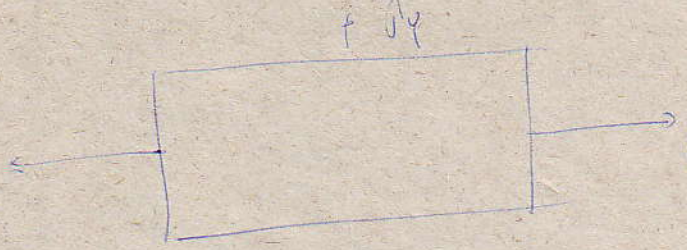
Kuliah Senin

Soal ujian → kalau mengkerut (memendek) → negatif → jika memanjang → positif



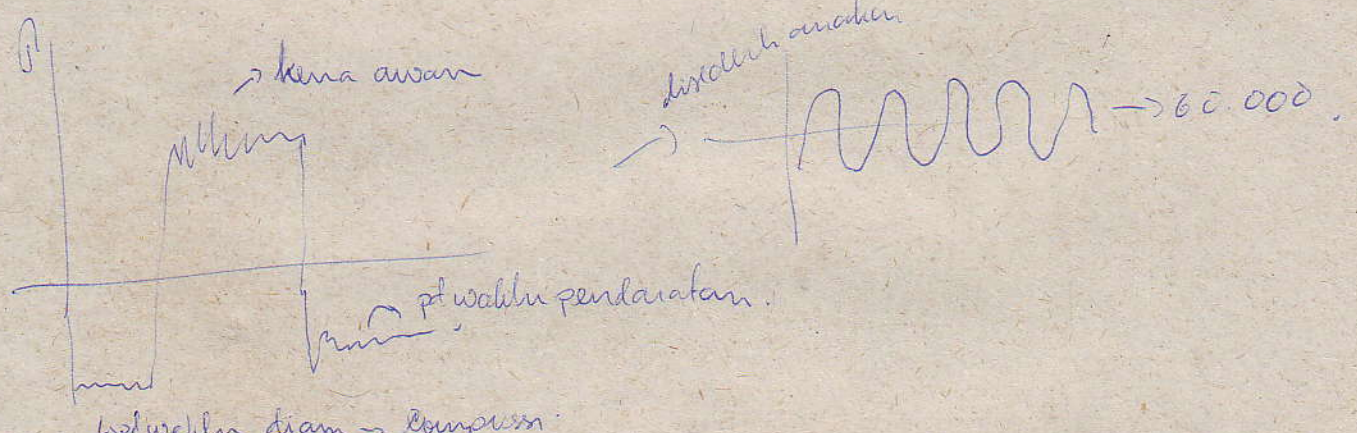
$\varepsilon_x > 0 \rightarrow \sigma_x > 0$

$\varepsilon_y > 0 \rightarrow \sigma_y > 0$.

$\varepsilon_x > 0$, $\varepsilon_y < 0$ →
- $\sigma_x > 0$, $\sigma_y = 0$
- $\sigma_x > 0$, $\sigma_y < 0$
- $\sigma_x > 0$, $\sigma_y > 0$

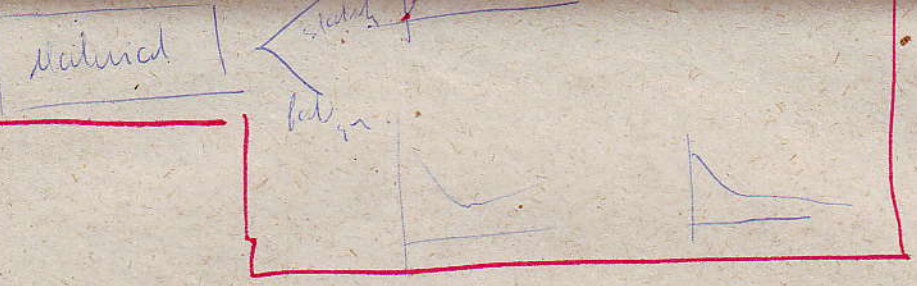
load | stability | fail.

- stabil akan musnah bila diberi beban → bentuk semula tergantung pd pembebanan.
- Diagram layar pd slim sayap CN: → diuraikan utk 60.000 kali.



- Beban statik harus dibandingkan dg statik fail
- " fatigue " " " " fatigue "
- fatigue biasanya lebih berbahaya daripada statik.

iv material



→ $\sigma = \frac{W}{A}$ → dibandingkan dg σ_y atau S_y (?)

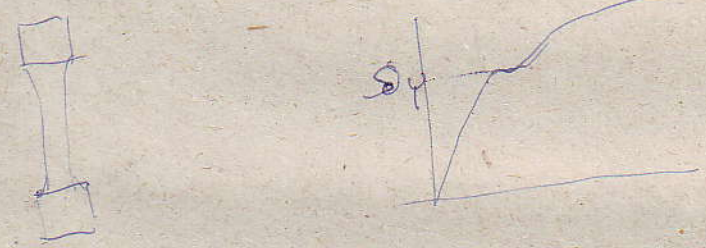
" " σ_{ult} atau S_u (?)

W

* Brittle → bila $\varepsilon < 5\%$ }

TEORI OF FAILLIRE.

1. Max - normal stress teori (Tegangan normal) → utk material yg getas.
2. Max - geser stress teori (" geser) } utk material yg liat.
3. Distorsi Energi Teori (Energi distorsi) —



* Material bila ditarik melebihi σ_y → akan gagal

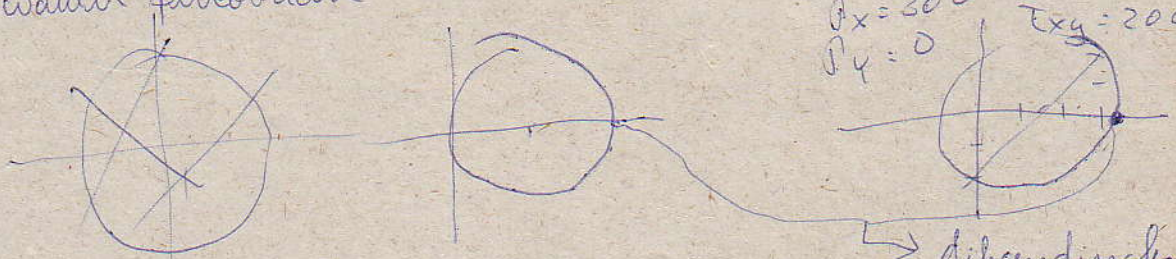
Uni aksial.

* Uni aksial jarang terjadi pd kenyataan, biasanya minimal bi aksial → maka kita menggunakan lingkaran Mohr.

{ + Maximum Normal Stress Teori → berlaku utk material BRITTLE
(Coulomb Teori / Mohr Teori)
+ Material dianggap failure bila tegangan normal max pd material tsb sama dengan tegangan normal material tsb waktu dilakukan percobaan.

Misal:

Pd waktu percobaan



material yg diuji
$\sigma_x = 300$
$\sigma_y = 0$
$\tau_{xy} = 200$

→ dibandingkan

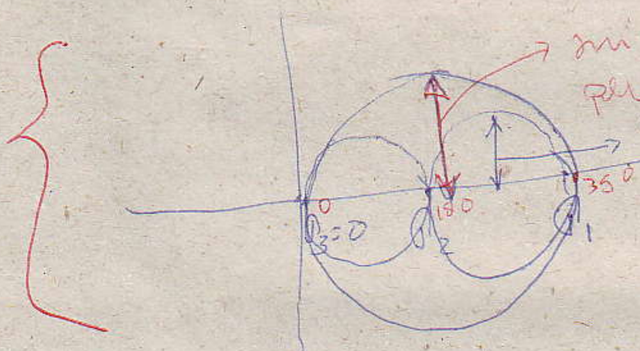
Max shear stress Teori → utk material yg liat (Tresca Teori)

* Bila suatu benda ditarik beban, yg dibandingkan adalah max shear stress
* Alasan → Pd waktu benda yg liat ditarik, maka akan gagal pd sudut 45°.

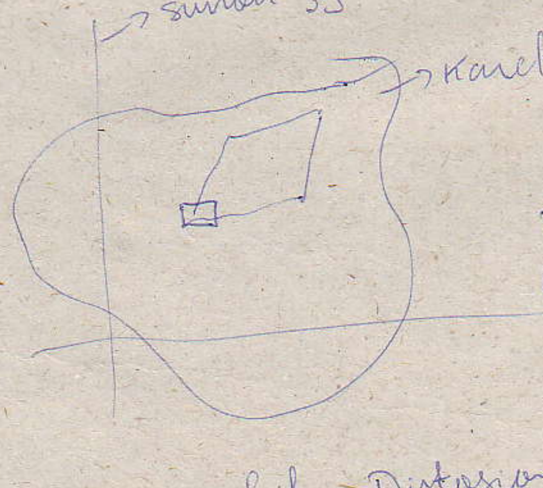
* utk lingkaran Mohr, maka sebetulnya ada σ_z yg = 0.
jadi sebetulnya pd kasus diatas

$\sigma_x = 390$
$\sigma_y = 180$
$\tau_{xy} = 0$
$\sigma_z = 0$

Maka lingkaran Mohrnya.



Distorsi Energi Theori (~~Hu~~ Mises Teori / ~~Huber Hencky~~ Hencky).
→ utk liat juga.
* Bayangkan selembar karet.



→ jika ditarik, akan berubah bentuk dan ukuran.

Bentuk berubah → Distorsion.
ukuran " → dilation.

Kita bisa menghitung Distorsion Energi
Misal: → F × δ = work, besa → disimpan dalam per berupa strain Energi → termasuk energi

Contoh: 3. Baca hal 166.

1. Komponen

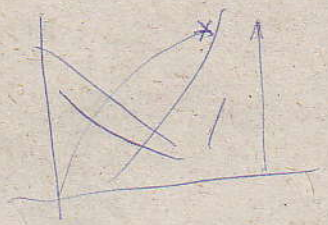
σ_x : - - -

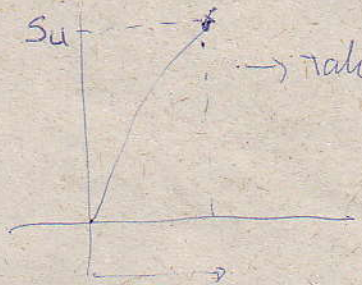
σ_y : - - -

τ_{xy} : - - -

Besi tuang (getas)

Data material.





→ tak punya yield.

Perlubisa pakai dengan yg lebar, dg memperhitungkan $\sigma_2 = 0$

dikenal lingkaran → didapat σ_1, σ_2, σ_3

$|\sigma_1| > S_u$ → Tidak

$|\sigma_2| > S_u$ S_y, kalau bahan getas tak ada yieldnya

$|\sigma_3| > S_u$ ↳ akan failure.

$\sigma_2 = 0$

→ harus ada minimal dua (σ_1 dan σ_2) tegangan utama dg lingkaran mohr

dueliliby → < 5%

Soal lain.

Komponen

σ_x

σ_y

τ_{xy} : - -

Material : Aluminium.

Data material.

lingkaran mohr

σ_1, σ_2, σ_3

$\left|\frac{\sigma_1 - \sigma_2}{2}\right| > \frac{S_y}{2}$

$\left|\frac{\sigma_1 - \sigma_3}{2}\right| > \frac{S_y}{2}$

$\left|\frac{\sigma_2 - \sigma_3}{2}\right| > \frac{S_y}{2}$

→ strenght yield

} failure.

Bila diturunkan

$$S_y < \sqrt{\sigma_x^2 + 4\tau_{xy}^2}$$

↓

jadi kalau < → benar di Tresca.

Soal lain.

Komponen

σ_x

σ_y

τ_{xy}

Material Aluminum.

$$\sigma_{1,2} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$$

$$\tau_{maks} = \frac{\sigma_1 - \sigma_2}{2}$$

$$S_y^2 < \sigma_x^2 + 4\tau_{xy}^2$$

$$S_y^2 < \sigma_x^2 + 3\tau_{xy}^2$$

Jawab:

$$U_d = \frac{1+\nu}{3}\left\{\sigma_1^2 + \sigma_2^2 + \sigma_3^2 - \sigma_1\sigma_2 - \sigma_1\sigma_3 - \sigma_2\sigma_3\right\}$$

↳ Energi distorsi (⊗ Energi dalam → dlm termodinamika)

$$U_{d.t} = \frac{1+\nu}{3}\left\{S_y^2\right\}$$

$$S = \sqrt{\sigma_1^2 + \sigma_2^2 - \sigma_1\sigma_2}$$

Utk Distorsi Energi

$$FS = \frac{S_{material}}{S}$$

Load → Material < getas / liat <

↓ stimulan

↓ stresses

↓ failure Teori

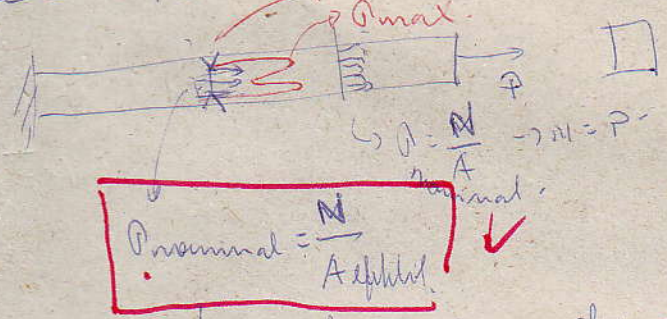
$\sigma < \frac{S}{FS}$

↳ aman.

FS → Faktor of Safety → tujuannya utk menutupi kesalahan : yg kita perbuat.

↳ Bila tidak linear perhitungannya → FS dikalikan dg load.

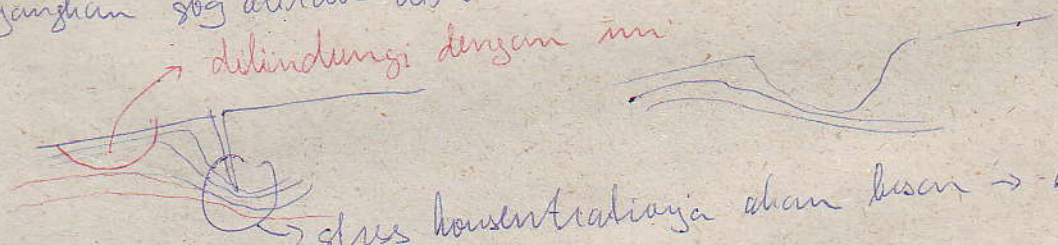
Local Efek. → Stress Concentration Faktor $(K_t) = \frac{\sigma_{max}}{\sigma_{nominal}}$



↳ nilai harga nominalnya → tegasa ini salah.

Teori Aliran

Bayangkan sbg aliran air → dilindungi dengan ini

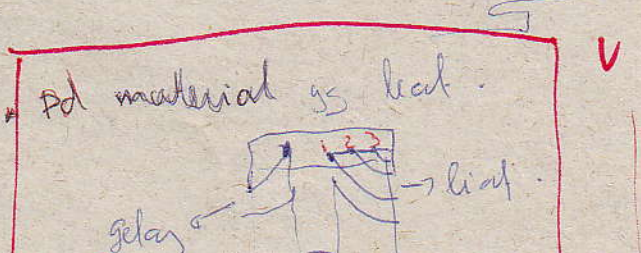


↳ stress konsentrasinya akan kecil → dapat dilihat dg streamline yg rapat.

Misal dlm penggunaan → bolt beam

↳ K_t nya kecil dan Bolt Beam dapat menolak.

Pd material yg liat.



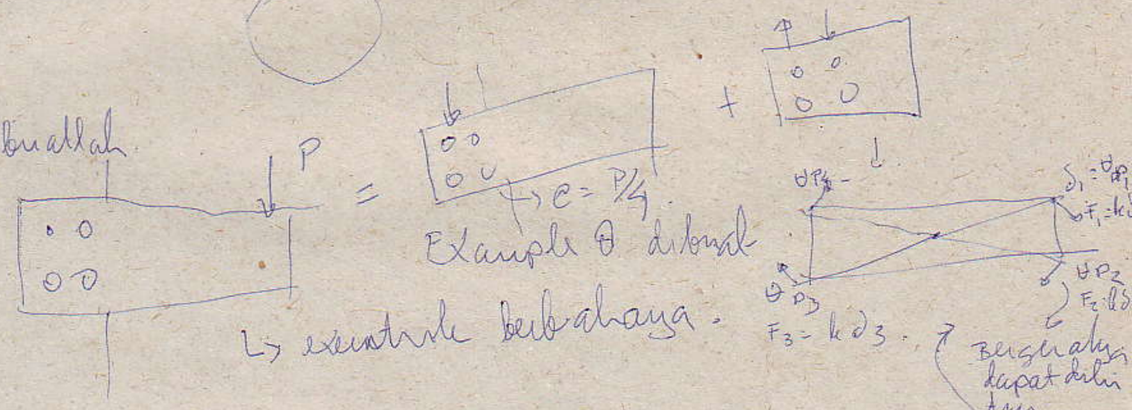
* Untuk bahan yg liat, perhitungan Kt tak usah diikutkan, sedang bahan getas harus dicantumkan.

* Skema yg baik. slah

→ Paku keling (RIVET). PR: 21, 22, 23

* Kuliah Tertinggal. (Pengambilan benda dan terangkan.
* Baca selinder yg tipis. → Rumusnya hafalkan.

* Example 6 buatlah
* section 16



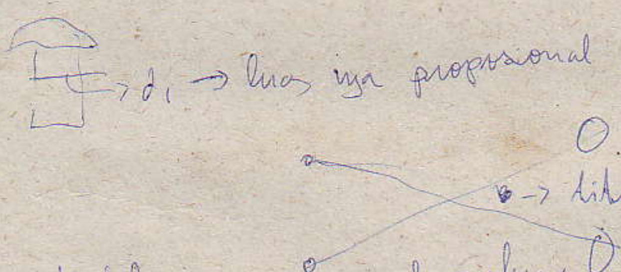
Example 8 dibuat

↳ exentrik berbahaya. $F_3 = k\delta_3$. Berguna dapat dilihat...

* Bayangkan → batangnya kaku dan pakunya spt per

↳ $M_t = F_1 P_1 + \ldots$ = M yg diakibatkan beban.

* Bagaimana bila paku tak sama.



→ δ_1 → luasnya proporsional dg stiffnessnya (k).

O. → titik berat bergeser ke kanan

Gayanya adalah teg geser pd paku.

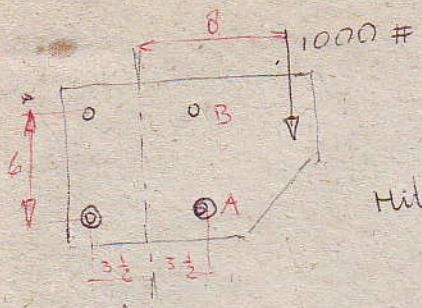
$F_4 = \theta \cdot k_4 P_4$

↳ θ didapat dari $M_t = F_1 P_1$

didapat $F_4 \rightarrow \tau_4 = \frac{F_4}{luas}$.

PR = no 30

KULIAH

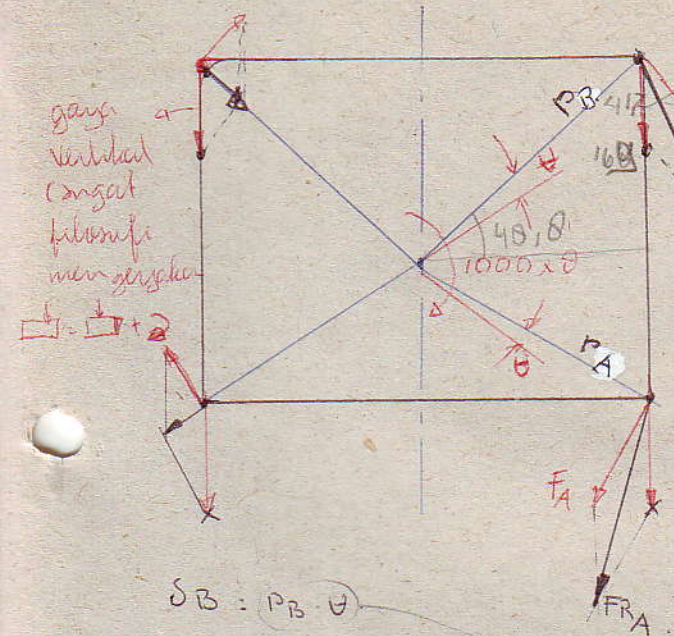


O = 7/8" dia
o = 5/8" dia

Hitunglah nilai dari tegangan geser pd pusat dari keling A dan B

jawab:
Penampang lebih besar, maka stifnes lebih kaku. (kekakuan sebanding dengan luas penampang.

Luas Rivet A → $\left(\frac{\pi}{4}\right)\left(\frac{49}{64}\right)(2)$
" B → $\left(\frac{\pi}{4}\right)\left(\frac{25}{64}\right)(2)$
$\left(\frac{\pi}{4}\right)\left(\frac{74}{64}\right)(2)$ +



Besar gaya B → $\frac{\left(\frac{\pi}{4}\right)\left(\frac{25}{64}\right)\Phi}{\left(\frac{\pi}{4}\right)\left(\frac{74}{64}\right)(2)} \times 1000 = \frac{25}{148} \times 1000$

— " — A → $\frac{\left(\frac{\pi}{4}\right)\left(\frac{49}{64}\right)}{\left(\frac{\pi}{4}\right)\left(\frac{74}{64}\right)(2)} \times 1000 = \frac{49}{148} \times 1000$

$F = \sqrt{(353,81)^2 + (169)^2 + 2 \cdot (353,81)(169) \cos 48,8}$
$= 482,87$

$\delta_B = P_B \cdot \theta$

$\delta_A = P_A \cdot \theta$

$F_B = K_B \cdot \delta_B = e \cdot \frac{\pi}{4} \cdot \frac{25}{64} \cdot \delta_B$

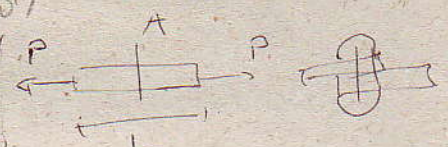
$F_A = K_A \cdot \delta_A = e \cdot \frac{\pi}{4} \cdot \frac{49}{64} \cdot \delta_A$

→ bukan F_{RB} → karena gaya yg terlibat hanya saling meniadakan.

$1000 \cdot 8 = (P_B \cdot F_B + P_A F_A) \times 2$

$= (P_B^2 \cdot e \cdot \theta \frac{\pi}{4} \cdot \frac{25}{64} + P_A^2 \cdot e \cdot \theta \frac{\pi}{4} \cdot \frac{49}{64})\ 2$

$= 2e \cdot \theta \left(P_B^2 \cdot \frac{\pi}{4} \cdot \frac{25}{64} + P_A^2 \cdot \frac{\pi}{4} \cdot \frac{49}{64}\right)$ → didapat e.



$\sigma = E \cdot \varepsilon$

$\frac{P}{A} = E \cdot \frac{\delta}{L}$

$P = A \left[\frac{E}{L}\right] \delta$

$\tau = G \gamma$

$\tau_B = \frac{F_B}{\frac{\pi}{4} \cdot \frac{25}{64}} = \frac{e\theta \cdot P_B \cdot \frac{\pi}{4} \cdot \frac{25}{64}}{\frac{\pi}{4} \cdot \frac{25}{64}} = (e\theta) P_B = 1153,2$

$F_B = 353,8$

$\tau_B = \frac{\text{resultan gaya}}{\text{luas}}$

$= 1571,68$ lb

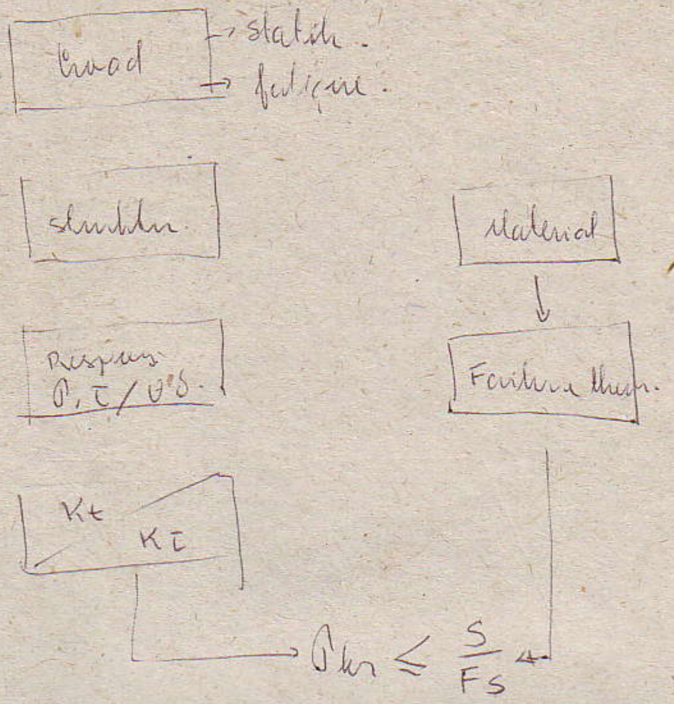
$\tau_A = (e\theta) P_A = 876,85$

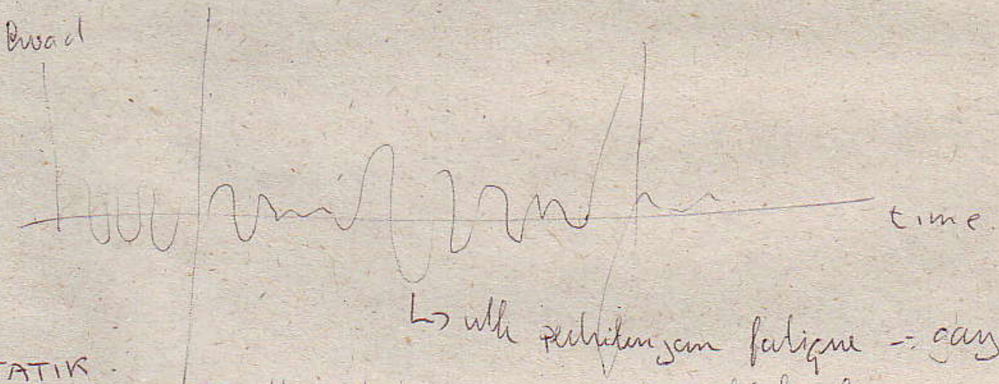
$F_A = 527,27$

Jadi ada 3 persamaan.

- $\Sigma F_y = 0$
- Hubungan δ dg θ.
- Hubungan gaya x δ = Momen.

Hal Baru ✓





↳ utk perhitungan fatique → gayanya lebih kecil.

STATIK

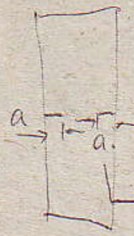
↳ utk perhitungan statik → lebih besar gayanya

→ stress consentration Faktor.

K_t = 1 bila kuat (jadi tidak berpengaruh)

= K_t bila getas.

↳ menimbulkan stress konsentration. ✓



K_I (stress intensity Faktor = $\sigma = \sqrt{\pi \cdot a}$. ✓

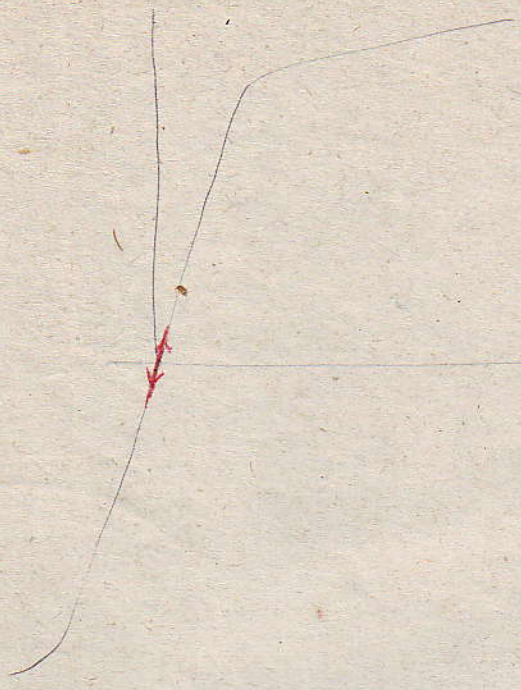
↳ krak

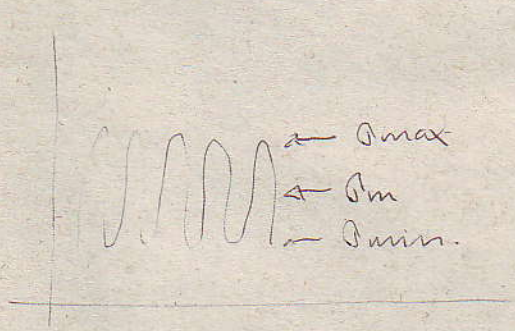
* K_I nanti akan dibandingkan dg K_{Ic}. ✓

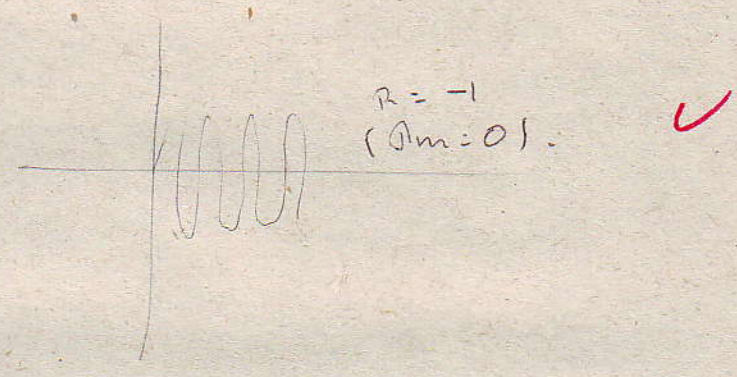
Diatas itu beban statik

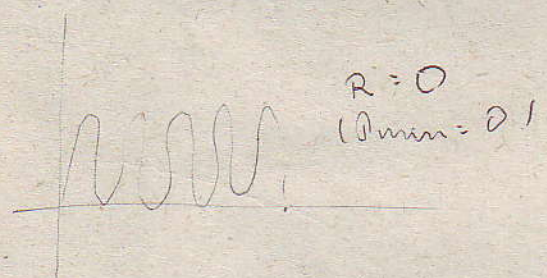
Fatique ✓

* K_{Ic} logam yang getas sangat kecil.
* Fatique : lelah.









σ (N/mm²)

At.

Tensile strength.
ultimate "

low c f → sudah plastik.
high c f → bisa plastik.

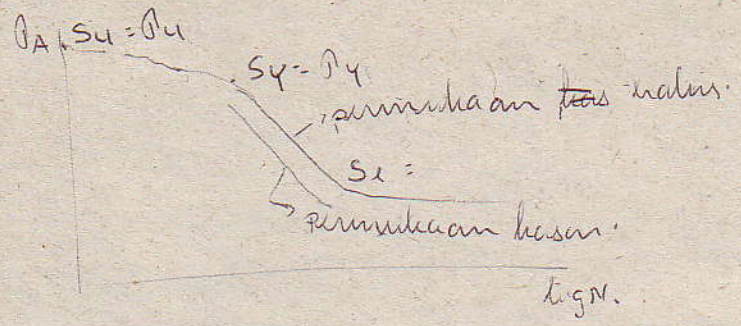
endurance.

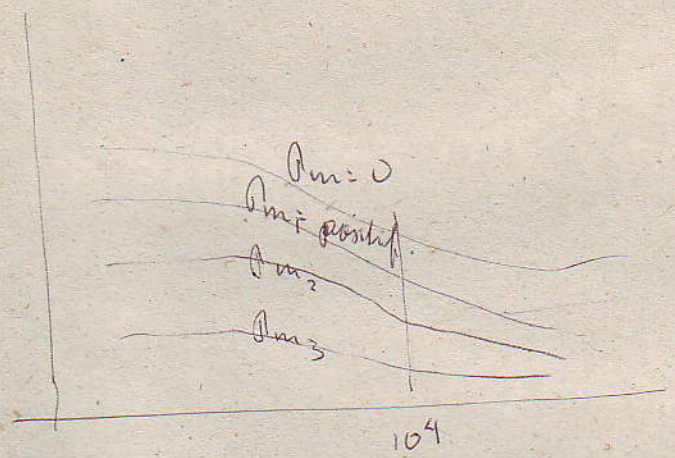
fatigue limit / endurance limit.
↳ ± 1/3 σ_{ult}

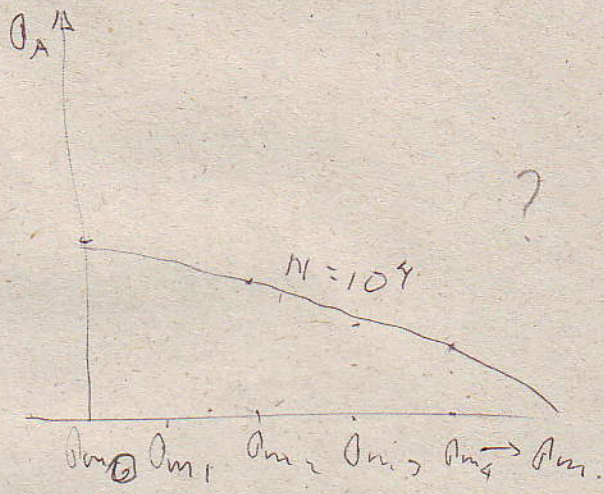
low cycle fatigue ← → high cycle fatigue
10^3

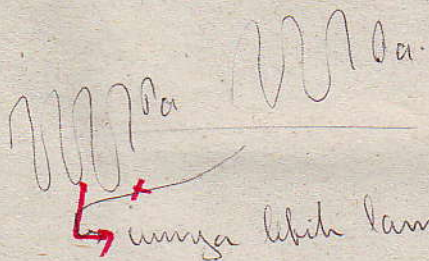
susah lihat.

- yg berpengaruh pd fatigue:
  1. kekasaran permukaan → makin kasar → umur makin pendek.

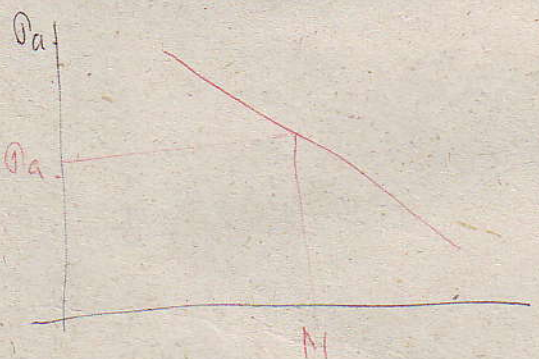








?



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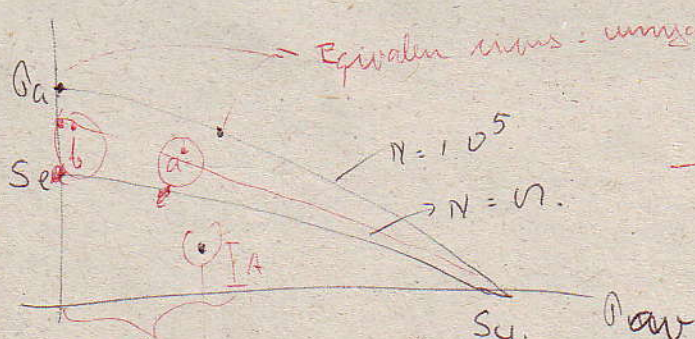


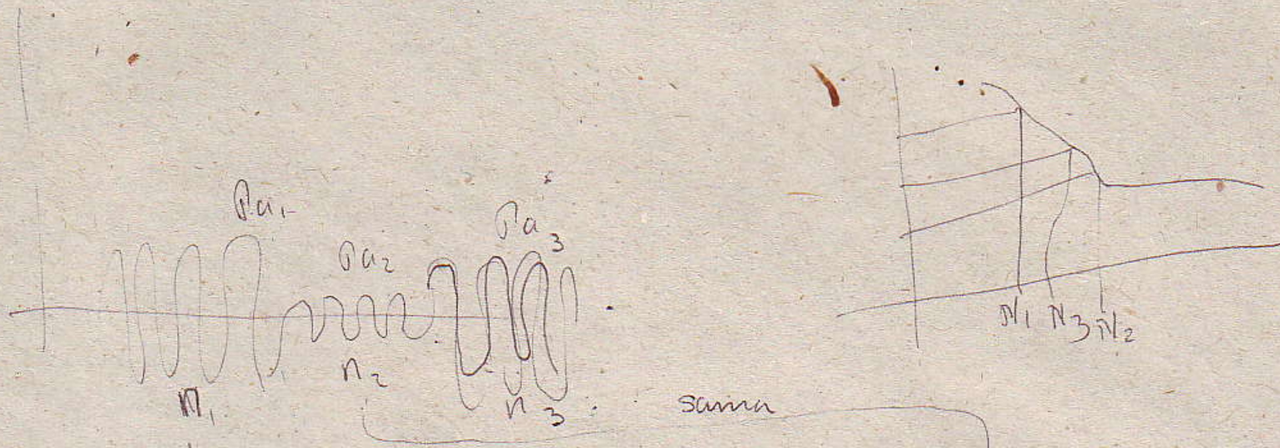
→ Equivalen stress : umur sama.

→ utk titik a punya umur sama dg b, maka kita tahu σ_a dg diagram di atas kita tahu umur

σ_{aw} → Dg amplitudo A dan σ_{mean} ? : σ_m → umur infinite → kurva

~~dan A~~ titik di bawah $N = \infty$.

* Bagaimana menggambarnya.



↓

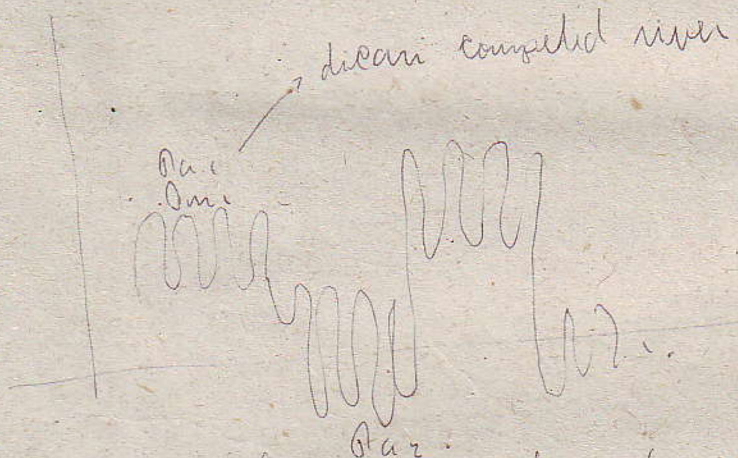
Kalau kaya dg ini, ia akan mencapai $\frac{n_1}{N_1} + \frac{n_2}{N_2} + \frac{n_3}{N_3} = 1$ → akan kecil.

↗ Palmgren – Miner.

tapi rumusnya tak 1, tapi bisa 1,9, paling kecil 0,3

* Bagaimana kalau kacaupembebanannya : → ~~ty tib~~
jawab: Dilihat, berapa N_1, N_2 dll.

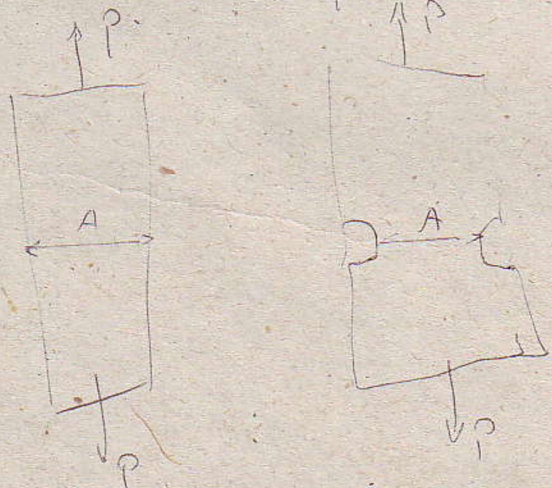
* Bagaimana kalau .



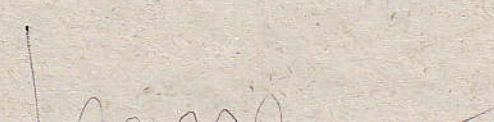
→ jika ada consentrasi, maka Sa 1 dikalikan Kf, sedang Sm tak dikalikan.

* Bagaimana kalau fatigue dan ada consentrasi.

* ~~PBR~~.



Kt → tergantung pd bentuk
↓
Kf ≤ 2 → " " " dan material.
↳ ~~K~~ Konsentrasi fatigue faktor.



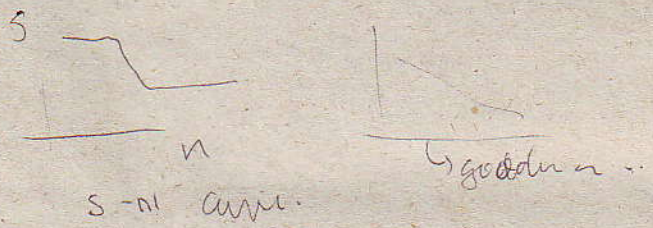
✓

- jadi pd fatigue yg berpengaruh adalah amplitudenya (σ_a).

↳ utk yg tiat → utk yg statis. σ_m juga dikalikan dg K.

DR.
- buat example 7A.
- chapter 2 : 10 dan 12 dan 45

- Pd fatigue data material.



$\Sigma \frac{n}{N} = 1$

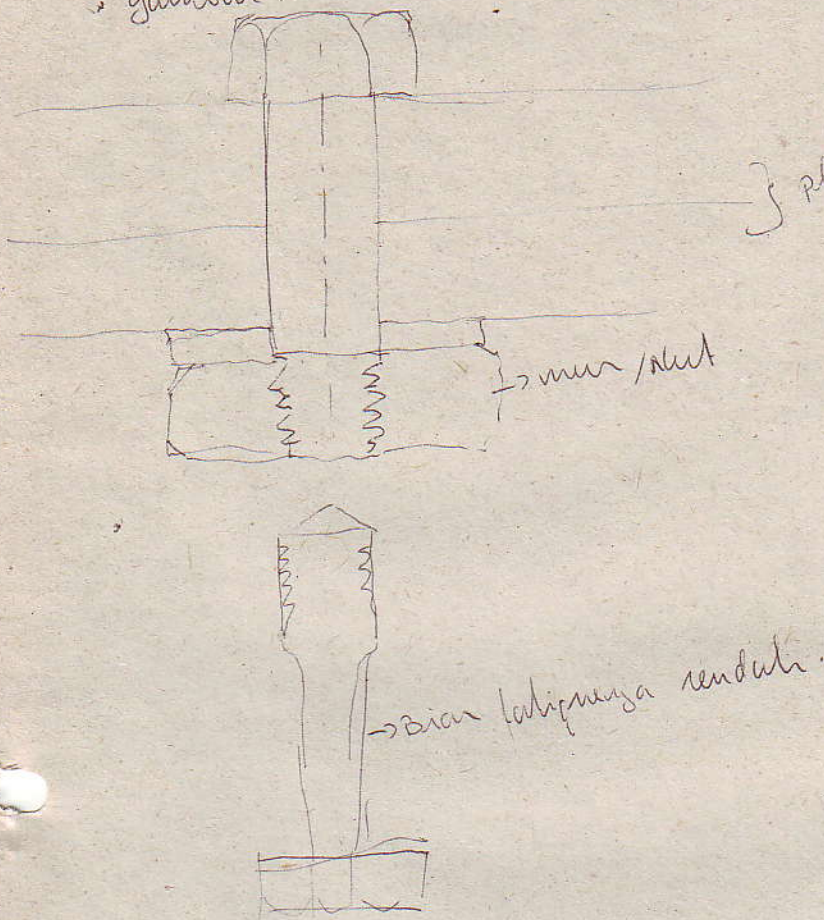
S-N curve.

- dinyatakan dgn → Sant.

- Endurance limit stress σ adalah merupakan harga tegangan yg terlinggi dimana material tak akan fail / gagal, walo utk banyak kalikan manapun (biasanya 10 juta kalikan).

SCREWS

* Prinsip . menyambungnya → memakai → sama. dg keling
* gambar :



BAB I 1 4 9 12 23 28 31 41 51
58 89 98 102 103 106 112 113
115 118 119.

BAB II 1, 3, 5, 10, 12, 21, 22, 23

BAB III —

BAB IV —

BAB V (SKRUP) 5. 24.

BAB VI —

BAB VII (KELING) — Contoh 7 (340), 8, 8A

d. $F_{p_{min}} = \frac{K_P}{K_b + K_P} P_{max} - 2500$

$= \frac{0,1}{0,696} 2400 - 2500$

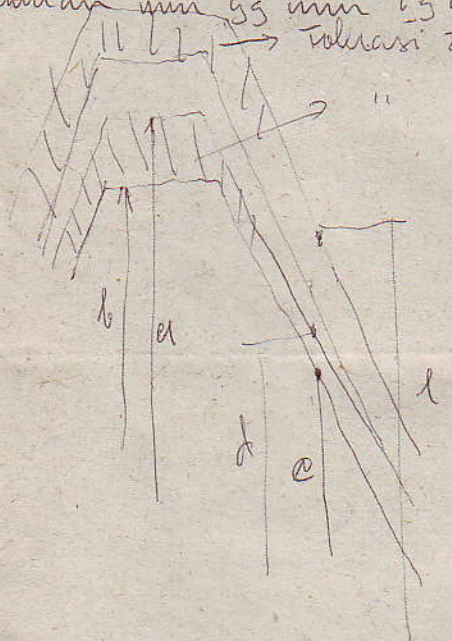
$= -776$ lb.

5.24. Insya Allah → yang ditanya saja.

* Perbedaan allowance dg Toleransi

Jawab

- Daerah toleransi dari shaft adalah daerah antara ukuran shaft max dg ukuran shaft min yang diizinkan.
- Daerah toleransi dari mur adalah daerah antara ukuran mur yg max dg ukuran mur yg min yg diizinkan.



→ toleransi zone utk mur.

" " utk baut.

a = max diameter utama utk shaft

b = min " " " "

c = min diameter pitch utk shaft

d = max " " " "

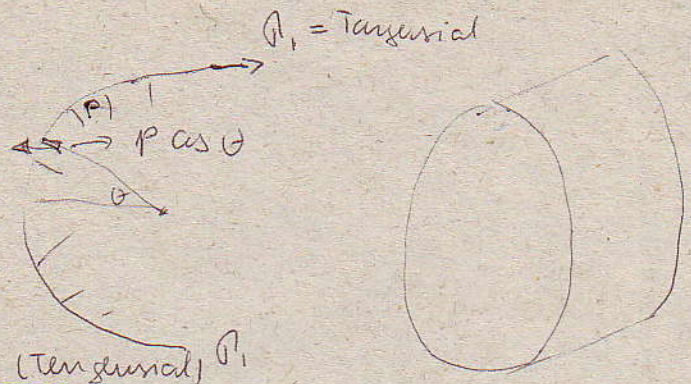
t = max " " " mur.

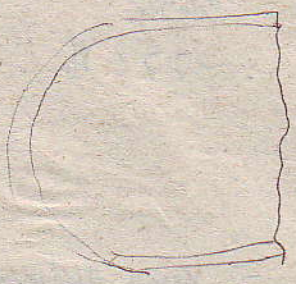
- Syarat mutlak max berada pd "diameter pitch" shaft terbesar dan mur dari diameter pitch yg terkecil yg diizinkan utk daerah toleransi.

* Allowance → daerah khusus antara diameter pitch dari shaft dan mur. dimana. Kedua bagian dipas pd kondisi metal max

B 7.

~~RIVET~~ SELINDER TIPIS





$$F = \int_0^{\frac{\pi}{2}} p \cos\theta \; p.l \, d\theta$$

$$p p l \sin\theta \Big|_0^{\pi/2} = p p l$$

$$\sigma_1 = \frac{F}{t.l} = \frac{p p.l}{t l} = \frac{p p}{t}$$

σ_2 (longitudinal).

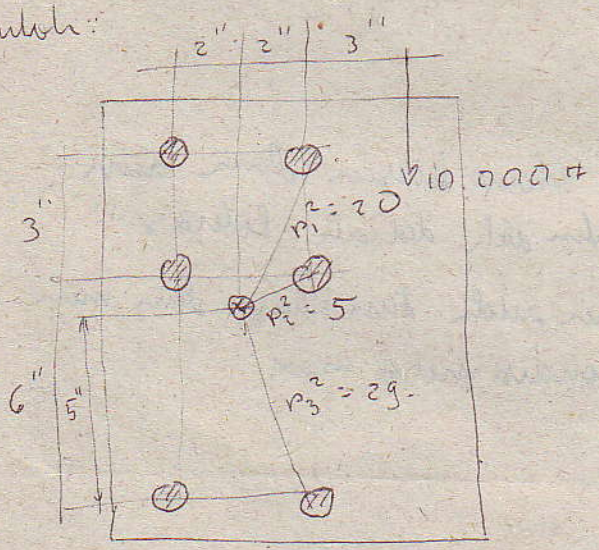
$$p \cdot \pi p^2 = \sigma_2 \cdot 2\pi p \cdot t$$

$$\sigma_2 = \frac{p \cdot p}{2t}$$

Rivet.

Teori sesya Allah.

Contoh:



Carilah tegangan geser pd rivet

PROYEK UA

ELEMEN MESIN

RUMUS? !

Semua

* $\delta = \frac{Pl}{AE}$

* $\bar{Y} = \frac{\int y\,dA}{A} = \frac{A_1\bar{Y}_1 + A_2\bar{Y}_2 + \dots}{A_1 + A_2 + \dots}$

* $\sigma = E\frac{y}{\rho}$

* $M = \frac{E \cdot I}{\rho}$

* $\frac{d^2y}{dx^2} = -\frac{M}{EI}$

* $\frac{dM}{dx} = V$

* $\tau_{xy} = \gamma \cdot G$ → Modulus geser.

↳ regangan geser.

* $G = \frac{E}{2(1+\mu)}$

* $\tau = \frac{V \cdot Q}{I \cdot t} \rightarrow Q = A\bar{Y}$

*  distribusi tegangan geser → $\tau_{max} = \frac{3V}{2A}$

* $P_e = \frac{\pi^2 \cdot EI}{l^2}$

Beban eksentrik atau tegangan bending.

$\sigma_{max\ min} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left(\frac{\sigma_x - \sigma_y}{2}\right)^2 + \tau_{xy}^2}$

* $\sigma_x' = \frac{\sigma_x + \sigma_y}{2} + \frac{\sigma_x - \sigma_y}{2}\cos 2\theta + \tau_{xy}\sin 2\theta$.

* $\varepsilon_y = -\mu\frac{\sigma_x}{E}$ $\quad \varepsilon_x = -\mu\frac{\sigma_y}{E}$

* $\varepsilon_y = \frac{1}{E}(\sigma_y - \mu\sigma_x)$ $\quad \varepsilon_x = \frac{1}{E}(\sigma_x - \mu\sigma_y)$

* $\sigma_x = \frac{E}{1-\mu^2}(\varepsilon_x + \mu\varepsilon_y)$ $\quad \sigma_y = \frac{E}{1-\mu^2}(\varepsilon_y + \mu\varepsilon_x)$

M? jika lihat E. T. dan P.

Distorsi energi teori

$S^2 = \sigma_1^2 + \sigma_2^2 - \sigma_1\sigma_2$

$S^2 = \sigma_x^2 + \sigma_y^2 - \sigma_x\sigma_y + 3\tau_{xy}^2$

Shear stress teori.

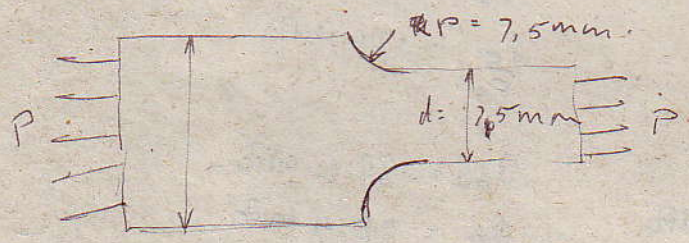
* E steel 30×10^6 psi = lb/in² atau 206900 N/mm² = MPa

E Brass / Bronze 15×10^6 psi = lb/in² atau 103400 N/mm²

Al 10×10^6 69000 N/mm².

~~Contoh~~ 7:

2.10.



Tebal = 13 mm.

Beban berubah dari 90.000 → 45.000 N.

Pada uji material σ_{YP} = 290 MPa. σ_e = 165 MPa.

FS = 2.

Carilah D max yg diizinkan.

A = 75 · 13 = 975

Jawab

$P_{AV} = \frac{90.000 + 45.000}{2} = 67500$ N

$\sigma_{AV} = \frac{67500}{975}$ N/mm² = 69,231 MPa

$P_r = \frac{90000 - 45.000}{2} = 22500$ N

$\sigma_r = \frac{22500}{975}$ N/mm² = 23,077 MPa

Menurut rumus:

$$\frac{\sigma_{YP}}{FS} = \sigma_{AV} + \frac{K \cdot \sigma_{YP}}{\sigma_e} \sigma_r$$ ✓

$\frac{290}{2} = 69,231 + \frac{K \cdot 290}{165} 23,077.$

145 = 69,231 + 40,5596 K.

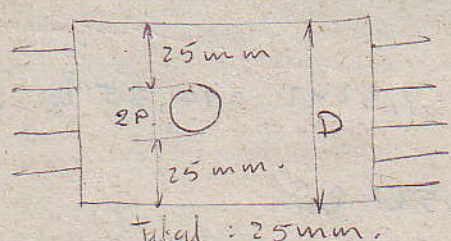
K = 1,87.

Dengan tabel 2-4. → dari data K = 1,87 dan $\frac{r}{d} = \frac{7,5}{75} = 0,1$ mm.

diperoleh D/d = 1,26.

Maka D = 1,26 · 75 = 94,5 mm

2.12. Diket:



Cari diameter lubang dan lebar plat.

P = 89000 - 160000. N.

$\frac{\sigma_{YP}}{FS}$ = 210 MPa. $\frac{\sigma_c}{FS}$ = 126 MP.

Jawab.

$\sigma_{AV} = \frac{89000 + 160000}{2 \cdot 50 \cdot 25} = 99,6$ MPa.

$\sigma_r = \frac{160.000 - 89000}{2 \cdot 50 \cdot 25} = 28,4$ MPa

Dirulang Rumus:

$$\frac{\sigma_{yp}}{FS} = \sigma_{av} + \frac{K \cdot \sigma_{yp} \cdot \sigma_r}{\sigma_e}$$

$$1 = \frac{FS}{\sigma_{yp}} \cdot \sigma_{AV} + \frac{K \cdot FS}{\sigma_e} \cdot \sigma_r$$

$$1 = \frac{1}{210} \cdot 99,6 + \frac{K}{126} \cdot 28,4 \text{ MPa}.$$

$$1 = 0,4743 + 0,2254\ K.$$

$K = 2,33$ → Dari gambar 2-10

diperoleh $\frac{D}{d} = 0,18$

$r = 0,18 \cdot 50$

$= 9.$

jadi $r = 9.$

$D = 18 + 50 = 68.$

sidang dikt:

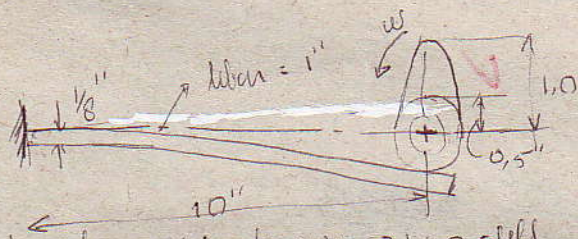
$\frac{\sigma_{yp}}{FS} = 210$ MPa.

$\frac{\sigma_c}{FS} = 126$ MPa.

$\sigma_{AV} = 99,6$ MPa.

$\sigma_r = 28,4$ MPa

45.



Material → cold-drawn 3140 steel

Stress concentration = 0.

Spring surface as ground.

Carilah FS dari spring.

jawab: Jadi $\sigma_u = 115\,000$ Psi $\quad \sigma_{yp} = 98\,000$ Psi $\quad \sigma_e = 52000$ Psi $E = 30.000.000$ Psi

jadi penampangnya:

$$I = \frac{bh^3}{12}$$

$$= \frac{1 \cdot (\frac{1}{8})^3}{12}$$

$$= 1,6276 \text{"}^3 \times 10^{-4}.$$

Pmin:

$$\delta = \frac{P_{min} \cdot L^3}{3EI} \iff 0,5 = \frac{P_{min} \cdot 10^3}{3.30 \cdot 10^6 \cdot 1,6276 \times 10^{-4}}$$

$$0,5 = 0,068267\ P_{min}$$

$$P_{min} = 7,3242 \text{ lb}_f.$$

Pmax

$$\delta = \frac{P_{max} \cdot L^3}{3EI} \iff P_{max} = 2 \cdot 7,3242 = 14,65 \text{ lb}$$

$$\sigma_{n\,max} = \frac{M \cdot Y}{I} = \frac{14,65 \cdot 10 \cdot 1/16}{1,6276 \times 10^{-4}} = 56250 \text{ Psi}.$$

$\sigma_{n\,min} = 28125$ Psi

Maka $\sigma_{AV} = \frac{56250 + 28125}{2} = 42187,5$ Psi

Rumus :

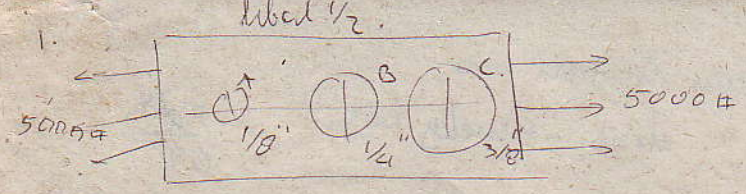
$$\frac{P_{yp}}{FS} = P_{AV} + \frac{K \cdot P_{yp}}{P_c} \cdot P_{ip}$$

$$\frac{98000}{FS} = 12187,5 + \frac{98000}{52000} \cdot 14062,5$$

$$98000 = 68689,9\ FS$$

$$FS = 1,4267$$

1.



Carilah tegangan pd tiap lubang

jawab:

Utk yang A. → Lihat tabel di hal 94.

$d = (1 - \frac{1}{8}) = \frac{7}{8}$.

$r = \frac{1}{16}$.

$r/d = \frac{1/16}{7/8} = 0,07$. → dengan tabel / gambar

2.10 → K = 2,6.

$\sigma = K \cdot \sigma_{nominal} = 2,6 \cdot \frac{5000}{\frac{1}{2} \cdot \frac{7}{8}} = 29714,28$ Psi.

Utk ss B → cara sama.

Utk gg C → " "

3. Diket: Baja 1045 → $\sigma_x = 3300$ psi. $\sigma_{yp} = 59.000$ Psi.

$\sigma_y = -29000$.

$\tau_{xy} = 0$.

a) Carilah FS → dg teori max shear stress 1,23

b) " FS-1 " " stress energy 1,92

c) " FS → jika bahan dari Besi cor 2,37.

$\sigma_{ut} = 25.000$

$\sigma = 100.00$

jawab.

a) $\sigma_{max\,1,2} = \frac{\sigma_x + \sigma_y}{2} \pm \sqrt{\left[\frac{|\sigma_x - \sigma_y|}{2}\right]^2 + \tau_{xy}^2}$.

$= \frac{3300 - 29000}{2} \pm \sqrt{\left(\frac{3300 + 29000}{2}\right)^2 + 0}$

$= -12850 \pm 16150$

$\sigma_1 = -12850 + 16150 = 3300$

$\sigma_2 = -12850 - 16150 = -29000$

$\tau_{max} = \frac{3300 + 29000}{2} = 16150$

$FS = \frac{\frac{1}{2} \cdot 59.000}{16150} = 1,83$.

b) $S^2 = \sigma_x^2 + \sigma_y^2 - \sigma_x \sigma_y + 3\tau_{xy}^2$

$S = \sqrt{(33000)^2 + (-29000)^2 + 33000 \cdot 29000} = 3,07829 \times 10^4$

$FS = \frac{\sigma_{yp}}{S} = \frac{59 \cdot 10^3}{3,07829 \times 10^4} = 1,92$.

5. Poros diberi beban torsi 40.000 in lb
$\sigma_{YP} = 50.000$ psi   FS = 2
a) carilah diameter → dg teori teg geser max
b) " " → " " Mises - Hencky teori

$\frac{1}{4}$ $\frac{\pi d^4}{64}$

jawab:

a) $F_s = \frac{\frac{1}{2}\sigma_{YP}}{\tau_{max}}$ $\tau_{max} = \frac{T\,r}{I_p}$ $I_p = \frac{\pi d^4}{32}$

$2 = \frac{\frac{1}{2} \cdot 50.000\ \pi \cdot d^3}{40.000 \cdot 16}$ $= \frac{T \cdot d/2}{\frac{\pi d^4}{32}} = \frac{T\,16}{\pi d^3}$

$d^3 = \frac{2 \cdot 40.000 \cdot 16}{25.000 \cdot \pi}$

d = ~~3,7 in~~ = 2,535

b) $F_s = \frac{\sigma_{YP}}{S}$

$S = \sqrt{\sigma_1^2 + \sigma_2^2 - \sigma_1\sigma_2}$

$= \sqrt{\left(\frac{16T}{\pi d^3}\right)^2 + \left(\frac{16T}{\pi d^3}\right)^2 - \left(\frac{16T}{\pi d^3}\right)\left(\frac{-16T}{\pi d^3}\right)}$

$= \frac{16T}{\pi d^3}\sqrt{3}$

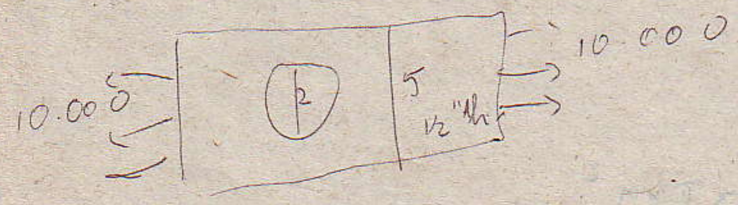
Jadi

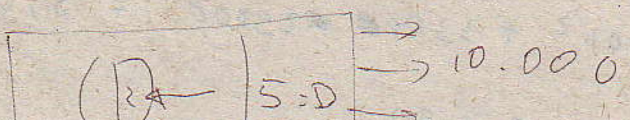
$2 = \frac{50.000\ \pi \cdot d^3}{16 \cdot 40.000\sqrt{3}}$

$d^3 = \frac{2 \cdot 16 \cdot 40.000 \cdot \sqrt{3}}{50.000 \cdot \pi}$

d = 2,42 in

21. Gambar di bawah ini sama dan bahannya gelas.
a) Pembebanannya polos dan terdistribusi.
b) " spt pd gambar.





Jawab : Penjelasan lihat hal - 94.

b) $\frac{H}{D} >> 1$

$\frac{2p}{D} = \frac{2}{5} = 0,4$ → $K = 2,75$

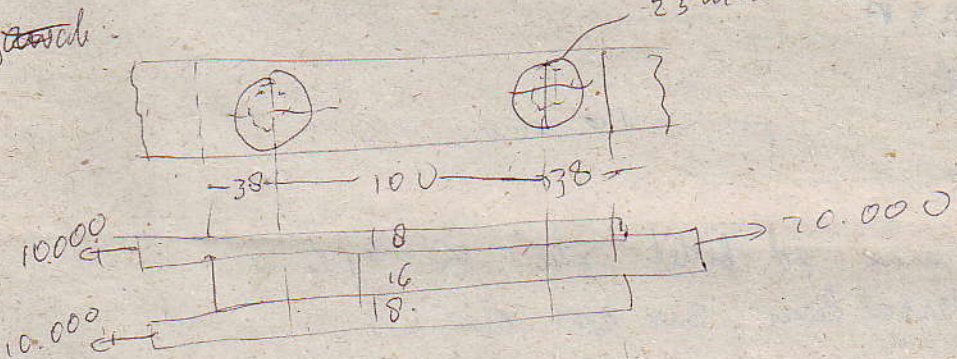
$\sigma_{max} = 2,75 \cdot \frac{10000}{1\frac{1}{2}(5-2)} = 6111,1$

a) $\left.\begin{matrix} p = 1 \\ d = 3 \end{matrix}\right\} \frac{p}{d} = \frac{1}{3} = 0,333$ → $K = 2,2$

$\sigma_{max} = 2,2 \cdot \frac{10000}{1\frac{1}{2}(5-2)} = 4888,8$ gs

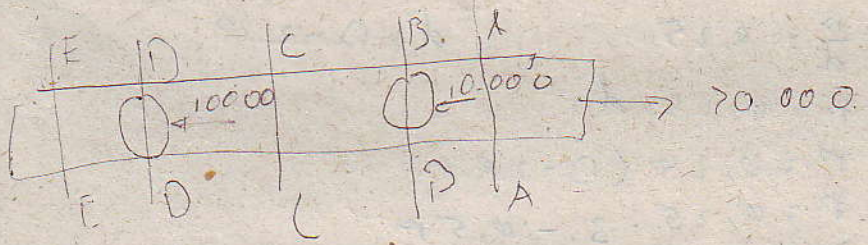
2. Plat di bawah ini dari bahan gs brittle. Diasumsikan tiap lubang menahan 1/2 beban. Carilah Tegangan max pd batang yg lebar.

Jawab :



Satuan MPa.

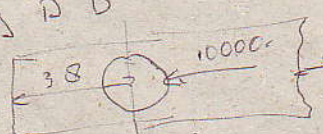
Jawab ;



Penampang E E

$\sigma = 0$

Penampang D D



$\sigma = 3,7 \cdot \frac{10000}{16 \cdot (75 - 25)}$

$= 46,25$ MPa

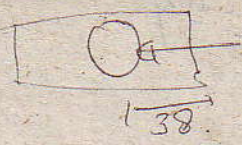
$\frac{H}{D} = \frac{38}{75} = 0,51$

$\frac{2p}{D} = \frac{25}{75} = 0,333$

$K = 3,7$ → hal 94.

Penampang c c.

$\sigma = \frac{10.000}{} = 8,333$ MPa



$\frac{r}{d} = \frac{12,5}{50} = 0,25$

↳ $K = 2,3$

$\sigma = 2,36 \cdot \frac{10.000}{16 \cdot 50}$

$= 29,75$

$\frac{H}{D} > 1$

$\frac{2r}{D} = \frac{25}{75} = 0,33 \rightarrow K = 3,8$

$\sigma = 3,1 \cdot \frac{10.000}{16 \cdot 50}$

$= 38,75$

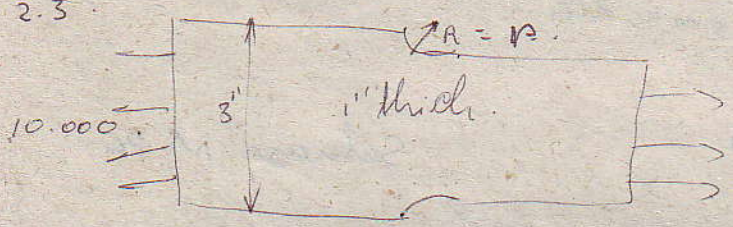
$\sigma_{ijin} = 67,5$ MPa

Penampang A A :

$\sigma = \frac{20.000}{16 \cdot 75} = 16,67$ MPa

Jadi σ_{max} di B B → 67,5

2.3



a) Carilah tegangan max pd fillet jika $K = 1,6$

b) FS jika material dari Bus coi class 25

jawab :

a) $K = 1,6 \rightarrow \frac{r}{d} = 0,25$ $\quad d = D - 2r$

$r = 0,25 \cdot d$

$r = 0,25 (D - 2R)$

$r = 0,25 \cdot 3 - 0,5r$

$\frac{3}{2}r = 0,75$

$r = 0,5$

$\sigma = 1,6 \cdot \frac{10.000}{2 \cdot 1} = 8000$ Psi

b) Soal → Bus coi kekuatan tarik → $\sigma_{ut} = 25.000$

$FS = \frac{\sigma_{ut}}{\sigma} = \frac{25.000}{8000} = 3,125$