Journal of Engineering Research and Applied Science
Available at www.journaleras.com
Volume 4(1), June 2015, pp 291-295
ISSN 2147-3471 © 2015

A study on the effects of weather conditions on the worker health and performance in a construction site

S.A.Yildizel[1], G.Kaplan[3], Y.Arslan[2], M.S.Yildirim[1], A.U.Ozturk[1]

[1]Celal Bayar University, Civil Engineering, Manisa, Turkey.
[2]Duzce University, Duzce Vocational Schools, Duzce, Turkey.
[3]Kastamonu University, Kastamonu Vocational Schools, Duzce, Turkey.

Accepted 21 May 2015

Abstract
The temperature of the working environment affects the performance of the workers in physical and psychological ways. Thermal stress directly influence the labor productivity in the environment of low and high environment also causes work accidents. Especially considering the nature of the construction industry, the construction sites are located at uncovered areas exposed to the severe climatic conditions and so the workers are relatively more prone to the thermal stress considering any other business. This study considered specifically the construction industry, depending on climatic conditions at the site, the influence of the heat stress on the employees were investigated considering the performance and health basis moreover several recommendations were made on ways to cope with heat stress.

Keywords: Thermal stress; climatic conditions; construction site; worker's health

1. Introduction

It is of atmost importance that worker health and the conditions of the working environment must be paid attention to in order for the operations to be continued smoothly and to have the expected results in a construction site. Therefore, the working environment must be organized in a way to make the workers comfortable physically and psychologically. Several work accidents occur every other day due to unsuitable physical and psychological conditions available in a workplace (espc. due to heat stress: see Figure 1) when necessary measures are not taken [1].

Project manager and/or construction site chief is responsible for the improvement of physical conditions in a construction site. Workplace accidents which occur due to unfavorable working conditions are most commonly associated with the employer or the workplace in manufacturing organizations [3]. Physically unfavorable working conditions are in question when factors such as insufficient lighting, ventilation, heating, etc. in place and therefore occupational safety is disregarded [4].

Weather condition is one of the most important physical working conditions. Concepts such as movement of air, humidity and temperature are addressed under weather conditions. One of the most important factors to be evaluated under temperature is the heat stress (Figure 3). It is possible to minimize the effects of heat stress which is arising from the climate conditions on the performance in many ways. Workers must be informed about cold stress, it must be ensured that related symptoms are understood and worker safety must be increased raising awareness on this subject particularly in construction sites with such risks. Nevertheless, construction site chief and/or manager should take measures to minimize the risks involved in heat stress for both themselves and the workers. The use of protective equipment in order to avoid heat loss under extreme heat conditions makes it possible to protect extremities such as hands, feet and face from heat stress to a great extent. In cases of machinery-human interactions in the construction site including icing and similar road conditions, measures such as de-icing and use of chemicals on the construction site

[a] Corresponding author;
Phone: +90-532-637-2672, Email: yusufarslan@duzce.edu.tr

minimizes workplace accidents related with climate conditions [4].

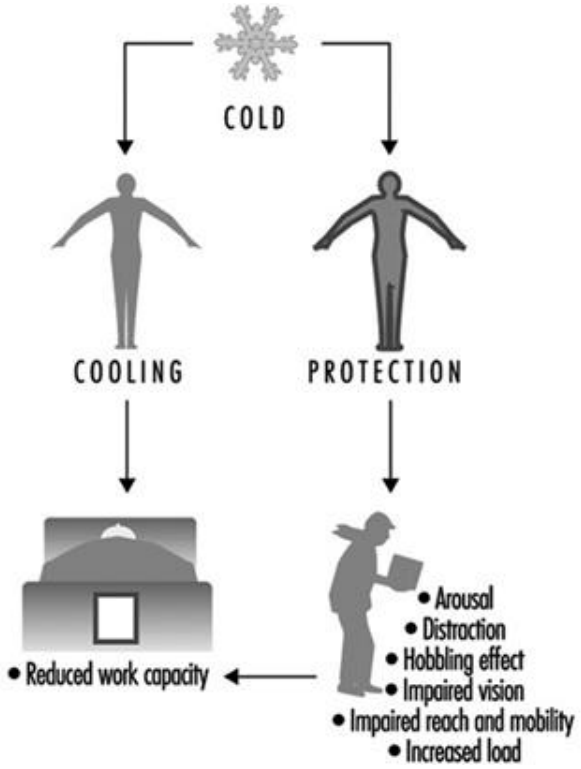

Figure 1. Reasons of work accidents: heat changes [8].

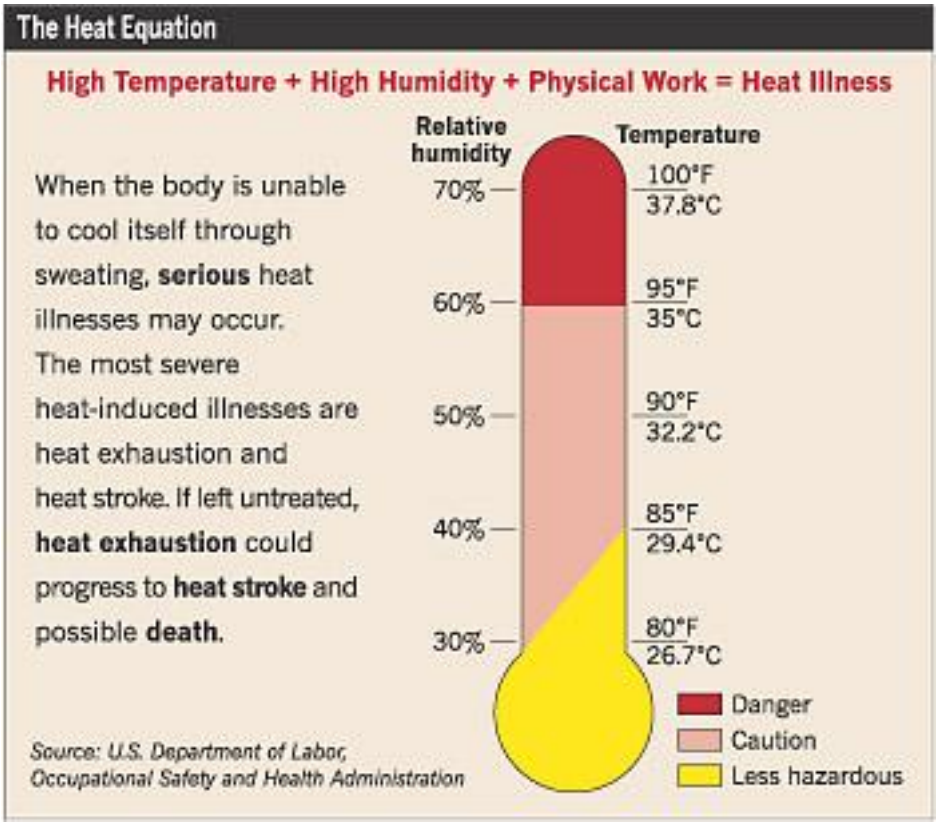

Figure 2. Heat illness conditions [7].

Heat stress, especially in the cases of very high and very low temperatures, is a common issue for the workers. Dehydration due to perspiration (see Figure 2) and metabolic electrolyte imbalances are common in the cases related with high temperatures. Performance drops with the occupational coordination skills and concentration being affected under these conditions and it is expected to experience increased amounts of workplace accidents when the environment heat exceeds acceptable levels [5].

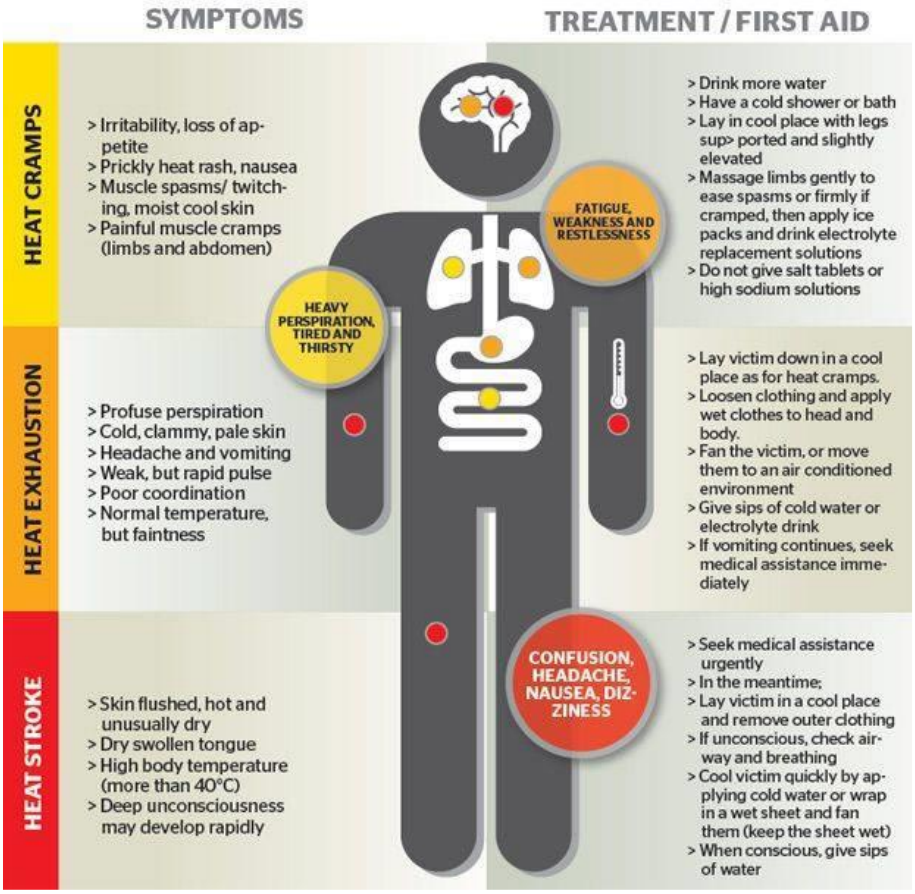

Figure 3. Heat stress [9].

2. Application

In this chapter, the effects of heat stress on performance and worker health were assessed for a construction site in Moscow. Workers and their tasks are the same in both of the applications. Same equipment and materials were used in the floor and wall coating works of the Terminal A and Terminal B, which are identical buildings. As one may know, several methods are utilized for efficiency calculations under the discipline of construction management. Among these methods are factor efficiency calculations, total efficiency calculations and labor efficiency calculations [6]. Applications took place during the wintertime in 2007 and 2008 and calculated according to the total efficiency method. Aspects such as material, labor, management, engineering, construction techniques, equipment used, contract type and computer support are identical for both applications. Efficiency calculations assessed the work done for each month, and the monetary equivalents of the sources used.

2.1. Application – I (November 2007 – March 2008)

The environmental temperature of the indoors workplace which accommodated 200 workers was kept between 16oC and 21oC with the help of blower fans. Additionally, workers were equipped with cold resistant materials and equipment. An efficiency analysis was conducted for the relevant work items in the period in question (Figure 4). Man-hour values were considered for the planned and actual values in

this analysis.

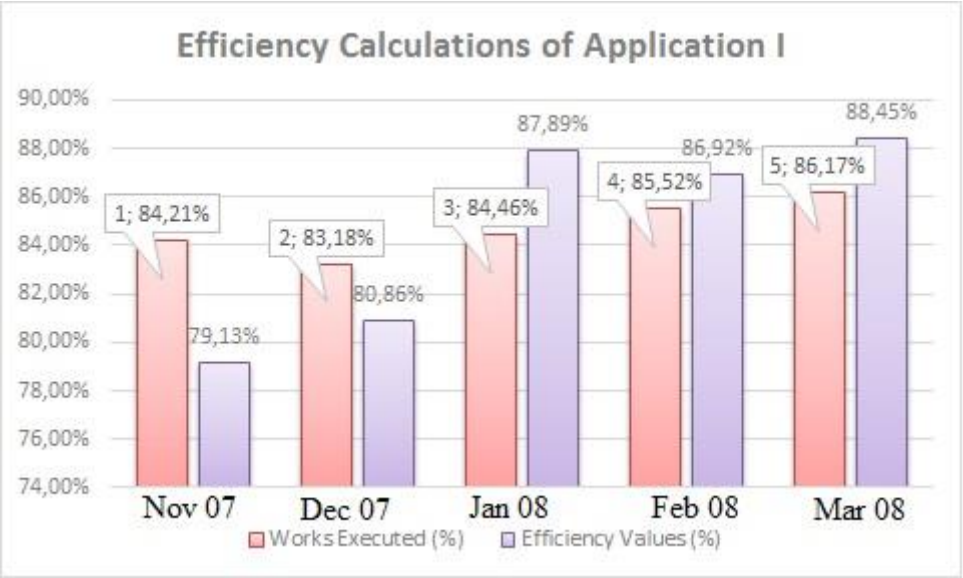

Figure 4. Efficiency calculations of application – I.

2.2. Application – II (November 2008 – March 2009)

The environmental temperature of the indoors workplace which accommodated 194 workers was kept between 20oC and 23oC with the help of blower fans. Additionally, workers were equipped with cold resistant materials and equipment. An efficiency analysis was conducted for the relevant work items in the period in question (Figure 5). Man-hour values were considered for the planned and actual values in this analysis. Workers were served with hot tea in intervals of 20 minutes in addition to the application conducted for the previous year.

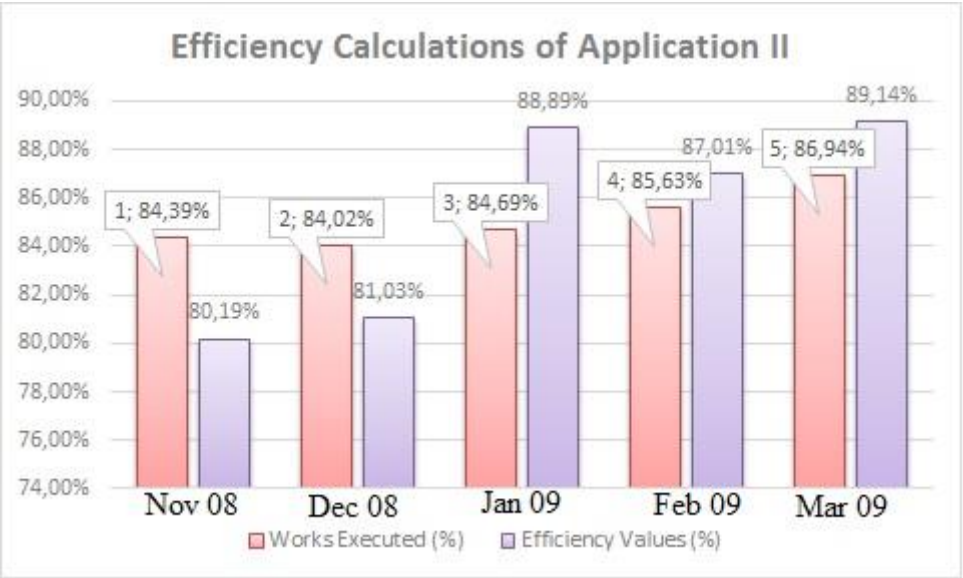

Figure 5. Efficiency calculations of application – II.

3. Assessment and Result

The following findings were obtained in the light of the analyses conducted:

- Increasing the temperature resulted in increased yield according to the man-hour

calculations of the Application II.

- As the environmental temperature rearrangement and serving hot beverages regulates the functions of human sense organs, it acted as a factor reducing the concentration loss.
- It is possible to make adjustments in each construction site based on the labor and the regulations of the relevant country and according to the reaction of workers to the adjusted working hours.
- Other factors were considered constant in the calculation of the aforementioned increase in the efficiency. The emphasis here is the effects of small modifications made to the environment under agreeable conditions and force-major principles on the human psychology and physiology. Measures and arrangements which may be achieved with rather small amounts of expenses allow for significant gains for large-scale projects.

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