



Computer-Aided Ergonomics: Design, Development and Ergonomic Analysis of Load Carrier for an Indian coolie

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Abstract : Transport is an important part of Indian Economy. India's rail network is the 4th longest and most heavily used system in the world. Passengers get on-and-off trains and luggages are loaded or unloaded at railway station where coolie (porter) play very important role. A porter is a person who carries goods (luggages) for others in day to day life at railway stations. However, the way of transporting luggage is of great concern. Majority of stations do not have an elevator or slant roller for easy transfer of luggage therefore, Porter has to carry weight over head or shoulders to transfer through stairs. Coolies work throughout the day and repeated movement of their body parts, especially hands and legs resulting in sprains regularly and temporarily while in permanent damage it causes some kind of postural deformation which can further lead to musculoskeletal disorder (MSD) and lifelong impairment. Therefore, a systematic approach complying ergonomic design needs of load carriage system for coolie in Indian scenario. The aim of present research is to design and develop load carriage system in the form of a trolley for Indian coolie and ergonomically analyses the developed model of load carriage system in 3D CAD environment.

1 INTRODUCTION

Transport is an imperative piece of Indian Economy. India's rail system is the fourth longest and most intensely utilized framework as a part of the world. Travellers get on-and-off trains and bags are stacked or emptied at railroad station where coolie (watchman) assumes imperative part. A doorman is a man who conveys products (bags) for others in everyday life at railroad stations. Notwithstanding, the method for transporting baggage is of extraordinary concern. Dominant part of stations doesn't have a lift or inclination roller for simple exchange of gear in this manner, Porter needs to convey weight over head or shoulders to exchange through stairs. Coolies work for the duration of the day and rehashed development of their body parts, particularly hands and legs bringing about sprains routinely and briefly while in perpetual harm it causes some sort of postural twisting which can further prompt musculoskeletal issue (MSD) and deep rooted hindrance. In this way, a deliberate methodology consenting ergonomic outline needs of burden carriage framework for coolie in Indian situation.

Comfort is expected in all areas & it suits for porters too. As porters spend a very good amount of time of their life in carrying loads of luggages on their back, the most problems are faced during regular running at the platforms & climbing the stairs with the luggage's overhead. Uncomfortable posture leads to grave discomforts like a permanent hunchback, spinal cord problems & Musco-skeletal disorders which was evaluated worldwide

in 2012. Comfort-ability is a regular concern in the field of porters, carrying luggage involves continuous postural deformity.

To reduce the affect in the postures by designing a load carrier which acts as an easy to handle hand-driven machine in the stairs to carry a luggage. It also can be used as a regular luggage carrier on plain surfaces , which adds to its dual value.

2 METHODOLOGY

A 3D model of two-legged triangular base three wheeler trolley was outlined in CATIA programming. It comprises of two handles to guarantee the straight and agreeable stance while moving the heaps. The material utilized for development was as a part of agreement with the guidelines of Indian railroads for trolleys. The trolley was assessed in virtual environment with modify computerized puppets for the fifth, 50th and 95th percentile male speaking to anthropometric database of the Indian populace. Different human component parts of 3D-CAD model were assessed in DELMIA programming with advanced puppets. The trolley was tried to lift a greatest heap of 60 kg with the assistance of Finite Element Analysis (FEA).

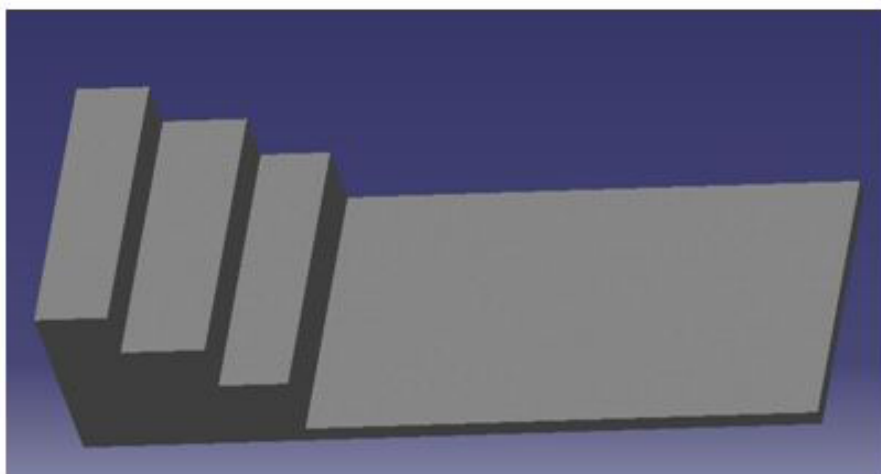
2.1 SEGMENTS OF THE LOAD CARRIER ASSEMBLY



HANDLE OF THE CARRIER



BASE WITH WHEELS



STAIRS OF HOWRAH RAILWAY STATION WITH MEASURED STEPS LENGTH



HANDLES WITH A 50th Percentile MALE MANICKIN SHOWING THE HAND GRASP STRUCTURE OF A COOLIE IN THE HOWRAH STATION

2.1.1 SURVEYS & DATA COLLECTION

An initial survey was carried out to identify the problems faced by the coolies in the famous Howrah Station since we find the existence of Porters in these places due to the rush parameters of Passengers.

We understood the following points:-

1. It is very necessary that the hand grip should be perfectly placed on the handle.
2. The porters should be restricted to carry a load of up to 40 kg only in the one instance
3. The regular range of steeps that have to be covered in stations to carry the luggage through the stairs.
4. Postural Analysis is an inevitable part in which we recorded the awkward postures of Porters due to over-burdening of luggage as shown in the below live examples,

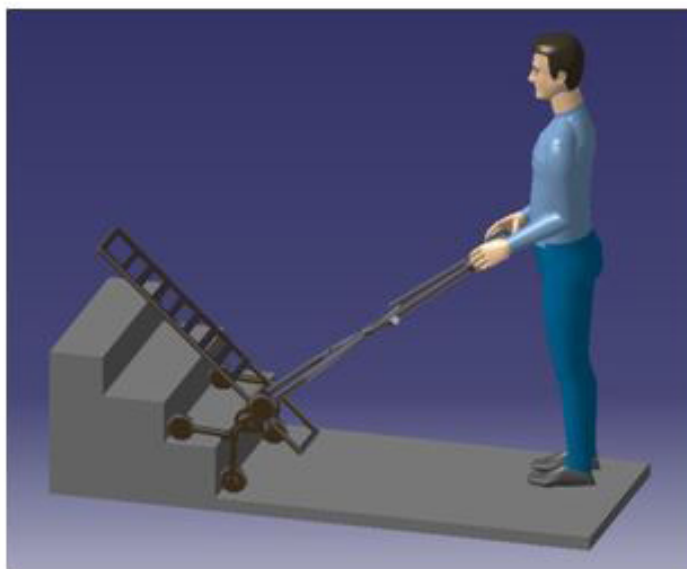
3.1 RESULTS & DISCUSSION

To avoid such problems, collected as a result of initial survey & data abstraction we finalised the design of an ergonomically feasible comfortable trolley. The trolley consists of the following parts:-

1. A chassis designed with a sticky base to carry the luggage.
2. A perpendicularly shaped two legged three wheeled moving system
3. A hand grasp model based on the anthropometric data of a 50th percentile Indian Male Human Hand Grasp
4. A stair model having the regular dimensions as mentioned in the Indian railways handbook
5. The handle of the carrier is designed to provide maximum lifting force with a minimum applied force
6. An ergonomic evaluation with DHM & RULA Analysis gives highly satisfactory results which is shown further

3.2 MECHANISM

The mechanism here is very simple which is shown by the following Assembly model of the carrier:-



Since the wheels are at right angles to each other, once a wheel gets stuck at a stair, the third wheel gets a torque so strong that due to combined human effort & weight of the luggage, which is to be considered around at 40 kg approximately, the carrier follows a step upward with a limited amount of force.

This mechanism can be easily used in straight grounds where three wheels will follow a straight path & all the wheels will act as rollers & facilitate the movement of luggage's with quick action. A stretchable handle is present This approves the dual usability of the load carrier-cum-stretcher.

5. CONCLUSION

Discomforts & unavailability of equipments have considerably reduced the efficiency of porters & have caused long term unbearable problems to the generations of the famous Indian Coolies which are the most undesired consequences. Load Carrier if designed ergonomically with the above mentioned considerations will result in a higher degree of comfort level to the porters. Normally the angles in which people bent using their spinal cord to lift the luggages will be completely eradicated. So, the anthropometric data of the human male plays a very vital role. Effective application of ergonomics in work system design helps in order to achieve a balance between task demands and worker characteristics. The motive of this paper was to analyze various postures adopted by porter for transferring luggage from one place to another. A simple and efficient load carriage system was proposed and evaluated in virtual environment with digital human modeling software for its feasibility to implement it in real scenario. The present paper would encourage use of digital human modeling technology which allows easier and prior identification of ergonomics problems, and eliminates trials using real humans as subjects and thus would ensure user friendly product with saving production cost, time and manual labour.



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