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PROBLEMS IN THE STRENGTH AND STABILITY OF INHOMOGENEOUS STRUCTURES OF ROCKET AND SPACE HARDWARE WITH ACCOUNT FOR PLASTICITY AND CREEP

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Shell structures provide a compromise between strength and mass, which motivates their use in rocket and space hardware (RSH). High and long-term loads cause plastic and creep deformations in structural elements. RSH structures feature inhomogeneity: design inhomogeneity (polythickness, the presence of reinforcements, openings, etc.) and technological inhomogeneity (defects produced in manufacturing, operation, storage. and transportation, defects produced by unforeseen thermomechanical effects, etc.). These factors, which characterize structural inhomogeneity, are stress and strain concentrators and may be responsible for an early failure of structural elements and inadmissible shape imperfections. In inhomogeneous structures, different parts thereof are deformed by a program of their own and exhibit a different stress and strain level. In accounting for a physical nonlinearity, which is governed by plastic and creep deformations, the following approach to the determination of the stress and strain field is efficient: the calculation is divided into stages, and at each stage parameters that characterize the plastic and creep deformations developed are introduced: additional loads in the equilibrium equations or boundary conditions, additional deformations, or variable elasticity parameters (the modulus of elasticity and Poisson's ratio). Successive approximation schemes are constructed: at each stage, an elasticity problem is solved with the introduction of the above parameters. Special consideration is given to the determination of the launch vehicle and launch complex life. This is due to damages caused by alternate high-intensity thermomechanical loads. The basic approach relies on the theory of low- and high-cycle fatigue. The plasticity and the creep of a material are the basic factors in the consideration of the above problems. This paper considers various aspects of the solution of RSH strength and stability problems with account for the effect of plastic and creep deformations.

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