TUGAS WAJIB

STRUKTUR BAJA

Disusun Oleh:

YUDHA SEPTIAWAN LUBIS

14-811-0059

PROGRAM STUDI TEKNIK SIPIL

FAKULTAS TEKNIK

UNIVERSITAS MEDAN AREA

MEDAN

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LEMBAR PENGESAHAN

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Disusun Oleh:

YUDHA SEPTIAWAN LUBIS

14.811.0059

Disetujui Oleh:

Kaprodi Teknik Sipil	**Dosen Pengampu**
Ir. Kamaluddin Lubis, MT.	**Ir. H. Edy Hermanto, MT**

FAKULTAS TEKNIK
PROGRAM STUDI TEKNIK SIPIL
UNIVERSITAS MEDAN AREA

Jalan Kolam No. 1 Medan Estate Medan

Nomor :

Lamp :

Hal : Pembimbing tugas wajib

Medan, 17-3 20.17

Kepada : Yth, ~~Bapak~~ Ir. H. Zaj Hermansyah MT

Staf Pengajar Program Studi Jurusan Sipil

Universitas Medan Area

Di Medan,-

Dengan hormat,

Sehubungan dengan mahasiswa yang tersebut namanya dibawah ini:

Nama : Yudha Septiawan Lubis

Stambuk : 14.811.0059

Tk/Jurusan : Teknik Sipil

Telah memenuhi syarat mengambil tugas wajib : Bayi

yang merupakan salah satu persyaratan sidang sarjana di Jurusan sipil, maka dengan ini kami mohon kesediaan Bapak, untuk dapat membimbing mahasiswa tersebut diatas .

Demikianlah kami sampaikan atas perhatian dan kerja sama yang baik kami ucapkan terima kasih.

Hormat kami,

Ketua Prodi Jurusan Sipil

Iskandaluddin Lubis.MT

Tembusan: Pertinggal

JURUSAN TEKNIK SIPIL
FAKULTAS TEKNIK
UNIVERSITAS MEDAN AREA

TUGAS BAJA

Diberikan kepada :
Nama :
NPM :

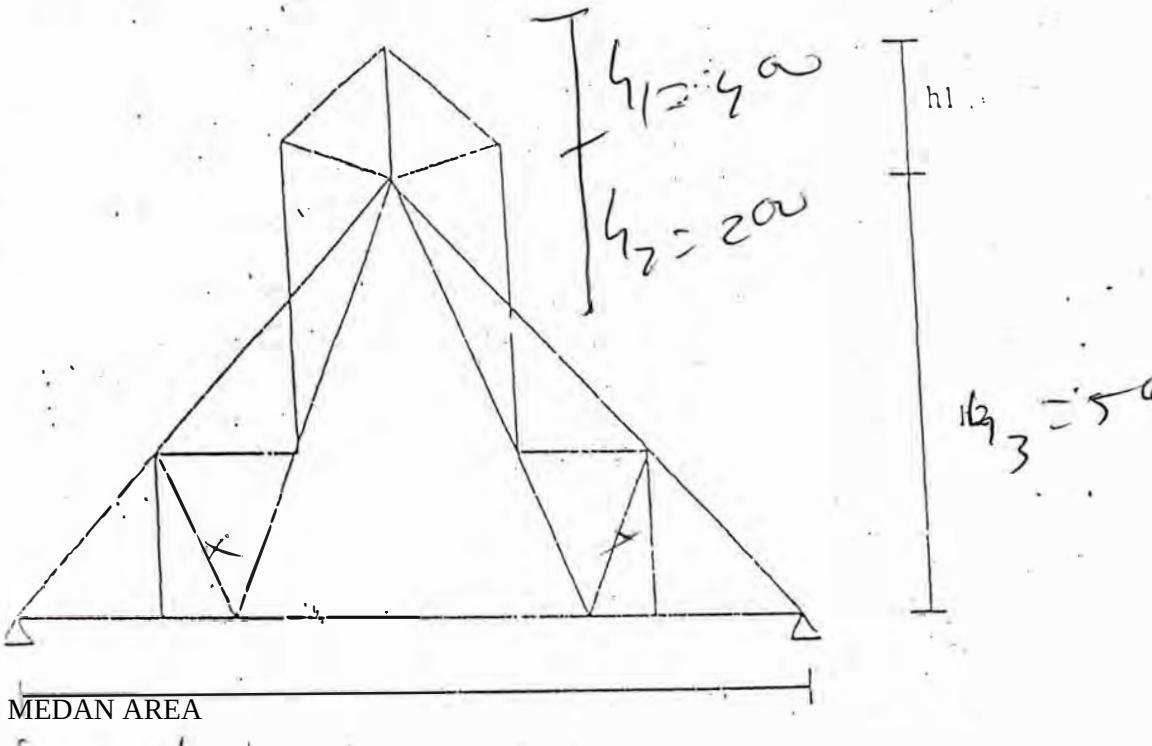
Diketahui :

- Bentang ..... L = m
- Tinggi ..... H1 = m
- Jarak Gading-gading Kap..... l = m
- Jenis Atap.....
- Mutu Baja.....

Diminta :

- Dimensionering gording dalam 3 variasi
- Daftar gaya-gaya batang
- Dimensionering batang profil dan detail
- Daftar kontrol bahan untuk berat sendiri

A).



JURUSAN TEKNIK SIPIL
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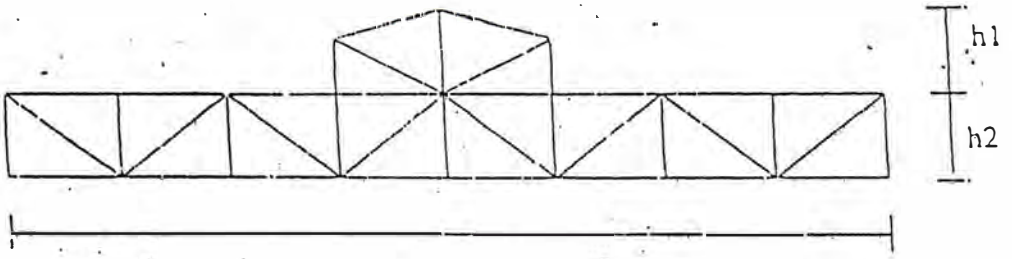
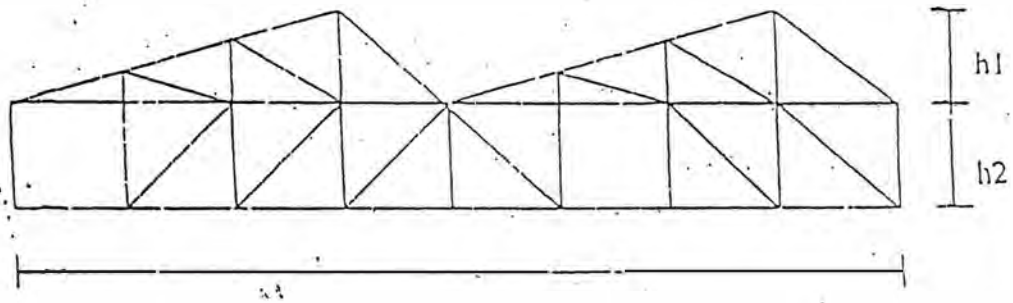
B).



C).



Medan, Nopember 20

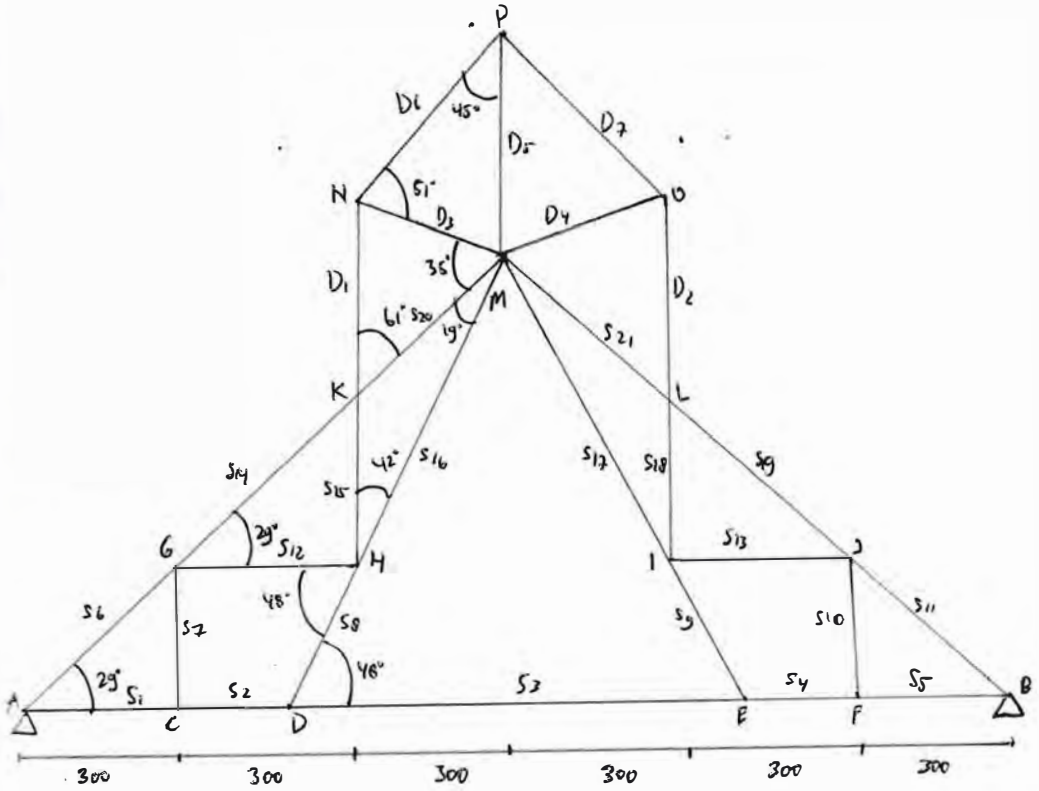
Dosen Pengasuh,

DAFTAR ASISTENSI TUGAS STRUKTUR BAJA II

NAMA : Yudha Septiawan Lubis

NPM : 148110059

NO	TANGGAL	KETERANGAN	TANDA TANGAN
1	17/06-17		
2	11/07-17		
	17/7/17		



Diketahui

1. Bentang (L) = 12 meter
2. tinggi (H) : 8 meter

   Konstruksi A : 3 meter

   Konstruksi B : 5 meter

3. Jarak gading ke kap : 3 meter
4. Jenis Atap : Seng
5. mutu baja = Bj 37
6. Panjang masing2 rangka Batang :

D_1 : 2 m

D_2 : 2 m

D_3 = 3,02 m

D_4 = 3,02 m

D_5 = 3,33 m

D_6 = 4,24 m

D_7 = 4,24 m

S_1 : 3 m

S_2 : 1,5 m

S_3 : 9 m

S_4 = 3,43 m

S_7 = 1,64 m

S_8 = 2,64 m

S_{11} = 3,43 m

S_{12} = 3 m

S_{13} = 3 m

S_{16} = 4,48 m

S_{17} = 4,48 m

S_{18} = 2,33 m

S_{21} = 3,43 m

Sudut

Sin 29 = 0,48
cos 29 = 0,87
Sin 6° = 0,10
Cos 6° = 0,99
Sin 84 = 0,99
cos 84 = 0,10

Sin 48 = 0,74
cos 48 = 0,66
Sin 45° = 0,707
Cos 45 = 0,707
Sin 90 = 1
cos 90 = 0

Sin 19° = 0,33
Cos 19 = 0,95
Sin 35° = 0,57
cos 35 = 0,81

Dimensi

1. Dimensi gording dlm 3 varinsi
2. Daftar gaya = Batang
3. dimensi batang profil dan dotasi
= Daftar kontrol bahan utuk berat sendiri

Perhitungan beban

Panjang masing = Rangka Batang

D1 = 2
D2 = 2
D3 = 3,02
D4 = 3,02
D5 = 3,33
D6 = 4,24
D7 = 4,24
D8 = 3,43
D9 = 3,43

...an mati

...nutup atap : 8,48 x 5 x 10 = 424 kg

...ngikat atap = 1 kg

Ventilasi : 20 x 20,5 = 410 kg

Gording = 5 x 4,76 x 13 bh = 309,4 kg

Pengikat gording : 1 kg

...ngun Atap (L 65.65.7) = 28,71 x 6,83 kg/m = 196,64 kg

Total beban mati : 1342,04 kg

Beban P1 : 312,04 kg

P2a : 515 kg

P2b : 515 kg

- Beban hidup

Beban P1 : 100 kg

P2a : 100 kg

P2b : 100 kg

300 kg

Beban Angin

- Data Atap :

Jarak gording (L) : 1

kemiringan (α) : 29

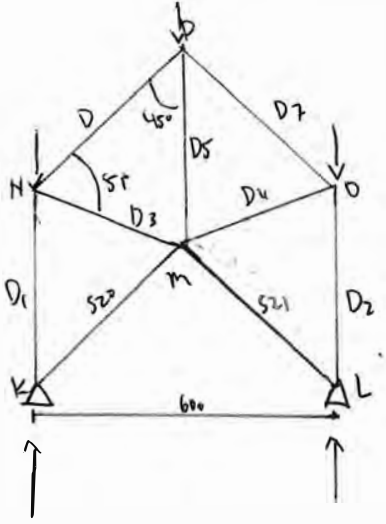
besar beban angin (W) : 25 kg/m²

- koef angin tekan

- Pada bidang tidak ada angin

Wp : C x L x W

Wda : (C x α - 0,4 x L x W



Perhitungan reaksi

$\Sigma M_K = 0$

$= R_{LV} \times 6 - P_{2b} \times 6 - P_1 \times 3 - P_{2a} \times 0$

$= R_{LV} \times 6 - 515 \times 6 - 312{,}04 \times 3 - 515 \times 0$

$R_{LV} = 358{,}98$ kg

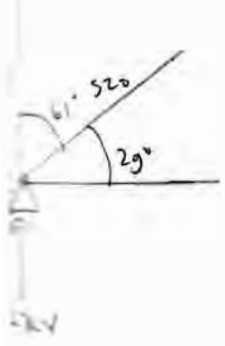
$\Sigma M_L = 0$

$= R_{KV} \times 6 - P_{2a} \times 6 - P_1 \times 3 - P_{2b} \times 0$

$= R_{KV} \times 6 - 515 \times 6 - 312{,}04 \times 3 - 515 \times 0$

$R_{KV} = 358{,}98$ kg

Titik buhul K



$\Sigma H = 0$

$S_{20} = 0$

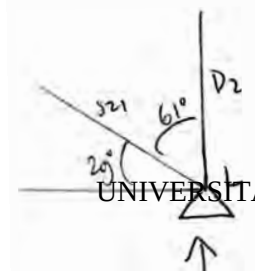
$\Sigma V = 0$

$R_{KV} + D_1 + S_{20} \times \sin 29° = 0$

$358{,}98 + D_1 + 0{,}40 \times 0 = 0$

$D_1 = -358{,}98$ kg (Tekan)

Titik buhul L



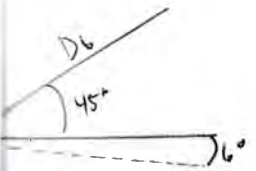
$\Sigma H = 0$

$S_{21} = 0$

$\Sigma V = 0$

$R_{LV} + D_2 + S_{21} \times \sin 29° = 0$

Titik buhul N



$\Sigma V = 0$

$D_1 - P_{2a} + D_6 \times \sin 45^\circ + D_3 \times \sin 6^\circ = 0$

$-358,98 - 515 + 56 \times \sin 45^\circ + D_3 \times \sin 6 = 0$

$-873,98 + 0,707 \times D_6 + 0,10 \times D_3 = 0 \quad \ldots (1)$

$\Sigma H = 0$

$D_6 \times \cos 45^\circ + D_3 \times \cos 6^\circ = 0$

$0,707 \times D_6 + 0,99 \times D_3 = 0$

$D_6 = -1,4 \times D_3 \quad \ldots (2)$

Pers 1

$-873,98 + (0,707 \times (-1,4) \times D_3 + 0,10 \times D_3 = 0$

$-873,98 - 0,99 \times D_3 + 0,10 \times D_3 = 0$

$-873,98 - 0,89 \times D_3 = 0$

$D_3 = -982$ kg (tekan)

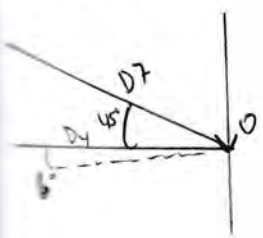
Dari hasil diatas, maka diperoleh

$D_6 = -1,4 \times D_3$

$= -1,4 \times -982$

$D_6 = 1374,8$ kg (tarik)

Titik Buhul O



$\Sigma V = 0$

$D_2 - P_{2b} + D_7 \times \sin 45^\circ + D_4 \times \sin 6^\circ = 0$

$-358,98 - 515 + D_7 \times \sin 45 + D_4 \times \sin 6 = 0$

$-873,98 + 0,707 \times D_7 + 0,10 \times D_4 = 0 \quad \ldots (1)$

$\Sigma H = 0$

$D_7 \times \cos 45 + D_4 \times \cos 6^\circ = 0$

$0,707 \times D_7 + 0,99 \times D_4 = 0$

$D_7 = -1,4 \times D_4 \quad \ldots (2)$

Pers 2 disubstitusi ke Pers 1

$-873,98 (0,707 \times (-1,4) \times D_4 + 0,10 \times D_4 = 0$

$D_4 = -982$ kg Tekan

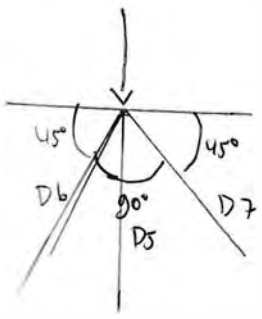
Dari hasil diatas, maka diperoleh

$D7 = -1{,}4 \times D4$

$= -1{,}4 \times 982$

$D7 = 1374{,}8$ kg (Tarik)

Titik Buhul P



$\Sigma V = 0$

$D6 \times \sin 45° - P_1 + D7 \times \sin 45° + D5 = 0$

$1374{,}8 \times 0{,}707 - 312{,}04 + 1374{,}8 \times 0{,}707 + D5 = 0$

$D5 = 312{,}04$ kg (tarik)

$\Sigma H = 0$

$D6 \times \cos 45° + D7 \times \cos 45° = 0$

$0{,}707 \times D7 + 0{,}707 \times D6 = 0$

$D7 = -D6$

No Batang	Batang Tarik (+)	Batang Tekan
D1	-	-358,98
D2	-	-358,98
D3	982	-
D4	982	-
D5	-	312,04
D6	-	1374,8
D7	-	1374,8
S20	-	-
S21	-	-

Perhitungan Gaya batang Beban hidup

Perhitungan reaksi

$\Sigma m\, k = 0$

$= R_{LV} \cdot 6 - P_{2b} \times 6 - P_1 \times 3 - P_{2a} \times 0$

$R_{LV} \times 6 - 100 \times 6 - 100 \times 3 - 100 \times 0$

$R_{LV} = 150$ kg

$\Sigma m_L = 0$

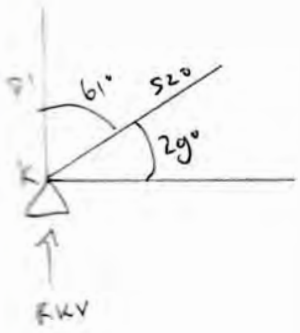
$= R_{KV} \times 6 - P_{2a} \times 6 - P_1 \times 3 - P_{2b} \times 0$

$= R_{KV} \times 6 - 100 \times 6 - 100 \times 3 - 1 \times 0$

$R_{KV} = 150$ kg

- Perhitungan Gaya batang

Titik buhul K



$\Sigma H = 0$

$S20 = 0$

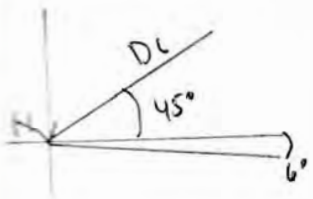
$\Sigma V = 0$

$R_{KV} + D_1 S_{20} \times \sin 29° = 0$

$150 + D_1 + 0{,}48 \times 0 = 0$

$D_1 = -150$ kg (Tekan)

Titik Buhul N



$\Sigma V = 0$

$D_1 - P_{2a} + D_6 \times \sin 45° + D_3 \times \sin 6° = 0$

$-150 - 100 + D_6 \sin 45° + D_3 \sin 6° = 0$

$-250 + 0{,}707 \times D_6 + 0{,}10 \times D_3 = 0 \ldots (1)$

$\Sigma H = 0$

$D_6 \times \cos 45° + D_3 + \cos 6° = 0$

$0{,}707 \times D_6 + 0{,}99 \times D_3 = 0$

$D_6 = -1{,}4 \times D_3 \ldots (2)$

Persamaan (2) ke (1)

$-250 + (0{,}707 \times (-1{,}4) \times D_3 + 0{,}10 \times D_3 = 0$

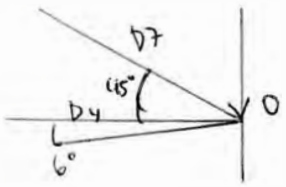
Dari hasil diatas, maka diperoleh

$D_6 = -1,4 \times D_3$

$= -1,4 \times -280,90$

$D_6 = 393,26$ kg (Tarik)

Titik buhul O



$\Sigma V = 0$

$D_2 - P_{2b} + D_7 \times \sin 45° + D_4 \times \sin 6° = 0$

$-150 - 100 + D_7 \sin 45° + D_4 \times \sin 6 = 0$

$-250 + 0,707 \times D_7 + 0,10 \times D_4 = 0 \quad \ldots (1)$

$\Sigma H = 0$

$D_7 \times \cos 45° + D_4 \times \cos 6° = 0$

$0,707 \times D_7 + 0,99 \times D_4 = 0$

$D_7 = -1,4 \times D_4 \quad \ldots (2)$

Pers 2 disubstitusi ke Pers 1

$-250 + (0,707 \times (-1,4)) \times D_4 + 0,10 \times D_4 = 0$

$-250 - 0,99 \times D_4 + 0,10 \times D_4 = 0$

$-250 - 0,89 \times D_4 = 0$

$D_4 = -280,90$ kg (Tekan)

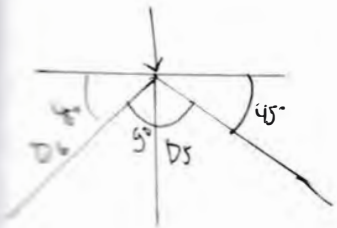
Dari hasil diatas, diperoleh

$D_7 = -1,4 \times D_4$

$= -1,4 \times -280,90$

$D_7 = 393,26$ (Tarik)

Titik Buhul P



$\Sigma V = 0$

$D_6 \times \sin 45° - P_1 + D_7 \sin 45 + D_5 = 0$

$393,26 \times 0,707 + 100 + 393,26 \times 0,707 + D_5 = 0$

$D_5 = 100$ kg (Tarik)

$\Sigma H = 0$

$D_6 \cos 45° + D_7 \times \cos 45° = 0$

$0,707 \times D_7 + 0,707 \times D_6 = 0$

TABEL GAYA BATANG

PERHITUNGAN GAYA BATANG (BEBAN HIDUP)		
No Batang	Batang Tarik (+)	Batang Tekan (-)
D1	-	-150
D2	-	-150
D3	280.9	-
D4	280.9	-
D5	-	100
D6	-	393.26
D7	-	393.26
S20	-	-
S21	-	-

Perhitungan Gaya Batang beban angin Datang

wda = 4,5 kg/m

wda cos 45 = 3,18 kg/m

wda sin 45° = 3,18 kg/m

wdb = 4,5 kg/m

wdb cos 45° = 3,18 kg/m

wdb sin 45° = 3,18 kg/m

wpa = 10 kg/m

wpa cos 45° = 7,07 kg/m

wpa sin 45° = 7,07 kg/m

wpb = 10 kg/m

wpb cos 45 = 7,07 kg/m

wpb sin 45 = 7,07 kg/m

wdc = 22,5 kg/m

- Perhitungan Reaksi ditik K dan L

$\Sigma m_K = 0$

$R_{LV} \times 6 - w_{da} \cos 45° \times 3 - w_{db} \cos 45° \times 6 + w_{pa} \cos 45° \times 3 + w_{pb} \times 0$

$R_{LV} = 8,30$ kg

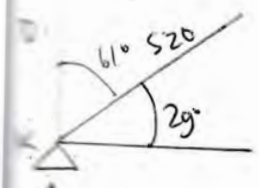
$\Sigma m_L = 0$

$R_{KV} \times 6 - w_{da} \cos 45° \times 3 - w_{db} \cos 45° \times 6 + w_{pa} \cos 45° \times 3 + w_{pb} \times 0$

$R_{KV} \times 6 - 3,18 \times 3 - 3,18 \times 6 + 7,07 \times 3$

$R_{KV} = 8,30$ Kg

Tinjau buhul k



RKV

$\Sigma H = 0$

$Wdb + S20 \cos 29 = 0$

$22,5 + 0,87 \times S20 = 0$

$S20 = -25,86$ kg (Tekan)

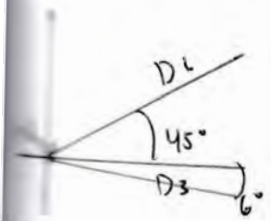
$\Sigma V = 0$

$RKV + D1 + S20 \times \sin 29° = 0$

$8,30 + D1 + (-25,86) \times 0,48 = 0$

$D1 = 4,1$ kg (Tarik)

Tinjau buhul N



$\Sigma V = 0$

$Wdb \times \sin 45 + D1 + D6 \times \sin 45 + D3 \times \sin 6° = 0$

$4,5 \times 0,707 + 4,1 + D6 \times \sin 45° + D3 \times \sin 6° = 0$

$7,28 \times D6 + 0,10 \times D3 = 0 \ldots (1)$

$\Sigma H = 0$

$D6 \times \cos 45 + D3 \cos 6° + Wdb \times \cos 45° = 0$

$0,707 \times D6 + 0,99 \times D3 + 4,5 \times 0,707 = 0$

$0,707 \times D6 + 0,99 \times D3 + 3,18 = 0 \ldots (2)$

Di eliminasi kepers 2

$7,28 \times D6 + 0,10 \times D3 + 7,98 = 0$

$0,707 \times D6 + 0,99 \times D3 + 3,18 = 0$

$-0,89 \times D3 + 4,8 = 0$

$D3 = -5,39$ kg (tekan)

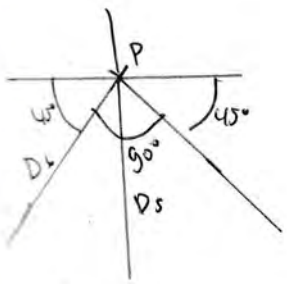
Dari fungsi diatas, maka diperoleh

$7,98 + 0,707 \times D6 + 0,10 \times D3 = 0$

$7,98 + 0,707 \times D6 + 0,10 \times (-5,39) = 0$

$D6 = -9,22$ kg (tekan)

Titik buhul P



$\Sigma H = 0$

$D6 \times \cos 45° + D7 \times \cos 45° + Wda \times \cos 45° = 0$

$0,707 \times (-9,22) + 0,707 \times D7 + 4,5 \times 0,707 = 0$

$D7 = -4,71$ (Tekan)

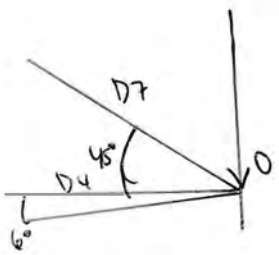
$\Sigma V = 0$

$D6 \times \sin 45° + Wda \times \cos 45 + D7 + \sin 45° + D5 = 0$

$(-9,22 \times 0,707 + 4,5 \times 0,707 + (-4,71 \times 0,707 + D5 = 0$

$D5 = 6,66$ ug (Tarik)

Titik buhul O



$\Sigma H = 0$

$D4 \times \cos 6 + D7 \cos 45 = 0$

$0,99 \times D4 + 0,707 \times (-4,71) = 0$

$D4 = 3,36$ ug (Tarik)

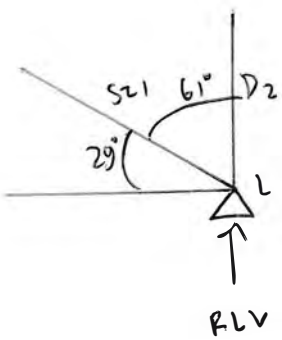
$\Sigma V = 0$

$D7 \times \sin 45° + D4 \sin 6° + D2 = 0$

$(-4,71) \times 0,707 + 3,36 \times 0,10 + D2 = 0$

$D2 = 2,99$ ug (Tarik)

Titik buhul L



$\Sigma V = 0$

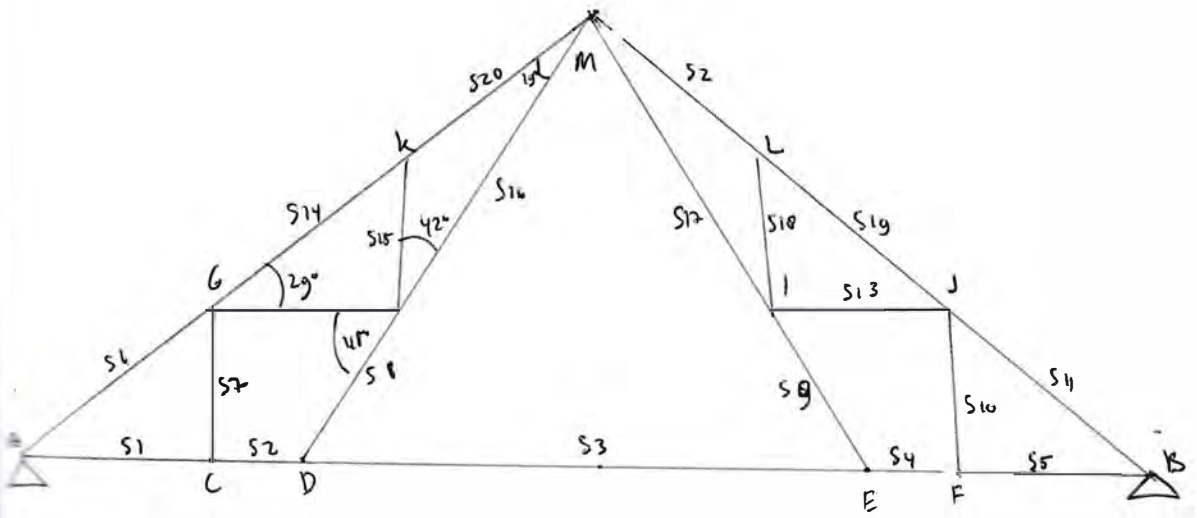
$RLV = +D2 + S21 \times \sin 38° = 0$

$8,30 + 2,99 + 0,62 \times S21 = 0$

$S21 = -18,20$ ug (Tekan)

TABEL GAYA BATANG

PERHITUNGAN GAYA BATANG BEBAN ANGIN		
No Batang	Batang Tarik (+)	Batang Tekan (-)
D1	-	4.1
D2	-	2.99
D3	-	-5.39
D4	3.36	-
D5	6.66	-
D6	-	-9.22
D7	-	-4.71
S20	-	-25.86
S21	-	-18.20



Panjang rangka batang

S1 = 3, m	S11 = 3,43 m
S2 = 1,5 m	S12 = 3 m
S3 = 6 m	S13 = 3 m
S4 = 1,5 m	S14 = 3,43 m
S5 = 3, m	S15 = 1,66 m
S6 = 3,43 m	S16 = 4,48 m
S7 = 1,66 m	S17 = 4,48 m
S8 = 2,24 m	S18 = 2,33 m
S9 = 2,24 m	S19 = 3,43 m
S10 = 1,66 m	S20 = 3,43 m
	S21 = 3,43 m

- Beban mati

Penutup atap : 15,2 × 5 × 10 = 760 kg

Penggantung atap = 2 kg

Gording : 5 × 4,76 × 14 bh = 333,2 kg

Penggantung gording : 3 kg

Rangka atap = 75,56 × 12,14 = 917,298 kg

Total beban mati : 2015,50 kg ≈ 2016 kg

Beban P1 : 168 kg × 2 titik : 336 kg

P2 = 336 kg × 5 titik = 1680 kg

2016 kg

- Beban hidup

Beban P_1 = 100 kg × 2 titik = 200 kg
beban P_2 = 100 kg × 5 titik = 500 kg
700 kg

- Beban angin

Jaran gording (L) = 1,27 m
Kemiringan (α) = 38°
Besar beban angin (W) = 30, kg/m^2

$Wda = (C \times \alpha - 0,4) \times L \times W$

$Wda = (0,02 \times 38) - (0,40) \times 1,27 \times 30$

$Wda = 13,72$ kg/m = Wdb

$\alpha = 65° - 90°$
$Wdc = C \times L \times W$

$Wdc = 0,90 \times 1,27 \times 30$

$Wdc = 34,29$

- Koef angin hisap (ch)

$WP = C \times L \times W$

$WP = -0,40 \times 1,27 \times 30$

$WP = -15,24$ kg/m

RAV = 671, 02 kg P_2 = 336 kg P_{2R} = 1007,02 kg
RLV = 671, 02 kg P_1 = 168 kg P_{2L} = 1007,02 kg

- Perhitungan reaksi titik A dan B

$\Sigma MB = 0$

$RAV \times 18 - P_1 \times 0 - P_2 \times 3 - P_{2L} \times 6 - P_2 \times 9 - P_{2R} \times 12 - R_x \times 15 - P_1 \times 18 = 0$

$RAV \times 18 - (168 \times 0) - (336 \times 3) - (1007,02 \times 6) - (336 \times 9) - (1007,02 \times 12) - (336 \times$
$- (168 \times 18) = 0$

$18\ RAV = 0 + 1008 + 6042,12 + 3024 + 12084 + 5040 + 3024$

$RAV = \frac{30222,36}{18}$

$RAV = 1679,0$ kg

$\Sigma M_B = 0$

$-R_{BV} \times 18 + P_1 \times 0 + P_2 \times 3 + P_{2k} \times 6 + P_2 \times 9 + P_{21} \times 12 - P_2 \times 15 - P_1 \times 18 = 0$

$-R_{BV} \times 18 + (168 \times 0) + (336 \times 3) + (1007{,}02 \times 6) + (336 \times 9) + (1007{,}02 \times 12) + (336 \times$
$+ (168 \times 18) = 0$

$18\, R_{BV} = 0 + 1008 + 6042{,}12 + 3024 + 12084 + 3024$

$R_{BV} = \dfrac{30222{,}36}{18}$

$R_{BV} = 1679$ kg

Kontrol

$\Sigma V = 0$

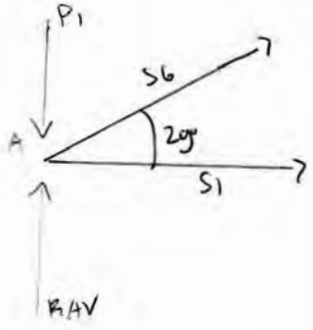
$R_{AV} + R_{BV} - P_1 - P_2 - P_{2k} - P_{2l} - P_2 - P_1 = 0$

$1679 + 1679 - 168 - 336 - 1007 - 336 - 1007 - 336 - 168 = 0$

$3358 - 3358 = 0$ (Oke)

- Perhitungan Gaya batang

Titik buhul A



$\Sigma V = 0$

$R_{AV} + S_6 \sin 29 - P = 0$

$1679 + 0{,}48 \times S_6 - 168 = 0$

$-S_6 = \dfrac{1511}{0{,}48}$

$S_6 = -3147{,}9$ kg (tekan)

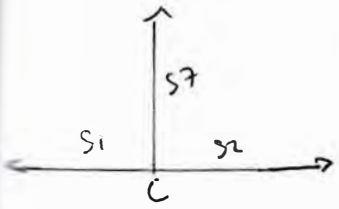
$\Sigma H = 0$

$S_6 \times \cos 29 + S_1 =$

$0{,}87 \times (-3147{,}9) + S_1 = 0$

$S_1 = 2738{,}67$ kg (Tarik)

Titik buhul C



$\Sigma V = 0$

$S7 = 0$ kg

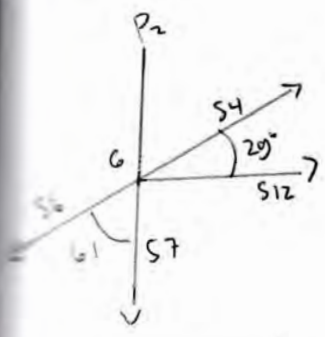
$\Sigma H = 0$

$S2 - S1 = 0$

$S2 - 2738,67 = 0$

$S2 = 2738,67$ kg (tarik)

Titik buhul G



$\Sigma V = 0$

$P2 + S7 + S6 \sin 29 + S14 \sin 29 = 0$

$336 + 0 + 0,48 \times -3147,9 + 0,48 \times S14 = 0$

$-S14 = \frac{1174,99}{0,48}$

$S14 = -2447,89$ kg (tekan)

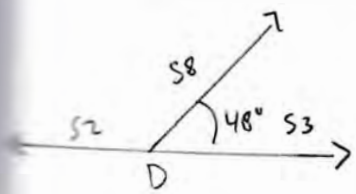
$\Sigma H = 0$

$S14 \cos 48 + S6 \cos 48 + S12 = 0$

$-2447,89 \times 0,66 + -2452,9 \times 0,66 + S12 = 0$

$S12 = 3234,54$ kg (tarik)

Titik buhul D



$\Sigma V = 0$

$S8 \sin 48 = 0$

$S8 \times 0,74 = 0$ ... (1)

$\Sigma H = 0$

$S8 \times \cos 48° + S2 + S3 = 0$ ... (2)

Eliminasi per 1 dan 2

$0,74 \times S8 = 0$ | $\times 0,66$

$0,66 \times S8 + 2738,67 + S3 = 0$ | $\times 0,74$

$0,48 \times S8 = 0$

$0,48 \times S8 + 2026,61 + S3 = 0$

Masukan nilai S_3 ke dalam pers 2

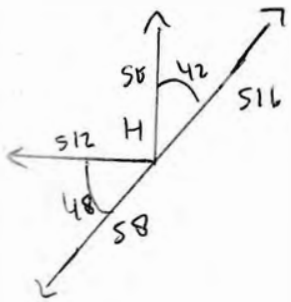
$0,66 \times S8 + 2738,67 + 33 = 0$

$0,66 \times S8 + 2738,67 + (-2026,61) = 0$

$S8 = \frac{712,06}{0,66}$

$S8 = 1078,87$ kg (tarik)

Titik buhul H



$\Sigma V = 0$

$S15 + S8 \sin 48 - S16 \times \sin 48° = 0$

$15 + 1078,87 \times 0,74 - S16 \times 0,74 = 0 \ldots (1)$

$\Sigma H = 0$

$S12 + S8 \times \cos 48 + S16 \cos 48 = 0$

$3234,52 + 1078,87 \times 0,66 + S16 \times 0,66 = 0$

$-S16 = \frac{3749,07}{0,544}$

$S16 = -5009,65$ (Tekan)

Masukkan nilai S16 ke Pers 1

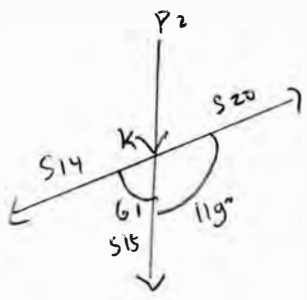
$S15 + 1078,87 \times 0,74 - S16 \times 0,74 = 0$

$S15 + 1078,87 \times 0,74 - (-5009,65) \times 0,74 = 0$

$S15 = -798,36 - 3707,06$

$S15 = -4505,42$ kg (tekan)

Titik buhul K



$\Sigma H = 0$

$S14 \times \sin 61° - S20 \sin 61 = 0$

$0,87 \times -2447,89 - 0,87 \times S20 = 0$

$-S20 = \frac{2129,66}{0,87}$

$S20 = -2447,88$ kg (tekan)

Perhitungan gaya batang akibat beban hidup

RKV = 671,02 kg P_2 = 100 kg P_{2K} = 771,02 kg

RLV = 671,02 kg P_1 = 100 kg P_{2L} = 771,02 kg

- Perhitungan reaksi titik A dan B

$\Sigma MB = 0$

$RAV \times 18 - P \times 0 - P_2 \times 3 - P_{21} 6 - P_2 \times 9 - P_{2K} \times 12 - P_2 \times 15 - P_1 \times 18 = 0$

$RAV \times 18 - (100 \times 0) - (100 \times 3) - 771,02 \times 6) - (100 \times 9) - (771,02 \times 12) - (100 \times 15) -$

$\Sigma RAV = \frac{18378,36}{18}$

$RAV = 1021$ kg

$\Sigma MA = -RBV \times 18 + P_1 \times 0 + P_2 \times 3 + P_{2K} \times 6 + P_2 \times 9 + P_{21} \times 12$

$+ P_2 \times 15 + P_1 \times 18 = 0$

$-RBV \times 18 + (100 \times 0) + (100 \times 3) + (771,02 \times 6) + (100 \times 9) + (72102 \times 12) + (100 \times 1$

$+ 100 \times 18 = 0$

$18 RBV = 0 + 300 + 4626,12 + 900 + 9252,24 + 1500 + 1800$

$RBV = \frac{18378,36}{18}$

$RBV = 1021,02$ kg

kontrol

$\Sigma V = 0$

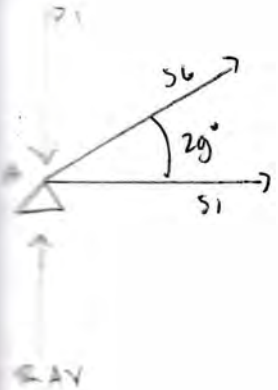
$RAV + RBV - P_1 - P_2 - P_{2K} - P_2 - P_{2L} - P_2 - P_1 = 0$

$1021,02 + 1021,02 - 100 - 100 - 771,02 - 100 - 771,02 - 100 - 100 = 0$

2042,04 kg - 2042,04 kg = 0 (ok)

Perhitungan Gaya batang

Titik buhul A



$\Sigma V = 0$

$R_{AV} + S6 \sin 29 - P1 = 0$

$1021 + 0{,}48x\ S6 - 100 = 0$

$-S6 = \frac{921}{0{,}48}$

$S6 = -1918{,}75$ kg (tekan)

$\Sigma H = 0$

$S6 \cos 29 + S1 = 0$

$0{,}87 \times (-1918{,}75) + S1 = 0$

$S1 = 1669{,}33$ kg (tarik)

Titik buhul C

$\Sigma V = 0$

$S7 = 0$ kg

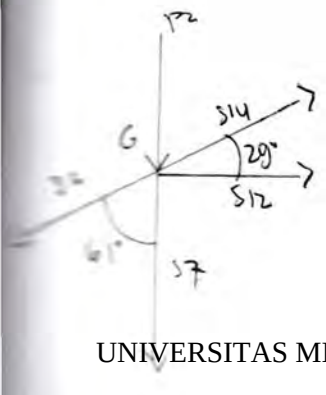
$\Sigma H = 0$

$S2 - S1 = 0$

$S2 - 1669{,}33 = 0$

$S2 = 1669{,}33$ kg (Tarik)

Titik buhul G



$\Sigma V = 0$

$P2 + S7 + S6 \sin 29 + S14 \sin 29 = 0$

$100 + 0 + 0{,}48(-1918{,}75) + 0{,}4 \times S14 = 0$

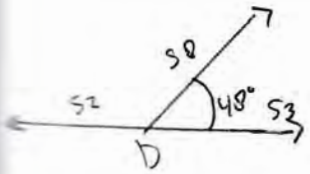
$-S14 = \frac{821}{0{,}48}$

$S14 = -1710{,}41$ kg (Tekan

$\Sigma H = 0$

$S14 \cos 29 + S6 \cos 29 + S12 = 0$

Titik buhul D



$\Sigma V = 0$

$S8 \sin 48° = 0$

$S8 \times 0,74 = 0 \quad \ldots (1)$

$\Sigma H = 0$

$S8 \cos 48 + S2 + S3 = 0$

$0,66 \times S8 + 1669,33 + S3 = 0 \quad \ldots (2)$

Eliminasi Pers 1 dan 2

$0,74 \times S8 = 0 \quad | \times 0,66$

$0,66 \times S8 + 1669,33 + S3 = 0 \quad | \times 0,74$

$0,476 \times S8 = 0$

$0,476 \times S8 + 1233,30 + S3 = 0$

$S3 = -1235,30 \text{ kg}$ (tekan)

Substitusi nilai S3 ke pers 2

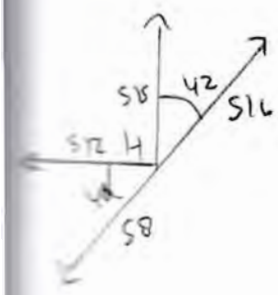
$0,66 \times S8 + 1669,33 + S3 = 0$

$0,66 \times S8 + 166,33 + (-1235,30) = 0$

$S8 = \frac{434,03}{0,66}$

$S8 = 657,62 \text{ kg}$ (Tarik)

Titik buhul H



$\Sigma V = 0$

$S15 + S8 \sin 48 + S16 \sin 48° = 0$

$S15 + 657,62 \times 0,74 - S16 \times 0,74 = 0 \quad \ldots (1)$

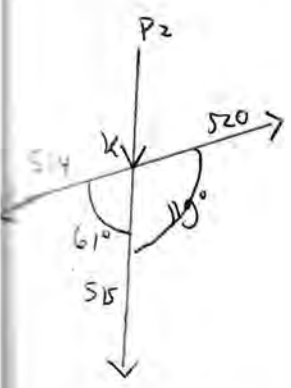
$\Sigma H = 0$

$S12 + S8 \cos 57 + S16 \cos 57 = 0$

$3157,36 + 657,62 + 0,66 + S16 \times 0,66 = 0$

$S16 = \frac{749,38}{0,66}$

Titik buhul K



$\Sigma H = 0$

$S14 \sin 48° - S20 \sin 48° = 0$

$0,87 \times -1710,41 - 0,87 \times S20 = 0$

$-S20 = \frac{1250,26}{0,780}$

$S20 = -1488,81$ kg (Tekan)

Besaran Gaya Sama Pada Batang - batang berikut ini

$S1 = S5$

$S2 = S4$

$S3 = S3$

$S6 = S11$

$S7 = S10$

$S8 = S9$

$S12 = S13$

$S14 = S19$

$S15 = S18$

$S16 = S17$

$S20 = S21$

REKAPITULASI GAYA BATANG AKIBAT BEBAN TETAP

No. Batang	BEBAN MATI		BEBAN HIDUP		BEBAN TETAP	
	Batang Tarik (+)	Batang Tekan (-)	Batang Tarik (+)	Batang Tekan (-)	Batang Tarik (+)	Batang Tekan (-)
S 1	2738,67	-	1669.33	-	4408	-
S 2	2738,67	-	1669.33	-	4408	-
S 3	-	(2026.61)	-	(1235.30)	-	(3261.91)
S 4	2738,67	-	1669.33	-	4408	-
S 5	2738,67	-	1669.33	-	4408	-
S 6	-	(3147.9)	-	(1918.75)	-	(5066.65)
S 7	-	-	-	-	-	-
S 8	1078.87	-	657,62	-	1736,49	-
S 9	1078.87	-	657,62	-	1736,49	-
S 10	-	-	-	-	-	-
S 11	-	(3147.9)	-	(1918.75)	-	(5066.65)
S 12	3234.52	-	3157.36	-	6391.88	-
S 13	3234.52	-	3157.36	-	6391.88	-
S 14	-	(2447.89)	-	(1710.41)	-	(4158.3)
S 15	-	(4505,42)	-	(1326.85)	-	(5832,27)
S 16	-	(5009,65)	-	(1135.43)	-	(6145,08)
S 17	-	(5009,65)	-	(1135.43)	-	(6145,08)
S 18	-	(4505,42)	-	(1326.85)	-	(5832,27)
S 19	-	(2447.89)	-	(1710.41)	-	(4158.3)
S 20	-	(2447.88)	-	(1488.81)	-	(3936.69)
S 21	-	(2447.88)	-	(1488.81)	-	(3936.69)
D 1	-	(358.98)	-	(150.00)	-	(508,98)
D 2	-	(358.98)	-	(150.00)	-	(508,98)
D 3	982	-	280.9	-	1262.9	-
D 4	982	-	280.9	-	1262.9	-
D 5	-	(312.04)	-	100	-	(412.04)
D 6	-	(1374.8)	-	393.26	-	(1768,06)
D 7	-	(1374.8)	-	393.26	-	(1768,06)

Perhitungan Gaya Batang Akibat beban angin datang

Perhitungan Reaksi dititik K dan L

$\Sigma M_B = 0$

$RAV \times 18 - wda \sin 29 \times 18 - wda \sin 29 \times 12 + wda \sin 29 \times 9 - 0 \times 6 - 0 \times 3 - 0 \times$

$RAV \times 18 - 22,28 \times 18 - 22,28 \times 12 + 22,28 \times 9 - 0 \times 6 - 0 \times 3 - 0 \times 0 = 0$

$RAV = 66,84$

$\Sigma M_A = 0$

$RBV \times 18 - wda \sin 29 \times 0 - wda \sin 29 \times 3 - wda \sin 38 \times 6 + wd \sin 29 \times 9 - 0 \times 12$

$- 0 \times 15 - 0 \times 18 = 0$

$RBV \times 18 - 22,28 \times 0 - 22,28 \times 3 - 22,28 \times 6 + 22,28 \times 9 - 0 \times 2 - 0 \times 15 - 0 \times 18 = 0$

$RBV = 22,28$ kg

$\Sigma ML = 0 \rightarrow RAV + RBV - (4 \times wda \sin 29)$

$= 89,11$ kg $- 89,11$ kg $= 0 \rightarrow$ OK

Perhitungan gaya batang

Titik buhul A

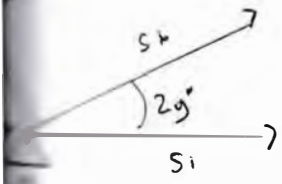
$\Sigma V = 0$

$RAV + S6 \sin 29 - wda \sin 29 = 0$

$66,84 + 0,48 \times S6 - 22,28 = 0$

$-S6 = \frac{44,56}{0,48}$

$S6 = -92,83$ kg (Tekan)



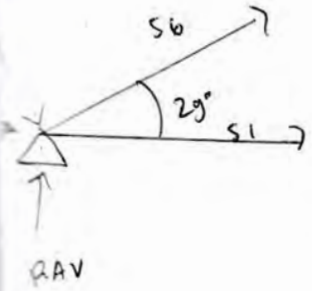
$\Sigma H = 0$

$S6 \cos 29 + S1 + wda \cos 29 = 0$

$80,42 + (-92,83) + S1 + 17,41 = 0$

$S1 = 63,35$ kg (Tarik)

Titik Buhul A



$\Sigma V = 0$

$RAV + S6 \sin 29 - Wda \sin 29^\circ = 0$

$66,84 + 0,48 \times S6 - 22,28 = 0$

$-S6 = \frac{44,56}{0,48}$

$S6 = -92,83$ kg (Tekan)

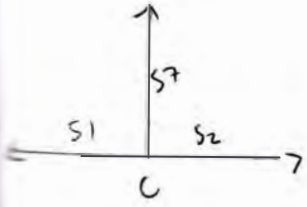
$\Sigma H = 0$

$S6 \cos 29 + S1 + Wda \cos 29 = 0$

$0,87 \times (-92,83) + S1 + 17,41 = 0$

$S1 = 63,35$ kg (Tarik)

Titik buhul C



$\Sigma V = 0$

$S7 = 0$ kg

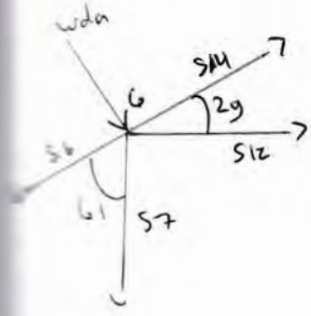
$\Sigma H = 0$

$S2 - S1 = 0$

$S2 - 63,35 = 0$

$S2 = 63,35$ kg (Tarik)

Titik buhul G



$\Sigma V = 0$

$Wda \sin 29 + S7 + S6 \sin 29 + S14 \sin 29^\circ = 0$

$22,28 + 0 + 0,48 \times -92,83 + 0,48 \times S14 = 0$

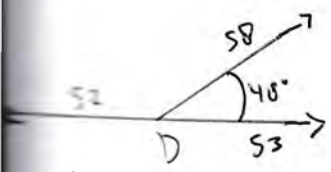
$-S14 = \frac{22,27}{0,48}$

$S14 = -46,39$ kg (Tekan)

$\Sigma H = 0$

$S14 \cos 29 + S6 \times \cos 29 + S12 = 0$

Titik Buhul D



$\Sigma V = 0$

$S8 \sin 48° = 0$

$S8 \times 0{,}74 = 0 \quad \ldots (1)$

$\Sigma H = 0$

$S8 \cos 48 + S_2 + S_2 = 0$

$0{,}66 \times S8 + 63{,}35 + S3 = 0 \quad \ldots (2)$

Pers 1 dan 2 di eliminasi

$0{,}74 \times S8 = 0 \quad | \times 0{,}66$

$0{,}66 \times S8 + 63{,}35 + S3 = 0 \quad | \times 0{,}74$

$0{,}48 \times S8 = 0$

$0{,}48 \times S8 + 46{,}87 + S3 = 0$

$S3 = -46{,}87$ kg (tekan)

Masukkan nilai S3 ke Pers 2

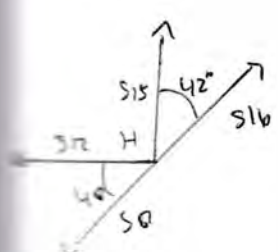
$0{,}66 \times S8 + 63{,}35 + S3 = 0$

$0{,}66 \times S8 + 63{,}35 + -46{,}87 = 0$

$S8 = \frac{16{,}48}{0{,}66}$

$S8 = 24{,}96$ kg (Tarik)

Titik Buhul H



$\Sigma V = 0$

$S15 + S8 \sin 48 + S16 \sin 48 = 0$

$S15 + 24{,}96 \times 0{,}74 - S16 \times 0{,}74 = 0 \ldots (1)$

$\Sigma H = 0$

$S12 + S8 \cos 48 + S16 \cos 48 = 0$

$-21{,}12 + 24{,}96 \times 0{,}66 + S16 \times 0{,}66 = 0$

$-S16 = 137{,}50$

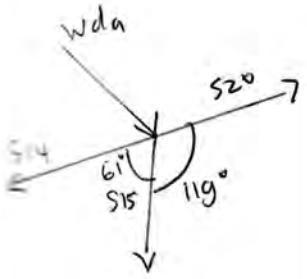
Memasukkan nilai S16 ke pers I

$S15 + 24,96 \times 0,74 - S16 \times 0,74 = 0$

$S15 + 24,96 \times 0,74 + 208,47 \times 0,74 = 0$

$S15 = -172,73$ kg (tekan)

Titik buhul K



$\Sigma H = 0$

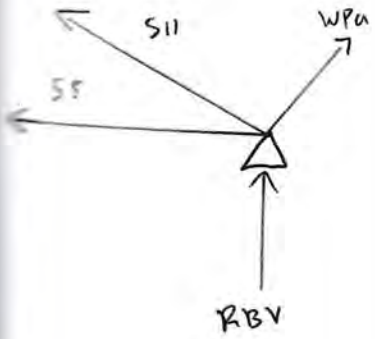
$S14 \sin 61° - S20 \sin 61° = 0$

$0,87 \times -46,39 - 0,87 \times S20 = 0$

$-S20 = \frac{40,35}{0,87}$

$S20 = -46,37$ kg (tekan)

Titik buhul B



$\Sigma V = 0$

$RBV + S11 \times \sin 29 = 0$

$22,28 + 0,48 \times S11 = 0$

$-S11 = \frac{22,28}{0,48}$

$S11 = -46,41$ kg (tekan)

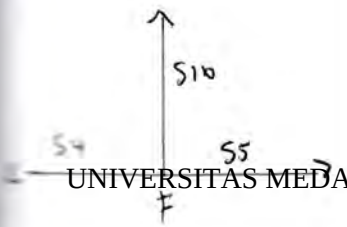
$\Sigma H = 0$

$S11 \times \cos 29 + S5 = 0$

$0,87 \times (-46,41) + S5 = 0$

$S5 = 40,37$ kg (Tarik)

Titik buhul F



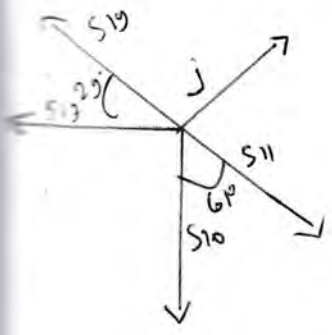
$\Sigma V = 0$

$S10 = 0$ kg

$\Sigma H = 0$

$S4 - S5 = 0$

Titik buhul J



$\Sigma V = 0$

$S10 + S11 \sin 2g + S1g \sin 2g = 0$

$0 + 0{,}48 \times -46{,}41 + 0{,}48 \times S1g = 0$

$-S1g = \frac{22{,}27}{0{,}48}$

$S1g = -46{,}39$ kg (Tekan)

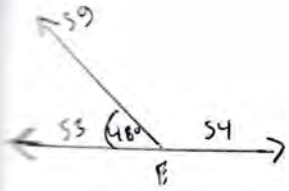
$\Sigma H = 0$

$S1g \cos 2g + S1 \cos 2g + S13 = 0$

$46{,}41 \times 0{,}87 + -46{,}41 \times 0{,}87 + S13 = 0$

$S13 = 80{,}75$ kg (Tarik)

Titik buhul E



$\Sigma V = 0$

$S9 \sin 48 = 0$

$S9 \times 0{,}74 = 0$ ... (1)

$\Sigma H = 0$

$S9 \cos 48 + S4 + S3 = 0$

$0{,}66 \times S9 + 40{,}37 + S3 = 0$ -- (2)

Eliminasi Pers 1 dan 2

$0{,}74 \times S9 = 0 \quad | \times 0{,}66$

$0{,}66 \times S9 + 40{,}37 + S3 = 0 \quad | \times 0{,}74$

$0{,}456 \times S4 = 0$

$0{,}456 \times S9 + 29{,}87 + S3 = 0$

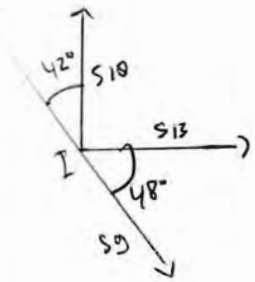
$S3 = -29{,}87$ kg (tekan)

Masukkan nilai S3 ke pers 2

$0{,}66 \times S9 + 40{,}37 + S3 = 0$

$0{,}66 \times S9 + 40{,}37 + (-29{,}87) = 0$

Titik buhul I



$\Sigma V = 0$

$S18 + S9 \sin 48 + S17 \sin 48 = 0$

$S18 + 15,9 \times 0,74 - S17 \times 0,74 = 0 \quad \ldots (1)$

$\Sigma H = 0$

$S13 + S9 \cos 48° + S17 \cos 48 = 0$

$80,75 + 15,9 \times 0,66 + S17 \times 0,66 = 0$

$-S17 = \frac{91,24}{0,66}$

$S17 = -138,24$ kg (Tekan)

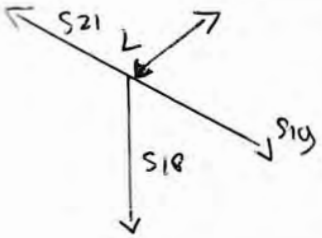
memasukkan nilai S16 ke pers 1

$S18 + 15,9 \times 0,74 - S17, 0,74$

$S18 + 15,9 \times 0,74 - (-138,24) \times 0,74 = 0$

$S18 = -114,06$ kg (Tekan)

Titik Buhul L



$\Sigma H = 0$

$S19 \sin 52 - S21 \sin 52° = 0$

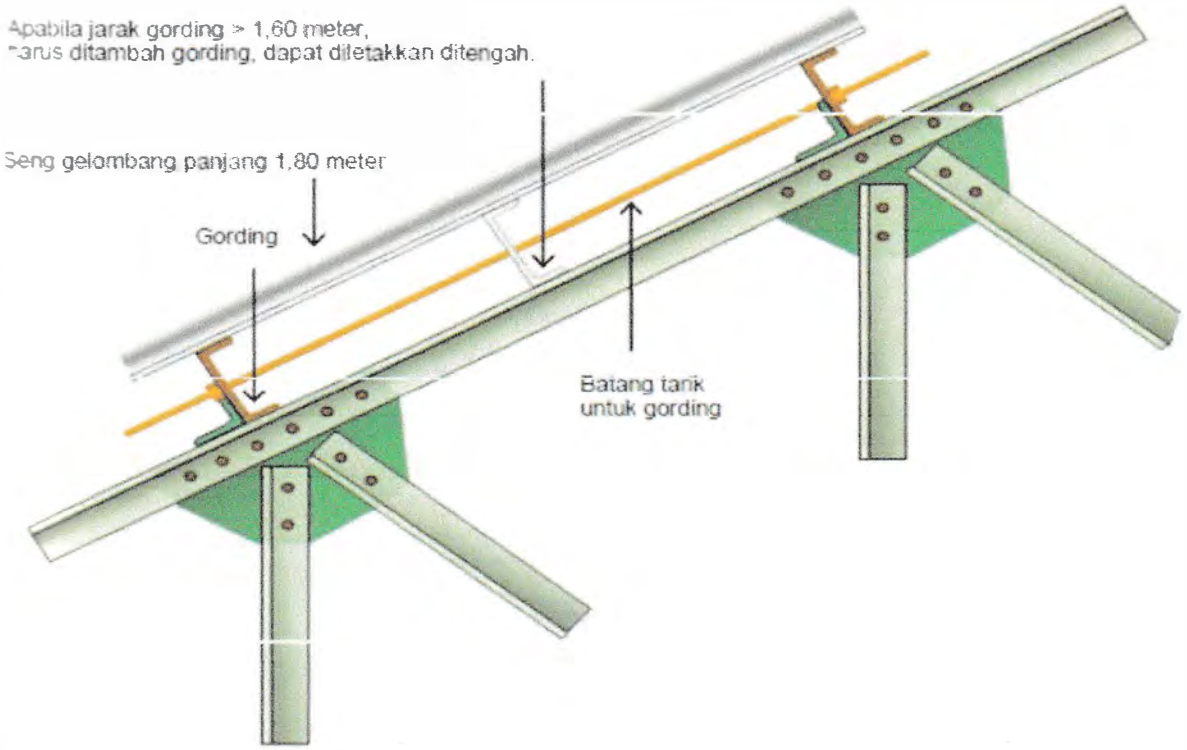
$0,87 \times -46,39 - 0,87 \times S2 = 0$

$-S21 = \frac{40,35}{0,87}$

$S21 = -57,64$ kg (Tekan

REKAPITULASI GAYA BATANG AKIBAT BEBAN TETAP

No. Batang	BEBAN TETAP		BEBAN ANGIN		BEBAN DIPAKAI	
	Batang Tarik (+)	Batang Tekan (-)	Batang Tarik (+)	Batang Tekan (-)	Batang Tarik (+)	Batang Tekan (-)
S 1	4408	-	63.35	-	4408	-
S 2	4408	-	63.35	-	4408	-
S 3	-	(3261.91))	-	(46.87)	-	(3261.91)
S 4	4408	-	40.37	-	4408	-
S 5	4408	-	40.37	-	4408	-
S 6	-	(5066.65)	-	(92.83)	-	(5066.65)
S 7	-	-	-	-	-	-
S 8	1736,49	-	24.96	-	1736,49	-
S 9	1736,49	-	24.96	-	1736,49	-
S 10	-	-	-	-	-	-
S 11	-	(5066.65)	-	(36.19)	-	(5066.65)
S 12	6391.88	-	121.12	-	6391.88	-
S 13	6391.88	-	80.75	-	6391.88	-
S 14	-	(4158.3))	-	(46.39)	-	(4158.3)
S 15	-	(5832,27)	-	(172.73)	-	(5832,27)
S 16	-	(6145,08)	-	(208,47)	-	(6145,08)
S 17	-	(6145,08)	-	(138.24)	-	(6145,08)
S 18	-	(5832,27)	-	(114.06)	-	(5832,27)
S 19	-	(4158.3))	-	(46.39)	-	(4158.3)
S 20	-	(3936.69)	-	(46.37)	-	(3936.69)
S 21	-	(3936.69)	-	(57.64)	-	(3936.69)
D 1	-	(508,98)	-	(4.1)	-	(508,98)
D 2	-	(508,98)	-	(2.99	-	(508,98)
D 3	1262.9	-	-	(5.39)	1262.9	-
D 4	1262.9	-	3.36	-	1262.9	-
D 5	-	(412.04)	6.66	-	-	(412.04)
D 6	-	(1768,06)	-	(9.22)	-	(1768,06)
D 7	-	(1768,06)	-	(4.71)	-	(1768,06)



I. DIMENSI GORDING DALAM 3 (TIGA) VARIASI

Jarak Gording Dalam Perencanaan Ini Harus Disesuaikan Dengan Ukuran Penutup Atap, Dalam Perencanaan ini penutup atap yang digunakan :

SENG BJLS, DENGAN PANJANG, L = 1.80 M

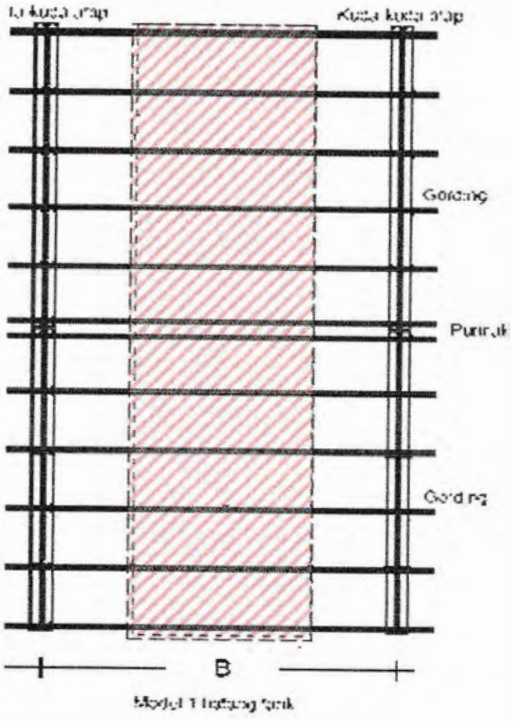
Dengan Demikian, Dengan Jarak Overlap BJLS = 0.20 m x 2 (Atas Dan Bawah), Sehingga Panjang Efektif Seng BJLS = 1.40 M

JARAK GORDING ≤ 1.40 M

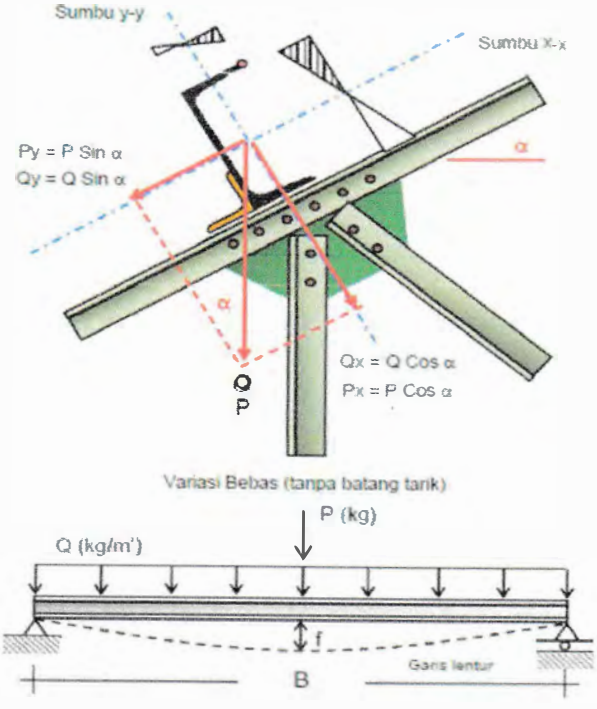
Perencanaan Gording Ini Dicoba Dengan 3 (Tiga) Variasi Yaitu :

1. **VARIASI-A TANPA BATANG TARIK**
2. **VARIASI-B DENGAN SATU BATANG TARIK (TUNGGAL)**
3. **VARIASI-C DENGAN DUA BATANG TARIK (GANDA)**

VARIASI-A TANPA BATANG TARIK



D



Variasi - A Tanpa batang tarik

A Perhitungan beban

a Beban mati

- penutup atap seng bergelombang = 1,27 x 10 = 12,70 kg/m
- Asumsi Berat Gording = 23,80 kg/m

Jumlah QDL = 36,50 kg/m

b Beban hidup

- Beban terpusat ditengah batang = 100 kg

JLh PLL = 100 kg

C Beban Angin

- Pada bidang angin $\alpha = 65° - 90° \rightarrow C = 0,90$, $\alpha \leq 65° \rightarrow C = 0,02 \times \alpha - 0,40$ (Angin datang)
- Pada bidang tidak ada angin $\rightarrow C = -0,40$ (angin pergi)
- Beban angin yg diambil = 0,90 x 1,27 x 25 = 28,58 kg/m

B Tegangan Izin

- Mutu baja : St. 37
- Pembebanan tetap = 1600 kg/cm² (σ_t)
- Pembebanan Sementara = 1,3 x 1600 = 2080 kg/cm² (σ_s)

C Lendutan max yg diizinkan

- Batas lendutan max arah vertikal untuk DL dan LL

$$f = \frac{1}{250} \times B = \frac{1}{250} \times 5 = 0,02\ m = 2,00\ cm$$

D Perhitungan momen untuk masing² Beban

a. Beban mati (QDL)

$$M_{yG} = \frac{1}{8} \times Q_{DL} \times \cos 2g \times B^2 = \frac{1}{8} \times 36,50 \times 0,970 \times 25 = 99,23\ kg.m$$

$$M_{xG} = \frac{1}{8} \times Q_{DL} \times \sin 2g \times B^2 = \frac{1}{8} \times 36,50 \times 0,480 \times 25 = 54,75\ kg.m$$

b Beban hidup (PLL)

$$M_{yP} = \frac{1}{4} \times P_{LL} \times \cos 2g \times B = \frac{1}{4} \times 100 \times 0,870 \times 5 = 108,75\ kg.m$$

$$M_{xP} = \frac{1}{4} \times P_{LL} \times \sin 2g \times B = \frac{1}{4} \times 100 \times 0,480 \times 5 = 60,00\ kg.m$$

C. Beban Angin (WLL)

$M_{yW} = 0$ kg.m

$M_{xW} = \frac{1}{8} \times W_{DL} \times B^2 = \frac{1}{8} \times 28{,}58 \times 25 = 89{,}30$ kg m

E. Perhitungan momen maksimum dengan kombinasi beban

a. Pembebanan tetap ($\sigma_t = 1600$ kg/cm²)

$M_{y\,max} = M_{yQ} + M_{yP} = 99{,}23 + 108{,}75$ kg.m $= 207{,}98$ kg.m

$M_{x\,max} = M_{xQ} + M_{xP} = 54{,}75 + 60 = 114{,}75$ kg.m

b. Pembebanan Sementara ($\sigma_s = 2080$ kg/cm²)

$M_{y\,max} = M_{yQ} + M_{yP} + M_{yW} = 99{,}23 + 108{,}75 + 0 = 207{,}98$ kg.m

$M_{x\,max} = M_{xQ} + M_{xP} + M_{xW} = 54{,}75 + 60{,}00 + 89{,}30 = 204{,}05$ kg.m

c. Momen max yg digunakan utk Perhitungan

$M_{x\,max} = 204{,}05$ kgm $= 20{,}405$ kg cm

F. Perhitungan Tahanan momen untuk memperoleh dimensi Profil

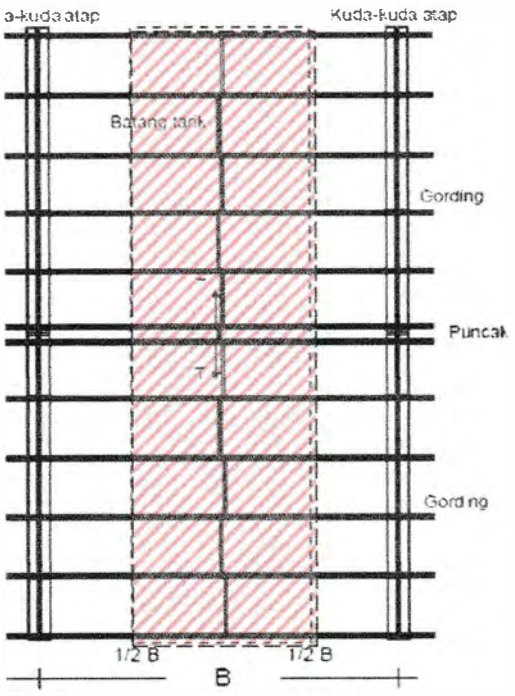
$$\sigma_s = \frac{M_{x\,max}}{W}$$

$$2080 = \frac{20{,}405}{W}$$

$$W = \frac{20{,}405}{2080}$$

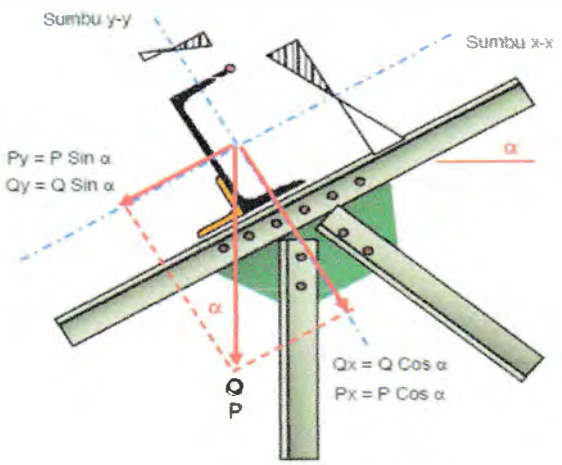
$W = 9{,}81$ cm³

2. VARIASI-B DENGAN SATU BATANG TARIK (TUNGGAL)

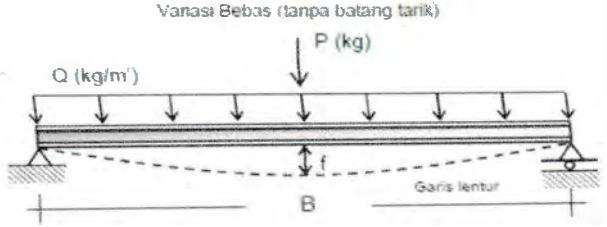


Model 1 batang tarik

D



Variasi Bebas (tanpa batang tarik)



Varians - B dengan satu batang tarik (tunggal)

- Rekap perhitungan item A S C item D Varians A

Q_{DL} = 36,50 kg.m

P_{LL} = 100 kg

W_{LL} = 28,58 kg

σ_t 1600 kg.m

σ_s = 2080 kgm

f = 2 cm

l_B = 2,5 m

- Perhitungan momen max dengan kombinasi beban

a. beban mati (Q_{DL})

$m_{yQ} = \frac{1}{8} \times 36,50 \times 0,870 \times 6,25 = 24,80$ kg.m

$m_{xQ} = \frac{1}{8} \times 3650 \times 0,480 \times 6,25 = 13,68$ kg.m

b. beban hidup (P_{LL})

$m_{yP} = \frac{1}{4} \times 100 \times 0,870 \times 2,5 = 54,37$ kg.m

$m_{xP} = \frac{1}{4} \times 100 \times 0,480 \times 2,5 = 30$ kg.m

C. beban Angin(W_{LL})

$m_{yW} = 0$ kg.m

$m_{xW} = \frac{1}{8} \times 28,58 \times 2,5 = 8,93$ kg.m

- Perhitungan momen max dengan kombinasi beban

$M_{xmax} = m_{xQ} + m_{xP} + m_{xW} = 13,68 + 30 + 8,93 = 52,61$ kg.m $\approx$ 53 kg.m

- Perhitungan tahanan momen untuk memperoleh dimensi Profil

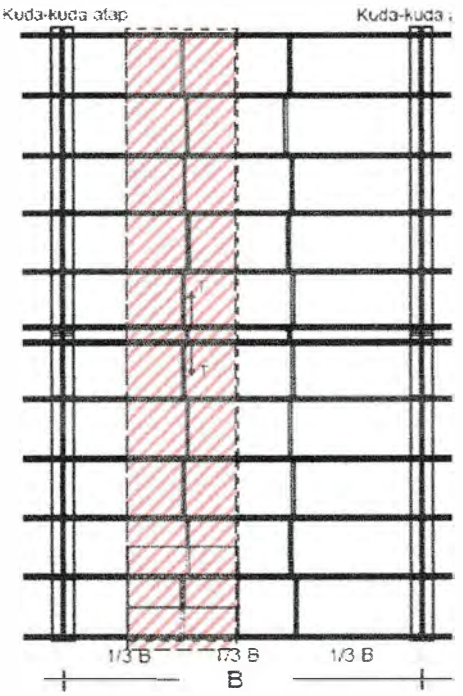
$\sigma_s = \frac{M_{xmax}}{W}$

$2080 = \frac{853}{W}$

$W = \frac{53}{2080}$

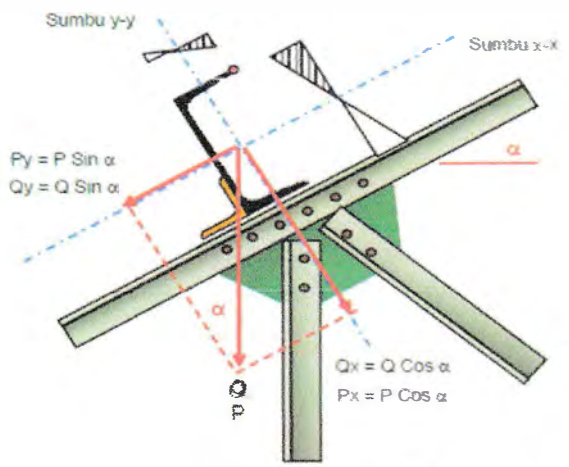
$W = 0,02$ cm^3

3. VARIASI-C DENGAN DUA BATANG TARIK (GANDA)

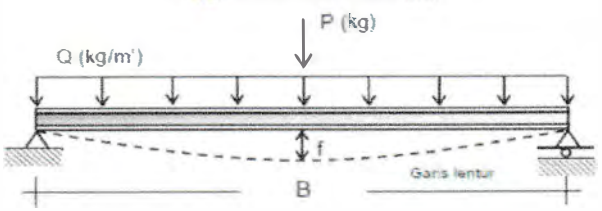


Model 2 batang tarik

D



Variasi Bebas (tanpa batang tarik)



3 Varians C dengan 2 batang tarik (Ganda)

- Rekap Perhitungan Item A s.d Item D Varians A

Q_{DL} = 36,50 kg.m

P_{LL} = 100 kg

W_{LL} = 28,58 kg.m

σ_E = 1600 kg.m

σ_S = 2080 kg.m

f = 2 cm

1/3 B = 1.67 m

- Perhitungan momen max dengan kombinasi beban

a. beban mati (QDL)

$m_{yQ} = \frac{1}{8} \times 36,50 \times 0,870 \times 2,8 = 11,03$ kg.m

$m_{xQ} = \frac{1}{8} \times 36,50 \times 0,480 \times 2,8 = 6,08$ kg.m

b. beban hidup (PLL)

$m_{yP} = \frac{1}{4} \times 100 \times 0,870 \times 1,7 = 36,25$ kg.m

$m_{xP} = \frac{1}{4} \times 100 \times 0,480 \times 1,7 = 20$ kg.m

C. Beban angin (WLL)

$m_{yW} = 0$ kg.m

$m_{xW} = \frac{1}{8} \times 28,58 \times 2,8 = 9,92$ kg.m

- Perhitungan momen max dengan kombinasi beban

$m_{x\,max} = 36,01$ kg.m = 36 kg.cm

- Perhitungan tahanan momen untuk memperoleh dimensi profil

$\sigma_S = \frac{m_{x\,max}}{W}$

$2080 = \frac{36}{W}$

$W = \frac{36}{2080}$

$W = 0,017 \approx 0,02$ cm³

Pemilihan Profil Gording

A. Dari hasil Perhitungan

1. Variasi A Tanpa batang tarik

Tahanan momen = 9,81 cm^3

2. Variasi B Dengan 1 batang tarik (tunggal)

Tahanan momen = 0,02 cm^3

3 Variasi C Dengan dua batang tarik (Ganda)

Tahanan momen = 0,02 cm^3

W yang diambil harus $\geq$ 0,02 cm^3 dan $\leq$ 9,81 cm^3

Data yang mendekati adalah

C 75 x 45 x 15 x 1,6 W = 7,24 cm^3

Wx = 7,24 cm^3

Wy = 3,13 cm^3

Ix = 27,1 cm^3

Iy = 8,71 cm^3

5. Kontrol Tegangan

1. Variasi A tanpa Batang tarik

$$\sigma_s = \frac{m_{max}}{W_x} + \frac{My_{max}}{W_y}$$

$$2080 \geq \frac{204.05}{7,24} + \frac{207,98}{3.13}$$

$$2080 \geq 28,18 + 66,44$$

$$2080 \geq 94,62 \quad (OK)$$

2. Variasi B dengan 1 batang tarik (tunggal)

$$2080 \geq \frac{53}{7,24} + \frac{79}{3,13}$$

$$2080 \geq 7,32 + 25,23$$

$$2080 \geq 32,55 \quad (OK)$$

3. Variasi C dengan dua batang tarik (Ganda)

$$2080 \geq \frac{3601}{7,24} + \frac{47,20}{3,13}$$

$$2080 \geq 4,97 + 15,10$$

$$2080 \geq 20,07 \quad (OK)$$

6. Kontrol lendutan

Variasi A Tanpa bantang tarik

Data

$Q_{DL} = 36,50$ kg.m

$P_{LL} = 100$ kg

$W_{LL} = 28,58$ kg

$EI = 2,10E+06\ (2,1 \times 10^6)$

$I_x = 27,1\ cm^3$

$I_y = 8,71\ cm^3$

$\sin 29^\circ = 0,480$

$\cos 29 = 0,870$

$B = 5$ m

a. beban mati (QDL)

$$F_x = \frac{4}{384} \times \frac{Q_{DL} \times \sin 29 \times B^4}{EI \times L \times} \rightarrow \times 10^6$$

$$= 0,01 \times \frac{1,1 \times 10^{10}}{5,69 \times 10^7}$$

$$= 2\ cm$$

$$F_y = \frac{4}{384} \times \frac{Q_{DL} \times \cos 29 \times B^4}{EI \times I_y}$$

$$= \frac{4}{384} \times \frac{1,98 \times 10^{10}}{1,83 \times 10^7}$$

$= 11,30\ cm > 2,00\ cm$ Lendutan Ok

2 Variasi B dengan 1 batang Tarik (tunggal)

Data

$Q_{DL} = 36,50$ kg.m $\sin 29° = 0,480$

$P_{LL} = 100$ kg $\cos 29° = 0,876$

$W_{LL} = 28,58$ kg.m $\frac{1}{2}B = 2$ m

$EI = 2,1 \times 10^6$

$Lx = 2,71\ cm^3$

$Ly = 8,71\ cm^3$

a. beban mati (Q_{DL})

$$Fx = \frac{4}{384} \times \frac{2,8 \times 10^8}{5,69 \times 10^7}$$

$= 0,05$ cm

$$Fy = \frac{4}{384} \times \frac{5,08 \times 10^8}{1,83 \times 10^7}$$

$= 0,29$ cm

b. beban mati (P_{LL})

$$f_x = \frac{1}{48} \times \frac{P_{LL} \times \sin 29 \times \frac{1}{2}B^4}{EI \times Lx}$$

$$= \frac{1}{48} \times \frac{7,68 \times 10^8}{5,69 \times 10^7}$$

$= 0,28$ cm

$$f_y = \frac{1}{48} \times \frac{P_{LL} \times \cos 29 \times \frac{1}{2}B^4}{EI \times Ly}$$

$$= \frac{1}{48} \times \frac{1,39 \times 10^9}{1,83 \times 10^7}$$

$= 1,59$ cm

c. beban angin (W_{LL})

$$Fx = \frac{4}{384} \times \frac{W_{LL} \times \sin 29 \times \frac{1}{2}B^4}{EI \times Lx}$$

$$= \frac{4}{384} \times \frac{2,10 \times 10^8}{5,69 \times 10^7}$$

$= 0,04$ cm

d. kombinasi lendutan

$fx = 0,05 + 0,28 = 0,33$ cm

$fy = 0,29 + 1,59 = 1,87$ cm

Maka lendutan max

$$F_{max} = \sqrt{F_x^2 + F_y^2}$$

$$= \sqrt{0,11 + 3,51}$$

$$= 1,9 \text{ cm} \leq 2 \text{ cm} \quad \text{Lendutan (Ok)}$$

3. Variasi C Dengan dua batang tarik (Ganda)

Data

$\frac{1}{3}B = 1,67$

a. Beban mati (QDL)

$$F_x = \frac{4}{384} \times \frac{1,36 \times 10^9}{5,69 \times 10^7}$$

$$= 0,02 \text{ cm}$$

$$F_y = \frac{3}{384} \times \frac{2,47 \times 10^8}{1,83 \times 10^7}$$

$$= 0,14 \text{ cm}$$

b. Beban hidup (PLL)

$$F_x = \frac{1}{48} \times \frac{3,73 \times 10^8}{5,69 \times 10^7}$$

$$= 0,14$$

$$F_y = \frac{1}{48} \times \frac{6,77 \times 10^8}{1,83 \times 10^7}$$

$$= 0,77 \text{ cm}$$

c. Beban angin

$$F_x = \frac{4}{384} \times \frac{1,07 \times 10^8}{5,69 \times 10^7}$$

$$= 0,02$$

d. Kombinasi lendutan

$$F_x = 0,02 + 0,14 = 0,16 \text{ cm}$$

$$F_y = 0,14 + 0,77 = 0,91 \text{ cm}$$

Maka lendutan max

$$F_{max} = \sqrt{F_x^2 + F_y^2}$$

$$= \sqrt{0,03 + 0,83}$$

$$= 0,93 \text{ cm} \leq 2 \text{ cm} \quad \text{Lendutan (Ok)}$$

7. Dimensi dan Variasi Gording

Profil baja yang digunakan

C 75 x 45 x 15 x 1,6 mm

A = 75 mm	Ix = 27,1 cm^4
B = 45 mm	Iy = 8,71 cm^4
C = 15 mm	Wx = 7,24 cm^3
t = 1,6 mm	Wy = 3,13 cm^3
q = 2,32 mm	F = 2,952 cm^3

8. Dimensi Batang Tarik

A. Beban yang bekerja

- Penutup Atap Seng bergelombang = 1,27 × 1,67 × 10 × 0,480 = 10,18 kg
- Gording = 1,67 × 2,32 × 0,480 = 1,86 kg
- Beban hidup = 100 × 0,480 = 48 kg

= 60,04 kg

B. Rancana Dimensi

$$\sigma_s \geq \frac{P / \cos\theta}{\frac{1}{4}\pi d^2}$$

$$1600 \geq \frac{660 / \cos 29^\circ}{0{,}25 \cdot 3{,}14\, d^2}$$

$$d^2 \geq \frac{759{,}13}{1256}$$

$$d^2 \geq 0{,}78 \text{ cm}$$

Diambil diameter batang tarik besi beton ϕ 12 mm

Direncanakan profil Batang

Batang tarik

a. Batang tarik tersusun dari baja siku ganda

b. gaya batang, Pembebanan tetap : 4408 kg (N)

c. Panjang batang kritis = 3000 mm (Lk)

Ketentuan

a. Tegangan izin dasar, Pembebanan tetap = 1600 kg/cm²

b. Tegangan izin tarik (75% x σ) Pembebanan tetap = 1200 kg/cm²

c. Kelangsingan max λmax = 240

d. Jari² inersia Imin > Lk/λmax = $\frac{300}{240}$ = 1,25 cm

e. Jumlah lubang < 15% x F netto

f. Ditentukan Profil minimum batang Struktur ⌋L 100.100.8

Perhitungan

$$A_{netto} = \frac{N}{\sigma n} = \frac{4408}{1200} = 3{,}67 \text{ cm}^2$$

$$A_{brutto} = \frac{A_{netto}}{\text{[illegible]}} = \frac{3{,}67}{\text{[illegible]}} = 4{,}31 \text{ cm}^2$$

Dari tabel diperoleh ⌋L 100.100.8, F = 15,47 C_2,2f = 30,94. 48,1x = 3,07 > 2,08 OK

Kontrol tegangan

Anetto = 85 % = 2f = 26,30 cm²

$$\sigma = \frac{N}{A_{netto}} = \frac{4408}{26{,}30} = 167{,}6 \text{ cm}^2 < 1200 \text{ kg/cm}^2 \text{ ... OK}$$

Direncanakan profil Batang

Batang tarik

a. Batang tarik tersusun dari baja siku ganda

b. gaya batang, Pembebanan tetap : 4408 kg (N)

c. Panjang bentang kritis = 3000 mm (Lk)

Ketentuan

a. Tegangan izin dasar, Pembebanan tetap = 1600 kg/cm²

b. Tegangan izin tarik (75% x5) Pembebanan tetap = 1200 kg/cm²

c. kelangsingan max λmax = 240

d. Jari² inersia Imin > Lk/λmax = $\frac{300}{240}$ = 1,25 cm

e. Jumlah lubang < 15% x F netto

f. Ditentukan Profil minimum batang Struktur JL 100.100.8

Perhitungan

$$A_{netto} = \frac{N}{\sigma n} = \frac{4408}{1200} = 3,67 \text{ cm}^2$$

$$A_{brutto} = \frac{A_{netto}}{85\%} = \frac{3,67}{0,85} = 4,31 \text{ cm}^2$$

Dari tabel diperoleh JL 100.100.8, f = 15,47 $C_{2,2f}$ = 30,94. 48,1x = 3,07 > 2,00 OK

Kontrol tegangan

Anetto = 85 % = 2f = 26,30 cm²

$$\sigma = \frac{N}{A_{netto}} = \frac{4408}{26,30} = 167,6 \text{ cm}^2 < 1200 \text{ kg/cm}^2 \text{ ... OK}$$

Kontrol kelangsingan

$$\lambda = \frac{Lk}{i_x} = \frac{3}{3,07} = 0,97$$

Batang tarik yg menggunakan ⊥L 100.100.8

t : 8 mm

k : 9 mm

r_1 : 10 mm

r_2 : 5 mm

F : 30,94 cm^2

W : 24,29 kg

I_x : 292 cm^4

I_y : 600,03 cm^4

i_x : 5,07 cm

i_y : 4,44 cm

S_x : 40,28 cm

S_y : 58,26 cm

Batang tekan

a. batang tekan tersusun dari baja siku ganda

b. gaya batang, Pembebanan tetap = 11,330, 25 kg (N)

c. Panjang tekuk : 5.550 mm (Lk)

Ketentuan

a. tebal Plat buhul = 10 mm

b. tebal plat kopel : 5 mm

c alat sambung paku : 10mm

- Tegangan izin dsr $\bar{\sigma}$: 1400 kg/cm²

- Geser $\bar{\tau}$: 1120 kg/cm²

- Desak S1 > 2d $\overline{\sigma ds}$: 2 800 kg/cm²

- Desak 1.5d ≤ S1 $\overline{\sigma ds}$ = 2400 kg /cm

-1 Tegangan izin Pl $\bar{\tau}$: 812 kg/cm²

d. Kelangsingan max λ max : 200

e jari² inersia Imin > Lk / λmaks = $\frac{555}{200}$ = 2,78 cm

f Profil minimum bg struktur ⅃L 100.100.8

λx > 110

$\lambda = \frac{Lk}{Ix} = \frac{555}{3,07}$ = 180,78 > 110 kg/cm² ... ok

momen inersia tausir

I tausir = 1,21 × -3596,35 × 2,32²

= 23,42 cm⁴ Satu profil 11,71 cm⁴

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Control tekuk

a. thd tekuk 1 sb x

$$\lambda = \frac{Lk}{ix} = \frac{555}{3,07} = 180,78$$

Faktor tekuk

$$\lambda g = \pi \times \sqrt{\frac{E}{0,70 \times 1200}} \qquad \omega = \frac{\lambda}{\lambda g} = \frac{180,78}{171,30} = 1,06$$

$$= 3,14 \times \sqrt{\frac{2500000}{840}} \qquad \omega x = 1,61$$

$$\lambda g = 171,30$$

Tegangan tekuk

$$\sigma x = \omega x \frac{N}{A\,total} = 1,61 \frac{-11338,95}{30,94} = -590,04 < 1200 \text{ kg/cm}^2$$

b. thdp tekuk 1 sb -y

$$Iy\,total = 2\,(Iy + A\,(y_{2a})^2)$$

$$a = 2e + y$$

$$= 3,36$$

$$Iy = 1239,58 \text{ cm}^4$$

$$iy = \sqrt{\frac{Iy\,tot}{A\,tot}} = \sqrt{\frac{1239,58}{30,94}} = 6,33 \text{ cm}$$

$$\lambda = \frac{Lk}{iy} = \frac{555,}{6.33} = 87,68 \text{ cm}$$

$$\lambda iy = \sqrt{\lambda y^2 + \frac{m}{2} \lambda_1^2}$$

dimana

$$\lambda y = 58,26$$

$$\lambda_y = \frac{L_k/n}{i_{min}} \leq 50$$

$$50 = \frac{555/n}{1,66}$$

$$n = \frac{555}{50} = 9,57 \text{ buah medan plat kopel}$$

diambil = 10 buah

$$\lambda_1 = \frac{l_k/n}{i_{min}} = \frac{555/10}{1,16} = 43,50$$

$$\lambda_{Ey} = \sqrt{\lambda_y^2 + \frac{m}{2}\lambda_1^2}$$

$$= \sqrt{58,26^2 + \frac{m}{2} 4350^2}$$

$$= 72,7$$

Faktor tekuk $\omega = 0,85$

$$\sigma_x = \omega_x \frac{N}{A_{tot}} = 0,85 \frac{-11838,95}{30,94} = -311,51 < 1200 \text{ kg/cm}^2$$

kontrol kestabilan

$\lambda_1 = 43,50 \longrightarrow 1,2$

$\lambda_{1x} \geq 1,2\ \lambda_1$

$180,78 > 30$

$\lambda_1 = 43,50$

$\lambda_{1y} = 1,2\ \lambda_1$

$72,71 > 30,00$

Rencana Plat kopel

$$\frac{Ip}{a} \leq 10 \frac{I_1}{L_1} \quad \text{atau} \quad Ip \leq 10\, a \frac{I_1}{L_1}$$

Dimana momen inersia plat kopel adalah

$$Ip = 1/12\, t h^3$$

digunakan plat kopel dengan dimensi

tinggi $t = 10$ mm

tebal $h = 100$ mm

Sehingga $I_1 = I_n = I_{min} = 833333{,}3$ mm^4

$= 83{,}3$ cm^4

dik : $a = 7{,}14$

$L_1 = 21$ cm

$$\text{maka} : \frac{83}{7} \leq 10 \frac{2g_2}{21}$$

$$12 \leq 13g \quad \ldots \text{ OK}$$

Rencana Paku

Paku diameter = 10 mm

S1 = 2d = 20 mm

S1 diambil = 25 mm

c = s = 3d = 30 mm

c : s1 diambil = 30 mm

s2 = w = 35 mm

b = 2s2 + y = 70 mm

h = 2 s1 diambil + s = 60 mm

Kekuatan Paku

S1 > 2d σ ds = 2800 kg/cm²

Pgv = 2 $\frac{1}{4} \pi d^2 \tau$ = 860 kg/cm²

Pds = t d σ ds = 784 kg/cm²

Rencana Paku

Paku diameter = 10 mm

$S1 = 2d$ = 20 mm

S1 diambil = 25 mm

$c = s = 3d$ = 30 mm

c : s1 diambil = 30 mm

$S2 = w$ = 35 mm

$b = 2s2 + y$ = 70 mm

$h = 2\,s1$ diambil $+ s$ = 60 mm

Kekuatan Paku

$S1 > 2d \cdot \sigma\, ds$ = 2800 kg/cm²

$Pgy = 2 \cdot \frac{1}{4} \pi d^2 \tau$ = 860 kg/cm²

$Pds = + d \cdot \sigma\, ds$ = 784 kg/cm²

Perhitungan Jumlah baut Plat buhul

1. titik buhul - A

1.1 Profil S1

N = 4408 kg

Pds = 784 kg/cm²

Pgs = 860 kg/cm²

Jumlah paku = $\frac{N}{Pgs} = \frac{4408}{860} = 5,13 = 6$ buah

1.2. profil S6

N = 5066,65

Jumlah paku = $\frac{N}{Pds} = \frac{5066,65}{784} = 6,46 = 7$ buah

2 Titik buhul C

2.1 Profil S1 dan S2

N = 4408 kg

Jumlah paku = $\frac{N}{Pgs} = \frac{4408}{860} = 5,13 = 6$ buah

2.2 profil S7

N = 0 kg

3 titik buhul D

3.1 Profil S3

N = 3261,91 kg

$$\text{Jumlah paku} = \frac{N}{Pds} = \frac{3261,91}{784} = 4,16 \text{ bh} = 5 \text{ buah}$$

3.2 profil S8

N = 1736,49

$$\text{Jumlah paku} = \frac{N}{Pgs} = \frac{1736,49}{860} = 2,02 = 3 \text{ buah}$$

4 Titik buhul H

4.1 Profil S8

N = 1736,49 kg

$$\text{Jumlah paku} = \frac{N}{Pgs} = \frac{1736,49}{784,} = 2,21 = 3 \text{ buah}$$

4.2 Profil S12

N = 6391,88 kg

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{6391,88}{784} = 8,15 = 9 \text{ buah}$$

4.3 Profil S15

N = -5832,27 kg

$$\text{Jumlah paku} = \frac{N}{Pds} = \frac{5832,27}{784} = 7,44 = 8 \text{ buah}$$

4.4. Profil S16

N = -6145,08 kg

$$\text{Jumlah paku} = \frac{N}{Pds} \quad \frac{6145,08}{784} = 7,84 = 8 \text{ buah}$$

5. Titik buhul 6

5.1 profil S6

N = -5067 kg

$$\text{Jumlah paku} = \frac{N}{Pds} = \frac{5066,65}{784} = 6,46 = 7 \text{ buah}$$

5.2 profil S7

N = 0 kg

5.3 profil S12

N = 6391,88 kg

$$\text{Jumlah paku} = \frac{N}{Pgs} = \frac{6391,88}{860} = 7,43 = 8 \text{ buah}$$

5.4 profil S14

N = -4158,3 kg

$$\text{Jumlah paku} = \frac{N}{Pds} = 5,3 = 6 \text{ buah}$$

6. Titik buhul k

6.1 profil S14

N = - 4158,3 kg

$$\text{Jumlah paku} = \frac{N}{Pds} = \frac{4158,3}{784} = 5,3 = 6 \text{ buah}$$

6.2 Profil S15

N = - 5852,27 kg

$$\text{Jumlah paku} = \frac{N}{Pds} = \frac{5852,27}{860} = 6,78 = 7 \text{ buah}$$

6.3. Profil S 20

N = - 3936,69 kg

Jumlah paku = $\frac{N}{Pds} = \frac{3936,69}{784} = 5,02 = 6$ buah

6.4 Profil D1

N = - 508,98

Jumlah paku = $\frac{N}{Pds} = \frac{508,98}{784,} = 0,65 = 1$ buah

7 Titik buhul N

7.1 ~~titik buhul~~ Profil D1

N = - 508,98 kg

Jumlah Paku = $\frac{N}{Pgs} = \frac{508,98}{784} = 0,65 = 1$ buah

7.2 Profil D3

N = 1262,90 kg

Jumlah paku $\frac{N}{Pgs} = \frac{1262,90}{860} = 1,47 = 2$ buah

7.3 Profil D6

N = - 1768,06 kg

Jumlah paku = $\frac{N}{Pds} = \frac{1768,06}{784} = 2,26 = 3$ buah

8. Titik buhul P

8.1 Profil D6

N = - 1768,06 kg

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{1768,06}{784} = 2,26 = 3 \text{ buah}$$

8.2. Profil D5

N = - 412,04 kg

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{412,04}{784} = 0,5 > = 1 \text{ buah}$$

8.3 Profil D7

N = - 1768,06 kg

$$\text{Jumlah paku} = \frac{N}{Pds} = \frac{1768,06}{784} = 2,26 = 3 \text{ buah}$$

9. Titik buhul M

9.1 Profil S16

N = -6145 kg

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{6145,08}{784} = 7,84 = 8 \text{ buah}$$

9.2 Profil S17

N = - 6145 kg

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{6145,08}{784} = 7,84 = 8 \text{ buah}$$

9.3 Profil S20

N = -3936,69 kg

Jumlah Paku = $\frac{N}{Pds} = \frac{3936,69}{784} = 5,02 = 6$ buah

9.4 Profil S21

N = -3936,69 kg

Jumlah Paku = $\frac{N}{Pds} = \frac{3936,69}{784} = 5,02 = 6$ buah

9.5 Profil D3

N = 1262,90 kg

Jumlah Paku = $\frac{N}{Pds} = \frac{1262,90}{860} = 1,47 = 2$ buah

9.6 Profil D4

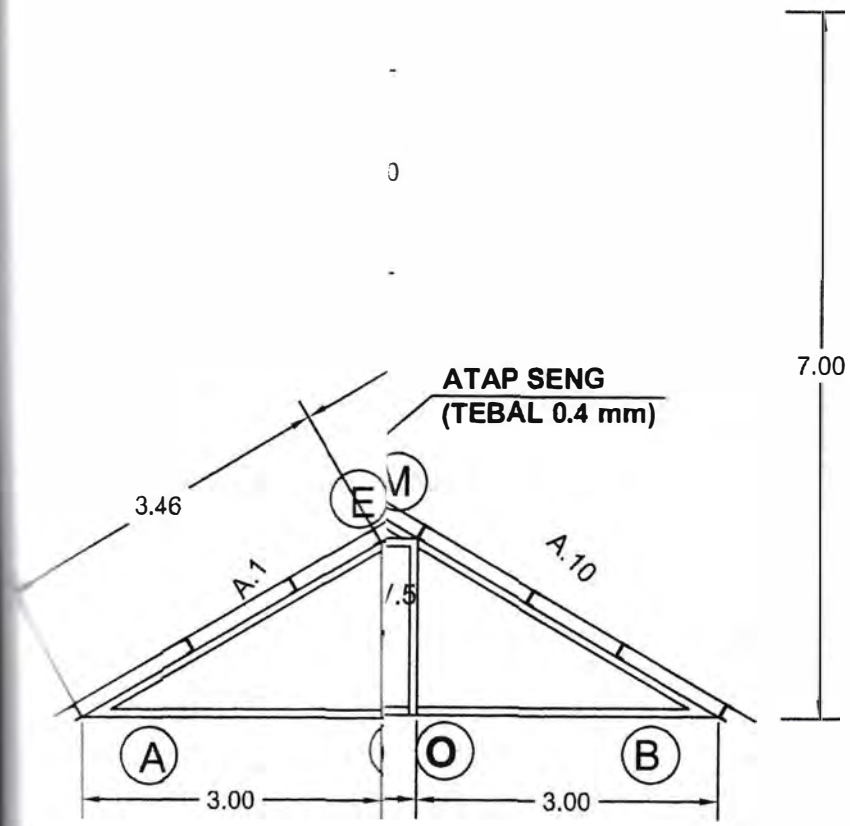
N = 1262,90 kg

Jumlah Paku = $\frac{N}{Pds} = \frac{1262,90}{860} = 1,46 = 2$ buah

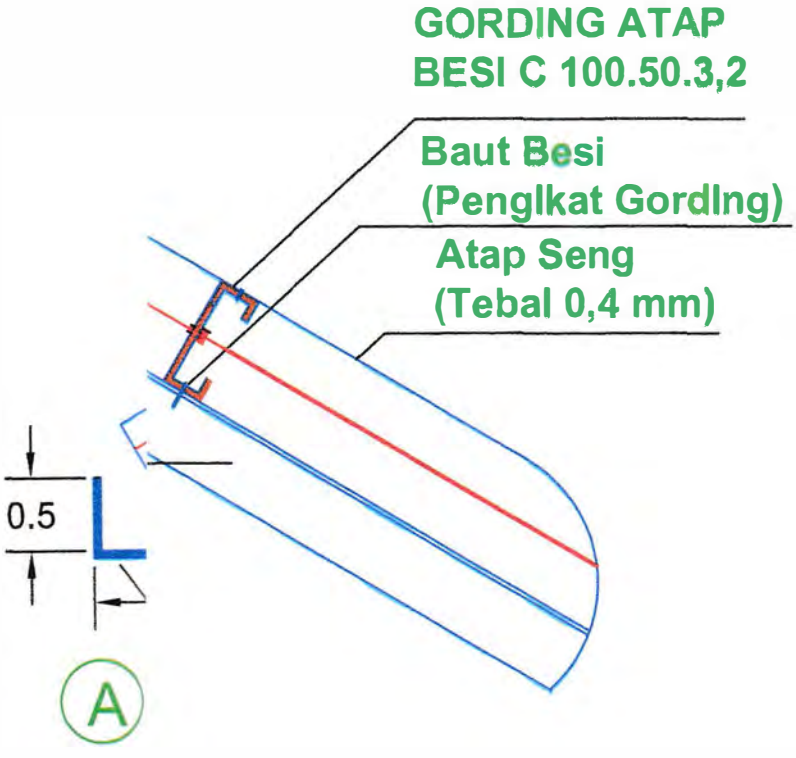
9.7 Profil D5

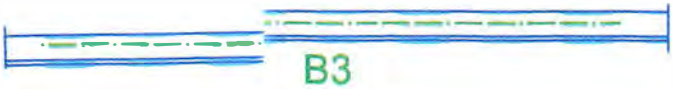
N = -412,04 kg

Jumlah Paku = $\frac{N}{Pds} = \frac{412,04}{784} = 0,53 = 1$ buah


ATAP SENG
(TEBAL 0.4 mm)
7.00
3.46
E
M
A.1
A.10
A
O
B
3.00
3.00

ANG TARIK


GORDING ATAP
BESI C 100.50.3,2
Baut Besi
(Penglkat Gordlng)
Atap Seng
(Tebal 0,4 mm)
0.5
A



B3

ıul t = 8 mm