iJRASET
International Journal For Research in
Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH
IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 9 Issue: XI Month of publication: November 2021

DOI: https://doi.org/10.22214/ijraset.2021.38957

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue XI Nov 2021- Available at www.ijraset.com

Resistance of Structural Materials to Deformation in the Case of Linear and Flat Stresses

Anvarjon Xakimov
Associate Professor of Namangan Engineering Construction Institute, Namangan city, 12 Islam Karimov street

Annotation: The deformation resistance properties of structural materials in the case of linear and flat stresses are given on the basis of experimental results. The method of estimating the mechanical properties of the material based on the initial deformation diagrams is described.
Keywords: Stress, deformation, longitudinal force, internal pressure, stress state, deformation diagram, initial deformation, Yung modulus, Poisson's ratio, anisotropy, strength, yield strength

I. INTRODUCTION

Ensuring high load-bearing capacity of new technical devices, their optimization, increasing the accuracy of strength calculation methods, improving technological processes associated with heat-force effects on materials, requires detailed knowledge of physical and mechanical properties of materials in different situations.

Since the materials work in the field of plastic deformations, it is necessary to optimize the weight parameters of the structural elements in order to make the most of the load-bearing capacity of the devices. Therefore, the deformation properties and finite deformation directions of materials in accordance with the stress state of the mechanics of deformable solids, as well as the problems of finite curves transformation involving complex loads and applied residual deformation of the theory of applied plasticity or safe stresses on material independence are of particular interest.

The experimental results relating to the problems mentioned above apply to common construction materials. However, the use of materials with high relative strength in new techniques requires the study of the laws of their deformation. Such materials need to be studied over a wide temperature range, according to their different loading applications, in order to assess the cases of finite deformation-stress. Optimizing the structure of a number of materials is of great importance, which determines the heat treatment for maximum use of the strength reserve. Heat treatment is an easy and effective means of changing the mechanical properties of structural materials such as deformation ability, ductility and strength. The complexity and interdependence of the processes that occur in titanium alloys during heat treatment require reliable experimental results that allow the coordination of the relationship between mechanical properties and the order of heat treatment to ensure that the materials have the required properties. Data on the study of the mechanical properties of materials in the complex stress state are of particular importance, taking into account the effect of stress state in the calculation of the strength of certain device elements.

II. THE MAIN PART

In order to analyze the effect of the stress state on the laws of deformation resistance, simple loads are generated in the stress space by routine control of the amounts of longitudinal force and internal pressure in thin-walled tubular specimens. These are the main voltages in voltage cases σ_z (longitudinal tension) and σ_θ (tangential voltage $\kappa = \sigma_z / \sigma_\theta = \infty$ (elongation); 0 (transverse axial elongation); $-\infty$ (longitudinal compression); +1(two-axis elongation in one plane); and the ratios of head voltages are +2, +0.5, and -1 (pure shear) of flat voltages. About the change in the geometric dimensions of the sample in accordance with the amount of external load obtained from such experiments $\sigma_z(\sigma_\theta) -$ longitudinal (transverse) tension $- \mathcal{E}_z(\mathcal{E}_\theta)$ allows to construct initial deformation diagrams in longitudinal (transverse deformation) coordinates.

Using the following expressions:

$$\mathcal{E}_i = \frac{\sqrt{2}}{3}\sqrt{(\mathcal{E}_z - \mathcal{E}_\theta)^2 + (\mathcal{E}_\theta - \mathcal{E}_r)^2 + (\mathcal{E}_z - \mathcal{E}_r)^2 + \frac{3}{2}\gamma^2} \qquad (1)$$

$$\mathcal{E}_i = \frac{1}{\sqrt{2}}\sqrt{(\sigma_1 - \sigma_2)^2 + (\sigma_2 - \sigma_3)^2 + (\sigma_3 - \sigma_1)^2} \qquad (2)$$

which is invariant in sample size and shape σ_i- voltage intensity and $\mathcal{E}_i$- deformation diagrams are constructed on the deformation intensity axes.

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor: 7.429
Volume 9 Issue XI Nov 2021- Available at www.ijraset.com

The initial deformation diagrams generally reflect the processes that take place in material deformation [1,2] and allow qualitative and quantitative analysis of the indicators. Such indicators characterizing the processes of material deformation ─ Wool modulus, Poisson's ratio, yield strength, description of the process of transition to the elastoplastic state (presence or absence of elastic field, etc.), material hardening in the elastoplastic field, strength limit (σ_b) and representing the tendency of the material to brittle $\sigma_{ок}(\sigma_{0.2})$ and σ_b the ratio between, the maximum amount of homogeneous deformation, which determines the loss of dominance of the plastic deformation process of the material, and so on.

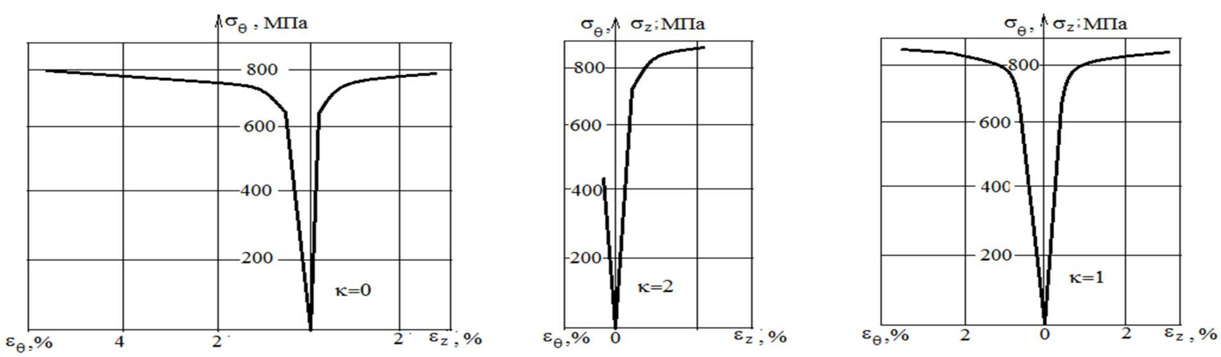
Let us consider the analysis of deformation diagrams of some structural materials.

1 in the form of α – titanium alloy σ_z-ε_z , σ_θ-ε_θ initial deformation curves on the axes and in Fig. 2 σ_i - $\varepsilon_i$generalized diagrams on the axes are given.

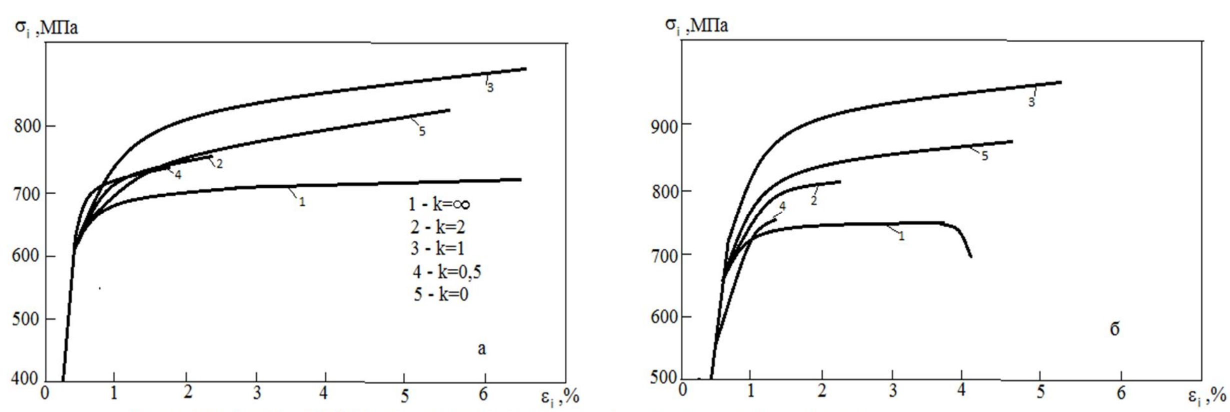
It can be seen that for Vt5 and Vt5-kt alloys it is characteristic that the generalized deformation curves are significantly scattered. In particular, the maximum deviation for the Vt5 alloy is relative to the mean ±9%, Вт5-1кт for ± 7%.

The location of the diagram in the k = + 1 state indicates that these alloys have the ability to withstand the highest deformation under the two-axis flat elongation stress state. Longitudinal single-axis elongation shows that such materials have the lowest resistance to deformation. Also $\sigma_z = \sigma_z(\varepsilon_z)$ and $\sigma_\theta = \sigma_\theta(\varepsilon_\theta)$ the asymmetry of the curves in the area of elastoplastic deformation at stress k = + 1 and the mismatch in the axial longitudinal and transverse elongation indicate the anisitropy of these materials. Generalized deformation curves of materials σ_i - ε_i scattering in the axes, the assessment of the state of plastic deformation of device elements made of these materials, shows that it is inappropriate for them to apply the concept of a single, invariant to the stress state, the deformation curve.

Approximate function $\sigma_i = A(\varepsilon_i)^n$ The hardening coefficients of the materials in Also $\alpha = \sigma_{i\,0,2}/\sigma_{ib}$ the coefficient is also almost the same. For example, k = 0.5 is for both alloys with uneven two-axis elongation $\alpha \approx 0{,}82$.



1-расм. Вт5-1кт котишманинг дастлабки деформацияланиш диаграммаси



2-расм. Вт5-1кт (а) ва ВТ5 (б) котишмалар умумлашган деформацияланиш эгри чизиклари

Titanium alloys Vt5 and VT5-1kt have a sufficiently high deformation ability in linear and two-axis straight elongation. This property is clearly shown in the diagrams, which show that the intensity of finite plastic deformations depends on the stress state. Both alloys have the least marginal deformations when loaded in the stress state at head ratios k = 0.5 and k = 2.

III. CONCLUSIONS

The results of the study allow to determine the criteria of flexibility, strength and deformation of materials in the field of mechanics of deformable solids, expanding existing assumptions, obtaining new scientific results and satisfactorily describing the finite state of the studied materials.

The obtained data can be used in the calculation and design of device elements operating at normal and high temperatures in the elastoplastic field.

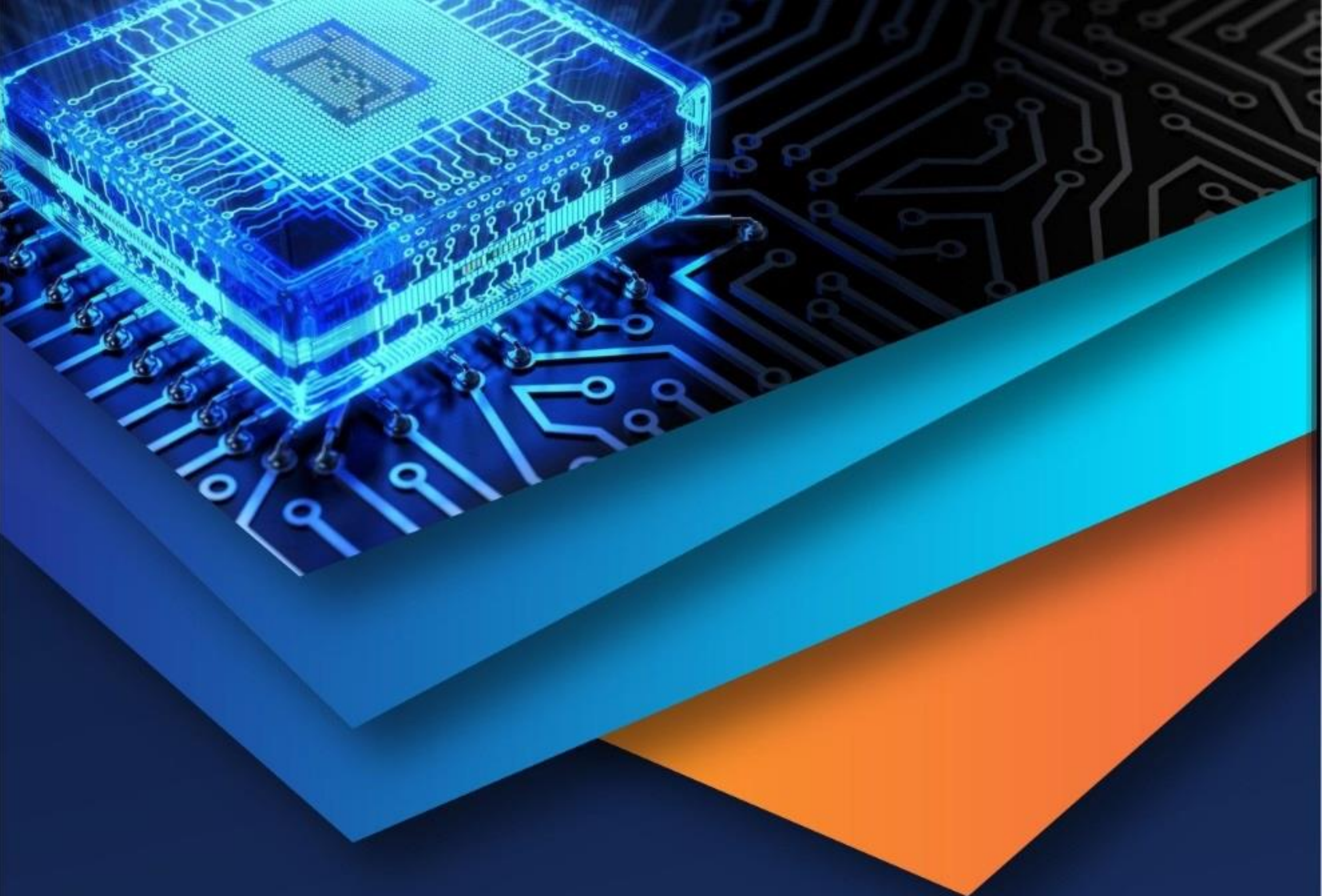
REFERENCES

[1] Lebedev Kovalchuk B.I., Giginyak F.F. Lomashevsky V.N. Mechanical properties of structural materials in a complex stress state─Spr.-Kiev: Nauk. dumka. 1983, p. 365.

[2] Pisaranko G.S., Lebedev A.A. Deformation and strength of materials under complex stress conditions. ─Kiev: Nauk. dumka. 1976, p. 415.

[3] Xakimov A.F., Daminov J.A. On the readability condition of transversal isotropic materials. Problems of Mechanics, Journal of Uzbekistan, Issue 2-3, 2017, pages 155-157

[4] Lebedev A.A., Kovalchuk B.I., Kulchitsky N.M., Khakimov A.F. Experimental study of the processes of deformation of steel along two-link trajectories.- Problems of Strength, 1988, N3, pp. 7-10.



10.22214/IJRASET

INDEX COPERNICUS

45.98

IMPACT FACTOR: 7.129

TOGETHER WE REACH THE GOAL

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY