# THE EXPOSURE ASSESSMENT OF THERMAL EXPOSURE AND SAFETY AND HEALTH INSPECTION OF A SELECTED WAREHOUSE IN KLANG VALLEY

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DISSERTATION SUBMITTED IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF TECHNOLOGY ENVIRONMENTAL MANAGEMENT

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## ABSTRACT

Health and safety are important features in the workplace, as we spend a large amount of time at different types of workplaces. In retail and warehousing services especially, storage of products poses a hazardous risk if not managed properly. Air movement, temperatures, stock positioning, general cleanliness and lighting contributes to the overall safety of workers working in these warehouses. This thesis serves to contribute to the discussion on improving the quality of warehouse management through effective environmental health and safety. The focus is in identifying the relationship between the outdoor and indoor temperatures in a warehouse to the level of comfort experienced by the personnel in charge of managing the warehouse, leading to the productivity level of the supervisor. As for goods stored in the warehouse, impact of work place hazards on the safety of staff entering the warehouse is analyzed. The current company SOP is evaluated if gaps exist in implementation. Readings of thermometer placed in warehouse are analyzed. The research showed that the positioning of the existing stocks in the warehouse constitutes an obstruction to the emergency exits. These obstructions also restricted the air flow circulation, making it quite unventilated to work for a longer period of time. Records showed that temperatures were on the high side, with some months exceeding 30$^{o}$C. It is recommended that the temperature range be reset to a narrower range as the optimum temperature for thermal comfort is between 18 to 26$^{o}$C, as well as for electricity savings. In conclusion, the temperature range can be reduced to between 15$^{o}$C to 25$^{o}$C by taking into account the optimal thermal comfort and the impact of relative humidity in the warehouse on the products stored. Various trainings on warehouse safety should be adapted to different levels of workers working in the warehouse or those who need to use the warehouse. Additional storage place or special section should be allocated to cater for extra stocks arrived during peak seasons.

## ABSTRAK

Kesihatan dan keselamatan merupakan ciri penting di tempat kerja. Kita menghabiskan sejumlah besar masa di pelbagai jenis tempat kerja mengikut jenis pekerjaan. Dalam perkhidmatan runcit dan industri pergudangan terutamanya, penyimpanan produk akan menimbulkan risiko berbahaya jika tiada pengurusan sebaiknya. Peralihan udara, suhu, kedudukan, kebersihan umum dan pencahayaan menyumbang kepada keselamatan pekerja yang bekerja di gudang. Menyedari kepentingan isu-isu tersebut, tesis ini bertujuan untuk menyumbang kepada perbincangan meningkatkan kualiti pengurusan melalui pengurusan kesihatan alam sekitar yang berkesan. Tumpuan diberikan kepada penyiasatan hubungan antara suhu luar dan dalam bangunan di sebuah gudang untuk mengetahui tahap keselesaan yang dialami oleh kakitangan yang berurusan di gudang. Faktor ini berkait rapat dengan tahap produktiviti penyelia gudang yang dipengaruhi secara langsung atau tidak langsung oleh keadaan kerja di kawasan yang tertutup, dan dalam kajian kes ini, keadaan suhu di dalam gudang. Bagi barangan yang disimpan di dalam gudang, impak bahaya di tempat kerja terhadap keselamatan pekerja yang memasuki gudang dianalisa. SOP gudang syarikat ini dinilai untuk mengetahui sekiranya terdapat jurang dalam aspek pelaksanaan. Bacaan termometer yang diletakkan di gudang juga dianalisa. Rekod menunjukkan bahawa kedudukan stok yang sedia ada di dalam gudang menjadi halangan kepada pintu kecemasan. Halangan ini juga mempengaruhi peredaran aliran udara. Suhu semasa di gudang memberi kesan ke atas keselesaan termal pekerja gudang dan kesegaran produk. Rekod menunjukkan bahawa suhu adalah di paras tinggi , dengan beberapa bulan melebihi 30ºC. Menurut Standard Prosedur Operasi gudang syarikat, julat suhu antara 15ºC hingga 30ºC. Ia adalah disyorkan bahawa suhu julat dilaraskan kerana suhu optimum untuk keselesaan haba adalah antara 18 hingga 26ºC, dan juga untuk penjimatan elektrik. Kesimpulannya, suhu boleh dikurangkan kepada 15ºC ke 25ºC dengan mengambil kira keselesaan haba yang

optimum dan kesan kelembapan dalam gudang. Pelbagai latihan tentang keselamatan gudang perlu disediakan untuk pekerja di gudang atau mereka yang perlu menggunakan gudang. Tempat penyimpanan tambahan atau bahagian khusus harus diperuntukkan untuk menampung stok tambahan semasa musim puncak.

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# CHAPTER 1

# INTRODUCTION

## 1.1 Issues in workplace health and safety

Health and safety has always been an important feature in the workplace. We spend a large amount of time at various workplaces according to the types of occupation we hold, ranging from cubicles in office spaces, confined spaces, factories, warehouses, construction sites and a variety of others. Most of the time, workers spend some nine to twelve hours in enclosed areas compared to at home, thus increasing the chances of facing workplace hazards.

In retail and warehousing services especially, storage of products poses a hazardous risk if not managed properly. Air circulation, temperatures, stock positioning, cleanliness and lighting are among the activities that could contribute to the overall safety of workers working in these warehouses.

## 1.2 Factors affecting worker's performance and health

Environmental health and safety in workplace is an important aspect that affects the performance and health of workers, according to Health and Safety Executive (HSE) UK. Among the risk factors that might arise from workplace are temperature extremes, repetition, force (from carrying workload), awkward posture, static posture, contact stress, and psycho social.

The temperature of the working environment is an important aspect in health and safety issues at the workplace (Environmental, Health and Safety (EHS) Guidelines, 2007). While working in the outdoor environment can be prone to heat exposure in the tropical climate and cold weather in temperate climate, indoor temperature is also important in ensuring the safety and comfort of the workers. This could cause temperature stress-related injury or in the worst case, death.

Extreme temperatures can be regulated through mechanical ventilation and controls. Some options that have been suggested to manage temperature stress-related injuries include keeping an eye on the weather changes for outdoor work so that advance warning or weather watch can help with work arrangement, alter work-rest periods according to outdoor temperature and workload, or providing shelters and keeping the workers hydrated (Environmental, Health and Safety (EHS) Guidelines, 2007).

## 1.3 Development of Measurement and Regulations in relation to thermal comfort

The importance of temperature and thermal comfort could not be underestimated. There are several studies that support this idea. For example, the American Conference of Governmental Industrial Hygienists (ACGIH, 2006) recommended specified temperature limit for workers working in warm environments, taking into account the humidity, air movement and temperature of the air in which the workers work. This measurement has also been adopted by some territories and provinces in Canada as a way to manage workplace related heat pressure. Further details regarding the range of temperature in achieving thermal comfort in varying workplace condition can be found in Table 1.1.

**Table 1.1:** ACGIH Screening Criteria for Heat Stress Exposure (ACGIH, 2013)

| **WBGT values in °C for 8 hour work day five days per week with conventional breaks** | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| **Allocation of Work in a Work/Rest Cycle** | **TLV®** | | | | **Action Limit** | | | |
| | Light | Moderate | Heavy | Very Heavy | Light | Moderate | Heavy | Very Heavy |
| 75-100% | 31.0 | 28.0 | -- | -- | 28.0 | 25.0 | -- | -- |
| 50-75% | 31.0 | 29.0 | 27.5 | -- | 28.5 | 26.0 | 24.0 | -- |
| 25-50% | 32.0 | 30.0 | 29.0 | 28.0 | 29.5 | 27.0 | 25.5 | 24.5 |
| 0-25% | 32.5 | 31.5 | 30.5 | 30.0 | 30.0 | 29.0 | 28.0 | 27.0 |

WBGT: wet bulb globe temperature

TLV: Threshold Limit Value

Table 1.1 serves as a reference of screening tool for management to evaluate heat stress exposure for workers, with assumption of 8-hour workdays in a 5-day workweek and workers are generally in good conditions (hydrated, healthy and wearing lightweight clothing).

**Table 1.2:** Humidex range on degrees of thermal effect on people (CCOHS, 2015)

| **Humidex Range (°C)** | **Degrees of Comfort** |
|---|---|
| 20 - 29 | Comfortable |
| 30 - 39 | Varying degrees of discomfort |
| 40 - 45 | Uncomfortable |
| 46 and Over | Many types of labour must be restricted |

The humidex scale tabulated in Table 1.2 is used as source of information about hot weather condition. Human discomfort due to heat is quantified in this scale by taking into consideration the effect of air temperature and relative humidity. In short, as the relative humidity (moisture content) of the air is higher thus the humidex reading increases.

**Table 1.3:** Adaptation of ACGIH screening criteria in Canadian health and safety regulations (CCOHS, 2015)

| Jurisdiction | Regulation | Temperature |
|---|---|---|
| Canada, Federal | Personal service food preparation area<br>Materials handling: operators' compartment<br>First aid room | 18°C min./29°C max.<br>27°C max.<br>21°C - 24°C |
| National Joint Council (Public Service Canada) | Occupational Health and Safety Directive | 20-26°C<br>Humidex 40°C max. (as measured at workstation) |
| British Columbia | Heat Stress Regulations<br>Indoor Air Quality Regulation, ASHRAE 55-1992 Standard | Limits in WBGT units similar to ACGIH TLV |
| | Summer Indoor<br>Winter Indoor | 23.3 - 27.2°C or 74 - 81°F<br>20.5 - 24.4°C or 69 - 76°F |
| Alberta | (Guidelines only) | Similar to ACGIH TLVs for heat and cold exposure |
| Saskatchewan | Thermal environment | Reasonable and appropriate to nature of work |
| Manitoba | Thermal environment | ACGIH TLVs for heat and cold exposure |
| Ontario | Construction projects: | |
| | Change room for underground workers<br>Work chamber<br>Medical locks | 27°C min.<br>38°C max.<br>18°C min./27°C max. |
| | Enclosed workplace, Industrial Establishment Regulations | 18°C min. |
| Quebec | Safety in mines:<br>Dryhouse temperature<br>Occupational exposure limits | 22°C min.<br>WBGT similar to ACGIH TLVs |
| New Brunswick | Enclosed place of employment: | |
| | Light work while sitting, mental work | 20°C min. |
| | Light work while sitting, work with small machine tools | 18°C min |
| | Moderate physical work, standing | 16°C |
| | Heavy physical work | 12°C min. |
| | Work conditions | 1997 ACGIH TLVs for heat and cold exposure |
| Nova Scotia | Workplace Health and Safety Regulation | ACGIH TLVs for heat and cold exposure |

| Jurisdiction | Regulation | Temperature |
|---|---|---|
| Prince Edward Island | Enclosed workplace: | |
| | Light work while sitting, mental work | 20°C min. |
| | Light work while sitting, work with small machine tools | 19°C |
| | Light work, standing | 17°C |
| | Moderate work standing | 16°C |
| | Heavy work | 12°C min. |
| | Occupational exposure limit | ACGIH TLVs for heat and cold exposure |
| Newfoundland and Labrador | Occupational exposure limit | ACGIH TLVs for heat and cold exposure |
| Northwest Territories | Overnight minimum temperature only, Camp Sanitation Regulation | 18°C min |
| Nunavut | Overnight minimum temperature only, Camp Sanitation Regulation | 18°C min |
| Yukon Territory | Thermal environment | Similar to ACGIH TLVs for heat and cold exposure |

Table 1.3 showed that several Canadian occupational health and safety regulations have adopted the ACGIH threshold value in both hot and cold exposure for indoor and outdoor work.

## 1.4 Relation of temperature and Indoor Air Quality (IAQ)

Another issue related to temperature is the indoor air quality or known as IAQ. Temperature and air quality affect the wellbeing of the occupants, whether it is in the short term or long period. Air quality affects the health, comfort and productivity of the building occupants, more so in industrial workplaces, although non-industrial workplaces are also affected by the indoor quality.

The American Industrial Hygiene Association (AIHA) has developed a document on IAQ, with the aim of helping building owners decide on the ways to improve IAQ. Good IAQ is when the air "is free of odours and dust, does not contain harmful contaminants, is neither too still nor too drafty, and is a comfortable temperature and humidity" (AIHA, 2009).

### 1.4.1 Poor indoor air quality – the impacts

Poor indoor air quality will result in various illnesses and discomfort to the body and mind, such as flu or a cold: headaches, sinus problems, congestion, dizziness, nausea, fatigue, and irritation of the eyes, nose, or throat. Unfortunately, the air quality will have different impact on different people and therefore is difficult to correlate to the workplace. If a worker complains about the indoor air quality while the others do not suffer from the same illnesses, it would be harder to put down the cause for the illness to the workplace environment. However, if a few more occupants were to complain of similar illnesses, there may be cause for concern that the indoor air quality is in fact poor.

### 1.4.2 Poor indoor air quality – the causes

The common causes for poor air quality are the existence of air borne contaminants, such as chemicals, bacteria, pollen, and dust. When these contaminants are combined with the other conditions in the indoor space, such as temperature, lighting, humidity, noise, pre-existing health conditions of the occupants and the stress related situations, they can greatly affect the overall health and wellbeing of the occupants.

Heating, ventilation and air-conditioning (HVAC) systems, fragrances, tobacco smoke and metabolic wastes also contributes to the build-up of indoor contaminants and will cause discomfort when it reaches a high toxicity level. Another potential infection is the Legionella bacteria which can cause building related illness, as a result of microbial growth from dusty surfaces and damp materials (DOSH, 2005).

## 1.5 Warehouse incidents and accidents

### 1.5.1 Definition of warehouse

A warehouse is a part of the industrial workplace feature having its own health and safety hazards. A warehouse has been defined as "a large building for storing things before they are sold, used or sent out to shops" ("Warehouse", 2016).

### 1.5.2 Warehouse accidents

Due to its feature, a warehouse may present potential hazards such as accidents occurring. "An accident is a separate, identifiable, unintended incident, which causes physical injury" (HSE, 2016). As illustrated in Figure 1.1, accidents are caused by a specific external event such as falling objects (HSE, 2016). Events that have the potential to cause injury or producing undesirable situation are known as incident (Figure 1.2) (HSE, 2004).

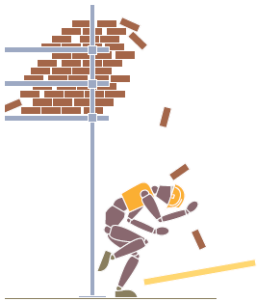

**Figure 1.1**: Accident

**Figure 1.2:** Incident (near-miss)

Some examples of accidents that can occur in warehouses are slips and trips and falls from height (HSE, 2016). For example, the owners of a convenience store in the UK that failed to maintain good housekeeping in the store and caused a customer to trip and fell over plastic binding causing hip injury were fined by the court (HSE, 2016).

In an example from the USA, the Occupational Safety and Health Administration (OSHA) cited ten types of hazards that can occur in warehouses, such as forklifts, hazard communication, electrical wiring methods and design, floor and wall openings and holes, exits, mechanical power transmission, respiratory protection, lockout and portable fire extinguishers (Murray, 2015). It said that forklifts accidents killed about 100 warehouse workers and injured 95,000 workers annually. In addition, it was reported that workers failed to wear respiratory protection resulting in workers ingesting fumes, sprays or matters which caused permanent injury or death.

## 1.6 Problem statement – policy, standards and regulation

### 1.6.1 Thermal comfort

Using the warehouse workplace as an example, if temperature is an issue (for example too cold or too hot) in the warehouse, the executive will modify the air-conditioning in order to suit the overall working condition. For health and safety issues, changing the temperature may merely be a matter of complying with the health and safety regulation or policy as determined by the relevant ministry or authority, and not because of the intention to advance the management quality.

### 1.6.2 Indoor air quality

It is said that Indoor air quality concerns are a fact of life for building owners, business owners, managers, and occupants. It is not possible to satisfy every occupant at all times, particularly in the case of thermal comfort. However, it is possible and necessary to provide a work environment that is healthy and safe.

A building managed with an aim for preventing IAQ problems may not guarantee that occupants will not occasionally complain about IAQ, but it does greatly reduce the likelihood of chronic discomfort and will likely increase building occupants' productivity (AIHA, 2009).

### 1.6.3 Warehouse ergonomic

Apart from the thermal comfort and indoor air quality, both occupational and personal risk factors can affect an individual's wellbeing at work by taking into consideration on the physical postures of the workers and the warehouse ergonomics. According to the U.S Department of Health, "Ergonomics is the science of fitting workplace conditions and job demands to the capabilities of employees."

For businesses requiring employees to engage in work that moves repeatedly such as warehouse storage workers, there might be a chance for injury to take place when the muscles tissues of certain body parts do not have adequate time to recover. This condition will result in musculoskeletal disorder. Musculoskeletal disorders also known as MSD can affect muscles, tendons, nerves, joints and spinal disks (University of Alabama Huntsville (UAH), 2006).

Another well being of the employee which might be considered is the amount of physical force undertaken by a person in maintaining control of tools, such as handling heavy machinery in the course of performing tasks. Repetitively working in a similar position for a long period of time causing the body to deviate from its neutral position (the position which is the safest and most efficient in which to work) into an un-neutral position causing stress to the muscles, and joints, as well as blocking the blood flow to various parts of the body.

Realizing the various factors that may affect the health and safety of the workers, warehouse ergonomics have come to be recognized as one important aspect in the design of warehouse plans and workplace generally. It is believed that when risk factors for the above are reduced, productivity is likely to increase and the overall work quality is improved (University of Alabama Huntsville (UAH), 2006).

### 1.6.4 Policy and standards in health and safety issues

By identifying risk factors that caused injuries and performance decrement, we are able to decrease the level of injuries, illnesses and workers' compensation cost. Efficiency at work can be increased as well as physical well being. Further to this, cases such as absenteeism and turn-over will subsequently decrease. By identifying risk factors that caused injuries and performance decrement, we are able to decrease the level of injuries, illnesses and workers' compensation cost.

ISO 14000 Standards is one type of standard which arose from the need for standardizing the overall quality. The International Standards Organization introduced standards for evaluating a company's environmental responsibility in 1996. These standards, termed ISO 14000, focus on three major areas, namely, management systems

standards (which measure systems development and integration of environmental responsibility into the overall business), operations standards (which include the measurement of consumption of natural resources and energy) and environmental systems standards (which measure emissions, effluents, and other waste systems).

It is anticipated that the increasing awareness of green technology, and "greater interest in green manufacturing and more awareness of environmental concerns, ISO 14000 may become an important set of standards for promoting environmental responsibility" (Wiley, 2004).

Apart from the ISO14000 Standards, a study conducted by the European Foundation for the Improvement of Living and Working Conditions in 1996 showed that "29% of the interviewed employees think that their health is negatively affected by their jobs. The most commonly mentioned work-related to health problems were concern on musculoskeletal disorders and mental stress. The study also indicated that the interviewed employees further experienced other psychological problems such as irritability, insomnia and anxiety states." This shows that health and safety of the workers is greatly affected by the working conditions in a long period of time, and it extends beyond physical discomfort to mental health and wellbeing of the workers (Robson et. al., 2007).

## 1.7 Objectives

Recognizing the importance of the issues discussed above this thesis serves to contribute to the discussion on improving the quality of warehouse management through effective environmental health and safety.

There are several objectives that guide this research.

1. To identify thermal comfort level among employees based on the temperature reading recorded. It is believed that an optimum thermal comfort will influence the quality of performance and management of the warehouse.
2. To determine workplace hazard related to daily activities among employees. This research aims to determine whether the existing building poses any health, safety or security risks to the people in the building generally. It will also identify accidents or incidents existing in the warehouse.
3. To evaluate gaps in terms of implementation and effectiveness of the standard operating procedure of the selected company warehouse.

## 1.8 Research Questions

The following research questions are raised:

1. Whether there is any health or safety risk at the selected warehouse?
2. Whether the planning and arrangement of stocks give impact on the safety of personnel in the building?
3. Whether the current standard operating procedure in warehouse is effective?
4. Whether there are solutions to overcome non compliance in order to better prevent health and safety risk from developing in commercial buildings?

## 1.9 Expected Research Outcome

It is expected that temperature will influence the total quality management. The conditions in the warehouse need to be in its optimum to create a safer working environment. The human body is very sensitive to the temperature fluctuations, which subsequently influence the moods and perceptions.

While the body has a unique mechanism to stabilise its internal temperature according to the fluctuations in the outdoor environment, changes in the enclosed area, which is used to store goods may influence the working conditions.

Another possible outcome of this research is providing the link between operating expenses and total quality management. In other words, how better workplace affects the quality of the management and as a result affect the economics involved in operating the company. Operating expenses, also known as OPEX, are the types of expenses which relates to the production of goods and services, such as wages, expenses incurred for research and development purposes, and costs of raw materials ("Operating expenses", 2012).

Expenses that are incurred for the purposes of producing things for the company, that is, personnel costs, administrative costs, sales, or equipment depreciation are examples of operating expenses ("Operating Expense (OPEX)", 2016). The most direct way in which operating costs grow higher is the inefficient use of the physical appliances and environment, as discussed earlier, in the case of lighting, ventilation, air conditioning, heating, air flow and indoor air quality.

## 1.10 Scope and Limitation of the Study

This research indentifies the relationship between environmental health and safety and total quality management. The main focus is in examining the influence of outdoor and indoor temperatures in a warehouse on the comfort level experienced by the personnel in charge of managing the warehouse. The term 'total quality management' in this sense refers to work-related productivity level of the warehouse supervisor which

may be directly or indirectly influenced by the general working conditions in an enclosed area, and in this example, the temperature in the warehouse.

There are several components affecting total quality management. Two factors which stand out are the temperature at the lower part of the warehouse and the arrangement of goods in the warehouse. In respect of temperature, there is a need to consider the risk on the workers' health, including that of the warehouse supervisors. As for goods stored in the warehouse, there may be situations where goods are delivered at a larger capacity than normal resulting in an overflow, which may impact the safety of personnel entering the warehouse. A different arrangement in the warehouse may also impact the air flow in the warehouse. In identifying these two major influences in the working conditions and productivity of the warehouse; appropriate measures can be implemented to resolve the problems.

One of the limitations of the study is the range and currency of the data in respect to the temperature and humidity reading. There is limited data obtainable because the records are only available from year 2010. Further data could not be obtained because a change of work place has taken place.

# CHAPTER 2

# LITERATURE REVIEW

## 2.1 Introduction to Environmental Health and Safety (EHS)

Today, occupational health and safety laws in this country and many other parts of the world clearly hold the employer responsible for protecting the health and safety of their workers. However, the expectation that the employer is responsible has been in place long before the twentieth century. Because the employer controlled the ways and means by which work is accomplished, society, through various measures and social standards, has held employers accountable for protecting workers against foreseeable workplace hazards.

The principle that employers should be held responsible for the safety and well-being of their employees was established as early as 1200 A.D. in England. Prior to the Industrial Revolution, employers and employees often worked in small family units fostering close relationships between the overseer and the subordinate. As with a parent, the master, under English common law, was responsible for the servant's safety and well being. Originating from the law of King Henry I (1068–1135), masters were responsible and liable for loss of life and injury of a servant that occurred as a result of the negligence of the master regardless of whether the master was knowledgeable.

In the 1700s, through the efforts of Lord Holt, the common law practice of holding the employer responsible expanded to include negligence of a fellow servant or co-worker. The underlying principle behind these expectations was that masters often had first-hand knowledge of the tasks of the servant and, therefore, the hazards and risks associated with their actions. Because the employers had this knowledge about the

hazards, they were expected do what was necessary to assure employees avoided foreseeable injury or illness.

### 2.1.1 Other guidelines and legal requirement for Occupational Safety and Health (OSH)

Besides industrial practices and guidelines, there are legal requirements to be complied with for maintaining a reasonable occupational safety and health in the office. For example, the Ministry of Human Resources Malaysia published Guidelines on Occupational Safety and Health in the Office in 1996 pursuant to the Occupational Safety and Health Act (OSHA) 1994. The purpose of the OSHA is to "secure the safety, health and welfare of persons at work, for protecting others against risks to safety or health in connection with the activities or persons at work." This shows that the law regulates the factors that affect the health, safety and welfare of the people in various working environments.

In order to achieve this purpose, the OSHA requires employers, workers and even the self employed to meet particular standards on health, safety and welfare. These standards are applicable to employers mainly because they are the responsible parties providing a safe working environment to the workers. Employers play important roles to implement, execute, monitor and review the guidelines in order to achieve an effective total quality management.

### 2.1.2 Employers' responsibilities

Some of the requirements that the employers must comply with are related to the provision and maintenance of all the equipments at work, so that they function safely and are able to be operated without hazards by the workers. Apart from maintenance of equipments, employers must also ensure that the systems at work do not pose risks to health. This could include, for example in warehouse, the stocks handling system or the stocks arranging systems. Other equipment and substances related requirements that the employer must comply with and prescribed by the OSHA is ensuring that the storage, usage and transportation of equipment, substances and materials are carried out in a safe manner, without risks to health.

In order to allow the workers to work in a safe environment, employers are required to provide information, instructions, trainings as well as supervision as part of the maintenance of the workers' health and safety. This includes instructions regarding entrance and exits, such as emergency exits in case of leaving a hazardous place and preventing hazards from arising. Although employers and employees are covered by the OSHA, the requirement to provide a safe working environment is also imposed on employers to cover visitors to the workplace. This means that visitors expect the workplace to be safe.

### 2.1.3 Standards in OSHA

OSHA's legal requirements for the employers and employees are usually standards found in occupational health and safety policies around the world. For example, in the USA, the US Public Law 91-596 in 1970 (Geigle Safety Group, 2013) was enacted for several purposes, which are similar to the OSHA. It sought to ensure a safe and healthy working environment for workers through enforcing the standards contained in the law,

and providing research, information, education and training for occupational health and safety. All these purposes aim towards promoting a safe and healthy working environment to workers. Section 5 of the law is relevant because it mandates employers to provide each employee a working place which is free from occupational hazards which are causing or will potentially cause death or severe physical harm to the workers. Employers are also required to comply with all the standards relating to occupational health and safety pursuant to the law and other subsequent regulations or orders issued under the law.

In addition to the general legal requirements pertaining to employer duties to workers in respect of workplace health and safety, there are examples of codes of practice or guidance governing safety in warehouse. The Approved Codes of Practice (ACOPs) are authorised by the USA Health and Safety Executive (HSE) Board with the permission of the Secretary of States. Although the ACOP is a recommendation and not a statute, a failure to comply with the provisions will result in liability if the employer or company is prosecuted for breaching other relevant health and safety laws. Thus the ACOPs have special legal status (HSE, 2013).

An example for the warehouse safety is Regulation 12 of the ACOP. It deals with the smooth operation of traffic flows at workplaces by mandating the removal of obstructions at workplaces with the purpose of preventing workers from falling or tripping over the obstacles or slipping because of these obstacles.

The ACOP 108 similarly requires employers to establish good flooring suitable for the purpose of the business, and particularly to ensure that such flooring can support or maintain the loads placed on them, as well as being certain that there are sufficient room

for smooth traffic flow. The ACOP 109 likewise provides that floor surface should be kept from holes or uneven, slippery slopes because these can cause workers or anyone entering the workplace to slip, fall or become unbalanced due to the presence of the holes, which caused them to lose control and fall together with the loads they are carrying. The surface of the floor is a source of potential workplace hazard, as such, any wet surface or spills that have occurred should be cleaned immediately. Removing obstacles from traffic route, in places of workplace importance, for example at emergency exits, stairs or corners prevent workers from falling or tripping when these routes are needed.

In summary, it appears that the OSHA provides a useful guide to employers in establishing and maintaining health and safety standards to ensure that employees are not exposed to hazardous working environment. These laws, although not exhaustive, provides a framework for the operation and management of risks, and overseeing the health and safety policies in workplaces. Where the basic requirements of the law are met, it goes a long way towards improving the health and safety of workers, which is mutually beneficial to both employers and employees.

## 2.2 Environmental health and safety (EHS) – Thermal Comfort

Thermal comfort of the occupants in any building is affected by various factors, which goes on to influence the overall health of these occupants, as well as the safety of the people working in such an environment, or visitors to these building. Thus, environmental health and safety involve the immediate workers, with long term effect on their overall health and productivity at work. That is also why "designing buildings that are thermally comfortable for the majority of occupants is an ever evolving pursuit" (Dixon, 2010).

One aspect of thermal comfort is the indoor air quality, also known as IAQ. IAQ affects the health and wellbeing of occupants, either in the short or the long term. However, as said earlier, this is not the only determining factor, as occupants are also exposed to the other sensory, such as "lighting, acoustics, vibration, aesthetics, comfort and security, along with safety and ergonomic design factors" (Spengler and Chen, 2000). Rising expectations of occupants for healthy work environments are forcing building owners, operators and managers to reconsider the importance of indoor air quality.

In a more recent survey conducted by the International Facility Managers Association, indoor air quality and thermal comfort were the top operational issues in all types of buildings. According to a recent survey of building tenants commissioned by BOMA, control and quality of air was the fourth most important criterion for attracting and retaining tenants. The study also showed that quality heating, ventilating, and air conditioning is extremely important for retaining tenants. Buildings and their indoor air quality can adversely impact occupants' health (Spengler and Chen, 2000).

Figure 2.1 shows the relationship between people's response to thermal comfort and building. The building acts as a party to provide a comfortable thermal environment to its occupants. On another hand, occupants will adapt to the building's environment to achieve comfort level or vice versa.

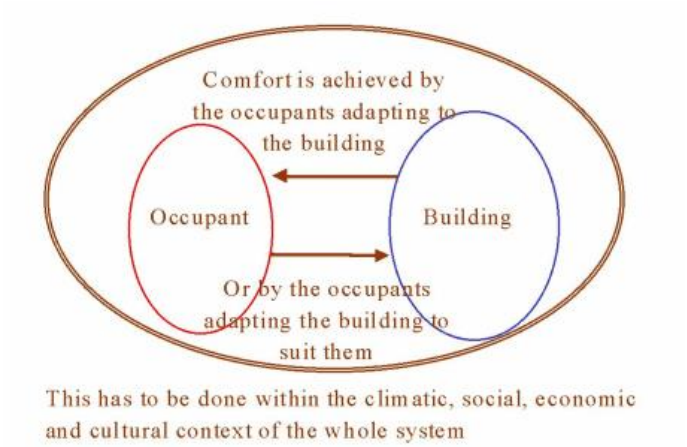


**Figure 2.1:** Relationship between occupants and building in terms of thermal comfort

There are several examples of the relationship between thermal comfort and performance of workers, and studies have been conducted and continually being carried out to improve and ways of having better thermal comfort for the occupants. Although most of these studies are conducted in the office settings, or residential apartments, some of the principles can be applied to the warehouse setting too. For example, a field study in natural ventilated office buildings in Oxford, UK concerning the thermal comfort of workers seeks to investigate the effects the outdoor temperature has on the indoor temperature and the use of the occupants' environmental controls in summer. "The results suggest that the use of controls is also related to thermal sensation and their appropriate use is a significant part of adaptive behaviour to modify the indoor thermal conditions. The results make it possible to predict the effect of temperature on the ventilation rate in naturally ventilated buildings.

Availability of controls and their appropriate use is key to better performance of the building and for improving occupant satisfaction (Raja et. al., 2001). The finding here is valuable to suggest that proper thermal comfort control influence the overall ventilation and well being of the building, which then affects the occupants' satisfaction and which has consequences on the quality of work produced. While outdoor temperature fluctuations cannot be controlled, the indoor temperature can be controlled to achieve

the optimum level desired for improved performance. In fact, building-related symptoms affecting occupants can be traced to the indoor environmental comfort. Building related symptoms can occur resulting in, for example, stuffy nose; sore or dry throat; dry, itching, or irritated eyes; and dry, itching, or irritated skin, lower respiratory (at least one of wheeze, shortness of breath, or chest tightness); cough; upper respiratory (at least one of stuffy or runny nose, sneezing, or sore or dry throat); dry, itching, or irritated eyes; fatigue or difficulty concentrating; headache; and dry, itching, or irritated skin (Mendell and Mirer, 2009).

In a study conducted by Mendell and Mirer in year 2009, the investigators reported the finding that "Thermal factors within buildings may play a substantial but unrecognized role in causing building-related symptoms (BRS)". Some but not all prior research have found that warmer indoor temperatures even within their recommended thermal comfort range for office spaces are associated with higher prevalence of symptoms among office workers.

For instance, Mendell et al. (2009) found that increased temperatures even within a range below 25.6$^{o}$C were associated with substantially increased severity of many symptoms, and reported no significant association with sensory irritation symptoms of temperatures between 18$^{o}$C and 26$^{o}$C. These researches reported investigated the associations of thermal factors with BRS, defined as symptoms experienced in the building at least 1 day per week during the last 4 weeks, and also improving when away from the building. Maintaining buildings at warmer temperatures in summer, with the goal of reducing symptoms, would also result in substantial savings in energy use and financial costs by avoiding usage of air-conditioning. Maintaining buildings at cooler temperatures in winter, within the lower range of the comfort zone, with the goal of

reducing symptoms, does not have a symmetric, direct link to reduced energy use and financial costs.

Another example of the importance of thermal comfort to work performance is shown in a study which studies the impact of indoor air temperature and humidity in an office on sick building syndromes symptoms and performance (Fang et. al., 2004). Perceived air quality (PAQ), sick building syndrome (SBS) symptoms and performance of office work were studied in a real office space at three levels of air temperature and humidity and two levels of ventilation rate. The study confirmed the previously observed impact of temperature and humidity on perceived air quality and the linear correlation between acceptability and enthalpy.

Performance of office work was not significantly affected by indoor air temperature and humidity. However, several SBS symptoms were alleviated when the subjects worked at low levels of air temperature and humidity, which implies that a longer term exposure to low indoor air temperature and humidity might help to improve the performance of office work.

### 2.2.1 Definition and importance of thermal comfort

Thermal comfort is defined as: *"that condition of mind which expresses satisfaction with the thermal environment"* (Everly, 1999). In this sense, the term 'thermal comfort' describes a person's psychological state of mind and is usually referred to in terms of whether someone is feeling too hot or too cold.

According to the Regulation 7(1) of the Workplace Regulations stated that "during working hours, the temperature in all workplaces inside buildings shall be reasonable". The ACOP, paragraph 42, clarifies this by stating that "the temperature in workrooms should provide reasonable comfort without the need for special clothing". Adding that "where such a temperature is impractical because of hot or cold processes, all reasonable steps should be taken to achieve a temperature which is as close as possible to comfortable" (Everly, 1999).

Thermal comfort is very difficult to define because a range of environmental and personal factors need to be taken into account when deciding what will make people feel comfortable. These factors make up what is known as the 'human thermal environment'.

Despite the difficulty in determining with certainty the best thermal comfort temperatures, the ACOP 7 provides some guidance in relation to the temperature that would work best for workers. For example, the suggested temperature at workplace is at least 16$^{o}$C, while 13$^{o}$C is recommended for workers requiring more physical exertion. The guidance suggested, however, working in these range of temperatures does not automatically mean that thermal comfort is achieved.

There are other factors which may have an impact upon thermal comfort, including the air movement in the workplace, worker clothing as well as the relative humidity of the workplace. The ACOP 7 therefore suggested taking temperature readings as close as possible to the workers 'workstations' at a suitable height, and to stay away from windows where heat transmission can influence the temperature readings.

Besides this general guidance, the ACOP also cautioned against determining thermal comfort based on temperature readings in places 'where it would be impractical to maintain those temperatures' such as in places where there is constant exposure to outside temperature or in freezers. Special measures would apply to such different temperature setting (HSE, 2013).

A thermal environment that satisfies the majority of people in the workplace, or in a simple term, 'reasonable comfort' could be the best that one can realistically hope to achieve. There is no absolute rule or guideline to determine a thermal comfort environment. According to the Workplace (Health, Safety and Welfare) Regulation (NI) 1993, there is in fact a legal minimum temperature requirement of 16ºC unless the work involves severe physical effort (OHS, 1998). 80% of occupants might be considered as a reasonable limit for the minimum number of people who should be thermally comfortable in an environment. Under such definition, thermal comfort is not measured by air temperature, but by the number of employees complaining of discomfort caused by thermal levels.

To have "thermal comfort" means that a person wearing a normal amount of clothing feels neither too cold nor too warm. Thermal comfort is important both for one's well-being and for productivity. It can be achieved only when the air temperature, humidity and air movement are within the specified range often referred to as the "comfort zone".

Where air movement is virtually absent and when relative humidity can be kept at about 50%, the ambient temperature becomes the most critical factor for maintaining thermal comfort indoors. However, temperature preferences vary greatly among individuals. Nevertheless, an office which is too warm makes its occupants feel tired; on

the other hand, one that is too cold causes the occupants' attention to drift, making them restless and easily distracted.

Maintaining constant thermal conditions in the offices is important. Even minor deviation from comfort may be stressful and affect performance and safety. Workers already under stress are less tolerant of uncomfortable conditions. Thermal comfort is crucially important because it may psychologically affect one's overall morale. It may cause the increase of worker complaints, fall of productivity or in some cases people may refuse to work in a particular environment. The development of syndrome known as sick building syndrome may cause by some aspects of the thermal environment, for example, the air temperature, radiant heat, humidity and air movement.

#### 2.2.1.1 Factors influencing thermal comfort

Several factors play important role in defining thermal comfort, among these are two main factors which are environmental factors and personal factors as illustrated in Figure 2.2. Environmental factors include the aspects of air temperature, radiant temperature (thermal radiation which is the heat that radiates from a warm object, has greater influence than air temperature), air velocity (speed of air moving) and humidity.

Air temperature defines the level of how hot or cold the air around us and it is usually measured with a normal thermometer. Air velocity is considered as an important factor in thermal comfort because people are sensitive to it. Artificially heated still or stagnant air in indoor environments may cause people to feel stuffy and lead to a build-up in odour. Air velocity maybe corrected to account for a person's level of physical activity as physical activity also increases air movement (The Occupational Safety and Health Service, New Zealand, 1997).

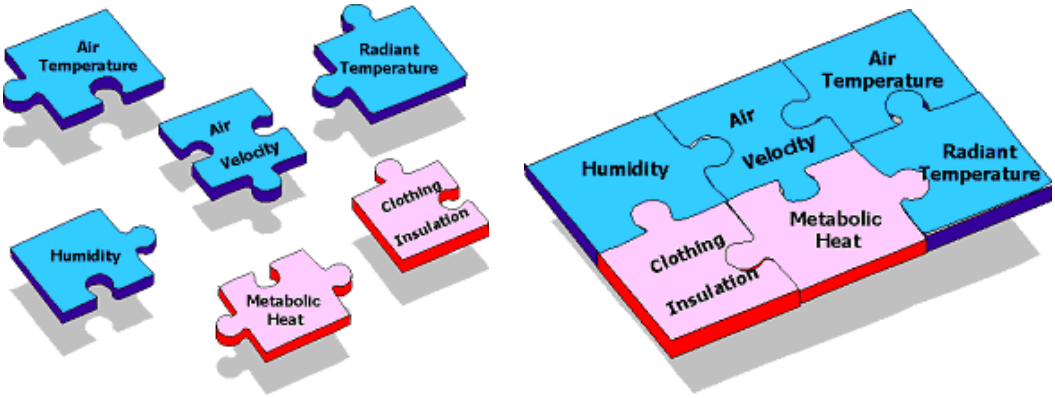


**Figure 2.2:** Factors affecting thermal comfort (HSE UK, 2016)

Humidity occurred when water is heated and it evaporates to the surrounding environment. It is considered as the concentration of water vapour present in the air and expressed as relative humidity (RH) of which indicates the percentage of moisture that would completely saturate air in the existing temperature. 40-70% of relative humidity (RH) does not have a major impact on thermal comfort and this ratio applied mostly in some offices due to the usage of computers. However, on warm or hot humid days especially where air-condition is not available or where the climatic condition outdoor may influence the indoor thermal environment, the relative humidity maybe higher than 70% for certain work places.

In indoor environments, the humidity can vary greatly, depending whether there are drying processes where steam is given off. Environments with high humidity have a lot of vapour in the air and it prevents the evaporation of sweat from the skin. Humidity is important in hot environments because when the humidity is high (80% +), less sweat evaporates (OHS, 1998).

Personal factors include clothing insulation and metabolic/work rate. Heat is released from our body and evaporates to the surroundings. However, clothing interferes with our ability to lose heat to the environment and the insulating effect of clothing on the person affect the thermal comfort. Heat stress and cold stress may be the primary factors caused by wearing too much clothing in the environment which is considered as warm or hot; or frost bite in cold condition. As people are adapting to the climate that they live, clothing is identified as both a potential cause of thermal discomfort and as a control for it.

The work rate is important for a thermal assessment because it describes the heat that being produced inside the body as one carry out physical activity. The more heat would be produced as the more physical work is done and the heat needs to be released to the surrounding so that one would not get overheat. A person's own physical characteristic such as their size and weight, age, fitness level and gender should be considered when assessing the thermal comfort and the impact of thermal on how they feel.

In general, there are a few main generic control measures available when comes to monitoring thermal comfort as summarised in Table 2.2. The methods of controls including control the heat source, the environment, separate the source of heat or cold from the worker, control the task by the length of time the worker are expected to do under the hot or cold condition. Control on clothing is done by evaluating the materials of clothing, dress code and if PPE is worn, need to assure that not more than PPE required is worn. Training and suitable clothing are provided to worker to protect them. Lastly, monitoring is important to provide appropriate supervision.

Table 2.1: Control measures in thermal comfort (Everly, 1999)

| CONTROL | APPLICATION |
|---|---|
| Source | Reduce or increase temperature<br>Insulate or clad the source |
| Environment | Replace hot air with cold<br>Increase air movement by ventilation<br>Replace cold air with heated air |
| Separation | Erect barriers<br>Shield work area<br>Restrict access |
| Task | Reduced time exposure<br>Reduced workload |
| Personal Protection | Special clothing<br>Special equipment<br>Provision of fans |
| Monitoring | Appropriate supervision<br>Medical checks and monitoring |

Some other optional controls for hot situations available are usage of air conditioning and ventilation to lower the air temperature. When there is moisture given to any work process, dehumidifiers can be used to lower the humidity. Exposure to radiant heat is reduced using blinds, curtains and installing of insulation to prevent heat radiating through roofs or walls. Suitable clothing is important to ensure that it is appropriate for the thermal condition.

To prevent the onset of thermal related illnesses, one should drink plenty of fluids during hot weather which cool water is the best. One should drink regularly during the whole day and shouldn't wait until you are thirsty to drink. They can also monitor their urine color as a good guide to hydration, normal urine color should be clear to light straw-colored, not dark or golden. Natural ventilation can be increased by opening windows and using fans (Everly, 1999).

In most of the commercial and industrial building, there are not designed to provide thermally comfortable condition for the occupants or employees. Alterations need to be made to the building itself in order for the employer to ensure thermal comfort are well catered for their employees. Despite moving into an existing building or building a new one, employers should prioritize the factor of thermal comfort towards the employees during the early stage of planning and moving process.

### 2.2.2 Workplace hazards and risks in EHS

Hazards are whatever things that potentially cause harm. A hazard can be anything — whether work materials, equipment, work methods or practices — that has the potential to cause harm; a risk is the chance, high or low, that somebody may be harmed by the hazard. Examples of hazards include electricity, chemicals, ladders or even drawers that are open or protruding boxes (HSE UK, 2016).

### 2.2.3 Examples of workplace hazards

An example is the warehouse environment, which combines lighting, temperature, humidity, air quality (ventilation) and decoration (DOSH, 1996). Other ill health effects of working in a warehouse environment are headaches, lethargy, ENT (ear, nose, throat) problems and stress. In most cases, emergency exit routes are important in case of fire, gas leakage or lift breakdowns. Emergency plans should be tested on a regular basis to ensure an orderly evacuation from the office. The plan should cover fire drills/safe evacuation, how to shut off machine and leave the workplace safe, name persons who are responsible for the evacuation and calling the emergency services, and detail the assembly areas. The emergency plan can be part of a safe work procedure.

### 2.2.4 Importance of assessing hazards and risks at workplace

Different types of buildings and purposes require different risk assessment. Risks can be assessed from the physical structures of a building to the internal working environment. For example, in respect of constrained working spaces, such as storage and warehouse facilities, standard operating procedures for storage and inventory control are important and to minimize risks present while working. Risk assessment is considered as the process of evaluating the risks to workers' safety and health from workplace hazards. It is a systematic examination of all aspects of work that considers factors such as what could cause injury or harm, whether the hazards could be eliminated and, if not what preventive or protective measures are, or should be, in place to control the risks.

#### 2.2.4.1 Identify potential hazards

How does one prevent or control risks at workplace? It has been suggested that the initial way is by identifying hazards. A physical examination around the workplace can help to uncover hazards that are present or that could be prevented. This would also have to consider the type of workplace, such as a business place, industrial plant or warehouse. Sometimes, hazards can be identified by checking any instructions or material from the manufacturers, records of workplace accidents or sick leaves.

Workplace supervisors are also advised to be aware of maintenance or cleaning operations in production cycles. There is a combination of hazards involved, such as hidden hazards and the more obvious hazards as described above. Although hazards primarily affect workers in their workplaces, there are other considerations when discussing workplace health and safety. People who may be affected by workplace hazards are contractors or temporary workers working on-site or visitors to the

workplace. In construction places for example, the public can also be affected (HSE UK, 2004).

#### 2.2.4.2 Formulate preventive measures

Once hazards are identified, the employer would have to carry out an assessment of the hazards and to plan out preventive measures. While it is impossible to remove all hazards or risks, they can be managed so as to minimise accidents occurring. Assessing risks involve expecting what are the reasonable hazards that would occur and then taking steps to address them. Tasks involved include making a proper check, knowing who might be affected and informing workers about the hazards and involving them in the process of managing those hazards and risk (HSE UK, 2004).

Risk assessment allows us to identify possible risk occurring in workplaces and from these risk, investigations can be made to carry out preventive measures to minimise these risks and to successfully prevent hazards from occurring. In the first step, we need to identify hazards and those individuals who might be at risks. It is important to be clear about who could be harmed for each hazard. With this information, it will help in identifying the best way of managing the risk. We can identify groups of people such as 'people working in the storeroom' or 'passers-by'. Particular attention should be paid to gender issues and to groups of workers who may be at increased risk or have particular requirements. In each case, it is important to identify how they might be harmed, such as what type of injury or ill health may occur.

Risks evaluation and prioritisation is the crucial component for the second step. In this part, we need to evaluate the risk arising from each hazard identified. A few considerations are taken place, for example, how likely it is that a hazard will cause

harm; serious level of that harm; and rate and the number of workers is exposed to this hazard. This is a straightforward process whereby it is mostly based on judgement and no specialist skills or complicated techniques are required when evaluating the workplace hazards or activities. Activities with hazards of low concerns, workplace where risks are well known or readily identified are included in the evaluation process. It is then followed by prioritisation of risks tackled in that order.

One shall decide on preventing actions and steps to control it after risks are identified. There are some general principles of prevention have to be taken into account when preventing and controlling risks. We need to avoid risks and substitute the dangerous by the non-dangerous or less dangerous. Source of the risk is the main concern that should be focused on. Continuous efforts to seek for improvement on the level of protection are required at the same time. The next step is to put the preventive and protective measures into actions and it is important to involve the workers in the process. A plan developed specifying on the measures to be implemented, personnel involved and time of execution, are crucial to ensure effective implementation. Prioritization should be given to any work related to the elimination or prevention of risks.

Monitoring and reviewing are the last steps taken to ensure that preventive and protective measures are working or being implemented effectively. Through the process of monitoring, new problems arise can be identified. Regular checks must not be neglected and has to be reviewed regularly depending on the nature of the risks, or the result of the findings of an accident's investigation. It is important for the employer to take note that risk assessment is not a once-and-for-all activity, continuous assessment and monitoring are utmost concerns.

In maintenance operations, some key success factors in risk preventions include the commitment from management, safety culture in the organization, involvement and participation of employees, well conducted risk assessment, and safety training. Indoor air quality is also another important health concern (DOSH, 2005). Good indoor air quality is required for a healthy indoor work environment, and sources of indoor air pollutants are tobacco smoke, chemical substances (formaldehyde) emitted from furnishings, ozone emitted from photocopiers and laser printers. Therefore, an indoor air quality assessment enable the management to identify the sources of air pollutants, evaluate exposure of occupants to the air pollutants and the adequacy of existing control measures, conclude the significance of health risk posed by the air contaminants and recommend further appropriate control measures to reduce risks.

An example of the importance of ensuring compliance with ESH due to its effect on employees' productivity at work is illustrated in Figure 2.3. From the graph, it shows that total of working days lost due to work-related incidents followed a down trend but shows signs of levelling in recent years.

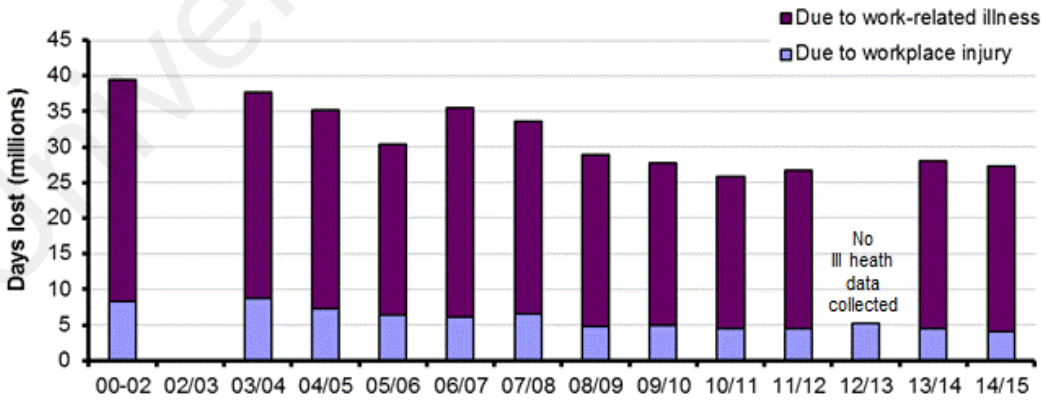


**Figure 2.3**: Estimated working days lost due to work-related incidents (HSE UK, 2016)

## 2.3 EHS in Warehouse

### 2.3.1 Definition of a Warehouse

A warehouse is a part of the industrial workplace feature having its own health and safety hazards. A warehouse has been defined as "a large building for storing things before they are sold, used or sent out to shops" (Cambridge Dictionaries Online, 2016). It has also been defined in a broad way to include "facilities and locations that provide warehousing, including the storage of iron ore in open fields, the storage of finished goods in the production facility and the storage of raw materials, industrial goods and finished goods while they are in transport" (Lee, 2015).

A warehouse performs an important role in economy. It provides the convenience of storing goods and products, either in their raw or finished forms. It is this convenience that allows producers of goods to serve customers with flexible timing. This means that "companies can make goods available when and where customers demand them" (Lee, 2015). Figure 2.4 illustrates the warehouse operation flow which starts from the receiving of goods from suppliers, internal warehouse process involving goods put-away and storage, picking and packing of stocks upon orders and shipping to customers.

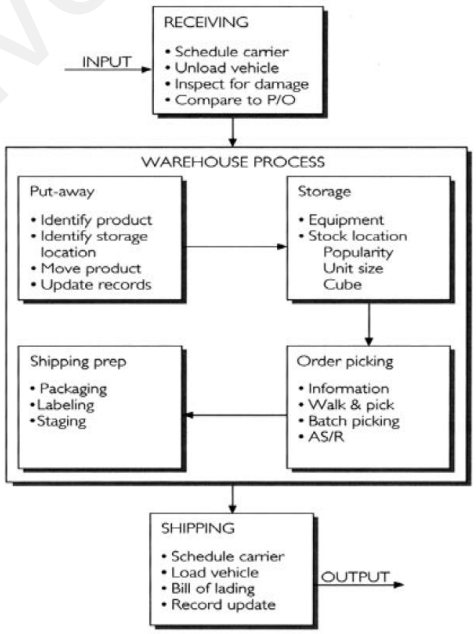


**Figure 2.4**: Warehouse operation flow chart (Lee, 2015)

### 2.3.2 Warehouse Safety – managing hazards and OSH standards

Warehouse operations can present a wide variety of potential hazards for the worker. Some of the hazards identified by OSHA included employees had to reach elevated and distant locations in storage shelves to access materials with unsafe use of forklifts. Workers had to repeatedly bend to reach low-level locations at floor level to access materials which caused repetitive motion injuries. Improper stacking of products where heavy boxes were lifted and placed onto pallets placed on the floor. Employees were performing forceful finger tasks with their wrists in bent postures while pricing products at poorly designed workstations (Mapfre, 2008).

#### 2.3.2.1 Area for warehouse activities

One way to prevent or minimise hazards is to allocate a particular area for warehousing-related activities, such as receiving goods and storing them prior to stocks despatched, undertaking sampling of materials where applicable, holding materials that are rejected prior to return to the manufacturer or producer, keeping materials temporarily prior to disposal or for quarantine purposes. However, this is only one way of ensuring warehouse safety for workers concerned. It is thus important to implement good practices, for example, good distribution practices from the National Pharmaceutical Control Bureau, Malaysia. This practice includes measures that employers need to take into account in the process of storing, transporting and distributing products and related materials in a way that preserves the nature and quality of the products.

#### 2.3.2.2 Protection from hazards

The Good Distribution Practice also referred to the need for workers to be in suitable protective gear when working in storage facilities. It mentioned the provision of training to new recruits, with continual training and assessment over the course of employment. Visitors to the plant are usually not permitted, but when the need arises they would be closely supervised (Guidelines on Good Distribution Practice (GDP), 2011).

#### 2.3.2.3 Fire risk

Physical hazards can occur within a warehouse. An example is the risk of fire. In a warehouse such as Nature's Farm, products that are stored are generally not fire-prone, compared to warehouses that stock goods such as explosives, fuels, and other combustible materials. Despite this, fire risk is still a concern in warehouses, because of its impact when a fire breaks out. One of the reasons is because fires may spread rapidly thus making it difficult to contain the spread. While fire extinguishers are installed in the warehouse, fires that spread quickly or when no one is around tends to be less contained. Usually after the happening of the fire burning, there could be multiple sources of fires, making it difficult to assess. Other influences that make fires in a warehouse much more difficult to contain include bad housekeeping, late discovery of fire, large amount of stocks which help fuelled the rapid spread of fire, production of toxic fumes arising from the burning, non-installation of automatic sprinklers and poor action plan to control the damage when emergency occurs.

#### 2.3.2.4 Standards and measures in managing hazards

As a continuous preventive measure, servicing and maintaining workplace on a regular basis can protect stored products from effects caused to the products by changes in temperature and relative humidity. In the example from the National Pharmaceutical

Control Bureau, there exist various specific rules to govern chemical products, cosmetics, drugs or poisons. Hazard identification applies to different types of products stored in such warehouses. As such, chemicals that are highly combustible, hazardous or sensitive would require special storage facilities. These measures not only have the purpose of preserving the quality of the products but more importantly protecting health and safety risks or hazards from happening to workers working in the premises (Guidelines on Good Distribution Practice (GDP), 2011).

The risks of fire in warehouse can be prevented by a number of options. If the fire is caused by electrical sources, an annual review or maintenance can help solve the problem. This will enable a detection of electrical faults before it becomes a fire source in itself. Another option is employing thermal imaging. Thermal imaging enables the measurement of the surface temperature of various types of electrical parts. Stocks that are stored near energy sources are also another fire hazard. When sufficient heat is generated, the stocks will burn and spread to other nearby stocks. Therefore, it is good for fire prevention not to arrange stocks near the fire source, or heating areas because while the stocks are by themselves not combustible, the surrounding areas may make it prone to catch fire in the event of a breakout.

Other than automatic fire sprinklers, manual fire extinguishers with appropriate capacity should be maintained in the warehouse. Specific distances for storage of goods and the manual extinguishers should also be complied with for best results in minimising the risk of fire spread. Installing these extinguishers alone will not serve its purpose if there is no trained personnel on how to properly use them in the event of emergency. These extinguishers should be kept in a place which is free from obstacles and easily accessible.

Apart from the fire risks, the presence of materials in the goods stocked may contribute towards creating hazards that affect the health and safety of workers. One example is goods which are prone to damage due to environmental factors, which could range from creating rusts, or perishable goods such as food and food products. In the case of warehouse containing health supplements, the product viability is highly affected by the conditions of the warehouse. Despite careful packaging which sealed the product freshness, if flood or extreme heat were to occur, then the freshness will be greatly reduced (Mapfre, 2008). One way to reduce the risks of product spillage or contamination is through securely re-enclosing opened materials. Any containers that are damaged should be promptly notified to the authorised staff. While it is inevitable that there will be changes to the temperature and climate in the transportation process, such exposure should be reduced where possible (Guidelines on Good Distribution Practice (GDP), 2011).

Good housekeeping is a necessity in a warehouse operation. Poor housekeeping is one of the factors causing injuries to occur. Housekeeping hazards are objects or materials in the aisle or on the floor which is considered as tripping hazards. Materials stacked or stored loosely that might fall on workers that working nearby. Hazardous materials that are not properly stored can lead to injury or illnesses. Water, oil, or other liquids that are not cleaned due to spillage can cause slips and falls. Materials that are marked for quarantine should be stored accordingly, such as in a special zone or restricted area.

On the other hand, materials that are marked for disposal or destruction should be treated according to the procedures as approved by the authorised body. Examples of authorised authorities in the case of the National Pharmaceutical Control Bureau are the

Bureau, the State Enforcement Offices and the Ministry of Natural Resources and Environment (Guidelines on Good Distribution Practice (GDP), 2011).

Handling equipments such as forklift and hand trucks are commonly used in warehouse. Whether workers are using equipment or lifting objects by themselves, there are a few material handling hazards that exist. Forklift can tip over if not driven carefully by trained and authorized operators. In addition, forklift operators must understand their machines and follow the track well. Pedestrian in the warehouse must be alert and on the lookout for forklifts and stay out of their way when it is in use. Hand trucks and other material handling equipments can also pose hazards to untrained employees – unbalanced loads or loads where they can't see ahead can be dangerous. Other than this, lifting loads that are too high or unbalanced creates a risk of back injuries, as well as the risk of tripping over or bumping into things.

For warehousing establishments, the top ten OSHA standards most frequently included in the agency's citations were:

1. Forklifts
2. Hazard communication
3. Electrical, wiring methods
4. Electrical, system design
5. Guarding floor & wall openings and holes
6. Exits
7. Mechanical power transmission
8. Respiratory protection
9. Lockout/tagout
10. Portable fire extinguishers

Poor Ergonomics which involve improper lifting, repetitive motion or poor design of operations can lead to musculoskeletal disorders in workers. If possible, workers are encouraged to use powered equipment instead of requiring a manual lift for heavy materials. Lifts should be reduced from shoulder height and from floor height by repositioning the shelf or bin. Overhead lighting is important as to ensure it is adequate for the task at hand.

Management should provide employees with task-oriented ergonomic training in order to improve their knowledge of handling stocks. Before the loads are lifted, test the load to estimate its weight, size and bulk, and to determine the proper lifting method. If the load exceeds the maximum weight a person can lift safely without assistance, get help and keep the back in a natural position while lifting. When carrying a load, ensure that do not twist but shift the feet and take small steps in the direction that intend to turn. Most importantly, floors must be kept clean and free of slip and trip hazards.

Besides ergonomics factor, improper material storage may fall and injure warehouse workers. To counter this issue, workers need to be trained to stack loads evenly and straight, where heavier loads are placed on lower or middle shelves. Workers are also reminded to remove one object at a time from shelves and always keep aisles and passageways clean and in good repair (OSHA pocket guide, 2004).

Other examples on the best practices for handling materials can be found from the Occupational Health Branch of the California Department of Health Services. For example, the Californian Department provides for warehouse workers in identifying the signs of ergonomics risks in stock handling. Some of the signs include pain, numbness and weakness especially in the back, neck, shoulders, wrists and hands. These signs

accumulate over a long period of time and worsen if not treated. Workers usually tend to ignore the early signs and attribute it to the normal hazards of warehouse work but those are the signs that will lead to more serious matters in the future. The Department suggested that warehouse workers notify their employers and to seek medical help promptly when signs arise (California Department of Health Services, 2001).

It is understandable how these injuries occur, due to the nature of the job, where repeated movements involving the upper body over long periods of time, which then caused strains on these muscles. Likewise, in a fast paced environment the injuries could be aggravated where swift repeat movements led to continuous injuries to the already weakened body part. There are several solutions to prevent or minimise further injuries. One of the recommended actions is for employers to provide an injury-prevention workspace. This includes making enough space for workers to move around without having to bend or twist their upper bodies unnecessarily. Another suggestion is to provide optimum lighting and comfortable temperatures. In case of handling excess or large stocks, equipments such as powered-handling trucks or lifts, cranes should be utilised instead of manual handling. Workers handling stocks should also be given frequent breaks, with desirable deadlines for stocks arrangements and handling. In the event that manual handling is necessary, some safe tips include keeping the stocks close to the body so that the impact from handling can be minimised, and avoid lifting stocks directly from the floor. These measures ought to prevent injuries (UAH, 2006).

The basic requirement for adequate lighting is that the work must be easy to see and the light comfortable to the eyes. Illumination is measure in units of LUX (Lumens per square metre). Sharp differences in illumination between adjacent areas should be avoided. Ideally the surrounding area should be slightly lower in luminous background.

Light should fall from the side rather than from the front to avoid reflections on the work surfaces (DOSH, 1996).

The type of emergencies that could occur in the building includes fires, gas leaks and lift failure. To ensure an orderly evacuation, an emergency plan should be prepared and tested on a regular basis. The plan should cover fire drills/safe evacuation, how to shut off machine and leave the workplace safe, name persons in-charge for the evacuation and calling the emergency services, and detail the assembly areas. The emergency plan can be part of a safe work procedure (DOSH, 1996).

Sometimes a workplace can be sectioned into different working purposes, which may comprise of an office space near or in the warehouse itself. In this case, it is relevant to consider the health and safety issues arising from a work space. The most prevalent hazards to workers are accidents happening in a work station environment. Common ones include slips, trips or falls caused by objects in the pathway or by the side which fell over to the walkway, lifting objects, or cuts and bruises when using equipments (DOSH, 1996).

Ladders in the way or cleaning water on the floor are risks to the workers' safety. A shoe which does not grip well on the floor is another contributing factor to the hazards at warehouse. What are the ways to overcome these hazards? Good housekeeping is essential to achieve this. Examples are clearing the work place pathways of obstacles or objects. The aisles need to be well lit and clear of electrical cords and unwanted materials. Shelves or objects which are free-standing ought to be secured properly to the wall or floor. Similarly, cabinet drawers should be closed to avoid accidentally

knocking into them. Office equipment should be in good working condition, for example, electric staplers should be used properly and staff trained for it (DOSH, 1996).

Apart from ensuring the physical environment is safe and risk free, workers in working space should be encouraged to take short breaks and exercises as prolonged sitting or repetitive movements cause injuries to various muscles of the body. Moving around, or taking short walks around the premise during lunch or coffee breaks helps to alleviate the muscle strains. These exercises will prevent fatigue from accumulating in the workers' bodies. Even simple movements such as shrugging the shoulders after working for a long time facing the computer screen and typing on the keyboard helps to release some of the tensions in the upper body (DOSH, 1996).

Besides, altering the body posture can help towards discharging the muscular stress of the neck, arm and shoulders. To reduce eye strains, look in other directions and close the eyes to breathe. However, caution must be exercised while stretching the muscles of the body because people do not want to overstretch the muscles. If pain is experienced, it is better to consult the doctor rather than aggravating the pain by stretching the muscles further (DOSH, 1996).

### 2.3.3 Indoor air quality and thermal comfort in a warehouse

Good indoor air quality (IAQ) is required for a healthy indoor work environment. Poor indoor air quality can cause a variety of short-term and long-term health problems. Health problems are commonly associated with poor IAQ include allergic reactions, respiratory problems, eye irritation, sinusitis, bronchitis and pneumonia.

There are many sources of indoor air pollutants and among the common ones are environmental tobacco smoke (ETS) emitted due to burning of tobacco products; various chemical substances such as formaldehyde emitted from furnishings; volatile organic compounds emitted from the use and application of solvents; and ozone emitted from photocopiers and laser printers. It should be noted that ETS has been recognized as a human carcinogen by the International Agency for Research on Cancer (IARC) in 2002 and exposure to it will increase the risk of coronary heart disease.

#### 2.3.3.1 Code of Practice and other guidelines

The purpose of Indoor Air Quality Code of Practice is to set minimum standards that will protect the health of employees and other occupants of an indoor or enclosed environment served by a common mechanical ventilation and/or air conditioning system. The Good Distribution Practice of the National Pharmaceutical Control Bureau referred to the need to record temperature at storage facilities at suitable intervals according to a specified level to confirm the maximum and minimum temperature for the day. Similarly, records of relative humidity should be recorded where possible (Guidelines on Good Distribution Practice (GDP), 2011).

IAQ problems arise in non-industrial buildings (an indoor or enclosed work space that is served by a common ventilating and/or air conditioning system where there are person at work, but does not include premises that are used primarily as manufacturing and production facilities and vehicles) when there is an inadequate quantity of ventilation air being provided for the amount of air contaminants present in that space. Hence, IAQ and heating, ventilation and air-conditioning systems (HVAC) are closely related.

Indoor air quality assessment is conducted with the following objectives (DOSH, 2005):

a) To identify the sources of the air contaminants either within the place of work or from the outside air;
b) To evaluate the exposure of the occupants to the air contaminants;
c) To evaluate the adequacy of existing control measures;
d) To conclude the significance of the health risk posed by the air contaminants;
e) To recommend further appropriate control measures to prevent or reduce risks.

#### 2.3.3.2 Relation of IAQ with thermal comfort

IAQ consists of humidity and ventilation components. Humidity refers to the amount of water vapour in the air. The optimum comfort range for relative humidity is 40%-60%. Low humidity can cause dryness of the eyes, nose and throat and may also increase the frequency of static electricity shocks. High humidity, above 80% can be associated with fatigue and report of "stuffiness". Ventilation refers to the movement of the air and rate of fresh air input. Air movement of less than 0.1 meters per second can lead to stuffy rooms whereas above 0.2 meters per second, draughts can be felt. Ventilation must be adequate. For each person a minimum rate of 10 litres fresh air per second per person for general office space or 10 litres of fresh air per second for every 10 square meters of floor space is recommended (DOSH, 1996).

Offices should be ventilated either naturally or artificially. For most office opening windows or doors will provide adequate ventilation. Where mechanical ventilation or air-conditioning is provided make sure the system is regularly checked, kept clean and well maintained to prevent a growth of *Legionella* bacteria or other organisms. Environment tobacco smoke is an indoor contaminant and there is growing recognition

that non-smokers may suffer adverse health effects through inhaling tobacco smoke. Organisations are increasingly expected to limit passive smoking risks in office in the interest of their employees and clients.

### 2.3.4 Importance of EHS and Assessment on Thermal Comfort

Physical and functional comfort are relate closely to one's productivity, while psychological comfort is linked to human needs such as the ability to control elements of one's job. Studies had shown that workers are feeling more comfortable and productive if given the control over their immediate physical environment, for example control over the lighting exposure or temperature. In a literature review, researchers found that "high levels of perceived control are associated with increases in job satisfaction, commitment, involvement, performance and motivation and with low levels of physical symptoms, emotional distress, and absenteeism" (Herman Miller Inc, 2008).

According to a Herman Miller (2008) research summary "…having some control over the workspace can improve comfort and the ability to get work done and reduce stress. This, in turn, can lead to greater productivity and better health." Attention to physical comfort takes on greater urgency when "people costs" are taken into account, since they are by far an organization's biggest expense: Salaries alone account for 84% of the cost per square foot of a commercial building, the other expenses being rent, maintenance, and energy. Physical comfort including the factors of quality of light, air, temperature, sound, and ergonomics is vital to job satisfaction and productivity. Productivity might be affected and tend to be at low point if employees are physically uncomfortable or if the building is unhealthy (Herman Miller Inc, 2008)

Functional comfort also affects productivity and job satisfaction since it deals with the tools an individual or group needs to work effectively. Providing workers with inappropriate tools will result in additional work stress and frustration. Functional comfort enables workers to interact effectively with their environment.

Psychological comfort addresses the human need for control over the job and the workspace, and, ideally, the ability to work in a space that provides visual interest or natural elements. While psychological comfort may not directly impact productivity, it does affect mood, cognitive function, and feelings of loyalty and commitment.

The quality of the work environment is strongly linked to both job satisfaction and productivity. Therefore, attention should be allocated to critical areas that support physical comfort such as temperature, lighting, acoustics, air quality and ergonomics (Herman Miller Inc, 2008). Figure 2.5 summarises the relationship between environmental quality, health and safety, employee productivity and total quality management:

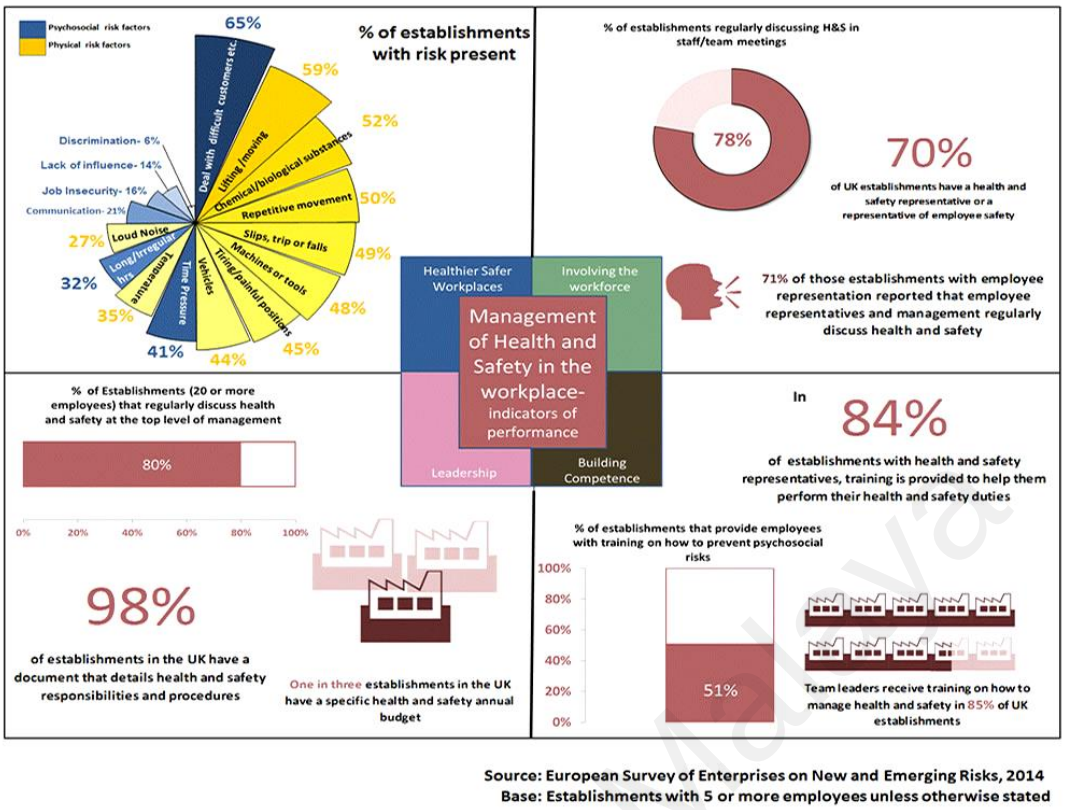


**Figure 2.5**: Correlation for effective total quality management (HSE, 2016)

## 2.4 Conclusion

The health and safety of workers in any workplace is important in improving employer accountability and measures to prevent or reduce workplace hazards. While there are many aspects of health and safety that contribute towards the overall environmental health and safety of a workplace, in the context of a warehouse, certain obvious and hidden risks, as identified above, together with warehouse thermal comfort potentially produce an impact on the workers' wellbeing and productivity. Indoor air quality and the relative humidity of the warehouse are some of the factors to be taken into account in determining the levels of thermal comfort. There is a correlation between optimum thermal comfort with the workers' productivity. The next chapter will investigate the relationship between thermal comfort and employee productivity, in addition to evaluating current warehouse standard operating procedure.

# CHAPTER 3

# METHODOLOGY

This study investigates the relationship between thermal comfort and employee productivity in a selected warehouse located in Klang Valley, comprising of 20 staffs including 3 warehouse personnel. The selected warehouse serves as a storage building for finished products that are transported from the manufacturers before they are distributed to the customers. Several methods help the study, including obtaining information about workers' level of thermal comfort from a thermal comfort checklist, assessing the existing Standard Operating Procedure of the warehouse compared to the current relevant Standard Operating Procedure, physical measurement of the temperature and humidity of the warehouse.

## 3.1 Hypothetical/experimental design

### 3.1.1 Rationality in measuring thermal comfort

Thermal comfort is one of the factors contributing to the workers' productivity, as explained in chapter 2. Thus, thermal comfort checklist, measuring the temperature of the warehouse and questionnaire contribute to the study.

### 3.1.2 Thermal comfort measurement

Thermal comfort is measured by a checklist of major issues, such as the air and radiant temperature, air movement, the metabolic rate and PPE. In this study, the main measurement involves the indoor temperature and air movement in the warehouse.

### 3.1.3 Guidelines to measure thermal comfort

In order to measure the factors contributing to thermal comfort more accurately, the predicted mean vote (PMV) and percentage people dissatisfied (PPD) index and use of BS EN ISO 7730 and BS EN ISO 10551 British standards are recommended. The PMV/PPD index predicts the thermal comfort of people working in a given environment. It uses the six basic factors, and has become the most widely used index in recent years. It has been adopted as a British and European and International standard.

## 3.2 Thermal comfort checklist

A brief checklist as showed in Table 3.1 will be used to investigate the level of thermal comfort experienced by the warehouse employees. The checklist below will help workers identify whether there may be a risk of thermal discomfort to them. The basic checklist provides a general understanding of the thermal comfort and does not replace an adequate thermal comfort risk assessment. In the checklist, the workers are asked to read the descriptions for each thermal comfort factor, and to answer YES or NO according to their experience. If the workers have two or more 'YES' answers, there may be a risk of thermal discomfort, it indicates the need to carry out a more detailed risk assessment. Workers who participated in the assessment below are also free to add or explain anything further in addition to their YES or NO answers.

Table 3.1: Thermal comfort check list (HSE 2016)

| FACTOR | CHECK LIST |
|---|---|
| Air temperature | - Does the air feel warm or hot?<br>- Does the temperature in the workplace fluctuate during a normal working day?<br>- Does the temperature in the workplace change a lot during hot or cold seasonal variations? |
| Radiant temperature | - Is there a heat source in the environment?<br>- Is there any equipment that produces steam?<br>- Is the workplace affected by external weather conditions?<br>- Are your workers wearing PPE that is vapour impermeable?<br>- Do your workers complain that the air is too dry?<br>- Do your workers complain that the air is too humid? |
| Air movement | - Is cold or warm air blowing directly into the workspace?<br>- Are workers complaining of draught? |
| Metabolic rate | - Is work rate moderate to intensive in warm or hot conditions?<br>- Are workers sedentary in cool or cold environments? |
| Personal Protective Equipment (PPE) | - Is PPE being worn that protects against harmful toxins, chemicals, asbestos, flame extreme heat, etc.?<br>- Can workers make individual alterations to their clothing in response to the thermal environment?<br>- What your workers think<br>- Do your workers think that there is a thermal comfort problem? |

As radiant heat also plays a part in the heat exchange between the person and the environment a globe thermometer is used to measure the radiant heat exchange, although this is also affected by air velocity. As rates of heat convection and evaporation are affected by the movement of air around the body, air speed also needs to be measured.

Therefore, in order to obtain an indication of the thermal environment it is necessary to measure dry bulb, wet bulb and globe temperatures along with air velocity. The wet and dry bulb thermometers are often contained within a sling psychrometer which can be rotated by hand to induce an air current to flow over the bulbs. Whereas a globe thermometer consists of mercury in glass thermometer placed with its bulb in the centre of a matt black sphere or globe. Heat indices attempt to combine the various parameters together with the work rate and the clothing worn into a single index which provides an indication of the degree of discomfort or stress to be expected.

### 3.3 Qualitative analysis

The data from the warehouse containing temperature records over a period of 2 years or 24 months is used to analyse the question examined in this thesis and its application in the case study conducted here.

The temperature is measured against the humidity of the storage condition because all the registered products has to be kept at the temperature and condition as regulated under the rules set by the National Pharmaceutical Control Bureau. The data showed that the various temperature in the warehouse located at the mezzanine floor between January 2011 to December 2011 between two selected time periods, namely once in the morning (9 a.m.) and once in the afternoon (3 p.m.). These two time periods are selected because at 3 p.m., the temperature reaches its maximum and monitoring is required to ensure the products quality are relatively unaffected.

The temperature and humidity sensor are placed separately, one which is nearer to the sliding window and another sensor is farther from the window. The locations are selected to show the difference between the temperatures for the products stored at both ends of the warehouse.

The storage temperature and condition is important to maintain the quality of the product. When the products are first manufactured in the factory, they undergo the process of stability test and kept at a controlled temperature. The manufacturer is required to provide 12 months (1 batch) & 24 months (1 batch) of stability data under the storage condition (30 ± 2 ºC / 65 ± 5% RH), which was later revised to 30 ± 2 ºC / 75 ± 5% RH. Flowing from this, the warehouse also needs to monitor the temperature accordingly. Therefore, it is important to ensure that the temperature is maintained

within the specified limit. Temperature control is not only important for the purposes of complying with the National Pharmaceutical Control Bureau guidelines; it also affects the thermal comfort of the personnel working in the warehouse.

## 3.4 Assessment on the existing Standard Operating Procedure

### 3.4.1 Assess the effectiveness of the current warehouse standard operating procedure

The available warehouse standard operating procedure document, effective 1st January 2011 aims to ensure that proper inventory control is in place so that stocks are properly received, safely placed and handled. On a general overview, the document covers policies and procedures for receiving stock, storing, stock transfers, stock take and responsibilities of warehouse personnel. The main procedure to be investigated here is the procedure on storage condition, housekeeping and thermal comfort. Reference can also be made to the guidelines of the National Pharmaceutical Control Bureau, Malaysia.

Temperature is important for these products and in order to maintain the required temperature, two thermometers are installed in that floor. The warehouse personnel are required to monitor the temperature by recording the various temperatures in the log book at 9 a.m. in the morning and 3 p.m. in the afternoon during working days only. Temperature is to be maintained within prescribed limits by the use of properly scaled temperature measuring device. The air condition is switched on for 24 hours and is serviced twice a year. These precautions are taken to ensure that the temperature remains the same for the entire time where the products are kept.

Ice-Point Method is used in respect of configuring the temperature of thermometer. This method required the thermometer to be submerged in ice water containing crushed ice. The thermometer, working normally should be $0^{o}C$; otherwise, it has to be replaced. This is to ensure that the thermometer is functioning well before any temperature is recorded.

Secondly, the existing standard operating procedure document titled Good Storage Practice will be useful as a reference that outlines procedures to be followed by all warehouse staff in respect of storage conditions, personnel who handle the products, sanitation, warehouse maintenance, complaints procedure and stock handling. This document is important because it reveals the types of procedures that are in place for storage conditions and the things that can be done to control the stock. For example, stock positioning is mentioned in the procedure where space should be maintained between the stacks to make easy for the store personnel in physical verification and location of batches.

Inventory control and stocks ordering are among aspects to be considered in giving impact towards warehouse management. Stocks received from suppliers are first located at quarantined area for verification purpose. Once information of stocks is matched with Purchase Order, warehouse executive will move the stocks to storage area. These stocks are assigned with specific batch number and expiry date and uploaded into system server. Stocks issued are based on FIFO (first in first out) and FEFO (first expiry first out) method. With periodic stock reconciliation every 6 months as stated in SOP, actual stocks level should be verified against record in system to identify discrepancies as well as properly manage inventory level.

Besides, storage cleanliness is also an important aspect, where cleaning and maintenance are done at least once a week. The requirement for cleanliness is also extended to the personnel that work specifically at the warehouse. Any personnel with a disease in a communicable form or with open lesions on the exposed surface of the body are restricted to work in storage areas. The purpose is to avoid contamination with the registered products.

Another aspect which is given importance is the procedure for controlling storage temperature is also provided in the document. The purpose is to monitor and ensure appropriate storage condition is maintained by using suitable temperature recording devices, to ensure the thermometer used will be calibrated on a regular basis for accuracy. This responsibility lies with the warehouse executive, who is required to ensure that the temperature is maintained within the prescribed limits by the use of proper temperature measuring device. The method in ensuring that the temperature is within the limits is done by requiring the personnel to record the daily temperatures in the Temperature Log Book. These data is then submitted to the head of the department for review every month. The procedure for recording temperatures is also set out. Particularly, the storage temperature should be kept between 15$^{o}$C and 30$^{o}$C. If the temperature exceeds 30$^{o}$C the head of department will be notified.

# CHAPTER 4

# RESULTS AND DISCUSSION

The following chapter discussed the results from data collected from the warehouse on the temperature of the warehouse. Besides the temperature, there is discussion on good storage practices which explained the standard operating procedures adopted by warehouse in storing their products.

## 4.1 Thermal comfort identification, assessment and analysis

The warehouse temperature is an important factor affecting the products stored in it. In order to ensure that products are still in good condition while being stored in the warehouse, temperature control becomes an essential requirement as good storage practices. The selected warehouse has a Standard Operating Procedure (SOP) on good storage practices. It contains instructions on the temperature which must be maintained at all times, the responsibilities of the warehouse managers in maintaining the temperature, the procedures and methods to monitor the temperature in order to be fall between the optimal range or to restore the temperature to the optimal condition for the warehouse and keeping the records.

The Standard Operating Procedure aims to supervise the storage conditions of the warehouse. It also provides instructions on suitable conditions which need to be maintained by ensuring recording instruments are installed to monitor the temperature at all times. Another objective of creating the Standard Operating Procedure is to ensure that the recording instrument, such as thermometer used will be regulated frequently so that the temperature recorded will be precise.

In achieving the two main aims, the warehouse manager is assigned with a number of responsibilities in relation to maintain the temperature. Firstly, the temperature is recorded on a daily basis in the temperature log book. These records are then submitted to the head of department on a monthly basis to be reviewed.

On a closer inspection, the standard operating procedures revealed that the warehouse storage area has two thermometers installed on the wall. The temperature range is quite wide because products should be stored at a temperature between 15$^{o}$C and 30$^{o}$C. Temperature readings will be taken twice daily during the working hours, once in the morning and once in the afternoon. It is only when the temperature is more than 30$^{o}$C that the head of the department will be notified.

### 4.1.1 Temperature in warehouse

The following contains discussion on data collected which shows the temperature taken at the storage area of the warehouse. This information is displayed in graphs below on a monthly basis for a period of 8 months on the two thermometers installed in the warehouse.

### 4.1.2 Temperature variance

One of the factors to be considered in temperature regulating, or as it is known from the standard operating procedure as calibration, is the outdoor temperature. As the temperature recorded was taken during the months from January to August, it happened during the Northeast Monsoon. The Northeast Monsoon occurs annually from the months of November to March and brings heavy rainfall to the eastern parts of Peninsular Malaysia and the Western parts of the state of Sarawak.

Graph starting from Jan 2011 to Mar 2011 as showed below, temperature is recorded during the Northeast monsoon. The two graphs of Figure 4.1 and 4.2 showed the humidity and temperature reading in the month of January on two occasions, one in the morning and another in the afternoon. A general observation is that the temperature is relatively lower in the morning at different locations in the warehouse.

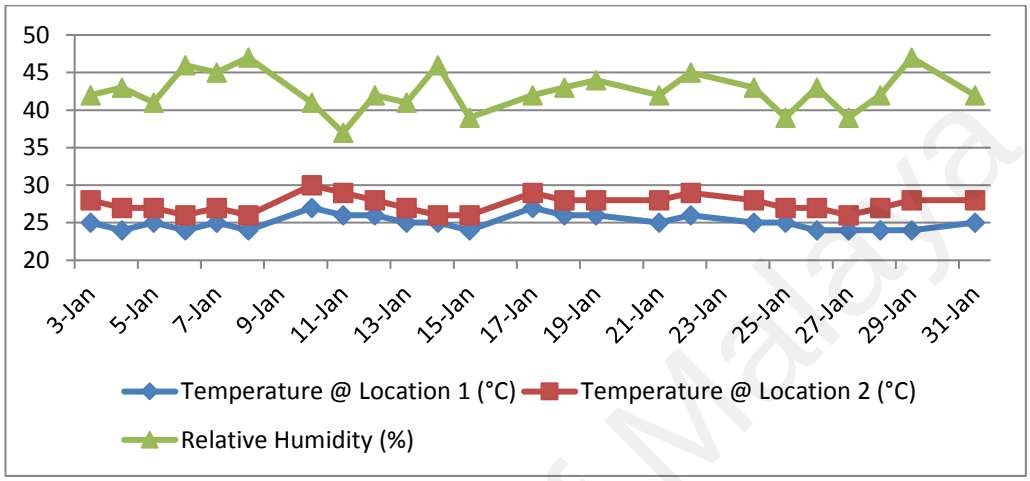


**Figure 4.1**: Temperature and humidity reading on Jan 2011, 9am

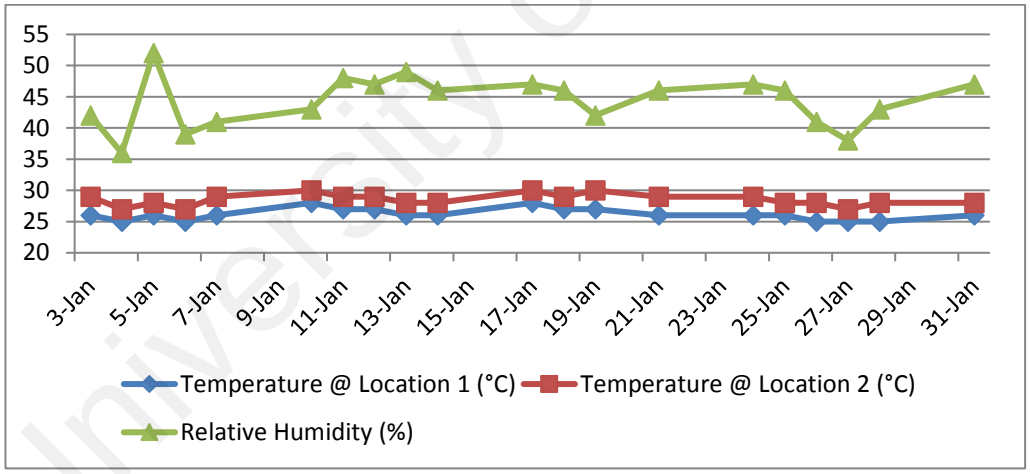


**Figure 4.2:** Temperature and humidity reading on Jan 2011, 3pm

The second set of graphs below showed the humidity and temperature reading for the month of February on two occasions, once at 9 a.m. and another at 3 p.m. Similar to the temperature reading in January, the temperature is relatively lower at location 1 compared to location 2.

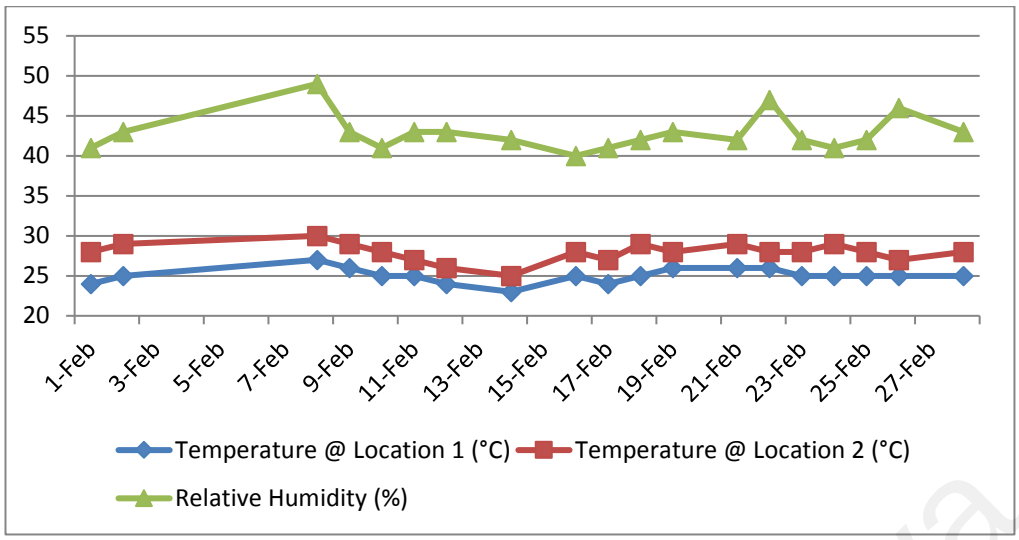


**Figure 4.3**: Temperature and humidity reading on Feb 2011, 9am

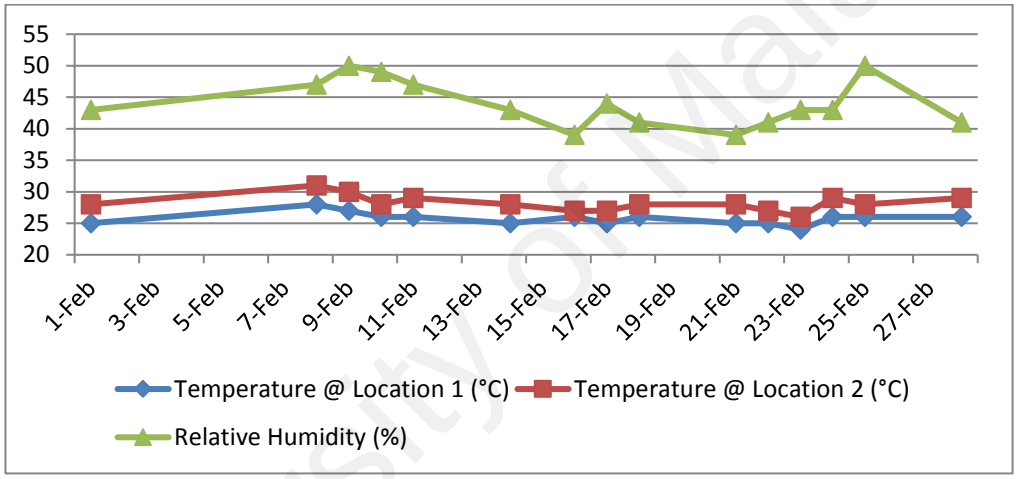


**Figure 4.4:** Temperature and humidity reading on Feb 2011, 3pm

One of the reasons for the variation is because the thermometer placed at T1 is in the inner side of the storage area which is further away from the window, but closer to the door, while the thermometer at T2 is located near the window. Figure 4.5 illustrated the locations of thermometers being placed which explained the temperature variances. In respect of the window, on warmer days, the heat from the sunlight can be transmitted to the warehouse. This is supported by the temperature record at T2 which is located at the window. However, even if the temperature recorded is higher at T2, it does not exceed the temperature specified in the Standard Operating Procedure which states that temperatures must not exceed 30°C.

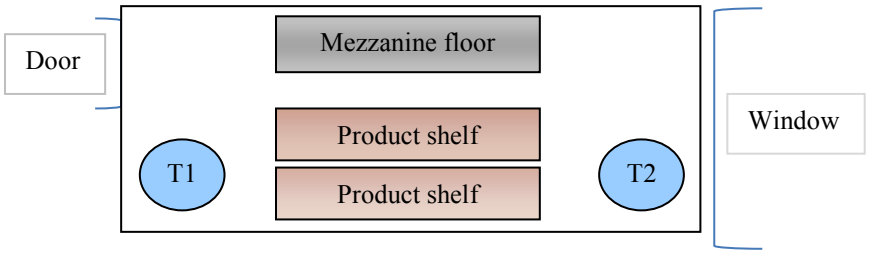


**Figure 4.5**: Location of the thermometer (T1 & T2) in warehouse mezzanine floor (top view)

Another possible reason for the temperature variation is the wind direction and circulation of air in the warehouse. If there are more movements coming in from the door because of the entry and exit of personnel it could either bring in cooler or warmer air into the warehouse, depending on the time of the day.

Compared to T2, the windows are shut all the time and the temperature is less affected by the air circulation. In conjunction with the built of the warehouse, the type of construction material used to build the warehouse contributed to the temperature variance and the condition of the products stored inside. The wall is cement which can trap the heat better and acted as coefficient of thermal conductivity. Besides cement material, brick walls also serves as effective heat conductor to achieve optimal thermal comfort especially in hot and humid weather. It can delay the temperature rise when the environmental temperature increases (Madhumathi and Sundarraja, 2012).

Another factor to consider is the condition of the warehouse, whether it is the type that has lots of exit and entry points and windows or just walls. In a warehouse with just ceilings and walls and no windows, the temperature would be lower generally because there is less heat from the sunlight.

However, with the current condition of the warehouse, with a wider window and a door there is more sunlight and heat coming in through the windows and air movements to the door. The heat generated from the morning sun could also be lower than the one in the afternoon or early afternoon, as is the case here. The measurement taken at 9 a.m. was reasonably lower than the one taken at 3 p.m. because the room still maintains the coolness of the previous night. The measurement taken later at 3 p.m. is higher because it has the whole afternoon sun to heat up the room and where the temperature peaked at midday. The maintenance and schedule check of the temperature measuring tool and the sensitivity of reading is another factor that contributes to the temperature variance.

There is a bigger discrepancy in terms of temperature and relative humidity in the month of March. Temperature recorded at 3 p.m. at location T2 is mostly higher than the temperature recorded at the same time in the months of January and February. The minimum temperature is 30$^{o}$C which is the highest temperature permitted under the Standard Operating Procedure and it tends to exceed the 30$^{o}$C-point throughout the month. The temperature at location T1 usually ranges between 26$^{o}$C to 28$^{o}$C throughout the month both in the morning and the afternoon. The temperature recorded in March at T1 is slightly higher than the temperature recorded at the same time in both January and February.

Another observation that can be deduced from the graphs for January and February is that the temperature taken on both mornings and afternoons are slightly lower compared to the temperature records from March onwards. A possible reason is because of the heavy rainfall during the northeast monsoon occurring at that time. The monsoon season occurs twice annually, once from May to September and the other time is from November to March.

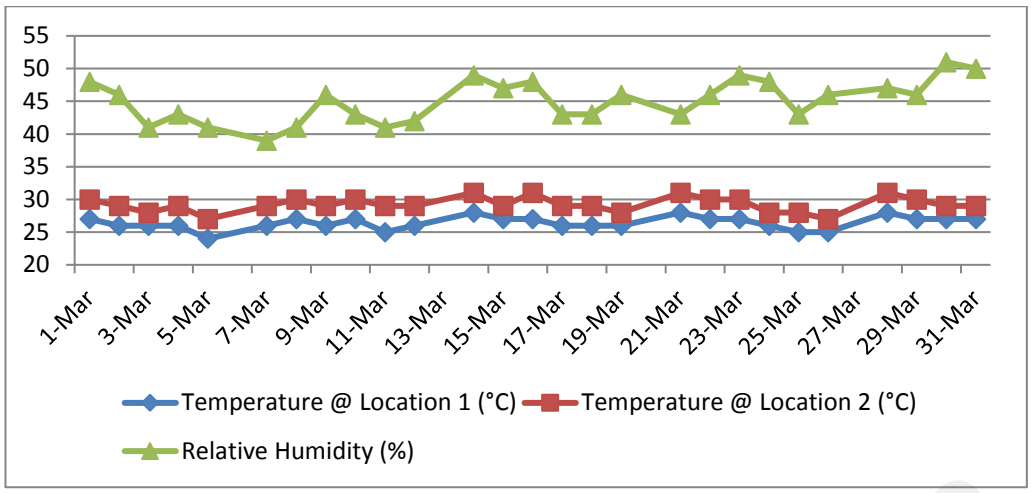


**Figure 4.6**: Temperature and humidity reading on Mar 2011, 9am

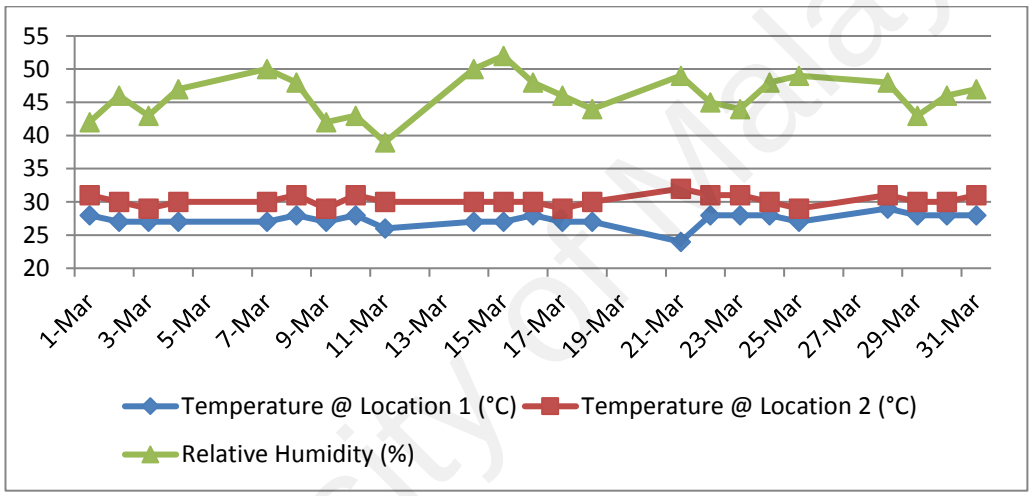


**Figure 4.7**: Temperature and humidity reading on Mar 2011, 3pm

The Northeast Monsoon season, which happens from November to March, is characterized by heavy rainfall to the eastern parts of Peninsular Malaysia while the Southwest Monsoon, which happens from May to September, does not bring heavy rainfall but means dry weather than normal. The warehouse is located in Petaling Jaya, which is at the east coast of Peninsular Malaysia and therefore more affected by the Northeast Monsoon rainfall. The rainfall can be very heavy until it causes flooding to low-lying areas or flash floods in urban areas.

There is a relationship between the differences of temperatures outdoors and indoors (the warehouse) during the monsoon season. Rainfall tends to cool down the heat in the air making the temperatures drop or stay even. The monsoon season usually brings lots of rain throughout the day, so it is reasonable that there is not much difference in the temperature for both morning and afternoon throughout February compared to January.

Graphs below show the temperature and humidity readings starting from May – Aug (southwest monsoon) of which drier weather took place. The Southwest Monsoon occurs in the months of May to September, and the temperature recorded in the warehouse is generally higher compared to the previous months. For example, temperature at T1 range from 28$^{o}$C to 30$^{o}$C in the afternoon compared to the same time in January, February and March. The average temperature recorded at T1 in the morning is 29$^{o}$C. This record is much higher than the temperature recorded at the same time in the three months before.

Meanwhile, the temperature at T2 exceeded 30$^{o}$C most of the time throughout the month except for the beginning of the month. The temperature recorded is mostly in the range of 30$^{o}$C to 32$^{o}$C. There is not much heavy rainfall during these months (May – September) and the weather becomes drier compared to the Northeast Monsoon season earlier.

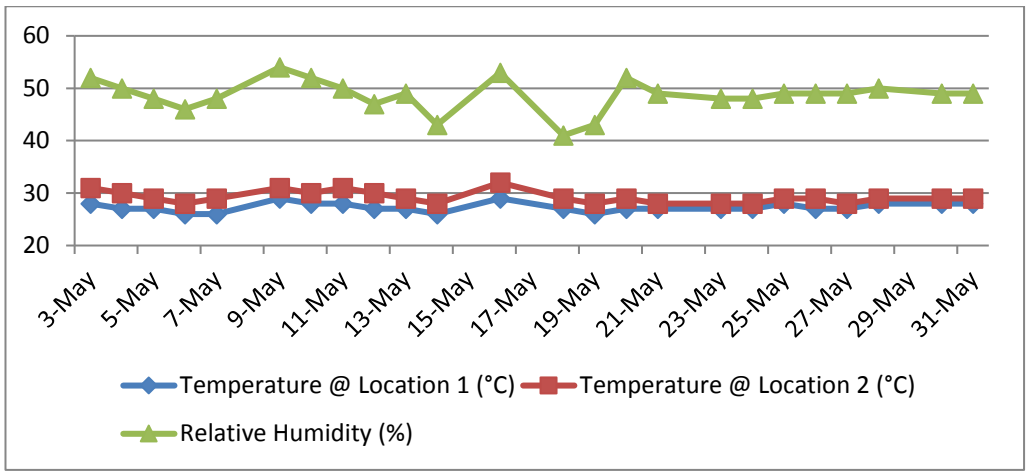


**Figure 4.8**: Temperature and humidity reading on May 2011, 9am

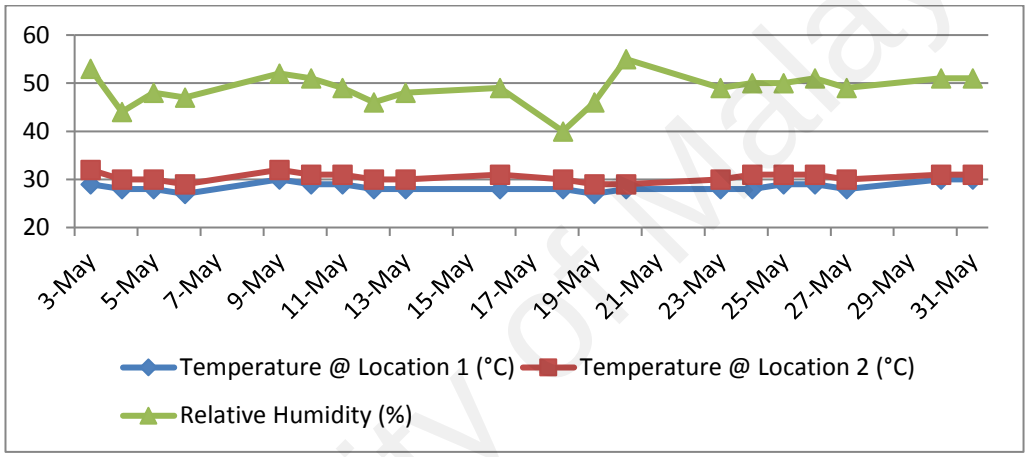


**Figure 4.9**: Temperature and humidity reading on May 2011, 3pm

There are several reasons for the variation in the temperature besides the Monsoon season effect. The location of T1 and T2 creates the differences in the temperature record. As indicated previously, T1 is located in the inner side of the room while T2 is located near the window. The drier season means less rainfall and the hot air is transmitted through the window where T2 is located. Dry air circulation would also impact the temperatures inside the warehouse.

The higher the temperature is the lower is the relative humidity. The afternoon sun, which is generally warmer than the morning sun becomes drier with the help of the monsoon and therefore makes the temperature record higher. That is why at T2 the average temperature is 30ºC or more. Lesser wind circulation also makes the air more static and does not produce any cooling effect.

The temperature recorded in the warehouse for the next three months from June to August are quite interesting. There were less humidity variance and the temperature, while generally higher for T1 and usual for T2 because of its location remains stable throughout the month. The average temperature recorded at T1 in the morning and afternoon is 28ºC. The temperature recorded is mostly in the range of 30ºC to 32ºC at T2.

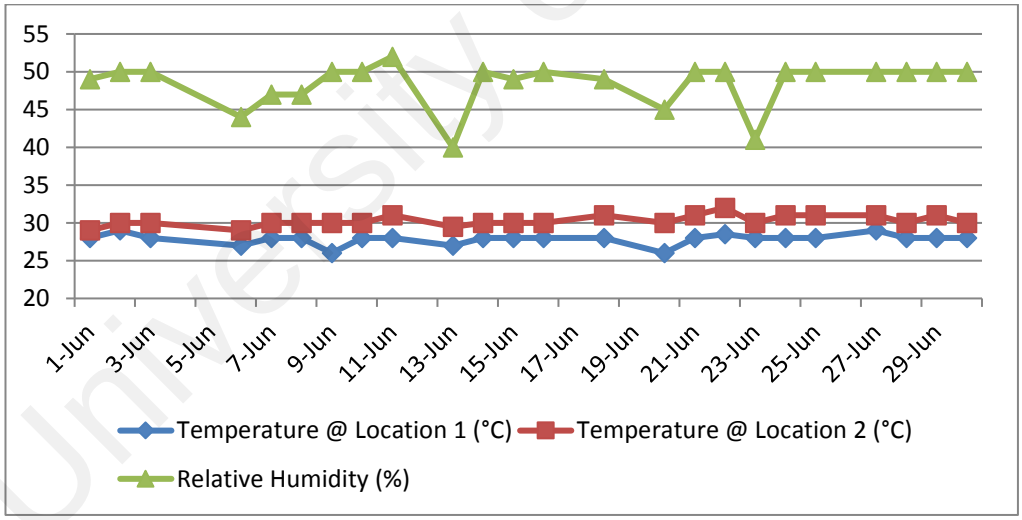


**Figure 4.10**: Temperature and humidity reading on June 2011, 9am

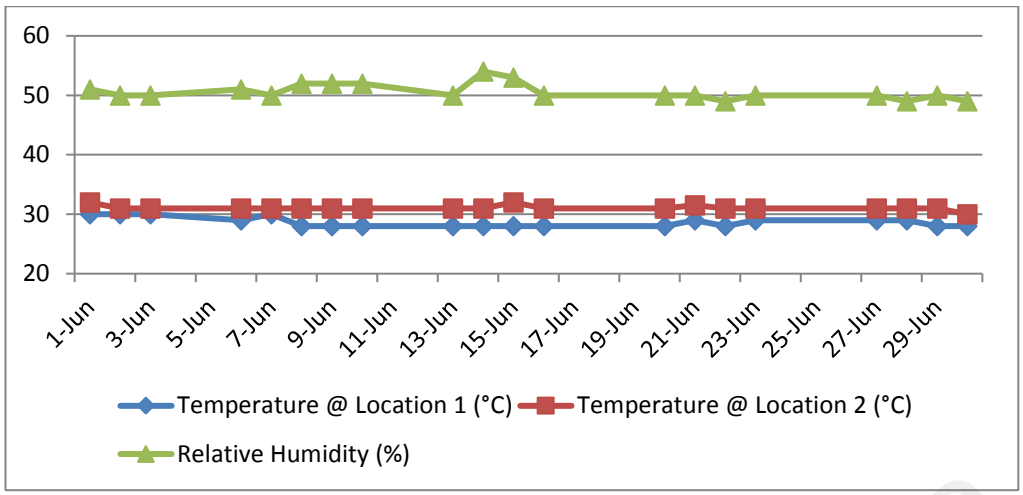


**Figure 4.11**: Temperature and humidity reading on June 2011, 3pm

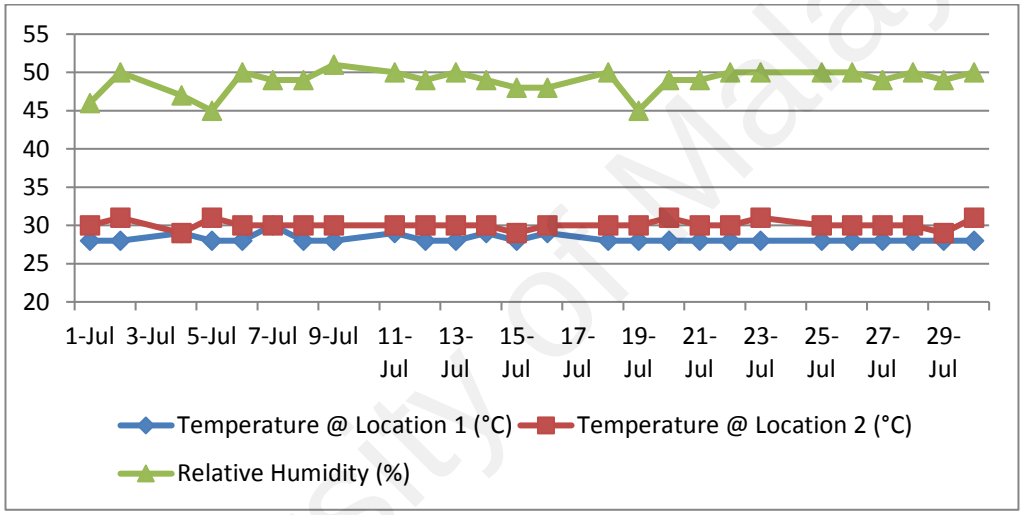


**Figure 4.12**: Temperature and humidity reading on July 2011, 9am

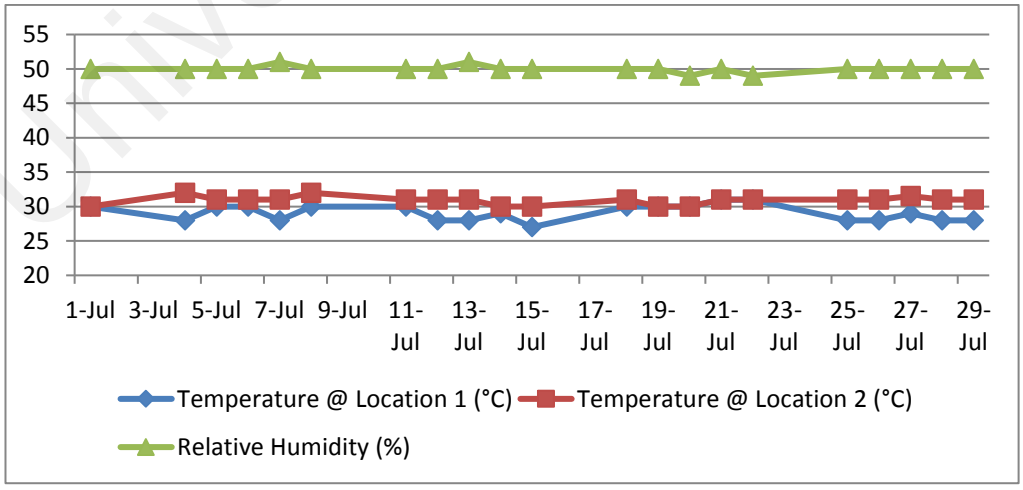


**Figure 4.13**: Temperature and humidity reading on July 2011, 3pm

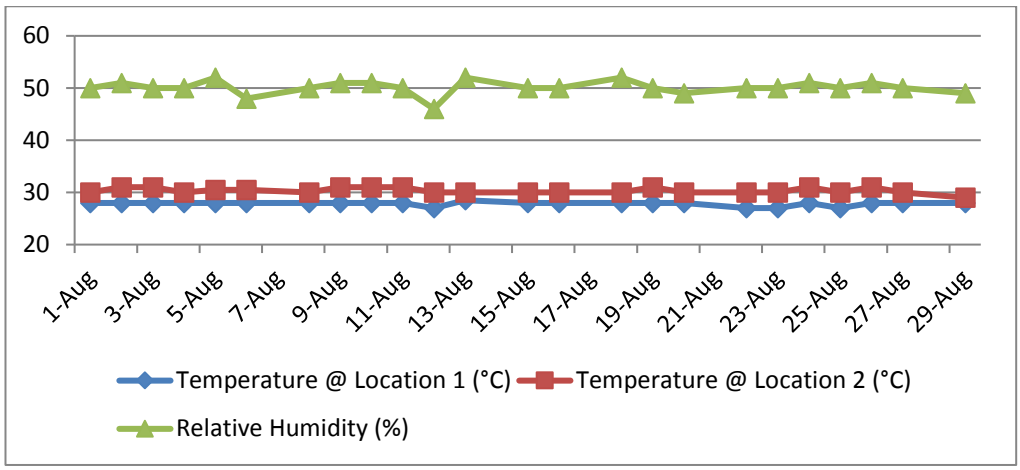


**Figure 4.14**: Temperature and humidity reading on Aug 2011, 9am

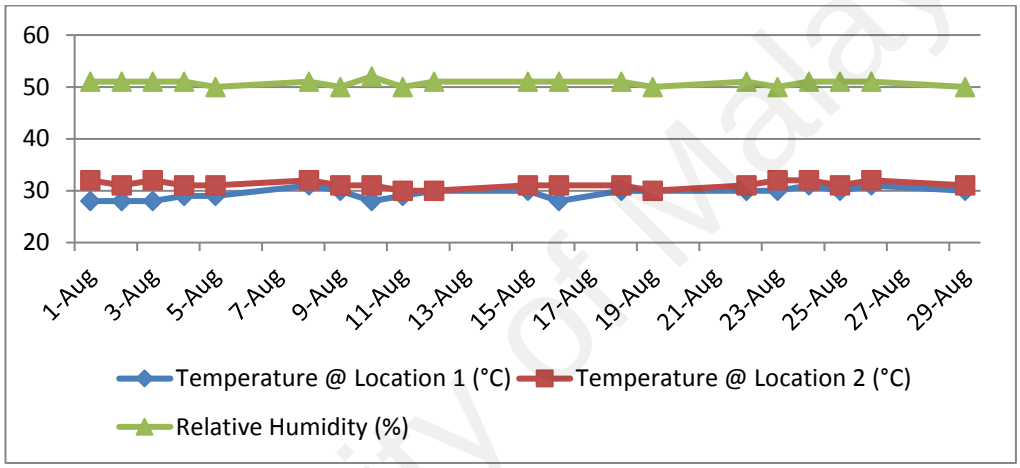


**Figure 4.15**: Temperature and humidity reading on Aug 2011, 3pm

There are some reasons for this stability especially in relation to the relative humidity, indoor temperature and human body temperature. Relative humidity means the percentage of the existing absolute humidity to the highest possible absolute humidity. Absolute humidity refers to the amount of water vapour divided by the amount of dry air in a volume of air at a given temperature. Therefore, if the air is hot, it can contain more water vapours. In a situation where the relative humidity is at 100 per cent, it means that the air is fully packed with water vapours, resulting in rainfall.

The relative humidity in the months from January to August is between 45 to 55 per cent. In relation to the human body temperature, sweating allows the body to cool and maintain its existing temperature. When the relative humidity is high, it becomes harder for the human sweat to evaporate into the air, causing the body temperature to rise. This is when the body becomes warmer than the real temperature (HowStuffWorks.com, 2001).

There are guidelines on optimal relative humidity for product storage. Based on the guidelines from Good Distribution Practice, where controlled environmental storage conditions are required, these conditions should be continuously monitored and the appropriate action should be taken where necessary. Materials and/or products and/or cosmetics requiring dry or humidity controlled storage should be stored in area where the relative humidity and temperature are maintained within prescribed limits by the use of proper equipment. On the product label, when the remark of "Dry place" indicated it means "no more than 70±5% relative humidity in normal storage condition" (Guidelines on Good Distribution Practice (GDP), 2011).

Relative humidity is used commonly to measure the level of humidity. Translated into a formula, it can be represented as follows:

**The actual relative = amount of humidity water vapour in the air x 100%**

The relationship between relative humidity and the amount of water vapour in the air is inseparable. More water vapour in the air means a higher relative humidity (Valsson and Bharat, 2011).

Table 4.1 demonstrates an example of the relationship between the relative humidity at any given temperature for the month of January. As the highlights in the table shows, the lower the temperature, the higher is the relative humidity, and as the temperature increases, there is a fall in the relative humidity. Relative humidity varies significantly when the temperature changes, even when the actual amount of water vapour in the air remains the same. Given that the amount of water vapour is held constant, then if there is a reduction in the temperature, the relative humidity goes up, while an increase in the temperature will result in the relative humidity decreasing.

Overall, humidity increases when the temperature decreases. This is demonstrated in the charts from the data provided. A huge degree of variance occurs in January 2011, while February recorded a more constant temperature against humidity, although greater temperature fluctuations occur in the morning compared to the afternoon. The average temperature recorded is 25$^{o}$C in March 2011; 27$^{o}$C from March to June 2011 and slightly higher (29$^{o}$C) from July 2011. Meanwhile, January 2010 recorded the lowest temperature at 21$^{o}$C, and it climbed to 24$^{o}$C average from February to August 2010. The range of temperatures showed that the warehouse storage conditions were kept at the limit according to the specified limit in the company warehouse standard operating procedure.

An example to show this is the data from 8$^{th}$ and 10$^{th}$ January in Table 4.1. The average temperature for 8$^{th}$ January is 25$^{o}$C, which is lower than the temperature on the 10$^{th}$ January at 28.5$^{o}$C. However the relative humidity for 8$^{th}$ January is at 47% compared to only 41% at a higher temperature on 10$^{th}$ January. This data support the fact that when temperature increases, relative humidity decreases and vice versa.

**Table 4.1**: Data of average temperature and relative humidity (%)

| DATE | Average Temperature (°C) | Relative Humidity (%) |
|---|---|---|
| 3-Jan | 26.5 | 42 |
| 4-Jan | 25.5 | 43 |
| 5-Jan | 26.0 | 41 |
| 6-Jan | 25.0 | 46 |
| 7-Jan | 26.0 | 45 |
| 8-Jan | 25.0 | 47 |
| 10-Jan | 28.5 | 41 |
| 11-Jan | 27.5 | 37 |
| 12-Jan | 27.0 | 42 |
| 13-Jan | 26.0 | 41 |
| 14-Jan | 25.5 | 46 |
| 15-Jan | 25.0 | 39 |
| 17-Jan | 28.0 | 42 |
| 18-Jan | 27.0 | 43 |
| 19-Jan | 27.0 | 44 |
| 21-Jan | 26.5 | 42 |
| 22-Jan | 27.5 | 45 |
| 24-Jan | 26.5 | 43 |
| 25-Jan | 26.0 | 39 |
| 26-Jan | 25.5 | 43 |
| 27-Jan | 25.0 | 39 |
| 28-Jan | 25.5 | 42 |
| 29-Jan | 26.0 | 47 |
| 31-Jan | 26.5 | 42 |

## 4.2 Over-flowing of goods and stocks arrangement

### 4.2.1 Potential hazards in warehouse

Warehouse operations can present a wide variety of potential hazards for the worker. According to OSHA, some of the hazards identified included employees had to reach elevated and distant locations in storage shelves to access materials with unsafe use of forklifts. Figure 4.16 showed the example where carton boxes are stacked or stored on top of shelves. Improper stacking of products where heavy boxes were lifted and placed onto pallets placed on the floor. Workers had to repeatedly bend to reach low-level locations at floor level to access materials which caused repetitive motion injuries. Employees were performing forceful finger tasks with their wrists in bent postures while pricing products at poorly designed workstations.

**Figure 4.16:** Placement of boxes which cluttered and disorganized

Good housekeeping is a necessity in a warehouse operation. Poor housekeeping is one of the factors causing injuries to occur (CCOHS, 1997-2014). Housekeeping hazards are objects or materials in the aisle or on the floor which is considered as tripping hazards. Materials stacked or stored loosely that might fall on workers that working nearby.

Hazardous materials that are not properly stored can lead to injury or illnesses. Water, oil, or other liquids that are not cleaned due to spillage can cause slips and falls. Hand trucks and other material handling equipments can also pose hazards to untrained employees – unbalanced loads or loads where they can't see ahead can be dangerous. Other than this, lifting loads that are too high or unbalanced creates a risk of back injuries, as well as the risk of tripping over or bumping into things.

Besides ergonomics factor, improper material storage may fall and injure warehouse workers. To counter this issue, workers need to be trained to stack loads evenly and straight, where heavier loads are placed on lower or middle shelves. Workers are also

reminded to remove one object at a time from shelves and always keep aisles and passageways clean and in good repair (OSHA pocket guide, 2004).

The Standard Operating Procedures (SOP) contains procedures for handling and controlling stocks. This affects the storage method and creates safety risks for the personnel working in the storage area. Stocks that arrive in the warehouse will be arranged according to its Standard Operating Procedures.

For example, based on warehouse SOP, stocks received from supplier will be put at the quarantine area (Figure 4.17) in order to allow the store personnel to inspect the specifications of the goods received against the purchase order. Inspections will reveal any damage or contamination or other matters to be further investigated by the management. In respect of stock arrangement in the warehouse, stocks are placed on metallic pallets in an upright position with the labels visible at all times and keeping them from moistures and termites. This ensures that the products are protected from damage.

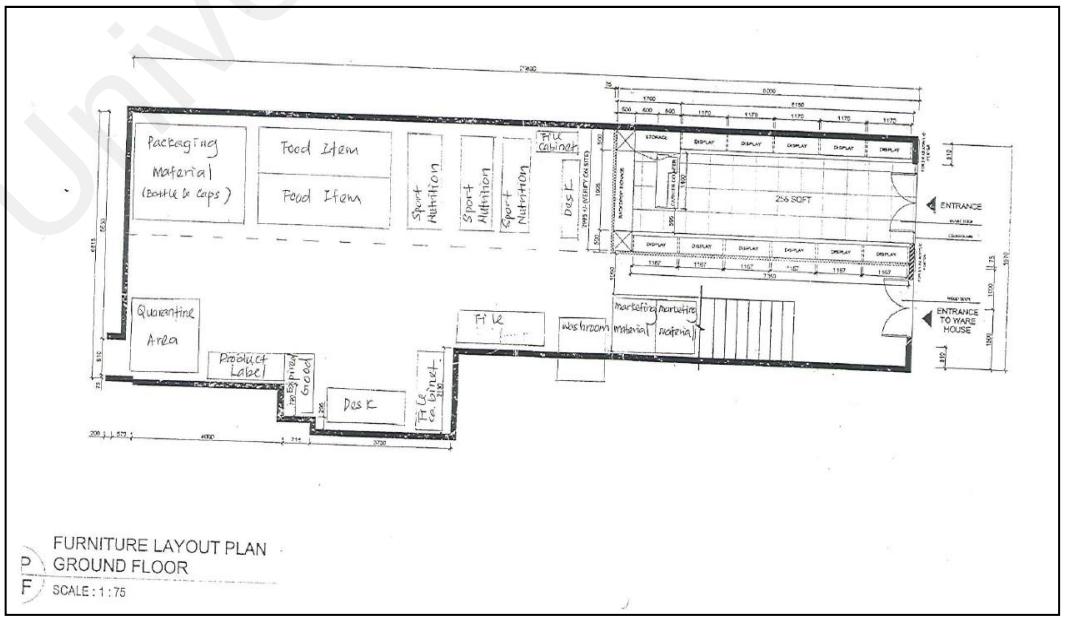


**Figure 4.17**: Warehouse layout plan – ground floor

However, the images in Figure 4.18-4.21 showed the actual positioning of the stocks in the warehouse. For example, in Figure 4.18, the walkway to the entrance of the warehouse showed limited space movements when stocks overflowed. When there are masses of stocks, the stocks allocated to other outlets are arranged along the walkway. This arrangement created a narrow walkway and the edges of the stocks may obstruct the pathways, and possibly cause personnel who are running in an emergency to trip and fall if they are unaware of the obstructions.


**Figure 4.18**: The walkway at the entrance of warehouse

In Figure 4.19, further into the warehouse, stocks can be seen stacking on top of one another on the floor. This is caused by lack of storage spaces and shelves for putting the boxes. However, these stocks are not piled up high to the ceiling. The labels are visible from the top and makes for easier identification when certain stocks are needed.


**Figure 4.19**: Indoor view of the warehouse

Figure 4.20 showed that there is not enough space to accommodate more stocks if there is a higher demand for the products. This situation occurs mostly during festive seasons or when the company launches nationwide sales. Although it is not a long term obstruction, the peak seasonal activities may also create hazards in the warehouse.


**Figure 4.20**: Stacking of stocks inside warehouse

Warehouse condition with respect of the stocks arrangement showed in Figure 4.21 and Figure 4.22 are cause for concern. They showed more stacking of stocks which are very near to the wall and ceiling. The obstruction is dangerous because the stocks are actually blocking the emergency exits at the back of the warehouse. Marketing materials such as cupboards, standees and boxes are piled up here because they are only used when it is needed, such as during road shows and nationwide sales.

It is clearly showed from Figure 4.21 that the emergency exit is blocked and possesses hazardous risk to the personnel who entered the warehouse or those who are checking the stocks, carrying out stock-takes, or arranging the stocks for a longer period of time there.

The stocks are also blocking another possible emergency exit (Figure 4.22), which is the sliding window. It blocks the sunlight and air circulation, which affects the indoor temperature. The forklift in Figure 4.21 may not even be useful in this kind of non-spacious condition.


**Figure 4.21**: Close view. Stocks had blocked the emergency outlet at the back of warehouse.

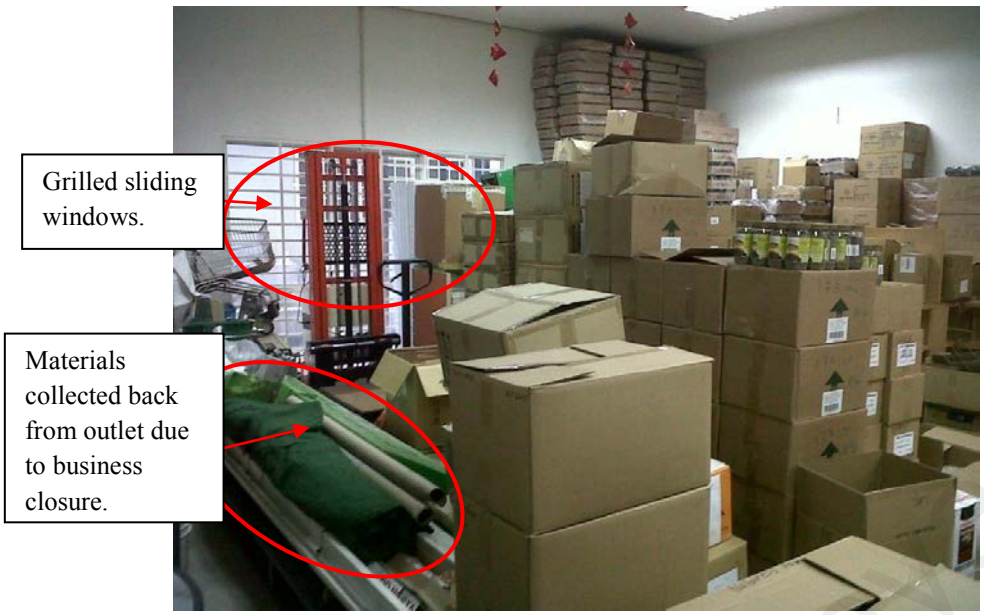


**Figure 4.22**: Blockage on another potential exit at the back of warehouse

The images from Figure 4.18 – 4.22 illustrate a type of storage arrangement which pose risks to the products and hazards to the workers working in there or entering and exiting the place. It is therefore important to identify these hazards and set out to minimise and remove the risks posed to the workers.

## 4.3 Integration of health and safety concern in warehouse design

Warehouse in this study is located at one of Jaya One's shop lots, with the size of 1,226 square feet. The warehouse consists of two parts, one is ground floor and second part is the mezzanine floor where supplements are stored. According to the Warehouse Safety Guide, warehouse design is an important aspect in preventing prospective health and safety issues from arising and is influenced by a number of factors.

### 4.3.1 Warehouse size and shape

One of the factors influencing warehouse design is taking into account the shape and size of the warehouse to the types and nature of the stocks to be stored in the warehouse. This would mean understanding the products and purpose of use of the warehouse so that it is suitable for the products.

For example, storing food (raw and pure honey) and retail merchandises (clothing materials) requires different types of storing conditions and the design, layout and an arrangement of the warehouse varies. Even safety measures differ to varying degrees, depending on the types and nature of products. Food products might require wider walkway or entrance to cater for stocks arrival.

### 4.3.2 Warehouse loading area

Besides that, the loading area and subsequent handling of goods will also affect the warehouse design, particularly the width or types of bays to be built in the warehouse in order to accommodate for receiving of goods from suppliers.

### 4.3.3 Compliance to laws and regulations

Other factors include complying with the laws, regulations or guidelines specified by the local authorities at that time. Permissions may need to be sought if a major alteration to the design of the warehouse is proposed. This is particularly true for the storage of hazardous or combustible materials such as fuel or liquids. Extra precautions are required to minimise the occupational health and safety risks. Apart from that, the warehouse must be easily visible, accessed and identified so that products can be loaded, unloaded or stored. Most importantly, there must be left some free spaces between the products and the ceiling of the warehouse (Mapfre, 2008).

### 4.3.4 Warehouse capacity and potential hazards

While the layout, design and arrangement of the warehouse is an important factor to the health and safety of the workers, another vital consideration is the amount of load that the warehouse needs to store and accommodate. This could range from taking into account the quantity, heating value (for example in the case of combustible materials), and the nature of the stocks stored. As mentioned above, the nature and types of products stored in the warehouse requires different health and safety accommodations.

The heating value is important because it affects the fire spread rate in the event of emergency. In general, fire inspections are looking for housekeeping-type hazards such as blocked exits, blocked aisles, damaged sprinkler systems, missing or neglected fire extinguishers and exit lights, accumulations of flammable debris, or misuse of electrical equipment such as extension cords (Piasecki, 2000).

Combustible and clothing materials may more easily catch fire compared to more stable products, such as in the case of the Nature's Farm products, where items stored are health supplements and pills. However, this does not mean that the products will not catch fire easily, because as seen from the images above, those supplementary health products are stored in paper boxes and cartons, which are liable to catching fire in the event of a fire spread.

Other marketing materials stored together with the products may also add to fire risks or any other risks. In addition, the supplements are packaged in plastic bottles which may lead to the melting and adding fuel to the burning once it catches fire. Plastic content is the single storage characteristic most likely to contribute to a class IV or Class V high-hazard commodity classification (Piasecki, 2000).

### 4.3.5 Warehouse location

The location of the warehouse can affect the safety of the products stored in it. If the warehouse is located in a high-hazard risk premises, then it would face a higher risk for damage arising from fire or explosion.

Warehouse in this study is located in one of the Jaya One commercial shop lots. One suggestion to resolve the risks of fire arising from the types of load is maintaining good housekeeping practices at the warehouse. This means that products that are considered as posing risks to damage by creating excessive smokes or fumes when burned should be segregated from easily combustible products. This also includes a clear path to exits such as windows or stairs.

Apart from maintaining space between the products and the ceiling, space must also be created between the products and the walls. The same goes to the space between roof trusses and automatic sprinklers. Figure 4.23 demonstrated the condition where fire will be one of the hazards due to the arrangement of stocks which stacked up near to ceiling and automatic sprinkler.

**Figure 4.23**: Products are stacked up high close to the ceiling which possesses risk.

### 4.3.6 Fire risks in warehouse

Other long term options to prevent occupational health and safety hazards arising from fire risks are frequent maintenance of fire protection equipments. Proper training involving both the personnel familiar in fire equipment and employees can go a long way in ensuring these equipments can be utilised in times of need. It is beneficial for warehouse workers to become familiar with the safety procedures in controlling or managing hazards arising from fires in a warehouse situation.

Importantly, fire can be contained more easily when it is first discovered, therefore, detecting the fire at the first instance and learning to control them so that it does not spread to other places. Ensuring that the warehouse workers know what to do in a fire situation or the procedures is equally important. For example fire drills could be good practice to detect the flaws or to improve the existing emergency plans which can be rolled out in real emergencies.

Warehouses are the main aspect of the retail industry and keeping them fire risk free is essential to the continuity of the business. Any losses suffered will impact upon the business' credibility and supply of products to the customers. As a result of these special factors, warehouse should be kept risk free, especially damage from fire. Some businesses would put in extra precautions in terms of fire safety that may be well above the requirements of the law. This makes for good business sense, as well as from the health and safety perspective.

### 4.3.7 Other risks possess in warehouse

Other than risks from fire, environmental damage and thefts should be taken into consideration. The management should put more emphasis on dealing with the implementation of health and safety policies and ensure that the employees are involved to make things work. Otherwise, the policies will just remain as policies without being put to good use.

## 4.4 Implementation and execution of safety policies in warehouse

Besides ensuring that there are health and policy statements prepared by the management and employers as required by the law, a crucial aspect is in the implementation and execution of these health and safety policies in the workplace.

For example, in the case of the Standard Operating Procedures of warehouse, the procedures set out the health and safety standards that ought to be complied with. However, the analysis showed some discrepancies in the execution of these standards. Although the results discussed here are limited to the thermal comfort and effect on the products and the warehouse workers, it still shows some weaknesses in the implementation of the standards.

The temperature of the warehouse must be maintained within a range but in some circumstances the temperature exceeded the range specified in the Standard Operating Procedure. Although there are external factors that may influence the temperature fluctuations, it is in fact vital that the temperature be maintained to preserve product freshness. Realising the importance of compliance with the standards to the overall warehouse health and safety and the impact on product freshness, supervisors and the management play a key role in ensuring implementation of the standards.

### 4.4.1 Key role players in implementation of policies

In achieving warehouse safety, the management and the supervisors have key roles to play. Supervisors occupy a pivotal role because he or she is the person who can immediately take action or direct any plans to be carried out to effect a safe working environment (Geigle Safety Group, 2013). This means that supervisors function as the manager, not only for the workers, but also responsible for the overall working environment, the machineries function (in the case of the warehouse) and other related matters on a day-to-day basis. In this sense, it is thus pertinent that the supervisors understand their authorities and roles that they have to play to ensure a hazard-less working environment, particularly utilising their managerial and leadership skills in implementing health and safety policies.

### 4.4.2 Qualities of Key role players

What then are the qualities of an effective supervisor or manager? The OSHA Academy Course stipulates five characteristics of safety supervision and leadership of supervisors (Geigle Safety Group, 2013). The first involves supervision, meaning keeping an eye out on the work that are being carried out and ensuring that the workers are free from harm and danger. The second involves training the workers on health and safety education. The third requires accountability on the part of the employees where supervisors are resolute in ensuring that workers are aware of the company health and safety policies and at the same time conforming to these policies.

The next concerns the provision of the necessary resources for workers to work safely. An example is installing safety equipments at the warehouse or workplace, and providing protective gears and truck lifts, pallets and other materials for the safe handling of stocks to the workers.

Last but not least, supervisors and managers can create a supportive working environment to the workers in terms of workload arrangement, recognition or other related matters so that workers are not working under extra pressures. These five characteristics of supervision and leadership appear to go a long way to ensuring a productive working environment for the workers, while keeping health and safety issues in check. Workers tend to follow the leadership of the management and when done effectively, can create a health and safety conscious working culture. In this respect, accidents at workplace can be greatly reduced, making the workplace a viable place to work in.

### 4.4.3 Responsibilities of stakeholder - Employers

The US 1970 Occupational Safety and Health Act stipulates various employer responsibilities, ranging from providing hazard-free workplaces to monitoring the hazards that could not be eliminated altogether and ensuring compliance with the law (Geigle Safety Group, 2013).

Employers are also required to maintain safe equipments for the employees' use and constantly supervise and update the standard safety operating procedures. These procedures should then be made known to the employees, and communicated to them, ensuring that they are aware of the risks and safety procedures in place. Employers are responsible for reporting any incidents at workplaces to the OSHA office. Employees' medical records are to be made available to the employees and any authorised officers.

Employers thus play an important role throughout the process of establishing, complying with, implementing, monitoring and reporting occupational health and safety procedures. Inspections can be carried out by a general walkabout in the work places.

This is because the safety committee may not be able to pick out the hazards and these employer inspections can help to resolve this oversight. Inspections can be made according to five categories – materials, equipment, environment, people and systems. These categories will help employers who appoint supervisors to oversee health and safety procedures identify the hazards in an organised way. While this could be helpful, it has a disadvantage – there may be hazards that are not covered under these categories and thus will be overlooked.

Apart from the walkabout inspections, employers can review any occupational risks through a job hazard analysis. This is more detailed than the walkabout inspection as it requires both the employers and employees to analyse every step involved in the work and improve it to make it safer for the employees. This hazard analysis is potentially useful as preventive measures in preventing occupational hazards.

Another aspect is on the higher level of control, which controls the exposure to the occupational hazards. This level consists of eliminating and substituting hazards, utilising administrative and engineering controls as well as using protective equipments. The first two controls are more effective because of its preventive nature. Engineering controls, particularly, physically protects the employees from risks such as fire exits, barriers and alarms. Investing in engineering controls may be costly in the beginning but this will be overcome in the longer term as operating costs becomes lower (Geigle Safety Group, 2013).

Another measure that the employers can utilise is improving the systems of safety management. This will uncover the ineffectiveness of existing safety management and give the employers a chance to review the safety and health policies, identify the

weaknesses of any particular department and the changes to be made to the higher management level or leadership style. This goes towards understanding behaviours and attitudes towards managing safety at the workplace.

A related measure is the provision of safety training. While this has been mentioned before, its importance cannot be underestimated. Safety training incorporates the important elements of education, skills, attitude, knowledge, training and experience. Safety training equips workers with the knowledge of safety measures in the workplace and making them aware of why it is vital to be safe in the workplace. Such training not only educates workers but goes towards changing the attitudes towards safety and health and consequently, their behaviours at workplace. Workers will then understand the consequences and importance of safety training and compliance will follow.

### 4.4.4 Responsibilities of stakeholder – Employees

Employees on the other hand are responsible for several aspects under the US law. They must abide by the occupational safety and health standards, including the rules, regulations and orders issued under the law. However, only where the employer makes the employee accountable to complying with the law, the employee does not incur any penalty for non-compliance with the standards. One way of overcoming this difficulty is by making employees comply with the company's policy rather than complying with the law. This will have the effect of making the employees comply with the standards because of the company's concern for the employees' safety and wellbeing rather than merely complying with the requirements of the law.

Employees can contribute to the inspections of hazards identification by adding to the categories in their area of work as they are more familiar with the daily operations of the work and the risks that are involved. Such inspections should also become a frequent activity, so that it becomes part of the culture of the workplace.

It is interesting to understand why employees do not find it necessary to comply with the safety and health laws at the workplace. According to Ferdinand F. Fournies, the main reason employees failed to comply with the safety and health laws is because they are ignorant about the reason for complying. Thus education and safety training becomes important to address this ignorance. The management and supervisors thus play vital roles in ensuring workers' awareness of the law and the importance of these laws.

Safety training should happen when a worker commence work at the workplace and subsequently at other suitable times throughout the employment. Therefore, demonstrations, retraining and certification of safety training is a frequent occurrence at workplaces. Workers who have had experience in other workplaces should also be educated and trained about the new standards that are applicable to them, which may be different from their previous workplaces. Training topics can broadly include general safety rules and policies that are specific to the type of work the employee is hired to do.

### 4.4.5 Responsibilities of stakeholders – Employers and Employees

Eventually, supervision is the main ingredient in safety supervision. They are the ones who are tasked with the overall oversight of safety and health at the workplace. In a large organisation, delegation is a usual practice, with the delegated staff reporting to the supervisors on agreed times.

Safety leadership then becomes important, and it is recommended that a 'tough caring' style of leadership produces better supervision outcomes. For example, recognising that the management is responsible for decision-making which steers the production processes, workers are not naturally lazy, but shaped by their previous experiences and if properly stimulated are able to direct their behaviour, workers seek job safety and security as well as recognition, and the management then is responsible for providing such recognition where due and to realise their potential.

Communications from both employers and employees are essential here. The management needs to ensure a safe working environment that achieves their company's goals and therefore, a 'tough caring' leadership approach helps towards producing a healthy and safe working environment. Disciplinary actions can be meted out to employees, but only after the supervisors have accounted for it themselves. This will produce a justifiable outcome.

# CHAPTER 5

# CONCLUSION AND RECOMMENDATIONS

## 5.1 Conclusion

There are several conclusions from this study. The conditions of the warehouse posed a number of health and safety risks to warehouse personnel, workers and others who, either need to enter the warehouse or working for a long period of time in the warehouse. These health and safety risks potentially have long term side effects on the productivity of the workers, such as workers taking medical leave due to the health hazards they encountered at the warehouse. Apart from addressing the needs to minimise the health and safety risks in the warehouse, the management levels are required to make some changes to the way health and safety risks are monitored. This will include training new and existing warehouse supervisors about storage arrangement that will minimise health and safety risks the most so that workers can work in a safer warehouse.

### 5.1.1 A safe and comfortable working environment is important

The research shows the importance of maintaining a safe and optimum temperature working environment in a warehouse. Readings of temperature concluded that the thermal comfort level is at manageable stage. Health and safety issues are important because warehouse poses dangers if people do not work safely or do not follow the safety procedures in place (Inglis, 2008). Being safe enabled a safe working environment for everyone, including the customers, and the running of the warehouse can flow without interruptions.

### 5.1.2 Hazards identification and impact on daily operations

Improper carton stacking and stocks arrangement which blocked the exit of warehouse had poses hazards to the workers. The next thing is recognising potential tripping and slipping hazards. For example, loose cords that are lying on the floor or dangling from the walls should be taped securely. Prompt procedures should also be installed to deal with spills of liquid or chemicals in the warehouse. Other important considerations include the operation of machineries and equipment that are installed in the warehouse. Warehouse workers should receive appropriate training prior to using the machineries and equipment (such as forklifts, or pallet trucks) to avoid unnecessary health and safety hazards, both to the workers operating them and the people around.

### 5.1.3 Assessment on Standard Operating Procedure

Having investigated the standard operating procedures and analysing the data available, it appears that there seems to be no complaints from customers, owing to the lack of data in this aspect regarding the quality of the products. There does not appear to be any major grievances from the working staff. From this information, it can be said to imply that the products and the working environment in the warehouse is effective in influencing good management. This shows that the company was able to keep the registered products in good condition most crucially the temperature and thus able to keep the customers happy. However, it may be possible that the warehouse workers did not file any official or formal complaints to the employer and all seems well. It is also possible that returns and refunds of products are the normal operating routines that happen in the retail industry and thus not treated as part of the warehouse health and safety issue.

## 5.2 Recommendations

### 5.2.1 Training for warehouse personnel and employees

Training workers about the importance of health and safety at work is essential in reducing occupational health and safety risks. For example, making a clear path for the movement of goods prevents workers from tripping or slipping while carrying the goods. Besides that, the amount of load being carried each time is an important consideration. Distribute the weight evenly and keep the heavier load closer to the body.

There are various trainings that can be adapted to different workers working in the warehouse or those who need to use the warehouse. For example, the training programme can aim at various levels of warehouse workers; sales clerks, product receivers, storage and arrangement workers and lift truck operators (St-Vincent et. al., 2008). For sales clerk handling containers, they should be trained to understand the two main physical characteristics of handling related risk factors – volume and weight, and packaging. Containers which are large and heavy increase accident risks because of risks of collisions, and require extra muscular exertion to move around.

One way of resolving is to store these bulky containers at a lower height or on the floor. Another option is to store these containers near their display product so as to limit their movement during stocking time. When moving these containers, adapted handling and lifting equipment would be necessary. In respect of packaging, elastic packaging may cause musculoskeletal disorder in workers who tried to recover it, a way to overcome such packaging is to buttress the container so that it becomes less pliable to be carried or moved around. The other alternative is to modify containers in advance after discussion with suppliers to increase the stability of such containers (St-Vincent et. al., 2008).

For warehouse which often housed bulky containers or storage, training can be delivered to the workers on how to properly handle such containers in a safe way so as to minimise health and safety hazards. Warehouses are usually limited in physical movements due to the storage arrangement and the nature of use. Shelves, the presence of lift trucks or pallets add to the limited accessibility, making such confined spaces a risk in creating injuries when workers react during any incidents. There are several recommendations to overcome these hazards due to limited space, workers are encouraged to handle these containers at the same placement height, moving pallets into a wider space for further handling (St-Vincent et. al., 2008).

Stock management is another important area of training. Managing stocks efficiently potentially reduced the risks in health and safety. Warehouse workers can stock the containers according to their sizes, which will increase the stability. Receivers who deal with receipt of products can do their part in managing stocks after being trained in space management and that they progressively transport the containers from a mixed pallet to an empty pallet. Lift truck drivers meanwhile, can remove the pallets immediately to storage spaces so that these pallets will not be lying around creating unnecessary space constraint and acting as obstacles. Step ladders must be hung after use to avoid any workers tripping over them (St-Vincent et. al., 2008).

### 5.2.2 Instil the Health and safety awareness among employees

Dangers that can arise from working in the warehouse include using various types of tools and equipments that require specialised skills and training. The type of health and safety training that would be useful for office workers and can be extended to the warehouse includes induction, skills and management training (DOSH, 1996). Induction enables new workers who had just recently joined the company to be familiar with the

basics such as the emergency exits, fire evacuation procedures and exits, office good housekeeping, as well as electricity and most crucially the safety and health policy.

Skills and management training provide workers and other office staffs with particular responsibilities pursuant to the health and safety policy which is suited according to the workers' competency. This means that different staffs and workers will have definite responsibilities such as carrying out manual handling training at specific times of the year, or carrying out office inspections or accident investigations.

At the management level, supervisors and managers are required to oversee, monitor and guide the workers as they carry out these trainings. In this sense, the managers need to explain to the workers an overview regarding the law on health and safety at workplace, as well as guidance for conducting risk assessment and safety management programmes (DOSH, 1996).

Health and safety training is not a new thing. It has been implemented in most of the developed working environment, and an accepted practice worldwide. Workers at the entry level positions are usually more vulnerable towards workplace injury (WorkSafeBC, 2008). Health and safety training should also cater for workers with disabilities. For example, special training programme for workers with disabilities are being carried out in British Columbia, Canada (Inglis, 2008). In a study published in 2006, there are about 33 per cent of workers with disabilities being employed (Wilson et. al., 2006) in Canada, with findings that people with disabilities are just as safe as usual workers, although they are frequently disregarded (Hawthorne, 2008).

Training for workers with disabilities requires a different type of method. The usual method such as lectures or presentation may not be as effective, therefore videos could be used to convey the message to them. Visual, or hands-on practical training will also suit them more, and accompanied by plain language so that they can understand the health and safety policies easily (Inglis, 2008).

In respect of health and safety policies training for workers working in warehouses, employers, and community based employment agencies agreed that there are several important learning areas for entry level workers working in warehouses (Inglis, 2008). One of them is generally understanding what the hazards that can be present in warehouses are and recognising the signs of these hazards. One of the ways is to recognise safety posters, as well as familiarising themselves with emergency procedures, and where the exits and emergency supplies are located. Knowing these vital signs allow for a more efficient handling of the exits during emergency times. Most importantly, keeping the aisles, walkways and emergency points clear can help keep the workplace safe. Knowing where the first aid kits are located and fire extinguishers help with emergency situations.

### 5.2.3 Application of Personal Protective Equipment (PPE) and tools in warehouse

Another main learning area is clothing. Working in the warehouse requires continuous or multiple movements, therefore well fitted clothes with proper protective gear are essential. Clothing which are oversized or saggy may get entangled with other products or racks and ladders in the warehouse. This also means that no jewellery is to be worn while working in the warehouse or operating any machinery. Apart from proper clothing, shoes are also vital to the safety of workers in the warehouse. Protective boots

or other protective gears such as goggles and visibility vests protects the workers and enable others to clearly identify the workers at work.

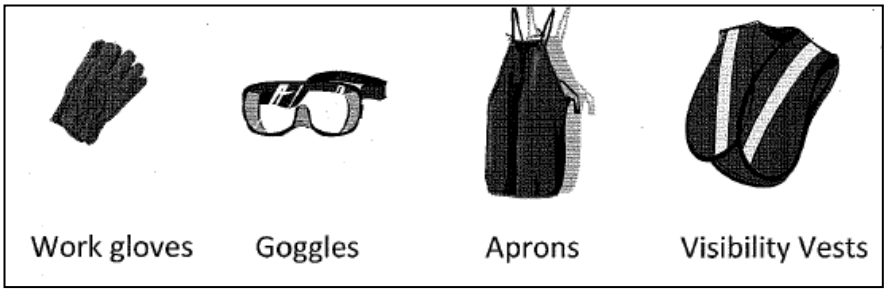


**Figure 5.1**: Personal Protective Equipment

### 5.2.4 Training on utilization of warehouse tools

Common tools found in warehouses should also be used properly to avoid injuries. One common injury that usually occurs among warehouse workers is lifting of heavy boxes. Workers ought to be trained to lift boxes with bended knees and straight back to avoid injuries to the back.

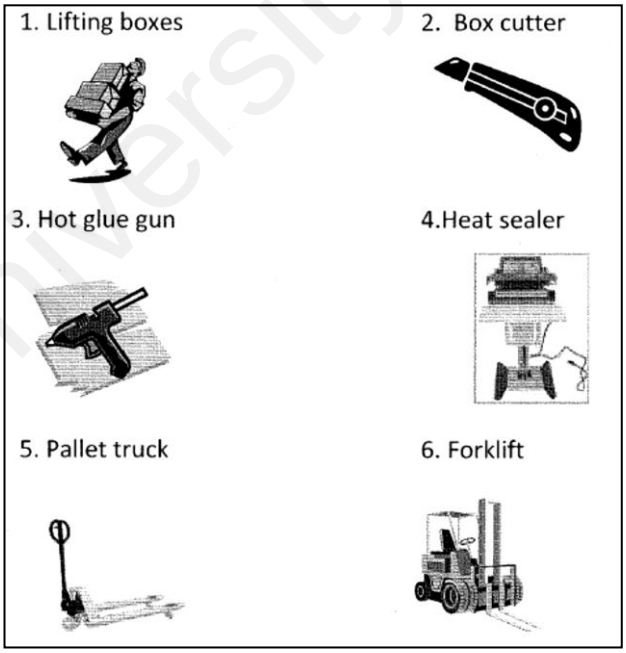


**Figure 5.2**: Common tools in warehouses

**Figure 5.3**: Hand truck for lifting purpose

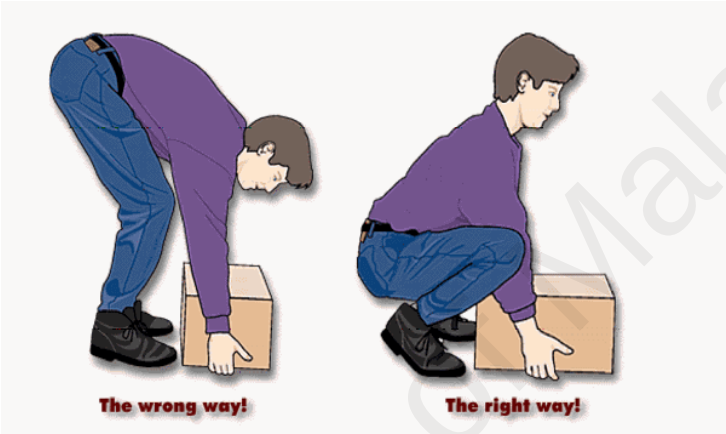


**Figure 5.4**: Correct postures while lifting heavy box

### 5.2.5 Stocks management to reduce hazards in warehouse

Another suggestion arising from the research regarding the air ventilation is repositioning of the stocks and installing an additional air conditioning system pertaining to the thermal calibration. The research shows that the positioning of the existing stocks in the warehouse as shown by the images constitutes an obstruction to the emergency exits. These obstructions also restrict the air flow circulation, making it rather unventilated to work for a longer period of time, especially during stock takes. Stocks are to be removed from the emergency exits. The images do not show the existence of fire extinguishers. Either they have been blocked from view or they are not installed as required. These could potentially be risky and hazardous when they are required and could not be accessed. Repositioning the stocks away from emergency

exits, windows (so that there will be more air ventilation) and making the fire extinguishers visible goes a long way in minimising health and safety risks.

Another challenge that the research uncovers from a study of the warehouse is the projected arrangement of stocks in the future. Based on the current positioning of the stocks and products, it is possible that there will be continuous stocks being arranged that way. The warehouse also housed additional stocks during peak seasons of the year, such as during promotion period, road shows and the festive seasons. The warehouse maybe overflowing with stocks during these period of time and may reach the maximum storing capacity. A suggestion to deal with this temporary overflow of stocks in the future is either to move these additional stocks to another storage place or to create a special section for storing them so that the stocks in other areas of the warehouse need not be moved or shuffled around.

It is understood that the current warehouse also store marketing and promotional materials such as flyers, banners and standees. These marketing materials should be cleared away and moved to another storage area so that the warehouse only stores boxes of products with similar sizes for easier handling. These will also eliminate the risks for occupational hazards arising from paper materials and standees.

There is evidence to support this suggestion. For example, it is suggested that stock management is closely connected to the amount of stock, its turnovers and storage space. The influx of stocks, including those that had recently arrived, and managing surplus of stocks influenced the workers and the company (St-Vincent et. al., 2008). Stock influx, as shown in the research at the warehouse requires workers to handle these goods in greater volume than usual. This may result in more frequent uncomfortable movements

by workers in receiving, scanning the goods, especially where several orders by the same or different suppliers arrive at the same time. Without an efficient system of receiving stocks and goods, there might be a backlog of stocks to be transferred from the receipt area and into the warehouse.

Managing the flow of stock arrival and loading onto the warehouse for storage or other areas, such as the display or sales area, is important to avoid obstruction in the warehouse. Products or stocks that are less in demand can be stocked elsewhere and the prime, easily accessible spots in the warehouse are set aside for best-selling or fast-moving stocks. The use of pallets to help workers move the stocks should be utilised more often, to avoid workers' injuries especially in the back. This suggestion has been discussed more fully above.

Recently arrived stocks waiting to be moved to the warehouse may also contribute to the distribution and positioning of stocks in the warehouse. These stocks may, on a temporary basis, be placed on the footpath, exits or piled on other stocks. These problems could be solved by assigning selected workers who would be responsible to ensure that stocks that have arrived recently are immediately moved to a designated area for further dealing, such as inventories and related matters. Forming up special groups of workers to attend to stocks that have recently arrived can ensure that these new stocks can be redirected to the selected areas in a better and faster way.

Surplus stocks can too contribute to congestion and disorganisation in the warehouse. Such disorganisation result in extra time in locating the particular stock, stocks may be inadvertently written off as they could not be found, or workers having to plough through the warehouse in order to find the specific stock. In locating these 'hidden'

stocks, workers may be exposed to other hazards such as stocks that have shifted and falling over due to instability and the products may be damaged.

One of the recommendations, as suggested earlier, is to store these excess stocks in other places or outside the store. This would require advance preparation, in discussing when these surplus stocks will be due and where to store them, including the receipt and storing process. The walking directions or pathways in the warehouse should also be modified to allow the storing of surplus stocks on a temporary basis. Workers need to be notified of the changes during these periods of time. Apart from manual stock identification, a computerised system can help towards quicker identification of the particular stocks (St-Vincent et. al., 2008).

### 5.2.6 Monitoring temperature in warehouse to achieve optimum thermal comfort

The third suggestion arising from observing the temperature in the warehouse is making physical changes to the temperature control, which then affects the relative humidity of the warehouse. The current temperature at the warehouse creates an impact on the thermal comfort of the warehouse workers and product freshness. Although the temperature is calibrated, their records show that they are on the high side, with some months exceeding 30$^{o}$C, although sometimes seasonal changes affect temperature fluctuations. It is recommended that the temperature range be reset to a narrower range.

According to the company's warehouse Standard Operating Procedure, the temperature range is between 15$^{o}$C to 30$^{o}$C. Taking into account the optimal thermal comfort and the impact of relative humidity in the warehouse on the products stored, the temperature range can be reduced to between 15$^{o}$C to 25$^{o}$C.

There are good reasons for this change in the temperature calibration. Firstly the optimum temperature for thermal comfort is between 18 to 26ºC. Secondly, Malaysia has introduced a new law which proposed that indoor temperature ought to be maintained at 24ºC, although for other economic reasons and not just because it is the optimal temperature for thermal comfort. This new law may be implemented soon, although it is uncertain when it will be enforced. According to the news report, government offices "have been ordered to set their air-conditioner temperature no lower than 24ºC to give nature a helping hand and to cut electricity bills" (Ahmad, 2011). The outcome is that 24ºC is a comfortable temperature suitable for the Malaysian climate.

There is reason to say that this proposed law is reasonable, because air conditioning is usually set at a temperature lower than 24ºC, resulting in the situation where office workers have to wear scarves, shawls or sweaters in a warm country such as Malaysia (Tenaga Nasional Berhad, 2016). It is suggested that a temperature range of 24 to 26ºC is comfortable for workers and optimum in electricity savings.

The effect of temperature on the thermal comfort of workers has some support in the literature. For example, it is suggested that a temperature range between 20 and 26ºC is the ideal temperature where most people function comfortably (DOSH, 1996). Malaysia, a country with warm weather on the high side exceeding 30ºC, usually utilise air conditioning in residential homes and in offices to regulate and maintain a comfortable temperature below 30ºC. Apart from the use of air conditioning, large windows, or glass partitions in high rise office buildings contribute to the heat getting into the buildings. This situation increased the temperatures and air conditioning would have to be adjusted to a lower temperature to offset the additional heat.

Compared to other countries where there are seasonal changes, for example in the UK, the UK legislation sets out specific requirements for a comfortable working environment in its Workplace (Health, Safety and Welfare) Regulations 1992. In respect of regulating temperature, the maximum or minimum temperature in place is dependent upon the types and function of that workplace. Temperature should be maintained at a range where no special clothing is required to be worn. The comfortable temperature for people working in 'workrooms' is 16ºC, but will be lower than 16ºC if more physical exertion is demanded for carrying out the work (HSE, 2013).

Controlling temperature by itself is insufficient to maintain a comfortable level of thermal comfort for workers working in a confined space. Other factors such as air circulation and relative humidity influenced the overall thermal comfort of workers (HSE, 2013). Measures to attain thermal comfort include shading windows, insulating hot pipes, sitting desks away from windows generating heat. Meanwhile in other examples, Canada's Ministry of Labour, Health and Safety established that workplaces such as factories, shops or offices are required to maintain a minimum temperature of 18ºC except for outdoor work or in freezers (Ontario, 2014). However other workplaces are free to set their own temperatures, as there are no minimum or maximum temperatures being imposed, although there must always be concerned with heat stress as one of the occupational hazards.

While temperature measurement can be measured and recorded physically, the changes in the relative humidity are more subtle. Temperature and relative humidity are closely related because they affect one another by changing the air saturation, water evaporation, air circulation and variation in air pressures (Valsson and Bharat, 2011), as illustrated in Figure 5.5. Air pressure differences due to air temperatures of different

locations, would in turn produce wind (air movement). Relative humidity indicates the percent of water vapour in the air, comparing to what would be present if it was saturated. It expresses the relationship in the level of saturation, of how close to be saturated. When the value of relative humidity is 100%, it means the air is fully saturated.

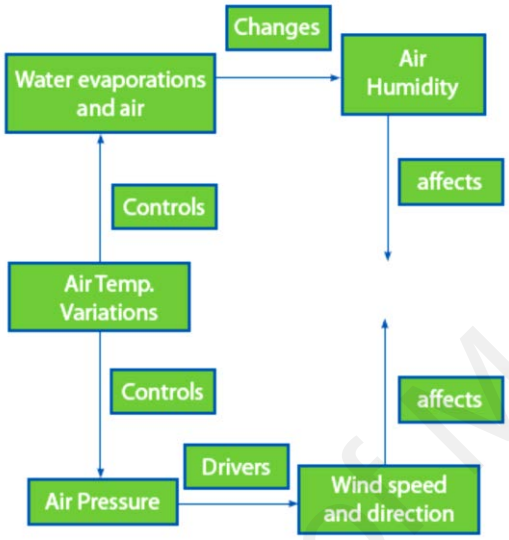


**Figure 5.5**: Climatic variables and their correlation (Valsson and Bharat, 2011)

Temperature and air pressure affects the relative humidity (The Rotronic Humidity Handbook, 2005). An example of office building shows that an office space which is heated by a heater does not affect the value of the partial pressure of water vapour, meaning the local vapour pressure remains the same in the building. The saturation vapour pressure on the contrary is increased causing the relative humidity in the close surrounding area of the heater is lowered.

Temperature and relative humidity has an inverse relationship (Figure 5.7). If temperature increases, relative humidity decreases. And if temperature decreases, relative humidity increases. Hygrothermograph in Figure 5.6 showed the trace of temperature and relative humidity relationship over a 24-hour period. From the graph it

showed that the highest values of relative humidity are seen in the early morning where the lowest temperature occurred. On the contrary, when the highest temperature occurred in the late afternoon, lowest values of relative humidity is observed (University Corporation for Atmospheric Research, 2008).

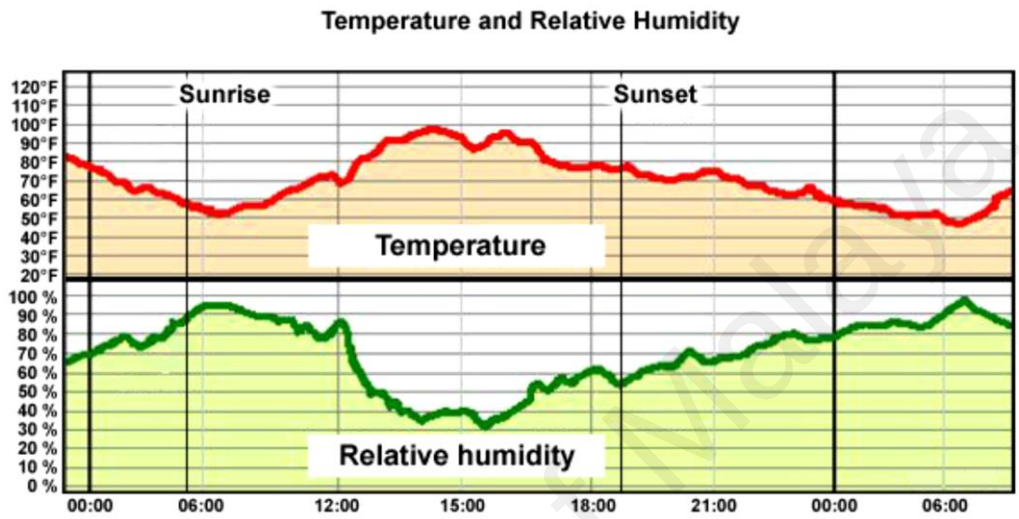


**Figure 5.6**: Hygrothermograph trace of temperature and relative humidity over a 24-hour period (University Corporation for Atmospheric Research, 2008).

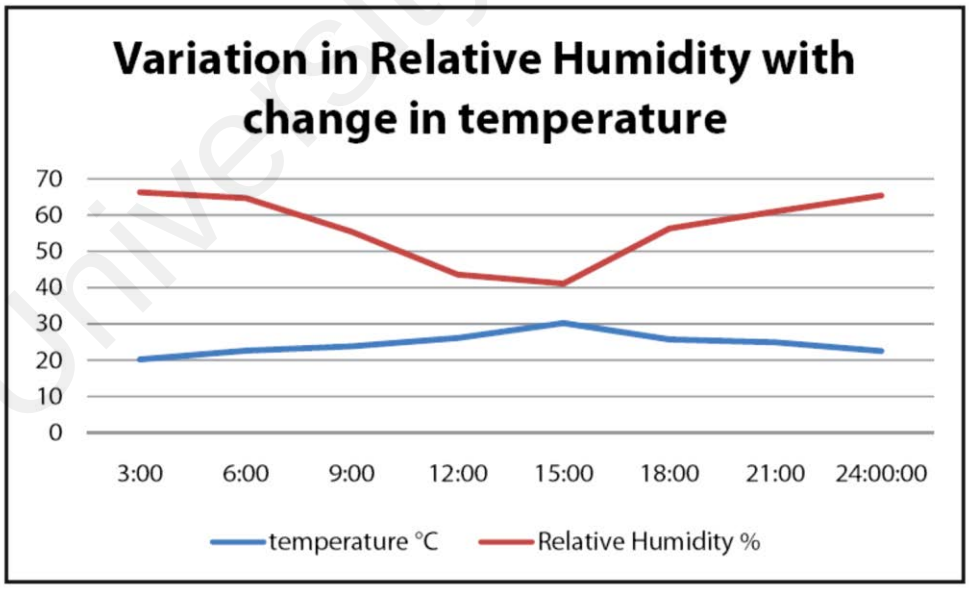


**Figure 5.7**: Variation in relative humidity with change in temperature (Valsson and Bharat, 2011)

### 5.2.7 Revision on current Standard Operating Procedure

The warehouse Standard Operating Procedures manual needs to be modified in the light of the proposed changes to the temperature calibration, and health and safety policies. The current practices, which are reflected in the graphs, showed that temperatures are monitored twice a day but it usually exceeds the 30$^{o}$C range as specified in the Standard Operating Procedures. New practices may be implemented to train supervisors in ensuring that temperatures are monitored more appropriately and up to the standard required.

A safety committee is important in ensuring actions are taken in terms of preventing injuries to workers. In the committee, a combination of staff from the management level and the labour workers can participate in providing support to the warehouse personnel. Sometimes, a consultant familiar in ergonomic issues can be requested to become a member to provide technical assistance. A safety committee plays the role of encouraging reporting of work related injuries which can help identify risks at work. This will then help towards resolving the issues at the management level by implementing various solutions at the workplace. If the new solutions are effective, those measures will then be implemented in the workplace and followed by a period of observation on the effectiveness (California Department of Health Services, 2001).

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