



Çukurova Üniversitesi

BETONARME 1

Çalışma Soruları

Prof. Dr. Cengiz DÜNDAR

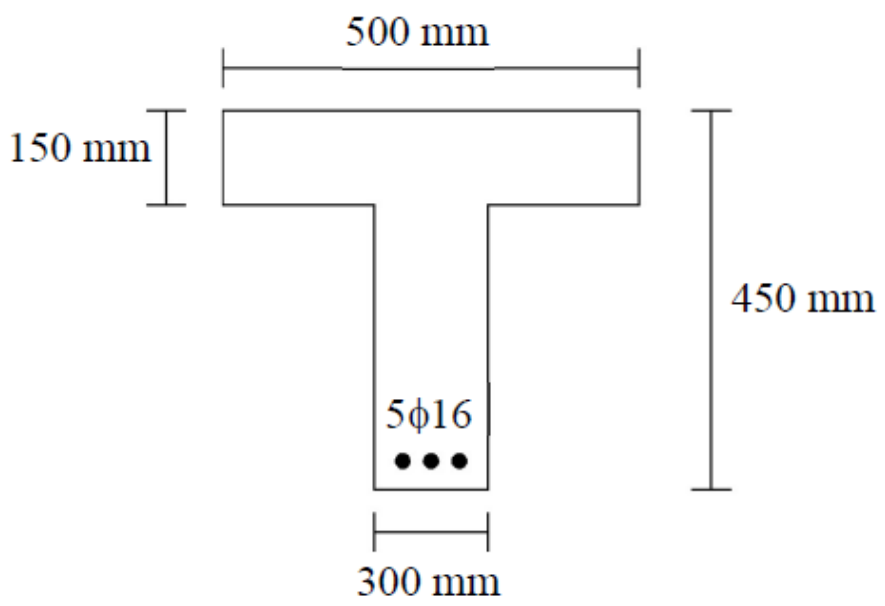
Arş. Gör. Sedat KARAAHMETLİ

Soru 4

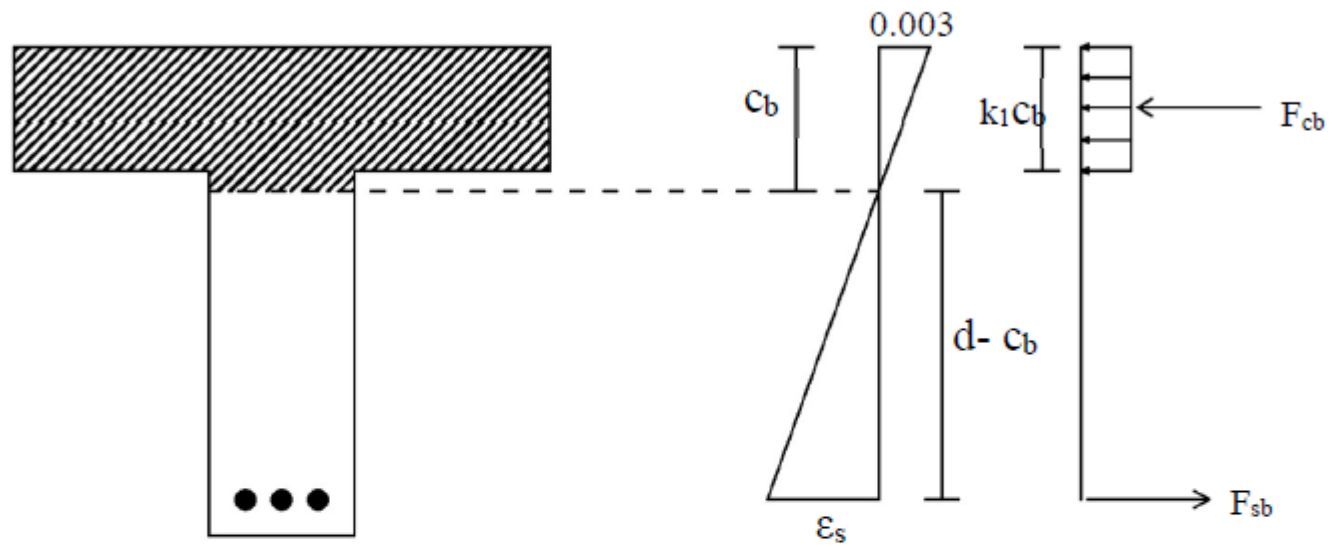
Şekilde verilen kirişin

- a) Dengeli donatı alanını (A_{sb}) bulunuz.
- b) Kirişin eğilme momenti kapasitesini belirleyiniz?

$A_s=1005 \text{ mm}^2$
C20, S420
 $d'=50 \text{ mm}$



Denge Durumu



$$\epsilon_s = \epsilon_{sy} = \frac{f_{yd}}{E_s} = \frac{365}{200000} = 0.001825$$

$$\frac{c_b}{d - c_b} = \frac{0.003}{0.001825} \rightarrow c_b = 248.7 \text{ mm}$$

$$k_1 c_b = 211.4 \text{ mm}$$

Denge Denklemi

$$\sum F = 0$$

$$F_{cb} - F_{sb} = 0$$

$$0.85 f_{cd} A_{cc} - A_{sb} f_{yd} = 0$$

$$0.85 * 13 * [211.4 * 300 + (500 - 300) * 150] = A_{sb} * 365$$

$$A_{sb} = 2828 \text{ mm}^2$$

$A_{sb} > A_s$ olduğundan kiriş denge altıdır.

a) Kirişin eğilme momenti kapasitesini belirleyiniz?

Denge Denklemi

$$k_1 c = 150 \text{ mm} \quad (\text{kabul edilir})$$

Denge denklemi

$$F_c = F_s$$

$$0.85 f_{cd} * k_1 c * b = A_s f_{yd}$$

$$0.85 * 13 * 150 * 500 = 1005 * 365$$

$$828750 > 366825 \quad (\text{oldugundan } k_1 c < 150 \text{ mm})$$

$$F_c = F_s$$

$$0.85 f_{cd} * k_1 c * b = A_s f_{yd}$$

$$0.85 * 13 * k_1 c * 500 = 1005 * 365$$

$$k_1 c = 66.4 \text{ mm}$$

$$M_r = A_s f_{yd} * \left(d - \frac{k_1 c}{2} \right)$$

$$M_r = \left[1005 * 365 * \left(400 - \frac{66.4}{2} \right) \right] 10^{-6}$$

$$M_r = 134.6 \text{ kNm}$$

Soru 5

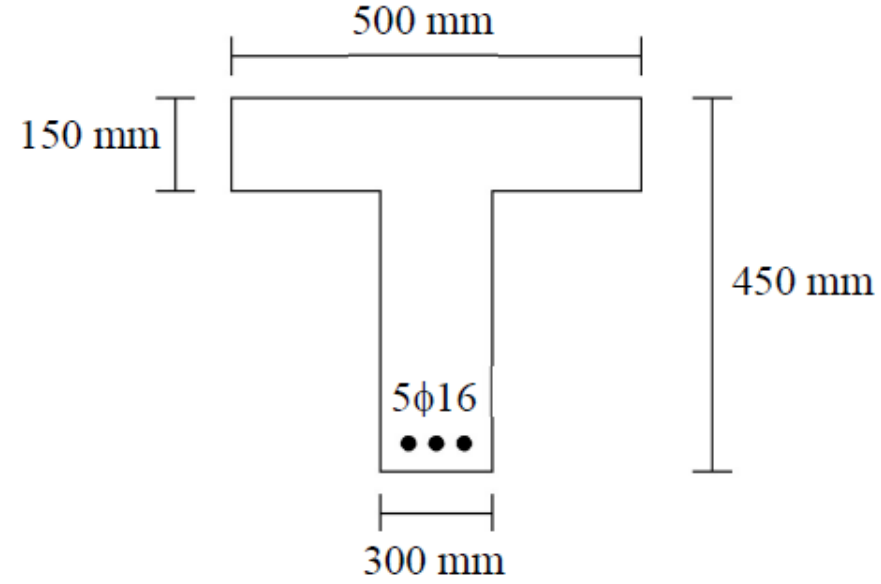
Şekilde verilen kirişin

- Dengeli donatı alanını (A_{sb}) bulunuz.
- Kirişin eğilme momenti kapasitesini belirleyiniz?

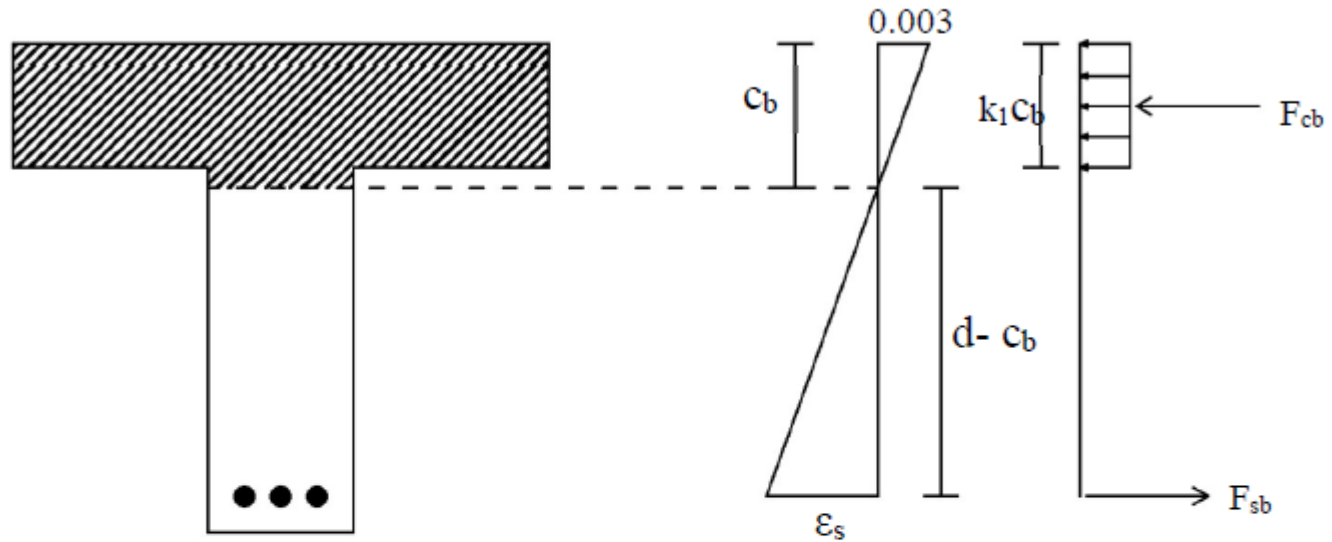
$$A_s = 2300 \text{ mm}^2$$

C20, S420

$$d' = 50 \text{ mm}$$



Denge Durumu



$$\epsilon_s = \epsilon_{sy} = \frac{f_{yd}}{E_s} = \frac{365}{200000} = 0.001825$$

$$\frac{c_b}{d - c_b} = \frac{0.003}{0.001825} \rightarrow c_b = 248.7 \text{ mm}$$

$$k_1 c_b = 211.4 \text{ mm}$$

Denge Denklemi

$$\sum F = 0$$

$$F_{cb} - F_{sb} = 0$$

$$0.85 f_{cd} A_{cc} - A_{sb} f_{yd} = 0$$

$$0.85 * 13 * [211.4 * 300 + (500 - 300) * 150] = A_{sb} * 365$$

$$A_{sb} = 2828 \text{ mm}^2$$

$A_{sb} > A_s$ olduğundan kiriş denge altıdır.

a) Kirişin eğilme momenti kapasitesini belirleyiniz?

Denge Denklemi

$$k_1 c = 150 \text{ mm} \quad (\text{kabul edilir})$$

Denge denklemi

$$F_c = F_s$$

$$0.85 f_{cd} * k_1 c * b = A_s f_{yd}$$

$$0.85 * 13 * 150 * 500 = 3000 * 365$$

$$828750 < 839500 \quad (\text{oldugundan } k_1 c > 150 \text{ mm})$$

$$F_c = F_s$$

$$0.85 f_{cd} * [k_1 c * b_w + (b - b_w) * h_f] = A_s f_{yd}$$

$$0.85 * 13 * [k_1 c * 300 + (500 - 300) * 150] = 2300 * 365$$

$$k_1 c = 153.2 \text{ mm}$$

Ağırlık merkezinin yeri

$$\bar{x} = \frac{\left[k_1 c * b_w * \frac{k_1 c}{2} + (b - b_w) * h_f * \frac{h_f}{2} \right]}{k_1 c * b_w + (b - b_w) * h_f}$$

$$\bar{x} = \frac{\left[153.2 * 300 * \frac{153.2}{2} + (500 - 300) * 150 * \frac{150}{2} \right]}{153.2 * 300 + (500 - 300) * 150}$$

$$\bar{x} = 75.98 \text{ mm}$$

$$M_r = A_s f_{yd} * (d - \bar{x})$$

$$M_r = [2300 * 365 * (400 - 75.98)] 10^{-6}$$

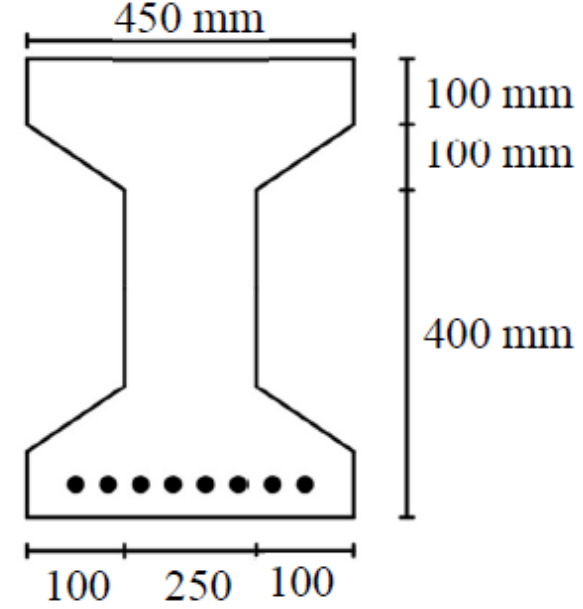
$$M_r = 272 \text{ kNm}$$

Soru 8

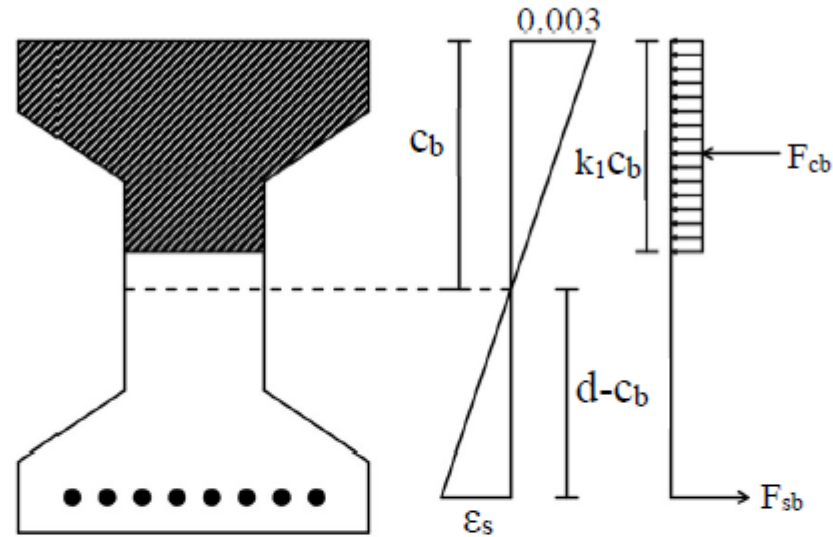
Şekilde verilen kirişin

- Dengeli donatı alanını (A_{sb}) bulunuz.
- Kirişin eğilme momenti kapasitesini belirleyiniz?

C20, S420, $A_s=2036 \text{ mm}^2$, $d'=30 \text{ mm}$



Denge Durumu



$$\varepsilon_s = \varepsilon_{sy} = \frac{f_{yd}}{E_s} = \frac{365}{200000} = 0.001825$$

$$\frac{c_b}{d - c_b} = \frac{0.003}{0.001825} \rightarrow c_b = 354.4 \text{ mm}$$

$$k_1 c_b = 301.2 \text{ mm}$$

Denge Denklemi

$$\sum F = 0$$

$$F_{cb} - F_{sb} = 0$$

$$0.85 f_{cd} A_{cc} - A_{sb} f_{yd} = 0$$

$$0.85 * 13 * \left[(450 * 100) + 2 * \left(\frac{100 * 100}{2} \right) + (250 * 201,2) \right] = A_{sb} * 365$$

$$A_{sb} = 3188 \text{ mm}^2$$

$A_{sb} > A_s$ olduğundan kiriş denge altıdır.

c) Kirişin eğilme momenti kapasitesini belirleyiniz?

Denge Denklemi

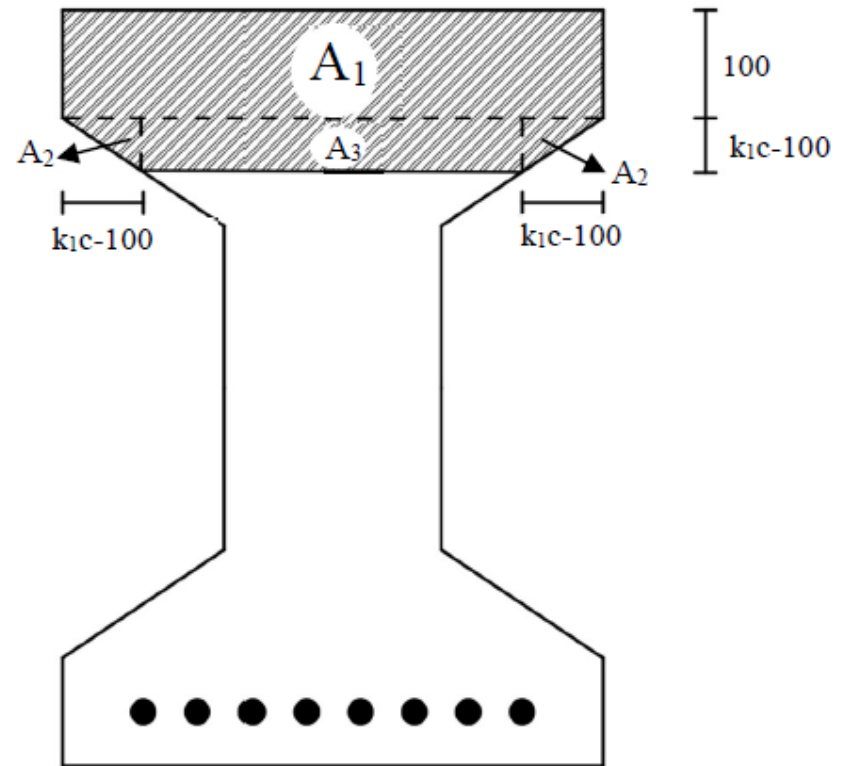
$$\sum F = 0$$

$$F_c - F_s = 0$$

$$0.85 f_{cd} A_{cc} - A_s f_{yd} = 0$$

$$0.85 * 13 * A_{cc} - 2036 * 365 = 0$$

$$A_{cc} = 67244 \text{ mm}^2$$

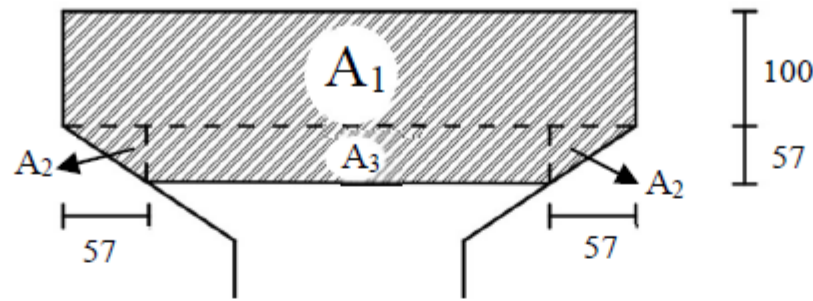


$$A_{cc} = A_1 + 2A_2 + A_3$$

$$67244 = 450 * 100 + 2 * \frac{(k_1c - 100) * (k_1c - 100)}{2} + (450 - 2 * (k_1c - 100))(k_1c - 100)$$

$$(k_1c)^2 - 650(k_1c) + 77444 = 0$$

$$k_1c = 157 \text{ mm}$$



Ağırlık merkezinin yeri

$$\bar{x} = \frac{450 * 100 * \left(\frac{100}{2}\right) + 2 * \left[\frac{57 * 57}{2} * \left(\frac{57}{3} + 100\right)\right] + (450 - 2 * 57) * 57 * \left(\frac{57}{2} + 100\right)}{450 * 100 + 2 * \frac{57 * 57}{2} + (450 - 2 * 57)(57)}$$

$$\bar{x} = 75.44 \text{ mm}$$

$$M_r = 0.85 f_{cd} A_{cc} * (d - \bar{x})$$

$$M_r = [0.85 * 13 * 67244 * (570 - 75.44)] 10^{-6}$$

$$M_r = 367 \text{ kNm}$$

