Design and Fabrication of Wheelchair CUM Stretcher

Yash Shah, Neel Patel, Nischay Patel, Shail Patel, Piyush Surani

Abstract: The wheelchair and stretcher are very widely used in hospitals, airports, train stations, shopping malls, etc. This design here is a modified wheelchair stretcher as needed. This machine converts the wheelchair into a stretcher. The chair transforms into a stretcher when the levers are operated. The stretchers can be detached from the main frame according to the convenience of the patient and doctors can make it easier access to the patient with less effort and transport. The folding mechanism enables a large number of stretchers arranged in chair form to be accommodated in a comparatively smaller space. In hospitals, patients have to be moved from a wheelchair to a stretcher, from a stretcher to a bed, from a bed to a wheelchair or vice versa; which creates unsafe conditions for patients. A wheelchair stretcher is required to facilitate mobility for the disabled patient.

Keywords: Wheelchair, Stretcher, Space, Patient’s Mobility.

I. INTRODUCTION

The concept of Design and Fabrication of Wheelchair cum Stretcher is useful for disabled patient’s mobility. DISABILITY is the term that has been used for many decades. According to Oxford Etymology, “disability” is used in many contexts, namely 1650 as a sport called “CAP IN HAND”, 1750 used in horse races, 1870 it is “Any race or competition in which the competitors try to equalize the odds, by giving an advantage to the less efficient or a disadvantage to the most efficient”. Finally, the first use of disability to designate a mental or physical disability is recorded in a caption from 1915: The disabled child. Since 1915 the word “DISABILITY / DISABILITY” has been the trade name for people with physical or mental disabilities.

II. PROBLEM DEFINITION

The proportion of patients in India is increasing day by day. In hospitals, patients have to move from the wheelchair to the stretcher, from the stretcher to the bed, from the bed to the wheelchair or vice versa; which creates unsafe conditions for patients. Moving patients to hospitals is a common problem for nurses.

III. PROJECT SCOPE

Propose a design that reduces caregiver effort and provides safer transfer for patients in hospitals.

IV. DESIGN CALCULATION

Wheels With A Load:
- Body: Mass : 35 Kg
- Weight of Body (Newton): 343.43 N
- Weight of Human: 120 Kg
- Human Weight (Newton): 1177.211 N
- Rack and Pinion(Follower): Mass : 3.401 Kg
- Weight of Rack and Pinion (Newton): 33.354 N
- Force: 343.43 + 1177.21 + 33.354 = 1553.904 N

Wheels with Force on each:
- Force = \( F_1 = F_2 = \frac{\text{Force}}{4} = \frac{1553.904}{4} = 388.474 \text{ N} \)

Load on Back Rest:
- Link Inclination : 20°
- Weight of Human : 40 Kg
- Frame: Mass: 10.001 Kg
- Force = (40.001 + 9.301) \* 9.81001 = 483.63011 N
- Force Actual = F \* sin20° = 263 N

Leg Rest with Load:
- Inclined Link Angle : 10°
- Weight of Human: 40.001 Kg
- Frame : Mass : 10.001 Kg
- Force = (40.001 + 10.001) \* 9.8101 = 491.501 N
- Actual Force Magnitude = 266.8254 N

Analysis Stress:
- Front Wheels Stress:
  \[ \text{Front Wheel Stress} = 10 \text{ mm Stress(Bending)} = \sigma_b \]
  \[ = \frac{My}{I} \]
  \[ \text{Moment(1)(Front)} = F_1 * \left(\frac{l}{2}\right) = 388.474 \times 20 \]
  \[ = 7769.48 \text{ N.mm} \]

  \[ y = \frac{d_1}{2} = \frac{10}{2} = 5 \text{ mm} \]

  \[ I = \frac{64 \times d_1^4}{N} = 490.8739 \text{ mm}^4 \]

  \[ \sigma_b = 79.13927 \times \frac{N}{mm^2} \]

  \[ \text{Shear Stress} = \tau = \frac{TR}{I} \]

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\[ Torque(T) = F_f1 \times \left( \frac{l}{2} \right) = 388.474 \times 20 \]
\[ = 7769.48 \text{ N} \cdot \text{mm} \]

\[ R = \frac{d_1}{2} = 5 \text{ mm} \]
\[ J = \frac{32}{32} d_1^4 = 981.7478 \text{ mm}^4 \]
\[ \tau = 39.56 \frac{N}{\text{mm}^2} \]

Rear Wheel Stress:
shaft Diameter \(d_2\) Rear Wheel = 10 mm
Stress(Bending) = \(\sigma_b = \frac{My}{I} \)

Moment(2)(Rear) = \(F_f1 \times \left( \frac{l}{2} \right) = 388.474 \times 50 \)
\[ = 19423.7 \text{ N} \cdot \text{mm} \]

\[ y = \frac{d_1}{2} = 10 \text{ mm} \]
\[ I = \frac{I}{64} = 490.8739 \text{ mm}^4 \]
\[ \sigma_b = 197.848 \frac{N}{\text{mm}^2} \]

Shear Stress = \(\tau = \frac{TR}{J} \)

\[ Torque(T) = F_f1 \times \left( \frac{l}{2} \right) = 388.474 \times 50 \]
\[ = 19423.7 \text{ N} \cdot \text{mm} \]

\[ R = \frac{d_1}{2} = 5 \text{ mm} \]
\[ J = \frac{32}{32} d_1^4 = 981.7478 \text{ mm}^4 \]
\[ \tau = 98.92 \frac{N}{\text{mm}^2} \]

Factor of Safety:
\[ F.O.S = \frac{\text{Ultimate Tensile Stress on Material}}{\text{Maximum Stress Generated in Material}} \]
\[ = \frac{500}{197.848} = 2.52 \]

V. 3D DESIGN

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VI. CONNECTION GRAPH

Connection Graph of Transmitter

Connection Graph of Receiver

VII. LIST OF COMPONENT WITH ESTIMATION

| Sr.No | Part Name                  | Quantity in KG/Piece | Rate | Amount in RS |
|-------|----------------------------|----------------------|------|-------------|
| 1     | SS Box Pipe                | 30 feet              | 80   | 2400        |
| 2     | Seal                       | 1 Set                | 3500 | 3500        |
| 3     | Iron Rod                   | 3 feet               | 100  | 300         |
| 4     | Self Rotating Trolley Wheel| 2 Nos                | 400  | 800         |
| 5     | Spring                     | 4 Nos                | 190  | 400         |
| 6     | Locking Nobs               | 4 Nos                | 50   | 200         |
| 7     | 4 Inch Hinges              | 8 Nos                | 150  | 1200        |
| 8     | 4 Inch Rubber wheel        | 2 Nos                | 240  | 480         |
| 9     | RF Remote                  | 1 Nos                | 1900 | 1900        |
| 10    | Wiper Motor                | 1 nos                | 1600 | 1600        |
| 11    | Rack                       | 1 Nos                | 1600 | 1600        |
| 12    | Pinion                     | 1 Nos                | 400  | 400         |
| 13    | DC motor                   | 1 Nos                | 3800 | 3800        |
| 14    | wooden Plate               | 1 Nos                | 600  | 600         |
| 15    | DC Motor Mounting Clamp    | 2 Nos                | 20   | 80          |
|       | **Total**                  |                      |      | **19260**   |

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