

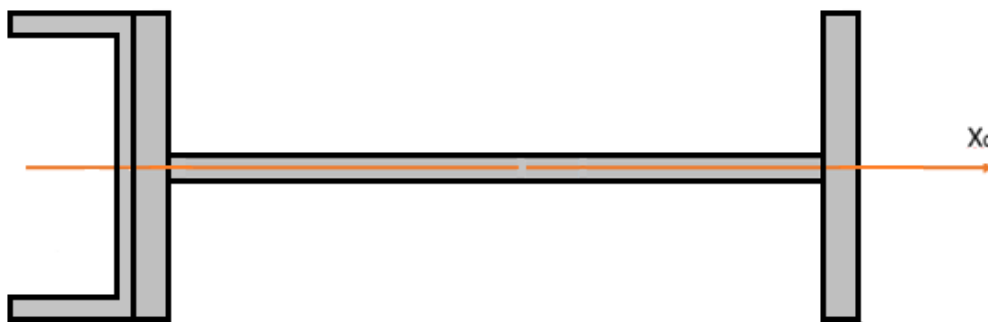
1-NAZORAT ISHI

NOSIMMETRIK KESIMLARNING INERSIYA MOMENTLARI

Berilgan metall ustunning murakkab kesimi uchun quyidagilarni bajarish talab etiladi (1-rasm):

- 1) Kesimning og'irlik markazi holati aniqlansin;
- 2) Nosimmetrik kesimning bosh markaziy o'qlarga nisbatan inersiya momentlari aniqlansin.

Hisoblash uchun berilgan ma'lumotlar: Shveller № 40Π; Qo'shtavr № 40K5.



1-rasm.

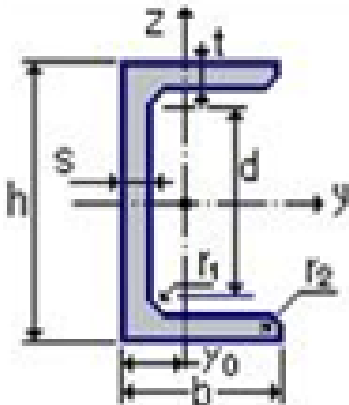
Masalani yechish

Murakkab shaklning o'g'irlik markazi holati uni oddiy shakllarga ajratilganda quyidagi formulalardan aniqlanadi:

$$\left\{ \begin{aligned} X_s &= \frac{\sum S_{iy}}{\sum A_i} = \frac{\sum A_i \cdot x_i}{\sum A_i} = \frac{A_1 \cdot x_1 + A_2 \cdot x_2 + \dots + A_n \cdot x_n}{A_1 + A_2 + \dots + A_n}; \\ Y_s &= \frac{\sum S_{ix}}{\sum A_i} = \frac{\sum A_i \cdot y_i}{\sum A_i} = \frac{A_1 \cdot y_1 + A_2 \cdot y_2 + \dots + A_n \cdot y_n}{A_1 + A_2 + \dots + A_n} \end{aligned} \right\} \quad (1)$$

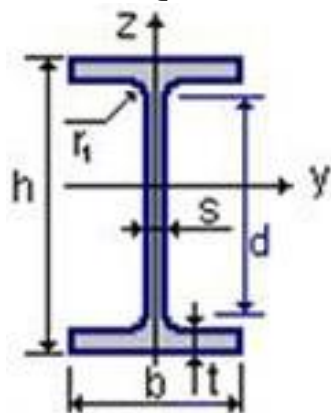
Bizning holda metall ustun ko'ndalang kesimi prokat shveller va qo'shtavr shakllardan topadi(2-rasm). Profillarga tegishlii goemetrik harakteristikalarini yozib olamiz.

1-shakl. Shveller № 40Π



$h = 400 \text{ mm}$
 $b = 115 \text{ mm}$
 $s = 8 \text{ mm}$
 $t = 13,5 \text{ mm}$
 $A_1 = 61,5 \text{ sm}^2$
 $I_z = I_{y_1} = 760 \text{ sm}^4$
 $I_y = I_{x_1} = 15620 \text{ sm}^4$
 $y_0 = 30,5 \text{ mm}$

2-shakl. Qo'shtavr № 40K5



$$\begin{aligned} h &= 431 \text{ mm} \\ b &= 400 \text{ mm} \\ s &= 23 \text{ mm} \\ t &= 35,5 \text{ mm} \\ A_2 &= 371 \text{ sm}^2 \\ I_y = I_{y_2} &= 121570 \text{ sm}^4 \\ I_z = I_{x_2} &= 37910 \text{ sm}^4 \end{aligned}$$

Bizning hol uchun (1) formulalar quyidagi ko'rinishni oladi(2-rasm):

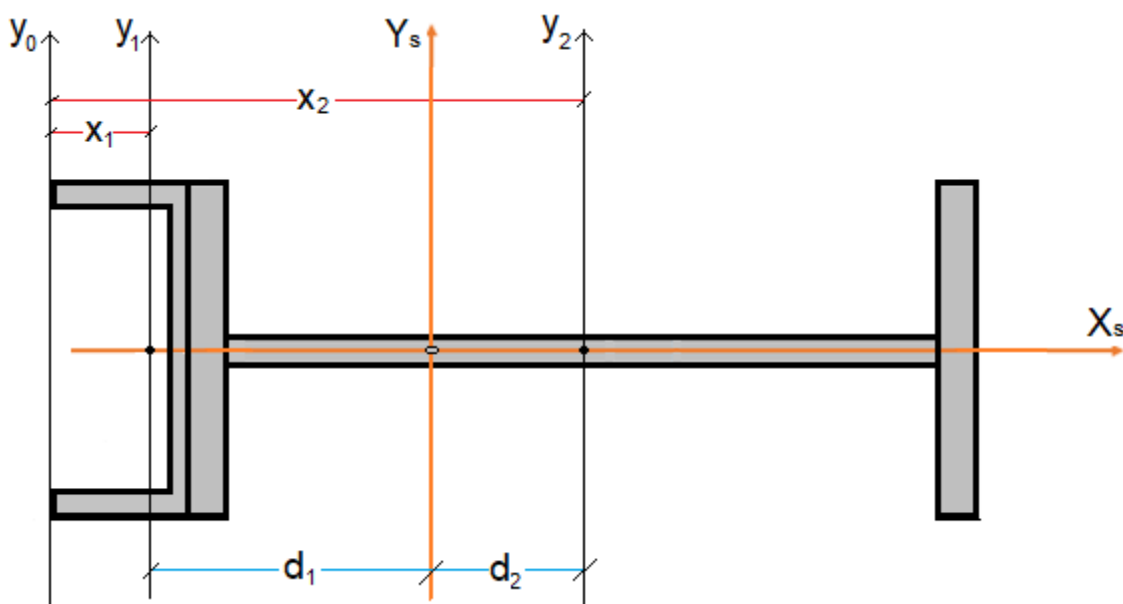
$$X_s = \frac{A_1 \cdot x_1 + A_2 \cdot x_2}{A_1 + A_2}$$

$$Y_s = \frac{A_1 \cdot y_1 + A_2 \cdot y_2}{A_1 + A_2}$$

Murakkab shaklning o'g'irlik markazi holatini aniqlash uchun (1) formuladagi boshlang'ich o'q (y_0)dan shakllarning og'irlik markazlarigacha bolgan masofa(x_1 , x_2)larni aniqlab olamiz (2-rasm):

$$x_1 = b^{shv} - y_0^{shv} = 115 - 30,5 = 84,5 \text{ mm} = 8,45 \text{ sm};$$

$$x_2 = b^{shv} + \frac{h^{qo'sh}}{2} = 115 + \frac{431}{2} = 330,5 \text{ mm} = 33,05 \text{ sm}.$$



2-rasm.

Shakllar simmetrik bo'ganligidan X_s markaziy o'q shakllarning xususiy o'lari bo'lganligi uchun - Y_s ifodasidagi $y_1 = y_2 = 0$ bo'ladi.

Murakkab shaklning o'g'irlik markazi holatini (1) formuladan aniqlaymiz.

Ikkala shakl simmetrik bo'ganligi uchun X_s markaziy o'q holati ma'lum. U holda $Y_s=0$.

$$X_s = \frac{A_1 \cdot x_1 + A_2 \cdot x_2}{A_1 + A_2} = \frac{61,5 \cdot 8,45 + 371 \cdot 33,05}{61,5 + 371} = 29,55 \text{ sm.}$$

O'girlik markazi koordinatalari to'g'ri topilganligini tekshiramiz. Bunda kesimning markaziy o'qlarga nisbatan statik momentlari nolga teng bo'lishi kerak:

$$S_{x_s} = 0; S_{y_s} = 0 \quad (2)$$

Bizning holda X_s markaziy o'q holati ma'lum bo'ganligi uchun $S_{x_s} = 0$.

$$S_{y_c} = A_1 \cdot d_1 + A_2 \cdot d_2 \quad (3)$$

(3) ifodadagi d_1 va d_2 markaziy o'q (Y_s) dan shakllarning xususiy o'q (y_1, y_2)larigacha bo'lgan masofa(x_1, x_2)lar(2-rasm).

$$d_1 = x_1 - x_s = 8,45 - 29,55 = -21,1 \text{ sm;}$$

$$d_2 = x_2 - x_s = 33,05 - 29,55 = 3,5 \text{ sm.}$$

Olingan natijalarni (3) ga qo'ysak

$$S_{y_c} = 61,5 \cdot (-21,1) + 371 \cdot 3,5 = -1297,65 + 1298,5 = 0,85 \approx 0$$

Demak kesimning o'g'irlik markazi to'g'ri topilgan.

2. Nosimmetrik kesimning bosh markaziy o'qlarga nisbatan inersiya momentlari aniqlash.

Nosimmetrik kesimning bosh markaziy o'qlarga nisbatan inersiya momentlari quyidagi formulalardan aniqlanadi:

$$\begin{aligned} I_{x_s} &= I_{x_1} + A_1 c_1^2 + I_{x_2} + A_2 c_2^2 \\ I_{y_s} &= I_{y_1} + A_1 d_1^2 + I_{y_2} + A_2 d_2^2 \end{aligned} \quad (4)$$

Bu erda X_s markaziy o'q shakllarning xususiy o'lari bo'lganligi uchun c_1 va c_2 koordinatalar nolga teng bo'ladi(2-rasm).

U holda bosh markaziy o'qlarga nisbatan inersiya momentlari

$$I_{x_c} = 15620 + 0 \cdot 61,5 + 37910 + 0 \cdot 61,5 = 53530 \text{ sm}^4$$

$$I_{y_c} = 760 + 61,5 \cdot (-21,1)^2 + 121570 + 371 \cdot (3,5)^2 = 154255 \text{ sm}^4.$$