

Analysis of Tank with under Body Structure

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Abstract—In engineering engineers are trying to optimize a system and redesign for better result. In this paper we are trying to improve ability of strength for tank in industry transportation application. During process of redesign of tank main point is ability of system. In this paper with use chassis we will improve strength of tank with low strength and low cost plastic material with example and analysis in CAD software. Our aim is use a low strength plastics material for produce high strength tanks

Keywords – Chassis, CAD software.

I INTRODUCTION

In generally use of different type plastics for tank production due to low cost and easy manufacturing in rotational molding process, blow molding process, injection molding process etc [1]. There are many types of plastics like ABS, Acrylic, Kydex®, Noryl®, PETG, Polycarbonate, Polystyrene (HIPS), Polysulfone, PVC, RadelR®, Ultem, PET, Polypropylene, PPS, PTFE, PVDF (Kynar®), UHMW-PE etc.[2] basically we applied this plastics per our application and properties of plastics. In this paper our aim is not a selection process of plastics but our aim is how we increase ability of system by simulation and analysis of model in cad software during this simulation we take a scaled model tank and apply different loads and condition on it. Difference is that here we use a chassis in tank which improve a model strength. Generally use many types's design of chassis in tank model. Chassis may be in different material with must high bending strength. In this paper apply a finite element analysis process in sample model. After applying the condition in sample model show a result of analysis. This can use in production for different types of chassis and different type of tank.

II APPLYING LOADS ON MODEL

Here simple tank design is given for study purpose two handles of tank which shown in green colors are fix (give constrain). Applying pressure 2000 lbf/in² on cross-section are of tank as shown in fig1. Here for study purpose not fully body taken. This study is going with two different conditions.

(1) Study and analysis without chassis or frame and measure stress and displacement produce in structure.

(2) Study and analysis with chassis or frame and measure stress and displacement which produce in structure chassis is in middle of structure.

Above both situation applying same condition of constrain and loads as

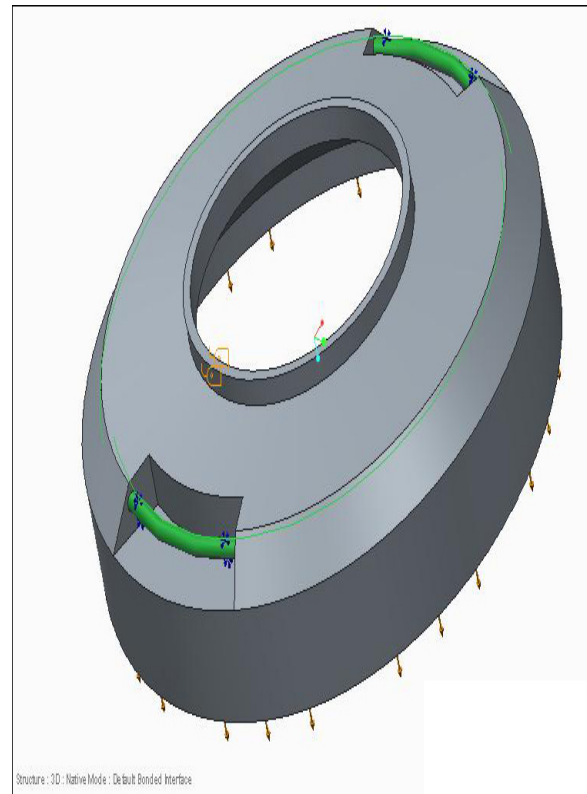


Figure 1. cross sectional view of tank with given constrain and loads

III MATERIAL PROPERTIES

Selection of material in analysis process is also most important process here in this case chassis of tank must be contain high bending strength and stiffness because chassis transfer a stress to all structure and protect structure again filler by different case [3]. In this analysis for study purpose take a stainless steel structure chassis other is material of tank which can take low-cost plastic like Polypropylene, pvc etc plastic.

TABLE I. EXAMPLE OF PLASTICS WITH BENDING STRESS AND COST.[4]

cost is increase as per arrow	
<ul style="list-style-type: none"> • Ultem® • Radel R® • Polysulfone • Noryl® • Polycarbonate • ABS • Polystyrene (HIPS) • Kydex® • PVC • PETG • Acrylic 	<ul style="list-style-type: none"> • PPS • PEEK • PVDF (Kynar®) • PTFE • PET • PBT • Nylon • Acetal • UHMW-PE • HDPE • LDPE • Polypropylene
bending stress is increase as per arrow	
<ul style="list-style-type: none"> • Ultem® (30% glass-filled) • Polycarbonate (20% glass-filled) • PVC • Ultem® • Acrylic • Polysulfone • Noryl® • Radel R® • Polycarbonate • Kydex® • Polystyrene (HIPS) • PETG • ABS 	<ul style="list-style-type: none"> • PPS • PEEK • Nylon (6 cast) • Acetal • Nylon • PET • Acetal (Copolymer) • PBT • PVDF (Kynar®) • Polypropylene • HDPE • UHMW-PE • PTFE • LDPE

IV MESHING OF TANK HEAD

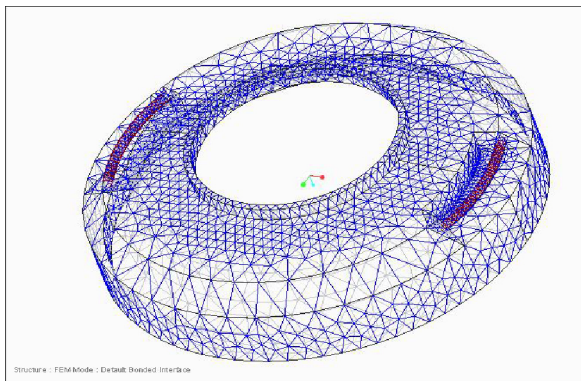


Figure 2. FEA mode without chassis (upper portion of tank)

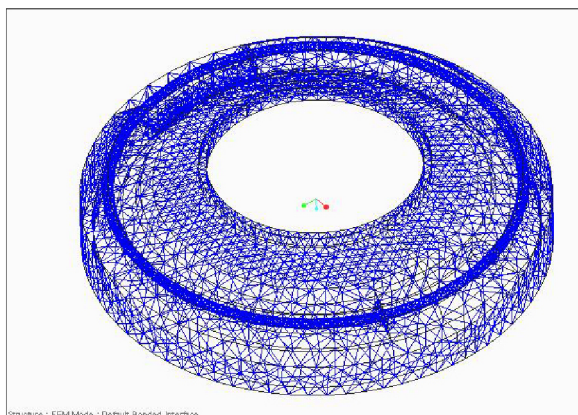
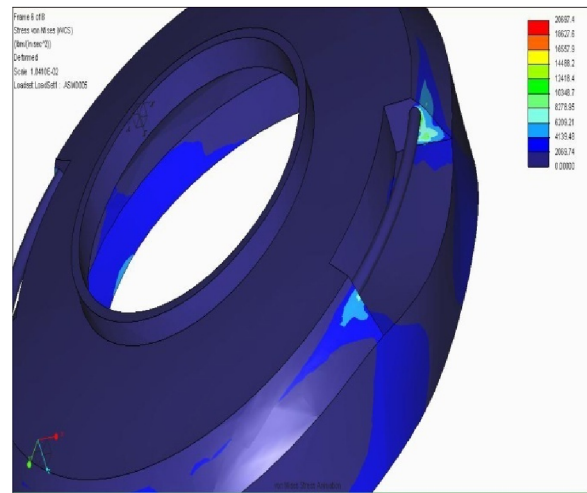
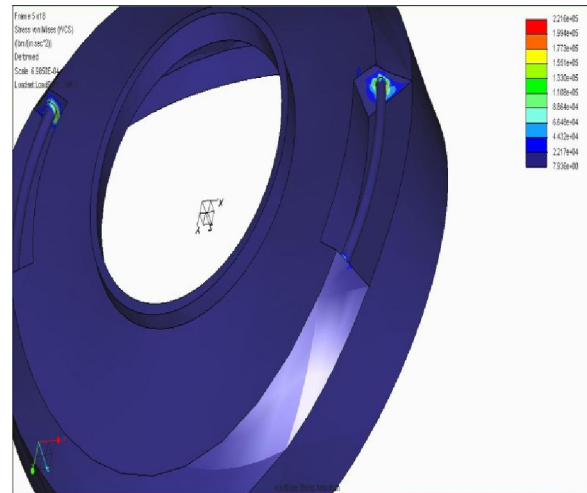


Figure 3. FEA mode with chassis

V MODAL ANALYSIS RESULT



- a) Maximum stress without chassis -221600 lbm/ (in sec²)
- b) Maximum stress with chassis-20697.4 lbm/ (in sec²) in same condition of constrain and loads.

Here important is ratio which is given by

$$\text{Ratio} = \frac{\text{maxi. stress of structure without chassis} _ 221600}{\text{maxi. stress of structure with chassis} _ 20697.4} = 10.70$$

So result says that a structure of tank with chassis is ten times more powerful compare with normal tank structure.

VI COMPARISON BETWEEN DISPLACEMENT VECTORS

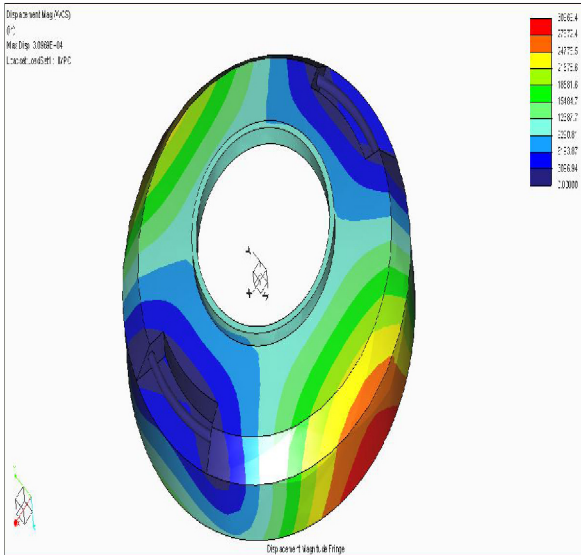


Figure 6. Displacement magnitude of structure without chassis

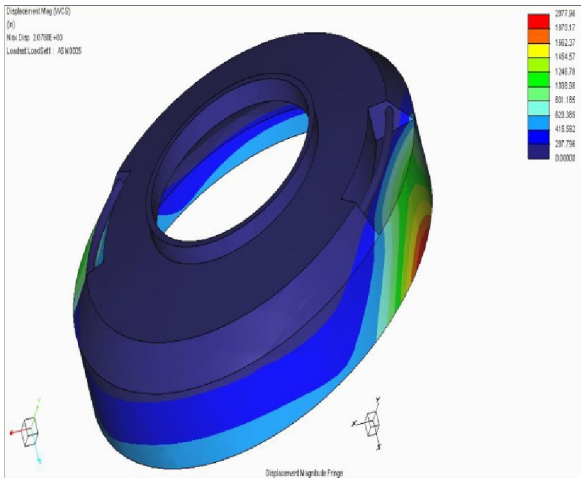


Figure 7. Displacement magnitude of structure with chassis

$$\text{Ratio} = \frac{\text{maxi. displacement magnitude of structure without chassis}}{\text{maxi. displacement magnitude of structure with chassis}} = \frac{30969.4}{2077.96} = 14.90$$

VII COMPARISON OF MODEL BY GRAPH

Analysis result of tank design shows that critical area of tank a handle of tank after applying a load on tank. In figure 8 shows a green color periphery of handle taking a graph of stress von mises vs periphery of handle circle (curve arc length) give a result of analysis below graphs are result of analysis.

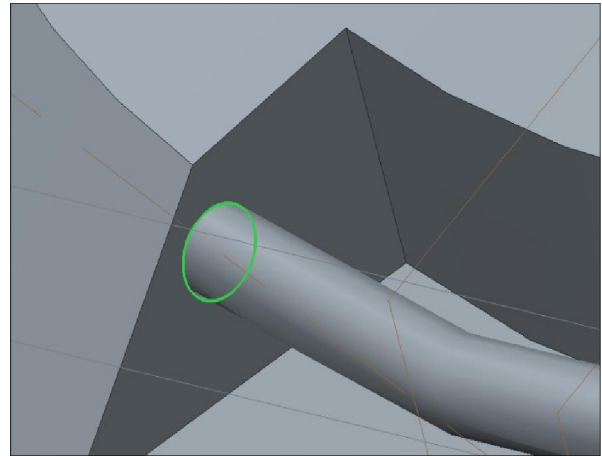


Figure 8. handle of tank (critical failer are of tank)

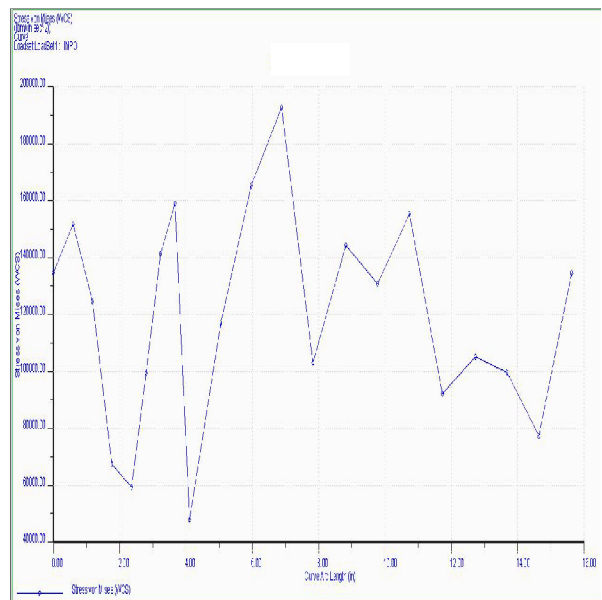


Figure 9. stress and displacement create on curve arc length of handle without chassis.

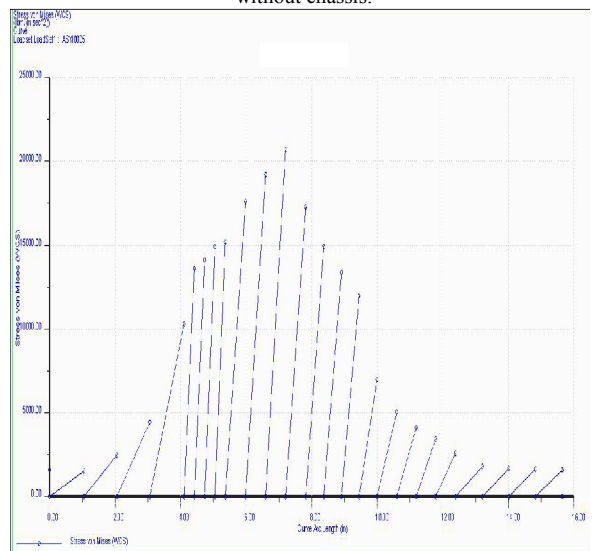


Figure 9. stress and displacement create on curve arc length of handle with chassis.

VIII..CONCLUSION

A result of Static structural analysis shows that structure of tank with chassis is stronger and less filer in different cases. Application of this type design can use in heavy part transpiration system with low cost plastic material and use different types of chassis design for put in structure of tank with different application. Also, use wastage of punching operation sheet metal for making a chassis.[5]

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