ISSN(Online) : 2319 - 8753
ISSN (Print) : 2347 - 6710

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

Vol. 4, Special Issue 6, May 2015

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.

Cristiano Spelta [1] et al, in his work explained about the analysis and design of a control system for the reduction of the mechanical vibration and the perceived acoustic noise in a washing machine. Ms. Neha Virkhare and Prof. R.W. Jasutkar [2] described about the washing machine system consists of the neuro- fuzzy and fuzzy techniques that will help the system to take its own decisions like release of water and washing powder as per need of cloth. Feng Tyan [3] et al, in his work explained about the multibody dynamic model is developed for a front loading type washing machine in details. Sunil Patel and S.A. Kulkarni [4] explained about the optimization of crosspiece of washing machine. Seiichirou Suzuk [5] in his work described the vibration simulation result of the washing machine. A.K.Ghorbani-Tanha [6] et al, describes about the Operation of home appliances like washing machines can produce undesirable vibrations and noise and their purpose of this study is to analyze and develop a control system for vibration reduction of washing machines employing smart materials. Morio Mitsuishi and Yutaka Nagao [7] describes how a Finite Element Analysis model of washing machine dehydration dynamics were developed and validated with operating test measurement results. Sichani [8] et al, in his work explained about the structures which are excited during their normal operation can be studied with operational modal analysis (OMA) methods. Sudeep Sunil Kolhar and Dhiren Ramanbhai Patel [9] propose an idea for the optimization of a washing machine in terms of reduction in drum vibration, power consumption and water consumption. Evangelos Papadopoulos and Iakovos Papadimitriou [10] present a simplified three dimensional dynamic model of a horizontal-axis portable washing machine.

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.

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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.

(1) (2)

Fig. 1. Different views of the Washing Machine Drum

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 1: MATERIAL PROPERTIES OF STAINLESS STEEL

Density	7.75e-006 kg mm^-3
Young's Modulus Pa	1.93e+005
Poisson's Ratio	0.31
Coefficient of Thermal Expansion	1.7e-005 C^-1
Specific Heat	4.8e+005 mJ kg^-1 C^-1
Thermal Conductivity	1.51e-002 W mm^-1 C^-1
Resistivity	7.7e-004 ohm mm

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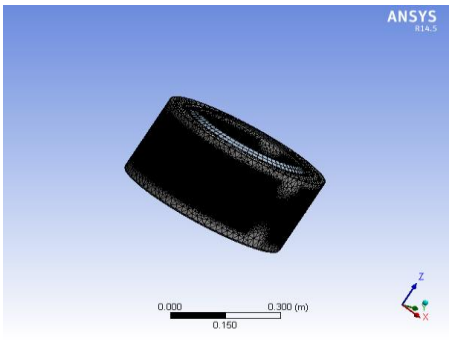
Meshing

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.

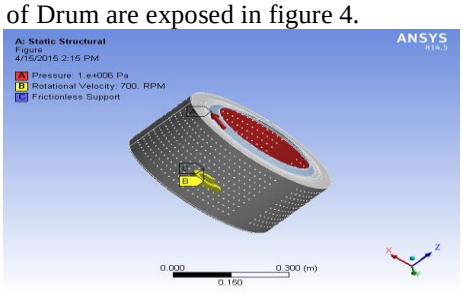


(3)

Fig. 3. Meshed Model of Washing Machine Drum

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.



(4)

Fig. 4. Pressure, Rotational Velocity, Frictionless Support of Drum

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.

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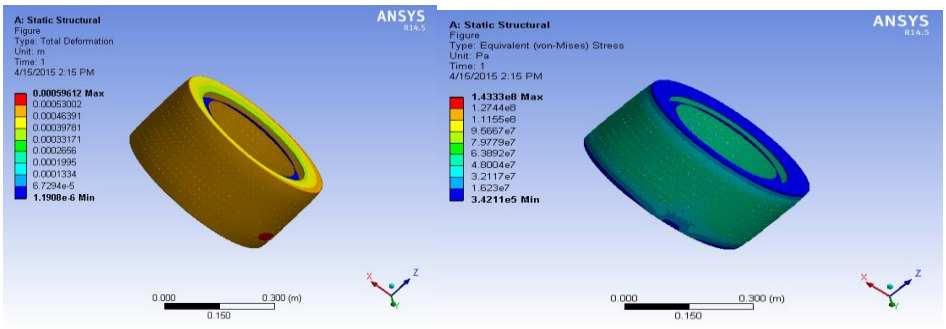

Fig. 5. Total Deformation and Equivalent Stress Distribution on Drum

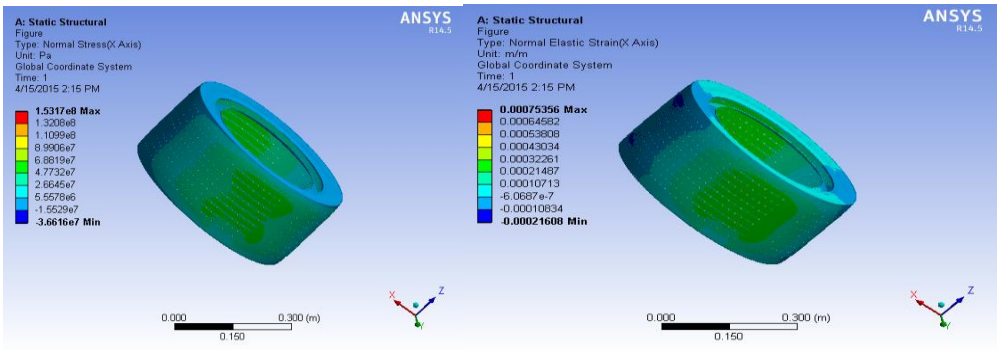

Fig. 6. Normal Stress Distribution and Normal Elastic Strain Distribution on Drum

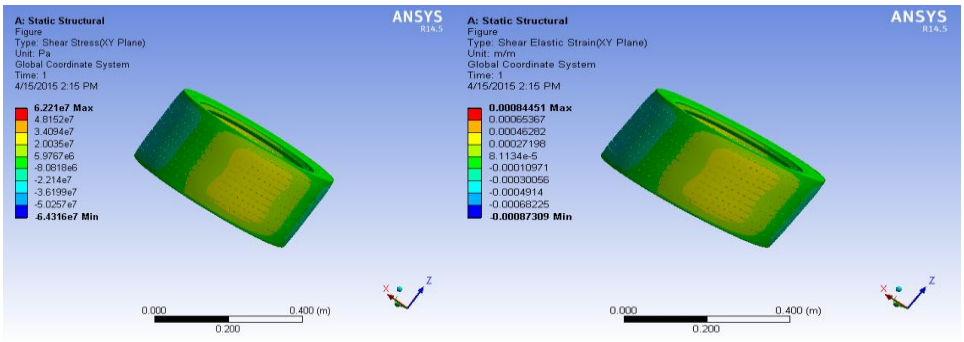

Fig. 7. Shear Stress and Shear elastic strain Distribution on Drum

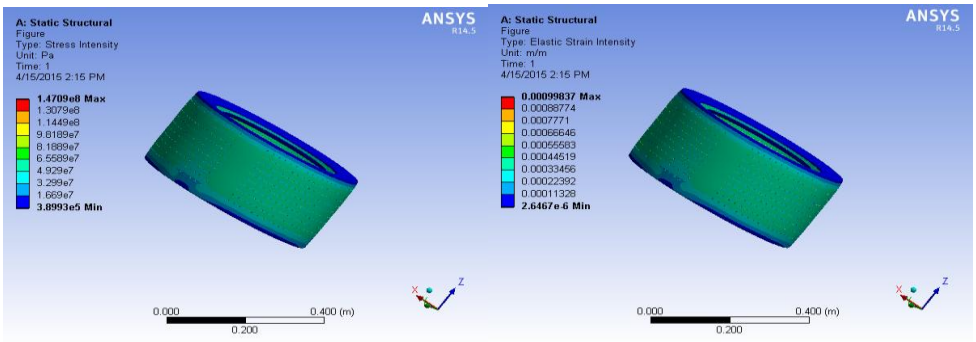

Fig. 8. Stress intensity and Elastic Stress intensity on Drum.

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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

[1] Cristiano spelta, Sergio saveresi, Giuseppe Fraternale and Nicola Gaudiano. 'Vibration Reduction in a Washing Machine via Damping Control. Proceedings of the 17th World Congress (IFAC), Seoul, Korea. July 6-11, pp.11835-11840 2008.

[2] Ms. Neha Virkhare, Prof. R.W. Jasutkar., Neuro-Fuzzy Controller Based Washing Machine. International Journal of Engineering Science Invention, Volume. 3, Issue 1, January 2014, pp. 48-51.

[3] Feng Tyan and Chung-Ta Chao., Modeling and Vibration Control of a Drum-Type Washing Machine via MR Fluid Dampers. Proceedings of 2009 CACS International Automatic Control Conference, National Taipei University of Technology, Taipei, Taiwan. Nov 27-29, 2009.

[4] Sunil Patel and S.A. Kulkarni., Optimization of Crosspiece of Washing Machine. International Journal of Research in Engineering and Technology, Volume. 2, Issue 3, March 2013, pp. 389-392.

[5] Seiichirou., A Study on the Dynamic Behaviour of an Automatic Washing Machine. Korea ADAMS User Conference, 2001. pp. 1-6.

[6] A.K.Ghorbani-Tanha, H.Salahshoor, S.Mohammadzadeh., Semi-Active Vibration Control of a Washing Machine using Magnetoheological Dampers. 3rd International Conference on Integrity, Reliability and Failure, Porto/Portugal. July 20-24, 2009.

[7] Morio Mitsuishi and Yutaka Nagao., Washing Machine Dehydration Dynamics Analysis. Estech Corporation. Yokohama-shi, Japan. pp. 1-8.

[8] Sichani, Mahdi Teimouri, Mahjoob and Mohammad J., Operational Modal Analysis applied to a horizontal washing machine: A comparative approach. International Operational Modal Analysis Conference, Denmark. 2007.

[9] Sudeep Sunil Kolhar and Dhiren Ramanbhai Patel., Optimization of a Drum Type Washing Machine by analytical and computational assessment. Internstional Journal of Scientific and Engineering Research, Volume 4, Issue 6, June-2013.

[10] Evangelos Papadopoulos and Iakovos Papadimitriou., Modeling, Design and Control of a Portable Washing Machine during the Spinning Cycle. Proceedings of the 2001 IEEE/ASME International Conference on Advanced Intelligent Mechatronics System (AIM 2001), Como, Italy. 8-11 July 2001, pp. 899-904.