Design Analysis for Gear Motor System Assembly to Automate the Rolling Shutter Operation-FEA Results

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Abstract— Over the years roller shutters have been used for security purpose with opening and closing feature in every commercial as well as residential areas like doors for vans, garages, shops, schools, prisons and warehouses, if not maintained properly get rusted, and it takes lot of effort to lift them, usually this effort is so high that it can cause back injury to the operator. Even for large size shutters it is impossible to lift them without any mechanism. Considering these problems it is important to design a motorized system which can facilitate the opening and closing of shutter by the press of the button and thus reduce the back injuries. Thus it is important to design such mechanism for safety purpose. In this project keeping in mind those problems, we have designed Gear Motor system assembly to automate the Rolling shutter operation that can provide safety to the operator. First we have studied different types of shutters available in the market and accumulated the design specification for selected shutter from the manufacturer. Using this design specification a CAD model of Gear motor system assembly of rolling shutter modeled in CAD software solidworks. In fem software HYPERMESH mesh model of the Gear motor system assembly generated and processed to the linear static analysis using NASTRAN. From the results we concluded that stresses obtained in static analysis are within the limits, hence the design of gear motor assembly to automate the rolling shutter operation is safe.

Key words: Rolling Shutter Operation, Gear Motor Assembly

I. INTRODUCTION

Roller shutters are usually defined as a vertical revolving barrier at the entrance to a building or room, traditionally made of metal or wood, its leafs, curtains or slats will be rolled upwards during its opening position and downwards during its closing position.

Due to the advancement of new inventions, roller shutters are also made of various improved materials such as aluminum and plastics, coupled with other insulations.

The advantage of using roller shutter is for space efficiency to provide a clear unobstructed opening, while completely securing and compartmentalizing the opening hole during closure. it is a type of door or window shutter consisting of many horizontal slats (or sometimes bars and web systems) hinged together. The door is raised to open it and lowered to close it.Roller shutters have many applications, including doors for garages, warehouses, shops, etc.these shutters over the years, if not maintained properly get rusted, and it takes lot of effort to lift them, usually this effort is so high that it can cause back injury to the operator, thus it is important to design a motorized system which can facilitate the opening and closing of shutter by the press of the button and thus reduce the back injuries.

II. PROBLEM FORMULATION

These shutters over the years, if not maintained properly get rusted, and it takes lot of effort to lift them, usually this effort is so high that it can cause back injury to the operator, thus it is important to design a motorized system which can facilitate the opening and closing of shutter by the press of the button and thus reduce the back injuries.

A. Objectives of Project are

1) To design a gear motor assembly which can be mounted on new or existing shutters to make them work automatically.
2) This will significantly reduce human fatigue to operate roller shutters.
3) To design such a mechanism which is economically low cost.
4) Easily mountable on existing shutters.
5) Less skilled person can easily operate.
6) Low maintenance.
7) Reduce back injuries due to shutter operation

B. Methodology

- Data collection from the site for existing roller shutter.
- CAD modeling of the gear motor attachment:
- FEM Model generation:
- Analysis of design in FEA:
- Result and conclusion:

III. ANALYSIS

A. Mesh Model:

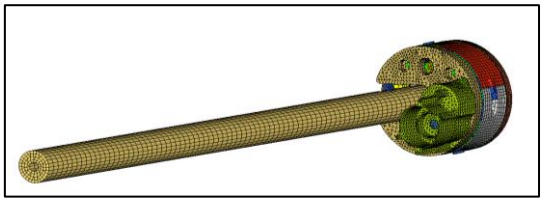

Fig. 1: Meshed model

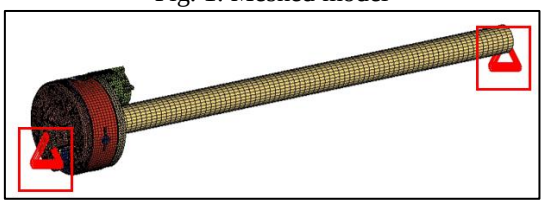

Fig. 2: Constraints

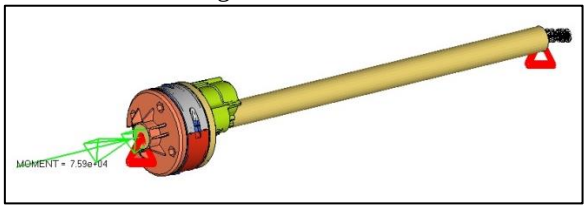

Fig. 3: Torque

B. Results of Modal Analysis

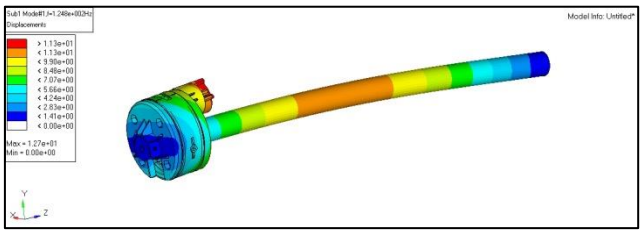

Fig. 4: Mode 1: 1.248e+002Hz

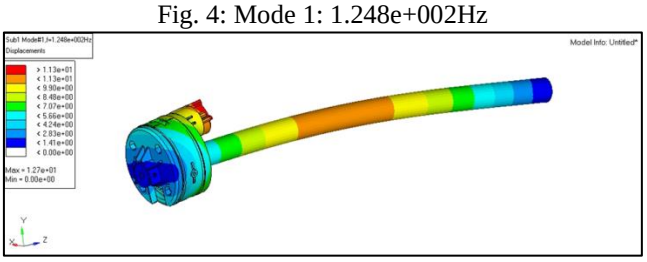

Fig. 5: Mode 2: 1.248e+002Hz

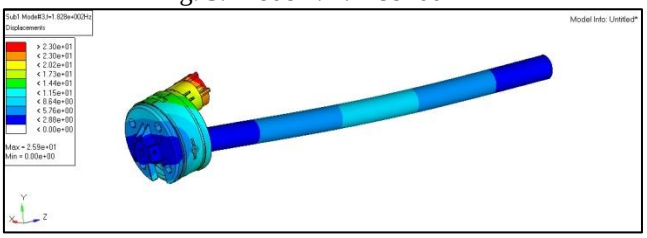

Fig. 6: Mode 3: 1.828e+002Hz

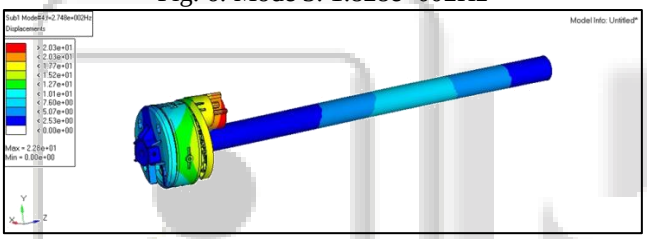

Fig. 7: Mode 4: 2.748e+002Hz

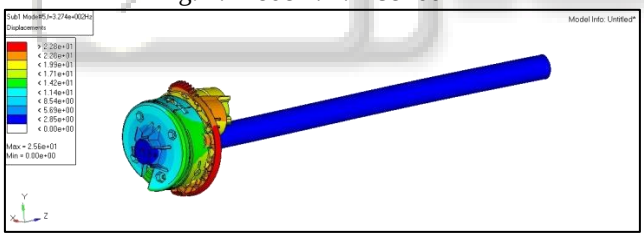

Fig. 8: Mode 5: 3.27e+002Hz

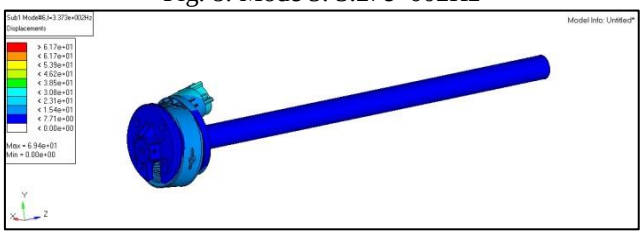

Fig. 9: Mode 6: 3.373e+002Hz

C. Results of Linear Static Analysis

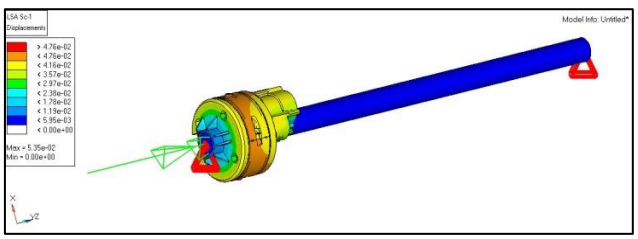

Fig. 10: Displacement: 0.053mm

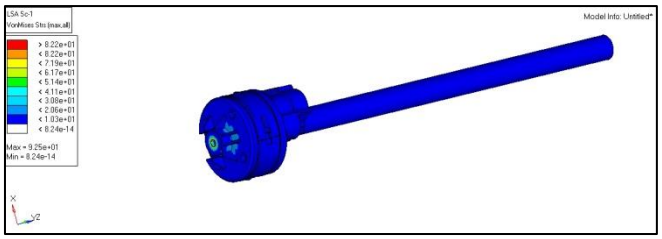

Fig. 11: VonMises stress: 92.5Mpa

IV. RESULTS & DISCUSSION

Results obtained from the static analysis are within the limits, hence we have successfully designed gear motor assembly for roller shutter which reduces human fatigue to operate and back injuries. Easily mountable and low maintenance required.

V. CONCLUSION

Considering problem this project was successfully executed in stipulated time. Design and Analysis of Gear Motor system assembly to automate the Rolling shutter operation performed. Shutters need to be designed which reduces the complexity and back injuries. The structural integrity of bracket assembly should be such as to permit the structure to sustain stresses and fulfill the need. Using FEA method, we designed such system.

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