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STRESS - STRAIN ANALYSIS OF VERTICAL PRESSURE VESSELS SUPPORTED BY BRACKETS

N.Vukojević, D.Vukojevic
University of Zenica,
Faculty of Mechanical Engineering,
Fakultetska 1, 72000 Zenica,
Bosnia and Herzegovina

M. Šutković
Proming d.o.o.
Šehitluci bb, Bugojno
Bosnia and Herzegovina

ABSTRACT
Vertical pressure vessels according EN 13445 are supported on four different kind of supports. In paper is presented stress-strain analysis of pressure vessel supported by brackets. Problems with supports is specially marked by great preassure vessels and without correctly choosing, supports type can become potentially weak point in construction. Here are analised stress-strain conditions for bracket supports and for free ring supported pressure vessel. Analysis should indicate some problems of correctly modeling and positioning of supports in this type of structure.
Keywords: pressure vessels, supports, stress-strain analyse .

1. INTRODUCTION
High pressure vessels analised in this paper are axisymetrically structure made by forging. Stress-strain distribution is defined by *Lamè* equiations [61,62,71].

Based model of pressure vessel is supported with four brackets welded on outer side of vessel cylindrical part. Bracket supports are welded steel plate, Figure 1. Analised pressure vessel is per brackets supported on fixed base. Geometrical shape and dimension of this configuration is shown on Figure 1.

Another type of refered pressure vessel is supported on continual configured basis as known as scirt supports. This both kind of supports are standard types defined according EN13345[39].

By numerical models with brackets is not taken into account angle welds that with its geometrical shape decrease stress concentration in this regions. This simplified numerical model caused some bigger stresses in bracket support zones.

Problems with supports is specially marked by great preassure vessels and without correctly choosing supports type can become potentially weak point in construction. Here are analised stress-strain conditions for bracket supports and for free ring supported pressure vessel. Analysis should indicate some problems of correctly modeling and positioning of supports in this type of structure.

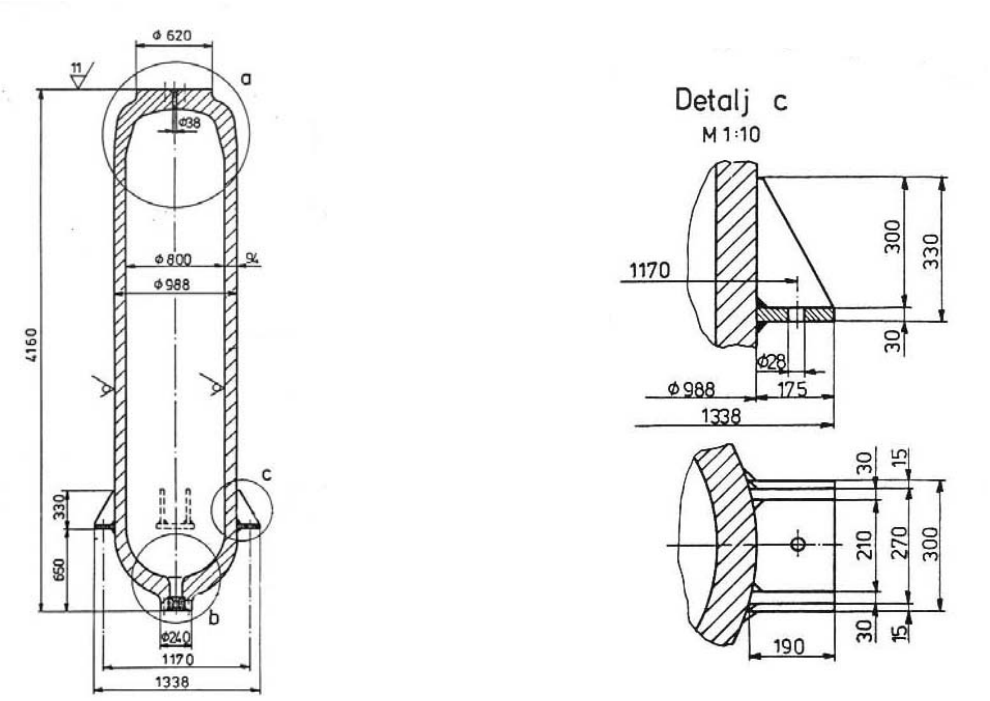


Figure 1. Pressure vessel-dimensions

2. NUMERICAL ANALYSIS

Boundary conditions are choosen according real operating conditions of analised pressure vessel. Pressure vessel and supports are loaded with inner pressure of 35 [MPa] and it's own weight. Pressure vessel is made of isotropic austenitic steel. Results of numerical anaysis are presented on Figure 2. Maximal total stress magnitude of σ_{tot}=175 [MPa]occurs on inner side of cylinder vessel part by both of analised kind of vessel supports.

Total stress distribution in case of continual configured supports, Figure 2a, is uniform but by bracket supported vessel, Figure 2b, there are remarkable disparate stress distribution. This disparate stress distribution is unlikely because may cause crack initiation in regions with high residual stress issued by welding.

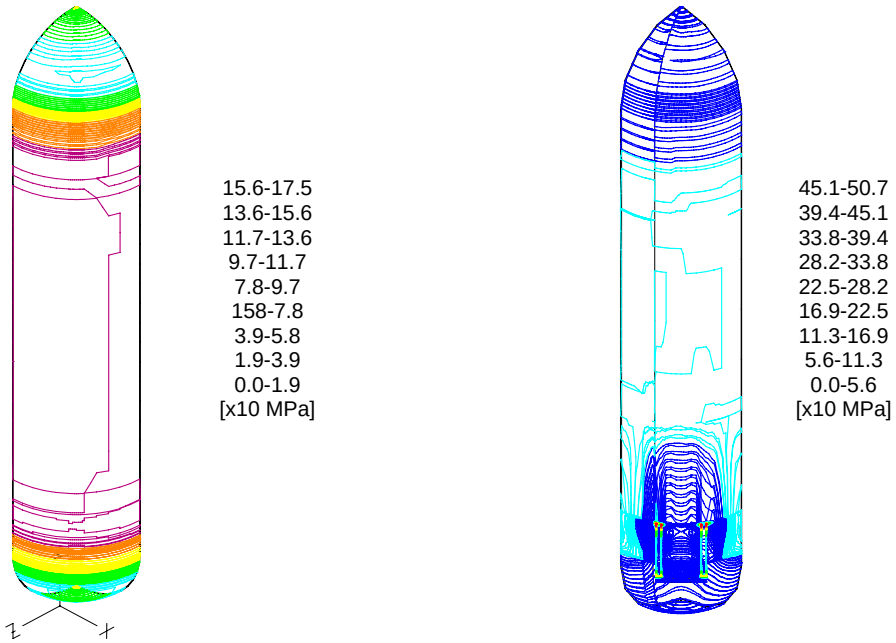
Maximal total stress in region of continual supports was less then 80 [MPa], but in region of bracket supports this values were in lower side less then 110 [MPa] and on the top this total stress has extrem magnitude of 500 [MPa].

3. EXPERIMENTAL ANALYSIS

Experimental researches are made by strain gauges located as shown Figure 4 and 5. Data aquisition is accomplished by strain gauges type XY91/10/120 8HBM) and measuring system UPM40 A (HBM).

Strain gauges are positioned on lower side of brackets, Figure 5. Analysis is made in case of free supporting on three different points without inner pressure, Figure 2. Results of this measuring are presented in Table 1. As results shown total stress caused by self weight of pressure vessel is negligible small.

Another analysis is made durring hidro test with operating pressure of 35 MPa and results are presented in Table 2.



a) Model with continual configured supports *b) Model with bracket supports*

Figure 2. Stress distribution of numerical models under inner pressure of 35 MPa

Table 1. Bracket supports total stress caused by self weight

Support locations	Total sterss MM1 σtot [MPa]	Total stressMM2 σtot [MPa]
I	3,0	2,0
II	3,4	1,5
III	7,9	3,7

This researches are made on both kind of supports. Maximal total stress determinated by strain gauges durring hidro test on bracket supports was: σ_{totMM1}=90,5 MPa i σ_{totMM2}=86 MPa. Total stress on pressure vessel with continual cofigured supports durring hidro test was 58 do 67 MPa, Figure 4.

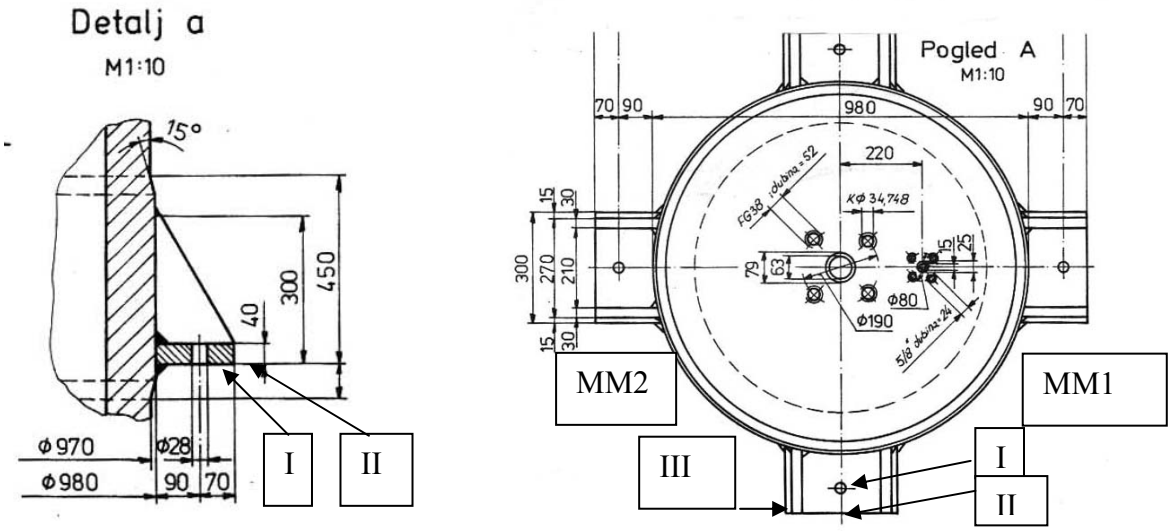


Figure 3. Support locations

Figure 4. Strain gauges position by continual configured supports

Figure 5. Strain gauges position by bracket supports

4. CONCLUSIONS

Results based on presented analysis shown that great pressure vessel supported on bracket supports demonstrate poor solution in relation to continual cofigutared supports (scirt supports).

Bracket type of supports is unfavorable in case of initial crack failures with growth tendention.

Results deviaton between numerical and experimental analysis are implication of different wall thikness of pressure vessel made by forging.

Selection of supports give unfavorable parameters of stress state and unstable potential crack initiation and growth. Bracket supports require welding and in a case of great pressure vessels great bracket and welds are necessary. All this things cause great input of heat and great residual stress which initiate another kind of problems.

5. REFERENCES

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