BUXORO DAVLAT TEXNIKA UNIVERSITETI (BUXORO TABIIY RESURSLARNI BOSHQARISH INSTITUTI) (O‘ZBEKISTON),

BIRLASHGAN MILLATLAR TASHKILOTINING “QISHLOQ XO‘JALIGI VA OZIQ OVQAT” TASHKILOTI (FAO),

GUMBOLT NOMIDAGI BERLIN UNIVERSITETI (GERMANIYA),

PRESOV UNIVERSITETI (SLOVAKIYA),

VALENSIYA POLITEXNIKA UNIVERSITETI (ISPANIYA),

ZALF AGROTEXNOLOGIYALAR ILMIY TADQIQOT MARKAZI (GERMANIYA),

INTI XALQARO UNIVERSITETI (MALAYZIYA),

HERRIOT WATT UNIVERSITETI (MALAYZIYA)

“YASHIL ENERGETIKA VA UNING QISHLOQ VA SUV XO’JALIGIDAGI O’RNI” MAVZUSIDAGI XALQARO ILMIY VA ILMIY-TEXNIKAVIY ANJUMANI

MATERIALLAR TO‘PLAMI

29-30-aprel, 2025-yil

ISSN: 978-9910-10-082-6
UO‘K 556.182:551.5(08)
BBK 26.222+26.236
«DURDONA» Nashriyoti

“Yashil energetika va uning qishloq va suv xo’jaligidagi o’rni” mavzusidagi xalqaro ilmiy va ilmiy-texnikaviy anjumani materiallar to‘plami (2025-yil 29-30-aprel) -B.: Buxoro davlat texnika universiteti (Buxoro tabiiy resurslarni boshqarish instituti), 2025.

To‘plamga kiritilgan tezislardagi ma’lumotlarning haqqoniyligi va iqtiboslarning tog‘riligiga mualliflar mas’uldir.

Elektron pochta manzili: buxtimi@mail.ru

Series, Volume 2388, IV International Conference on Applied Physics, Information Technologies and Engineering 2022 (APITECH-IV 2022) 05/10/2022-08/10/2022 Bukhara, Uzbekistan

3. **S.R. Akhmedov, T.O. Zhuraev, D. Agzamova,** "On resonance damping vibrations of tubular structures", Bukhoro-1998,

4. **Sh R Akhmedov, X T Tuxtaeva, Z U Amanova, I N Tursunov, Sh H Hakimov, M M Rajabova, M B Bahriddinov, Sh Egamurodov, S Mirzayev**. "*Scientific basis of the effect of groundwater sources on annual plant growth current natural conditions*", 2023 *IOP Conf. Ser.: Earth Environ. Sci.* 1138 012034. doi:10.1088/1755-1315/1138/1/012034

5. **Ахмедов, Ш. Р**. *Модульное исследование влияния термических эффектов источников орошения на продуктивность хлопкового поля*. Диссертация на учен. ст. к. т. н. Ташкент, 1991.

6. **Tursunov I. N., Radjabova M. M., Ergashev M. G'**, *Vegetatsiya davrida yer osti suvlaridan qishloq xo'jaligi ekinlar (kungaboqar)ni yetishtirishda bo'ladigan ta'sirni aniqlash.* Journal of new century innovations, http://newjournal.org/index.php/new/article/view/8749

7. **Ismoil Safarov, MuhsTeshaev, Sharif Axmedov, Navruzbek Qalandarov, Abdurakhim Marasulov**, "Dynamic stress-strastates viscoelastic half-spaces from the effects of cylindrical inclusion loads", PROCEEDINGS OF THE II INTERNATIONAL CONFERENCE ON ADVANCES MATERIALS, SYSTEMS AND TECHNOLOGIES: (CAMSTech-II 2021), https://doi.org/10.1063/5.0092396

8. **Sh.R.Akhmedov, T.O. Juraev, U.Kh.Umedova**. (2022). *Impact of Seismic Waves on Structures a Deformable Medium*. Texas Journal of Engineering and Technology, *7*, 53–56. https://zienjournals.com/index.php/tjet/article/view/1443

9. **N.Duskaraev, Sh.R.Akhmedov, T.O.Juraev, U.X.Umedova.** (2022). Dynamic Stresses Near the Working Surface from A Plane Wave. *Eurasian Scientific Herald*, *7*, 125–132. https://geniusjournals.org/index.php/esh/article/view/1082

10. **Akhmedov, S., Juraev, T., Abrorov, A., Gafurova, N., Mirzaev, J**. (2023). Determination of loads of blast wave on aboveground and underground structures. *E3S Web of Conferences* (Vol. 390). EDP Sciences.

QOVUSHQOQ-ELASTIK MUHITDA JOYLASHGAN SUYUQLIKLI SILINDRIK INSHOOTLARDAGI GARMONIK TO'LQINLAR YUKLANISHINI TAHLILI

Safarov I. I.

Toshkent kimyo texnologiyalar instituti professori, f-m.f.d.

Axmedov Sh. R.

"TIQXMMI" MTU Buxoro tabiiy resurslarni boshqarish instituti dotsenti, t.f.n.

Jo'rayev O., Jalolova G.

"TIQXMMI" MTU Buxoro tabiiy resurslarni boshqarish instituti magistrantlari

Annotatsiya. *Elastiklik tizimda silindrik ichki yuzasining doiraviy halqasini bir xil turdagi garmonik yuklanganda elastik to'lqinlarning tarqalish masalasi qo'yiladi. Siljish maydoni kontur integrallari sifatida namoyon bo'ladi. Ichki yuzasidagi tebranishlar va to'lqinlar tahlil qilinadi. Uzoqdagi maydon uchun siljishlar va kuchlanishlar uchun yetarli nuqta uslubi bilan asinxronik ifodalar olingan.*

Kalit so'zlar: *Qovushqoq-elastik muhit, elastik to'lqin, silindrik quduq, seysmik to'lqin.*

Abstract. *The problem of propagation of elastic waves when a circular ring of the cylindrical inner surface is subjected to a uniform harmonic load an elastic system is posed. The displacement field is represented as contour integrals. The vibrations and waves on the inner surface are analyzed. Asynchronous expressions for the displacements and stresses for the far field are obtained using the sufficient point method.*

Keywords: *Viscoelastic medium, elastic wave, cylindrical well, seismic wave.*

Абстрактный. *В упругой системе рассматривается задача распространения упругих волн при воздействии равномерной гармонической нагрузки на круговое кольцо внутренней поверхности цилиндра. Поле смещения выражается в виде контурных интегралов. Анализируются вибрации и волны на внутренней поверхности. Асинхронные выражения для смещений и напряжений в дальней зоне были получены с помощью метода достаточной точки.*

Ключевые слова: *Вязкоупругая среда, упругая волна, цилиндрическая скважина, сейсмическая волна.*

Yer qimirlash jarayonida manba energiyasining ma’lum qismi seysmik to‘lqbilan birga bo‘ladi. Agar yer qimirlash manbai ancha chuqurlikda bo‘lsa, u holda yer osti inshootiga birinchi bo‘lib bo‘ylama to‘lqyetib keladi, faqat ma’lum vaqt kechikish bilan ko‘ndalang to‘lqkeladi. Ularni inshootlarga yetib borishi gruntning fizik-mexanik xossalari, to‘lqenergiyasi va uning parametrlariga bog‘liq bo‘ladi. Asosiy massa to‘lqeneriyasi ko‘ndalang hajmiy to‘lqbilan tarqaladi. Yetarlicha uzun quvurlar uchun to‘lqyuklanishini quvurning o‘qiga perpendikulyar deb, qo‘yilgan masalani tekis masalaga olib kelish mumkbo‘ladi. Ko‘ndalang to‘lqinning tenglamadan kelib chiquvchi ($E_1 = E_2, \rho_1 = \rho_2, \nu_1 = \nu_2, \varphi_0 = 0$) halqa (yoki kontur) kuchlanishi ($\sigma^*_{\theta\theta} = \sigma_{\theta\theta} / \sigma_0$; $\sigma_0 = \mu\beta^2\psi_0$; ψ_0 -tushadigan to‘lqamplitudasi, μ -Lame koeffitsienti)

$$\sigma^*_{\theta\theta} = \frac{8}{\pi}\left(1 - \frac{1}{n^2}\right)\sum_{n=1}^{\infty} i^n \frac{n\left(n^2 - 1 - \frac{\beta^2\alpha^2}{2}\right)H_n(\alpha a)}{\Delta_n} \sin n\,\theta e^{-i\omega t}$$

bunda

$$\Delta_n = \alpha a H_{n-1}(\alpha a)\left[(n^2-1)\beta a H_{n-1}(\beta a) - (n^3 - n + \frac{1}{2}\beta^2\alpha^2)H_n(\beta a)\right] +$$
$$+H_n(\alpha a)\left[-(n^3 - n + \frac{1}{2}\beta^2\alpha^2)\beta a H_{n-1}(\beta a) + (n^2 - n - \frac{1}{4}\beta^2\alpha^2)\beta^2\alpha^2 H_n(\beta a)\right]$$

bunda $\alpha = \frac{\omega}{\sqrt{C_p^2 - i\Delta_p}}, \beta^2 = \frac{\omega^2}{\sqrt{C_S^2 - i\Delta_S}},$

$$\Delta_s = \frac{\lambda_0}{\rho} i\left(\Gamma^c_\lambda(\omega) + \Gamma^s_\lambda(\omega)\right),\ \Delta_p = \frac{\lambda_0}{\rho} i\left(\Gamma^c_\lambda(\omega) + \Gamma^s_\lambda(\omega)\right) + 2\frac{\mu_0}{\rho} i\left(\Gamma^c_\mu(\omega) + \Gamma^s_\mu(\omega)\right),$$

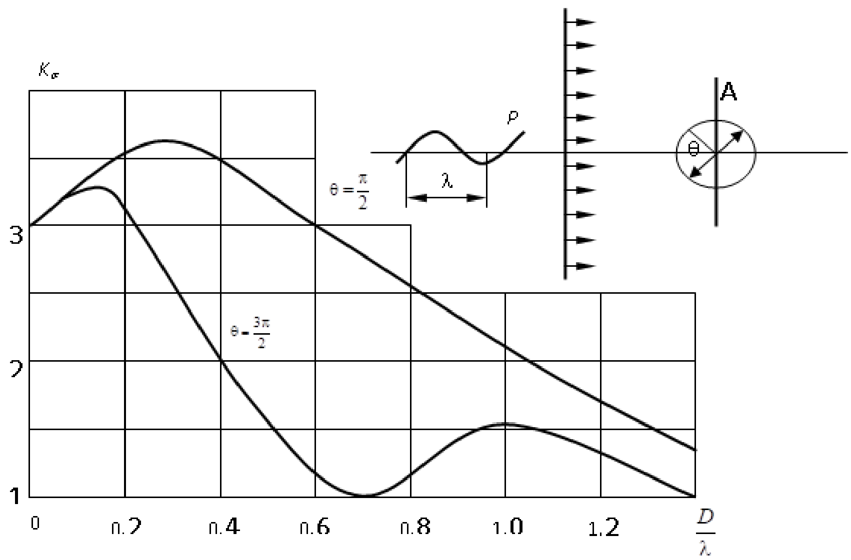
$H_n(\beta a)$ -Xankelning 1-chi jinsli funksiyasi; C_P va C_S-mos ravishda bo‘ylama va ko‘ndalang to‘lqtezliklari; $Д_p$ va $Д_s$-mos ravishda bo‘ylama va ko‘ndalang to‘lqinlarni so‘nishini ifodalovchi parametr; ω-aylanma chastota, π = 3,14. Agar to‘lquzunligi cheksizlika intilsa va reologik parametrlar nolga intilsa, u holda eng katta qiymatga ega bo‘lgan halqa kuchlanishi quyidagicha bo‘ladi:

$$\sigma_{\theta\theta} = \frac{2G\upsilon_0}{c_S}\left(1 - c_S^2/c_p^2\right)\sin 2\,\theta \sin \omega\, t,$$

bunda G-gruntning siljish moduli, υ_0-tushadigan seysmik to‘lqamplitudasi. Seysmik to‘lqinlar uzunligi quvur ko‘ndalang kesim o‘lchamlaridan katta bo‘lganligi sababli $\frac{D}{\lambda} < 1$ bo‘ladi. Kuchlanishlarning dinamik konsentratsiyasi koeffitsienti Kσ (maksimal halqa kuchlanishini tushadigan to‘lqamplitudasiga nisbati) 5.1-rasmda keltirilgan.

Uzun to‘lqsohasida $\left(\frac{D}{\lambda} = 0{,}04 \div 0{,}16\right)$dinamik kuchlanishlar konsentratsiyasi koeffitsienti 5-10% statik kuchlanishdan katta ekan [1]. Agar $\frac{D}{\lambda} > 0{,}16$ bo‘lganda dinamik kuchlanishlar konsentratsiyasi koeffitsienti statik holat kuchlanishlardan kichik bo‘lar ekan. Sonli natijalar 1- va 2- rasmlarda keltirilgan.

Silindrik bo‘shliqdagi maksimal kuchlanishlarni paydo bo‘lishi, oldingi bobda topilgan diskret chastotalarni mavjudligi bilan izohlanadi. Qovushqoqlik hususiyatlarini hisobga olish dinamik kuchlanishlar konsentratsiyasi koeffitsientini 10-15% kamaytirishga imkon beradi. Uzun to‘lqinli sohada ideal suyuqlikli va suyuqliksiz quvur kuchlanishlari 15%-gacha, qisqa to‘lqinli sohada esa ularning farqi 40 %- gacha farq qilar ekan.

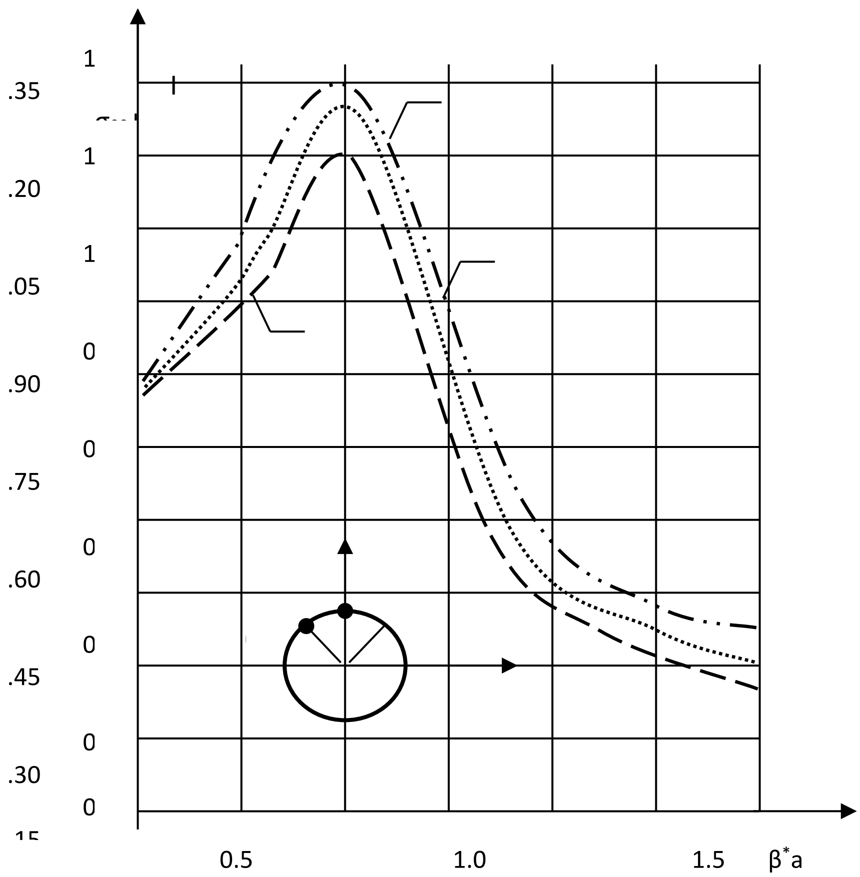


1- rasm. *Dinamik kuchlanishlar konsentratsiyasi koeffitsienti to'lquzunligiga nisbatan o'zgarishi.*

Agar silindrik jism absolyut qattiq deb olinsa, u holda tekis to'lqbo'yicha olingan natijalar (to'lquzunligi cheksizga intilsa) quvurning statik holati uchun olingan natijalari bilan ustma-ust tushar ekan [1]

$$\lim_{\beta\to 0}\sigma^*_{\theta\theta} = -4\sin 2\theta.$$

Agar qatlam va muhitning xarakterlovchi parametrlar (Yung modullari, Puasson koeffitsientlari va zichliklari) teng bo'lsa va yopishqoqlik xossasi hisobga olinmasa, u holda $r = a$ halqa kuchlanishining $\sigma^*_{\theta\theta} = \sigma_{\theta\theta} / \sigma_0$; $y_0 = \mu\beta^2\psi_0$ ifodasi quyidagi ko'rinishni egallaydi:



2–rasm. *Halqa kuchlanishini ko'ndalang to'lqsoniga nisbatan o'zgarishi.*

$$\sigma^*_{\theta\theta} = -\frac{8}{\pi}\left(1-\frac{1}{k^2}\right)\sum_{n=1}^{\infty} i^{n+1}\frac{n\left(n^2-1-\frac{\beta^2\alpha^2}{2}\right)H_n(\alpha a)}{\Delta_n}\cdot\sin n\theta,$$

bunda $k^2=\beta^2/\alpha^2=\frac{c_\alpha^2}{c_\beta^2}=\frac{2(1-\nu)}{1-2\nu}$; ν-Puasson koeffitsienti;

$$\Delta_n = \beta^2\alpha^2\left(n^2+n-\frac{\beta^2\alpha^2}{4}\right)H_n(\alpha a)H_n(\beta a)+\alpha\beta\, a^2(n^2-1)H_{n-1}(\alpha a)\times$$
$$H_{n-1}(\beta a)+\left(n-n^3-\frac{\beta^2\alpha^2}{2}\right)\left[\beta a\, H_n(\alpha a)H_{n-1}(\beta a)+\alpha a\, H_{n-1}(\alpha a)H_n(\beta a)\right].$$

Barcha kuchlanishlar va ko'chishlar quyidagi ko'rinishda olindi:

$$\left(R+iIm(lm)^{-i\omega t}\left(R^2+Im^2\right)^{1/2^{-i(\omega t-\gamma)}}\right).$$

1-elastik muhit (A=0). 2- A=0,01; β=0,05; ν=0,25; α=0,1. 3-A=0,05;β=0,01; ν=0,25; α=0,1

Foydalanilgan adabiyotlar

1. **I. Safarov, M. Teshaev, Sh. Axmedov, D. Rayimov, F. Homidov**, *Manometric Tubular Springs Oscillatory Processes Modeling with Consideration of its Viscoelastic Properties*, International Scientific Conference "Construction Mechanics, Hydraulics and Water Resources Engineering" (CONMECHYDRO-2021), (01010), https://doi.org/10.1051/e3sconf/202126401010
2. **I I Safarov, M Kh Teshaev, Sh R Axmedov, S A Boltayev, Sh N Almuratov**, *Intrinsic oscillations of viscoelastic three-layer truncated conical shell***,** Journal of Physics: Conference Series, Volume 2388, IV International Conference on Applied Physics, Information Technologies and Engineering 2022 (APITECH-IV 2022) 05/10/2022-08/10/2022 Bukhara, Uzbekistan
3. **S.R. Akhmedov, T.O. Zhuraev, D. Agzamova,** "On resonance damping vibrations of tubular structures", Bukhoro-1998,
4. **Sh R Akhmedov, X T Tuxtaeva, Z U Amanova, I N Tursunov, Sh H Hakimov, M M Rajabova, M B Bahriddinov, Sh Egamurodov, S Mirzayev**. "*Scientific basis of the effect of groundwater sources on annual plant growth current natural conditions*", 2023 *IOP Conf. Ser.: Earth Environ. Sci.* 1138 012034. doi:10.1088/1755-1315/1138/1/012034
5. **Ахмедов, Ш. Р**. *Модульное исследование влияния термических эффектов источников орошения на продуктивность хлопкового поля*. Диссертация на учен. ст. к. т. н. Ташкент, 1991.
6. **Tursunov I. N., Radjabova M. M., Ergashev M. G'**, *Vegetatsiya davrida yer osti suvlaridan qishloq xo'jaligi ekinlar (kungaboqar)ni yetishtirishda bo'ladigan ta'sirni aniqlash.* Journal of new century innovations, http://newjournal.org/index.php/new/article/view/8749
7. **Ismoil Safarov, MuhsTeshaev, Sharif Axmedov, Navruzbek Qalandarov, Abdurakhim Marasulov**, "Dynamic stress-strastates viscoelastic half-spaces from the effects of cylindrical inclusion loads", PROCEEDINGS OF THE II INTERNATIONAL CONFERENCE ON ADVANCES MATERIALS, SYSTEMS AND TECHNOLOGIES: (CAMSTech-II 2021), https://doi.org/10.1063/5.0092396
8. **Sh.R.Akhmedov, T.O. Juraev, U.Kh.Umedova**. (2022). *Impact of Seismic Waves on Structures a Deformable Medium*. Texas Journal of Engineering and Technology, *7*, 53–56. https://zienjournals.com/index.php/tjet/article/view/1443
9. **N.Duskaraev, Sh.R.Akhmedov, T.O.Juraev, U.X.Umedova.** (2022). Dynamic Stresses Near the Working Surface from A Plane Wave. *Eurasian Scientific Herald*, *7*, 125–132. https://geniusjournals.org/index.php/esh/article/view/1082
10. **Akhmedov, S., Juraev, T., Abrorov, A., Gafurova, N., Mirzaev, J**. (2023). Determination of loads of blast wave on aboveground and underground structures. *E3S Web of Conferences* (Vol. 390). EDP Sciences.