Stress Analysis of Washing Machine Drum

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ABSTRACT: In this paper a Washing Machine Drum is built and analysed in ANSYS. The aim is to help Asko appliances for conducting similar analysis for future manufacturing of high capacity drums by reducing experimentation. The analysis is mainly concerned with an evenly distributed load at a constant angular velocity. The load is applied with the help of lead plates instead of clothes. The three dimensional model of the Drum is created using the CREO software. The model is imported to ANSYS 14, where the boundary conditions, loads and constraints are given and the analysis is made.

KEYWORDS: Stress Analysis, CREO, Ansys, Boundary Conditions

I. INTRODUCTION

Washing machines are commonly used in almost every home worldwide. These appliances make it easy to clean clothing; a process that time ago was heavy and unpleasant. The performance of these machines is based on the rotation of the clothes inside a cylinder while they are mixed with water and some kind of cleaning powder or soap. It is not hard to imagine that the load of these clothes, when they are soaked in water can create big reaction forces in the cylinder when they are rotating. This situation makes it very important to calculate accurately and for safety side the mechanical characteristics of the cylinder mentioned and the tripod that transmits the turning forces to the cylinder.


These studies made us to have a detailed study on Stress Analysis. Hence the Stress Analysis of Washing machine drum is carried out using Ansys Software.
II. WORK FLOW WITH FEM

The flow of work used for simulation of stress analysis of washing machine drum are given as follows,

1. Creation of 3D model
2. Preparation of the model before taking it into FEM software such as elimination of bad geometry, simplification of unnecessary parts and improvement of contact regions
3. Basic inputs in Ansys. This information will allow the model to work properly during simulation and will define the behavior of the parts during the analysis
4. FEM inputs. These parameters will control the computational time and the accuracy of results in the simulation. A special analysis of factors is performed in order to define them.
5. Simulation is carried out by the software
6. Results obtained need to be evaluated and judged as good or bad before presenting them in the report.

Creation of 3D Model

Creo Elements/Pro (formerly Pro/ENGINEER), PTC's parametric, integrated 3D CAD/CAM/CAE solution, is used by discrete manufacturers for Mechanical Engineering, Design and Manufacturing. Created by Dr. Samuel P. Geisberg in the mid-1980s, Pro/ENGINEER was the industry's first successful rule-based constraint (sometimes called "parametric" or "variational") 3D CAD modeling system. The parametric modelling approach uses parameters, dimensions, features, and relationships to capture intended product behavior and create a recipe which enables design automation and the optimization of design and product development processes. We created model of Washing machine Drum using CREO software. The different views of the model are shown in figure 1.

![Different views of the Washing Machine Drum](image)

Preparation of Model

The modelled drum is converted to IGES File, so that it is imported to Ansys to perform the stress analysis. ANSYS Workbench Platform is used for the same.

Inputs to Ansys

The part exists; define a library of the materials (Stainless Steel) that compose the object being modelled. This includes thermal and mechanical properties. The Properties of stainless steel is given in Table 1.

<table>
<thead>
<tr>
<th>TABLE 1: MATERIAL PROPERTIES OF STAINLESS STEEL</th>
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<tbody>
<tr>
<td>Density</td>
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<tr>
<td>Young's Modulus Pa</td>
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<tr>
<td>Poisson's Ratio</td>
</tr>
<tr>
<td>Coefficient of Thermal Expansion</td>
</tr>
<tr>
<td>Specific Heat</td>
</tr>
<tr>
<td>Thermal Conductivity</td>
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<tr>
<td>Resistivity</td>
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Meshing

Meshing the entire drum is done by small tetrahedral pieces called elements that share common points called nodes. Ansys suggests a global element size and tolerance for meshing. The size is only an average value, actual element sizes may vary from one location to another depending on geometry. It is recommended to use the default settings of meshing for the initial run. For a more accurate solution, use a smaller element size. The meshed model is shown in figure 3.

Load & Constraint

Once the system is fully modelled, the last task is to burden the system with load and constraints, such as physical loadings or boundary conditions. The analysis is mainly concerned with an evenly distributed load at a constant angular velocity. The load is applied with the help of lead plates instead of clothes. Pressure, Rotational Velocity 700RPM, Frictionless Support of Drum are exposed in figure 4.

III. RESULTS AND DISCUSSION

The Total Deformation, Equivalent Stress Distribution, Normal Stress Distribution, Normal Elastic Strain Distribution, Shear Stress, Shear elastic strain Distribution, Stress intensity and Elastic Stress intensity of the washing machine Drum was shown below.
Fig. 5. Total Deformation and Equivalent Stress Distribution on Drum

Fig. 6. Normal Stress Distribution and Normal Elastic Strain Distribution on Drum

Fig. 7. Shear Stress and Shear elastic strain Distribution on Drum

Fig. 8. Stress intensity and Elastic Stress intensity on Drum.
IV. APPLICATIONS

The steel’s resistance to corrosion and staining, low maintenance and familiar luster make it an ideal material for many applications. There are over 150 grades of stainless steel, of which fifteen are most commonly used. The alloy is milled into coils, sheets, plates, bars, wire, and tubing to be used in cookware, cutlery, household hardware, surgical instruments, major appliances, industrial equipment (for example, in sugar refineries) and as an automotive and aerospace structural alloy and construction material in large buildings. Storage tanks and tankers used to transport orange juice and other food are often made of stainless steel, because of its corrosion resistance. This also influences its use in commercial kitchens and food processing plants, as it can be steam-cleaned and sterilized and does not need paint or other surface finishes. For the drum is usually subjected to water and soap solutions the stainless steel is a right choice.

V. CONCLUSION

The 3D model is prepared in CREO and then CAE analysis is performed using ANSYS-14. The Total Deformation, Equivalent Stress Distribution, Normal Stress Distribution, Normal Elastic Strain Distribution, Shear Stress, Shear elastic strain Distribution, Stress intensity and Elastic Stress intensity of the washing machine Drum was found.

REFERENCES