4. НП 306.2.141-2008 Общие положения безопасности атомных станций.
5. ПРБАС-89 ДНАОП 0.03-1.76-89 Правила радиационной безопасности при эксплуатации атомных станций.
6. НП 306.2.099-2004 Общие требования к продлению эксплуатации энергоблоков АЭС в сверхпроектный срок по результатам выполнения периодической переоценки безопасности.

УДК 624.012

***Gavrilenko V.A.**, student of grope CS-17, faculty of Construction*
*Scientific chief **Karasev A.G.**, Ph.D, associated professor, department of Life protection and workplace safety*
Prydniprovs'ka State Academy of Civil Engineering and Architecture

ON THE NUMERICAL ANALYSIS OF EXPERIMENTAL DATA ON THE BUCKLING OF CONICAL SHELLS

The problem of buckling of closed elastic shallow circular thin-walled cones under external pressure is a classic problem of shells theory. Both geometrically linear and nonlinear solutions were provided for this problem. It's well known fact, that a sensitivity of critical and limit pressures to the initial imperfections of the middle surface of shallow conical shells shape is relatively small. The question of influence of material's orthotropy on the buckling load of shallow conical shells remains insufficiently studied.

The aim of the work is to evaluate the effectiveness of the numerical analysis of buckling of closed shallow conical shells under external pressure, by comparing the calculation, carried out by ANSYS software, with the experimental results, presented in [1].

The research program included tests of 4 series of closed conical shells (over 100 small specimens made of heavy paper (Whatman paper) [1]. Each series unites the shell with the same thickness ratio R/h = 183; 245; 304; 452.

Test device is a metallic hollow circular cylinder with a hermetically closed lower end and the upper end of a free-flange, to which is attached the sample plane. The inner cylinder diameter corresponds to the base of a conical shell (2R), and the width of the flange - bandwidth allowance providing fixation sample.

Numerical analysis of the influence of surface deviations of the median and orthotropic material resistance was carried out in the ANSYS software with use of quadrangular SHELL 181.

The loading was realized as uniformly distributed over the entire surface of the cone external transverse pressure q. Boundary conditions of the base of the cone edge corresponded to a fixed clamped support and fixed hinge support. In the calculations were determined the critical pressure value of q^{cr} and buckling linear analysis.

Based experimental and computational critical pressures are presented on fig.1, for the angle α of generator line for shell series 1. Here, white circles and rhombus match the experimental values of the critical buckling pressure asymmetric, dark circles – axially symmetric inverted form. The calculated curves with even numbers correspond to a fixed hinge support edge of the shell, with the odd - fixed clamped support. Curves 1 and 2 represent the values of the critical pressure geometrically perfect isotropic conical shells averaged elastic constants, curves 3, 4 - geometrically perfect shells orthotropic, curves 5, 6 - imperfect shells from an isotropic material with averaged properties formed Coons patch surfaces of four panels curves 7, 8 - imperfect (4 panels) orthotropic shells.

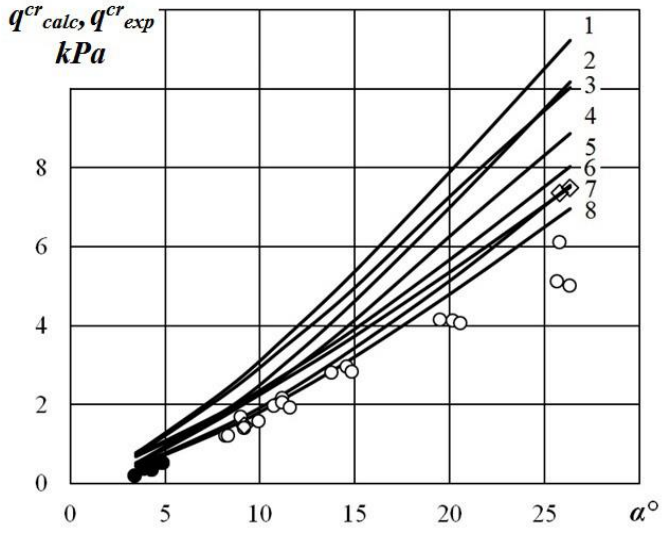

Fig. 1. Experimental and calculated dependences of critical pressures from angle α for shells series 1 (R/h = 183, R = 42 mm)

Comparison with the known extensive test results of the elastic flat closed conical shells made of sheets of paper, has showed that from a wide variety of theories and computational methods, including refined, in the best agreement with experiment proved calculation in ANSYS software, made taking into account the periodic in the circumferential direction initial geometry deviations and weak orthotropic shells material.

Thus, the critical pressure of existing conical shells structures with known form deviation from ideal can be obtained in ANSYS software by introducing and taking into account all deviations of the structure features, the characteristics of the material, as well as initial imperfections and other disturbances design scheme to the geometrical and the calculated shell model.

REFERENCES

1. Krasovsky V., Prokopalo E. and Varyanichko M. 2005 Buckling of shallow conical shells under external pressure in physical and numerical experimets. News of science of Pridniprov'ya, Series „Engineer sciences", no. 2, pp. 20-31 (in Russian).