

**O`ZBEKISTON RESPUBLIKASI
OLIV VA O`RTA MAXSUS TA`LIM VAZIRLIGI**

NAMANGAN MUHANDISLIK-PEDAGOGIKA INSTITUTI

«METALL KONSTRUKSIYALARI» FANIDAN

AMALIY MASHG`ULOTLARNI TASHKIL ETISH BO`YICHA

USLUBIY KO`RSATMA

Namangan – 2015

Ushbu uslubiy ko'rsatma 5580200-Binolar va inshootlar qurilishi ta'lim yo'nalishi bo'yicha institut va kasb hunar kollejlari ta'lim olayotgan talabalar uchun «Metall konstruksiyalar» fanidan amaliy mashg'ulotlarni o'tkazish uchun mo'ljallangan.

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Uslubiy ko'rsatma «Binolar va inshootlar qurilishi» kafedrasida ko'rib chiqilib, chop etishga tavsiya etilgan. 6-sonli majlis bayoni, 28 avgust 2015 yil.

Uslubiy ko'rsatma Namangan muhandislik- pedagogika institutining uslubiy kengashida ko'rib chiqilib, chop etishga ruxsat etilgan. 4-majlis bayoni, 31 avgust 2015 yil.

Po'lat to'sinlarni hisoblash va loyihalash

Berilgan:

1. Foydali me'yoriy yuklama $P_o'' = 22kN/m^2$
2. Oraliq $L = 18m$
3. Ustun qadami $B = 6m$
4. To'sin ostigacha masofa $h_1 = 5.4m$
5. To'shama ustigacha masofa $h_2 = 7.4m$
6. Material Vst3kp2

1. TO'SHAMA HISOBI

To'shama o'lchami uning oralig'ini qalinligiga nisbati orqali aniqlanadi.

$$\frac{a}{t_m} = \frac{4 \cdot n_o}{15} * \left(1 + \frac{72 \cdot E_1}{n_o^4 \cdot P_o''} \right) = \frac{4 \cdot 150}{15} * \left(1 + \frac{72 \cdot 2,26 \cdot 10^4}{150^4 \cdot 22} \right) = 40 \cdot \left(1 + \frac{162,72}{5,0625 \cdot 22} \right) = 98,44$$

bu yerda: $E_1 = \frac{E}{1-\nu^2} = \frac{2.1 \cdot 10^4}{1-0.3^2} = 2.26 \cdot 10^4 kN/sm^2$ keltirilgan elastiklik moduli.

$n_o = \left(\frac{l}{f} \right) = 150$ nisbiy egilishga teskari bo'lgan kattalik

agar $P_o'' < 10 \dots t_T = 6 - 8mm$

To'shama qalinligini quyidagi tartibda aniqlaymiz. agar $11 < P_o'' < 20 \dots t_T = 8 - 10mm$

agar $21 < P_o'' < 30 \dots t_T = 10 - 12mm$

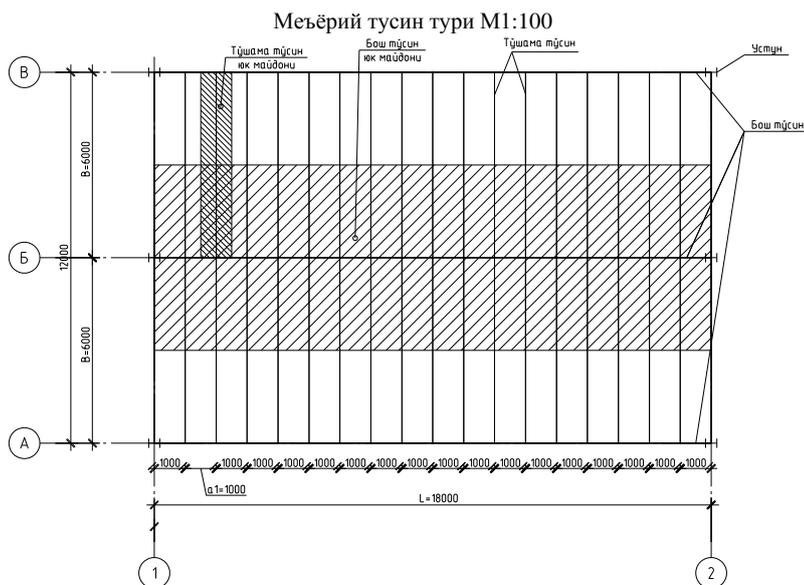
agar $30 < P_o'' \dots t_T = 12 - 14mm$

To'shama o'lchamlarini $t_m = 10mm \dots a_1 = t_m * \left(\frac{a}{t_T} \right) = 1 * 98.44 = 98.44sm \dots a_1 = 1m$ qabul

qilamiz.

I. To'sin to'rini 2 ta variant bo'yicha hisoblaymiz

I-variant me'yoriy to'sin to'rini xisoblaymiz.



1. To'shama to'sinni tanlash.

To'shama to'sin uchun yuklamalarni aniqlaymiz.

a) Me'yoriy yuklama

$$q_{TT}'' = (P_o'' + g_T) \cdot a = (22 + 0,785) \cdot 1 = 22,785 \text{ кН/м}$$

bu yerda: $g_T = t_T \cdot \rho = 0,01 \cdot 78,5 = 0,785 \text{ кН/м}^2$ 1 м^2 to'shama og'irligi.

b) Xisobiy yuklama

$$q_{TT} = (n_p \cdot P_o'' + n_g \cdot g_T) \cdot a = (1,2 \cdot 22 + 1,05 \cdot 0,785) \cdot 1 = 27,22 \text{ кН/м}$$

bu yerda: $n_p = 1,2$ va $n_g = 1,05$ -yuk bo'yicha ishonchlilik ko'effitsientlari

2. Eguvchi moment qiymatini xisoblaymiz.

$$M_{\max} = \frac{q_{TT} \cdot B^2}{8} = \frac{27,22 \cdot 6^2}{8} = 122,49 \text{ кН} \cdot \text{м} = 12249 \text{ кН} \cdot \text{см}$$

3. Talab qilingan qarshilik momenti xisoblaymiz

$$W_{TK} = \frac{M_{\max}}{c_1 \cdot R_y \cdot \gamma} = \frac{12249}{1,1 \cdot 22,5 \cdot 1} = 494,9 \text{ см}^3$$

bu yerda:

c_1 – материалнинг пластик ишини хисобга олувчи коэф.

R_y – Материалнинг хисобий каршилиги

γ – иш шароити коэф.

4. Sortimentdan aniqlangan kattalik bo'yicha qo'shtavr tanlaymiz

Куштавр № = 33

$$W_x = 597 \text{ см}^3$$

$$S_x = 9840 \text{ см}^4$$

$$g_{TT} = 0,422 \text{ кН/м}$$

5. Tanlangan kesimni tekshiramiz

a) Kuchlanish bo'yicha tekshirish:

$$\sigma = \frac{M_{\max}}{c_1 \cdot W_x} = \frac{12249}{1.1 \cdot 597} = 18.65 \text{ KH/cm}^2 \leq R_y \cdot \gamma = 22.5 \text{ KH/cm}^2$$

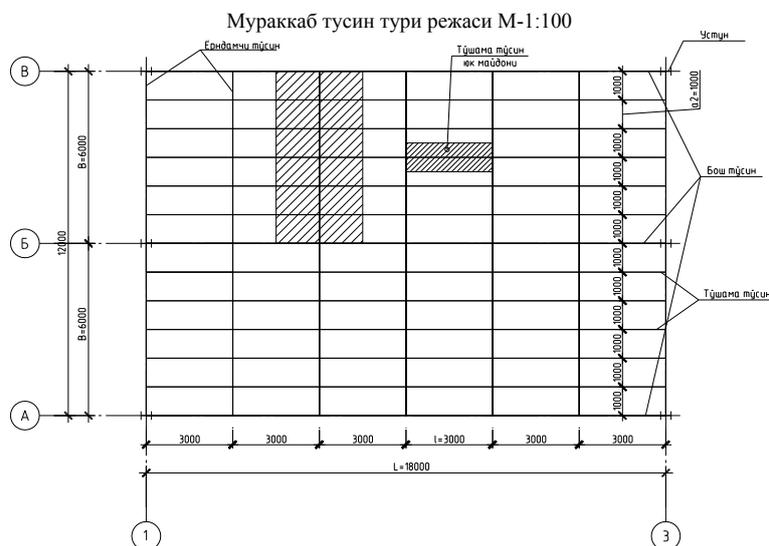
b) Salqilik bo'yicha tekshirish:

$$f = \frac{5}{384} \cdot \frac{q_{TT}'' \cdot B^4}{E \cdot J_x} = \frac{5 \cdot 0,22785 \cdot 600^4}{384 \cdot 2,1 \cdot 10^4 \cdot 9840} = 1,89 \leq 2,4 = \left[\frac{f}{\ell} \right] = \frac{1}{250} * B = \frac{1}{250} * 600$$

6. I-variant bo'yicha metall sarfini hisoblaymiz

$$g_1 = g_T + \frac{g_{TT}}{a} = 0,785 + \frac{0,422}{1} = 1,207$$

II-variant murakkab to'sin to'rini hisoblaymiz



1. To'shama to'sinni tanlash.

Ikkinchi variant uchun to'shama oralig'i va qalinligini aniqlash lozim (agarda birinchi variantdagi qiymatlar to'g'ri kelsa ularni qoldirish mumkin, aks xolda xisoblab, raxbar bilan kelishib qabul qilinadi)

Ikkinchi variant uchun birinchi varianda kabul qilingan qiymatlar mos tushadi, ularni qoldirgan holda xisob ishlarini bajaramiz. $a_2 = 1 \text{ M}$, $t_T = 10 \text{ MM}$ $\ell_1 = 3 \text{ M}$

ℓ_1 - yordamchi tusin qadami bo'lib uning qiymati 2-5 m oralig'ida olish mumkin (to'sin oralig'i shunday tanlanishi kerakki bosh to'singa kamida 5 ta yordamchi to'sin tayansin).

To'shama to'sin uchun yuklamalarni aniqlaymiz.

a) Me'yoriy yuklama

$$q_{TT}'' = (P_o'' + g_T) \cdot a_2 = (22 + 0,785) \cdot 1 = 22,785 \text{ KH/M}$$

bu yerda: $g_T = t_T \cdot \rho = 0,01 \cdot 78,5 = 0,785 \text{ 1m}^2 \text{ to'shama og'irligi}$.

b) Xisobiy yuklama

$$q_{TT} = (n_p \cdot P_o'' + n_g \cdot g_T) \cdot a_2 = (1,2 \cdot 22 + 1,05 \cdot 0,785) \cdot 1 = 27,22 \text{ KH/M}$$

bu yerda: $n_p = 1,2$ va $n_g = 1,05$ -yuk bo'yicha ishonchlilik koeffitsientlari

2. Eguvchi moment qiymatini xisoblaymiz

$$M_{\max} = \frac{q_{TT} \cdot \ell_1^2}{8} = \frac{27,22 \cdot 3^2}{8} = 30,6225 \text{ кН} \cdot \text{м} = 3062,25 \text{ кН} \cdot \text{см}$$

3. Talab qilingan qarshilik momenti xisoblaymiz

$$W_{TK} = \frac{M_{\max}}{c_1 \cdot R_y \cdot \gamma} = \frac{3062,25}{1,1 \cdot 22,5 \cdot 1} = 123,73 \text{ см}^3$$

bu yerda:

c_1 – материалнинг пластик ишини hisobga oluvchikoeff.

R_y – Материалнинг hisobий каршилиги

γ – иш шароити коэф.

7. Sortimentdan aniqlangan kattalik bo'yicha qo'shtavr tanlaymiz

Куштавр № = 18

$$W_x = 143 \text{ см}^3$$

$$\mathfrak{I}_x = 1290 \text{ см}^4$$

$$g_{TT} = 0,184 \text{ кН/м}$$

8. Tanlangan kesimni tekshiramiz

Kuchlanish bo'yicha tekshirish:

$$\sigma = \frac{M_{\max}}{c_1 \cdot W_x} = \frac{3062,25}{1,1 \cdot 143} = 19,46 \text{ кН/см}^2 \leq R_y \cdot \gamma = 22,5 \text{ кН/см}^2$$

Salqilik bo'yicha tekshirish:

$$f = \frac{5}{384} \cdot \frac{q_{TT}^n \cdot \ell_1^4}{E \cdot \mathfrak{I}_x} = \frac{5 \cdot 0,22785 \cdot 300^4}{384 \cdot 2,1 \cdot 10^4 \cdot 1290} = 0,904 \leq 1,2 = \left[\frac{f}{\ell} \right] = \frac{1}{250} * l_1$$

II YoRDAMChI TO'SINNI TANLASH

1. Yordamchi to'sin uchun yuklamalarni aniqlaymiz.

a) Me'yoriy yuklama

$$q_{TT}^n = \left(P_o^n + g_T + \frac{g_{TT}}{a} \right) \cdot \ell_1 = \left(22 + 0,785 + \frac{0,184}{1} \right) \cdot 3 = 68,907 \text{ кН/м}$$

bu yerda: $g_T = t_T \cdot \rho = 0,01 \cdot 78,5 = 0,785 \text{ 1m}^2$ to'shama og'irligi.

b) Xisobiy yuklama

$$q_{TT} = \left[n_p \cdot P_o^n + n_g \left(g_T + \frac{g_{TT}}{a} \right) \right] \cdot \ell_1 = \left[1,2 \cdot 22 + 1,05 \left(0,785 + \frac{0,184}{1} \right) \right] \cdot 3 = 82,25 \text{ кН/м}$$

bu yerda: $n_p = 1,2$ va $n_g = 1,05$ -yuk bo'yicha ishonchlilik koeffitsientlari

2. Eguvchi moment qiymatini xisoblaymiz

$$M_{\max} = \frac{q_{TT} \cdot B^2}{8} = \frac{82,25 \cdot 6^2}{8} = 370,125 \text{ кН} \cdot \text{м} = 37012,5 \text{ кН} \cdot \text{см}$$

3. Talab qilingan qarshilik momenti xisoblaymiz

$$W_{TK} = \frac{M_{\max}}{c_1 \cdot R_y \cdot \gamma} = \frac{37012,5}{1.1 \cdot 22.5 \cdot 1} = 1495,45 \text{ см}^3$$

bu yerda:

c_1 – материалнинг пластик ишини хисобга олувчи коэф.

R_y – Материалнинг хисобий каршилиги

γ – иш шароити коэф.

4. Sortimentdan aniqlangan kattalik bo'yicha qo'shtavr tanlaymiz

Куштавр № = 50

$$W_x = 1598 \text{ см}^3$$

$$\mathfrak{I}_x = 39727 \text{ см}^4$$

$$g_{ET} = 0.785 \text{ кН/м}$$

5. Tanlangan kesimni tekshiramiz

a) Kuchlanish bo'yicha tekshirish:

$$\sigma = \frac{M_{\max}}{c_1 \cdot W_x} = \frac{37012,5}{1.1 \cdot 1598} = 21,05 \text{ кН/см}^2 \leq R_y \cdot \gamma = 22.5 \text{ кН/см}^2$$

b) Salqilik bo'yicha tekshirish:

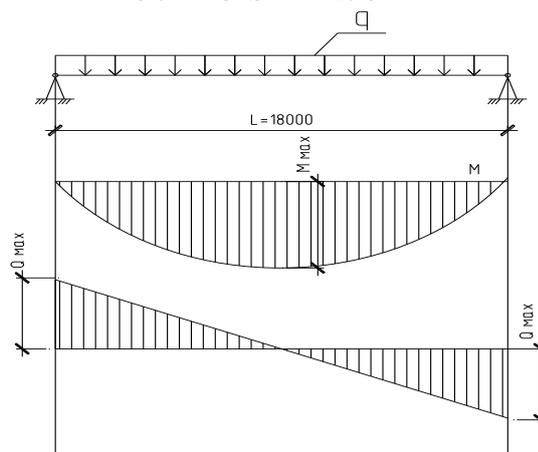
$$f = \frac{5}{384} \cdot \frac{q_{TT}'' \cdot B^4}{E \cdot \mathfrak{I}_x} = \frac{5 \cdot 0,689 \cdot 600^4}{384 \cdot 2,1 \cdot 10^4 \cdot 39727} = 1,42 \leq 2,4 = \left[\frac{f}{l} \right]$$

6. II-variant bo'yicha metall sarfini hisoblaymiz

$$g_2 = g_T + \frac{g_{TT}}{a_2} + \frac{g_{ET}}{l_1} = 0.785 + \frac{0.184}{1} + \frac{0.785}{3} = 1.23$$

Metall sarfi bo'yicha birinchi variant samarali bo'lganligi uchun keyingi hisoblarda birinchi variant yuklamasi bo'yicha olib boramiz.

IV. BOSH TO'SIN HISOBI



Bosh to'sin kesimini qo'shtavr shaklli, payvandlab tayyorlanadigan qilib tanlaymiz

Bosh to'sin uchun yuklamalarni aniqlaymiz.

a) Me'yoriy yuklama

$$q_{BT}'' = (P_o'' + q_{\min}) \cdot B = (22 + 1,207) \cdot 6 = 142,02 \text{ кН/м}$$

bu yerda: Q_{\min} Q_1 va Q_2 лардан кичиги

b) Xisobiy yuklama

$$q_{BT} = (n_p \cdot P_o^H + n_g \cdot q_{\min}) \cdot B = (1.2 \cdot 22 + 1.05 \cdot 1,207) \cdot 6 = 169,32 \text{ кН/м}$$

bu yerda: $n_p = 1,2$ va $n_g = 1,05$ -yuk bo'yicha ishonchlilik koeffitsientlari

2. Zo'riqlashlarni xisoblaymiz

a) Eguvchi moment

$$M_{\max} = \frac{q_{BT} \cdot L^2}{8} = \frac{169,32 \cdot 18^2}{8} = 6857,46 \text{ кН} \cdot \text{м} = 685746 \text{ кН} \cdot \text{см}$$

b) Qirquvchi kuch

$$Q_{\max} = \frac{q_{BT} \cdot L}{2} = \frac{169,32 \cdot 18}{2} = 1523,88 \text{ кН}$$

3. Talab qilingan qarshilik momenti xisoblaymiz. Bosh to'sinni plastik deformatsiyalarni yuzaga kelishini hisobga olgan holda hisoblaymiz

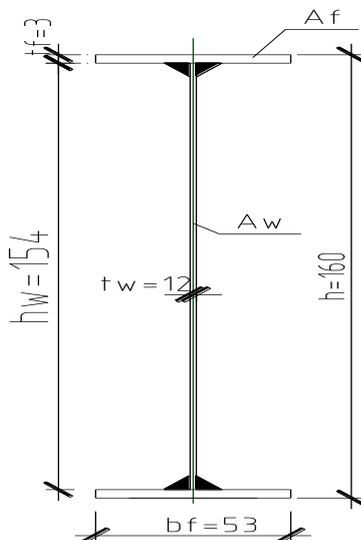
$$W_{TK} = \frac{M_{\max}}{c_1 \cdot R_y \cdot \gamma} = \frac{685746}{1.1 \cdot 20,5 \cdot 1} = 30410,02 \text{ см}^3$$

bu yerda:

c_1 – материалнинг пластик ишини hisobga oluvchikoeff.

R_y – Материалнинг hisobiy qarshiligi (листли пулат учун)

γ – иш шароити коэф.



Bosh to'sin balandligini oldindan taxmin qilgan holda, uning optimal balandligini hisoblaymiz. Buning uchun to'sin balandligi

$$h' \approx \left(\frac{1}{10}\right) \cdot L = \frac{18}{10} = 1,8 \text{ м}$$

va devor qalinligini topamiz.

$$t_w = 7 + 3 \cdot h' = 7 + 3 \cdot 1,8 = 12,4 \text{ мм}$$

Devor qalinligini $t_w = 12 \text{ мм}$ qabul qilamiz.

optimal balandlik

$$h_{opt} = K \sqrt{\frac{W_{TK}}{t_w}} = 1,15 \cdot \sqrt{\frac{30410,02}{1,2}} = 183,0 \text{ см}$$

To'sin balandligini quyidagi me'yor bo'yicha qabul qilish mumkin.
 agar $h < 120$ булса 5 см кадам билан,
 agar $120 < h < 160$ булса 10 см кадам билан,
 agar $h > 180$ булса 20 см кадам билан

To'sinning minimal balandligi quyidagicha hisoblanadi.

$$h_{\min} = \frac{5}{24} \cdot \frac{c_1 \cdot R_y \cdot L}{E} \cdot \left(\frac{\ell}{f}\right) \cdot \frac{q_{BT}^H}{q_{BT}} = \frac{5 \cdot 1,1 \cdot 20,5 \cdot 1800 \cdot 400}{24 \cdot 2,06 \cdot 10^4} \cdot \frac{142,02}{169,32} = 137,89 \text{ см}$$

Bu yerda $\left(\frac{\ell}{f}\right) = 400$ nisbiy egilishga teskari bo'lgan kattalik

To'sin balandligini optimal balandlikka yaqin, ammo minimal balandlikdan kichik bo'lmagan qilib qabul qilish kerak.

$h_o = 160$ см qabul qilamiz.

Qabul qilingan to'sin devori qalinligini urinma kuchlanishga tekshiramiz

$$t_w = \frac{3}{2} \cdot \frac{Q_{\max}}{h \cdot R_{cp}} = \frac{3 \cdot 1523,88}{2 \cdot 160 \cdot 12,6} = 1,19 < 1,2$$

bu yerda: $R_{cp} = 0,58 \cdot R_y = 20,5 \cdot 0,58 = 12,00 \text{ KH/cm}^2$ -materialning qirg'ilishga bo'lgan hisobiy qarshiligi.

Bo'ylama qovurg'a qo'ymaslik uchun quyidagi shart bajarilishi kerak.

$$t_w = \frac{h \cdot \sqrt{\frac{R}{E}}}{5,5} = \frac{160 \sqrt{\frac{20,5}{2,06 \cdot 10^4}}}{5,5} = 0,91 < 1,2$$

Tekshirish natijalarini qabul qilingan qalinlik bilan solishtirib, urinma kuchlanishga mustaxkamlik sharti bajarilgani va maxalliy ustvorlikni ta'minlash uchun bo'ylama qovurg'alar qo'yish shart emasligini aniqlaymiz.

To'sinning yuk ko'tarish qobiliyati orqali to'sin tokchasi o'lchamlarini hisoblaymiz.

$$A_{f,TK} = \frac{W_{TK}}{h_o} - \frac{h_o \cdot t_w}{6} = \frac{30410,02}{160} - \frac{160 \cdot 1,2}{6} = 158,06 \text{ см}^2$$

To'sin tokchasi eni

$$b_f = \frac{A_{f,TK}}{t_f} = \frac{158,02}{3} = 52,68 \text{ см} \quad b_{f=53} \text{ см qabul qilamiz}$$

bu yerda: $t_f = (2 \div 3) \cdot t_w$ - tokcha qalinligi.

uni $t_f = 30 \text{ мм}$ qabul qilamiz

Maxalliy ustvorlik sharti bo'yicha qabul qilingan tokcha enini tekshiramiz.

$$\frac{b_{cs}}{t_f} = \frac{53 - 1,2}{3 \cdot 2} = 5,75 < 0,11 \frac{h_o}{t_w} = 0,11 \frac{157}{1,2} = 14,11 < 0,5 \sqrt{\frac{E}{R_y}} = 0,5 \sqrt{\frac{2,06 \cdot 10^4}{20,5}} = 15,84$$

Bu yerda $b_{cs} = \frac{bf - tw}{2}$ ga teng.

Keltirilgan egiluvchanlikni aniqlaymiz.

$$\lambda_{\omega} = \frac{h_o}{t_w} \cdot \sqrt{\frac{R}{E}} = \frac{157}{1,2} \cdot \sqrt{\frac{20,5}{2,06 \cdot 10^4}} = 4,04$$

Qabul qilingan to'sin kesimini mustaxkamlikka tekshiramiz. Buning uchun kesim inertsiya va karshilik momentini aniqlaymiz.

a) Inertsiya momenti:

$$\mathfrak{J}_x = \frac{t_w \cdot h_w^3}{12} + 2 \cdot A_f \left(\frac{h_w}{2} + \frac{t_f}{2} \right)^2 = \frac{1,2 \cdot 154^3}{12} + 2 \cdot 53 \cdot 3 \left(\frac{154}{2} + \frac{3}{2} \right)^2 = 2324821,9 \text{ cm}^4$$

b) Bu yerda $A_f = b_f \cdot t_f = 53 \cdot 3$ ga teng

v) Qarshilik momenti:

$$W_x = \frac{2 \cdot \mathfrak{J}_x}{h_0} = \frac{2 \cdot 2324821,9}{160} = 30566,4 \text{ cm}^3$$

g) To'sindagi me'yoriy kuchlanish:

$$\sigma = \frac{M_{\max}}{c_1 \cdot W_x} = \frac{685796}{1,1 \cdot 30566,4} = 20,39 < 20,5 \text{ KH/cm}^2$$

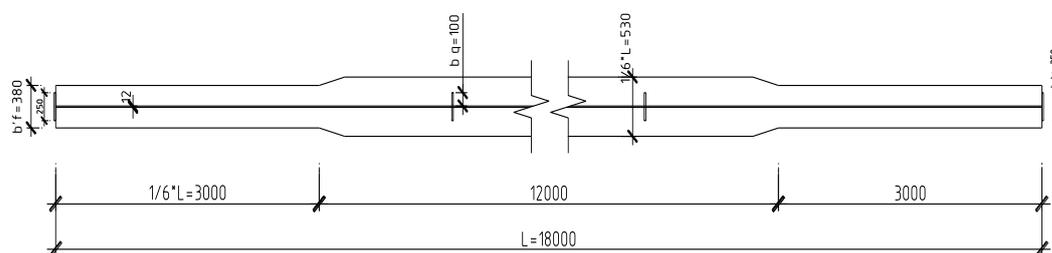
To'la kuchlanishga yetmaganlik darajasini aniqlaymiz.

$$\Delta\% = \frac{R_y - \sigma}{R_y} \cdot 100\% = \frac{20,5 - 20,39}{20,5} \cdot 100\% = 0,5 < 5\%$$

To'sin balandligi minimal balandlikdan katta olinganligi sababli ikkinchi chegaraviy holat bo'yicha tekshirishni bajarmaymiz.

V. TO'SIN KESIMINI UZINLIK BO'YICHA O'ZGARTIRISH

To'sin kesimini uzunlik bo'yicha o'zgarishi



To'sin tokchasi kesimini tayanchdan $\frac{1}{6} \cdot L$ masofada o'zgartiramiz. Har xil kesimli

tokchalar E42 elektrod bilan payvandlanadi.

1. Kesim o'zgarish joyidagi hisobiy zo'riqishlarni aniqlaymiz:

a) Eguvchi moment

$$M_1 = \frac{q_{BT} \cdot x_1 \cdot (L - x_1)}{2} = \frac{169,32 \cdot 3 \cdot (18 - 3)}{2} = 3809,7 \text{ KH} \cdot \text{M} = 380970 \text{ KH} \cdot \text{CM}$$

bu yerda: $x_1 = \frac{1}{6} \cdot L = \frac{1}{6} \cdot 18 = 3 \text{ M}$

b) Qirquvchi kuch

$$Q_1 = q_{BT} \left(\frac{L}{2} - x_1 \right) = 169,32 \left(\frac{18}{2} - 3 \right) = 1015,92 \text{ KH}$$

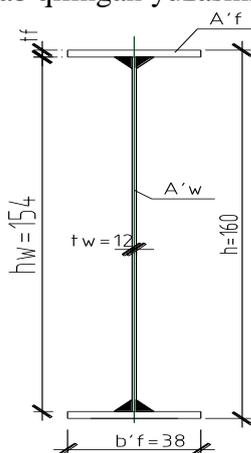
2. O'zgargan kesimni metarialning elastik ishlashi bo'yicha tanlaymiz. Talab qilingan qarshilik momentini hisoblaymiz.

$$W'_{TK} = \frac{Q_1}{R_{c6}} = \frac{380970}{0,85 \cdot 20,5} = 21863,4 \text{ cm}^3$$

bu yerda:

$$R_{ce} = 0,85 \cdot R_y$$

3. O'zgaragan kesim tokchasining talab qilingan yuzasini hisoblaymiz:



$$A'_{f,TK} = \frac{W'_{TK}}{h_o} - \frac{h_o \cdot t_w}{6} = \frac{21863,4}{160} - \frac{160 \cdot 1,2}{6} = 104,65 \text{ cm}^2$$

tokcha eni

$$b'_f = \frac{A'_{f,TK}}{t_f} = \frac{104,65}{3} = 34,88 \text{ cm}$$

tokcha enini $b'_f = 380 \text{ mm}$ qabul qilamiz.

4. O'zgaragan kesim uchun inertiya va qarshilik momentlarini aniqlaymiz:

a) ineriya momenti.

$$\mathfrak{I}'_x = \frac{t_w \cdot h_w^3}{12} + 2 \cdot A'_f \cdot \left(\frac{h_w}{2} + \frac{t_f}{2} \right)^2 = \frac{1,2 \cdot 154^3}{12} + 2 \cdot 38 \cdot 3 \cdot \left(\frac{154}{2} + \frac{3}{2} \right)^2 = 1770219,4 \text{ cm}^4$$

Bu yerda $A'_f = b'_f \cdot t_f = 38 \cdot 3$ ga teng

Qarshilik momenti:

$$W'_x = \frac{2 \cdot \mathfrak{I}'_x}{h_o} = \frac{2 \cdot 1770219,4}{160} = 22127,74 \text{ cm}^3$$

To'sindagi me'yoriy kuchlanish:

$$\sigma = \frac{M_1}{W'_x} = \frac{380970}{22127,74} = 17,21 \text{ KH/cm}^2 < R_{ce} = 17,425 \text{ KH/cm}^2$$

Bu yerda $R_{ce} = 0,85 \cdot R_y = 0,85 \cdot 20,5 = 17,425 \text{ KH/cm}^2$

To'la kuchlanishga yetmaganlik darajasini aniqlaymiz.

$$\Delta\% = \frac{R_{ce} - \sigma}{R_{ce}} \cdot 100\% = \frac{17,425 - 17,21}{17,425} \cdot 100\% = 1,2 < 5\%$$

VI. TO'SIN UMUMIY USTVORLIGINI TEKSHIRISH VA TA'MINLASH.

Tayanchda to'sin devorini urinma kuchlanishga tekshiramiz.

$$\tau = \frac{Q_{\max} \cdot S_1}{J_1 \cdot t_w} = \frac{1523,88 \cdot 12506,4}{1770219,4 \cdot 1,2} = 8,97 \text{ KH/cm}^2 < R_{cp} = 0,58 \cdot R_y = 11,89 \text{ KH/cm}^2$$

bu yerda: S_1 -yarim kesim statik momenti.

$$S_1 = b'_f \cdot t_f \cdot \frac{h_o}{2} + \frac{t_w \cdot h_w^2}{8} = 38 \cdot 3 \cdot \frac{157}{2} + \frac{1,2 \cdot 154^2}{8} = 12506,4 \text{ cm}^3$$

$$h_0 = h_{\text{om}} - t_f = 160 - 3 = 157 \text{ cm}$$

To'sin kesimi o'zgartirilgan joyida keltirilgan kuchlanishni tekshiramiz.

$$\sigma_{\text{kel.}} = \sqrt{\sigma_1^2 + 3 \cdot \tau_1^2} \leq 1,15 \cdot R_y$$

$$\sigma_1 = \frac{M_1}{W_1} \cdot \frac{h_w}{h} = \frac{380970}{22127,74} \cdot \frac{154}{160} = 16,56 \text{ KH/cm}^2$$

$$\tau_1 = \frac{Q_1 \cdot S_{n1}}{J_1 \cdot t_w} = \frac{1015,92 \cdot 8949}{1770219,4 \cdot 1,2} = 5,13 < R_{cp}$$

bu yerda: S_{n1} siqiladigan tokcha statik momenti

$$S_{n1} = b_f' \cdot t_f \cdot \left(\frac{h_w}{2} + \frac{t_w}{2} \right) = 38 \cdot 3 \cdot \left(\frac{154}{2} + \frac{3}{2} \right) = 8949 \text{ cm}^3$$

$$\sigma_{\text{kel.}} = \sqrt{16,56^2 + 3 \cdot 5,13^2} = 18,79 \text{ KH/cm}^2 < 1,15 \cdot R_y = 1,15 \cdot 20,5 = 23,575 \text{ KH/cm}^2$$

VII. TO'SIN MAHALLIY USTVORLIGINI TEKSHIRISH VA TA'MINLASH.

Tokcha maxalliy ustvorligi hisob davomida tekshirildi. Devorning mahalliy ustvorligini tekshiramiz. Birinchi navbatda bikrlilik qovurg'alarini qo'yish shartini tekshiramiz.

$$\bar{\lambda}_w = \frac{h_w}{t_w} \cdot \sqrt{\frac{R_y}{E}} = \frac{154}{1,2} \cdot \sqrt{\frac{20,5}{2,06 \cdot 10^4}} = 4,04 > 2,2 \quad \text{shart ko'rsatadika ko'ndalang qovurg'alar}$$

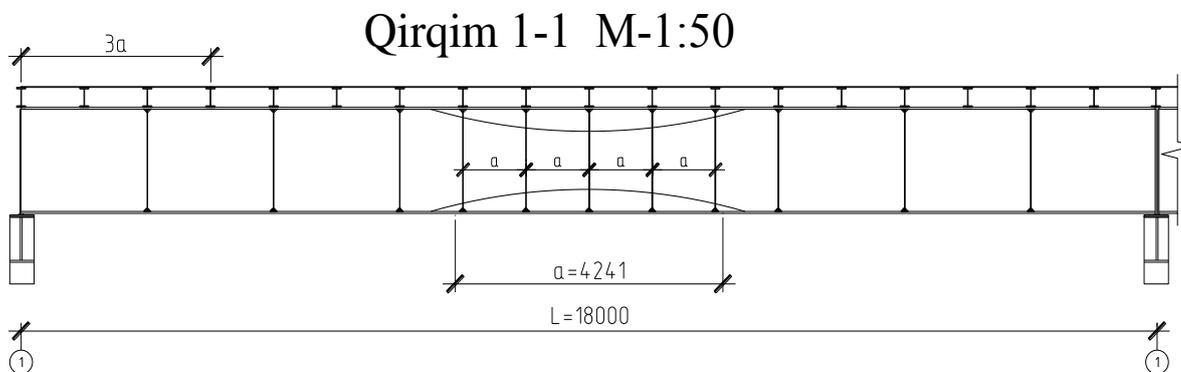
bilan to'sin kuchaytirilishi lozim. Bundan tashqari plastik deformatsiyalar sodir bo'lish qismida har bir to'shama to'sin ostiga ko'ndalang qovurg'a qo'yilishi kerak, chunki plastik deformatsiyalar sodir bo'lish qismida mahalliy kuchlanishlarni hosil bo'lishi mumkin emas. Plastik deformatsiya sodir bo'ladigan qism uzunligini hisoblaymiz.

$$a = L \sqrt{1 - \frac{1}{c_1} \cdot \frac{h}{h_w}} = 1800 \sqrt{1 - \frac{1}{1,1} \cdot \frac{160}{154}} = 424,1 \text{ cm}$$

Qovurg'a o'lchamlarini hisoblaymiz

$$b_p = \frac{h_w}{30} + 40 = \frac{1540}{30} + 40 = 91,33 \text{ mm} \text{ qabul qilamiz } b_p = 100 \text{ mm}$$

$$t_h = 2 \cdot b_p \sqrt{\frac{R_y}{E}} = 2 \cdot 10 \sqrt{\frac{20,5}{2,06 \cdot 10^4}} = 0,63 \text{ cm} \text{ qabul qilamiz } t_p = 8 \text{ mm}$$



$\bar{\lambda}_w = 4,04 > 2,2$ ko'rsatadiki devor maxalliy ustvorligini tekshirish lozim. Tayanchdan $3a$ masofada tekshirishni amalga oshiramiz buning uchun shu kesimdagi zo'riqishlarni hisoblaymiz.

a) Eguvchi moment

$$M_2 = \frac{q_{BT} \cdot x_2 \cdot (L - x_2)}{2} = \frac{169,32 \cdot 3 \cdot (18 - 3)}{2} = 3809,7 \text{ KH} \cdot \text{M} = 380970 \text{ KH} \cdot \text{CM g}^2$$

bu yerda: $x_2 = 3 \cdot a = 3 \cdot 1 = 3 \text{ M}$

a=1 metall sarfi samarali bo'lgan variantdagi to'shama oraligi

b) Qirquvchi kuch

$$Q_2 = q_{BT} \left(\frac{L}{2} - x_2 \right) = 169,32 \left(\frac{18}{2} - 3 \right) = 1015,92 \text{ KH}$$

Ta'sir etuvchi kuchlanishlarni aniqlaymiz

$$\sigma_2 = \frac{M_1}{W} \cdot \frac{h_w}{h} = \frac{380970}{30566,4} \cdot \frac{154}{160} = 11,996 \text{ KH/CM}^2$$

$$\tau_2 = \frac{Q_2}{h_w \cdot t_w} = \frac{1015,92}{154 \cdot 1,2} = 5,497 \text{ KH/CM}^2$$

$$\sigma_{los} = \frac{F}{l_m \cdot t_w} = \frac{163,32}{20 \cdot 1,2} = 6,81 \text{ KH/CM}^2$$

bu yerda: $F = 2 \cdot q_{TT} \cdot \frac{B}{2} = 2 \cdot 27,22 \cdot \frac{6}{2} = 163,32 \text{ KH}$ -to'shama to'sin tayanch reaksiyasi

$$l_m = b + 2 \cdot t_f = 14 + 2 \cdot 3 = 20 \text{ CM}$$

Kritik kuchlanishlarni hisobdaymiz.

$$\tau_{cr} = 10,3 \cdot \left(1 + \frac{0,76}{\mu^2} \right) \cdot \frac{R_{cp}}{\lambda_{ycl}^2} = 10,3 \cdot \left(1 + \frac{0,76}{1,94^2} \right) \cdot \frac{12}{4,04} = 36,77 \text{ KH/CM}^2$$

bu yerda: $h_o = h_w$, $\lambda_{ycl} = \lambda_w$

$$\mu = \frac{x_2}{h_o} = \frac{300}{154} = 1,94$$

ko'rilayotgan bo'lak uchun $\frac{x_2}{h_o} = 1,94$ va $\frac{\sigma_{los}}{\sigma_2} = \frac{6,81}{11,996} = 0,56$

δ ni hisoblaymiz

$$\delta = \beta \frac{b_f}{h_o} \cdot \left(\frac{t_f}{t_w} \right)^3 = 0,8 \frac{53}{154} \left(\frac{3}{1,2} \right)^3 = 4,3$$

3- Jadvaldan (Ilova) $\frac{x_2}{h_o} = 1,94$ va $\delta = 4,3$ qiymatlar $\frac{\sigma_{los}}{\sigma_2} = 1,009 > 0,56$

bo'lganligi uchun me'yoriy kritik kuchlanish quyidagi formula bo'yicha aniqlanadi.

$$\sigma_{cr} = \frac{c_{cr} \cdot R_y}{\lambda_w^2} = \frac{21,75 \cdot 20,5}{3,93^2} = 28,87 \text{ KH/CM}^2$$

bu yerda: $c_{cr} = 34,6$ 1- jadvaldan (Ilova) $\delta = 4,3$ qiymat bo'yicha olingan koef.

$$\sigma_{los,cr} = \frac{c_1 \cdot R_y}{\lambda_a^2} = \frac{21,75 \cdot 20,5}{3,93^2} = 28,87 \text{ КН/см}^2$$

bu yerda: $\bar{\lambda}_a = \frac{x_2}{2 \cdot t_w} \sqrt{\frac{R_y}{E}} = \frac{300}{2 \cdot 1,2} \sqrt{\frac{20,5}{2,06 \cdot 10^4}} = 3,93$

2- jadval (Ilova) dan $\delta = 4,3$ va $\frac{x_2}{2 \cdot h_w} = \frac{300}{2 \cdot 154} = 0,97$ bo'yicha

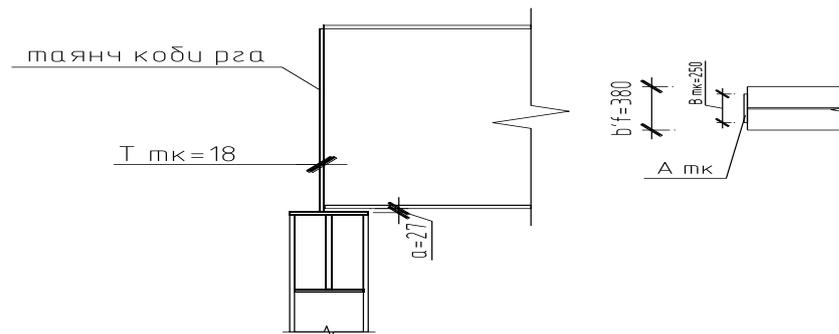
$c_1 = 21,75$

aniqlangan qiymatlar bo'yicha tekshirishni bajaramiz

$$\sqrt{\left(\frac{\sigma_2}{\sigma_{cr}} + \frac{\sigma_{los}}{\sigma_{los,cr}}\right)^2 + \left(\frac{\tau_2}{\tau_{los,cr}}\right)^2} = \sqrt{\left(\frac{11,996}{43,46} + \frac{6,81}{28,87}\right)^2 + \left(\frac{5,497}{36,77}\right)^2} = 0,53 < \gamma = 1$$

Tekshirish shuni ko'rsatdiki to'sin ustvorligi ta'minlangan.

VIII. TAYANCH QOBURG'A HISOBI.



To'sin tayanch reaksiyasini $V_{BT} = Q_{max} = 1523,88 \text{ КН}$

Tayanch qovurg'a ezilish yuzasini hisoblaymiz

$$A_{TK} = \frac{V_{BT}}{R_{cm,m}} = \frac{1523,88}{35} = 43,54 \text{ см}^2$$

bu yerda: $R_{cm,m}$ - (Sortament) tayanch qovurg'a materialini ezilishga bo'lgan qarshiligi.

Tayanch qovurg'a qalinligini topish uchun uni enini belgilash lozim:

agar $b_f \leq 250 \text{ мм}$ булса $b_{TK} = b_f$ олинади

агар $b_f \geq 250 \text{ мм}$ булса $b_{TK} = 250 \text{ мм}$ олинади

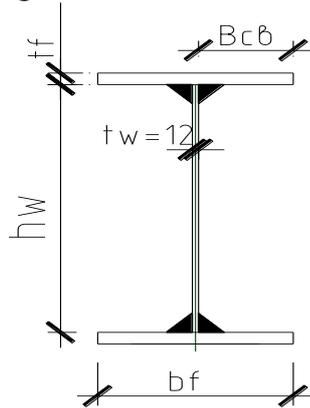
Tayanch qovurg'a enini $b_{TK} = 250 \text{ мм}$ qabul qilamiz va

$$t_{TK} = \frac{A_{TK}}{b_{TK}} = \frac{43,54}{25} = 1,74 \text{ мм}$$

$t_{TK} = 1,8 \text{ мм}$ qabul qilamiz.

$$a = 1,5t_{TK} = 1,5 \cdot 1,8 = 27 \text{ мм}$$

IX. MAZKAZIY SIQILISHGA ISHLOVCHI TO'LA KESIMLI USTUN HISOBI



Ustun kesimini qo'shtavr shaklli qabul qilamiz va uning hisobiy uzunligini aniqlaymiz

$$\ell_o = H_y = \mu(h_1 + 0,6)$$

Bu yerda: μ - Sterjen chetlarini birikishiga bog'luq bo'lgan koeffitsient.

h_1 -kurs loyixasi vazifasida berilgan satx

$$\ell_o = 0,7(5,4_1 + 0,6) = 4,2 \text{ m}$$

Egilibchanlik tasir etayotgan yukka qarab aniqlanadi

N	<	1500	$\varphi = 120 \div 100$		
1500	<	N	<	2500	$\varphi = 100 \div 80$
2500	<	N	<	3500	$\varphi = 80 \div 60$
3500	<	N			$\varphi = 60 \div 40$

Ustunga ta'sir etuvchi hisobiy yuklama

$$N_y = 2 \cdot Q_{\max} = 2 \cdot 1523,88 = 3047,76 \text{ kH}$$

Ustun egiluvchangligini $\lambda = 60$ qabul qilib 6-jadvaldan (Ilova) $\varphi = 0,827$ qiymatni aniqlaymiz va ustun kesimining talab qilingan yuzasini topamiz.

$$A_{y,TK} = \frac{N_y}{\varphi \cdot R_y} = \frac{3047,76}{0,827 \cdot 20,5} = 179,77 \text{ cm}^2$$

Talab qilingan radius inertsiyani hisoblaymiz

$$i_{TK} = \frac{\ell_o}{\lambda} = \frac{420}{60} = 7 \text{ cm}$$

koeffitsientlar $\alpha_1 = 0,24$ va $\alpha_2 = 0,42$ dan foydalanib kesim o'lchamlarini aniqlaymiz.

$$b_f = \frac{i_{TK}}{\alpha_1} = \frac{7}{0,24} = 29,2 \text{ cm} \quad h_w = \frac{i_{TK}}{\alpha_2} = \frac{7}{0,42} = 16,66 \text{ cm}$$

$$b_f \leq h_w \text{ shartga ko'ra } b_f = 30 \text{ cm} \quad h_w = 36 \text{ cm} \text{ qabul qilamiz}$$

Ustun devori qalinligini hisoblaymiz

$$t_w = \frac{0,2 \cdot A_{y,TK}}{h_w} = \frac{0,2 \cdot 179,77}{36} = 0,99 \text{ cm}$$

$$\text{Ustun devorini } t_w = 10 \text{ mm} \quad A_w = h_w \cdot t_w = 1,0 \cdot 36 = 36 \text{ cm}^2$$

Ustun tokchasi o'lchamlarini hisoblaymiz

$$t_f = \frac{A_{y,TK} - A_w}{2 \cdot b_f} = \frac{179,77 - 36}{2 \cdot 30} = 2,39 \text{ cm}$$

$$t_f = 25 \text{ mm} \text{ qabul qilamiz.}$$

Keltirilgan egiluvchanlikni aniqlaymiz $\bar{\lambda}$

$$\bar{\lambda} = \lambda \cdot \sqrt{\frac{R}{E}} = 60 \cdot \sqrt{\frac{20,5}{2,1 \cdot 10^4}} = 1,87$$

Agar $\bar{\lambda} \leq 0,8$ unda $\frac{h_w}{t_w} \leq \sqrt{\frac{R}{E}}$ tekshiriladi

Agar $\bar{\lambda} > 0,8$ unda $\frac{h_w}{t_w} \leq (0,36 + 0,8 \cdot \bar{\lambda}) \cdot \sqrt{\frac{R}{E}}$ tekshir lozim, bu shartlar bo'yicha quyidagi

tekshirishni amalga oshiramiz

$$\frac{h_w}{t_w} \leq (0,36 + 0,8 \cdot \bar{\lambda}) \cdot \sqrt{\frac{R}{E}} = (0,36 + 0,8 \cdot 1,87) \cdot \sqrt{\frac{20,5}{2,1 \cdot 10^4}} = 59,4 \quad \frac{36}{1} = 36 < 59,4$$

$$b_{cs} = \frac{b_f - t_w}{2} = \frac{30 - 1}{2} = 14,5$$

$$\frac{b_{cs}}{t_w} \leq (0,36 + 0,8 \cdot \bar{\lambda}) \cdot \sqrt{\frac{E}{R}} \Leftrightarrow (0,36 + 0,8 \cdot 1,87) \cdot \sqrt{\frac{2,1 \cdot 10^4}{20,5}} \quad 5,8 < 17,5$$

u o'qi bo'yicha inertsia momentini hisoblaymiz

$$\mathfrak{I} = 2 \cdot \frac{t_f \cdot b_f^3}{12} = 2 \cdot \frac{2,5 \cdot 30^3}{12} = 11250 \text{ cm}^4$$

$$i_y = \sqrt{\frac{\mathfrak{I}_y}{A}} = \sqrt{\frac{11250}{186}} = 7,8 \text{ cm}$$

$$A = 2 \cdot A_f + A_w = 2 \cdot 30 \cdot 2,5 + 36 = 186 \text{ cm}^2$$

$$\lambda = \frac{\ell_o}{i_y} = \frac{420}{7,8} = 54 \quad \varphi = 0,843$$

$$\sigma = \frac{N_y}{\varphi \cdot A} = \frac{3047,74}{0,843 \cdot 186} = 19,44 \text{ KH/cm}^2 < R_y = 20,5 \text{ KH/cm}^2$$

$$\Delta\% = \frac{R_y - \sigma}{R_y} \cdot 100\% = \frac{20,5 - 19,44}{20,5} \cdot 100\% = 5,18\% > 5\% \text{ shart bajariladi, shuning uchun devor}$$

qalinligini o'zgartiramiz. U holda

$$A = 2 \cdot A_f + A_w = 2 \cdot 30 \cdot 2,5 + 36 \cdot 0,8 = 178,8 \text{ cm}^2$$

$$i_y = \sqrt{\frac{\mathfrak{I}_y}{A}} = \sqrt{\frac{11250}{178,8}} = 7,93 \text{ cm}$$

$$\lambda = \frac{\ell_o}{i_y} = \frac{420}{7,93} = 53 \quad \varphi = 0,8564$$

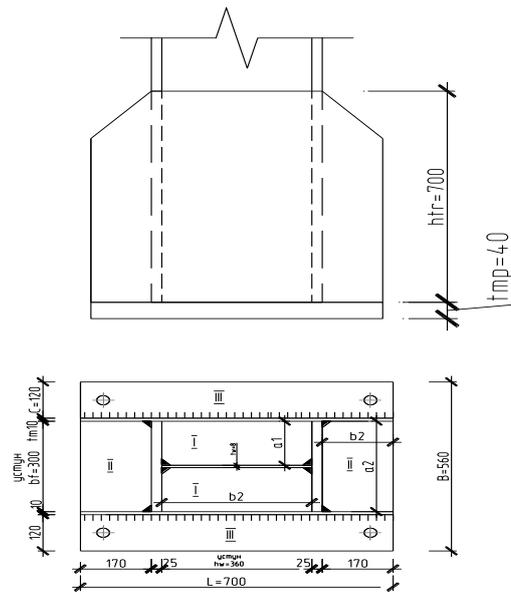
$$\sigma = \frac{N_y}{\varphi \cdot A} = \frac{3047,74}{0,8564 \cdot 178,8} = 19,9 \text{ KH/cm}^2 < R_y = 20,5 \text{ KH/cm}^2$$

$$\Delta\% = \frac{R_y - \sigma}{R_y} \cdot 100\% = \frac{20,5 - 19,9}{20,5} \cdot 100\% = 2,9\% < 5\%$$

Shart bajarildi qabul qilingan to'sin kesim yaroqli hisoblanadi.

USTUN PASHTANGI HISOBI

Ustun pashtangi M 1:10



Ustun pashtingiga tushadigan to'la yuklama quyidagi formula bilan aniqlanadi.

$$N = N_y + n_g \cdot A \cdot g \cdot H \cdot \rho = 3047,76 + 1,05 \cdot 0,01788 \cdot 10 \cdot 6 \cdot 78,5 = 3136,2 \text{ кН}$$

Tayanch pilita talab qilinganyuzasini topamiz

$$A_{TK,II} = \frac{N}{R_{cm,\delta}} = \frac{3136,2}{0,84} = 3733,57 \text{ см}^2$$

bu yerda:

$$R_{cm,\delta} = \gamma \cdot R_{np} = 1,2 \cdot 0,7 = 0,84$$

Traversa qalinligini konstruktiv ravishda 8-12 mm olish mumkin. Pashtang konsol qismining uzunligini konstruktiv ravishda 100—120 mm olish mumkin. Traversa qalinligini 10 mm, konsol qismi uzunligini 120 mm qabul qilamiz va pashtang enini hisoblaymiz.

$$B = b_f + 2 \cdot t_{mp} + 2 \cdot c = 30 + 2 \cdot 1 + 2 \cdot 12 = 56 \text{ c}$$

Pashtang uzunligi

$$L = \frac{A_{TK,II}}{B} = \frac{3733,57}{56} = 66,67 \text{ см}$$

$$L = 70 \text{ см} \text{ qabul qilamiz, u xolda } A_{II} = 56 \cdot 70 = 3920 \text{ см}^2$$

$$g = \sigma_\phi = \frac{N}{A_{II}} = \frac{3136}{3920} = 0,8$$

To'rt tomonidan tayangan 1-uchastkada

$$a = \frac{b_f - t_w}{2} = \frac{30 - 1,2}{2} = 14,6$$

$$\frac{b_1}{a_1} = \frac{36}{14,6} = 2,46$$

4—жадвалдан (Пова) → α

5—жадвалдан (Пова) → β коэффициентлароллинади

$$\alpha = 0,125; \quad M = \alpha \cdot g \cdot a^2$$

$$M_1 = 0,125 \cdot 0,8 \cdot 14,6^2 = 21,30$$

Uch tomonidan tayagan 2 uchastka

$$a_2 = 30 \text{ cm} \quad b_2 = \frac{L - (h_w + 2 \cdot t_f)}{2} = \frac{70 - (36 + 2 \cdot 2.5)}{2} = 14.5$$

$$\frac{e_2}{a_2} = \frac{14.5}{30} = 0.48 \quad \beta = 0.06$$

$$M_2 = \beta \cdot g \cdot e_2^2 = 0.06 \cdot 0.8 \cdot 30^2 = 43.2$$

3-uchastka

$$M_3 = \frac{g \cdot c^2}{8} = \frac{0.8 \cdot 12^2}{8} = 14.4$$

Tayanch plita qalinligini momentning kata qiymati bo'yicha quyidagi formula bilan aniqlanadi.

$$t_{tp} = \sqrt{\frac{6 \cdot M_{\max}}{R_y}} = \sqrt{\frac{6 \cdot}{20.5}} = 3.56 \quad t_{tr=4.0} \text{ cm qabul qilamiz.}$$

Traversa balandligini xisoblaymiz.

$$h_{mp} = \frac{N}{4 \cdot K_{uu} \cdot (\beta \cdot R_{yu}^{ce})_{\min} \cdot \gamma} = \frac{3132.77}{4 \cdot 0.8 \cdot (0.7 \cdot 21.5) \cdot 1} = 65.05$$

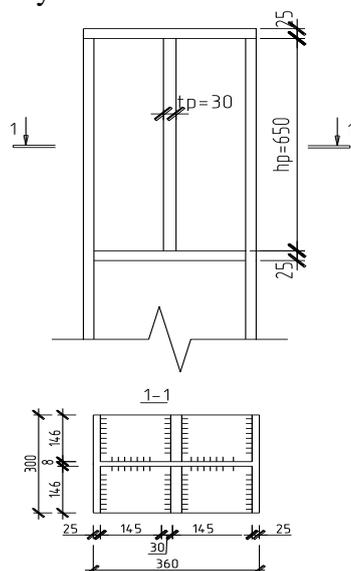
$$\beta_{uu} = 0.7 \quad R_{yu}^{ce} = 16.42 \quad R_{yc}^{ce} = 21.5$$
$$\beta_c = 1.0$$

$$\beta_{uu} \cdot R_{yu}^{ce} = 0.7 \cdot 21.5 = 15.05$$

$$h_{mp} = 70 \quad \text{qabul qilamiz}$$

USTUN KALLAGI XISOBI.

Tayanch plitalar o'lchamlarini ustun kesimi o'lchamlari bo'yicha chiqaramiz. Ularning qalinligi esa konstruktiv ravishda 20-25 mm olinishi mumkin. Qovurg'a balandligini xisoblaymiz.



$$h_p = \frac{N}{4 \cdot K_{uu} \cdot (\beta \cdot R_y^{cs})_{\min} \cdot \gamma} = \frac{3044.34}{4 \cdot 0.8 \cdot (0.7 \cdot 21.5) \cdot 1} = 63.21$$

$$h_p = 65 \quad \text{qabul qilamiz}$$

Qovurg'a qalinligi quyidagicha xisoblanadi.

$$t_p = \frac{N}{\sigma_{cm} \cdot R_{cm.m}} = \frac{3044.34}{30 \cdot 35} = 2.9$$

$$\sigma_{cm} = \sigma + 2 \cdot t_{on} = 25 + 2 \cdot 2.5 = 30$$

$$t_p = 30 \quad \text{qabul qilamiz}$$

$$D = h_2 - h_1 = 7.4 - 5.4 = 2$$

$$1\text{-var. } K = h_{\sigma\delta} + h_{mm} + t_m = 160 + 30 + 1 = 191$$

$$2\text{-var. } K = h_{\sigma\delta} + h_{em} + h_{mm} + t_m = 160 + 50 + 18 + 1 = 229$$

Агар $D > K$ булса тусинлар таяниши хисобини бажариши зарур эмас.

KURS LOYIXASI TOPSHIRIQLARI

Foydaoik me`yoriy yuklama

Oxirgi raqam	Oxirgidan oldingi raqam										
	0	1	2	3	4	5	6	7	8	9	
0	28,3	13,6	28,8	18,7	20,4	20,6	18,5	18,4	28,3	208	0
1	20,1	24,1	20,2	24,4	20,3	24,5	20,5	24,8	20,7	26,0	1
2	22,2	25,1	22,4	25,2	22,6	25,3	22,8	25,4	23,0	25,6	2
3	16,1	17,5	16,2	18,1	28,2	15,4	28,3	16,8	28,5	16,5	3
4	23,4	15,7	23,2	25,8	28,6	25,9	23,8	26,6	24,0	25,1	4
5	19,2	16,3	19,3	16,5	19,4	18,9	19,5	18,9	19,9	19,8	5
6	23,4	19,9	23,6	23,6	17,8	23,5	16,9	23,9	23,7	26,7	6
7	17,4	27,5	27,2	27,9	17,1	27,8	27,4	27,6	18,5	18,3	7
8	15,4	26,4	15,6	26,5	15,8	15,3	24,8	15,1	26,9	15,2	8
9	20,0	15,7	27,4	17,4	18,4	27,3	19,4	20,4	25,4	30,1	9
Oxirgi raqam	0	1	2	3	4	5	6	7	8	9	Oxirgi raqam
	Oxirgidan oldingi raqam										

Oraliq

Oxirgida n oldingi raqam	Oxirgi raqam										
	0	1	2	3	4	5	6	7	8	9	
0	16,4	14,0	17,7	17,8	20,6	18,2	18,1	20,1	21,1	21,8	0
1	15,2	15,0	18,0	14,5	10,2	10,0	12,2	13,6	14,2	9,8	1
2	15,3	9,6	16,0	11,4	15,5	11,0	11,6	11,3	13,7	14,8	2
3	15,4	9,9	17,0	14,4	16,6	12,0	12,2	12,4	13,3	14,0	3
4	15,6	10,9	19,0	21,0	17,0	12,6	13,2	12,8	13,9	10,0	4
5	15,7	10,4	18,3	21,4	17,3	10,2	18,2	18,8	18,9	19,1	5
6	16,8	19,3	20,0	21,8	17,4	10,3	16,9	18,4	18,6	10,8	6
7	15,9	11,2	18,0	19,2	17,6	16,4	16,5	18,3	18,5	19,5	7
8	16,1	20,5	20,0	14,6	19,4	20,2	17,1	17,9	13,7	20,3	8
9	16,8	20,9	18,0	21,0	19,6	20,4	17,3	17,5	19,9	20,7	9
Oxirgida n oldingi raqam	0	1	2	3	4	5	6	7	8	9	Oxirgida n oldingi raqam
	Oxirgi raqam										

Oxirgi ikkita raqam yig'indisi	Ustun qadami	Tusin ostigacha masofa (h_1)	To'shama ustigacha masofa (h_2)	Material, marka
0	6,4	4,8	7,0	Vst3ps5
1	6,0	5,4	7,4	Vst3ps2
2	6,6	6,8	8,6	Vst3ps6
3	7,0	6,0	8,0	Vst3Gps2
4	7,6	5,0	7,2	09G2S
5	8,0	6,5	8,6	10XNDP
6	6,6	4,3	6,3	15XSND
7	7,4	4,5	6,7	14G2AF
8	6,4	4,0	6,4	16G2AF
9	6,7	6,0	8,2	Vst3ps-6
10	6,0	5,6	7,6	Vst3ps-5
11	6,4	4,8	6,8	09G2S
12	5,8	6,2	8,4	10XNDP
13	6,0	7,4	9,2	10XSND
14	5,8	7,0	9,0	14G2AF
15	7,2	5,4	7,4	16G2AF
16	6,8	6,2	8,4	Vst3kp2
17	8,0	6,4	8,6	09G2S
18	7,0	5,8	7,9	15XSND

1-jadval.

δ	$\leq 0,8$	1	2	4	6	10	≥ 30
Скр	30	31,5	33,3	34,6	34,8	35,1	35,5

2-jadval.

δ	Значения С1 для сварных балок при a/h_0 , равном								
	$\leq 0,50$	0,60	0,80	1,00	1,20	1,40	1,60	1,80	2,00
≤ 1	11,5	12,4	14,8	18	22,1	27,1	32,6	38,9	45,6
2	12	13	16,1	20,4	25,7	32,1	39,2	46,5	55,7
4	12,3	13,3	16,6	21,6	28,1	36,3	45,2	54,9	65,1
6	12,4	13,5	16,8	22,1	29,1	38,3	48,7	59,4	70,4
10	12,4	13,6	16,9	22,5	30	39,7	51	63,3	76,5
≥ 30	12,5	13,7	17	22,9	31	41,6	53,8	68,2	83,6

3-jadval.

Балки	δ	Предельные значения σ/σ при a/h_0 , равном							
		0,80	0,90	1,00	1,20	1,40	1,60	1,80	$\geq 2,00$
Сварные	≤ 1	0	0,146	0,183	0,267	0,359	0,445	0,540	0,618
	2	0	0,109	0,169	0,277	0,406	0,543	0,652	0,799
	4	0	0,072	0,129	0,281	0,479	0,711	0,930	1,132
	5	0	0,066	0,127	0,288	0,536	0,874	1,192	1,468
	10	0	0,059	0,122	0,296	0,574	1,002	1,539	2,154
	≥ 30	0	0,047	0,112	0,300	0,633	1,283	2,249	3,939
На высокопрочных болтах	-	0	0,121	0,184	0,378	0,643	1,131	1,614	2,347

4-jadval.

b_1/a_1	1	1,1	1,2	1,3	1,4	1,5	1,6	1,7	1,8	1,9	2	2 дан катта
α	0,048	0,055	0,063	0,069	0,075	0,081	0,086	0,091	0,094	0,098	0,01	0,125

5-jadval.

b_2/a_2	0,5	0,6	0,7	0,8	0,9	1	1,2	1,4	2	2 дан катта
β	0,06	0,074	0,088	0,097	0,107	0,112	0,12	0,126	0,132	0,133

6-jadval.

Гибкость λ	Коэффициенты ϕ для элементов из стали с расчетным сопротивлением R , Мпа					
	200	240	280	320	360	400
10	0,988	0,987	0,985	0,984	0,983	0,982
20	0,967	0,962	0,959	0,955	0,952	0,949
30	0,939	0,931	0,924	0,917	0,911	0,905
40	0,906	0,894	0,883	0,873	0,863	0,854
50	0,869	0,852	0,836	0,822	0,809	0,796
60	0,827	0,805	0,785	0,766	0,749	0,721
70	0,782	0,754	0,724	0,687	0,654	0,623
80	0,734	0,686	0,641	0,602	0,566	0,532
90	0,665	0,612	0,565	0,522	0,483	0,447
100	0,599	0,542	0,493	0,448	0,408	0,369
110	0,537	0,478	0,427	0,381	0,338	0,306
120	0,479	0,419	0,366	0,321	0,287	0,26
130	0,425	0,364	0,313	0,276	0,247	0,223
140	0,376	0,315	0,272	0,24	0,215	0,195
150	0,328	0,276	0,239	0,211	0,189	0,171

Марки стали, расчетные сопротивления стали, сварных и болтовых соединений, МПа										Фасон бо`йича қаршилиқ
	ПО`лат маркаси	Прокат қалинлиги, мм	ГОСТ ёки ТУ	R^H / R_B^H	R	$R_{см.т}$	$R_{ср}$	$R_{уc}^{св}$	$R_{см}^{б*}$	
1	Вст3Гпс5	Лист 21-40	ГОСТ 380-71(с изм.)	225/370	215	350	125	165	450	
2	Вст3пс6	Лист 21-40		225/370	215	350	125	165	450	230
3	Вст3сп5	Лист 21-40		225/370	215	350	125	165	450	
4	Вст3кп2	Лист 4-20		225/365	215	350	125	165	440	
5	Вст3кп2	Лист 21-40		215/365	205	350	120	165	440	
6	Вст3кп2	Лист 41-100		205/365	195	350	115	165	440	225
		Фасон 4-20		235/365	225	350	130	165	440	
8	Вст3пс6-1	Лист 4-10	ТУ 14-1-3023-80	235/365	230	355	135	165	440	240
9	Вст3пс6-1	Лист 11-20		235/355	230	345	135	160	420	240
		Фасон 4-10		245/370	240	360	140	165	450	
		Фасон 11-20		245/365	240	365	140	165	440	
12	Вст3пс6-2	Лист 4-10		275/370	270	360	155	165	450	270
13	Вст3пс6-2	Лист 11-20		265/365	260	355	150	165	440	270
		Фасон 4-10		275/380	270	370	155	170	465	
		Фасон 11-20		275/370	270	360	155	165	450	
16	Вст3сп5-1	Лист 4-10		245/365	240	355	140	165	440	250
17	Вст3Гпс5-1	Лист 11-20		235/365	230	355	135	165	440	240
		Фасон 4-10		255/380	250	370	145	170	465	
		Фасон 11-20		245/370	240	360	140	165	450	
20	Вст3сп5-2	Лист 4-10		275/380	270	370	155	170	465	280
21	Вст3Гпс5-2	Лист 11-20	265/370	260	360	150	165	450	270	
		Фасон 4-10	285/390	280	380	160	175	485		
		Фасон 11-20	275/380	270	370	155	170	465		
24	09Г2С-гр.1	Лист 4-10	345/490	335	480	195	220	690		

25	09Г2С-гр.1	Лист 11-20		325/470	315	460	180	210	645	
26	09Г2С-гр.2	Лист 4-10		365/510	355	500	205	230	735	360
27	09Г2С-гр.2	Лист 11-20		345/490	335	480	195	220	690	345
		Фасон 4-10		370/520	360	505	210	235	760	
		Фасон 11-20		285/450	345	490	200	225	710	
30	09Г2С	Лист 21-32	ГОСТ 19282-73	305/460	290	480	170	205	625	310
31	09Г2С	Лист 33-60		285/450	270	430	155	200	605	345
32	10ХНДП	Лист 4-9	ГОСТ 19282-73	345/470	330	450	190	210	645	330
33	10ХНДП	Лист 10-16	ТУ 14-1- 1217-75	295/440	280	420	160	200	585	330
		Фасон 4-12	ТУ 14-1- 389-72	345/470	330	450	190	210	645	
35	15ХСНД	Лист 4-32	ГОСТ 19282-73	345/490	330	465	190	220	690	310
		Фасон 10-32	ГОСТ 19281-73	325/470	310	450	180	210	645	
37	14Г2АФ	Лист 4-50	ГОСТ 19282-73	390/540	400	515	215	245	805	400
38	16Г2АФ	Лист 4-32		440/590	400	535	230	265	930	400
39	16Г2АФ	Лист 33-50		410/570	375	520	220	255	880	

профил номери	1 музунасининг оғирлиги кг	Ўлчамлари										Кесим юзаси см ²	Ўқларнинг сарafka милдори					
		h	b	d	t	R	r	X-X			У-У							
								мм	мм	мм	мм		мм	мм	мм	мм		
706	184	700	210	17,5	28,2	24	10	175370	5010	27,4	2940	3910	373	4,09				
70a	158	700	210	15	24	24	10	152700	4360	27,5	2550	3240	309	4,01				
70	138	700	210	13	20,8	24	10	134600	3840	27,7	2230	2730	260	3,94				
65	120	650	200	12	19,2	22	9	101400	3120	25,8	1800	2170	217	3,77				
60	104	600	190	11,1	17,8	20	8	75450	2510	23,9	1450	1720	181	3,6				
55	89,8	550	180	10,3	16,5	18	7	55150	2000	22	1150	1350	150	3,44				
50	76,8	500	170	9,5	15,2	17	7	39290	1570	20	905	1040	122	3,26				
45	65,2	450	160	8,6	14,2	16	7	27450	1220	18,2	699	807	101	3,12				
40	56,1	400	155	8	13	15	6	18930	947	16,3	540	666	85,9	3,05				
36	48,6	360	145	7,5	12,3	14	6	13380	743	14,7	423	516	71,1	2,89				
33	42,2	330	140	7	11,2	13	5	9840	597	13,5	339	419	59,9	2,79				
30a	39,2	300	145	6,5	10,7	12	5	7780	518	12,5	292	436	60,1	2,95				
30	36,5	300	135	6,5	10,2	12	5	7080	472	12,3	268	337	49,9	2,69				
27a	33,9	270	135	6	10,2	11	4,5	5500	407	11,3	229	337	50	2,8				
27	31,5	270	125	6	9,8	11	4,5	5010	371	11,2	210	260	41,5	2,54				
24a	29,4	240	125	5,6	9,8	10,5	4	3800	317	10,1	178	260	41,6	2,63				
24	27,3	240	115	5,6	9,5	10,5	4	3460	289	9,97	163	198	34,5	2,37				
22a	25,8	220	120	5,4	8,9	10	4	2790	254	9,22	143	206	34,3	2,5				
22	24	220	110	5,4	8,7	10	4	2550	232	9,13	131	157	28,6	2,27				
20a	22,7	200	110	5,2	8,6	9,5	4	2030	203	8,37	114	155	28,2	2,32				
20	21	200	100	5,2	8,4	9,5	4	1840	184	8,28	104	115	23,1	2,07				
18a	19,9	180	100	5,1	8,3	9	3,5	1430	159	7,51	89,8	114	22,8	2,12				
18	18,4	180	90	5,1	8,1	9	3,5	1290	143	7,42	81,4	82,6	18,4	1,88				
16	15,9	160	81	5	7,8	8,5	3,5	873	109	6,57	62,3	58,6	14,5	1,7				
14	13,7	140	73	4,9	7,5	8	3	572	81,7	5,73	46,8	41,9	11,5	1,55				
12	11,5	120	64	4,8	7,3	7,5	3	350	58,4	4,88	33,7	27,9	8,72	1,38				
10	9,46	100	55	4,5	7,2	7	2,5	198	39,7	4,06	23	17,9	6,49	1,22				

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