ACTA TECHNICA CORVINIENSIS
– Bulletin of Engineering
Tome X [2017]
Fascicule 4 [October – December]
ISSN: 2067 – 3809

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ERGONOMIC ASPECTS OF THE SPORTS ACTIVITIES MICROENVIRONMENT AT THE TECHNICAL UNIVERSITY OF VARNA

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Abstract: Ergonomic norms are part of the norms limiting harmful effects on human health. Using them, the limit of people's satisfaction by the effects of environment is determined. Failure to observe these norms, especially in the conditions of active motor activity, causes various physiological reactions in athletes' organisms and increases the risk of respiratory diseases. The article reflects on the parameters of the microclimate in the sports hall of the Technical University of Varna. The experimental part includes measuring of the temperature, relative humidity, air dust and light in the hall. An analysis of the data obtained is carried out and the conformity of the data to the ergonomic standards and requirements is established.
Keywords: microclimate, air parameters, ergonomics

INTRODUCTION

As a complex interdisciplinary science based on knowledge of methods and science of humans and human labour which are aimed at altering working environment, ergonomics provides for maximal preservation of working capacity and human health [1]. Working environment is a multi-component system including the conditions at which certain activities are carried out. It is affected by the following factors: illumination, noise, vibrations, microclimate (air motion and humidity, temperature, dustiness, etc.) [2].

The multi-functional sports hall at the Technical University of Varna was renovated in 2009. The capacity of the hall is 80 sportspeople. The building is of a panel type and insulation is provided for its bases. The measurements of the hall are 20/42 and the built-up area is 840 m^2. Natural illumination filters through double windows which are set in the walls on both opposite sides alongside the building. The illuminated height of the area is 2.20 m. The hall has TARKET flooring and a Euro-certificate for 8 kinds of sport and this allows for its continuous use. The characteristics of the hall are in compliance with the norms for such types of buildings with regard to fire-extinguishing systems, lighting, emergency lighting, radiant and gas heating [3].

Ergonomic norms are part of the norms limiting harmful effects on human health. Using them, the limit of people's satisfaction by the effects of environment is determined. Failure to observe these norms, especially in the conditions of active motor activity, causes various physiological reactions in athletes' organisms and increases the risk of respiratory diseases [4,5,6].

Table1. Ergonomical norms for measuring the level of comfort at the working place

Parameter	Values	
Temperature	Optimal	21^{o}C
	Perturbation Influence	27-30^{o}C
	Harmful Effect	34^{o}C
Humidity	Optimal	30-70%
	Perurbation Influence	20-80%
	Sanitary Norm	15-90%
Illumination	Optimal	200-500 lx
	Ergonomic	150-200 lx
	Harmful Effect	100-50 lx
Noise	Optimal	40 dB
	Ergonomic	65dB
	Sanitary	90-100 dB

- **Aim:** Obtaining accurate and reliable data about the physical parameters of the microenvironment at the multi-functional sports hall of TU-Varna.
- **The object of the research** is the working environment at which specialized sports training classes are held at TU-Varna.
- **The subject of the research** is the condition and alteration of the physical parameters: temperature, relative humidity of air, level of illumination and dustiness at the sports facility.

Tasks:

» Development of methodics for carrying out the research.
» Elaboration of instruments for measuring the indicators of the working environment condition.
» Processing and analyzing the obtained results.

METHODICS

The research was carried out during the winter semester of the Academic year 2015/2016 and is in compliance with the respective regulatory requirements [2,8,9,10].

It is a known fact that the accuracy of the results of scientific research is a function of a number of factors, among them being the working environment parameters. The latter consists of the following components:

- ✓ Air temperature
- ✓ Temperature of spraying
- ✓ Relative humidity
- ✓ Air purity
- ✓ Lighting

As a combination of activities ensuring precision, reproducibility, repetitiveness and accuracy of the results, metrological supervision includes determining and choosing:

» Indicators whose condition and changes are measured
» time and place for the study
» devices (means of) measuring and their metrological characteristics
» methods of registering, preserving and systemizing the results
» software for processing the obtained information

For the purposes of this study, an experimental setting which is in compliance with the requirements for distance from the source of natural illumination was mounted at the sports hall.

Figure1. Experimental setting

A twenty-four-hour measuring was carried out, as the processed data is derived between 8.00 a.m. and 17.00 pm.

Air temperature is a main factor determining the heat load on an individual who is in a closed room. Measuring is carried out with a thermosensitive resistor, elaborated from semiconductive material.

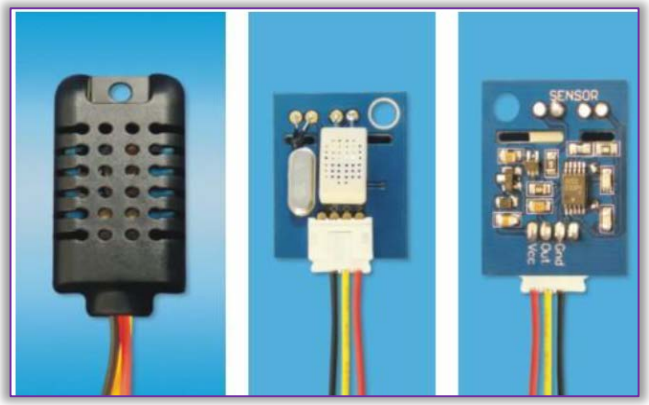

Figure 2. A combined AM2301 sensor for temperature and relative air humidity measuring [7]

The device measures two temperatures simultaneously- the air temperature according to the so-called dry thermometer and spraying temperature.

The latter indicates the temperature at which condensation of the moisture contained in air begins.

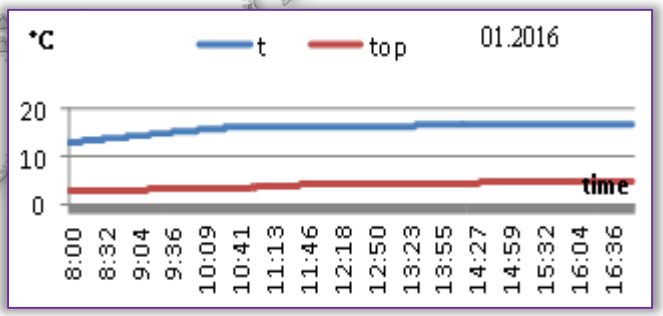

Figure 3 a. Hourly alteration of air temperature and spraying temperature in January 2016

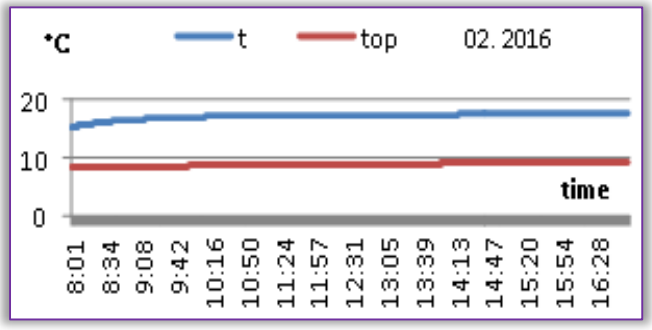

Figure 3b. Hourly alteration of air temperature and spraying temperature in February 2016

Figure 3a, Figure 3b, Figure 4a and Figure 4 b illustrate the hourly and daily values of air temperature and spraying temperature in a sports hall. The hourly values of air temperature for January vary between 12.9°C (8:00h) and17°C (16:00h).

The daily values are: min 12.0°C (18.01.) and max 18.5°C (31.01.). The values of spraying temperature are respectively hourly: 2.9°C (8:03 h) and 4.8°C (17:00h) and daily min -1.97°C (18.01) and max 8.54°C (12.01)

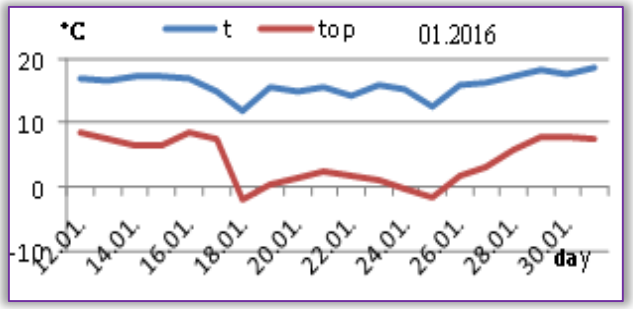

Figure 4a. Alteration of air temperature and spraying temperature in January 2016

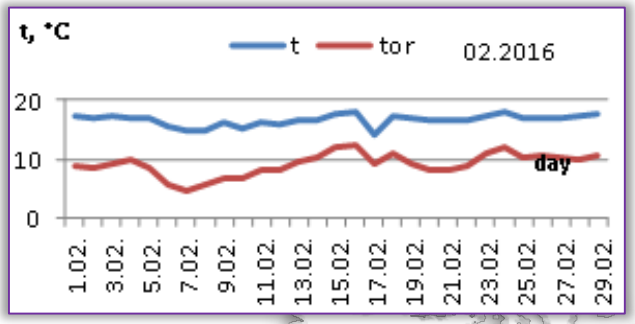

Figure 4 b. Alteration of air temperature and spraying temperature in February 2016

According to the same indicators the data for February are, as follows: hourly min 15.45°C (8:01h), max 17.8°C (16:53h). The daily minimal values are 14.08°C (17:02.) and the maximal are 18.09°C (16.02.).

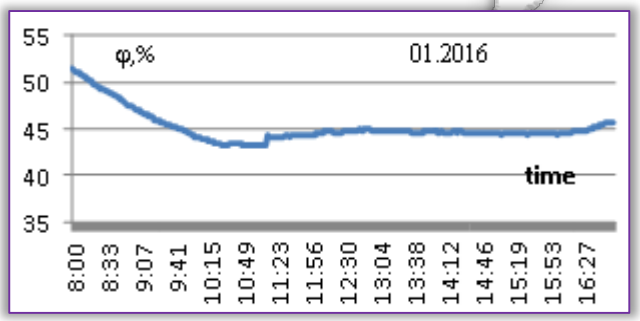

Figure.5a. Hourly alteration of air relative humidity in January 2016

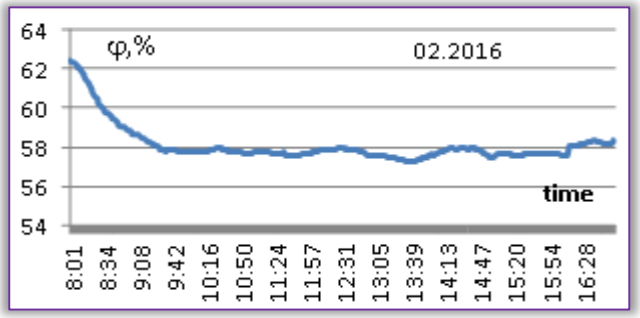

Figure 5b.Hourly alteration of air relative humidity in February 2016

The hourly values for air irrigation temperature are respectively: min 8.28°C (8:01 h) and max 9.04°C (16:50h).The daily values show 4.58°C (7.02) and 12.14°C (16.02).

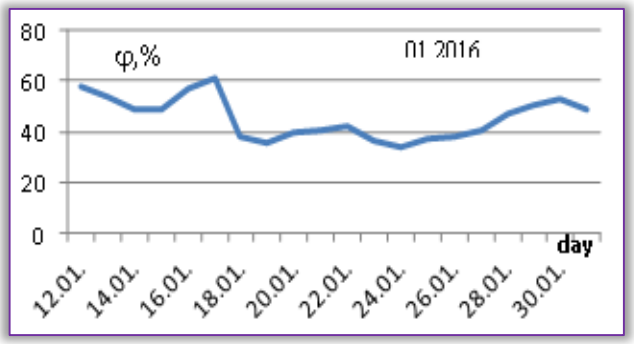

Figure.6a. Alteration of air relative humidity in January 2016

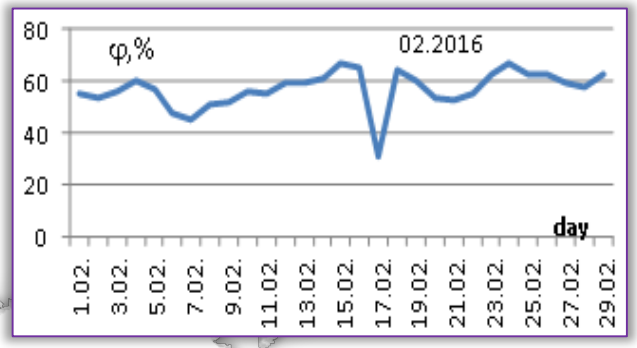

Figure 6b. Alteration of air relative humidity in February 2016

Figure 5a, Figure 5b, Figure 6a and Figure 66 illustrate the hourly and daily values of relative humidity of air in the sports hall. The hourly values for January are in the range between 43.23% (10:55 h) and 51.38% (8:00h). The daily values are respectively: from 34.12% (24.01.) to 61.43% (17.01.).

The hourly data in the studied indicator for February are: 57.2% (13:40h) and 62.4% (8:01h). The daily values are: min 31.09% (17.02.) and max 66.85% (24.02.).

- Another physical factor of the working environment is **room illumination**.

[11] regulates illumination of sports halls with the aim of providing good visual conditions for the users of the sports facility (athletes, judges, spectators) and in compliance with the requirements for colour television broadcasts). The standard specifies values to the lighting in terms of illumination, uniform distribution of light, dazzle-limiting and colour properties of the sources of light. It also sets down the methods of measuring these values.

The illumination of the sports hall is measured with a GL55 sensor – Figure7.

The results obtained by the measurements are shown in Figure 12 and Figure13.

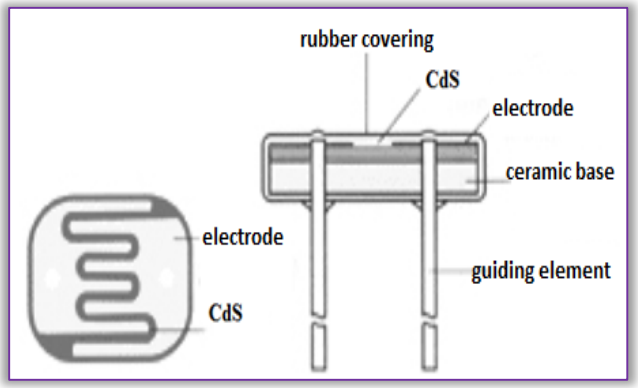

Figure 7. GL55 Illumination measuring sensor [12]

Figure 8a, Figure 8b, Figure 9a and Figure 9b illustrate the hourly and daily values of illumination of the sports hall. The hourly values for January range between 58.9Lux (8:00 h) and 490 Lux (13:50h). The minimal daily value is 105 Lux (16.01.) and the maximal one is 390 Lux (13.01.).

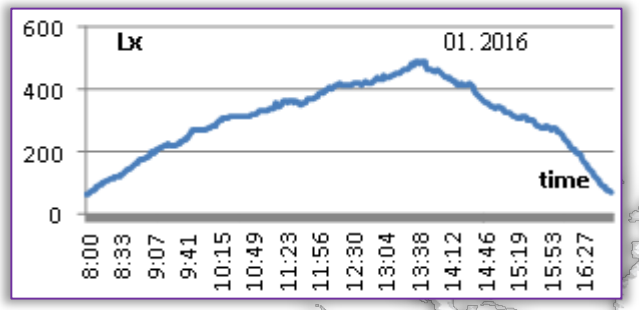

Figure 8a.Hourly alteration of the illumination of the sports hall in January 2016

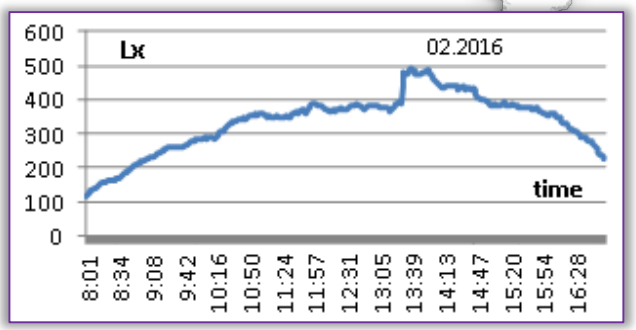

Figure 8b. Hourly alteration of the illumination of the sports hall in February 2016

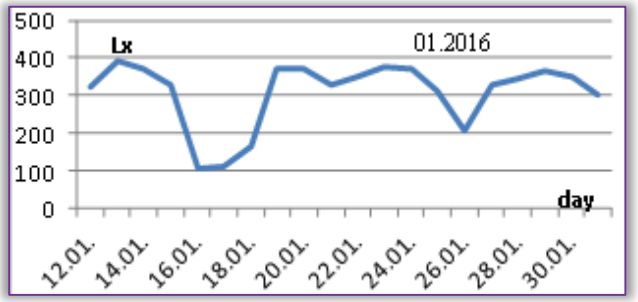

Figure 9a. Daily alteration of the illumination of the sports hall in January 2016

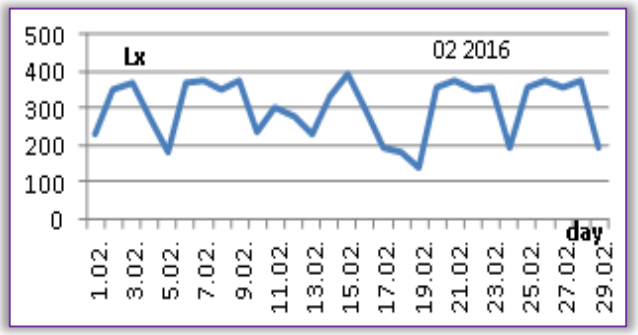

Figure.9b. Daily alteration of the illumination of the sports hall in February 2016

The hourly illumination distribution for February is 115 Lux (8:01h) and 490 Lux (13:40h). The daily values are in the range between 134 Lux (19.02.) and 393 Lux (15.02.).

Dustiness

The sanitary and hygienic requirements to air purity in the rooms are determined not only by the condition of comfort for the occupation by people, but also the conditions of the whole volume, ensuring safety of living to organisms.

Dust concentration should not exceed 10 mg/m^{3}in closed rooms and depends on the activity and the number of the athletes.

Polluted air is particularly harmful to the students due to a number of reasons: doing sports increases inhaling tenfold; deeper inhaling leads to larger saturation with polluted air of the most sensitive parts of lungs; most often polluted air is inhaled through the mouth as result of which penetrates into lungs freely.

Figure 10. GP2Y1010AU0F sensor

GP2Y1010AU0F is a sensor for registering the presence of dust particles in the air on the basis of optical measuring instruments. Reflected light of the fine dust particles in the air is registered, measured in V for their transformation into mg/m^3 is illustrated in Figure 9.

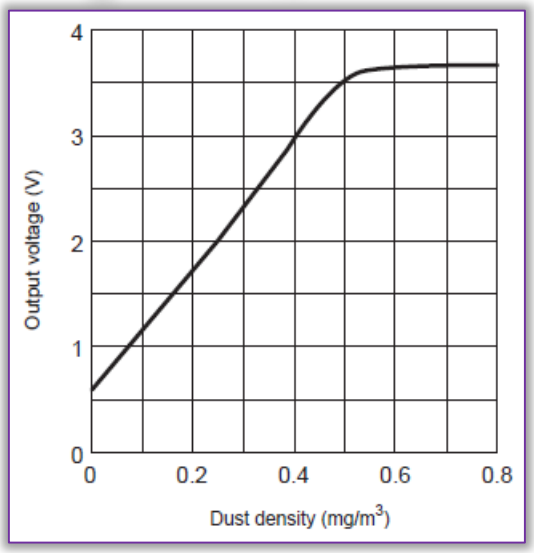

Figure.11.Transformation of V into mg/m³

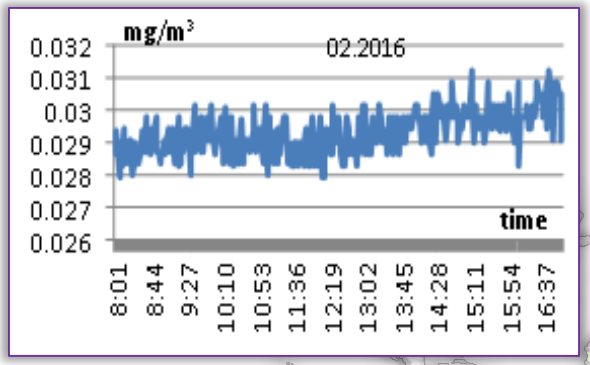

Figure.12a. Hourly alteration of air dustiness in January 2016

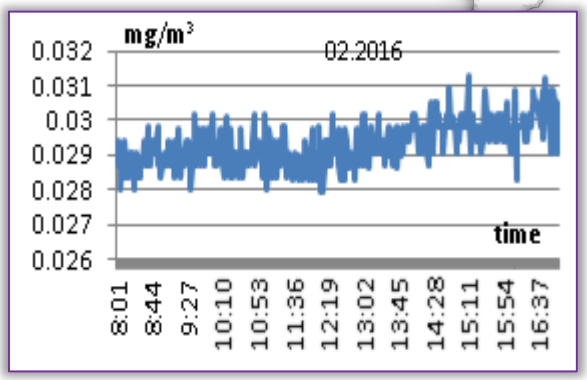

Figure.12b. Hourly alteration of air dustiness in February 2016

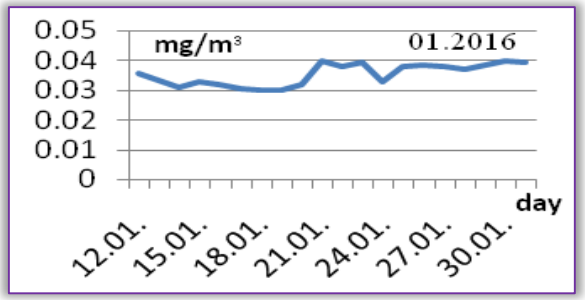

Figure 13a.Daily alteration of air dustiness in January 2016

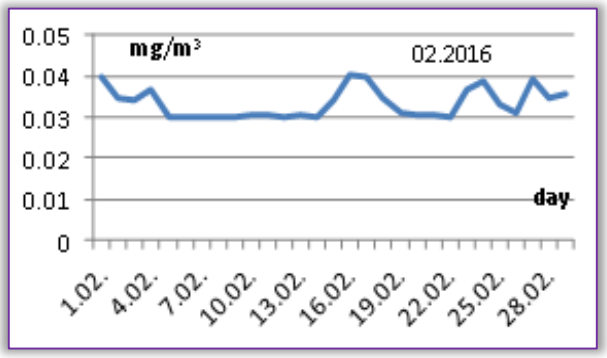

Figure.13b. Daily alteration of air dustiness in February 2016

Figure 12a, Figure 12b, Figure 13 a and Figure 13b reflect the hourly and daily values of air dustiness of the sports hall. The hourly values for January range from 0.033mg/m³ (8:01 h) to 0.038 mg/m³ (15:50h). The daily values indicate: 0.03 mg/m³ (18.01.) and 0.04 mg/m³ (21.01.).

The hourly data for dustiness for February are 0.028 mg/m³ (8:05h) and 0.031 mg/m³ (16:45h) and the respective daily values are: 0.032 mg/m³ (19.02.) and 0.040 mg/m³ (16.02.).

ANALYSIS OF THE OBTAINED RESULTS

- The data (hourly and daily) for the air temperature in the object of the study are in compliance with the sanitary and hygienic requirements for the winter period (18-22°C).
- The measured data for air relative humidity are in the ergonomical norms for comfort for the studied indicator. The measured temperatures of air spraying are in the allowable limits and do not create the preconditions for condensation.
- The illumination at the sports hall is in compliance with the requirements and this is corroborated by the obtained results.
- The registered low values of the indicator of dustiness are explained with the availability of special flooring and the option for natural ventilation.

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ISSN:2067-3809