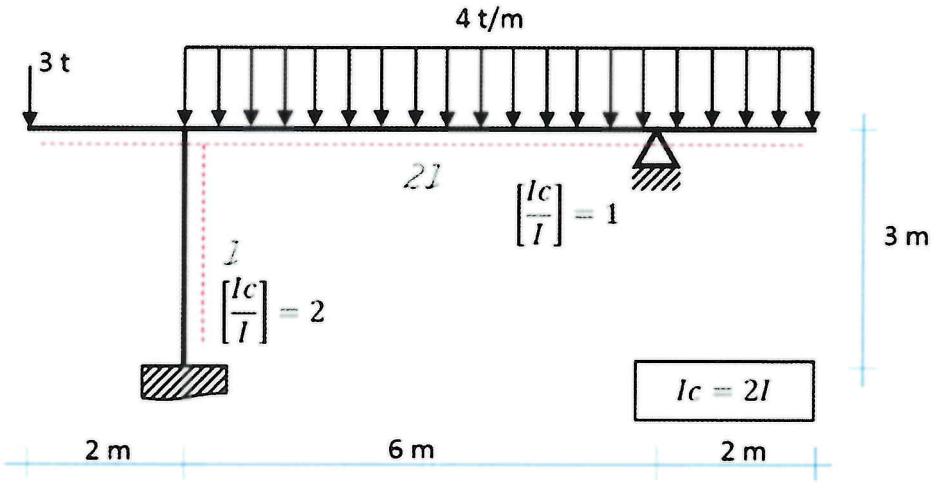
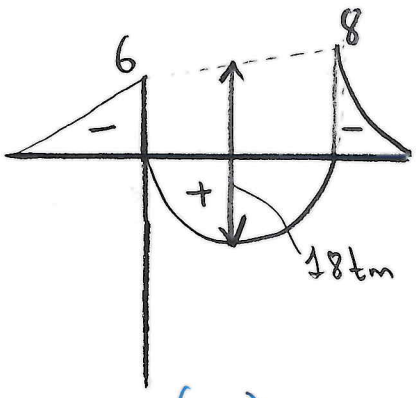
BİLECİK ŞEYH EDEBALİ ÜNİVERSİTESİ
MÜHENDİSLİK FAKÜLTESİ
İNŞAAT MÜHENDSİLĞİ BÖLÜMÜ

İNM 302 YAPI STATİĞİ II

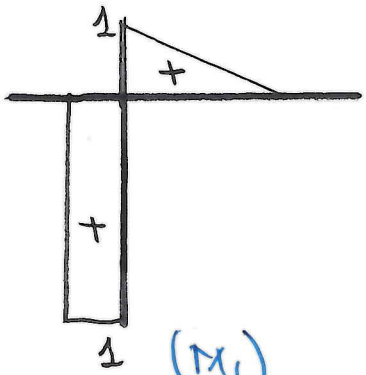
ARA SINAV SORULARI

1. Şekilde verilen hiperstatik sistemin; Kesme kuvveti (T) ve eğilme momenti (M) diyagramlarını çiziniz.

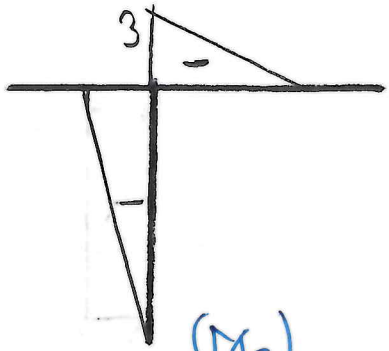




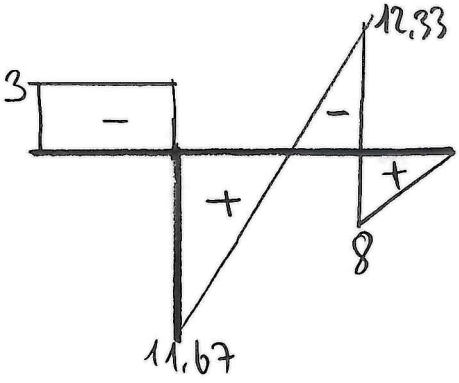
(M_0)



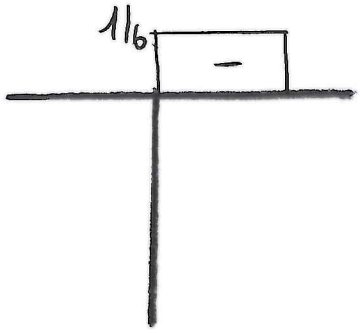
(M_1)



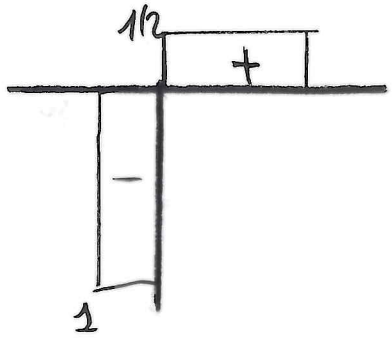
(M_2)



(T_0)

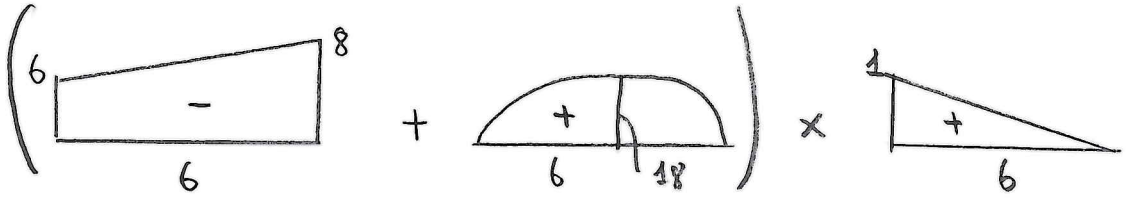


(T_1)



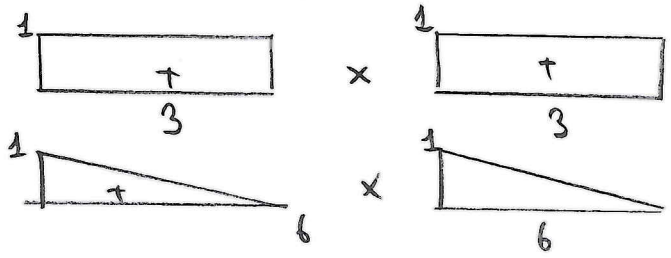
(T_2)

M_0 ve M_1 diyagramları çarpılır.



$$\frac{1}{2}\left[-\frac{1}{6}\,6(1)\left[2(6)+8\right]+\frac{1}{3}.6.(18).1\right]=EI\,\delta_{10} \qquad EI_c\,\delta_{10}=8$$

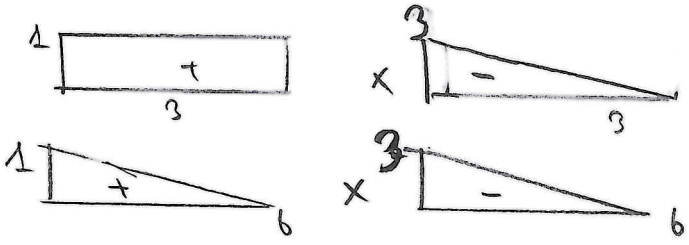
M_1 ve M_1 diyagramları çarpılır.



$$3.(1)(1)+\frac{1}{3}6.(1)(1).\frac{1}{2}=EI\,\delta_{11}$$

$$EI\,\delta_{11}=4$$

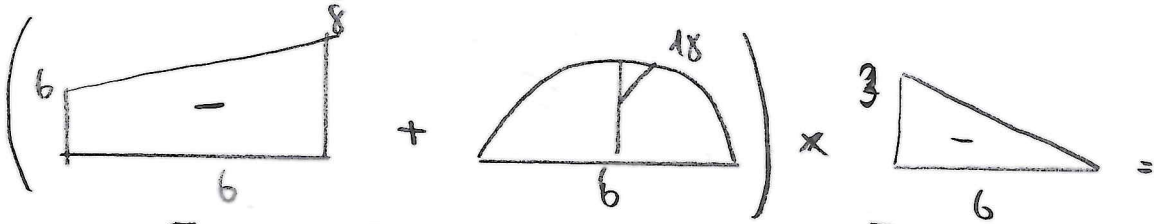
M_1 ve M_2 diyagramları çarpılır.



$$\frac{1}{2}-3(1).(3)-\frac{1}{3}.6.(1).(3).\frac{1}{2}=EI\delta_{12}$$

$$EI\,\delta_{12}=-7{,}5$$

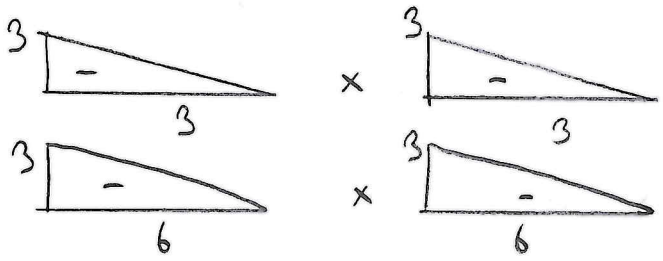
M_0 ve M_2 diyagramları çarpılır



$$\frac{1}{2}\left[\frac{1}{6}\,6(3)\left[2(6)+8\right]-\frac{1}{3}\,6(18)(3)\right]=EI_c\,\delta_{20}$$

$$EI_c\,\delta_{20}=-24$$

M_2 ve M_1 diyagramları çarpılır:



$$\frac{1}{3} \cdot 6.(3).(3).\frac{1}{2} + \frac{1}{3}\,3.3.3 = E\,I\,\delta_{22}$$

$$EI\delta_{22} = 18$$

$$EI\,\delta_{11}X_1 + EI\,\delta_{12}X_2 + EI\delta_{10} = 0$$
$$EI\,\delta_{21}X_1 + EI\,\delta_{22}X_2 + EI\delta_{20} = 0$$

$$4X_1 - 7.5X_2 = -8$$
$$-7.5X_1 + 18X_2 = 24$$

$$30X_1 - 56.25X_2 = -60$$
$$-30X_1 + 72X_2 = 96$$

$$15.75X_2 = 36 \qquad X_2 = 2.28 \approx 2.3$$

$$X_1 = 2.28 \approx 2.3$$

$M_a = 0 + 1.(2,3) + 0 = 2,3$ tm

$M_b = 0 + 1.(2,3) - 3.(2,3 = -4.6$ tm

$M_c = -6 + 0 + 0 = -6$ tm

$M_d = -6 + 1(2,3) - 3(2,3) = -10,6$ tm

$M_e = -8 + 0 + 0 = -8$ tm

$M_f = -8 + 0 + 0 = -8$ tm

$T_a = 0 + 0 - 1(2,3) = -2,3$ t

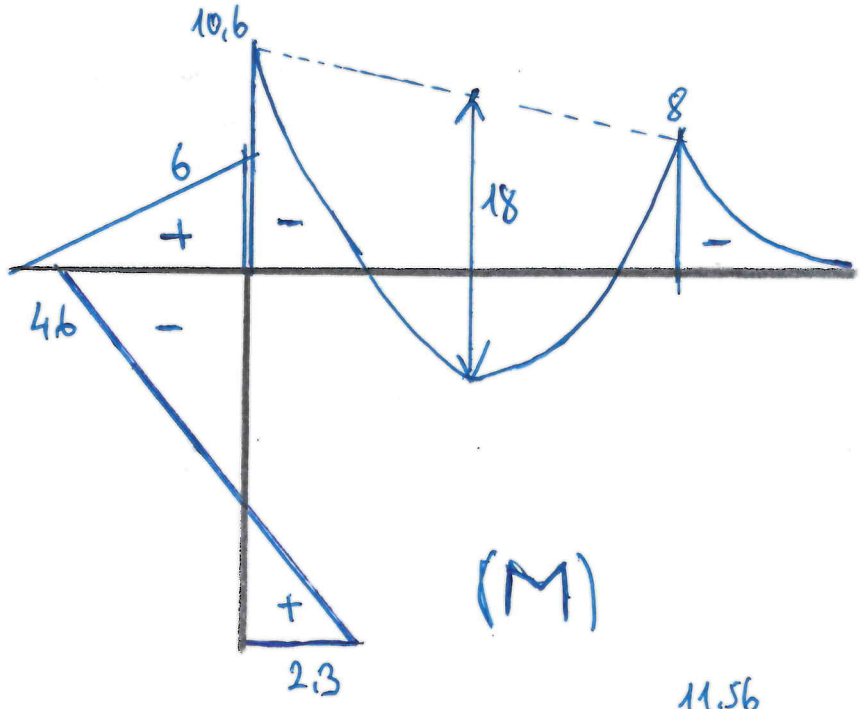
$T_b = 0 + 0 - 1(2,3) = -2,3$ t

$T_c = -3 + 0 + 0 = -3$ t

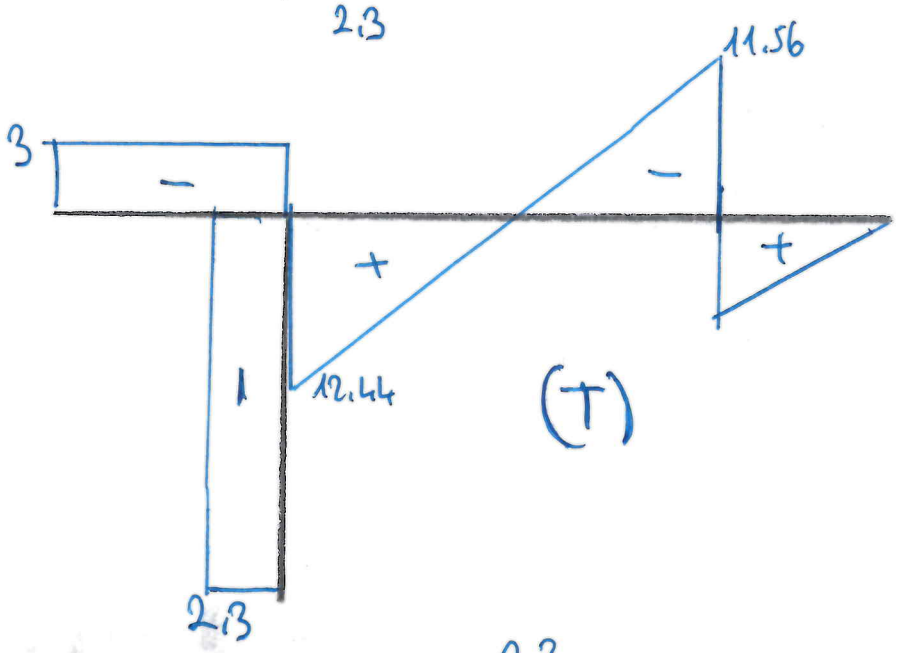
$T_d = 11,67 - 1/6(2,3) + 1/2(2,3) = 12,44$ t

$T_e = -12,33 - 1/6(2,3) + 1/2(2,3) = -11,56$ t

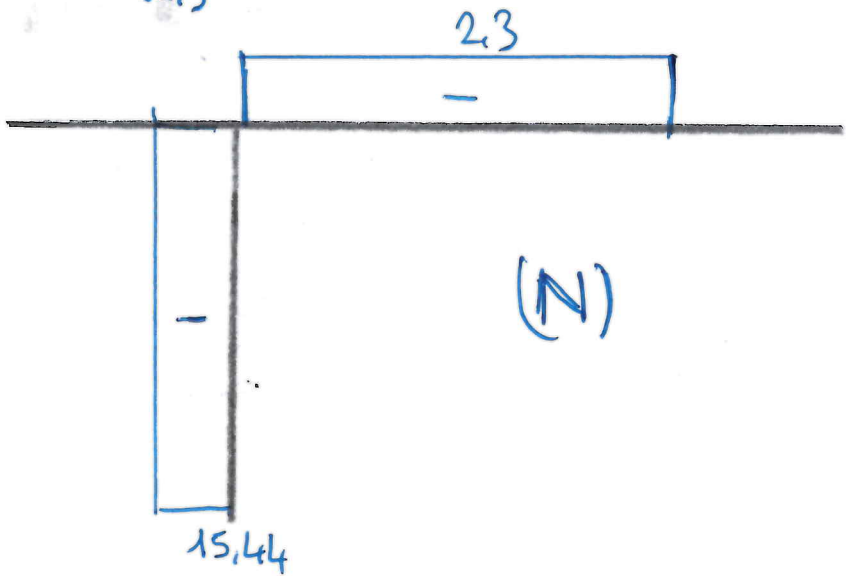
$T_f = 8 + 0 + 0 = 8$ t



(M)

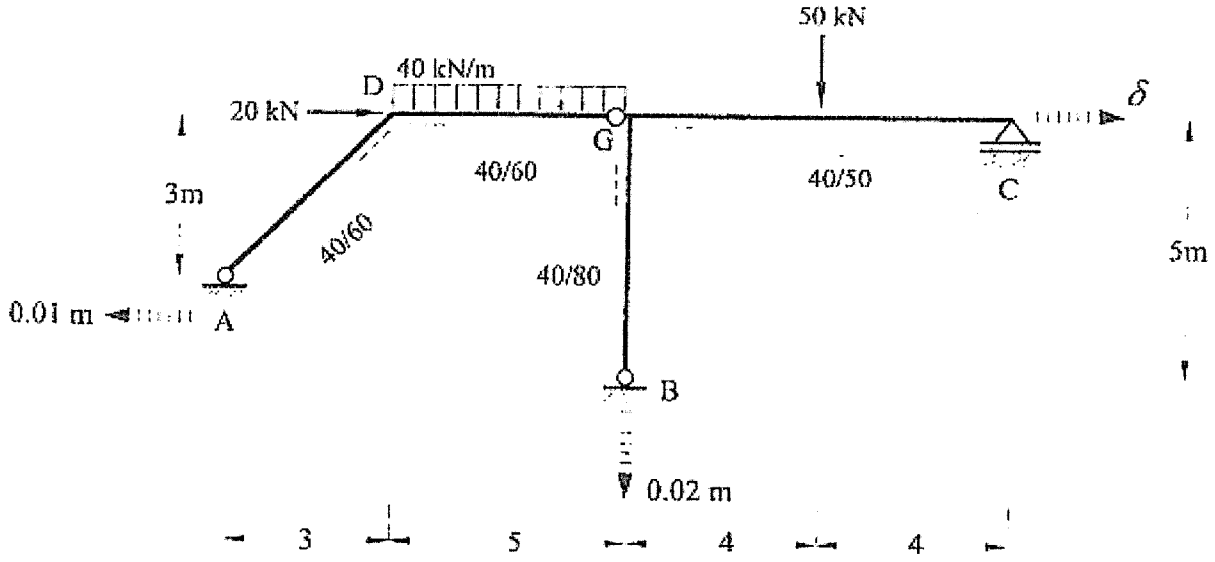


(T)



(N)

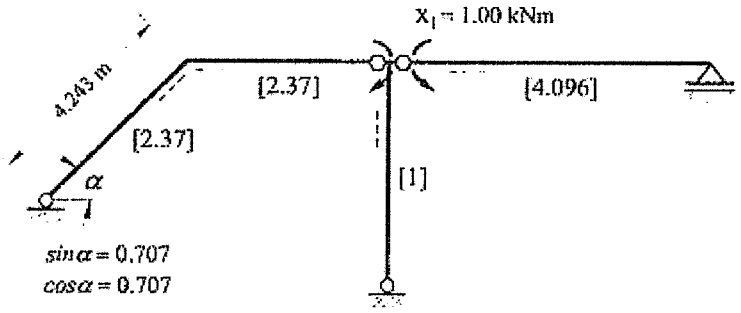
2. Dış etkileri ve geometrisi aşağıda tanımlanan sistemin, verilen dış yükler için M diyagramını çiziniz.



Sistemi oluşturan çubukların enkesit boyutları aşağıdaki tabl

Çubuk	b [cm]	d [cm]	I [cm^4]	
A-D / D-G	40	60	720000	**1.728 I**
G-B	40	80	1706666.667	**4.096 I**
G-C	40	50	416666.667	**I**

Seçilen izostatik esas sistem, hiperstatik bilinmeyenler ve $[I_c/I]$ oranları;



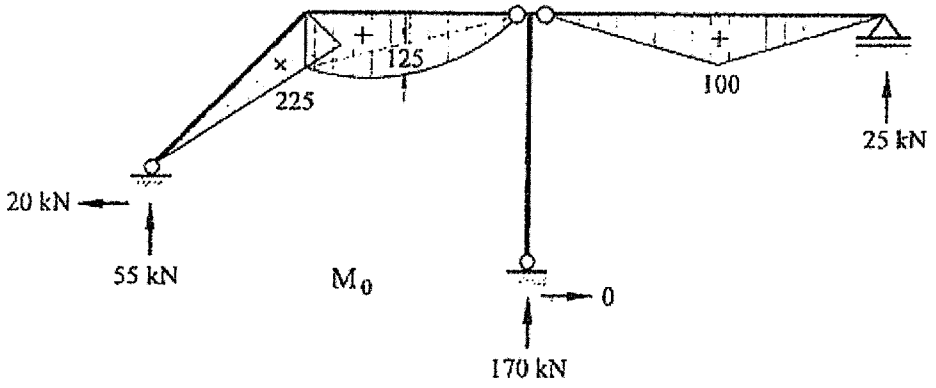
$[I_c/I]$
izostatik esas sistem

$$I_c = 4.096I$$

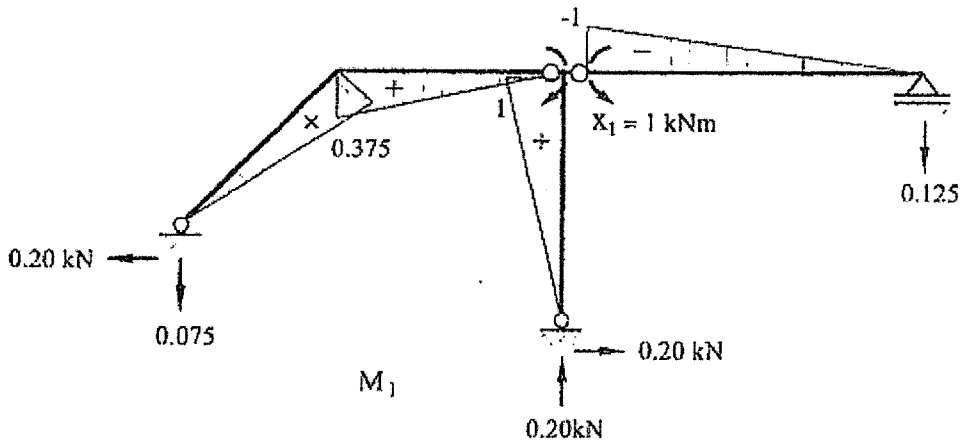
$$EI_c = 30250000 \times 4.096 \times 0.0041666 = 516258.406\ kNm^2$$

a. Dış yükler için çözüm;

$X = 0$ yüklemesi, M_0 diyagramı



$X_1 = 1$ yüklemesi, M_1 diyagramı;



$EI_c\delta_{11}$ ve $EI_c\delta_{10}$ terimlerinin hesabı;

$$EI_c\delta_{11} = \frac{1}{3}\times 4.243\times 0.375\times 0.375\times[2.37] + \frac{1}{3}\times 5\times 0.375\times 0.375\times[2.37] + \frac{1}{3}\times 5\times 1\times 1\times[1] + ...$$

$$.....+\frac{1}{3}\times 8\times(-1)\times(-1)\times[4.096] = 13.616$$

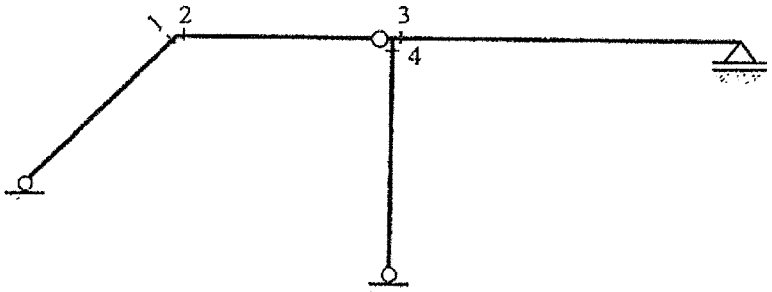
$$EI_c\delta_{10} = \frac{1}{3}\times 4.243\times 0.375\times 225\times[2.37] + \frac{1}{3}\times 5\times 0.375\times 225\times[2.37] + \frac{1}{3}\times 5\times 0.375\times 125\times[2.37] + ...$$

$$.....+\frac{1}{6}\times 8\times(-1)\times 1.5\times 100\times[4.096] = -17.940$$

Süreklilik denklemi;

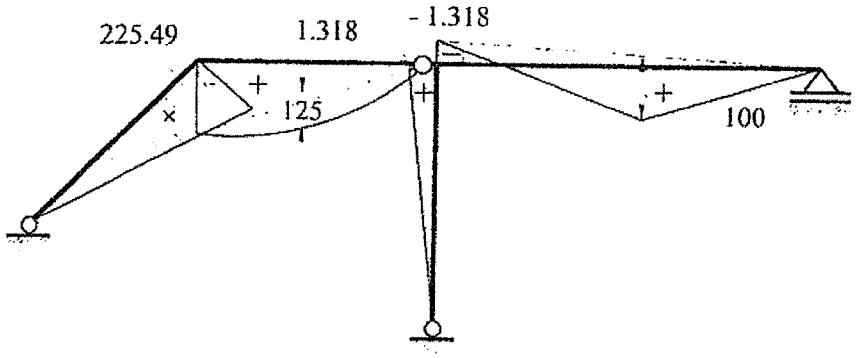
$$EI_c\delta_{11}X_1 + EI_c\delta_{10} = 0 \;\Rightarrow\; 13.616X_1 - 17.940 = 0 \;\Rightarrow\; X_1 = 1.318\ kNm$$

Süperpozisyon ve M diyagramı;



$$M^i = M_0^i + M_1^i X_1 .....(i = 1,2,3,4)$$

$M^1 = 225 + 0.375$ x $(1.318) = 225.49\ kNm$
$M^2 = 225.49\ kNm$
$M^3 = 0 - 1$ x $(1.318) = -1.318\ kNm$
$M^4 = 0 + 1$ x $(1.318) = 1.318\ kNm$



M *(dış yük)*
[kNm]