YOG'OCH, UNING YONG'INDAN XAVFI, YONG'INDAN HIMOYA QILISH USULLARI VA SAMARADORLIGINI BAHOLASH

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Kirish. Yog'och sellyuloza, yuqori molekulyar og'irlikdagi uglevod ($C_6H_{10}O_5$) n va eng keng tarqalgan tabiiy polimer bo'lib, ular bir-biriga bog'langan.

Yog'och inshootlarning yong'inga chidamliligining haqiqiy chegarasi quyidagi formula bilan belgilanadi:

$P_f = \tau_0 + \tau_{sr}$

τ_0 - bu o'tin zarbasi boshlangandan boshlab, uning yonishigacha bo'lgan vaqt, -0 4 minut sifatida qabul qilinadi. namlik bo'lgan yog'och uchun W = 12%;

τ_{sr} - o'tin yoqilishi boshlanishidan cheklash holatining boshlanishigacha bo'lgan vaqt.

$$\tau_{cr} = \frac{Z_{cr}}{V},$$

Qaerda:

V - Yog'ochni yoqish tezligi (2.1-jadval);

Z_{cr} - bu yog'ochni maydalashning kritik chuqurligi, unga erishilganda strukturaning yong'inga chidamliligi bo'yicha cheklangan holati yuzaga keladi; (η) koeffitsient qiymatini (h/b) va (Z_{cr}/h) parametrlari bilan bog'lab, grafikalar (2.3-bet [2]) yordamida aniqlanadi.

Eng kichik qism hajmi, mm	Yog'ochni charchash darajasi, mm / min	
	yopishtirilgan	butun
120 va undan ko'p	0,6	0,8
120 dan kam	0,7	1,0

Z_{cr} ni hisoblash uchun yong'in paytida yog'och inshoot a'zosining chegaralanadigan holatini aniqlaydigan tenglik qo'llaniladi:

$\sigma_f = R_f$

Yong'indagi σ_f kuchlanish strukturaning geometrik xarakteristikalari (A, W, J, i) o'zgarishiga bog'liq.

Geometrik xarakteristikalardagi bu o'zgarishlar η koeffitsienti orqali ifodalanadi, uning qiymatlari quyidagi shaklda keltirilgan: uning qiymatlari quyidagicha ifodalanadi: $\eta_A = A_f/A$, η_W

= W_f/W, $\eta_J = J_f/J$, $\eta_i = i_f/i$, qaerda A_f , W_f, J_f, i_f agar - yong'in paytida kesmaning geometrik xususiyatlari. $\eta=f(h/b,Z_{cr}/h)$ koeffitsientining A va W, J geometrik xarakteristikalariga bog'liqligi uch va to'rt tomonlama isitish bilan (2.3-bet [3]).

Grafalardagi egri chiziqlar chizig'i nuqta bilan cheklangan. Agar η, h/b и Z_{cr}/h parametrlarining kesishish nuqtalari chiziqli nuqta chizig'idan past bo'lsa, Z_{cr} qiymati 0,25 · b deb qabul qilinadi.

Egilgan yog'och yong'inga yonish chidamliligini hisoblash.

Yong'inning haqiqiy yong'inga chidamliligi uchta dizayn shartlaridan hisoblangan minimal Z_{cr} qiymatidan aniqlanadi.

Birinchi shart - normal stresslar paytida kuchni yo'qotish:

$$\eta_w = \frac{M_n}{W \cdot R_{fw}},$$

Qaerda:

R_{fw} - yog'ochning egilishga qarshiligi (2.2-jadval), MPa;

W - to'rtburchaklar kesim uchun qarshilik momenti, m3, quyidagi formula bilan aniqlanadi:

$$W = \frac{b \cdot h^2}{6},$$

Mn – yong'inning o'rtasidagi egilish momenti, кН·м, standart yuk ta'siridan kelib chiqadi:

$$M_n = \frac{q_n \cdot l^2}{8}.$$

Ikkinchi shart - siljish stresslariga nisbatan kuchni yo'qotish:

$$\eta_A = \frac{1{,}5Q}{A \cdot R_{fqs}},$$

Qaerda:

R_{fqs} - yog'ochning parchalanishiga yong'inga qarshilik (2.2-jadval), MPa;

A - tasavvurlar maydoni, m2;

Q - transvers kuch, kN, uning qiymati standart yukdan quyidagi formula bilan aniqlanadi:

$$Q = \frac{q_n \cdot l}{2}.$$

Uchinchi shart - bu egilgan inshootlarning barqarorligini yo'qotish. Yog'ochni charchash chuqurligiga emas, balki bog'lovchi elementlarning pinli ulanishlarining buzilish ehtimoliga ham bog'liq.

Yong'in sharoitida elementlarning barcha pinli ulanishlari bir vaqtning o'zida ishlamay qoladi deb hisoblasak, unda yassi shaklning (deformatsiyaning) barqarorligini yo'qotish uchun yong'inga chidamlilik chegarasi metall ulanishlarning yuk ko'tarish qobiliyatini yo'qotishiga teng bo'ladi, ya'ni. 15 daqiqa. Buni o'rnatishning iloji yo'qligi sababli (barcha dastgoh ulanishlari muvaffaqiyatsiz bo'ladimi yoki yo'qmi), ta'lim maqsadida, tinglovchiga darslik dizayni topshirig'ida ulanishlar qulab tushgan lpf nurining uzunligi berilgan. Amalda, bu uzunlik, berilgan yog'och nur ostida xonadagi yong'in yukining joylashishiga qarab o'rnatilishi mumkin.

Egilgan yog'och elementlarning yong'inga chidamliligini barqarorlik holatidan hisoblash ketma-ketligi

1. Z_1, Z_2, ..., Z_i qiymatlari bilan o'rnatiladi, chuqurligi $Z_{cr\ 1...i} \le 0{,}25b$; shartiga muvofiq 3 dan kam emas;

2. 2. Belgilangan $Z_{1...i} / h$ и h / b;

3. Grafik jihatdan $\eta_{w1} \dots \eta_{wi}$

4. Yog'ochni $(\varphi_{fw_1} \dots \varphi_{fw_i})$ uch yoki to'rt tomondan qirg'in qilish natijasida nurlanish oralig'idagi kesmaning o'lchamlari o'zgarishini hisobga olgan holda koeffitsientlarning qiymatlari quyidagi formula bilan aniqlanadi:

$$\varphi_{f,w_{1...i}} = 140 \cdot \frac{(b - 2Z_{cr_{1...i}})^2}{l_{pf}(h - n \cdot Z_{cr_{1...i}})} \cdot k_{f\phi} \cdot k_{f\text{жсж}_{1...i}}$$

bu erda h - nurlanish qismining balandligi, m; b - nurlanish qismining kengligi, m; Zcr - charringning kritik chuqurligi, m; l_{pf} - bog'lanish qulagan nur uzunligi, m; $k_{\phi f}$ - bu formulalar (2.10) yoki (2.11) bilan aniqlangan l_{pf} qismidagi egilish momenti diagrammasi shakliga bog'liq bo'lgan koeffitsient:

$k_{f\phi} = 1{,}75 – 0{,}75 \cdot \alpha_f$, при $l_{pf} < 0{,}5L$, (2.10)

$k_{f\phi} = 1{,}35 + 1{,}45 \cdot (c / l_{pf})^2$, при $l_{pf} = 0{,}5L$,

$$\alpha_f = \frac{M_{l_{pf}}}{M_n},$$

$$c = \frac{l_{pf}}{2},$$

L - nurning uzunligi;

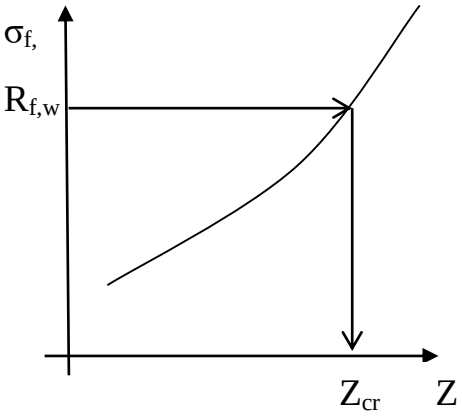
M_n $M_{l_{pf}}$ oraliqning o'rtasida va aloqalar qulagan joyda lahzalar;

$k_{fжм}$ - doimiy koeffitsient nurlari uchun 1 ga teng bo'lgan koeffitsient;

k - nurlanish ta'siriga uchragan, uning uchastkasining balandligi bo'ylab nurlanish tomonlarining soni (uch tomonlama isitish bilan k = 1, to'rt tomonlama k = 2 bilan).

1. Nurni loyihalash qismidagi kuchlanishlar quyidagi formula bilan aniqlanadi:

$$\sigma_{f,w_{1...i}} = \frac{M_n}{\varphi_{f,w_{1...i}} \cdot W \cdot \eta_{w_{1...i}}},$$



6. Grafik tuzildi va Zcr aniqlandi:

7. Yong'inga chidamlilikning haqiqiy chegarasi (2.1) formula bo'yicha aniqlanadi.

Misol:

№ 1. Yong'in paytida ishlaydigan yog'och yonishning yong'inga chidamliligini hisoblash.

Dastlabki ma'lumotlar:

Taxminiy oralig'i L, m	Kesmaning o'lchamlari, mm		To'liq dizayndagi nurli yuk q kPAa	Beam qadam a_b m	Yog'och navi	Isitilgan tomonlarning soni	Yiqilish sodir bo'lgan nurning uzunligi ulanishlar l_{pf}, m	Вариантлар
	Balandligi h	Kengligi B_b						
12	990	160	2,7	6	2	3	3	1
11	980	165	2,6	5	2	3	3	2
13	950	155	2,7	6	2	3	2	3
10	970	150	2,8	8	2	3	2	4
9	960	160	2,9	7	2	3	3	5

12	975	145	2,6	5	2	3	3	6
8	995	130	2,5	4	2	3	2	7
11	990	135	2,4	6	2	3	2	8
13	995	145	2,3	4	2	3	3	9
14	900	155	2,1	5	2	3	2	10
10	970	165	2,2	7	2	3	3	11
11	960	140	2,0	6	2	3	3	13
12	965	160	1,9	5	2	3	2	14
13	975	150	2,3	4	2	3	2	15
10	980	155	2,5	5	2	3	3	16
11	975	154	2,1	3	1	4	3	17
12	980	150	2,7	3	1	4	3	18
11	980	165	2,3	4	1	4	3	19
13	950	155	2,5	3	1	4	2	20
13	970	150	2,1	4	1	4	2	21
10	960	160	2,9	3	1	4	3	22
11	975	145	2,6	3	1	4	3	23
8	995	130	2,5	3	1	4	2	24
11	990	135	2,4	3	1	4	2	25
13	995	145	2,3	3	1	4	3	26
14	900	155	2,1	3	1	4	2	27
10	970	165	2,2	3	1	4	3	28
11	960	140	2,0	3	1	4	3	29
12	965	160	1,9	3	1	4	2	30

Biz yong’inga ta'sir etuvchi standart yukni hisobga olgan holda hisoblash usuli bilan nurga nisbatan yong'inga qarshilik talablarini aniqlaymiz.

1 metr uzunlikdagi uzunlik uchun standart yuk:

$qn = q \cdot аб / \gamma_f = 2,7 \cdot 6 / 1,2 = 13,5$ кН/ м.

$h / B_b = 990 / 160 = 6,19$

1. Kuchni yo'qotish uchun normal stresslarni hisoblash:

$$\eta_w = \frac{M_n}{W \cdot R_{fw}}$$

$$M_n = \frac{qL^2}{8} = \frac{13{,}5 \cdot 12^2}{8} = 243 кН \cdot м$$

Oddiy stresslar uchun quvvatni o'zgartirish omili:

$$\eta_W = \frac{M_n}{WR_{fw}} = \frac{243 \cdot 10^3}{26{,}14 \cdot 10^{-3} \cdot 26 \cdot 10^6} = 0{,}36$$

Bu yerda:

W - to'rtburchaklar kesim uchun qarshilik momenti, ga teng

$W = b_б \cdot h^2 / 6 = 160 \cdot 990^2 / 6 = 26{,}14 \cdot 10^6$ мм^3 $= 26{,}14 \cdot 10^{-3}$ м^3;

R_{fw} - bu 26 MPa ga teng bo'lgan, qizdirilganda yog'ochning egilishga loyiq qarshilik kuchi (2-darajali yog'och uchun 2.1-band. [2]);

P.2.3.1 [2] monogramma bo'yicha qizdirilgan tomonlar soni 3 uchun,

$h / b_б = 6{,}19$ и $\eta_w = 0{,}36$, biz buni aniqlaymiz

$z_{crw} = 0{,}25 \cdot b_б = 0{,}25 \cdot 160 = 40$ mm (topilgan kesishish nuqtasi chiziqli nuqta chizig'idan pastda joylashganligi sababli).

2. Quvvatni yo'qotish uchun siljish stresslarini hisoblash:

$$\eta_A = \frac{1{,}5Q}{A \cdot R_{fqs}}$$

Standart yukdan kesish kuchi

$$Q_n = \frac{q_n L}{2} = \frac{13.5 \cdot 12}{2} = 81 \text{ кН}$$

Kesish stresslari uchun quvvatni o'zgartirish omili

$$\eta_a = \frac{1{,}5 \cdot Q_n}{b_б h R_{fqs}} = \frac{1{,}5 \cdot 81 \cdot 10^3}{160 \cdot 10^{-3} \cdot 990 \cdot 10^{-3} \cdot 1.1 \cdot 10^6} = 0.7$$

bu erda R_{fqs} - 1,1 MPa ga teng bo'lgan yog'ochning parchalanishga qarshi yonish qarshiligi (2-darajali yopishtirilgan yog'och uchun 2.1-bet. [2]).

P.2.3.2 [2] monogramma bo'yicha qizdirilgan tomonlar soni 3 uchun,

$h / b_б = 6{,}19$ и $\eta_A = 0{,}7$ buni aniqlang

$z_{crA} = 0{,}025$ h $= 0{,}025 \cdot 990 = 24{,}75$ мм.

3. Yukni hisoblash:

1. Karbonizatsiya chuqurligining chegara qiymatlarini toping

$$Z_{cr1} = 10 \cdot V = 10 \cdot 0{,}6 = 6 мм$$

L_{pf} uzunligining ma'lum bir qismidagi bog'lanishlarning yong'inga chidamliligi an'anaviy ravishda 0,25 soat (15 min) deb qabul qilinadi, chunki ular metalldir. Shu vaqt ichida τ_0=5 min ni hisobga olgan holda nurlanish uchastkasining karbonlanish chuqurligining qiymati.

$$Z_{cr1} = (15-5)\cdot V = 10\cdot V$$

V - yog'ochni yoqish tezligi 2.2-bandga muvofiq olinadi [2].

$$Z_{cri} = 0{,}25\cdot b = 0{,}25\cdot 160 = 40 мм$$

Ushbu chegaralar ichida har qanday uchta Z qiymatini tanlaymiz.

Z_{cr1}=10 мм, Z_{cr2}=20 мм, Z_{cr3}=30 мм,

Z_{cr} / h nisbatini aniqlaylik

Z_{cr1}/h = 10/990 = 0,01

Z_{cr2}/h = 20/990 = 0,02

Z_{cr3}/h = 30/990 = 0,03

P.2.3.1 [5] monogramma bo'yicha qizdirilgan tomonlar soni 3 va bilish uchun

$h / b_б$ = 6,19 , biz Z_{cr}/h ga qarab $\eta_{w1...}$ η_{w3} koeffitsientlarini aniqlaymiz.

η_{w1} = 0,86

η_{w2} = 0,73

η_{w3} = 0,6

Biz $(\varphi_{fw_1}...\varphi_{fw_3})$ koeffitsientlarning qiymatini (2.9) formulaga binoan yog'ochni uch tomondan charxlash natijasida nurlar oralig'idagi kesmaning o'lchamlari o'zgarishini hisobga olgan holda aniqlaymiz.

Buning uchun avval $k_{fф}$ - (2.10) yoki (2.11) formulalar bo'yicha l_{pf} qismidagi egilish momenti diagrammasi shakliga qarab koeffitsientni aniqlaymiz.

$$M_{lpf} = \frac{q_n}{2}\left(\frac{L}{2} - l_{pf}\right)\left(\frac{L}{2} + l_{pf}\right) = \frac{13.5}{2}\left(\frac{12}{2} - 3\right)\left(\frac{12}{2} + 3\right) = 182.25 кНм$$

$$\alpha_f = \frac{182,25}{243} = 0,75$$

Demak, lpf <0.5L dan kelib chiqadi.

$k_{fф}$ = 1,75–0,75·0,75=1,1875

$k_{fжм}$ = 1.

n - nurlanish ta'siriga uchragan nurning uchastkasining balandligi bo'ylab tomonlari soni (uch tomonlama isitish bilan n = 1, to'rt tomonlama n = 2 bilan).

Подставляем в формулу и вычисляем:

Formulaga almashtiring va φ_{fw} ni hisoblang:

$$\varphi_{f,w_1} = 140 \cdot \frac{(0{,}16 - 2 \cdot 0{,}01)^2}{3(0{,}99 - 1 \cdot 0{,}01)} \cdot 1{,}1875 \cdot 1 = 1{,}108$$

$$\varphi_{f,w2} = 140 \cdot \frac{(0{,}16 - 2 \cdot 0{,}02)^2}{3(0{,}99 - 1 \cdot 0{,}02)} \cdot 1{,}1875 \cdot 1 = 0{,}82$$

$$\varphi_{f,w_3} = 140 \cdot \frac{(0{,}16 - 2 \cdot 0{,}03)^2}{3(0{,}99 - 1 \cdot 0{,}03)} \cdot 1{,}1875 \cdot 1 = 0{,}58$$

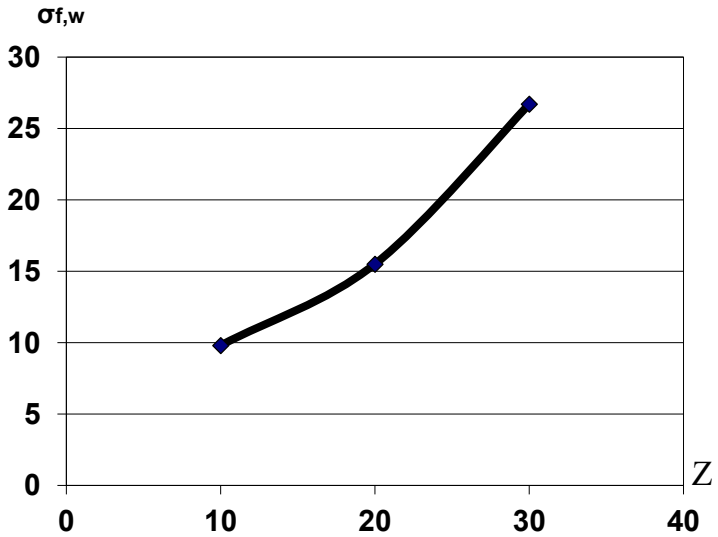
Keyin (2.12) formuladan foydalanib σ_{fw} nurining dizayn qismidagi kuchlanishlarni aniqlaymiz:

$$\sigma_{f,w_1} = \frac{243 \cdot 10^3}{1{,}108 \cdot 26{,}14 \cdot 10^{-3} \cdot 0{,}86} = 9{,}8 МПа;$$

$$\sigma_{f,w_2} = \frac{243 \cdot 10^3}{0{,}82 \cdot 26{,}14 \cdot 10^{-3} \cdot 0{,}73} = 15{,}5 МПа;$$

$$\sigma_{f,w_3} = \frac{243 \cdot 10^3}{0{,}58 \cdot 26{,}14 \cdot 10^{-3} \cdot 0{,}64} = 26{,}7 МПа;$$

$\sigma_{f,w}$ ning Z_i (R_{fw} = 26 МПа)ga bog'liqlik grafigini tuzamiz:



$Z_{cr,ycm}$ = 29,5 мм.

Выбираем из трех вычисленных Z_{cr} – наименьшее:

Z_{cr} = 24,75 мм.

Biz aniqlaymiz $\tau_{cr} = \frac{Z_{cr}}{V} = \frac{24,75}{0,6} = 41,25 мин$

V (charging darajasi) = 0,6 (s.2.2. [2])

$П_ф$ = 4 (мин) + 41,25 (мин) = 45,25 min ni aniqlang.

Kuchlanishda ishlaydigan yog'och konstruktsiya elementlarining yong'inga chidamliligini hisoblash.

Cho'zish uchun tenglik (2.3) $\sigma_{ft} = R_{ft}$ shaklini oladi. Ushbu tenglikni quyidagicha ifodalash mumkin:

$$\frac{N_n}{\eta_A \cdot A} = R_{ft},$$

Bu yerdan

$$\eta_A = \frac{N_n}{R_{ft} \cdot A},$$

Qayerda:

N - bo'ylama me'yoriy kuch, H;

R_{ft} - hisoblangan tortishish kuchi (2.2-jadval), Pa.

Bundan tashqari, $\eta=f(h/b,Z_{cr}/h)$ (2.3-bo'lim [2]) bog'liqligidan foydalanib, Z_{cr}/h, parametrining qiymati, keyin Z_{cr}. zaryadlash chuqurligi aniqlanadi. τ_{cr} и $П_ф$ qiymatlari (2.1) va (2.2) formulalar bilan aniqlanadi.

N - bo'ylama me'yoriy kuch,H;

R_{fc} - dizayndagi siqilishga qarshilik (2.2-jadval), Pa.

Jadval 2.2 - yog'och inshootlarning yong'inga chidamliligi chegaralarini aniqlash uchun dizayn qarshiligi Rf.

Kuchlanish qarshilik	Belgilar	Yog'och turiga qarab dizayn qarshiligi, MPa		
		1	2	3

Bükme	R_{fw}	29	26	18
Don bo'yicha siqilish	R_{fc}	26	23	16
Elyaflar bo'ylab cho'zish	R_{ft}	20	15	-
Elyaflar bo'ylab maydalash:	R_{fqs}			
butun		3,0	2,7	2,7
yopishtirilgan		1,2	1,1	1,1

Ma'lumki, metall issiqlik tarqalishining yuqori koeffitsientiga ega, shuning uchun uning qalinligi bo'yicha haroratni tenglashtirish juda tez sodir bo'ladi. Bu bir xil harorat taqsimotini qabul qilishga imkon beradi.

$$t_{cm,\Delta\tau} = t_{cm} + \frac{\alpha(t_в - t_{cm}) \cdot \Delta\tau}{c_{tem} \cdot \rho_{cm} \cdot t_{red}}$$

himoyalanmagan metall konstruksiyalarning haroratini hisoblash algoritmi. Tenglamadan kelib chiqadigan bo'lsak, isitish vaqtida konstruktsiyaning harorati metallning pasaytirilgan qalinligiga bog'liq (belgilangan tred).

Metallning berilgan qalinligi har qanday tasavvurlar konfiguratsiyasiga ega bo'lgan novdalarni oddiy plastinkaga kamaytirishga imkon beradi. Kamaytirilgan metall qalinligining qiymati odatda kesmaning uning qizdirilgan perimetrga nisbati sifatida aniqlanadi, ya'ni.

$$t_{red} = \frac{A}{U}$$

Qaerda:

A - tasavvurlar maydoni, m2;

U - isitiladigan perimetr, m

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