ERGONOMIC ANALYSIS OF MANUAL WORK CASE STUDY OF LIFTING KRAT BOTTLED DRINK IN PT X

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Lifting and lowering of goods is the activity which used widely at work. Lifting and lowering of krat bottled drink to the truck in distribution department PT X is dominant activity. Lifting and lowering must be done with correct method to achieve effective work and safety for worker.
Data from distribution department show that lifting and lowering activity of bottle krat during 1 hour per day, lifting frequency 10 times in every minutes each on average.
Analysis using biomechanics and NIOSH equation show that lifting of krat bottled drink to truck is not safe, indicates by RWL < 15kg and LI > 1.

Keyword: material manual handling, NIOSH equations, safe load

1. Introduction

Lifting and Lowering of material by manually usually applied in everyday activities . On modern production system material handling in manual is still required when the equipments or technique tools in not available

Lifting and Lowering of material by manually, if this not done in ergonomic way, will generate accident in industry. Sigh of muskoloskeletal is the first of sigh at parts of muscle skeletal felt by someone start from a real light sigh until very pain. It's happened because muscle receive static load recurring in long times, will be able to cause sigh in the form of damage at hinge, ligament and muscle. This industrial accident known as "Over exertion". Lifting and carrying overloaded can be damage to the body. Data about the accident has reached mean value 18% from all accident during the year 1982-1985 according to statistical in state part of New South Wales. From this accident data 93 % between it resulted from strain, while 5% between of hernia. From data about strain 61% of pain it happen on the back.

Process Lifting and lowering activity also is used in PT X . Loading and unloading of krat bottled drink to the truck is a dominant activity. There are many method to loading the krat to the truck. First loading to the truck using forklift. Second loading to the truck manually. To arrange in huge of number of krats usually using forklift. But sometimes loading and unloading Krat bottle to the truck is done by manually. To quicken removes process, usually krat is heaped by 6-7 stack, then is keeled over be turned around. As a result some krat can be moved at the same time.

Based on data it is known that the worker at distribution department of PT X have a job to move the krat to the truck. They work during 1 hour around, lifting frequency , 10 times every minutes each on average. Base on duration of this activity length enough and executed every day worked it is very necessary to be investigated to know that procedure was safe or not based on Recommended Weight Limit and Lifting Index criterion.

2. Theory

2.1 Biomechanics

Biomechanics is a study about human bodies mechanics. Body consist of hundred of bones to build the structure of human bodies. Structure of the body used to take and give force. The force that act upon the body are conveniently divided into two types: external force and internal forces. The human body have a limitation to receive the external force. For lifting and lowering activity safety criteria based on compression load at inter vertebral disc between lumbar number five and sacrum number one. (L5 /S 1). Some research indicates that the activity with over

flexion posture or extension posture can result overload at opo physical joint. Other research indicates that around 65% lumbar damage as result of torsion load.

2.2 Load Lifting Limitation.

Load lifting limitation came from several point of view as the follow as : biomechanics, legal aspect, physiology and physically. Some states in Australia gives legal definition maximum load lifting as follows: man below(under maximum 16 years 14 kg, man between 16-18 age 16 kg, man above 18 years the re is no limitation, woman 16-18 age 11 kg maximum, woman above 18 years age 16 kg maximum.

Another criteria is based on physiology payload by considering average of metabolism payload from activity lifts recurrent. This thing is knowable from consumption of oxygen. Other way is with measuring the accentual direct in anti node during activity lifts.

Load limitation also come from biomechanics. It is determined based on compression load at inter vertebral disc between lumbar number five and sacrum number one. (L5 /S 1). NIOSH specifies the maximum force to lift load based on compression force 6500 Newton at L5 /S1. Recommended Weight Limit (RWL) is a safe load which can be lifted by worker without risk. RWL stated in United States by NIOSH in 1991. NIOSH Equation applied at condition of as follows as:

1. Load is static load, there is no addition of load in the middle of work.
2. Load is lifted with both hands.
3. Lifting or lowering is done during 8 hour maximum.
4. Lifting or lowering is not done when sitting or kneeling.
5. The working area is not narrow.

Recommended load lifted according to NIOSH is as follows:

RWL = LC x HM x VM x DM x AM x FM x CM …….(1)

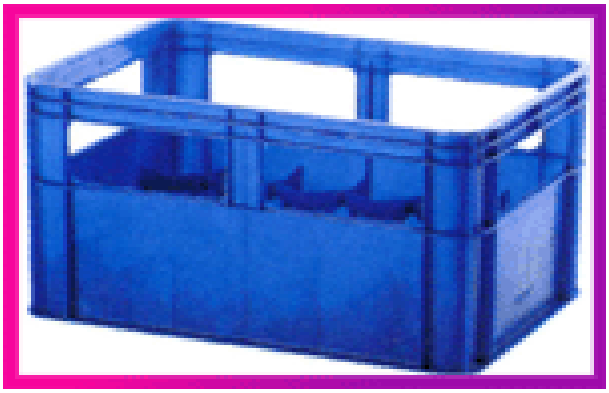
LC is lifting constanta = 23 kg. H equals the horizontal distance from the mid-point of the line joining the inner ankle bone to a point on the floor directly below the mid-point of the hand grasps. V is the vertical height of the hands above the floor. D is the distance component and is defined as the vertical travel distance of the hands between the lift origin and destination. A is the asymmetry component and refers to angular displacement or twisting of the body where the lift begins and ends. F is the frequency component and is defined as the number of lifts per minute. Equations and charts determine multipliers for each task variable. The horizontal multiplier HM is 25/H for H measured in cm. If H is less than or equal to 25 cm, the multiplier is 1.0. The vertical multiplier VM is the absolute value or deviation of V measured at the origin, from an optimum height of 75 cm. The VM equation is 1 - (0.003 | V - 75 |) and when V is at 75 cm VM is equal to 1.0. The distance multiplier DM is (0.82 + (4.5/D) and DM is equal to 1.0 when D is at 25 cm. The asymmetric multiplier AM is 1-0.0032A where AM has a maximum of 1.0 when the load in directly in front of the body and decreases as the angle of asymmetry (A) increases. The CM is the coupling component and describes the hand-to-object ease of gripping. A good grip coupling reduces the maximum grasp force and increases the acceptable weight limit. Single task analysis uses the RWL equation and should be used when task variables do not vary.

Li = Load Weight/Recommended Weight Limit.....(2)

Li > 1 indicates that the job is not safe and must be improvisation on Figures 1 and 2 show the values of the remaining multipliers (FM) and (CM).

Tabel 1 Coupling Multiplier

Coupling type	Coupling Multiplier	
	V<75 cm	V≥ 75 cm



Good	1.00	1.00
Fair	0.95	1.00
Poor	0.90	0.90

Figure 1. Krat Bottle Drink

Tabel 2. Frequency Multiplier

Frequency Lift/min	Work Duration					
	≤ 1 hour		<1 but≤2 Hours		>2 but≤8 hours	
	V ≤ 30 ”	V≥ 30 ”	V ≤ 30 ”	V≥ 30 ”	V ≤ 30 ”	V≥ 30 ”
≤ 0.20	1.00	1.00	0.95	0.95	0.85	0.85
0.5	0.97	0.97	0.92	0.92	0.81	0.81
1	0.94	0.84	0.88	0.88	0.75	0.75
2	0.91	0.91	0.84	0.84	0.65	0.65
3	0.88	0.88	0.79	0.79	0.55	0.55
4	0.84	0.84	0.72	0.72	0.45	0.45
5	0.80	0.80	0.60	0.60	0.35	0.35
6	0.75	0.75	0.50	0.50	0.27	0.27
7	0.70	0.70	0.42	0.42	0.22	0.22
8	0.60	0.60	0.35	0.35	0.18	0.18
9	0.52	0.52	0.30	0.30	0.00	0.15
10	0.45	0.45	0.26	0.26	0.00	0.13
11	0.41	0.51	0.00	0.23	0.00	0.00
12	0.37	0.37	0.00	0.21	0.00	0.00
13	0.00	0.34	0.00	0.00	0.00	0.00
14	0.00	0.31	0.00	0.00	0.00	0.00
15	0.00	0.28	0.00	0.00	0.00	0.00
≥15	0.00	0.00	0.00	0.00	0.00	0.00

3. Data Description

Based on the field data is known as follows:

a. Lifting elevation from floor at initial condition is 20 cm (Elevation of the handle krat)
b. Destination elevation from floor is 110 cm (elevation of the truck 90 cm)
c. Krat bottled drink lifted by 2 hand.
d. Angle of asymmetrical 45 degree both in initial and destination of lifting.
e. Specification of the krat bottled drink are 15 kg weight, contents of 24 bottles, 25,5 cm height, 28 cm width and 41 cm length.
f. Horizontal travel 35 cm at initial position and 40 cm to the destination.
g. Vertical travel 90 cm
h. Coupling multiplier is good.
i. Lifting frequency 10 times per minute and work duration less than one hour .

4. Discussion

Lifting activity of krat bottled drink to the truck seen to be a simple work and without risk. But if see carefully there are some mistake that is:

a) The worker tends to bend their body when start to lifts krat causing excessive force at backbone joint, especially lumbar fifth and sacrum first (L5/S1). Correct posture is lifting with the legs and posture always stands up.
b) The data collected demonstrates that the frequency component for the task is excessive and should be reduced through a reduction of the duration of the lifting time. The horizontal distance H is excessive with larger sized boxes and should be decreased. The vertical distance multiplier as a function of the distance an object travels before placement is excessive and should be reduced.

RWL = LC x HM x VM x AM x FM x CM Li = 4,621< weight of the krat bottle drink and Load Weight/ Recommended Weight Limit = L/ r w l = 3,262. This condition indicates that the job is not safe and must be improve.

5. Conclusion

The goal of this study was to determine ergonomic acceptable limits according to the NIOSH method for an industrial lifting station. Results of the study show that RWL = 4,621<15 kg and LI = 3,246>1, indicates the task is not safe and must be improve

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