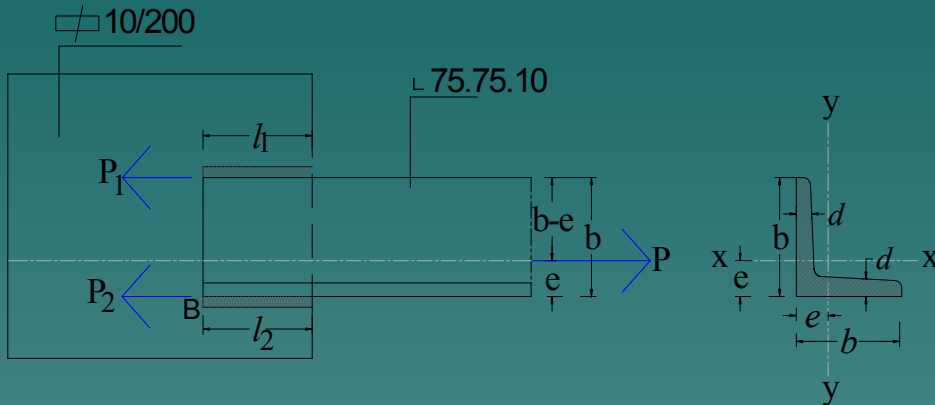
$$l_{br} = l_n + 3a$$

$$= 1,683 \text{ cm} + 3 \times 0,707 \text{ cm}$$

$$= 3,804 \text{ cm} \approx 4 \text{ cm}$$

Jadi panjang las $l_1 = l_2 = 40 \text{ mm}$

Contoh 4



Diket: Konst spt gbr.
Gaya $P = 2500$ kg; las
pada dua muka.

$$\bar{\sigma} = 1400 \text{ kg/cm}^2$$

$$\bar{\tau} = 0,6\bar{\sigma} = 840 \text{ kg/cm}^2$$

Hitung panjang las

Penyelesaian:

Dari tabel profil, utk L 75.75.10 didapat:

$$b = 75 \text{ mm} = 7,5 \text{ cm};$$

$$d = 10 \text{ mm} = 1 \text{ cm}$$

$$e = 2,21 \text{ cm}$$

$$d = 1 \text{ cm} \rightarrow a = 0,707d$$

$$a = 0,707 \times 1 \text{ cm} = 0,707 \text{ cm}$$

$$b - e = 7,5 \text{ cm} - 2,21 \text{ cm} = 5,29 \text{ cm}$$

$$\Sigma M_B = 0$$

$$P_1 \cdot b - P \cdot e = 0$$

$$P_1 = \frac{P \cdot e}{b} = \frac{2500 \text{ kg} \times 2,21 \text{ cm}}{7,5 \text{ cm}} = 737 \text{ kg}$$

$$\Sigma H = 0$$

$$P_1 + P_2 - P = 0$$

$$P_2 = P - P_1$$

$$P_2 = 2500 \text{ kg} - 737 \text{ kg} = 1763 \text{ kg}$$

$$\tau_1 = \frac{P_1}{F_{gs1}} \Rightarrow \text{ambil } \tau_1 = \bar{\tau} = 840 \text{ kg/cm}^2$$

$$F_{gs1} = \frac{P_1}{\bar{\tau}} = \frac{737 \text{ kg}}{840 \text{ kg/cm}^2} = 0,877 \text{ cm}^2$$

$$F_{gs1} = a \cdot l_{1n} = 0,707 \text{ cm} \cdot l_{1n}$$

$$0,877 \text{ cm}^2 = 0,707 \text{ cm} \cdot l_{1n}$$

$$l_{1n} = \frac{0,877 \text{ cm}^2}{0,707 \text{ cm}} = 1,24 \text{ cm}$$

$$l_{1br} = l_{1n} + 3a = 1,24 \text{ cm} + (3 \times 0,707 \text{ cm})$$

$$l_{1br} = 3,361 \text{ cm} < l_{\min} = 4 \text{ cm}$$

$$\text{ambil } l_{1br} = 4 \text{ cm}$$

$$\tau_2 = \frac{P_2}{F_{gs2}} \Rightarrow \text{ambil } \tau_2 = \bar{\tau} = 840 \text{ kg/cm}^2$$

$$F_{gs2} = \frac{P_2}{\bar{\tau}} = \frac{1763 \text{ kg}}{840 \text{ kg/cm}^2} = 2,099 \text{ cm}^2$$

$$F_{gs2} = a.l_{2n} = 0,707 \text{ cm}.l_{2n}$$

$$2,099 \text{ cm}^2 = 0,707 \text{ cm}.l_{2n}$$

$$l_{2n} = \frac{2,099 \text{ cm}^2}{0,707 \text{ cm}} = 2,969 \text{ cm}$$

$$l_2 = l_{2n} + 3a = 2,969 \text{ cm} + (3 \times 0,707 \text{ cm})$$

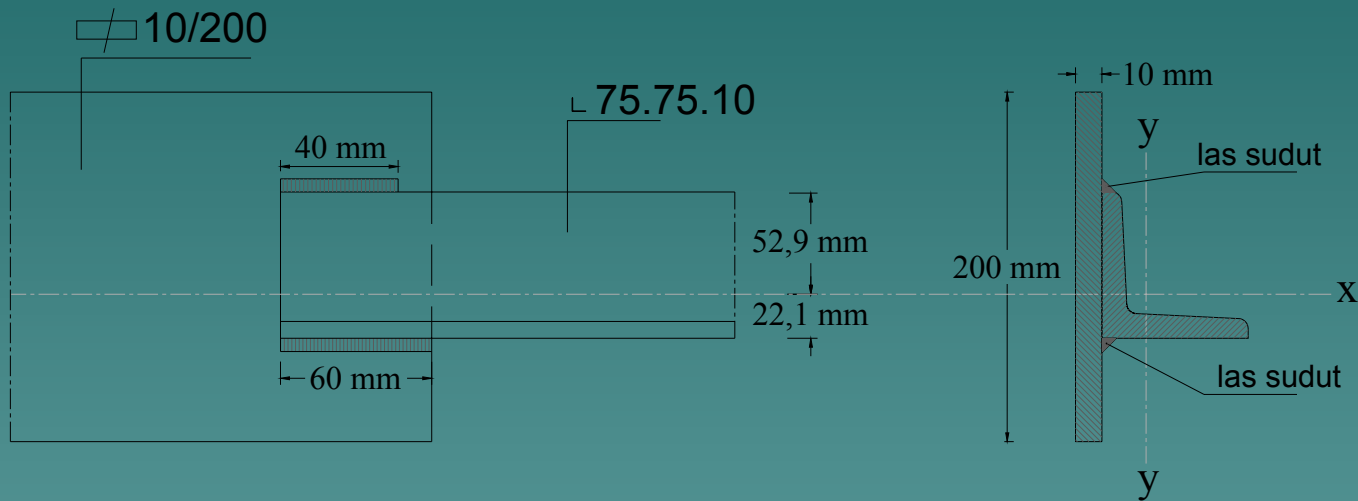
$$l_{2br} = 5,09 \text{ cm} \Rightarrow \text{ambil } 6 \text{ cm}$$

Resume:

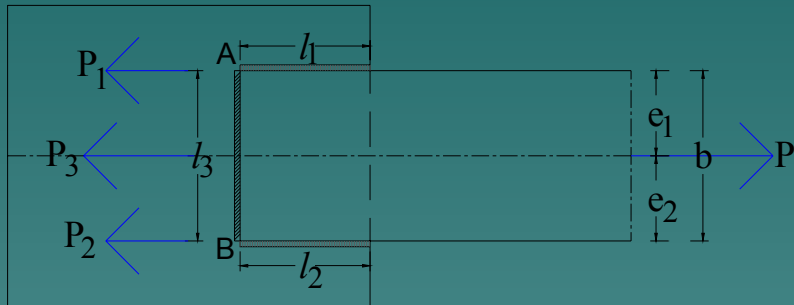
Panjang las atas $l_1 = 4 \text{ cm}$

Panjang las bawah $l_2 = 6 \text{ cm}$

Sket gambar sambungan



✓ Las dipasang pada tiga bagian



$$\Sigma M_A = 0$$

$$P_2(e_1 + e_2) + P_3 \frac{e_1 + e_2}{2} - P \cdot e_1 = 0$$

$$P_2 \cdot b + P_3 \cdot \frac{1}{2} b - P \cdot \frac{1}{2} b = 0$$

$$P_2 = \frac{1}{2} P - \frac{1}{2} P_3$$

$$P_3 = F_{3br} \cdot \bar{\tau}$$

$$P_3 = l_{3n} \cdot a \cdot \bar{\tau}$$

$$l_{3n} = e_1 + e_2 - 3a = b - 3a$$

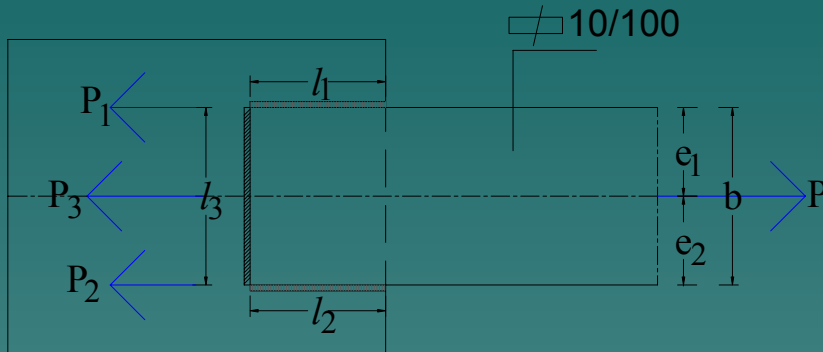
$$\Sigma M_B = 0$$

$$P_1(e_1 + e_2) + P_3 \frac{e_1 + e_2}{2} - P \cdot e_2 = 0$$

$$P_1 \cdot b + P_3 \cdot \frac{1}{2} b - P \cdot \frac{1}{2} b = 0$$

$$P_1 = \frac{1}{2} P - \frac{1}{2} P_3$$

Contoh 5



Diket: Konst spt gbr.
Gaya $P = 10.000$ kg; las
pada tiga muka.

$$\bar{\sigma} = 1400 \text{ kg/cm}^2$$

$$\bar{\tau} = 0,6\bar{\sigma} = 840 \text{ kg/cm}^2$$

Hitung panjang las

Penyelesaian:

$$s = 10 \text{ mm} = 1 \text{ cm};$$

$$a = 0,707s = 0,707 \text{ cm}$$

$$b = 100 \text{ mm} = 10 \text{ cm};$$

$$e_1 = e_2 = \frac{1}{2} b = 5 \text{ cm}$$

Las ujung dipasang sepanjang b

$$l_{3br} = b = 10 \text{ cm}$$

$$l_{3n} = l_{3br} - 3a$$

$$= 10 \text{ cm} - 3 \times 0,707 \text{ cm} = 7,879 \text{ cm}$$

$$P_3 = F_{3gs} \bar{\tau} = l_{3n} \cdot a$$

$$P_3 = 7,879 \text{ cm} \times 0,707 \text{ cm} \times 840 \text{ kg/cm}^2 = 4680 \text{ kg}$$

$$e_1 = e_2 \Rightarrow P_1 = P_2$$

$$\Sigma H = 0$$

$$P_1 + P_2 + P_3 - P = 0$$

$$P_1 + P_2 = P - P_3$$

$$P_1 = \frac{P - P_3}{2}$$

$$P_1 = \frac{(10.000 - 4.680) \text{ kg}}{2} = 2.660 \text{ kg}$$

$$\tau_1 = \frac{P_1}{F_{gs1}} \Rightarrow \text{ambil } \tau_1 = \bar{\tau} = 840 \text{ kg/cm}^2$$

$$F_{gs1} = \frac{P_1}{\bar{\tau}} = \frac{2.660 \text{ kg}}{840 \text{ kg/cm}^2} = 3,167 \text{ cm}^2$$

$$F_{gs1} = a.l_{1n} = 0,707 \text{ cm}.l_{1n}$$

$$3,167 \text{ cm}^2 = 0,707 \text{ cm}.l_{1n}$$

$$l_{1n} = \frac{3,167 \text{ cm}^2}{0,707 \text{ cm}} = 4,479 \text{ cm}$$

$$l_{1br} = l_{1n} + 3a = 4,479 \text{ cm} + (3 \times 0,707 \text{ cm})$$

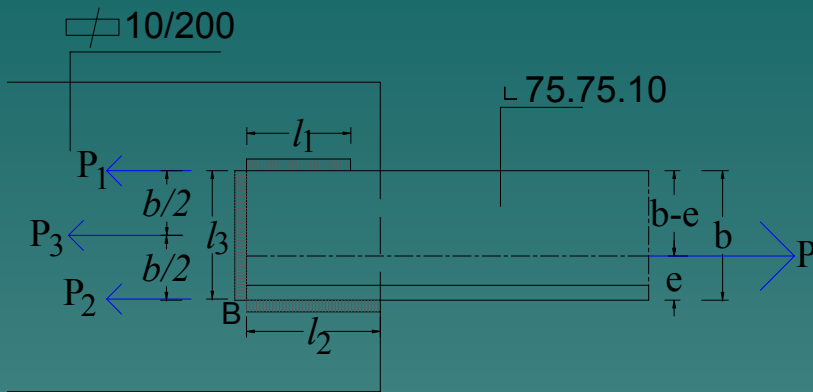
$$l_{1br} = 6,6 \text{ cm} \approx 7 \text{ cm} > l_{\min} = 4 \text{ cm} \Rightarrow \text{ok}$$

Resume:

Panjang las $l_1 = l_2 = 7 \text{ cm}$

Panjang las $l_3 = 10 \text{ cm}$

Contoh 6



Diket: Konst spt gbr.
Gaya $P = 7.500 \text{ kg}$; las
pada tiga muka.

$$\bar{\sigma} = 1400 \text{ kg/cm}^2$$

$$\bar{\tau} = 0,6\bar{\sigma} = 840 \text{ kg/cm}^2$$

Hitung panjang las

Penyelesaian:

Dari tabel profil, utk L 75.75.10 didapat:

$$b = 75 \text{ mm} = 7,5 \text{ cm};$$

$$d = 10 \text{ mm} = 1 \text{ cm}$$

$$e = 2,21 \text{ cm}$$

$$d = 1 \text{ cm} \rightarrow a = 0,707d$$

$$a = 0,707 \times 1 \text{ cm} = 0,707 \text{ cm}$$

$$b - e = 7,5 \text{ cm} - 2,21 \text{ cm} = 5,29 \text{ cm}$$

Panjang las l_{3br} diambil = b

$$l_{3br} = b = 7,5 \text{ cm}$$

$$l_{3n} = l_{3br} - 3a$$

$$= 7,5 \text{ cm} - 3 \times 0,707 \text{ cm} = 5,379 \text{ cm}$$

$$\tau_3 = \frac{P_3}{F_{3n}} \Rightarrow \text{ambil } \tau_3 = \bar{\tau} = 840 \text{ kg/cm}^2$$

$$P_3 = F_{3n} \bar{\tau}_3 = a \cdot l_{1n} \bar{\tau}_3$$

$$P_3 = 5,379 \text{ cm} \times 0,707 \text{ cm} \times 840 \text{ kg/cm}^2$$
$$= 3.195 \text{ kg}$$

$$\Sigma M_B = 0$$

$$P_1 \cdot b + P_3 \cdot \frac{1}{2}b - P \cdot e = 0$$

$$P_1 = \frac{P \cdot e - P_3 \cdot \frac{1}{2}b}{b}$$

$$= \frac{7500 \text{ kg} \times 2,21 \text{ cm} - 3195 \text{ kg} \times \frac{1}{2} \times 7,5 \text{ cm}}{7,5 \text{ cm}}$$

$$= \frac{15.575 - 11.981,25 \text{ kgcm}}{7,5 \text{ cm}} = 612,5 \text{ kg}$$

$$\Sigma H = 0$$

$$P_1 + P_2 + P_3 - P = 0$$

$$P_2 = P - P_1 - P_3$$

$$P_2 = 7.500 \text{ kg} - 3.195 \text{ kg} - 612,5 \text{ kg} = 3.692,5 \text{ kg}$$

$$\tau_1 = \frac{P_1}{F_{gs1}} \Rightarrow \text{ambil } \tau_1 = \bar{\tau} = 840 \text{ kg/cm}^2$$

$$F_{gs1} = \frac{P_1}{\bar{\tau}} = \frac{612,5 \text{ kg}}{840 \text{ kg/cm}^2} = 0,729 \text{ cm}^2$$

$$F_{gs1} = a \cdot l_{1n} = 0,707 \text{ cm} \cdot l_{1n}$$

$$0,729 \text{ cm}^2 = 0,707 \text{ cm} \cdot l_{1n}$$

$$l_{1n} = \frac{0,729 \text{ cm}^2}{0,707 \text{ cm}} = 1,031 \text{ cm}$$

$$l_{1br} = l_{1n} + 3a = 1,031 \text{ cm} + (3 \times 0,707 \text{ cm})$$

$$l_{1br} = 3,152 \text{ cm} < l_{\min} = 4 \text{ cm} \Rightarrow \text{ambil } l_{1br} = 4 \text{ cm}$$

$$\tau_2 = \frac{P_2}{F_{gs2}} \Rightarrow \text{ambil } \tau_2 = \bar{\tau} = 840 \text{ kg/cm}^2$$

$$F_{gs2} = \frac{P_2}{\bar{\tau}} = \frac{3.692,5 \text{ kg}}{840 \text{ kg/cm}^2} = 4,396 \text{ cm}^2$$

$$F_{gs2} = a.l_{2n} = 0,707 \text{ cm}.l_{2n}$$

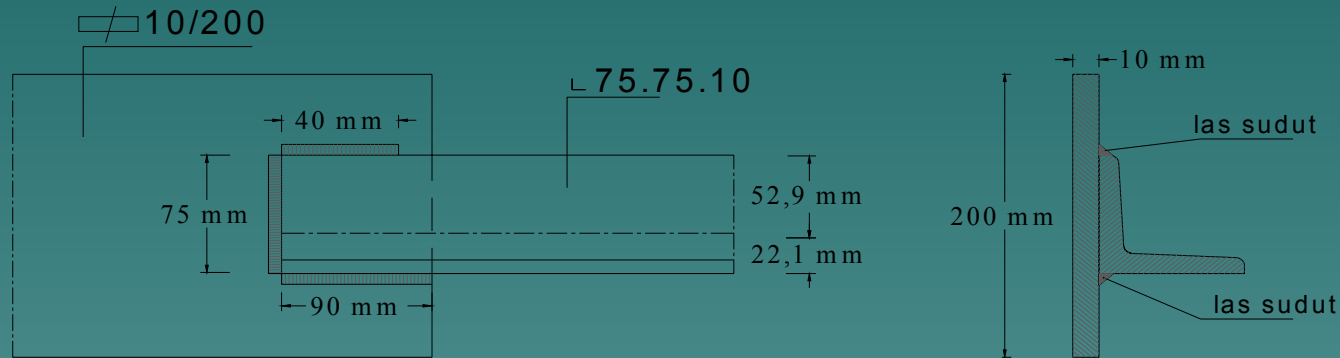
$$4,396 \text{ cm}^2 = 0,707 \text{ cm}.l_{2n}$$

$$l_{2n} = \frac{4,396 \text{ cm}^2}{0,707 \text{ cm}} = 6,218 \text{ cm}$$

$$l_{2br} = l_{2n} + 3a = 6,218 \text{ cm} + (3 \times 0,707 \text{ cm})$$

$$l_{1br} = 8,339 \text{ cm} \approx 9 \text{ cm}$$

Sket gambar sambungan



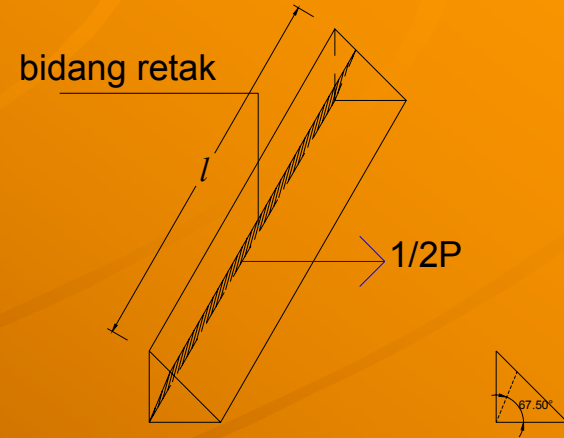
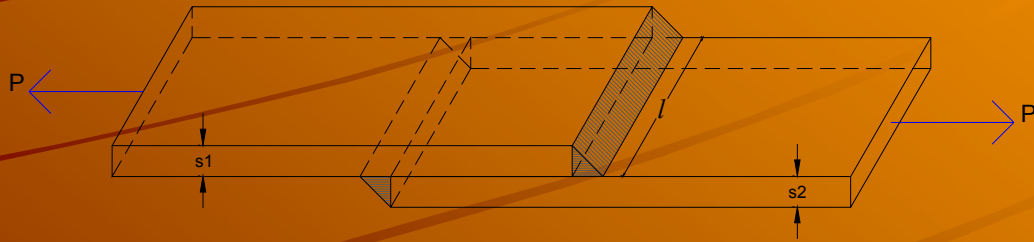
Resume:

Panjang las $l_1 = 4 \text{ cm}$

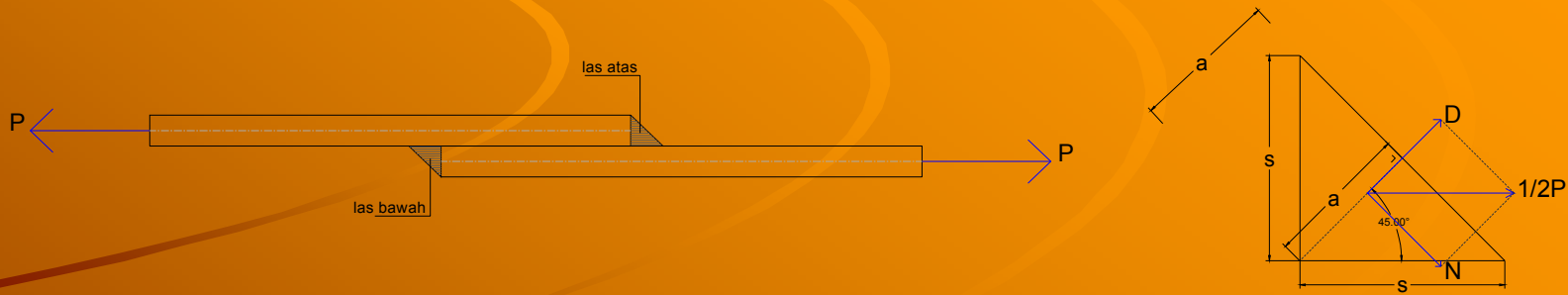
$l_2 = 9 \text{ cm}$

$l_3 = 7,5 \text{ cm}$

- Arah gaya $P \perp$ las



Bidang retak utk las sudut yang dibebani gaya P dengan arah \perp las, akan membentuk sudut $67\frac{1}{2}^\circ$ dengan kaki las. Untuk mempermudah dalam perhitungan, diambil sudut 45°



Gaya $P \perp$ las, akan ditahan oleh las sudut atas dan bawah sebesar P_1 dan P_2 .

Untuk $s_1 = s_2$, maka $P_1 = P_2 = \frac{1}{2}P$.

Gaya $P/2$ bekerja pada titik berat bidang retak \rightarrow
 $\frac{1}{2} P // P$.

Gaya geser $D = \frac{1}{2}P \sin 45^\circ$

Gaya normal $N = \frac{1}{2}P \sin 45^\circ$

$D = N$

$$\tau = \frac{D}{F_{gs}} \leq \bar{\tau} \Rightarrow \bar{\tau} = 0,6 \bar{\sigma}$$

$$\sigma = \frac{N}{F_{tr}} \leq \bar{\sigma}$$

$$\sigma_i = \sqrt{\sigma^2 + 3\tau} \leq \bar{\sigma}$$

F_{gs} = luas bidang geser = luas bidang retak

$$F_{gs} = a \cdot l_n$$

Dimana:

$$a = \text{tebal las} = s \sin 45^\circ = 0,707s$$

s = tebal plat yang disambung

l_n = panjang las neto

$$l_n = l_{br} - 3a$$

l_{br} = panjang las bruto

F_{tr} = luas bidang tarik = luas bidang retak



Untuk $s_1 \neq s_2$ (tebal plat tidak sama)

$$P_1 = \frac{s_1}{s_1 + s_2} \cdot P \Rightarrow P_2 = P - P_1$$

$$\tau_1 = \frac{P_1}{F_{gs1}} \leq \bar{\tau}$$

$$F_{gs1} = l_{1n} \cdot a_1$$

$$l_{1n} = l_{1br} - 3a_1 \Rightarrow a_1 = 0,707s_1$$

$$\tau_2 = \frac{P_2}{F_{gs2}} \leq \bar{\tau}$$

$$F_{gs2} = l_{2n} \cdot a_2$$

$$l_{2n} = l_{2br} - 3a_2 \Rightarrow a_2 = 0,707s_2$$




$$\sigma_1 = \frac{P_1}{F_{tr1}} \leq \bar{\sigma}$$

$$F_{tr1} = l_{1n} \cdot a_1$$

$$\sigma_2 = \frac{P_2}{F_{tr2}} \leq \bar{\sigma}$$

$$F_{tr2} = l_{2n} \cdot a_2$$


$$\sigma_{i1} = \sqrt{\sigma_1^2 + 3\tau_1^2}$$

$$\sigma_{i2} = \sqrt{\sigma_2^2 + 3\tau_2^2}$$

Contoh 7



Diket: Konst spt gbr.
Gaya $P = 5000 \text{ kg}$;
Las sudut selebar plat.

$$\bar{\sigma} = 1400 \text{ kg/cm}^2$$

$$\bar{\tau} = 0,6\bar{\sigma} = 840 \text{ kg/cm}^2$$

Kontrol kekuatan las

Penyelesaian:

Tebal plat tidak sama

$$s_1 = 8 \text{ mm} = 0,8 \text{ cm} \rightarrow a_1 = 0,707 \times 0,8 = 0,566 \text{ cm}$$

$$s_2 = 10 \text{ mm} = 1 \text{ cm} \rightarrow a_2 = 0,707 \times 1 = 0,707 \text{ cm}$$

$$b = 100 \text{ mm} = 10 \text{ cm} \rightarrow l_{1br} = l_{2br} = b = 10 \text{ cm}$$

$$l_{1n} = l_{1br} - 3a_1 = 10 - 3 \times 0,566 = 8,302 \text{ cm}$$

$$l_{2n} = l_{2br} - 3a_2 = 10 - 3 \times 0,707 = 7,879 \text{ cm}$$

$$P_1 = \frac{s_1}{s_1 + s_2} \cdot P = \frac{0,8cm}{0,8cm + 1cm} \times 5.000 kg = 2.222 kg$$

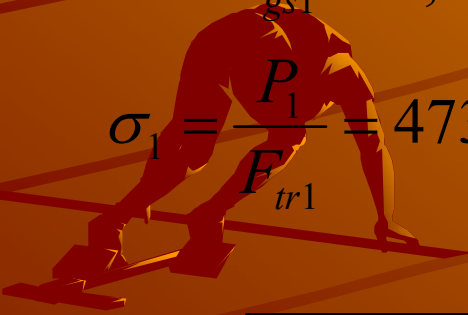
$$\Sigma H = 0 \Rightarrow P_2 = P - P_1 = 5.000 kg - 2.222 kg = 2778 kg$$

Las atas

$$\tau_1 = \frac{P_1}{F_{gs1}} = \frac{2.222kg}{8,302 \times 0,566cm^2} = 473 kg/cm^2 \leq \bar{\tau}$$

$$\sigma_1 = \frac{P_1}{F_{tr1}} = 473 kg/cm^2$$

$$\sigma_i = \sqrt{\sigma_1^2 + 3\tau_1^2} = \sqrt{473^2 + 3(473)^2} = 946 kg/cm^2 < \bar{\sigma}$$



Las bawah

$$\tau_2 = \frac{P_2}{F_{gs2}} = \frac{2.778 \text{ kg}}{7,879 \times 0,707 \text{ cm}^2} = 499 \text{ kg/cm}^2 \leq \bar{\tau}$$

$$\sigma_2 = \frac{P_2}{F_{tr2}} = 499 \text{ kg/cm}^2$$

$$\sigma_i = \sqrt{\sigma_2^2 + 3\tau_2^2} = \sqrt{499^2 + 3(499)^2} = 998 \text{ kg/cm}^2 < \bar{\sigma}$$

Jadi las cukup kuat