

Annual report of “Mechanics of deformable solids” department of IMM of Ministry of Science and Education for 2023

Scientific direction: Fluid, gas and deformable solid mechanics

Subject: Mathematical modeling of destruction of deformable bodies.

In “Mechanics of deformable solids” department work 10 collaborators:

1. Talybly Latif Khalil – head of department
2. Mir-Salim-zade Minavar Vagif – leading research associate
3. Mammadova Mehriban Ali – leading research associate
4. Bagirov Emin Telman – senior research associate
5. Nagiyeva Nigar Miryashar – senior research associate
6. Mammadova Hijran Ali – research associate
7. Muradova Ayten Gadim – junior research associate
8. Mammadov Isgandar Gudrat – engineer
9. Bagirova Sema Asif – senior laboratory assistant
10. Rzayeva Vusala Bayazkhan – senior laboratory assistant

7 of these (six) are research associates and 2 (two) senior laboratory and an engineer. According to the research plan of 2023 in the department were carried out research on the topic " Mathematical modeling of destruction of deformable bodies ". The plan provided for six works on the subject. Scientific works are carried out according to the plan.

I. Scientific activity

Work: On one refinement in mathematical modeling of the processes of deformation and destruction of viscoelastic bodies.

Executor: doct.ph.math.sci., prof. L.Kh.Talybly

On the basis of experimental data published in the literature, mathematical modeling of the processes of deformation and destruction of viscoelastic bodies was carried out on the basis of a theory newly created by the author. The areas of deformation and destruction are divided into four subregions. The defining equations corresponding to each region are written down. A new concept, the damage condition, has been introduced into the literature, and its mathematical expression has been written. The introduced damage condition predicts the time of

formation of the first damage in a viscoelastic body. Instead, a new failure condition is defined, which makes it possible to predict the failure time of the structure.

The following scientific works have been published:

1. Cyclic bending and delayed fracture of bars of viscoelasticplastic material // Azerbaijan University of Architecture and Construction, Engineering Mechanics Scientific and Technical Journal, September 2022, Issue 12 Volume 4 Number 3, pages 32-4
2. On one mathematical model of characteristics of corrosion strength of materials // Международнойнаучно-практическийжурнал, Endless Light in Science, 20 January 2023, p.305-309
3. Solution of the viscoelastic boundary value problem for a rotating disk / Modern Problems of Mathematics and Mechanics“ of the International Conference dedicated to the 100th anniversary of the National Leader Heydar Aliyev, Baku, 26-28 April 2023, p.389-391

Work: On the method of modeling the stress state of bodies with viscoelastic properties under physical-linear deformation.

Executor: cand.ph.m.s., lead.re.ass. M.A.Mammadova

A new method of mathematical modeling of the stress state of physical non-linearly deformable viscoelastic bodies of the Boltzmann type is proposed.

The following scientific works have been published:

1. The solution of the problem of cycle loading of hereditary elasticoplastic ball at pulsating internal pressure // Proceedings Book International Conference on Engineering Science, Azerbaijan Technical University, november 11-12, 2022, Baku, p.386-392
2. Напряженно-деформированное состояние наследственно упругопластического шара при пульсирующем внутреннем давлении// Международной научно-практический журнал, Endless Light in Science, 17 Декабря, 2022 с.175-181
3. Исследование изгибных колебаний вязкоповреждающегося стержня при отсутствии эффекта залечивания дефектов // Bakı universitetinin xəbərləri, Fizika-riyaziyyat elmləri seriyası, №4, 2022, s.47-56
4. Cyclic bending and delayed fracture of bars of viscoelasticplastic material // Azerbaijan University of Architecture and Construction, Engineering Mechanics Scientific and Technical Journal, September 2022, Issue 12, Volume 4, Number 3, pages 32-4

5. Solution of the problem of the long durability of hollow shaft at torsion with the account of its damageability / Modern Problems of Mathematics and Mechanics“ of the International Conference dedicated to the 100th anniversary of the National Leader Heydar Aliyev, Baku, 26-28 April 2023, p.251-252
6. Delayed fracture of bars of viscoelasticplastic material on cyclic bending / XI. uluslararası avrasya uygulamalı bilimler kongresi, 27-28 mayıs 2023, Ankara, p.2

Work: The problem of minimizing a stringer plate weakened by a system of periodic holes.

Executor: cand.ph.m.s., lead.re.ass. M.V.Mirsalimzade

The problem of minimizing an infinite plate with stringers with periodic holes made of an elastically deformable material is given and solved. The plate is subjected to uniaxial tension under the action of a ball force acting at infinity. As a result of the solution, the corresponding stress-strain state is determined at the considered point.

The following scientific works have been published:

1. Частичный контакт берегов трещины в стрингерной пластине с круговым отверстием // Актуальные проблемы строительства и строительной индустрии: Сборник материалов XXIV Межд. научно-техн. конф. / под общ. ред. Т.Е. Сеницыной. Тула: Изд-во ТулГУ, 2023. С. 41-46.

Work: On the dispersion of axisymmetric waves propagating in a prestressed elastic plate immersed in a compressible fluid.

Executor: sen.res.ass. E.T.Bagirov

The problem of scattering of axisymmetric waves propagating on an elastic plate stressed in a compressible fluid is posed, and the solution of the problem is obtained by numerical methods. A large number of graphs were constructed and qualitative analysis was carried out.

The following scientific works have been published:

1. On the influence of finite initial strains of the plate made of highly elastic material and loaded by the compressible inviscid fluid on the dispersion of the axisymmetric waves propagating in this plate // Journal of Baku Engineering University, Mechanical and Industrial Engineering, 2022, Vol.6, Number 1, p.22-35
2. Dispersion of axisymmetric quasi-scholte waves in the pre-strained highly elastic plate loaded by compressible inviscid fluid // Azerbaijan University of Architecture and Construction, Scientific and Technical Journal on “Engineering Mechanics”, Iss.12, Vol. 4, No. 3, Sep. 2022, p.42-55

3. The influence of the axisymmetric inhomogeneous residual stresses in the hollow cylinder contained inviscid compressible fluid on the dispersion of the axisymmetric waves propagating in that // Pedaqoji universitetin xəbərləri. Riyaziyyat və təbiət elmləri seriyası – 2022, c. 70, №3, s. 9-23
4. On the influence of the inhomogeneous residual stresses on the dispersion of axisymmetric longitudinal waves in the hollow cylinder // Tran. Natl. Acad. Sci. Azerb. Ser. Phys.-Tech. Math. Sci. Mechanics, 42 (8), 25-35 (2022)
5. On the axisymmetric waves propagating in the prestrained highly elastic plate under bilateral contact with various fluids // 23 Ulusal Mekanik Kongresi, 4-8 Sentyabr, Konya Teknik Universitesi, 2023, s.144-157
6. The influence of the imperfect contact condition on the dispersion of the axisymmetric waves in the bi-layered hollow cylinder with inhomogeneous initial stresses // The International Scientific Conference "Actual Problems of Mechanics" (to the 145th anniversary of the birth of S.P. Timoshenko), The National Academy of Sciences of Ukraine, November 14-16, 2023
7. The dispersion of the axisymmetric waves propagating in the pre-strained highly elastic plate under bi-lateral contact with a fluid // Waves in Random and Complex Media, 2022, p.1-37
8. Dispersion of the axisymmetric waves propagating in the hydro-elastic system consisting of the pre-strained highly elastic plate, compressible inviscid fluid, and rigid wall // Archive of Applied Mechanics ,08 November 2022, p. 861–879
9. The influence of inhomogeneous residual stresses arising from the contact of the cut on the dispersion of axisymmetric longitudinal waves in the two-layer hollow cylinder // International Applied Mechanics, 59 (4), 2023, p.132-144
10. Dispersion of axisymmetric longitudinal waves propagating in an inhomogeneous prestressed hollow cylinder immersed in an inviscid compressible fluid // Journal of Sound and Vibration, Volume 569, 20 January 2024, p.1-32
11. “Дисперсия осесимметричных волн в гидроупругих системах из высокоэластичных пластин и сжимаемой жидкости” /Министерство Науки и Образования Азербайджанской Республики, Баку 2023, 145с.
12. On the influence of the residual stresses arising from the contact of the cut on the dispersion of axisymmetric longitudinal waves in the two-layer hollow cylinder / Modern Problems of Mathematics and Mechanics“ of the International Conference dedicated to the 100th anniversary of the National Leader Heydar Aliyev. Baku, 26-28 April , 2023, p. 136 – 138
13. The influence of the imperfect contact condition on the dispersion of the axisymmetric waves in the bi-layered hollow cylinder with inhomogeneous initial stresses / The International Scientific Conference "Actual Problems of Mechanics"

(to the 145th anniversary of the birth of S.P. Timoshenko), The National Academy of Sciences of Ukraine, November 14-16, 2023

14. Dynamics of the oscillating, moving and oscillating-moving loads acting on the inner surface of the hollow cylinder surrounded by the elastic medium (survey) / The International Scientific Conference "Actual Problems of Mechanics" (to the 145th anniversary of the birth of S.P. Timoshenko), The National Academy of Sciences of Ukraine, November 14-16, 2023

Work: Mathematical modeling of fatigue failure of an elastic plastic deformable wedge

Executor: sen.res.ass. N.M. Nagiyeva

A mathematical formulation of the problem of fatigue failure of an elastic ideal plastically deformable wedge is given. Determine the number of repetitions of the force acting on the wedge. First, the problem of elastic ideal plastic deformation of the wedge from its natural state was solved. After that, the corresponding residual deformations were determined. The elastic plastic problem under repeated force was also solved and the number of repetitions of the force acting on the wedge leading to the collapse of the wedge was determined.

The following scientific works have been published:

1. Об определении числа циклов нагружения до разрушения оси автомобиля / Современные проблемы математики и механики» Международной конференции, посвященной 100-летию общенационального лидера Гейдара Алиева. Баку, 26-28 апреля 2023 года, стр. 308-309.

Work: Mathematical model of the characteristics of the process of corrosion destruction.

Executor: res.ass. H.A.Mammadova

A function is proposed that characterizes the process of corrosion destruction of the "metal-aggressive environment" system. The proposed function also allows setting the loading time in case of stationary loading.

The following scientific works have been published:

1. Формула, которая позволяет определить коррозионное разрушение под напряжением // JOURNAL OF BAKU ENGINEERING UNIVERSITY-MECHANICAL AND INDUSTRIAL ENGINEERING, 2022. Volume 6, Number 2, p.122-126

2. On some results of processing the experimental data of tense metals's corrosion longevity considering an influence of various factors // News of Azerbaijan High Technical Educational Institutions, Vol.25, Issue 3(143), 2023, p.17-23

3. On determining the time to corrosive failure with nonsteady potential changes / Modern Problems of Mathematics and Mechanics“ of the International Conference dedicated to the 100th anniversary of the National Leader Heydar Aliyev. Baku, 26-28 April, 2023, p.250

4. Corrosive failure of elliptic bar under the action of torque / VII International Scientific Conference of Young Reseachers dedicated to the 100th anniversary of the National leader of Azerbaijan, Heydar Aliyev, 28-29 April 2023, Baku, Azerbaijan, p.859

Work: Mathematical modeling of the stress state of a composite pipe of a viscoelastic material.

Executor: jun.re.ass. A.G. Muradova.

The problem of determining the stress-strain state of a viscoelastic composite pipe is formulated mathematically. The problem was solved by A. A. Ilyushin's approximation method.

Work: Asymptotic study of oscillations of a cylindrical shell in contact with a solid medium reinforced with shafts

Executor: senior laboratory assistant V.B. Rzayeva

Oscillations of a cylindrical shell in contact with a solid medium reinforced with shafts are asymptotically investigated.

1. Free vibrations of a nonhomogeneous rod-cylindrical shell-fluid system // Transactions of NAS of Azerbaijan, Series of Physical-Technical & Mathematics Science (issue Mechanics), Volume 43, issue 7, Baku, “Elm”, 2023, p.60-68.

2. Qeyri-bircins halqalarla möhkəmləndirilmiş qeyri-bircins silindrik örtüyün mayedə sərbəst rəqslərinin tədqiqi / The XXXIV International Scientific Symposium "From the 20th of January to Karabakh Victory”, Turkey, The 28th of January 2023, p.248-251

3. Free vibrations of an inhomogeneous fluid-contacting shell strengthened with inhomogeneous rods / Modern Problems of Mathematics and Mechanics“ of the International Conference dedicated to the 100th anniversary of the National Leader Heydar Aliyev, Baku, 26-28 April, 2023, p.341-343

II. Scientific organizational activity

Members of the department were published 32 scientific works – 20 papers, and 11 theses, and a monography.

Employees of the department (L.Kh.Talybly, M.A.Mammadova, E.T.Bagirov, N.M.Nagiyeva, H.A.Mammadova, V.B.Rzayeva) made various scientific reports at the international conference dedicated to the 100th anniversary of the national leader Heydar Aliyev. M.A. Mamedova, V.B. Rzayeva presented their scientific works at the conferences held in Turkey (Ankara).

E.T.Bagirov's monograph entitled "Dispersion of axisymmetric elastic waves in hydro-elastic systems consisting of highly elastic plate and compressible fluid" has been published.

L.Kh.Talybly was the chairman of the final examination committee of the bachelor's degree in mechanics at the Baku State University.

Graduate students of the Faculty of Mechanics and Mathematics (February-March) and the Faculty of Applied Mathematics (April-May) of the Baku State University completed a scientific internship at our department.

Every Friday, a seminar on deformable solids is held in the department.

Head of the Department

doct.phys.math.sci., prof., L.Kh.Talybly