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DESIGN AND DEVELOPMENT OF TWO IN ONE FOLDABLE STRETCHER CUM WHEEL CHAIR

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Abstract - *In this project the stretcher and wheel chair 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. In ICU there is a problem of shifting the severely injured or fractured patients from stretcher to wheel chair those problems can be reduced by using this product. It is used to take ECG & SCAN report for the patients without changing from stretcher to wheelchair. This model consists of three rectangular couches which are joined together. These joints are not a permanent joint so that it can be adjustable to any angles and also assemble or dismantle of this product will be easy. These plates are joined by bolted joints, so that all the plates can be foldable to stretcher or to wheel chair. Four wheels are fitted in the base. The dimensions used for this project is developed for Indian standards. All the dimensions are taken from "Anthropometric and strength data of Indian agricultural workers for farm equipment design" published by central institute of agricultural engineering, Bhopal. All the parts used in this project are made up of stainless steel 202 for the Product development. The telescopic rods are used to adjust the required length and angle the holes provided in the telescopic pipe are used to fold the stretcher into different angle. The product cost is Rs 14500 which is 40% less than the conventional products.*

Key Words: Mobility, Couches, dismantle, Anthropometric, Telescopic rod.

INTRODUCTION

Stretchers have been used since olden days, on battlefield and in urgent situation, where wheel vehicles are delayed by uneven land. In their simplest form, they generally consisted of a canvass with long edges sewn to themselves to form pockets through with wooden poles could be slid. This form was common with militaries right through the middle of the 20th century, and in tragedy situations, where rapid triaging and movement of patients based on severity of injuries is critical, they are still used by emergency response providers.

The stretchers used in emergency vehicles have wheels that make shipping over highway easier, and have a padlock inside on it to sheltered the injured during transportation.

"Normalized" stretchers, or folding stretchers, are the simplest type. They are made of two poles and two transversal hinged bars with a cloth stretched between the poles and four feet. The bars can be folded for storage. They are now rarely used by modern emergency services, but are still widely used by organizations for which the storage space is an important factor, e.g. first aid associations, or French companies (a stretcher is mandatory). These stretchers are often used as beds.

Calamity stretchers are planned for simple storage space and transportation. They consist of a tubular aluminum arrangement with a washable fabric. They cannot be fold up, but can be piled up.

As normalized or disaster stretcher have no wheels, they are usually carried by three or four people. When they must be carried by only two people, they tie straps to the poles, so the weight is supported by the shoulders and not by the hands.

The stretcher can also be used as a wheel chair for carrying handicapped persons. For this top rectangular plate has to be lifted up and by removing the rod which is fixed with the middle plate. Now the rod is fixed at the required place, hence the plate is in vertical position. The bottom rectangular plates is also moved downwards by removing the rod and fixed at the required place which is comfortable for the patient.

The expandable rod fixed at the top rectangular plate will be in vertical position. Now that rod has to be moved downwards so that wheels touch the ground. This can be achieved by removing the screw which is fixed for the stretcher condition and it has to be reseated to the new position for the wheel chair. The expandable rods fixed at the middle plate can also be reseated to new position in order to change the height of the wheel chair. Two rods are fixed at the top the rectangular plate for keeping the hand in the wheel chair so that the patient arms can be freed. A plate is also fixed at the bottom of the bottom rectangular plate for keeping the legs of the patient.

2. MATERIALS AND METHODS

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.

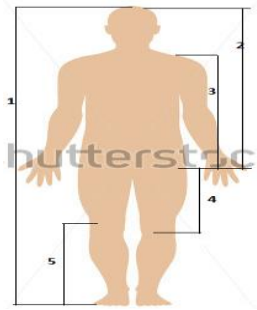


Fig.2.1 Anthropometric parameters

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

State	Sample Size For (No. Of People)	Total Height (Mean in mm)	Sitting Height (Mean in mm)	Acromial height (Mean in mm)
Tamil Nadu	1000	1629	781	561
Gujarat	733	1632	809	557
Pune	1249	1624	822	555
Punjab	490	1698	852	587
West Bengal	947	1627	842	561

Table 2.2 Knee length and Height

State	Sample Size For (No. Of People)	Knee length (Mean in mm)	Knee height (Mean in mm)
Tamil Nadu	1000	540	507
Gujarat	733	531	505
Pune	1249	536	507
Punjab	490	580	566
West Bengal	947	539	480

The data's from the above mentioned tables are taken from "**ANTHROPOMETRIC HUMAN DATA BOOK"**. From these data the following dimensions have been taken for the design. Some of the states were only considered for the dimensions, it is well enough for all individuals.

Overall length of the stretcher -1850 mm
Height of wheel chair - 650 mm
Length of the acromial section - 550 mm
Length of the sitting section - 600 mm
Length of the knee section - 600 mm
Length of the footrest - 170 mm
Width of the product - 580 mm
Weight of the unit - 42 kg

2.1 MATERIAL USED FOR DESIGN

Stainless steels are additionally ordered by their crystalline structure: Austenitic, or 200 and 300 arrangement, stainless steels have an austenitic crystalline structure, which is a face-focused cubic precious stone structure. Austenite steels make up more than 70% of aggregate stainless steel creation. They contain a most extreme of 0.15% carbon, at least 16% chromium and adequate nickel and additionally manganese to hold an austenitic structure at all temperatures from the cryogenic area to the dissolving purpose of the compound. 200 Series - Austenitic chromium-nickel-manganese compounds. Sort 201 is solidified through cool working; Type 202 is a universally useful stainless steel. Diminishing nickel content and expanding manganese brings about frail consumption resistance

2.2 CONCEPT DEVELOPEMENT

The Fig.2.2 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. 2.2: Concept design 1

The problem was revealed during the simulation of the conceptual design using the analysis software. The simulated design which reveals the consequence of the problem is shown in the Fig.2.3

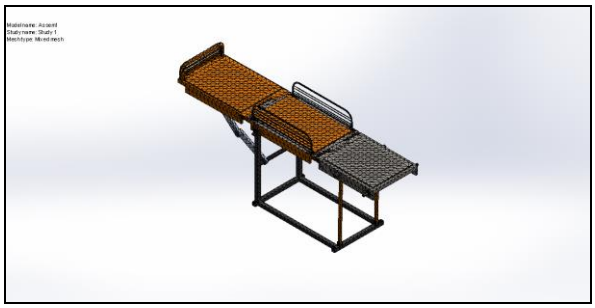


Fig. 2.3: Simulated conceptual design

To overcome from the unbalance problem the second concept was developed is shown in Fig.2.4

Fig. 2.4: Conceptual design 2

In this concept the unbalanced problem was recovered by developing the square stainless steel pipe in the middle plate.

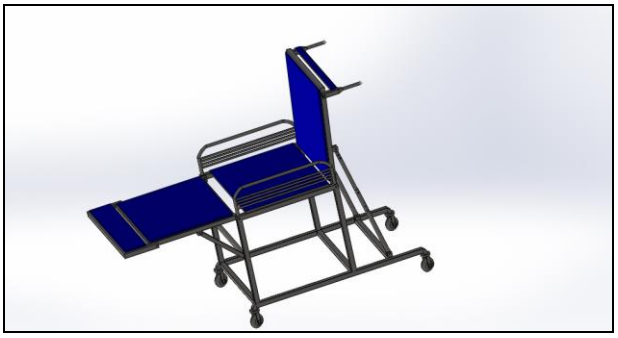
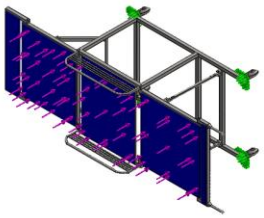


Fig. 2.5: Foldable view

Fig. 2.6: Foldable view of wheelchair

2.3 SIMULATION ANALYSIS



2.3.1 Mesh information

Table 2.3: Mesh information

Mesh type	Solid Mesh
Mesher Used:	Standard mesh
Automatic Transition:	Off
Include Mesh Auto Loops:	Off
Jacobian points	4 Points
Element Size	79.3754 mm
Tolerance	3.96877 mm
Mesh Quality	High
Re mesh failed parts with incompatible mesh	On

Table 2.4: Mesh information details

Total Nodes	4137
Total Elements	2047
Maximum Aspect Ratio	45.784
% of elements with Aspect Ratio < 3	65.6
% of elements with Aspect Ratio > 10	2.49
% of distorted elements(Jacobian)	0.0977
Time to complete mesh(hh;mm;ss):	00:01:41

3. RESULTS AND DISCUSSION

For the development of the product we have used stainless steel 202.The fabrication of the equipment includes the assembly and individual fabrication of the parts used in it. The parts used are found to be Base, Frame section, Supporting Bars, Telescopic pipes, Linkages, Plates ,Handles, Railings, Wheels and additional parts such as IV stand and Mattresses.

The Individual fabricated sections are explained below along with their parameters such as dimensions. Material types and its structural images are explained below.

The Foldable top frame shows the adjustable movement of the Acromial section of the equipment


Fig. 3.1: Base & Foldable top frame

The Outer frame section includes the foot resting section and the Acromial section, the assembly of these includes the attachment of the two sections over to the upper frame. The upper frame refers to the secondary portion of the Acromial section where the supporting bars are extended from the lowest base section of the equipment.

Fig. 3.2: Assembled view of outer frame and base

In the stretcher position the frames which withhold the acromial and foot rest sections in a diagonal position is simply shown. This evidently provides sufficient amount of support for resting of the patient at a more comfortable position.

Fig. 3.3: Overall view of stretcher position with ss sheets

This view is simply to show that the acromial section is adjustable from an angle of (0-90) Deg front the diagonal pace to the upwards section. Considering the foot rest section which is adjusted towards the downward direction with the same perpendicular movement.

In the Fig. an adjustable knob is provided to the sides of the base section, this is found to adjust the positioning and height of IV stand.

Fig. 3.4: Top plate foldable with SS sheets

In the above Fig.3.4 the wheel chair position is provided viewing the movement of the acromial section to the perpendicular position and the corresponding foot res section to the downwards section, the plate which is found at the foot rest section is extendable. The knobs which are provided on to the bottom section are simply removable and thus make the equipment be viewed as a conventional wheel chair.

As the bottom knobs are removable the top section knobs are simply adjusted to the proper diagonal position, providing the required position for the movement of the equipment.

The Fig.3.5 shows the full view of the equipment in stretcher position, the orientation of the equipment is found to be same as that of the Fig. providing SS sheets but, the comfort providing factor of mattress are attached and displayed.

The mattresses on the other hand provides more comfort for the patients resting position and are found to be easily removable there by providing the equipment with two forms.

Fig. 3.5: Overall view of wheel chair position with ss sheets

Fig. 3.6: Full view in stretcher position

The Linkage bars connecting the acromial and base section are found to be made of stainless steel, it is provided with small linking factors such as nuts and bolts which are easily removable and reattach able. On adjusting the linkage bar the entire movement of the acromial section is controlled, thereby playing a vital role in converting the equipment from stretcher position to wheel chair section.

The adjustment is not subjected to particular horizontal or vertical movements, to provide a more comforting lean back position the acromial section could be adjusted throughout the angles of (0-90) Deg and fixed. The foot resting section is also provided with linkage bars comprising of similar functioning.

Fig. 3.7: Equipment with adjustable acromial position

The linkage bar provided at the foot resting section can be completely folded within the base section. Hence the linkage bars attached to the base bar section at the acromial section and the linkage bar at the foot resting section is found to play an efficient role in converting the stretcher position to wheel chair position and vice versa thereby fulfilling the purpose and requirement of the equipment.

Fig.3.8: Equipment with wheel chair position

3.1 IMPROVISED DESIGN

The following further ideas that are suggested in optimizing the design is through usage of automation procedures in adjustment with help of minor level of hydraulic and pneumatic systems. The improvised design of the product using double acting cylinder is shown Fig.3.9.

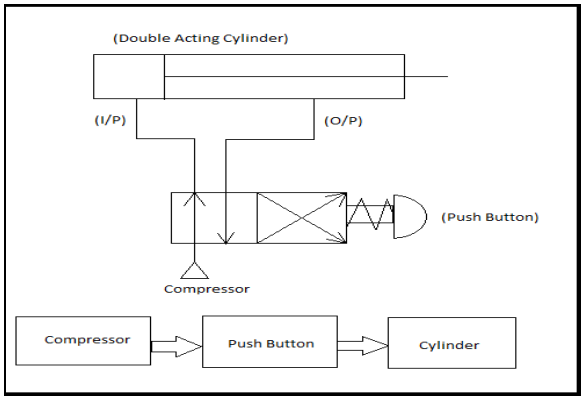


Fig. 3.9: Pneumatic circuit for improvised design

The Fig.3.9 shows the pneumatic circuit for the improvised design of two in one foldable stretcher cum wheel chair. In this concept instead of folding the equipment manually the double acting cylinder and compressor is used for easy folding of the equipment using push button. When the push button is pressed the pneumatic air from the compressor expand the acromial section to the required

position after that it will come to the retracted position again by pressing the push button.

The design of improvised concept using solid works software is shown below. The stages of the equipment using double acting cylinder are shown in fig. The double acting cylinder is mounted in the base of the design which is in the retracted position is shown in Fig.3.10.

The Fig 3.11 shows the expandable position of the wheel chair using double acting cylinder. When the push button is pressed the pneumatic air lifts the acromial section to the expandable position to the wheel chair.

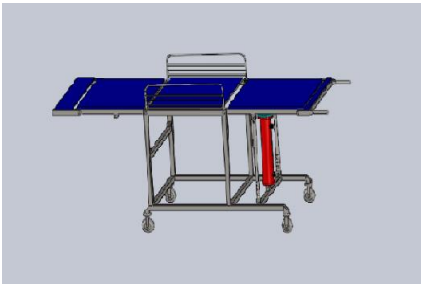


Fig. 3.10: Improvised concept design in stretcher position

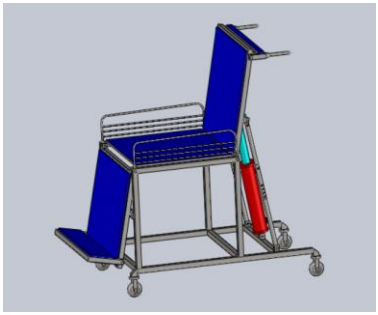


Fig. 3.11: Expandable position of wheel chair

4. CONCLUSION

The Conventional form of a stretcher and a wheel chair have a less form of cost efficiency, the combined form of both these equipments serves a greater purpose of providing high cost efficiency and high comfort to the patient.

The simple form of an utila folding stretcher which is used in an ambulance vehicle is recommended to be replaced with the optimized form of the equipment, as in special circumstances of serious hazards to health of the patient, the optimized equipment may serve the multiple purposes of providing comfort, requiring less time for transfer of patient from a stretcher to a wheel chair, adjustment of present position of the patient to even more comfortable state based on the surrounding environment.

The final form of concluding the optimized design is by stating the facts of using it in hospitals at a larger amount and by extending the usage of the design enormously through further optimization by implementing the same specifications that is available in the stretcher and wheelchair which will result in reducing the mobility problem of the patient and provide the human comfort.

The proposed idea of our improvised design by implementing pneumatics for easy folding of the acromial section which is extended by the compressed air from the compressor. For that the compressor is fitted with double acting cylinder through push button.

Push button is the easy technique for the sick and old patient to fold the acromial section easily without more effort. It does not require manual effort to folding the equipment from stretcher to wheelchair. The old patients can adjust the angle easily by pushing the button. It is concluded that the optimized design will provide all the specifications than the conventional product by limiting its cost for the social benefit.

REFERENCES

1. "Anthropometric and strength data of Indian agricultural workers for farm equipment design" published by central institute of agricultural engineering, Bhopal. Pg No. 3.1-3.59.

2. ASM committee (1991) 'Heat Treating, ASM International', Materials Park, Ohio.

3. ASM committee (2003) 'Corrosion: Fundamentals, testing and protection', 9th ed., ASM International, Materials Park, Ohio.

4. ASM-committee (1980) 'Properties and selection: Stainless Steels, Tool Materials and Special Purpose Metals', ASM International, Materials Park, OH.

5. Chia Hooi, T. (2002) 'Sensitisation of Austenitic Stainless Steels', University of Cambridge.

6. Fusina, F. J. and David, (2000): Ten factors for specifying hinges, magazine of "American Machine Design" April 20, 2000, pp 67- 70.

7. Katoch S. (2005) 'Introduction of Modern Stretcher in Armed Forces for Improving Casualty Evacuation', Medical Journal Armed Forces India: Vol. 61, no 2 pp157-162.

8. Lo Nigro, R. , Malandrino, G. And FragalÈ, I.L.(2001)' Chemistry of Materials 13' 4402–4404., DOI: 10.1021/cm011232f.

9. Mangonon, P.L. (1998) 'The Principles of Material Selection for Engineering Design 'Prentice Hall.

10. Robert Baboian (2005) 'Corrosion Tests and Standards: Application and Interpretation', 2nd ed., ASTM International.

11. Streicher, M.A. and F.B. Pickering, F.B. (1999) 'Stainless Steel: Past, Present and Future', in: 'The Metallurgical Evolution of Stainless Steel', pp. 442–475. American Society for Metals (ASM) and the Metals Society, Ohio, London.

12. Totten, G.E. (2006) 'Steel Heat Treatment: Metallurgy and Technology', 2nd ed., Taylor & Francis Group.

13. Winston Revie, R. and Uhlig, H.H. (2008) 'Corrosion & corrosion control: An Introduction to Corrosion Science and Engineering' 4th ed., John Wiley & Sons, Inc., New Jersey.