

# Stress Analysis of Mechanisms for Trolley-Cum-Wheelchair at 170°

Prof. Praful R.Randive<sup>1</sup>, Prof.Suyogkumar w.Balbuddhe<sup>2</sup>

<sup>1</sup> Assistant professor, Mechanical Engineering, DMIETR Wardha, Maharashtra, India

<sup>2</sup> Assistant professor, Mechanical Engineering, Prabhat polytechnicRuihi, Maharashtra, India

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**Abstract** - Generally a person who is suffering from some kind of deceases and requires continuous monitoring by doctor and may require external aids like oxygen, blood transformation, saline etc. for cure is known as a patient. He is generally admitted in a hospital. The patient is confined to bed in hospital and is required to be moved to other places for taking X-ray or undergoing sonography or CT scan procedure. The handling of the patient is rather difficult and is required to be planned meticulously. In patient handling, a lot of problems are being faced by nursing staffs, the people who handle the patient at home, and the patient himself. These problems consist of pain to patient, in various portions of body like shoulder, back, legs, etc; while moving him from one place to another place. In the hospitals, the nursing staff is also facing some health problems like pain in their shoulders and backbone, as they have to do the work of patient handling repeatedly. The main objective of this research work is to analyze the various stresses induced in the trolley-cum-wheelchair, used for patient handling.

**Key Words:** sonography, trolley-cum-wheelchair,

## 1.1 History of the Wheelchair [8]

The use of wheelchairs in the U.S. goes back to the Civil War. According to Able Data, the first recorded use of wheelchairs in the United States was during the Civil War. Since that time, wheelchairs have helped people at many points in their lives, for example during recuperation from an injury. For people with a permanent medical condition that prevents them from walking, wheelchairs can be a lifeline to greater mobility and the opportunity to work and live a more fulfilling life.

In 1907, engineer, Harry Jennings, built the first folding, tubular steel wheelchair. That was the earliest wheelchair similar to what is in modern use today. That wheelchair was built for a paraplegic friend of Jennings called Herbert Everest. Together they founded Everest & Jennings, a company that monopolized the wheelchair market for

many years. In 1907, Harry Jennings applied for patent of this wheelchair; In 1933 Mr. Everest broke his back in a mining accident. Herbert wanted a wheelchair that could be put in an automobile. Together these friends founded Everest & Jennings, a company that saw the potential of their invention and were able to mass market their well known "X-brace", which is still in use today. 1948 Removable armrests introduced. The Removable Arm Transport Wheelchair is specially designed to make the patient's trip comfortable and enjoyable. Removable desk-length armrests make transfer into and out of the transport chair much easier. The carbon steel frame with double-coated chrome provides an attractive, chip-proof, easy to maintain finish. The upholstery is comfortable and durable, while 8" wheels in front and back provide a smooth ride. 1950's Lightweight chairs developed for sports use. Lightweight wheelchairs, generally, comes within the weight of 9kg to 14kg. They give comfort to carry it easily and handle it without any hassle. And traditional wheelchairs are much heavier and they usually come in a weight of 20kg. Wheelchairs while come in light weight variety, then they can be folded easily and thus, they are very much space saving. These kinds of wheelchairs are made in light aluminum and can be stored within the car compartment easily. Thus, these kinds of wheelchairs can be transported easily and they do not give any kind of strain on the body due to its less weight. Most of the wheelchairs have to be operated manually. But there are varieties in wheelchairs which can be operated by the means of electric power. There are structurally similar to the manual one but they have multi-function option. Electric wheelchair was invented in the year 1950.

## 1.2 Gurney Stretcher [5]



Fig 1.1

A Gurney, known as a trolley outside North America, is the U.S. term for a type of stretcher used in modern hospitals and ambulances in developed areas. A hospital gurney is a kind of narrow bed on a wheeled frame which may be adjustable in height. For ambulances, a collapsible gurney is a type of stretcher on a variable-height wheeled frame. Normally, an integral lug on the gurney locks into a sprung latch within the ambulance in order to prevent movement during transport. It is usually covered with a disposable sheet and cleaned after each patient in order to prevent the spread of infection. Its key value is to facilitate moving the patient and sheet onto a fixed bed or table on arrival at the emergency room. Both types may have straps to secure the patient. Standard gurneys have several adjustments. The bed can be raised or lowered to facilitate patient transfer. The head of the gurney can be raised so that the patient is in a sitting position (especially important for those in respiratory distresses) or lowered flat in order to perform CPR, or for patients with suspected spinal injury who must be transported.

**2.PRESENT WORK ON ANALYSIS OF MECHANISM OF TROLLEY-CUM-WHEELCHAIR FOR PATIENT**

In this research work the four bar chain mechanism used in trolley-cum-wheelchair for safe patient handling is analyzed. The Design and simulation is already done by the Research scholar but he did not calculate the stresses in four bar mechanism as well as in trolley cum wheelchair<sup>[1]</sup> as shown in fig 2.1. Determination and verification of the stress in four bar chain mechanism and the trolley cum wheelchair is the objective of present work. With the help of CAD software i.e. NX-6 and ANSYS, then with the help of these software I can calculate the stress in hole mechanism of trolley cum wheelchair. This project relates to a multipurpose Wheel chair cum Trolley for patients. More particularly it relates to a wheel chair which can convert in to a Trolley.

1. Lifting and shifting of a disabled/bedridden person has always been difficult, risky and problematic. This lifting and shifting is dangerous and painful for the disabled person if done by the untrained person. The patients are scared of this procedure, as there is a danger of slipping and falling and getting injured.

2. This lifting and shifting is strenuous for the nurse. When he/she is trying to lift the patient, he/she has to bend over the patient to lift him. This posture in the long run gives the nurses a back pain and can turn into permanent back problems. A lot of medical literature is

available on back problems of nurses as it is very common in nurses.

3. A disabled person mainly needs to be shifted from a bed to change the bed or bed sheet. The person also needs to be lifted when putting a bed pan under him. This lifting and shifting is painful and dangerous for the disabled/bedridden person.

4. Many lifting and shifting apparatuses are available in the market. All these apparatus are expensive and unpractical at home as it takes a lot of space and a lot of training for the user. In hospitals some help is available but at home one is helpless and finds lifting and shifting very difficult. It has been observed that it is very difficult to nurse bedridden persons, the main difficulties are:

- 2.1 Shifting of patient from Trolley to Wheel chair for transport;
- 2.2 Shifting of patient from wheel chair to bed for sleeping or rest; and
- 2.3 Sifting the person for putting bed pan under him.

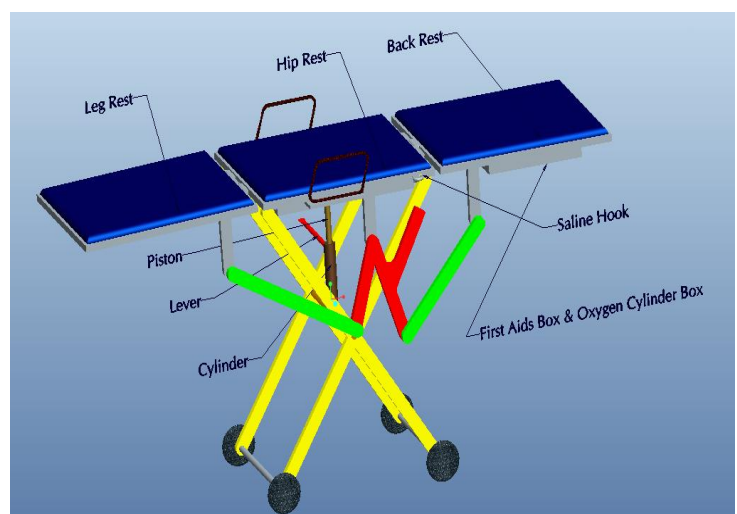


Fig 2.1 **trolley-cum-wheelchair**

So our main concept is to reduce this type of problems during patient handling and introduced new technology of Trolley cum Wheelchair by using four bar mechanisms

and my project analyzed design of four bar mechanisms with considering the fixed dimension of trolley

The model is drawn on NX-6 software following parts are used in the model

- |                                                                                                                                         |                                                                                                                                                                                                                  |
|-----------------------------------------------------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <ol style="list-style-type: none"> <li>1. Backrest</li> <li>2. Hip rest</li> <li>3. Leg rest</li> <li>4. Rest connector pins</li> </ol> | <ol style="list-style-type: none"> <li>5. Pins</li> <li>6. link 2</li> <li>7. coupler</li> <li>8. Link 4</li> <li>9. Support connector</li> <li>10. Support connector pins</li> <li>11. Cross support</li> </ol> |
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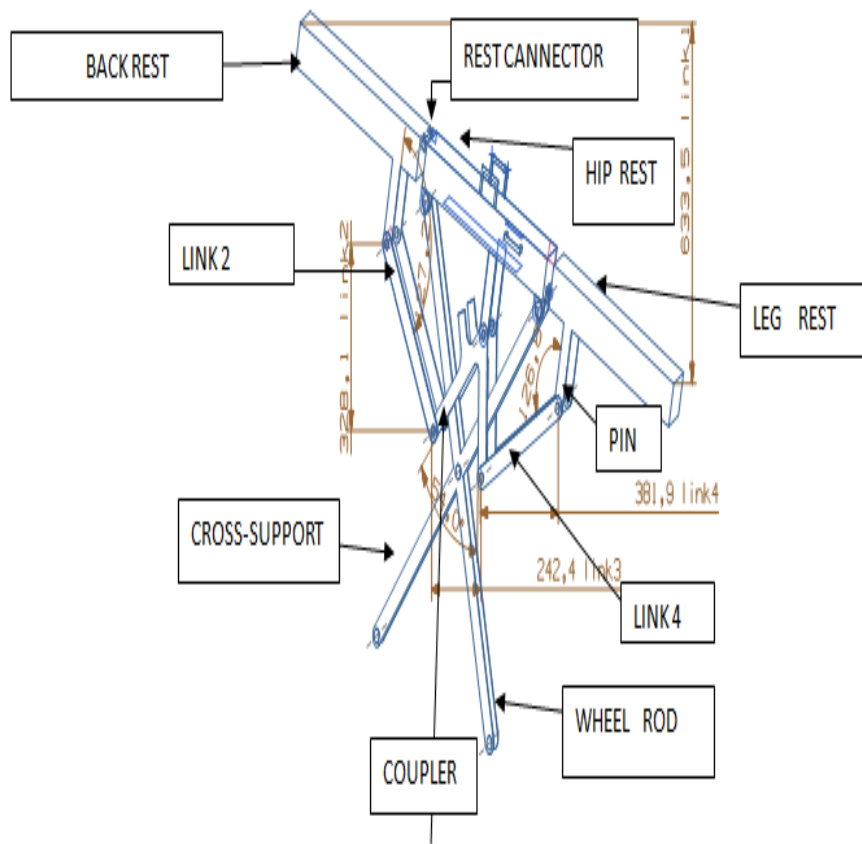


Fig 2.2 Various Parts Of Trolley-Cum-Wheelchair

Types Of Stress	Types Of Values	Link			L4
		L2	L3		
			1 <sup>st</sup> End Near Link 4	2 <sup>nd</sup> End Near Link 2	
Maximum Shear Stress (Mp)	Analytical Value Mpa	0.9908	1.0330	0.2816	1.8900
	FEM Value Mpa	2.0945	0.5074	1.3504	1.8405
	Deviati on Mpa	1.1103	0.5257	1.0688	0.0495
Deformation (mm)	Analytical Value mm	0.0374	0.0235	0.0039	0.0374
	FEM Value mm	0.5005	0.2008	0.2006	0.2424
	Deviati on mm	0.4630	0.1772	0.1966	0.2049
Maximum Principle Stress Mpa	Analytical Value Mpa	2.9700	2.0720	0.2816	2.0720

Table 2.1 FEM READING.

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