

Manufacturing of a Wheelchair Cum Stretcher for a Variety of Uses

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Abstract - In hospitals, airports, train stations, retail centers, etc., wheelchairs and stretchers are frequently utilized. Depending on the needs, this design is a modified wheelchair stretcher. According to the needs, this device can be utilized to transform a wheelchair into a stretcher. This can be manually accessed. When the levers are pulled, the chair becomes a stretcher. According to the patient's and the doctors' convenience, the stretchers can be removed from the main frame, making it simpler to carry and access the patient. With the help of the folding mechanism, it is simpler to store several stretchers in the shape of chairs in a comparably small amount of space. Every day, there are more patients in the world. Therefore, it is dangerous for patients to be transferred from a wheelchair to a stretcher, a bed to a wheelchair, or vice versa, in hospitals. A wheelchair cum stretcher is required to improve the mobility of impaired patients and to supply cutting-edge medical technology for usage in hospitals.

Key Words: Medical equipment, folding mechanism, stretcher, wheelchair, etc.

1. INTRODUCTION

A chair with wheels is a wheelchair. The device comes in many designs that allow for electric propulsion by motors or manual propulsion by the sitting occupant manually turning the rear wheels. The seat frequently has handles behind it so that someone else can push it. People who find it difficult or impossible to walk due to an illness, accident, or handicap use wheelchairs. A wheel bench is frequently used by people who have trouble standing and walking. The earliest human creations were the wheel and the chair[1]. A wheelchair is a wheeled mobility aid created specifically for people with disabilities. The machine can be moved manually by spinning the wheels by hand or automatically using a variety of systems[9]. People who find it difficult or impossible to walk owing to a physical or physiological condition, an injury, or a handicap use wheelchairs. Early wheelchairs were solely designed to facilitate a disabled person's movement from one location to another, but today's wheelchairs are seen as a means of both transportation and personal expression. The

number of disabled people in India has significantly increased in recent years[3]. Many people have congenital limitations, a small fraction are accident victims, and various types of mobility equipment are an unavoidable part of their daily lives.

A mobility aid is a tool created to assist persons who have mobility impairments in moving around or to generally improve their mobility. There are several walking devices that can help people who have trouble walking, as well as wheelchairs or mobility scooters for people who have a more severe impairment or who need to travel farther than they normally would on foot[4]. The white cane and guide dog have been used for many years by those who are blind or visually impaired. Other aids can be used to help with transfers or mobility inside a building or in areas where there are variations in level. The term "mobility aid" has typically been used to refer to low-tech mechanical devices. The phrase can also be seen in official papers, such as those that discuss different types of tax breaks. It describes those gadgets that allow for a degree of independence of movement akin to that of unsupported walking or rising from a chair. Wheelchairs that can be manually moved by the user or a companion[2]. Users can go forward and backward at rates determined by how much force they can use by manipulating the push rims. They can also turn left or right and pass over nearby dips and peaks. Four tiny wheels protrude from a small platform on a wheelbase chair, also called a scooter. The kind of chair that is put on this platform varies depending on the user's demands and disability; some are even made from a mold of the user in their ideal sitting posture. The wheelbase chair's controls are attached to a frame that curves upward from the platform's front to a height and position that is comfortable for the user. The top of the frame is coupled with a horizontal steering bar. A stretcher is a medical tool used to carry patients for a brief period of time. It features grips on either side of the stretcher's length to make it easier to carry[7]. A stretcher is a mobile bed on wheels used to move patients who are unable to walk or stand unaided. People who are in critical condition and accident victims are transported from one location to another using stretchers. The design is

straightforward, supporting the patient on a metal bed at the top and having a metal frame with caster wheels. Stretchers have been employed on battlefields and in emergency situations when rocky terrain makes wheeled vehicles impractical since antiquity. They typically consisted of a canvas sling with long sides that were stitched to one another to create pockets through which wooden poles could be passed. Stretchers are now made of a range of lightweight materials and have fittings that allow them to be attached to other devices. The term "mobility aid" has typically been used to refer to low-tech mechanical devices. The phrase can also be seen in official papers, such as those that discuss different types of tax breaks. It describes those gadgets that allow for a degree of independence of movement akin to that of unsupported walking or rising from a chair.

Modern wheelchairs are made of lightweight materials and have much more advanced features that are microprocessor controlled. Today's wheelchair market has undergone a revolution, driven by human needs and desires. Better wheelchair options are anticipated in the future that could accommodate human inventiveness and benefit the less fortunate[6]. Several components make up the wheelchair's basic structure. It is merely a set of wheels mounted to a chair, to put it simply. There are some essential components that every wheelchair must have. To prevent fatigue from setting down on a seat for an extended period of time, it must be comfy. It ought to have a backrest that offers enough lumbar support. It must have a foot rest as well as an arm rest at the ideal height. The most crucial need is that the wheels have brakes. The wheelchair's design has undergone numerous alterations since it was first invented. There are many different types of wheelchairs available today, including folding, rigid, electric, and self-propelled models. Other categories include standing wheelchairs, sports wheelchairs, mobility scooters, toilet wheelchairs, stairs climbing wheelchairs, etc. based on their intended use. The variety of wheelchairs reflects the requirement to accommodate different needs.

The objective of the work are.

- A developed stretcher or wheel chair allows a caregiver or nurse to transfer a patient conveniently from a bed to a stretcher and vice versa. Mobility is relatively simple in both configurations, both on a stretcher and in a wheelchair.
- Providing a detachable stretcher to make it simple to move the patient.
- When the stretcher is removed, the base can be used as a wheelchair.
- Creating a prototype model with constrained supplies and scarp. cost decrease as a result.

2. DESCRIPTION

The major component involved in the construction of the WHEELCHAIR CUM STRETCHER are:

- ❖ Chassis
- ❖ Rear wheel
- ❖ Casters
- ❖ Bolt and Nut
- ❖ Main base structure
- ❖ Bearing
- ❖ Rack and Pinion Gear

A. Chassis

The base is essentially a platform or what is referred to as the assembly's support. Metal channels consisting of aluminum, mild steel, stainless steel, etc. are used to form the basis. This wheelchair's base is made up of a framework known as a frame that is composed of mild steel.

The individual can sit on a platform made of metal that is fastened to the upper surface of the frame. In essence, the welding procedure is used to join the sheet to the frame. Arc welding is the type of welding used in this design. When the frame and sheet metal are connected, a hard structure known as the foundation is created.



Figure 01-Chassis

B. Rear Wheels

The shaft that connects the rear wheels to one another keeps them in alignment. The wheel has a 69mm diameter. This wheel will support the weight of the entire body, including that of the user.

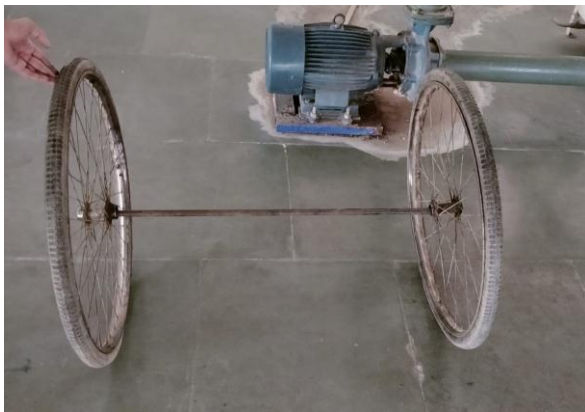


Figure 2: Rear wheels with the shaft

C. Casters

End bearings and bearing caps are used to secure the caster wheels to the chair's frame. The wheel is comprised of inch-diameter fiber wheels. A caster (also known as a castor) is an undriven single, double, or compound wheel that is intended to be mounted to the bottom of a bigger object (the "vehicle") to make it easier to move. The materials they are often made of include rubber, plastic, nylon, aluminum, or stainless steel, and they come in a range of sizes. For optimal balancing and easy direction changes, we have included two caster wheels in the front of this item.

D. Principal framework

The seat platform is located on this, which is the main base. Here, the wheel shaft and base are joined by welding. It is detachable because the nuts and bolts are used to secure the wheels. In order to keep the base leg removable in case we need to replace the caster, the casters are also attached to it.



Figure 3: Complete base structure

E. Bearings

Because the bearings could break if they were hammered into the shaft, they are pressed into place smoothly. Both the bearing and the bearing cap are composed of steel. In order to reduce friction and power loss, ball and roller bearings are commonly employed in tools and machinery. Ball bearings have been around since at least Leonardo da Vinci, although their design and production have advanced significantly since then. It took years of research and development to bring this technology to its current degree of perfection. When it is possible to employ a standardized bearing of the right size type, the advantages of such specialist research can be realized.

E. Rack and Pinion arrangement:

The block, which holds the rack and pinion, is the crucial component of the apparatus. The linear motion is changed into rotating motion by this block. Rotary motion is converted into linear motion using a rack and pinion gear arrangement. The line of action is perpendicular to the pinion, and the rack is a piece of a gear with infinite pitch diameter.

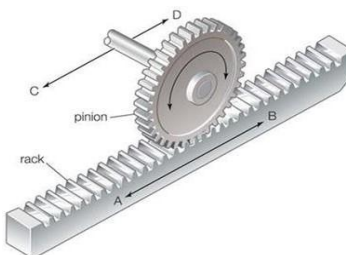


Figure 4- Arrangement of rack and pinion

3. DESIGN SPECIFICATIONS AND CALCULATIONS

A. ANALYSING THE PROBLEM



Figure 5- Basic manual wheelchair parts

- The primary issue we had was deciding what kind of material to use. After a few failures, we came to the conclusion that low weight and high strength material should be used.

- The wheelchair's base's frame's capacity to support a heavy body.
- The stretcher's structural strength.
- How many connections.
- Setting the mechanism in place.
- Appropriate spacing to allow for design changes made during development.
- Mounting wheels.
- a wheelchair to stretcher locking system.
- Hinges and joints.

B. DESIGN CALCULATION

Material Used for Development

- 1) M.S. hollow bar of total length 15m
- 2) M.S. hollow bar of diameter 20mm
- 3) M.S. L shape 1" of length 6m
- 4) G A Coated M.S sheet of 2 mm thickness 3*(50*50).
- 5) M.S. Plate of 2mm
- 6) Bolt and nut of 10 mm diameter and 2 inches' length
- 7) Caster – 6 pieces
- 8) One pair of Wheels of diameter 69cm
- 9) Sponge (foam)
- 10) Leather cover

Load calculations

• **Load on the wheels**

Weight of Body =35 kg

Weight of Body (Newton)=343.43N

Weight of the Human = 120kg=1177.20 N

Weight of Rack & Pinion = 3.4 kg = 33.354N Force

= [343.43+33.354+1177.20] =1553.904 N

Force on each wheel

Force F1 = F2 =Force/4 = 1553.904/4 =388.474 N

• **Load on Back Rest**

• Link inclination = 20

egree Human weight = 40 kg

Weight of the frame = 10 Kg

Force = (40+ 9.3) * 9.81= 483.63 N

Force actual = F* sin 20 = 263N

• **Load on Leg Rest Link**

inclination= 10 degree Human

weight = 15kg Weight of the

frame – 10 kg

Force = (40+10) M * 9.81 = 490.5 N

Force actual = 266.8254 N

C. Stress Calculation

❖ **Stress on front casters**

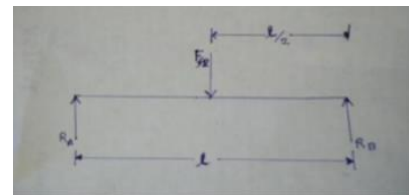


Figure 6-Force distribution front

caster Front wheel shaft diameter(d1) = 10 mm

➤ Bending

stressσb= My / I

Moment = Ff1*(L/2) = 388.474*20=7769.48 N.mm

Y=d1/2=5mm

$I = \frac{\pi}{64} d1^4 = 490.8739 \text{ mm}^4$

σb=79.13927 N/mm²

➤ Shear stress

$\tau = \frac{TR}{J}$

Torque(T)=FF1*(L/2)=388.474*20=7769.48 N.mm

R=d1/2=5mm

$J = \frac{\pi}{32} d1^4 = 981.7478 \text{ mm}^4$

τ=39.56 N/mm²

❖ **Stress on rear wheel**

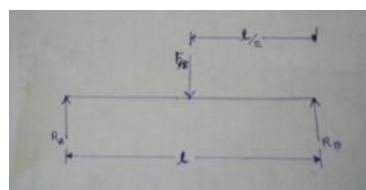


Figure 7- Force distribution on rear wheel

Rear wheel shaft diameter(d_2) = 10 mm

➤ Bending

stress $\sigma_b = My/I$

Moment = $Ff_1 \cdot (L/2) = 388.474 \cdot 50 = 19423.7 \text{ N}\cdot\text{mm}$

$Y = d_1/2 = 5 \text{ mm}$

$I = \frac{\pi}{64} d_1^4 = 490.8739 \text{ mm}^4$

$\sigma_b = 197.848 \text{ N/mm}^2$

➤ Shear stress

$\tau = \frac{TR}{J}$

Torque(T) = $FF_2 \cdot (L/2) = 388.474 \text{ N} \cdot 50$

= 19423.7 N·mm

$R = d_2/2 = 5 \text{ mm}$

$J = \frac{\pi}{32} d_1^4$

= 981.7478 mm⁴

$\tau = 98.92 \text{ N/mm}^2$

D. Factor of Safety

F.O.S. = $\frac{\text{ultimate tensile stress on material}}{\text{maximum stress generated in material}}$

= $\frac{500}{197.848}$

= 2.52

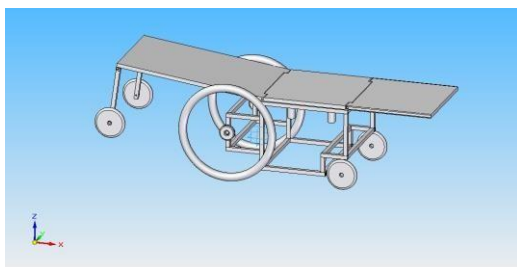


Figure 8- 3D Final Assembly Wheelchair cum stretcher

4. RESULTS AND DISCUSSIONS

The Traditional wheelchair and cum stretchers are pricey and have several flaws. The wheelchair that is available lacks a stretcher option. Therefore, this new form of wheelchair cum stretcher is created to address all of these limitations. The following is a list of the benefits of this design over traditional wheelchairs.

- Detachable stretcher is supplied, providing comfort while shifting the patient from one bed to another.
 - Easy maintenance makes it more effective.
- This design is easy to construct;
 - The base can be utilized as a chair even after detaching.
- The stretcher's additional wheels make it easier to use as a trolley.
- Compared to the market model, this one is less expensive.

5. CONCLUSIONS

The mechanism was invented and designed to lessen human weariness. Today, wheelchairs are seen as both a mode of transportation and a chance for its users to exhibit their unique personalities. enabling the nurse's assistant to handle the patient more easily in serious situations. Transferring a patient from a bed to a wheelchair from one location to the hospital or another becomes highly challenging for the nursing staff and the patient alike. Stress is created in the patient's body as well as the nursing staff as a result of the transition from bed to wheelchair or vice versa. By creating a new design for the stretcher and wheelchair that includes a detachable stretcher that can be operated easily and used as a trolley when necessary, the aforementioned issues that arise when a patient is transferring from a bed to a wheelchair can be eliminated. Although this design may cost a little more than a standard wheelchair, it has many more functions that can benefit both the patient and the nursing staff. Additionally, we are aware that there is much room for improvement in the future.

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