PRESENT ENVIRONMENT AND SUSTAINABLE DEVELOPMENT, VOL. 6, no. 2, 2012

THE BIOCLIMATIC COMFORT OF AN IT OFFICE AND ITS OCCUPANTS' PERCEPTION ABOUT THEIR WORKING ENVIRONMENT

Nicoleta Ionac[1], Cătălin Adrian Mihoc[2], Paula Tăbleț[3]

Key words: bioclimatic indices, IT office, comfortable working environment.

Abstract. This study highlights the time variation of two most important bioclimatic indices inside an IT office building. This way, during one year's time period, from February 2010 to February 2011, we have recorded the dry-air temperature, air relative humidity and wind speed (although very low in indoor spaces) and consequently calculated the monthly, daily and hourly values of the Temperature-Humidity Index (THI) and the Wind-Chill Index (Wind-chill) with its equivalent air-temperature. The recordings of the data were made by means of an automatic microclimatic indoor station. The results show that quantitative bioclimatic analyses may be useful instruments in assessing the bioclimatic comfort and well-being and the working environmental conditions inside an office building, where artificial microclimates are created. Moreover, we have also applied a specific questionnaire, to which the office occupants answered, and noticed that there is a close correspondence between the optimal values of bioclimatic indices and the subjective perception of well-being and comfort of people in collective environments.

Introduction

Climate undoubtedly represents the main factor contributing to the quality of life, even for the simplest reason that it is omnipresent and permanent. And despite the fact that, nowadays, people live or work in buildings that protect them against bad weather and ensures them optimal or acceptable conditions as regards indoor air-temperature, humidity etc., this doesn't necessarily mean that they totally avoid weather's bad moods. Indoor microclimates largely depend on outdoor meteorological and climatic conditions and to ensure optimal living or working conditions requires great and costly efforts. As more and more people spend most of their time in indoor spaces, the indoor microclimatic conditions become more and more important for their health and well-being, largely influencing their life quality. For this, a thorough analysis of some relevant indicators is highly recommended.

[1] Prof. PhD., University of Bucharest, Romania, rinmozel@yahoo.com
[2] Ph.D. Student, University of Bucharest, Romania, biagyydog@yahoo.com
[3] Ph.D. Student, University of Bucharest, Romania, tablet.paula@unibuc.ro

And this study actually presents the main bioclimatic characteristics of an office building and its occupants' perception about their working environment.

1. Location, period and observations means and methods

The microclimatic measurements that were necessary to calculate the bioclimatic indices which we considered relevant for this study, were made inside a large office building (NOVO F), which is the largest building of this type, in a great office-building complex (NOVO), located in the northern part of Bucharest capital-city, on the Pipera inter-fluvial field, at 5, Fabrica de Glucoză Street, in sector 2 (Figure 1). Within this large office-building area, where more than 3,000 people work, the NOVO F building is a 13-storey high building, reaching the maximum height of 47.98 m, at the ceiling level of the last floor. On the 11th open-office floor, there are 265 computer-working posts (*cubicles*), arranged in 4 compact groupings, facing to the N, E, S, and W sides of the building (Figure 2). The N-oriented group includes 60 office desks, arranged on 12 rows, with 5 desks on a row. The office desk no. 18, on which the instrumental measurements were made, lies somewhere close to the middle of this desk-grouping and its location largely influenced the bioclimatic comfort of its occupant.

Fig. 1 - NOVO F Office building


Fig. 2 - Office cubicles (11th floor, NOVO F).

By means of the *Casella Microtherm* microclimatic weather station, instrumental records of the dry-air temperature, air relative humidity and wind speed were made for almost one year period (February 2010 – February 2011), from 30 to 30 minutes. After all data were collected, we calculated the resulting monthly, daily and hourly values of two bioclimatic indices: the Temperature-Humidity Index (THI) and the Wind-Chill Index (Wind-Chill) with its equivalent air-temperature, also analyzing their variation, in order to get a general, objective overview of the ambient comfort of the respective IT office. Moreover, the objective assessment of the indoor bioclimatic comfort, based on instrumental measurements and quantitative analysis, was completed with a study on the subjective perception of the office-clerks on their working environment. In this respect, a simple questionnaire was applied to almost 200 persons working in the

offices on the 11th floor of the NOVO F building, thus reflecting their satisfaction or dissatisfaction about the microclimate they have to work in eight hours a day.

2. Bioclimatic indices

The bioclimatic analysis was based on the following indices

2.1. The Temperature-Humidity Index (THI), which expresses the actual ambient temperature perceived by the human body under specific conditions of humidity, establishes the *effective body temperature* (ET), starting from the premises that evaporation of water from the human skin is the main physical process of heat loss (cooling). The ET values indicate the human *thermal comfort* in a given area and it is generally admitted that ET values ranging between 15-20^{0}C best describe a state of optimal comfort (values below this physiological limit indicating hypothermal discomfort and above it, hyperthermal discomfort) (Table 1). It is calculated on the formula (Kyle, 1994):

$$THI = T_{dry} - (0.55 - 0.0055 \cdot RH) \cdot (T_{dry} - 14.5)$$

where: T_{dry} = Dry-air temperature (°C);
RH = Relative humidity (%).

Tab. 1 – The value classes and the associated bioclimatic comfort of THI (°C)

THI index (°C)	**Type of bioclimate**
THI ≤ – 40	Hyper-glacial
– 40 < THI ≤ – 20	Glacial
– 20 < THI ≤ – 10	Excessively cold
– 10 < THI ≤ – 1.8	Very cold
– 1.8 < THI ≤ 13	Cold
13 < THI ≤ 15	Cool
15 < THI ≤ 20	Comfort
20 < THI ≤ 26.5	Hot
26.5 < THI ≤ 30	Very hot
THI > 30	Sultry

2.2. The Wind-Chill Index (**Pr)** is a bioclimatic indicator that objectively expresses the combined effect of air-temperature and wind-speed on the heat budget of the human body; its value representing the intensity of the energy loss per unit of body surface (W/m^2 body surface) by means of different physical processes: radiation, convection, evaporation, etc. It is calculated on the formula (Siple P.A., Passel C.F.,1945):

$$\text{Wind-chill} = (12.1452 + 11.6222\sqrt{v} - 1.16222\ v) \times 33 - T_{dry}$$

The subsequent **wind-chill equivalent temperature (Tpr)** generally represents the temperature (°C) that air would have if taking into account its cooling power. It is calculated on the formula:

$$T\ p.r. = (33 + (T_{dry} - 33) \times (0.474 + 0.454\sqrt{v} - 0.0454\ v))$$

where: T_{dry} = Dry-air temperature (°C);

v = wind speed (m/s)

Table 2 gives the physiological effects corresponding to the wind-chill values.

Tab. 2 – Physiological effects corresponding to the Pr (W/m²) and Tpr (°C) indices (Ionac N. and Ciulache S., 2008)

Cooling power of the wind – Pr (W/m²)	**Wind-chill equivalent temperature - Tpr (^{0}C)**	**Physiological effects**
P r = 200 - 400	Tpr > +10	No discomfort (Comfort)
P r = 400 - 600	+10 ≥ Tpr >-1	Mild discomfort
P r = 600 - 800	-1 ≥ Tpr > -10	Increased discomfort
P r = 800 – 1 000	-10 ≥ Tpr >-18	Very cold
P r = 1 000 – 1 200	-18 ≥ Tpr >-29	Hypocaloric stress
P r = 1 200 – 1 400	-29 ≥ Tpr >-50	Risk of frostbite in prolonged exposure conditions

3. Bioclimatic assessement of the IT office indoor space

Since the indoor space of an IT office is generally too close for a relevant spatial analysis, this bioclimatic assessment has mainly been based on the monthly, daily and hourly variations of the bioclimatic indices taken into consideration, which sometimes determine slightly visible value differences but, nevertheless, real, that may effectively change the occupants'perception about their working environment.

3.1. The variation of monthly means actually represents the variation, over the whole period of reference, of daily means for each month.

The Temperature-Humidity Index (THI) values reflect a hot bioclimate for all months, except for October 2010, December 2010 and January 2011, when comfortable conditions prevail. This is mainly due to the lower outdoor temperatures, which, in busy working days, may compensate for the indoor heat surplus. The lowest value was recorded in January 2011 (19.47 °C), while the highest, in August 2010 (23.23 °C), as Table 3 shows.

Tab. 3 – Variation of THI (°C) monthly means

Month	Monthly means	Type of bioclimate	Month	Monthly means	Type of bioclimate
II 2010	20.69	Hot	IX 2010	21.27	Hot
III 2010	20.29	Hot	X 2010	19.86	Comfort
IV 2010	20.94	Hot	XI 2010	20.57	Hot
V 2010	21.64	Hot	XII 2010	19.97	Comfort
VI 2010	22.38	Hot	I 2011	19.47	Comfort
VII 2010	23.08	Hot	II 2011	20.04	Hot
VIII 2010	23.23	Hot			
Average	21.00	Hot	Average	21.00	Hot

The Wind-chill Index (Pr) shows some slight differences between the summer (and beginning of autumn) and the winter months. For instance, if in winter there are values around 450 W/m² (February 2010 with 449.98 W/m² and December 2010 with 449.26 W/m²), in September 2010 a much higher value of 461.90 W/m² appears. One can notice physiological effects of mild discomfort for all the analyzed months, as in Table 4.

Tab. 4 – Variation of Pr (W/m²) monthly means

Month	Monthly means	Physiological effects	Month	Monthly means	Physiological effects
II 2010	449.98	Mild discomfort	IX 2010	461.90	Mild discomfort
III 2010	452.84	Mild discomfort	X 2010	453.94	Mild discomfort
IV 2010	455.94	Mild discomfort	XI 2010	451.54	Mild discomfort
V 2010	458.09	Mild discomfort	XII 2010	449.26	Mild discomfort
VI 2010	459.55	Mild discomfort	I 2011	455.84	Mild discomfort
VII 2010	458.68	Mild discomfort	II 2011	457.31	Mild discomfort
VIII 2010	457.61	Mild discomfort			
Average	455.69	Mild discomfort	Average	455.69	Mild discomfort

On the contrary, the Wind-chill equivalent temperature (Tpr) values indicate the prevalence of comfortable conditions all year round. Monthly Tpr values are very close one to another and the difference between the highest and lowest monthly means is very little. The lowest value was recorded in October 2010 (27.40 °C) due to the increased cooling of outdoor air. Similar values are also recorded the following months: November (27.97 °C), December (27.83 °C) and January (27.87 °C). The highest value was recorded in August 2010 (29.29 °C),

due to the hot outdoor temperatures. Similar values, above 29 °C are also encountered in July (29.05 °C) (Table 5).

Tab. 5 – Variation of wind-chill equivalent temperature (°C) monthly means

Month	Monthly means	Physiological effects	Month	Monthly means	Physiological effects
II 2010	28.68	No discomfort (Comfort)	IX 2010	28.08	No discomfort (Comfort)
III 2010	28.32	No discomfort (Comfort)	X 2010	27.40	No discomfort (Comfort)
IV 2010	28.55	No discomfort (Comfort)	XI 2010	27.97	No discomfort (Comfort)
V 2010	28.56	No discomfort (Comfort)	XII 2010	27.83	No discomfort (Comfort)
VI 2010	28.73	No discomfort (Comfort)	I 2011	27.87	No discomfort (Comfort)
VII 2010	29.05	No discomfort (Comfort)	II 2011	28.37	No discomfort (Comfort)
VIII 2010	29.29	No discomfort (Comfort)			
Average	28.36	No discomfort (Comfort)	Average	28.36	No discomfort (Comfort)

Tab. 6 – Variation of THI (°C) daily means

Date	Daily means	Type of bioclimate	Date	Daily means	Type of bioclimate
1	21.17	Hot	17	21.23	Hot
2	21.04	Hot	18	21.42	Hot
3	20.96	Hot	19	21.30	Hot
4	21.00	Hot	20	21.34	Hot
5	21.15	Hot	21	21.32	Hot
6	21.22	Hot	22	21.22	Hot
7	21.21	Hot	23	21.00	Hot
8	21.20	Hot	24	20.97	Hot
9	21.14	Hot	25	20.99	Hot
10	21.30	Hot	26	21.35	Hot
11	21.48	Hot	27	21.14	Hot
12	21.40	Hot	28	21.09	Hot
13	21.23	Hot	29	21.27	Hot
14	21.39	Hot	30	21.17	Hot
15	21.48	Hot	31	21.34	Hot
16	21.27	Hot			
Average	21.22	Hot	Average	21.22	Hot

3.2. The variation of daily means actually represents the variation of the mean value of the bioclimatic indices taken into consideration for each day, irrespective of the month, from the whole period of reference.

The daily variation of the Temperature-Humidity Index (THI) shows a hot bio-climate. Most of the values reach 21°C, the highest reaching 21.48°C (in the 11th and 15th), while the lowest was 20.96 °C to day 3. The average value for the entire period was 21.22 °C (Tab. 6), and the difference between the highest and the lowest values was less than 1°C, actually 0.52°C. This shows that the pattern of evolution is not different from one hour to another. In fact, one can see a slight increase of values from the beginning to the end of the interval. The lowest values were recorded in the beginning and the second part of the interval (days 2-4, 23-25), while the highest value was recorded exactly in days 11 and 15, when work is busier and human agitation is most intense.

However, the Wind-chill daily means (Pr) indicate mild uncomfortable conditions. Although the calculated values are close to one another, there are always ups and downs between two-three consecutive days, mostly at the beginning of the interval, although the general variation profile reflects a constant decrease from the beginning to the end of the interval. The daily mean Wind-chill value is 456.41 W/m², and the difference between the day with the highest value (18 with 460.09 W/m²) and the one with the lowest value (4 with 452.44 W/m²) is not so high - 7.65 W/m² (Tab. 7).

Tab. 7 – Variation of Wind-chill (W/m²) daily means

Date	Daily means	Physiological effects	Date	Daily means	Physiological effects
1	456.26	Mild discomfort	17	459.04	Mild discomfort
2	459.56	Mild discomfort	18	460.09	Mild discomfort
3	456.01	Mild discomfort	19	456.85	Mild discomfort
4	452.44	Mild discomfort	20	456.06	Mild discomfort
5	457.11	Mild discomfort	21	457.91	Mild discomfort
6	455.11	Mild discomfort	22	457.07	Mild discomfort
7	457.36	Mild discomfort	23	457.51	Mild discomfort
8	459.97	Mild discomfort	24	455.15	Mild discomfort
9	456.00	Mild discomfort	25	453.63	Mild discomfort
10	455.50	Mild discomfort	26	455.64	Mild discomfort
11	454.41	Mild discomfort	27	456.92	Mild discomfort
12	455.69	Mild discomfort	28	455.95	Mild discomfort
13	456.10	Mild discomfort	29	453.89	Mild discomfort
14	455.44	Mild discomfort	30	454.45	Mild discomfort
15	458.73	Mild discomfort	31	454.88	Mild discomfort
16	457.34	Mild discomfort			
Average	456.41	Mild discomfort	Average	456.41	Mild discomfort

.

The variation of the wind-chill equivalent temperature (Tpr) daily means only shows comfortable physiological effects for all days. The average all-period value is 28.40°C, the highest value being recorded on day 15 (28.61°C) (Tab. 8), while the lowest one, on day 23 (28.16°C), resulting in a difference of just 0.45°C between these two specific days.

3.3. The variation of hourly means presents the annual variation of the respective bioclimatic indices at each observation hour, from each month of the period taken into consideration (Februarie 2010 – Februarie 2011).

The THI hourly mean values describe a constant hot bioclimate for all hours. They start increasing at 6.00 am (when the minimum value is recorded – 20.32°C), until 1.00 pm, when it remains constant (the maximum being reached at 3.00 pm, with 21.52°C), then it decreases progressively until 6.00 am, when it starts to go up again. The hourly mean of the entire interval is 20.97°C, and the difference between the highest and the lowest hourly mean is 1.2°C (Tab. 9).

Tab. 8 – Variation of wind-chill equivalent temperature (°C) daily means

Date	Daily means	Physiological effects	Date	Daily means	Physiological effects
1	28.39	No discomfort (Comfort)	17	28.34	No discomfort (Comfort)
2	28.38	No discomfort (Comfort)	18	28.54	No discomfort (Comfort)
3	28.31	No discomfort (Comfort)	19	28.34	No discomfort (Comfort)
4	28.30	No discomfort (Comfort)	20	28.33	No discomfort (Comfort)
5	28.31	No discomfort (Comfort)	21	28.49	No discomfort (Comfort)
6	28.44	No discomfort (Comfort)	22	28.40	No discomfort (Comfort)
7	28.50	No discomfort (Comfort)	23	28.16	No discomfort (Comfort)
8	28.45	No discomfort (Comfort)	24	28.25	No discomfort (Comfort)
9	28.29	No discomfort (Comfort)	25	28.33	No discomfort (Comfort)
10	28.46	No discomfort (Comfort)	26	28.48	No discomfort (Comfort)
11	28.54	No discomfort (Comfort)	27	28.33	No discomfort (Comfort)
12	28.44	No discomfort (Comfort)	28	28.40	No discomfort (Comfort)
13	28.37	No discomfort (Comfort)	29	28.44	No discomfort (Comfort)
14	28.54	No discomfort (Comfort)	30	28.37	No discomfort (Comfort)
15	28.61	No discomfort (Comfort)	31	28.51	No discomfort (Comfort)
16	28.45	No discomfort (Comfort)			
Average	28.40	No discomfort (Comfort)	Average	28.40	No discomfort (Comfort)

The variation of the Wind-chill hourly mean values (Pr) indicates light physiological discomfort for all hours. The hourly mean value of the entire interval

is 455.48 W/m², and the difference between the highest value (at 2.00 pm with 471.00 W/m²) and the lowest one (5.00 am with 439.38 W/m²) is quite consistent – 31.62 W/m². Although the variation pattern shows a value increase from the beginning to the end of the interval, the corresponding bioclimatic effects keep very constant, as shown in Table 10.

Tab. 9 – Variation of THI (°C) hourly means

Hour	Hourly means	Type of bioclimate	Hour	Hourly means	Type of bioclimate
00.00	20.73	Hot	12.00	21.43	Hot
01.00	20.65	Hot	13.00	21.48	Hot
02.00	20.58	Hot	14.00	21.49	Hot
03.00	20.51	Hot	15.00	21.52	Hot
04.00	20.44	Hot	16.00	21.49	Hot
05.00	20.36	Hot	17.00	21.50	Hot
06.00	20.32	Hot	18.00	21.50	Hot
07.00	20.45	Hot	19.00	21.35	Hot
08.00	20.51	Hot	20.00	21.23	Hot
09.00	20.65	Hot	21.00	21.07	Hot
10.00	21.00	Hot	22.00	20.93	Hot
11.00	21.30	Hot	23.00	20.81	Hot
Average	20.97	Hot	Average	20.97	Hot

Tab. 10 – Variation of Wind-chill (W/m²) hourly means

Hour	Hourly means	Physiological effects	Hour	Hourly means	Physiological effects
00.00	441.32	Mild discomfort	12.00	468.95	Mild discomfort
01.00	440.30	Mild discomfort	13.00	469.49	Mild discomfort
02.00	439.88	Mild discomfort	14.00	471.00	Mild discomfort
03.00	439.91	Mild discomfort	15.00	470.38	Mild discomfort
04.00	439.71	Mild discomfort	16.00	469.69	Mild discomfort
05.00	439.38	Mild discomfort	17.00	470.26	Mild discomfort
06.00	439.57	Mild discomfort	18.00	467.55	Mild discomfort
07.00	443.58	Mild discomfort	19.00	456.82	Mild discomfort
08.00	454.10	Mild discomfort	20.00	449.18	Mild discomfort
09.00	464.41	Mild discomfort	21.00	444.92	Mild discomfort
10.00	469.12	Mild discomfort	22.00	442.32	Mild discomfort
11.00	467.77	Mild discomfort	23.00	441.51	Mild discomfort
Average	455.48	Mild discomfort	Average	455.48	Mild discomfort

The hourly variation of the wind-chill equivalent temperature means (Tpr) shows physiological comfort for all analyzed hours. The highest value was recorded at

6.00 pm (28.78°C), and the lowest one, at 6.00 and 8.00 am (27.89°C), the mean of the entire period reaching 28.35°C. The pattern variation shows a value increase from 8.00 am to 3.00 pm, that is exactly during working hours. Then, the values remain constant until 6.00 pm, when they drop (due to the fact that the occupants are leaving the office) until 6.00 am, after which they remain constant up to 8.00 am (Table 11).

Tab. 11 – Variation of wind-chill equivalent temperature (°C) hourly means

Hour	Hourly means	Physiological effects	Hour	Hourly means	Physiological effects
00.00	28,27	No discomfort (Comfort)	12.00	28,63	No discomfort (Comfort)
01.00	28,20	No discomfort (Comfort)	13.00	28,70	No discomfort (Comfort)
02.00	28,13	No discomfort (Comfort)	14.00	28,71	No discomfort (Comfort)
03.00	28,07	No discomfort (Comfort)	15.00	28,76	No discomfort (Comfort)
04.00	28,00	No discomfort (Comfort)	16.00	28,74	No discomfort (Comfort)
05.00	27,94	No discomfort (Comfort)	17.00	28,75	No discomfort (Comfort)
06.00	27,89	No discomfort (Comfort)	18.00	28,78	No discomfort (Comfort)
07.00	27,96	No discomfort (Comfort)	19.00	28,75	No discomfort (Comfort)
08.00	27,89	No discomfort (Comfort)	20.00	28,71	No discomfort (Comfort)
09.00	27,90	No discomfort (Comfort)	21.00	28,59	No discomfort (Comfort)
10.00	28,17	No discomfort (Comfort)	22.00	28,46	No discomfort (Comfort)
11.00	28,49	No discomfort (Comfort)	23.00	28,35	No discomfort (Comfort)
Average	28,35	No discomfort (Comfort)	Average	28,35	No discomfort (Comfort)

4.The IT office occupants' perception about their working environment

Bioclimatic comfort is mainly based on the complex relationships between air-temperature, humidity and wind-speed, but these climatic factors do not solely influence human well-being because individual reactions depend not only on the elements of the caloric budget, but also on subjective factors that largely differ from one person to another (Ionac N. and Ciulache S., 2003). In this respect, we have made a specific questionnaire, which was distributed to more than 200 office clerks. By analyzing their answers, we found out that their overall bioclimatic perception roughly corresponds to the conclusions of the quantitative bioclimatic analysis presented above. Obviously, they usually feel disturbed by their artificial environment, especially in summer and winter, and mostly due to the temperatures being too high or too low.

Below are the questions addressed and the answers are presented in Fig. 3a – 3h.

1. Usually, during work, you are feeling…
2. Do you have problems with the "air-currents" at your working place?
3. In what period of the year are you feeling most uncomfortable at the office?
4. How often do you experience uncomfortable symptoms: in summer/ winter?
5. What time of the day are you feeling most uncomfortable?
6. Usually, in the office, you are wearing clothes….. (fill in…)
7. Do you have a window at your work place?

8. Do you use additional heating or cooling devices?

Conclusions

The bio-climate type in indoor spaces largely depends on the influence of the strongest climatic element. Therefore, if considering the temperature-humidity index (THI), based on air-temperature and humidity values, it shows rather hot bioclimatic conditions, especially when analyzing its hourly and daily variation. The Wind-chill (Pr) index variation, calculated on wind-speed, which is almost null in indoor spaces, expresses constant comfortable conditions (except November 2010), partially because of the indoor high temperatures and the poor air-circulation.

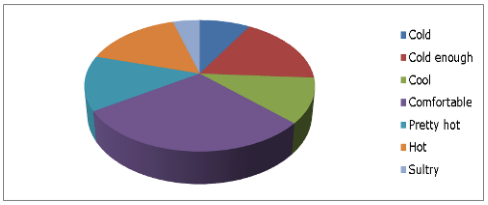

Fig. 3a – Results question 1

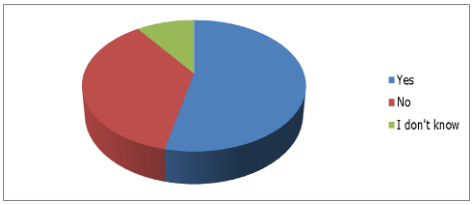

Fig. 3b – Results question 2

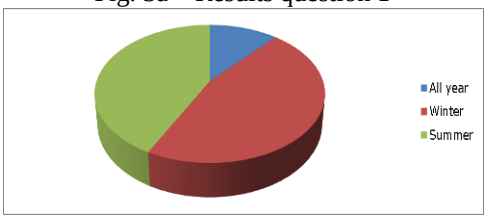

Fig. 3c – Results question 3

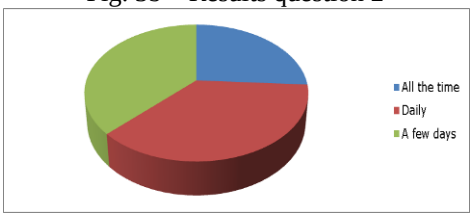

Fig. 3d – Results question 4

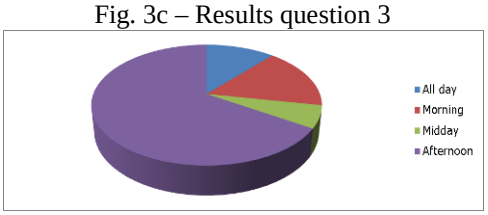

Fig. 3e – Results question 5

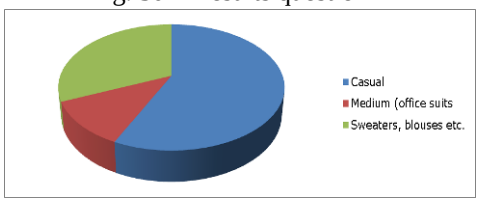

Fig. 3f – Results question 6

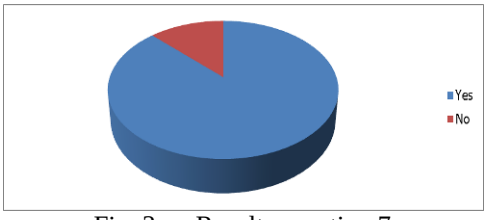

Fig. 3g – Results question 7

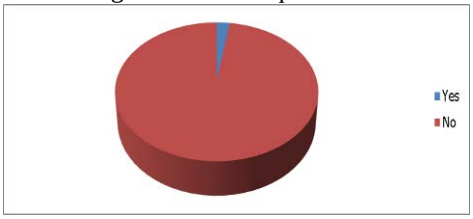

Fig. 3h – Results question 8

References:

Ionac Nicoleta, Ciulache S. (2003), *Influența microclimatului spațiilor închise asupra confortului şi sănătății umane*, "Comunicări de Geografie" vol. VII, Editura Universității din Bucureşti, p.129-134.

Ionac Nicoleta, Ciulache S. (2008), *Atlasul bioclimatic al României*, Editura Ars Docendi a Universității din Bucureşti, Bucureşti

Kyle W.J. (1994), *The human bioclimate of Hong Kong, Brazdil R, Kolář M. (eds.)* Proceedings of the Contemporary Climatology Conference, Brno. TISK LITERA, Brno, pp 345-350.

Siple P.A., Passel C.F. (1945), *Measurements of dry atmospheric cooling in subfreezing temperatures*, Proc. Amer. Phill. Soc., 89: 177 - 199.

.