

# Design and Development of Mechanically Operated Standing Wheelchair

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**Abstract**— “Design and Development of mechanically operated standing wheelchair” is fully mechanized based standing wheelchair. The specialty is it works on the gear drive and chain drive mechanism. This wheelchair has fixed frame and moving frame on which the wheelchair is working. The front and reverse movement of the vehicle can be selected by the lever mechanism which is connected to the gears. By changing the gears with the help of lever the front and reverse motion has been carried out.

**Keywords**—(Design Specification, Functional Requirement ,Ease Of Use, Details Of Components)

## INTRODUCTION

Generally wheelchairs are supposed to transport disable peoples with seating position only. A standing wheelchair is assistive technology, similar to a standing frame, that allows a wheelchair user to raise the chair from seated to standing position and vice versa. Mechanically operated standing wheel chair is a modification of basic wheel chair to enhance the life of disable peoples by giving them a mean to stand and move anywhere. It is social friendly, easy to use, reliable and affordable since it is full mechanically operated. Designing of standing wheelchair is based on the gear mechanism, belt drive, chain drive, and ratchet. This wheelchair is economic friendly and maintenance friendly. Cost goes approx. Rs.25000/-

### I. SCENARIO OF WHEELCHAIR

#### A. Electrical Wheelchair

Electrical wheelchairs are bit modification in the manual wheelchairs. These wheelchairs are working on the battery which requires charging after specific period of time .It is only feasible on a smooth road surfaces. Because of cost it is not affordable.

#### B. Electrical standing wheelchairs.

Redman power chair’, it is the world’s highest quality standing wheelchair. People with spinal cord injury can reap the health benefits of standing wheelchair. Physical benefits of standing wheelchairs are

- Decrease urinary tract infection problem
- Improver blood circulation around the body
- Standing exercise greatly improve bowl function
- Wheelchair helps distribute your weight and improve healing bed sores

#### C. Pediatric Wheelchair

These types of wheelchair provide a key-enabling technology to young children who would be unable to navigate independently in their environment. Standard powered wheelchairs are still heavily dependent on the cognitive capabilities of users. Unfortunately, this excludes disabled users who lack the required problem-solving and spatial skills, particularly young children. For these children to be denied powered mobility is a crucial set-back; exploration is important for their cognitive, emotional and psychosocial development.

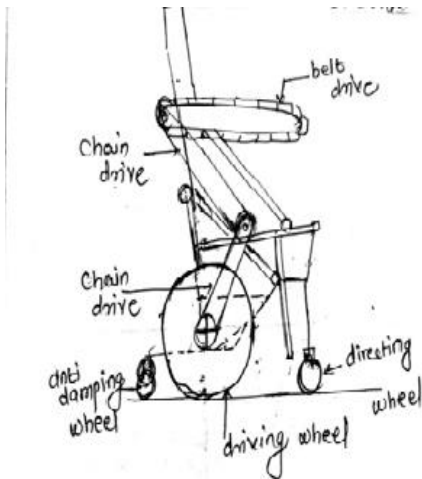
#### D. Stair climbing wheel chair

The stair-climbing wheelchair exists at present can be grouped into 3 categories: - continuous stair climbing wheelchair, intermittent-stair climbing wheelchair and auxiliary stair climbing wheelchair. Continuous stair climbing wheelchair has only one set of supporting device, the wheelchair relies on this supporting device for continuous motions. In Intermittent stair climbing wheelchair the process of climbing stairs of is similar to the people climbing up and down stairs, it is also called walking stair climbing wheelchair. Intermittent stair climbing wheelchair is one of the supporting devices that elevate the wheelchair and other set of support system. In auxiliary stair climbing wheelchair, the attachments rely on another device installed on the wheelchair and it needs assistance to help realize the function of climbing stairs. Stair lift requires wide stair way which is very expensive.

### II. WHAT IS STANDING WHEELCHAIR

This standing chair consists of four main parts including the base, seat, back and handrail. The base is a horizontal board with four chair legs or four wheels if used as wheel chair. The seat is hinged at the front of the base board. The back is hinged at the rear of base board. There are two rods extend from the bottom of the back part. Rods are working as a shaft of the sleeves of the handrail part. Obviously, the back part will rotate if torque applied on the rods. The back rest of the wheelchair is designed in such a way that it will get reciprocate. This up- down movement of the back rest being controlled by the gear trains and chain drive. This chain drive is controlled with the belts in hand.

### III. SPECIALITY OF MECHANICALLY STANDING WHEELCHAIR



A. This chair is changes the position of the man seating on chair make him stand i.e. "Standing Chair". In mechanically operated standing wheelchair all the included mechanisms are working on gear drive, chain drive, belt drive. It has two frames that are moving frame and standing frame. The very important mechanism of sitting to standing position it is based on the moving frame which is connected with a gear drive.

#### B. Currently developed Mechanical Standing wheelchair

The advantage of this kind of wheelchair is simplicity in structure. This chair is operated on a lever application. Position of seat is fixed on the horizontal plane, but movable in vertical by installing back on a rod. This wheelchair uses pure mechanical method to aid standing up. We think this method of easiest way to achieve our goal. Because of the simple structure, this wheelchair has some problem when it works. The wheelchair is operated manually, which means disabled people must have strong forearms to force the wheelchair work. If patient is weak in stamina or have problems in their arms, they cannot operate this kind of wheelchair.

### IV. EASE OF USE OF STANDING WHEELCHAIR

It can be easily operated with a tracks provided with a hand rest. Seats are placed by considering well ergonomics. The operation of lever is so smooth that one can change the drive easily. Energy required for the change of posture from sitting to standing is less. The movement of the chair to travel from distance to distance is easy. As it uses gears for operation and smooth engagement plays good role in operation. Bearings are used wherever necessary to reduce the friction. A small boy or girl can easily operate it. It has large load carrying capacity and secure handling makes it user friendly.

- A. Ease of use in a seating position as the belt drives are connected with the chain drive in a sequence with gear drive.
- B. It gives the easiness in forward motion as the belt drive gives a positive drive to the mechanism.
- C. The wheelchair motion also be possible in standing position of the chair. The lever is connected to the gear drive for the changing of the drive. Ergonomic consideration are also effectively work in change of position.

### V. FUNCTIONAL CHARACTERISTICS

#### A. Seating Comfort and Support

Much research has been done, and then it is found that the seating comfort and the posture of the person who is going to seat on the chair is much important. Mainly the position the person after the wheelchair get stand is very much important. To overcome that problem the strap arrangement at the seat has been done to feel him comfort and safe also after the standing.

#### B. Mobility

Mobility is nothing but one of the ergonomic factor. Mobility is also dependent upon the rolling characteristics of the wheelchair. One of the most advantages is the less force and high efficiency of the person to propel the wheelchair. Experimental models have been built with a geared transmission in the hub, allowing two or more ratios between the hand rim and the drive wheel. Lever or crank drives, or hand rim drives that are separate from the drive wheels, provide a simpler means for obtaining an optimum mechanical advantage through a bicycle-type chain and sprocket transmission.



## VI .DESIGN SPECIFICATION STANDING WHEELCHAIR.

### A. Material Selection

Most important factor in selection of suitable material for the frame was to make the frame sturdy, yet light. Mild steel is mostly used in conventional wheelchair. Mild steel is easily available in the required diameter and length and also not expensive. One main advantage of using mild steel is that it is easy to fabricate with it as welding of mild steel is by arc welding process which is cheap compared to other welding methods. Use of other materials like alloys of aluminum were not selected as the availability is less and also the fabrication cost is high.

#### Mild Steel

1. Easily available
2. Low cost
3. Easy to fabricate
4. Arc welding can be used which is cheaper compared with other methods.

#### Alloys of aluminum

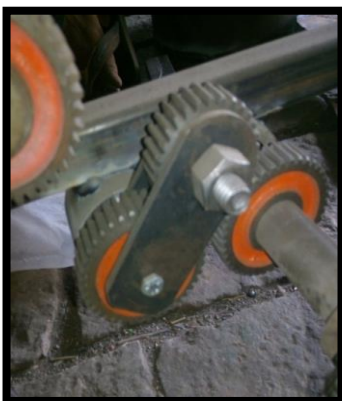
1. Availability is less
  2. Fabrication cost is high
  3. Corrosion resistant
  4. Higher tensile strength
4. Cost: - Rs. 310/kg

#### Titanium

1. Very light in weight
2. High corrosion resistance

### B.Dimension of gear

- 1.Number of teeth on pinion= 30
- 2.Number of teeth on gear= 40
- 3.Module= 1.7 mm
- 4.Face width= 25.5 mm
- 5.Pitch circle diameter of pinion= 51 mm
- 6.Pitch circle diameter of gear= 68 mm
- 7.Addendum (m)= 1.7 mm
- 8.Dedendum (1.25m)= 2.125 mm
- 9.Clearance (0.25m)= 0.425 mm
- 10.Tooth thickness (1.5708m)= 2.6703 mm
11. Fillet radius (0.4m) = 0.68 mm



### C. Selection of chain

Selected chain is 08B-01 Pitch is  $P=12.7$ , no. of links = 110  
Pitch circle diameter=  $P/\sin(180/z) = 12.7/\sin(180/24) = 97.29$  mm

For sprocket having 12 teeth

$$\alpha = 360/z = 360/12 = 30^\circ \quad \dots \text{pitch angle}$$

$$\text{Pitch circle diameter} = P/\sin(180/z) = 12.7/\sin(180/12) = 49.07 \text{ mm}$$

For sprocket having 36 teeth

$$\alpha = 360/z = 360/36 = 10^\circ \quad \dots \text{pitch angle}$$

$$\text{Pitch circle diameter} = P/\sin(180/z) = 12.7/\sin(180/36) = 145.72 \text{ mm}$$

For sprocket having 18 teeth

$$\alpha = 360/z = 360/18 = 20^\circ \quad \dots \text{pitch angle}$$

$$\text{Pitch circle diameter} = P/\sin(180/z) = 12.7/\sin(180/18) = 73.14 \text{ mm}$$

The speed ratios

$$Z1/Z2 = N2/N1$$

$$12/24 = N2/352$$

$$N2 = 176 \text{ rpm}$$

Similarly for second chain

$$Z4/Z3 = N3/N4$$

$$18/36 = N3/176$$

$$N3 = 88 \text{ rpm}$$

## VII. DETAILS OF COMPONENT

A] We made two frames differently one is fixed frame and other is moving. That is, it reciprocates up and down on a pipe above the fixed frame. User has to seat on the moving frame.

B] We are using belt (B 52/ 17\*1320 Li Antistatic and heat resistance for raising and lowering the moving - frame. User has to rotate the pulleys which transmits the motion and torque to chain arrangement.

C] Chain drive is arranged as one is on a fixed frame and one is arranged on a moving frame.that the drive transmission will easily take place.

D] Gears are arranged in such a way that one is to the sprocket and again to the wrench drive gets transmitted accordingly Gears have specified gear ratios that they multiply the torque.

E] Belt is arranged in such a manner that it creates lever action and hence it can lift the user with minimum efforts. Belt's one end is connected to wrench and other end is to moving frame. When user rotates belt drive it transmits power to wrench then sprocket on the wrench winds belt around its shaft, therefore moving frame gets pushed back and hence it lifts the user.

## VIII. ACKNOWLEDGMENTS

All the photographs and drawing are provided by the DYP CET, Kolhapur. All the information is collected by the publisher during research and development.

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