

AN ERGONOMIC AND SAFETY EVALUATION OF FOOTWEAR USED BY MALE INDUSTRIAL WORKERS IN NIGERIA: A CASE STUDY

V. O. Oladokun and N. I. Onwusika

Department of Industrial and Production Engineering,
University of Ibadan,
Ibadan, NIGERIA

ABSTRACT

This study focuses on footwear used by Nigerian industrial workers. The suitability and comfortability of these shoes used in a typical Nigerian factory were assessed based on their response to some well-structured questionnaires. Some important features of the shoes were compared with internationally recommended standards. The result shows that 62% of the respondents' shoes are suitable. These are mostly shoes that are light weight, low heeled, made of leather material, and steel toed, though some of them are not steel toed. When compared with the standard features and characteristics, it is observed that about 60% complies with the internationally accepted standards of EN 345, EN 346 and EN347 for safety shoes, protective shoes and work shoes respectively.

Keywords: Footwear, Industrial shoes, Ergonomics, Safety shoes

INTRODUCTION

Ergonomics can be defined as the application of biological knowledge in the fields of anatomy, physiology, experimental psychology and occupational medicine to the study of work done in gainful employment with the purpose of achieving an optimum man-machine system in which a proper balance is maintained between the workload and work capacity by seeing to it that the best possible use is made of worker's powers and capabilities in the interest of his own health and dignity and in the interest of productivity (Burger and De Jong, 1962). Anthropometry is a part of ergonomics that deals with the measurements of the dimensions and other physical characteristics of the human body. These characteristics include center of gravity, volume, inertial properties, weight or mass of body segments, range of movements etc (Martand, 2000). Anthropometric data is a function of factors like age, sex, race, economic status and environment. For good ergonomic and safety design it is essential for gadgets like footwear to reflect these anthropometric data variations.

In a developing country like Nigeria, much has not been reported on anthropometric data (Ibitokun, 1990). Also the country has not put in place appropriate governmental policy and structures for ensuring some measure of standardization in personal gadgets used in Nigeria. As Nigeria is

largely an import-oriented economy, many personal wears used by Nigerian workers were not actually designed with the Nigerian worker in mind. It has been found that many imported equipment in Nigeria are not ergonomically suitable for the Nigerian users (Abdul and Olaboye 2002, Adejuyigbe and Ali, 2004). Hence the need to evaluate those personal wears frequently used by the Nigerian industrial worker with a view to knowing their safety and ergonomic suitability.

This study focuses on footwear used by industrial workers which is also known as industrial shoes or safety shoes. Industrial footwear or shoe is one of the most important components of the personal protective equipment used by industrial workers. The objectives of this study include the evaluation of the ergonomic and safety features of the footwear used by industrial workers, identification and analysis of the ergonomic and safety problems that may arise as a result of using substandard footwear and making appropriate suggestions/recommendations based on the result of the evaluation. It is hoped that this will lead to increase in productivity and improvement in occupational health and safety of workers.

The main components of an industrial footwear include quarter, the box, throat, inside board, insole shank, welt, toe cap, grommet, outsole, air column, laces, treads, steel toes cap, pronose, membrane

vamp and heel According to McPhoil (1988), the anatomy of safety shoe can be divided into an upper and lower (or bottom part) Sections of the upper part includes vamp, quarter, toe box, throat, insole board and topline Sections of the lower part consists of an insole, shank and heel

To choose the correct industrial footwear, it is essential that a full risk assessment be made, so that the style and material to complement the working environment can be selected (Audemars, 1978) A similar work reported in Parsons and Wray (1998) was carried out on footwear for postal workers The main findings of the study showed that most of the footwear supplied to the postal workers were considered suitable for indoor work and unsuitable for outdoor work, particularly in the winter despite meeting the requirements of the European occupational footwear standard For the safety footwear, inadequate grip and poor durability were found to be the main problem, comfort and styling were also mentioned

In July 1995, the European Union (EU shoe standards, 1995, Parsons and Wray, 1998) introduced harmonized standards for footwear as follows -

(1) The EN 345 (Safety shoes/boots) This safety footwear has toe caps that are tested for protection against mechanical impacts with a test energy of 2000 Joules Marked SB (Safety Basic), it has the following description Leather upper, air tight lining, padded tongue and collar, steel midsole, light weight dual density

polyurethane sole, 2000 Joules toe cap, petrol, chemical and oil resistant, anti-static and anti-slip, water repellent and shock absorbent

(2) EN 346 (protective shoes/boots) - This footwear has protective toe caps that are tested for protection against mechanical impacts with a test energy of 100 Joules Marked PB (Protective Basic), it has the following description Non-slip soles for safety, self cleaning soles - clean while working, steel shank for protection, steel toe in selected styles, foot bed insole for added comfort, petrol, chemical and oil resistant, pull-up and kick-off plugs and shock absorbent

(3) EN 347 (Work shoes/boots) - In this case protective toe caps are not necessary and are not submitted for testing Marked O (Occupational) it has the following description Extremely high wear resistant, ladder grip antistatic, non-skid, petrol, chemical and oil resistant, low heel, specially designed sole pattern, solid sole pattern, pull up and kick-off plugs and low bending resistance

(4) EN 344 (Requirements for foot wear testing method) - This serves as requirement at the testing method for foot wear It provides a basis at which the testing is done

Fig 1 illustrates the European Union harmonized standards for footwear.

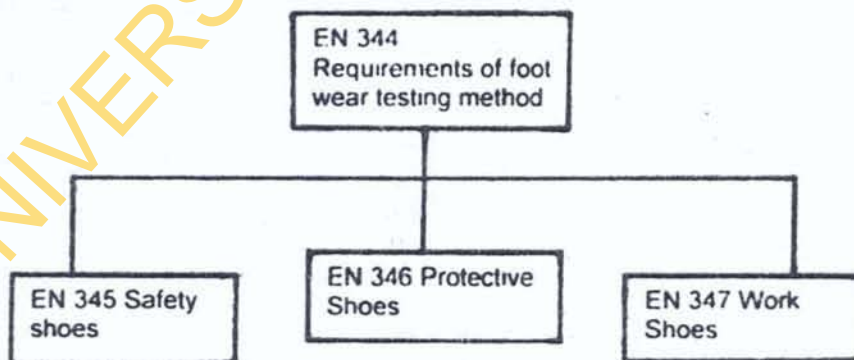


Fig. 1: The European Union harmonized standards for footwear

METHODOLOGY

This study was carried out in a refrigerator manufacturing company where industrial workers wear footwear for long working hours on a daily basis. Ergonomic and safety conditions under which these footwear are worn are properly investigated and evaluated. The methodology involved the use of questionnaire, conducting oral interview and carrying out some experimental measurements.

Well-structured questionnaires were administered to sixty industrial workers in the company. The questionnaire is divided into four sections for easy administration and analysis. The Sections are A: Footwear Evaluation, B: Occupational Health, C: General Work Environment, and D: Job Design and Assessment.

Oral interview was also conducted in order to cover some areas that are possibly not covered by the questionnaire. The oral interview involved all the sixty participating workers. For each worker, appropriate measurements and examination of his shoe were carried out and recorded against the questionnaire he has filled. The following features were measured and recorded: 1-Shoe weight, 2-Heel length, 3-Shoe material, 4- Shoe size, 5 -Shoe style (presence of steel toe/laced)

RESULTS AND DISCUSSIONS

A summary of the results of the questionnaires is presented in Table 1 while Table 2 shows the suitability analysis.

Mapping the features of the shoes used (by each worker) to the response of the worker in the questionnaire and using the oral interview, a suitability analysis was carried out for different types of shoes used by the workers. This was done to correlate the responses to these features.

Adopting suitability index 0 and 1 for not-suitable and suitable respectively, the weight of the shoes

was categorised into two groups A and B, where category A = 2kg and less (judged as light) and category B = above 2kg (judged as heavy). The heel lengths of the shoes were grouped into two categories A and B, where category A: ≤ 2.5 (judged as low) and category B > 2.5 (judged as high).

The overall result shows that 38% of the respondents' shoes are unsuitable. These are mostly shoes with high heels, heavy weight, made of rubber material and not steel toed. The result also shows that 62% of the respondents' shoes are suitable. These are mostly shoes that are light weight, low heeled, made of leather material, and steel toed, though some of them are not steel toed. When compared with the standard features and characteristics, it is observed that the latter percentage complies with the internationally accepted standards of EN 345, EN 346 and EN347 for safety shoes, protective shoes and work shoes respectively.

CONCLUSIONS AND RECOMMENDATIONS

The study has investigated the suitability of industrial shoes used in Nigeria. Industrial footwear whose insole is equipped with a pressure distributing steel link is recommended. The steel link distributes pressure over the entire foot such that when one is standing on a ladder, one will not feel the pressure on the sharp contact area on the ladder. Also shoes made of membrane are recommended for its waterproof quality. This membrane allows perspiration to escape and prevent penetration of water. These shoes are recommended for effectiveness and efficiency at work. This will bring about reduction in occupational health problems and hence increase in productivity.

It is also recommended that similar studies be carried out in other types of work environment and/or focusing on some other protective wears such as helmet, operational clothes etc.

Table 1: Summary of Results of Questionnaire

Question's		Response summary
No	Content	
1	How does your footwear appear to feel when working?	71 7% shoes feel very comfortable 20% feels not so comfortable 8 3% feel uncomfortable
2	How does your footwear feel when not working	56 7% feel very comfortable 25% feel not so comfortable 18 3% feel uncomfortable
3	Does your footwear feel very heavy?	No =55 2% Yes heavy=44 8%
4	Does your footwear feel too tight?	No =81 7% Yes= 18 3%
5	Does your footwear cause you to slip, trip or fall?	No=100%
6	Is your footwear waterproof?	No = 80% Yes = 20%
7	Does your footwear react to weather conditions?	Yes= 61 7% No =38 3%
8	Is it more comfortable in cold weather condition?	Yes=83 3% No= 6 7%
9	Is it more comfortable in hot weather?	Yes=27 1% No= 72 9%
10.	How many types do you have in the workplace?	96 7% have less 3 types of shoes 3 3% have 3 types and above
11	How will you describe the grip of your footwear?	Good grip =95% Bad grip=5%
12	How durable is your footwear?	Very durable= 13.3% Durable=80% Not durable=6 7%
13	Is the sole of your footwear flexible?	Not durable=51 7% Durable= 48 3%
14	Does your footwear provide good support and protection?	Good support=93 3% Not good support 6 7%
15	Do you think your footwear is suitable for your type of job?	Yes= 80% No= 20%
16	Do you have pains on your feet when working?	Yes =46 7% No = 53 3%
17	If yes, how often do you have them?	51 7% of the workers that have pains claimed they rarely have it while 48 3 claimed they often have it
18	What type of treatment do you usually get for the pains?	Self medication =65 5% Doctor's prescription=34 5%
19	Does the pains cause you to stop working during working hours?	No=88 3% Yes=11 7%
20.	Has the pains caused you to be absent from work?	No=86 7% Yes=13 3%
21.	How will you rate the weather condition/temperature of your workplace?	Hot=75% Normal=25%
22	How will you rate the workshop floor?	Okay=98 3% Slippery= 1 7%
23.	Are equipment and machines properly stored to avoid tripping?	Yes=86 2% No= 13 8%
24.	Is there constant oil or water spillage on the workshop floor?	No=100%
25	How often do accidents occur on the workshop floor due to slip, trip or fall?	Rarely=96 7% Often=3 3% s
26	Does your job involve a lot of walking around?	Yes=75% No=25%
27	Do you often drop equipment or tools on your feet?	No=93 3% Yes=6 7%
28	If yes, how often	86% of the workers that drop tools on their feet claimed they rarely do so with 10% claiming they often do and 4% claiming that do very often
29	Does your job involve using your feet to exert force?	No=81 4% Yes=18 6%
30	Does your job involve you stepping on sharp objects?	No=94 9% Yes=5 1%

Table 2: Results of Suitability Analysis

Respondent No	Heel length	Weight	Feet size	Material/style	Suitability return
1	A	A	8.5	Steel toed/leather	1
3	A	A	8.5	..	1
16	A	A	10.0	..	1
17	A	A	10.0	..	1
18	A	A	10.0	No steel toe/leather	1
19	A	A	10.0	..	1
22	A	A	10.0	Steel toed/leather	1
26	A	A	10.0	..	1
27	A	A	10.0	..	1
28	A	A	10.5	No steel toed/leather	1
29	A	A	10.5	..	1
30	A	A	10.5	..	1
31	A	A	10.5	..	1
32	B	B	10.5	No steel toe/rubber	0
33	B	B	10.5	..	0
34	B	B	10.5	..	0
38	B	B	10.5	Steel toed/leather	0
39	B	B	10.5	..	0
40	B	B	10.5	..	0
41	B	B	11.0	..	0
44	B	B	11.0	No steel toe/rubber	0
45	B	B	11.0	..	0
58	B	B	11.0	..	0

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