“TOSHKENT IRRIGATSIYA VA QISHLOQ XO‘JALIGINI MEXANIZATSIYALASH MUHANDISLARI INSTITUTI” MILLIY TADQIQOT UNIVERSITETI

Fan: Materiallar qarshiligi

Mavzu 08 Siljish deformatsiyasi

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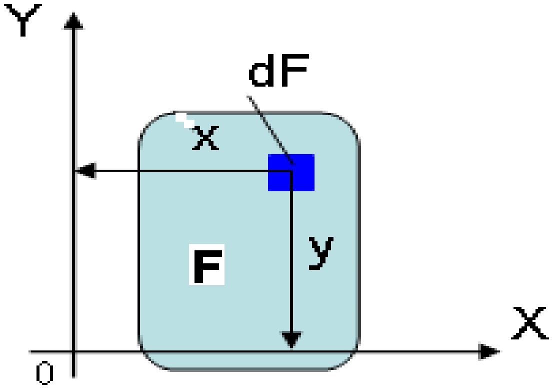
Mexanika va kompyuterli modellashtirish kafedrasi dotsenti

Reja:

1. Sof siljish haqida tushuncha.
2. Sof siljishda guk qonuni. Cho'zilish va siljishda elastiklik modullari o'rtasidagi bog'lanish.
3. Siljishga ishlaydigan birikmalarning amaliy hisobi.

Tekis shakllarning statik va inertsiya momentlari



1-rasm

$$S_x = \int_F y dF \qquad S_y = \int_F x dF \qquad (1)$$

$$S_x = F \cdot Y_c, \quad S_y = F \cdot X_c \qquad (2)$$

$I_x = \int_F y^2 dF$ - tekis shaklning x o'qiga nisbatan inertsiya momenti; (3)

$I_y = \int_F x^2 dF$ - tekis shaklning u o'qiga nisbatan inertsiya momenti; (4)

$I_{xy} = \int_F xy dF$ - tekis shaklnig markazdan kochirma inertsiya momenti; (5)

$I_\rho = \int_F \rho^2 dF$ - tekis shaklning qutb inertsiya momenti. (6)

Oddiy shakllarning inersiya va qarshilik momentlari (markazdan o'tgan o'qlarga nisbatan)

a) *To'gri to'rtburchak:*

$$I_X = \int_{-h/2}^{h/2} bY^2 dY = b\int_{-h/2}^{h/2} Y^2 dY = \frac{bh^3}{12}$$

$$I_Y = \int_{-b/2}^{b/2} hX^2 dX = h\int_{-b/2}^{b/2} X^2 dX = \frac{hb^3}{12}$$

b)*Kvadrat:*

$$I_x = I_y = \frac{a^4}{12}$$

v) *Uchburchak:*

$$I_x = \frac{bh^3}{36}$$

$$I_y = \frac{bh^3}{48}$$

g) *Doira:*

$$I_P = \int_F \rho^2 dF = 2\pi \int_0^{d/2} \rho^3 d\rho = \frac{2\pi d^4}{64} = \frac{\pi d^4}{32}$$

$$I_X = I_Y = \frac{I_P}{2} = \frac{\pi d^4}{64}$$

d) *Xalqa:*

$$I_P = \int_A \rho^2 dF = 2\pi \int_{d_1/2}^{d/2} \rho^3 d\rho = \frac{2\pi d^4}{64} - \frac{2\pi d_1^4}{62} = \frac{\pi d^4}{32}\left(1 - \frac{d_1^4}{d^4}\right) = \frac{\pi d^4}{32}\left(1-\alpha^4\right)$$

$$I_X = I_Y = \frac{I_P}{2} = \frac{\pi d^4}{64}\left(1-\alpha^4\right)$$

a) To'gri to'rtburchak:

$$W_x = \frac{I_x}{Y_{\max}} = \frac{\frac{bh^3}{12}}{\frac{h}{2}} = \frac{bh^2}{6}; \quad W_x = \frac{bh^2}{6}(sm^3)$$

$$W_y = \frac{hb^2}{6}(sm^3)$$

b) Kvadratda:

$$W_x = W_y = \frac{a^3}{6}\left(sm^3\right)$$

v) Doira:

$$W_x = W_y = \frac{\pi d^3}{32}\left(sm^3\right)$$

$$W_p = \frac{\pi d^3}{16}\left(sm^3\right)$$

g) Xalqa:

$$W_x = W_y = \frac{\pi D^3}{32}(1-\alpha)\left(sm^3\right)$$

$$W_p = \frac{\pi D^3}{16}\left(1-\alpha^4\right)\left(sm^3\right)$$

Parallel o‘qlarga nisbatan inersiya momentlari o’rtasidagi bog’lanish

$$x_1 = x + b, y_1 = y + a \qquad I_X = \int_F Y^2 dF; \quad S_X = \int_F Y dF = 0; \quad F = \int_F dF$$

$$I_{x_1} = \int_F y_1^2 \cdot dF, \qquad I_{y_1} = \int_F x_1^2 \cdot dF, \qquad I_{x_1 y_1} = \int_F x_1 \cdot y_1 \cdot dF$$

$$I_{x_1} = \int_F Y_1 dF = \int_F (y+a)^2 dF = \int_F y^2 dF + 2a\int_F y dF + a^2 \int_F dF = I_x + 2aS_x + a^2 \cdot F$$

$$\int_F y dF = S_x, \int_F x dF = S_y, \int_F dF = F$$ bulganligi uchun

$$I_{x_1} = I_x + a^2 \cdot F, \quad I_{y_1} = I_y + b^2 \cdot F,$$

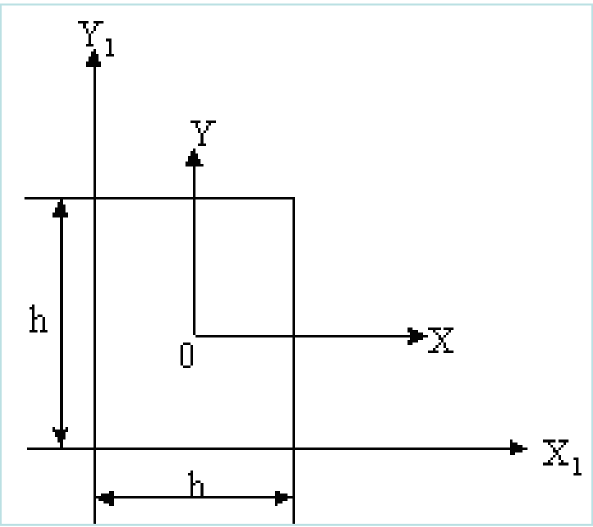
$$I_{x_1 y_1} = I_{xy} + a \cdot b \cdot F, \quad I_{\rho_1} = I_\rho + \left(a^2 + b^2\right) \cdot F$$

Misol:

Berilgan: h=4 sm

b=2 sm, F=bh=8 sm^2

$$I_x = \frac{bh^3}{12} = \frac{2 \cdot 4^3}{12} = \frac{96}{12} = 8\ (sm^4)$$



$$I_y = \frac{b^3 h}{12} = \frac{2^3 \cdot 4}{12} = \frac{32}{12} = 2{,}667\ (sm^4)$$

$$I_{x_1} = I_x + \left(\frac{h}{2}\right)^2 \cdot F = \frac{bh^3}{12} + \left(\frac{h}{2}\right)^2 \cdot b \cdot h = \frac{2 \cdot 4^3}{12} + \left(\frac{4}{2}\right)^2 \cdot 2 \cdot 4 =$$
$$= 8 + 32 = 40\ (sm^4)$$

$$I_{y_1} = I_y + \left(\frac{b}{2}\right)^2 \cdot F = \frac{hb^3}{12} + \left(\frac{b}{2}\right)^2 b \cdot h = \frac{4 \cdot 2^3}{12} + \left(\frac{2}{2}\right)^2 \cdot 2 \cdot 4 = 2{,}667 + 8 = 10{,}667\ (sm^4)$$

Bosh inersiya o‘qlari va bosh inersiya momentlari

Bosh inersiya momentlari o’qlardan biriga nisbatan *max* bo’lsa, ikkinchisiga nisbatan *min* bo’ladi va qo’yidagicha topiladi:

$$I_{\frac{max}{min}} = \frac{I_x + I_y}{2} \pm \frac{1}{2}\sqrt{\left(I_x - I_y\right)^2 + 4I_{xy}^2}$$

Bosh o’qlarning vaziyati quyidagi formula orqali topiladi:

$$tg2\alpha = \frac{2I_{xy}}{I_y - I_x}$$

Quyidagi kattaliklar tekis shaklning o‘qlarga nisbatan inersiya radiuslari deyiladi.

$$i_x = \sqrt{\frac{I_x}{F}}, \quad i_y = \sqrt{\frac{I_y}{F}}, \quad (sm)$$

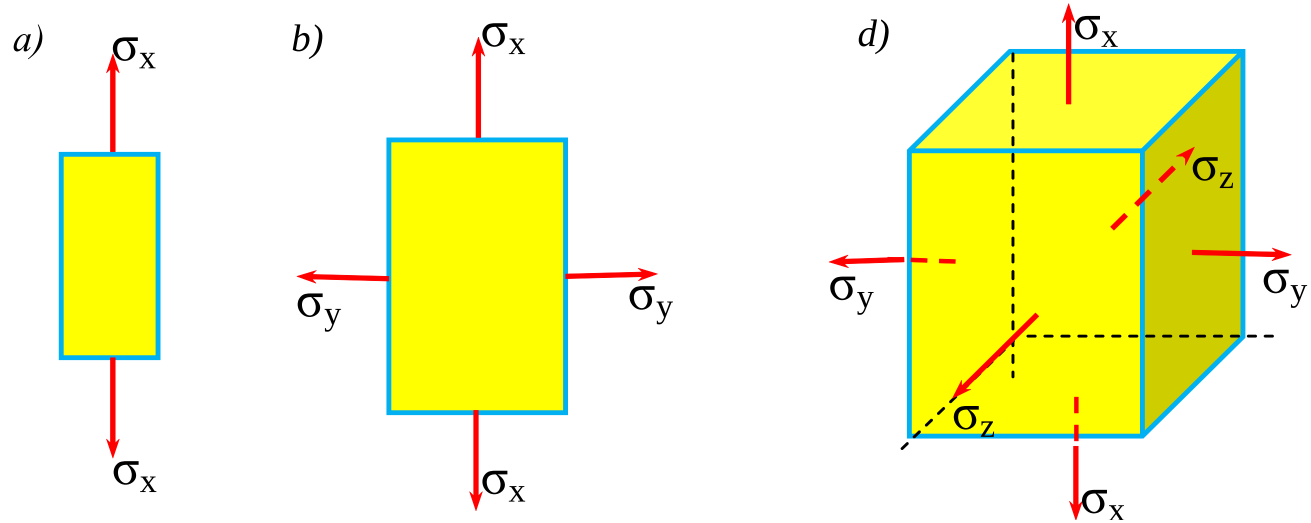
Nuqtadagi kuchlanish xolati to'g'risida tushuncha va uning turlari.

Nuqtaning kuchlanish xolati deb, shu nuqta orkali o'tkaziladigan barcha yuzalarda paydo bo'ladigan kuchlanishlar to'plamiga aytiladi. nuqtaning kuchlanish xolati uch turga bo'linadi, ya'ni:

a). Agar $\sigma_x \neq 0$; $\sigma_y = \sigma_z = 0$; bo'lsa bunday kuchlanganlik xolati ***chiziqli yoki bir o'qli*** kuchlanganlik xolati deyiladi

b). $\sigma_x \neq 0$; $\sigma_y \neq 0$; $\sigma_z = 0$; bo'lsa ***tekis yoki ikki o'qli*** kuchlanganlik xolati deb yuritiladi

d). Agar $\sigma_x \neq 0$; $\sigma_y \neq 0$; $\sigma_z \neq 0$. bo'lsa ***xajmiy yoki uch o'qli*** kuchlanganlik xolati deb yuritiladi



1 rasm

Agar ko'rilayotgan nuqta atrofidan shunday parallelepiped ajratish mumkin bo'lsaki, uning barcha qirralarida kuchlanishlar mavjud bo'lsa, bunday kuchlanish holati hajmiy yoki **fazoviy kuchlanish holati** deyiladi

Agar ajratilgan parallelepipedning ikkita qarama-qarshi qirralari kuchlanishdan holi bo'lsa, bunday kuchlanish holati tekis to'rtta qarama-qarshi qirralari kuchlanishdan holi bo'lsa **chiziqli kuchlanish holati** deb ataladi.

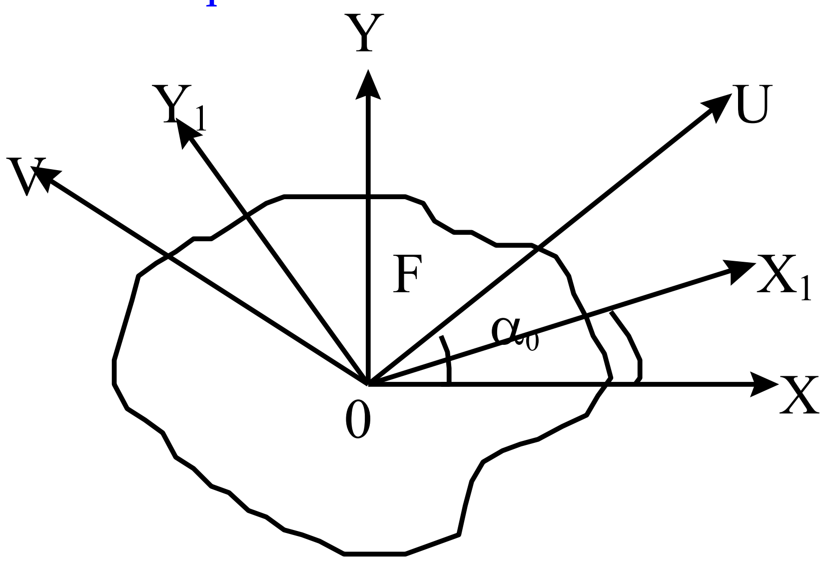
Bu yuzachalar bosh yuzachalar deyilib, unda hosil bo'lgan kuchlanishlar esa **bosh kuchlanishlar** deb ataladi (shunday natija tekis kesimlarning inertsiya momentlarida ham olingan edi).

Bosh yuzalar va bosh kuchlanishlar. muhandislik konstruktsiyalarini hisoblaganda nuqta orqali o'tgan barcha yuzalarda hosil bo'ladigan kuchlanishlarni bilish shart emas, faqat kuchlanishlarning eng katta va kichik qiymatlarini aniqlash etarli. Shuning uchun bosh kuchlanishlarni va bu kuchlanishlar hosil bo'layotgan bosh yuzalarni aniqlash asosiy masalalardan biri bo'ladi. Tekshirilayotgan nuqtadan o'tuvchi bosh yuzachalar σ_z, σ_y kuchlanishga ega bo'lgan yuzachalarga nisbatan α burchakka burilgan bo'lsin. Ixtiyoriy qiya yuzada hosil bo'ladigan kuchlanish σ_α ni α burchak funktsiyasi ((5.5)ga asosan) deb qarab, α bo'yicha birinchi tartibli hosila

$$tg2\alpha_0 = \frac{2\tau_z}{\sigma_z - \sigma_y}$$

Bosh inersiya o'qlari va bosh inersiya momentlari

Bosh inersiya o'qlari va bosh inersiya momentlar formulalardan kurinib turibdiki tekis shaklning I_{X1}, I_{Y1}, I_{X1Y1} inersiya momentlarining qiymatlari α burchakka bog'lik bulib, uning o'qlarga nisbatan olingan inersiya momentlarning yigindisi har doim o'zgarmas miqdor bo'lar ekan.



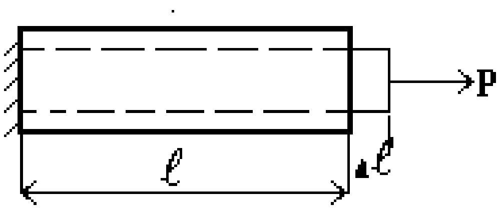
$$I_{x_1} = I_x \cdot \cos^2\alpha + I_y \cdot \sin^2\alpha - I_{xy}\sin 2\alpha$$

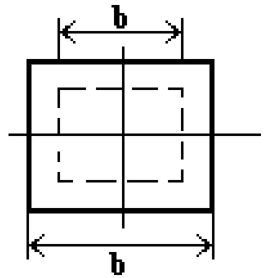
$$I_{y_1} = I_y \cdot \cos^2\alpha + I_x \cdot \sin^2\alpha + I_{xy}\sin 2\alpha$$

$$I_{x_1y_1} = \frac{I_x - I_y}{2}\sin 2\alpha + I_{xy}\cdot\cos 2\alpha$$

Umumlashtirilgan GUK qonuni.

*Chiziqli kuchlanish holatida Guk qonuni:

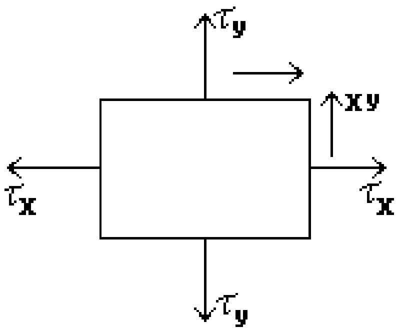




$$\varepsilon = \frac{\Delta \ell}{\ell} \quad \varepsilon^{1} = -\frac{\Delta b}{b}, \qquad \Delta b = b - b_1$$

$$\varepsilon = \frac{\sigma}{\mathrm{E}}, \quad \varepsilon^{1} = -\mu \frac{\sigma}{\mathrm{E}} \qquad \left| \frac{\varepsilon^{'}}{\varepsilon} \right| = \mu$$

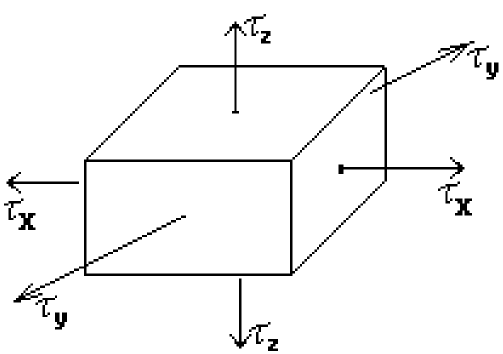
*Tekis kuchlanish holatida Guk qonuni:



$$\varepsilon_X = \frac{1}{\mathrm{E}}\left(\sigma_X - \partial \sigma_y\right) \qquad \gamma_{Xy} = \frac{1}{G}\tau_{Xy} \qquad G = \frac{\mathrm{E}}{\eta(1+\partial)}$$

$$\varepsilon_y = \frac{1}{\mathrm{E}}\left(\sigma_y - \partial \sigma_X\right)$$

*Hajmiy kuchlanish holati:



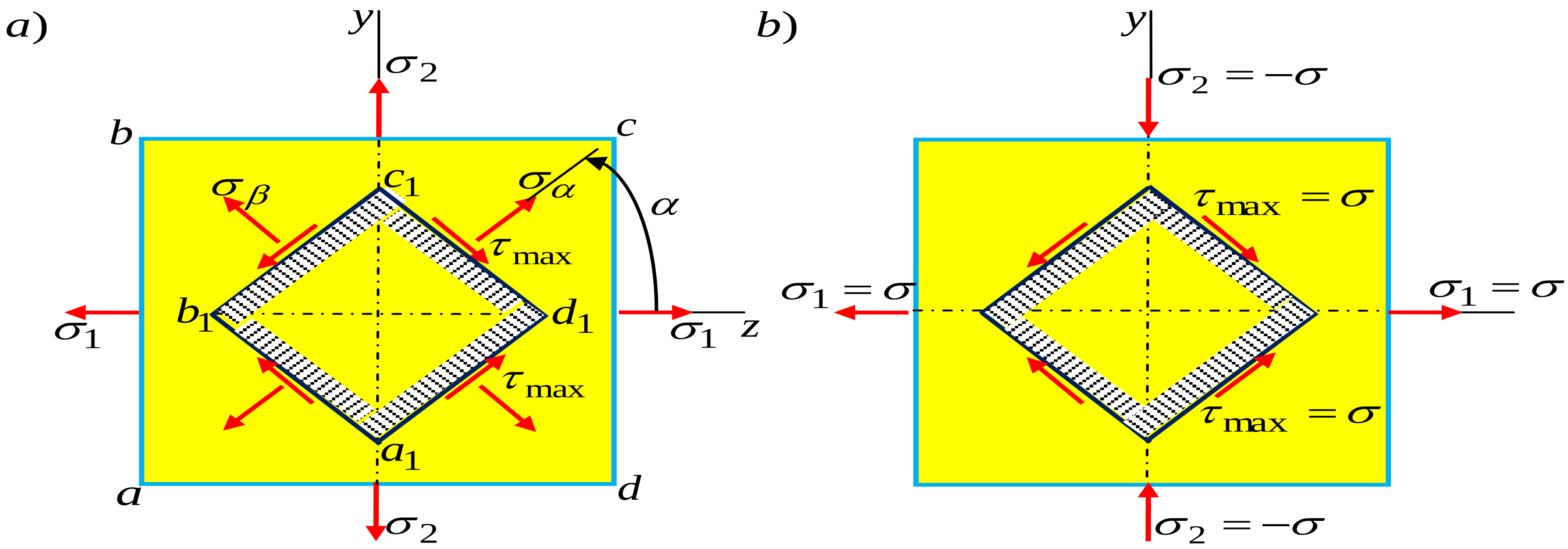
$$\varepsilon_X = \frac{1}{\mathrm{E}}\left[\sigma_X - \partial\left(\sigma_y + \sigma_Z\right)\right]$$

$$\varepsilon_y = \frac{1}{\mathrm{E}}\left[\sigma_y - \partial\left(\sigma_X + \sigma_Z\right)\right] \qquad \gamma_{Xy} = \frac{1}{G}\tau_{Xy}$$

$$\varepsilon_Z = \frac{1}{\mathrm{E}}\left[\sigma_Z - \partial\left(\sigma_X + \sigma_y\right)\right]$$

1. Nuqtaning deformatsiyalangan holatini tekshirganda parallelopipedning shunday holati mavjudligini ya'ni uning yuzalariga faqat urinma kuchlanishlar ta'sir qilishini ko'rgan edik.

Sof siljish deganda - ma'lum yo'nalishlarda olingan o'zaro perpendiko'lyar ikkita yuzachaga faqat urinma kuchlanishlargina ta'sir etadigan tekis kuchlanish va deformatsiyalanish holati tushuniladi. Bu yuzachalar sof siljish yuzachalari deyiladi.

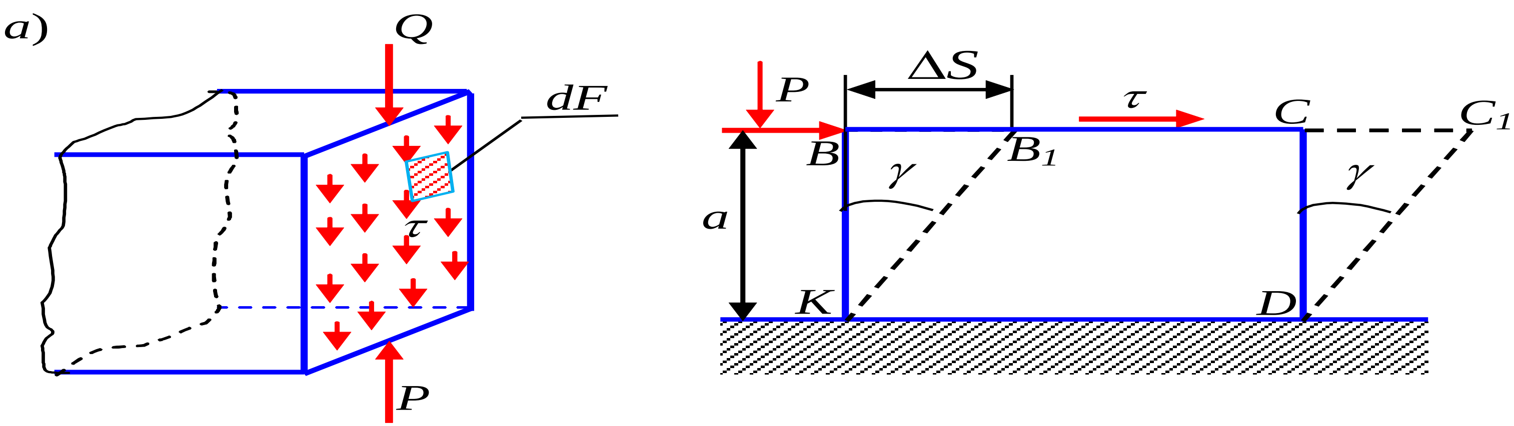


element Y o'qi bo'yicha cho'zilishda (σ_2) va **z** o'qi bo'yicha siqilishda (σ_1) bo'lsin $(\sigma_1=-\sigma_1=\sigma)$. U holda element tomonlariga 45^0 ostida joylashgan qiya yuzalarda quyidagicha kuchlanishlar hosil bo'ladi:

$$\sigma_\alpha = \sigma_1 cos^2\alpha + \sigma_2 \sin^2\alpha = \frac{1}{2}\sigma - \frac{1}{2}\sigma = 0$$

$$\tau_\alpha = \frac{\sigma_1 - \sigma_2}{2}\sin 2\alpha = \frac{\sigma + \sigma}{2} = \sigma$$

Yoqlariga faqat urinma kuchlanishlar ta'sir qiladigan elementning kuchlanganlik holati sof siljish deyiladi. Sof siljish natijasida elementning shakl o'zgarib, quyidagicha nisbiy deformatsiyalar hosil bo'ladi:



Sof siljish ta'siridan element o'lchamlari o'zgarmaydi, faqat uning shakli o'zgarib romb shakliga keladi. Absolyut siljish ***ΔS*** xarfi bilan belgilanadi.

γ **-** burchak esa siljish burchagi yoki nisbiy siljish deyiladi. ***γ = ΔS/a*** ljish burchagi asosan radianlarda ifodalanadi. Nisbiy deformatsiya bilan siljish burchagi orasidagi bog'lanish element deformatsiyasi natijasida quyidagicha ifodalanadi:

$$\varepsilon_1 = -\varepsilon_3 = \varepsilon = \frac{1}{E}\left[\sigma_1 - \mu(-\sigma_3)\right] = \frac{\sigma}{E}(1+\mu)$$ u holda $$\varepsilon = \frac{\tau}{E}(1+\mu)$$ ni hosil qilamiz.

$\varepsilon = \gamma/2$ Bu qiymatni formulaga qo'yib, siljish uchun guk qonuni hosil qilamiz:

$$\tau = \frac{E}{2(1+\mu)} \cdot \gamma = \gamma \cdot G$$

bu yerda ***G*** materialning siljishdagi elastiklik moduli yoki ikkinchi tur elastiklik moduli deyiladi. Bu ifoda jism elastiklik modullari orasidagi bog'lanishni ifodaladi.

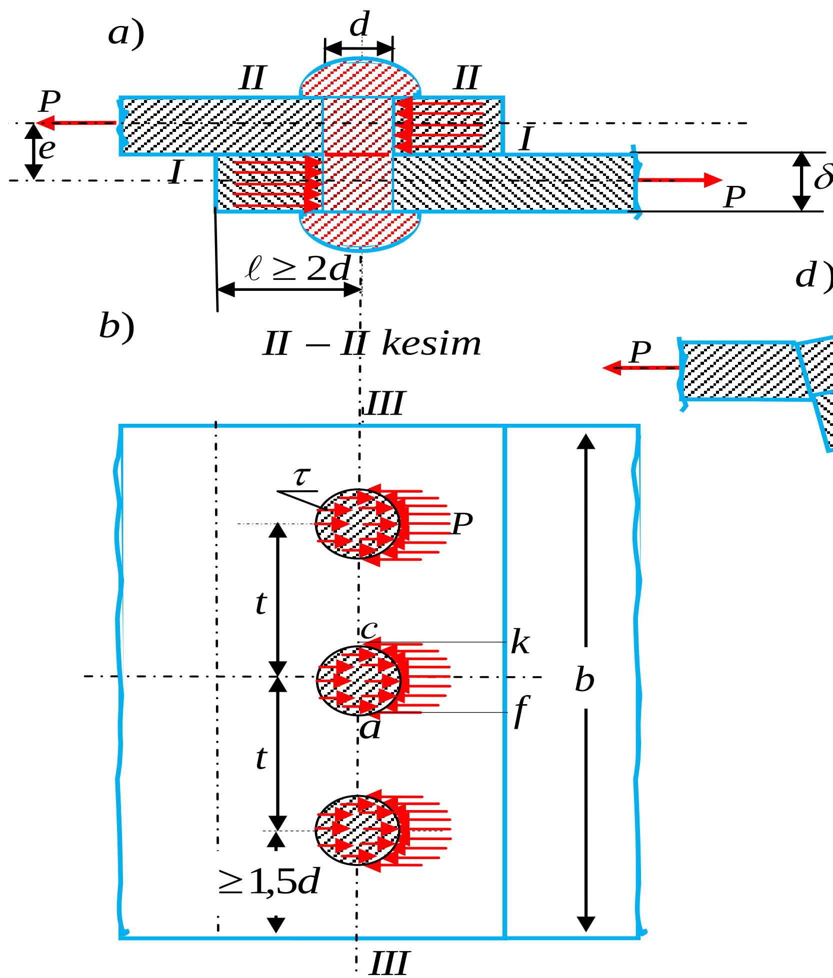
$$G = \frac{E}{2(1+\mu)}$$

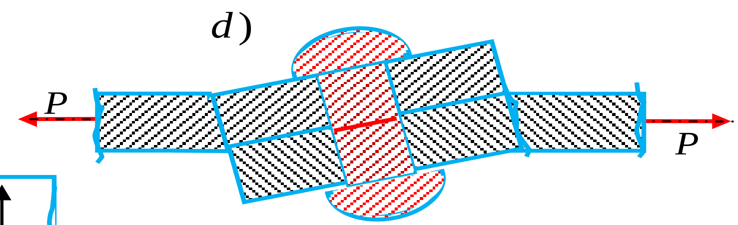
Demak siljish uchun guk qonuni quyidagicha bo'ladi: $\boldsymbol{\tau = G \cdot \gamma}$

Masalan ***"G"*** pulat uchun: $G = \frac{E}{2(1+\mu)} = \frac{2\cdot 10^6}{2(1+0.25)} = \frac{2\cdot 10^6}{2\cdot 1{,}25} = 8\cdot 10^5 \; kg/sm^2$

$$\Delta S = \frac{Q\cdot a}{G\cdot F} \quad (sm)$$ - siljishdagi obsolyut deformatsiya

3. Parchin mixli birikmalar hisobi. parchin mixli birikmalarning parchin mixlari siljishga, ulanuvchi listlarning devorlari ezilishga hisoblanadi.





$$\tau = \frac{P}{nF_m} = \frac{P}{n\dfrac{\pi d^2}{4}} \le [\tau]$$

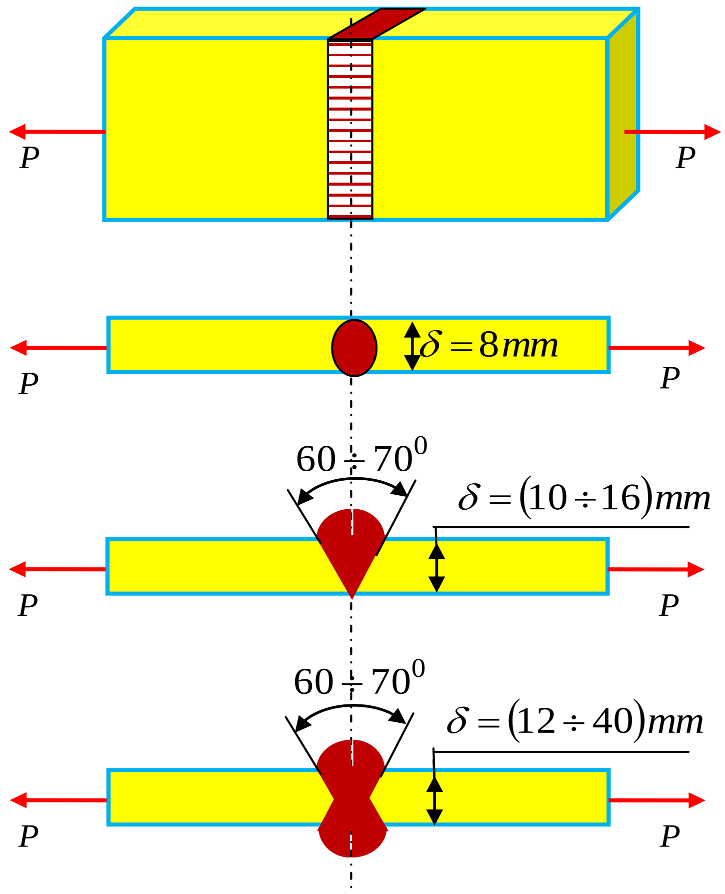
bu erda n - parchin mixlar soni;

$[\tau]$ - parchin mix materiali uchun ruxsat etilgan urinma kuchlanish.

Payvand birikmalar hisobi. Payvand birikmalarning choklari siljishga hisoblanadi.

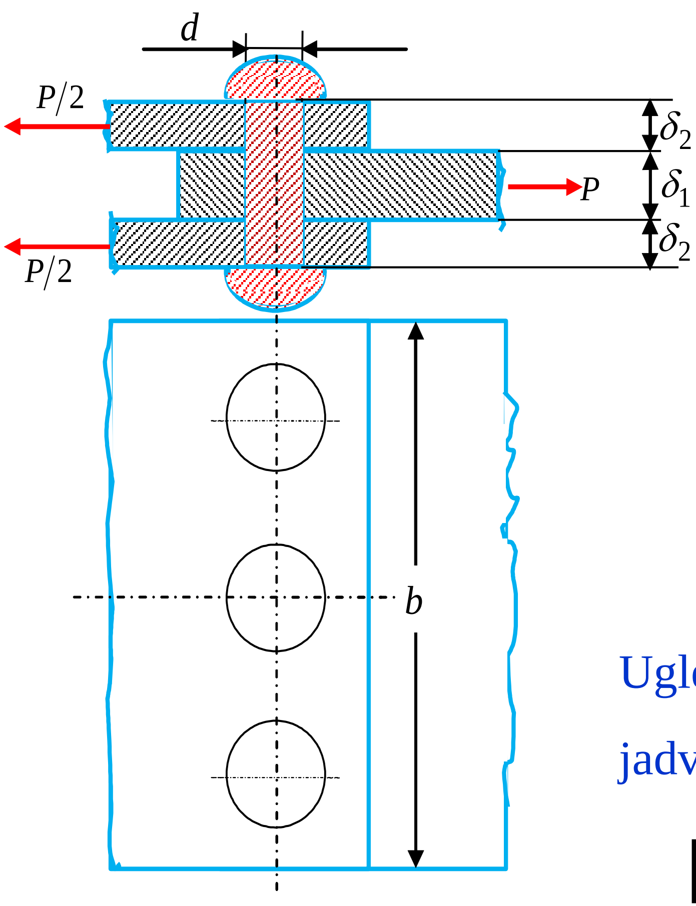
$$\tau = \frac{P}{0{,}7t(l_1 + l_2)} \leq [\tau_{эл}]$$

bu erda t - payvand chokining balandligi, l_1, l_2 - choklarning uzunliklari $[\tau_{el}]$ - ruxsat etilgan urinma kuchlanish.



1-Misol. Cho‘zuvchi kuchlar ta’sirida bo‘lgan po‘lat 2 rusumli materialdan tayyorlangan konstruksiya quyidagi chizmada keltirilgan. Konstruksiya elementlar: parchin mixlar mustahkamlikka, ezilishga va polosalar uzilishga tekshirilsin.

Berilganlar: $P = 10\,kN;\quad \delta_1 = 5\,mm;\quad \delta_2 = 3\,mm;\quad b = 50\,mm;\quad \sigma_T = 230\,MPa.$



Ustma ust qo‘yilgan ikki kesimli parchin mixli birikma.

Yechish. Mexanik xarakteristikalar–oquvchanlik chegarasi va loyihalash me’yoriy koeffitsienti bo’yicha ruxsat etilgan kuchlanishni aniqlaymiz:

$$[\sigma_{ch}] = \frac{\sigma_T}{n} = \frac{230}{1,5} \approx 160\,MPa;$$

$$[\tau_{kes}] = 0,6[\sigma] = 96\,MPa;$$

$$[\sigma_{ez}] = (2 \div 2,50,6)[\sigma_r] = (2 \div 2,50,6)\cdot 160 = (320 \div 400)\,MPa;$$

Uglerodli po‘lat material uchun ruxsat etilgan kuchlanishlarni jadvaldan quyidagilarni qabul qilish tavsiya etilgan:

$$[\sigma_{ch}] = 115\,MPa;\quad [\tau_{kes}] = 70\,MPa;\quad [\sigma_{ez}] = 175\,MPa.$$

Hisoblash ishlarda kesilish uchun berilgan yuqorida berilgan ruxsat etilgan kuchlanishning $[\tau_{kes}] = 96MPa$; $[\tau_{kes}] = 70MPa$ eng kichik ruxsat etilgan kuchlanishni $[\tau_{kes}] = 70MPa$ qabul qilamiz.

Parchin mixlarning ko‘ndalang kesimi yuzasini, uning siljishdagi mustahkamlik sharti $\tau = \dfrac{Q}{F_{kes}} \leq [\tau]$ dan foydalanib aniqlaymiz.

Chizmadan ko‘rinadiki, parchin mix sterjeni ikkita tekislik bo‘yicha kesilishga ishlaydi, unda sterjenning o‘rta qismi chap tomonga siljiydi.

Unda konstruksiyadagi parchin mixlar kesilish tekisliklarini yuzalari yig‘indisi quyidagiga teng deb qarash mumkin: $F_{kes} = \dfrac{\pi d^2}{4} m \cdot n$

Siljishdagi mustahkamlik shartidan parchin mix diametrini aniqlash mumkin

$$\tau = \frac{Q}{\frac{\pi d^2}{4}} \leq [\tau]; \qquad d \geq \sqrt{\frac{4Q}{\pi \cdot m \cdot n \cdot [\tau]}}.$$

Qaralayotgan konstruksiya uchun parchin mixlarning kesilish tekisliklar soni $m=2$, parchin mixlar soni $n=3$ teng. Unda diametri:

$$d \geq \sqrt{\frac{4\cdot 10000}{3{,}14\cdot 2\cdot 3\cdot 70\cdot 10^{6}}} = 0{,}004997\ m.$$

Parchin mix diametrini $d = 5\,mm$ ga teng deb qabul qilamiz.

Parchin mixning ezilishda ishlashdagi mustahkamligini tekshirib ko‘ramiz:

$$\sigma_{ez} = \frac{P}{F_{ez}} \leq [\sigma_{ez}]$$

Bu yerda F_{ez} parchin mixning diametrik ezilish tekisligini ifodalaydi va u quyidagiga teng bo‘ladi:

$$F_{ez} = d\cdot\delta_1\cdot n = 5\cdot 5\cdot 3 = 75\,mm^2.$$

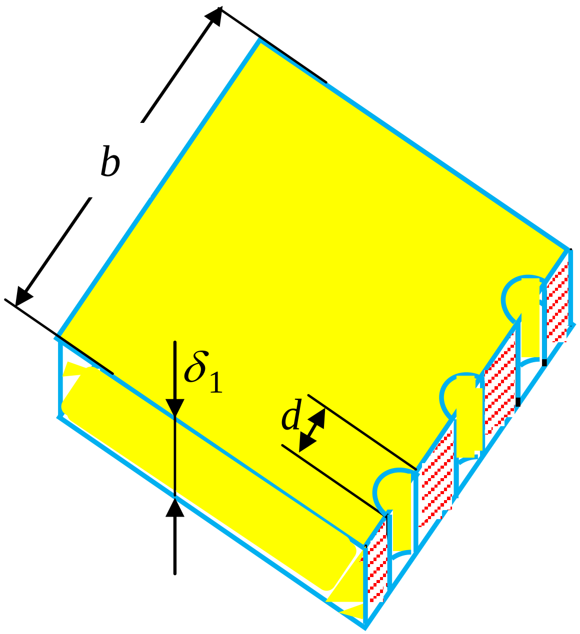
Unda:

$$\sigma_{ez} = \frac{P}{F_{ez}} = \frac{10000}{75} = 133{,}333\,MPa.$$

$$\frac{175-133{,}333}{175}100\% = 23{,}81\%.$$

Demak, parchin mixlarning ezilishda mustahkamligi ta’minlangan.

Polosalar parchin mixlar joylashadigan teshiklar bilan zaiflashtiriladi, unda teshiklar joylashgan kesimi eng kichik ishchi kesim bo‘lib, u xavfli kesim hisoblanadi quyidagi chizmada.



Polosaning ko‘ndalang kesimi.

Polosaning zaiflashgan kesim yuzasi quyidagi formuladan aniqlanadi:

$$F_{uzi} = b \cdot \delta_1 - n \cdot d \cdot \delta_1 = \delta_1 (b - n \cdot d) = 5(50 - 5 \cdot 5) = 175\, mm^2.$$

Unda kuchlanish

$$\sigma_{uzi} = \frac{P}{F_{uzi}} = \frac{10000}{175} = 57{,}1 MPa.$$

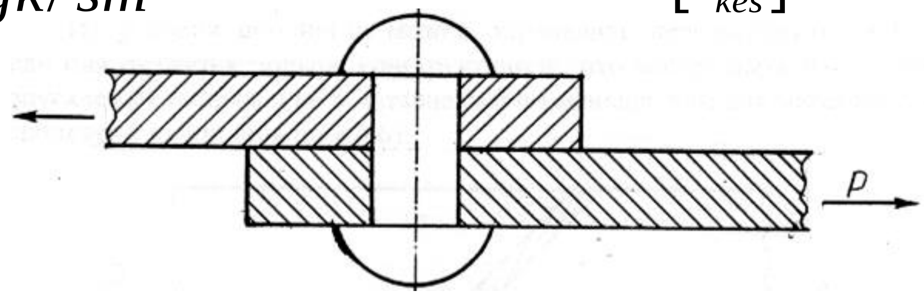
$$\frac{115 - 57{,}1}{115} 100\% = 50{,}35\%.$$

Demak, polosalarning uzilishga mustahkamligi ta’minlangan.

Xulosa: Ikki diametridan kesiluvchi parchin mix diametri siljishdagi mustahkamlik shartidan tanlab olindi. Polosalar uzilishga va parchin mixlarning ezilishga qarshilik ko‘rsatish shartlarining bajarilishi aniqlandi.

2-Misol. Qalinligi *t = 10 mm*, uzunligi *40 sm* bo‘lgan ikkita list diametri *d = 20 mm* bo‘lgan parchin mixlar yordamida biriktirilgan. Siljituvchi kuch *P = 20 tk*. Teshik parmalab teshilgan, parchin mix materiali *St. 2,* listlar ustma – ust mahkamlangan. Bu birikma mustahkamligini ta’minlash uchun parchin mixlar soni topilsin.

$$[\sigma_{ch}] = 2800\ kgk/sm^2 \qquad [\tau_{kes}] = 1400\ kgk/sm^2$$



Kesilishdaga nisbatan mustahkamlik shartidan parchin mixlarning soni:

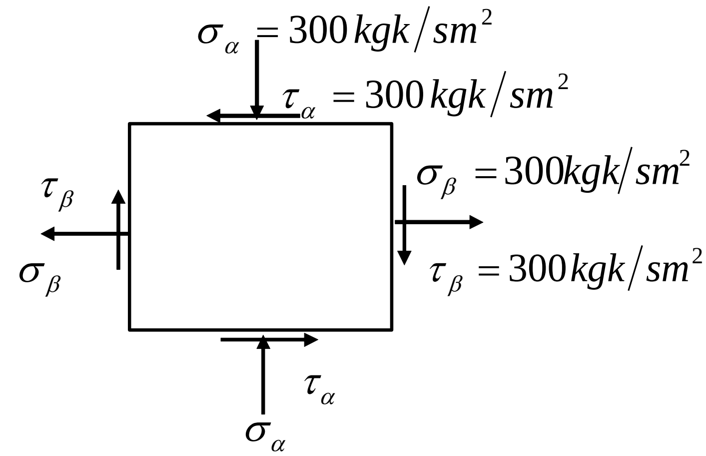
$$n = \frac{P}{F \cdot [\tau_{kes}]} = \frac{20000}{3{,}14 \cdot 1400} = 4$$ dona, bunda $$F = \frac{\pi d^2}{4} = 3{,}14\ sm^2$$

Ezilishdagi mustahkamlik shartidan:

$$n = \frac{P}{F_{ez} \cdot [\sigma_{ez}]} = \frac{20000}{2 \cdot 12800} \approx 3{,}6 = 4$$ dona, bunda $$F_{ez} = t \cdot d = 1 \cdot 2 = 2\ sm$$

Bundan ko‘rinadiki yuqoridagi birikmada parchin mixlarning sonini kesilish shartidan ***n = 5 ta*** deb olish kerak.

3-Misol. Sof siljish holatidagi materiali po‘latdan bo‘lgan parallelepiped tomonlarining nisbiy siljish burchagi va solishtirma potensial energiyasi topilsin (1-shakl).



1-shakl

Echish: Parallelepipedning materiali po‘latdan bo‘lganligi uchun cho‘zilishdagi elastiklik moduli $E = 2 \cdot 10^6\, kgk/sm^2$, Puasson koeffitsienti $\mu = 0{,}25$ bo‘lganda siljishdagi elastiklik G modulini hisoblaymiz.

$$G = \frac{E}{2(1+\mu)} = \frac{2 \cdot 10^6}{2(1+0{,}25)} = 8 \cdot 10^5\, kgk/sm^2$$

Siljishdagi **Guk qonuni**dan foydalanib nisbiy siljish burchagini topamiz:

$$\gamma = \frac{\tau}{G} = \frac{300}{8 \cdot 10^5} = 3{,}75 \cdot 10^{-4}$$

Solishtirma potensial energiyani hisoblaymiz:

$$u = \frac{\tau^2}{2G} = \frac{(300)^2}{2 \cdot 8 \cdot 10^5} = 0{,}05625\, \kappa gk/sm^2$$

O'z-o'zini tekshirish savollari:

1.Qanday kuchlanish holatiga sof siljish deyiladi?

2. Siljishda Guk qonuni qanday ifodalanadi?

3.Bo‘ylama elastiklik moduli siljishdagi elastiklik modullari orasida qanday matematik bog‘lanish mavjud?

4.Birinchi va ikkinchi darajali elastiklik modullari orasida qanday munosabat mavjud?

5.Parchin mix uchun mustahkamlik sharti qanday ifodalanadi?

6.Parchin mixli birikmaning listlari mustahkamlikki qanday tekshiriladi?

7.Payvand birikmalar mustahkamlikka qanday hisoblanadi?

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