

Tasarım Kesit Etkilerinin Belirlenmesi

$$F_d = 1.4G + 1.6Q$$

$$F_d = G + Q + 0.2S + E_d^{(H)} + 0.3E_d^{(Z)}$$

$$F_d = 0.9G + H + E_d^{(H)} - 0.3E_d^{(Z)}$$

$$E_d^{(Z)} \approx (2/3)S_{DS}G$$

$$E_d^{(H)} = \pm E_d^{(X)} \pm 0.3E_d^{(Y)}$$

$$E_d^{(H)} = +E_d^{(X)} + 0.3E_d^{(Y)}$$

$$E_d^{(H)} = +E_d^{(X)} - 0.3E_d^{(Y)}$$

$$E_d^{(H)} = -E_d^{(X)} + 0.3E_d^{(Y)}$$

$$E_d^{(H)} = -E_d^{(X)} - 0.3E_d^{(Y)}$$

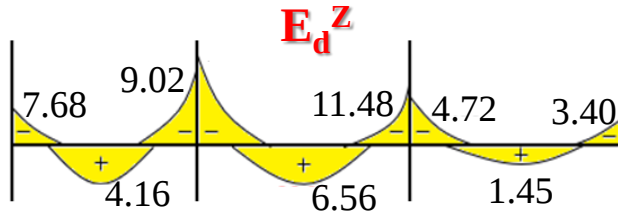
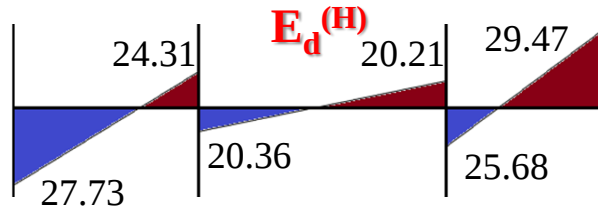
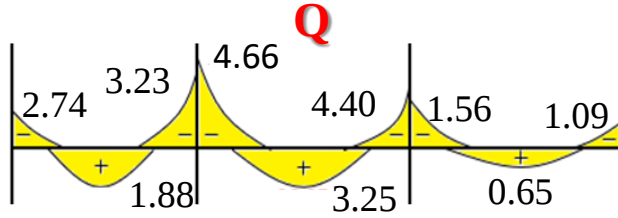
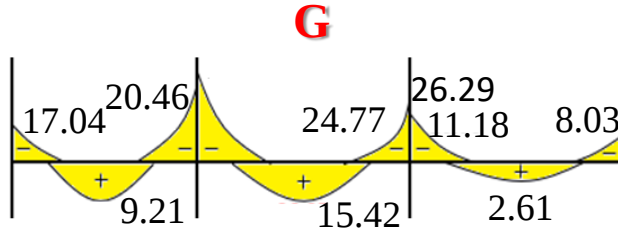
$$E_d^{(H)} = \pm 0.3E_d^{(X)} \pm E_d^{(Y)}$$

$$E_d^{(H)} = +0.3E_d^{(X)} + E_d^{(Y)}$$

$$E_d^{(H)} = +0.3E_d^{(X)} - E_d^{(Y)}$$

$$E_d^{(H)} = -0.3E_d^{(X)} + E_d^{(Y)}$$

$$E_d^{(H)} = -0.3E_d^{(X)} - E_d^{(Y)}$$



3A Mesnet Momenti

$$M_d = 1.4M_G + 1.6M_Q = 1.4 \times (-17.04) + 1.6 \times (-2.74) = -28.24 \text{ kNm}$$

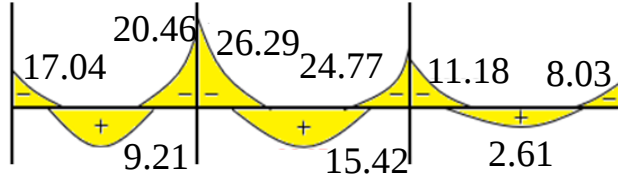
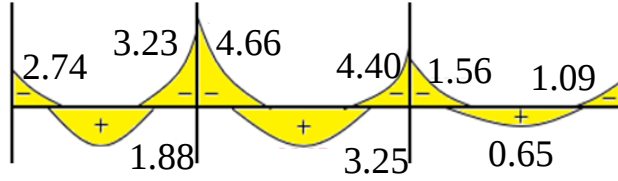
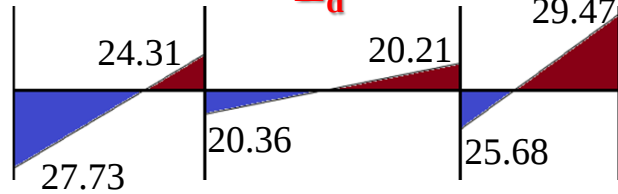
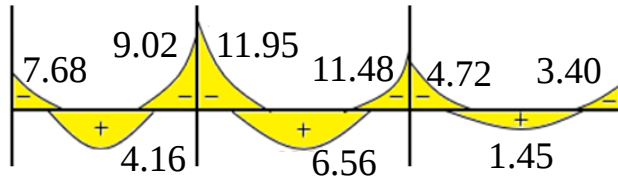
$$\begin{aligned} M_d &= M_G + M_Q + M_{E_d^{(X)}} + 0.3M_{E_d^{(Z)}} \\ &= -17.04 + (-2.74) + 27.73 + 0.3 \times (-7.68) = 5.65 \text{ kNm} \end{aligned}$$

$$\begin{aligned} M_d &= M_G + M_Q - M_{E_d^{(X)}} + 0.3M_{E_d^{(Z)}} \\ &= -17.04 + (-2.74) - 27.73 + 0.3 \times (-7.68) = -49.81 \text{ kNm} \end{aligned}$$

$$\begin{aligned} M_d &= 0.9M_G + M_{E_d^{(X)}} - 0.3M_{E_d^{(Z)}} \\ &= 0.9 \times (-17.04) + (27.73) - 0.3 \times (-7.68) = 14.7 \text{ kNm} \end{aligned}$$

$$\begin{aligned} M_d &= 0.9M_G - M_{E_d^{(X)}} - 0.3M_{E_d^{(Z)}} \\ &= 0.9 \times (-17.04) - (27.73) - 0.3 \times (-7.68) = -40.8 \text{ kNm} \end{aligned}$$

Bu mesnette +14.7 kNm için hesaplanan donatı kirişin alt tarafında, -49.81 kNm için hesaplanan donatı da kirişin üst tarafında bulunmalıdır.

G**Q****E_d^(H)****E_d^Z**

K104 Açıklık Momenti

$$M_d = 1.4M_G + 1.6M_Q = 1.4 \times (9.21) + 1.6 \times (1.88) = \mathbf{15.90 \text{ kNm}}$$

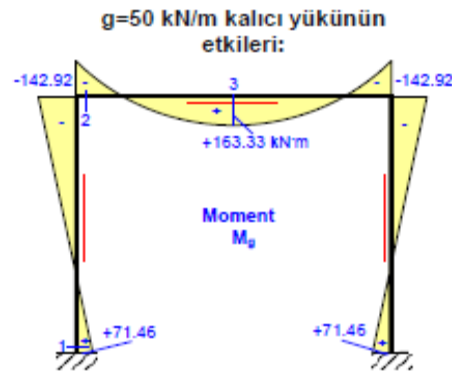
$$\begin{aligned} M_d &= M_G + M_Q + M_{E_d^{(x)}} + 0.3M_{E_d^{(z)}} \\ &= 9.21 + 1.88 + 0 + 0.3 \times 4.16 = 12.34 \text{ kNm} \end{aligned}$$

$$\begin{aligned} M_d &= M_G + M_Q - M_{E_d^{(x)}} + 0.3M_{E_d^{(z)}} \\ &= 9.21 + 1.88 - 0 + 0.3 \times 4.16 = 12.34 \text{ kNm} \end{aligned}$$

$$\begin{aligned} M_d &= 0.9M_G + M_{E_d^{(x)}} - 0.3M_{E_d^{(z)}} \\ &= 0.9 \times 9.21 + 0 - 0.3 \times 4.16 = 7.04 \text{ kNm} \end{aligned}$$

$$\begin{aligned} M_d &= 0.9M_G - M_{E_d^{(x)}} - 0.3M_{E_d^{(z)}} \\ &= 0.9 \times 9.21 - 0 - 0.3 \times 4.16 = 7.04 \text{ kNm} \end{aligned}$$

K104 kirişinin açıklığında +15.90 kNm için hesaplanan donatı kirişin alt tarafına konmalıdır. Üst tarafa donatı gerekmez ancak minimum montaj donatısı konmalıdır.



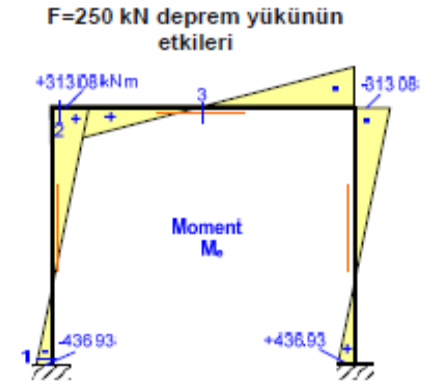
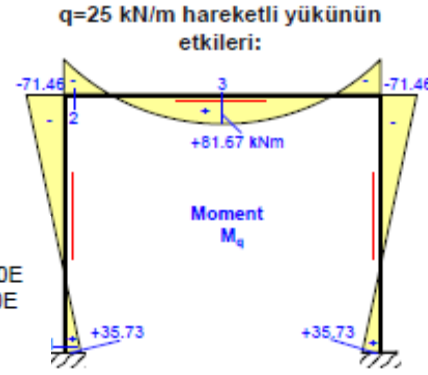
$$F_d = 1.4G + 1.6Q$$

$$F_d = 1.0G + 1.0Q + 1.0E$$

$$F_d = 1.0G + 1.0Q - 1.0E$$

$$F_d = 0.9G + 1.0E$$

$$F_d = 0.9G - 1.0E$$



a) Tasarım momentleri:

1 noktasında tasarım momentleri:

$$M_d = 1.4 \cdot 71.46 + 1.6 \cdot 35.73 = +157.21 \text{ kN-m}$$

$$M_d = 71.46 + 35.73 + (-436.93) = -329.74 \text{ "}$$

$$M_d = 71.46 + 35.73 - (-436.93) = +544.12 \text{ "}$$

$$M_d = 0.9 \cdot 71.46 + (-436.93) = -372.62 \text{ "}$$

$$M_d = 0.9 \cdot 71.46 - (-436.93) = +501.24 \text{ "}$$

2 noktasında tasarım momentleri:

$$M_d = 1.4 \cdot (-142.92) + 1.6 \cdot (-71.46) = -314.42 \text{ kN-m}$$

$$M_d = -142.92 - 71.46 + 313.08 = +98.70 \text{ "}$$

$$M_d = -142.92 - 71.46 - 313.08 = -527.46 \text{ "}$$

$$M_d = 0.9 \cdot (-142.92) + 313.08 = +184.45 \text{ "}$$

$$M_d = 0.9 \cdot (-142.92) - 313.08 = -441.71 \text{ "}$$

3 noktasında tasarım momentleri:

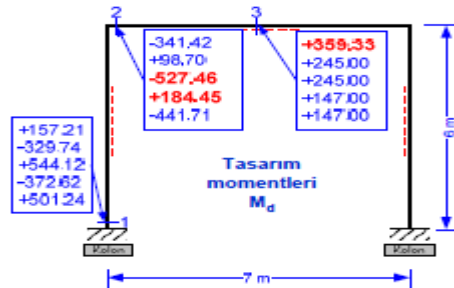
$$M_d = 1.4 \cdot 163.33 + 1.6 \cdot 81.67 = +359.33 \text{ kN-m}$$

$$M_d = 163.33 + 81.67 + 0 = +245.00 \text{ "}$$

$$M_d = 163.33 + 81.67 - 0 = +245.00 \text{ "}$$

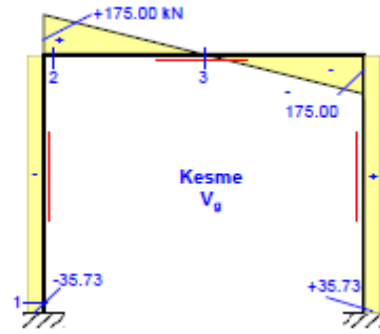
$$M_d = 0.9 \cdot 163.33 + 0 = +147.00 \text{ "}$$

$$M_d = 0.9 \cdot 163.33 - 0 = +147.00 \text{ "}$$

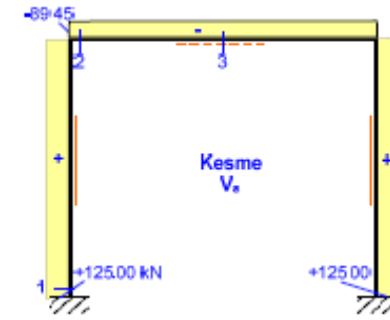
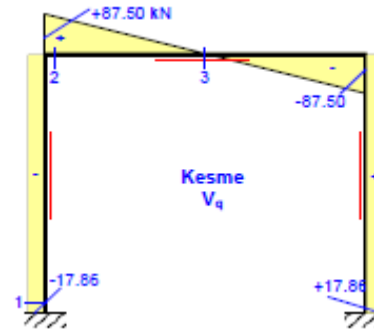


2 noktasında: Bu noktada $M_d = +184.45 \text{ kN-m}$ momenti için hesaplanan boyuna donatı kirişin **alt tarafına**; $M_d = -527.46 \text{ kN-m}$ için hesaplanan donatı da kirişin **üst tarafına** konmalıdır.

3 noktasında: Bu noktada $M_d = +359.33 \text{ kN-m}$ momenti için hesaplanan donatı kirişin **alt tarafına** konmalıdır. Bu noktada negatif moment olmadığından **üst tarafa donatı gerekmez**, momentin oluşturacağı basınç kuvvetini beton alır. Ancak, yönetmeliklerin ön gördüğü kadar **minimum montaj donatısı konulmalıdır**.



$$\begin{aligned} F_d &= 1.4G + 1.6Q \\ F_d &= 1.0G + 1.0Q + 1.0E \\ F_d &= 1.0G + 1.0Q - 1.0E \\ F_d &= 0.9G + 1.0E \\ F_d &= 0.9G - 1.0E \end{aligned}$$



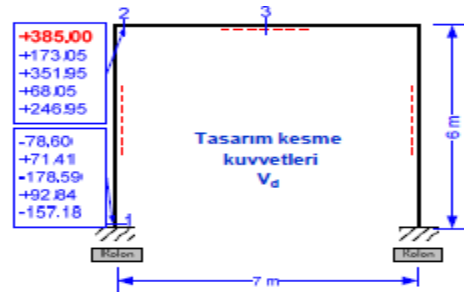
b) Tasarım kesme kuvvetleri:

1 noktasında tasarım kesme kuvvetleri:

$$\begin{aligned} V_d &= 1.4 \cdot (-35.73) + 1.6 \cdot (-17.86) = -78.60 \text{ kN} \\ V_d &= -35.73 - 17.86 + 125.00 = +71.41 \text{ " } \\ V_d &= -35.73 - 17.86 - 125.00 = -178.59 \text{ " } \\ V_d &= 0.9 \cdot (-35.73) + 125.00 = +92.84 \text{ " } \\ V_d &= 0.9 \cdot (-35.73) - 125.00 = -157.16 \text{ " } \end{aligned}$$

2 noktasında tasarım kesme kuvvetleri:

$$\begin{aligned} V_d &= 1.4 \cdot 175.00 + 1.6 \cdot 87.50 = +385.00 \text{ kN} \\ V_d &= 175.00 + 87.50 + (-89.45) = +173.05 \text{ " } \\ V_d &= 175.00 + 87.50 - (-89.45) = +351.95 \text{ " } \\ V_d &= 0.9 \cdot 175.00 + (-89.45) = +68.05 \text{ " } \\ V_d &= 0.9 \cdot 175.00 - (-89.45) = +246.95 \text{ " } \end{aligned}$$



Kesme kuvvetinin işareti betonarme hesabın sonucunu değiştirmez. Mutlak değerce en büyük kesme kuvveti betonarme hesaba esas alınır.

2 noktasında: $V_d = +385.00$ kN kesme kuvveti betonarme hesaba (sargı donatısı hesabına) esas alınmalıdır.