UCH SHARNIRLI ARKALARNI HISOBLASH

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Annottatsiya: Uch sharnirli arkani hisoblab va unga oid masala ishlash edi.Uch sharnirli arkani tushunish edi.

Kalit so'zi: uch sharnirli arka , arka o'qi , bo'ylama kuch,tortqli uch sharnir, rama, ferma, havon.

O'zaro bitta sharnir vositasida ulangan va fundamentga ikkita qo'zg'almas sharnirli tayanchlar yordamida tiralgan ikki egri brusdaan tuzilgan geometrik o'zgarmas sistema uch sharnirli arka deyiladi.

Uch sharnirli arkaga qanday vertikal kuchlar ta'sir etishidan qat'i nazar,uning tayanchlarida doim gorizontal yo'nalgan keruvchi reaksiya kuchlari bo'ladi.Bu gorizontal reaksiyalar havon deyiladi.

4. 1- расм.
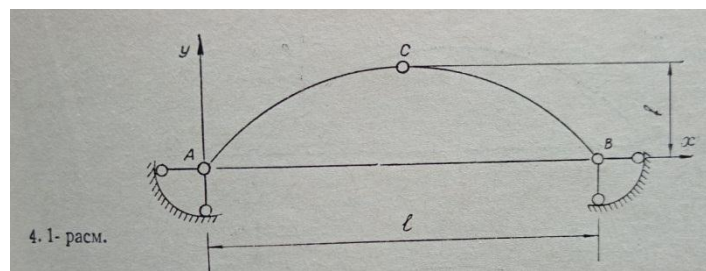
Havonli sistemalar arkalar sharnirlarining soniga ko'ra,uch, ikki sharnirli va sharnirsiz bo'lishi mumkin.Ikkita qo'zg'almas sharnirli va bitta oraliq sharniri bo'lgan uch sharnirli arka static aniq geometrik o'zgarmasdir.Undagi tayanch reaksiyalarining to'rtta tashkil etuvchisini aniqlash uchun statikaning uchta muvozanat tenglamasiga qo'shimcha bitta tenglama kiritish kerak.

Bu tenglama arkaning oraliq sharnirini C dan chap yoki o'ng tomonda ta'sir etuvchi hamma kuchlardan shu sharnirga nisbatan olingan momentlar yig'indisining 0ga tenglik shartiga asosan tuziladi.

Uch sharnirli arkaning static aniq va geometric o'zgarmas ekanligini quyida

berilgan formulaga asosan tekshiriladi:

$$W = 3D - 2SH - CT$$

Uch sharnirli arkada D=2; SH=1; C=4.U holda erkinlik darajasi SH=3*2-2*1-4=0 bo'ladi va uchala sharnirlar bir to'g'ri chiziqda yotmagai uchun sistema static aniq va geometric o'zgarmasdir.

Agar egri brus uchlari ikkita qo'g'almas sharnirli tayanchlarga tiralgan bo'lsa,bunday sistema ikki sharnirli arka deb atalad.Bunday arka to'rtta noma'lum tashkil etuvchi tayanch reaksiyalarga ega bo'lib,uning static aniqmaslik darajasi 1ga teng.Uchlari qistirilgan va orqliq sharnirli bo'lmagan arka sharnirsiz arka deb ataladi.

Sharnirsiz arkada doim 6ta noma'lum tashkil etuvchi tayanch rekasiyalari hosil bo'ladi.Bu rekasiyalarni aniqlash uchun uchta muvozanat tenglamasdidan tashqari yana uchta qo'shimcha tenglamalar tuzish kerak.Demak,bu sistema static aniqmasdir.Arka ko'ndalang kesimlarining og'irlik

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markazidan o'tuvchi ACB egri chiziq arka o'qi deyiladi.Arka o'qi parabolik, aylana,ellips va boshqa shakldagi egri chiziqlardan iborat bo'lishi mumkin.A va B tayanch sharnirlar orasidagi masofa arka proliyoti deyiladi.Agar tayanchlar har xil balandlikda joylashgan bo'lsa ular orasidagi gorizontal masofa arka proliyoti hisoblanadi.

A va B tayanch sharnirlar tovon sharnir,oraliq C sharnir esa qulf sharnir deb ataladi.AB tayanch Chizig'idan arka o'qining eng yuqorigi nuqtasigacha bo'lgan masaofa arkaning ko'tarilish cho'qqisi deyiladi va u f harfi bilan belgilanadi.

Agar tayanch sharnirlarni tortqi deb ataluvchi sterjen bilan birlashtirsak,u holda arkaning havon reaksiyasini tortqi o'ziga qabul qiladi.Bunday arka tortqili uch sharnirli arka deyiladi.tortqili arkada ikkala tayanchni qo'zg'almas qilib olishga ehtiyoj qolmaydi,shunung uchun ulardan bittasi qo'zg'almas,ikkinchisi esa qo'zg'aluvchan sharnirli tayanch bo'ladi.Tortqidagi zo'riqishni aniqlash uchun uni kesib,orqliq sharnir C ga nisbatan momentlar tenglamasini yozamiz:

$\sum M_C^{chap}=0$ yoki $\sum M_c^{o'ng}=0$

Tortqili arka tayanchlarining tuzilishiga ko'ra havonsiz sistema deb hisoblanadi.Agar egri bruslar siniq o'qli sterjenlar bilan almashtirilsa uch sharnirli rama hosil bo'ladi. (4.3-rasm, b)

Tayanch reaksiyalarini aniqlash. Uch sharnirli arkaga vertical yuklar ta'sirida qilayotgan hol uchun tayanch reaksiyalarini aniqlaymiz (4.4-rasm). Og'ma tayanch reaksiyalari R_A va R_B ni vertikal va garizontal tashkil etuvchilar V_A, V_B, H_A va H_B ga ajratamiz. Ularning qiymatini toppish uchun muvozanat tenglamasi hamda qo'shimcha to'rtinchi tenglama $\sum M_C^{chap}=0$ yoki $\sum M_c^{o'ng}=0$ tuziladi. Chap tayanch reaksiyaning vertical tashkil etuvchisi V_A ni aniqlash uchun arkaning o'ng tayanchi arkaning o'ng tayanchi B ga nisbatan muvozanatlik momentlar tenglamasi yoziladi:

$\sum M_B=0$, $V_A l - P_1(l-a_1) - P_2(l-a_2) - P_3(l-a_3) - ql^2|8=0$,

Bundan

$V_A = 1/l[P_1(l-a_1)+P_2(l-a_2)+P_3(l-a_3)+ql^2/8]$ (a)

O'ng tayanch reaksiyaning vertical tashkil etuvchisini aniqlash uchun tayanch A ga nisbatan muvozanatlik momentlar tenglamasini yozamiz:

$\sum M_B=0$, $P_1 a_1 + P_2 a_2 + P_3 a_3 + ql/2*3/4l - V_B l=0$,

Bundan

$V_B = 1/l[P_1 a_1 + P_2 a_2 + P_3 a_3 + 3ql^2/8]$ (b) Yani:

$V_A = A_{balka}$; $V_B = B_{balka}$

Uch sharnirli arka tayanch reaksiyalarining gorizontal tashkil etuvchilari H_A va H_B

orasidagi munosabatni aniqlash uchun unga ta'sir etayotgan hamma kuchlarning gorizontal o'qqa proeksiyalari yig'indisini nolga tenglashtiramiz:

$\sum X=0$.

Analitikaviy usul. Muvozanat shartlari ($\sum M_A=0$); $\sum M_B=0$, $\sum X=0$)

dan foydalanamiz:

$\sum M_A = -V_B*20 + P_1*4 + P_2*14 + q*10*15=0$;

Bundan

$V_B = 1/20(12*4+6*14+2*10*15)=21.6$

$\sum M_B = V_A*20 - P_1*16 - P_2*6 - q*10*5$

V_A=1/20(12*16+6*6+2*10*5)=16.4m

Bo'ladi topilgan V_A, V_B reaksiyalarning qiymatlarini

$\sum Y=0$

Muvozanat tenglamasi yordamida tekshiramiz:

$\sum Y=V_A$

Demak V_A=16.4m. V_A=21.6m reaksiyalarning qiymatlari to'g'ri topilgan.

$\sum X=H_A-H_B=0$, Bundan $H_A=H_B=H$. C sharnirda undan bir tomondagi hamma kuchlardan hosil bo'lgan eguvchi moment nolga teng bo'lishi shartidan foydalanib, quyidagi qo'shimcha tenglamani yozamiz:

$\sum M_c^{chap}=-H_A*f+V_A*1/2-P_1*6=0;$

bundan

$H_A=\frac{1}{f}(V_A*l/2-P_1*6)$ =1/5(16.4*10-12*6=18.4m

bo'ladi.

Demak $H_{A=}H_B=H$=18.4m

b)Grafikaviy usul. Arka o'lchamlari asosida shu arkani biror masshtabda chizamiz (76-shakl, a,b).

Masalani yechish uchun arkani o'qi uchta nuqtadan A,C,B nuqtalardan o'tishi shart.)Arkaning o'ng tomoniga qo'yilgan P_2va q kuchlarning teng tasir etuvchisi R ni topamiz. Buning uchun kuch va arqon ko'pburchaklarini yasaladi.

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