ISSN : 2455-9679
Impact Factor : 2.865

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INTERNATIONAL JOURNAL OF RECENT TECHNOLOGY SCIENCE & MANAGEMENT

# "DESIGN AND DEVELOPMENT OF TWO IN ONE FOLDABLE AMBULANCE STRETCHER CUM BED"

***Shubhi Barsainya*** [1], ***Prof. S.L. Ahirwar*** [2]
[1]*M.Tech Scholar, Dept. of Mechanical Engineering, OIST, Bhopal, MP, India*
[2]*Associate Professor, Dept. of Mechanical Engineering, OIST, Bhopal, MP, India*

## ABSTRACT

***In this project the stretcher cum Bed used in hospitals are combined with each other, so that it can be used for multi-purpose instead of using both of them separately. It can reduce the mobility problem of the patients. Stretcher is an essential part of medical first aid system. Safe and early delivery can save life of a serious patient. Today stretcher is available in different designs. Efforts are taken to make the stretcher more comfortable in ergonomic point of view and more attractive in aesthetic point of view.***

***In this project we have taken four materials like Structural steel, Aluminium Alloy , E Glass fiber and other composite materials carbon fiber and in this project we have made our model on 3D model on CATIA design software and simulation has done ob ANSYS 17.0 version software and static analysis has carried out with help of ANSYS design software.***

***Keyword:*** *Mobility, Static analysis, Anthropometric, ANSYS, CATIA, stretcher*

## I. INTRODUCTION

Ambulance stretchers are a vital piece of life saving equipment used by paramedic operators. The operator's ability to save a life may falter due to the lack of durability or poor design of a stretcher they are using to transport a patient. In the medical field, this is unacceptable and the potential for accidents must be reduced. Through the new designing of the stretcher's individual parts and sub assemblies, the dependability will increase due to a decreased number of potential failure points. The goal of the new design is to maximize stretcher functionality and stretcher dependability, while increasing comfort for the patient in order to reduce further damage due to vibrations that propagate through the ambulance caused by uneven road surface.
Healthcare is a growing industry that is essential to the longevity of humanity. It is an important aspect of everyday life that is always changing and adapting to compete with the everyday changes of the world. The advances in medicine can be as small as the medications developed for treating deceases to the actual equipment monitoring and caring for people. The ambulance stretcher or gurney is a piece of equipment used in the health field that may be overlooked at times. This item may be overlooked in importance, but it is a necessary step towards recovery. If this device does not fully meet the obligation it is designed for, the likelihood of saving multiple lives per day would drastically decline. The objectives for this project are to redesign an ambulance stretcher to be more rugged, dependable, and adaptable for use in the field. The particular features that were chosen to concentrate on for redesigning the stretcher are vibrations, number of parts, and easiness of use for the healthcare provider. The thoughts backing these features are to allow the

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Impact Factor : 2.865

worker to administer more adequate care to the patient whether inserting an intravenous needle or stabilizing a fractured vertebrae with fewer vibrations transmitted during the procedure, allowing a faster assembly time for the stretcher with fewer and simpler parts, and combining simplicity in parts.


**Fig.1 Ambulance Stretcher**

## II. OBJECTIVE

The primary considerations for the number of parts and increasing the likelihood of developing an “easy to use” system for the new design include the following characteristics: overall weight, maximum load capacity, and cost. Cost is more of a secondary concern when headed towards the production phase. . The planning of the stretcher CATIA was utilized to demonstrate the model. Since the model was made in CATIAV5R20 an extra to ANSYS 17.0 can be utilized later on to decide the stresses on individual parts and in addition the whole framework.

## III. PROBLEM DEFINITION

Moving patients in hospitals is a typical problem for the overseers and Patients.
Present Method of Patient dealing with who meet with a mishap The patient is exchange from different spots like from Ambulance to O.T./ICU/X-beam focuses/MR filter/Sonography can be continue through different stages.

- Accident spot to stretcher
- Stretcher to ambulance
- Ambulance to hospital stretcher/wheelchair
- Stretcher/wheelchair to bed at O.P.D
- O.P.D to ICU/ward bed
- O.P.D. to X-Ray focus/MRI/SCAN/Pathology focus
- Back to the bed of ICU/Ward bed

## IV. METHODOLOGY

### 4.1 MATERIALS & METHOD

For the design consideration we have analysed the dimensions of human parameters and refers the “**Anthropometric human data book”**. The book consists of human parameters like Total height, sitting height, acromial height, and knee height and knee length for various states in our country. We have used these dimensions for designing purpose.

ISSN : 2455-9679
Impact Factor : 2.865

The Fig.4.1 shows the concept design which was developed by using solid works software. This design was developed by using the dimensions taken from the "ANTHROPOMETRIC HUMAN DATA BOOK". This is a failure model because of the existence of an unbalance problem in the middle plate.

The bottom plate in the concept design was found to be unbalanced due to the improper positioning of the linkage bar to the conceptual leg section. The supporting bars in the conceptual design were found to be insufficient, further providing less support to the subsequent resting portion of the conceptual design.

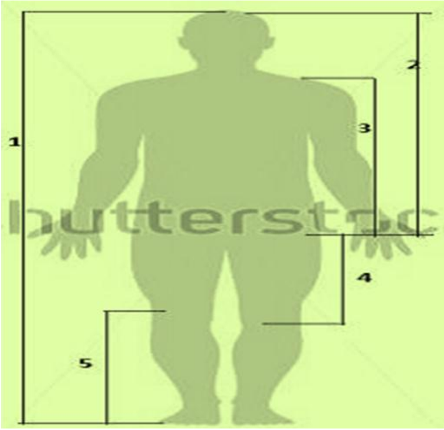


**Fig.4.1 Anthropometric parameters**

1) Total height 2) Sitting height 3) Acromial height 4) Knee length 5) Knee height

### 4.2 SPECIFICATIONS

A framework of two poles with a long piece of canvas slung between them, used for carrying sick, injured, or dead people.

**Table 4.1 Stretcher Specifications**

| Dimensions | Unit | Remark |
|---|---|---|
| Capacity | Kg | Up to 150 kg |
| Overall length of stretcher | mm | 2000 |
| Width of the product | mm | 500 |

### 4.3 MATERIALS PROPERTIES

#### 4.3.1 CARBON Fiber

Carbon strands or carbon filaments (on the other hand CF, graphite fiber or graphite fiber) are filaments about 5– 10 micrometers in measurement and made for the most part out of carbon particles. Carbon strands have a few points of interest including high firmness, high elasticity, low weight, high concoction opposition, high temperature resilience and low warm development. These properties have made carbon fiber exceptionally prominent in aviation, structural building, military, and motorsports, alongside other rivalry sports. In any case, they are moderately costly when contrasted and comparative filaments, for example, glass strands or plastic strands.

**Table. 4.2 Carbon fiber**

| Material Field Variable | Value | Units |
|---|---|---|
| Density | 1950 | Kg/m³ |
| Young's Modulus | 300000 | MPa |
| Poisson Ratio | 0.30 | |
| Tensile Strength | 5090 | MPa |

#### 4.3.2 STRUCTURAL STEEL

The goal of the Structural Steel Design Awards is to commend the magnificence of the United Kingdom in the field of steel development, especially exhibiting its potential as far as productivity, cost viability, feel, manageability and advancement.

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Every year the honors plot pulls in numerous magnificent sections from generally going ventures. Fruitful undertakings are required to have a base limit of brilliance in structural and building terms and to be financially savvy. Every year's entrances mirror the inexorably elevated expectations that are being accomplished, not just in structure and all parts of manufacture, yet additionally in short development software engineers and precision on location.

**Table 4.3 Structural Steel Mechanical properties**

| Material Field Variable | Value | Units |
|---|---|---|
| Density | 7850 | Kg/m$^3$ |
| Young's modulus | 2E+05 | Mpa |
| Poisson Ratio | 0.30 | |
| Shear modulus | 76923 | Mpa |
| Bulk Modulus | 1.6667E+05 | Mpa |
| Tensile Yield Strength | 250 | Mpa |
| Compressive Yield Strength | 250 | Mpa |
| Tensile Ultimate Strength | 460 | Mpa |
| Compressive Ultimate Strength | 0 | Mpa |

**4.3.3 ALUMINUM ALLOY**

Aluminum Alloys (or aluminum combinations; see spelling contrasts) are compounds in which aluminum (Al) is the transcendent metal. The average alloying elements are copper, magnesium, manganese, silicon, tin and zinc. There are two important characterizations, to be specific throwing combinations and created amalgams, the two of which are additionally subdivided into the classifications warm treatable and non-warm treatable. About 85% of aluminum is utilized for created items, for instance moved plate, foils and expulsions.

**Table 4.4 Aluminum Alloy Properties**

| Material Field Variable | Value | Units |
|---|---|---|
| Density | 2770 | Kg/m$^3$ |
| Young's modulus | 2.3E+05 | Mpa |
| Poisson Ratio | 0.33 | |
| Shear modulus | 26692 | Mpa |
| Bulk Modulus | 69608 | Mpa |
| Tensile Yield Strength | 280 | Mpa |
| Compressive Yield Strength | 280 | Mpa |
| Tensile Ultimate Strength | 310 | Mpa |
| Compressive Ultimate Strength | 0 | Mpa |

**Table 4.5 E Glass Properties**

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Impact Factor : 2.865

| Material Field Variable | Value | Units |
|---|---|---|
| Density | 2000 | $Kg/m^3$ |
| Young's modulus X Direction | 45000 | Mpa |
| Young's modulus Y Direction | 10000 | Mpa |
| Young's modulus Z Direction | 10000 | Mpa |
| Poisson Ratio XY | 0.3 | |
| Poisson Ratio YZ | 0.4 | |
| Poisson Ratio ZX | 0.3 | |
| Shear modulus XY | 5000 | |
| Shear modulus YZ | 3846.2 | |
| Shear modulusXZ | 5000 | |

## V. MODELING

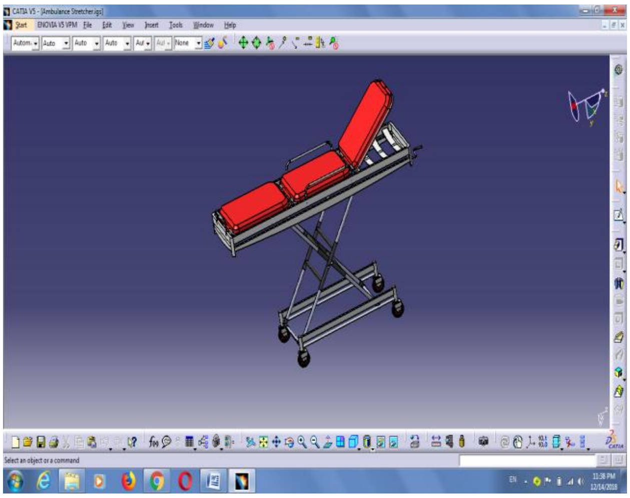

**Fig.5.1 Stretcher CAD model on CATIA**

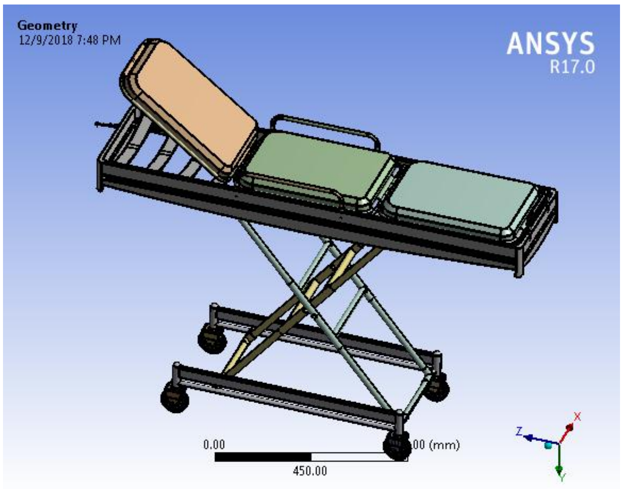


**Fig.5.2 Stretcher CAD model import on ANSYS**

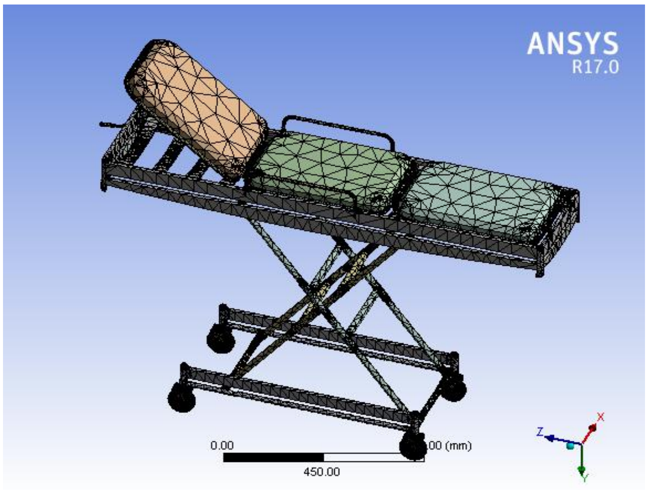


**Fig.5.3 Stretcher CAD model meshing on ANSYS**

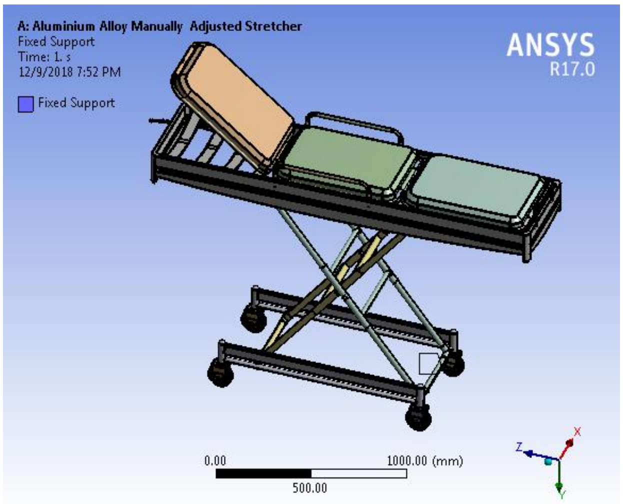


**Fig.5.4 Aluminium Alloy Stretcher CAD model fixed support applied**

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Impact Factor : 2.865

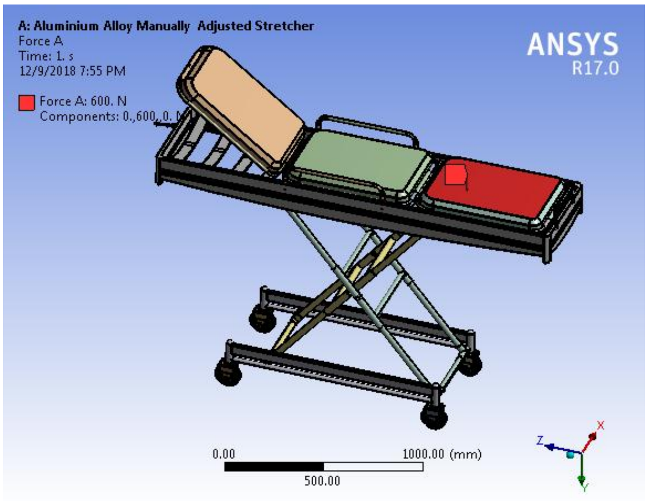


Fig.5.5 Aluminium Alloy Stretcher CAD model forced A applied

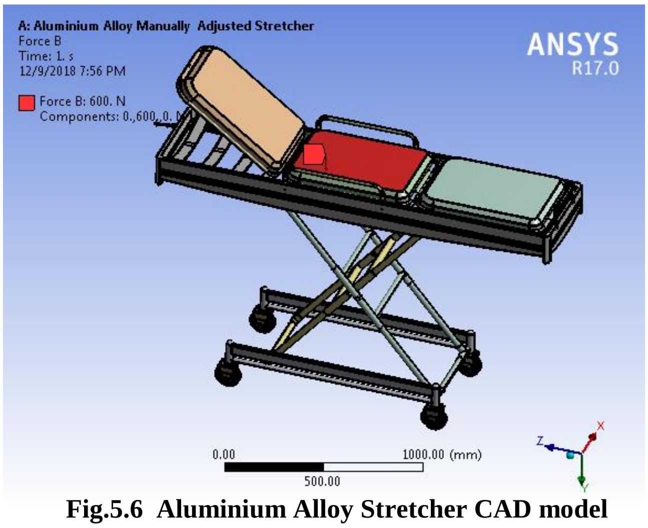


Fig.5.6 Aluminium Alloy Stretcher CAD model forced B applied

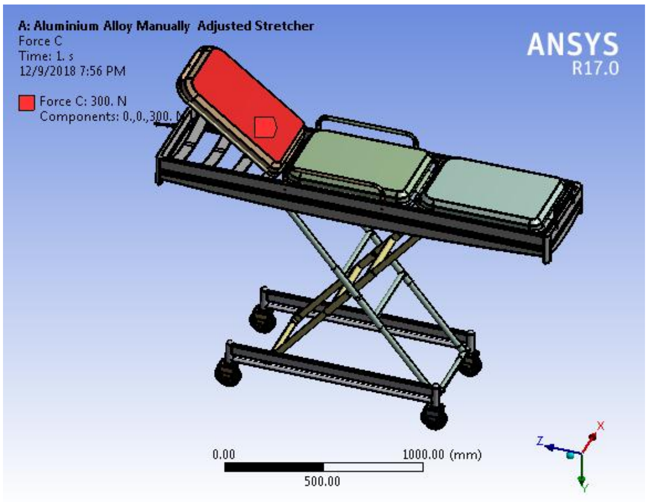


Fig.5.7 Aluminium Alloy Stretcher CAD model forced C applied

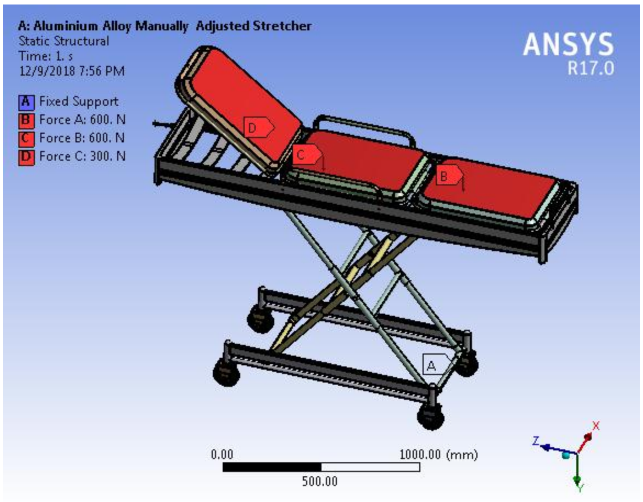


Fig.5.8 Aluminium Alloy Stretcher CAD model completed boundary conditions applied

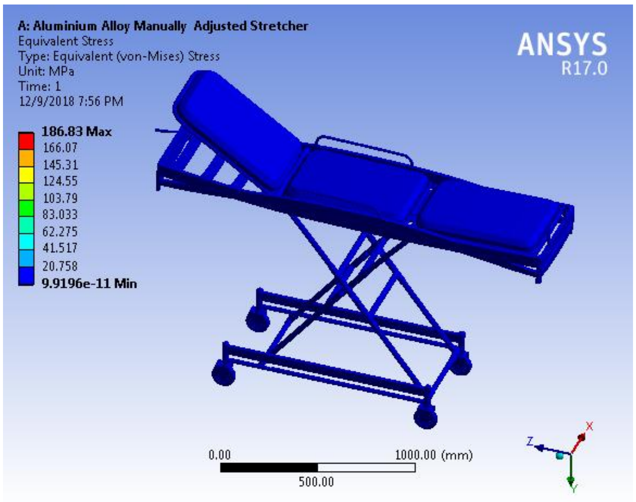


Fig.5.9 Aluminium Alloy Stretcher CAD model Von misses stresses

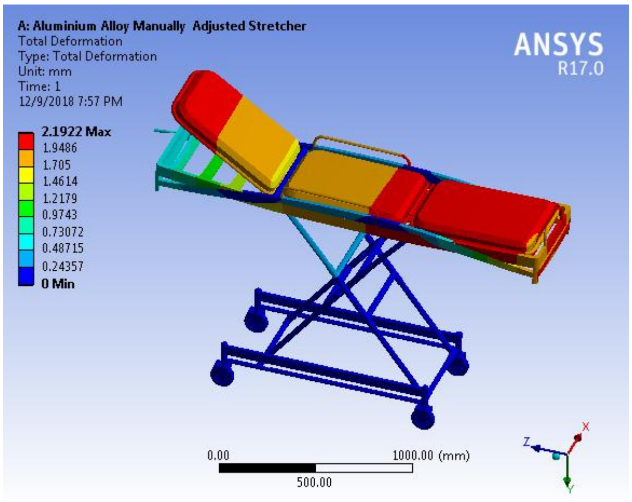


Fig.5.10 Aluminium Alloy Stretcher CAD model deformations

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Impact Factor : 2.865

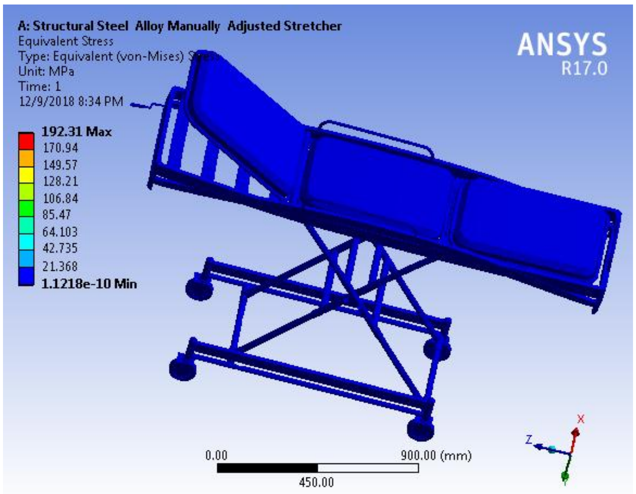


Fig.5.11 Structural Steel Stretcher CAD model von misses stresses

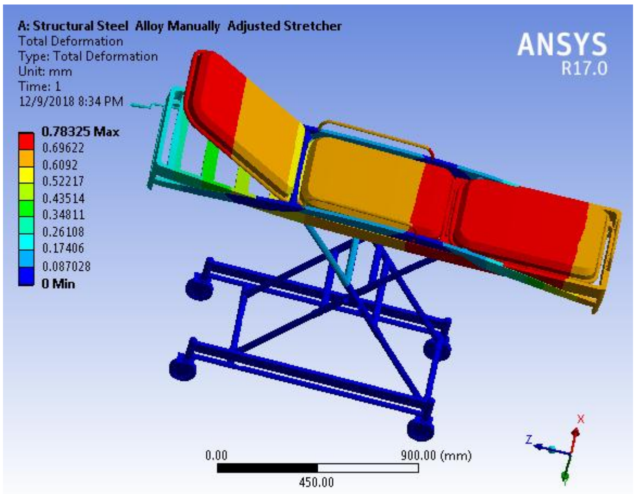


Fig.5.12 Structural Steel Stretcher CAD model deformations

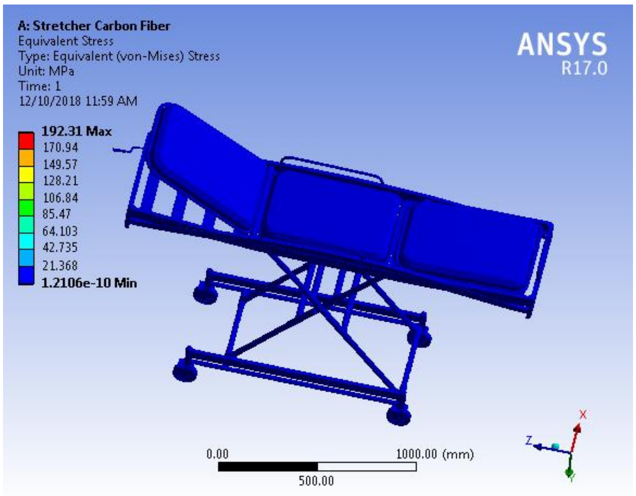


Fig.5.13 Carbon fiber Stretcher CAD model von misses stresses

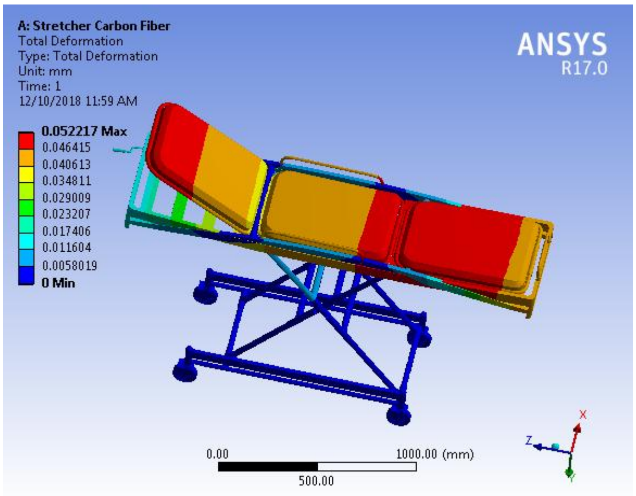


Fig.5.14 Carbon fiber Stretcher CAD model deformations

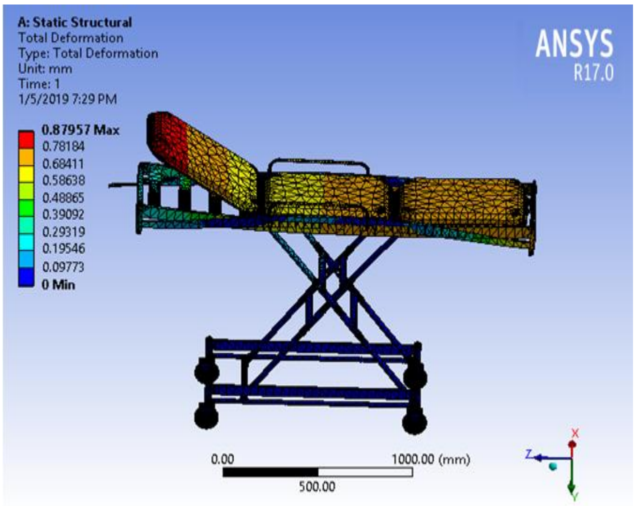


Fig.5.15 E poxy Glass fiber Stretcher CAD model total deformation

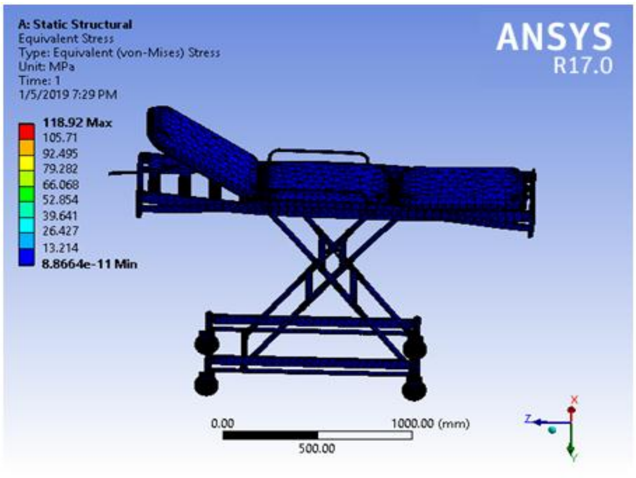


Fig.5.16 E poxy Glass fiber Stretcher CAD model von misses

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## VI. Results & Discussion

In this work we find value of vonmisses stresses S-460, Aluminium Alloy, and Carbon fiber are respectively **192.31** MPa, **186.83** MPa and **192.31**MPa and total deformation for these materials likes S-460, Aluminium Alloy, and Carbon fiber are respectively **2.19** mm, **0.78** mm, and **0.058 mm** .

Here we can see that we have used four different materials in all materials we will be selected composite material to other than because it is light weight and heavy duty its deformation and stresses are under considerable range.

Different papers discussed above in the literature review helps in designing of compact stretcher. Prem Chand Gupta, Suresh Garg had successfully mention the need of compact size casualty evacuation stretcher and use of hinge joint to make the stretcher foldable. The stretcher design by them is purchased for mass production by Artificial Limb Manufacturing Corporation ALIMCO, Kanpur. Mr. Sudarshan Martande and Y. N. Jangale have designed a shock absorber using FEM tool and have made its analysis successfully. Different parameters measured using FEM are very close to their actual values. Vajreshwari Umachagi,, Katta Venkatarmana gives idea about use of shock absorbers for vibration control of stretcher. Shock absorber works effectively only when they are implemented properly in the stretcher design. Arif Duran, Hayrettin Ozturk's study helps to make the stretcher safe for patients. Different requirements of patient and doctors from a good and effective stretcher are considered from a survey. Ace wire spring & form company inc. had given properties of different spring materials from their paper, helps to select proper material for spring design.

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**Table.6.1 Materials von misses stresses comparison**

| Von misses stresses (MPa) | | | |
|---|---|---|---|
| Aluminium Alloy | Structural Steel | Stretcher Carbon Fiber | E Glass Fiber |
| 9.90E-11 | 1.21E-10 | 1.21E-10 | 8.8E-11 |
| 20.758 | 21.368 | 21.368 | 13.2 |
| 41.517 | 42.735 | 42.735 | 26.4 |
| 62.275 | 64.103 | 64.103 | 39.6 |
| 83.03 | 85.47 | 85.47 | 52.8 |
| 103.79 | 106.84 | 106.84 | 66.02 |
| 124.55 | 128.21 | 128.21 | 79.2 |
| 145.31 | 149.57 | 149.57 | 92.4 |
| 166.07 | 170.94 | 170.94 | 105.7 |
| 186.83 | 192.31 | 192.31 | 118.92 |

**Table.6.2 Materials Deformations comparison**

| Stretcher Deformations (mm) | | | |
|---|---|---|---|
| Carbon Fiber | Structural Steel | Aluminium Alloy | E Glass Fiber |
| 0 | 0 | 0 | 0 |
| 0.011 | 0.087 | 0.24 | 0.097 |
| 0.017 | 0.17 | 0.48 | 0.19 |
| 0.023 | 0.26 | 0.73 | 0.29 |
| 0.029 | 0.34 | 0.97 | 0.39 |
| 0.034 | 0.43 | 1.2 | 0.48 |
| 0.0406 | 0.522 | 1.46 | 0.58 |
| 0.046 | 0.6 | 1.7 | 0.68 |
| 5.00E-02 | 0.69 | 1.9 | 0.78 |
| 0.058 | 0.78 | 2.19 | 0.879 |

ISSN : 2455-9679
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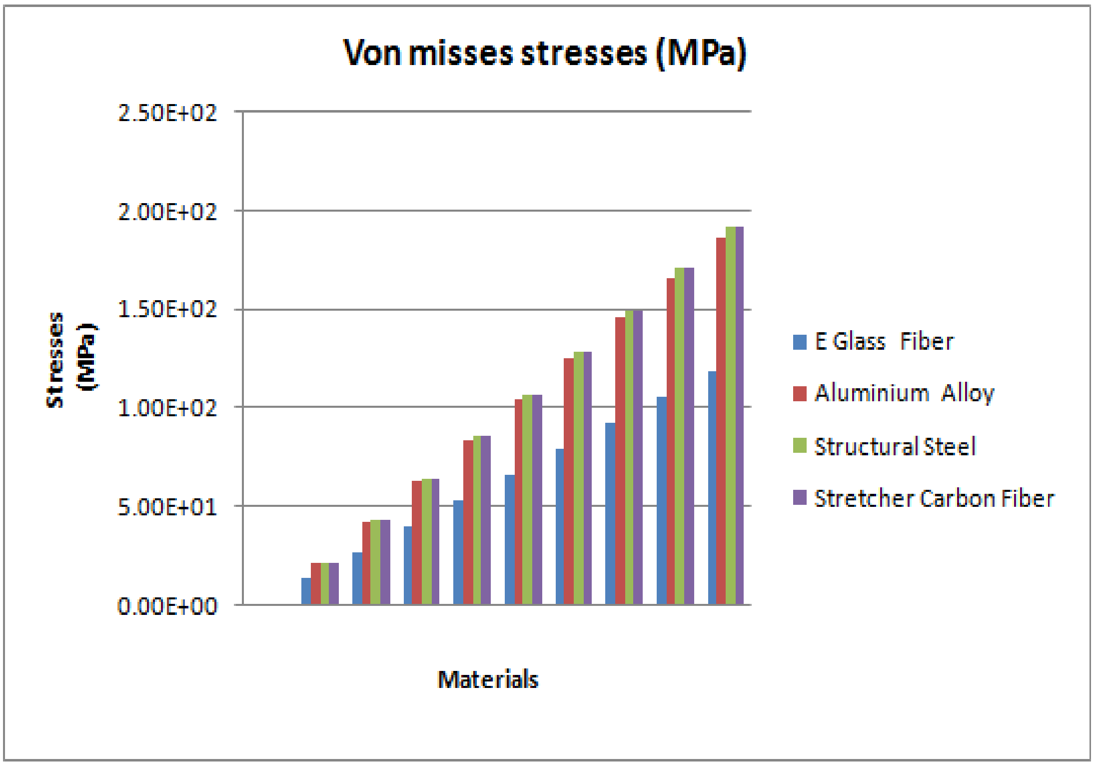


**Fig. 6.1 Materials von misses stresses comparison charts**

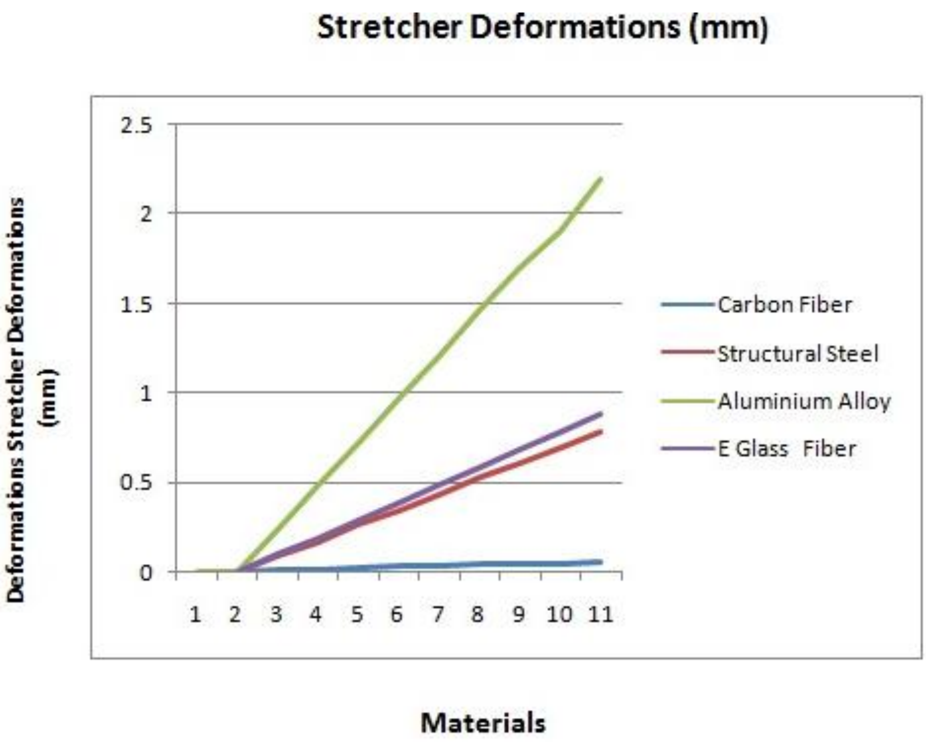


**Fig. 6.2 Materials deformation comparison charts**

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## VII. Conclusion

Patient feels more comfortable and safe on this stretcher than traditional stretchers., it can be used in the army and emergency department.

To conclude, the paper provided a detailed discussion of the mechanism design concept of the bed cum stretcher. The application of this methodology has been related to a re-developing a hospital bed for laying and transporting a bedridden patient to improve the life quality for these patients.

We achieved our goals by the use of engineering tools such as CADD/Analysis software's and knowledge of subjects such as Design of Machine Elements, Strength of Materials and Engineering Mechanics.

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