Health Status Of Workers In Furnace Operation On Foundry Task

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Abstract: The principle targets of this investigation were to recognize the trickiest stances in pounding undertakings performed at foundry, located at Howrah in West Bengal through utilization of the RULA, OWAS strategy and to create proposals for development of working techniques and working environments. Seventeen skilled laborers, with mean age of 42.6, from three foundry partook in the field study. The furnace tasks undertakings during the three-month time frame for this study. Significant distributions and material on Work-related body-part inconvenience assessment procedures have been gathered for consideration in this investigation and measure the logical writing on observational strategies. Self-assessment of laborers can be utilized to gather information on work environment introduction to physical components by utilizing strategies that incorporate specialist meetings and polls. As observational strategies are more inescapable than self-rating - based methods and can be used as a useful device in the work environment, The reason for every order is sketched out and estimated in evaluating the seriousness, recurrence, and term of business related physiological uneasiness, and fuses a significant number of the key qualities distinguished in this writing investigation.

Index Terms: Discomfort feelings, Health status, Posture analysis, OWAS, RULA, Stress analysis

1. INTRODUCTION

The traditional work analysis methods are often limited because their goal of accounting for labour time requirements precluded the possibility of gathering sufficient information to meet the goal of minimizing overexertion injuries in the workplace [1, 2]. The primary elements in biomechanically oriented Ergonomics job analysis programs are investigated. An analysis of job factors that expose the person to risk of specific musculoskeletal problem or that raise the person's risk of incurring such problems, and an evaluation to determine the degree of risk in given population of worker those approaches are use to identify potential or existing musculoskeletal problem active surveillance or passive surveillance [3]. The primary advantage of active surveillance in that the resulting statistical in a description of current concern and behavior of the workers on a particular job and may provide an identification of a condition before workers develops symptoms sufficient to require medical treatment. Passive surveillance however provides a history of more serious and costly injuries and provides the economic [4, 5]. A professional engineer, job designer or ergonomist is still obligated to search the literature for any safety or ergonomics design standard guidelines pertaining to the proposed job [6,7]. In this context, job designer consult with ergonomic expert to make sure that no new design that they propose contain any exertion requirements that are beyond a given population capability [8]. This then is the third approach that is used to identify potential musculoskeletal problems. If then become necessary to perform for job factor analysis associated with exertion that, repeated, frequently sustained and performed in awkward postures involving vibration or produce high contact stresses [9,10]. If job is highly repetitive or relatively short duration then the time and motion analysis method is employed to identify the risk factors, otherwise it can checklist to document the job [11,12]. In the context of present study set of present that is conducted in three different foundries [13]. It was found that all activities are physically demanding operation coupled with either forceful exertion or repetitive in nature or one of short duration. In addition to those workers are performing their day job within adequate space or away from workstation or very close to workstation or improper handling the equipments [14, 15]. All these conditions forced them to adapt an awkward posture resulting in the development of injuries and musculoskeletal disorders, body pain discomfort [17]. The words who are working in the workplace contribute to the growth of national economics and they ultimately become a burden of the society. The present study is undertaken to highlight the postural load being experienced by the workforce in their day's job.

2 MATERIALS AND METHODS

The investigation work was done in three foundries units at Howrah in West Bengal. The depiction of seventeen workers in various foundry units were gotten and assessed with the assistance of OWAS and NORDIC uneasiness overview strategy was utilized for planning the various territories of torment, disappointments during the activity. Pulse and postural anxieties were likewise taken note.

2.1 Furnace Operation

In present investigation it is observed that cupola furnace is used in melting Pig iron (with or without Iron or Steel Scrap) for Iron Casting, the lining of the cupola shell is made of fire bricks. Metals, cocks, flux are used and these are charged from the top (Charging door). Air is blown near the bottom of cupola. The molten metal is taken out through a tapped hole, where metals come to the bottom of shell and the slag and the slag floats over the metal. The liquid metal is tapped out to the ladle with proper lining.

2.2 Postural Assessment

Various strategies were applied for investigation of body stances of furnace operator. This device can be utilized to evaluate an assortment of undertakings, in any sitting position where body pose is static, dynamic or quickly evolving. This technique is the snappy study strategy for use in Ergonomic mediations of work places where MSDs are accounted for. This evaluation strategy can gets to bio-mechanical and postural stacking of the laborers body.

2.2.1 Ovako Work Posture Analysis System

The Ovako Work Posture Analysis System (OWAS) was first developing in steel industries between 1974-1978. The need was to be identify and assess poor posture arose the fact that many jobs at the steel mills including physically stressful task.

It involves the assessment of body parts such as back, arms and legs, the method is carried out load involvement and force used in posture during the work and the same is given to the body parts incorporated with the score of load and the force. In the order to get final score a table given an index to find out the appropriate OWAS scoring (1-4). The final step in this technique action reminder is categorized according to the score get work out from the table. Based on these score corrective measures are taken accordingly. It is used for the evaluation of postural load during work. This strategy depends on a basic and methodical order of work act joined with perception of work undertakings. This technique can be applied being developed of a working environment or a work strategy, to lessen its musculoskeletal burden and to make it more secure and more gainful, arranging of another work environment or work strategy, ergonomic review and word related wellbeing overview.

3 OBSERVATIONS AND CASE STUDY

3.1 Observation: 1

This method is used for the evaluation of postural load during work. It is based on a simple and systematic classification of work posture combined with observation of work tasks. It can be applied in development of a workplace to reduce its musculoskeletal load and to make it safer and more productive.

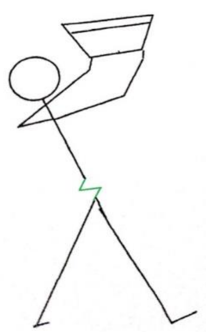

***Fig1: OWAS** Coading 4.3.4.3*

Fig 1 shows the diagram of carrying job of action level 4 by OWAS method.

3.2 Observation: 2

A worker while carrying a concrete mix has been shown in the below stick diagram the different body part involved into that position are back was bent sideway (forward) as well as twisted therefore the adduction back muscle are getting stress. By generating compressive and shear force both the legs are in static condition. The amount of load being carried by the workers was 23 kgs; therefore the final coding has become 3.

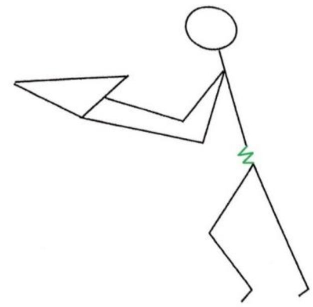

***Fig2: OWAS** Coading 3.1.4.3*

Fig 2 shows the diagram of carrying job of action level 3 by OWAS method.

3.3 Questionnaires and Interview Technique

The Questionnaires comprise of inquiries relating to various issues identified with this specific activity. Day by day movement of the laborer, distress level of various body parts, working and resting periods were plotted and determined. NORDIC body distress overview was utilized for planning and plotting various zones of agony of the body leaves behind its power. Body uneasiness level can likewise be determined with the assistance of this technique.

3.4 CAD Model of Human Body

Fig 3 indicates the actual work posture of the worker in furnace operation. 3D model of human body was developed with the help of solid works software [Fig 4]. The model was exposed to ANSYS for analysis of stresses. The upper part of the worker's body was directly involved with the furnace operation. The upper part of the body i.e. trunk, clavicles, upper arm, fore arm, neck and hands were connected by anatomically motivated restricted articulations. These are pelvis, neck, sternoclavicular joint, shoulders, elbow and wrists. The upper part of the body provides twenty (20) degree of freedom: DOF for each neck joint is three, three for each shoulder, three for pelvis, two for each elbow and two for each wrist.

***Fig 3:** Actual Working posture of worker in furnace operation*

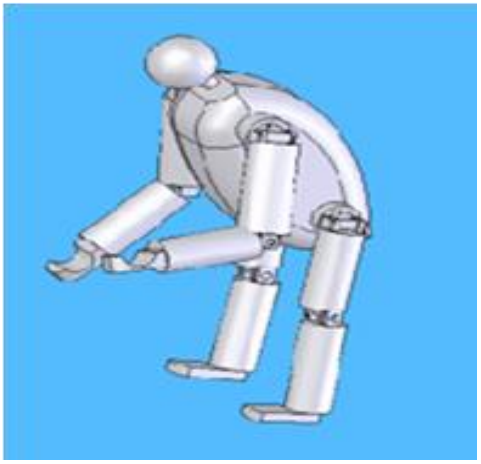

Fig 4: *CAD model of worker in furnace operation*

3.5 Body Stress Assessment

Body inconvenience and wounds are related with various joints of the human body. To get precise outcomes, the conveyance of worries in various body parts, muscles and joints in a particular work stance and specific remaining burden is required. It is significant and furthermore important to create sensible model to comprehend the presentation of human body. The muscles worry during the granulating was concentrated in subtleties by building up a 3D model in Solid Works programming and examination of body pressure and muscles is done in ANSYS-R17.0 programming. The FEM investigation was done in ANSYS-R17.0 programming to get von Mises worries at specific burden and work pose.

3.6 Heart Rate Analysis

To get accurate results, the heart rate in a specific work posture and particular work load is required. The heart rate of furnace workers during operation was taken with the help of heart rate monitor and also analyzed.

4 FRAMEWORK AND FLOW CHART

Occupational safety & health are the major concerns in small scale units to improve the productivity and job quality. Some of the common problems are improper design, mismatch between worker abilities & job demand and adverse environment.

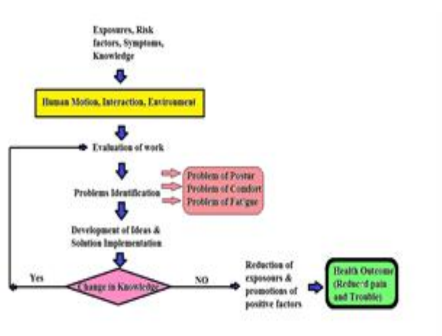

Fig 5*: Flow chart of health outcome of furnace workers*

It has been noticed that human factors improve the productivities, workers health, safety and job satisfaction. From this frame work and flow chart [Fig 5], it is clear that ergonomically designed work stations can reduce muscular problems, physical fatigue and will improve workers health. Proper Ergonomic knowledge, planning and awareness can also reduce physical and mental stresses.

5 RESULTS AND DISCUSSION

The result of RULA score indicates that the working postures of most of the workers were above the line indicated in the fig 6. Immediate change of Ergonomic intervention was needed of the furnace workers. The result of this study revealed that the furnace workers were engaged in manual handling jobs, leading to various muscular disorders primarily affecting the upper part of the body.

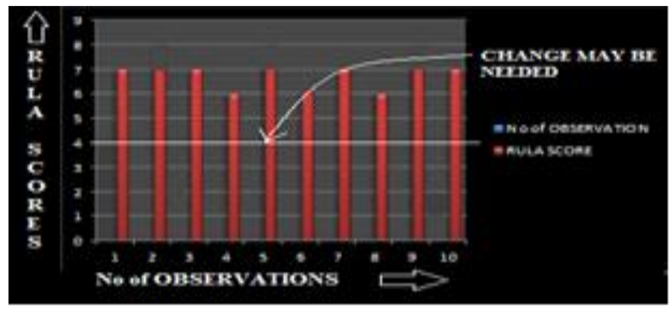

Fig 6: *RULA Score of furnace workers*

TABLE 1

Demographic data of the furnace workers (n=17)

Variable	Workers
Mean Age (years)	42.6± 6.75 (32-57)
Height (cm)	165.9±4.6(158-177)
Weight(Kg)	65.35± 5.77 (57-82)
Working experience(Years)	23.35± 6.30 (12-39)
BMI(Kg/m)	23.73± 1.89 (21.01-27.34)
BSA(m^2)	1.72± 0.08(1.57-1.99)

TABLE 2

Physiological characteristic of the furnace workers (n=17)

Variable	Workers
Resting Heart Rate(bpm)	70± 2.53(67-75)
HR Max (bpm)	177± 6.25(163-188)
Heart Rate Reserve (bpm)	106± 7.22 (91-118)
Resting VO_2(ml/Kg/min)	8.82± 1.28 (7-11)
VO_2 Max(ml/Kg/min)	30.75±5.0 (24.61-41.44)
Resting Body Temp(^{0}F)	98.5± 0.25 (98.10-99.00)
Working Heart Rate (bpm)	107±4.94 (95-121)
OWAS	2.41± 0.91 (1-4)

Demographic and Physiological characteristic data of furnace workers are shown in table1 & table 2 respectively. Software Ergo-Fellow was used for plotting the different areas of pain, dissatisfactions of the workers body during operation. Fig7 indicates the discomfort frequency in different body parts of the operator of furnace.

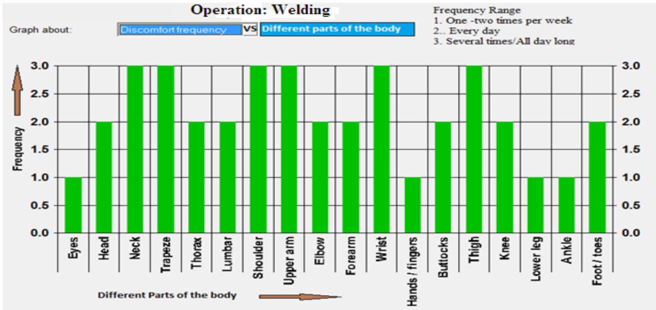

***Fig 7**: Discomfort Frequency in Different body parts of furnace workers*

More than 80% of the workers were got affected in their wrist, hand, trapeze and neck due to unsuitable position of electrode holder, body posture and unergonomic man machine interface.

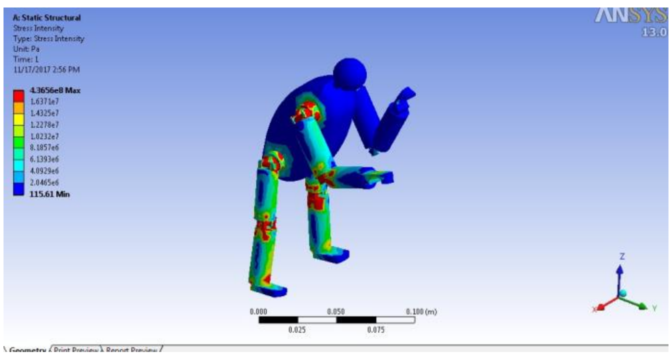

***Fig 8**: Stress intensity distribution patterns of furnace workers*

A poor posture contributes to stress and stress donates to poor posture. When the body is stressed, the muscle of human body tense up. The different joints and muscles of human body are the most affected parts due to poor posture. Sitting in a slouched position in the shop floor for an extend period of time put a great deal of stresses of upper as well as lower body specially if the workers body is not supported. Poor work posture increases body stresses and other physical problems as well. Human body is designed to stand strong and erect, effortlessly. Poor posture leads to back pain during furnace operation in long period of time.

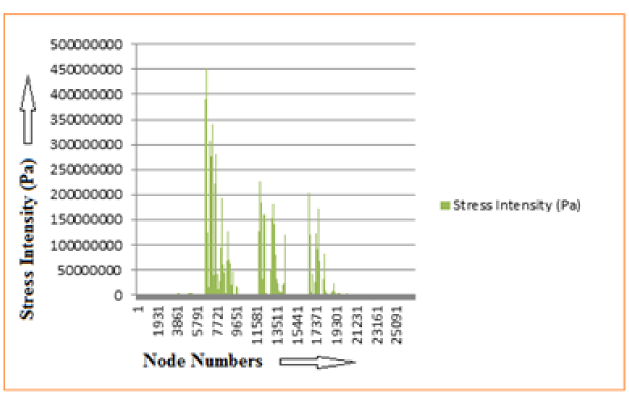

***Fig 9:** Stress intensity Vs node number*

The three-dimensional finite element model consists of 13810 elements which are connected through 25837 nodes. The stress contour map revealed that the maximum intensity of stress varied from 4.3656×10^{8} P_a to 1.6371×10^{7} P_a for particular work posture and load [Fig: 8]. Node numbers 6460 to 7600, 13919, 17371 mark highly stressed denoted by red colours. Stress intensity vs node number is also shown in the fig 9.

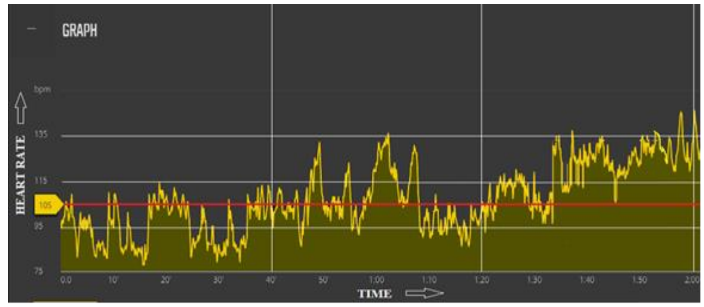

***Fig 10:** Heart rate Vs Time during furnace operation*

Fig.10 indicates heart rate in bpm of the worker with respect to time in minutes. In the last 40 minutes the heart rate increased markedly for being in awkward work posture for a long time. The rate in the 1st working zone is within the acceptable range which exceeded beyond the severe level due to inappropriate body posture.

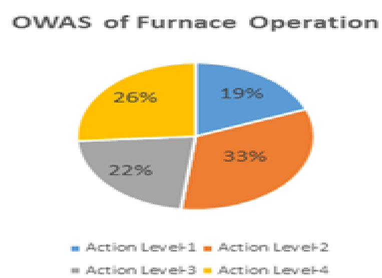

***Fig 11:** Pai chart of OWAS of furnace operation*

Fig.11 shows the pai chart of OWAS of furnace operation .The total number of postures recorded on the basis of OWAS techniques involving in case of core working were 60. While analyzing the posture 14 postures have been missed and 46 postures have been identified. Out of 46 effective postures around 19% cases are not required any action, and around 33% cases are required to be taken corrective action in the future. Like that around 22% cases correction needs to be taken as possible and only around 26% cases immediate corrections are required. It appears from the result that the postures adopted in core furnace are awkward posture as most of the cases are in the action level 2, 3 and 4 respectively. Awkward postures in the near future likely to create more problems on the different parts of the body like back, arm and legs.

5 CONCLUSIONS

The optimization for postural prediction, heart rate analysis, stresses in different body parts, discomfort of different joints were presented in this research work. It can be concluded that MSDs were present in the activities carried out in furnace operation in foundry task in different units where major number of workers were involved in bad body postures. The worker adapt awkward postures involving frequent twisting, bending, over reaching etc. The postural load is very much match with the cardiovascular stress among the worker. The worker of this presence group is likely to be suffered different types of musculoskeletal disorder with postural stress and its impact prevailed in the workplace. It can suggest from the above finding that the exercise programs are to be initiates among the working population such that they could undertake an exercise involving the different muscle musk, tendon and bone that are belong recruited while at work, so that the feeling of the stress and stain could be minimized and also recommends that awareness and training program are urgently needed among the worker.

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