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The Study of Furniture Slider Mover

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Abstract: This paper is summary of the device that uses to lift the part as call FUSLIMO or Furniture Slider Mover. FUSLIMO was designed to lift the part by a small device that can move smoothly and freely on the floor where cannot impair the furniture stylist look. The device was divided into three main functioning component are top plate, bottom plate and ball bearing. The finite element analysis (FEA) was applied to investigate the suitable material and the strength of the part. The factor have been studied on the material and force applied. The result show the FUSLIMO is able to with stand with maximum load up to 100kg.The result also shows the plate made from plastic material are deform with such load applied.

Keywords: FEA, Load and Furniture

1. Introduction

The common problem rises that have to face by the housewife is to move the furniture which needs more manpower for that purpose. Heavy weight of furniture is the problem due to moving the object even by two persons. This heavy furniture will consume people’s laziness for moving it for cleaning and interior design purpose. The time taken to move that heavy furniture will take longer and person will high sigh. The heavy load may cause to low back pain. The Mayo Clinic, USA mention that the Back pain is a very common complaint with approximately 80% of all Americans will have low back pain at least once in their lives [1]. According to the NHS (National Health Service), UK, back pain is the largest cause of work-related absence in the United Kingdom. Although back pain may be painful and uncomfortable, Even though back pain can affect people of any age, it is significantly more common among adults aged between 35 and 55 years. The most the back pain happen due to human lift the heavy part during their works.

In conjunction of this problem, the Furniture Slider mover ‘FUSLIMO’ was design to reduce the human fatigue when moving the heavy part. The ‘FUSLIMO’ is Furniture Moving System by a unique product that makes daily cleaning jobs easier. This heavy furniture mover allows lifting, place and sliding to move furniture that is otherwise very difficult to move, clean in hard to reach places, adjust area rugs and level appliances. The ergonomic design makes the process seem effortless and protects the back pain.

2. Literature review of the product

2.1 Top Plate

Generally the top Plate of FUSLIMO is making by using Mild steel material, also called plain-carbon steel. This material was selected due to its price is relatively low while it provides material properties that are acceptable for many applications, Low carbon steel contains approximately 0.05–0.3% carbon and mild steel contains 0.3–0.6%[2] carbon; making it malleable and ductile. Mild steel has a relatively low tensile strength, but it is cheap and malleable; surface hardness can be increased through carburizing.[4].It is often used when large quantities of steel are needed, for example as structural steel. The density of mild steel is approximately 7.85 g/cm3 (7850 kg/m3 or 0.284 lb/in3) and the Young's modulus is 210 GPa (30,000,000 psi).[5]

2.2 Ball Bearing

The movement of FUSLIMO is use ball bearing concept.. L_{10} fatigue life is that life which 90% of a representative group of identical bearings can be expected to achieve or exceed before evidence of subsurface material fatigue appears. The life of the remaining 10% is unpredictable. The life which 50% of the bearings may be expected to achieve or exceed is approximately 5 times the L_{10} life. This is known as the L_{50}or median life. There is no significant difference between the dynamic capacities for inner race rotation versus outer race rotation. This is due to the relatively small ratio of ball diameter to pitch diameter in REalISlIM® bearings.A REalI-SlIM® bearing can withstand is dependent upon the amount of support provided by the shaft and housing. The published capacity numbers allow the user to quickly

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estimate the bearing L_{10} life for a one dimensional load case. The life can be estimated using one of the following equations:

$$L_{10} = \left(\frac{C}{P}\right)^3 * 1000,000\ revolutions \quad \text{............(1)}$$

Where; L10 is Life in Revolution, C is KAYDON dynamic rating and P is Applied Load effective

3. Literature review of the product

The study begin by product design, analyze the product, fabrication and testing functional. It can be shown in fig 1

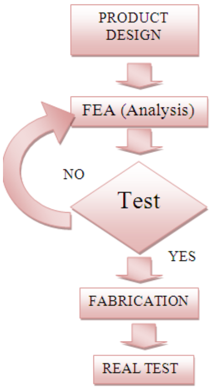

Fig 1.Process of the making FUSLIMO

3.1 Design of FUSLIMO

The FUSLIMO was divided by 3 main parts which is Top Plate, bottom Plate and ball Bearing. The overall size of the product is 54mm X 54mm X 9mm. The ball bearing Ø2mm and Ø8mm was placed inside the FUSLIMO and screwing by M3. Fig 2 show the conceptual design of the FUSLIMO.

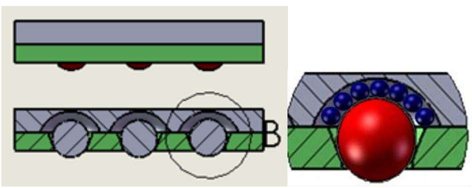

Fig 2. Structural model

3.1 Finite Element Analysis of FUSLIMO

The study would characterize the wear of a particular matching operation and the strength due to the stress applied. A parametric study would then be conducted to investigate whether the characteristic of the ball bearing and Fuslimo base which could be change to the highest acceptable stiffness The COSMOS/Works can be used to carry out static stress analysis on the model that is in the extreme position, and determines whether the design structure meets the requirements of stiffness and strength under static. The part was tested with suitable material as show in table 1 and 2.

Table 1. Simulation Information

Mesh Type	Solid mesh
Mesher Used	Standard
Element Size	2.247mm
Number of elements	9240
Number of nodes	15758
Load applied	1000N

Table 2: Linear elastic isotropic condition of three different materials

Item	Stainless Steel	Plastic	Mild Steel
Mass	0.087 kg	0.013 kg	0.082 kg
Volume (m^3)	1.133e-5	1.133e-5	1.133e-5
Elastic modulus (N/m^2)	2.1e+011	2.4e+009	1.9e+011
Poisson's ratio	0.28	0.35	0.27
Mass density (kg/m^3)	7700	1200	7300
Yield strength (N/m^2)	6.204e+008	2.068e+008	2.757e+008

4. Result and discussion

Finite Element design analysis results are based on linear static analysis and the material is assumed isotropic. Linear static analysis assumes that: 1) the material behavior is linear complying with Hooke's law, 2) induced displacements are adequately small to ignore changes in stiffness due to loading, and 3) loads are applied slowly in order to consider dynamic effects.

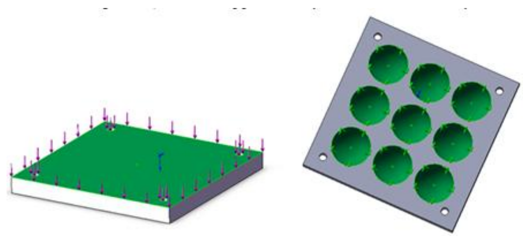

Fig 3.The locations where the load and constraint were applied in the FEA simulation

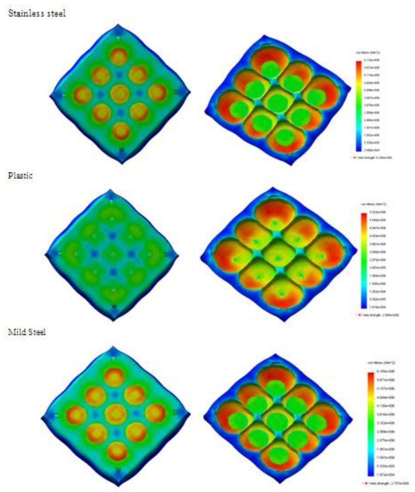

Fig. 4 Comparison of the stress von misses on top Fuslimo cover for different materials.

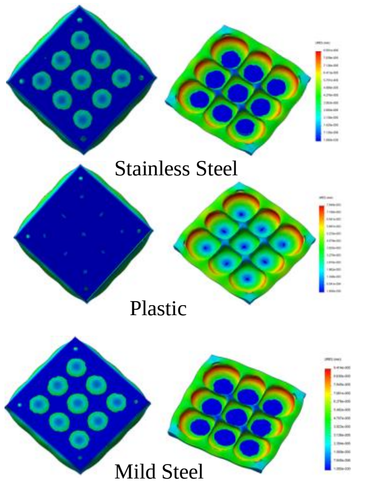

Fig 5. Comparisons the displacement value on top cover with different materials.

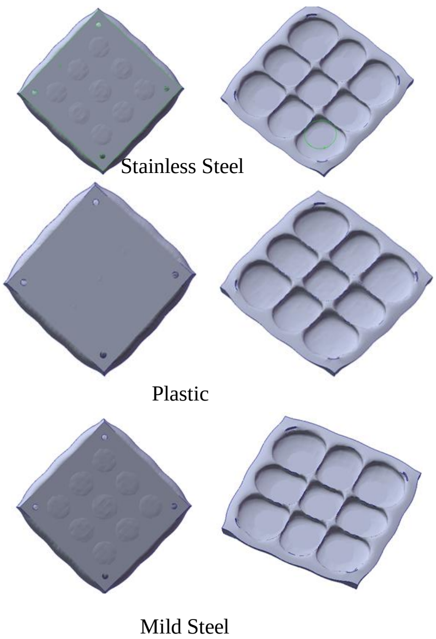

Fig 6. FEA on Mild steel show by Deformation Distribution

Table 3. Stress distribution results for three different materials (Von Misses)

Material	Type	Min (N/m^2)	Location Min	Max (N/m^2)	Location Max
Stainless Steel	Von Misses stress	24556.9	(-35.69 mm, 5 mm, 27.90 mm)	6.13e+6	(-27.77 mm, 1.96 mm, -16.07 mm)
Plastic		16159.6		5.93e+6	(-28.71 mm, 1.78 mm, -14.03 mm)
Mild Steel		19721.2	(17.17 mm, 3.33 mm, -24.96 mm)	6.18e+6	(-28.71 mm, 1.78 mm, -14.03 mm)

Table 4. The lowest Factor of Safety and Yield Strength value after FEA simulations.

Material	Lowest Factor of Safety	Yield Strength (N/m^2)
Stainless Steel	100	6.20e+8
Plastic	34	2.00e+8
Mild Steel	45	2.75e+8

Table 5. The maximum and minimum displacement values for three different materials.

Material	Min (mm)	Location Min	Max (mm)	Location Max
Stainless Steel	0	(-31.82mm, 0mm, 25.28mm)	8.55e-5	(-29.46mm, 4.096mm, -16.94mm)
Plastic	0	(-31.82mm, 0mm, 25.28mm)	7.00e-3	(-28.73mm, 4.09mm, 21.74mm)
Mild Steel	0	(-31.82mm, 0mm, 25.28mm)	9.414e-5	(-28.73mm, 4.09mm, 21.73mm)

After simulation on top fuslimo cover, the stress distribution was generated with different type of material which is stainless steel, plastic and mild steel. By referring to Fig 4 and Table 3, the lowest value for maximum stress von misses is 5.93e+6 N/m^2 for plastic material meanwhile the highest value for maximum stress von misses is 6.18N/m^2 for mild steel material. However the maximum stress von misses value for stainless steel is little bit different with mild steel which is 6.13e+6 N/m^2. Therefore, it demonstrate that the plastic material is the weakest material compare to stainless steel and mild steel due to the value of von misses for plastic is the lowest and it is not suitable to apply for Fuslimo. In addition to that, from Fig 5 and Table 5, the smallest value of displacement is 8.55e-5mm for stainless steel and the highest value of displacement is 7.00e-3mm for plastic material. It shows that, the stainless steel give the smallest movement of displacement when 1000N is applied on Fuslimo. Meanwhile, mild steel also generated a smaller value of displacement which is 9.414e-5mm compare to the plastic. Furthermore, regarding to the lowest factor of safety in Table 4, stainless steel is highest FOS value which is 100, second is mild steel which is 45 and the smallest FOS value is plastic that is 34. From the simulation results, the mild steel is selected to apply on the Fuslimo top cover, it is because the mild steel generates the optimum value for the von misses, displacement and lowest factor of safety compare to stainless steel and plastic to support the estimate load 1000N. Besides that, in the costing factor, the mild steel is the cheapest price in market. Fig 7 shown the completed product

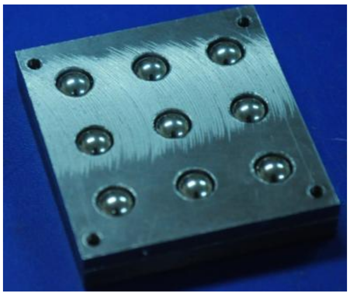

Fig 7. Completed Product (FUSLIMO)

5. Conclusion

The COSMOS/Works analysis was used for FEA study. The result study according to response as an example stress distribution, displacement distribution and deformation distribution. The lowest factor of safety, yield strength and the maximum displacement for three different materials were found. For lowest safety factor, the stainless steel is the best aspect, but the mild steel is acceptable material that can be choose too. For the maximum and minimum displacement values, the minimum result has indicated that the stainless steel and mild steel were acceptable to be used as FUSLIMO base material. However, to cut the overall cost and keep in acceptable strength then the mild steel is the chosen one.

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References

[1] Medical news today Article Date: 03 Dec 2009 - 9:00 PDT,http://www.medicalnewstoday.com/articles/172943.php

[2] Classification of Carbon and Low-Alloy Steels" http://en.wikipedia.org/wiki/Carbon_steel

[3] Knowles, Peter Reginald (1987), Design of structural steelwork (2nd ed.), Taylor & Francis, p. 1, ISBN 978-0-903384-59-9.

[4] Engineering fundamentals page on low-carbon steel,Elert, Glenn, Density of Steel, retrieved 2009-04-23.

[5] Modulus of Elasticity, Strength Properties of Metals Iron and Steel, retrieved 2009-04-23

[6] Yin Liu (2006).Finite Element Analysis of Coring Rock Sample Test-bed with COSMOS/Works

[7] Dehua Sun, "Static strength and stiffness analysis of a component with COSMOS/Works," Journal of Anhui Vocational Technical College.China, vol 4, pp.13-15, Jun 2005.

[8] Bo fang Zhu, "Principle and application of finite element method,"Water Resources and Electric Power Press. Beijing, 1979.

[9] K. Hüseyin Koç1(2011), The use of finite element method in the furniture industry African Journal of Business Management Vol. 5(3), pp. 855-865.