ATUL I KEDIA 846108

SPECIAL PROJECT

A DOCUMENTATION ON MANUAL MATERIAL HANDLING

SPECIAL PROJECT

A DOCUMENTATION ON
MANUAL MATERIAL HANDLING

BY : ATUL I. KEDIA

GUIDE : DR. G.G. RAY

INDUSTRIAL DESIGN CENTRE

INDIAN INSTITUTE OF TECHNOLOGY

POWAI

BOMBAY 400 076

OCTOBER 1985.

INDEX

1. INTRODUCTION

Since the dawn of the history, man has been struggling to find ways and means of extending and multiplying his own physical efforts in order to free his muscles from the burden of life's tasks. Not that human beings are inherently lazy. This ceaseless search for easier ways to do things is indicative that Homo sapiens has intelligence and that he uses it to his own advantage in his struggle with his environment.

One of man's earliest activities had to do with moving various kinds of objects. The term "materials handling" when taken in its literal sence, pays historical tribute to the simple fact that the human hand and by extension, the human body were the first means employed in this task. Even today, the human body is the most universal type of materials handling machine. Man is able to grasp, pick up, transport, elevate, convey (by pushing over a surface) transfer and set down a vide variety of materials within the limits of his physical strength.

Day by day the requirements of manual materials handling (MMH) are tremendously increasing and today we find MMH in each and every walks of life.

In USA and other foreign countries, lots of studies, researches and experiments have been done up till now and various facts and figures regarding MMH are already established. But in India the Socio-Economic status of the people is entirely different than that of other developed country's people. Here the availability of sophisticated equipments, tools, fixtures etc to each and every person is just illusory to think. The population is too high in India and resources of earnings are limited, which forces the people to over work. For earning his bread, The person works much more than his physical capability. As per the last sensus, it has been found that 70% people of the total population of India are mannual labourers, which clearly indicates tremendous amount of human energy involved in MMH. The unemployment problem also forces even a literate man to involve himself into the work of physical labour.

The excessive load carried by a man or the load carried by a man for excessive period of time leads to breakage of various body segments or components depending on the kind of load he carries, which are absolutely unrepairable. Eventhough if in

few cases they can be repaired, the fake segments cannot carry any amount of load. Due to overloading, the muscles of the body are over stretched and thay are either torn out or the ligament is detached. These muscles eventhough replaced in body by dead fibres, they loose the property of force generation in the body. This way the overloading or improper handling has a great detrimental, permanent effect on the human body. Variables which are to be considered before studying and analysing the effect of MMH on the human beings are the following.

1. TASK VARIABLES

* Location of the object to be lifted (accessibility).
* Size and shape of the object.
* Height from and/or to which the object is lifted.
* Weight and weight distribution of the object.
* Relation between the object's c.g. and the points of grasp.
* Wheather the object is lifted by handles.
* Working position characteristics (e.g. awkward rather than normal).
* Manipulatory accuracy requirements.
* Frequency and duration of lifting and carrying movements.

2. HUMAN VARIABLES

* Age and sex of the person or persons doing the lifting.
* Body dimensions (stature, arm length etc).
* Physical fitness.
* Experience and training.

3. SOCIO ECONOMIC FACTORS

* Economical status.
* Quantity and quality of available nutrients.
* Prevalence of disease.
* Patterns of habitual activity.

4. ENVIRONMENTAL VARIABLES

* Temperature of object to be carried as well as temperature of surroundings.
* Humidity.
* Ventilation.
* Vibration.

In India, no much work has been done on studying the problems associated with the MMH. Even the factory laws simply indicate that 30% of the body weight of the person can be considered as the safe weight for that person to carry. This statement is

very general. This does not indicate the various variables listed above, like at what postures, by which body segments, at what frequency, at what age etc. This necessitates the study of MMH in India and hence our project.

In India, many of load carrying methods are developed traditionally. Since the ancient times the person is trying to develop various methods for available materials by trial and error. Those methods are traditionally transferred and have become habits of the today's people. There is nothing much scientific in that.

For a scientist or a research fellow it is absolutely necessary to find out, what are those methods or habits, or how many ways the people follow to handle the materials. Thus an elaborate documentation of the different ways and habits involved in material carrying by the Indian people, is necessary. Further detailed analysis on validity of those methods can be determined by simulating the same conditions.

2. OBJECTIVES

The objectives of this project are the following.

1. To document broadly the various modes of MMH seen in our day to day life.
2. Categorisation of those methods of handling on the basis of the amount of load being carried and body segments used.
3. Categorisation of those methods depending on Socio-Economic status of the people.

The visuals on different modes of load carrying with respect to different body segments used are presented here. It also gives how the socio-economic factors and amount of load affect the load carrying activity.

3. METHODOLOGY

Photogrammetric technique was used to document the various modes of MMH. The various available incidents of MMH were shot on Ektachrome film by using a 35 mm camera with f 1.4 normal lens as well as a f 3.5 135 mm telephoto lens, depending on the requirements.

The following places were especially chosen for photographic work, where considerable amount of MMH was observed.

* Construction sites.
* Grain markets.
* Vegetable markets.
* Railway stations.
* Bus stands.
* Villages.
* Industries.
* Transporter's godowns.
* Educational Institutes, etc.

After getting those photographs, appropriate photographs were selected out and printed in Black and White.Line diagrams of those photographs were obtained with bleaching technique. After obtaining all line diagrams, classifications were done on the basis of body segments involved in carrying the loads.

4. RESULTS

The study and analysis of the MMH postures of Indian people lead to the following results and conclusions.

The various body segments used in carrying the different kinds of materials were hands, shoulder, head and back depending on the weight, volume, distance, height of object and other factors.

ONE HAND.

* Weight upto 25 Kgs. were carried in one hand.
* Certain equipments like bucket, suitcase etc are designed to permit use of one hand only.
* Hand was used sometimes to support the load when it was carried on head or back or shoulder.

TWO HANDS

* Total weight upto 30 Kgs. were carried in to hands.
* Hands were used to support the load when it was carried on head or back or shoulder.

SHOULDER

* Weights upto 70-75 Kgs. were carried on shoulder.
* Items like shoulder bag, purse etc allows both the hands to remain free.

* More items or containers as well as containers without handles were also being carried on shoulder

BACK

* Weights upto 100 Kgs. were seen to be carried on back.
* Generally vegetable, grain and cement bags with large volume were seen to be carried.

HEAD

* Weights upto 120-130 Kgs. were seen to be carried on head.
* Some objects eg. Tricycle which were not at all suitable to carry in other ways were carried on head.
* Some soft materials like cotton, grass etc. were seen obstructing the vision of the person carrying them.

TRANSITION

It was seen that few items were carried in one or two hands but at waist or shoulder levels. This was due to intermediate loads or due to habits.

Following are the examples whichare shown in the line diagrams.

* A 'Dubba' carried in one hand at waist level - Habit.

* A 'water pot' carried in one hand at waist level - Habit.
* A big Gamela full of bananas carried at shoulder level with two hands - Intermediate load.

As a general rule we can conclude from the documented postures and weights that

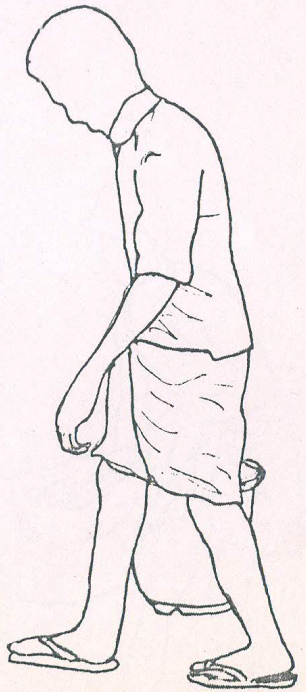
"Lifting weight was greatest when the lift weight was in the same vertical plane as body and it decreased rapidly as the weight moved away from the body.

Considering Socio-Economic factors, it was clearly found that most of the largest weights were carried by the lower class of people. By middle class people the weights carried were considerably more but they were carried mainly in hands and not by shoulders or back or head. Very less amounts of weights were carried by higher class. Their heavy belongings were carried by lower class people only.

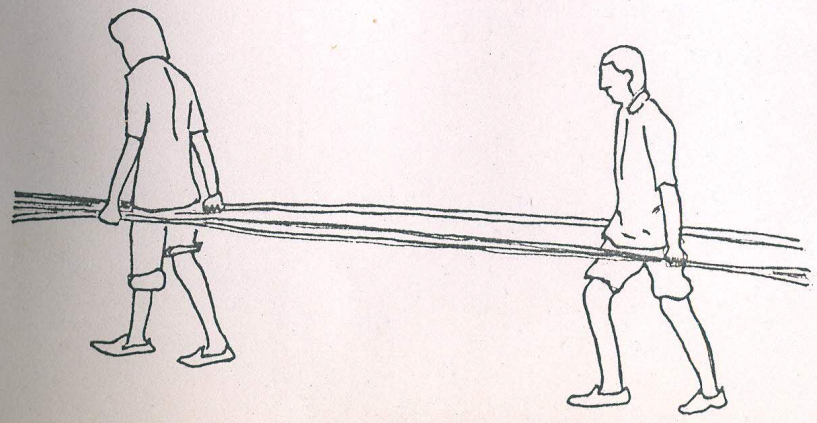
The load carrying capacity of female workers was found lesser than that of male workers, but compared to other developed countries, the load carried by Indian females was very large. Children of the age group 8 to 20 years were also found involved in heavy materials handling.

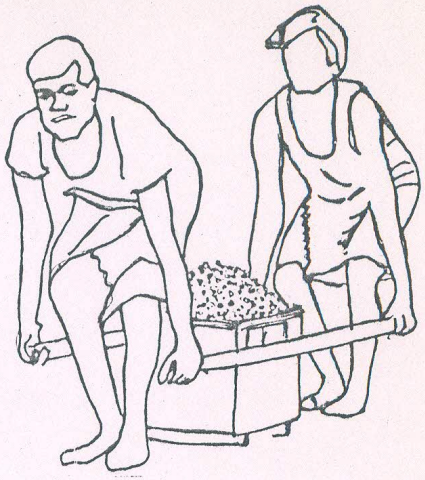
LOAD CARRIED BY DIFFERENT BODY SEGMENTS

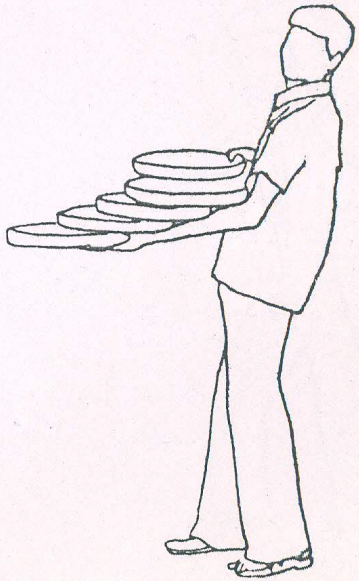
ONE HAND



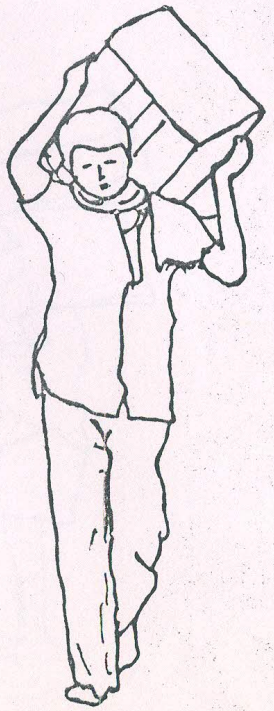
TWO HANDS

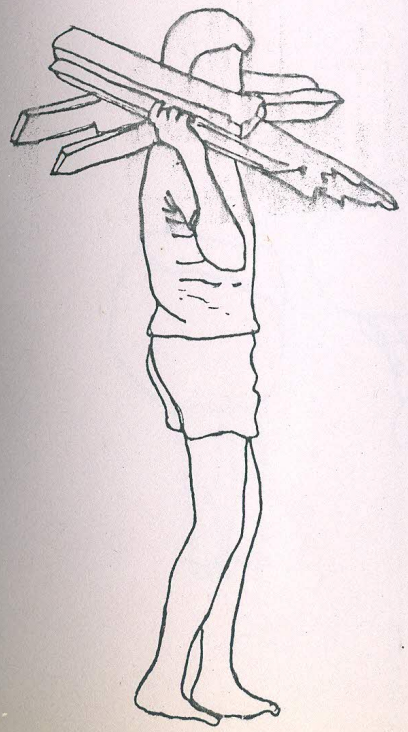


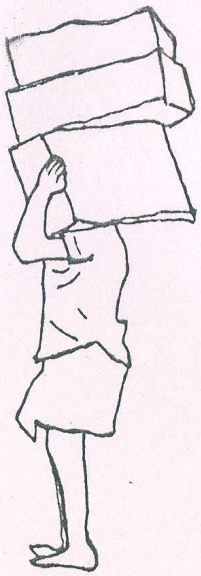


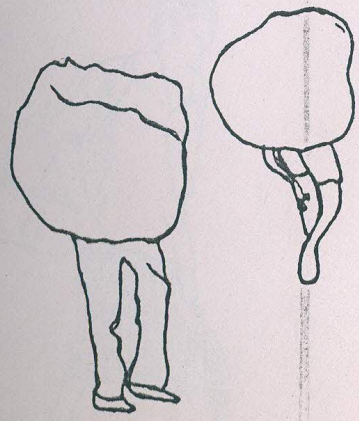


SHOULDER

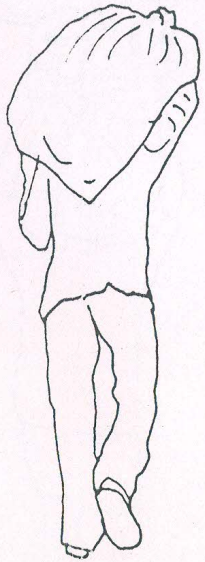




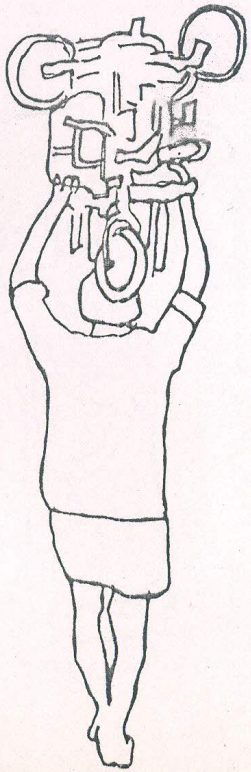


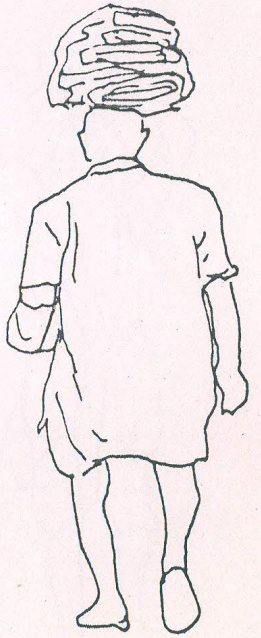


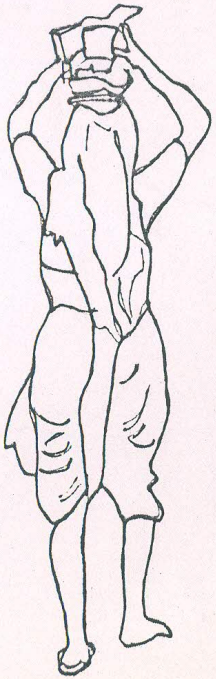
BACK

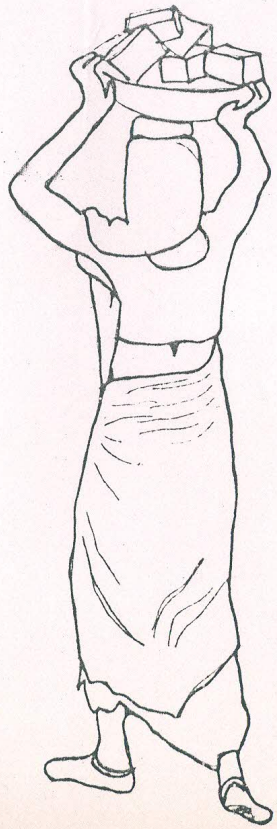


HEAD

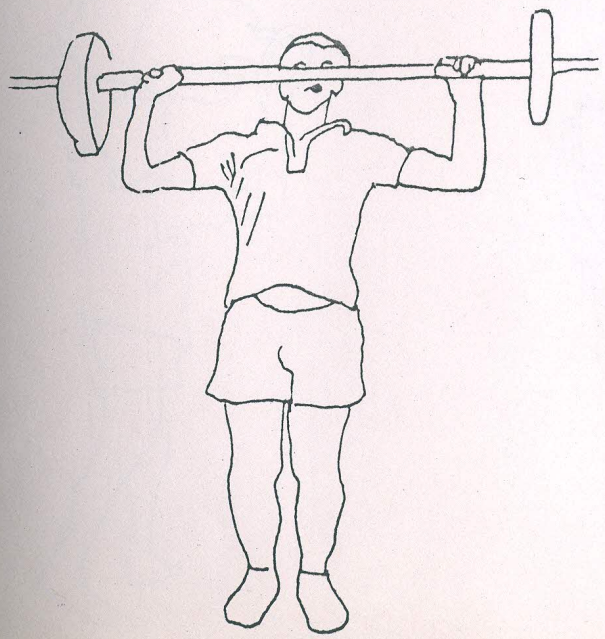


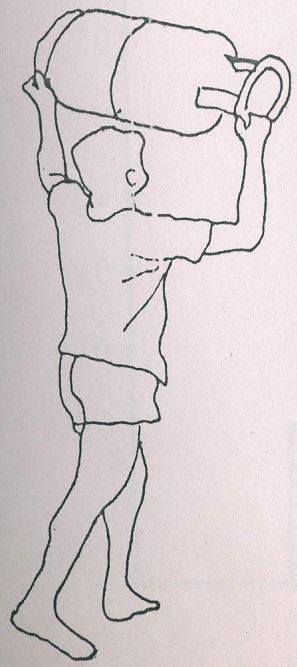


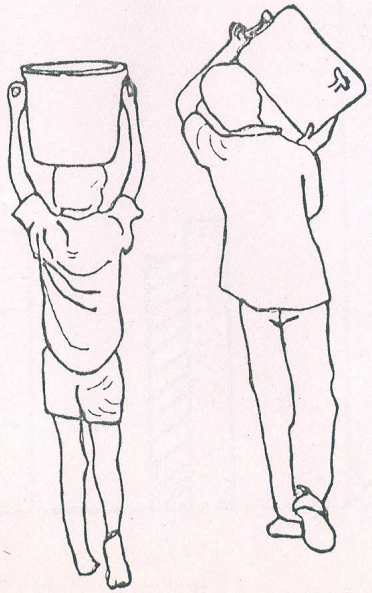


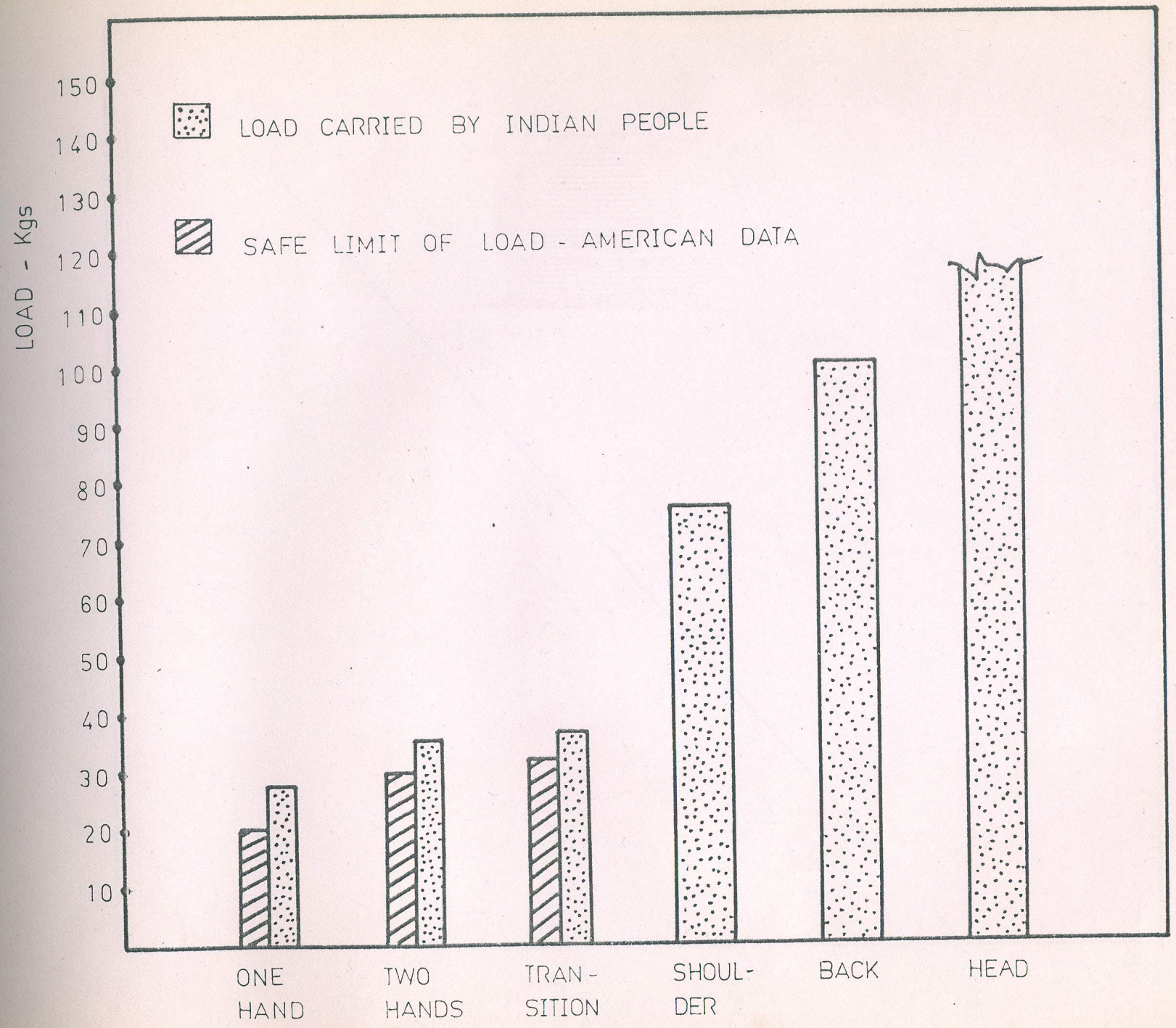


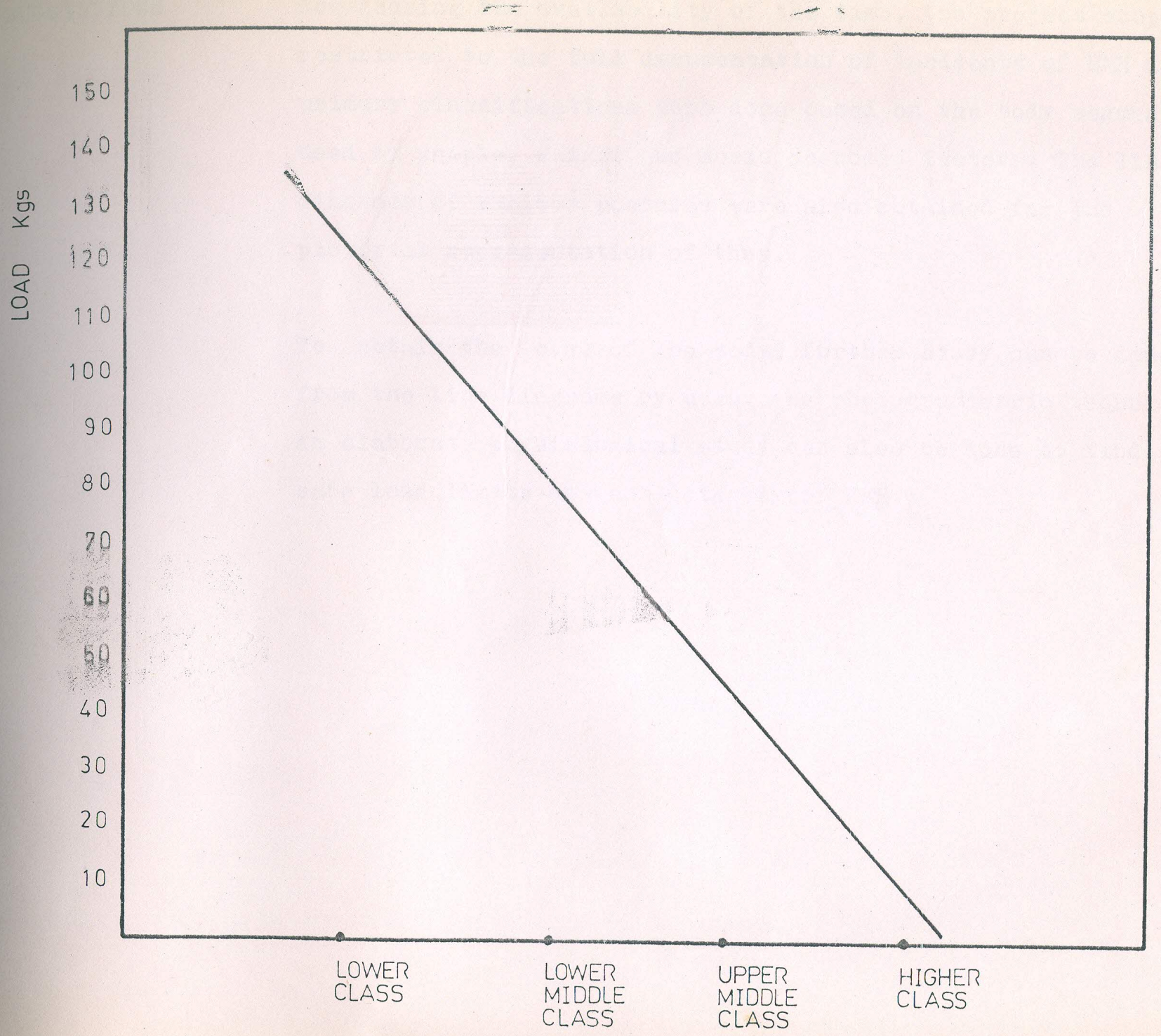
TRANSITION








LOAD CARRIED BY INDIAN PEOPLE
SAFE LIMIT OF LOAD - AMERICAN DATA
LOAD - Kgs
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ONE HAND
TWO HANDS
TRAN-SITION
SHOUL-DER
BACK
HEAD


LOAD Kgs
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
LOWER CLASS
LOWER MIDDLE CLASS
UPPER MIDDLE CLASS
HIGHER CLASS

5. SUGGESTIONS

Considering the availability of the time, the project scope was restricted to the full documentation of incidents of MMH and primary classifications were done based on the body segments used by people, Weight and Socio Economic factors. The line diagrams of various postures were also obtained for the pictorial representation of them.

To obtain the c.g. of the body, further study can be done from the line diagrams by using the photogrammetric technique. An elaborate physiological study can also be done to find out safe load limits on e ach category of MMH.

ACKNOWLEDGEMENT.

I am highly indebted and I take this opportunity to express my deep sence of gratitude towards Dr. G.G.Ray and all other faculty associates and friends who helped me in achieving the success of this project.

A.I. KEDIA
IDC - 1985.

REFERENCES

1 Apple J.M.(1972) Materials Equipments and Methods (1 st ed.) NewYork, John Wiley.

2 Haynes D.O.(1957) Materials Handling Applications (1st ed.) Philadelphia, Chilton Company.

3 Mc Cormic E.J.(1970) Human Factors Engg.(3rd ed.) New York, Mc Graw Hill.

4 Murrell K.H.F.(1975) Ergonomics: Man in his working environment (5th ed.) Chapman & Hall.

5 Stoker H.E.(1955) Materials Handling Principals, equipments,andmethods. (2nd ed.) New York, Prentice Hall.

6 The Human Factors Society Inc. (Oct 1983) Human Factors, sp. issue Manual Materials Handling, Santa Monica, USA.

7 Woodson W.E.(1981) Human Factors Design Handbook, New York, Mc Graw Hill.