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COMPUTER SIMULATION OF THE EFFECT OF ANNULAR INCLUSIONS ON THE STRESS CONCENTRATION IN THIN-WALLED CYLINDRICAL AND CONICAL SHELLS WITH CIRCULAR OPENINGS*Oles Honchar Dnipro National University**72 Gagarin Ave., Dnipro 49010, Ukraine; e-mail: hart@ua.fm, semencha.aleksey@gmail.com*

Shell structures are used in various industries, such as the aerospace industry, the oil and gas industry, power engineering, mechanical engineering, construction, etc. Due to their design or manufacturing features, their integrity may be disrupted by the presence of various openings, around which local stresses develop. Finding ways to reduce stress concentrations around openings is an important problem in deformable solid mechanics.

This paper presents the results of a computer simulation and a finite-element analysis of the stress and strain field of thin-walled cylindrical and truncated conical shells with circular openings in the presence of annular inclusions around them made of a material whose properties differ from the main material of the shells. The effect of the elastic modulus of an inclusion and its geometric parameters on the stress and strain concentration in the vicinity of the openings was studied. Several inclusion materials and inclusion widths were considered. An annular inclusion made of a homogeneous material and located in the shell plane was considered. Stress and strain intensity distributions in the local stress concentration zones were calculated. A comparative analysis of the results obtained for cylindrical and conical shells was carried out. The study showed that the presence of a "soft" homogeneous annular inclusion makes it possible to reduce the stress concentration around the opening by ~13–35% depending on the inclusion width and elastic modulus both for a cylindrical and a conical shell. Certain combinations of the geometric and mechanical parameters of the inclusion give rise to a "mechanical" effect, which consists in shifting the stress concentration zone from the opening edge to the inclusion – shell material interface. For conical shells, due to their geometric features, a "conical" effect occurs: the stresses increase not only in the vicinity of the opening-weakened zone, but also near the cone basis.

Keywords: *thin-walled cylindrical shell, thin-walled truncated conical shell, circular opening, annular inclusion, stress and strain field, stress concentration factor, finite-element method.*

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