Survey Research of Selected Issues the Sick Building Syndrome (SBS) in an Office Building

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Abstract – The reason why the Sick Building Syndrome appears is not enough flow of the fresh air going into the rooms. It could cause various ailments, although it is difficult to determine their source and the symptoms disappear soon after leaving the building. The paper discusses the sources of the indoor air pollution, symptoms of Sick Building Syndrome and shows the solutions how to avoid the phenomena of “sick” buildings. In addition, the results of questionnaire surveys on the well-being of employees, which were carried out in an office building in Warsaw, were presented. The vast majority of respondents in the building spend 8 hours, during which their well-being deteriorates. More than half of the respondents felt typical symptoms of the Sick Building Syndrome. To avoid the formation of “sick building” should be replaced regularly air. The exchange method is not important.

Keywords – pollution of indoor environmental; Sick Building Syndrome; survey

1. INTRODUCTION

In the pursuit of energy efficiency, we often forget about the ventilation of rooms. Currently, up to 80 % (some sources even provide 90 %) of energy expenditure are related to ventilation [1]–[3]. The exchange of air in rooms is necessary and it does not matter how it will take place [4]. We can exchange air in a natural way – contrary to appearances, causing the greatest energy losses [5]–[8] or fully automated mechanical with heat recovery, significantly more expensive during investment, but more energy-efficient during operation [7], [9].

The ventilation and air conditioning system itself can be a source of indoor air pollution [2], [7], [10], [11]. In addition to the development of microorganisms inside the ducts are more prosaic pollution like dust.

A „sick building” is when 30 % of all users complain about the internal environment, while experiencing various types of ailments [12]. The ailments are stronger the longer people are in the “sick” room. It isn’t possible to specify what causes these disabilities. Unpleasant symptoms are mainly associated with poor air quality in the room [13], [14]. After leaving the “sick building”, the discomfort disappears in a short time.

1.1. Sources of Air Pollution in Rooms

The source of air pollution in the room may be: living organisms (e.g. people, fungi) [15]–[17] building materials and elements of interior design (e.g. furniture and linings, for the production of which solvents, impregnates, compounds emitted by painting paints or asbestos, televisions, computers), ventilation and air conditioning systems (e.g. microorganisms living in non-cleaned

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ventilation ducts [13], [14]) – Fig. 1, external air (e.g. chemical and biological pollution), self-use of premises (e.g. smoking tobacco, cooking).

Fig. 1. Dust chamber with a filter section (own collection).

1.2. Symptoms of a Sick Building Syndrome

The symptoms of the Sick Building Syndrome experienced by people are primarily [7], [18], [19]: headache and dizziness, fainting, nausea, fatigue, allergic symptoms, irritation of mucous membranes: irritation of eyes, nose and throat, dry cough, drying and flaking of the skin, difficulty concentrating, difficult breathing, hypersensitivity to odours.

A “sick building” not only harms people staying in it. A building to which a too small stream of ventilation air is being destroyed. Mushrooms, molds and microorganisms thrive in “sick buildings” [13], [17] attack potted plants, cause degradation of building walls (Fig. 2) and their equipment [7], [20], [21]. The moisture accumulated in the room, at elevated temperature, is not only a breeding ground for fungi and molds, it also destroys building partitions and building equipment itself (Fig. 3).

The aim of the article is to analyse surveys conducted to determine whether the building being tested is a “sick building”. The presented research, in summary, leads to the need to prepare procedures for determining “sick buildings”. Such procedures are not specified in the applicable standards [22], [23].

Fig. 2. Mushroom and mold on the building wall (own collection).

Fig. 3. Mushroom on building equipment (own collection).

2. SURVEY – METHODOLOGY AND RESULTS

Survey research was carried out in Warsaw. The office building employs 200 people, on one floor, in various rooms, 50 people work. There is collective ventilation in the building, in each room there is a grille. In the rooms there is no control of the stream size, temperature value. In some rooms there are non-opening windows.

Temperature, humidity, CO₂ concentration, PM₁₀, PM_{2.5} were also measured. The measurement results are given in Table 1.

TABLE 1. PARAMETERS OF THE INDOOR AIR ON ANALYSED BUILDING

Windows	Temperature, °C	Humidity, %	CO ₂ concentration, ppm	PM ₁₀ , µg/m ³	PM _{2.5} , µg/m ³
Non-opening windows	24.7	65	1672	84	48
Opening windows	23	48	1221	51	27

In analysed office building indoor air temperature was recorded in range from 23 °C to 24.7 °C. In some people's opinion and standards [22] it was too high. Relative humidity was in range 48 % to 65 % was high according to [22]. Carbon dioxide concentration exceeded recommended 1000 ppm [22] reached 1221 to 1672 ppm. PM₁₀ was in range 51 to 84 µg/m³ and exceed the acceptable standards [24], [25]. PM_{2.5} was in range 27 to 48 µg/m³ and exceed the acceptable standards [25].

Fig. 4. Age of respondents.

The age of respondents is presented in Fig. 4. The largest group of respondents were people up to 30 years old – 19 people, the smallest oldest, aged 51–60 – 6 people. The study was attended by 28 people with humanistic education and 22 people with technical education. The respondents are 30 women and 20 men.

Fig. 5. The answer to the question: How many hours a day do you spend at work?

To the question: How many hours a day do you spend at work? Most of the respondents – 43 people, responded that 5 to 10 hours (Fig. 5).

While constructing the survey, the questionnaires presented in the literature [26]–[28] were used. 50 people agreed to participate in the study.

The survey included the following questions:

- Age: up to 20□; 21–30□; 31–40□; 41–50□; 51–60□; more than 61 □;
- Gender: W□; M□;
- Education: Technical□; Humanistic□;

- How many hours a day do you spend at work? Below 5□; 5 to 10□; above 10□;
- Do you use ventilation/air conditioning at work? Yes□; No□;
- How do you care for indoor air?
- How do you feel immediately after leaving the office building? (several answers):
I take a deep breath □; My head hurts □; My eyes are burning □; My stomach hurts □;
I am dry in my throat □; The joy that I leave this building □; None of the above □.

Fig. 6. Answers to the question: How do you care for air in the rooms?

Fig. 7. Answers to the question: How do you feel immediately after leaving the office building?

36 respondents use ventilation or air conditioning, while 14 do not use. Answers to the question: How do you care for indoor air? there were only four (Fig. 6). The vast majority of respondents – 43 people, air the room. To the question: How do you feel immediately after leaving the office? in response to which you could mark several answers. Respondents usually marked one or two responses (Fig. 7).

39 % of responses concerned headache, 13 % indicated eye burning, 7 % complained of abdominal pain and 9 % of respondents complained of dry throat. 10 % of people taking part in the survey take a deep breath from the building. 5 % of respondents were satisfied that they were leaving the building, not indicating any complaints, while 17 % of the respondents didn't feel any complaints.

3. DISCUSSION

Links between the Sick Building Syndrome and health presents many publications [2], [9], [12], [17], [28]–[30]. The close connection with the quality of internal air and with thermal comfort is presented in publications. Surprising is the statement of the Sick Building Syndrome in the research presented by Polizzi et al. [31], Vance and Weissfeld [32], Ulpiani [33], Ulpiani et al. [34] in which no questionnaire surveys were carried out. This raises the question: what was the basis of the Sick Building Syndrome? After all, by definition: A “sick building” is when 30 % of all users complain about the internal environment, while experiencing various types of ailments. The fact that the internal conditions are bad isn't synonymous with the occurrence of the Sick Building Syndrome.

Many researchers avoid the term Sick Building Syndrome [2], [9], [10], [12], [13], [17], [25] because it is a very broad concept. Nevertheless, the phenomenon of the Syndrome of the Sick Building associate's human health with the internal environment. Therefore, procedures should be developed to clearly determine whether the building is sick or healthy. Similar to the procedures determining the energy efficiency of buildings [35], [36].

The work focused on the reception of internal air by the surveyed. The reason is that the average person isn't able to identify causes such as the number of microorganisms in the internal environment, the amount of electromagnetic radiation, or the amount of chemicals in the room coming from external or internal air or derived from building materials and building equipment.

In the presented study, 39 % of respondents consciously stated that after a day of work complaining about headaches, 13 % indicated eye burning, 16 % of people taking part in the study had other ailments. 17 % of respondents didn't feel any complaints. It should be clearly stated that the building is sick. At least one of the recommended solutions should be used:

- Increasing the ventilation air stream and improving the efficiency of air distribution in the rooms, this reduces the concentration of pollutants;
- In rooms with high concentrations of pollutions, for example a printer or welding station or a kitchen where huge amounts of moisture are generated, it is necessary to install a local air pollutant;
- Removal of sources and causes of pollution, cleaning of places where dust and moisture collect, in particular elements of the ventilation system

4. CONCLUSIONS

To avoid the formation of “sick building” should be, among others, replaced regularly air. The method of air exchange is not important. You can use natural or mechanical ventilation.

Summing up the survey, it should be noted that the vast majority of respondents in the building spend 8 hours, during which their well-being deteriorates. Most of the workers, despite installed mechanical ventilation, air the room, instinctively improving the parameters of the indoor air. More than half (68 %) of respondents felt typical symptoms of a Sick Building Syndrome. Therefore, the examined building is “sick”.

Surveys must be the basis for the study of a Sick Building Syndrome. A standard set of questions applicable in all countries should be developed. Measuring procedures should be implemented depending on the external climate

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