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STUDY OF STRESS AND DISPLACEMENT FOR AN OPTIMIZED PROFIL OF SPHERE-CYLINDER GRP UNDER THE DIFFERENT LOAD OF INTERNAL PRESSURE

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STUDII DE TENSIUNI ŞI DEFORMAŢII PENTRU UN PROFIL SFERĂ-CILINDRU GRP SUB DIFERITE ÎNCĂRCĂRI DE PRESIUNE INTERNĂ

Articolul prezintă un studiu al stării de tensiuni și deplasări realizat cu programul NASTRAN V4.0 pentru o învelitoare cilindru-sferă GRP optimizată după metoda propusă de autoare [1] cu ajutorul programului OPTIMISIS [2] pentru valoarea tensiunii echivalente von Mises σ_{VM} = 50 MPa și supusă presiunii p = 4 MPa. Modelul de învelitoare optimizat a fost studiat pentru presiunile de 0.4 MPa, 4 MPa și 40 MPa. Concluzia este ca valoarea tensiunii echivalente von Mises σ_{VM} și deplasarea totală δ_t crește cu creșterea presiunii dar valoarea tensiunii von Misses σ_{VMo} și deplasarea totală δ_{to} pentru modelul optimizat sunt foarte mici in comparaţie cu valoarea tensiunii echivalente von Mises și deplasării totale pentru aceleași încărcări dar pentru învelitoarea cilindru-sferă neoptimizată și de grosime constantă t = 10 mm.

The article presents a study of the State of tension and displacements with NASTRAN Software v4.0 for cylinder-sphere a GRP optimized after the proposed method by the author [1] with OPTIMISIS [2] for the equivalent voltage von Mises σ_{VM} = 50 MPa and subject to pressure of p = 4 MPa.

Cuvinte cheie: tensiune echivalentă von Mises, deplasare totală, învelitoare sferă-cilindru GRP, metoda elementelor finite

Keywords: equal von Mises stress, displacement, covers the sphere-cylinder GRP, finite elements method

1. Introduction

In this paper it made the study of the behavior of the optimized profile through D.A. Florea [1] method, for the different values of the internal, constant, uniform pressure. The study it imposed because for that the profile of the non-optimized shell, the values of equivalence von Mises stress σ_{VM} and their total displacement $\delta_{t.}$ are very great with the increase the pressure.

The analysis for the stress and displacement state it made with FEM method with NASTRAN V4.0 programmed, for a shell with thickness t = 10 mm under the pressure of 0.4 MPa, 4 MPa and 40 MPa.

Than it analyses through of FEM method with the NASTRAN V.4.0 programmed, the stress and displacement state under the pressure of 0.4 MPa, 4 MPa and 40 MPa, for the shell optimized at the equivalence von Mises stress 50 MPa for the pressure p = 4 MPa. The model of the shell sphere-cylinder GRP studded it presented in figure 1, having the geometrical characteristics: thickness t = 10 mm, internal radius r = 50 mm, length of the cylinder l = 500 mm and the material characteristics, module Young of elasticity E = 7E+3 MPa, Poisson's coefficient μ = 0.34.

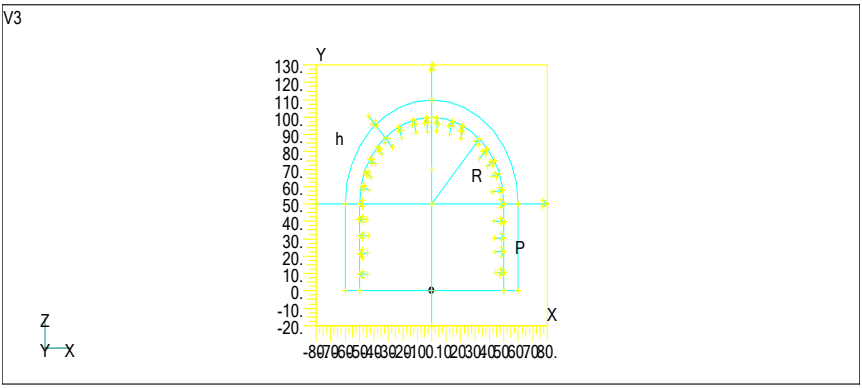

Fig. 1 The model sphere-cylinder

2. Study of the stress and displacement state in the shell GRP of constant thickness at the different pressure

The model FEM for the cylinder-sphere shell with the thickness t = 10mm, studded with the NASTRAN V.4.0 programmer under the pressure p = 0.4 MPa it presents in figure 2.

The graphic of equivalence von Mises stress for the studded case (figure 2) at the pressure p = 0.4 MPa, it presents in figure 3. For the same model under the pressure p = 4 MPa the graph of equivalence von Mises stress it presents in figure 4 and for the model under the pressure p = 40 MPa the graph of equivalence von Mises stress it presents in figure 5.

The total displacement for the studded case for the pressure p = 0.4 MPa it presents in figure 6, for the pressure p = 4 MPa it presents in figure 7 and for the pressure p = 40 MPa in figure 8.

The Table 1 presents synthetics the value of equivalence von Mises stress, minimum and maximum values, the total displacement for the studded cases for model with t = 10 mm.

The shell with the characteristics presented was optimized through the method D.A. Florea [1] used the OPTIMISES [2] programmed for the pressure p = 4 MPa.

The FEM model studded with the programmed NASTRAN V.4.0 for the optimized shell is presented in figure 9.

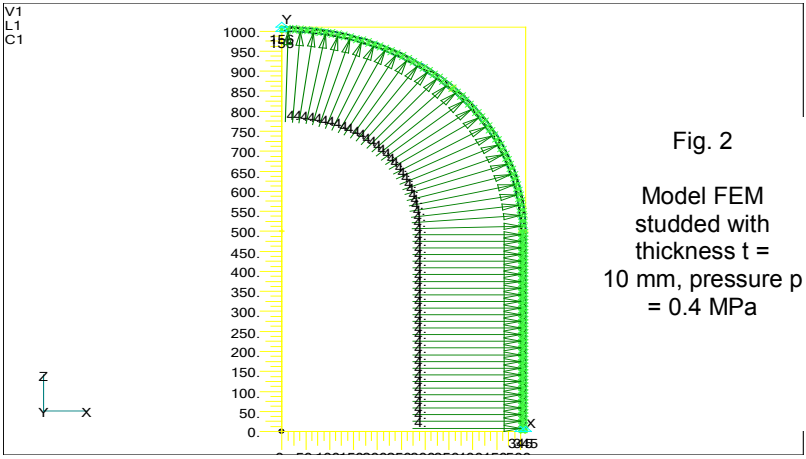

Fig. 2

Model FEM studded with thickness t = 10 mm, pressure p = 0.4 MPa

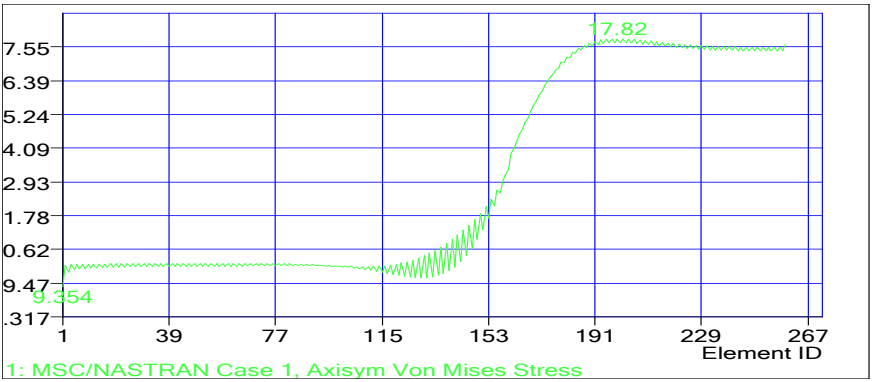

Fig. 3 Graph of equivalence von Mises stress for the model with
t = 10 mm p = 0.4 MPa

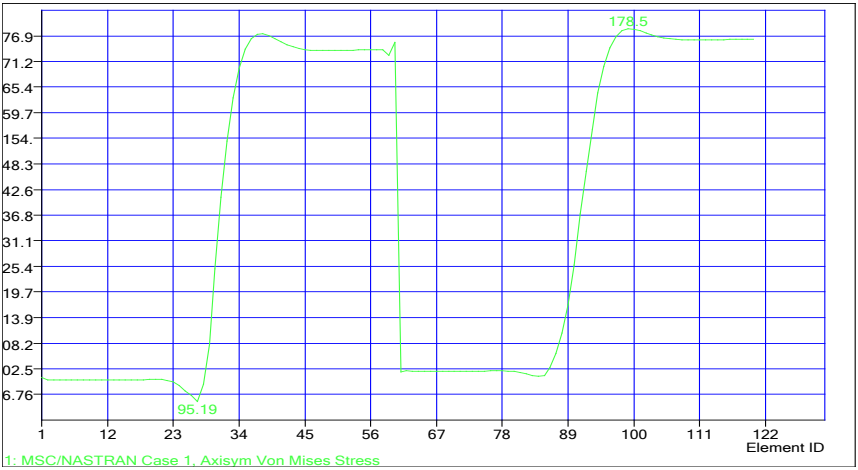

Fig. 4 Graph of equivalence von Mises for the model with t = 10 mm, p = 4 MPa

The optimized shell was subjected at the pressure with the values: p = 0.4 MPa, p = 4 MPa and p = 40 MPa. The graphics of equivalence von Mises stress for the three value of the pressure applied at the optimized profile are presented in figure 10, figure 11, figure 12.

The graphics at the displacement δ_t for the three values of the pressure applied at the optimized profile are presented in figure 13, figure 14 and figure 15.

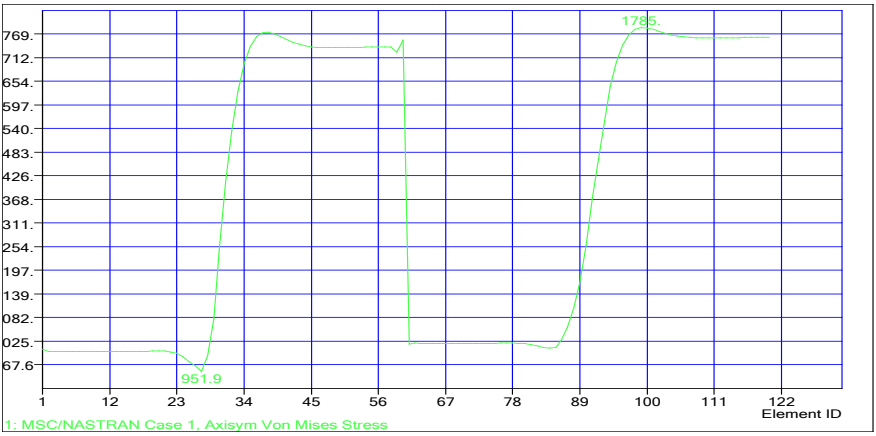

Fig. 5 Graph of equivalence von Mises stress for the model with t = 10 mm, p = 40 MPa

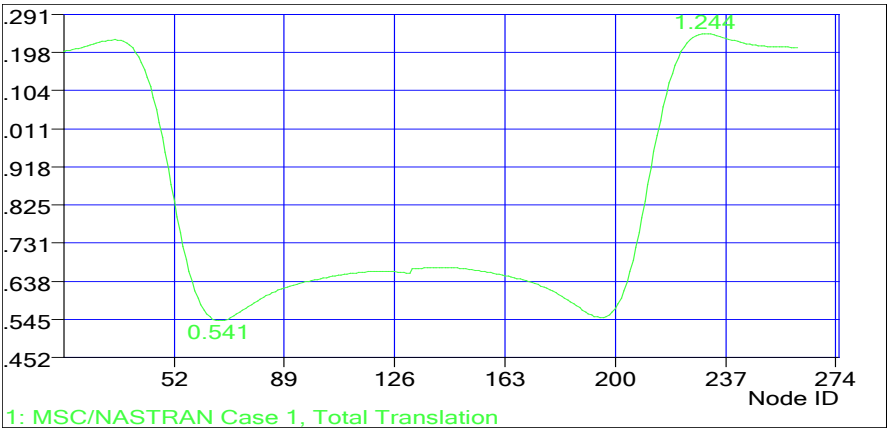

Fig. 6 Graph of the total displacement for the pressure p = 0.4 MPa, model with t = 10 mm

The Table 2 presents synthetics the maximum and minimum equivalence von Mises stress σ_{VM} and the total displacement δ_t for the optimized shell under p = 0.4 MPa, 4 MPa and 40 MPa.

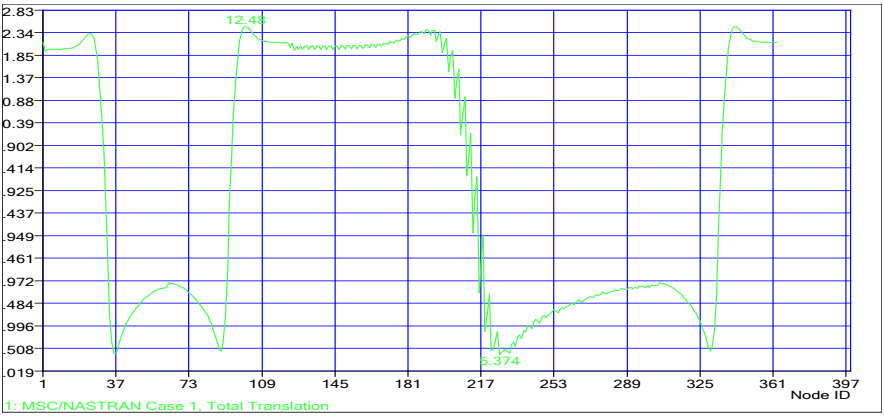

Fig. 7 Graph of total displacement for the pressure
p = 4 MPa, model with t = 10 mm

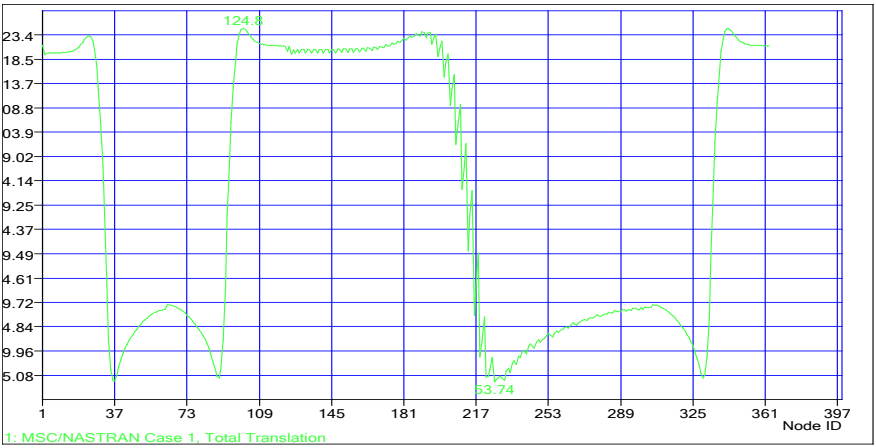

Fig. 8 Graph of total displacement for the pressure
p = 40 MPa, model with t = 10 mm

Table 1

No	Mo-del	Pre-ssu-re [MPa]	Equivalence on Mises stress σ_{VM} [MPa]		$\Delta\sigma_{VM}$ [MPa]	Total displacement δ_t [mm]		$\Delta\delta_t$ [mm]
			Mini-mum	Maxi-mum		Mini-mum	Maxi-mum	
1	t=10 mm	0.4	9.354	17.82	8.466	0.541	1.244	0.703
2	t=10 mm	4	95.19	175.8	80.61	5.35	12.48	7.13
3	t=10 mm	40	951.943	1785.78	832.635	53.74	124.76	71.02

4. Conclusion

■ The results from the Table 1 and Table 2 show that for the non optimized profile, the equivalence von Mises stress has a variation band great with the values between 8.466 MPa and 832.635 MPa and the total displacement great with the values between 0.703 mm and 71.02 mm at the pressure between 0.4 MPa and 40 MPa.

■ For the optimized profile, the values of equivalence von Mises stress has the band of the variation small between 1.706 MPa and 94.1 MPa and so the variation band for the total displacement small between 0.039 mm and 9.03mm for the pressure between 0.4 MPa and 40 MPa.

■ The conclusion is that for the optimized profile the stress of equivalence Von Mises stress are constant and very small on the shell of the different values of the pressure, and so the total displacement are constant on the shell and very small at the different values of the pressure in corporation of the values for the non optimized profile.

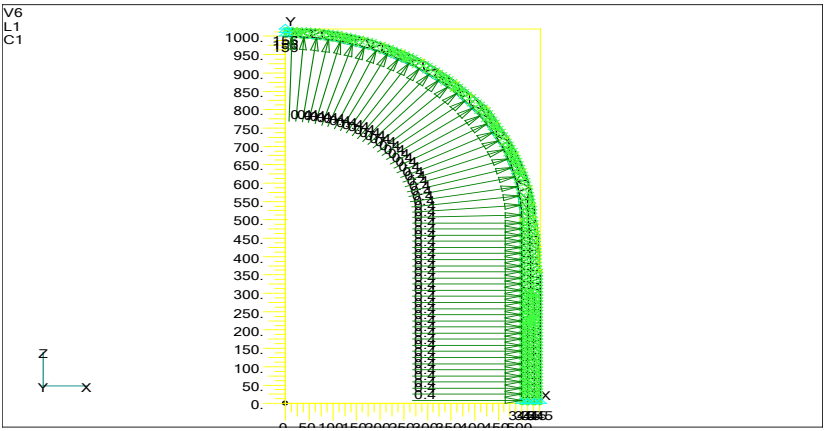

Fig. 9 FEM model for the optimized shell

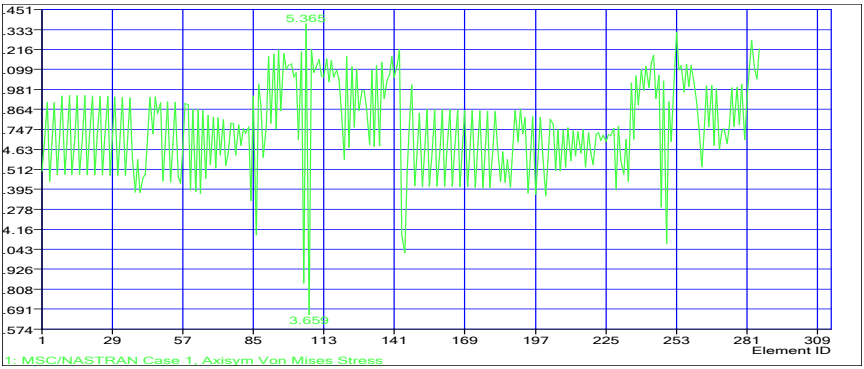

Fig. 10 Equivalence von Mises stress for the optimized profile at the pressure p = 0.4 MPa

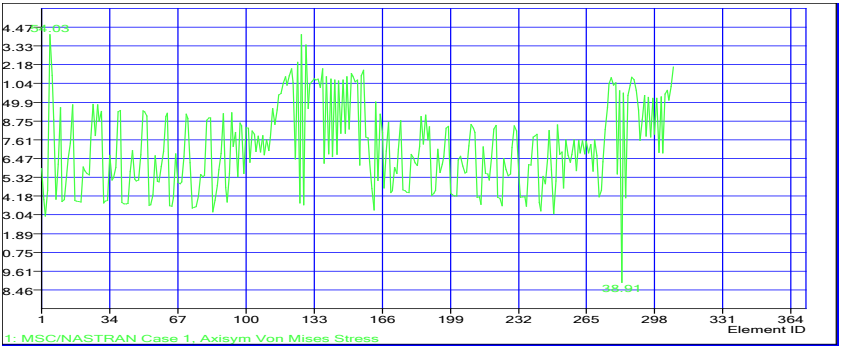

Fig.11 Equivalence von Mises stress for the optimized profile at the pressure p = 4 MPa

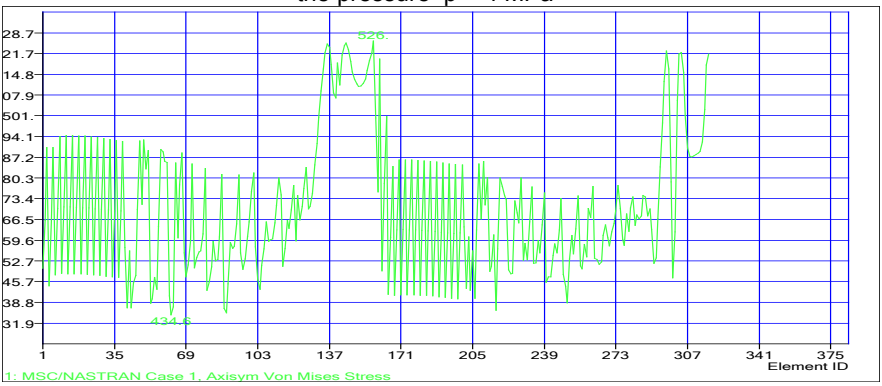

Fig. 12 Equivalence von Mises stress for the optimized profile at the pressure p = 40 MPa

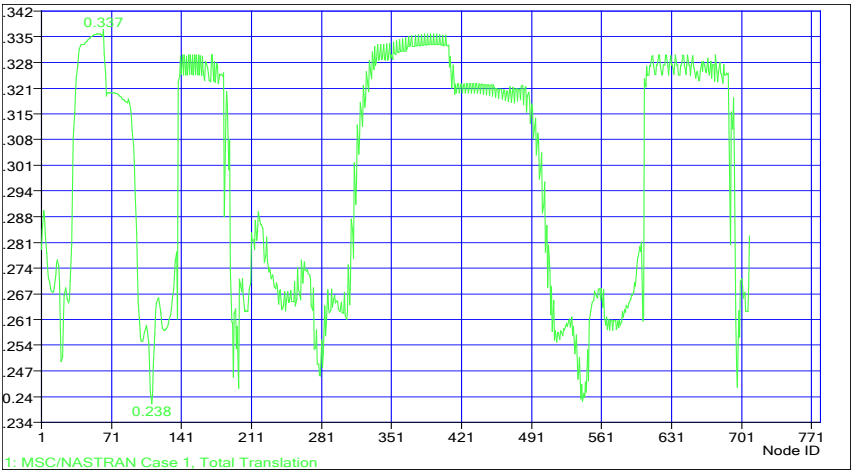

Fig.13 Total displacement for the optimized profil for the pressure p= 0.4 MPa

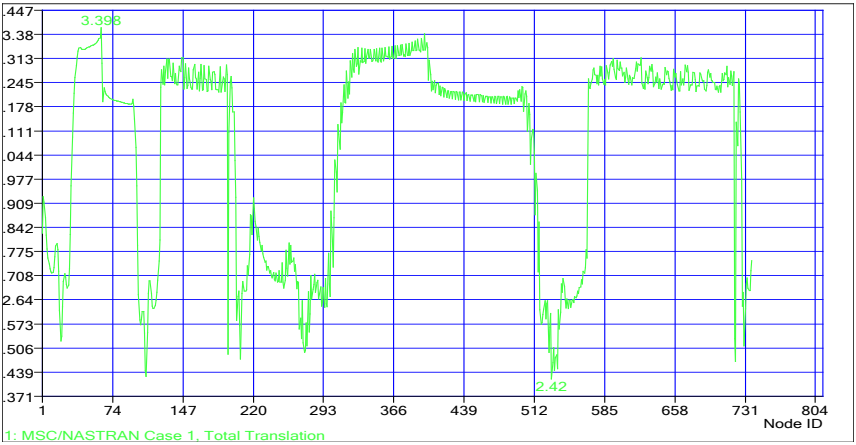

Fig.14 Total displacement for the optimized profile for the pressure p = 4 MPa

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[2] Florea, Dora A.T., *Theoretical aspect with regard a programme for the optimization in the elastic field of the thin shells cylinder-sphere under intrernal pressure*, Buletin Ştiintific al UPT, Tom 52(66), Fasc.5, 2007, pag. 31-34.
[3] * * * NASTRAN V.4.0.

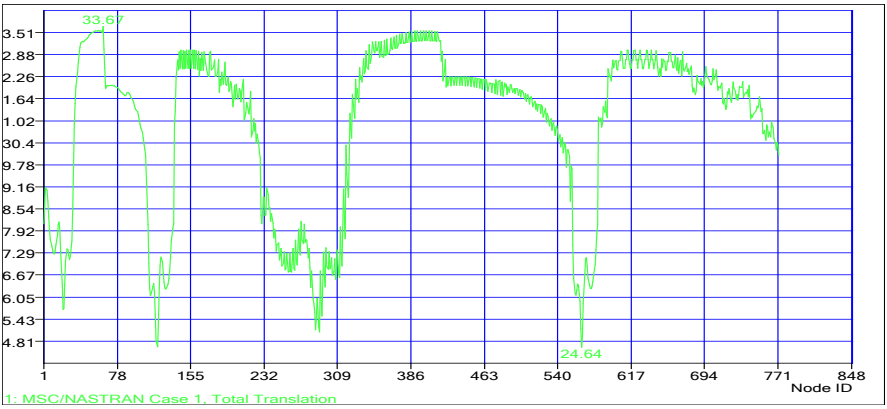

Fig.15 Total displacement for the optimized profile for the pressure p = 40 MPa

Table 2

No	Model	Pre-ssu-re [MPa]	Equivalente on Mises stress σ_{VM} [MPa]		$\Delta\sigma_{VM}$ [MPa]	Total displacement δ_t [mm]		$\Delta\delta_t$ [mm]
			Mini-mum	Maxi-mum		Mini-mum	Maxi-mum	
1	Optimi-zed	0.4	3.659	5.365	1.706	0.238	0.337	0.039
2	Optimi-zed	4	38.91	54.03	15.12	2.42	3.39	0.97
3	Optimi-zed	40	434.6	526	91.4	24.64	33.67	9.03

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