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Improving the Stiffness for Rear Panel of a Washing Machine

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Abstract: ***Various products such as refrigerators, mobile phones, televisions, washing machines, remote controls, telecommunication and military equipment, etc. are subjected to drop tests to assess their fragility and impact tolerance. It is difficult and expensive to understand the effect of various parameters on the product performance during the test. Finite element simulations using LS-DYNA® effectively help to understand these effects.***
In this paper we have improved the stiffness of a rear panel of a washing machine by integrating new plastic parts called spacers and metal reinforcement plates. To get the best results we have considered the pre-stresses as well.
Keywords: *1,* ***stiffness*** *2,* ***spacers*** *3,* ***Reinforcement plates*** *4,* ***Rear panel*** *5,* ***pre-stress analysis***

I. INTRODUCTION

In this modern day to day life, people are looking for things to get simpler.any home appliance or any object after impacting the load it will get deformation. We have to check whether the deformations are in acceptable range or not, by using simulations. If a load is acted on washing machine, we will see deformations, to avoid these deformations, we do analysis. While transporting, the oscillating drum gets vibrate and deformations take place to avoid these deformations, we use plastic components named spacers.The main components and dimensional figure is shown in fig:1 and fig:2

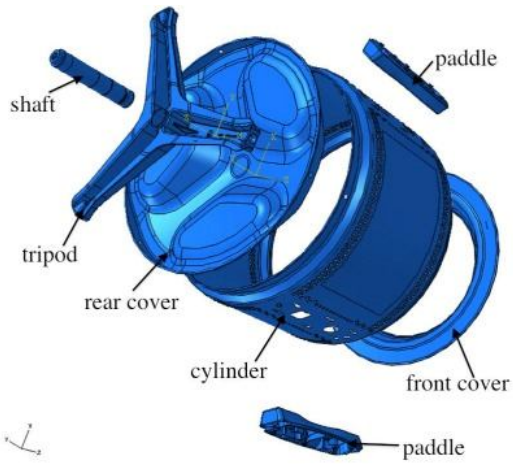


Fig1; Main components of washing machine

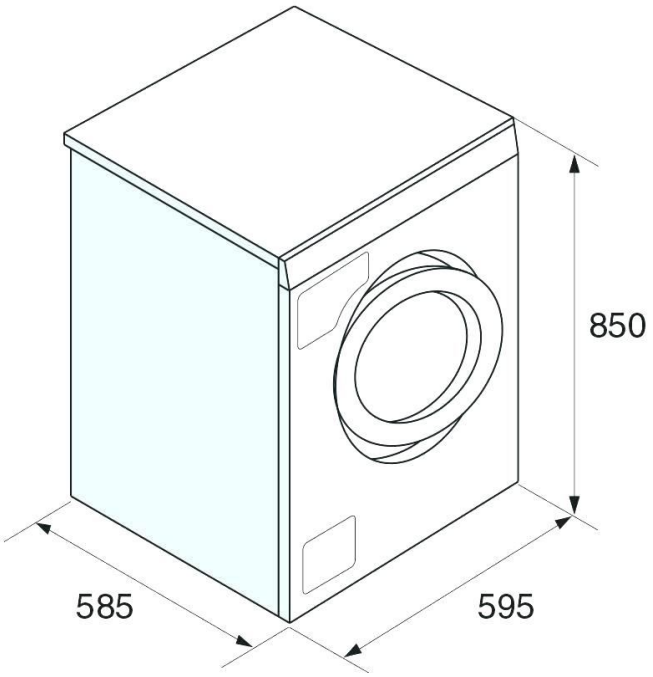


Fig 2:Dimensions of washing machine

II. PROBLEM DEFINITION AND METHODOLOGY

A. Problem definition

To improve the stiffness for the rear panel of a washing machine by incorporating spacers and reinforcement plates in the design. To get the best results we have considered the pre stresses as well.

B. Methodology

1) Approach: Crash or failure simulation is nonlinear explicit in nature. In other words, it is time dependent. The deformations can be calculated at any instant of time. The following step by step procedure is to be followed to accomplish crash or failure analysis of the washing machine rear panel shown in fig:3

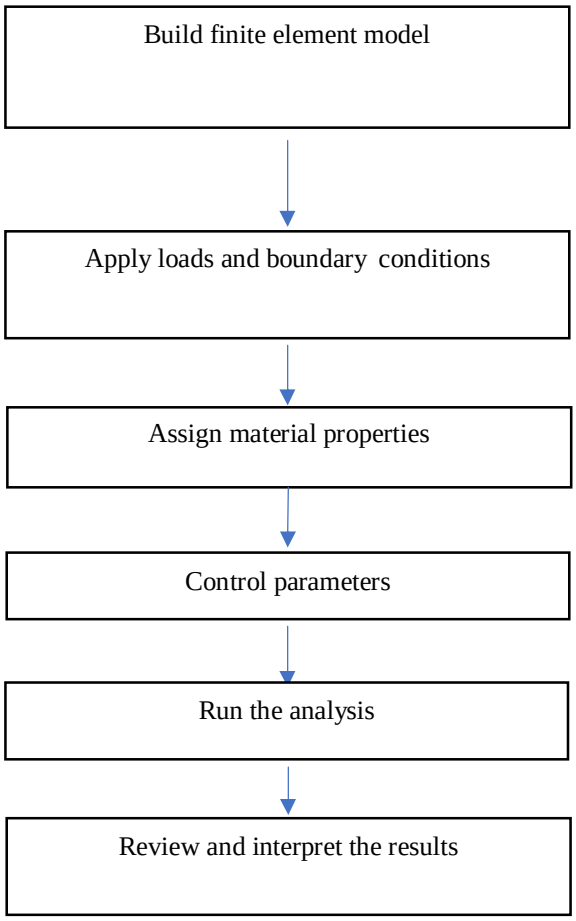


Fig3: step by step procedure

The washing machine model was analysed for energy absorption characteristics in the following three steps:

- Pre-Processing using Hyper mesh
- Solution using Ls-Dyna
- Post processing using Ls-PrePost

III.DESIGN AND ANALYSIS

A. Design

The washing machine (585*595*850) mm or (23.03*23.4*33.4) inches is designed by using Auto CAD software as per the dimensions shown in table. The spacers are incorporated in designing the washing machine to withstand the drag forces when the washing machine is in transportation. The fig: 4 depicts, the rear view

Table: 1 Dimensions Of The Washing Machine

S.NO	DIMENSIONS	DIMENSIONAL VALUES (MM)
1	Length	595
2	Height	585
3	width	850

Fig4: Rear view of rear panel of washing machine

Mass of washing machine = 66.516kg
Area of washing machine = 8.906e+06 mm^2
Volume of the washing machine = 7.005e+07 mm^3
Mass of the rear panel = 3.107 kg
Total Washing Machine with Plastic material = 66.516 kg

B. Components

The different components used are like the rigid base, spacers and reinforcement plates. The components spacers help us to withstand drag forces while it was in transportation and the reinforcement plates helps in providing the extra strength to the washing machine both during the transportation as well in the washing machine usage. The rigid base and spacers figure is shown below.in fig:5 and fig:6

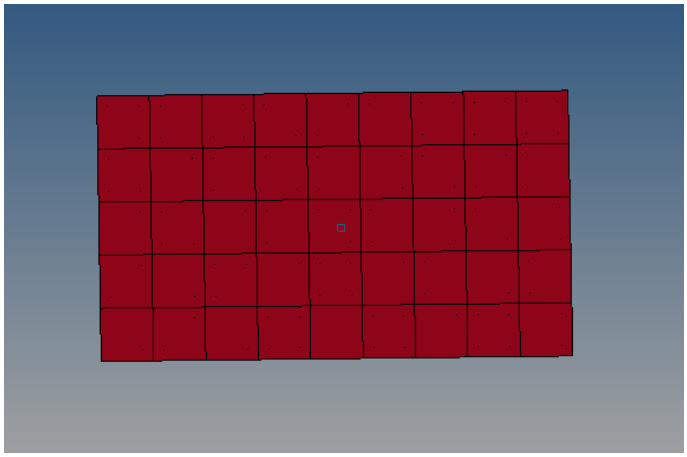


Fig 5:Rigid Base

Fig 6:spacers

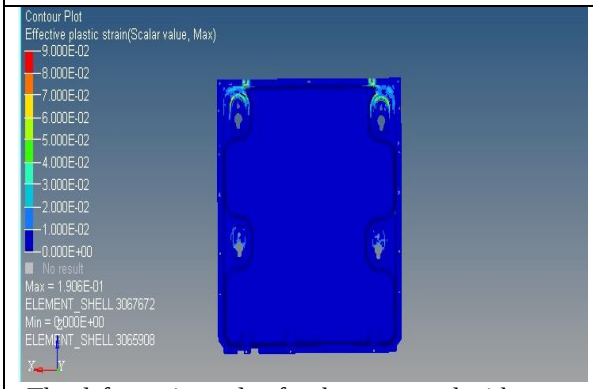
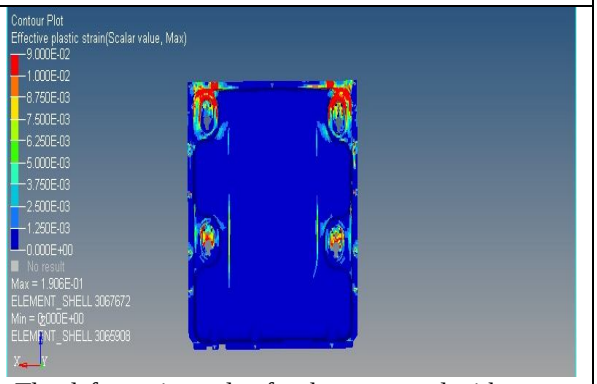
C. Pre Stress Analysis

During Assembly or Mounting process there will be some stresses developed. Those stresses will be negligible when compared to stresses after impact. But to get accurate results we have to consider those stresses as well. These are called as **pre-stresses**

IV. RESULTS AND ANALYSIS

The washing machine model is considered for analysing the energy absorption characteristics. An input height parameter of 30cm was given as input, and a runtime 50ms is given and the results are interpreted as follows.

Difference Between Deformation With And Without Spacers For An Effective Plastic Strain

WITH SPACERS	**WITHOUT SPACERS**
	
•The deformation value for the rear panel with spacers, after impact is equals to 3.000E-02.	•The deformation value for the rear panel without spacers ranges up to after impact is equals to 9.000E-02.

A. Energy Balance Curves

According to the Law of Conservation of energy, Energy can neither be created nor be destroyed, but it can be converted from one form of energy to other form. Applying the same principle to washing machine analysis, the amount of kinetic energy lost during impact must be converted to other forms of energy such as internal energy, sliding energy and hour glass energy. It is also noted that, there may be negligible errors in calculating energy ratio because all the processes in this universe are irreversible and some losses are always included which deviates energy ratio slightly from one.

B. Global Stat Energy

From the Fig. 7 it is clear that the absorption of Internal Energy (IE), Sliding Energy (SE), spring and damper energy and Hour glass Energy (HE) for washing machine analysis is 82.5%, 7.2%, 10.15%, 0% respectively. The summation of all the energies leads to 99.85% which indicates the energy ratio is approximately one with an error of 0.15%. At 0 Ms, the percentage of internal energy. It shows that the kinetic energy lost during impact is appeared in the form of IE, SE and HE.

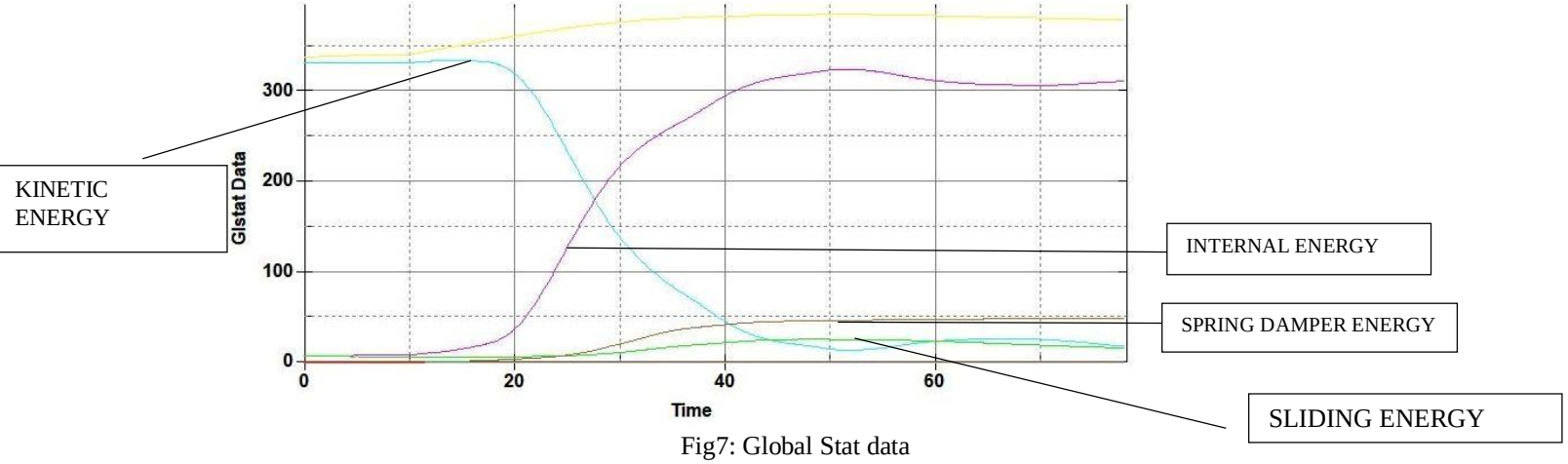


Fig7: Global Stat data

V. CONCLUSIONS

As we have used reinforcement plates and spacers, we have reduced stresses and permanent deformations of a rear panel in a washing machine during drop test. Earlier when we used only bolts without the reinforcement plates and spacers the value of permanent deformations was around 9.000E-02. Now with the inclusion of the reinforcement plates and spacers in the washing machine the value of permanent deformations was around 3.000E-02. Since the permanent deformation values got reduced after using the reinforcement plates and spacers, as a result the stiffness of the rear panel also increases.

VI. ACKNOWLEDGMENT

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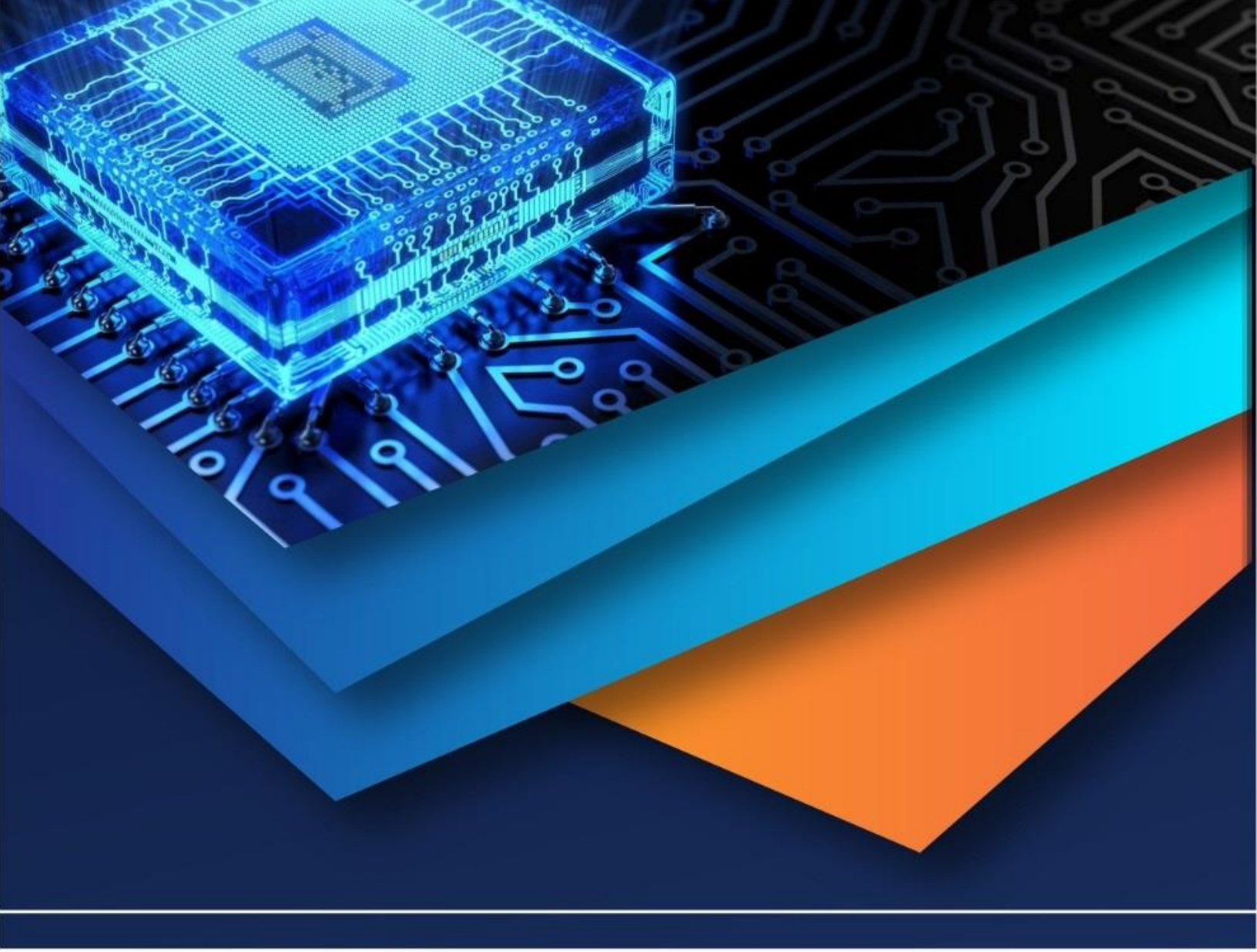

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