Abstract

to the series of papers “Temporal effects of irreversible deformation of solids under dynamic loads”, presented by a young scientist, senior researcher Selyutina Nina Sergeevna

The challenge of the instability of the strength and deformation characteristics of a material under dynamic loading is a complex and actual task of solids mechanics. In this series of papers, the model of irreversible deformation is developed, which allows predicting dynamic effects in a wide range of strain rates. A comparative analysis of some well-known models of dynamic plastic deformation was given. The influence of the strain rate on the stress-strain relations in the wide range of strain rates for aluminum alloys and steels was described by a relaxation model of plasticity, by original and improved empirical Johnson-Cook models, and by the Rusinek-Klepachko phenomenological model. It was shown, that the relaxation model of plasticity is capable to effectively predict a wide spectrum of responses of materials to fast and slow dynamic loading. Expressions for the parameters of empirical models were obtained through the characteristics of the incubation time criterion of yielding, and satisfactory agreement was obtained when comparing them with experimental data. It was shown that the parameters of empirical models can depend on the strain rate. The independence of the characteristics of the incubation time criterion of yielding on the loading history and their relation to the structural-temporal peculiarities of the plastic deformation process gives an advantage to the approach based on the concept of incubation time relative to empirical models, as well as an effective and convenient formula for determining the yield strength in the wider range of strain rates. New results were obtained on the effect of heterogeneity on the dynamic strength of natural and structural materials. The effects of strength inversion were considered as a consequence of the strain rate sensitivity of the material, the dominant value of water saturation on the dynamic strength of concrete and rocks, and the strength of fiber-reinforced concrete under the influence of dynamic loads. Estimates were given of the structural and temporal characteristics of concrete and rocks depending on the coefficient of water saturation, and new studies of the influence of the percentage of fiber on the structural and temporal characteristics of fiber-reinforced concrete were considered.