3.8   Perhitungan Sloof

3.8.1 Perhitungan Sloof Arah Memanjang

Direncanakan :

Ukuran Balok   = 250 mm x 500 mm

Tulangan Pokok   = D19

Tulangan Sengkang   = Ø10 mm

fc'   = 25 Mpa

fy   = 400 Mpa

Selimut Beton   = 40 mm

1. Pembebanan Sloof

    -   Akibat Beban Mati

        Berat sendiri sloof   = 0,25m x 0,5m x 24 KN/m^3 = 3 KN/m

        Berat dinding   = 4,2m x 2,5 KN/m^2 = 10,5 KN/m

        Berat Plesteran (2cm)   = 4 x 4,2m x 0,21 KN/m^2 = 3,52 KN/m
        $$\overline{}+$$
                                                                Wd = 17,02 KN/m
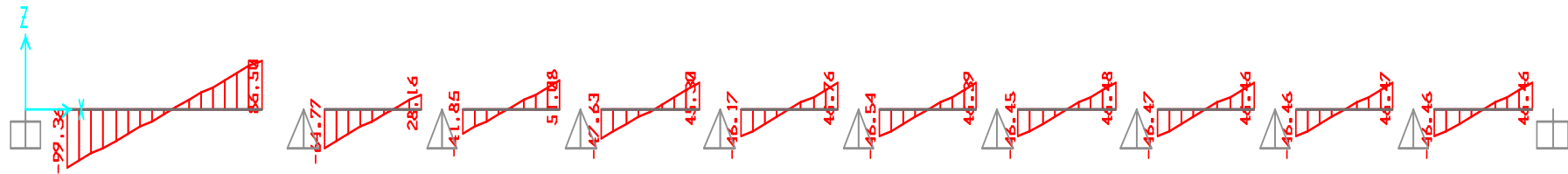
    -   Akibat Beban Hidup (Wl) = 0

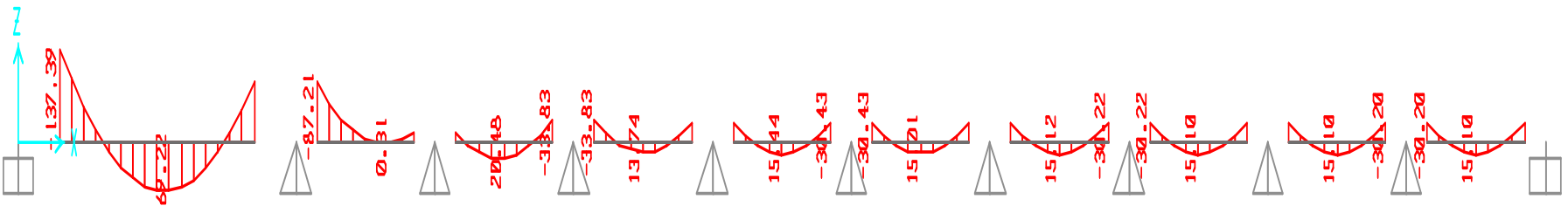   -   Beban terfaktor (Wu)   = 1,4 Wd

                                = 1,4 x 17,02 KN/m

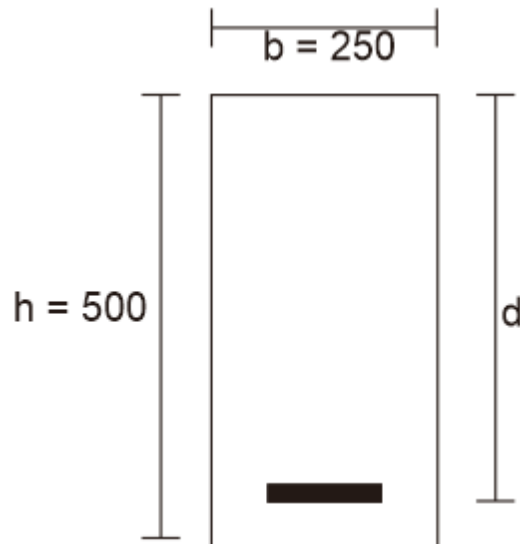   = 23,828 KN/m
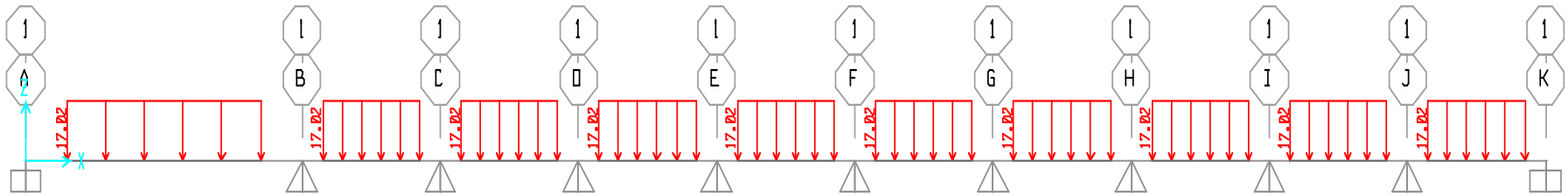
Gambar 3.8.1 Pembebanan Sloof Arah Memanjang

Gambar 3.8.2 Diagram Gaya Lintang Arah Memanjang

Gambar 3.8.3 Diagram Momen Arah Memanjang

2. Penulangan Sloof

- Tulangan Tumpuan (pada balok 250mm x 500mm)

Mu   = 119,71 KNm

deff = h − p − Øsengkang − ½ tul.pokok

   = 500 − 40 − 10 − ½ 19

   = 440.5 mm

$k \quad = \dfrac{Mu}{\emptyset \times b \times d^2} = \dfrac{119,71 \times 10^6}{0,8 \times 250mm \times (440,5mm)^2} = 3,084$

$\rho = \rho min = 0,0084$

As   = ρ x b x deff

   = 0,0084 x 250mm x 440,5mm

   = 925,05 mm

$n \quad = \dfrac{As}{\frac{1}{4} \times \pi \times d^2} = \dfrac{925,05\ mm}{\frac{1}{4} \times \pi \times 19^2} = 3,26 \sim 4$ buah

$As_{terpasang} \qquad = 4 \times ¼ \times \pi \times (19mm)^2 = 1134,114\ mm^2$

<u>Kontrol Lebar Balok</u>

Cek 1 lapis, syarat $b_{perlu} < b$

b_{perlu} = 2.p + 2 Øsengkang + 4 Ø tul.pokok + 3.jarak antar tulangan

   = (2x40mm) + (2x10mm) + (4x19mm) + (3x25mm)

   = 250 mm

b_{perlu} = 250 mm < b = 250 mm (oke)

Cek momen nominal

$\alpha \quad = \dfrac{As.fy}{0,85.fc.b} = \dfrac{1134,114 \times 400}{0,85.25.250} = 85,40$ mm

$\emptyset \, Mn = \emptyset. \, As. \, Fy. \left(d - \dfrac{\alpha}{2}\right)$

$\qquad = 0,8 \times 1134,114 \times 400 \times (440,5 - \dfrac{85,40}{2})$

$\qquad = 144,367 \times 10^6 \, Nmm$

Syarat : $\emptyset \, Mn = 144,367 \times 10^6 \, Nmm > Mu = 119,71 \times 10^6 \, Nmm$

(aman)

Jadi menggunakan tulangan 4D19

550

4 D 19

300
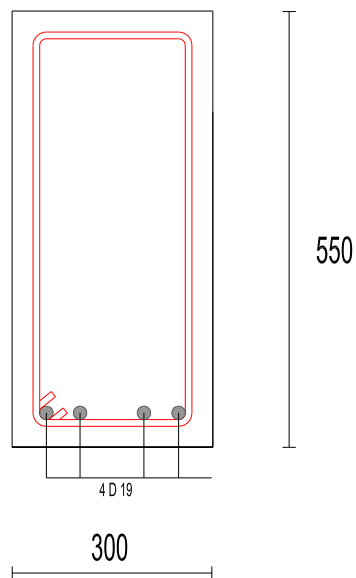
- Tulangan Lapangan (Balok 250mm x 500mm)
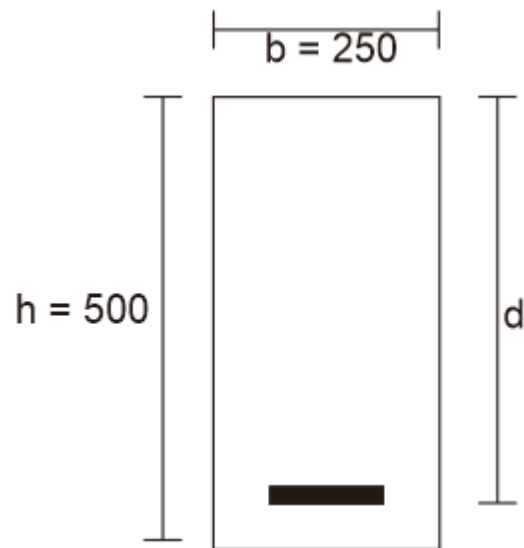
Mu $= 134,10$ KNm

deff $= h - p - \varnothing$sengkang $- \frac{1}{2}$ tul.pokok

$\quad = 500 - 40 - 10 - \frac{1}{2} \, 19$

$\quad = 440,5$ mm

k $\quad = \dfrac{Mu}{\varnothing \times b \times d^2} = \dfrac{134,10 \times 10^6}{0,8 \times 250mm \times (440,5mm)^2} = 3,455$

$\rho = \rho min = 0,0095$

As $\quad = \rho$ x b x deff

$\quad = 0,0095$ x 250mm x 440,5mm

$\quad = 1046,18$ mm

n $\quad = \dfrac{As}{\frac{1}{4} \times \pi \times d^2} = \dfrac{1046,18mm}{\frac{1}{4} \times \pi \times 19^2} = 3,689 \sim 4$ buah

As$_{terpasang}$ $\quad = 4$ x $\frac{1}{4}$ x π x $(19mm)^2 = 1134,11$ mm^2

Kontrol Lebar Balok

Cek 1 lapis, syarat b$_{perlu}$ < b

b$_{perlu}$ $= 2.p + 2 \, \varnothing$sengkang $+ 4 \, \varnothing$ tul.pokok $+ 2.$jarak antar tulangan

$\quad = (2x40mm) + (2x10mm) + (4x19mm) + (3x25mm)$

$\quad = 250$ mm

b$_{perlu}$ $= 250mm < b = 250$ mm (oke)

<u>Cek momen nominal</u>

$$\alpha = \frac{As.fy}{0,85.fc.b} = \frac{1134,114 \times 400}{0,85.25.250} = 85,40 \text{ mm}$$

$$\emptyset \, Mn = \emptyset. As. Fy. \left(d - \frac{\alpha}{2}\right)$$

$$= 0,8 \times 1134,114 \times 400 \times \left(440,5 - \frac{85,40}{2}\right)$$

$$= 144,367 \times 10^6 \, Nmm$$

Syarat : $\emptyset \, Mn = 144,367 \times 10^6$ Nmm $> Mu = 134,10 \times 10^6$ Nmm

(aman)

Jadi menggunakan tulangan 4D19
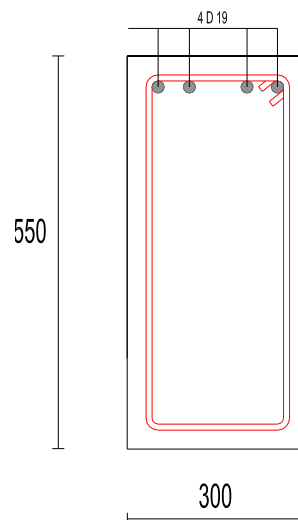
- Tulangan Geser

  Faktor Reduksi $\emptyset = 0,75$

  deff $= 440,5$ mm

  Vu $=$ Vu' $= 110,12$ KN

  $$\frac{Vu}{Vu'} = \frac{x}{l-x}$$

  $$\frac{110,12 \, KN}{110.12 KN} = \frac{x}{3,9m-x}$$

  $3,9 \, m - x = x$

$x = \frac{3,9m}{2} = 1,95m$

$x1 \quad = \frac{1}{2} b + deff = \frac{1}{2} . 250mm + 440,5mm = 565,5mm = 0,565 \ m$

$x2 \quad = x - x1 = 1,95 \ m \ - 0,565m = 1,385m$

$Vu_{kritis} \quad = \ 110,12 \ KN \ x \ \frac{1,95-0,440}{1,95} = 85,272 \ KN = 85272 \ N$

$Vc \quad = \frac{1}{6} \times \sqrt{fc'} \times bw \times deff$

$\qquad = \frac{1}{6} \times \sqrt{25} \times 250mm \ x \ 440,5 \ mm$

$\qquad = 91770,83 \ N$

$ØVc = \frac{1}{2} \ x \ Ø \ x \ Vc$

$\qquad = \frac{1}{2} \ x \ 0,75 \ x \ 91770,83N$

$\qquad = 31798,93 \ N$

$Vu_{kritis} = 85272 \ N < ØVc = 91770N \rightarrow$ tidak perlu tulangan geser

Diameter yang diambil misalkan Ø10

$Vs \quad = \frac{Vu}{Ø} - Vc$

$\qquad = \frac{85272 \ N}{0,75} - 31,798 \ N = 113664,202$

$Av \quad = 2 \ x \ \frac{1}{4} \ x \ \pi \ x \ ds^2$

$\qquad = 2 \ x \ \frac{1}{4} \ x \ \pi \ x \ (10mm)^2 = 157,07 \ mm^2$

$S \quad = \frac{Av \ \times fy \times deff}{Vs} = \frac{157,07 \ \times 400 \times 440,5}{113664,202} = 243,486 \ mm$

Cek terhadap jarak Smin dan Smaks

$Smin = \frac{4 \times Av \ \times fy}{bw} = \frac{4 \times 157,07 \ \times 400}{250} = 1005,248mm$

$Vs \qquad > \frac{1}{3} \times \sqrt{fc'} \times bw \times deff$

$113664,202 \qquad > \frac{1}{3} \times \sqrt{25} \times 250 \times 440,5$

$113664,202 \qquad < 183541,666$ (tidak oke)

Jadi digunakan tulangan sengkang Ø10 – 100mm

4.8.1 Perhitungan Sloof Arah Melintang

Direncanakan :

Ukuran Balok	= 300 mm x 600 mm
Tulangan Pokok	= D19
Tulangan Sengkang	= Ø10 mm
fc'	= 25 Mpa
fy	= 400 Mpa
Selimut Beton	= 40 mm

1. Pembebanan Sloof
   - Akibat Beban Mati

     Berat sendiri sloof $= 0,3$m x $0,6$m x 24 KN/m^3 $= 4,32$ KN/m

     Berat dinding $= 4,2$m x $2,5$ KN/m^2 $= 10,5$ KN/m

     Berat Plesteran (2cm) $= 4$ x $4,2$ m x $0,21$ KN/m^2 $= 3,528$ KN/m $+$

     Wd $= 18,348$KN/m

   - Akibat Beban Hidup (Wl) $= 0$
   - Beban terfaktor (Wu) $= 1,4$ Wd
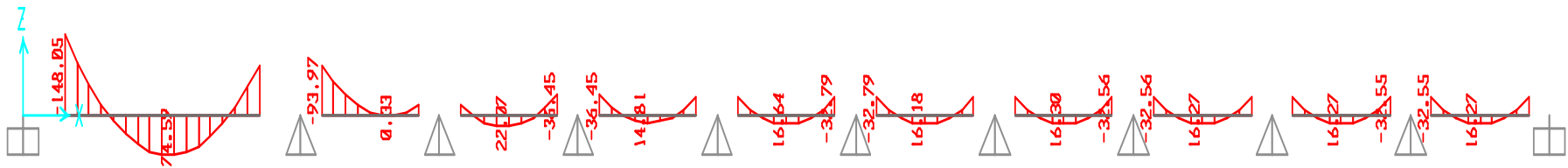
     $= 1,4$ x $18,348$KN/m

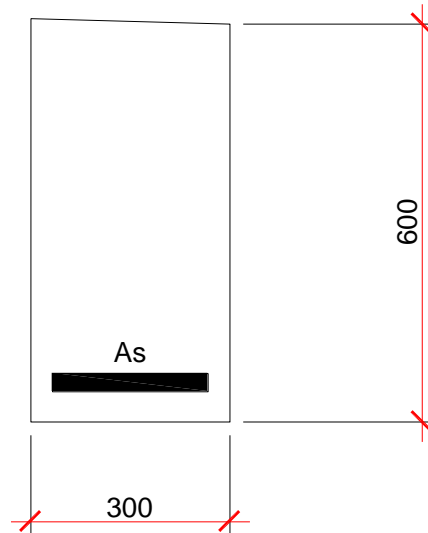 $= 25,687$ KN/m
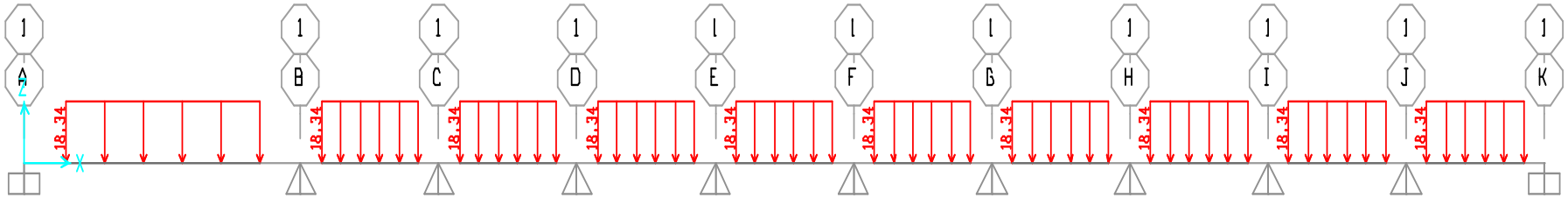
Gambar 3. Pembebanan Sloof Arah Melintang
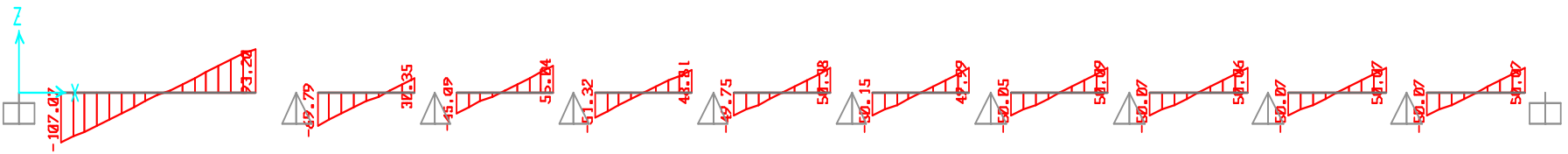
Gambar 3. Diagram Gaya Lintang Arah Melintang

Gambar 3. Diagram Momen Arah Melintang

2. Penulangan Sloof

- Tulangan Tumpuan (pada balok 300mm x 600mm)

Mu = 129,00 KNm

deff = h – p – Øsengkang – ½ tul.pokok

= 600 – 40 – 10 – ½ 19

= 540,5 mm

k $= \dfrac{Mu}{\emptyset \times b \times d^2} = \dfrac{120,00 \times 10^6}{0,8 \times 300mm \times (540,5mm)^2} = 1,711$

$\rho = \rho min = 0,0045$

As = ρ x b x deff

= 0,0045 x 300mm x 540,5mm

= 729,675mm

n $= \dfrac{As}{\frac{1}{4} \times \pi \times d^2} = \dfrac{729,675\ mm}{\frac{1}{4} \times \pi \times 19^2} = 2,573 \sim 3$ buah

As$_{terpasang}$ = 3 x ¼ x π x (19mm)^2 = 850,56mm^2

Kontrol Lebar Balok

Cek 1 lapis, syarat $b_{perlu} < b$

b_{perlu} = 2.p + 2 Øsengkang + 3 Ø tul.pokok + 2.jarak antar tulangan

$\qquad$ = (2x40mm) + (2x10mm) + (3x19mm) + (2x25mm)

$\qquad$ = 207 mm

b_{perlu} = 207mm < b = 300 mm (oke)

Cek momen nominal

$\alpha \qquad = \dfrac{As.fy}{0,85.fc.b} = \dfrac{850,56 \,.400}{0,85.25.400} = 40,026$ mm

$\emptyset\, Mn = \emptyset.\, As.\, Fy.\left(d - \dfrac{\alpha}{2}\right)$

$\qquad = 0,8 \times 850,56 \times 400 \times \left(540,5 - \dfrac{40,026}{2}\right)$

$\qquad = 150,519 \times 10^{6}\, Nmm$

Syarat : $\emptyset\, Mn = 150,519 \times 10^{6}$ Nmm > Mu = 129,00 $\times 10^{6}$ Nmm (aman)

Jadi menggunakan tulangan 3D19

- Tulangan Lapangan (Balok 300mm x 600mm)
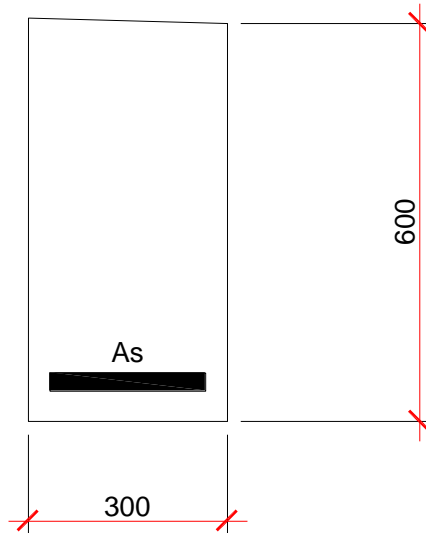
Mu = 144,50 KNm

deff = h – p – Øsengkang – ½ tul.pokok

= 600 – 40 – 10 – ½ 19

= 540,5 mm

k $= \dfrac{Mu}{\varnothing \times b \times d^2} = \dfrac{144,50 \times 10^6}{0,8 \times 300mm \times (540,5mm)^2} = 2,060$

$\rho = \rho min = 0,0055$

As $= \rho$ x b x deff

= 0,0055 x 300mm x 540,5 mm

= 891,825 mm

n $= \dfrac{As}{\frac{1}{4} \times \pi \times d^2} = \dfrac{891,825\ mm}{\frac{1}{4} \times \pi \times 19^2} = 3,145 \sim 3$ buah

As$_{terpasang}$ = 3 x ¼ x π x (19mm)^2 = 850,58mm^2

Kontrol Lebar Balok

Cek 1 lapis, syarat b$_{perlu}$ < b

b$_{perlu}$ = 2.p + 2 Øsengkang + 3 Ø tul.pokok + 2.jarak antar tulangan

= (2x40mm) + (2x10mm) + (3x19mm) + (2x25mm)

$= 207 \text{ mm}$

$b_{perlu} = 207 \text{mm} < b = 300 \text{ mm (oke)}$

<u>Cek momen nominal</u>

$\alpha \quad = \dfrac{\text{As.fy}}{0,85.\text{fc.b}} = \dfrac{891,825.400}{0,85.25.300} = 55,963 \text{ mm}$

$\emptyset \text{ Mn} = \emptyset.\text{As. Fy.} \left(d - \dfrac{\alpha}{2} \right)$

$\qquad = 0,8 \times 891,925 \times 400 \times (540,5 - \dfrac{55,963}{2})$

$\qquad = 155,427 \times 10^6 \text{ Nmm}$

Syarat : $\emptyset$ Mn $= 155,427 \times 10^6$ Nmm $>$ Mu $= 144,50 \times 10^6$ Nmm (aman)

Jadi menggunakan tulangan 3D16

- Tulangan Geser

  Faktor Reduksi $\emptyset = 0,75$

  deff $= 540,5 \text{ mm}$

  Vu $= 118,68 \text{ KN}$

  Vu' $= 81,61 \text{ KN}$

  $\dfrac{Vu}{Vu'} = \dfrac{x}{l-x}$

  $\dfrac{118,68 \ KN}{81,61 \ KN} = \dfrac{x}{3,9m-x}$

  $1,454 \ (3,9m - x) = x$

  $3,9m - 1,454 \ x = x$

  $x = \dfrac{3,9m}{1,454}$

  $x = 2,682 \text{ m}$

  $L - x = 3,9 - 2,682m = 1,218m$

  $Vu_{kritis} \quad = Vu \times \dfrac{x-deff}{x}$

$$= 118{,}68 \text{ KN x } \frac{2{,}682-0{,}540}{2{,}692} = 94{,}873\text{KN} = 94873\text{N}$$

$$\text{Vc} = \frac{1}{6} \times \sqrt{fc'} \times bw \times deff$$

$$= \frac{1}{6} \times \sqrt{25} \times 300mm \times 540{,}5mm$$

$$= 135125\text{N}$$

$$\text{ØVc} = \text{½ x Ø x Vc}$$

$$= \text{½ x 0,75 x 135125N}$$

$$= 50671{,}875 \text{ N}$$

$\text{Vu}_{\text{kritis}} = 118{,}68 \text{ N} > \text{ØVc} = 50671{,}875\text{N} \rightarrow$ tidak perlu tulangan geser

Diameter yang diambil misalkan Ø10

$$\text{Vs} = \frac{\text{Vu}}{\text{Ø}} - \text{Vc}$$

$$= \frac{118{,}68 \text{ N}}{0{,}75} - 50671{,}875 \text{ N} = \text{-}50513$$

$$\text{Av} = 3 \text{ x ¼ x } \pi \text{ x ds}^2$$

$$= 3 \text{ x ¼ x } \pi \text{ x (10mm)}^2 = 235{,}619 \text{ mm}^2$$

$$\text{S} = \frac{\text{Av} \times \text{fy} \times \text{deff}}{\text{Vs}} = \frac{235{,}619 \times 400 \times 540{,}5}{50513} = 941{,}300 \text{ mm}$$

Cek terhadap jarak Smin dan Smaks

$$\text{Smin} = \frac{3 \times \text{Av} \times \text{fy}}{\text{bw}} = \frac{3 \times 235{,}619 \times 400}{300} = 642{,}476\text{mm}$$

$$\text{Vs} > \frac{1}{3} \times \sqrt{\text{fc}'} \times \text{bw} \times \text{deff}$$

$$50513 > \frac{1}{3} \times \sqrt{25} \times 300 \times 540{,}5$$

$$50153 > 270250 \text{ (oke)}$$

Maka Smaks = d/2 = 540,5/2 = 270,25 ~ 300 mm

Jadi digunakan tulangan sengkang Ø10 – 200mm