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Pre-StressedAnalysis of Plastic Pump-Housing

(Static Structural Analysis snd Pre-Load Test)

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***Abstract*— Pump-housing consists of a 5 part assembly representing an impeller type pump. Our primary goals are to analyze the assembly with a preload on the belt of 100N to test in this we are observing that the impeller will not deflect more than 0.075mm with the applied load and also plastic pump housing will not exceed the material's elastic limits around the shaft bore using the FEA software ANSYS WORKBENCH 16.1 . This Analysis can be made by taking some assumptions Belt load is assumed to be at the contact surface of Belt and the pulley, which can be given with Bearing load in positive X-direction, Pump house is rigidly mounted to the rest of the pump assembly, Assuming wall condition at the face of Housing – used compression only support. In this analysis we also carryout a sub-modeling analysis on Plastic Housing for accurate resolution of von-Mises Stress. Sub-modeling was carried out to reduce the stresses at the area of interest. It was done by preparing the geometry and preparing a cut boundary constraint and importing the loads and refining the mesh. To conclude Pre-stressed analysis was carried out using a static structural and frequency ranges from 100 to 1000Hz**

***Keywords*— Analysis, Modalanalysis, Von Mises Stress, Submodeling**

I. INTRODUCTION

Static Structural Analysis of part assembly pre-load test for is made in this pump consists of a 5 part assembly representing an impeller type pump. Our primary goals are to analyze the assembly with a preload on the belt of 100N to test so that the impeller will not deflect more than 0.075mm with the applied load and also to observe the use of a plastic pump-housing will not exceed the material's elastic limits around the shaft bore. In later stages this pump-housing should undergo pre-stressed Modal analysis and also sub-modeling analysis on Plastic Housing for accurate resolution of von-Mises Stress. But throughout the whole process the major area of concern which is always to be kept in mind is the safety of the pump-house. that can be achieved by performing good number of iteration in the designs as per the results obtained after the analysis of the pump-house So this paper is all about what and all are the necessary tests which are to be performed on the pump-housing and how to optimize the results in order to ensure the safety of the housing

II. DESIGNING THE PUMP-HOUSING

Before getting started with the analysis, first of all it is necessary to know the basic steps which are being involved in designing pump-house It is always advised to go through all the rules and constraints by keeping which in mind pump-house has to be built After designing the basic structure of the pump-house in any of the designing software e.g. SOLIDWORKS, CATIA, etc., the next challenging task is to select the appropriate material for making the parts of the pump is the only way by giving strength to safety of the pump-housing can be ensured. While selecting the material for the pump one has to be very careful as the selection of material also plays a very vital role in giving strength to the body of the pump. As there are a number of materials which are available for making the pump, there are always a lot of confusions in selecting the best one for us. So materials can be selected on the basis of different parameters such as, its availability in the market, cost of the material, properties of the material and its strength to weight ratio.

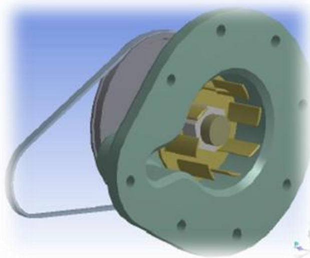

Fig.1. imported pump view 1

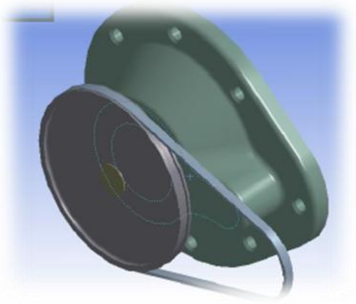

Fig.2. imported pump view 2

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A . *Assumptions to be made before importing the geometry to ANSYS 16.1 software*

1. Belt load is assumed to be at the contact surface of Belt and the pulley, which can be given with Bearing load in positive X-direction.
2. Pump house is rigidly mounted to the rest of the pump assembly
3. Assuming wall condition at the face of Housing – used compression only support

TABLE.1. Properties of various materials

Name	Density g/cm3	Young Modulus	Poisson´s Ratio
Structural Steel	7850	200	0.3
polyethylene	950	78	0.46

In this assembly
PUMP-HOUSING material is taken **Polyethylene** remaining IMPELLER,PULLEY,SHAFT AND NUT are taken structural steel

III. MESHING

In this project we use both global mesh and local mesh settings for reducing the stresses and improve the stiffness of geometry.

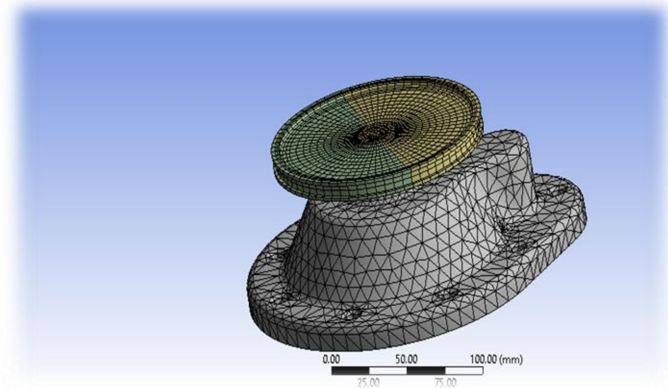

Fig.3.Fully meshed pump

A. Connections

As this is a linear problem only bonded and no seperation contacts are used. By default it has bonded contact then we changed no separation contacts for pump house to pulley ,pump house to shaft and mp house to impeller. Rest all contacts are by default bonded

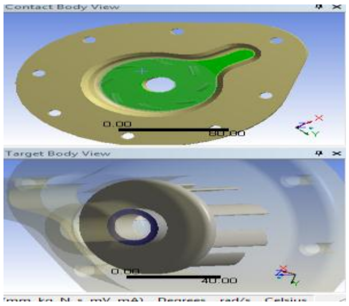

Fig.4.contact 1

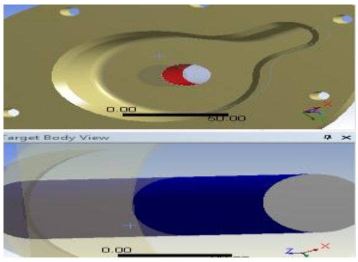

Fig.5.contact 2

IV. BOUNDARY CONDITIONS

Now a fixed support is applied to faces of holes by creating a named selection of same size and type. And a compression only support to the face of the pump housing as we assumed that it is fixed to wall surface and by compression only supports moving in ,out are restricted. Bearing load of 100N is selected on the circular face of a pulley in positive x direction.

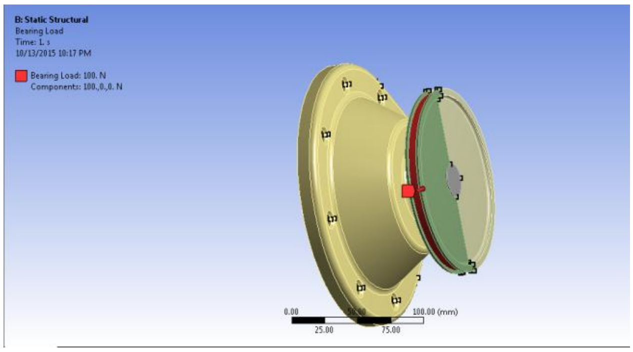

Fig.6. Bearing Load

A bearing load of 100N is applied on the belt so the required tension is created on the pump housing

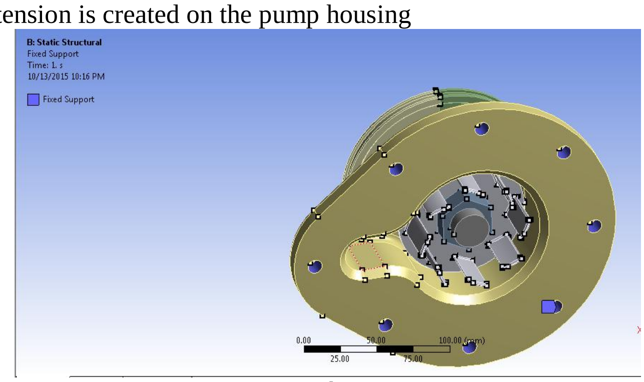

Fig.7.Fixed Supports

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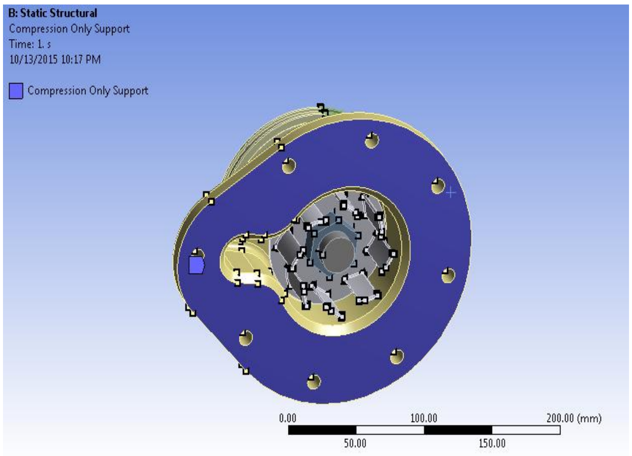

Fig.8. Compression Support

V.RESULT

By checking the impeller deformation we can verify that one of our goal is met. The maximum deformation is approximately to 0.0231(goal<0.075mm)

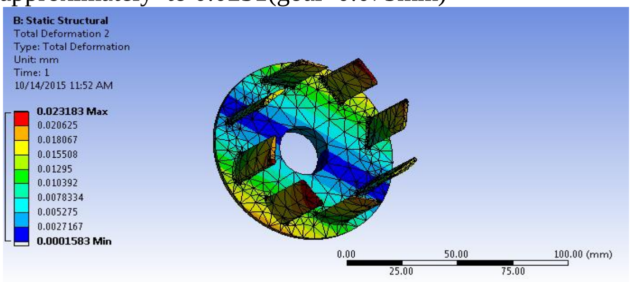

Fig.9. Impeller Deformation

As we apply the boundary conditions and we find the stress and deformation.When the solution is complete highlight the results to plot each. While the overall plots can be used as reality to verify our loads. The maximum high stress is 0.61918 Mpa

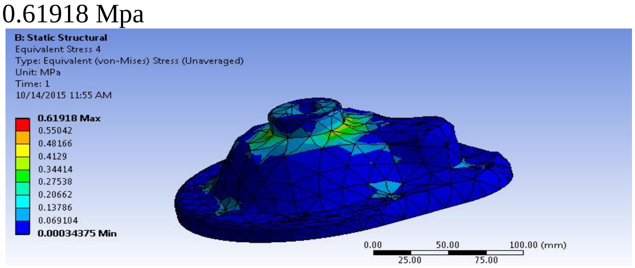

Fig.10. Total Deformation

A . pre-stressed model analysis

pre-stressed model analysis is carried out with a large deflections on and the no of mode shapes given were 6 and the frequency range was given from 100 to 1000 hz (given) . The mode shapes and deformations are as follows.

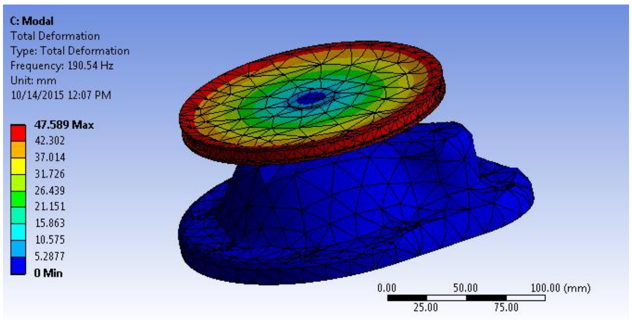

Fig.11. MODE 1

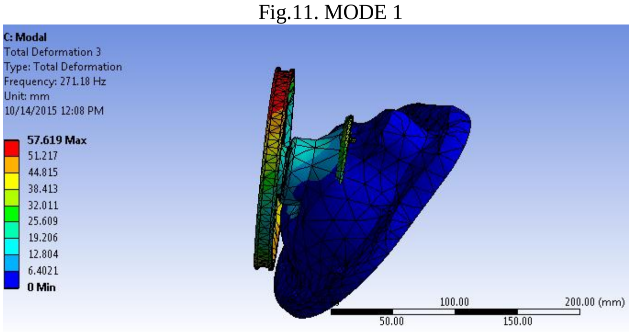

Fig.12. MODE 2

B. *sub-modelling*

Sub modelling was carried out to reduce the stresses at the area of interest. It was done by preparing the geometry and preparing a cut boundary constraint and importing the loads and refining the mesh

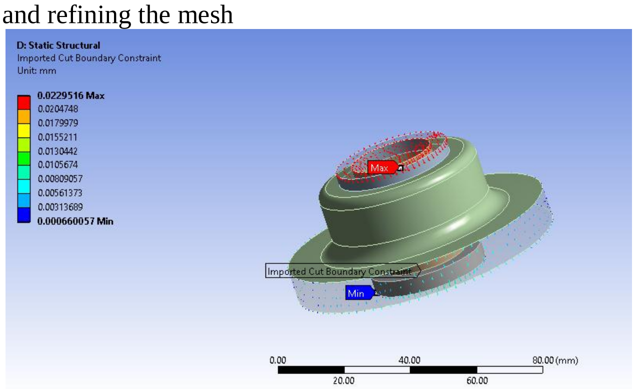

Fig.13.SUB- MODELLING 1

By scoping the results of stresses on pump housing in full model and sub model the values got increased(0.85 to 0.94)

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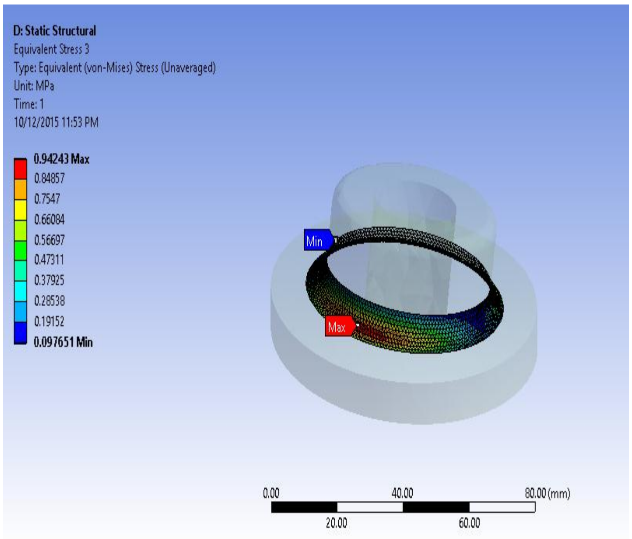

Fig.14. SUB-MODELLING 2

VII. CONCLUSION

The impeller deflection is less than 0.075mm The plastic pump housing materials elastic limits were less than 25Mpa.Pre-stressed analysis was carried out using a static structural and frequency ranges from 100 to 1000Hz.Sub modelling analysis was carried out.

VIII .REFERENCES

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