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Research Article

Analysis of Load Constant of Women Worker by Taguchi Technique & Mathematical Regression Modeling

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Abstract

The women power is decreasing day by day; whose women workers work at manual material handling in the Construction Company and industries. They are not pleasure as comfortable as they were in the earlier time. New recruitments are not in the same ratio as anyone leaving Construction Company and industries. This in twist increases the work load on the present women workers. It has been seen that the women workers are not assigned to the proper load according to their physical aspects and strength. This causes an uneven distribution of work in the Construction Company & industries, which is twist causes severe physical back ach problems to the employees and also decreases the load lifting capacity of women worker. The purpose of this paper is to efficiently determine the optimum combination of three parameters (Worker age, Worker weight and worker strength) for mitigate the load constant of the women worker, the researcher have used the Taguchi parameter optimization methodology, and finally the Modeling of input parameters (Worker age, worker weight and worker strength) and output parameter (Load constant) is done. With the help of mathematical modeling one can select the appropriate anyone for a particular load for a particular work to minimize the back ach problem of women worker in the Construction Company and industry.

Keywords: *(MMH) Manual Material Handling, Taguchi Techniques and (LC) Load Constant, women worker.*

1. Introduction

Manual Material Handling (MMH) including lifting, calculating load constant for the women worker which is assign for lowering, pushing, pulling, twisting, carrying and holding is the lifting work. For calculating the load constant researcher applied the there are kinds of injuries and disabilities associated with Taguchi Optimization Technique and calculates the load MMH tasks, among which Low back ach disorders (LBDs) are constant according to worker's age, worker's weight and the most common of all musculoskeletal disorders and are a strength of women worker. The Taguchi process helps to select or to determine the assignment of right workers on to the right lifted load by optimizing all the available factors. Many Authors developed many mathematical models to optimize these parameters to get the zero or minimum loss in target achievement by various processes. The variation in the worker age, worker weight and strength other factors affecting the Load constant. Here the Taguchi design of experiments is used to optimize the considered parameters. Taguchi method is that it emphasizes a mean performance characteristic value close to the target value rather than a value within certain specification limits, thus improving the worker capacity. Additionally, Taguchi's method for experimental design is straightforward and easy to apply to many engineering situations, making it a powerful yet simple tool. It can be used to quickly narrow down the scope of a research project or to identify problems in a construction industry from data already in existence. Also, the Taguchi method allows for the analysis of many different parameters without a prohibitively high amount of experimentation.

2. Literature review

According to Punnett et al (2005) about 37% of all LBDs are directly attributable to occupational risk factors (RFs). Thus identifying and Taguchi method is a powerful methodology/ technique for preventing risk of LBD is the most significant problem the design of high quality systems (Taguchi, 1990) and has complained by workers and it is still a hard topic for been widely used in engineering design (Ross, 1988). Many researchers have Taguchi design provides a simple, efficient and systematic developed tools and techniques for identify jobs which are approach to optimize design for performance, quality and associated with risk of LBD (Ciriello & Snook, 1999; cost over a verity of conditions. Taguchi steps are shown in Marras, 2000; Marras, Fine, Fergusan, & Waters, 1999;. Zurada, Karwowski, & Marras, 1997).

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Chaffin and Park (1973) developed a lifting strength ratio (LSR) and demonstrated its relationship to LBD. LSR was defined as the ratio of the maximum load lifted on the job and lifting strength in the same load position for a large/strong man. Snook (1978) defined MMH limits for lifting, lowering, pushing, pulling and carrying activities based on psychophysical criteria.). Chaffin and Park (1973) developed a lifting strength ratio (LSR) and demonstrated its relationship to LBD. LSR was defined as the ratio of the maximum load lifted on the job and lifting strength in the same load position for a large/strong man. Snook (1978) defined MMH limits for lifting, lowering, pushing, pulling and carrying activities based on psychophysical criteria, based on a sample of 191 compensable low-back injury claims, concluded that a worker is three times more susceptible to low-back injuries if performing a manual handling task which is acceptable to less than 75% of the working population.

In 1981 the National Institute for occupational Safety and Health (NIOSH), a US federal agency recognized the problems related to lower back injuries and published the Work Practices Guide for manual lifting. This contained a summary lifting related literature before 1981, and guidelines are also given for lifting (Ayoub, Selan, Jiang, 1983). In this MMH area load that lifted by the person is play important role LBD problem. Load is also known as load constant it is load that is lifted by worker without any musculoskeletal problem.

NIOSH (1991) is set the value of load constant, which is 23 kg., but researcher are going to find that it may change with age, weight and strength of women worker. In this paper researchers derive a formula for calculating the load constant for the women worker which is assign the lifting work.

For calculating the load constant researcher applied the taguchi optimization technique and calculates the load constant according to workers age, workers weight and women worker's strength.

3. Taguchi methodology

Taguchi method is a powerful methodology/ technique for preventing risk of(low back disorder) LBD is the most significant problem the design of high quality systems (Taguchi, 1990) and has complained by workers and it is still a hard topic for been widely used in engineering design (Ross, 1988). Many researchers have Taguchi design provides a simple, efficient and systematic developed tools and techniques for identify jobs which are approach to optimize design for performance, quality and cost over a variety of conditions. Taguchi steps are shown in figure 1 for present research work.

3.1. Design of experiment

Once the experimental design has been determined and the trials have been carried out, the measured performance characteristic from each trial can be used to analyze the relative effect of the different parameters. To demonstrate the data analysis procedure, the following L9 array will be used. The experimental design was done according to L9 orthogonal array based on the Taguchi method. The use of Taguchi orthogonal array would evidently reduce the number of experiments. The L9 orthogonal array had three columns and nine rows, so it had six degrees of freedom to utilized in the research is larger the Better. Researchers manipulate three parameters with three levels as indicated in Table 1. Thus, in this investigation three parameters with three levels were indicated in Table 2.

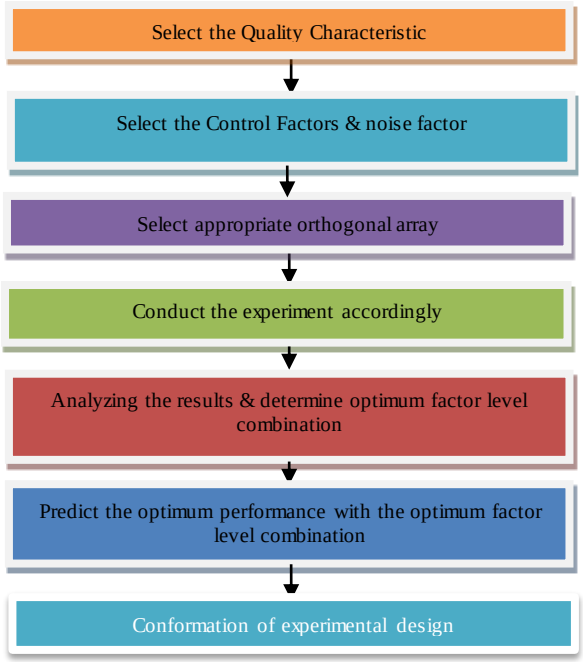

Figure 1: Steps of Taguchi Method

Table: 1 Orthogonal L9 Array of Taguchi

Experiment S.No.	Parameters		
	Level 1	Level 2	Level 3
1	1	1	1
2	1	2	2
3	1	3	3
4	2	1	3
5	2	2	1
6	2	3	2
7	3	1	2
8	3	2	3
9	3	3	1

Table: 2 process parameter & their levels

S.No.	Symbol	Process parameter	Level		
			Lower	Medium	Higher
1	A	Age	18-30	30-42	42-54
2	B	Weight	30-40	40-50	50-60
3	C	Strength	0-10	Oct-20	20-30

For this research work, researchers visited to many constructions company & collected data which are require for the research these are shown in table 3. These data is randomly selected among the workers of company which represent random age group, weight & strength. Data collected from the table in given below appendix, which's collected are many construction company.

Table: 3 Data collected according to L9 Array

S.No.	Name of women worker	Age	Weight of worker	strength of Worker	Lifted weight
		(Yrs)	(Kg)	(Kg)	(kg)
1	Arushi	26	38	10	9
2	Surti	18	42	20	13
3	Ramkuaari	22	53	30	23
4	Dwarika b.	33	39	30	22
5	Sumitra	38	50	10	8
6	Radha	38	52	20	12
7	Bekunthi	48	39	20	15
8	Munnibai	46	43	30	21
9	Kaushlya	49	59	10	8

3.2.Taguchi parametric optimization technique

The experimental design was done according to L9 Orthogonal array based on the Taguchi method. The use of Taguchi orthogonal array would evidently reduce the number of experiments. As per the Taguchi technique the Quality characteristic utilized in the research is larger the Better. Researchers have calculated load lifting capacity, Mean Slandered Deviation (MSD) Of Load Constant and Signal to Noise Ratio (S/N) for analysis of the data. For Following formula is used for calculation of larger the better. Data analysis is shown in table: 4.

Table: 4 Data Analysis

Exp. No.	Worker Age	Worker Weight	Worker Strength	Load Constant	S/N Ratio
1	L	L	L	9	-19.04
2	L	M	M	13	-22.26
3	L	H	H	23	-27.23
4	M	L	H	22	-26.84
5	M	M	L	8	-18.06
6	M	H	M	12	-21.58
7	H	L	M	15	-23.52
8	H	M	H	21	-26.44
9	H	H	L	8	-18.06

MSD = (1/Y12+ 1/Y22 + 1/Yn2 …….) / N

S/N = - 10 log10 (MSD)

3.3 Load Constant (LC)

Case 1- The main effect of the women worker's age on load constant at various level is calculated as follow.

For lower level-

$A_1 = (9+13+23) / 3 = 15$

For medium level-

$A_2 = (22+8+12) / 3 = 14$

For higher level-

$A_3 = (15+21+8) / 3 = 14.66$

Case 2- the main effect of the women worker's weight on load constant at various level is calculated as follow.

For lower level-

$B_1 = (9+22+15) / 3 = 15.33$

For medium level-

$B_2 = (13+8+21) / 3 = 14$

For higher level-

$B_3 = (23+12+8) / 3 = 14.33$

Case 3- The main effect of the women worker's Strength on load constant at various level is calculated as follow.

For lower level-

$C_1 = (9+8+8) / 3 = 8.33$

For medium level-

$C_2 = (13+12+15) / 3 = 13.33$

For higher level-

$C_3 = (23+22+21) / 3 = 22$

4. Result and conclusion

A woman worker of younger age, lower weight with higher strength will have maximum load constant and A woman worker of older age, higher weight and lower strength will have minimum load constant. In the table the value is bold show that is highest possible lifted weight for women worker according to Taguchi method.

Table: Factors effected table for load constant

S.No.	Symbol	Controllable factors	Level		
			Lower	Medium	Higher
1	A	Age	**15**	14	14.66
2	B	Weight	**15.33**	14	14.66
3	C	Strength	8.33	13.33	**22**

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