

Annual report of “Mechanics of deformable solids” department of IMM for 2022

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 assistants and an engineer. According to the research plan of 2022 in the department were carried out research on the topic "Variable load of bodies of irreversible deformation". The plan provided for six works on the subject. Scientific works are carried out according to the plan.

I. Scientific activity

Work: Solution of the generalized Mirzajanzade -Ogibalov problem for estimating the delay time in transitional flow modes of viscoelastic medium

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

A.Kh.Mirzajanzade and P.M.Ogibalov solved the problem of determining the delay time in the transitional modes of the medium flow, expressed by the Voigt model. To solve this problem, the authors used the Laplace transform. First, the desired solution was determined by the authors in the Laplace transform, and then the original solution was constructed. In this planned work, physical linear equations of the theory of viscoelasticity were used more general than the Voigt model. For the solution of the problem, a qualitatively new solution method was proposed, which does not involve the application of any of the methods of integral transformations. As a result of the application of this method, the exact solution of the problem was found - the time of delay and the solution was obtained by a qualitatively new method that does not involve the use of any of the methods of integral transformations.

The following scientific works have been published:

1. Метод решения общей квазистатической задачи теории линейной вязкоупругости и его применение / Azərbaycan Xalqının Ümummilli Lideri Heydər Əliyevin anadan olmasının 99-cu ildönümünə həsr olunmuş «Riyaziyyat və Mexanikanın Aktual Problemləri» adlı Respublika Elmi Konfransı, BDU, 2022, səh.330.
2. Some exact solutions to problems of nonlinear viscoelasticity / The International scientific Conference “Modern Problems of Mathematics and Mechanics” dedicated to the 110-th anniversary of the academician Ibrahim Ibrahimov, Baku, June 29 – 1 July, 2022, p.199-200.

Work: Deformation of an elliptic cross-section beam with viscoelastic-plastic mechanical properties

Executor: cand.ph.m.s., lead.re.ass. M.A.Mammadova; jun.re.ass. A.G.Muradova.

A beam with an elliptical cross section undergoes a torsional deformation. The beam material is expressed by the nonlinear equations of the viscoelastic-plastic theory. It is considered that the components of the stress tensor are expressed by the functional determined by experience with the components of the strain tensor. Such materials have a hereditary property - the stress components are determined by the values of the deformation components at the considered moment of time, as well as their values up to this moment. At the same time, these materials are observed by the presence of residual deformations in the process of unloading. Mathematical statement of the problem is given. The statement of the problem includes the special cases of the deterministic equations that express the viscoelastic-plastic properties of the bodies written for the torsion problem of the considered beam. To these equations, at the same time, the equilibrium equations of the beam, the appropriate boundary conditions, and the Cauchy relations between deformation and displacements are added. Thus, as a result, the considered beam torsion process is mathematically modeled as a non-linear problem. The method of successive approximation is used to solve this problem. In the initial approximation, the solution of the appropriate elastic-plastic problem is used. In each subsequent approximation, the elastic-plastic problem determined by the previous approximations, i.e., including the known additional volume and surface forces, is solved. It is proved that these approximations converge to the solution. The solution of the problem concludes with the determination of the time dependence of the residual stresses and deformations. At this time, it is considered that the process of releasing the load of the beam is a viscoelastic process.

The following scientific works have been published:

1. Solution of the problem of deformation and stress of a thin round viscoelastic disk in the field of non-stationary and non-homogenous temperature // International Journal of Engineering Science Invention (IJESI). |Volume 11 Issue 2 Series II || February 2022 || PP 15-21. (co-author Muradova A.Q.)
2. Steady - state longitudinal vibrations of a viscously damaged rod with regard to secondary effects // Proceedings of Azerbaijan High Technical Educational Institutions Volume 14, Issue 03, 2022, p.63-70. (co-author Rzayeva V.)
3. Scattered destruction of a twisted hollow inhomogeneous damaged prismatic body // Engineering mechanics, Scientific and technical journal № 1-2(4) 2022, p.151-154. (co-author Muradova A.Q.)
4. Long durability of the damaged hollow shaft at torsion // Proceeding of Azerbaijan Higher Technical Educational Institutions, Mechanics and Machine engineering, vol.24, issue 04, 2022, p.52-56.
5. Delayed torsional destruction of an anisotropic hollow cylinder //Journal of Baku Engineering University Mechanical and Industrial Engineering, 2022, Vol.5, №2, p.60-64.
6. A thin round viscoelastic disk in the field of nonstationary temperature / 2.International Antalya Scientific Research and Innovative Studies Congress. March 17-21, 2022, Antalya, Turkey, p.191-192. . (co-author Rzayeva V.)
7. Solution of the problem of torsion of physically linearly viscoelastic body / 6th Ankara International Congress on Scientific Research. April 1-3, 2022, Ankara, Turkey, p.338-339. (co-author Rzayeva V.)
8. Кручение призматического физически линейной вязкоупругого тела / Azərbaycan Xalqının Ümummilli Lideri Heydər Əliyevin anadan olmasının 99-cü ildönümünə həsr olunmuş «Riyaziyyat və Mexanikanın Aktual Problemləri» adlı Respublika Elmi Konfransı, BDU, 2022. səh.294-295. (co-author Muradova A.Q.)
9. Long-term torsional strength of a damaged hollow shaf /The International scientific Conference “Modern Problems of Mathematics and Mechanics” dedicated to the 110-th anniversary of the academician Ibrahim Ibrahimov, Baku, June 29 – 1 July, 2022, p.134. (co-author Muradova A.Q.)

Work: Elastic-plastic case for perforated stringer plate

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

The problem of stretching an infinite perforated plate from an ideal elastoplastic deformable material is solved. The plate is reinforced with stringers. It is assumed that the plate holes are completely surrounded by a plastic zone. In this setting, the stress-strain state of the plate is determined. As the defining equations of the plate material, the equations of the theory of flow of ideal elastic plasticity

are used. Analysis of the obtained results was carried out and geometric representations were obtained.

The following scientific works have been published:

1. Optimization of the bearing capacity of a stringer panel with a hole // Journal of Applied Mechanics and Technical Physics, 2022, Vol. 63, No. 3, pp. 513–523.
2. Оптимизация несущей способности стрингерной панели с отверстием // Прикладная механика и техническая физика. 2022. т. 63, № 3. С.161-172.
3. Равнопрочная форма отверстия в стрингерной панели с трещиной // Сб. трудов 23-й Международной научно-технической конференции: «Актуальные проблемы строительства и строительной индустрии». 29-30 июня 2022 г., Тула, Россия.с. 86-92

Work: Torsional wave dispersion in a hollow two-layer cylinder with a non-uniform initial stress caused by internal and external radial

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

The two-layer hollow cylinder experiences initial mechanical stresses. In addition, it is subjected to dynamic torsional loading. The problem of the wave dispersion of the considered cylinder is solved. The solution was analyzed and the results were illustrated in the form of graphs.

The following scientific works have been published:

1. On the dispersion of axisymmetric waves in the pre-strained highly elastic plate loaded by compressible inviscid fluid / The International scientific Conference “Modern Problems of Mathematics and Mechanics” dedicated to the 110-th anniversary of the academician Ibrahim Ibrahimov, Baku, June 29 – 1 July, 2022, p.62-64.
2. On the dispersion of axisymmetric waves propagating in the pre-strained highly elastic plate embedded in the compressible inviscid fluid / The 8th International Conference on Control and Optimization with Industrial Applications, Baku, 24-26 August, 2022, p.111-113.

Work: Transverse vibration of a beam of circular cross-section

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

Almost any structural element can be a source of vibrations. The main reasons for the formation of vibration are associated with mechanical, sound and resonant phenomena. The problem of the transverse vibration of a circular beam is given and mathematically solved.

The following scientific works have been published:

1. Зависимость поверхностного поглощения от отношения частоты объемных столкновений электронов и частоты колебаний внешнего электрического поля /V Всероссийская научная конференция с международным участием 9–11 декабря 2021 г., г. Сыктывкар, с.14-15. (co-author Süleymanova S.Ş.)
2. Elastico – plastic torsional deformation of a hardening beam /The International scientific Conference “Modern Problems of Mathematics and Mechanics” dedicated to the 110-th anniversary of the academician Ibrahim Ibrahimov, Baku, June 29 – 1 July, 2022, p.162.

Work: Corrosion destruction of a torsional rectangular cross-section beam in an aggressive medium with non-stationary concentration

Executor: res.ass. H.A.Mammadova

A beam of rectangular cross section is twisted by a torque in a corrosive medium with a non-stationary concentration. Depending on the intensity of the impact force and the characteristics of the aggressive environment, the time to corrosion failure of the considered beam is theoretically determined. In solving the problem, the appropriate solution of the theory of elasticity and the formula for determining the dissolution time proposed by the author were used. As a result of the analysis of the received solution, it was found that the corrosion distribution of the considered beam first starts from the contour of the beam and moves towards the center of the beam. At the same time, the rate of progress of corrosion disintegration was determined. The result is prepared for publication in a journal as an article.

The following scientific works have been published:

1. Определения времени разрушения полубесконечной пластины в агрессивной среде при ее деформации наклонной силой // Azərbaycan Memarlıq və İnşaat Universiteti, “Mühəndis Mexanikası” jurnalı, 2022, № 1-2 (4), səh. 128-132.
2. Corrosive destruction of a thick –walled pipe under the action of a torque // Azərbaycan Memarlıq və İnşaat Universiteti, “Mühəndis Mexanikası” jurnalı, 2022, № 1-2 (4), səh.147-150.
3. On the time of corrosive failure of metals with regard to mechanical stress and temperature effect // Azerbaijan Higher Technical Educational Institutions, Mechanics and Machine Engineering, volume 24 issue 03, 2022, p.34-36.
4. The definition of time to corrosion failure // Journal of Baku Engineering University Mechanical and Industrial Engineering, 2022, vol.5, №2, p.51-59.

5. On one empiric formula for corrosive strength of metals / 2nd International Science and Engineering Conference / Baku Engineering University, 26-27 november 2021, Baku, Azerbaijan, p.308-309.
6. Коррозионное разрушение при изгибе призматического бруса с эллиптическим поперечным сечением / Azərbaycan xalqının ümummilli lideri Heydər Əliyevin anadan olmasının 99-cu ildönümünə həsr olunmuş «Riyaziyyat və Mexikanın Actual Problemləri» adlı respublika elmi konfransı, BDU, 2022. səh. 300-301.
7. Corrosive failure of a hollow cone under the action of torque / The International Scientific Conference “Modern Problems of Mathematics And Mechanics” dedicated to the 110-th anniversary of the academician Ibrahim Ibrahimov, Baku, june 29 – 1 july, 2022, p.135.

II. Scientific organizational activity

Members of the department were published 29 scientific works – 13 papers, two of them included in the Science Citation Index Expanded database, 1 conference material and 15 theses.

Employees of the department (L.Kh.Talybly, M.A.Mammadova, M.V.Mirsalimzade, E.T.Bagirov, N.M.Nagiyeva, H.A.Mammadova, A.G.Muradova, V.B.Rzayeva) made scientific reports at various foreign and national conferences. The names and places of the conferences are mentioned in the list of scientific works.

V. B. Rzayeva has successfully completed her master's degree and was admitted to the dissertation. Currently, she is the senior laboratory assistant of the department, and at the same time continues her scientific activities.

Head of the department L.Kh.Talybly gave scientific reports at the plenary and all-institute seminars at the scientific conference held at Baku State University dedicated to the 99th anniversary of national leader Heydar Aliyev. At the same time, he was the chairman of the graduation examination commission in mechanical engineering at Baku State University.

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

Head of the Department

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