

3.9 Penulangan Sumuran

a. Analisa Pembebanan

Dari hasil perhitungan kombinasi pembebanan abutmen beserta pondasi sumuran ditinjau terhadap titik A, digunakan kombinasi yang mempunyai gaya dan momen terbesar yaitu kombinasi I.

$$\begin{aligned} V_u &= 1,2 (M + P_i + G_c + G_s) + 1,6 (H + G_t) \\ &= 1,2 (3665,5035 + 1320,3 + 12864,7 + 3314,732) + \\ &\quad 1,6 (3262,739 + 7065,6) \\ &= 41923,625 \text{ kN} \end{aligned}$$

$$V_u \text{ satu sumuran} = \frac{41923,625}{4} = 10480,9 \text{ kN}$$

$$\begin{aligned} M_u &= 1,2 (M_M + M_{P_i} + M_{G_c} + M_{G_s}) + 1,6 (M_H + M_{T_{as}}) \\ &= 1,2 (17044,6 + 8053,83 + 64709,441 - 9115,513) + \\ &\quad 1,6 (15171,74 - 2157,368) \\ &= 117653,823 \text{ kNm} \end{aligned}$$

$$M_u \text{ satu sumuran} = \frac{117653,823}{4} = 29413,456 \text{ kNm}$$

$$\begin{aligned} H_u &= 1,6 T_{as} \\ &= 1,6 \times 1114,64 \\ &= 1783,424 \text{ kN} \end{aligned}$$

$$H_u \text{ satu sumuran} = \frac{1783,424}{2} = 891,712 \text{ kN}$$

b. Perhitungan Penulangan

$$\begin{aligned} M_u &= 29413,456 \text{ kNm} \\ &= 29413,456 \times 10^6 \text{ Nmm} \end{aligned}$$

$$f'_c = 25 \text{ MPa}$$

$$f_y = 400 \text{ MPa}$$

▪ Tulangan utama

$$\begin{aligned} A_{gr} &= \frac{1}{4} \pi \cdot D^2 \\ &= \frac{1}{4} \pi \cdot (5000^2 - 3000^2) \\ &= 12566370,61 \text{ mm}^2 \end{aligned}$$

$$e_t = \frac{Mu}{Vu} = \frac{29413,456}{10480,9} = 2,8 \text{ m} = 2800 \text{ mm}$$

$$e_{t \text{ min}} = (15 + 0,03 h) = 15 + 0,03 \cdot 5000 = 165 \text{ mm} < 1770 \text{ mm}$$

mencari harga r pada tabel Gideon 4 hal. 95 harus mencari nilai – nilai pada sumbu horisontal dan pada sumbu vertikal dengan nilai :

- pada sumbu horizontal :

$$\begin{aligned} &= \frac{Vu}{\phi \cdot A_{gr} \cdot 0,85 \cdot f'_c} (e_t / h) \\ &= \frac{10480,9 \times 10^3}{0,65 \cdot 12566370,61 \cdot 0,85 \cdot 25} (2800 / 5000) \\ &= 0,034 \end{aligned}$$

- pada sumbu vertikal :

$$\begin{aligned} &= \frac{Vu}{\phi \cdot A_{gr} \cdot 0,85 \cdot f'_c} \\ &= \frac{10480,9 \times 10^3}{0,65 \cdot 12566370,61 \cdot 0,85 \cdot 25} = 0,06 \end{aligned}$$

$$d'/h = 300/3750 = 0,08 = 0,1$$

dari tabel gideon 4 hal. 98 didapat nilai $r = 0,12$

bila $f'_c = 25 \text{ MPa}$ maka $\beta = 1$

$$\begin{aligned} \rho &= r \cdot \beta \\ &= 0,12 \times 1 \\ &= 0,12 \end{aligned}$$

$$\begin{aligned} A_s \text{ tot} &= \rho \cdot A_{gr} \\ &= 0,12 \times 12566370,61 \\ &= 1508 \text{ mm}^2 \end{aligned}$$

dipakai tulangan D 16 - 200 (1508 mm²)

- Tulangan bagi

$$\text{Gaya horisontal } (H_u) = 891,712 \text{ kN}$$

$$\begin{aligned} \text{Gaya geser nominal } (\phi V_c) &= 0,60 \cdot \frac{1}{6} \cdot \sqrt{f'_c} \cdot b \cdot d \\ &= 0,60 \times \frac{1}{6} \times \sqrt{25} \times 3250 \times 300 \\ &= 487500 \text{ N} \end{aligned}$$

$$(\phi V_c) = 487,5 \text{ kN}$$

$\phi V_c < V_u$, maka memerlukan tulangan bagi

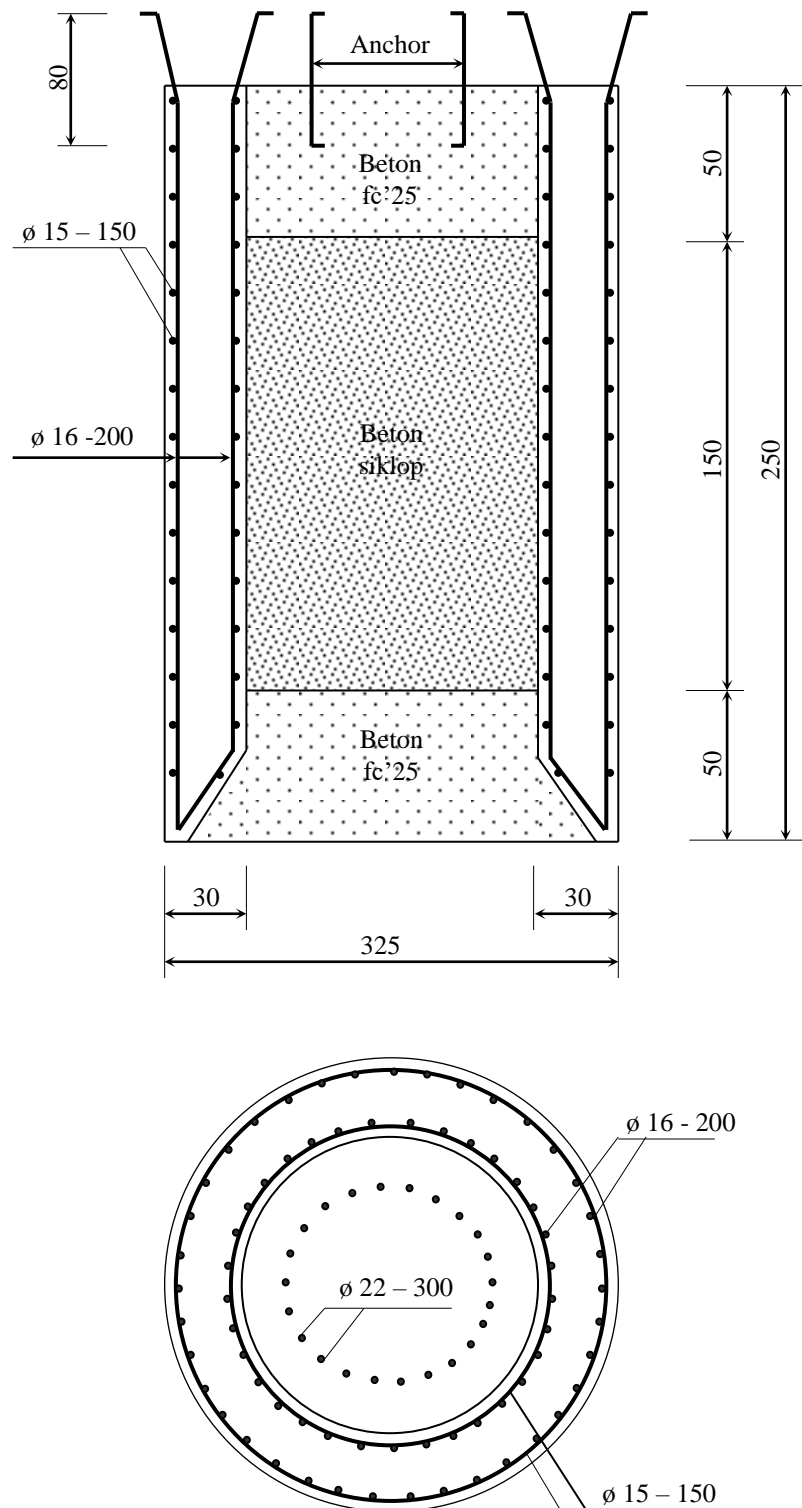
$$\phi V_s = V_u - \phi V_c = 1048,09 - 487,5 = 560,59 \text{ kN}$$

dimisalkan jarak sengkang $s = 200 \text{ mm}$

$$\begin{aligned} A_v &= \frac{\phi V_s \cdot s}{0,6 \cdot f_y \cdot d} \\ &= \frac{560,09 \times 10^3 \times 200}{0,6 \times 400 \times 325} \\ &= 1436 \text{ mm}^2 \end{aligned}$$

dipakai tulangan D 15 – 150 ($A_s = 1436 \text{ mm}^2$)

c. Gambar Penulangan



Gambar 3.47 Penulangan Sumuran