WHEEL CHAIR CUM STRETCHER FOR A DISABLED PERSON

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Abstract -

In India the number of disabled peoples is increasing every year because of some reasons. Mobility issues arise for patients for transportation especially inindoor 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 needof designing new equipment which can solve the problem relatedtomedicalfield.Thereisaneedforawheelchair 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 difficulttaskinhospitals.Thepresentlyusedwheelchair and stretcher design is not meeting the user's need. Consideringtheissueslikesafety,hygienic,cleaningand functionality the concepts weregenerated.

Keywords: **Mobility Aid, Lead screw, Wheelchair cum Stretcher.**

I.INTRODUCTION

A wheelchair is a wheeled by mobility device designedespeciallyfordisabledindividuals.Wheelchair isadevicewhichcanempowerandenableapersonwith a disability to live a normal and independent life. Over the years this device has evolved rapidly from manually to the powered automated wheelchairs. Wheelchairs are usedbythatpeopleforwhomwalkingisimpossibledue to various problems physiological or physical. Huge amount of people have congenital disabilities, so the percentage of the victim of accidents and that is the inevitable part of their life. Mobility scooters for more severedisabilityorlongerjourneysareused.Mobilizing or shifting of patient from wheelchair to stretcher or vice-versacausesdiscomfort.Butstillthesewheelchairs have not been able to satisfy the needs of the disabled people .With the help of this wheelchair convertible to stretcher a patient can be seated on wheelchair onwhich he can also be operated by converting it to stretcheralso it will be convenient for hospital staff to move apatient. Understanding various issues regarding mobility equipment, the better design will be an asset formedical field and helping hand for disabledindividual.

A . WHEELCHAIR INVENTION

The first combination of wheel to furniture was in Greece in 530 BC. The first dedicated wheelchair was madeforKingPhillipIIforSpainin1595.Itwasnotaself-propelled one, a servant's assistance is to be needed for the movement.

B . PROBLEM IDENTIFICATION

Paralyzed patients are dependent on their caretaker. Thetransferoftheseimmobilizedpatientsfrombedtoa 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 patientis

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 availablesupport
devices to ease the effort of available caregivers.

II.LITERATURE REVIEW

Journal papers and patents explored here are related directly or indirectly to the proposed area of work that isdesign and development of a wheel chair cum Stretcher. These papers are to support and enlighten the whole process of design in the specific area. A wheel chair ischair with wheels , designed to help the disabled individuals. Stretchers are mobility devices used to transport the patients from one place to other. These both medical mobility aids are used in hospitals and clinics for helping the patients. Stretchers are simple in constructionand the patient needs the support of an assistant to transport from one place to other. Whereas wheelchair isdesigned in such a way that either patient can control the device manually or with the help of someone's assistance. According to Mr. Peter Axel son, Mr. Jean Minkel , and Mr. Denise Chesney, [1] selection of an appropriate wheelchair will lead a comfortable living to the user. Performance, safety and dimensions are the three categories which have to be considered while selecting a manual or powered wheelchair. An excellent approach to the wheelchair selection is to set priorities based on user's mobility and seating needs . It is highly recommended that an patient can consult with there habilitation specialists in order to select the appropriate wheel chair.

James J. Kauzlarich , [2] says self excited vibration is one of the most interesting topics in the field of vibrations and is the science prevailing caster wheel shimmy. Self excited vibration is characterized by vibration that is produced by the motion of the system like wheel chair speed. It can be observed that in most of the cheapest wheelchairs , the design of the casters makes use of a slidingfrictionaldamperinthespindlesupporttoimprove the shimmy characteristics. Understanding the theory of damping for the casters show how shimmy prevention works in ultra-light and powered wheel chairs.

Mr. Richard Simpson,[3]says almost 10% of all individual who are legally blind also have a mobility impairment and majority of these individuals are dependent on others mobility. A smart power assistance module (SPAM) for manual wheelchair is being developed to provide independent mobility for this population. The power assist wheelchair that provides for obstacle detection and avoidance for those with visual impairments.Thecontrolofthewheelchairwillbecarried out by the microprocessor and also allow the SPAM to provide a smoother and nuancedcontrol.

According to Mr. Rory A. Cooper, [4] rehabilitation is a humanistic profession. Measurement of the user and wheelchair are critical to achieving maximum functional mobility. He says Biomechanics and ergonomics provide the information necessary to understand many aspects of eelchair use. These factors affect seating comfort and posture, propulsion, efficiency and pain. Proper seating is an important aspect of wheelchair selection, and wheelchair cushions provide pressure relief and some postural support.

Dr. Daniel E. Jolly, [5] says proper preparation should be taken before transferring the patient from wheelchairto bed or vice versa. Use of sliding boards will be helpfulfor paraplegic patients. The best sliding board is made ofhard wood,smooth,taperedonends.Supportoftwoassistance, support straps, belts etc will facilitate easy transfer. The patient should not be slide into chair, lift from the wheelchair and transfer is the optional and safety method for patienttransfer.

III . 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 patentresearch
- Market study and user(GEMBA)survey
- Benchmarking
- Concept generation andselection
- Final conceptrefinement.

The basic design of the device has evolved from the concept of a convertible wheelchair. Thus the initial sketchesfortheprojectdesignincludedonlytheskeletal structure of awheelchair.

DESIGN AND SPECIFICATIONS

Design is done by using creo 2.0 .

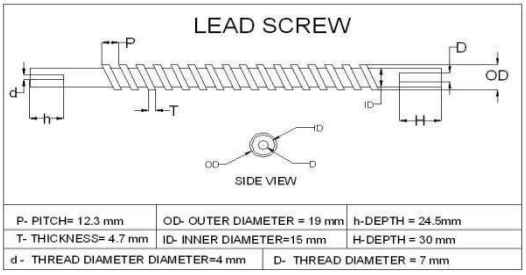


Fig. 1: Specification of lead screw

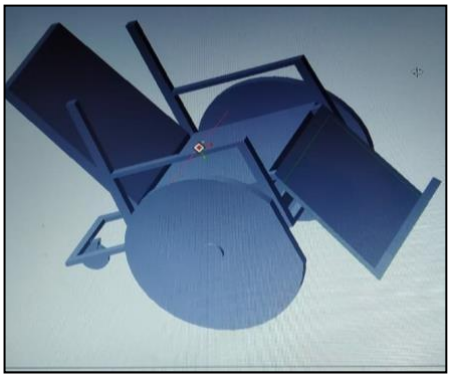


Fig. 2: wheel chair position

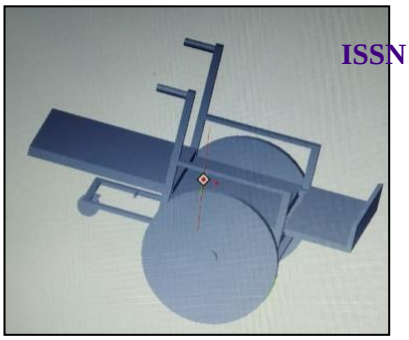


Fig. 3: stretcher position

IV. DESCRIPTION OFEQUIPMENT

A. MAIN BASE STRUCTURE

The base is basically a platform or it can also be called as a support for the entire assembly. The base is constructed withthehelpofchannelsmadeofmetalssuchasaluminum, stainless steel, mild steel etc. In the design of this wheelchair,thebaseconsistsofastructurecalledasaframe made of mildsteel.

A sheet of metal is fixed on the top surface of the frame which acts as a platform for the person to sit. The sheet is basically welded to the frame with the help of welding method. The type of welding employed in this design is arc welding. When the sheet metal is combined with frame it forms a rigid structure so called as base.

Fig.4: Main base structure

B. LEAD SCREW

A lead screw , also known as a power screw or translation screw, is a screw used as a linkage in a machine, to translate turning motion into linear motion. Because ofthe largeareaofslidingcontactbetweentheirmaleandfemale members, screw threads have larger frictional energy losses compared to other linkages. They are not typically used to carry high power, but more for intermittent use in low power actuator and positioner mechanisms. Common applicationsarelinearactuators,machineslides(suchasin machine), vises, presses, and jacks. Lead screws are manufactured in the same way as other thread forms (they may be rolled, cut, or ground). A lead screw is sometimes usedwithasplitnutwhichallowsthenuttobedisengaged from the threads and moved axially, independently of the screw's rotation, when needed (such as in single-point threading on a manuallathe).

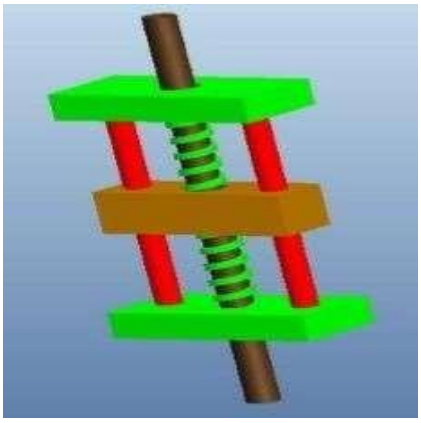


Fig.5: Lead Screw

Power screws are classified by the geometry of their thread. V-threads are less suitable for lead screws than others such as Acme because they have more friction between the threads. Their threads are designed toinduce this friction to keep the fastener from loosening. Lead screws, on the other hand, are designed to minimize friction. Therefore, in most commercial and industrial use, V-threads are avoided for lead screwuse.

C. WHEELS

A wheel is a circular component that is intended to rotate on an axle. The wheel is one of the main components of thewheelandaxlewhichisoneofthesixsimplemachines. Wheels are also used for other purposes, such as a ship's wheel, steering wheel andflywheel.

Wheels, in conjunction with axles allow heavy objects tobemovedeasilyfacilitatingmovementortransportation while supporting a load, or performing laboring machines. Common examples are found in transport applications. A wheel greatly reduces friction by facilitating motion by rolling together with the use of axles. In order for wheels to rotate, a moment needs to be applied to the wheel about its axis, either by way of gravity, or by application of another externalforce.

V. WORKINGPRINCIPLE

The working of wheelchair convertible stretcher is so simple that the patient feels comfortable during the transformation from wheelchair into stretcher and vice versa.

A. In operation when the wheelchair is to be converted into stretcher the operation starts with rotating the ratchet lever. The lever is connected to the backrest with lead screw.

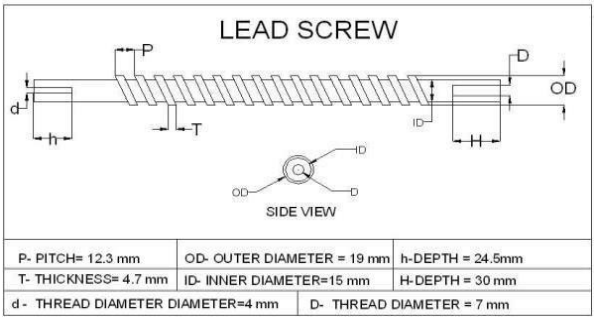
B. After rotating the lever, the link in the seat back lead screw mechanism un-meshes and due to the weight on the backrest it will gradually lower down. This will convert the wheelchair into thestretcher.

C. Now if we have to convert the stretcher into wheelchair, again rotating the lever of the seat back lead screw mechanism. By applying light load on the back rest, the backrest will also rise up till its original position.

CALCULATION FOR LEADSCREW

Parameters are taken from standard lead screw (Approximate only):

Pitch of the lead screw P = 12.3 mm
Speed of Lead Screw, N = 30 rpm
Outerdiameter =19mm
Innerdiameter =15mm
Thickness =4.7mm



P- PITCH= 12.3 mm	OD- OUTER DIAMETER = 19 mm	h-DEPTH = 24.5mm
T- THICKNESS= 4.7 mm	ID- INNER DIAMETER=15 mm	H-DEPTH = 30 mm
d - THREAD DIAMETER DIAMETER=4 mm	D- THREAD DIAMETER = 7 mm	

Fig .6: Specification of Lead Screw

The linear velocity of the lead screw = N x p
= 30 x12.3
= 369 mm/min
= 6.15mm/s

The angular velocity of the lead screw =2πN/60
= 2π (30)/60= 3.14 radian/s

Power of theleadscrew P = 3.6W

Torque of theleadscrew = Px60/2πN
= 3.6 x 60/2πN
= 0.57 Nm

Maximum withstanding capacity = torque/radius of lead screw
= 0.57 /9.5 x 10^{-3}

Maximum withstanding capacity =60N

Lead screw Formulas:

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

$T_{Total} = T_{Friction} + T_{Acceleration}$

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 = μs W

Where Coefficient of static friction, μs=0.15

Let us assume the torque required to accelerate the sliding parts as 200 pounds

1pounds =0.453kg
200pounds = (0.453 x 200)= 90.6 kg
1kg = 9.81N
90.6 kg = (9.81 x 90.6) = 888.76N

W is the weight of the load.

Frictional force, F = 0.15 x 888.76 = 133.34N

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)
= 32.96 N-mm

VI. FABRICATIONDETAILS

a) Firstly manufacturing the frame as per ourdesign.

- Back rest: Back rest of wheelchair convertible stretcher is made up of square cross- section and flat mild steel plates are welded in it.
- Seat: The seat is made up of mild steel of cross-section and flat mild steel plates are welded in the frame. It is directly connected to the base of the wheelchair convertiblestretcher.
- Legsupport:Legsupportofwheelchairconvertible stretcherisalsomadeupofmildsteelsquarecross-section and flat mild steel plates are welded inthe

frame.

- ❖ Foot rest: The foot rest is made up of mild steel square cross-section by bending its edges and is welded at the bottom of the legrest.
- ❖ Lead screw mechanism: The Lead screw mechanism is rigidly attached to the seat and backrest by means of nuts and bolts. This mechanismhelpsinlockingofbackrestandlegrest at some specific angles.
- ❖ Fasteners: These are used to connect the linkages and to fix the seat back recliner mechanism rigidly which helps in the process of conversion of wheelchair into stretcher and viceversa.

b) After that manufacture the back attachment and leg attachment by usingpipe.

c) Connect that attachment at pivoting to theframe.

d) Connectinglinkisconnectedtolegattachmentand at the base nut is connected. Wheels are connected to the base of theframe.

The proposed model is shown in which Fig shows the front view of wheelchair mode , side view of stretcher mode

Fig.7: wheel chair model

Fig.8: stretcher model

Result and validation

The proposed stretcher cum wheelchairmodel has clearly shown that the mechanism used to perform reclining and lifting backrest is more efficient, economicalandeffective.Thestretchercumwheelchair eliminates the steps of transferring of patients from wheelchair to stretcher or viceversa.

In this model ratchet mechanism is used for lifting and reclining of backrest. But it can carry a load of 65 Kg. To carry more load lead screw mechanism can be replaced by motors. The proposed model does not required external power. This model consume less space as well as less maintenance.

VII. Advantages andapplications

The advantages, disadvantages, applications and future scope of this proposed model are:

Advantages

The advantages are as follows:

- ❖ Increases the comfort level of patient and patient handlingstaff.
- ❖ Prevent damages to patient while transferring from wheelchair tostretcher.
- ❖ Occupy lessspace.
- ❖ Easily converts from wheelchair to stretcher & vice versa.
- ❖ Emergency & serious patients who should not be moved or disturbed from their position can beshifted.
- ❖ Shifting of patient is reduced i.e. stretcher is not needed anymore.

Applications

The applications are as follows:

- ❖ Most useful inhospitals.
- ❖ Most useful in old agehomes.

VIII. Future Scope

The weight of the wheelchair may be reduced by selecting light weight materials for frames and body suchasaluminum.Thiswillhelpineasymovementand control of the wheelchair cum stretcher. Electrically operated wheelchair can also be used instead of mechanical wheelchairs, but cost of operation may be increased. The physiotherapic device may be fully automated instead of manually operated. This will furtherincreasethecostoftheequipmentaswellasthe running cost. Thus increasing the degree of automation and technology used increases thecost.

IX. CONCLUSIONS

The project was aimed at designing and manufacturing a wheelchair cum stretcher that can overcome theshort comings of a conventional wheelchair, with focus on cost effectiveness and utility.

The existing system has the limitationofshifting patientsfromwheelchairtostretcher.Thisproductwill be helpful for paralyzed patients,movementimpaired personals,aswellasforoldagepersons.Ourproductwilleli minatetheuseofseparatewheelchairand stretcher in the hospitals, so that we caneliminatethe step of shifting patients from bed or stretchertowheel chair and vice versa. The wheelchair willconsumelessspace and is manufactured at low cost.Suchequipment can induce self-reliability and satisfaction intheusers. We achieved our goals by the useofengineering tools such as CADD/Analysis software's and knowledge of subjects such as DesignofMachine Elements, Strength of Materials andEngineering Mechanics.

We gained a lot of practical knowledge regarding, planning, purchasing, assembling and machining while doing this project work. We feel that the project work is a good solution to bridge the gates between the institution and the industries. We are proud that we have completed the work with the limited time successfully.

ACKNOWLEDGEMENT

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