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Research Paper

# DESIGN AND ANALYSIS OF COMPACT STRETCHER WITH RUBBER SHOCK ABSORBERS

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Design of stretcher is very important while considering safety of patient. It is an essential part of medical first aid services. In critical situations safe and in time delivery can save life of peoples. Efforts are taken to make the stretcher more light in weight and compact for easy travelling. Use of shock absorbers can reduce vibration shocks. Use of shock absorber can reduce the intensity of vibration shocks produced during traveling of patient. Rubber shock absorbers are light in weight and less costly also mounting of rubber shock absorbers is easy, they can mount using any mechanical mechanism. In critical situations, there are chances of death due to bleeding or damage to internal body parts because of vibrations produced. Use of rubber shock absorbers becomes helpful in such situations, since they can reduce the shocks to a minimum level. Hence while considering the importance of safety, this paper focuses on the effective use of this shock absorbers in hand lifting stretcher.

**Keywords:** Vibration, Cad, Catia, Shock Absorber, Ansys

## INTRODUCTION

While considering delivery of patients that have caught in road accidents or in a terrorist attack and also during mega disasters, hand lifting stretchers are more useful than wheel stretcher. To design a hand lifting stretcher, the points to be considered are, it should be light in weight and easy to carry in any situation, it should be comfortable in ergonomic point of view and also attractive in aesthetic point of view. There are many patients who are in need of more comfortable method of being transferred between

stretcher and ambulance. This transfer occurs everytime and any reduction in movements to the patient's body would increase convenience and comfort for both the patient and the person transferring the patient. The field of application of the invention is in the light stretcher transport sector and for the adaptation for ambulances. At the present time the operation for the introduction of the stretchers into the ambulances or health vehicle has to consider the problem of how to do it without making the sick or injured person uncomfortable. Said operation has to be carried

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out without the risk of making it worse depending on type of wounds or injuries.

To achieve all this facilities in one product, it is necessary to design a stretcher with some technique of using shock absorbers and also some technique for easy transportation in ambulance. A number of stretchers are available in the market with different designs. But it has been seen that the cost of stretcher also increases with use of shock absorbers. Hence, it is necessary to use low cost shock absorber in hand lifting stretcher.

Rubber shock absorbers are light in weight and also low cost. Also they can easily implement in hand lifting stretcher. Theses shock absorbers are introduced in between bed and handle so that they can work as vibration dampers. One can make it compact upto 1/3<sup>rd</sup> of its original size.

**LITERATURE REVIEW**

An exhaustive literature review is carried out to understand the present practices in stretcher design. It would help to use shock absorber effectively in a hand lifting stretcher. In 2012, S Ramamruthem has published his latest edition of book “Strength of Materials”, It consist of different formulaes for calculating stress and strength of various materials. Different parameters for calculation of bending and shear

stress of rectangular pipe, sheet are given in this book. ASM handbook gives idea about different mechanical and physical properties of materials like natural rubber, galvanized iron, mild steel, etc.

In January 2012, Premchand Gupta, Suresh Garg and Sachin Maheshwari had published a paper on design of casualty evacuation stretcher using hinge joint. They have studied use of different joints to make compact design of stretcher which is suitable for Indian army. The stretcher becomes foldable and more compact with use of hinge joints. Vajreshwari Umachagi, Katta Venkatarmana, G R Reddy, had studied on use of shock absorber for vibration control of different structures. Arif Duran, Hayrettin Ozturk, UmitYasar, Muchahit Emet had studied the effect of stretcher type on safety and ease of treatment in an emergency department. A survey of 139 questionnaires from 15<sup>th</sup> January to 29<sup>th</sup> February 2012 would decide the requirements of patients from a god stretcher. Saeed Moaveni, has published his 3<sup>rd</sup> edition book on Finite Element Analysis, Theory and Application with ANSYS, it gives idea about part analysis in ansys. Prof. Shyam Tichkoo has published his books CATIAV5-6R2012 for Engineers and Designers and ANSYS Workbench 14.0 for Engineers and Designers gives idea about design in catia and its analysis in Ansys.

**Table 1: Parts Specification**

Component	Material	Dimention (mm)	Design criteria
Rectangular Pipe (2)	G.I.	50*25*2Length =1950	Bending, Tensile.
Rectangular Pipe (4)	G.I.	50*25*2Length= 300	Bending
Circular Pipe (Hollow)	G.I.	Dia.=16Length=5140	Shear, Bending
Bends (4)	G.I.	Dia.=16	Standard
Sheet (3)	M.S.	650*575*1	Tensile

## PROJECT MODEL

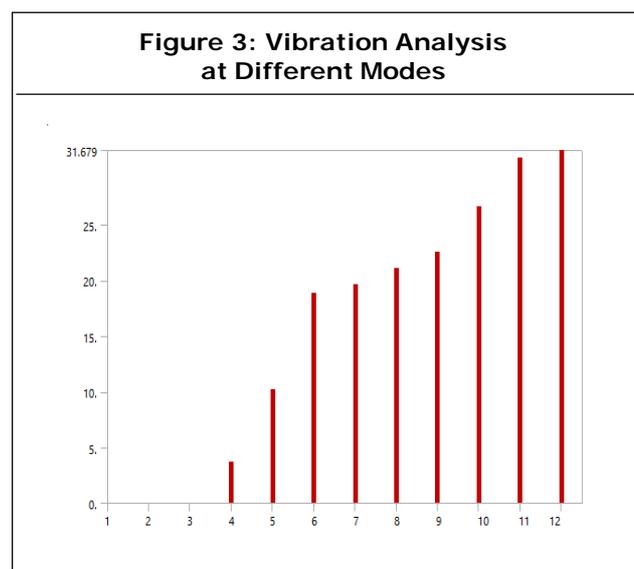
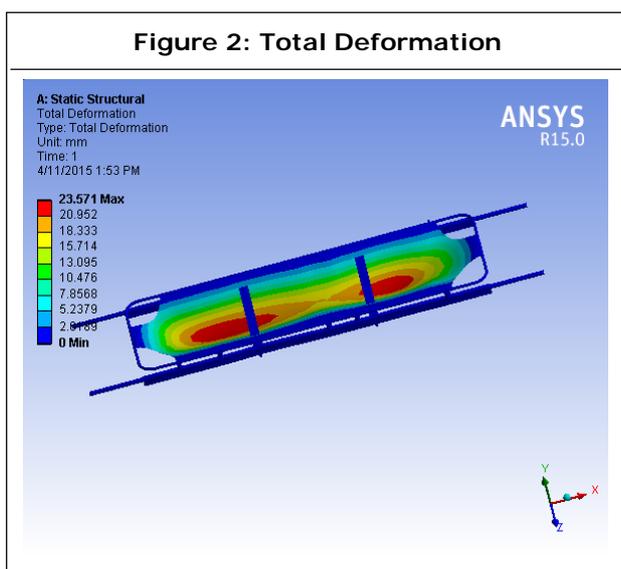
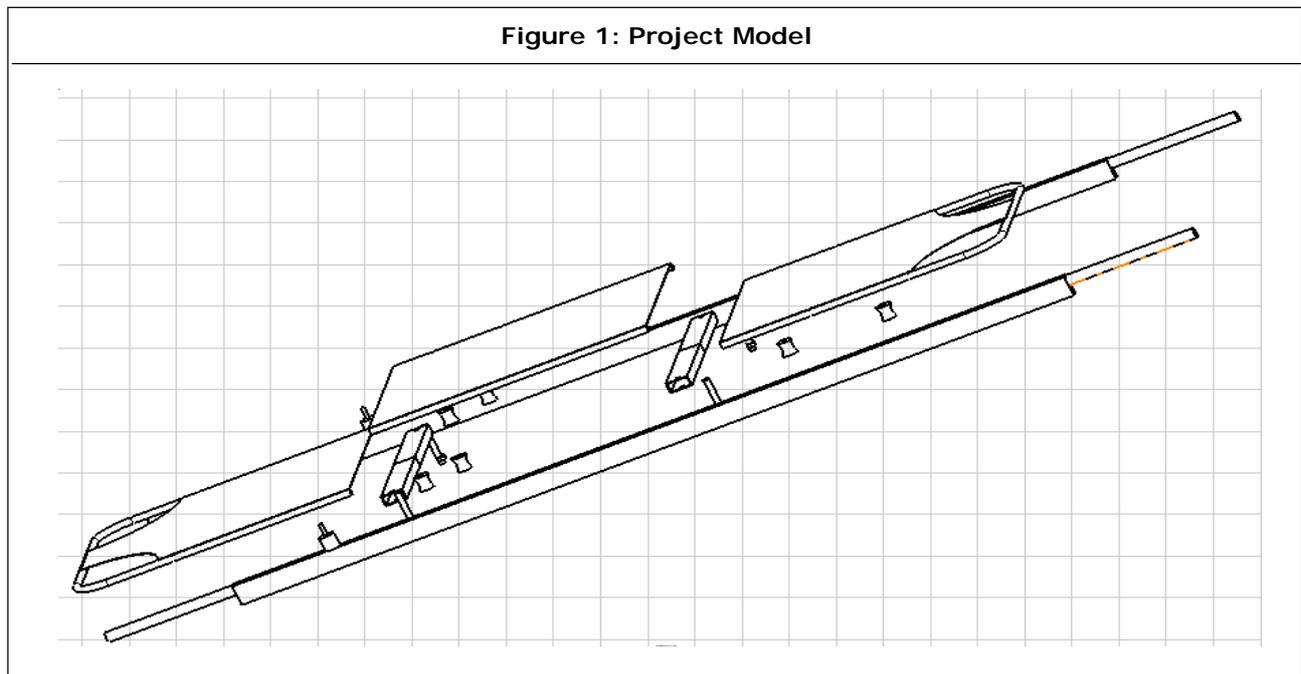
Figure 1 shows the project model design in CATIA. It gives brief information about various parts used in stretcher. Two GI rectangular rods, eight rubber shock absorbers, MS sheet bed are joined together as shown to make stretcher. Stretcher is foldable horizontally and 3 beds can be separated easily while transportation of stretcher. And also can be joined easily when required.

## PARTS SPECIFICATION

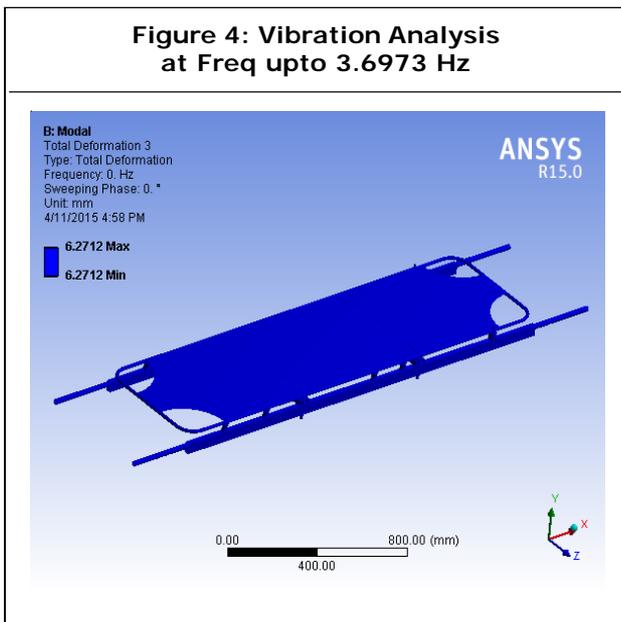
Table 1 Parts Specification

## RESULTS

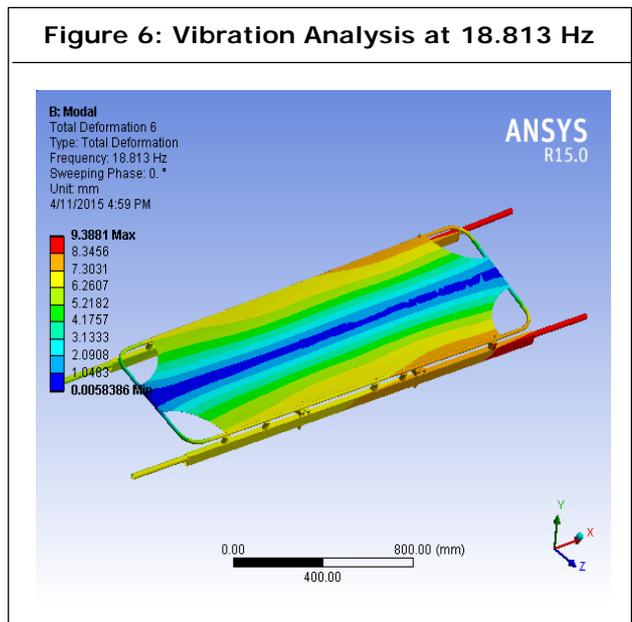
Stretcher model is analyzed using ANSYS whose results are taken under structural and vibration analysis mode. Figure 2 shows results of structural analysis under total load of 210 kg, it gives maximum deformation of 23 mm.



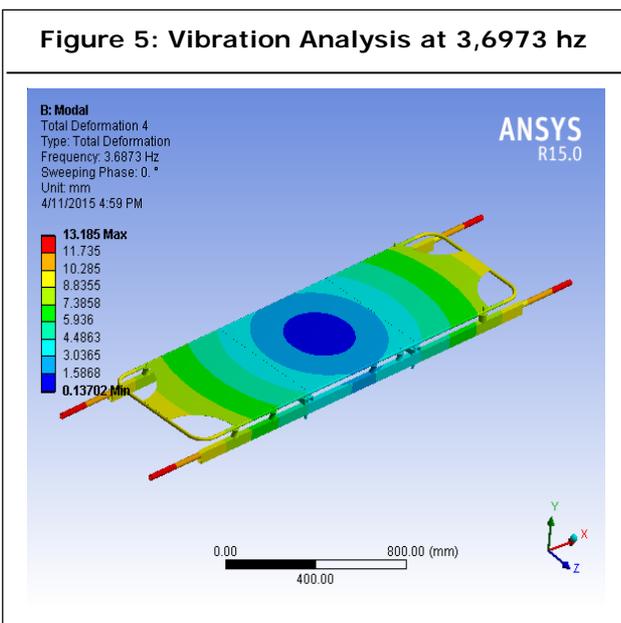
**Figure 4: Vibration Analysis at Freq upto 3.6973 Hz**



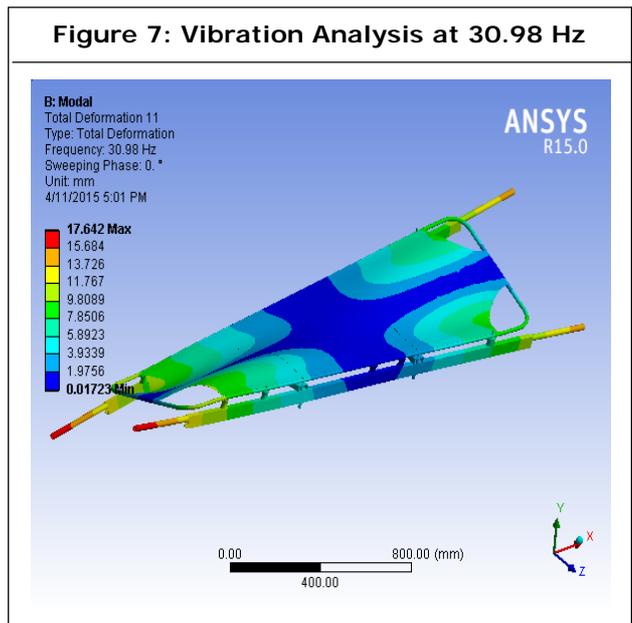
**Figure 6: Vibration Analysis at 18.813 Hz**



**Figure 5: Vibration Analysis at 3,6973 hz**



**Figure 7: Vibration Analysis at 30.98 Hz**



Vibration analysis of stretcher under 12 modes of vibration is shown in Figure 3. Graph consist of modes of vibration along x-axis and frequency along Y-axis. Up to 3.6973 Hz frequency it doesn't give any vibrations above that it shows its behavior under vibration. At frequency of 31.679 Hz maximum vibration occurs at 12<sup>th</sup> mode.

Figure 4 shows vibration analysis at freq upto 3.6973 Hz.

Up to frequency of 3.6973 Hz, Model does not shows any vibration. At 3.6973 Hz vibration start to occur at 4<sup>th</sup> mode as in Figure 5. After that it shows vibration at different modes as in graph. And at frequency of 31.98 Hz it gives maximum vibration at 12<sup>th</sup> mode as in Figure 6.

Figure 7 shows vibration analysis at 30.98 Hz.

## CONCLUSION

With use of rubber shock absorbers it doesn't show any vibration below 3.6973 Hz. Above that it shows some vibrations but can be easily damped out by shock absorber. Hence this model can be used for critical patients also. Also this model can be separated and joined again easily, hence can be transfer from one place to another easily by separating parts. Use of Aluminium can reduce weight of stretcher upto 5 kg and use of push lock buttons instead of nut bolt makes it easier for separating and join which reduces time required for joining stretcher parts.

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