NOVATEUR PUBLICATIONS
International Journal of Research Publications in Engineering and Technology [IJRPET]
ISSN: 2454-7875
VOLUME 3, ISSUE 4, Apr.-2017

DESIGN AND FABRICATION OF WHEELCHAIR CONVERTIBLE STRETCHER

KOLGIRI S. G.
Department of Mechanical Engineering, S. B. Patil College of Engineering, Indapur

BANDGAR ANIL BHAGWAN
Department of Mechanical Engineering, S. B. Patil College of Engineering, Indapur

BHALERAO HRISHIKESH RAJENDRA
Department of Mechanical Engineering, S. B. Patil College of Engineering, Indapur

BHOSALE AVINASH ANIL
Department of Mechanical Engineering, S. B. Patil College of Engineering, Indapur

DOIPHODE SUNIL DINESH
Department of Mechanical Engineering, S. B. Patil College of Engineering, Indapur

ABSTRACT:

In India the number of disabled peoples is increasing every year because of some reasons. Mobility issues arise for patients for transportation especially in indoor and outdoor area. Transferring the patients from wheelchair to stretcher is great issue for nurse and care taker. By considering and analyzing these issues about the handling and transferring of patient there is need of designing new equipment which can solve the problem related to medical field. There is a need for a wheelchair cum stretcher to facilitate the disabled patient's mobility. It has been observed that every year the numbers of disabled individuals are increasing by different kinds of accidents. Transferring the patients from wheelchair to the stretcher or to the bed is a difficult task in hospitals. The presently used wheelchair and stretcher design is not meeting the user's need. Considering the issues like safety, hygienic, cleaning and functionality the concepts were generated.

1. INTRODUCTION:

Chair and wheel were invented earlier by men. A wheelchair is mobility device for disabled person. To rest on bed patient needs to transfer from wheelchair. This task done by with the help of care taker or nurse. During transferring of patient lots of safety precaution have to taken. There are number of handling and moving devices available in the market. But these devices have some limitations and drawbacks.

Hence there is a need of developing new device which can perform task like handling with care and transferring with safety of person.

1.1 WHEELCHAIR INVENTION:

The first combination of wheel to furniture was in Greece in 530 BC. The first dedicated wheelchair was made for King Phillip II for Spain in 1595. It was not a self -propelled one, a servant's assistance is to be needed for the movement.

2. PROBLEM IDENTIFICATION:

Paralysed patients are dependent on their caretaker. The transfer of these immobilized patients from bed to a wheel chair is a difficult process and in most of the instances, two or more caretakers are required. However, it is estimated that 1 in 3 caretakers will have back injuries. Most injuries occur because the patient is relatively heavy to lift and access to them is difficult when attempting to place the patient onto another seat. This poses a need for improving the available support devices to ease the effort of available caregivers.

3. LITURATURE REVIEW:

Journal papers and patents explored here are related directly or indirectly to the proposed area of work that is design and development of a Wheelchair Cum Stretcher. These papers are to support and enlighten the whole process of design in the specific area.

3.1 WHEELCHAIR AND STRETCHER:

A wheelchair is chair with wheels, designed to help the disabled patients. Stretchers are mobility devices used to transport the patients from one place to other. These both medical mobility aids are used in hospitals for helping the patients. Stretchers are simple in construction and the patient needs the support of caretaker to transport from one place to other. Whereas wheelchair is designed in such a way that either patient

can control the device manually or with the help of someone's. The device consists of handle with cushion in hand rest and seating area. The direction movement is a critical part when it comes to emergency situation. Proper selection of caster wheels facilitates to overcome the situations.

3.2 SELECTION OF WHEELCHAIR:

According to Mr. Peter Axelson, Mr. Jean Minkel, and Mr. Denise Chesney, selection of an appropriate wheelchair will lead a comfortable living to the user. It is highly recommended that a novice can consult with the rehabilitation specialists in order to select the appropriate wheelchair.

4. DESIGN METHODOLOGY:

Design methodology helps to find out the best solution for each design situations. A systematic approach and procedure is to be followed to achieve the suitable solution. It involves the following steps.

- Journals and patent research
- Market study and user (GEMBA) survey
- Bench marking
- Concept generation and selection
- Final concept refinement.

The basic design of the device has evolved from the concept of a convertible wheelchair. Thus the initial sketches for the project design included only the skeletal structure of a wheelchair.

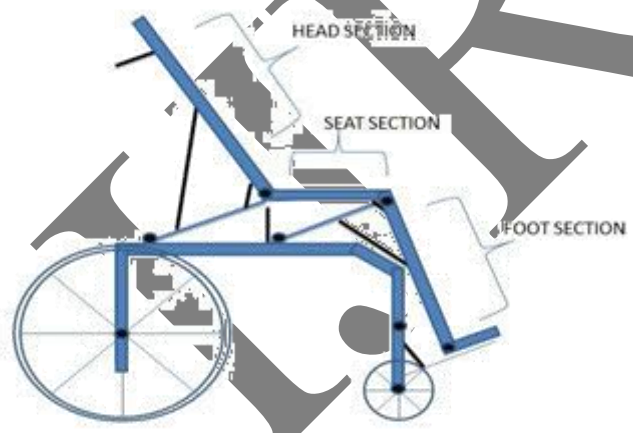


Fig.3.1: Preliminary sketch of the device in wheelchair position.

Then the convertible feature was included to the design at a conceptual level and tremendous amount of brainstorming was done. Though hydraulic actuators are the best in terms of load handling and stability, the relatively high cost and the bulkiness of the units hindered their choice for our purpose. Electric motors have good load carrying capacity, speed control characteristics, precision etc. But their implementation necessitates the use of Gears, belts or pulleys making the over unit becomes bulky and heavy. So, the electric motor & lead screw were selected.

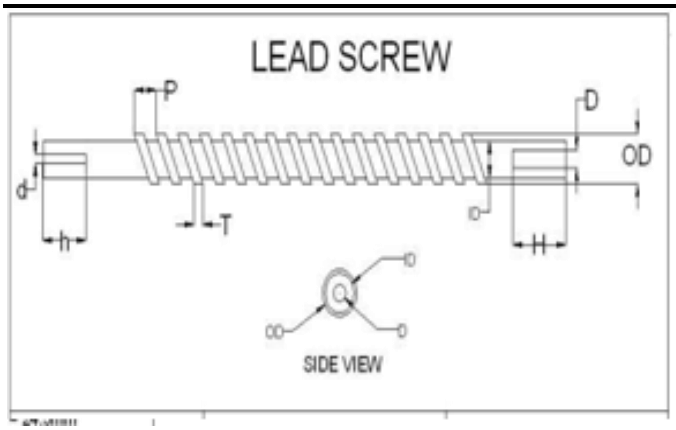
5. FABRICATION:

The entire fabrication of the device has been done around a basic framework. The framework has been made by welding together mild steel pipes of square and rectangular cross sections, using Metal Arc Welding and Arc Welding Electrodes (3.15mm x 350, 100-140 AMPS, DC(+/-)/AC OCV 50(min)). The relative low cost, availability and properties like decent tensile, compressive strengths and weld-ability favored the choice of mild steel over other metals. The frame has three main sections, namely the head, seat and foot sections. The framework along with the support surfaces bears the patients weight. The seat section forms the basis as far as the assembling is concerned. The head section and foot section are hinged to the seat section. The movable support segments are anchored in the seat and head sections. The movable segments are then given a cushion each. Also the head section is given a pillow type cushion. Arm rests are attached on either sides of seat section such that they can be swung sideways with the seat edge as the pivot. The leg of the fabricated prototype is integral to the seat section. The angular orientations of the legs are so as to provide the best balance. Each leg terminates into a flange on which a wheel is attached. Rear wheels of 800mm diameter and front wheels of 200mm diameter have been used here. The wheels provide the mobility to the device both in the stretcher and chair position. Each wheel has the ability to facilitate steering and front wheels could facilitate 360 degree rotation of the device.

6. CALCULATION FOR LEAD SCREW:

Parameters taken from standard lead screw (Approximate only):

Pitch of the lead screw P = 12.3 mm
Speed of Lead Screw, N = 30 rpm
Outer diameter = 19 mm
Inner diameter = 15 mm
Thickness = 4.7 mm
The linear velocity of the lead screw
= N x p
= 30 x12.3
= 369 mm/min
= 6.15 mm/s
The angular velocity of the lead screw
= 2πN/60
= 2π (30)/60
= 3.14 radian/s



Design and Fabrication of Stretcher Cum Wheel Chair
Power of the lead screw
P = 3.6 W
Torque of the lead screw
= P x 60/2πN
= 3.6 x 60/2πN
= 0.57 Nm
Maximum withstanding capacity
y= torque/radius of lead screw
= 0.57 /9.5 x 10-3
Maximum withstanding capacity = 60 N
Lead screw Formulas:

The torque required driving load W using lead screw with pitch (p) and efficiency (η) has the following components:

TTotal = TFriction + TAcceleration

Calculation for Frictional Torque Friction torque can also be an assist in engineering. Bolts and nuts, or screws are often designed to be fastened with a given amount of torque, where the friction is adequate during use or operation for the bolt, nut or screw to
Remain safely fastened.
Frictional force, F = μsW
Where Coefficient of static friction,
μs = 0.15
Let us assume the torque required to accelerate the sliding parts as 200 pounds
1 pounds = 0.453 kg
200 pounds = (0.453 x 200)= 90.6 kg
1kg = 9.81 N
90.6 kg = (9.81 x 90.6)= 888.76 N
W is the weight of the load.
Frictional force ,
F = 0.15 x 888.76=133.314N
Frictional Torque , Tfriction
= (F x p) / (2 x π x η)
Where:
F = frictional force in newton
p = pitch in rev/ mm = 1/12
η = lead screw efficiency, 65%
= (133.34 x 12.3) / (2 x 3.14 x 0.65)
= 32.96N-mm

7. CONCLUSIONS:

This wheelchair cum stretcher concept has lot of advantages. The motor powered drive can shift user to the bed and back again. Due to 360 degrees movement of wheelchair seat the user can transfer from any side. The cushion on the head section, seat and leg section ensures comfort ride for the user. This wheelchair with some further improvement can provide the wheelchair patient the complete comfortable ride.

Our study was to develop a concept of wheelchair convertible stretcher with saving the space and prevent exertion of patient as well as by making sure that the patient does not get hurt.

The mechanism and safety of patient were our main priorities while designing the conceptual model of wheelchair convertible stretcher.

REFERENCES

1) International Journal of Research in Mechanical Engineering Volume 1, Issue 2, October-December, 2013, pp 01-10, IASTER 2013 www.iaster.com, ISSN Online:2347-5188 Print: 2347-8772
2) Sreerag C S1, Gopinath C2, Manas Ranjan Mishra31-M.Sc. [Engg] Student, 2-Professor, 3-Asst. Professor, Department of DesignM. S. Ramaiah School of Advanced Studies, Bangalore 560 058
3) *International Journal of Mechanical Engineering and Technology (IJMET) Volume 7,Issue* 2, March-April 2016, pp. 261265, Article ID: IJMET0702027
4) *International Journal of Innovative Research Science, Engineering and Technology* (An ISO 3297: 2007 Credited Organization)Vol. 4, Issue 10, October 2015
5) IJIRST *International Journal for Innovative Research in Science Technology* Volume 2 | Issue 11 | April 2016 ISSN (online): 2349-6010
6) IJRET: *International Journal of Research in Engineering and Technology* eISSN: 2319-1163 | pISSN: 2321-7308 [6]
7) IJIRST –International *Journal for Innovative Research in Science & Technology*| Volume 2 | Issue 11 | April 2016 ISSN (online): 2349-6010
8) Peter Axelson., *A guide to wheelchair selection, paralyzed veterans of America, Library of Congress Cataloguing-in-publication data*, Washington 1994.
9) James J. Kauzlarich., Wheelchair caster shimmy II: *Damping, Journal of Rehabilitation Research and Development, Volume*. 37, No. 3, pp 305- 313, May/June 2000.

10) Dr. Rory A. Cooper., *Wheelchair selection and conguration,* ISBN 1-888799 1820 8, March 1998
11) Mr. Daniel E. Jolly*., Wheelchair transfer, The Ohio state university college,Columbus, ohio*, retrieved on 24th Sept. 2010
12) Debkumar Chakrabarti, *Indian Anthropometric Dimensions for Ergonomic Design Practice, National Institute of Design,* Ahmedabad, 1999
13) *Unknown, wheelchair, stretcher,* hydraulic lifting, www.googleimages.com, retrieved on 8th . 2010
14) Shaker W. G., *Convertible bed and wheelchair, US Patent Numbe*r: 4,717,169,1988.
15) Weiss N., *Wheelchair and bed with movable body supporting portions*, US 3 Patent Number: 5,659, 910, 1997.
16) Axelson P., A guide to wheelchair selection, paralyzed veterans of America, Library of Congress Cataloguing in-publication data, Washington 1994.
17) Cooper R., *Wheelchair selection and conjuration,* ISBN 1-888799188, March1998.
18) Chakrabarti D., Indian *Anthropometric Dimensions for Ergonomic Design Practice, National Institute of Design*, Ahmedabad,1999