Analytical Stress Calculation in Trolley-Cum-Wheelchair

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ABSTRACT

A wheelchair and a stretcher are the basic needs of transportation in hospitals to transfer patients indoor or outdoor. But transferring patients from bed to wheelchair or wheelchair to stretcher or stretcher to bed is a cumbersome task for the staff of hospital. During the transfer they might hurt or mishandle the patient which could be avoided.This could be used extensively not just in a hospital but also in a residential environment. This would be a great boon for patients and their caretakers, as the patients do not have to be handled or disturbed. As it could also be operated by the patient himself, this would be useful for the elderly patients to make them feel more self-reliant. Since we are combining two products it will eliminate a complete class of products which could result in material, cost, and time and space savings.

Keyword: - *trolley-cum-wheelchair, and operation….*

1. INTRODUTION

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[1].. 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.

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1.1 A EMS STRETCHER

This stretchers used in ambulances have wheels that make transportation over pavement easier, and have a lock inside the ambulance and seatbelts to secure the victim during transport. An integral lug on the gurney locks into a sprung latch within the ambulance in order to prevent movement during transport. Modern stretchers may often in have the addition of battery-powered hydraulics to raise and collapse the legs automatically. This eases the workload on EMS personnel, who are statistically at high risk of back injury from repetitive raising and lowering of patients. Specialized bariatric stretchers are also available, which feature a wider frame and higher weight capacity for heavier patients. Stretchers are usually covered with a disposable sheet or wrapping

1.2 GURNEY STRETCHER

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. 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 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 on a long spine board. The feet can be raised to what is called the trendelenberg position, indicated for patients in shock.

2. CONSTRUCTION OF TROLLEY CUM WHEELCHAIR

shows the trolley cum wheelchair consists of backrest, hip rest and leg rest connected together by a four bar mechanism OABC. The OA is a fixed link AC and OB are movable links and BC is a coupler in form of a lever which is used for changing trolley cum wheelchair from trolley position to chair position and vice versa. Link AC is connected to Backrest while link OB is connected to leg rest. The hip rest is immovable and is parallel to the ground always.

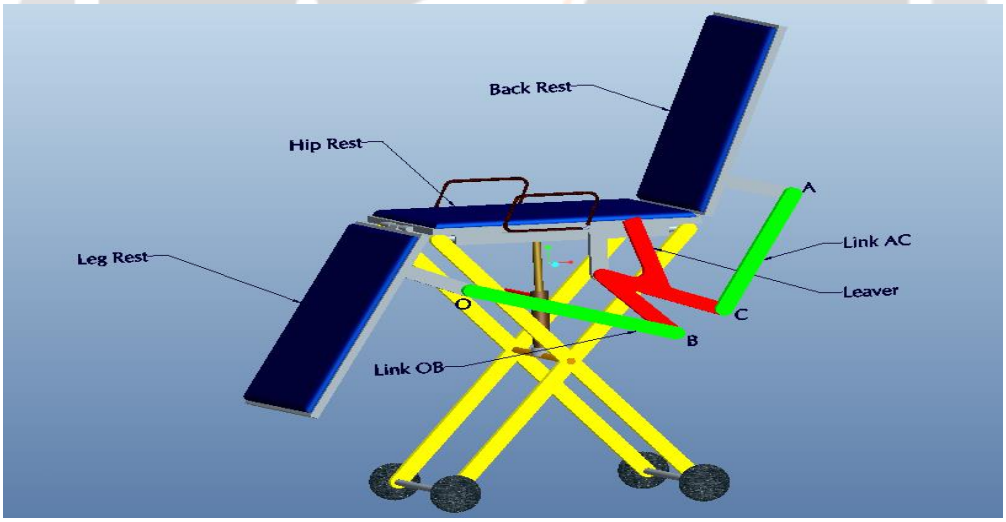

Fig-1 Trolley-cum-wheelchair

2.1 The analytical calculation using free body diagram

The analytical calculation using free body diagram and mechanics are details as below. Further free body diagram consideration trolley was considered in stretcher mode with all three rest in straight line following fig. 2.1 shows the semantic view of the stretch trolley with distances of various link and angles sustained by then.

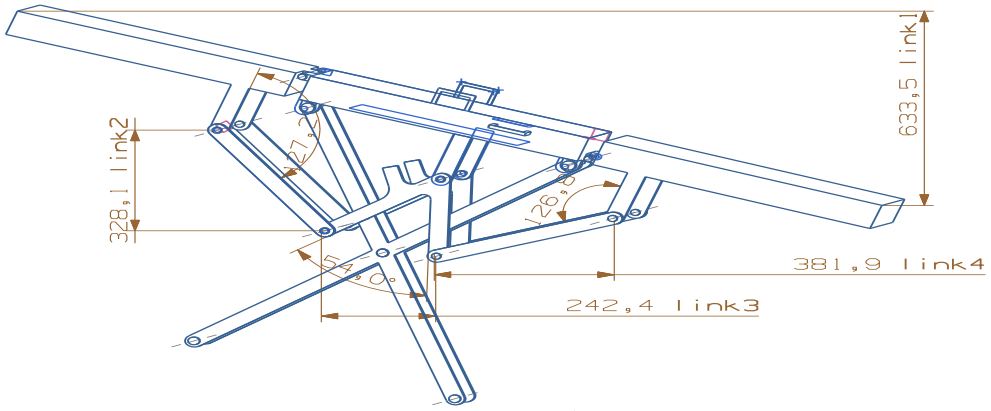

Fig-2.1: Trolley-Cum-Wheelchair with 180^0 angle between Back Rest and Hip Rest.

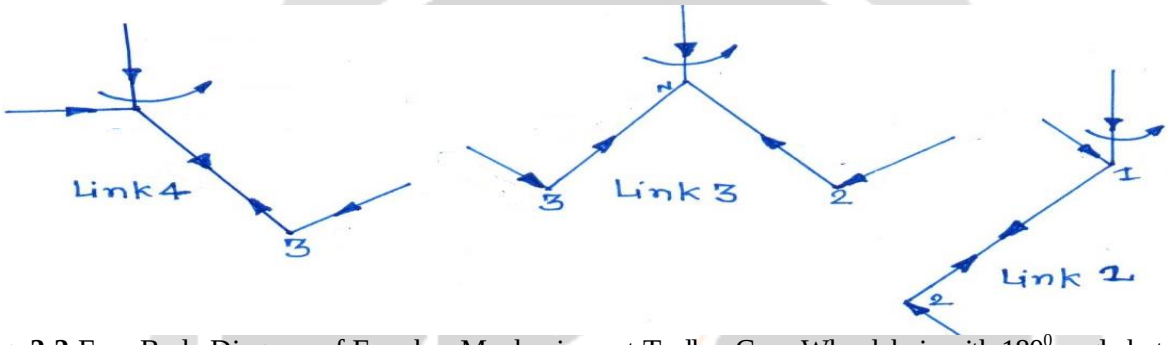

Fig. 2.2 Free Body Diagram of Four bar Mechanism at Trolley-Cum-Wheelchair with 180^0 angle between Back Rest and Hip Rest.

Table 2.1 Comparision of Stress at four bar links at180^0 angle between backrest and hip rest

Types Of Stress	Types Of Values	Link			
		L2	L3		L4
			1st End Near Link 4	2nd End Near Link 2	
Maximum Shear Stress (Mpa)	Analytical Value (Mpa)	2.023	1.0280	0.1950	1.891
Deformation (mm)	Analytical Value (mm)	0.03784	0.0242	0.0002	0.0718
Maximum Principle Stresses (Mpa)	Analytical Value (Mpa)	2.0006	2.0430	0.2980	3.7760

Bending Stresses (Mpa)	Analytical Value (Mpa)	8.08	At fulcrum pin between l_1 & l_2 is 114.96	7.8000
	Permissible Stress (Mpa)	517.5	517.5	517.5
	Deviation(Mpa)	509.42	402.54	509.7

4. CONCLUSIONS

The linkages sizes are mostly evolved from the previous design and not much variation in them where made while the mechanism were modification. Hence some studies in this regard are justified. The conventional mechanical approach are used to find the forces involved through free body diagram. The result obtained were used to find theoretical stresses in each of the element which showed that stresses are much less and hence there is scope for reduction in material. The maximum stress is induced at 150^0 inclination is in link 3 and it is of the order 6.9746 Mpa which is significantly less then permissible stress. Hence it can be concluded that trolley-cum-wheelchair under consideration could have different cross-section for it^s linkages preferably the hallow cross-section shall contribute to the decrease in weight significantly hence it can be concluded that the current design under consideration is unnecessary heavy and hence have wide scope for optimization.

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