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ERGONOMICS LOAD CARRYING FRAME FOR LABOR

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Abstract—: The Ergonomics is an applied science of equipment design, as for the workplace, intended to maximize workers' productivity by reducing operator fatigue, discomfort and risk of injury in order to improve the quality of work life. In the developing countries, women carry a heavy load on their head at construction sites as most of the work is manually done by them. Most of them adopt the wrong posture while carrying the load and face several problems related to health. About 72 percent of women lift load by bending their back whereas only 28 percent of them lifted load by bending their knees. Though the head mode was energy efficient but the stress in neck muscle and cervical spine did contribute to cervical spondylitis, which is the major health risk. The design of the intervention is such that instead of concentrating total weight of load on head a part of load is transferred to shoulder, which is preventing direct loading of cervical spine. The idea thus focuses on developing a system to improve the safety of carrying loads by focusing on Ergonomics.

Keywords— Ergonomics, cardiovascular, posture, drudgery

I. INTRODUCTION

The study involves a lot of pain and drudgery for people especially women who have to carry the load on their head. Hence it is important to understand the bio-mechanical aspect of this. The construction industry in India is the second largest economic activity after agriculture. Safety consciousness is yet to percolate to these construction sites where majority of the workers work under hazardous conditions. Carrying bricks on head is the most common practice adopted by the labourers at construction sites in India and the other developing countries. Most of these labourers are women especially in India. Carrying load on head might cause injuries in brain and neck, pain in muscles and other spinal problems. Bricks on back using a rope, on shoulders using wooden plank, etc. are few others ways of doing the task of transporting bricks on construction sites. However, these solutions may not be safe and comfortable, though they increase the efficiency. Wheel barrows and pulleys are also used at large construction sites but at small scale the brick carrying is done by labourers. There are many prototypes/devices are available which are not in use or well accepted by the Labourers. The other reason could be the labourers did not find these devices useful and comfortable. Hence, efforts are required to be made to reduce the drudgery by providing some assistive system such that it will lead to distribution of load in other parts of the body such as shoulders.

2. LITERATURE SURVEYS

2.1. Load Carrying Pattern by Women Labourers by Beena Yadav

Beena Yadav did a study assess the type of activities performed, materials carried, posture adopted while carrying the head load by women labourer at construction sites. Head load carriage followed by brick breaking was the predominant activity carried out by maximum women labourers.The majority of the respondents (59%) carried the heavy load greater than 20 kg.The majority (64%) used to hold the load by both the hands raised above shoulder level whereas 21 percent carried the load by holding it with alternate hands followed by carrying the load without holding it (15%). While carrying the load, the women should avoid twisting the spine to turn but move their feet instead. Help from another worker should be taken or a trolley should be used to move heavy objects. While lifting the load, knees should be bent and back should be kept straight with the load being lifted slowly and smoothly. Head load carrier should be used for carrying a heavy load on the head. [1]

2.2 Introduction to Ergonomics by Robert Bridger 2003

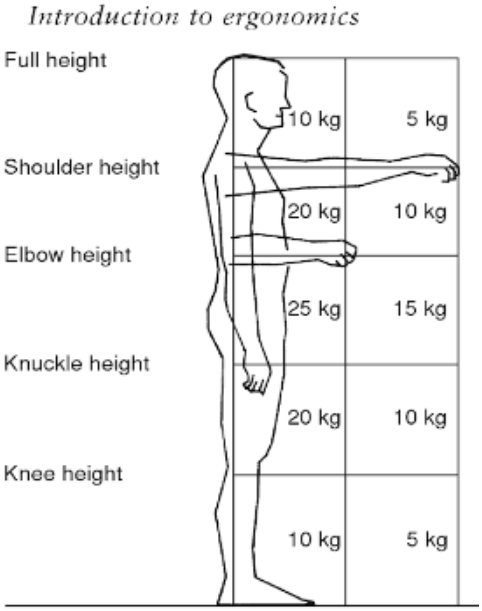

Fig: recommended load for lifting (UK Manual handling regulations, reproduced with permission)

Maximum loads for lifting and lowering

Fig from UK Manual handling regulations, gives recommended maximum loads for sagittal lifting. This can be used for initial screening of manual handling tasks and it is permissible to interpolate between loads if the hands are close to a boundary value, indicated by vertical lines. [2]

2.3 Assistive Aid for Women Workers Carrying Load on Their Head by Rakesh Maheshwari

A case study by Rakesh Maheshwari where he found that along with other problems loading and unloading is also a major issue, additional person other than one who is going to lift the weight, is required to help while loading /unloading on/from his/her head. Bending along with free movement of head and torso is also required. His in consultation with stakeholders following criteria were decided before starting the ideation for developing effective affordable solution. It should be light in weight, easy to manufacture, affordable in cost (preferably less than Rs 200), facilitate better visibility and free movement of hands while carrying load, improve load distribution uniformly across the head with possibilities of load transfer to shoulders, etc. The device was found to reduce drudgery of workers including women. The study would also inspire technology developers for active involvement of stake holders, irrespective of their education and professional hierarchy. [2]

2.4 Ergonomic assessment of manual load carrying among women farm workers a thesis by Swagatika Jena

Swagatika Jena has comes to know on the basis of present study that the material manually carried by farm women were fodder, water, farm inputs and farm produce with most common mode as head loading. The quantum of load carried varied between 10-30 kg. The participants had to walk for 1-2 km with these loads every day. Also an ergonomic intervention is being developed to reduce direct head loading by partially shifting the load either to shoulder or back lowering the musculoskeletal problems among farm woman workers. According to work category and 40 % of VO_2 max as sustainable limit, carrying up to 20 kg load on horizontal surface is permissible for all the three modes (head, back and shoulder). Carrying 15 kg or more on head and back on 10 % ground inclination and shoulder mode at 5 % or more inclination falls under "heavy workload" category. [7]

2.5 Comparative analysis of steel and aluminum structure by Josip Peko

This study presented a practical application of aluminum in the case of modern building design involving low weight design priority (that is, increased span/depth ratio, transportation, and installation) and durability (resistance to corrosion). The masses of the aluminum and steel variants of the considered structure corresponded to 28 kg/m^2 and 72 kg/m^2, respectively. The initially higher price of the aluminum variant did not necessarily indicate a higher price for the entire structure if the advantages of aluminum were properly exploited. It was concluded that aluminum could compete with steel for the specific conditions involving snow and wind load considered in this study. And he said that it is important to note that aluminum is the only lightweight metal that is used in load-bearing structures in structural engineering. [9]

3. DESIGN CONSIDERATION

It should be light in weight, easy to manufacture, affordable in cost, durable, facilitate better visibility and free movement of hands while carrying load, improve load distribution uniformly across the head with possibilities of load transfer to shoulders in order to reduce the pressure put on the spine when load is carried on the head. There is also a good hand grip which reduces stress on the spine when load is carried on the back or while pushing a cart. Ergonomically the load is distributed on the shoulder and at the lumber support by softer material. Its lower part is fitted to the body with the help of flexible belts. It reduces cumulative trauma like headache, backache and other body strains. It should be used to carry a load of 20- 30 kg per trip at one time.

4. TYPES OF LOAD TO BE CARRIED AND DIFFERENT MODES

Efficient design of device will lead to increase amount of load to be carried then compared to the conventional method of load carrying. Right now the conventional method of load carrying leads to weight distribution in a particular part of the body. The load carrying equipment can be designed such that it will lead to distribution of weight in other parts too. This will decrease the muscular effort required for carrying the load.

4.1 TYPES OF LOADS IN DIFFERENT AREAS.

1. Construction sites

The load carried by construction site workers is mostly cement, sand, stones and bricks. Two workers are required to lift and place the load (both cement and brick loads) on one of the workers who then carries away the load to further distances. Unloading of both cement and bricks however requires only one worker. The weight is generally carried on the head by the workers, and varies from 25-30 Kgs in case of sand/cement and around 40 Kgs (or 12 bricks) in case of bricks.

2. Grain market

A typical grain bag ranges anywhere from 50 – 100 kgs. The labourers incurred serious injuries on their neck area a lot, mainly because the whole weight of the bag always fell on one side of the shoulder.

3. Railway station

The average amount of load that the coolie used to carry was around 40 kg. They have health problems too such as joint pain due to carrying load though they are used to carrying of load. Many a times, they fell which lead to serious injury under the pressure of load and the demand of carrying the load in minimum time.

4.2 DIFFERENT MODES OF CARRYING LOADS

The design is aimed to enable three methods of lifting and shifting of the loads by worker, such as above the head, at the back and push or pull.

- It can be changed from one design to another with specific functions. One, to hold lighter load on the head; second, to hold medium weight on the back and third, to push or pull load in a trolley.

(a) Overhead Load Carrier (b) Load carrier as a backpack (c) Load carrier as a trolley

5. MATERIALS SELECTION

We can use following variety of materials or its alloys

- Steel
- Aluminum Alloy
- Beryllium
- PVC pipes
- Soft materials
- Wood

While selecting a material, several factors must be considered, including the cost, strength, resistance to wear, density and machinability. Different materials were explored for making the prototype. Carbon fiber was found to be the best suitable material for the application, as it has high tensile strength. Considering Manufacturability, Tensile strength, Load carrying capacity and Weight into mind, aluminum were found to be most suitable materials.

Aluminum has a density around one third that of steel or copper making it one of the lightest commercially available metals. The resultant high strength to weight ratio makes it an important structural material allowing increased payloads or fuel savings for transport industries in particular. Aluminum is well suited to cold environments. It has the advantage over steel in that its' tensile strength increases with decreasing temperature while retaining its toughness. Steel on the other hand becomes brittle at low temperatures. The tensile strength of pure aluminum is around 90 MPa but this can be increased to over 690 MPa for some heat-treatable alloys. Hence, it was preferred for developing the carrier.[9]

6. CONCLUSION

The paper has yielded a technology developed considering social, gender and cultural issues of women workers involved in carrying load on their head. In the Above literature review, it shows that any the researchers have worked on the input parameters like Work-related musculoskeletal disorders (wmsds), load, drudgery and work postures. By studying all the review papers and research papers by different authors we came to the conclusion that the parameters responsible for the output of the design a load carrier that can ease the manual labour and exertion on the labourer and increase his/her efficiency. So, an exercise of developing affordable and acceptable technological solution for reducing drudgery of women workers involved in transportation of load on their head can be carried out.

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