# DESIGN AND FABRICATION OF STAIR CASE CLIMBING WHEEL CHAIR

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**Abstract**

The project deals with designing and manufacturing of a manually operated staircase can be used leveled plane as staircases. the concern in this project was to provide stability to the person who is traveling in simultaneously maintaining as possible. mind all calculations were performed. The model was designed using SOLIDWORKS and subsequently done using ANSYS software. This project will assist physically disabled people in their daily lives and it will be quite useful in rural and semi-urban areas. The overall cost of the project is certainly low as compared to the commercially available staircase climbers.

**Keywords:** Design,Manufacturing, Staircase, Calculations, Analysis

## I.INTRODUCTION

India is a developing country but still certain parts are undeveloped where escalators and lifts are rarely found and commercially available wheelchairs are too costly to be bought by middle class people. This paper introduce a new horizon for the movability of physically challenged people over the stairs. It will enhance their personal mobility, which is a precondition for enjoying human rights. Total cost associated with the project was Rs. 9900/-.

## II. REVIEW

Lin Zhang and Xi Feihong [2] suggested a design of stair climbing wheelchair in which the planetary wheel mechanism was modeled and analyzed in Auto desk Inventor and Rhino. Feature of lock system will avoid the wheelchair to slip down while climbing up and down stairs.

R Rajeskaret.al [3] designed and fabricated a staircase climbing wheelchair. Instead of using normal wheels, penta wheels were used and each steel rod on which penta wheels are fixed, is equally inclined at 72° from each other. While climbing, the idle wheel will be in contact with the ground and another wheel will be in contact with the stair. The wheelchair moves slowly when it is pulled backwards towards the staircase.

Marissa L. Jacovich[4] designed and tested a consumer-grade hand truck capable of climbing over stairs, curbs or uneven terrain while putting minimum strain on user. Sufficient research has been done related to available staircase climbers and similar mechanisms.

## *II. PROPOSE METHO*

Design should have an ergonomic approach so that patient does not have any discomfort. The wheelchair should not bend or fail under excess loading. While moving on flat surface it should consume less work input to move along the line. The coefficient of friction of rubber wheels should be such that minimum work would be required to push the chair as well as the system should not slip while climbing. Rotation of shaft and hub should be easy with the provided tolerance between the shaft and hub. This shaft should not have any horizontal motion.

Major part of the structure should not bend with a mild load impact acting on it. The structure should be stable under all conditions. Pentagonal structure angle is 72 degree and it should not change appreciably ($\pm$ 4$^{\circ}$) else the motion of pentagonal structure while moving on stairs would be difficult. the circuit which is mounted on chair should be working under proper expected conditions. A burger alarm as well as a message to the cellular network should be received as soon as possible. For this, GSM should have good network access. The heart beat sensor would respond as quickly as possible whenever range of frequency is abrupt.

## CALCULATIONS FOR STABILITY

### A. Mechanics during downstream of staircase climber

During downstream, mechanism is self-energizing. When the small wheel rotates on plane floor, the action of weight causes reaction from bottom ground and rim will be stable. The moment when wheel leaves that reaction during first downstream stair, mechanism and calculations starts and that position is shown in the figure below.

**Mechanics during upstream of staircase climber**

Upstream mechanism starts when wheels comes in contact with stairs. The blockage provided by stairs on the wheel gives it a tangent force so that rim can rotate. More is the applied force, more will be blockage force and in turn tangent force will be more. At critical situation when reaction is maximum, further input in applied force will cause rim to start climbing over the stair. This state of rim is shown in figure below.

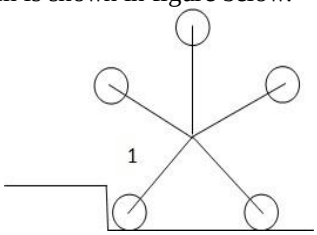


Fig.3. Upstream of staircase climber

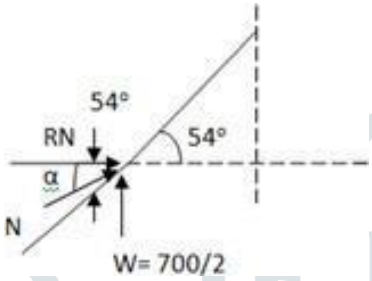


Fig.4. FBD of link 1

Note :- To have net +ve torque available, angle between $R_N$ and N (resultant of $R_N$ and W)

$\alpha < 54°$

$\tan^{-1}(W/R_N) < 54°$

$(350/R_N) < \tan(54°)$

$R_N > 254.289$ N

Hence if effort applied is more than 260N then wheelchair will climb

This force is quite large for anyone to climb. Following are the two solutions for the above problem:-

1. Decrease the angle of wheelchair with respect to ground. By doing so, the applied force will decrease.

2. During climbing upstream the patient should face the ground this would require the least force.

## III. DESIGN

### *A. Material consideration in designing wheelchair*

1. In this stage economics and cost of project is the primary concern, therefore cheap material is selected. Major part of the wheelchair is manufactured by the same square pipe of 24 foot.

2. AISI 1018 mild/low carbon steel can be instantly welded by all the conventional welding processes (low carbon welding electrodes are used) and produces a uniform, harder case. AISI 1018 mild/low carbon steel offers a good balance of toughness, strength and ductility.

3.Apart from advantages of mild steel, mild steel has less anti corrosive property. If the rim arms and seat corrode, it won't cause much problem to wheelchair, only it will fail at aesthetic point of view.

4.If shaft gets rusted it will increase the coefficient of friction which will increase the required force applied for motion and also will cause trouble during dismantling and assembly. The surface which is rusted and corroded when rubbed with each other produces noise. To avoid this problem mild steel cannot be used for the shaft hence highly polished circular steel pipe is selected.

## VI. FABRICATION

1.Mild steel is used for major part of fabrication, i.e, for the pentagonal structure and frame. Hollow steel is preferred for providing the required strength and flexibility.
2.First the pentagonal structure was designed and errors in dimensions was compensated while fabricating the framework.
3.All the dimensions are the result for static and dynamic analysis along with an ergonomic approach

## VIII. RESULT AND CONCLUSION

### *A. Result*

Maximum weight that can be carried by chair is about 170 kg's comprising of self weight of body as well as weight of the wheelchair. For the standard value of stair as 18cm, designed pentagonal wheels will not in any way obstruct the motion of the wheelchair.

### *B. Conclusion*

1.Effort needed to lift the wheelchair is experimentally demonstrated and it is almost equal to theoretically calculated.
2.Medical aid circuit gives its outcome by sending a message from GSM module which is tracing pulse sensor via arduino connected to it. Any irregular heartbeat sensed is followed by sending a message to caretaker for rescue and buzzer gets on
3. The project has major man machine relationship, hence all the ergonomics consideration has been taken for ease usage of machine
4.Weight of project is similar to weight of a standard wheelchair even an unskilled person will be able to drive it.

## IX. REFERENCES

**[1]** R Rajasekar , "Design And Fabrication of Staircase Climbing Wheelchair", International Journal Of Mechanical Engineering And Robotics Research (Vol. 2, No. 2, April 2013)

**[2]** Murray John Lawn, "Study Of Stair- Climbing Assistive Mechanisms for The Disabled", Graduate School of Marine Science and Engineering Nagasaki University, Japan,
Dec 2002
[3] Basil Hamed , "Design and Implementation of Stair-Climbing Robot for Rescue Applications"International Journal of Computer and Electrical Engineering, Vol. 3, No. 3, June 2011

[4] A S Shriwaskar& S K Choudhary , "Synthesis, Modeling, Analysis And Simulation Of Stair Climbing Mechanism" , Int. J. Mech. Eng. & Rob. Res. 2013, Synthesis, Modeling, Analysis And Simulation Of Stair Climbing Mechanism