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SICK BUILDING SYNDROME

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Abstract *The sick building syndrome (SBS) is defined as environmentally related condition with increased prevalence of non-specific symptoms among the populations of certain buildings, often without clinical signs and objective measures of symptoms. SBS complaints seem to be the result of the interaction of environmental, occupational, and psychological factors, and they are probably not caused by poor indoor air quality alone. This review gives a brief overview of SBS, along with focusing on many of the causes of sick homes and buildings and discussing the research dedicated to solving this increasing problem. Relevant literature during the past 20 years was selected from Medline and discus the overview focuses on the relationship between selected aspects of in- door environment quality and health and comfort outcomes related to sick building syndrome. Among environmental factors assessed, there were generally consistent findings associating increased symptoms with air-conditioning, many workers in a space, video terminal use, and ventilation rates at or below 10 liters/second/person. Among personal factors assessed, there were generally consistent findings associating increased symptoms with female gender, job stress/dissatisfaction, and allergies. Sick building syndrome generally affects people employed in offices or other buildings that house many workers in close proximity. Most frequently, it occurs in newer office buildings which are designed to be energy-efficient. A multi-disciplinary approach including personality aspects, allergic disorders and indoor exposures should be applied in investigations of human health problems related to staying in modern buildings.*

Keywords: **Air quality, Environment, Occupants, Pollution, Sick Building Syndrome,**

I. INTRODUCTION

The term Sick Building Syndrome (SBS) is used to describe cases in which building occupants experience general non-specific symptoms of malaise such as irritation of the eye, nose, and throat, lethargy and dizziness (Broderbund, 1999). These acute health and comfort problems appear to be experienced by the sufferers during the time they occupy or spend in a building and disappear soon after they leave the building. There are no specific illnesses or causes that can be identified. The complaints may be localized on a particular floor in a zone or may be widespread throughout the building (United State Environmental Protection Agency 2006). Additional symptoms of the syndrome include nose bleeding, dry cough, burning in trachea, dry or itchy skin, nausea, heart palpitations, shortness of breath and/or exhaustion after normal activities, muscle cramps and joint pains, tremors, swelling of the legs, trunk and ankles, difficulty in concentration, chronic fatigue, sensitivity to odours, pregnancy problems including miscarriages and cancer.

A building is referred to as 'sick' if 20% of its occupants suffer from the symptoms of SBS and get relief soon after leaving the building. The effect of the syndrome is reduction in worker productivity and an increased absenteeism including employee sick leave applications. Caution should be taken that complaints may also result from other causes. These may include illnesses contracted elsewhere, acute sensitivity e.g. to allergies, job related stress, or dissatisfaction and other psychological factors.
The aim of this paper is to identify the causes and effects of sick building syndrome and explain why occupants of investigated buildings experience acute health problems and discomfort during the time they occupied the buildings.

II. HISTORY & BACKGROUND

In the late 1970s, it was noted that nonspecific symptoms were reported by tenants in newly constructed homes, offices, and nurseries. In media it was called "office illness". "The term "Sick Building Syndrome" was coined by WHO in 1986, when they also estimated that 10-30% of newly built office buildings. In the 1990s, therefore, extensive research into "sick building" was carried out. Various physical and chemical factors in the buildings were examined on a broad front. In the 1990s "sick buildings" were contrasted against "healthy buildings". The chemical content of building materials was highlighted.

III. REVIEW

3.1 Causes of Sick Building Syndrome

In spite of the numerous investigations, journal articles and conference papers, little has actually been proven about the causes of SBS. Different experts have disparate theories. One school of thought suggests that the main cause is chemical, while another proffers fungi as primarily to blame or physical factors such as humidity, temperature or lighting or the air-conditioning systems. The United States Environmental Protection Agency (2006) lists four causes of SBS as:

- Inadequate ventilation;
- Chemical contaminants from outdoor sources;
- Chemical contaminants from indoor sources; and
- Biological contaminants.

The majority of the above causes result from a number of sources as stated by the United States Environmental Protection Agency and these include:

- Poor design concept of buildings in areas of illumination, ventilation and in the production and installation of air conditioning systems;
- Poor and uninformed occupant activities in buildings;
- Use of building materials that are hazardous to occupants' health; and
- Operation and maintenance of buildings in manners inconsistent with their original design or prescribed operating procedure.

These show that the sources are mainly influenced by architectural properties, as well as organizational and facilities management processes. Some of the sources of SBS are discussed below.

3.1.1 Inadequate Ventilation

The design of air-tight buildings with windows that do not open results to insufficient air necessary to maintain the health and comfort of building occupants. Inadequate ventilation may also occur if heating, ventilation and air conditioning system do not effectively distribute air to the occupants of a building and this is thought to be a very significant factor in SBS. Till mid 1900's, building ventilation standards defined 15 cubic feet per minute (cfm) of outside air per building occupant.

3.1.2 Chemical Contaminants from Outdoor Sources

The air that enters a building from outdoors can be a source of indoor air pollution, especially in a situation where fumes from motor vehicle exhaust, plumbing vents and building exhaust (e.g. bathrooms and kitchens) find their way into a building due to poorly located inlets, vents, windows, other openings and poor location of high voltage air conditioning (HVAC) system inlet vents.

3.1.3 Chemical Contaminants from indoor sources

Most indoor pollution comes from sources within the building. Examples of these sources include adhesives for carpeting, upholstery, manufactured wood products, chemicals from copy machines, pesticides and cleaning, formaldehyde ozone and high level Volatile Organic Compounds (VOCs). A major contributor or source of high level VOCs is environmental tobacco smoking in addition to other toxic compounds and respirable particulate matter (Health, 2006). VOCs have been shown by researchers to cause chronic and acute health effects at high concentrations. Some are known as carcinogens, (combination of products such as carbon monoxide, nitrogen dioxide as well as respirable particles) which come from un-vented kerosene and gas space heaters; woodstoves, fire places and gas stoves.

3.1.4 Biological Contaminants

These include pollens, bacteria, viruses and moulds. These contaminants may breed in stagnant water that has accumulated in dust humidity and drain pans or where water has collected on ceiling tiles, carpeting or insulation. Bird and insect droppings can be a source of biological contaminants; some of these contaminants like mildew could also breed on damp surfaces.

3.2 Control of Indoor Air Quality

The control of pollutants at their source is the most efficient strategy for maintaining clear indoor air. But it is not always possible or practicable. Thus, ventilation either naturally or mechanically is the second most effective approach to providing acceptable indoor air. In the past, most buildings had operable windows that opened and aired stuffy rooms. But today, most new office buildings are constructed without operable windows; instead, mechanical ventilation systems are used to ensure exchange of indoor air with a supply of relatively clean outdoor air. With whatever method, adequate ventilation is essential to help flush buildings of pollutants such as carbon dioxide, nitrogen oxides, formaldehyde, which if left to accumulate can be harmful.

3.3 Solutions to Sick Building Syndrome

Solutions to sick building syndrome usually include combinations of the following:-

- Increase in ventilation rates and air distribution;
- Air Cleaning ;
- Pollutant sources removal or modification ; and
- Education and communication.

3.3.1 Increasing ventilation rates and air distribution often can be a cost effective means of reducing indoor pollutant levels. HVAC systems should be designed, at a minimum, to meet ventilation standards in local building codes; however, many systems are not operated or maintained to ensure that these design ventilation rates are provided. In many buildings, IAQ can be improved by operating the HVAC system to at least its design standard. When there are strong pollutant sources, local exhaust ventilation may be appropriate to exhaust contaminated air directly from the building.

3.3.2 Air cleaning can be a useful adjunct to source control and ventilation but has certain limitations. Particle control devices such as the typical furnace filter are inexpensive but do not effectively capture small particles. High performance air filters capture the smaller, respirable particles but are relatively expensive to install and operate. Mechanical filters do not remove gaseous pollutants. Some specific gaseous pollutants may be removed by adsorbent beds, but these devices can be expensive and require frequent replacement of the adsorbent material.

3.3.3 Pollutant source removal or modification is an effective approach to resolving an IAQ problem when sources are known and control is feasible. Examples include routine maintenance of HVAC systems, e.g., periodic cleaning or replacement of filters; replacement of water-stained ceiling tile and carpeting; institution of smoking restrictions; venting contaminant source emissions to the outdoors; adhesives, and use of these pollutant sources during periods of non-occupancy. Several of these options may be exercised at one time.

3.3.4 Education and communication are important elements in both remedial and preventive indoor air quality management programs. When building occupants, management, and maintenance personnel fully communicate and understand the causes and consequences of IAQ problems, they can work more effectively together to prevent problems from occurring, or to solve them if they do.

SUMMARY

Indoor environment is a crucial part of the design process; therefore, designers need to change their thinking about this physical environment and increase their awareness of health impact on occupants. Building factors that affect sick building syndrome are high indoor temperatures which enhances fungi, low fresh ventilation which enhances producing biological contaminants, poor individual control of temperatures, poor building service maintenance and poor cleaning or cleaning ability. It is therefore recommended that occupants' education on the subject matter is necessary so as to reduce the negative effects of

human activities to the indoor air quality and health of the building occupants. If this is done, occupants could reduce causative behaviours and activities and improve indoor air quality.

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