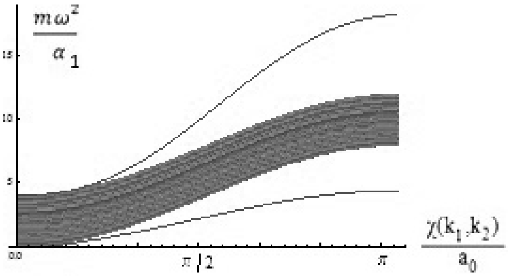
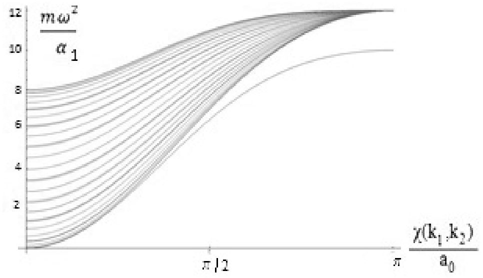
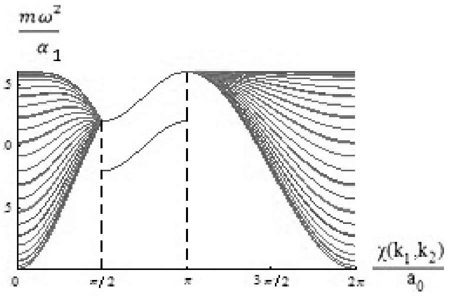


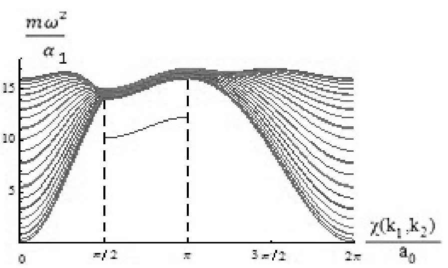
a



b



c



d

Fig.1. Volume vibration bands and surface waves for:

a) SC (001) crystal having an adsorbed surface monolayer ($m_0 / m = 1/2$ and $m_0 / m = 2$);

b) SC (001) crystal having a free-surface in second neighbors approximation, y=0.25;

Volume vibration bands and surface waves for $k_1+k_2=\pi$ quasi-two-dimensional wave vector region in FCC (001) crystal having a free-surface:

c) in first neighbors approximation;

d) in second neighbors approximation, y=0.25.

band narrows when the two-dimensional quasi-wave vector $\chi(k_1, k_2)$ approaches to π. The narrowing rate depends on *y* value. For example, when *y* = 0.25 volume vibration band degenerates into a line at $\chi(k_1, k_2) = \pi$, which means that vibrations are localized in a single layer within the considered area. As for surface wave in this case, it takes place for SC (001) in the approximation of second neighbours even considering the free-surface crystal. For FCC with (001) surface orientation plane, a volume band occurs within the region where in nearest-neighbours interaction model it degenerates into a single line as there are only vibrations localized in one layer there. The way the volume vibration band changes depending on various values of $y \equiv \alpha_2 / \alpha_1$ is illustrated (here α_1 is an interaction coefficient between nearest neighbours, α_2 is the one for next-nearest neighbours interaction). The results obtained for FCC (001) conform to the research results carried out in [4].

LITERATURE

1. Alldredge G.P.// Phys.Lett. A. – 1972. – v.41,N3. – P.281.
2. Gelfgat I.M.// Fiz.Niz.Temp. – 1977. – v.19. – P.1711.
3. Kosevich Yu.A., Syrkin E.S. // J. Phys.: Condensed Matter. – 1990. – v.2,N22. – P.5047 – 5052.
4. Kovalev A.S., Rysich N.V., Syrkin E.S. // Phys. Low–Dim. Struct. – 2002. – v.104,N3/4. – P.99 – 104.

BUCKLING OF THIN WALLED CYLINDRICAL SHELLS UNDER COMBINED LOADS

*Pupazescu A., *Zaharia M.*

Petroleum-Gas University, Ploiesti, Roumania

Thin walled cylindrical shells are widely used as silos for storing bulk solids. These structures are susceptible to buckling when they are subjected to axially compressive loads that are due to the friction between the bulk material stored and the silo walls, but also to the seismic actions.

Sometimes, for example, under the wind action or during discharge, in addition to axial compression, can also act external pressure, and cylindrical shell is subjected to a combined action. This problem can be studied both with analytical methods and with linear buckling analysis (LBA) based on finite element method.

The analytical method is based on Donnell's equation [1] for the equilibrium of cylindrical shells. After calculation, the final equation that express the critical axial buckling load as a function of the axial half waves number *m,* the circumferential waves number *n* and the external applied pressure *q,* is:

$$P = \frac{E \cdot t^3}{12(1-\nu^2)} \frac{\left(\frac{m^2\pi^2}{l^2} + \frac{n^2}{R^2}\right)^2}{\frac{m^2\pi^2}{l^2}} + \frac{E \cdot t}{R^2} \frac{\frac{m^2\pi^2}{l^2}}{\left(\frac{m^2\pi^2}{l^2} + \frac{n^2}{R^2}\right)^2} - qR \frac{\left(\frac{n}{R}\right)^2}{\frac{m^2\pi^2}{l^2}} \qquad (1)$$

where E is the Young's modulus, ν is the Poisson's ratio, R is the mean radius of cylindrical shell, l is the length and t represent its thickness.

The value of critical axial buckling load P_{cr} can be determined by giving values to external pressure and by minimizing P with regards to various values of *m*and *n.*

On the other hand, LBA can be used to predict the theoretical value for the buckling load that can be calculated by multiplying the load that was applied to the structure in static analysisphase *P,* with the load factor λ_{cr} given by computer program.

When combined actions, in static analysis phase, thestructureis loaded with acompressiveaxialforce havingvalue$P_{ax}$and an externalpressureq_{ext}. The program will provide afactorλ which multiplied byP_{ax}andq_{ext}leads to getting the critical valuesof the twoloadsacting simultaneously.

The goal of this research is to analyze the influence ofexternal pressure on the stability of cylindrical shell under axial compression depending onitsdimensional characteristics.

The studied models were represented by circular cylindrical shells of external radius R_e= 1734 mm, length l = 1508 mm, respectively 3016 mm and thickness t = 3 mm, respectively 4 mm, subjected to axial compression and external pressure. Material properties were: the Young's modulus $E = 2.1\text{x}10^5$ and Poisson's ratio $\nu = 0.3$. The analytical and numerical results are presented in Fig. 1.

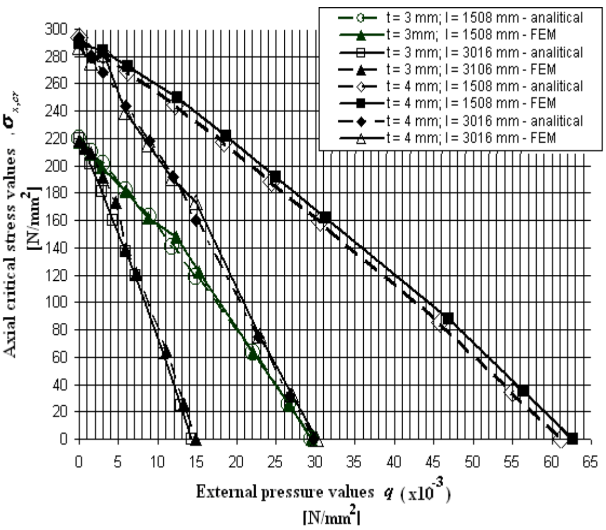


Fig. 1. Analytical and numerical results

Conclusions. Theresultspresented in thisarticle show thatthe presence ofexternalpressurehasthe effect to decrease the criticalaxial bucklingload. It can be seen, also, that an increase inthe wall thicknessof thecylindricalshellhasthe effect of extendingthe stable domain, while increasingits lengthmakes this domainto berestricted.

The resultsobtained withthe finite element methodare very close to the analytical, which means that the use ofthe numerical methodcanleadtoaccurate informationaboutthe behavior of thesestructureswhen subjected to combined actions. This thing is very useful, especially whenstudyingcomplex structuressuch asstiffenedcylindricalshellsor shells with geometricimperfections, for which theanalytical methodis difficult to apply.

LITERATURE

1. Batdorf S. S., A simplified method of elastic stability analysis for thin cylindricalshells // National Advisory committee for aeronautics. Technical note N1341– Washington. – 1947.
2. Frank A., Larsen K., Methods for decreasing the total solution time of linear buckling finite element analyses. (Master's Thesis). Department of Mechanical & Manufacturing Engineering,Aalborg University, 2012.
3. Huang H., Han Q., Feng N. Buckling of Functionally Graded Cylindrical Shells under Combined Loads // Mech. Advanced Mater. Struct. – 2011. – v.18, N5. – P.337–346.
5. Prabu B., Rathinam N., Srinivasan R., Naarayen K.A.S., Finite element analysis of buckling of thin cylindrical shell subjected to uniform external pressure // J. Solid Mechanics. – 2009. – v. 1, N. 2. – P.148–158.
6. Timoshenko S., Gere J. Theory of elastic stability. Mc Graw-Hill Book Co., New York. – 1936.

SEMI-ANALYTICAL SOLUTION FOR POROUS FIN WITH TEMPERATURE-DEPENDENT HEAT TRANSFER COEFFICIENT AND EMISSIVITY

*[*1]Shahbabaei M., [2]Saedodin S., [3]GanjiD.D., [4]Rahimipetroudi I.*

[1]Department of Mechanical Engineering, Azad University, Shirgah Branch, Iran
[2]Department of Mechanical Engineering, Semnan University, Semnan , Iran
[3]Department of Mechanical Engineering, Noshirvani University, Babol , Iran
[4]Department of Mechanical Engineering, Azad University, Sari Branch, Iran

In the present study, the problem of nonlinear equations arising in Spine Cylindrical Porous Fin with Temperature Dependent Heat transfer Coefficient and Emissivity is investigated. The Maxwell equations have been used, and also Rossel and approximation for radiation heat transfer and Darcy model for simulating the flow in porous medium have been adapted. The governing equations are reduced to a nonlinear ODE. The fin is supposed to be an insulated tip fin, which is exposed to a magnetic field. The Collocation Method (CM) is employed to compute an approximation to the solution of the system of nonlinear differential equations governing on the problem. It has been attempted to show the capabilities and wide-range applications of the CM in comparison with Homotopy Perturbation Method and numerical method namely Boundary Value Problem method (BVP) in solving this problems. The results reveal that CM is very effective and simple and can be applied for other nonlinear problems.