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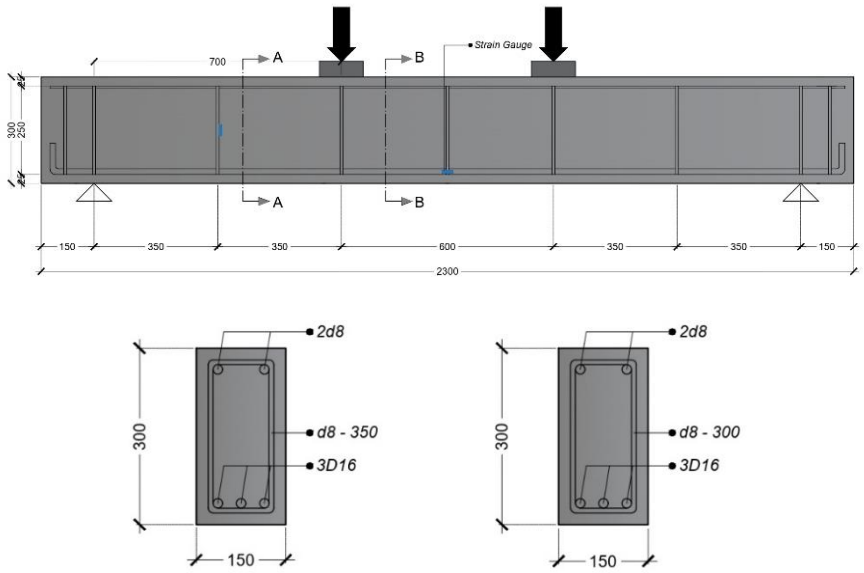
Perhitungan Kapasitas Lentur dan Kapasitas Geser Balok Beton Bertulang



Data Balok :

- Panjang Balok (L) = 2300 mm
- Tinggi Balok (h) = 300 mm
- Lebar Balok (b) = 150 mm
- Jarak serat tekan ke titik berat tulangan Tarik (d) = 264 mm
- Jaral serat tekan ke titik berat tulangan tekan (d') = 32 mm
- Kuat tekan beton (f'c) = 21.1 MPa
- Kuat leleh tulangan longitudinal
  - Tulangan tekan (fy') = 336,75 MPa
  - Tulangan tarik (fy) = 384.82 MPa
- Luas tulangan balok
  - Tulangan tekan (As') = 100,53 mm^2
  - Tulangan Tarik (As) = 603,19 mm^2

a. Kapasitas Lentur (Mn)

$$C_C + C_S = T_S \quad \text{.....(13)}$$

$$\left(0.85 \times f'c \times a \times b\right) + \left(A_s' \times f_y'\right) = A_s \times f_y \quad \text{.....(14)}$$

$$a = \frac{(A_s \times f_y)-(A_s' \times f_y')}{0.85 \times f'c \times b} \quad \text{.....(15)}$$

Dimana :

C_C = gaya tekan pada beton (kN),

C_S = gaya tekan pada tulangan (kN),

T_S = jumlah gaya total dari tulangan tarik (kN),

a = tinggi blok tekan equivalen (mm)

Diperoleh :

$$a = \frac{(A_s \times f_y)-(A_s' \times f_y')}{0.85 \times f'c \times b}$$

$$a = \frac{(603.19\ \text{mm}^2 \times 384.82\ \text{MPa})-(100.53\ \text{mm}^2 \times 336.75\text{MPa})}{0.85 \times 21.1\ \text{MPa} \times 150\ \text{mm}}$$

$$a = 73.70\ \text{mm}$$

$$Mn = T_S \times \left(d-\frac{a}{2}\right) \quad \text{.....(16)}$$

$$Mn = A_s \times f_y \times \left(d-\frac{a}{2}\right) \quad \text{.....(17)}$$

Diperoleh :

$$Mn = A_s \times f_y \times \left(d-\frac{a}{2}\right)$$

$$Mn = 603.19\ \text{mm}^2 \times 384.82\ \text{MPa} \times (264\ \text{mm}-\frac{73.70}{2})$$

$$= 52.73\ \text{kNm}$$

Sehingga,

$$\mathrm{Pn} = \frac{\mathrm{Mn}}{0.35}$$

$$\mathrm{Pn} = \frac{52.73\ \mathrm{kNm}}{0.35\ \mathrm{m}} = 150.65\ \mathrm{kN}$$

b. Kapasitas Geser (Vn)

$$\mathrm{V_c} = \frac{1}{6}\sqrt{\mathrm{f'c}} \times \mathrm{b_w} \times \mathrm{d} \quad \text{..... (18)}$$

Diperoleh :

$$\mathrm{V_c} = \frac{1}{6}\sqrt{\mathrm{f'c}}\,.\,\mathrm{b_w}\,.\,\mathrm{d}$$

$$\mathrm{V_c} = \frac{1}{6}\sqrt{21.1\ \mathrm{MPa}}\,.\,150\ \mathrm{mm}\,.\,264\ \mathrm{mm}$$

$$\mathrm{V_c} = 30.32\ \mathrm{kN}$$

$$\mathrm{V_s} = \frac{\mathrm{A_s} \times \mathrm{f_y} \times \mathrm{d}}{\mathrm{s}} \quad \text{..... (19)}$$

Diperoleh :

$$\mathrm{V_s} = \frac{\mathrm{A_s} \times \mathrm{f_y} \times \mathrm{d}}{\mathrm{s}}$$

$$\mathrm{V_s} = \frac{100.53\ \mathrm{mm^2} \times 384.82\ \mathrm{MPa} \times 264\ \mathrm{mm}}{350\ \mathrm{mm}}$$

$$\mathrm{V_s} = 29{,}18\ \mathrm{kN}$$

Jadi, kuat geser nominal (Vn) :

$$\mathrm{V_n} = \mathrm{V_c} + \mathrm{V_s}$$

$$\mathrm{V_n} = 30.32\ \mathrm{kN} + 29{,}18\ \mathrm{kN} = 59.50\ \mathrm{kN}$$

Sehingga,

$\mathrm{Pn} = 2\mathrm{Vn}$ ..... (20)

$\mathrm{Pn} = 2 \times 59.50\ \mathrm{kN} = 118.99\ \mathrm{kN}$

Berdasarkan hasil perhitungan analitis menunjukkan $P_{n\ lentur} > P_{n\ geser.}$ Hal ini mengindikasikan bahwa balok beton bertulang mengalami kegagalan geser.