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REZULTATE EXPERIMENTALE OBȚINUTE PRIN APLICAREA METODEI GRAFICE PENTRU OPTIMIZAREA ÎNVELITORII CILINDRU-SFERĂ SUB PRESIUNE INTERNĂ

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EXPERIMENTAL RESULTS ACQUIRING THROUGH APPLING A GRAPHICAL METHOD FOR OPTIMIZATION OF SPHERE-CYLINDER SHELL UNDER INTERNAL PRESSURE

Paper presents the analysis results of the stress state for the optimized through the graphical method of sphere-cylinder shell proposed by Dora Florea in the paper [1].The optimized contour with the programme SPLINE29 was enforce the achievement for the von Mises equivalents stress value of 17.8 MPa as analyzed by NASTRAN V.4.0 [3] programme. The profile presents a variation of the equivalents von Mises stress in the interval 15.18 MPa and 18.55 MPa. The maxim variation relative of the imposed stress for the optimization is 0.76 MPa with plus and 2.62 MPa with minus. In a critical point the variation of stress is 1.74 MPa.

Lucrarea prezintă rezultatele analizei stării de tensiuni pentru optimizarea unei învelitori sferă-cilindru prin metoda grafică de optimizare propusă în lucrarea [1] de către Dora Florea. Conturul s-a optimizat cu impunerea de a se obține valoarea de 17,8 MPa pentru tensiunea echivalentă von Mises pe întreg profilul. Profilul obținut prin rularea programului SPLINE29 a fost supus analizei stării de tensiuni cu programul de elemente finite NASTRAN V4.0 [3], abaterea maximă față de tensiunea impusă pentru optimizare fiind de 0,76 MPa cu plus de tensiune, respectiv 2,62 MPa cu minus de tensiune, variația în punctul critic fiind de 1,74 MPa pe învelitoarea cilindrică.

Keywords: Graphics of Echivalente von Mises stress, sphere-cylinder, internal pressure, spline function, NASTRAN V4.0, programme SPLINE29

Cuvinte cheie: grafică tensiuni echivalente von Mises, sferă-cilindru, presiune internă, funcție spline, NASTRAN V4.0, program SPLINE29

1. İntroduction

Optimized method presented in the paper [1] with regard to sphere-cylinder shell with purpose of achievement a equivalents von Mises stress constant on the whole shell, has a point of start the functions F_k of the equivalents von Mises stress determined through the FEM method, as consequence to run the element finite programme NASTRAN V4.0 [3] for the studded case.

The function F_k are knowledge under the table form in n equidistance points $x_{i,i=1...n}$ for a number of m thickness of shell g_k:

$$F_k(x_i,g_k)=y_i \quad , i=1\ldots n, k=1\ldots m \tag{1}$$

Through the proposed method by Dora Florea [1] , in the end to determined the values of the thickness shell $t_{i,i=1...n}$ in n points on the shell for a imposed value Y_u of the equivalente von Mises stress:

$$t_i=T(Y_u,x_i)_{\ i=1...n} \tag{2}$$

2. Experimental results

For the achievement the proposed purpose, to wrote the SPLINE29 programme in Pascal V.6.0 language, which has the input date for the equivalents von Mises stress obtain after analysis the stress state with the finite element NASTRAN V.4.0 [3] for the studded case. For the test it consider a sphere-cylinder shell with the geometrical parameters: radius of the sphere r=500 mm, the length of the cylinder l = 500 mm, the module Young of elasticity E = 7E+3 MPa, the Poisson coefficient μ = 0.34, under the internal pressure p = 0.4 MPa for the thickness $g_{k=1,2,3,5}$ = 5, 7, 9, 11 mm.

As the restriction to imposed for the equivalents von Mises stress σ_{VM} = 17.81 MPa, what represents the maximum equivalents von Mises stress for the shell with the mention parameters and the thickness $g_{k=4}$ =10 mm, the stress what was imposed in the shell with the contour of the thickness determined in m equidistance points.

The programme show the graphics of equivalents von Mises stress for various thickness g_k. In fig.1 is show the equivalents von Mises stress for the thickness $g_{k=4}$=10 mm. So the programme allow the

visualization of the thickness shell function of the equivalents von Mises stress achievement in a point of the shell section, this thick being possible for any point from section. So in fig.2 is show the function

$$g_k = G_{i=1}(y_k, x_{i=1}), \quad k=1\ldots n \tag{3}$$

for the point $x_1=0$.

The programme provided in the final, the thickness of the shell for whole section at a value of equivalents von Mises stress imposed.

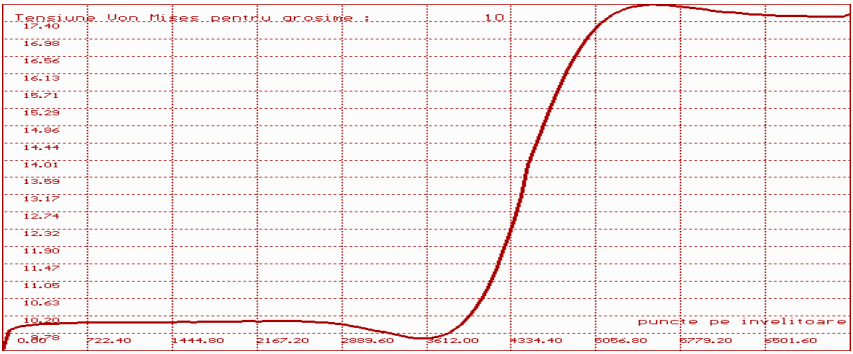

Fig.1 Equivalents von Mises stress for $g_{k=4}$=10 mm , $y_i=F_{k=1}(x_i, g_{k=4})$, i=1…n

Fig.3 represents the variation of the shell thickness t_i for the 130 points in which was discretised the shell section, the values obtained after interpolation for spline function of the family function $G_{i,i=1\ldots n}$. The value of the thickness computed in m equidistance points was used for the analysis of the stress state of the determined shell, with the NASTRAN V4.0 programme. The details of the obtained contour with the element finite CTRIA3 used for the stress analysis are show in fig.4 and fig.5.

After stress analysis for the shell with the thickness in 130 points on the section of the shell, computed through SPLINE29 programme, was obtain the equivalents von Mises stress, show in fig.6.

In fig.6 it remark that existed a peak of 18.55 MPa which presents a small deviation of 0.75 MPa from the equivalents von Mises stress of 17.8 MPa imposed initial to be realized in the shell.

Fig. 2 Function of thickness with von Mises stress for the point $x_1=0$, $g_k=G_{i=1}(y_k, x_{i=1})$, k=1…m

So it evidence a small deviation in less of the equivalents von Mises stress in the sphere, where the equivalents von Mises stress is 17.3 MPa. So in the cylinder the equivalents von Mises stress on the internal face is around of the value 17.85 MPa, which is a value very approach of the value 17.8 MPa imposed to realize. It can see a top of minimum equivalents von Mises stress of 15.18 MPa, results as following picking of dates.

To appreciate that the variation of the equivalents von Mises stress from imposed value are following the error of the gathering dates and the compute method, but this variation are very small.

3. Conclusion

■ It appreciate that the obtain results are very good and the method are polishing. The profile presents a variation of the equivalents von Mises stress in the interval 15.18 MPa and 18.55 MPa.

■ The maxim variation relative of the imposed stress for the optimization is 0.76 MPa with plus and 2.62 MPa with minus .In a critical point the variation of stress is 1.74 MPa.

■ The tops of minimum equivalents von Mises stress of 15.18 MPa may be can eliminated.

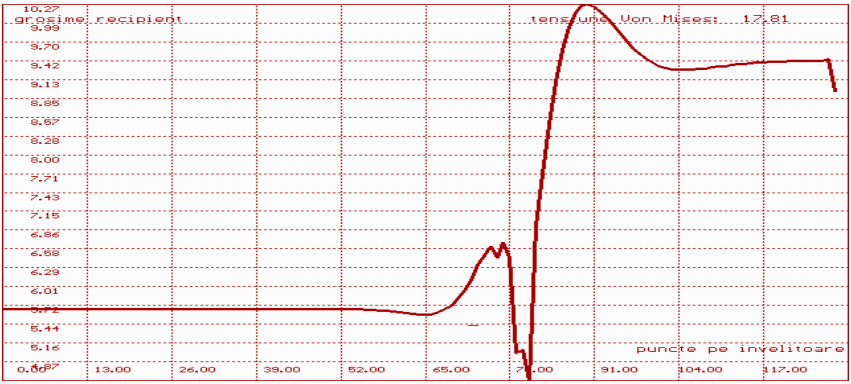

Fig. 3 Function of thickness $t_i = T(Y_u, x_i)$, $i = 1 \ldots n$

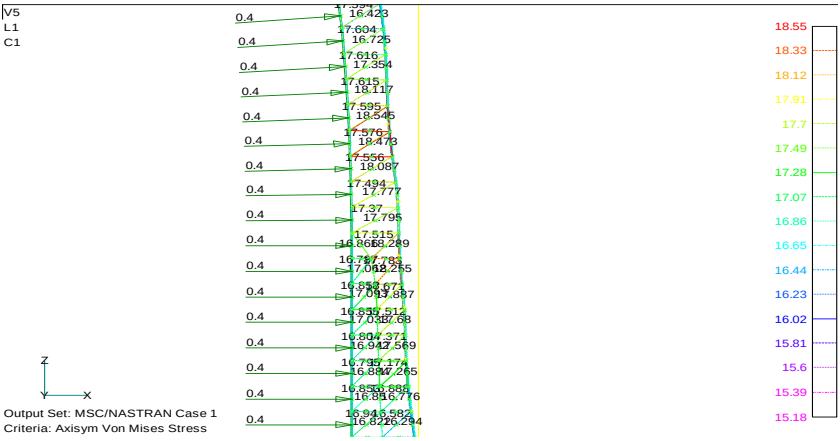

Fig. 4 Detail of profile for function of thickness t_i from fig.3 with the equivalents von Mises stress on the finites elements

REFERENCES

[1] Dora Florea, *About for the graphical method of the optimum contour determination for the sphere-cylinder shell under internal pressure with achievement uniform stress state,* Stiinta și Inginerie, 2018, Cluj Napoca, vol.33.

[2] Turbo Pascal 6.0, Editura Teora, 1992.

[3] Nastran V 4.0.

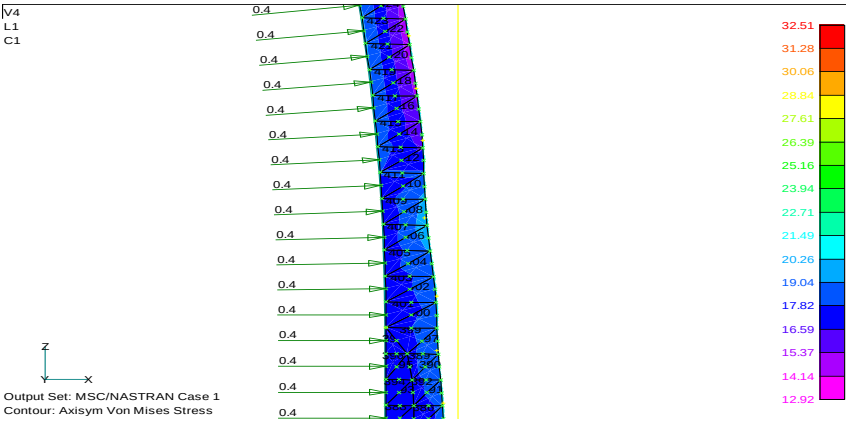

Fig. 5 The equivalents von Mises stress in the section from fig.4

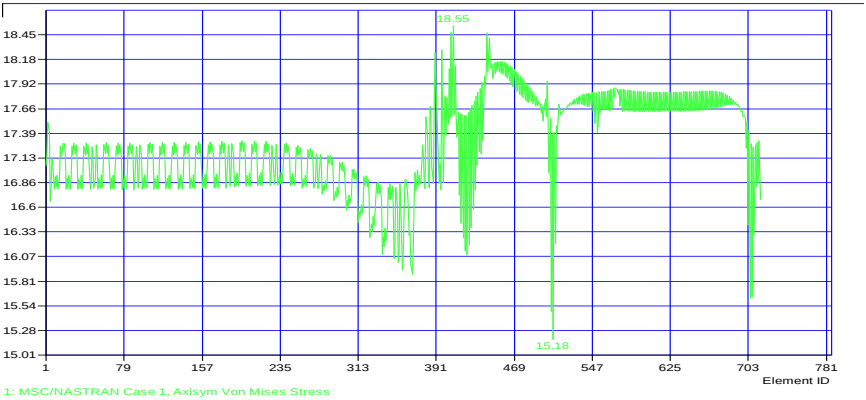

Fig. 6 Graphics of the equivalents von Mises stress for the profile obtained with SPLINE29 programme

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