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Ergonomical calculation for assesting recmonded wieght limit for Manual Material Handling task: An Review

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Abstract

Many companies are facing with the problem of worker's health during manual material handling ultimately which results the reduction in productivity. This is due to undefined weight limit for the workers. Even The National Institute for Occupational Safety and Health (NIOSH) have fixed it's maximum limit of 23kg but still ,some problems like Muscular Disorders , Low Back Disorders are being faced by workers during MMH. It's because of the some limitations in NIOSH's RWL equation. With this review paper author wants to disclose these limitation and the research which have been done on these areas. Author has done a literature Review of past few years on that area and sharing his experience with this paper.

Keywords—MMH, Ergonomics, Fuzzy Logic,

I INTRODUCTION

There are kinds of injuries and disabilities associated with MMH tasks, among which LBDs represent the most common and most costly musculoskeletal disorder experienced in the workplace. In this MMH area load that lifted by the person plays important role in LBD problem. Load constant it is load that is lifted by worker without any musculoskeletal problem [5].

Recommended load constant for worker leads to:-

- Improved productivity
- Saves cost
- Improved worker's life
- Increases safety
- Quality of products increased
- Stress & fatigue reduced
- Efficiency increased

In literature authors discussed about the importance of ergonomics in manual material handling which cause MSDs. Most of the authors have taken maximum of five factors for analysing manual material handling tasks but for safe manual material handling there are numbers of factors which effect safe lifting

In the latest ISO draft, the acceptable weight for non-repetitive lifting is less than 25 kg under ideal circumstances [3]. The limits could vary ranged from 20 kg to 100 kg for adult male while considering different lifting conditions (ILO, 1990)[1][2][3]. There was a tendency in legislation to reduce the limit for further reducing the risk of low back injury. The original NIOSH equation included four lifting factors and a load constant of 40 kg, whereas the revised equation added two more multiplier and reduced the load constant to 23 kg. But this can vary according to many other factors like workers age, strength and the method of lifting like on head or on shoulders etc[2][3].

II FACTORS FOR ANALYSING MANUAL MATERIAL HANDLING TASKS

These following factor should considered while evaluating LC and RWL for worker, but on literature reviewing authors found that only 3-5 maximum factors had been considered by past researchers. But in actual these all factors are responsible directly or indirectly for worker's health injury during MMH job [3][5][8][9].

1. Hazardous movements or postures (e.g., twisting, extended bending and reaching)
2. Anthropometry
3. Environmental factors include:
   - Temperature
   - Relative humidity
   - Lighting
   - Noise
   - Time constraints (e.g., machine–paced work or deadline pressures)
4. Weight lifted
5. Lifted Height
6. Distance moved
7. Frequency
8. Coupling type
9. Absent or inappropriate handles,
10. extended periods of time
11. physical conditions such as
    - Obstacles
    - floor surfaces (e.g., slippery, uneven or damaged)

III LITERATURE REVIEW

A.

Authors: Ganesh Pal Singh Jadon & Manish Kumar Sagar

Journal: IJERT

Year: 2012

Title: Evaluation of Load Constant of Worker in Industry by Using A Fuzzy Logic Approach

Factor Considered: Age, Height, Weight, Strength

B.

Authors: Ajay Bangar, &Vikrant Joshi, Neetu & K.C.Arora

Journal: IJMIE

Year: 2011

Title: Analysis of Recommended Weight Limit to Mitigate the Lower Back Pain in Manual Material Handling Task

Factor Considered: Age, Capacity,

C.

Authors: André Plamondon & Christian Larivière

Journal: Ergonomics, Taylor & Francis

Year: 2011

Title: Relative importance of expertise, lifting height and weight lifted on posture and lumbar external loading during a transfer task in manual material handling

Factor Considered: Expertise, Lifting height, Weight lifted

D.

Authors: Andre´ Plamondon

Journal: Ergonomics, Taylor & Francis

Year: 2010

Title: Biomechanical differences between expert and novice workers in a manual material Handling task

Factor Considered: Lifting height, Load,

E.

Authors: Miguel A. Perez

Journal: Ergonomics, Taylor & Francis

Year: 2008

Title: A neural network model for predicting postures during non-repetitive manual materials handling tasks

Factor Considered: 41 anthropometric and strength characteristics

F.

Authors: Isabel L. Nunes

Journal: The Ergonomics Open Journal

Year: 2010, *3*, 38-48

Title: Handling Human-Centered Systems Uncertainty Using Fuzzy Logics – A Review

G.

Authors: Danijela Tadic, Marko Djapan, Mirjana Misita, Miladin Stefanovic, Dragan D. Milanovic.

Journal: International Journal of Occupational Safety and Ergonomics (JOSE)

Year: 2012 Vol. 18, 2 .115-126

Title: A Fuzzy Model for Assessing Risk of Occupational Safety in the Processing Industry.

 ISBN: 978-93-86171-85-6

Factor Considered: Uneven or Slippery Surface, Carrying Loads, Frequency, Biological Hazards

It's clear by above literatures that some gap is still vacant among the factors which must be noticed in determining the actual RWL. Except these literatures many other are place on references of this paper.

IV REVISED NIOSH EQUATION FOR THE DESIGN AND EVALUATION OF MANUAL LIFTING TASKS

Recommended Weight Limit (RWL): The RWL is the principal product of the revised NIOSH lifting equation. The RWL is defined for a specific set of task conditions as the weight of the load that nearly all healthy workers could perform over a substantial period of time (e.g., up to 8 hours) without an increased risk of developing lifting-related LBP. By healthy workers, mean workers who are free of adverse health conditions that would increase their risk of musculoskeletal injury[7].

The RWL is defined by the following equation:[2][3]

$$RWL = LC \times HM \times VM \times DM \times AM \times FM \times CM$$

- LOAD CONSTANT (LC)
- HORIZONTAL MULTIPLIER (HM)
- VERTICAL MULTIPLIER (VM)
- DISTANCE MULTIPLIER (DM)
- ASYMMETRIC MULTIPLIER (AM)
- FREQUENCY MULTIPLIER (FM)
- COUPLING MULTIPLIER (CM)

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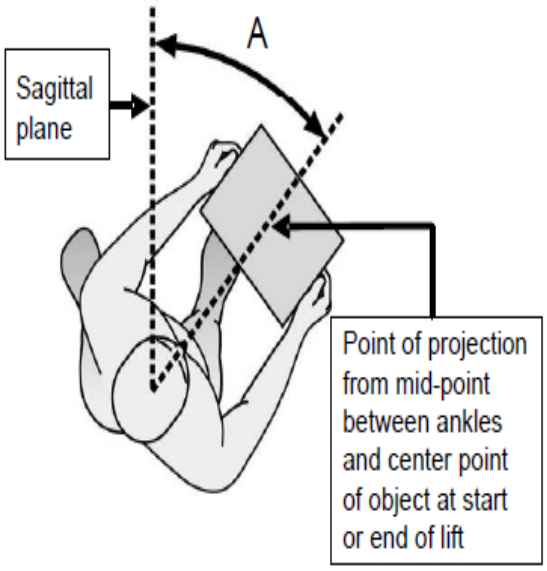

Fig. 1 TA (trunk angle),
view for angle of Asymmetry Multiplier (AM)

Fig. 2 top

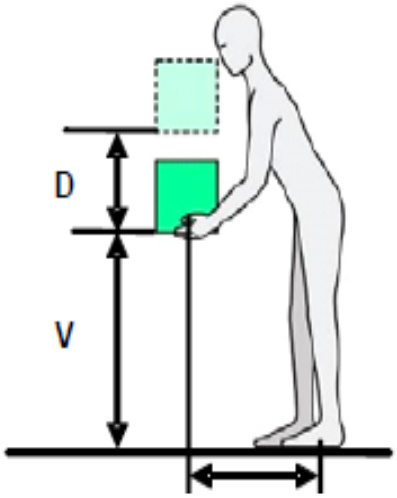

Fig. 3 Distance location of V, D, H.

H (Horizontal distance from the load to the ankles) and V (vertical distance from the load to the floor) Wt_{LD} and Wt_{CM} (weight of the load and upper body mass respectively), MA_{LD} and MA_{CM} (horizontal moment arm with load and upper body Centre of mass, respectively)

V LIMITAIONS OF NIOSH'S EQUATION

The following list identifies a set of work conditions in which the application of the lifting equation could either under- or overestimated the extent of Physical stress associated with a particular work-related activity.[2][3]

1. The revised NIOSH lifting equation is based on the assumption that manual handling activities other than lifting are minimal and do not require significant energy expenditure, especially when repetitive lifting tasks are performed. Examples of non-lifting tasks include holding, pushing, pulling, carrying, waking, and climbing. If such non-lifting activities account for more than about 10% of the total worker activity, then then of worker's energy expenditures and/or heart rate may be required to assess the metabolic demands of the different tasks.

2. The revised lifting equation does not inc1ude task factors to account for unpredicted conditions, such as unexpectedly heavy loads, slips, or falls. Additional biomechanical analyses may be required to assess the physical stress on joints that occur from traumatic incidents. Moreover, if the environment is unfavourable (e.g, temperature or humidity significantly outside the comfort range)

3. The revised equation was not designed to assess tasks involving one handed lifting, lifted while seated kneeling or lifting in a constrained or restricted work space.

4. The equation does not apply to lifting unstable loads for purpose of applying the equation; an unstable load would be defined as an object in which the location of the center of rnass varies. Significantly during the lifting activity.

5. The revised equation assumes that the worker/floor surface coupling provides at least a 0.4 (preferably 0.5) coefficient of static friction between the shoe sole and the waking surface. An adequate worker/floor surface coupling is necessary when lifting to provide a firm footing and to control accidents and injuries resulting from foot slippage.

6. The revised lifting equation assumes that lifting and lowering tasks have the same level of risk for low back injuries (i.e. that Lifting a box from the floor to a table is as hazardous as lowering the same box from a table to the floor}. This assumption may not be true if the worker actually drops the box rather than lowering it all the way to the destination.

VI CONCLUSIONS

The review presented in this paper provided only shortcomings of the various criteria, but many of the criteria are useful, or perhaps just need to be redefined. It does not appear that MMH-related injuries will disappear soon, and the costs associated with these injuries continue to rise. There has been a tremendous amount of research conducted in the area of MMH. This research has provided numerous criteria and data that have been applied to reduce the incidence and severity of MMH-related injuries. This paper is based on the literature review of application of fuzzy logic in MMH and applications & limitations of NIOSH's RWL equation, from 1998 to 2012. Since many data regarding this theory are ill or vague that's why determining more accurate result for actual RWL is very difficult task. Some approx result is possible with fuzzy logic application. Fuzzy logic best deals with uncertainty or ill data.

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