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Ergonomic Improvement of Material Handling By Redesigning Trolley

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Abstract: ***Ergonomic improvement in assembly line is the thing which the term generally refers to the scientific method of creating a favorable work and work space which demands to the ability of the workers. Ergonomic configuration is important to guarantee high efficiency, keep away from alignment and damage, and lift fulfillment and confidence among the workforce. More than satisfied and fulfilled workforce, work cells made of ergonomic structure offer noteworthy incentive to producers in terms of lesser output and worker compensation premiums. The system will be reactive or proactive when applying ergonomics. In reactive ergonomics, identifying current problems and take measures to correct them. In proactive ergonomics, seeing areas that can be improved and fix the issues before they become large problems. Each organization ensures the safety and comfortable environment of their workers, in turn they believe in increased quality and in performance ergonomically designed work cells and working equipments are the key area to be concentrated. In this study the problem is analyzed through pareto chart and cause and effect diagram one issue is taken as pallet transfer manual because of this manual pallet transferring workers facing issue like back pain and for this is a solution of ergonomically designed trolley to reduce worker fatigue and the productivity was improved by using major problem solving tools.***

Keywords: Ergonomic, work cell, trolley

I. INTRODUCTION

Ergonomic is characterize as the intelligent control which concerns about the cognizance of joint efforts among individuals and various parts of a structure, and the use of hypothesis, benchmarks, data and procedures to design in order to move in front for human welfare and by large framework performance HF and E is implemented to fulfill the need of departmental health, security and also ensures increased product output [1]. The design structure makes the workers to handle the machine in an easy way and creating a pleasant environment of work. Legitimate ergonomic design is inevitable to counteract damage due to repetitive strains and other disorders related to muscle and bones, which may develop day by day and convert permanently after a long period of time. Ergonomics and human needs worried about the interface between the, apparatus and their surroundings [2-4]. It assesses the client's abilities and constraints in looking to guarantee that task, capacities, information and environment to suit each other. To overview the pair between an individual and the used innovation, human elements masters or ergonomists think about the activity (action) being done and the requests on the client; the hardware utilized [5-6]. Ergonomics draws on numerous controls in its investigation of people and their surroundings.

II. METHODOLOGY

Problem Selection
Objectives of the project
Problem description
Brain storming
Fish bone diagram
Validation of possible causes
Root cause
Wheel designing
Fabrication

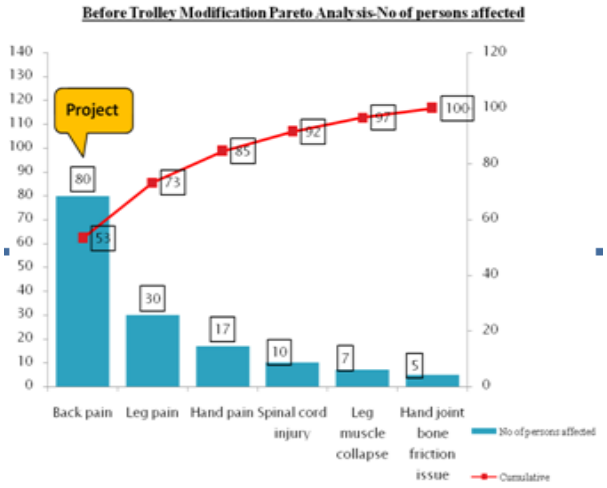

Fig. 1.Pareto chart

III. PARETO CHART

Pareto chart shown in figure 1 peaks the principal (large occurring) number of factors. In the control of quality, it usually represents the foremost common sources of defects, frequent occurring form of defect, or the foremost frequent reasons for problem solving, and so on. Wilkinson (2006) devised associate degree algorithmic rule for manufacturing statistically primarily based acceptance limits (similar to confidence intervals) for every bar within the Pareto chart.

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IV. BRAINSTORMING

It is the technique where a group of persons forms a team and sit together and analyze the root cause for the problem and record the data of the causes. Finally they reduce the causes of possibilities into very few and list it out. The final decision will be taken by the authority of this team. Initially the team members participate in this meeting, each and every individual voice of ideas & suggestions taken for considerations and they are recorded. These suggestions, ideas may be fruitful or not so. All the points are taken for discussion collectively. Finally they reduce it to very few and results are short listed. The same procedure is followed to detect the root causes for the separation of the shield and results are listed as below Puling and pushing force of the trolley by operator is high. Due to friction at the rolling surface. Irregular physical activity of the operator needs to be avoided. Operator fatigue should be reduced. Trolley movement should be reduced. Material of the trolley should be change in required parts. Entire trolley need to be redesigned. Wheel should be aligned with the epoxy floor. Rolling resistance refers the resistance of wheel against the floor surface Rolling resistance is due to elasticity property of the material and because of the irregular surface finish of the rolling surface.

V. CAUSE AND EFFECT DIAGRAM

It is graphical chart of tabular structure to count and determine the potential cause of a problem. This also called as fish bone diagram. The central structure shows the effect with multiple branches emerging from stem which counting the various groups of available causes of the problem. Figure 2 shows the fish bone diagram.

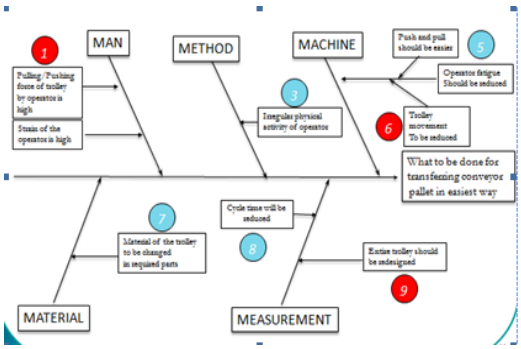

Fig. 2.Fish bone diagram

VI. ROOT CAUSE

Resistance to rolling is the estimation of the opposing effect of ground surface at the wheel contact point or ground interface with the wheels. It is mostly demonstrated in the unit of pounds and is the estimation of energy lost with respect to unit distance of rolling. For a tire rotating on a smooth surface, the tire will change its shape to some extent, and that flexibility will cause some retardation to the rolling motion.

The smooth surface may undergo change of dimension, especially if surface is relatively smooth. Good example for smooth surface is sand floor area. Energy loss is estimated by the rolling resistance as something is rolled on a particular distance. Figure 3 and 4 shows the rolling resistance and selection of trolley wheel.

(i) Due to the contact area friction
(ii)For the reason of elasticity property of material
(iii) Due to the property of roughness

VII. FACTORS TO BE CONSIDERED

Load acting on wheels

Diameter of wheel

Material hardness

Floor material and surface roughness

Condition of floor

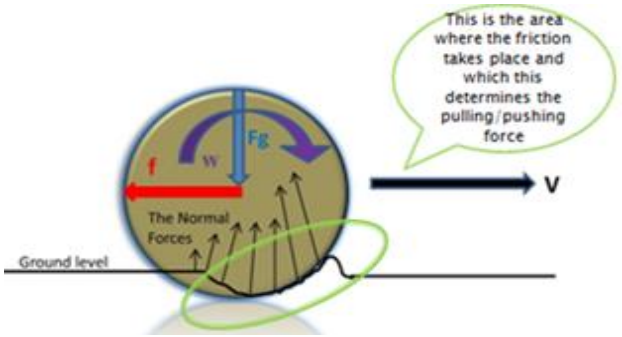

Fig. 3.Rolling Resistance

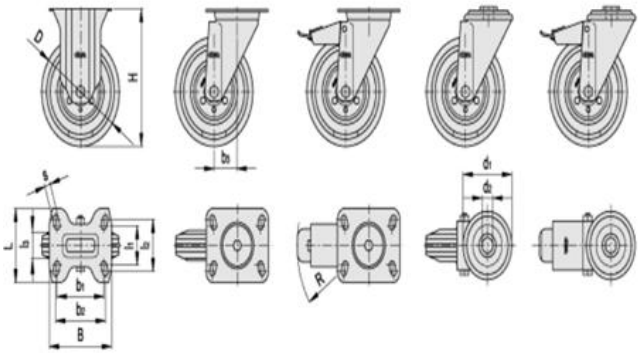

Fig. 4.Rolling Resistance Selection of trolley wheel

VIII. WHEEL SELECTION

Wheel Material: - PU-CI (Polyurethane 85A with center core cast iron)
Wheel model number:-RE.E3-200-PBL-N
Dia of the wheel: - 200mm.
Height of the wheel = 240mm.

IX. FRAME DESIGN

Total trolley weight should be 1/3 of the load to be carried it means.
Our Required load is 1500Kg inclusive of safety load.
Trolley weight = 1/3*L
Where L = load to be carried.
Calculation
=1/3*1500
=500Kg.
Our trolley weight should be 500Kg or more than this. Figure 5 shows the designed trolley frame.

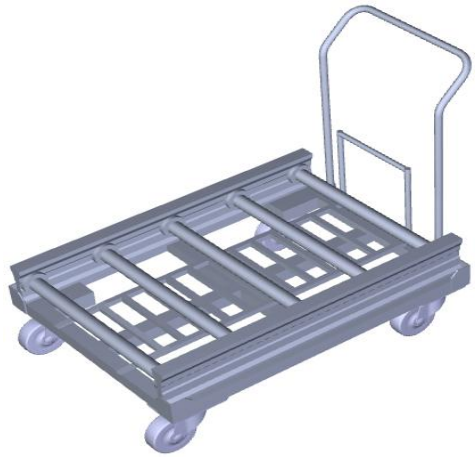

Fig. 5.Designed Trolley Frame

X. RESULTS AND DISCUSSION

The Formula

F = f X W/R
WHERE,
F = The force required to overcome the rolling friction
f = The coefficient of rolling friction (units must match same units as R (radius)
W = Load on the wheel
R = Radius of the wheel

Material

POLYURETHANE 85A with CI (material chosen by manufactures data book)

Step 1

Based on pallet load, Load for each wheel is calculated "W"

W = 2000kg →Since required load to carry
= 19613.3N
= 19613.3/4 → Since In a trolley there are 4 wheels
= **4903.325 N** on each wheel.

Step 2

Polyurethane exhibits a variety of ranges of coefficient,
For Polyurethane 85A coefficient of rolling resistance
Surface Speed 6-10 kph (Approx by assumption)
= 0.8 →Since by databook 5.1 Brauere design data

Step 3

Its already find that the radius of wheel is equal half of the Wheel diameter.
Wheel diameter selected is D = 8 in= 203.2mm hence radius is 203.2/2
R=203.2/2 = **101.6mm.**

Step 4

Estimate the load "F" required to overcome the friction of wheel rolling
F = f x W/R
F= 0.8*4903.325/101.6
F=38.6088 N
For four wheels 38.6088*4 = 154.43 N in Kg 15.74 ≈ 16kg
Hence for our designed trolley Pulling or Pushing force is **154.43 N**. Table 1 shows the material selection and figure 6 shows the trolley length – displacement.

Table 1: Material Selection

Material Used By Standard(IS2062)		
Sl No	DESCRIPTION	MATERIAL
1	Square tube	IS 4923(MS)
2	Ms sheet	IS 4923(MS)
3	Ms plate	IS 4923(MS)
4	Ms pipe	IS 4923(MS)
5	Ms Rod	IS 4923(MS)
6	Washer	IS2016
7	8" swivel wheel	PU-CI
8	BEARING	NSK

Fig. 6.Trolley length – Displacement

XI. FRAME DESIGN

The trial have been conducted by pulling the trolley with force gauge and the pulling force is within the calculated force the designed push pull force is **154.43N** but the obtained force is **123.85N.** Figure 7, 8 and 9 shows the animated load test, trolley load test and ergonomically modified trolley.

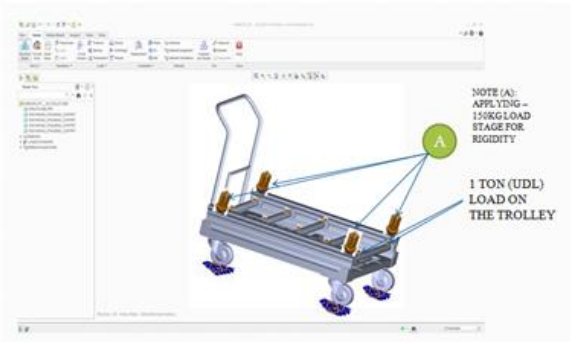

Fig. 7.Animated load test

Fig. 8.Trolley load test

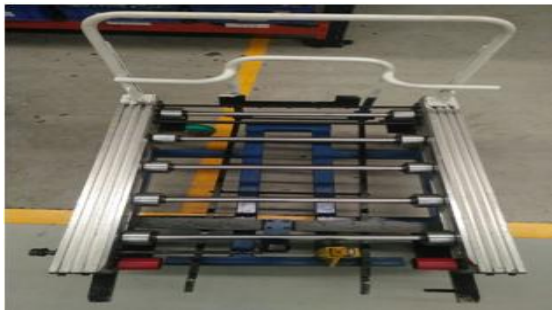

Fig. 9.Ergonomically modified trolley

Before the pallet transfer is done by hand pallet, the pulling force of the unit is 522.5N and this transferring of the pallet is done 240 times in a day this cause operator fatigue and operator undergone with some medical concern like back pain. The cost estimation of each and every components used and with inclusive of other cost like transportation, consumables, labor. Table 2 shows the cost estimation.

Table 2: Cost Estimation

Sl No	DESCRIPTION	Qty	Unit price	Total price
1	Square tube(in kg)	19.88	56	1113.28
2	Ms sheet(in kg)	0.5	51	25.5
3	plate(in kg)	18.21	48	874.08
4	Ms pipe(in kg)	4.4	55	242
5	Ms Rod(in kg)	0.5	52	26
6	Washer(in pcs)	16	5	80
7	8" swivel wheel(in pcs)	4	4000	16000
8	BEARING(in pcs)	10	1650	16500
9	Aluminum extrusion (in pcs)	2	2000	4000
10	ROLLER SETUP (in pcs)	5	3500	17500
11	Others	1	7000	7000
			Total	63360.86

XII. CONCLUSION

This task work lead us a great exposure and awareness, to utilize our insight. A great deal of useful information is acquired in terms of arranging, obtaining, assembling and manufacturing while at the parallel time of this task. The ergonomic design lays a platform of connection between institution and enterprises. The "ERGONOMIC IMPROVEMENT IN ASSEMBLY LINE" is working with acceptable significant Ergonomic plays an important role we have done to our capacity and aptitude utilizing accessible offices. In this manner a "A NEW TROLLEY" was build which decreases the fatigue of the worker in sequential construction system. By utilizing more procedures, and new imaginative thoughts a new assembly line setup with better ergonomics, that ensures fatigue free, safety and high productive environment will be developed, The Fatigue of the worker especially back pain in handling the trolley is totally eliminated by the new trolley design. Future scope aims to make the automated assembly line.

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