

**TUGAS WAJIB**  
**KONSTRUKSI BAJA**

Diajukan untuk Melengkapi Tugas Sarjana Fakultas Teknik  
Jurusan Sipil Universitas Medan Area

**Oleh :**

**WINDY ANISA PUTRI**  
**14.811.0103**



**PROGRAM STUDI TEKNIK SIPIL**  
**FAKULTAS TEKNIK**  
**UNIVERSITAS MEDAN AREA**  
**2019**



FAKULTAS TEKNIK  
PROGRAM STUDI TEKNIK SIPIL  
UNIVERSITAS MEDAN AREA

Jalan Kolam No. 1 Medan Estate Medan

Nomor : Medan, 17-3 20.17  
Lamp :  
Hal : Pembimbing tugas wajib

Kepada : Yth, Bapak *W. H. S. H. Permadi*  
Staf Pengajar Program Studi Jurusan Sipil  
Universitas Medan Area  
Di Medan,-

Dengan hormat,

Sehubungan dengan mahasiswa yang tersebut namanya dibawah ini:

Nama : *WINDY AMISA PUTRI*  
Stambuk : *14 011 0103*  
Tk/Jurusan : *TEKNIK SIPIL*

Telah memenuhi syarat mengambil tugas wajib : *Baya*  
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

*Am*  
Inkarnaluddin Lubis.MT

Tembusan: Pertiinggal

7/4/16

JURUSAN TEKNIK SIPIL  
FAKULTAS TEKNIK  
UNIVERSITAS MEDAN AREA

TUGAS BAJA

Diberikan kepada :

Nama

: WINDY ANISA PUTRI

NPM

: 14-011-0103

Diketahui :

- Bentang ..... L = m
- Tinggi ..... H1 = m
- Jarak Gading-gading Kap ..... l = 500 m
- Jenis Atap ..... =
- Mutu Baja ..... =

Diminta :

ST 37

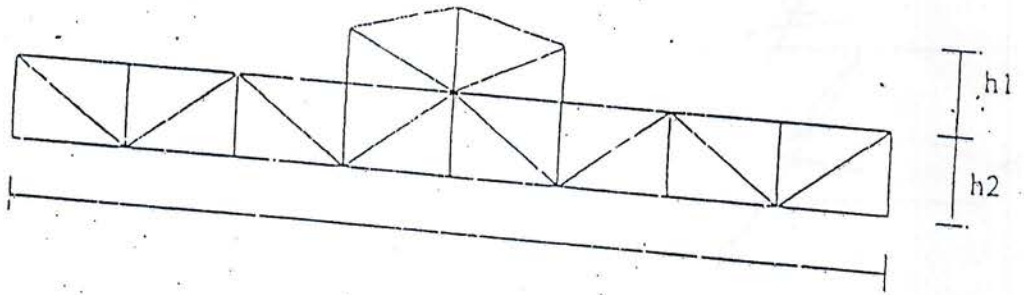
- Dimensionering gording dalam 3 variasi
- Daftar gaya-gaya batang
- Dimensionering batang profil dan detail
- Daftar kontrol bahan untuk berat sendiri

\* Date = 7/4/16  
Windy Anisa Putri

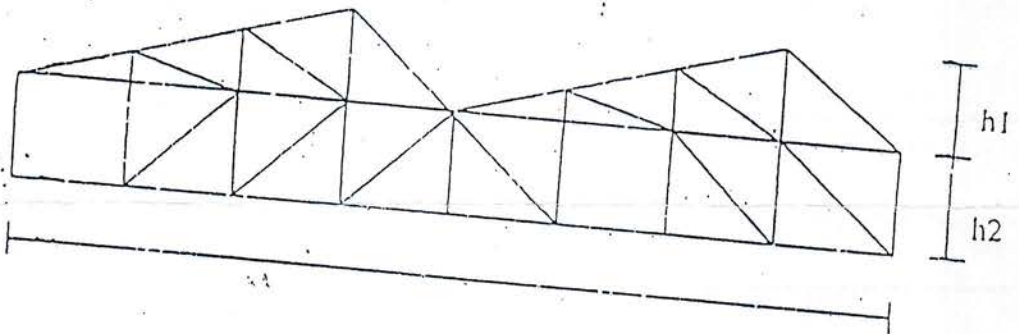
A).

JURUSAN TEKNIK SIPIL  
FAKULTAS TEKNIK  
UNIVERSITAS MEDAN AREA

B).



C).



Medan, Nopember 20  
Dosen Pengasuh,





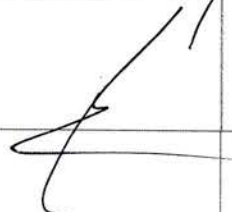
*Handwritten signature and date:*  
20/11/17  
03  
M. H. Emy. H. C. S. M. A. R. A.



DAFTAR ASISTENSI TUGAS STRUKTUR BAJA II

NAMA : Windy Anisa Putri

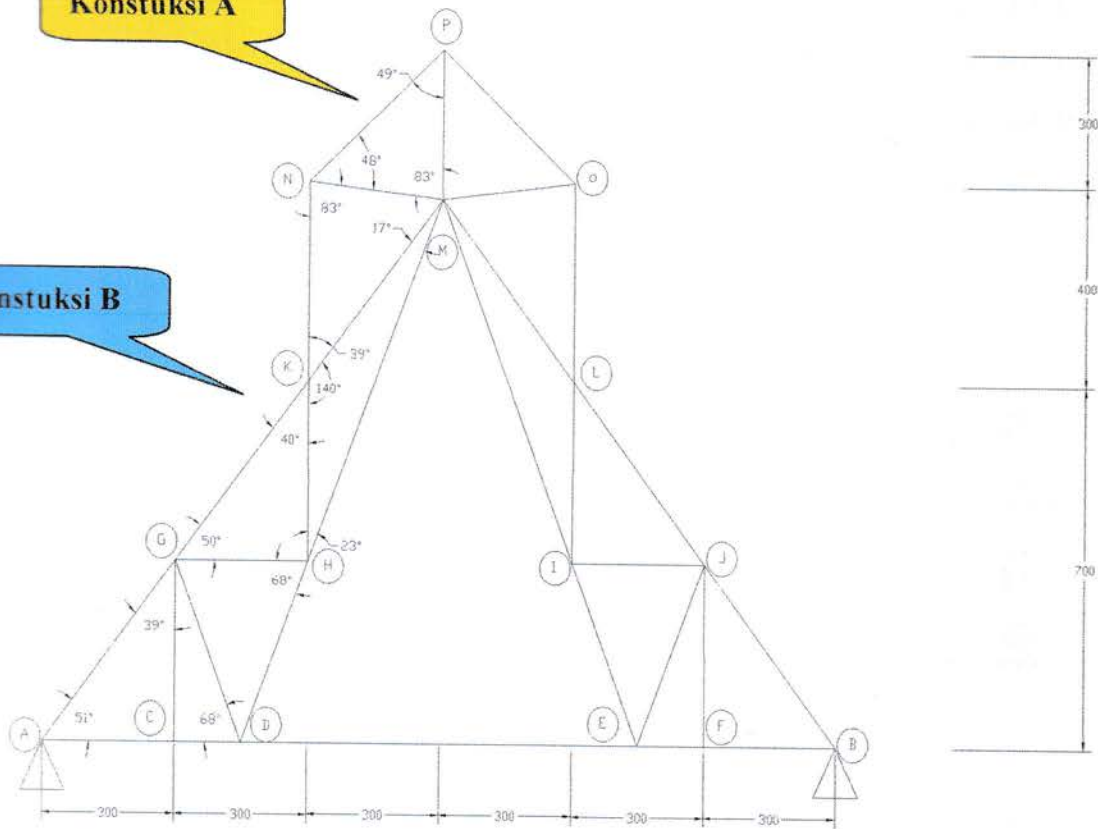
NPM : 148110103

NO	TANGGAL	KETERANGAN	TANDA TANGAN
1	13/06/17	bayangan	
2	10/07-12/07	bayangan	
3	9/07-9/07	bayangan	
4	15/05-17/05	bayangan	
29/05		lesai	

## GAMBAR RANGKA ATAP

**Konstuksi A**

**Konstuksi B**



### A. Diketahui

1. Bentang (L) = 18.00 Meter
2. Tinggi (H) = 14.00 Meter
  - Konstuksi A = 3.00 Meter
  - Konstruksi B = 11.00 Meter
3. Jarak Gading-Gading Kap = 5.00 Meter
4. Jenis Atap = Seng
5. Mutu Baja = BJ 37
6. Panjang Masing-masing Rangka Batang :
 

• Rangka $D_1 = 4.00$ m	• Rangka $D_5 = 3.00$ m
• Rangka $D_2 = 4.00$ m	• Rangka $D_6 = 4.00$ m
• Rangka $D_3 = 3.00$ m	• Rangka $D_7 = 4.00$ m
• Rangka $D_4 = 3.00$ m	



- Rangka  $S_1 = 3.00$  m
- Rangka  $S_2 = 1.50$  m
- Rangka  $S_3 = 9.00$  m
- Rangka  $S_4 = 1.50$  m
- Rangka  $S_5 = 3.00$  m
- Rangka  $S_6 = 5.42$  m
- Rangka  $S_7 = 4.5$  m
- Rangka  $S_8 = 4.76$  m
- Rangka  $S_9 = 4.76$  m
- Rangka  $S_{10} = 4.5$  m
- Rangka  $S_{11} = 5.42$  m
- Rangka  $S_{12} = 3.00$  m
- Rangka  $S_{13} = 3.00$  m
- Rangka  $S_{14} = 5.42$  m
- Rangka  $S_{15} = 4.5$  m
- Rangka  $S_{16} = 8.99$  m
- Rangka  $S_{17} = 8.99$  m
- Rangka  $S_{18} = 4.5$  m
- Rangka  $S_{19} = 5.42$  m
- Rangka  $S_{20} = 4.96$  m
- Rangka  $S_{21} = 4.96$  m

7. Sudut – sudut :

$$\begin{aligned} \sin 49^\circ &= 0.75 \\ \cos 49^\circ &= 0.65 \end{aligned}$$

$$\begin{aligned} \sin 48^\circ &= 0.74 \\ \cos 48^\circ &= 0.66 \end{aligned}$$

$$\begin{aligned} \sin 17^\circ &= 0.29 \\ \cos 17^\circ &= 0.95 \end{aligned}$$

$$\begin{aligned} \sin 83^\circ &= 0.99 \\ \cos 83^\circ &= 0.12 \end{aligned}$$

$$\begin{aligned} \sin 68^\circ &= 0.92 \\ \cos 68^\circ &= 0.37 \end{aligned}$$

$$\begin{aligned} \sin 51^\circ &= 0.77 \\ \cos 51^\circ &= 0.63 \end{aligned}$$

$$\begin{aligned} \sin 39^\circ &= 0.63 \\ \cos 39^\circ &= 0.77 \end{aligned}$$

$$\begin{aligned} \sin 167^\circ &= 0.22 \\ \cos 167^\circ &= -0.97 \end{aligned}$$

$$\begin{aligned} \sin 17^\circ &= 0.29 \\ \cos 17^\circ &= 0.95 \end{aligned}$$



**A. DIMINTA**

1. Dimensionering gording dalam 3 variasi
2. Daftar gaya-gaya batang
3. Dimensionering batang profil dan detail
4. Daftar Kontrol bahan untuk berat sendiri

Contoh Perhitungan Panjang Batang:

- Menghitung Panjang  $S_6$

$$\begin{aligned} S_6^2 &= S_1^2 + S_7^2 \\ S_6^2 &= 3.00^2 + 4.5^2 \\ S_6 &= 5.42 \text{ m} \end{aligned}$$

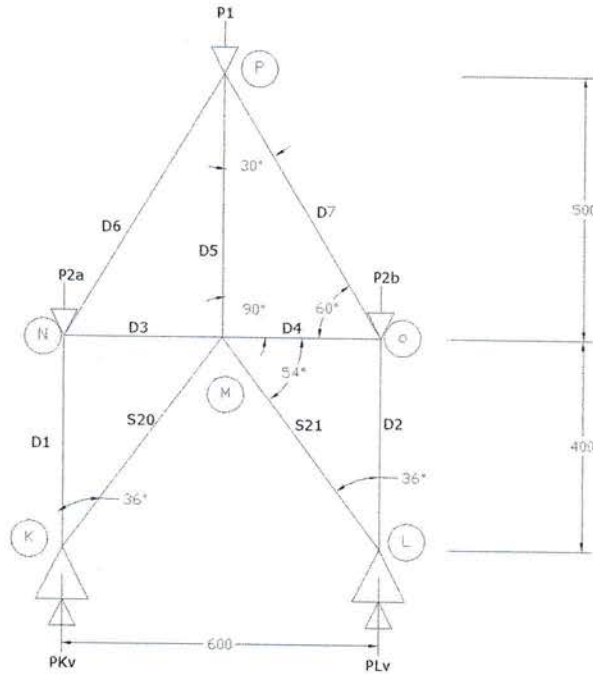
- Menghitung Panjang  $S_{14}$

$$\begin{aligned} S_{14}^2 &= S_{12}^2 + S_{15}^2 \\ S_{14}^2 &= 3.00^2 + 4.5^2 \end{aligned}$$

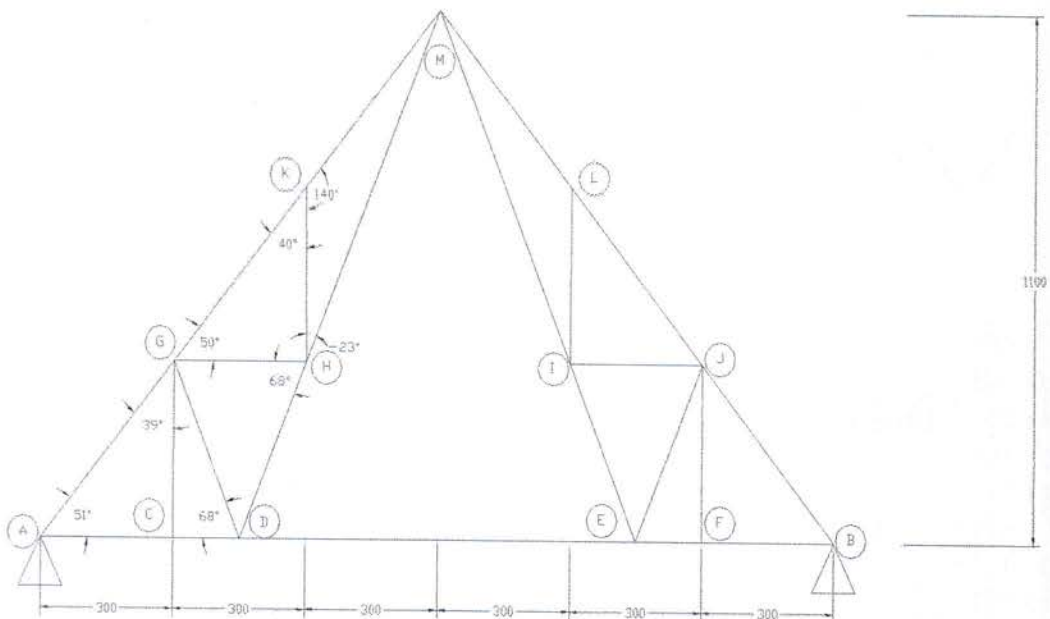
# I. DAFTAR GAYA-GAYA BATANG

Untuk menghitung gaya-gaya batang pada konstruksi kuda-kuda ini, konstruksi harus dihitung terpisah yaitu:

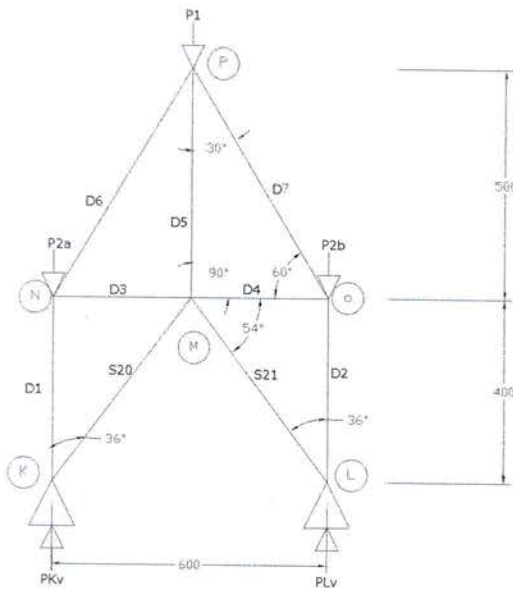
## - Konstruksi A



## - Konstruksi B



## L1 Perhitungan Beban



Panjang Masing-masing Rangka Batang:

- Rangka D1 = 4.00 m
- Rangka D2 = 4.00 m
- Rangka D3 = 3.00 m
- Rangka D4 = 3.00 m
- Rangka D5 = 3.00 m
- Rangka D6 = 4.00 m
- Rangka D7 = 4.00 m
- Rangka S20 = 5.00 m
- Rangka S21 = 5.00 m
- Total = 35 m**



### - Beban Mati

Nama Beban	Berat	Satuan	Uraian Beban	Total Beban
Penutup atap (seng)	10.00	Kg/m <sup>2</sup>	=(40.4 m x 9.00 m x 10.00 kg/m <sup>2</sup> )	3636 kg
Pengikat Atap	1.00	Kg/m <sup>2</sup>	=(Taksir)	1.00 kg
Ventilasi	20.50	Kg/m <sup>2</sup>	=(20.00 m x 20.50 kg/m <sup>2</sup> )	410 kg
Gording(C 75.40.15.3.2)	4.76	Kg/m	=(5.0 m x 4.76 kg/m x 13 bh)	309.4 kg
Pengikat Gording	1.00	Kg/m <sup>2</sup>	=(Taksir)	1.00 kg
Rangka Atap(L 65.65.7)	6.83	Kg/m	=(28.79 m x 6.83 kg/m)	196.64 kg
<b>Total Beban Mati</b>				<b>4554.04 kg</b>

UNIVERSITAS MEDAN AREA



- **Total Beban Mati = 4554.04 Kg** diuraikan menjadi beban P1, P2a, P2b:

Beban P1 = 903.8 kg
Beban P2a = 1825.12 kg
Beban P2b = 1825.12 kg
<b>Jumlah = 4554.04 Kg</b>

- **Beban Hidup (asumsi 1 Manusia Dewasa)**

Beban P1 = 100.00 Kg
Beban P2a = 100.00 Kg
Beban P2b = 100.00 Kg
<b>Jumlah = 300.00 Kg</b>

- **Beban Angin**

Data - data atap:

Jarak Gording ditinjau (L) = 1.00

Kemiringan atap ( $\alpha$ ) = 36

Besar beban angin (W) = 25.00 Kg/m<sup>2</sup>

Dari data-data diatas diperoleh:

- Koefisien angin tekan (ct) pada bidang angin/Angin Datang/Tiup:

$$\alpha \leq 65^\circ$$

$$W_{da} = (C \times \alpha - 0.4) \times L \times W$$

$$W_{da} = (0.02 \times 36) - 0.40) \times 1.00 \times 25$$

$$W_{da} = 8 \text{ kg/m} = W_{db}$$

$$\alpha = 65^\circ - 90^\circ$$

$$W_{dc} = C \times L \times W$$

$$W_{dc} = 0.90 \times 1.0 \times 25$$

$$W_{dc} = 22.5 \text{ kg/m}$$

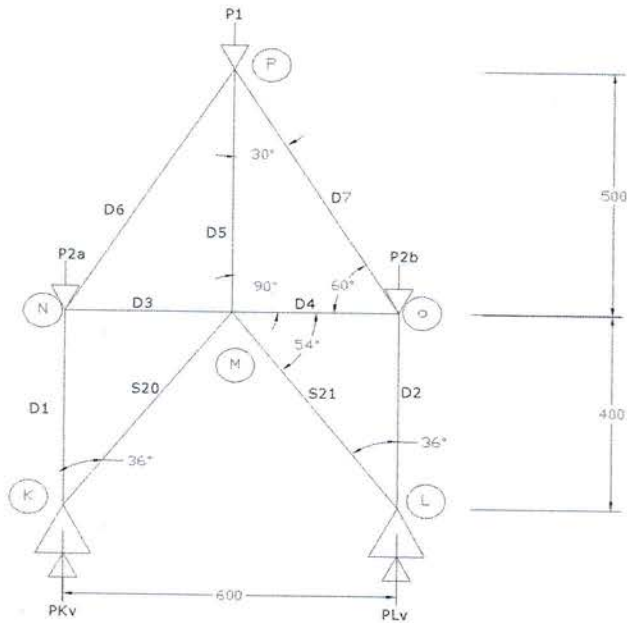
- Pada bidang tidak ada angin/Angin Pergi/Hisap

$$W_p = C \times L \times W$$

$$W_p = -0.40 \times 1.00 \times 25$$

$$W_p = -10 \text{ kg/m}$$

UNIVERSITAS MEDAN AREA



## I.2 Perhitungan Gaya Batang Beban Mati

✓ Perhitungan Reaksi

$$\Sigma MO = 0$$

$$RLV \times 6.00 - P2b \times 6.00 - P1 \times 3.00 - P2a \times 0 = 0$$

$$RLV \times 6.00 - 320.6 \times 6.00 - 160.3 \times 3.00 - 320.0 \times 0 = 0$$

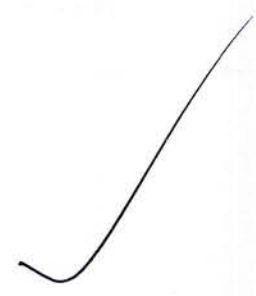
$$RLV = 400 \text{ Kg}$$

$$\Sigma MN = 0$$

$$RKV \times 6.00 - P2a \times 6.00 - P1 \times 5.00 - P2b \times 0 = 0$$

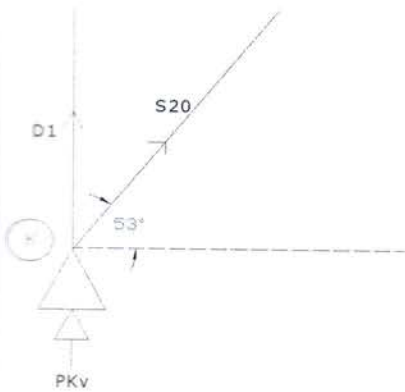
$$RKV \times 6.00 - 320.6 \times 6.00 - 160.3 \times 3.00 - 320.0 \times 0 = 0$$

$$RKV = 400 \text{ Kg}$$



✓ Perhitungan Gaya-Gaya Batang

TITIK BUHUL - K



$$\Sigma H = 0 ;$$

$$S20 = 0 ;$$

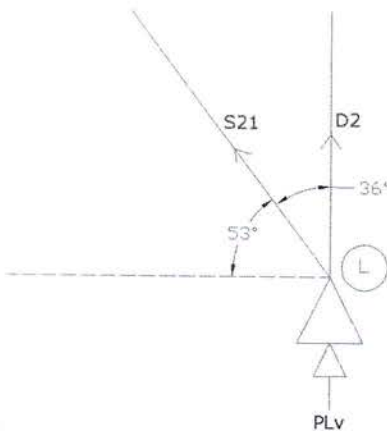
$$\Sigma V = 0 ;$$

$$RKN + D1 + S20 \times \sin 39^\circ = 0$$

$$4.00 + D1 + 5.00 \times 0.63 = 0$$

$$D1 = - 403.15 \text{ kg (Tekan)}$$

TITIK BUHUL - L



$$\Sigma H = 0 ;$$

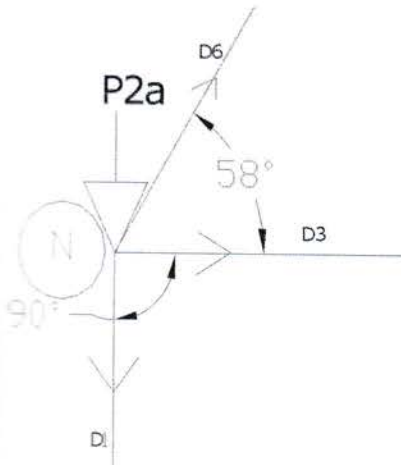
$$S21 = 0$$

$$\Sigma V = 0 ;$$

$$RLV + D2 + S21 \times \sin 53^\circ = 0$$

$$107.9 + D2 + 0.62 \times (0) = 0$$

$$D2 = - 107.9 \text{ kg (Tekan)}$$

**TITIK BUHUL - N**

$$\Sigma V = 0 ;$$

$$-D1 - P2a + D6 \times \sin 58^\circ + D3 = 0$$

$$-(-107.9) - 1825.12 + D6 \times \sin 58^\circ + D3 = 0$$

$$1717,22 + 0.84 \times D6 + D3 = 0 \text{ ----- 1)}$$

$$\Sigma H = 0 ;$$

$$D6 \times \cos 58^\circ + D3 = 0$$

$$0.707 \times D6 + 0.99 \times D3 = 0$$

$$D6 = -1.4 \times D3 \text{ ----- 2)}$$

Persamaan 2 disubstitusi ke persamaan 1, sehingga:

$$134.2 + (0.707 \times (-1.4) \times D3 + 0.10 \times D3 = 0$$

$$134.2 - 0.99 \times D3 + 0.10 \times D3 = 0$$

$$134.2 - 0.99 \times D3 + 0.10 \times D3 = 0$$

$$134.2 - 0.89 \times D3 = 0$$

$$\mathbf{D3 = 150.79 \text{ Kg (Tarik)}}$$

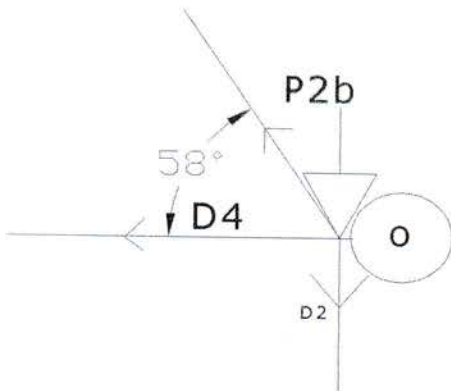
Dari hasil diatas, maka diperoleh nilai:

$$D6 = -1.4 \times D3$$

$$= -1.4 \times 150.79$$

$$\mathbf{D6 = -211.11 \text{ kg (Tekan)}}$$

**TITIK BUHUL - O**



$$\Sigma V = 0 ;$$

$$D2 - P2b + D7 \times \sin 58^\circ + D4 \times \sin 6^\circ = 0$$

$$-(-671.02) - 536.82 + D7 \times \sin 30^\circ + D4 \times \sin 6^\circ = 0$$

$$134.2 + 0.707 \times D7 + 0.10 \times D4 = 0 \text{ ----- 1)}$$

$$\Sigma H = 0$$

$$D7 \times \cos 58^\circ + D4 \times \cos 6^\circ = 0$$

$$0.707 \times D7 + 0.99 \times D4 = 0$$

$$D7 = -1.4 \times D4 \text{ ----- 2)}$$

Persamaan 2 disubstitusi ke persamaan 1, sehingga:

$$134.2 + (0.707 \times (-1.4) \times D4 + 0.10 \times D4 = 0$$

$$134.2 - 0.99 \times D4 + 0.10 \times D4 = 0$$

$$134.2 - 0.99 \times D3 + 0.10 \times D4 = 0$$

$$134.2 - 0.89 \times D4 = 0$$

$$\mathbf{D4 = 150.79 \text{ Kg (Tarik)}}$$

Dari hasil diatas, maka diperoleh nilai:

$$D7 = -1.4 \times D4$$

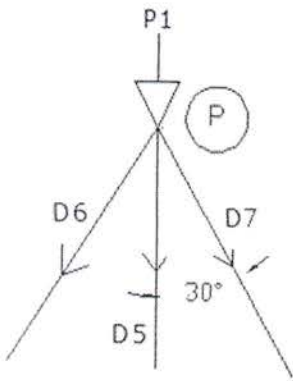
$$= -1.4 \times 150.79$$

$$\mathbf{D7 = -211.11 \text{ kg (Tekan)}}$$





**TITIK BUHUL - P**



$$\Sigma V = 0 ;$$

$$D6 \times \sin 45^\circ - P1 + D7 \times \sin 45^\circ + D5 = 0$$

$$211.11 \times 0.707 - 268.40 + 211.11 \times 0.707 + D5 = 0$$

$$D5 = - 30.109 \text{ kg (Tekan)}$$

$$\Sigma H = 0 ;$$

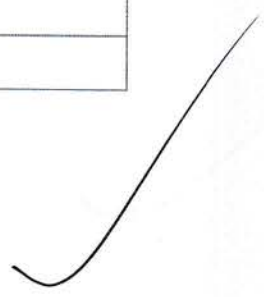
$$D6 \times \cos 45^\circ + D7 \times \cos 45^\circ = 0$$

$$0.707 \times -D7 + 0.707 \times -211.11 = 0$$

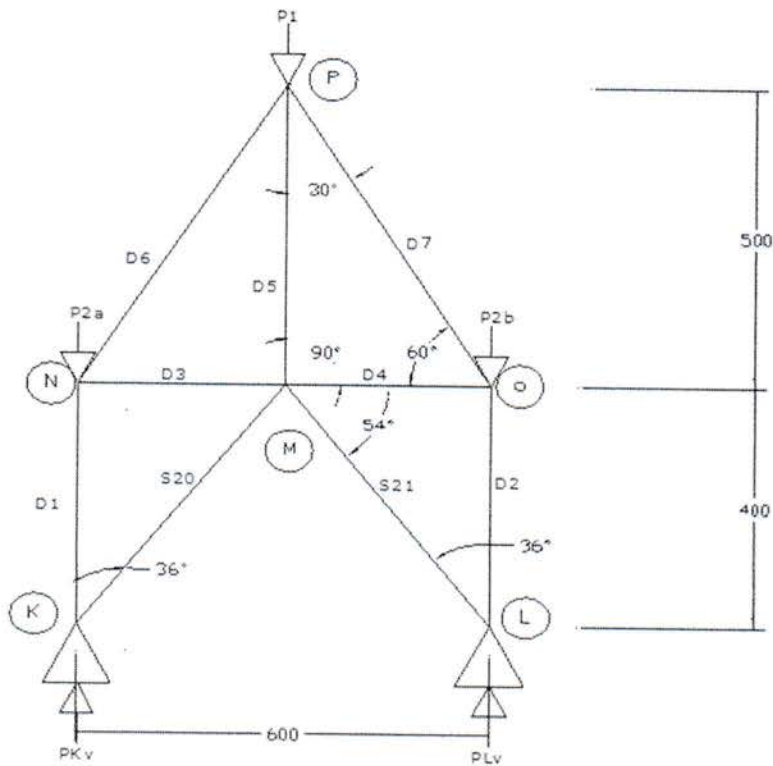
$$D7 = -211.11 \text{ kg (Tekan)}$$

**TABEL GAYA BATANG**

PERHITUNGAN GAYA BATANG (BEBAN MATI)		
No Batang	Batang Tarik (+)	Batang Tekan (-)
D1	-	-671.02
D2	-	-671.02
D3	150.79	-
D4	150.79	-
D5	-	- 30.109
D6	-	-211.11
D7	-	-211.11
S20	-	-
S21	-	-



### I.3 Perhitungan Gaya Batang Beban Hidup



#### ✓ Perhitungan Reaksi

$$\Sigma MK = 0$$

$$RLV \times 6.00 - P2b \times 4.00 - P1 \times 5.00 - P2a \times 0 = 0$$

$$RLV \times 6.00 - 100 \times 4.00 - 100 \times 5.00 - 100 \times 0 = 0$$

$$RLV = 150 \text{ Kg}$$

$$\Sigma ML = 0$$

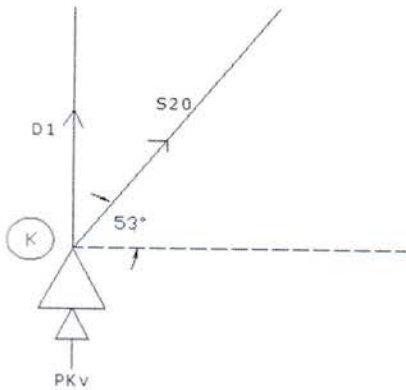
$$RKV \times 6.00 - P2a \times 4.00 - P1 \times 3.00 - P2b \times 0 = 0$$

$$RKV \times 6.00 - 100 \times 4.00 - 100 \times 3.00 - 100 \times 0 = 0$$

$$RKV = 150 \text{ Kg}$$

✓ Perhitungan Gaya-Gaya Batang

**TITIK BUHUL - K**



$$\Sigma H = 0 ;$$

$$S20 = 0 ;$$

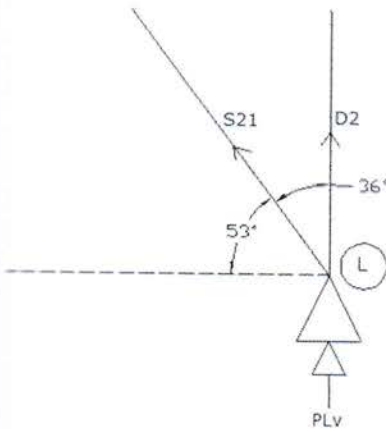
$$\Sigma V = 0 ;$$

$$RKV + D1 + S20 \times \sin 38^\circ = 0$$

$$150 + D1 + 0.62 \times (0) = 0$$

$$D1 = - 150 \text{ kg (Tekan)}$$

**TITIK BUHUL - L**



$$\Sigma H = 0 ;$$

$$S21 = 0$$

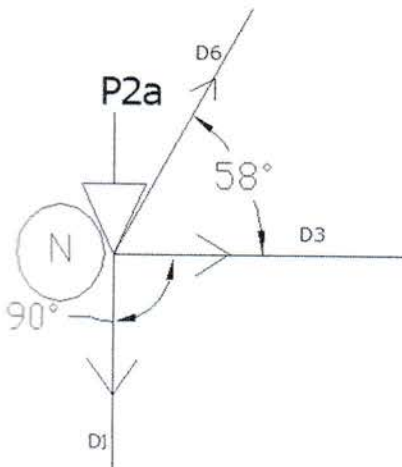
$$\Sigma V = 0 ;$$

$$RLV + D2 + S21 \times \sin 36^\circ = 0$$

$$150 + D2 + 0.62 \times (0) = 0$$

$$D2 = - 150 \text{ kg (Tekan)}$$

### TITIK BUHUL - N



$$\Sigma V = 0 ;$$

$$-D1 - P2a + D6 \times \sin 58^\circ + D3 \times \sin 6^\circ = 0$$

$$-(-150) - 100 + D6 \times \sin 58^\circ + D3 \times \sin 6^\circ = 0$$

$$50 + 0.707 \times D6 + 0.10 \times D3 = 0 \text{ ----- 1)}$$

$$\Sigma H = 0 ;$$

$$D6 \times \cos 58^\circ + D3 \times \cos 6^\circ = 0$$

$$0.707 \times D6 + 0.99 \times D3 = 0$$

$$D6 = -1.4 \times D3 \text{ ----- 2)}$$

Persamaan 2 disubstitusi ke persamaan 1, sehingga:

$$50 + (0.707 \times (-1.4) \times D3 + 0.10 \times D3 = 0$$

$$50 - 0.99 \times D3 + 0.10 \times D3 = 0$$

$$50 - 0.89 \times D3 + 0.10 \times D3 = 0$$

$$50 - 0.89 \times D3 = 0$$

$$D3 = 56.180 \text{ Kg (Tarik)}$$

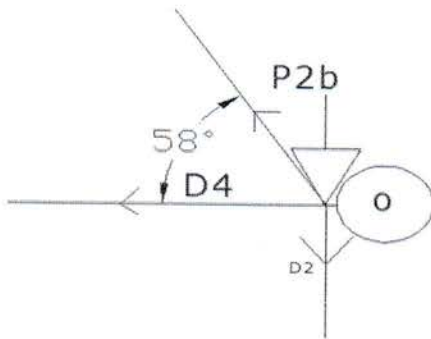
Dari hasil diatas, maka diperoleh nilai:

$$D6 = -1.4 \times D3$$

$$= -1.4 \times 56.180$$

$$D6 = -78.652 \text{ kg (Tekan)}$$

### TITIK BUHUL - O



$$\Sigma V = 0;$$

$$-D2 - P2b + D7 \times \sin 58^\circ + D4 \times \sin 6^\circ = 0$$

$$-(-150) - 100 + D7 \times \sin 58^\circ + D4 \times \sin 6^\circ = 0$$

$$50 + 0.707 \times D7 + 0.10 \times D4 = 0 \text{ ----- 1)}$$

$$\Sigma H = 0;$$

$$D7 \times \cos 58^\circ + D4 \times \cos 6^\circ = 0$$

$$0.707 \times D7 + 0.99 \times D4 = 0$$

$$D7 = -1.4 \times D4 \text{ ----- 2)}$$

Persamaan 2 disubstitusi ke persamaan 1, sehingga:

$$50 + (0.707 \times (-1.4) \times D4 + 0.10 \times D4 = 0$$

$$50 - 0.99 \times D4 + 0.10 \times D4 = 0$$

$$50 - 0.99 \times D4 + 0.10 \times D4 = 0$$

$$50 - 0.89 \times D4 = 0$$

$$D4 = 56.180 \text{ Kg (Tarik)}$$

Dari hasil diatas, maka diperoleh nilai:

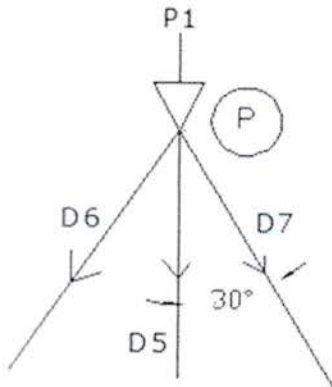
$$D7 = -1.4 \times D4$$

$$= -1.4 \times 56.180$$

$$D7 = -78.652 \text{ kg (Tarik)}$$



**TITIK BUHUL - P**



$$\Sigma V = 0 ;$$

$$D6 \times \sin 30^\circ - P1 + D7 \times \sin 30^\circ + D5 = 0$$

$$78.652 \times 0.988 - 100 + 78.652 \times 0.988 + D5 = 0$$

$$D5 = -11.214 \text{ kg (Tekan)}$$

$$\Sigma H = 0 ;$$

$$D6 \times \cos 30^\circ + D7 \times \cos 30^\circ = 0$$

$$0.154 \times -D7 + 0.154 \times -78.652 = 0$$

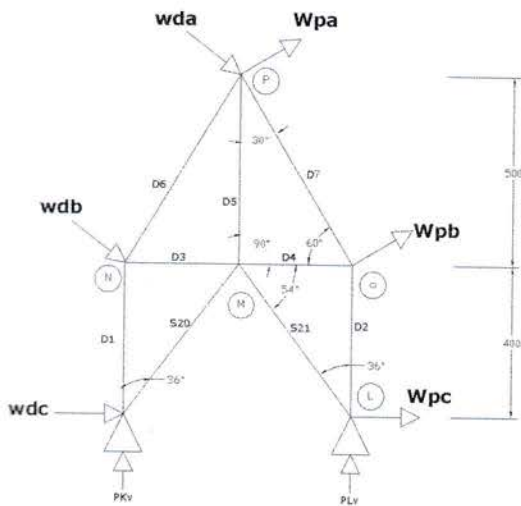
$$D7 = -78.652 \text{ kg (Tekan)}$$

**TABEL GAYA BATANG**

PERHITUNGAN GAYA BATANG (BEBAN HIDUP)		
No Batang	Batang Tarik (+)	Batang Tekan (-)
D1	-	-150.00
D2	-	-150.00
D3	56.180	-
D4	56.180	-
D5	-	- 11.214
D6	-	-78.652
D7	-	-78.652
S20	-	-
S21	-	-



## I. 4 Perhitungan Gaya Batang Beban Angin Datang



Besar nilai  $W_{da} = W_{db}$  &  $W_{pa} = W_{pb}$   
 Di Karenaan Besar sudut  $\alpha \leq 65^\circ$

$W_{da} = 16 \text{ Kg/m}$

$W_{da} \cos 45^\circ = 11.31 \text{ kg/m}$

$W_{da} \sin 45^\circ = 11.31 \text{ kg/m}$

$W_{db} = 16 \text{ Kg/m}$

$W_{db} \cos 45^\circ = 11.31 \text{ kg/m}$

$W_{db} \sin 45^\circ = 11.31 \text{ kg/m}$

$W_{pa} = 10 \text{ Kg/m}$

$W_{pa} \cos 45^\circ = 7.07 \text{ kg/m}$

$W_{pa} \sin 45^\circ = 7.07 \text{ kg/m}$

$W_{pb} = 10 \text{ Kg/m}$

$W_{pb} \cos 45^\circ = 7.07 \text{ kg/m}$

$W_{pb} \sin 45^\circ = 7.07 \text{ kg/m}$

$W_{dc} = 22.5 \text{ Kg/m}$



✓ **Perhitungan Reaksi di titik K dan L**

$$\Sigma ML = 0$$

$$RKV \times 6 - Wda \cos 45^\circ \times 3 - Wdb \cos 45^\circ \times 6 - Wpa \cos 45^\circ \times 3 + Wpb \times 0 = 0$$

$$RKV \times 6.00 - 11.31 \times 3 - 11.31 \times 6 - 7.07 \times 3 = 0$$

$$RKV = 21.0 \text{ Kg}$$

$$\Sigma MK = 0$$

$$RLV \times 6 + Wda \cos 45^\circ \times 3 - Wpa \cos 45^\circ \times 3 - Wpb \cos 45^\circ \times 6 + Wpb \times 0 = 0$$

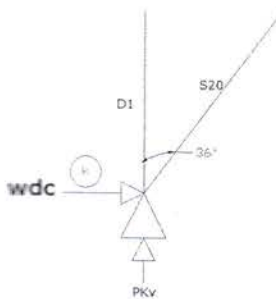
$$RLV \times 6 + 11.31 \times 3 - 7.07 \times 3 - 7.07 \times 6 = 0$$

$$RLV = 5.0 \text{ Kg}$$

$$\Sigma ML = 0 \rightarrow RKV + RLV - (Wda \cos 45^\circ - Wpa \cos 45^\circ) - (Wdb \cos 45^\circ - Wpb \cos 45^\circ) \\ = 21.0 + 5.0 - (8.0 - 5.0) - (8.0 - 5.0) = 0 \rightarrow \text{OK}$$

✓ **Perhitungan Gaya Batang**

**TITIK BUHUL - K**



$$\Sigma H = 0 ;$$

$$Wdc + S20 \times \cos 36 = 0$$

$$22.5 + 0.79 \times S20 = 0$$

$$S20 = -28.48 \text{ kg (Tekan)}$$

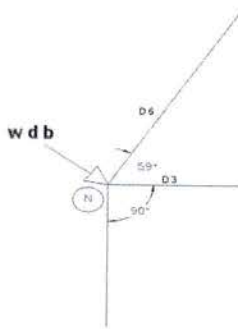
$$\Sigma V = 0 ;$$

$$RKV + D1 + S20 \times \sin 36^\circ = 0$$

$$21 + D1 + (-28.48) \times (0.62) = 0$$

$$D1 = -3.342 \text{ kg (Tekan)}$$

## TITIK BUHUL - N



$$\Sigma V = 0 ;$$

$$Wdb \times \sin 59 - D1 + D6 \times \sin 59 + D3 \times \sin 90 = 0$$

$$16 \times 0.637 + 3.342 + D6 \times \sin 59 + D3 \times \sin 90 = 0$$

$$7.97 + 0.637 \times D6 + 0.10 \times D3 = 0 \text{ ----- 1)}$$

$$\Sigma H = 0 ;$$

$$D6 \times \cos 59 + D3 \times \cos 90 + Wdb \times \cos 59 = 0$$

$$0.771 \times D6 + 0.99 \times D3 + 16 \times 0.771 = 0$$

$$0.771 \times D6 + 0.99 \times D3 + 11.31 = 0 \text{ ---- 2)}$$

Persamaan 2 di eliminasi ke persamaan 1, sehingga:

$$\begin{array}{r|l} 0.771 \times D6 + 0.99 \times D3 + 11.31 & = 0 \\ \hline 0.771 \times D6 + 0.10 \times D3 + 7.97 & = 0 \\ \hline 0.89 \times D3 + 3.34 & = 0 \end{array}$$

$$\mathbf{D3 = -3.75 \text{ Kg (Tekan)}}$$

Dari hasil diatas, maka diperoleh nilai:

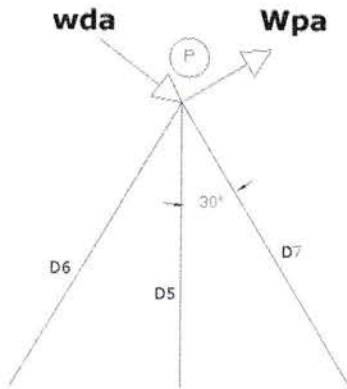
$$7.97 + 0.707 \times D6 + 0.10 \times D3 = 0$$

$$7.97 + 0.707 \times D6 + 0.10 \times (-3.75) = 0$$

$$\mathbf{D6 = -10.74 \text{ kg (Tekan)}}$$



**TITIK BUHUL - P**



$$\Sigma H = 0 ;$$

$$D6 \times \cos 30^\circ + D7 \times \cos 30^\circ + Wda \times \cos 30^\circ = 0$$

$$0.154 \times (-10.74) + 0.154 \times D7 + 16 \times 0.154 = 0$$

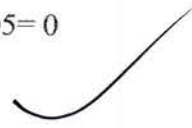
$$D7 = -5.26 \text{ kg (Tekan)}$$

$$\Sigma V = 0 ;$$

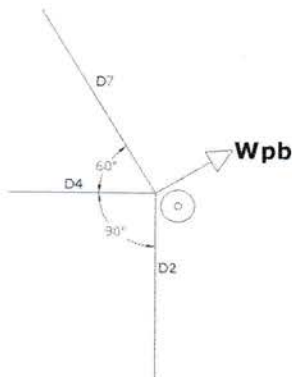
$$D6 \times \sin 30^\circ + Wda \times \cos 30^\circ + D7 \times \sin 30^\circ + D5 = 0$$

$$(-10.74) \times 0.707 + 16 \times 0.707 + (-5.26) \times 0.707 + D5 = 0$$

$$D5 = 0 \text{ kg}$$



**TITIK BUHUL - O**



$$\Sigma H = 0 ;$$

$$D4 \times \cos 6^\circ + D7 \times \cos 60^\circ = 0$$

$$0.99 \times D4 + 0.707 \times (-5.26) = 0$$

$$D4 = 3.76 \text{ Kg (Tarik)}$$

$$\Sigma V = 0 ;$$

$$D7 \times \sin 60^\circ + D4 \times \sin 6^\circ + D2 = 0$$

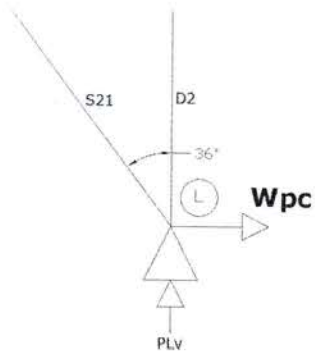
$$(-5.26) \times 0.707 + 3.76 \times 0.10 + D2 = 0$$

$$D2 = -3.342 \text{ Kg (Tekan)}$$





**TITIK BUHUL - L**



$$\Sigma V = 0 ;$$

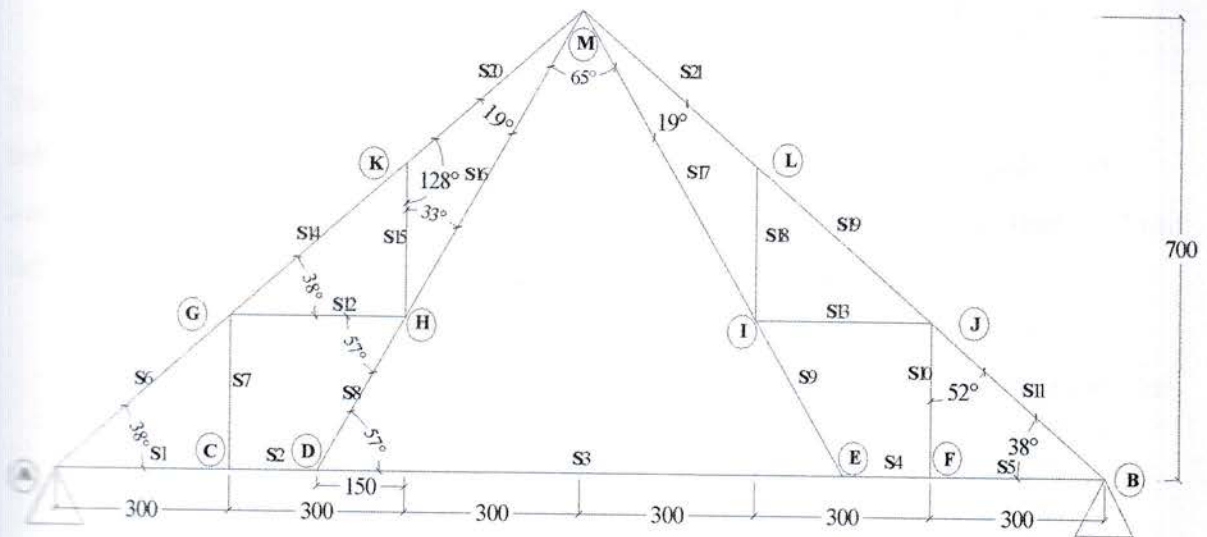
$$RLV + D2 + S21 \times \sin 36^\circ = 0$$

$$5 + (-3.342) + 0.62 \times S1 = 0$$

$$S21 = -2.67 \text{ kg (Tekan)}$$

**TABEL GAYA BATANG**

PERHITUNGAN GAYA BATANG BEBAN ANGIN		
No Batang	Batang Tarik (+)	Batang Tekan (-)
D1	-	- 3.342
D2	-	- 2.90
D3	-	- 3.76
D4	3.76	-
D5	0	0
D6	-	- 10.74
D7	-	- 5.26
S20	-	-28.48
S21	-	-2.67



### III.1 Perhitungan Beban

#### Panjang Masing-masing Rangka Batang

- |                                     |                                     |
|-------------------------------------|-------------------------------------|
| • Rangka S <sub>1</sub> = 3.00 m    | • Rangka S <sub>12</sub> = 3.00 m   |
| • Rangka S <sub>2</sub> = 1.50 m    | • Rangka S <sub>13</sub> = 3.00 m   |
| • Rangka S <sub>3</sub> = 9.00 m    | • Rangka S <sub>14</sub> = 3.80 m   |
| • Rangka S <sub>4</sub> = 1.50 m    | • Rangka S <sub>15</sub> = 2.33 m   |
| • Rangka S <sub>5</sub> = 3.00 m    | • Rangka S <sub>16</sub> = 5.55 m   |
| • Rangka S <sub>6</sub> = 3.80 m    | • Rangka S <sub>17</sub> = 5.55 m   |
| • Rangka S <sub>7</sub> = 2.33 m    | • Rangka S <sub>18</sub> = 2.33 m   |
| • Rangka S <sub>8</sub> = 2.77 m    | • Rangka S <sub>19</sub> = 3.80 m   |
| • Rangka S <sub>9</sub> = 2.77 m    | • Rangka S <sub>20</sub> = 3.80 m   |
| • Rangka S <sub>10</sub> = 2.33 m   | • Rangka S <sub>21</sub> = 3.80 m   |
| • Rangka S <sub>11</sub> = 2.80 m + | • Rangka S <sub>22</sub> = 3.80 m + |
| <b>Total = 34.8 m</b>               | <b>Total = 40.76 m</b>              |

#### - Beban Mati

Nama Beban	Berat	Satuan	Uraian Beban	Total Beban
Penutup atap (seng)	10.00	Kg/m <sup>2</sup>	=(15.2 m x 5.00 m x 10.00 kg/m <sup>2</sup> )	760 kg
Pengikat Atap	2.00	Kg/m <sup>2</sup>	=(Taksir)	2.00 kg
Gording(C 75.40.15.3.2)	4.76	Kg/m	=(5.0 m x 4.76 kg/m x 14 bh)	333.2 kg
Pengikat Gording	3.00	Kg/m <sup>2</sup>	=(Taksir)	3.00 kg
Rangka Atap (L 100.100.8)	12.14	Kg/m	=(75.56 m x 12.14 kg/m)	917.298 kg
<b>Total Beban Mati</b>				<b>2015.50 kg</b>

Total Beban mati = 2015.50 kg

beban dibulatkan ke atas menjadi = 2016 kg, beban kemudian diuraikan menjadi: P1

(untuk tumpuan) dan P2 (untuk titik buhul) Jumlah titik buhul = 5 titik, dan tumpuan = 2 titik

Beban yang ditanggung P1 adalah setengah dari beban pada P2, sehingga:

- **Total Beban Mati = 1342.04 Kg** diuraikan menjadi beban P1, P2a, P2b:

Beban P1 = 168 kg x 2 titik = 336 kg
Beban P2 = 336 kg x 5 titik = 1680 kg
<b>Jumlah = 2016 Kg</b>

- **Beban Hidup (asumsi 1 Manusia Dewasa)**

Beban P1 = 100.00 Kg x 2 titik = 200 kg
Beban P2 = 100.00 Kg x 5 titik = 500 kg
<b>Jumlah = 700.00 Kg</b>

- **Beban Angin**

Data - data atap:

Jarak Gording ditinjau (L) = 1.27 meter

Kemiringan atap ( $\alpha$ ) = 38°

Besar beban angin (W) = 30.00 Kg/m<sup>2</sup>

Dari data-data diatas diperoleh:

- Koefisien angin tekan (ct) pada bidang angin/Angin Datang/Tiup:

$$\alpha \leq 65^\circ$$

$$W_{da} = (C \times \alpha - 0.4) \times L \times W$$

$$W_{da} = (0.02 \times 38) - 0.40 \times 1.27 \times 30$$

$$W_{da} = \mathbf{13.72 \text{ kg/m}} = W_{db}$$

$$\alpha = 65^\circ - 90^\circ$$

$$W_{dc} = C \times L \times W$$

$$W_{dc} = 0.90 \times 1.27 \times 30$$

$$W_{dc} = \mathbf{34.29 \text{ kg/m}}$$

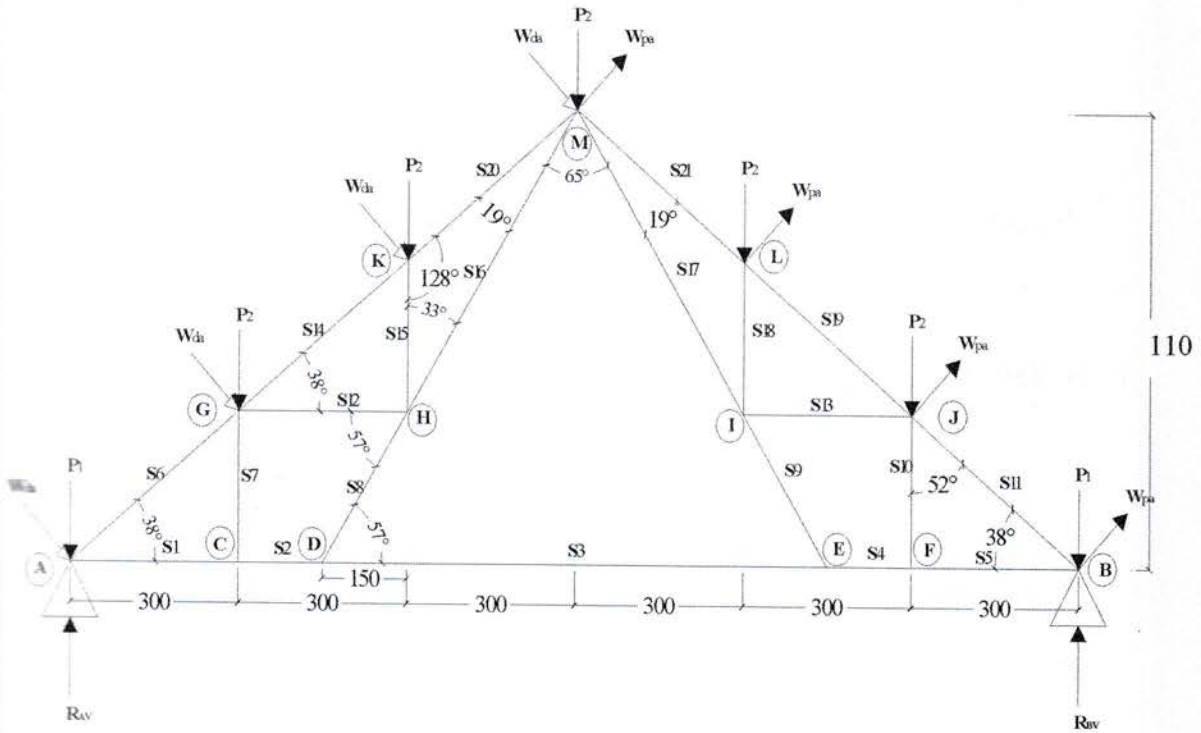
- Koefisien angin hisap ( ch ) Pada bidang tidak ada angin/Angin Pergi/Hisap

$$W_p = C \times L \times W$$

$$W_p = -0.40 \times 1.27 \times 30$$

$$W_p = -15.24 \text{ kg/m}$$

## II.2 Perhitungan Gaya-Gaya Batang Akibat Beban Mati



$$R_{KV} = 671.02 \text{ Kg} \quad P_2 = 336.00 \text{ Kg} \quad P_{2K} = 1007.02 \text{ Kg}$$

$$R_{LV} = 671.02 \text{ Kg} \quad P_1 = 168.00 \text{ Kg} \quad P_{2L} = 1007.02 \text{ Kg}$$

### Perhitungan Reaksi di Titik A dan B

$$\Sigma M_B = 0$$

$$R_{AV} \times 18.00 - P_1 \times 0.00 - P_2 \times 3.00 - P_{2L} \times 6.00 - P_2 \times 9.00 - P_{2K} \times 12.00$$

$$- P_2 \times 15.00 - P_1 \times 18.00 = 0$$

$$R_{AV} \times 18.00 - (168.00 \times 0.00) - (336.00 \times 3.00) - (1007.02 \times 6.00)$$

$$- (336.00 \times 9.00) - (1007.02 \times 12.00) - (336.00 \times 15.00) - (168.00 \times 18.00) = 0$$

$$18 R_{AV} = 0.00 + 1008 + 6042.12 + 3024 + 12084 + 5040 + 3024$$

$$R_{AV} = \frac{30222.36}{18}$$

$$R_{AV} = 1679.0 \text{ Kg}$$

UNIVERSITAS MEDAN AREA



$$\Sigma MA = 0$$

$$- RBV \times 18.00 + P_1 \times 0.0 + P_2 \times 3.00 + P_{2K} \times 6.00 + P_2 \times 9.0 + P_{2L} \times 12.00 - P_2 \times 15.00 - P_1 \times 18.00 = 0$$

$$- RAV \times 18.00 + (168.00 \times 0.00) + (336.00 \times 3.00) + (1007.02 \times 6.00) + (336.00 \times 9.00) + (1007.02 \times 12.00) + (336.00 \times 15.00) + (168.00 \times 18.00) = 0$$

$$18 RBV = 0.00 + 1008 + 6042.12 + 3024 + 12084 + 5040 + 3024$$

$$RBV = \frac{30222.36}{18}$$

$$RBV = 1679.0 \text{ Kg}$$

### Kontrol

$$\Sigma V = 0$$

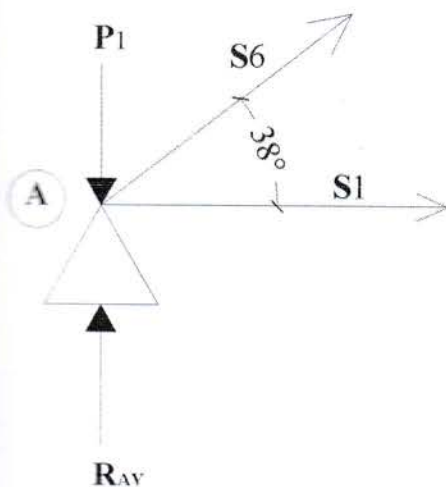
$$RAV + RBV - P_1 - P_2 - P_{2k} - P_2 - P_{2L} - P_2 - P_1 = 0$$

$$1679 + 1679 - 168.00 - 336.00 - 1007.0 - 336.00 - 1007.0 - 336.00 - 168.00 = 0$$

$$3358 \text{ Kg} - 3358 \text{ Kg} = 0 \text{ (Ok!)}$$

### ✓ Perhitungan Gaya-Gaya Batang

#### TITIK BUHUL - A



$$\Sigma V = 0 ;$$

$$RAV + S_6 \times \sin 38^\circ - P_1 = 0$$

$$1679.0 + 0.616 \times S_6 - 168.00 = 0$$

$$-S_6 = \frac{1511}{0.616}$$

$$S_6 = -2452.9 \text{ Kg (Tekan)}$$

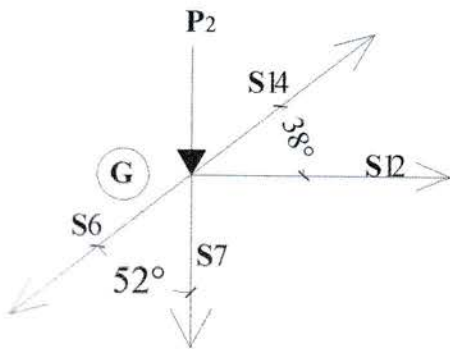
$$\Sigma H = 0 ;$$

$$S_6 \times \cos 38^\circ + S_1 = 0$$

$$0.788 \times (-2452.9) + S_1 = 0$$

$$S_1 = 1932.89 \text{ Kg (Tarik)}$$

**TITIK BUHUL - G**



$$\Sigma V = 0 ;$$

$$S7 = 0 \text{ Kg}$$

$$\Sigma H = 0 ;$$

$$S2 - S1 = 0$$

$$S2 - 1932.89 = 0$$

$$S2 = 1932.89 \text{ kg (Tarik)}$$

$$\Sigma V = 0 ;$$

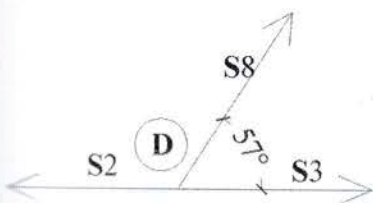
$$P2 + S7 + S6 \times \sin 38^\circ + S14 \times \sin 38^\circ = 0$$

$$336 + 0 + 0.616 \times -2452.9 + 0.616 \times S14 = 0$$

$$-S14 = \frac{1174.98}{0.616}$$

$$S14 = -1907.43 \text{ Kg (Tekan)}$$

**TITIK BUHUL - D**



$$\Sigma H = 0 ;$$

$$S14 \times \cos 38^\circ + S6 \times \cos 38^\circ + S12 = 0$$

$$-1907.43 \times 0.788 + -2452.9 \times 0.788 + S12 = 0$$

$$S12 = 3435.94 \text{ Kg (Tarik)}$$

$$\Sigma V = 0 ;$$

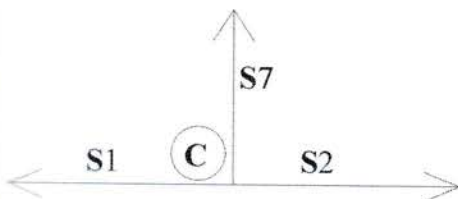
$$S8 \times \sin 57^\circ = 0$$

$$S8 \times 0.838 = 0 \text{ ----- Persamaan 1)}$$

$$\Sigma H = 0 ;$$

$$S8 \times \cos 57^\circ + S2 + S3 = 0$$

$$0.544 \times S8 + 1932.89 + S3 = 0 \text{ Persamaan 2)}$$





Persamaan 1 dan 2 di eliminasi, sehingga:

$$\begin{array}{r|l} 0.838 \times S_8 & = 0 \quad \times 0.544 \\ 0.544 \times S_8 + 1932.89 + S_3 & = 0 \quad \times 0.838 \quad - \end{array}$$

$$0.456 \times S_8 = 0$$

$$0.456 \times S_8 + 1619.76 + S_3 = 0 \quad -$$

$$S_3 = -1619.76 \text{ Kg (Tekan)}$$

Masukkan nilai  $S_3$  ke dalam Persamaan 2

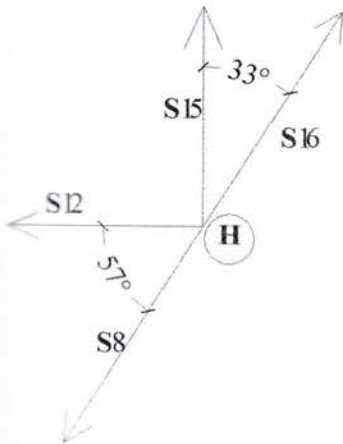
$$0.544 \times S_8 + 1932.89 + S_3 = 0 \quad \text{-----Persamaan 2)}$$

$$0.544 \times S_8 + 1932.89 + (-1619.76) = 0$$

$$S_8 = \frac{313.13}{0.544}$$

$$S_8 = 575.61 \text{ Kg (Tarik)}$$

### TITIK BUHUL - H



$$\Sigma V = 0 ;$$

$$S_{15} + S_8 \times \sin 57^\circ - S_{16} \times \sin 57^\circ = 0$$

$$S_{15} + 575.61 \times 0.838 - S_{16} \times 0.838 = 0 \quad \text{-----}$$

Persamaan 1)

$$\Sigma H = 0 ;$$

$$S_{12} + S_8 \times \cos 57^\circ + S_{16} \times \cos 57^\circ = 0$$

$$3435.94 + 575.61 \times 0.544 + S_{16} \times 0.544 = 0$$

$$-S_{16} = \frac{3749.07}{0.544}$$

$$S_{16} = -6891.68 \text{ Kg (Tekan)}$$

Memasukkan nilai  $S_{16}$  ke persamaan 1 untuk mendapatkan nilai  $S_{15}$ :

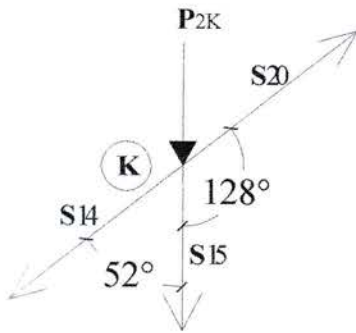
$$S_{15} + 575.61 \times 0.838 - S_{16} \times 0.838 = 0$$

$$S_{15} + 575.61 \times 0.838 - (-6891.68) \times 0.838 = 0$$

$$S_{15} = -482.361 - 5775.23$$

$$S_{15} = -6257.59 \text{ Kg (Tekan)}$$

TITIK BUHUL - K



$$\Sigma H = 0 ;$$

$$S14 \times \sin 52^\circ - S20 \times \sin 52^\circ = 0$$

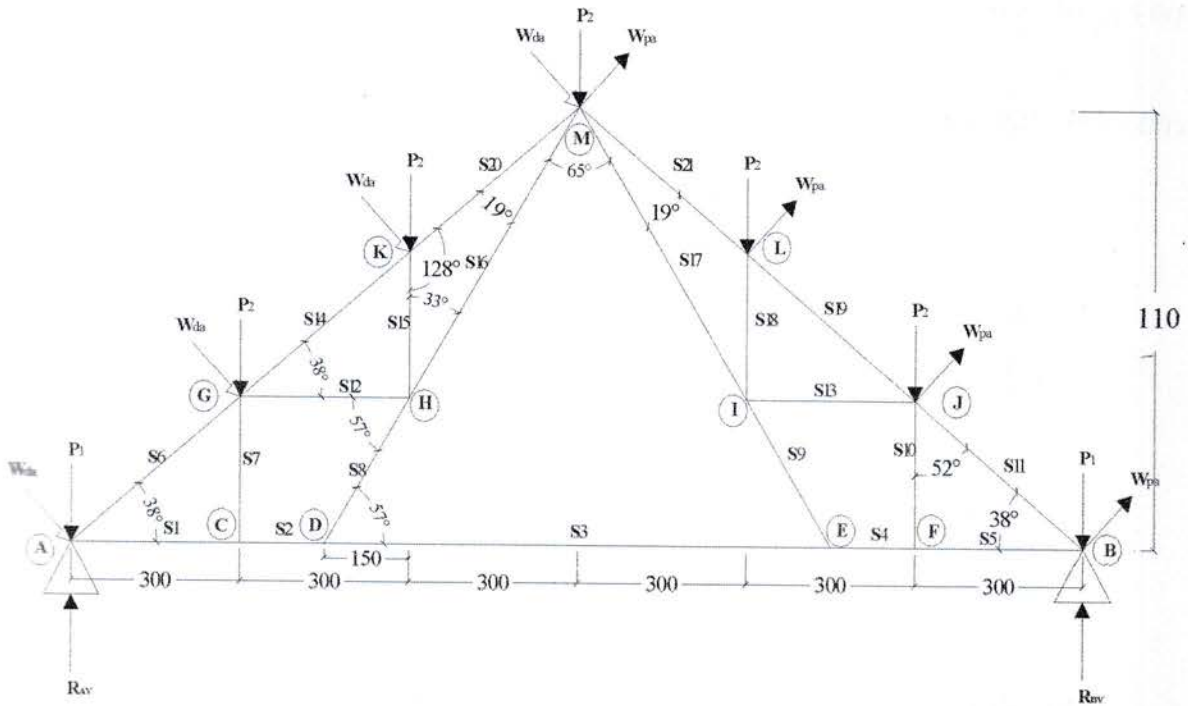
$$0.788 \times -1907.43 - 0.788 \times S20 = 0$$

$$-S20 = \frac{1503.05}{0.788}$$

$$S20 = -1907.43 \text{ Kg (Tekan)}$$



### II.3 Perhitungan Gaya-Gaya Batang Akibat Beban Hidup



$R_{KV} = 671.02 \text{ Kg}$

$P_2 = 100.00 \text{ Kg}$

$P_{2K} = 771.02 \text{ Kg}$

$R_{LV} = 671.02 \text{ Kg}$

$P_1 = 100.00 \text{ Kg}$

$P_{2L} = 771.02 \text{ Kg}$

✓ **Perhitungan Reaksi di Titik A dan B**

$\Sigma MB = 0$

$: R_{AV} \times 18.00 - P_1 \times 0.00 - P_2 \times 3.00 - P_{2L} \times 6.00 - P_2 \times 9.00 - P_{2K} \times 12.00 - P_2 \times 15.00 - P_1 \times 18.00 = 0$

$: R_{AV} \times 18.00 - (100.00 \times 0.00) - (100.00 \times 3.00) - (771.02 \times 6.00) - (100.00 \times 9.00) - (771.02 \times 12.00) - (100 \times 15.00) - (100 \times 18.00) = 0$

$18 R_{AV} = 0.00 + 300 + 4626.12 + 900 + 9252.24 + 1500 + 1800$

$R_{AV} = \frac{18378.36}{18}$

$R_{AV} = 1021.02 \text{ Kg}$

$$\Sigma MA = 0$$

$$: - RBV \times 18.00 + P1 \times 0.0 + P2 \times 3.00 + P2K \times 6.00 + P2 \times 9.0 + P2L \times 12.00 - P2 \times 15.00 - P1 \times 18.00 = 0$$

$$: - RAV \times 18.00 + (100.00 \times 0.00) + (100.00 \times 3.00) + (771.02 \times 6.00) + (100.00 \times 9.00) + (771.02 \times 12.00) + (100.00 \times 15.00) + (100.00 \times 18.00) = 0$$

$$18 RBV = 0.00 + 300 + 4626.12 + 900 + 9252.24 + 1500 + 1800$$

$$RBV = \frac{18378.36}{18}$$

$$RBV = 1021.02 \text{ Kg}$$

### Kontrol

$$\Sigma V = 0$$

$$RAV + RBV - P1 - P2 - P2k - P2 - P2L - P2 - P1 = 0$$

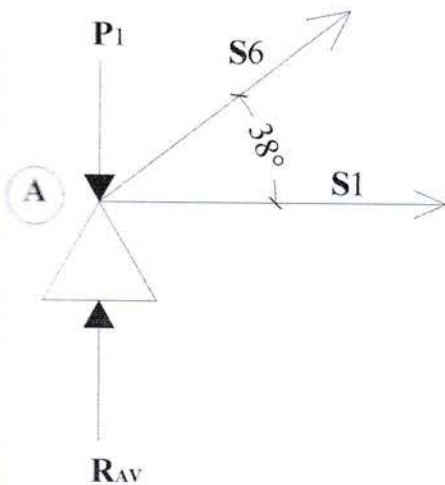
$$1021.02 + 1021.02 - 100.00 - 100.00 - 771.02 - 100.00 - 771.02 - 100.00 - 100.00 = 0$$

$$2042.04 \text{ Kg} - 2042.04 \text{ Kg} = 0 \text{ (Ok!)}$$



### ✓ Perhitungan Gaya-Gaya Batang

TITIK BUHUL - A



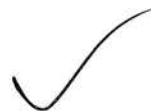
$$\Sigma V = 0 ;$$

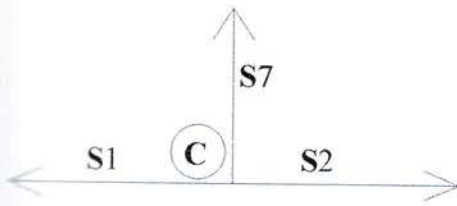
$$RAV + S6 \times \sin 38^\circ - P1 = 0$$

$$1021.0 + 0.616 \times S6 - 100.00 = 0$$

$$-S6 = \frac{921.02}{0.616}$$

$$S6 = - 1495.16 \text{ Kg (Tekan)}$$



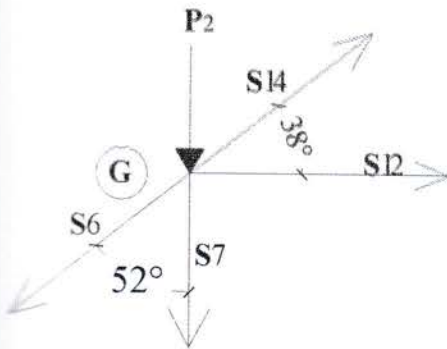
**TITIK BUHUL - C**

$$\Sigma H = 0;$$

$$S_6 \times \cos 38^\circ + S_1 = 0$$

$$0.788 \times (-1495.16) + S_1 = 0$$

$$S_1 = 1178.186 \text{ Kg (Tarik)}$$

**TITIK BUHUL - G**

$$\Sigma V = 0;$$

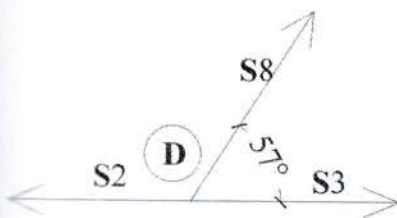
$$S_7 = 0 \text{ Kg}$$

$$\Sigma H = 0;$$

$$S_2 - S_1 = 0$$

$$S_2 - 1178.186 = 0$$

$$S_2 = 1178.186 \text{ kg (Tarik)}$$

**TITIK BUHUL - D**

$$\Sigma V = 0;$$

$$P_2 + S_7 + S_6 \times \sin 38^\circ + S_{14} \times \sin 38^\circ = 0$$

$$100 + 0 + 0.616 \times -1495.16 + 0.616 \times S_{14} = 0$$

$$-S_{14} = \frac{821.018}{0.616}$$

$$S_{14} = -1332.82 \text{ Kg (Tekan)}$$

$$\Sigma H = 0;$$

$$S_{14} \times \cos 38^\circ + S_6 \times \cos 38^\circ + S_{12} = 0$$

$$-1332.82 \times 0.788 + -1495.16 \times 0.788 + S_{12} = 0$$

$$S_{12} = 2228.448 \text{ Kg (Tarik)}$$

$$\Sigma V = 0;$$

$$S_8 \times \sin 57^\circ = 0$$

$$S_8 \times 0.838 = 0 \text{ ----- Persamaan 1)}$$

$$\Sigma H = 0 ;$$

$$S_8 \times \cos 57^\circ + S_2 + S_3 = 0$$

$$0.544 \times S_8 + 1178.186 + S_3 = 0 \text{ Persamaan 2)}$$

Persamaan 1 dan 2 di eliminasi, sehingga:

$$\begin{array}{r} 0.838 \times S_8 \qquad \qquad \qquad | = 0 \quad \times 0.544 \\ 0.544 \times S_8 + 1178.186 + S_3 \quad | = 0 \quad \times 0.838 \quad - \\ \hline \end{array}$$

$$0.456 \times S_8 \qquad \qquad \qquad = 0$$

$$\underline{0.456 \times S_8 + 987.32 + S_3 = 0 \quad -}$$

$$S_3 = - 987.32 \text{ Kg (Tekan)}$$

Masukkan nilai  $S_3$  ke dalam Persamaan 2

$$0.544 \times S_8 + 1178.186 + S_3 = 0 \text{ -----Persamaan 2)}$$

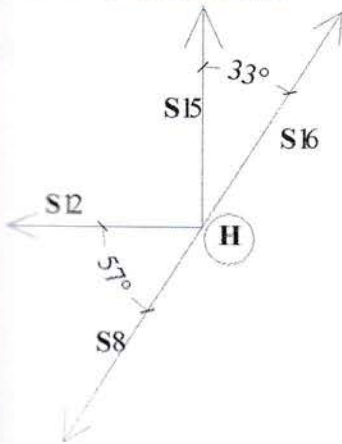
$$0.544 \times S_8 + 1178.186 + (-987.32) = 0$$

$$S_8 = \frac{190.866}{0.544}$$

$$S_8 = 350.86 \text{ Kg (Tarik)}$$



### TITIK BUHUL - H



$$\Sigma V = 0;$$

$$S15 + S8 \times \sin 57^\circ + S16 \times \sin 57^\circ = 0$$

$$S15 + 350.86 \times 0.838 - S16 \times 0.838 = 0 \text{ -----Persamaan 1)}$$

$$\Sigma H = 0;$$

$$S12 + S8 \times \cos 57^\circ + S16 \times \cos 57^\circ = 0$$

$$2228.448 + 350.86 \times 0.544 + S16 \times 0.544 = 0$$

$$-S16 = \frac{2419.31}{0.544}$$

$$S16 = - 4447.27 \text{ Kg (Tekan)}$$

Memasukkan nilai S16 ke persamaan 1 untuk mendapatkan nilai S15:

$$S15 + 350.86 \times 0.838 + S16 \times 0.838 = 0$$

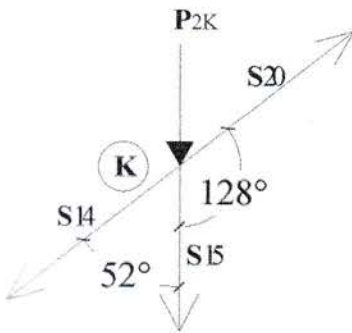
$$S15 + 294.02 - (-4447.27) \times 0.838 = 0$$

$$S15 = - 294.02 - 3726.81$$

$$S15 = - 4020.83 \text{ Kg (Tekan)}$$



### TITIK BUHUL - K



$$\Sigma H = 0;$$

$$S14 \times \sin 52^\circ - S20 \times \sin 52^\circ = 0$$

$$0.788 \times - 1332.82 - 0.788 \times S20 = 0$$

$$-S20 = \frac{1050.26}{0.788}$$

$$S20 = - 1332.817 \text{ Kg (Tekan)}$$



Karena bentuk konstruksi adalah simetris, maka nilai beban di sisi sebelahnya otomatis sama dengan nilai beban pada batang yang sama posisinya. Sehingga pada sisi tersebut tidak perlu dilakukan perhitungan lagi.

Besaran Gaya sama pada batang-batang berikut ini :

$$S1 = S5$$

$$S2 = S4$$

$$S3 = S3$$

$$S6 = S11$$

$$S7 = S10$$

$$S8 = S9$$

$$S12 = S13$$

$$S14 = S19$$

$$S15 = S18$$

$$S16 = S17$$

$$S20 = S21$$

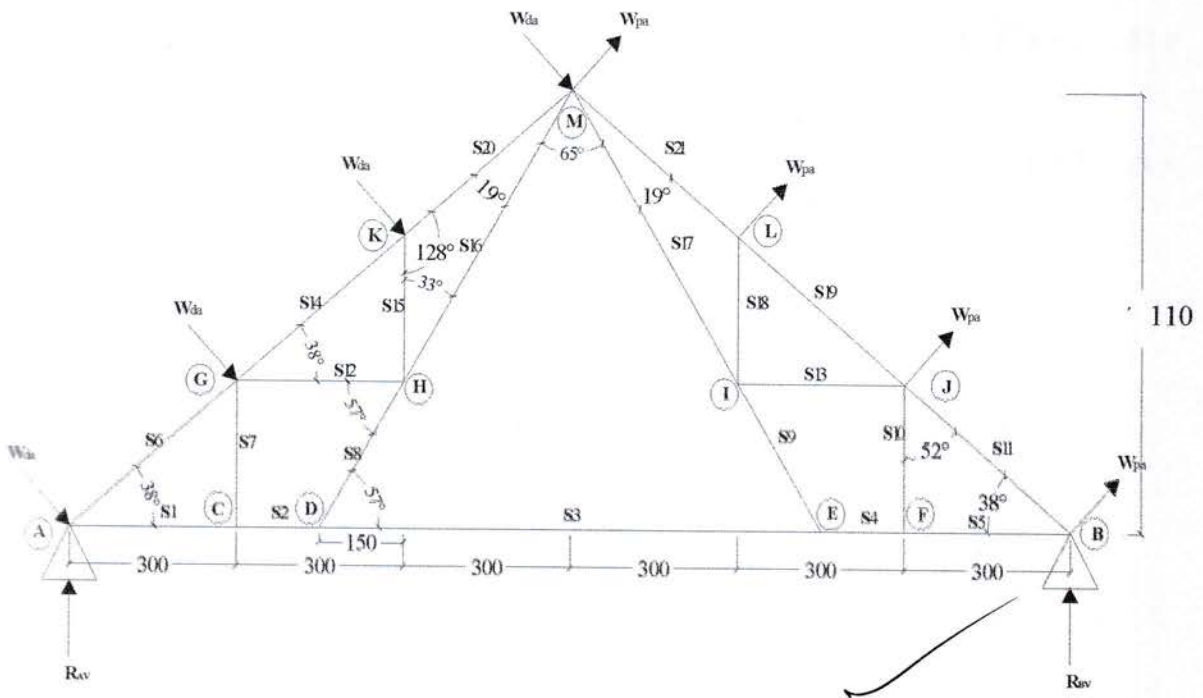
$$S20 = S21$$



**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 <sub>1</sub>	1,932.89	-	1,178.86	-	3,111.75	-
S <sub>2</sub>	1,932.89	-	1,178.86	-	3,111.75	-
S <sub>3</sub>	-	(1,619.76)	-	(987.32)	-	(2,607.08)
S <sub>4</sub>	1,932.89	-	1,178.86	-	3,111.75	-
S <sub>5</sub>	1,932.89	-	1,178.86	-	3,111.75	-
S <sub>6</sub>	-	(2,452.9)	-	(1,495.16)	-	(3,948.06)
S <sub>7</sub>	-	-	-	-	-	-
S <sub>8</sub>	575.61	-	350.86	-	926.47	-
S <sub>9</sub>	575.61	-	350.86	-	926.47	-
S <sub>10</sub>	-	-	-	-	-	-
S <sub>11</sub>	-	(2,452.9)	-	(1,495.16)	-	(3,948.06)
S <sub>12</sub>	3435.94	-	2,228.448	-	5664.388	-
S <sub>13</sub>	3435.94	-	2,228.448	-	5664.388	-
S <sub>14</sub>	-	(1907.43)	-	(1,332.82)	-	(3240.25)
S <sub>15</sub>	-	(6,257.59)	-	(4,020.83)	-	(10278.42)
S <sub>16</sub>	-	(6,891.68)	-	(4,447.27)	-	(11338.95)
S <sub>17</sub>	-	(6,891.68)	-	(4,447.27)	-	(11338.95)
S <sub>18</sub>	-	(6,257.59)	-	(4,020.83)	-	(10278.42)
S <sub>19</sub>	-	(1907.43)	-	(1,332.82)	-	(3240.25)
S <sub>20</sub>	-	(1907.43)	-	(1332.817)	-	(3240.25)
S <sub>21</sub>	-	(1907.43)	-	(1332.817)	-	(3240.25)
D <sub>1</sub>	-	(671.02)	-	(150.00)	-	(821.02)
D <sub>2</sub>	-	(671.02)	-	(150.00)	-	(821.02)
D <sub>3</sub>	150.79	-	56.180	-	206.97	-
D <sub>4</sub>	150.79	-	56.180	-	206.97	-
D <sub>5</sub>	-	(30.109)	-	(11.214)	-	(41.323)
D <sub>6</sub>	-	(211.11)	-	(78.652)	-	(289.77)
D <sub>7</sub>	-	(211.11)	-	(78.652)	-	(289.77)

## II.4 Perhitungan Gaya-Gaya Batang Akibat Beban Angin Datang



$$W_{da} = 13.72 \text{ Kg} \quad \cos 38^\circ = 0.788 \quad W_{da} \times \cos 38^\circ = 17.41 \text{ Kg}$$

$$\sin 38^\circ = 0.616 \quad W_{da} \times \sin 38^\circ = 22.28 \text{ Kg}$$

✓ Perhitungan Reaksi di titik K dan L

$$\sum M_B = 0$$

$$R_{AV} \times 18 - W_{da} \sin 38^\circ \times 18 - W_{da} \sin 38^\circ \times 15 - W_{da} \sin 38^\circ \times 12 + W_{da} \sin 38^\circ \times 9 - 0.00 \times 6.00 - 0.00 \times 3.00 - 0.00 \times 0.0 = 0$$

$$R_{AV} \times 18 - 22.28 \times 18 - 22.28 \times 15 - 22.28 \times 12 + 22.28 \times 9 - 0.0 \times 6.00 - 0.0 \times 3.0 - 0.00 \times 0.00 = 0$$

$$R_{AV} = 66.84 \text{ Kg}$$



$$\Sigma MA = 0$$

$$RBV \times 18 - Wda \sin 38^\circ \times 0.00 - Wda \sin 38^\circ \times 3 - Wda \sin 38^\circ \times 6 + Wda \sin 38^\circ \times 9 - 0.00 \times 12 - 0.00 \times 15 - 0.00 \times 18 = 0$$

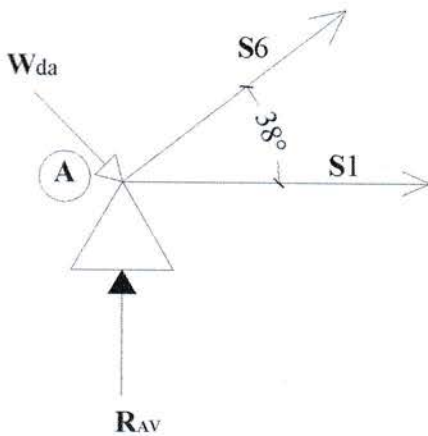
$$RBV \times 18 - 22.28 \times 0.00 - 22.28 \times 3 - 22.28 \times 6 + 22.28 \times 9 - 0.0 \times 12 - 0.0 \times 15 - 0.00 \times 18 = 0$$

$$RBV = 22.28 \text{ Kg}$$

$$\Sigma ML = 0 \rightarrow RAV + RBV - (4 \times Wda \sin 38^\circ) = 89.11 \text{ Kg} - 89.11 \text{ Kg} = 0 \rightarrow \text{OK}$$

### Perhitungan Gaya-Gaya Batang

#### TITIK BUHUL - A



$$\Sigma V = 0 ;$$

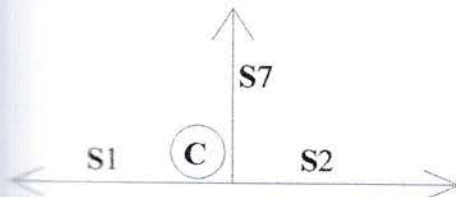
$$RAV + S6 \times \sin 38^\circ - Wda \sin 38^\circ = 0$$

$$66.84 + 0.616 \times S6 - 22.28 = 0$$

$$-S6 = \frac{44.56}{0.616}$$

$$S6 = -72.34 \text{ Kg (Tekan)}$$

#### TITIK BUHUL - C



$$\Sigma H = 0 ;$$

$$S6 \times \cos 38^\circ + S1 + Wda \cos 38^\circ = 0$$

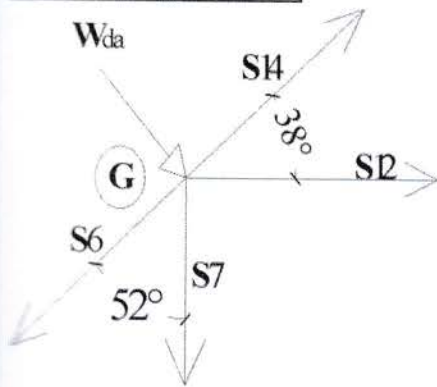
$$0.788 \times (-72.34) + S1 + 17.41 = 0$$

$$S1 = 39.59 \text{ Kg (Tarik)}$$

$$\Sigma V = 0 ;$$

$$S7 = 0 \text{ Kg}$$

**TITIK BUHUL - G**



$$\Sigma H = 0 ;$$

$$S_2 - S_1 = 0$$

$$S_2 - 39.59 = 0$$

$$S_2 = 39.59 \text{ kg (Tarik)}$$

$$\Sigma V = 0 ;$$

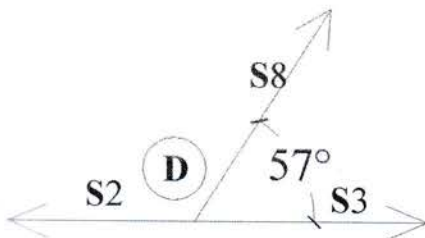
$$W_{da} \sin 38^\circ + S_7 + S_6 \times \sin 38^\circ + S_{14} \times \sin 38^\circ = 0$$

$$22.28 + 0 + 0.616 x - 72.34 + 0.616 x S_{14} = 0$$

$$-S_{14} = \frac{22.28}{0.616}$$

$$S_{14} = - 36.19 \text{ Kg (Tekan)}$$

**TITIK BUHUL - D**



$$\Sigma H = 0 ;$$

$$S_{14} \times \cos 38^\circ + S_6 \times \cos 38^\circ + S_{12} = 0$$

$$-36.19 \times 0.788 + -72.34 \times 0.788 + S_{12} = 0$$

$$S_{12} = 85.52 \text{ Kg (Tarik)}$$

$$\Sigma V = 0 ;$$

$$S_8 \times \sin 57^\circ = 0$$

$$S_8 \times 0.838 = 0 \text{ ----- Persamaan 1)}$$

$$\Sigma H = 0 ;$$

$$S_8 \times \cos 57^\circ + S_2 + S_3 = 0$$

$$0.544 \times S_8 + 39.59 + S_3 = 0 \text{ Persamaan 2)}$$

Persamaan 1 dan 2 di eliminasi, sehingga:



$$0.838 \times S_8 = 0 \times 0.544$$

$$\underline{0.544 \times S_8 + 39.59 + S_3 = 0 \times 0.838 -}$$

$$0.456 \times S_8 = 0$$

$$\underline{0.456 \times S_8 + 33.18 + S_3 = 0 -}$$

$$S_3 = -33.18 \text{ Kg (Tekan)}$$

Masukkan nilai  $S_3$  ke dalam Persamaan 2

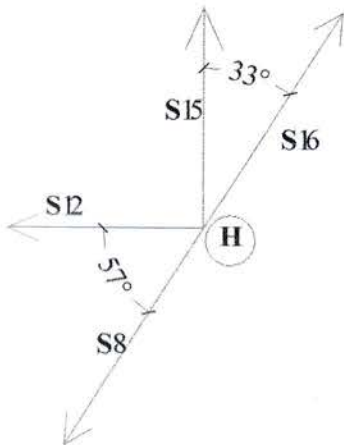
$$0.544 \times S_8 + 39.59 + S_3 = 0 \text{ -----Persamaan 2)}$$

$$0.544 \times S_8 + 39.59 + (-33.18) = 0$$

$$S_8 = \frac{6.41}{0.544}$$

$$S_8 = 11.78 \text{ Kg (Tarik)}$$

### TITIK BUHUL - H



$$\Sigma V = 0 ;$$

$$S_{15} + S_8 \times \sin 57^\circ + S_{16} \times \sin 57^\circ = 0$$

$$S_{15} + 11.78 \times 0.838 - S_{16} \times 0.838 = 0 \text{ -----}$$

$$\text{Persamaan 1)}$$

$$\Sigma H = 0 ;$$

$$S_{12} + S_8 \times \cos 57^\circ + S_{16} \times \cos 57^\circ = 0$$

$$85.52 + 11.78 \times 0.544 + S_{16} \times 0.544 = 0$$

$$-S_{16} = \frac{91.93}{0.544}$$

$$S_{16} = -168.99 \text{ Kg (Tekan)}$$

Memasukkan nilai  $S_{16}$  ke persamaan 1 untuk mendapatkan nilai  $S_{15}$ :

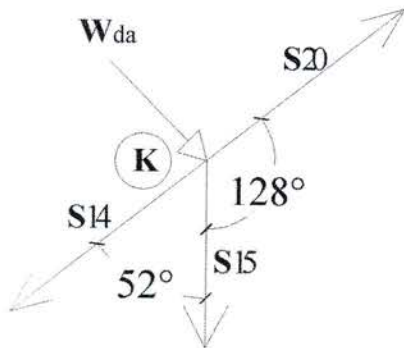
$$S_{15} + 11.78 \times 0.838 + S_{16} \times 0.838 = 0$$

$$S_{15} + 9.87 - (-168.99) \times 0.838 = 0$$

$$S_{15} = -9.87 - 141.61$$

$$S_{15} = -151.48 \text{ Kg (Tekan)}$$

**TITIK BUHUL - K**



$$\Sigma H = 0 ;$$

$$S_{14} \times \sin 52^\circ - S_{20} \times \sin 52^\circ = 0$$

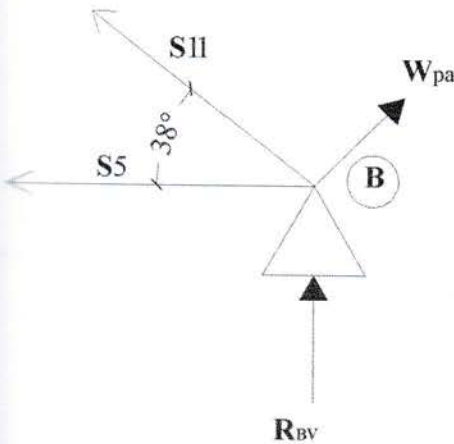
$$0.788 \times -36.19 - 0.788 \times S_{20} = 0$$

$$-S_{20} = \frac{28.517}{0.788}$$

$$S_{20} = -36.19 \text{ Kg (Tekan)}$$



**TITIK BUHUL - B**



$$\Sigma V = 0 ;$$

$$R_{BV} + S_{11} \times \sin 38^\circ = 0$$

$$22.28 + 0.616 \times S_{11} = 0$$

$$-S_{11} = \frac{22.28}{0.616}$$

$$S_{11} = -36.19 \text{ Kg (Tekan)}$$

$$\Sigma H = 0 ;$$

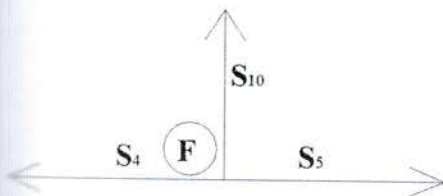
$$S_{11} \times \cos 38^\circ + S_5 = 0$$

$$0.788 \times (-36.19) + S_5 = 0$$

$$S_5 = 28.52 \text{ Kg (Tarik)}$$



**TITIK BUHUL - f**



$$\Sigma V = 0 ;$$

$$S_{10} = 0 \text{ Kg}$$

$$\Sigma H = 0 ;$$

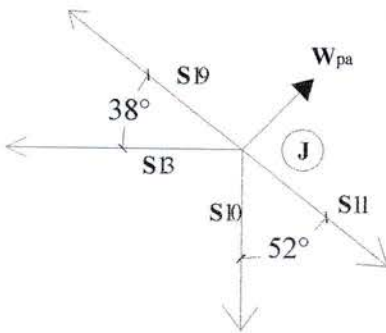
$$S_4 - S_5 = 0$$

$$S_4 - 28.52 = 0$$

$$S_4 = 28.52 \text{ kg (Tarik)}$$



**TITIK BUHUL - J**



$$\Sigma V = 0 ;$$

$$S_{10} + S_{11} \times \sin 38^\circ + S_{19} \times \sin 38^\circ = 0$$

$$0 + 0.616 x - 36.17 + 0.616 x S_{19} = 0$$

$$-S_{19} = \frac{22.28}{0.616}$$

$$S_{19} = - 36.19 \text{ Kg (Tekan)}$$

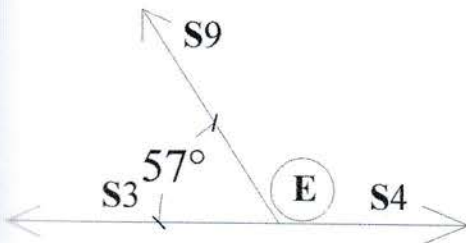
$$\Sigma H = 0 ;$$

$$S_{19} \times \cos 38^\circ + S_{11} \times \cos 38^\circ + S_{13} = 0$$

$$-36.19 \times 0.788 + -36.19 \times 0.788 + S_{13} = 0$$

$$S_{13} = 57.04 \text{ Kg (Tarik)}$$

**TITIK BUHUL - E**



$$\Sigma V = 0 ;$$

$$S_9 \times \sin 57^\circ = 0$$

$$S_9 \times 0.838 = 0 \text{ ----- Persamaan 1)}$$

$$\Sigma H = 0 ;$$

$$S_9 \times \cos 57^\circ + S_4 + S_3 = 0$$

$$0.544 \times S_9 + 28.52 + S_3 = 0 \text{ Persamaan 2)}$$

Persamaan 1 dan 2 di eliminasi, sehingga:

$$0.838 \times S_9 = 0 \quad \times 0.544$$

$$\underline{0.544 \times S_9 + 28.52 + S_3 = 0 \quad \times 0.838 \quad -}$$

$$0.456 \times S_9 = 0$$

$$\underline{0.456 \times S_9 + 23.90 + S_3 = 0 \quad -}$$

$$S_3 = - 23.90 \text{ Kg (Tekan)}$$

Masukkan nilai  $S_3$  ke dalam Persamaan 2

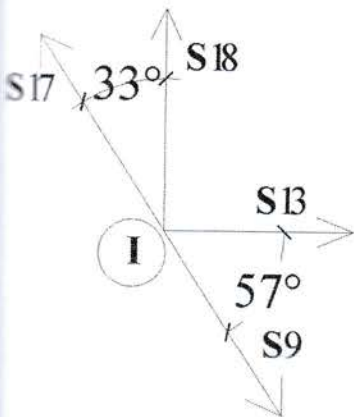
$$0.544 \times S_8 + 28.52 + S_3 = 0 \text{ -----Persamaan 2)}$$

$$0.544 \times S_8 + 28.52 + (-23.90) = 0$$

$$S_9 = \frac{4.62}{0.544}$$

$$S_9 = 8.493 \text{ Kg (Tarik)}$$

**TITIK BUHUL - I**



$$\Sigma V = 0 ;$$

$$S_{18} + S_9 \times \sin 57^\circ + S_{17} \times \sin 57^\circ = 0$$

$$S_{18} + 8.493 \times 0.838 - S_{17} \times 0.838 = 0 \text{ -----Persamaan 1)}$$

$$\Sigma H = 0 ;$$

$$S_{13} + S_9 \times \cos 57^\circ + S_{17} \times \cos 57^\circ = 0$$

$$85.52 + 8.493 \times 0.544 + S_{17} \times 0.544 = 0$$

$$-S_{17} = \frac{90.14}{0.544}$$

$$S_{17} = - 165.70 \text{ Kg (Tekan)}$$

Memasukkan nilai  $S_{16}$  ke persamaan 1 untuk mendapatkan nilai  $S_{15}$ :

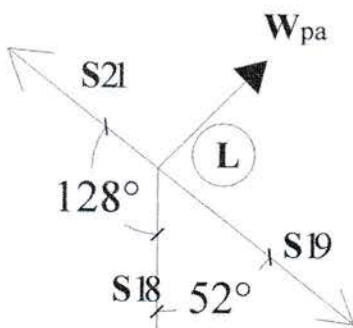
$$S_{18} + 8.493 \times 0.838 + S_{17} \times 0.838 = 0$$

$$S_{18} + 7.12 - (-165.7) \times 0.838 = 0$$

$$S_{18} = - 7.12 - 138.86$$

$$S_{18} = - 145.98 \text{ Kg (Tekan)}$$

**TITIK BUHUL - L**



$$\Sigma H = 0 ;$$

$$S_{19} \times \sin 52^\circ - S_{21} \times \sin 52^\circ = 0$$

$$0.788 \times -36.19 - 0.788 \times S_{21} = 0$$

$$-S_{21} = \frac{28.517}{0.788}$$

$$S_{21} = - 36.19 \text{ Kg (Tekan)}$$



**REKAPITULASI GAYA BATANG AKIBA BEBAN TETAP**

No. Batang	BEBAN TETAP		BEBAN ANGIN		BEBAN DIPAKAI	
	Batang Tarik (+)	Batang Tekan (-)	Batang Tarik (+)	Batang Tekan (-)	Batang Tarik (+)	Batang Tekan (-)
S 1	3,111.75	-	39.59	-	3,111.75	-
S 2	3,111.75	-	39.59	-	3,111.75	-
S 3	-	(2,607.08)	-	(33.18)	-	(2,607.08)
S 4	3,111.75	-	28.52	-	3,111.75	-
S 5	3,111.75	-	28.52	-	3,111.75	-
S 6	-	(3,948.06)	-	(72.34)	-	(3,948.06)
S 7	-	-	-	-	-	-
S 8	926.47	-	11.78	-	926.47	-
S 9	926.47	-	11.78	-	926.47	-
S 10	-	-	-	-	-	-
S 11	-	(3,948.06)	-	(36.19)	-	(3,948.06)
S 12	5664.388	-	85.52	-	5664.388	-
S 13	5664.388	-	57.04	-	5664.388	-
S 14	-	(3240.25)	-	(36.19)	-	(3240.25)
S 15	-	(10278.42)	-	(151.48)	-	(10278.42)
S 16	-	(11338.95)	-	(168.99)	-	(11338.95)
S 17	-	(11338.95)	-	(165.70)	-	(11338.95)
S 18	-	(10278.42)	-	(145.98)	-	(10278.42)
S 19	-	(3240.25)	-	(36.19)	-	(3240.25)
S 20	-	(3240.25)	-	(36.19)	-	(3240.25)
S 21	-	(3240.25)	-	(36.19)	-	(3240.25)
D 1	-	(821.02)	-	(3.342)	-	(821.02)
D 2	-	(821.02)	-	(2.90)	-	(821.02)
D 3	206.97	-	-	(3.76)	206.97	-
D 4	206.97	-	3.76	-	206.97	-
D 5	-	(41.323)	-	-	-	(41.323)
D 6	-	(289.77)	-	(10.74)	-	(289.77)
D 7	-	(289.77)	-	(5.26)	-	(289.77)



# TUGAS WAJIB KONSTRUKSI BAJA

## PERHITUNGAN JUMLAH BAUT PLAT BUHUL

### 1. TITIK BUHUL - A

#### 1.1 Profil S1

$$N = 3,111.75 \text{ Kg (+)}$$

$$Pds = 784.00 \text{ Kg/cm}^2$$

$$Pgs = 860.00 \text{ Kg/cm}^2$$

$$\text{Jumlah Paku} = \frac{N}{Pgs} = \frac{3,111.75}{860.00} = 3.62 \text{ Bh} = 4.00 \text{ Bh} = \mathbf{4.00 \text{ Bh}}$$

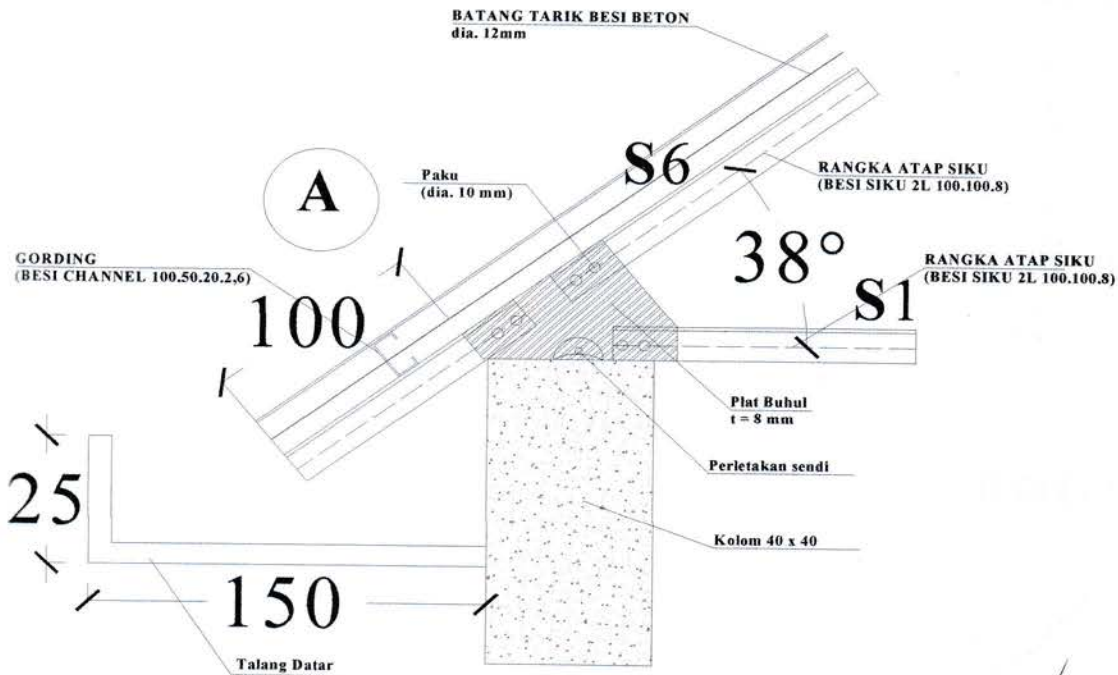
#### 1.2 Profil S6

$$N = 3,948.1 \text{ Kg (-)}$$

$$Pds = 784.00 \text{ Kg/cm}^2$$

$$Pgs = 860.00 \text{ Kg/cm}^2$$

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{3,948.06}{784.00} = 5.04 \text{ Bh} = 6.00 \text{ Bh} = \mathbf{6.00 \text{ Bh}}$$





# TUGAS WAJIB KONSTRUKSI BAJA

## 2. TITIK BUHUL - C

### 2.1 Profil S1 Dan S2

$$N = 3,111.75 \text{ Kg (+)}$$

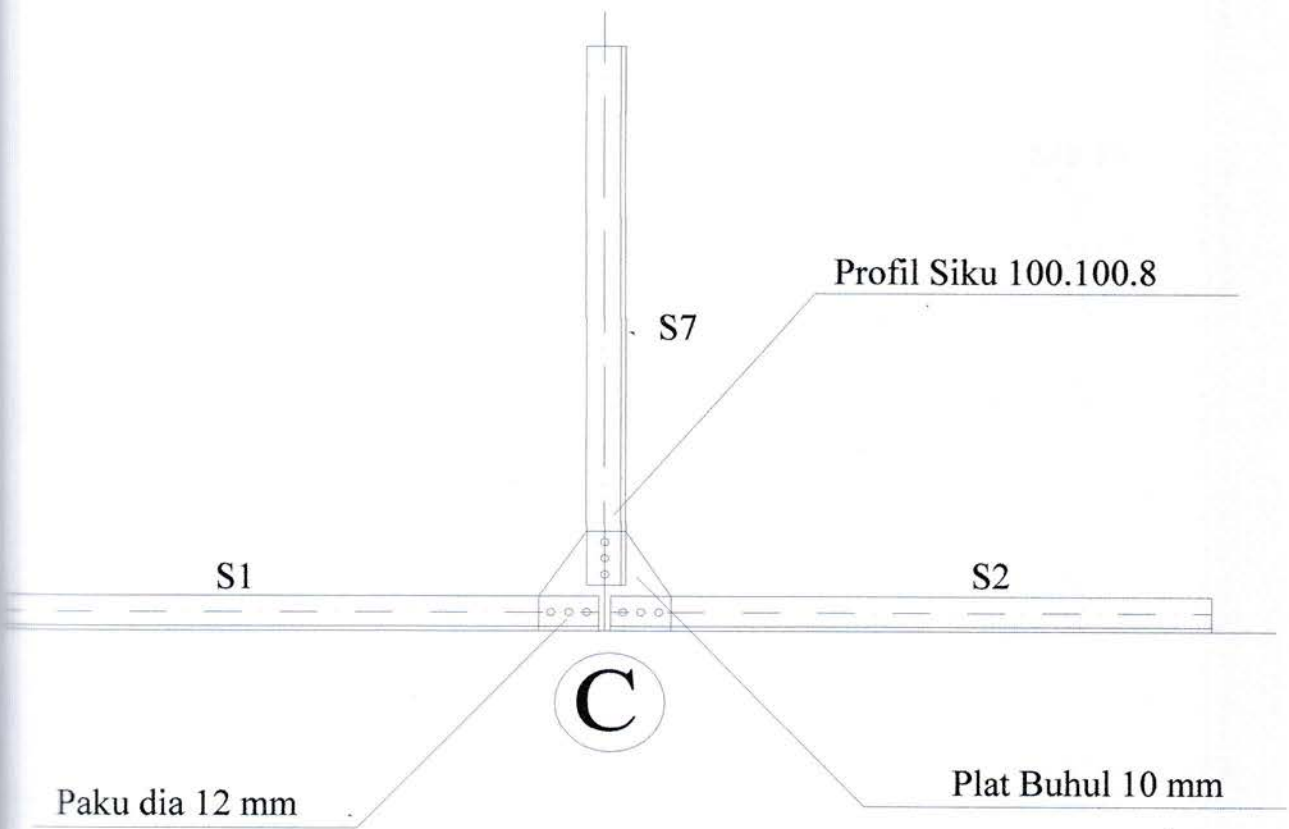
$$Pds = 784.00 \text{ Kg/cm}^2$$

$$Pgs = 860.00 \text{ Kg/cm}^2$$

$$\text{Jumlah Paku} = \frac{N}{Pgs} = \frac{3,111.75}{860.00} = 3.62 \text{ Bh} = 4.00 \text{ Bh} = \mathbf{4.00 \text{ Bh}}$$

### 2.2 Profil S7

$$N = 0.00 \text{ Kg (+)}$$



# TUGAS WAJIB KONSTRUKSI BAJA

## 3. TITIK BUHUL - D

### 3.1 Profil S3

$$N = 2,607.1 \text{ Kg (-)}$$

$$Pds = 784.00 \text{ Kg/cm}^2$$

$$Pgs = 860.00 \text{ Kg/cm}^2$$

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{2,607.08}{784.00} = 3.33 \text{ Bh} = 4.00 \text{ Bh} = \mathbf{4.00 \text{ Bh}}$$

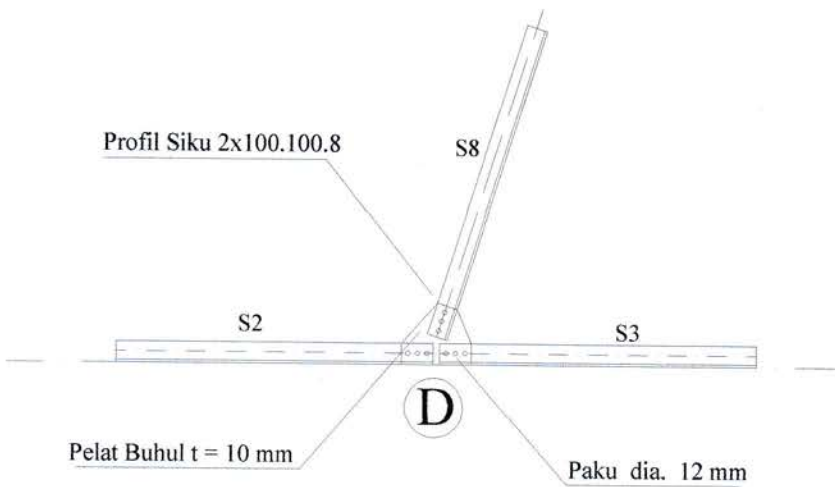
### 3.2 Profil S8

$$N = 926.5 \text{ Kg (+)}$$

$$Pds = 784.00 \text{ Kg/cm}^2$$

$$Pgs = 860.00 \text{ Kg/cm}^2$$

$$\text{Jumlah Paku} = \frac{N}{Pgs} = \frac{926.47}{860.00} = 1.08 \text{ Bh} = 2.00 \text{ Bh} = \mathbf{2.00 \text{ Bh}}$$



# TUGAS WAJIB KONSTRUKSI BAJA

## 4. TITIK BUHUL -H

### 4.1 Profil S8

$$N = 926.47 \text{ Kg (+)}$$

$$Pds = 784.00 \text{ Kg/cm}^2$$

$$Pgs = 860.00 \text{ Kg/cm}^2$$

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{926.47}{784.00} = 1.18 \text{ Bh} = 2.00 \text{ Bh} = \mathbf{2.00 \text{ Bh}}$$

### 4.2 Profil S12

$$N = 5,664.39 \text{ Kg (+)}$$

$$Pds = 784.00 \text{ Kg/cm}^2$$

$$Pgs = 860.00 \text{ Kg/cm}^2$$

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{5,664.39}{784.00} = 7.22 \text{ Bh} = 8.00 \text{ Bh} = \mathbf{8.00 \text{ Bh}}$$

### 4.3 Profil S15

$$N = 10,278.42 \text{ Kg (-)}$$

$$Pds = 784.00 \text{ Kg/cm}^2$$

$$Pgs = 860.00 \text{ Kg/cm}^2$$

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{10,278.42}{784.00} = 13.11 \text{ Bh} = 14.00 \text{ Bh} = \mathbf{10.00 \text{ Bh}}$$

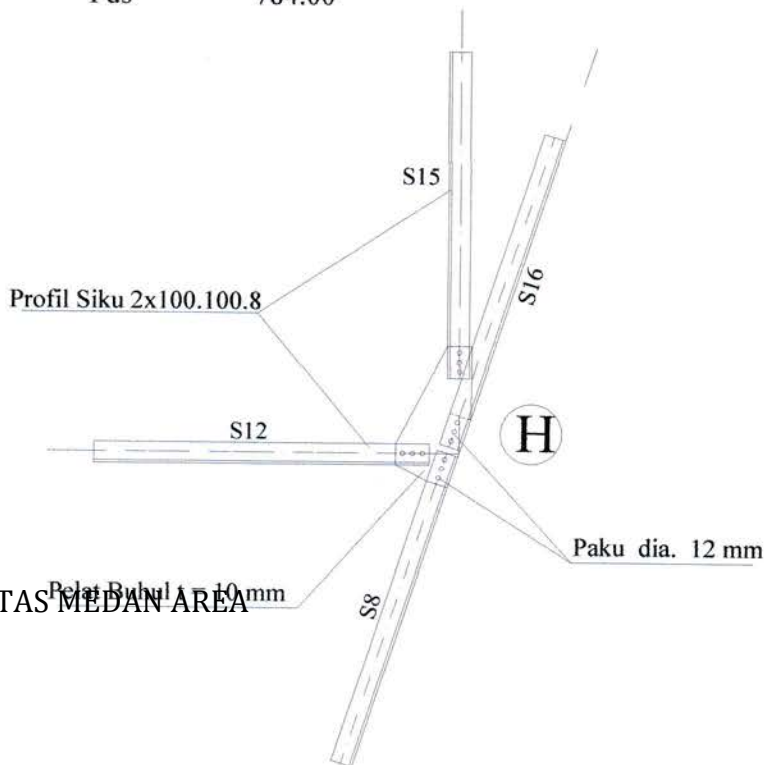
### 4.4 Profil S16

$$N = 11,339 \text{ Kg (-)}$$

$$Pds = 784.00 \text{ Kg/cm}^2$$

$$Pgs = 860.00 \text{ Kg/cm}^2$$

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{11,338.95}{784.00} = 14.46 \text{ Bh} = 15.00 \text{ Bh} = \mathbf{15.00 \text{ Bh}}$$



# TUGAS WAJIB KONSTRUKSI BAJA

## 5. TITIK BUHUL - G

### 5.1 Profil S6

$$\begin{aligned} N &= 3,948 \text{ Kg } (-) \\ Pds &= 784.00 \text{ Kg/cm}^2 \\ Pgs &= 860.00 \text{ Kg/cm}^2 \end{aligned}$$

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{3,948.06}{784.00} = 5.04 \text{ Bh} = 6.00 \text{ Bh} = \mathbf{6.00 \text{ Bh}}$$

### 5.2 Profil S7

$$N = \#REF! \quad (-)$$

### 5.3 Profil S12

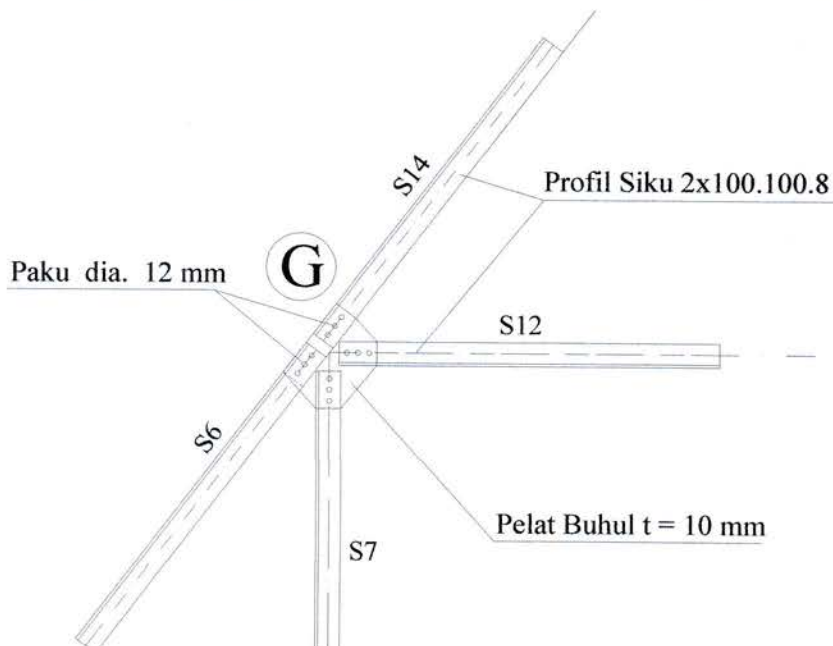
$$\begin{aligned} N &= 5,664.39 \text{ Kg } (+) \\ Pds &= 784.00 \text{ Kg/cm}^2 \\ Pgs &= 860.00 \text{ Kg/cm}^2 \end{aligned}$$

$$\text{Jumlah Paku} = \frac{N}{Pgs} = \frac{5,664.39}{860.00} = 6.59 \text{ Bh} = 7.00 \text{ Bh} = \mathbf{7.00 \text{ Bh}}$$

### 5.4 Profil S14

$$\begin{aligned} N &= 3,240.3 \text{ Kg } (-) \\ Pds &= 784.00 \text{ Kg/cm}^2 \\ Pgs &= 860.00 \text{ Kg/cm}^2 \end{aligned}$$

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{3,240.25}{784.00} = 4.13 \text{ Bh} = 5.00 \text{ Bh} = \mathbf{5.00 \text{ Bh}}$$



# TUGAS WAJIB KONSTRUKSI BAJA

## 6. TITIK BUHUL - K

### 6.1 Profil S14

$$N = 3,240.3 \text{ Kg } (-)$$

$$Pds = 784.00 \text{ Kg/cm}^2$$

$$Pgs = 860.00 \text{ Kg/cm}^2$$

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{3,240.25}{784.00} = 4.13 \text{ Bh} = 5.00 \text{ Bh} = \mathbf{5.00 \text{ Bh}}$$

### 6.2 Profil S15

$$N = 10,278.42 \text{ Kg } (-)$$

$$Pds = 784.00 \text{ Kg/cm}^2$$

$$Pgs = 860.00 \text{ Kg/cm}^2$$

$$\text{Jumlah Paku} = \frac{N}{Pgs} = \frac{10,278.42}{860.00} = 11.95 \text{ Bh} = 12.00 \text{ Bh} = \mathbf{12.00 \text{ Bh}}$$

### 6.3 Profil S20

$$N = 3,240.3 \text{ Kg } (-)$$

$$Pds = 784.00 \text{ Kg/cm}^2$$

$$Pgs = 860.00 \text{ Kg/cm}^2$$

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{3,240.25}{784.00} = 4.13 \text{ Bh} = 5.00 \text{ Bh} = \mathbf{5.00 \text{ Bh}}$$

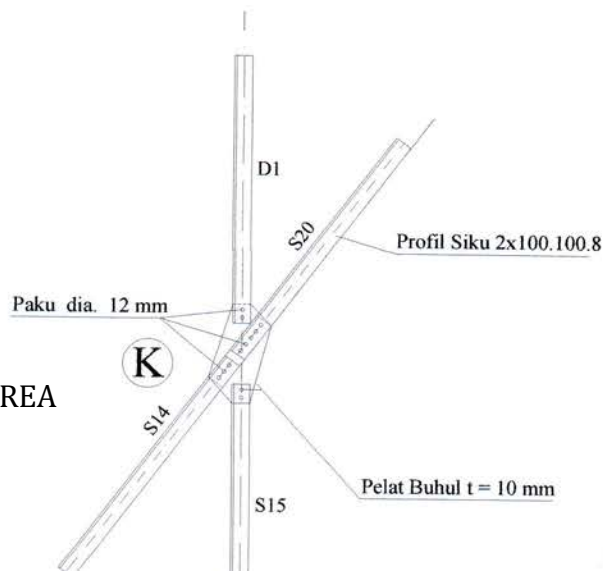
### 6.4 Profil D1

$$N = 821.02 \text{ Kg } (-)$$

$$Pds = 784.00 \text{ Kg/cm}^2$$

$$Pgs = 860.00 \text{ Kg/cm}^2$$

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{821.02}{784.00} = 1.05 \text{ Bh} = 2.00 \text{ Bh} = \mathbf{2.00 \text{ Bh}}$$





# TUGAS WAJIB KONSTRUKSI BAJA

## 7. TITIK BUHUL - N

### 7.1 Profil D1

$$N = 821.02 \text{ Kg (-)}$$

$$Pds = 784.00 \text{ Kg/cm}^2$$

$$Pgs = 860.00 \text{ Kg/cm}^2$$

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{821.02}{784.00} = 1.05 \text{ Bh} = 2.00 \text{ Bh} = \mathbf{2.00 \text{ Bh}}$$

### 7.2 Profil D3

$$N = 206.97 \text{ Kg (+)}$$

$$Pds = 784.00 \text{ Kg/cm}^2$$

$$Pgs = 860.00 \text{ Kg/cm}^2$$

$$\text{Jumlah Paku} = \frac{N}{Pgs} = \frac{206.97}{860.00} = 0.24 \text{ Bh} = 1.00 \text{ Bh} = \mathbf{1.00 \text{ Bh}}$$

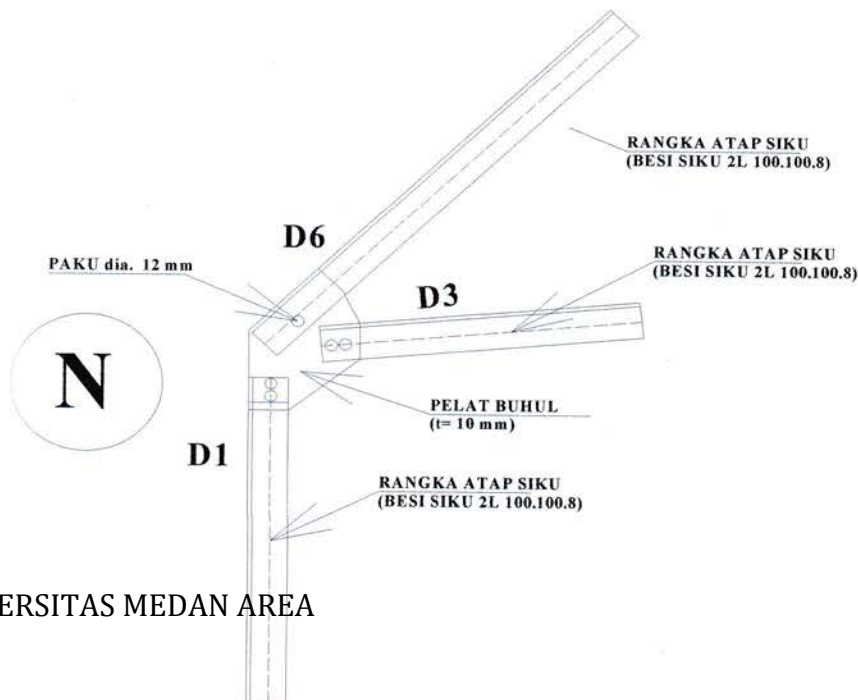
### 7.3 Profil D6

$$N = 289.77 \text{ Kg (-)}$$

$$Pds = 784.00 \text{ Kg/cm}^2$$

$$Pgs = 860.00 \text{ Kg/cm}^2$$

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{289.77}{784.00} = 0.37 \text{ Bh} = 1.00 \text{ Bh} = \mathbf{1.00 \text{ Bh}}$$





# TUGAS WAJIB KONSTRUKSI BAJA

## 9. TITIK BUHUL - M

### 9.1 Profil S16

$$\begin{aligned} N &= 11,339 \text{ Kg (-)} \\ Pds &= 784.00 \text{ Kg/cm}^2 \\ Pgs &= 860.00 \text{ Kg/cm}^2 \end{aligned}$$

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{11,338.95}{784.00} = 14.46 \text{ Bh} = 15.00 \text{ Bh} = \mathbf{15.00 \text{ Bh}}$$

### 9.2 Profil S17

$$\begin{aligned} N &= 11,339 \text{ Kg (-)} \\ Pds &= 784.00 \text{ Kg/cm}^2 \\ Pgs &= 860.00 \text{ Kg/cm}^2 \end{aligned}$$

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{11,338.95}{784.00} = 14.46 \text{ Bh} = 15.00 \text{ Bh} = \mathbf{15.00 \text{ Bh}}$$

### 9.3 Profil S20

$$\begin{aligned} N &= 3,240.3 \text{ Kg (-)} \\ Pds &= 784.00 \text{ Kg/cm}^2 \\ Pgs &= 860.00 \text{ Kg/cm}^2 \end{aligned}$$

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{3,240.25}{784.00} = 4.13 \text{ Bh} = 5.00 \text{ Bh} = \mathbf{5.00 \text{ Bh}}$$

### 9.4 Profil S21

$$\begin{aligned} N &= 3,240 \text{ Kg (-)} \\ Pds &= 784.00 \text{ Kg/cm}^2 \\ Pgs &= 860.00 \text{ Kg/cm}^2 \end{aligned}$$

$$\text{Jumlah Paku} = \frac{N}{Pgs} = \frac{3,240.25}{860.00} = 3.77 \text{ Bh} = 4.00 \text{ Bh} = \mathbf{4.00 \text{ Bh}}$$

### 9.5 Profil D3

$$\begin{aligned} N &= 206.97 \text{ Kg (+)} \\ Pds &= 784.00 \text{ Kg/cm}^2 \\ Pgs &= 860.00 \text{ Kg/cm}^2 \end{aligned}$$

$$\text{Jumlah Paku} = \frac{N}{Pgs} = \frac{206.97}{860.00} = 0.24 \text{ Bh} = 1.00 \text{ Bh} = \mathbf{1.00 \text{ Bh}}$$

### 9.6 Profil D4

$$\begin{aligned} N &= 206.97 \text{ Kg (+)} \\ Pds &= 784.00 \text{ Kg/cm}^2 \\ Pgs &= 860.00 \text{ Kg/cm}^2 \end{aligned}$$

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{206.97}{784.00} = 0.26 \text{ Bh} = 1.00 \text{ Bh} = \mathbf{1.00 \text{ Bh}}$$

# TUGAS WAJIB KONSTRUKSI BAJA

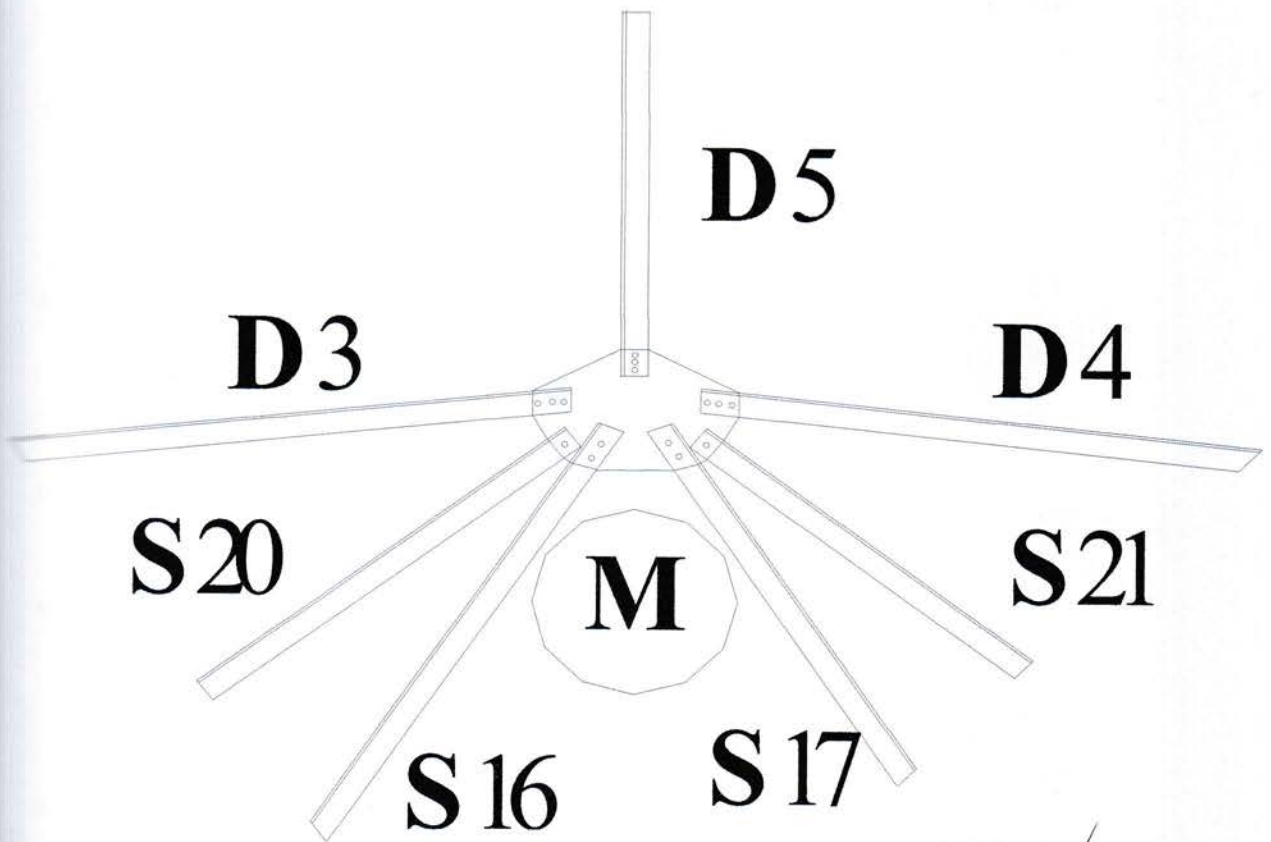
## Profil D5

$N = 41.32 \text{ Kg (-)}$

$Pds = 784.00 \text{ Kg/cm}^2$

$Pgs = 860.00 \text{ Kg/cm}^2$

$$\text{Jumlah Paku} = \frac{N}{Pds} = \frac{41.32}{784.00} = 0.05 \text{ Bh} = 1.00 \text{ Bh} = 2.00 \text{ Bh}$$



# Perencanaan Pelat Buhul

Direncanakan pelat buhul dengan dimensi

$$\square \quad 10 \times \quad 100$$

a. Cek luas penampang minimum dan shear leg :

Luas Penampang bruto:

$$A_b = 10 * 100 = 1000 \text{ mm}^2$$

Syarat Luas penampang minimum :

$$A_{min} = 85\% * A_b = 0.85 * 1000 = 850 \text{ mm}^2$$

Luas Penampang netto :

$$A_n = A_b - 2 * d * t_p = 1000 - 2 * 21 * 10 = 850 \text{ mm}^2$$

$$A_n = 850 \text{ mm}^2$$

shear leg:

$$x = \frac{10}{2} = 5 \text{ mm}$$

$$L = 4 * s = 4 * 60 = 240 \text{ mm}$$

Koefisien reduksi :

$$U = 1 - x/L = 1 - 5/240 = 0.979 > 0.9$$

$$U = 1 \quad (\text{SNI 03-1729-2002, psl. 10.2.5})$$

Maka :

$$A_e = A_n = 850 \text{ mm}^2$$

b. Daya dukung pelat pada daerah sambungan :

$$R_u = A_n * f_u = 850 * 370 = 314500 \text{ N}$$

$$R_u = 314500 \text{ N} > 2 * (0.75 * 860) = 1290 \text{ kg}$$

$$= 1290 \text{ kg} > 1290 \text{ kg} \longrightarrow \text{OK!!}$$

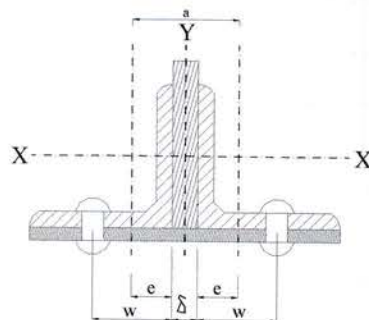
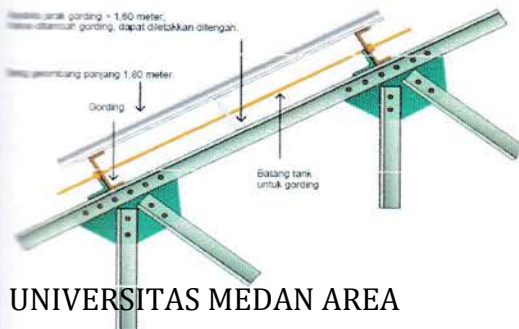
c. Cek terhadap geser balok :

$$f_u * A_n = 370 * 850 = 314500 \text{ N} = 31450 \text{ Kg}$$

$$0.6 * f_u * A_{min} = 0.6 * 370 * 850 = 188700 \text{ N} = 18870 \text{ Kg}$$

$f_u * A_n < 0.6 * f_u * A_{min}$ , maka kondisi geser blok adalah geser fraktur dengan tarik leleh, dengan tarik leleh,

$$N_n = 0.6 * f_u * A_{min} + f_u * A_n = 188700 + 314500 = 503200 \text{ N} > 1290 \text{ kg} \longrightarrow \text{Ok!}$$





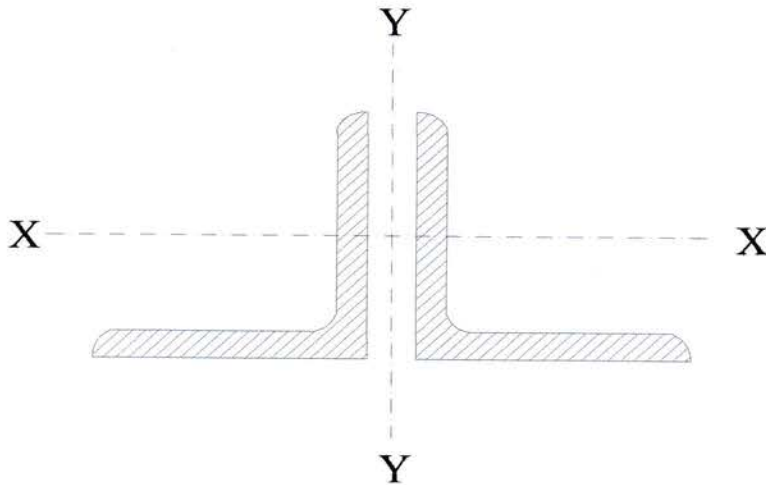
# TUGAS WAJIB KONSTRUKSI BAJA

## 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 <sub>1</sub>	3111.75	-	39.59	-	3111.75	-
S <sub>2</sub>	3111.75	-	39.59	-	3111.75	-
S <sub>3</sub>	-	-2607.08	-	-33.18	-	-2607.08
S <sub>4</sub>	3111.75	-	28.52	-	3111.75	-
S <sub>5</sub>	3111.75	-	28.52	-	3111.75	-
S <sub>6</sub>	-	-3948.06	-	-72.34	-	-3948.06
S <sub>7</sub>	-	-	-	-	-	-
S <sub>8</sub>	926.47	-	11.78	-	926.47	-
S <sub>9</sub>	926.47	-	11.78	-	926.47	-
S <sub>10</sub>	-	-	-	-	-	-
S <sub>11</sub>	-	-3948.06	-	-36.19	-	-3948.06
S <sub>12</sub>	5664.39	-	85.52	-	5664.39	-
S <sub>13</sub>	5664.39	-	57.04	-	5664.39	-
S <sub>14</sub>	-	-3240.25	-	-36.19	-	-3240.25
S <sub>15</sub>	-	-10278.42	-	-151.48	-	-10278.42
S <sub>16</sub>	-	-11338.95	-	-168.99	-	-11338.95
S <sub>17</sub>	-	-11338.95	-	-165.70	-	-11338.95
S <sub>18</sub>	-	-10278.42	-	-145.98	-	-10278.42
S <sub>19</sub>	-	-3240.25	-	-36.19	-	-3240.25
S <sub>20</sub>	-	-3240.25	-	-36.19	-	-3240.25
S <sub>21</sub>	-	-3240.25	-	-36.19	-	-3240.25
D <sub>1</sub>	-	-821.02	-	-3.34	-	-821.02
D <sub>2</sub>	-	-821.02	-	-2.90	-	-821.02
D <sub>3</sub>	206.97	-	-	-3.76	206.97	-
D <sub>4</sub>	206.97	-	3.76	-	206.97	-
D <sub>5</sub>	-	-41.32	-	-	-	-41.32
D <sub>6</sub>	-	-289.77	-	-10.74	-	-289.77
D <sub>7</sub>	-	-289.77	-	-5.26	-	-289.77

# TUGAS WAJIB KONSTRUKSI BAJA

## DIMENSI PROFIL BATANG



## BATANG TARIK

- a. Batang tarik tersusun dari baja siku ganda.
- b. Gaya batang, Pembebanan Tetap = 1,162.94 kg (N)
- c. Panjang Tekuk = 4,500.00 m (Lk)

### Ketentuan

- a. Tegangan izin dasar, pembebanan tetap = 1,600.00 kg/cm<sup>2</sup>
- b. Tegangan izin tarik (75% x 5), pembebanan tetap = 1,200.00 kg/cm<sup>2</sup>
- c. Kelangsingan maksimum  $\chi_{\text{mak}} = 240$
- d. Jari-jari inersia  $i_{\text{min}} > Lk / \chi_{\text{mak}} = \frac{450}{240} = 1.88 \text{ cm}$
- e. Jumlah lubang  $< 15\% \times F_{\text{netto}}$
- f. Ditentukan profil minimum batang struktur  $\llcorner 65. 65. 5$

### Perhitungan

$$A_{\text{netto}} = \frac{N}{\sigma_a} = \frac{1,162.94}{1,200.00} = 0.97 \text{ cm}^2$$

$$A_{\text{netto}} = \frac{\text{Abruto}}{85\%} = \frac{0.97}{0.85} = 1.14 \text{ cm}^2$$

$$i_{\text{min}} = 1.88 \text{ cm}$$

Dari tabel diperoleh  $\llcorner 65. 65. 5$ ,  $F=12.74 \text{ c2}$ ,  $2F = 25.48$ ,  $i_x = 1.99 > 1.88 \dots \text{ok!}$

### Kontrol Tegangan

$$A_{\text{netto}} = \frac{85\% \times 2F}{21.66} = 21.66 \text{ cm}^2$$

$$\sigma = \frac{N}{A_{\text{netto}}} = \frac{1,162.94}{21.66} = 53.70 \text{ cm}^2 < 1,200.00 \text{ kg/cm}^2 \dots \text{ok!}$$

# TUGAS WAJIB KONSTRUKSI BAJA

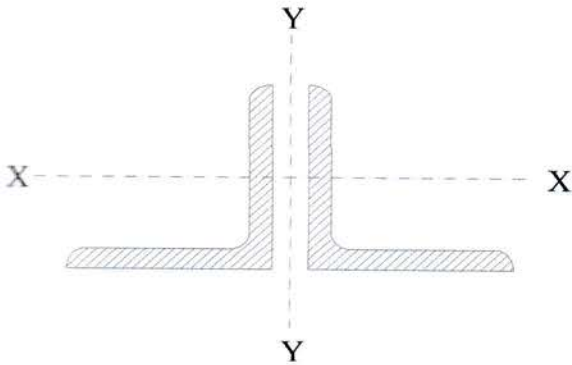
Kontrol Kelangsingan

$$\lambda = \frac{L_k}{i_x} = \frac{450}{1.99} = 226.13 < 2,400.00 \text{ kg/cm}^2 \text{ .....ok!}$$

Batang tarik yang menggunakan  $\text{JL } 65.65.5$

- Batang bawah = B<sub>1</sub>, B<sub>2</sub>, B<sub>3</sub>, B<sub>4</sub> Dan B<sub>5</sub>

- Batang diagonal = D<sub>1</sub>, D<sub>2</sub>, D<sub>3</sub>, D<sub>4</sub>, D<sub>5</sub> Dan D<sub>6</sub> serta batang R<sub>5</sub> Dan D<sub>6</sub>



**PROFIL JL 65.65.5**

t = 5.00 mm	I <sub>x</sub> = 50.60 cm <sup>4</sup>
T = 10.00 mm	I <sub>y</sub> = 116.5 cm <sup>4</sup>
r <sub>1</sub> = 8.50 mm	i <sub>x</sub> = 1.99 cm
r <sub>2</sub> = 3.00 mm	i <sub>y</sub> = 3.02 cm
F = 12.74 mm	S <sub>x</sub> = 10.70 cm
w = 10.00 mm	S <sub>y</sub> = 16.61 cm



# TUGAS WAJIB KONSTRUKSI BAJA

## BATANG TEKAN

- a. Batang tekan tersusun dari baja siku ganda.
- b. Gaya batang, Pembebanan Tetap = -3,622.93 kg (N)
- c. Panjang Tekuk = 2,320.00 m Lk)

### Ketentuan

- a. Tebal pelat buhul = 8 mm
- b. Tebal pelat kopel = 4 mm
- c. Alat sambung paku = 7 mm
- Tegangan izin dsr.  $\overline{\sigma} = 1,400.00 \text{ kg/cm}^2$
- Geser  $I = 1,120.00 \text{ kg/cm}^2$
- Desak  $S1 > 2d$   $\overline{\sigma}_{ds} = 2,800.00 \text{ kg/cm}^2$
- Desak  $1.5d < S1$   $\overline{\sigma}_{ds} = 2,400.00 \text{ kg/cm}^2$
- $S1 < 2d$
- Tegangan izin plt  $\overline{\tau} = 812.00 \text{ kg/cm}^2$

- d. Kelangsingan maksimum  $\chi_{\text{mak}} = 200$
- e. Jari-jari inersia  $i_{\text{min}} > Lk / \chi_{\text{mak}} = \frac{232}{200} = 1.16 \text{ cm}$
- f. Ditentukan profil minimum batang struktur  $\text{JL } 65. 65. 5$

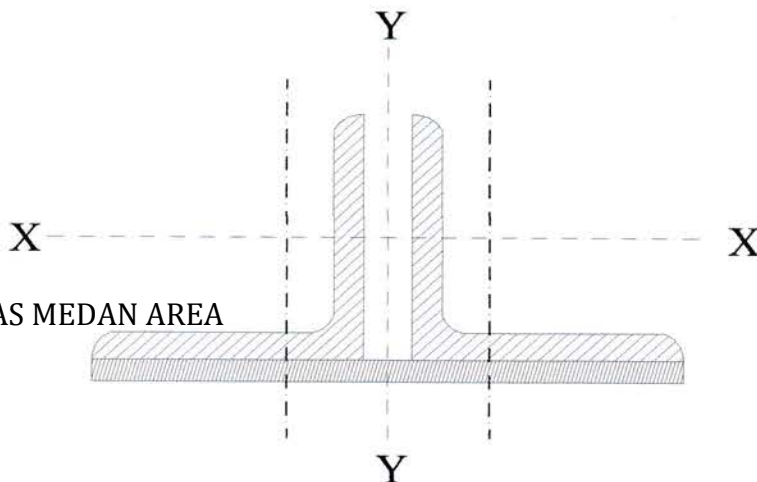
$$\chi_x > 110$$

$$\chi = \frac{Lk}{i_x} = \frac{232}{1.99} = 116.58 > 110.00 \text{ kg/cm}^2 \text{ .....ok!}$$

Momen Inersia ditaksir :

$$\begin{aligned} I_{\text{maksir}} &= 1.21 \times -3,596.35 \times 2.32^2 \\ &= 23.42 \text{ cm}^4 \text{ satu profil} = 11.71 \text{ cm}^4 \end{aligned}$$

UNIVERSITAS MEDAN AREA





# TUGAS WAJIB KONSTRUKSI BAJA

## Kontrol Tekuk

a. Terhadap Tekuk  $\perp$  sb-x

$$\chi = \frac{L_k}{i_x} = \frac{232}{1.99} = 116.58 > 200.00 \text{ kg/cm}^2 \dots\dots\text{ok!}$$

## Faktor Tekuk

$$\chi_s = \pi \times \sqrt{\frac{E}{0.70 \times 1200}} \quad \chi_g = \frac{\chi_x}{\chi_g} = \frac{116.58}{157.00} = 0.74$$

$$= 3.14 \times \sqrt{2500} \quad w_x = 1.61$$

$$\chi_s = 157.00$$

## Tegangan Tekuk

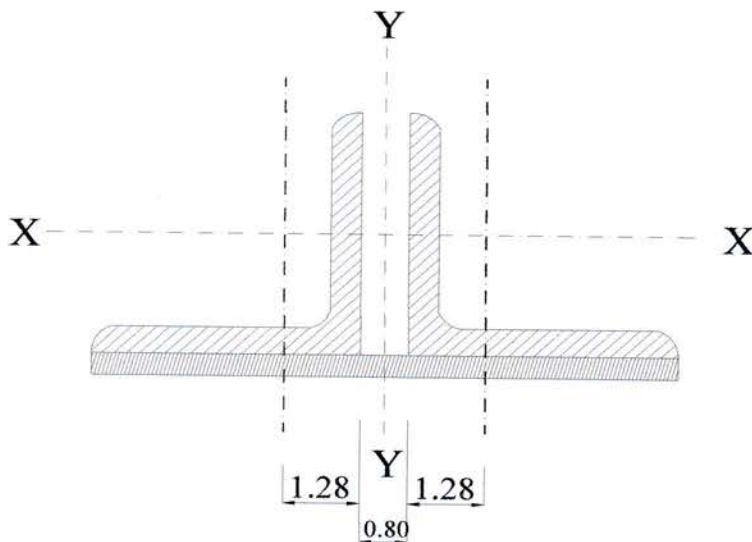
$$\sigma_x = W_x \frac{N}{A_{total}} = 1.61 \frac{3,622.93}{12.74} = 457.84 < 1,200.00 \text{ kg/cm}^2 \text{ ok!}$$

b. Terhadap Tekuk  $\perp$  sb-y

$$I_y \text{ total} = 2 ( I_y + A (1/2a)^2 )$$

$$a = 2e + \gamma = 3.36 \text{ cm}$$

$$I_y = 304.92 \text{ cm}^4$$



$$i_y = \sqrt{\frac{I_y \text{ tot}}{A_{tot}}} = \sqrt{\frac{304.92}{12.74}} = 4.89 \text{ cm}$$

$$\frac{L_k}{i_y} = \frac{232.00}{4.89} = 47.42 \text{ cm}$$



# TUGAS WAJIB KONSTRUKSI BAJA

$$\chi_{iy} = \sqrt{\chi_y^2 + \frac{m}{2} \chi_1^2}$$

Dimana

$$\chi_y = 47.42$$

$$m = 2$$

$$\chi_y = \frac{Lk/n}{i_{\min}} \leq 50$$

$$50 = \frac{232/n}{1.16}$$

$$n = \frac{232}{58}$$

$$= 4.00 \text{ buah medan pelat kopel}$$

**Diambil = 8 buah**

$$\chi_1 = \frac{Lk/n}{i_{\min}} = \frac{232/8}{1.16} = 25.00$$

Maka :

$$\begin{aligned} \chi_{iy} &= \sqrt{\chi_y^2 + \frac{m}{2} \chi_1^2} \\ &= \sqrt{47.42^2 + \frac{2}{2} 25.00^2} \end{aligned}$$

$$\chi_{iy} = 53.16$$

Faktor Tekuk  $w = 0.85$

$$\sigma_x = W_x \frac{N}{A_{\text{total}}} = 0.85 \frac{3,622.93}{12.74} = 241.72 < 1,200.00 \text{ kg/cm}^2 \text{ ok!}$$

## KONTROL KESTABILAN

$$\chi_1 = 25.00 \longrightarrow 1.20 \quad \chi_1 = 25.00$$

$$\chi_{iy} > 1.20 \quad \chi_1$$

$$\chi_{iy} > 1.20 \quad \chi_1$$

$$116.58 > 30.00$$

$$53.16 > 30.00$$

# TUGAS WAJIB KONSTRUKSI BAJA

## RENCANA PELAT KOPEL

Kekakuan pelat kopel

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

Diaman

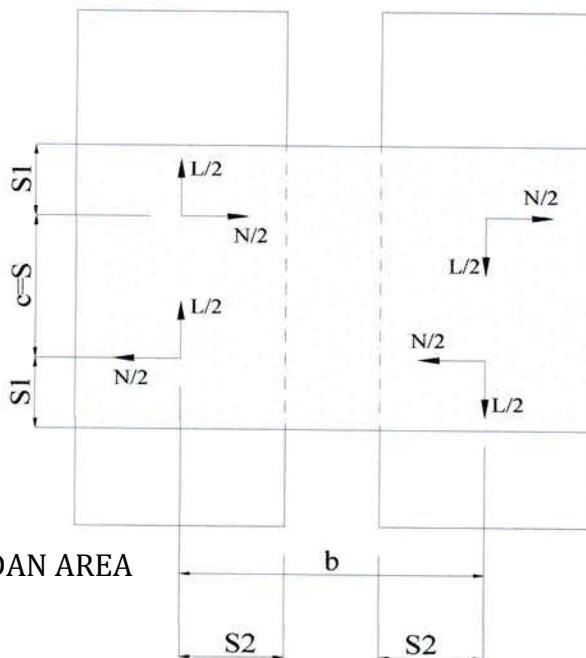
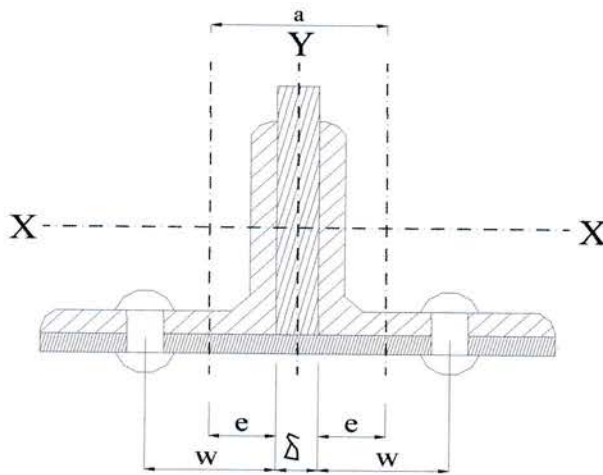
$$I_p = 1/12 t h^3 \quad t = 0.40 \text{ cm}$$

$$L_1 = 23.32 \text{ cm}$$

$$I_1 = I_n = I_{\min} = 3.25 \text{ cm}^4$$

$$h \geq 5.108 \text{ cm}$$

$$a = 3.36 \text{ cm}$$




# TUGAS WAJIB KONSTRUKSI BAJA

## RENCANA PAKU

Paku, diameter	=	7	mm
$S1 = 2d$	=	14	mm
S1 diambil	=	15	mm
$C = S = 3d$	=	21	mm
$C = S1$ diambil	=	30	mm
$b = 2 S1$ diambil + S	=	60	mm
$S2 = w$	=	35	mm
$b = 2S2 + \gamma$	=	78	mm

## KEKUATAN PAKU

$S1 > 2d, \sigma ds$	=	2,800	kg/cm <sup>2</sup>
$Pgs = (1) \frac{1}{4} \pi d^2 \tau$	=	430	kg/cm <sup>2</sup>
$Pds = t d \sigma ds$	=	784	kg/cm <sup>2</sup>



# TUGAS WAJIB KONSTRUKSI BAJA

## RENCANA PAKU

Paku, diameter	=	10 mm
$S1 = 2d$	=	20 mm
$S1$ diambil	=	15 mm
$C = S = 3d$	=	30 mm
$C = S1$ diambil	=	30 mm
$h = 2 S1$ diambil + $S$	=	60 mm
$S2 = w$	=	35 mm
$b = 2S2 + \gamma$	=	78 mm

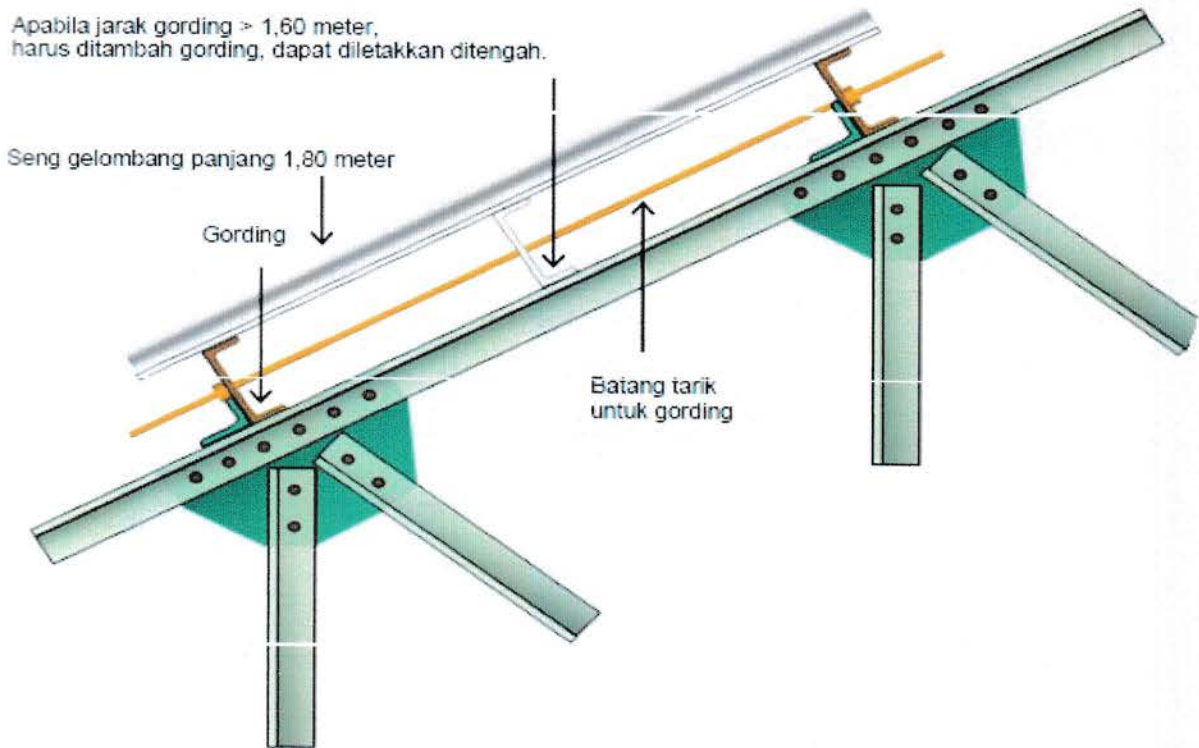
## KEKUATAN PAKU

$S1 > 2d, \sigma ds$	=	2,800	kg/cm <sup>2</sup>
$Pgs = (2) \frac{1}{4} \pi d^2 \tau$	=	860	kg/cm <sup>2</sup>
$Pds = t d \sigma ds$	=	784	kg/cm <sup>2</sup>



# TUGAS WAJIB KONSTRUKSI BAJA

Apabila jarak gording > 1,60 meter, harus ditambah gording, dapat diletakkan ditengah.



## **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  $\leq 1.40$  M**

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

**1. VARIASI-A TANPA BATANG TARIK**

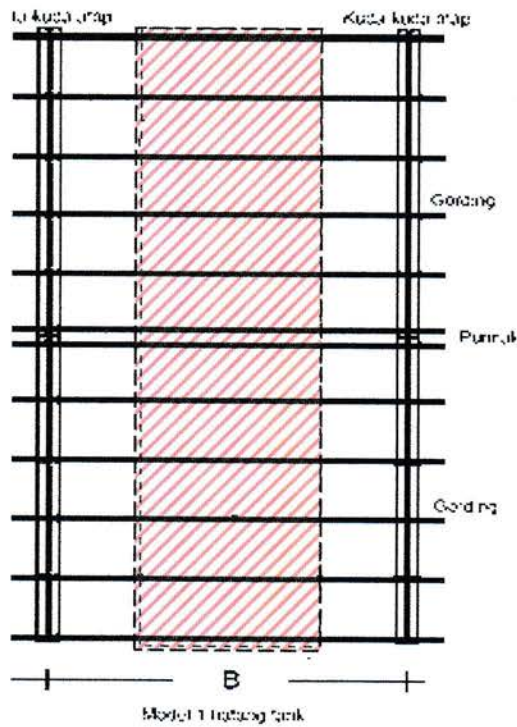
**2. VARIASI-B DENGAN SATU BATANG TARIK (TUNGGAL)**

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

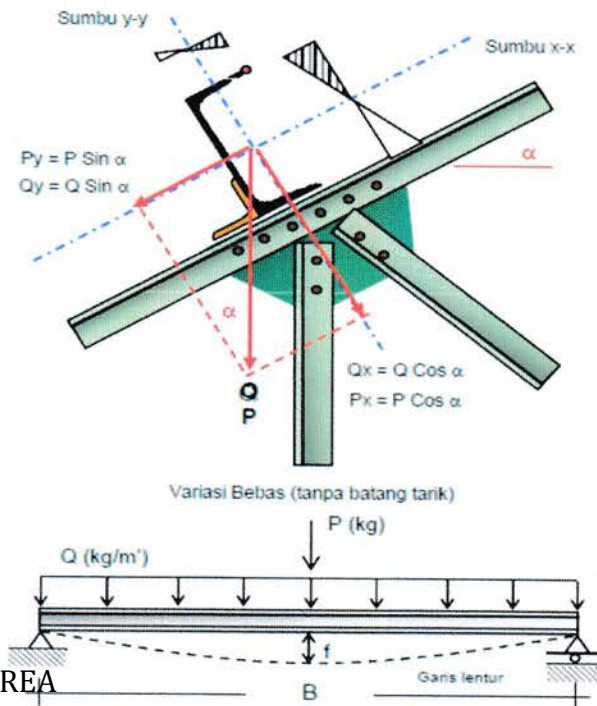


# TUGAS WAJIB KONSTRUKSI BAJA

## I. VARIASI-A TANPA BATANG TARIK



**D**



# TUGAS WAJIB KONSTRUKSI BAJA

## 1. VARIASI-A TANPA BATANG TARIK

### A. PERHITUNGAN BEBAN

#### a. Beban Mati

- Penutup Atap Seng Bergelombang =  $1.27 \times 10.00 = 12.70$  kg/m
- Asumsi Berat Gording = 23.80 kg/m
- Jumlah  $Q_{DL} = 36.50$  kg/m

#### b. Beban Hidup

- Beban Terpusat Ditengah Batang = 100 kg
- Jumlah  $P_{LL} = 100$  kg

#### c. Beban Angin

- Pada Bidang Angin,  $\alpha = 65^\circ - 90^\circ \rightarrow c = 0.90$ ,  $\alpha \leq 65^\circ \rightarrow c = 0.02 \times \alpha - 0.40$   
(Angin Datang)
- Pada Bidang Tidak Ada Angin,  $\rightarrow c = -0.40$   
(Angin Pergi)
- Beban Angin Yang Diambil =  $0.90 \times 1.27 \times 25.00 = 28.58$  kg/m

### B. TEGANGAN IZIN

- Mutu Baja = St.37
- Pembebanan Tetap = 1600.00 kg/cm<sup>2</sup> ( $\sigma_t$ )
- Pembebanan Sementara =  $1.30 \times 1600.00 = 2080.00$  kg/cm<sup>2</sup> ( $\sigma_s$ )

### C. LENDUTAN MAKSIMUM YANG DIIZINKAN

- Batas Lendutan Maksimum Arah Vertikal Untuk DL Dan LL

$$f = \frac{1}{250} \times B = \frac{1}{250} \times 5 = 0.02 \text{ M} = 2.00 \text{ CM}$$

### D. PERHITUNGAN MOMEN UNTUK MASING-MASING BEBAN

#### a. Beban Mati ( $Q_{DL}$ )

$$M_{YQ} = \frac{1}{8} \times Q_{DL} \times \cos 38^\circ \times B^2 = \frac{1}{8} \times 36.50 \times 0.788 \times 25 = 89.88 \text{ kg.m}$$

$$M_{XQ} = \frac{1}{8} \times Q_{DL} \times \sin 38^\circ \times B^2 = \frac{1}{8} \times 36.50 \times 0.616 \times 25 = 70.22 \text{ kg.m}$$

#### b. Beban Hidup (MEDAN AREA)

$$M_{YP} = \frac{1}{4} \times P_{LL} \times \cos 38^\circ \times B = \frac{1}{4} \times 100 \times 0.788 \times 5 = 98.50 \text{ kg.m}$$

$$M_{XP} = \frac{1}{4} \times P_{LL} \times \sin 38^\circ \times B = \frac{1}{4} \times 100 \times 0.616 \times 5 = 76.95 \text{ kg.m}$$

# TUGAS WAJIB KONSTRUKSI BAJA

## c. Beban Angin ( $W_{LL}$ )

$$M_{YW} = \quad = \quad 0.00 \text{ kg.m}$$

$$M_{XW} = \frac{1}{8} \times W_{DL} \times B^2 = \frac{1}{8} \times 28.58 \times 25 = 89.30 \text{ kg.m}$$

## E. PERHITUNGAN MOMEN MAKSIMUM DENGAN KOMBINASI BEBAN

### a. Pembebanan Tetap ( $\sigma_t = 1600 \text{ kg/cm}^2$ )

$$M_{YMAKS} = M_{YQ} + M_{YP} = 89.88 + 98.50 = 188.38 \text{ kg.m}$$

$$M_{XMAKS} = M_{XQ} + M_{XP} = 70.22 + 76.95 = 147.17 \text{ kg.m}$$

### b. Pembebanan Sementara ( $\sigma_s = 2080 \text{ kg/cm}^2$ )

$$M_{YMAKS} = M_{YQ} + M_{YP} + M_{YW} = 89.88 + 98.50 + 0.00 = 188.38 \text{ kg.m}$$

$$M_{XMAKS} = M_{XQ} + M_{XP} + M_{XW} = 70.22 + 76.95 + 89.30 = 236.46 \text{ kg.m}$$

### c. Momen Maksimum Yang Digunakan Untuk Perhitungan

$$M_{XMAKS} = 236.46 \text{ kg.m} = 23,646 \text{ kg.cm}$$

## F. PERHITUNGAN TAHANAN MOMEN UNTUK MEMPEROLEH DIMENSI PROFIL

$$\sigma_s = \frac{M_{XMAKS}}{\omega}$$

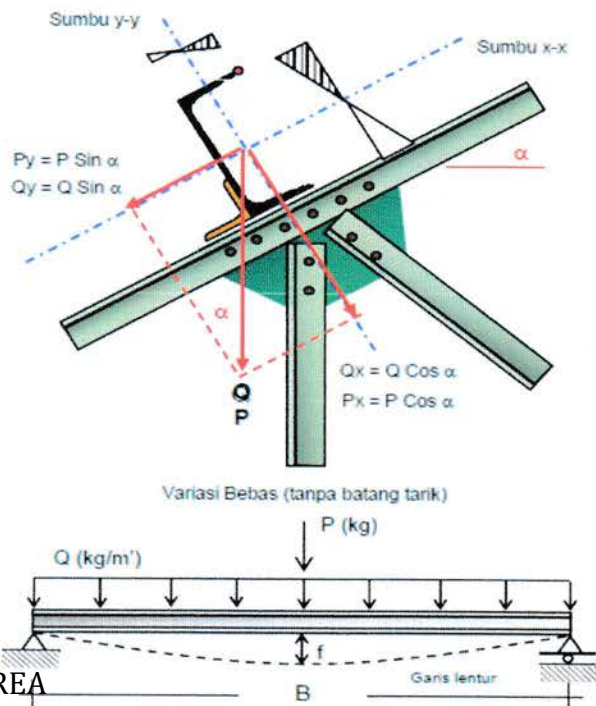
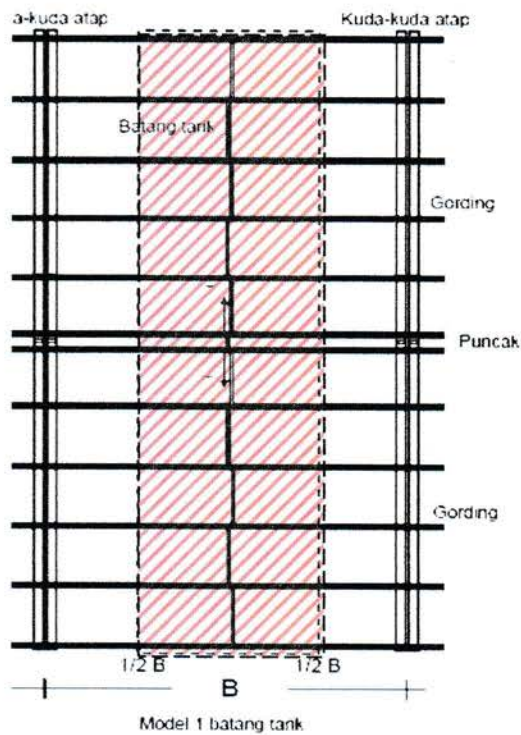
$$2,080 = \frac{23,646}{\omega}$$

$$\omega = \frac{23,646}{2,080}$$

$$\omega = 11.37 \text{ cm}^3$$

# TUGAS WAJIB KONSTRUKSI BAJA

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



**D**

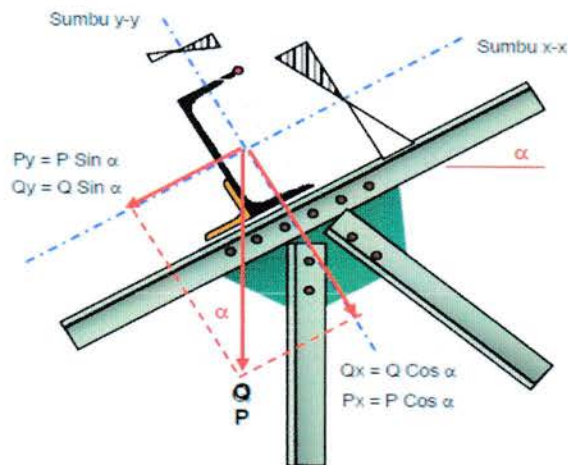
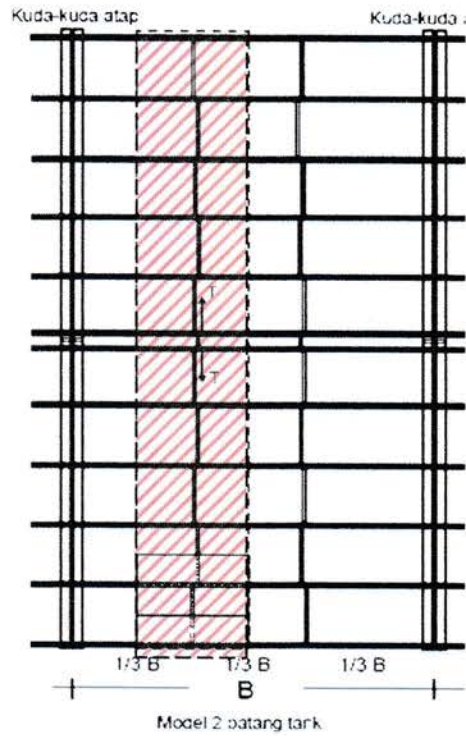




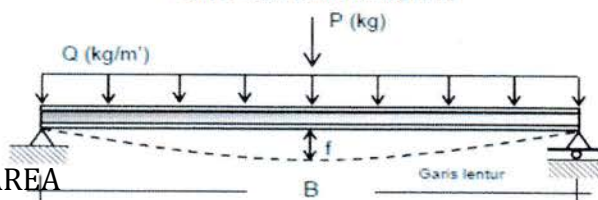


# TUGAS WAJIB KONSTRUKSI BAJA

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



Variasi Bebas (tanpa batang tarik)



# TUGAS WAJIB KONSTRUKSI BAJA

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

### REKAPITULASI PERHITUNGAN ITEM-A S-C ITEM-D VARIASI-A

$$\begin{aligned}Q_{DL} &= 36.50 \text{ kg.m} \\P_{LL} &= 100.00 \text{ kg} \\W_{LL} &= 28.58 \text{ kg.m} \\ \sigma_t &= 1,600 \text{ kg/cm}^2 \\ \sigma_s &= 2,080 \text{ kg/cm}^2 \\ f &= 2.00 \text{ cm} \\ 1/3 B &= 1.67 \text{ m}\end{aligned}$$

### E. PERHITUNGAN MOMEN MAKSIMUM DENGAN KOMBINASI BEBAN

#### a. Beban Mati ( $Q_{DL}$ )

$$M_{YQ} = \frac{1}{8} \times Q_{DL} \times \cos 38^\circ \times B^2 = \frac{1}{8} \times 36.50 \times 0.788 \times 2.8 = 9.99 \text{ kg.m}$$

$$M_{XQ} = \frac{1}{8} \times Q_{DL} \times \sin 38^\circ \times B^2 = \frac{1}{8} \times 36.50 \times 0.616 \times 2.8 = 7.80 \text{ kg.m}$$

#### b. Beban Hidup ( $P_{LL}$ )

$$M_{YP} = \frac{1}{4} \times P_{LL} \times \cos 38^\circ \times B = \frac{1}{4} \times 100 \times 0.788 \times 1.7 = 32.83 \text{ kg.m}$$

$$M_{XP} = \frac{1}{4} \times P_{LL} \times \sin 38^\circ \times B = \frac{1}{4} \times 100 \times 0.616 \times 1.7 = 25.65 \text{ kg.m}$$

#### d. Beban Angin ( $W_{LL}$ )

$$M_{YW} = \quad \quad \quad = 0.00 \text{ kg.m}$$

$$M_{XW} = \frac{1}{8} \times W_{DL} \times B^2 = \frac{1}{8} \times 28.58 \times 2.8 = 9.92 \text{ kg.m}$$

### E. PERHITUNGAN MOMEN MAKSIMUM DENGAN KOMBINASI BEBAN

#### c. Momen Maksimum Yang Digunakan Untuk Perhitungan

$$M_{XMAKS} = 43.37 \text{ kg.m} = 43 \text{ kg.cm}$$

### F. PERHITUNGAN TAHANAN MOMEN UNTUK MEMPEROLEH DIMENSI PROFIL

$$\sigma_s = \frac{M_{XMAKS}}{\omega}$$

$$2,080 = \frac{43}{\omega}$$

$$\omega = \frac{43}{2,080}$$

$$\omega = 0.02 \text{ cm}^3$$

# TUGAS WAJIB KONSTRUKSI BAJA

## 4. PEMILIHAN PROFIL GORDING

### A. Dari Hasil Perhitungan Diperoleh :

#### 1. VARIASI-A TANPA BATANG TARIK

Diperoleh Tahanan Momen = **11.37 cm<sup>3</sup>**

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

Diperoleh Tahanan Momen = **0.05 cm<sup>3</sup>**

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

Diperoleh Tahanan Momen = **0.02 cm<sup>3</sup>**

ω Yang Diambil Harus  $\geq 0,03 \text{ cm}^3$  dan  $\leq 17.23 \text{ cm}^3$

### B. Dari Hasil Di Atas Profil Yang Digunakan Untuk Gording

a. Profil Baja I - Steel, Ukuran Yang Mendekati Data Di Atas Dan Terdapat Di Pasar Adalah

**I - 80x42 , w = 19,00 cm<sup>3</sup>**

b. Profil Baja Channel , Ukuran Yang Mendekati Data Di Atas Dan Terdapat Di Pasar Adalah

**[ - 65x42 , w = 17,69 cm<sup>3</sup>**

c. Profil Baja Light Channel , Ukuran Yang Mendekati Data Di Atas Dan Terdapat Di Pasar Adalah

**C100x50x20x2,6 , ω = 17,90 cm<sup>3</sup>**

Dari Data Yang Diatas Yang Mendekati Dengan Data Perhitungan Adalah

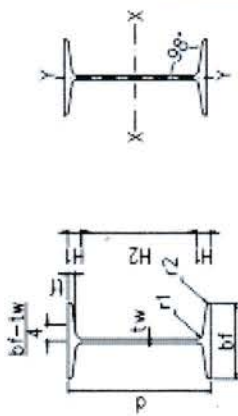
**C100x50x20x2,6 , ω = 17,90 cm<sup>3</sup>**

$$W_x = 17.90$$

$$W_y = 6.68$$

$$I_x = 89.70$$

$$I_y = 21.00$$



Note :

\*) Material : JIS G 3101 - SS 400

Fy = 2500 kg/cm<sup>2</sup> if tf ≤ 16 mm

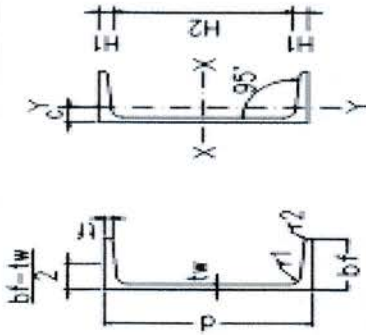
Fy = 2400 kg/cm<sup>2</sup> if 16 mm < tf ≤ 40 mm

Fy = 2200 kg/cm<sup>2</sup> if tf > 40 mm

Sectional Dimension				Sectional Properties										Compact Section Criteria			*)									
d mm	x mm	bf mm	d mm	tw mm	tf mm	r1 mm	r2 mm	H1 mm	H2 mm	Sec. of Area cm <sup>2</sup>	Unit Weight kg/m	Geometrical Moment of Inertia (cm <sup>4</sup> )			Radius of Gyration of Area (cm)			Modulus of Section (cm <sup>3</sup> )			bf/2tf	d/tw	rT (cm)	d/AF 1/cm	Lc (cm)	Lu (cm)
												Lx	Iy	Iz	ix	iy	iz	Sx	Sy	Sz						
I	80	x	42	3.9	5.9	3.9	2.3	10.8	38.7	7.57	5.94	78	6	3.21	0.91	19	5	3.56	20.51	1.12	3.23	53.5	174.3			
I	100	x	50	4.5	6.8	4.5	2.7	12.3	75.4	10.60	8.32	171	12	4.02	1.07	34	5	3.68	22.22	1.32	2.94	63.7	191.3			
I	120	x	58	5.1	7.7	5.1	3.1	14.0	92.0	14.20	11.15	328	22	4.81	1.23	55	7	3.77	23.53	1.53	2.59	73.9	209.4			
I	125	x	75	5.5	9.5	9.0	4.5	19.8	85.5	20.45	16.05	538	58	5.13	1.68	86	15	3.95	22.73	2.03	1.75	95.6	320.7			
I	140	x	66	5.7	8.6	5.7	3.4	15.7	108.7	18.30	14.37	573	35	5.60	1.39	82	11	3.84	24.55	1.74	2.47	84.1	228.1			



Standard Sectional Dimension of Single Channel Steel and Its Sectional Area, Unit Weight and Sectional Characteristic



Note :

\*) Material : JIS G 3101 - SS 400

Fy = 2500 kg/cm<sup>2</sup> if tf ≤ 16 mm  
 Fy = 2400 kg/cm<sup>2</sup> if 16 mm < tf ≤ 40 mm  
 Fy = 2200 kg/cm<sup>2</sup> if tf > 40 mm

Sectional Dimension				Sectional Properties																		
d	bf	tw	tf	r1	r2	H1	H2	Center of Grav. ©	Sec. of Area	Unit Weight	Geometrical Moment of Inertia (cm <sup>4</sup> )		Radius of Gyration of Area (cm)		Modulus of Section (cm <sup>3</sup> )		Compact Section Criteria		rT	d/Af	Lc	Lu
mm	mm	mm	mm	mm	mm	mm	mm	cm	cm <sup>2</sup>	kg/m	Ix	Iy	ix	iy	Sx	Sy	bf/2tf	d/tw	(cm)	1/cm	(cm)	(cm)
[ 50	x 38	5.0	7.0	7.0	3.5	14.9	20.3	1.37	7.10	5.57	26.40	9.10	1.93	1.13	10.56	3.74	2.71	10.00	1.21	1.88	48.4	299.3
[ 65	x 42	5.5	7.5	7.5	4.0	16.0	33.1	1.42	9.03	7.09	57.50	14.10	2.52	1.25	17.69	5.07	2.80	11.82	1.36	2.06	53.5	272.6
[ 75	x 40	5.0	7.0	8.0	4.0	15.9	43.3	1.28	8.82	6.92	75.30	12.20	2.92	1.18	20.08	4.49	2.86	15.00	1.32	2.68	51.0	210.0
[ 80	x 45	6.0	8.0	8.0	4.0	17.0	45.9	1.45	11.00	8.63	106.00	19.40	3.10	1.33	26.50	6.36	2.81	13.33	1.48	2.22	57.4	253.2
[ 100	x 50	5.0	7.5	8.0	4.0	16.8	66.4	1.54	11.92	9.36	188.00	26.00	3.97	1.48	37.60	7.51	3.33	20.00	1.67	2.67	63.7	211.0
[ 50		6.0	8.5	8.5	4.5	18.2	63.6	1.55	13.50	10.60	206.00	29.30	3.91	1.47	41.20	8.49	2.94	16.67	1.66	2.35	63.7	239.1





# TUGAS WAJIB KONSTRUKSI BAJA

## 5. KONTROL TEGANGAN

### 1. VARIASI-A TANPA BATANG TARIK

$$\sigma_s = \frac{M_{X\text{MAKS}}}{W_x} + \frac{M_{Y\text{MAKS}}}{W_y}$$

$$2,080 \geq \frac{236.46}{17.90} + \frac{188.38}{6.68}$$

$$2,080 \geq 13.21 + 28.20$$

$$2,080 \geq 41.41 \quad \text{OK !!}$$

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

$$\sigma_s = \frac{M_{X\text{MAKS}}}{W_x} + \frac{M_{Y\text{MAKS}}}{W_y}$$

$$2,080 \geq \frac{108.85}{17.90} + \frac{116.48}{6.68}$$

$$2,080 \geq 6.08 + 17.44$$

$$2,080 \geq 23.52 \quad \text{OK !!}$$

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

$$\sigma_s = \frac{M_{X\text{MAKS}}}{W_x} + \frac{M_{Y\text{MAKS}}}{W_y}$$

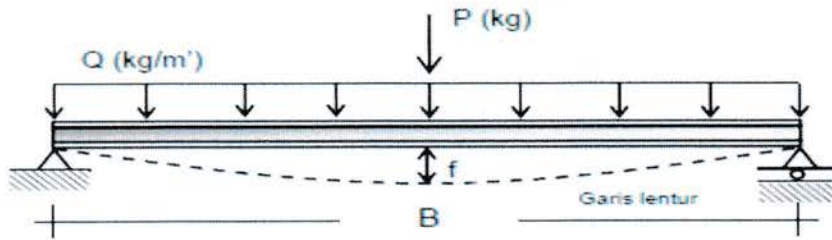
$$2,080 \geq \frac{43.37}{17.90} + \frac{42.82}{6.68}$$

$$2,080 \geq 2.42 + 6.41$$

$$2,080 \geq 8.83 \quad \text{OK !!}$$

# TUGAS WAJIB KONSTRUKSI BAJA

## 6. KONTROL LENDUTAN



### 1. VARIASI-A TANPA BATANG TARIK

#### DATA

$Q_{DL}$	= 36.50 kg.m	$\sin 38^\circ$	= 0.616
$P_{LL}$	= 100.00 kg	$\cos 38^\circ$	= 0.788
$W_{LL}$	= 28.58 kg.m	$B$	= 5.00 m
$EI$	= 2.10E+06		
$I_x$	= 89.70 cm <sup>4</sup>		
$I_y$	= 21.00 cm <sup>4</sup>		

#### a. Beban Mati ( $Q_{DL}$ )

$$\begin{aligned} f_x &= \frac{4}{384} \times \frac{Q_{DL} \times \sin 38^\circ \times B^4}{EI \times I_x} \\ &= \frac{4}{384} \times \frac{1.41E+10}{1.88E+08} \\ &= 0.78 \text{ CM} \end{aligned}$$

$$\begin{aligned} f_y &= \frac{4}{384} \times \frac{Q_{DL} \times \cos 38^\circ \times B^4}{EI \times I_y} \\ &= \frac{4}{384} \times \frac{1.80E+10}{4.41E+07} \\ &= 4.25 \text{ CM} > 2.00 \text{ CM} \quad \text{Lendutan Ok!!} \end{aligned}$$



# TUGAS WAJIB KONSTRUKSI BAJA

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

### DATA

$$\begin{aligned} Q_{DL} &= 36.50 \text{ kg.m} & \sin 38^\circ &= 0.616 \\ P_{LL} &= 100.00 \text{ kg} & \cos 38^\circ &= 0.788 \\ W_{LL} &= 28.58 \text{ kg.m} & 1/2B &= 2.00 \text{ m} \\ EI &= 2.10E+06 \\ I_x &= 89.70 \text{ cm}^4 \\ I_y &= 21.00 \text{ cm}^4 \end{aligned}$$

### a. Beban Mati ( $Q_{DL}$ )

$$\begin{aligned} f_x &= \frac{4}{384} \times \frac{Q_{DL} \times \sin 38^\circ \times 1/2B^4}{EI \times I_x} & f_y &= \frac{4}{384} \times \frac{Q_{DL} \times \cos 38^\circ \times 1/2B^4}{EI \times I_y} \\ &= \frac{4}{384} \times \frac{3.60E+08}{1.88E+08} & &= \frac{4}{384} \times \frac{4.60E+08}{4.41E+07} \\ &= 0.02 \text{ CM} & &= 0.11 \text{ CM} \end{aligned}$$

### b. Beban Hidup ( $P_{LL}$ )

$$\begin{aligned} f_x &= \frac{1}{48} \times \frac{P_{LL} \times \sin 38^\circ \times 1/2B^4}{EI \times I_x} & f_y &= \frac{1}{48} \times \frac{P_{LL} \times \cos 38^\circ \times 1/2B^4}{EI \times I_y} \\ &= \frac{1}{48} \times \frac{9.86E+08}{1.88E+08} & &= \frac{1}{48} \times \frac{1.26E+09}{4.41E+07} \\ &= 0.11 \text{ CM} & &= 0.60 \text{ CM} \end{aligned}$$

### c. Beban Angin ( $W_{LL}$ )

$$\begin{aligned} f_x &= \frac{4}{384} \times \frac{W_{LL} \times \sin 53^\circ \times 1/2B^4}{EI \times I_x} & f_y &= 0.00 \text{ CM} \\ &= \frac{4}{384} \times \frac{2.82E+08}{1.88E+08} \\ &= 0.02 \text{ CM} \end{aligned}$$

### d. Kombinasi Lendutan Yang Digunakan

$$\begin{aligned} f_x &= 0.02 \text{ CM} + 0.11 \text{ CM} = 0.13 \text{ CM} \\ f_y &= 0.11 \text{ CM} + 0.60 \text{ CM} = 0.70 \text{ CM} \end{aligned}$$

Maka Lendutan Maksimum

$$f_{\text{maks}} = \sqrt{f_x^2 + f_y^2}$$

$$= \sqrt{0.02^2 + 0.70^2}$$

$$= 0.72 \text{ CM} \leq 2.00 \text{ CM} \quad \text{Lendutan Ok!!}$$





# TUGAS WAJIB KONSTRUKSI BAJA

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

### DATA

$$\begin{aligned} Q_{DL} &= 36.50 \text{ kg.m} & \sin 38^\circ &= 0.616 \\ P_{LL} &= 100.00 \text{ kg} & \cos 38^\circ &= 0.788 \\ W_{LL} &= 28.58 \text{ kg.m} & 1/3B &= 1.67 \text{ m} \\ EI &= 2.10E+06 \\ I_x &= 89.70 \text{ cm}^4 \\ I_y &= 21.00 \text{ cm}^4 \end{aligned}$$

### a. Beban Mati ( $Q_{DL}$ )

$$\begin{aligned} f_x &= \frac{4}{384} \times \frac{Q_{DL} \times \sin 38^\circ \times 1/3B^4}{EI \times I_x} & f_y &= \frac{4}{384} \times \frac{Q_{DL} \times \cos 38^\circ \times 1/3B^4}{EI \times I_y} \\ &= \frac{4}{384} \times \frac{1.75E+08}{1.88E+08} & &= \frac{4}{384} \times \frac{2.24E+08}{4.41E+07} \\ &= 0.01 \text{ CM} & &= 0.05 \text{ CM} \end{aligned}$$

### b. Beban Hidup ( $P_{LL}$ )

$$\begin{aligned} f_x &= \frac{1}{48} \times \frac{P_{LL} \times \sin 38^\circ \times 1/3B^4}{EI \times I_x} & f_y &= \frac{1}{48} \times \frac{P_{LL} \times \cos 38^\circ \times 1/3B^4}{EI \times I_y} \\ &= \frac{1}{48} \times \frac{4.79E+08}{1.88E+08} & &= \frac{1}{48} \times \frac{6.13E+08}{4.41E+07} \\ &= 0.05 \text{ CM} & &= 0.29 \text{ CM} \end{aligned}$$

### c. Beban Angin ( $W_{LL}$ )

$$\begin{aligned} f_x &= \frac{4}{384} \times \frac{W_{LL} \times \sin 38^\circ \times 1/3B^4}{EI \times I_x} & f_y &= 0.00 \text{ CM} \\ &= \frac{4}{384} \times \frac{1.37E+08}{1.88E+08} \\ &= 0.01 \text{ CM} \end{aligned}$$

### d. Kombinasi Lendutan Yang Digunakan

$$\begin{aligned} f_x &= 0.01 \text{ CM} + 0.05 \text{ CM} = 0.06 \text{ CM} \\ f_y &= 0.05 \text{ CM} + 0.29 \text{ CM} = 0.34 \text{ CM} \end{aligned}$$

Maka Lendutan Maksimum

$$f_{\text{maks}} = \sqrt{f_x^2 + f_y^2}$$

$$= \sqrt{0.06^2 + 0.34^2}$$

$$= 0.35 \text{ CM} \leq 2.00 \text{ CM} \quad \text{Lendutan Ok!!}$$



# TUGAS WAJIB KONSTRUKSI BAJA

## 7. DIMENSI DAN VARIASI GORDING

Dari Perhitungan Di Atas Diperoleh Data

Profil Baja Yang Digunakan = Channel 100x50x3.2 mm

Kontrol Tegangan =

Variasi - A = (Tegangan Masuk)

Variasi - B = (Tegangan Masuk)

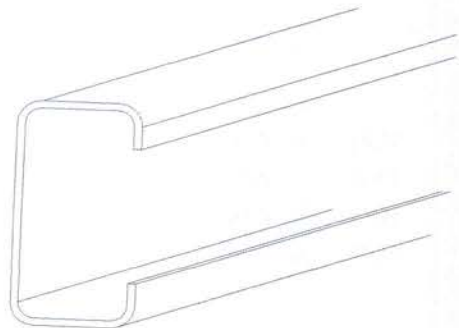
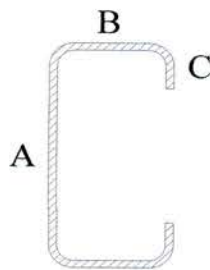
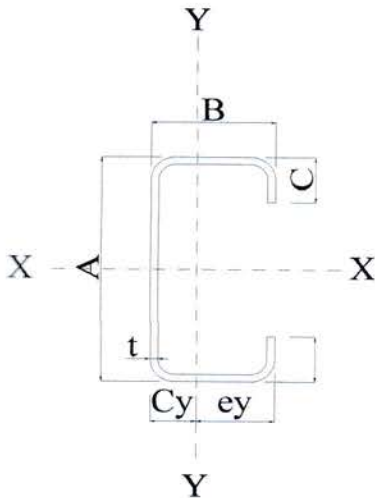
Variasi - C = (Tegangan Masuk)

Kontrol Lendutan =

Variasi - A = (Lendutan Masuk)

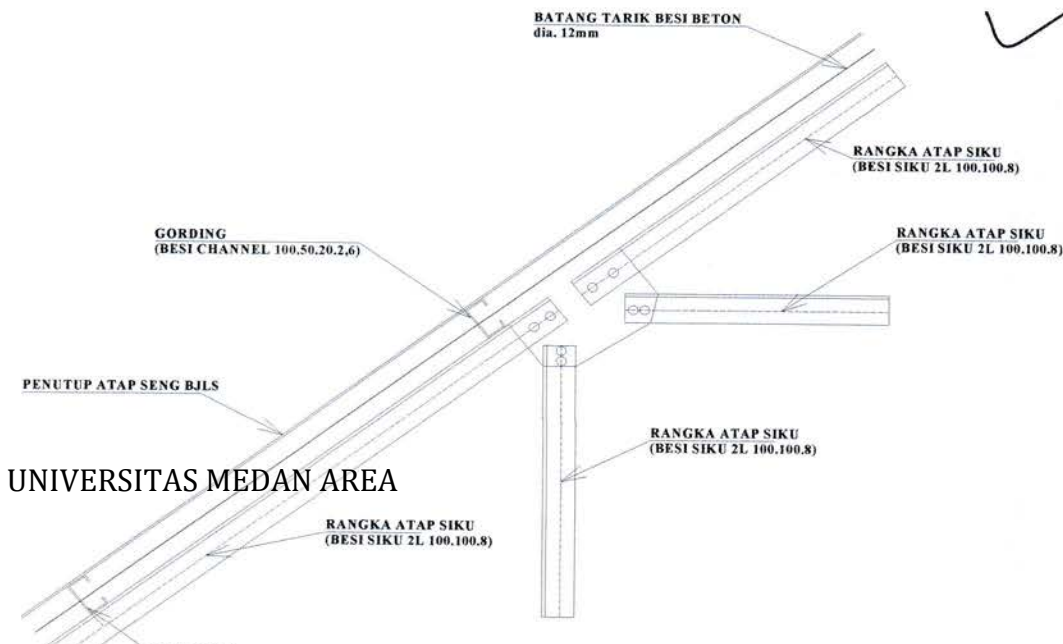
Variasi - B = (Lendutan Masuk)

Variasi - C = (Lendutan Masuk)



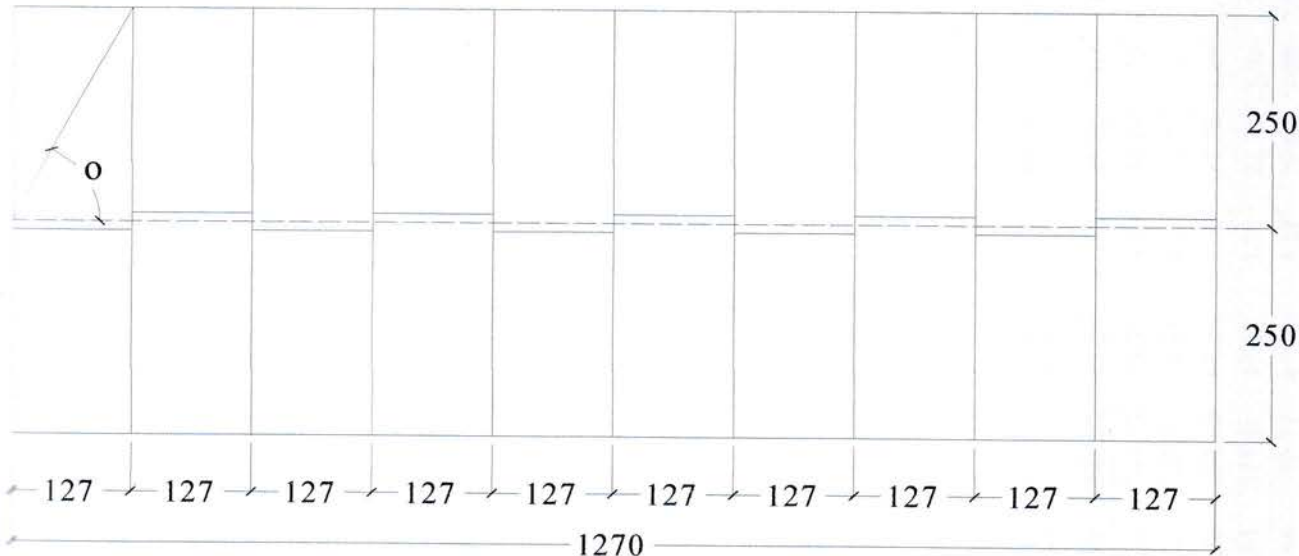
A = 100 mm	$I_x = 90 \text{ cm}^4$
B = 50 mm	$I_y = 21.00 \text{ cm}^4$
C = 20 mm	$W_x = 17.90 \text{ cm}^3$
t = 2.6 mm	$W_y = 6.68 \text{ cm}^3$
q = 4.55 kg/m	F = 5.796 cm <sup>2</sup>

### VARIASI YANG DIGUNAKAN VARIASI-C



# TUGAS WAJIB KONSTRUKSI BAJA

## 7. DIMENSI BATANG TARIK



### A. BEBAN YANG BEKERJA

- Penutup Atap Seng Bergelombang	=	1.27 x 1.67 x 10.00 x 0.616	=	13.06	kg
- Gording	=	1.67 x 4.55 x 0.616	=	4.68	kg
- Beban Hidup	=	100 x 0.616	=	61.60	kg
			=	79.35	kg

### B. RENCANA DIMENSI

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

$$1,600 \geq \frac{873}{0.25 \cdot 3.14 \cdot d^2} \cos 38^\circ$$

$$d^2 \geq \frac{1,107.61}{1,256.00}$$

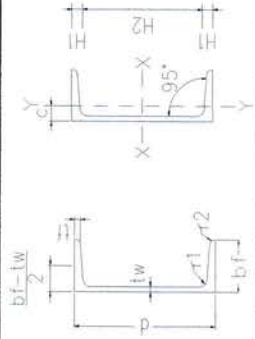
$$d^2 \geq \sqrt{0.882}$$

$$d^2 \geq 0.94 \text{ CM}$$

Diambil Diameter Batang Tarik Besi Besi Beton  $\phi$  12 mm

Standard Sectional Dimension of Single Channel Steel and Its Sectional Area, Unit Weight and Sectional Characteristic

UNIVERSITAS MEDAN AREA



Note :

\*) Material : JIS G 3101 - SS 400  
 Fy = 2500 kg/cm<sup>2</sup> if tf ≤ 16 mm  
 Fy = 2400 kg/cm<sup>2</sup> if 16 mm < tf ≤ 40 mm  
 Fy = 2200 kg/cm<sup>2</sup> if tf > 40 mm

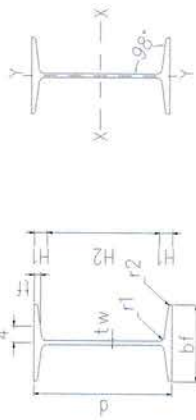
Sectional Dimension				Sectional Properties										Compact Section Criteria							
d	x	bf	mm	Center of Grav. ©	Sec. of Area	Unit Weight	Geometrical Moment of Inertia (cm <sup>4</sup> )			Radius of Gyration of Area (cm)			Modulus of Section (cm <sup>3</sup> )			bf/2tf	d/tw	rT	d/af	Lc	Lu
mm	mm	mm	mm	cm	cm <sup>2</sup>	kg/m	Ix	Iy	Iz	ix	iy	Sx	Sy	Sz	cm	cm	cm	cm	cm	cm	cm
[ 50	x 38	5.0	7.0	1.37	7.10	5.57	26.40	9.10	1.93	1.13	10.56	3.74	2.71	10.00	1.21	1.88	48.4	299.3			
[ 65	x 42	5.5	7.5	1.42	9.03	7.09	57.50	14.10	2.52	1.25	17.69	5.07	2.80	11.82	1.36	2.06	53.5	272.6			
[ 75	x 40	5.0	8.0	1.28	8.82	6.92	75.30	12.20	2.92	1.18	20.08	4.49	2.86	15.00	1.32	2.68	51.0	210.0			
[ 80	x 45	6.0	8.0	1.45	11.00	8.63	106.00	19.40	3.10	1.33	26.50	6.36	2.81	13.33	1.48	2.22	57.4	253.2			
[ 100	x 50	5.0	8.0	1.54	11.92	9.36	188.00	26.00	3.97	1.48	37.60	7.51	3.33	20.00	1.67	2.67	63.7	211.0			
[ 50	x 50	6.0	8.5	1.55	13.50	10.60	206.00	29.30	3.91	1.47	41.20	8.49	2.94	16.67	1.66	2.35	63.7	239.1			
[ 120	x 55	7.0	9.0	1.60	17.00	13.35	364.00	43.20	4.63	1.59	60.67	11.08	3.06	17.14	1.85	2.42	70.1	232.1			
[ 125	x 65	6.0	8.0	1.90	17.11	13.43	424.00	61.80	4.98	1.90	67.84	13.43	4.06	20.83	2.21	2.40	82.9	234.0			
[ 140	x 60	7.0	10.0	1.75	20.40	16.01	605.00	62.70	5.45	1.75	86.43	14.75	3.00	20.00	2.02	2.33	76.5	241.1			
[ 150	x 75	6.5	10.0	2.28	23.71	18.61	861.00	117.00	6.03	2.22	114.80	22.41	3.75	23.08	2.52	2.00	95.6	281.3			
[ 75	x 75	9.0	12.5	2.31	30.59	24.01	1050.00	147.00	5.86	2.19	140.00	28.32	3.00	16.67	2.49	1.60	95.6	351.6			
[ 160	x 65	7.5	10.5	1.84	24.00	18.84	925.00	85.30	6.21	1.89	115.63	18.30	3.10	21.33	2.20	2.34	82.9	240.0			
[ 180	x 75	7.0	10.5	2.13	27.20	21.35	1380.00	131.00	7.12	2.19	153.33	24.39	3.57	25.71	2.56	2.29	95.6	246.1			
[ 200	x 80	7.5	11.0	2.21	31.33	24.59	1950.00	168.00	7.89	2.32	195.00	29.02	3.64	26.67	2.74	2.27	102.0	247.5			
[ 90	x 90	8.0	13.5	2.74	38.65	30.34	2490.00	277.00	8.03	2.68	249.00	44.25	3.33	25.00	3.03	1.65	114.7	341.8			
[ 220	x 80	9.0	12.5	2.14	37.40	29.36	2690.00	197.00	8.48	2.30	244.55	33.62	3.20	24.44	2.73	2.20	102.0	255.7			
[ 240	x 85	9.5	13.0	2.23	42.30	33.21	3600.00	248.00	9.23	2.42	300.00	39.55	3.27	25.26	2.91	2.17	108.3	259.0			
[ 250	x 90	9.0	13.0	2.40	44.07	34.59	4180.00	294.00	9.74	2.58	334.40	44.55	3.46	27.78	3.09	2.14	114.7	263.3			
[ 90	x 90	11.0	14.5	2.40	51.17	40.17	4680.00	329.00	9.56	2.54	374.40	49.85	3.10	22.73	3.06	1.92	114.7	293.7			
[ 260	x 90	10.0	14.0	2.36	48.30	37.92	4820.00	317.00	9.99	2.56	370.77	47.74	3.21	26.00	3.08	2.06	114.7	272.6			



[ 300 x 90	9.0	13.0	14.0	7.0	29.4	241.3	2.22	48.57	38.13	6440.00	309.00	11.51	2.52	429.33	45.58	3.46	33.33	3.11	2.56	114.7	219.4
90	10.0	15.5	19.0	9.5	36.4	227.2	2.34	55.74	43.76	7410.00	360.00	11.53	2.54	494.00	54.05	2.90	30.00	3.08	2.15	114.7	261.6
90	12.0	16.0	19.0	9.5	36.8	226.4	2.28	61.90	48.59	7870.00	379.00	11.28	2.47	524.67	56.40	2.81	25.00	3.05	2.08	114.7	270.0
90	10.0	16.0	16.0	8.0	34.6	230.8	2.70	58.80	46.16	8030.00	495.00	11.69	2.90	535.33	67.81	3.13	30.00	3.42	1.88	127.5	300.0
[ 380 x 90	10.5	15.0	18.0	9.0	36.4	307.2	2.41	69.39	54.47	14500.00	535.00	14.46	2.78	763.16	70.49	3.13	36.19	3.45	2.38	127.5	236.9
90	13.0	16.5	18.0	9.0	36.8	306.4	2.33	78.96	61.98	15600.00	565.00	14.06	2.67	821.05	73.66	3.03	29.23	3.40	2.30	130.1	254.5
90	13.0	20.0	24.0	12.0	45.8	288.4	2.54	85.71	67.28	17600.00	655.00	14.33	2.76	926.32	87.80	2.50	29.23	3.39	1.90	130.1	308.4
[ 400 x 90	14.0	18.0	18.0	9.0	38.7	322.6	2.65	91.50	71.83	20350.00	846.00	14.91	3.04	1017.50	101.32	3.06	28.57	3.73	2.02	143.1	290.1

UNIVERSITAS MEDAN AREA

Note :  
 \*) Material : JIS G 3101 - SS 400  
 Fy = 2500 kg/cm<sup>2</sup> if tf ≤ 16 mm  
 Fy = 2400 kg/cm<sup>2</sup> if 16 mm < tf ≤ 40 mm  
 Fy = 2200 kg/cm<sup>2</sup> if tf > 40 mm



Sectional Dimension		Sectional Properties											Compact Section Criteria		rT (cm)		d/Af l/cm		*) Lc (cm)		*) Lu (cm)						
		d mm	bf mm	tw mm	tf mm	r1 mm	r2 mm	H1 mm	H2 mm	Sec.of Area cm <sup>2</sup>	Unit Weight kg/m	Geometrical Moment of Inertia (cm <sup>4</sup> )											Radius of Gyration of Area (cm)		Modulus of Section (cm <sup>3</sup> )		
												Ix											Iy	ix	iy	Sx	Sy
I	80	x 42	3.9	5.9	3.9	2.3	10.8	58.7	7.57	5.94	78	6	3.21	0.91	19	3	3.56	20.51	1.12	3.23	53.5	174.3					
I	100	x 50	4.5	6.8	4.5	2.7	12.3	75.4	10.60	8.32	171	12	4.02	1.07	34	5	3.68	22.22	1.32	2.94	63.7	191.3					
I	x 75	5.0	8.0	7.0	3.5	16.5	66.9	16.43	12.90	281	47	4.14	1.70	56	13	4.69	20.00	2.05	1.67	95.6	337.6						
I	120	x 58	5.1	7.7	5.1	3.1	14.0	92.0	14.20	11.15	328	22	4.81	1.23	55	7	3.77	23.53	1.53	2.59	73.9	209.4					
I	125	x 75	5.5	9.5	9.0	4.5	19.8	85.5	20.45	16.05	538	58	5.13	1.68	86	15	3.95	22.73	2.03	1.75	95.6	320.7					
I	140	x 66	5.7	8.6	5.7	3.4	15.7	108.7	18.30	14.37	573	35	5.60	1.39	82	11	3.84	24.55	1.74	2.47	84.1	228.1					
I	150	x 75	5.5	9.5	9.0	4.5	19.8	110.5	21.83	17.14	819	58	6.13	1.62	109	15	3.95	27.27	2.00	2.11	95.6	267.2					
I	x 125	8.5	14.0	13.0	6.5	29.4	91.2	48.15	36.23	1750	385	6.18	2.89	235	62	4.46	17.65	3.44	0.85	159.3	656.4						
I	160	x 74	6.3	9.5	6.3	3.8	17.4	125.3	22.80	17.90	935	55	6.40	1.55	117	15	3.89	25.40	1.94	2.28	94.3	247.2					
I	180	x 82	6.9	10.4	6.9	4.1	19.0	141.9	27.90	21.90	1450	81	7.21	1.71	161	20	3.94	26.09	2.15	2.11	104.5	266.5					
I	x 100	6.0	10.0	10.0	5.0	22.0	136.0	30.06	23.60	1670	138	7.45	2.14	186	28	5.00	30.00	2.68	1.80	127.5	312.5						
I	200	x 90	7.5	11.3	7.5	4.5	20.7	158.6	33.50	26.30	2140	117	7.99	1.87	214	26	3.98	26.67	2.36	1.97	114.7	286.1					
I	100	7.0	10.0	10.0	6.0	22.0	156.1	33.06	25.95	2170	138	8.10	2.04	217	28	5.00	28.57	2.63	2.00	127.5	281.3						
I	150	9.0	16.0	15.0	7.5	34.0	132.0	64.16	50.37	4460	753	8.34	3.43	446	100	4.69	22.22	4.12	0.83	191.2	675.1						
I	220	x 98	8.1	12.2	8.1	4.9	22.4	175.2	39.60	31.09	3060	162	8.79	2.02	278	33	4.02	27.16	2.56	1.84	124.9	305.7					
I	240	x 106	8.7	13.1	8.7	5.2	24.1	191.8	46.10	36.19	4250	221	9.60	2.19	354	42	4.05	27.59	2.77	1.73	135.1	325.5					
I	250	x 125	7.5	12.5	12.0	16.0	27.1	195.9	48.79	38.30	5180	337	10.30	2.63	414	54	5.00	33.33	3.32	1.60	159.3	351.6					
I	x 125	10.0	19.0	21.0	10.5	41.3	167.4	70.73	55.52	7310	538	10.17	2.76	585	86	3.29	25.00	3.37	1.05	162.6	556.7						
I	260	x 113	9.4	14.1	9.4	5.6	25.9	208.2	53.40	41.92	5740	288	10.37	2.32	442	51	4.01	27.66	2.95	1.63	144.0	344.8					
I	280	x 119	10.1	15.2	10.1	6.1	27.80	224.4	61.10	47.96	7590	354	11.15	2.44	542	61	3.91	27.72	3.10	1.55	151.7	363.4					



I	320 x 131	11.5	17.3	11.5	6.9	31.5	257.0	77.80	61.07	12510	555	12.68	2.67	782	85	3.79	27.83	3.40	1.41	170.4	415.0
I	340 x 137	12.2	18.3	12.2	7.3	33.3	273.4	86.80	68.14	15700	674	13.45	2.79	924	98	3.74	27.87	3.55	1.36	178.2	432.1
I	350 x 150	9.0	15.0	13.0	6.5	31.3	287.5	74.58	58.55	15200	702	14.28	3.07	869	94	5.00	38.89	3.93	1.56	191.2	361.7
I		12.0	24.0	25.0	12.5	50.6	248.8	111.10	87.21	22400	1180	14.20	3.26	1280	157	3.12	29.17	4.01	0.97	195.1	602.8
I	360 x 143	13.0	19.5	13.0	7.8	35.4	289.3	97.10	76.22	19610	818	14.21	2.90	1089	114	3.67	27.69	3.70	1.29	186.0	453.9
I	380 x 149	13.7	20.5	13.7	8.2	37.2	305.7	107.00	83.99	24010	975	14.98	3.02	1264	131	3.63	27.74	3.85	1.24	193.80	471.1
I	400 x 150	10.0	18.0	17.0	8.5	37.7	324.6	91.73	72.01	24100	864	16.21	3.07	1205	115	4.17	40.00	3.91	1.48	195.1	359.6
I	150	12.5	25.0	27.0	13.5	53.3	293.4	122.10	95.85	31700	1240	16.11	3.19	1585	165	3.00	32.00	3.96	1.07	195.1	549.4
I	155	14.4	21.6	14.4	8.6	39.1	321.9	118.00	92.63	29210	1160	15.73	3.14	1460	150	3.59	27.78	4.00	1.19	201.6	490.5
I	450 x 175	11.0	20.0	19.0	9.5	42.3	365.4	116.80	91.69	39200	1510	18.32	3.60	1742	173	4.38	40.91	4.59	1.29	227.7	455.8
I	175	13.0	26.0	27.0	13.5	55.2	339.7	146.10	114.69	48800	2020	18.28	3.72	2169	231	3.37	34.62	4.63	0.99	227.7	592.5
I	175	16.2	24.3	16.2	9.7	43.8	362.4	147.00	115.39	45850	1730	17.66	3.43	2038	204	3.50	27.78	4.37	1.09	221.2	538.0
I	500 x 185	18.0	27.0	18.0	108	48.5	403.0	180.00	141.30	68740	2480	19.54	3.74	2750	268	3.43	27.78	4.75	1.00	240.7	585.40
I	600 x 190	13.0	25.0	25.0	12.5	53.0	494.1	169.40	132.98	98400	2460	24.10	3.81	3280	259	3.80	46.15	4.91	1.26	247.2	463.9
I	190	16.0	35.0	38.0	19.0	74.1	451.7	22,450	176.23	130000	3540	24.06	3.97	4333	373	2.71	37.50	4.98	0.90	247.2	649.5

UNIVERSITAS MEDAN AREA