THE STRENGTH ANALYSIS FOR SOME BUTTONS USED IN THELIFTING PROCESS OFA HORIZONTAL CYLINDER

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ABSTRACT

In the paper is presented a stress analysis for some cylindrical buttons used for lifting up a horizontal cylinder. The maps of equivalent stresses are presented and some interesting results are obtained.

Keywords: lifting buttons.

GENERAL ASPECTS

The analysed cylinder and the lifting buttons have the geometry presented in figure 1. In figure 1a is presented a general view of the horizontal cylinder and in figure 1b is presented the geometry of the lifting buttons. As it can be noticed a lifting cylinder is welded directly on the horizontal header and the other one is welded on an intermediary pad located between the lifting cylinder and the header.

The main cylindre and all the other components are made from S 235 JR, material that has the following mechanical properties:

- Yield limit: R_e = 235 Mpa;
- Strength limit: R_m = 360 Mpa;
- Allowable limit: σ_a = 205 MPa.

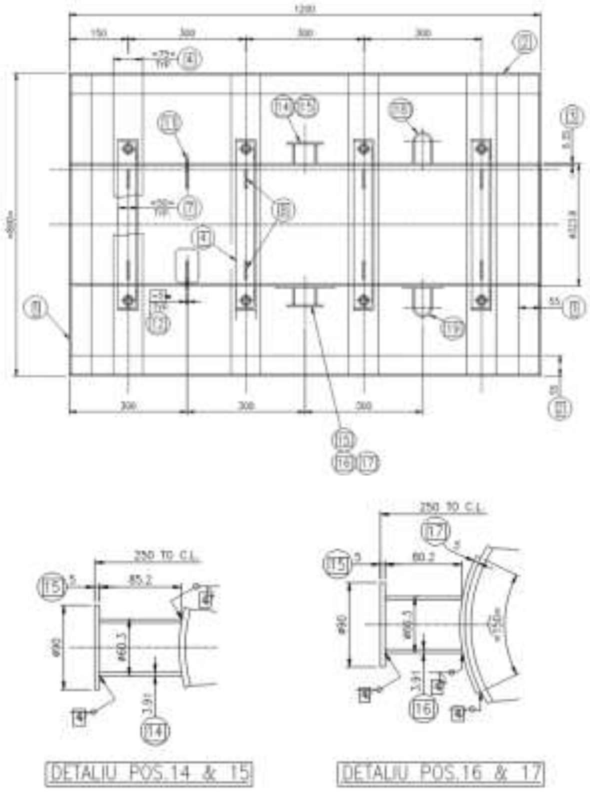
The calculation model used for stress analysis has been completed using the finite element method (FEM) for the horizontal cylinder presented in figure 2. The main cylinder has been embedded in the support and has been loaded with 1 kN, for every lifting button.

The stress analysis contains two load cases:

1- when the lifting button is directly welded on the horizontal cylinder;

2- when the lifting button is welded on an intermediary reinforcing pad.

For every load case different thicknesses for the lifting buttons have been used, starting with 1.65 mm up to 8.74 mm (the thickness of the main cylinder being 6.35 mm).



a

b

Figure 1.The overall view of the cylindrical shell

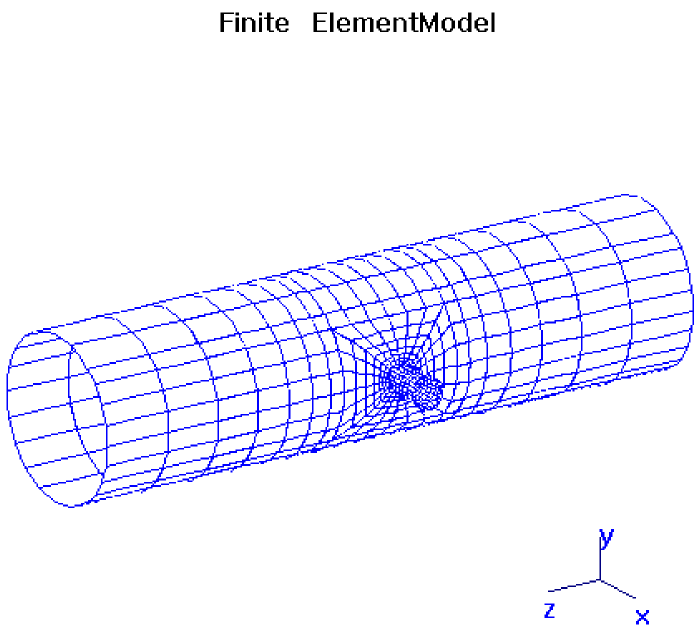


Figure 2.The calculation model

RESULTS OBTAINED

For the first load case, when the main cylinder is located in horizontal position and is embedded in the support, the main stress maps, for different thicknesses of the lifting buttons are presented in figures 3...8 below.

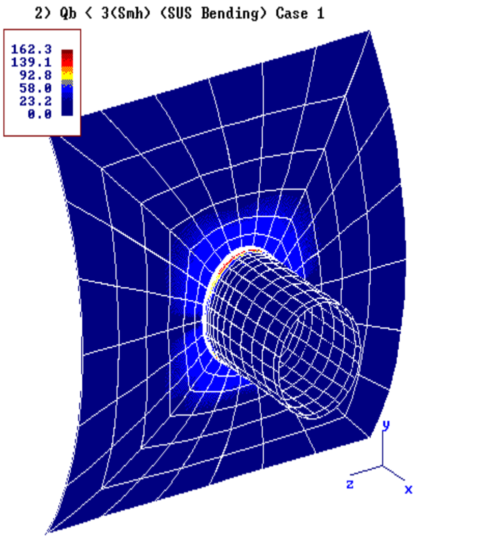


Figure 3. Stresses for 1.65 mm thickness

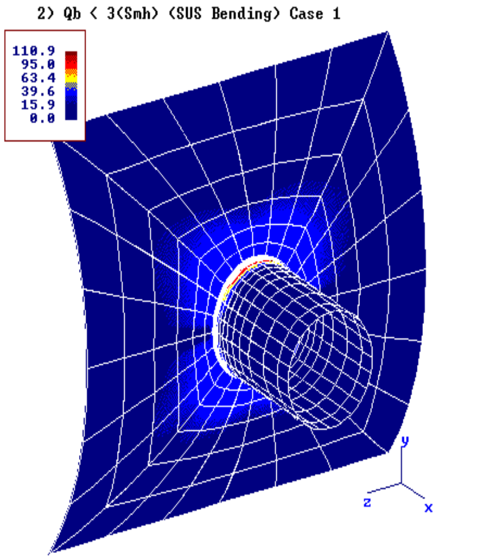


Figure 4. Stresses for 2.77 mm thickness

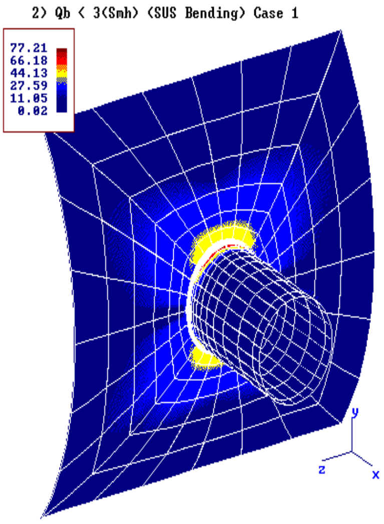


Figure 5. Stresses for 3.91 mm thickness

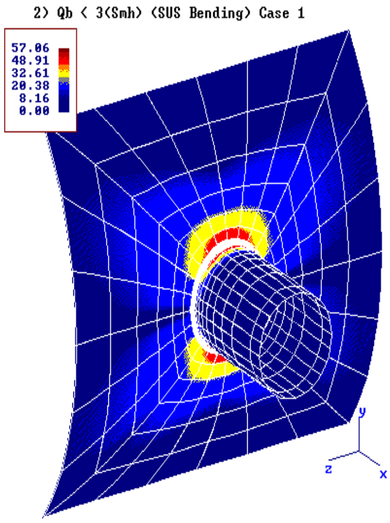


Figure 6. Stresses for 5.54 mm thickness

Analysing the stress distributions for different thicknesses of the lifting buttons the following conclusions can be enlighten:

- for the minimum thickness of the lifting buttons (1.65 mm) the maximum equivalent stress is around 165 MPa and appears in the lifting button at the connection with the main cylinder; the same situation appears for the 2.77 mm thickness too, the only difference being that the maximum equivalent stress is 120 MPa;

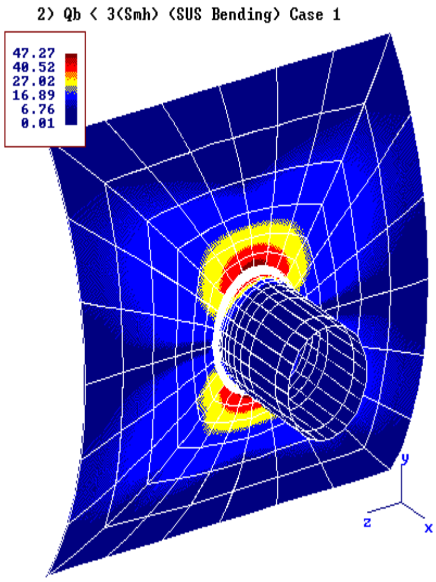


Figure 7. Stresses for 6.35 mm thickness

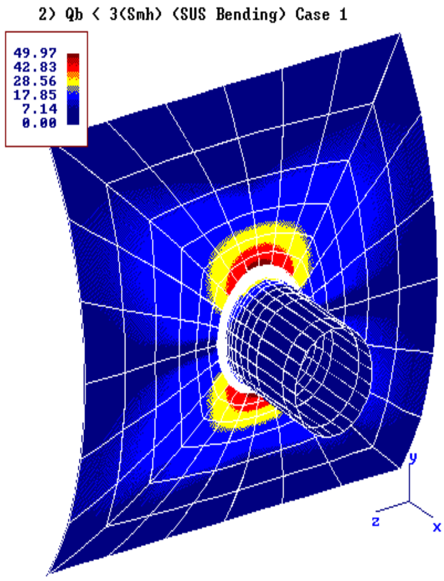


Figure 8. Stresses for 8.74 mm thickness

- as long as the thickness of the lifting buttons is getting higher, the maximum level of equivalent stresses is getting lower; the maximum stresses have the tendency to appear in the main cylinder; for a 3.91 mm thickness of the buttons the maximum equivalent stresses appear at the bottom of the buttons and have the maximum value of 77 MPa; for a 5.54 mm thickness of the buttons the maximum equivalent stresses appear together at the bottom of the buttons and in the cylinder at the junction with the buttons and have the maximum value of 58 MPa;
- the lower level of the equivalent stresses appear if the thickness of the lifting buttons is equal with the thickness of the main cylindrical shell; the maximum stresses appear in the junction area but are distributed mainly on the cylinder and have the value of 47 MPa;
- for a thickness of the lifting buttons higher than the cylinder (8.74 mm in comparison with 6.35 mm), the maximum level of stresses are getting higher and reach the approximate value of 50 MPa.

Analysing the above conclusions it can be noticed that the most favourable situation appears when the thickness of the lifting buttons are identically with the thickness of the cylindrical shell.

The following analysis contains the situation when the lifting buttons are welded on the 5 mm reinforcing pad that is welded on the main cylinder.

For the second load case, the main stress maps, for different thicknesses of the lifting buttons are presented in figures 9...14 below.

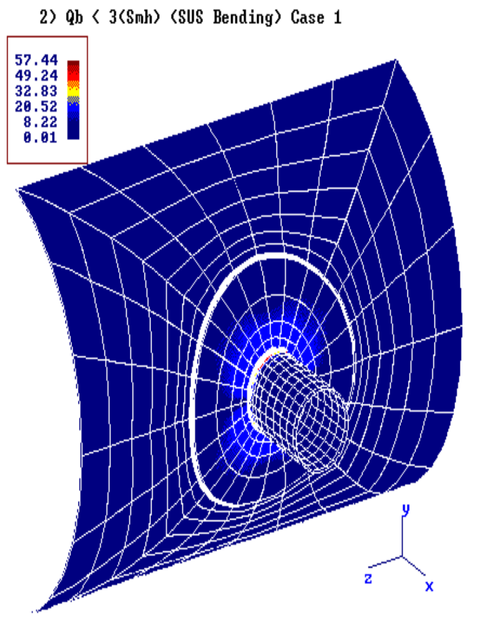


Figure 9. Stresses for 1.65 mm thickness

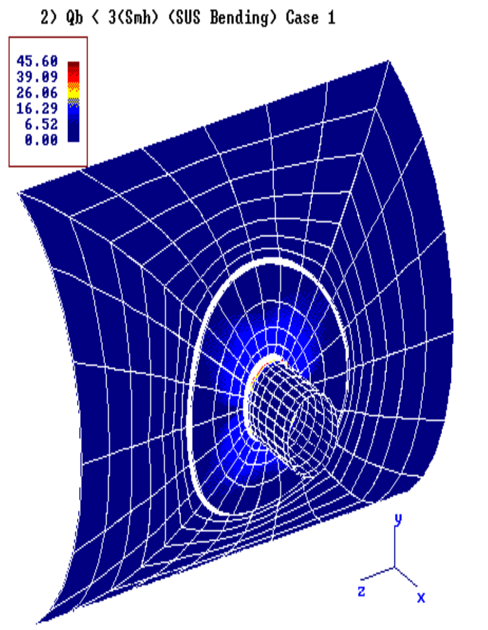


Figure 10. Stresses for 2.77 mm thickness

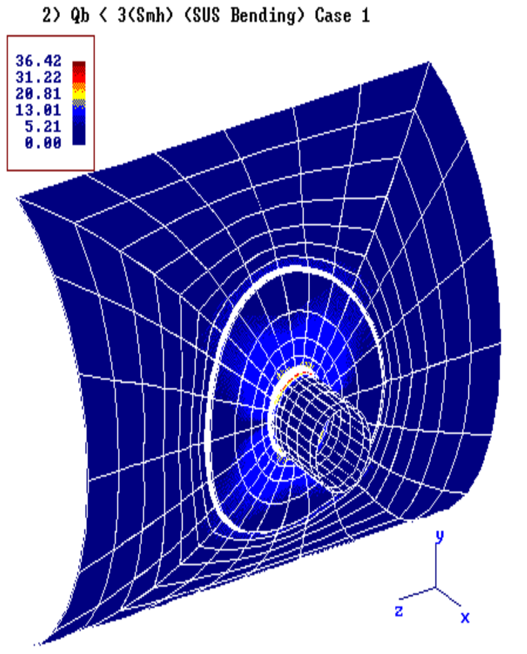


Figure 11. Stresses for 3.91 mm thickness

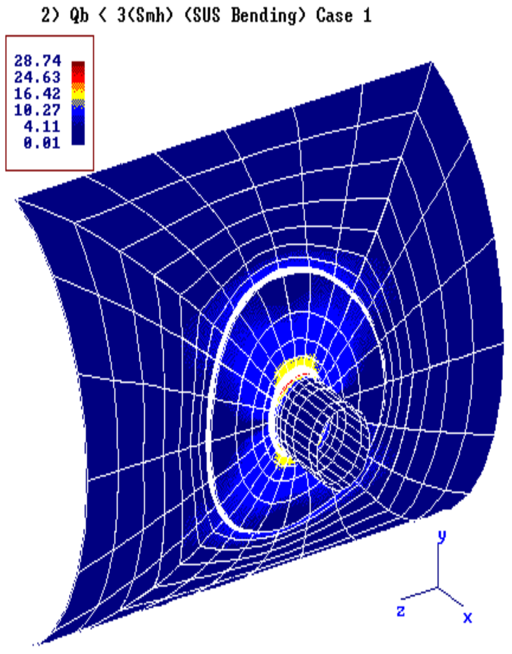


Figure 12. Stresses for 5.54 mm thickness

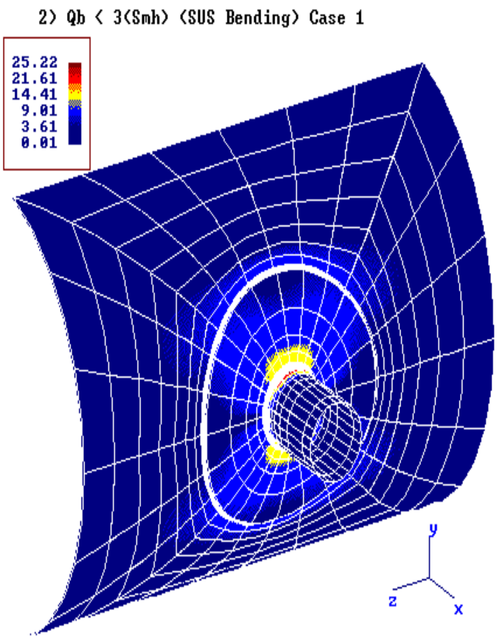


Figure 13. Stresses for 6.35mm thickness

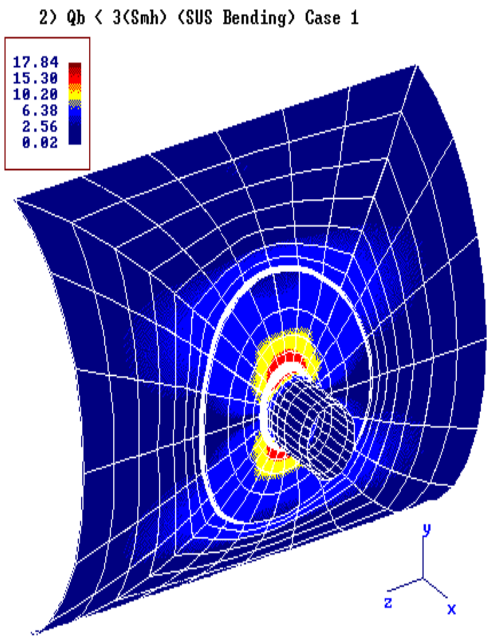


Figure 14. Stresses for 8.74 mm thickness

Analysing the stress distributions for different thicknesses of the lifting buttons the following conclusions can be enlighten:

- for the minimum thickness of the lifting buttons (1.65 mm) the maximum equivalent stress is around 54.4 MPa and appears in the lifting button at the connection with the main cylinder; the same situation appears also for the 2.77 mm thickness, the only difference being that the maximum equivalent stress is 45.7 MPa;
- as long as the thickness of the lifting buttons is getting higher, the maximum level of equivalent stresses is getting lower; the maximum stresses have the tendency to appear in the main cylinder also; for a 3.91 mm thickness of the buttons the maximum equivalent stresses appear at the bottom of the buttons and have the maximum value of 36.4 MPa; for a 5.54 mm thickness of the buttons the maximum equivalent stresses appear together at the bottom of the buttons and in the cylinder at the junction with the buttons and have the maximum value of 28.7 MPa;
- for a 6.25 mm thickness the maximum equivalent stress is 25.22 MPa and for 8.74 mm thickness the maximum stress is 17.84 MPa;
- the presence of the reinforcing pad leads to decreasing of the maximum equivalent stresses even when the thickness of the lifting buttons is higher than those of the main cylinder.

In all the above load cases the presence of the reinforcing pad represents a most favourable situation, recommended for the lifting process.

CONCLUSIONS

In the paper is presented a stress analysis for a lifting process of a cylindrical shell using some cylindrical lifting buttons in two cases: when the buttons are welded directly on the cylinder and when is welded on an intermediary reinforcing pad.

The results obtained for all the above load cases, for different thicknesses of the lifting buttons are synthetically presented in table 1 below.

Table 1.Maximum equivalent stresses FEA

Presence of reinforcing pad	**Thickness of the lifting buttons** [mm]	**Maximum equivalent stresses** [MPa]	**Observations**
Without pad	**1.65**	162.3	When the thickness of the lifting buttons becomes higher than the thickness of the cylinder an increasing of stresses can be observed
	2.77	118.9	
	3.91	77.21	
	5.54	57.86	
	6.35	47.27	
	8.74	49.97	
With pad	**1.65**	57.44	When the thickness of the lifting buttons becomes higher than the thickness of the cylinder an decreasing of stresses can be observed
	2.77	45.68	
	3.91	36.42	
	5.54	28.74	
	6.35	25.32	
	8.74	17.84	

Analysing the values of maximum equivalent stresses presented in the above table it can be drawn the following conclusions:

- the presence of the reinforcing pad is more favourable because the maximum levels of equivalent stresses are decreasing almost to a half of the initial values;

- in the case when the reinforcing pad is not present and the lifting buttons are welded directly on the main cylinder, is does not make sense to increase the thickness of the buttons over the thickness of the shell because the maximum level of equivalent stresses begins to increase.

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