

**O'ZBEKISTON RESPUBLIKASI OLIY VA O'RTA
MAXSUS TA'LIM VAZIRLIGI
ANDIJON MASHINASOZLIK INSTITUTI**



“ _____ ”

FAKULTETI

“ _____ ”

KAFEDRASI

“ _____ ”

YO'NALISHI

“ _____ ” **KURS “ _____ ”- GURUH TALABASI**
NING

“ _____ ”

**FANIDAN
TAYYORLAGAN**

MUSTAQIL ISHI

MAVZU: _____

TEKSHIRDI: _____

ANDIJON 2015

Mustaqil ish masalalari

1-MASALA YECHIMI

Bir uchi bilan qistirib mahkamlangan po`lat sterjen 1-shaklda ko`rsatilganidek yuklangan. Bunda:

$$F_1 = 2,0 \text{ T} = 20 \text{ kn},$$

$$F_2 = 4,0 \text{ T} = 40 \text{ kn},$$

$$A_1 = 1,0 \text{ cm}^2 = 1,0 \cdot 10^{-4} \text{ m}^2,$$

$$A_2 = 1,8 \text{ cm}^2 = 1,8 \cdot 10^{-4} \text{ m}^2,$$

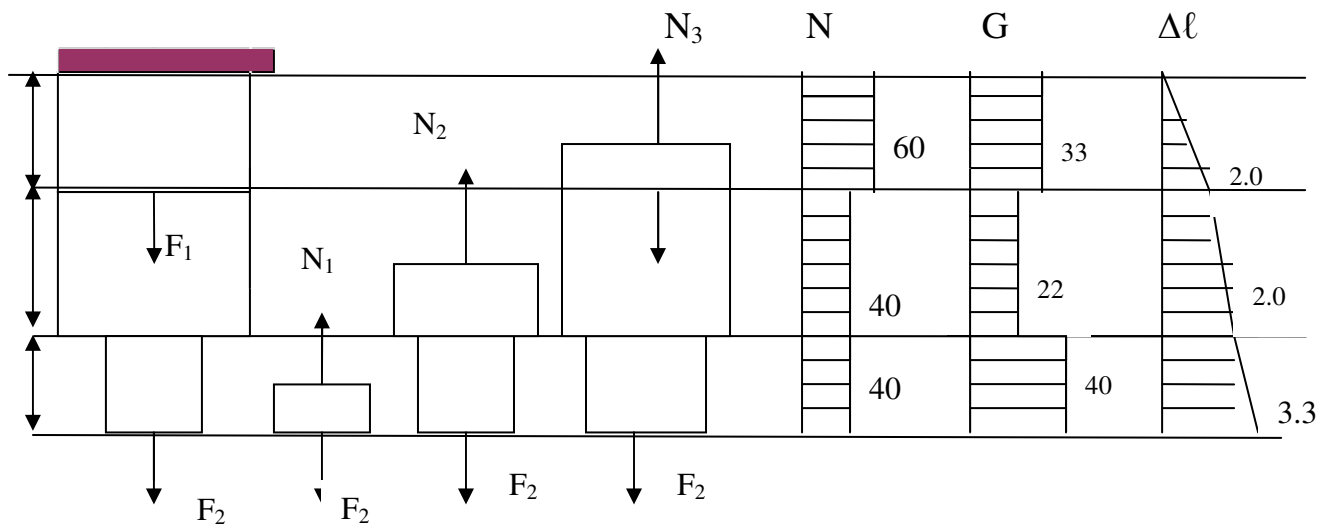
$$a = 2 \text{ m},$$

$$b = 1,8 \text{ m},$$

$$c = 1 \text{ m}$$

Kesimlardagi bo`ylama kuch, kuchlanish hamda kesim uchining absolyut deformatsiyasi epyurasi yasalsin.

Qirqish usuliga binoan kesimlar alohida ko`riladi.



1. Bo`ylama kuch «N»ni aniqlaymiz.

I-I kesim uchun

$$N_1 - F_2 = 0$$

$$N_1 = F_2 = 40 \text{ kn}$$

II-II kesim uchun

$$N_2 - F_2 = 0$$

$$N_2 = F_2 = 40 \text{ kn}$$

III-III kesim uchun

$$N_3 - F_1 - F_2 = 0$$

$$N_3 = 60 \text{ kn}$$

2. Kuchlanishlarni « σ » aniqlaymiz $\sigma = \frac{N}{A}$

$$\sigma_1 = \frac{N_1}{A_1} = \frac{40}{0,01} = 40 \cdot 10^{-3} \text{ } \kappa \text{H} / \text{ } \mathcal{M}^2$$

$$\sigma_2 = \frac{N_2}{A_2} = \frac{40}{0,018} = 2222 \text{ } \kappa \text{H} / \text{ } \mathcal{M}^2$$

$$\sigma_3 = \frac{N_3}{A_2} = \frac{60}{0,018} = 3333 \text{ } \kappa \text{H} / \text{ } \mathcal{M}^2$$

3. Deformatsiya « $\Delta \ell$ » topiladi. $\Delta \ell = \frac{N \cdot \ell}{E \cdot A}$

$$\Delta \ell_1 = \frac{N_1 \cdot c}{E \cdot A_1} = \frac{40 \cdot 1}{2 \cdot 10^8 \cdot 0,01} = 2 \cdot 10^{-5} \text{ } \mathcal{M}$$

$$\Delta \ell_2 = \frac{N_2 \cdot c}{E \cdot A_2} = \frac{40 \cdot 1,8}{2 \cdot 10^8 \cdot 0,018} = 2 \cdot 10^{-5} \text{ } \mathcal{M}$$

$$\Delta \ell_3 = \frac{N_3 \cdot a}{E \cdot A_2} = \frac{60 \cdot 2}{2 \cdot 10^8 \cdot 0,018} = 3,3 \cdot 10^{-5} \text{ } \mathcal{M}$$

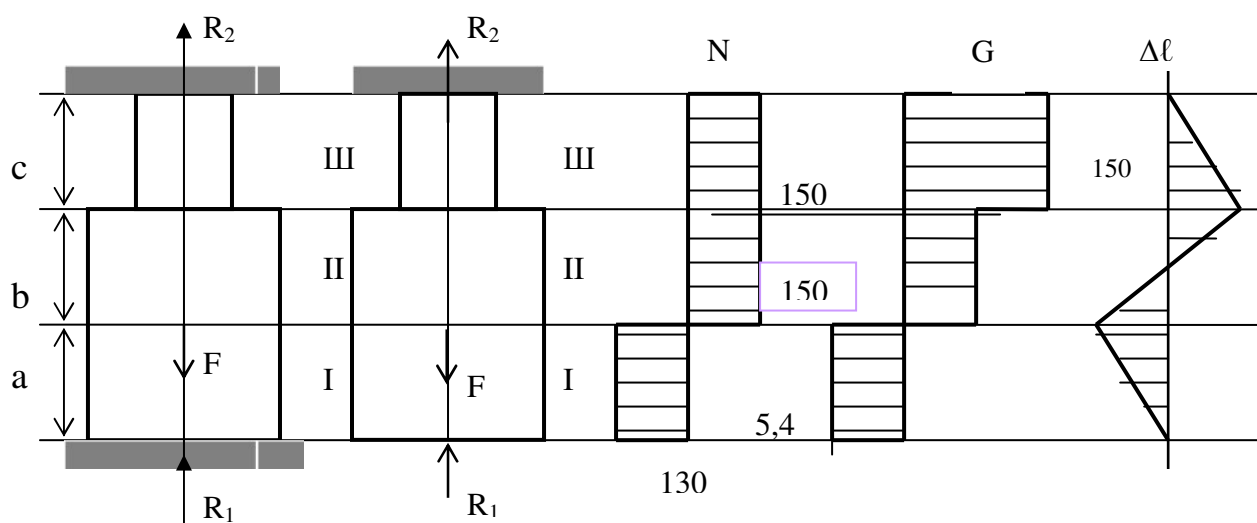
2- MASALA YECHIMI

STATIK NOANIQ MASALA.

Statikaning muvozanat tenglamalari yordamida aniqlab bo'lmaydigan masalalarga statik noaniq masalalar deyiladi.

1) Masala bir marta statik aniqlamas, chunki hamma aktiv va reaktiv kuchlar sterjenning markaziy o'qi bo'ylab ta'sir etadi. Shuning uchun statikaning bitta muvozanat tenglamasiga ko'shimcha tenglama tuziladi. Buning uchun quyidagi usul bo'yicha hisob sxemasi tuziladi.

- sterjen quyi chegarasidagi qo'zg'almas boglanish olib tashlanadi;
- olib tashlangan bog'lanishning ta'siri noma'lum reaktiv kuch R_1 , bilan almashtiriladi.



Berilgan: $F=280 \text{ kH}$,
 $A_1=14 \cdot 10^{-4} \text{ m}$
 $A_2=28 \cdot 10^{-4} \text{ m}$,
 $a=1,5 \text{ m}$,
 $b=0,6 \text{ m}$,
 $c=0,4 \text{ m}$

Echish: Statikaning muvozanat tenglamasini tuzamiz

$$1. \sum X = 0; \quad R_1 - F + R_2 = 0; \quad \Delta \ell = 0; \quad \Delta \ell = \Delta \ell_{R_1} + \Delta \ell_F = 0$$

$$\Delta \ell_{R_1} = -\frac{R_1 \cdot a}{E \cdot A_2} + \frac{F \cdot C}{E \cdot A_2} - \frac{R_1 C}{EA_1}$$

$$\Delta \ell_F = \frac{F \cdot b}{E \cdot A_2} + \frac{F \cdot C}{EA_1}$$

$$\Delta \ell_{R_1} + \Delta \ell_F = -R_1 \left(\frac{a}{A_2} + \frac{b}{A_2} + \frac{c}{A_1} \right) + F \left(\frac{b}{A_2} + \frac{c}{A_1} \right) = 0$$

$$R_1 = \frac{F \left(\frac{b}{A_2} + \frac{c}{A_1} \right)}{\left(\frac{a}{A_2} + \frac{b}{A_2} + \frac{c}{A_1} \right)} = \frac{280 \left(\frac{0,6}{24} + \frac{0,4}{14} \right)}{\left(\frac{1,5}{24} + \frac{0,6}{24} + \frac{0,4}{14} \right)} = 130 kH$$

$$R_2 = F - R_1 = 150 kH$$

$$\begin{aligned} x=0 \quad N_1 + R_1 &= 0 \quad N_1 = -R_1 = -130 kH \quad G_1 = \frac{N_1}{A_2} = -5,4 \cdot 10^4 \frac{kH}{m^2} \\ \sum \Delta \ell_1 &= \frac{N_1 \cdot a}{E \cdot A_2} = -\frac{130 \cdot 1,5}{2 \cdot 10^8 \cdot 24 \cdot 10^{-4}} = -4,06 \cdot 10^{-4} m \end{aligned}$$

$$N_2 + R_1 - F = 0 \quad N_2 = F - R_1 = 150 kH \quad G_2 = \frac{N_2}{A_2} = 6,2 \cdot 10^4 \frac{kH}{m^2}$$

$$\Delta \ell_2 = \frac{N_2 \cdot b}{E \cdot A_2} = \frac{150 \cdot 0,6}{2 \cdot 24 \cdot 10^4} = 1,87 \cdot 10^{-4} m$$

$$N_3 + R_1 - F = 0 \quad N_3 = F - R_1 = 150 kH \quad G_3 = \frac{N_3}{A_1} = 10,7 \cdot 10^4 \frac{kH}{m^2}$$

$$\Delta \ell_3 = \frac{N_3 \cdot c}{E \cdot A_1} = \frac{150 \cdot 0,6}{2 \cdot 14 \cdot 10^4} = 2,14 \cdot 10^{-4} m$$

Tekshirish: $\Delta \ell = \Delta \ell_1 + \Delta \ell_2 + \Delta \ell_3 = 0$

3- MASALA YECHIMI.

Tekis kesimlarning geometrik xarakteristikalari *Reja.*

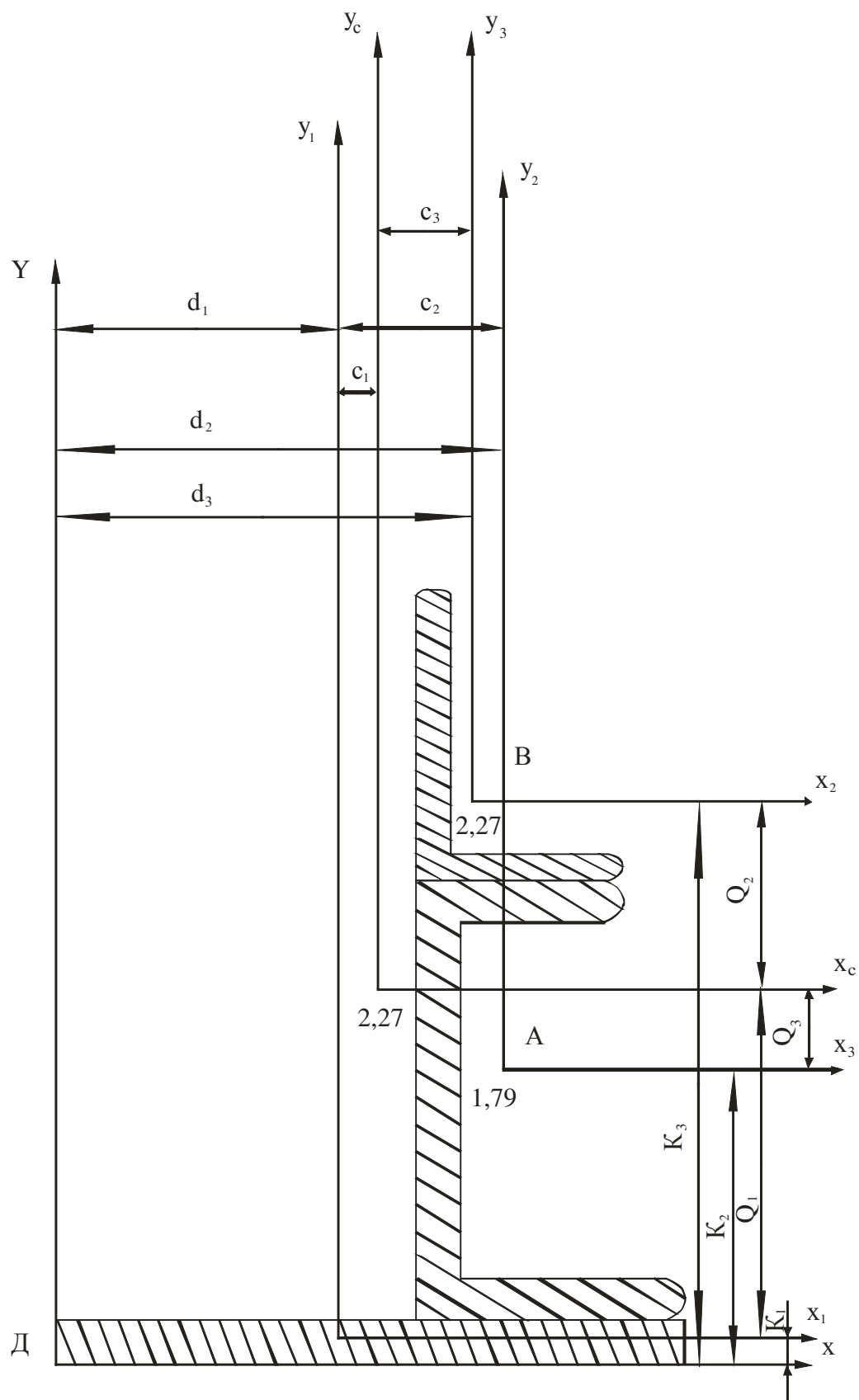
1. Og'irlik markazning koordinatalari topilsin.
2. Og'irlik markazi orqali o'tadigan Y_c va X_c o'qlarga nisbatan markazdan qochirma inertsia momentlari topilsin.
3. Bosh markaziy o'qlarga nisbatan inertsia markazning qiymati topilsin.
4. Tekshirish.

Berilgan: 80 x 80 x 8

Д  120 x 5
 $b_1 = 120 \text{ mm} = 12 \text{ sm}$
 $h_1 = 5 \text{ mm} = 0,5 \text{ sm}$
 $A_1 = b \cdot h = 6 \text{ sm}$
 $J_{x1} = 0,125 \text{ sm}^2$
 $J_{y1} = 72 \text{ sm}^4$

A [	$h_2 = 16 \text{ sm}$	$z_{02} = 1,79 \text{ sm}$
	$b_2 = 6,4 \text{ sm}$	$A_2 = 18 \text{ sm}^2$
	$d_2 = 0,5 \text{ mm}$	$J_{x2} = 741 \text{ sm}^4$
		$J_{y2} = 62,6 \text{ sm}^4$

B  80 x 80 x 8
 $A_3 = 12,3 \text{ sm}^2$
 $J_{x3} = 73,4 \text{ sm}^4$
 $J_{y3} = 137 \text{ sm}^4$
 $J_{x03} = 116 \text{ sm}^4$
 $J_{y03} = 30,3 \text{ sm}^4$
 $Z_{03} = 2,27 \text{ sm}$



$$d_1 = \frac{b}{2} = \frac{12}{2} = 6 \text{ cm}$$

$$K_1 = 0,25 \text{ cm}$$

$$d_2 = 6,27 \text{ cm}$$

$$K_2 = 5 + 16 + 2,27 = 23,27$$

$$d_3 = 5,79 \text{ cm}$$

$$K_3 = 13 \text{ cm}$$

$$2) \quad X_c = \frac{d_1 \cdot A_1 + d_2 \cdot A_2 + d_3 \cdot A_3}{A_1 + A_2 + A_3} = \frac{6 \cdot 6 + 6,27 \cdot 18 + 5,79 \cdot 12,3}{6 + 18 + 12,3} =$$

$$= \frac{220,077}{36,3} = 6,062$$

$$Y_c = \frac{k_1 \cdot A_1 + k_2 \cdot A_2 + k_3 \cdot A_3}{A_1 + A_2 + A_3} = \frac{0,25 \cdot 6 + 23,27 \cdot 18 + 13 \cdot 12,3}{6 + 18 + 12,3} = \frac{580,26}{36,3} =$$

$$= 15,98$$

$$c_1 = d_1 - x_c = -0,062 \quad a_1 = k_1 - y_c = -15,73$$

$$c_2 = d_2 - x_c = 0,208 \quad a_2 = k_2 - y_c = 7,29$$

$$c_3 = d_3 - x_c = -0,272 \quad a_3 = k_3 - y_c = -2,98$$

$$3) \quad J_{xc} = J_{x1} + c_1^2 A_1 + J_{x2} + c_2^2 A_2 + J_{x3} + c_3^2 A_3 =$$

$$= 0,125 + (-0,062)^2 \cdot 6 + 741 + 0,208^2 \cdot 18 + 73,4 +$$

$$+ (-0,272)^2 \cdot 12,3 = 816,237$$

$$J_{yc} = J_{y1} + a_1^2 A_1 + J_{y2} + a_2^2 A_2 + J_{y3} + a_3^2 A_3 =$$

$$= 72 + (-15,73)^2 \cdot 6 + 62,6 + 7,29^2 \cdot 18 + 137 +$$

$$+ (-2,98)^2 \cdot 12,3 = 2822$$

$$J_{xcyc} = J_{x1y1}^0 + a_1 c_1 A_1 + J_{x2y2}^0 + a_2 c_2 A_2 + J_{x3y3}^0 + a_3 c_3 A_3$$

$$J_{xcyc} = a_1 c_1 A_1 + a_2 c_2 A_2 + a_3 c_3 A_3 =$$

$$= (-15,73) \cdot (-0,062) \cdot 6 + 7,29 \cdot 0,208 \cdot 18 + (-2,98) \cdot (-0,272) \cdot 12,3 =$$

$$= 43,115$$

$$\operatorname{tg} 2\alpha = \frac{2 \cdot J_{xcyc}}{J_{xc} \cdot J_{yc}} = \frac{2 \cdot 43,115}{816,237 \cdot 2822} = 26712,522$$

$$J_{\max} = \frac{J_{xc} + J_{yc}}{2} + \sqrt{\left(\frac{J_{xc} - J_{yc}}{2}\right)^2 + J_{xcyc}}$$

$$J_{\max} = \frac{J_{xc} + J_{yc}}{2} + \sqrt{\left(\frac{J_{xc} - J_{yc}}{2}\right)^2 + J_{xcyc}} =$$

$$= \frac{816,237 + 2822}{2} + \sqrt{\left(\frac{816,237 - 2822}{2}\right)^2 + 43,115} = 2822,0214$$

$$J_{\min} = \frac{J_{xc} + J_{yc}}{2} - \sqrt{\left(\frac{J_{xc} - J_{yc}}{2}\right)^2 + J_{xcyc}} =$$

$$= \frac{816,237 + 2822}{2} - \sqrt{\left(\frac{816,237 - 2822}{2}\right)^2 + 43,115} = 816,2156$$

$$4) \quad J_{\min} + J_{\max} = Y_{xc} + Y_{yc}$$

$$J_{\min} + J_{\max} - Y_{xc} + Y_{yc} = 0$$

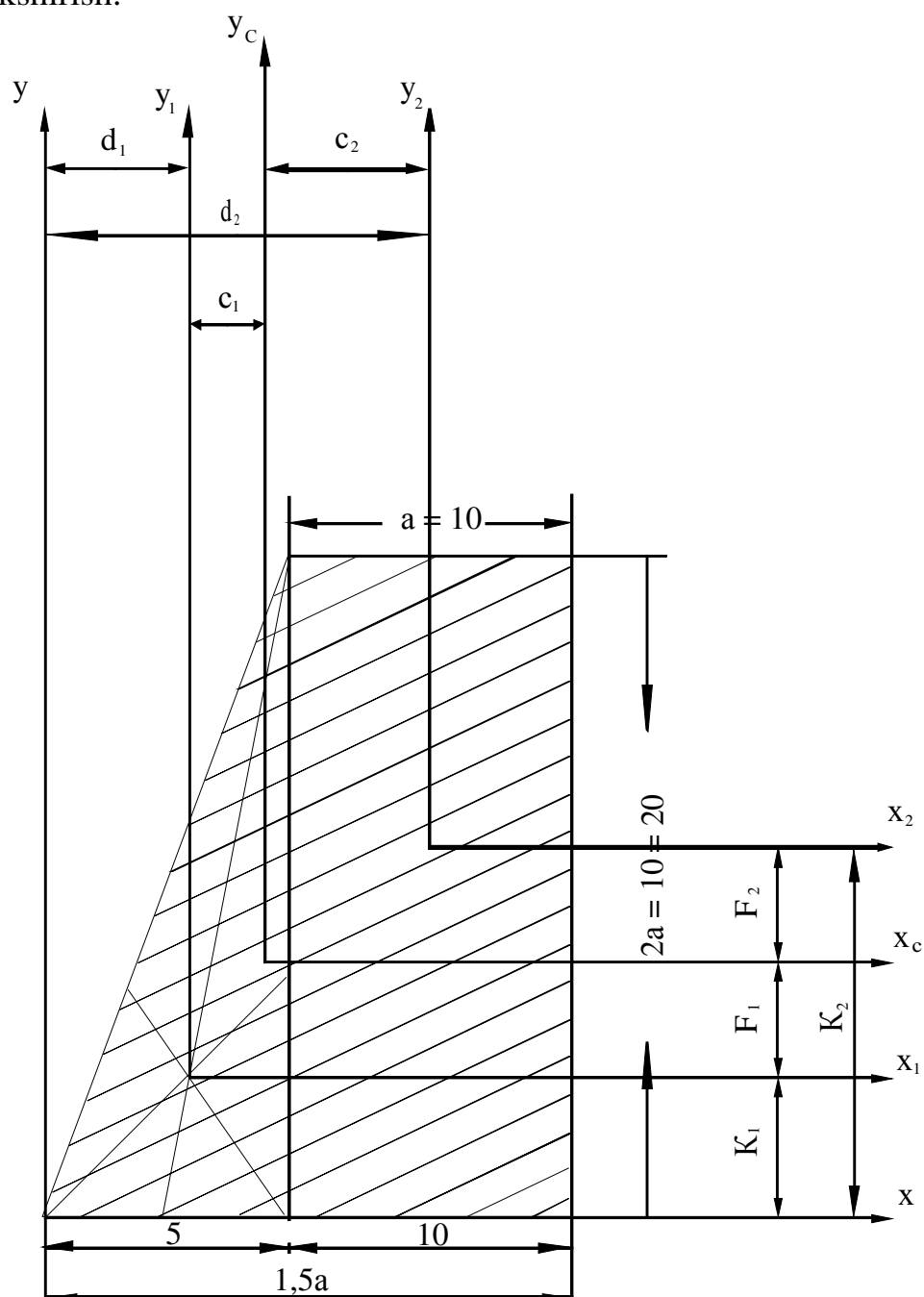
$$816,2156 + 2822,0214 - 816,237 - 2822 = 0$$

4 – MASALA YECHIMI

NOSIMMETRIK KESIM.

Reja:

1. Murakkab kesim uchun og'irlik markazi, koordinatalari aniqlansin.
2. Og'irlik markazi orqali o'tadigan x_s va y_s o'qlariga nisbatan markazdan qochirma inertsia momentlari topilsin.
3. Bosh markaziy inertsia o'qlarining vaziyati aniqlansin.
4. Bosh markaziy inertsia momentlari hisoblansin.
5. Tekshirish.



$$A_1 = bh = 5 \cdot 20 = 100$$

$$A_2 = \frac{10 \cdot 5}{2} = \frac{50}{2} = 25$$

$$J_{y1} = \frac{bh^3}{12} = \frac{5 \cdot 20^3}{12} = 3333,3$$

$$J_{x1} = \frac{bh^3}{12} = \frac{20 \cdot 5^3}{12} = 208,3$$

$$J_{y2} = \frac{bh^3}{36} = \frac{5 \cdot 20^3}{36} = 180$$

$$J_{x1} = \frac{bh^3}{12} = \frac{5 \cdot 20^3}{12} = 3333,3$$

$$\begin{aligned} d_1 &= 3,3 & k_1 &= 3,3 \\ d_2 &= 10 & k_2 &= 10 \end{aligned}$$

$$X_c = \frac{d_1 A_1 + d_2 A_2}{A_1 + A_2} = \frac{3,3 \cdot 100 + 10 \cdot 25}{100 + 25} = 4,64$$

$$Y_c = \frac{k_1 A_1 + k_2 A_2}{A_1 + A_2} = \frac{3,3 \cdot 100 + 10 \cdot 25}{100 + 25} = 4,64$$

$$c_1 = d_1 - x_c = 3,3 - 4,64 = -1,34$$

$$c_2 = d_2 - x_c = 10 - 4,64 = 5,36$$

$$F_1 = k_1 - y_c = 3,3 - 4,64 = -1,34$$

$$F_2 = k_2 - y_c = 10 - 4,64 = 5,36$$

$$J_{xc} = J_{x1} + c_1^2 A_1 + J_{x2} + c_2^2 A_2 = 208,3 + (-1,34)^2 \cdot 100 +$$

$$+ 3333,3 + 5,36^2 \cdot 25 = 4080,28$$

$$J_{yc} = J_{y1} + F_1^2 A_1 + J_{y2} + F_2^2 A_2 = 3333,3 + (-1,34)^2 \cdot 100 +$$

$$+ 180 + 5,36^2 \cdot 25 = 4051,98$$

$$J_{x1y1} = \frac{b^2 h^2}{72} = \frac{5^2 \cdot 20^2}{72} = 138,8$$

$$J_{xcyc} = J_{x1y1} + c_1 F_1 A_1 + J_{x2y2} + c_2 F_2 A_2 =$$

$$= 138,8 + (-1,34) \cdot (-1,34) \cdot 100 + 5,36 \cdot 25 = 1036,6$$

$$J_{\max} = \frac{J_{xc} + J_{yc}}{2} + \sqrt{\left(\frac{J_{xc} - J_{yc}}{2}\right)^2 + J_{xcyc}} =$$

$$= \frac{4080,28 + 4051,98}{2} + \sqrt{\left(\frac{4080,28 - 4051,98}{2}\right)^2 + 1036,6} = 4101,2984$$

$$J_{\min} = \frac{J_{xc} + J_{yc}}{2} - \sqrt{\left(\frac{J_{xc} - J_{yc}}{2}\right)^2 + J_{xcyc}} =$$

$$= \frac{4080,28 + 4051,98}{2} - \sqrt{\left(\frac{4080,28 - 4051,98}{2}\right)^2 + 1036,6} = 4030,9616$$

$$J_{\max} + J_{\min} = J_{xc} + J_{yc}$$

$$4101,2984 + 4030,9616 = 4080,28 + 4051,98$$

$$8132,26 = 8132,26$$