CHAPTER TWO
REVIEW OF LITERATURE

This chapter reviews the literature in six main areas along with a summary: (1) The Concept of Awareness, (2) The Definition of Sick Building Syndrome, (3) The Prevalence of Sick Building Syndrome Symptoms, (4) Associated Factors Causing Sick Building Syndrome Symptoms, (5) Solutions to Sick Building Syndrome, and (6) Relevant Research.

2.1 THE CONCEPT OF AWARENESS

It is important to create awareness. Traditionally, the term “awareness” has often been used synonymously with the term “consciousness.” Awareness is an accessible, up-to-date examination of scientific thinking about the nature of consciousness. Dourish (1992) defined awareness as “an understanding of the activities of others, which provides a context for your own activity” (p.109). According to Christiansen and Maglaughlin (2003), awareness is classified into four types: workplace awareness, which is knowledge of tasks within the virtual environment; availability awareness, which relates to the availability of people and objects; group awareness, which promotes the feeling of belonging to a group; and contextual awareness, which includes physical, social and mental context.

The ability of awareness is to read people and situations and make an assessment of their intent. It can also anticipate the probability of violence before it happens. However, awareness is not about being fearful or paranoid. It is a relaxed state of alertness that people may use normally in their everyday life. People’s level of awareness should be appropriate to the current circumstances. It is suggested that the apparent degree of awareness is an expression of adaptive psychological responses constructed in a social situation in the context of neurologically based cognitive impairment.

In general, awareness may also refer to public or common knowledge or understanding about a social, scientific, or political issue, and hence many movements try to foster "awareness" of a given subject. According to United Nations Educational, Scientific and Cultural Organization [UNESCO] (2009), it is generally accepted that

to raise public awareness of something is to inform and educate people about a topic or issue with the intention of influencing their attitudes, behaviors and beliefs towards the achievement of a defined purpose or goal. Common approaches for raising public awareness include personal and mass communication through mass media such as printed materials, websites and emails, feature articles in newspapers or magazines, radio and television.

2.2 THE DEFINITION OF SICK BUILDING SYNDROME

In recent years, Sick Building Syndrome (SBS) has emerged as a significant problem in the workplace, not only in the UK but most European countries, the USA, Canada, Australia and Japan. Wikom Sengkhisiri and Sasithorn Theptrakarnporn (วิกรม เสงคิสิริ และ สสิธร เทพตระการพร, 2548) stated that there are different words used to describe the phenomenon such as ‘building sickness’, ‘sick office syndrome’, ‘tight building syndrome’, ‘office eye syndrome’, and other terms have been used. However, none fully describes the condition but ‘Sick Building Syndrome’ has been recognized by the World Health Organization in 1983 and is the most widely used description.

Sick Building Syndrome is the term used to describe situations in which building occupants experience short-term acute health and comfort effects that are linked to the amount of time spent in a particular building. The complaints may originate from one particular room or zone of the building, or they may occur throughout the whole building. Symptoms seem to increase in severity with the amount of time spent in the building, and become less severe when time is spent away from it. No specific illness or cause can be identified. Godish (1995) stated that in contrast Sick Building Syndrome is distinguished from typical Building-Related Illnesses (BRI), which refers to recognized diseases that can be attributed to a building e.g. legionnaires’ disease, pneumonia and asthma, whereas Sick Building Syndrome describes the non-specific symptoms.

According to Dr. Soisuda Kesornthong of the Bureau of Occupational and Environmental Health Disease at the Ministry of Public Health (สร้อยสุดา เกสรทอง, 2549), the syndrome consists of a group of non-specific symptoms which can be classified into five groups as follows:

I. **Eye Symptoms:** dry or watering eyes, eye irritation, redness, burning, especially contact lens wearers being more vulnerable to the consequence of visual work

II. **Nasal Symptoms**: runny or blocked nose, congestion, nosebleeds, itchy or stuffy nose, sneezing

III. **Throat and Respiratory Tract Symptoms**: dry or sore throat, dry cough, chest tightness, swallowing and breathing difficulties

IV. **Skin Problems**: dry skin, skin rashes

V. **Other Symptoms:** headaches, dizziness, fatigue, lethargy, and loss of concentration

2.3 THE PREVALENCE OF SICK BUILDING SYNDROME SYMPTOMS

Baechler (1991) reveled that perhaps 30-50% of new and remodeled buildings with re-circulating ventilation or air conditioning systems have a high rate of complaints among workers and that up to 85% of workers in such building suffer from some symptoms.

A significant number of problem building investigations have been conducted in the United States by health hazard evaluation teams of the National Institute of Occupational Safety and Health (NIOSH). According to an investigation of NIOSH, it reported that symptoms were diverse and not specific enough to identify causal agents easily. Symptom prevalence as a percentage of buildings investigated is indicated in Table 1. In a large percentage of investigated buildings (>50%), occupants reported symptoms of eye irritation, dry throat, headache, fatigue, and sinus congestion.

Table 1. Frequency of Reported Symptoms in NIOSH Building Investigations

Symptoms	% of Buildings
Eye irritation	81
Dry throat	71
Headache	67
Fatigue	53
Sinus congestion	51
Skin irritation	38
Shortness of breath	33
Cough	24
Dizziness	22
Nausea	15

Note. From *Proceedings IAQ '86: Managing Indoor Air for Health and Energy Conversation.*

Norback's study (as cited in Godish, 1995, p. 12) indicated symptom prevalence rates in 11 Swedish sick office buildings in his book: "Indoor Air Quality and Personal Factors Related to the Sick Building Syndrome." Considerable variation in symptom prevalence rates was observed. Table 2 shows that notably high (>30%) prevalence rates were reported for eye irritation, nasal congestion, throat dryness, sensation of getting a cold, headache, and abnormal tiredness.

Table 2. Symptom Prevalence Rates in 11 Swedish 'Sick' Office Buildings

Symptoms	**Total mean prevalence (%)**
Eye irritation	36
Swollen eyelids	13
Nasal catarrh	21
Nasal congestion	33
Throat dryness	38
Sore throat	18
Cough	15
Headache	36
Abnormal tiredness	49
Sensation of getting a cold	42
Nausea	8
Facial itch	12
Facial rash	14
Itching on hands	12
Rashes on hands	8
Eczema	15

Note. From Norback, D. 1990. *Scand J. Work Environ. Health*

2.4 ASSOCIATED FACTORS CAUSING SICK BUILDING SYNDROME SYMPTOMS

Contributing factors can often relate to the design of the built environment and may include combinations of some of the following:

2.4.1 People-Related Risk Factor:

Personal Characteristics

Personal characteristics include gender, age, and a variety of lifestyle factors such as smoking, alcohol consumption, coffee consumption, regular exercise, use of contact lenses. etc.

As in earlier studies, women visit the doctor for a physical check-up more often than men and are more likely to be aware of health problems than men. However, they tend to have more symptoms associated with Sick Building Syndrome than men. Younger workers also have more symptoms than older workers. Females consistently report higher rates of Sick Building Syndrome symptoms than males. Differences in reporting rates may be as high as three to one (Godish, 1995, p. 30).

Hedge et al. (as cited in Godish, 1995, p.30) suggested that females may be more sensitive to environmental influences or may be aware of physical symptoms. According to the Danish Town Hall Study conducted by Skov et al. (as cited in Godish, 1995, p.12), prevalence rates for 12 work-related symptoms were summarized for males and females in Table 3.

Table 3. Symptom Prevalence among Male and Females Workers in Danish Town Hall Buildings

Symptoms	**Prevalence rates (%)**	
	Males	**Females**
Eye irritation	8.0	15.1
Nasal irritation	12.0	20.0
Blocked, runny nose	4.7	8.3
Throat irritation	10.9	17.9
Sore throat	1.9	2.5
Dry skin	3.6	7.5
Rashes	1.2	1.6
Headache	13.0	22.9
Fatigue	20.9	30.8
Malaise	4.9	9.2
Irritability	5.4	6.3
Lack of concentration	3.7	4.7

Note. From Skov, P. 1987. *Environ. Int.*

2.4.2 Psychosocial Risk Factors

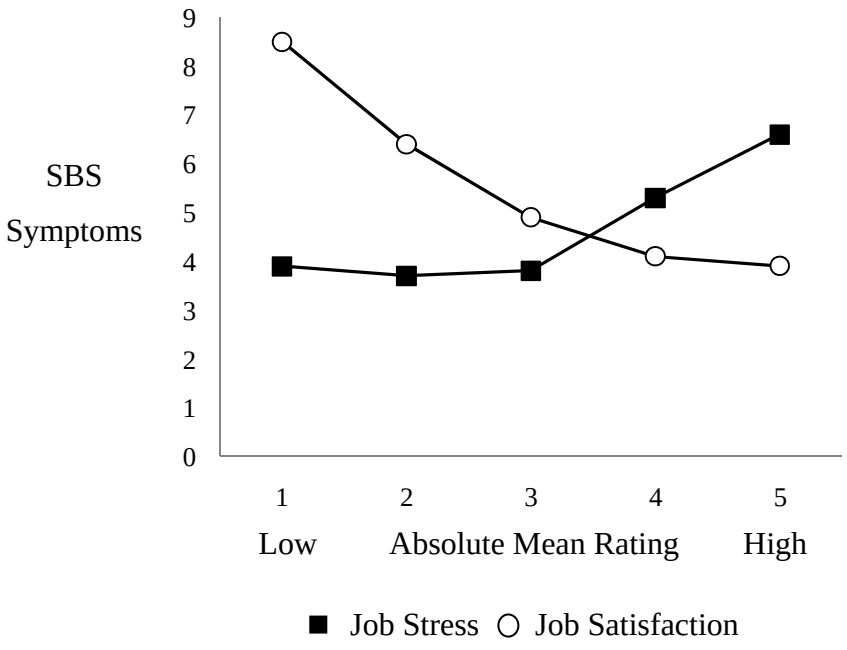
Job Stress

Hedge's study (as cited in Godish, 1995, p. 33) concluded in "The Role of Job Stress and Job Satisfaction in the Etiology of the Sick Building Syndrome in the Offices" that an office worker's level of self-reported job stress and job satisfaction was taken into account. He observed that work stress such as role conflict and workload were significantly related to overall symptom prevalence rates.

Job Satisfaction/Dissatisfaction

Negative correlations were reported between job satisfaction and the prevalence of sick building syndrome symptoms in an 18-office building study of Hedge. The effect of job stress and job satisfaction factors on symptoms reporting rates can be seen in Figure 3. As job stress increased, sick building syndrome symptom reporting rates increased, and as job satisfaction increased, symptom reporting rates decreased.

Figure 3. Relationship between Ratings of Job Stress, Job Satisfaction, and Sick Building Syndrome Symptom Prevalence Rates



Note. From Hedge's study. 1995.

2.4.3 Physical Environment Factors

Ventilation

Poor ventilation is a major factor in most problem buildings which are sealed and have mechanical ventilation or air conditioning. Fresh air is required for respiration and to dilute contaminants. Ventilation which is malfunctioning, badly maintained or designed can reduce the amount of air supplied to a level below a specified minimum and the distribution of fresh air within the occupied space may be inadequate. Circulating air must contain an adequate proportion of fresh outside air, otherwise it will only redistribute indoor air pollutants and contaminants, not dilute them. Also, when air is not changed or re-circulated enough, microorganisms such as bacteria, virus and fungi brought in by people or from contamination are more likely to spread throughout the building.

Temperature

Temperature is a physical variable that can have a major impact on comfort. In the winter in a northern climate, the outside air is much colder than the inside air, and there may be large temperature differences in various areas of a building.

Humidity

If a room is comfortable, people working in it under normal conditions are neither hot nor cold and sweaty nor dry. It's necessary to control humidity in the workplace. Very high humidity can cause discomfort, especially at elevated temperatures and may result in excessive condensation. Low humidity causes drying of the mucous membranes resulting in eye, nose and respiratory discomfort. People complain about sore throats, eye and skin irritations when the air is dry, particularly in the winter (May, 2006, p. 64). Rostron (1997) suggested that a relative humidity of 40-60% is appropriate for most offices. The recommended comfort requirement is an operative temperature of 20-24ºC.

Lighting

Lighting is related to both general satisfaction in the indoor environment and the comfort of visual performance. Eye work under inappropriate lighting can be a very obvious cause of Sick Building Syndrome, producing eye discomfort, eye strain, and fatigue. The last decade has brought widespread use of computers that have changed the demands of visual work. The eyes are the most important working tool and they have to function in an appropriate lighting environment. Complaints about 'too bright' artificial lighting are as frequent as 'too dim' daylight. Although social life and habits necessarily need artificial lighting, providing stimulation for eye performance, artificial lighting should be used when there is insufficient daylight, but not used permanently in windowless buildings (Rostron, 1997, p. 32).

2.4.4 Office Materials, Equipment, and Furnishing

A variety of materials and equipment used in the work environment have been implicated as potential risk factors for illness symptoms. These include carbonless copy paper, other papers, office copy machines, laser printers and other computer equipment. In addition, materials used to furnish building interiors may contribute to Sick Building Syndrome. Although emissions from a variety of building materials and furnishings may be responsible for sick building complaints, much research has focused on floor coverings, particularly textile materials, and their potential for contributing to Sick Building Syndrome and indoor air contamination.

2.4.5 Contaminants

Formaldehyde

Formaldehyde is a colorless gas, a simple compound of the chemical elements carbon, hydrogen, and oxygen found in more than 3,000 building products. It is used in particleboard in furniture, insulation, and especially in carpeting. Many building materials, furnishings and paper products contain formaldehyde. Possible health effects include mucous membrane irritation, asthma, neuro-psychological effects and malignant disease (Lawson, 1993, p. 187).

Asbestos

Asbestos is made of mineral fibers. It is used for spraying on ceilings or walls or it is used as duct insulation in the air-conditioning system. Asbestos fibers will be released into the air and penetrate the respiratory system. Fibers enter the body through the nose and mouth by inhalation and they will stick in alveoli. They will be lodged in the lungs. Asbestos–related conditions affect the lungs and surrounding tissues (Baechler, 1991, p. 248).

Tobacco Smoke

Tobacco smoke contains thousands of chemicals, including dangerous ones like nicotine, hydrogen cyanide, benzene, formaldehyde, and arsenic. Pakkhawat Sancharoen (ภควัฒน์ แสนเจริญ, 2551) disclosed that the contaminant that is mostly found in a building is tobacco smoke. If smoking is allowed in a building, it should be confined to an isolated space that is ventilated to the exterior.

2.5 SOLUTIONS TO SICK BUILDING SYNDROME

Many of the factors associated with Sick Building Syndrome relate to building design and construction. Actually, the prevention of indoor air pollution should begin at the design phase. In many cases it will be very difficult to change things when building and installation work have been completed. In some cases, alterations may be possible. Thus, the prevention of Sick Building Syndrome needs to be undertaken at an early stage during the planning of new building work, or change of use. According to the California State University Employees Union [CSUEU] (2008), before a newly built or renovated office space is occupied, all chemicals should be baked off by heating the area up to 80-85 degrees for 12 hours and then ventilating with fresh outdoor air for 12 hours.

Arun Chaisaeree (อรุณ ชัยเสรี, 2547) suggested that solutions to Sick Building Syndrome usually include combinations of removing pollutant sources or modifying, increasing ventilation quality, staying away from office machines, cleaning air, eliminating tobacco smoke, and communicating with each other. When building occupants, buildings' owners, architects and mechanical engineers fully communicate

and understand the causes and consequences of indoor air quality problems, they can work more effectively to solve problems together.

2.6 RELEVENT RESEARCH

Chatchai Ekpanyaskul (ฉัตรชัย เอกปัญญาสกุล, 2548) carried out his research about *Prevalence, Associated Factors and Impact of Sick Building Syndrome among Office Workers in Bangkok*. He found that the indoor environmental problems seemed to increase and adversely affect the well-being of office workers. He tried to find out the prevalence, associated factors and impact of Sick Building Syndrome among office workers in five air-conditioned government or state enterprise buildings in Bangkok. The study samples were selected from 1,264 officers in those buildings by cluster random sampling. He revealed in his study that the overall prevalence of Sick Building Syndrome was 20.58 percent. Most symptoms were mucous membrane irritation. Moreover, it was found that females having underlying disease, working with office equipment, using computers for more than 4 hours per day, having high psychosocial problems, and sitting near office machine were likely to be the factors being significantly associated with Sick Building Syndrome. The research also suggested that Sick Building Syndrome is a common problem in service providing sectors that should be a concern for relevant parties. The solution should be considered relating to personal factors, work characteristics, and work environment.

Nuttapong Laemun (ณัฐพงศ์ แหละหมัน, 2548) revealed in *The Prevalence Rate and Associated Factors of Sick Building Syndrome among Health Care Workers in Hospitals with Inadequate Ventilation* that a total of 1,800 questionnaires were distributed to health care workers from nine government hospitals in the central region and 1,500 were returned, with the response rate of 83.3%. The results showed that the most frequent symptom was eye irritation (17.94 percent). He also found that factors which were significantly associated with Sick Building Syndrome were more than 0.1 mg/qb.m of dust in the building, working more than five days per week, using printers, and complaints about bad ventilation, contamination and noise, respectively.

In summary, this chapter consisted of theories and concepts involved with the study. The concept of awareness was presented in the beginning of the chapter. The definition of Sick Building Syndrome, the prevalence of Sick Building Syndrome symptoms, associated factors causing Sick Building Syndrome symptoms, solutions to Sick Building Syndrome, and relevant research were presented, respectively. In the next chapter, the methodology of the research will be presented.