



MINISTRY OF TRANSPORT MALAYSIA
National Logistics Task Force



Guidebook to **Starting Warehousing Business in Malaysia**

A Practical Toolkit





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May 2021

Version 1.2.0

Published by
National Logistics Task Force (NLTF)

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Foreword

by Yang Berhormat Datuk Seri Ir. Dr. Wee Ka Siong

Minister of Transport Malaysia

The Ministry of Transport Malaysia (MOT) through the National Logistics Task Force (NLTF) and the relevant ministries, agencies, and departments have a long-term focus on strengthening the logistics sector given its importance to the Malaysian economy and workforce.

Warehousing being a major integral part of the logistics and supply chain, this Guidebook to Starting a Warehousing Business in Malaysia is a crucial starting point for those looking to contribute to the development and growth of this vital business sector.

This informative guidebook should serve as a reference to a range of regulations, specifications, performance criteria, and processes related to the development and management of a warehouse.

We must thank and extend our appreciation to all who have contributed to the substantial knowledge that went into this Guidebook, which should mark another milestone under the NLTF.



Message

by Yang Berbahagia Datuk Isham Bin Ishak

Secretary General, Ministry of Transport Malaysia

Transport and logistics involve a complex chain of activities from storage and warehousing to equipment maintenance. Creating efficient and effective warehousing and distribution systems is vital to supply chain management and the global economy.

This Guidebook is published after a series of workshops, roundtable, sessions and discussions with the relevant Ministries, Government Agencies, State Governments and State Agencies, as well as industry players. This initiative is one of the action items under the Cluster Working Group (CWG) for Institutional Mechanism and Regulatory Framework under the National Logistics Task Force (NLTF).

I hope parties interested in starting a warehousing business will use this Guidebook as a point of departure for planning and implementation. The Guidebook provides a comprehensive set of rules and regulations, standards, and procedures to build-up the warehousing business. Our purpose is to provide a framework to assist warehouse owners to understand the requirements of the authorities and their rights as well as for the authorities to promote the relevant process and procedures in warehouse set-up.

I believe that this Guidebook is proof to our commitment for betterment and will be the start of more initiatives in improving the warehousing business sector in Malaysia.



Foreword

by Yang Berbahagia Dato' Abdul Latif Hj. Abu Seman

Director General, Malaysia Productivity Corporation

I would like to congratulate and commend everyone who has contributed towards the successful publication of the Guidebook to Starting Warehousing Business in Malaysia: A Practical Toolkit. The Malaysia Productivity Corporation (MPC) is delighted to be part of the collaborative effort under the Cluster Working Group (CWG) for Institutional Mechanism and Regulatory Framework under the National Logistics Task Force (NLTF).

Starting a warehouse business and operating the business activity without clarity will not only affect compliance by both the authority and businesses but also increase cost of doing business, unnecessary burdens and high compliance costs. Hence this Guidebook serves as an essential toolkit in facilitating ease of doing business and raise the warehouse sector's overall standards.

Getting every new warehouse provider on the same page with warehouse operations and warehouse safety is the best way to optimise productivity. Better understanding of the stipulated requirements and procedures will ensure that the authority and business beneficiaries comply with good regulatory practices and best practices.

I believe this publication is an ideal guide and detailed reference book for anyone looking to gain a real insight into warehouse operations. Clear guidelines would greatly facilitate the establishment and maintenance of warehouses and operational processes will enhance the capabilities and business performance of the warehouse service providers to drive value added output and productivity to be regionally competitive.



Technical Terminology

Aisles	An aisle is, in general, a space for walking or working with rows of racks on both sides.	Carousels	Material Handling Equipment designed to bring product to picker so that the picker can remain stationed in a designated picking location without traveling. Ideally, order information is loaded or automatically transferred into the carousel system, and multiple orders are picked by multiple pickers at one time. Types of carousels include horizontal and vertical.
Apron	An area outside the dock door which is used by delivery vehicles to park or position for loading and unloading. The Apron is specifically designed to a depth that will allow trailer floors to fit with the warehouse floor in a way that facilitates loading and unloading.	CBM	Cubic meters, a unit of measurement for volume.
Bins	A four-sided structure that is mounted on a pallet. A bin may or may not have a cover. Or, an area in the warehouse used for storage of inventory that is being staged or at rest.	Conveyors	A conveyer that uses rollers to move product either by gravity or automation.
Buffer/ Accumulation Area	An area where goods or materials can be accumulated to meet the requirements of demands.	Dock Leveller	A plate at the dock door entrance that raised and lowered either manually or hydraulically to accommodate trailer floor heights.
Bulk Storage	Storage of large quantities of product in shipping containers. May also be the storage of product that is not packed (in loose form).	Elevation	The height from the opening floor of the warehouse to the lower point of the roofing structure. Sometimes, it is also known as the clear operating height of the warehouse.



FIFO	First-In, First Out. A concept where the retrieval of stored products are taken out in order of the oldest ones first and so on.	Manoeuvring areas	A location in the vicinity of a warehousing complex which allows arriving vehicles or containers to be interchanged or taking reverse positions to exit the vicinity.
Forklift	A warehouse vehicle, also called a lift truck, which is used for lifting and transporting pallets of product. A forklift may have a special attachment on the front for specialized handling of product.	Marshalling area	A location in the vicinity of a warehouse or a terminal or storage site where arriving vehicles or containers are reassembled and returned to the other warehouses or locations.
Floor Area Ratio	The floor area ratio (FAR) is the relationship between the total amount of usable floor area that a warehouse building has, or has been permitted for, and the total area of the land on which the warehouse building stands. This ratio is determined by dividing the total floor area of the warehouse building by the gross area of the land size.	Order Picking	A warehouse operation that involves picking individual items from cases and putting them together a carton or pack for shipment.
		Peak Flow Traffic	Maximum movement of traffic flow across the warehouse at any given time.
		Putaway	Movement of stock from the time it is unloaded to the time it is put in its final location.
Loading Dock	A loading dock or loading bay is an area of a warehouse where goods vehicles (usually road or rail) are loaded and unloaded.	Queueing	Queuing Theory: A short delivery cycle times from the time is ordered and delivered as to the requirements.
M2	Square meters, a unit of measurement for areas.	Racks	Metal framework in the warehouse used to store products several levels high.



Rate of Dilution	The rate of air exchange in an enclosed area with the fresh air from the exterior and is normally expressed in air changes per hour.	Storage areas	A specified area within a location for the storing of goods, materials or conveyance units.
Reach Truck	Is a narrow-aisle lift truck designed specifically for racked pallet storage. It consists of outriggers in front and telescoping forks that use a hydraulic scissors-type mechanism that allow you to pick up the load and retract it over the outriggers reducing the overall truck and load length, allowing operator to turn in a narrower aisle.	Storage Keeping Unit	A single unit of storage, which comprises of smaller items group together and placed onto the storage unit, like the pallet or container or bin.
Receiving Docks	See Loading Docks. Receiving Docks are specified docks for receiving purposes.	Swept Turning Circle	The turning radius of a vehicle is the radius of the smallest circular turn (i.e. U-turn) that the vehicle is capable of making.
Shipping Docks	See Loading Docks. Shipping Docks are specified docks for shipping purposes.	Trailers	An enclosed vehicle, towed by a truck, which is used for transporting product. There are a few different types of trailers. These include tractor trailers, semi-trailers, flat beds and reefers (refrigerated trailers).
Staging	A location for the purpose of building a buffer or accumulating goods or materials prior to the next movement.	Unloading Bay	See Loading Bay. Except it is for unloading.
Staking	A common method of storing on the floor, where one tier is placed on top of the other, e.g. pallet block staking.		

Acronyms

ACCCIM	Associated Chinese Chamber of Commerce and Industry Malaysia
AEC	ASEAN Economic Community
AFTA	ASEAN Free Trade Agreement
APEC	Asia-Pacific Economic Cooperation
ASEAN	Association of Southeast Asian Nations
ATIGA	ASEAN Trade in Goods Agreement
AWB	Air Waybill
B/L	Bill of Lading
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CPC	Container Packing Certificate
COO	Certificate of Origin
DOA	Department of Agriculture
DOE	Department of Environment
EU	European Union
FDI	Foreign Direct Investment
FMM	Federation of Malaysian Manufacturers
HBL	House Bill of Lading
HABW	House Air Waybill
IATA	International Air Transport Association
ICC	International Chamber of Commerce
ICAO	International Civil Aviation Organisation
ICT	Information and Communications Technology
ILO	International Labour Organization
ISO	International Standard Organisation
INCOTERM	International Commercial Terms (By ICC)
MATRADE	Malaysia External Trade Development Corporation
MICCI	Malaysian International Chamber of Commerce and Industry
MOA	Ministry of Agriculture & Agro-based Industry
MOF	Ministry of Finance
MOT	Ministry of Transport
MFN	Most Favoured Nations
MITI	Ministry of International Trade and Industry
NFPA	National Fire Protection Association, USA
NSW	National Single Window
OECD	Organisation for Economic Cooperation and Development
PKA	Port Klang Authority
PKFZ	Port Klang Free Zone
SME	Small and Medium Enterprise
SPS	Sanitary and Phyto-sanitary (certificate)
WCO	World Customs Organization
WTO	World Trade Organization



Objective

The purpose of this Guidebook is to provide those who are involved in or wishing to venture into warehousing services with the essential and relevant information that will assist them in understanding and participating effectively in the formulation of the various processes into their build-up of the warehousing business. It has been brought to the attention of various committees involved in transport facilitation that information relating to starting a proper warehousing business can only be found scattered in different documents or sites provided by the various ministries, departments, institutions and agencies, which are often unknown to those who are anxiously seeking them. As a result, it is often time consuming and it requires much effort to obtain the required information. This Guidebook attempts to gather the relevant information and assemble it together so that it becomes accessible in a convenient, handy and inexpensive toolkit. It is hoped that this Guidebook will facilitate those involved in providing warehousing services and also enabling more new entrepreneurs to effectively participate in this important sector of the economy.

Target of this Guidebook

Primarily, this Guidebook is targeted at those SMEs intending to enter into building-up a warehousing service providing business for the first time. It is assumed that this category of users knew very little about the various processes involved in the building up a warehousing service business. Therefore, the Guidebook is both

simple and practical, showing procedural steps involved with the different agencies required to have the various licenses and/or approvals granted. Additionally, the Guidebook provides definitions of warehousing terminologies commonly used in daily business communications which a warehousing service provider must be familiar with. It also provides information on the key players involved in the logistics and transportation segment of the business which a warehousing service provider may have to necessarily interact with during the course of their business transactions.

Introduction

The local government, either a town, city or district council, in many places is in charge of several duties, namely planning industrial areas or sites, encouraging their construction, development, management, maintenance and supervision. It also publishes rules, specifications, performance criteria and procedures pertaining to the construction, development, administration, operation and maintenance of these industrial sites or zones. In certain states, a development authority has taken over the roles of the town or district council. By virtue of the various rules and procedures, the conditions of designing buildings include the technical and environmental standards which also include, as well, conditions for security requirements. In the stipulations that the specified industrial zones or sites should be used for the purposes that they were built for, the authority must ensure



that the warehouse owners comply with all the pertaining technical, architectural, environmental and other standards, specifications and conditions, to preserve the environment and also to collaborate with the other relevant agencies in order to achieve such requirements.

In order to be able to implement all the required stipulations and standards, the National Logistics Task Force, headed by the Minister of Transport, deemed it important to develop a guidebook for warehouse entrepreneur on the building criteria and conditions, that aims at providing the appropriate guidelines on the required regulations, rules and conditions, including specifications and security requirements.

Disclaimer Statement

This Guidebook should be used only as a guide and in no way should be used as a substitute for any legal or regulatory advice. It is recommended that for clarification of any detailed information, users should contact with the relevant authority or organization involved in functions, processes or transactions of interest. It should be noted that the information contained in this Guidebook were obtained during the period of writing. Functions, systems, processes and procedures are dynamic and subject to changes from time to time, in order to align the with new policies, strategies and practices of the day. While the Guidebook may be revised periodically, the information contained herein may change before any updates can take place and it will be necessary to confirm the information herein stated with the relevant authority or organization, especially if the version being used has not been updated for some time. While every effort has been made to verify the accuracy of the information at the time of writing, the authors bear no legal responsibility or otherwise for the accuracy or content, as information are dynamic and subject to change from time to time.

This guide also aims to give a broader picture to all those who work with the authorities, as a way to introduce them to its conditions, specifications and procedures when applying for the various permits in the pursuit of constructing a warehouse. The guide also addresses all investors and investing offices that work with their consultants or their overseas branch offices in order to understand the stipulated requirements.

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1.

General Conditions for Building for Logistics Services Warehouses

1.1 Introduction

Guidelines and Updates

This guide is subjected to updates or additions that are required to be implemented, and that is adopted by the Authorities, thus becoming an integral part of the guide and shares the same objectivity. Readers should be reminded that this guide shall not be deemed absolutely complete and shall be taken as a general guide.

Applicability of this Guide

1. This guide is subject to all general legal and regulatory provisions and requirements that are implemented in Malaysia, as well as all international codes, references and agreements that Malaysia complies with.
2. The Building Codes, including international codes, references and agreements adopted by Malaysia includes the following:
 - a) Electrical Code: MS1979, Electrical Installations of Buildings – Code of Practice (minimum),
 - b) Energy Code: MS 1525, Code of Practice on Energy Efficiency for non-residential Buildings, UNDP Malaysia Building Sector Energy Efficiency Project, National Energy Policy (minimum),
 - c) Water & Sanitation: Water Services Industry Act 2006, National Water Services Commission Act for Peninsular Malaysia (not affecting East Malaysia), Sewerage Act 1994 (Affects both), and Water Forum, Ministry of Energy, Green Technology and Water (mandatory),
 - d) Mechanical System: MS 1460, MS 1918, MS IEC 60335 (minimum),
 - e) Indoor Air Quality: Code of Practice on IAQ, Department of Occupational Safety and Health (minimum),
 - f) Lighting: MS 1038, MS IEC 60364, MS 603, MS ISO 8995, MS 825, MS IEC 60335, MS 947 (minimum)
 - g) Security: No clear guidelines
 - h) Fire: Circular & Code issues by Fire Department
 - i) Structural: ICS D Section, MS 416, MS 977, MS IEC 8124, MS 544, MS 1294, MS 1057, MS 229, MS 1933, MS 1195, MS 1226, MS 1553, MS 1314, MS 1490 etc. (included in Building Code and mandatory),
 - j) Location, Siting & Zoning: 10th Malaysia Plan, Malaysia Economic Planning Unit, Town and Country Planning Act (mandatory but the enforcement is depends on situation),
 - k) Environment: Environmental Quality Act 1974-2011, Fisheries Act, Land Conservation Act, Local Government Act, National Forestry Act, National Park Act, Protection of Wildlife Act, Radioactive Substances Act, Water Enactment Act, Sarawak Biodiversity Center Ordinance, Sabah Biodiversity



Enactment, Sarawak Natural Resources and Environment Ordinance, Sabah Environmental Protection Enactment, Sabah Forest Enactment, Sarawak Forest Ordinance (mandatory),

- l) Safety: Department of Occupational Safety and Health's guidelines for public safety and health at construction sites, and code of practice for safe working in a confined space. Occupational Safety and Health Act 1994 (mandatory), and its related conditions and specifications are considered an integral part of this guide.

- 3. The latest Green Building Index (GBI) published by the Malaysian Green Building Confederation (MGBC) are considered an integral part of this guide, and are adopted when the related content is not included in this guide.
- 4. In case there is a contradiction between one of the guide's regulations and the codes, referential requirements, or it is impossible to reconcile between them in such a way as not to affect the specific conditions, the conditions as stipulated by the relevant authorities and agencies shall have the priority in implementation.

1.2 Duties of the Owner or Investor

- 1. Using this guide's regulations and conditions as a guide to compliance.
- 2. Respect the property rights of those who have adjacent facilities to your

project, irrespective whether material or moral in nature.

- 3. Collaboration with the adjacent project owners and commit to coordinate with them to repair any damages or deteriorations that may affect their buildings due to construction activities in the neighbouring building.
- 4. Prepare designs via an authorised consulting office in designing warehouses or architecture provided they meet the following conditions:
 - a) Sign the design drawings and seal them with their consultant's official seal.
 - b) Submit to the local authorities with the required number of copies of the drawings and its supporting documents.
- 5. Ensuring that compliance with work procedures and possession of necessary permits before launching any construction activities. No amendment to the original design is allowed after the permit is awarded unless amendments to the permit are approved by the authorities in order to take necessary measures during construction.

1.3 Duties of the Consulting Designer

- 1. The design of the warehouse shall be carried out in accordance to the international code of design, and the preparation of all necessary documents, including design drawings, technical specifications, quantities and other requirements.



2. The design activities should include the implementation of international environment standards such as ISO 14001:2015, and occupational health and safety standards such as OSHA 1994.
3. As the design is approved, no amendments to the approved design are allowed. In case of any modification during the implementation, it should be approved by the Authorities.
4. The designs and its technical standards and quantity lists should be reviewed for compliance with the conditions as stipulated by the Malaysian Building Codes, or international standards adopted by the approving authorities.
5. Coordinates with activities that deal with the exterior aspect of the project's work location.
6. Ensuring the activities are carried out in strict compliance with the norms and regulations that are used for construction sites.
7. Prepare regular reports on a monthly basis regarding the progress of the implementation of the warehouse's designs, confirming the compliance with the conditions and standards as stipulated by the authorities, to be sent to the owner or investor of the warehouse project on a monthly basis.

1.4 Duties of the Consulting Architect

1. Follow-up on activities carried out by the consulting designer of the warehouse during the implementation period.
2. Follow-up on activities carried out by the contractor during the construction period.
3. Follow-up on the implementation of the international environment standards on location such as ISO 14001:2015 and occupational health and safety standards such as OHSAS 1994.
4. Checking and verifying that the contractor clarifies all details of implementation, submits status reports and coordinating all activities during the implementation period.

1.5 Duties of the Contractor

1. Follow-up on activities in consultation with the consulting designer and architecture of the warehouse during the implementation period.
2. Constructing the warehouse in strict compliance with the design and the construction permit conditions.
3. Implementation of ISO 9001:2015.
4. Strict compliance with the technical standards and latest techniques in project implementation.
5. Ensuring that all devices and tools in the construction of the warehouse, whether they are security and fire-fighting equipment or electrical and mechanical devices, are in compliance with Factories & Machineries Act (FMA) 1967 requirements or international standards recognized, in case local standards are not available.



2.

Types of Warehouse and Storage Facility

2.1 What is a Warehouse?

Fundamentally, a warehouse is point of transfer where all goods are received and then despatched, as quickly, effectively and efficiently as possible. The basic processes of warehouse management have remained the same over time, where goods are receive into the warehouse, its orders processed & replenished and where some value-adding services are included and finally the goods are despatched for distribution to intermediate and final users. Advanced activities in warehouses tend to relate to the increased use of technology and automation, improved performance measurement and the effective management of resources. In its original context, warehouses processes are designed to support the role of the supply chain management, however with the introduction of new technology and equipment, warehouse processes have become more lean and friendly towards environment.

2.2 Classification of Warehouses

Generally, warehouses can be categorically divided into six types:

1. General warehouses,
2. Cold Storage warehouses,
3. Controlled humidity,
4. Flammable / Hazardous storehouses,
5. Shed storages and open storages.



General Warehouses

A general warehouse is designed to store pallets, bins and bulk for specific periods of time until they are merchandised. It operates as an independent facility with a room temperature of about 25~28 degrees, and includes receiving, shipping and loading spaces, as well as storage areas and the necessary aisles and spaces for offices and workers' services.



Figure 1 - General Warehouse

Cold Storage Warehouses

Cold storage warehouses are designed to maintain the quality, health and safety of perishable materials and products and general supply materials that require cold spaces for storage, with temperatures that vary between zero and 4 degrees for chilling, and zero and minus 16 degrees for freezing. In addition to general warehouses requirements, they include specific spaces for freezing and cooling, as well as equipment facilities and specific areas for mechanical equipment.



Figure 2 - Cold Storage Warehouses



Controlled Humidity

Controlled humidity warehouses resemble general ones in all aspects, except that they are constructed with steam insulating barriers. They contain control equipment in order to maintain a specific humidity level inside the building. The warehouse building can be separate or adjacent to a general warehouse.



Figure 3 - Controlled Humidity Warehouse

Controlled humidity warehouses are used to store merchandises and materials for many reasons, namely:

- a) Protecting technological materials and humidity sensitive materials against deterioration when storing them in general warehouses and preparing them for immediate use, upon releasing from the warehousing facilities.
- b) Reducing the initial conservation costs and the re-conservation costs that some products might need when storing them in general warehouses.
- c) Preserving materials placed in temporary storage until they are fixed, liquidated, conserved, re-conserved or assembled.
- d) Providing full protection for materials that are being treated for conservation

Flammable / Hazardous Storehouse.

Flammable / hazardous storehouses are different from general warehouses because of the dangerous aspect of the stored materials and the necessary measures taken to prevent, eliminate and extract gases and vapours that are generated by the storage of these materials, through appropriate ventilation, and according to the conditions for building warehouses and storing flammable / hazardous substances and the criteria and standards of the Fire Department and Department of Occupational Safety and Health. The substances



that are stored as part of this category of warehouses include poisons and some petroleum substances, oil and lubricants, chemical substances, acids, corrosive liquids and oxidizing substances, as well as other similar flammable and hazardous substances.



Figure 4 - Hazardous Warehouse

Shed Storage

It is a covered or semi-covered structure with no lateral or completely finished walls that may or may not, contain sprinklers and fire extinguishing alarm systems. This type of warehouses is usually used to store gas, petrol and oil cylinders, lubricants-filled cylinders, trucks, unpolished wood, as well as their construction material. It is noteworthy that shed storages that are used to store hazardous substances are subject to specific design requirements and conditions.



Figure 5 - Shed Storage Facilities



3.

General Principles for Planning Warehouse Buildings and Storage Facilities

3.1 Planning for Manpower and Area Requirements

1. The general principle to determine the size of manpower required in the warehouse would be dependent upon the type of activities and the level of automation and mechanisation and automation to be employed in the warehouse.
2. The general principle to identify land area requirements would depend on the following:
 - Fundamentally, the base dimensions of the land portion of the project, which includes the main warehousing building and its related services like loading and unloading, packaging, receiving, shipping, trucks interchanging areas, parking are for trucks and trailers, traffic movement areas, and traffic manoeuvring areas.
 - Secondly, the dimensions of the warehouse area depend on the type of storage methods to be deployed. The storage method may include using the loading rack patterns, the equipment and vehicles to be used in the material handling operations, taking into consideration of the main and auxiliary aisles between the rows, the number of required loading and unloading bays, shipping and receiving areas inside the

warehouse plus its cargo apron and aisles.

- Third, the dimensions of the area allocated for shed and or aisles storage would depend upon the occupancy rate of the warehouse and whilst leaving enough area for interim storage for unloading, loading, truck and trailer parking and cargo movements to store raw materials and final manufactured products.
- In general principles, there should be an optimized pattern of areas allocated for cargo storage, allocated aisles for traffic movements, for loading and unloading, staging & transfer, for general offices, for workers' services, for electrical feeding services and maintenance facilities. All such optimisation of area allocation shall depend upon the type of warehouse and its related activities to be built.

3.2 Planning for Warehouse Location

In the planning of a warehouse location, the following principles may be adopted as your guide in your initial designing process, though many other considerations may be involved in the decision-making:



Choice of Location

For best usage option of any chosen piece of land, it is always advisable to consult the land use map of the surrounding land areas adjacent to the propose warehouse site, taking into considerations of the regulations and conditions that has been incorporated into the land zoning scheme approved by the local government or development authority.

Special Provision for Fire Truck Movements

Besides the necessary areas for traffic and parking of trucks and trailers and the marshalling areas for the manoeuvring and circulation areas for trucks, special provision shall be taken into consideration for movements for fire trucks, for use for rapid movements and accessibility, in the case where such emergency situation warrants such needs.

Geographical Locations and Environmental and Nature

In the selection of a location for constructing a warehouse, environmental and natural factors surrounding the land portion should be taken into consideration. Such can be classified as followings:

- Newly zoned industrial areas: When selecting a location for a warehouse in a newly zoned industrial area, care should be taken on the solar radiation intensity which may generate high temperatures, water drainage in the location (floods) and dusty winds from the surrounding areas.
- Waterfront areas: The main considerations related to locating a warehouse in the waterfront areas are saltwater, salty humidity conditions, water splash, corrosive natural tendencies, deterioration caused by sea winds and high humidity.
- Rural areas: In most rural areas, where soil and other natural factors are usually not properly monitored, consideration must be given to water drainage depending on the location's topography, ensuring soil stability, and arranging the site location to adapt to the warehouse building's design and its related requirements, especially stable electricity feed and regular water supply.

Further to the approach on the principles for the planning of a warehouse location, the following factors should also be provided considerations:

Optimisation of Space Distribution in Location

- a) Determination of the loading bay areas should be placed in the best part of the selected location to achieve the maximum advantages towards operational efficiency:
- In order to achieve maximal effectiveness of entrance and exit of goods.
 - Providing the capacities for peak traffic movements and the types of trucks used in loading and unloading as well as transfer of goods.



- Providing maximum flexibility for any future changes due to circumstances at the chosen location.
 - Integrating between the design of the general location and the internal traffic movement provided areas on one hand, and the usages surrounding the location on the other hand.
 - The adoption of loading and unloading methods that may differ in accordance to the type of goods stored.
- b) Determination of the traffic movement flow pattern from the main entrance gate to the loading and unloading bays so that they can be either in one way or two ways traffic flows.

Determining Area Requirements for Traffic Flow

Factors for the determination of area requirements for the traffic flow of trucks and trailers inside the selected location:

- Ascertain the number of required loading bays for the warehouse.
- Ascertain the pattern of traffic flows (either one way or two ways).
- Ascertain the capability of using perpendicular exits or diagonal exits with optimal angle inside the warehouse location if perpendicular parking slots are not available.
- Ascertain the width of the loading bay dock.
- Ascertain the width of the warehouse apron.

- Ascertain the requirements for parking and waiting of trucks and trailers.

Directional Facing of Warehouse Building

Choosing the best directional positioning of the warehousing building would not only prevent the direct beaming of the sunlight into the openings of the warehouse but would also the best angle to allow breezes and winds into the building, both of these factors would permit the maximum compliance in the planning of the orientation of the warehouse building. The following principles should be used as a general guide:

- Take full advantage of the indirect sunlight, using the transversal north-south direction of the building, in designing a warehouse building that positively avoid the sun trajectory from the east-west direction.
- Using the capacity of a larger building to create a shading portion for another, in addition to providing shadings to walkways, either partially or completely.
- In achieving the "wind effect" by placing the warehousing building within the main direction of daily winds by erecting special wind barriers/structure as one of the possible solutions to protect against strong winds and yet harvesting the optimal winds.
- By placing the loading docks on the leeward side of the main wind direction.



Determining the Warehouse Structural Shape

In the determination for the type of shape for a warehouse building, the following considerations should be taken into account:

- A minimum travelling distance between active operational locations is best achieved in a square area, which when expanded further by one of the side into a rectangular shape in the future expansion of the warehouse not only increase the storage areas but also provide easy allocation of additional loading bays.
- Always avoid the use of irregular shapes such as "U-shaped" and "L-shaped".

Other Factors Affecting Traffic Flows

1. Flow of heavy trucks arriving and leaving the warehouse location
2. Flow of light trucks and trailers arriving and leaving the warehouse location
3. Flow of internal workers and visitors from external
4. Flow of cargo from external and adjacent warehouses
5. Internal movement of cargo inside the main storage areas: receiving of goods
6. Internal movement of cargo inside the main storage areas: shipping of goods
7. Internal movement and transfer of cargo between storage areas: transfer of goods.

3.3 Elements of Design for Warehouse Buildings

1. Generally, warehouse buildings shall have following elements in their design:
 - Areas for storage
 - Aisles for movement
 - Areas for staging
 - Areas for receiving and shipping
2. Areas for loading and unloading
3. Area for manoeuvring
4. Area for accumulation
5. Area for marshalling
6. Area for support services, such as:
 - receiving and shipping offices
 - administration, worker services and guard-house
 - entrance and exit gates
 - area for parking of trucks/trailers and private cars
 - area for facilities of truck and equipment maintenance

Types of Storage

There are four types of storage in which warehouses maybe designed to carry out their business activities, namely:

- 1) Storage for holding
This type of storage may include storage for raw materials or semi-finish and finished products, which are usually stored for a limited period of time.
- 2) Storage meant for transit
This type of storage is usually meant for a certain pattern of distribution system designed for specific purposes, which may concentrates on storing and distributing raw materials or finished products to specified manufacturers,



traders, or retailers. Such storage allows timely supply of goods or raw materials to the manufacturers, traders or retailers without having to carry heavy inventory.

3) Storage point for accumulation

In this category of storage type, warehouses can provide the necessary space to store goods or semi-finished components for a specific production procedure, involving deferred timing or different assemblers or manufacturers.

4) Repository Storage

This type of storage involving the warehouses to provide specific areas to storage finished products or parts of thereof, for a longer periods of time. This category is different as compared to the previous types, as this type is designed to provide maximum space for such storage in order to cater for the requirements that usually exceed the norms.

Elements of Storage

Storage and distribution spaces are the functional activities of warehouse and usually would occupy 70% to 80% of the total build-up area of the warehouse and remaining 20% to 30% for support services. The design for effective distribution of areas is by using Storage Unit approach as well as the size and type of material handling equipment used in the warehousing.

Fundamentally, there are three (3) categories of storage:

- Manually stored
- Storage using mechanical equipment
- Fully automated

Manual storage mainly involved providing adequate spaces and areas that would allow easy movement of workers.

Whilst designing for mechanised and fully automated storage, there is maximum usage of the space provided or available, including the usage of vertical space, in order to achieve economic efficiency for the warehouse.

The volumetric adoption of "CBM" is the fundamental business approach rather than the space adoption of "M2" in order to achieve maximum storage and reducing number of aisles. The efficiency is usually achieved using stacking onto storage equipment and the use of mechanical lifting equipment instead of using manually human labours.

Storage areas are generally occupied by the following elements:

- Pallet Racks, Bulk storage and Shelves or Bins
- Delivery and shipping area
- Staging area

Storage element types generally considered for warehouses are pallet racks and storage containers.

Pallets

Originally, pallets is a flat transport structure that supports goods in a stable manner which are lifted up and down by an mechanical lifting equipment, like a forklift, pallet jack or front loader. Pallet is the structural foundation of a unit load which permits easy handling and efficient storage capabilities. When goods are



placed on a pallet meant for transportation, it is usually secured with strapping and/or stretch wraps. Originally constructed with wooden materials, today, pallets come with different made of materials, such as plastics, paper-boards and sometimes of metal. For the ease of usage, pallets are standardised with specific dimensions and the most commonly used is 1 meter x 1.2 meters.

Racks

Racks are metal structures designed to store pallets. Racks are free-standing and when joined together, they usually form part of the structural system of racks. The structural system of racks would provide the design criteria for the use of mechanical and engineering equipment, specifically for the lifting and the automated handling.

When choosing the type of racks to be erected in a warehouse, the following considerations should be adhered to:

- Choosing the storing methods on the racks
- Weight limitation of each storage unit
- Ease of entering and exiting goods from storage areas
- Storage area available verses the expected volume of goods to be stored
- Volume of orders verses the speed required by receiving and shipping activities.

There are certain types of racks if activities involved staging or certain specific operations or purposes that may differ in respect of the volume and shape of the

material store. They may be the following types:

- Bins: For storing smaller items such as screws and electronic parts. Such storage maybe used for goods that come without item packaging or just in simple cardboard boxes. In the organising of such storage, separators are placed inside the bins creating the separation within its groups in order to achieve maximal use of the bins.
- Shelving: Common types that can be used to store containers and boxes as well as any irregular shapes.
- Carousels: In such storage, horizontal and vertical containers (of regular or irregular shapes) are linked together providing circular movements in either in a horizontal or vertical fashion. Such storage would enable the workers standing whilst the containers in the carousels would move towards them, easing the handling and picking of the required goods.

Lifting and Handling Systems

In the choice of design for warehouses, the selection of the lifting and handling equipment should be carefully considered taking into considerations of the following factors:

- The shape and weight of the storage units that needs to be lifted or moved
- The distance of movement required and the width of the aisles
- The characteristics of the materials handled, whether solid, liquid or gaseous





Typical example of a Racking System

- The degree of hazardousness of goods during the handling or movement

Lifting and handling systems can be of different types with its respective functional characteristics that can be used for the handling and transfer of storage units within a warehouse. These types can be generally categorised into:

- Manual type
- Mechanised or Automated type

Automated Storage

Different types of automated storage systems are available, where the storage can be partially or fully control by computerised systems for the rack stacking and order selection processes. In these automated type of storage, automation in the lifting techniques often form a greater part of the warehouse operations which requires specific dimensions for the aisles in-between the shelves.

Material Handling Equipment

Generally, there are two types of lifting and handling equipment that may vary according to the method of placing goods on shelves and respective storage units. Their usages are for two main reasons:

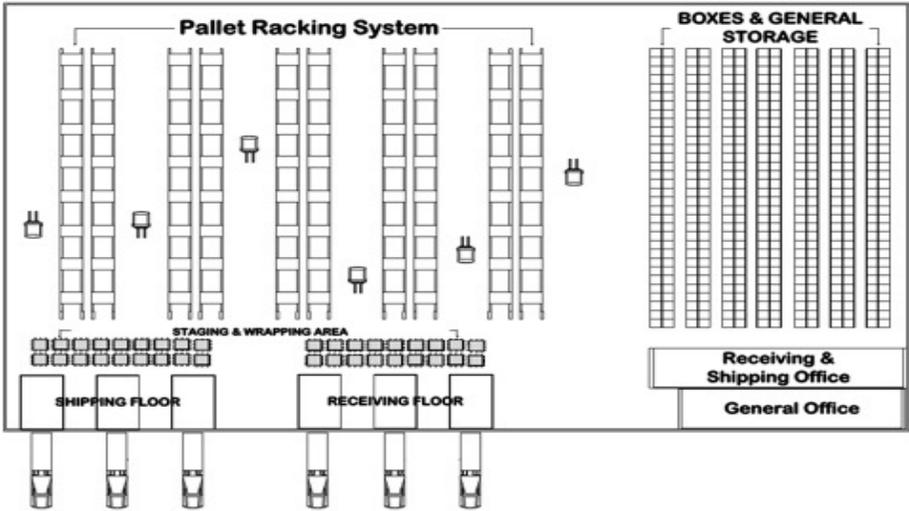
- stacking and
- order picking,

Of the two types, they may be manual, mechanised or automated.

Stacking Equipment

Stackers can be either of manual type, mechanised type or specially designed type for the transfer and storage of goods or materials. Forklift, a mechanised truck commonly used in warehouses, to lift, unload, stack and transfer of pallet or goods/materials.





An illustration showing elements of storage

Different types of forklifts are available in the market, like the gas-powered, electrical (battery) powered and the

pneumatic powered type. When designing for the warehouse working capabilities, it is necessary to determine the adequate number of such transfer equipment that would be used in the handling and transfer of goods and/or materials.

Order Picking Equipment

This type of equipment is specifically used to help in the picking of goods on a specific

order issued and transferring them to the packing area. This type of equipment can be manually operated (forklifts or vans) or of the mechanised and automated type designed to pick from a specific place or location.

Transport Systems

A transport system is designed for use within the warehouse to enable transporting of goods between two or more areas inside or outside the warehousing facility. This transport system is usually designed to transport standard packages like pallets or cartoons, where such system is usually of the mechanised and automated type.

Docks & Manoeuvring Areas

Docks & manoeuvring areas are considered complementary elements along with storage, receiving and shipping systems. In warehousing activities, the movement of goods starts at the receiving docks and finishes with the loading or shipping of the goods at the shipping docks.

Loading and Unloading Areas

Three main factors should be considered when designing for the loading and unloading areas:

1. The approaching pathway leading towards the storage location should ideally be separated from the main road with an entrance gate having sufficient width that permits smooth traffic flows.
2. The marshalling area, which is a buffering area, should be adequately provided for in ensuring the trucks having ample space while waiting before reaching the loading and unloading docks. This area is considered a vital area in which very often the loading/unloading docks are not sufficient to accommodate the arriving trucks, often the main cause of traffic congestion within the location leading to the loading/unloading docks. During the design stage, the following factors should be considered when determining the area requirements for the marshalling area within the warehouse location:
 - Considering the type and size of trucks and the anticipated numbers of trucks during its peak arrival and departure time of traffic flows.
 - Knowing that the movement of heavy (articulated) trucks taking wide space for movement when compared with smaller trucks, it would be prudent to separate the work areas for heavier trucks from smaller trucks and possibly to provide different traffic flows for each type of trucks.
 - Traffic surveillance of these areas by a specialized office alongside the guard-house.

- Queuing lanes should be clearly and visually marked whilst separating these lanes from manoeuvring areas, as heavier trucks require wider space to undertake its turnaround routines.
- The width of entrances and exits should be adequately designed to ensure smooth traffic flows. For more details, refer to Section 4 of this guidebook.

Loading and Unloading Docks

The efficient flow of goods in and out of the warehousing facilities is critical in the overall business activities.

Whilst the provisions for the usage of loading and unloading docks offer the outlets of goods to and fro the trucks, the design of these outlets, in terms of sufficient numbers, adequate space for the movement and parking of trucks at the bays would be dependent on the following factors:

- Considering the types of goods that need to be loaded/unloaded and the available time for arrival trucks to load and unload at these outlets.
- Considering the types of trucks that would be using these outlets, with trucks measuring between 6 meters to 16 meters in length.
- Considering the expected flows of goods at the aisles and the transfer areas.
- Expected growth of volume of goods to be handled in both, near and medium terms.



Supporting Areas

Besides the storage area, which is the main functional activity of the warehouse, there is a set of supporting areas which is functionally separated from the storage area and does not permit any direct entrance of workers to these areas. These areas are usually separated by fire insulating walls, in case of any hazardous or flammable incidences. Such supporting areas include the following functional workspaces.

Supervisory Office

Functional activities of certain workers, like the supervisors or work team leaders are usually provided with separate offices. Their location should be as near as possible to the relevant activity area and the design of such offices should comprise of work tables and file cabinets.

Receiving and Shipping Office

The receiving and shipping office, whose functionality is to secure an adequate area for the team of workers involved in receiving and shipping of goods, whilst a separate space is provided for truck drivers to relax while loading and unloading is undertaken by the warehouse workers, bearing in mind that the truck drivers should not be allowed to wander in the warehousing facility.

Packing/Packaging Areas

One of essential activity for warehousing is the provision of packing/packaging services which usually involved in the breaking and rebuilding of storage units involving smaller items of goods or

materials. Such activity usually would require an ample working space with table tops for the packing/packaging activity equipped with cardboard boxes, adhesive tapes, labels and a weighing scale.

Rest Areas for Workers and Employees

In order to create a good working environment, warehouse should provide areas for rest and recreational activity for its workers and employee, generally including a lounge, a restaurant with vending machines for drinks, locker rooms for changing of clothes/uniforms and prayer rooms for different faith. These requirements are determined in accordance to the expected number of workers and employees and its location should be closest to the workplace of workers and employees.

Parking for Private Cars

Daily movement of workers and employees into the warehouse with fixed schedule is deemed as a normal activity of a warehouse. They are seen to arrive and/or depart using either company vehicles or their own private cars. When designing a warehouse, care should be taken to consider the require number of parking lots in the vicinity of the warehouse for these private cars. Under provision of such requirements would result in having to use public road shoulders for parking of private cars.

When designing car parking lots, there should be adequate parking lots for workers and employees in the vicinity of the warehouse with the following considerations:



- As a good practice, the parking areas for private cars should be separated from the truck parking areas. This separation is necessary in order to guarantee general security to the employees and workers.
- For safety and security reasons, parking areas for private cars should always be separated from the operational areas of the warehouse specifically designed for delivery, shipping, marshalling and waiting activities.
- Any additional improvements that are needed to support the warehouse building, such as adding more parking areas for workers' private cars, expansion of the area for shipping and unloading operations, workplace for workers, and expansion of the general office, should be pre-check with the authority and the building owners or leaseholder.

3.4 Guidelines for Managing Land Usage

1. As a general rule of thumb, always commit yourselves to the allocated areas inside the approved perimeter of your land boundary.
2. Always conform yourselves to the conditions and restrictions that are attached to the contract of purchase, rental or lease to ensure that the owner or the leaseholder does not prematurely terminate their obligations. Legally, you should be guided by the conditions and restrictions on the following provisions:
 - The type of land uses (approved and/or prohibited by the authority)
 - Existing improvements undertaken to the land use must be pre-checked against the conditions and restrictions attached or approved for the development of the land, such as land occupancy, elevation, built-up area, fences, etc.
3. Always restraint yourselves to undertake modifications to the buildings without a prior authorisation from the Authority and the building owner or leaseholder.
4. Always limit yourselves on the usage of the building as determined by the contract of purchase, rental or lease agreement.
5. Restrict yourselves from using the setbacks (including back and lateral) for parking of trucks & private cars, storing of waste, damaged equipment or even placing air-conditioning chillers.
6. Never use the main roads as your marshalling or waiting areas for your incoming trucks.
7. For better facade management to be in line with local authority, preservation and maintenance of building outlook should be kept in good condition, including regular paint work.



4.

Guidelines for Building Warehouses in an Industrial or Zoned Area

4.1 Considerations for the Design of Warehouse Building Block

There are certain general considerations that can be used as a guide towards the designing of the block of logistics services and that can help to create a better working environment with positive impact on the warehouse building block, such as:

1. The general siting of the warehouse location and the warehouse building should be effectively be positioned so that there is no direct viewing of the service and maintenance areas of the warehousing. Such blockage of the direct view may not be possible at all times but by placing certain building blocks may help to do so in as much as possible.
2. All working areas that may be facing the main road or their adjacent properties may be covered with plants, trees or concrete walls which provide the direct blockage of the views.
3. Conducting a study in the location of the warehouse in respect of the traffic flows would help prevent any conflict with the existing traffic flows to and from the main road and its adjacent frontage.
4. Consideration to provide the necessary parking areas for trucks and trailers, including marshalling and waiting areas, within the location of the warehouse.

Considerations on Land Occupancy for Elements of the Building

1. Generally, consideration for the built up area of the warehouse should be between 50% and 60% of the land area approved and should never be below 50%.
2. The balance space reserved for traffic movements, setback areas, parking areas, landscape areas, loading and unloading areas should occupy between 40% and 50% of the approved land area.
3. As a rule of thumb, the floor area ratio (FAR) should never exceed 1.
4. Should the need to increase the floor area ratio to exceed 1, proper considerations should be placed upon the building structure, location, access to traffic flows and the type of cargo to be stored. Such considerations are also required by the authority when approving the permit allowing the construction of the warehouse.

Considerations for the Provisions of Setbacks

1. Generally, a certain allowance for the creation of the frontal setback (especially against the frontal road) should be between 20 to 30 meters, while the lateral is not lesser than 10 meters and back setback is not



below 6 m (including 1 m allocated for the site landscape and a sidewalk of 1 meter width around the building, except the loading and unloading docks.

2. Certain areas of the allowed setback maybe used for the electricity room, the standby generator, the guard room, car parking lots, and the fuel and gas tanks, with considerations of separations and safety walls.
3. Whilst using the frontal setback as parking areas for private cars, it is advisable to allow an additional setback of 6 meters from the frontal fence or wall.
4. When considering in using the lateral side of the warehouse for the loading and unloading bays for trucks, a minimum distance of 45 meter should be provided for, in additional to the setback mentioned above. For the creation of marshalling area for trucks, the distance of not lesser than 35 meters from the edge of the loading and unloading dock. In cases where the loading and unloading docks are placed diagonally at angle of 45 degrees to the lateral boundary of the warehouse building, a minimum of 25 meters be provided for, in addition of the 6 meters lateral setback mentioned above.

Considerations on the Elevation of Warehouse

1. Generally, the operating height of a general warehouse does not exceed 7.5 m from the operating floor to the lowest point of the ceiling structure. However, this height maybe be

further raised to accommodate the usage of storage system but there must be a minimum clearance of not lesser than 0.5 meter from the top of the storage system to the lowest point of the ceiling structure.

2. Depending upon the type of storage or racking systems used, elevations may vary accordingly. Such variation may be due to the type of material/ cargo to be stored, the storage technique or system employed.
3. In such special circumstances, which require the increasing of the elevation, it is always prudent to submit to the approving authority with supporting documentation (from the manufacturer or supplier of the storage system) for special approval before the commencement of construction of the warehouse.

Considerations for the Loading and Unloading Areas

1. It is always recommended that the locations of the loading and unloading area must always be distinctly identified in the master plan of the warehousing project.
2. Considerations must always be given to ensure easy traffic movements of cars and trucks within the warehouse vicinity and the maximum avoidance of any kind of obstacles that may hinder the passage for movements, bearing the considerations that the need to provide the proper space allowance for easy flows and manoeuvring of cars, trucks and trailers.



Considerations for Loading and Unloading Docks

1. One of the main elements in the start of and the ending of, any storage process is the usage of loading and unloading dock. Therefore, it is necessary, in the early design stage, to provide easy and safe movement passage for trucks, trailers and cargo vehicles, with sufficient flexibility provided as to the choice of their locations in order to meet the future requirements of the warehouse.
2. The design for the adequate number of loading docks with the correct dimensions, could determine the success factor of the warehouse work flow. The width of the loading docks could vary according to "angle of parking of trucks, the type of cargo handle, the method of loading used, and the handling tools and equipment used.
3. An internal aisle aligned to the loading dock of at least width of 4 meters. It is important to note that it is strictly prohibited to place or store cargo at the aisle. The aisle is allocated for entrance and exit from the loading dock area and the receiving area in the warehouse.
4. A buffer area should be organised for the delivery and shipping activities in the adjacent area to the movement aisle. This area is considered a collection point for goods that need to be shipped and also including activities that can be carried out there for the preparation, packing, collection, inspection of goods and reviewing before loading and shipping of the goods.
5. The efficiency of the activities in this area would very well dependent upon the optimal determination of space allocated, as this efficiency has obvious impact upon the delivery and shipping operations. Knowing that a smaller working area would lead to crowded loading docks, having lesser working space, and slowing down the loading and unloading activities. This would result in higher rate damaging of goods or even wrongly shipping of goods. Estimation of the optimum space for this working area in the warehouse would best by analysing previous records of delivery and shipping operations and its expected future growth movements.
6. Dock levellers should be provided for the loading and unloading area where there is a raised dock, height of which would vary according to the types of trucks and trailers using it. Generally, the height of the raised dock should be between 1 and 1.6 meters, provided that the height of the dock leveller height is not higher than the level of loading vehicle, to prevent forward sliding of goods into the vehicle and avoiding accident to those working inside the vehicle.
7. It is recommended that the dock leveller should not be raised exceeding 20 degree from horizontal and the lateral length provided may varies between 2 meters and 4.5 meters.
8. A dock shelter of no lesser than 6 meters from the ground level, should be provided along the apron of the loading and unloading area where a sufficient height should be



considered. The depth of the apron should not be lesser than 5 meters.

9. In between the loading docks, there should sufficient stairways for drivers and workers to use, when these people are required to access both the working areas and the dock aisles.

Considerations for Inclined Loading Docks

1. When designing for inclined loading docks, the width of the dock should not be lesser than 3.5 meters.
2. To facilitate the movement of the truck and trailer, a required distance of no lesser than 20 meters from the edge of the loading docks. A 25 meter distance is highly recommended if there is no aisle provided for the truck passage.

4.2 Considerations for Building Design

General Guidelines

Generally, having architectural design criteria for warehouse building is to achieve the 2 main objectives:

- a) to ensure homogeneous space with a designated functionality
- b) to ensure the building having visual outlook that it reflects the functionality of a warehouse.

The following factors should be taking into account in the designing process:

1. Chosen design should be simple but with modern architectural patterns, incorporating adequate architectural materials.
2. Ensuring that the elevations of warehouse buildings and its neighbouring buildings should be homogeneous and gradual in nature.
3. Preferably, use pre-fabricated steel structures that are engineering calculated with architecturally selected materials which are lighter than the regular steel buildings, and can be easily modified and added. Such approach is preferable due to its accuracy in calculation of the expected weights on the building columns and other structures.



A typical dock leveller

4. Due to over-emphasis on the economic consideration on the use of steel buildings and its structural cost, there is tendency to overlook on the aesthetic aspect of the warehousing building. Consider the following factors to help in the improvement of aesthetic of the building:
 - a. Do not exceed more than two homogeneous colours for painting the building.



- b. Build a complete building and avoid constructing additional structures on the top-side, lateral and front side of the building.
- c. In hiding any unwanted views on the frontal facade such as tanks or others, add simple elements in front of them.

Facades

1. When a building a warehouse facing more than one road, especially when the back or its lateral side is also facing a road, it would be prudent to give more attention to the design of facades as it would be visible from these angles. Providing the facade with suitable design and materials would provide sustainability to the maintenance of these facades.
2. The maximum allowance for the outer openings of windows on the frontal side should be between 15% and 25% of the total wall surface, whilst ensuring the largest portion of openings on the leeway side of the building is designed to provide maximum shading to achieve the reduction of temperature by direct sunlight exposure. The reverse is true if the sunlight direction is on the opposite direction.
3. Using brightly coloured substances that helps in the reflection of direct sunlight should be encouraged in all external finishing works of the warehouse facades.

Floors

In the design of the warehouse floors, the set of characteristics shall be considered:

1. The floor shall have sufficient floor strength to withstand the weights of equipment and any installations that are designed to be placed.
2. The floors should be highly levelled with no inclination.
3. The floors are resistant to shocks, scratch and heat.
4. Surface of the floor is non-reflective and easy on the eyes.
5. The surface of the floor is inodorous.
6. The floor surface should be sound-absorbing.
7. The thickness of the floor is no less than 15 cm of reinforced concrete. Additional provision in thickness is required if heavier loads are anticipated.
8. In the design for warehouse with high facilities, especially with high automated racks, the structural design of the floors for the aisles should be provided in accordance with the required floor strength.
9. In the use of reinforcement steel in the cement floor, the placement of which should be no less than 5 cm depth under the cement surface.



Service Areas

1. Provisions for employees and workers services in warehouses should be provided, such prayer rooms, cafeteria, restrooms, changing rooms, first aid room, where such facilities are adequate to the number of employees and workers.
2. The ratio of individuals for the above should not be lesser than 1 meter square per employee/worker.
3. The first aid room area is no less than 10 meter square.
4. Additionally, washrooms with cool water dispenser should be provided for the employee and workers.
5. If provided, changing rooms should be equipped with cabinet for each worker.
6. No living facility should be provided inside or within the limits of the building.
7. The policy for NON-SMOKING should be strictly imposed for all workers and employees within the warehouse storage limits. This policy may also be extended to all truck drivers and visitors whilst present within the warehouse storage areas.

4.3 Considerations for Site Design

Fences

The perimeter, except the openings of the entrance and exit, of the warehouse should be secured with fences in accordance to the regulations approved by the relevant

authority. The securing of the fence shall be subject to the following factors:

- Reinforced cement of ground beams at least 25 cm above the ground surface.
- Steel chain link fence fabric should be at least 3mm gauge with mesh openings not exceeding 50mm x 50mm and installed on a galvanised steel of 60mm x 60mm section with a height of no less than 2.5 meter.
- Steel bolts or studs used to affix the bands to the fence shall be bent, peened or welded to preclude the removal of the bolts or studs.
- Steel chain fence fabric should be fastened to intermediate posts whilst the top, middle and bottom section of the fence fabric be longitudinal reinforce with wire ties of at least 3mm gauge.

Entrance Gates

1. Ideally, each warehouse should have 2 gates with a minimum width of 10 meters, if separated or 6 meters wide each when they are adjacent to each another. Due to better security management, many have merged the 2 gates into one and providing a 15 meters wide main gate. Pedestrian gate is usually placed next to the main gate.
2. For better HR management, a separate gate may be provided for the entrance of employees and workers.
3. The height of the entrance/exit gates should be identical to the height of fences, of minimum 2.5 meters height.



4. Entrance gate is better managed when the guard-house and the traffic flow supervisory office are located adjacent to it.

Docks

1. Docks are required for loading and unloading of goods from/to trucks. Docks should be built around the warehouse of no lesser than 60 meters length and a depth of 15 meters. The elevation of the dock should be dependent upon the types of truck used. A generally accepted height is 1.5 meters from the level of the roads with the provision of dock levellers built into the docks. There should be adequate separation between each dock.
2. A ring road should be provided surrounding the warehouse with a width of 6 meters.
3. Concrete tiles, interlocking blocks, cement or asphalt layer may be the choice for the surfacing of the areas surrounding the warehouse.

Advertisement Banners & Signboard

1. Warehouses usually commit with its customers to posting advertising banners with the name of the products in accordance with the requirements of the respective customers.
2. In such circumstances, it is advisable to engage an advertisement contractor to undertake the printing of the banners, including affixing to the placement areas. The regulations imposed by the local authority governing the advertisement banners should be strictly adhered to.

Site Landscaping

1. In the design choice for the aesthetic facade of the warehouse, it may be necessary to provide greenery landscape in the vicinity. Such landscaping greenery may also be used to create a separation zone between the warehousing facilities and its non-warehousing facilities.
2. One of approach to provide aesthetic landscaping to the warehouse is to provide greenery along the perimeter of the warehouse using the space of the setbacks, within a width of 1 meter.
3. The process of securing the site landscape and the greenery should be best assigned to a contractor who are specialised for this type of activity.

4.4 Considerations for Utilities

Natural and Industrial Lightings

1. To reduce the cost of industrial lightings, it is much desirable to trap any natural lighting in the working portion of the warehouse for better quality lighting in the working environment.
2. The amount of illumination from the lighting sources should not be too dim or too bright for the working environment and should comply with the appropriate lighting specifications. Recommended illumination for warehouse areas should be dependent upon the activities of the work areas, the following matrix may be used as the general guides:



- Inactive or infrequent use areas - 50 lux
 - Active and regularly use areas for larger items with large labels - 100 lux
 - Active and regularly use areas for smaller items with small labels - 300 lux
3. As far as it is practical, the lighting of storage areas should be natural unless the functionality of the storage areas requires otherwise and openings for the natural lighting should have enough space of 10% or more of the facade area. Another highly recommended opening for natural lighting is through the roof ceilings. This provision should be carefully studied with the project engineers so that the ceiling opening lighting does not exceed 15% out of the total area of the ceiling. Whilst allowing natural lightings, considerations must be given to ensure the overall temperature of the warehouse should not exceed the desired level of coolness inside the warehouse.
 4. Whilst allowing the use of natural lightings, considerations should be given to ensure a shading system on the both the lateral sides and the back facade of the warehousing building be designed as to reduce radiance of direct sunlight into the work areas of the warehousing.
 5. In the case where external lightings are required, especially for illuminating the fences, marshalling and parking areas, this source of electrical power should be connected to an independent distribution board not directly sourced from the distribution power panel of the warehouse.
 6. The MS standards on Lighting: MS 1038, MS IEC 60364, MS 603, MS ISO 8995, MS 825, MS IEC 60335, MS 947 (minimum) shall apply where appropriate.

Ventilation and Air Conditioning

1. The proper maintaining of the ventilation system of the administrative offices, service offices, workers' rest rooms and the warehouse buildings, should be adequately designed in order to provide a healthy supply of clean air. Any occurrence of a breakdown of this system would attribute an air pollution situation to the entire working environment of the building.
2. Where possible, providing cross ventilation facilities in the work spaces would help in the elimination of the possibility of breakdowns in the ventilation system.
3. With the possibilities to secure openings in certain portion of the facade in the building, there are opportunities to allow the entry of the wind from a certain direction in order to cool down the environment inside the building. Care should also be taken to ensure that the incoming wind do not hold smoke and pollutants from neighbouring locations.
4. Another important aspect of ventilation in warehouse building is the reduction of odour build-up and air-borne particulate, mainly due to the retention of stale air. To overcome this air quality problem, the rate of dilution of the stale air must be achieved by mixing with the fresh air from exterior of the warehouse building. The rate of dilution should be at least 5 times per hour of air change.



5. Warehouse building maybe designed with a special “jack roof” installed at the apex top of the warehouse roof structure, where this “jack roof” is built slightly higher above the apex top. Such structure would permits constant flow of air from the exterior into the warehouse building, an effective contribution towards the rate of dilution on the overall building.

Air Conditioning

1. All cooling units to support the air-conditioning activities are best placed in a special area within the vicinity of the warehouse in order to allow for easy maintenance and the prevention of any water leakages from the cooling units.
2. When designing for the placement of the cooling units, consideration should be given to the daily wind direction as well as the adjacent areas. To avoid changing the frontal facade, such placement should be avoided whilst designing an area away from the main traffic flow and the working areas of the truck arrivals, marshalling areas and the dock side of the warehouse, should be encouraged.
3. In cases where the adjacent is a working area, a brick wall with an outer roof must be provided with appropriate thermal insulation.
4. To ensure proper management of this enclosure, attention should be paid towards the safe & fire aspect so that any of the systems or its components do become a source of danger, such as fire, it can be properly contained.

5. The MS standards on Indoor Air Quality: Code of Practice on IAQ, Department of Occupational Safety and Health (minimum) shall apply where appropriate.

Electricity

1. The electrical supply in most industrial or zoned areas is 3-phased with 230/240 volts.
2. Electrical activities must be designed in accordance to MS standards: (a) Electrical Code: MS 1979, Electrical Installations of Buildings – Code of Practice (minimum) and (b) Energy Code: MS 1525, Code of Practice on Energy Efficiency for non-residential Buildings, UNDP Malaysia Building Sector Energy Efficiency Project, National Energy Policy (minimum),
4. To accommodate an electrical transformers, an electrical room equipped with fire-fighting equipment, shall be provided during the design stage.
5. In general, it is required to comply with the required standards for the transformer room.
6. In the initial design stage for the warehouse, an original estimation for the required electrical power only for lightings, electrical plugs and ventilation, should be advised to the power supply authority and this estimation should use the formula of 80 watt per square meter space of the warehouse.



7. The aforesaid requirements are just general requirements for standard usage in the warehouse building. In the event of where the activity of the warehouse requires the employment of special machinery which requires higher supply of electrical power, the owner or investor through a professional electrical contractor can liaise with the electricity company to find an amiable solution.
8. The main distribution boards shall be installed for the warehouse inside the electrical room. The choice of suggested location for this electrical room shall be as close as possible to the point of high voltage supply.
9. The floor protection system should be design along with its various components to be in conjunction with the electrical room.
10. Information on main cable wiring and any additional information on distribution boards should be displayed, including symbols used, prominently in the vicinity of the electrical room.
11. Providing a spare source of electrical power, like a standby generating set, should be secured for certain important activities in the warehouse to operate during an interruption of general electricity supply while waiting for re-connection of the electrical power.

Rationalisation of Electrical Power Usage

In the rationalisation of electrical power usage, the following considerations may be used during the design stage:

1. When procuring any machinery for use, always consider machineries where power consumption is low.
2. To conserve power usage, always consider providing adequate thermal insulations for piping used for hot & cold air or liquid.
3. Wherever possible, consider the usage of solar power.
4. To reduce heat radiance inward in the warehouse, consider installing thermal insulations to building walls and underside of roofing structures.
5. Consider choice of bright colour paints which helps to increase reflection of sunlight.
6. When installing lightings, consider using reflectors in the lighting units to increase lighting yield.
7. Wherever possible, consider the use of timers and sensor devices in supporting offices, including lightings at the fencing posts.
8. Consider using modern LED lightings in replacing traditional lighting bulbs, which are energy efficient.
9. Wherever possible, consider using openings to allow natural lightings into the building.



Telecommunication

1. All buildings in industrial areas, including warehouses are usually pre-allocated with telecommunication cable by the telecommunication company.
2. In this respect, it is always prudent to communicate with the telecommunication company for all requirement relating to telephone, facsimile, broadband and digital data lines.
3. When planning for any internal telecommunication wiring networks, compliance with the technical standards are utmost important with the following considerations:
 - Wiring inside the building must be invisible laid, using wire channels and cable trays. Having such provisions will accommodate the current and as well as the future needs.
 - When creating wire channels and trays, always consider separate channels or trays for electrical cables and telecommunication and computer digital wirings. These cables and wirings should not be bundled together.

4.5 Considerations for Solid Wastes Management

Solid Waste

1. An area specially designed should be created, within the warehousing boundary to store solid wastes, which allows the entry of collection trucks into

this area without hindering the traffic flows of trucks in the marshalling and circulation areas as well as entering and exiting from the warehouse.

2. Designing for the size of storage bins for the solid wastes should be determined by the quantity of waste produced but as a general guide we can use the estimated quantity of 20 cubic meter per 100 square meter of warehouse storage space. This estimated quantity is used for planning purposes for normal warehouses but the planner needs to be mindful that it can differ between warehouses and also dependent upon the type and size of warehouse.
3. Solid wastes defined here includes all waste produced due to loading/unloading, separation of goods from its original packing units, storage activities or other activities of working by the warehouse workers, within the limits of warehouse, including:
4. Paperboard, wooden planks, plastic materials, metal straps and others produced from the building or breakup of the pallets during the staging operations.
5. Solid wastes maybe produced by the activities of warehouse workers, which includes humid materials (organic foodstuff, leftovers of food consumed) and dry materials (plastic, metals, paper, etc.).



6. In accordance to regulations governing the facilitation of recycling waste, it is always desirable, as much as possible, to pre-sort solid waste by separating humid waste from dry waste, in placing them into separated containers for the collection by the waste recycling contractors.
7. For easy collection of solid wastes produced by the warehousing operations, it is recommended that mobile waste bin be placed near the docks for direct collection of the waste. If the quantity of waste produced is exceeding the usual rate, installing a waste compactor to compress the solid waste should help in the collection process.
8. For warehouses with multiple floors, including the supporting offices, it should be designed that the warehouse be equipped with waste disposal chutes which are connected to mobile bins located at the basement, in order to facilitate waste disposal and collection processes.
9. Designing for solid wastes disposal and collection must take in considerations of the "General Health and Environmental Safety Regulations" imposed by local authorities. All mobile bins designed for waste collection should be properly equipped with covers, in order to prevent or limit the emission of odour and smell of the wastes.

Hazardous Wastes (Solid and Liquid)

1. Hazardous waste is defined as a type of waste with special characteristics that may cause a threat or harm to human health and the environment, many of these hazardous waste may be classified as one of the following:
 - Poisonous type
 - Highly oxidising or reactive type
 - Flammable or explosive type
 - Acidic or corrosive type
 - Infectious type
 - Radioactive type
2. If the any of the hazardous waste is counter-reactive with each other, care should be taken to ensure that such wastes are stored in separate bins or tanks. All such waste must be stored no longer than permitted by the competent authority for hazardous waste.
3. These bins and tanks designed for the collection and storage of hazardous waste must be placed in a special location within the warehouse boundary, preferably isolated by a fence or wall, with a minimum distance of 10 meters from the limits of the general warehousing operational areas.
4. If the activity of the warehouse involved storage of strong liquid substances, which are classified under the Dangerous Goods status, the warehouse must be equipped with secondary containments surrounding the storage tanks or bins, to allow separate containment storage in the case of any leakages or incidents.



4.6 Considerations for Environment

In the protection and preservation of the environment, all warehouses, irrespective of its types and activities, are recommended to adopt the following guidelines:

1. When selecting for the location of the warehouse, the general guidelines is to stay away from facilities that emit strong odour and smoke with the ground soil free from contaminants and non-prone to flooding.
2. The warehouse should be built with materials that are approved, which includes the floors and walls of the warehouse, are in compliance with the Safety and Health Regulations, imposed by the local authorities.
3. Working areas in the warehouse must bear distinctive marks indicating its presence and limits. Marks on the loading docks must also indicate the limits and directions of usage. The marks must be large in size and be visible from a distance of at least 15 meters.
4. Walls of warehouse must be designed to prevent the entry of pest and rodents.
5. The warehouse must be designed with an adequate ventilation system and where additional ventilation is required the warehouse should equipped with adequate suction fans.
6. Warehousing working areas should be designed with adequate lighting from natural light and also sufficiently equipped with industrial lightings.

Where possible, eco-friendly and energy-saving devices are incorporated into the lighting system.

7. To maintain proper level of temperature in the warehouse, it is recommended to employ the use of thermal isolating substances such as an insulator to keep the warehouse temperature cool and stable and not affected by external temperature, in order to prevent excessive use of electrical power.
8. Introducing safety methods to comply with the regulations of the Fire and Safety Department.
9. Maintain a cleanliness culture in all the warehousing activities.
10. Maintain a non-smoking culture in all the warehousing activities, including the supporting service units.

4.7 Considerations for Fire and Explosives

1. When a warehouse is designed for activities involving the storage of flammable materials, goods or products, the warehousing areas used for these purposes, should be provided with the walls that are resistant to fire or equipped with a carbon-dioxide flooding device.
2. The warehouse must comply with the rules and regulation of industrial fire-fighting and security and safety conditions imposed by the Fire and Safety Department.



3. The number of exits must be in accordance with the general design of the warehouse and the exits must lead directly to the exterior of the warehouse where a fire-assembly point is identified.
4. Sufficient fire-fighting equipment must be provided in the vicinity of the warehouse.
5. To allow workers or security guards to reach any point in a warehouse in case of any incidence like a fire, designing aisles in-between lines of goods with a minimum pathway of 1 meter should be adopted as one of the best practice.
6. In the case of storing pallets on racks, the highest point of the pallet's height to the lowest structure of the roof, must be no lesser than 1 meter distance apart.

4.8 Considerations for General Safety of Warehouse

1. Generally, the location of warehouses should be placed, as far as possible, away from main truck roads, residential buildings and other industrial facilities which are not conducive to warehousing activities.
2. The materials used for the construction of the warehouse should be non-flammable, especially when the warehouse is designed for the storage of flammable materials or products.
3. Where possible, the location of storage to be separate from one another, especially one for fast moving goods and the other for slow or long-term storage.
4. Materials stored in warehouses must be properly lined and organised, using the racks and selves should be the preferred choice.
7. To better manage in case of a fire incidence, each type of product or material should be separately stored in order to deploy the proper fire-fighting methods.
8. Wire and electrical devices must be secured in cable channels or trays.
9. Where possible, lighting installations should be placed directly above the respective aisles or places that are not easily exposed to accidental events.
10. Warehouse should be adequately equipped with fire detection devices.
11. Proper fire-fighting equipment be installed and with an automatic sprinkler system installed at the under-side of the roofing structure.
12. Maintaining proper cleanliness culture inside the warehouse and surrounding areas at all times.



5.

Guidelines for Specialised Warehouses

5.1 Cold Storage Warehouses

Cold storage warehouses, commonly known as cold-rooms, are facilities designed to preserve the quality of foods, food supplies, biomedical materials and perishable manufactured substances that require cooling in its storage. These facilities include cooling and freezing storage chambers with mechanised areas that may be equipped with inspection and repacking facilities.

Cold storage warehouses may be used as production facilities, in addition to the normal activities of wholesale, distribution or retail warehouses. The building is often designed not more than one level, and the storage areas are designed with a single large chamber or divided into several chambers, which can accommodate for smaller storage requirements and different kind of materials of goods to be stored. All the chambers are usually operated at the same temperature.

Types of Cold Storage Warehouse

Equipped with Cooling Units, Single or Multiple

In today's cold storage warehouses, most of them are equipped with cooling units, due to its ease of installation and operations. Fundamentally, the cooling unit fans would be providing a good cool air flows into the warehousing chambers. This type of cold storage warehouses, characterised by its low investment cost, usually requires relatively lower quantity of the refrigerant gas and yet providing the

sufficient cooling capacity in generating a good stream of cool air in the cooling storage chambers.

Most cold storage warehouses achieving its regular air distribution, either by positioning their cooling units to the ceiling or coolers to the ceiling or fixing the cooling units just outside the warehouse and making sure that the goods pallet are stored with vertical heights or on floors with adequate distance between them.

It is worth mentioning here that the use of multiple cooling units in cold storage warehouses would be more efficient and effective than just using a large central cooling unit, mainly for the following reasons:

- this approach would provide greater flexibility in the case of any malfunction or defect in any of the cooling units.
- the storage chambers are allowed to function normally in proportion to the actually cooling requirements of the stored goods or material.
- should there be any need to remove frost, it can be performed gradually, without having any major impact on storage circumstances.

Pre-Fabricated Cold Storage Warehouses

Pre-fabricated cold storage warehouses are constructed using ready-made insulation boards with structural component, where these insulation boards



when assembled together would form the walls for each of the storage chambers. Together with the ceiling boards, loading dock and the racking system, the pre-fabricated warehouses are built with the cold storage warehouse characteristics.

In this type of warehouse, a characteristic example of each storage chamber would have a nominal storage capacity of 200 metric tons, with the dimensions of 12 meters x 12 meters x 6 meters, constructed with isolating and supporting polyurethane boards that are surfaced lined on its inside and outside with thick plastic sheets and reinforced with galvanised steel frames. The flooring of the warehouse is usually coated with epoxy paint to prevent moisture condensation.

Due to the pre-fabricated structural characteristics, the process of build a storage chamber within the warehousing building would only take between 4 to 10 weeks to get ready its cold storage chamber.

Conditions for Cold Storage Warehouse

When designing for cold storage warehouses, the primary elements to be taken into considerations, among others are the following:

- the location of the engine rooms
- the location of the cooling equipment

The location of the engine room should be placed as close as possible to the where the air cooling equipment are located inside the storage chamber of the warehouse. Ideally, the cooling equipment should be located at either end of the warehouse

building, placed in a location that suites its expansion in the future. In turn, the engine room should be located away from the warehouse building, and the cool air is channel to the cooling equipment through a network of insulated pipes, which provides maximum flexibility for its future expansions, irrespective of its directions.

Floors

Generally, cold storage warehouse is constructed to one level only to avoid usage of stairways. Therefore the thickness of the floor may vary and is designed in accordance to the insulation materials used.

The level of the floor shall not be lower that the level of the sewage system. Furthermore, the inclinations of the floor shall not be permitted to orient towards the sewage in the floor are not allowed to orient flow towards the sewage system, thereby not hindering the operations of the handling equipment.

Doors and Windows

In cold storage warehouses, windows are usually not permitted in the main storage area of the warehouse.

Wherever sheets of glass are used to build the doors or windows in the office areas, equipment rooms, supervisors' rooms, workers' restrooms and changing rooms, the glass sheets used must be reinforced with metal wires and metal frames.

Wherever doors are required, the type used must be able to open or close in both directions.



Isolation placement and finishing materials
To ensure safety, prevention of fire and smoke emission, all structural entities, mechanised equipment, including cooling units and all piping designed for conveying cold air or liquid, must be placed in locations, away from the general areas of activities of the warehouse.

When taking into consideration factors concerning isolation, providing the appropriate external finishing materials can be as follows:

- using chemically appropriated substances that can be placed on the internal roofs
- always consider compliance with fire resistance and smoke emission factors when choosing the usage of materials for the internal roofs.
- no direct water entry is not allowed for any washing processes.

External roofs of the warehouse should be designed to withstand climatic corrosion factors.

In the consideration to use appropriate finishing materials for internal entities, care must be taken to ensure that the used finishing materials may not cause pollution or contamination to the stored goods or products. This is in strict compliance with the rules and regulations governing the health and safety aspect of storage.

Special Equipment for Cold Warehouse

All cargo handling trucks, whether of hydraulic, mechanical or electrical types, used in cold storage warehouses should have the special protection features which may be categorised as follows:

- Care should be provided to the protection of condensation in areas that are sensitive to moist and water. This is primarily due to the temperature-changing environment inside the warehouse.
- Certain working systems, including battery heaters, hydraulic systems, of these trucks must also be fully protected from the temperature changing environment, which may range from minus four degree to twenty degree, which could implicate its normal functional capabilities. Sometimes, these trucks are subjected to long and continuous working hours in such low temperature environment have severe impact on the working systems.

Alarm and Security Systems

As a best practice for safety and security, it is prudent to have the cold storage facilities fully equipped with a proper alarm and security systems, not only for fire prevention and intrusion detection but most importantly for high temperatures detection due to failure of the cooling system of the warehouse.

Each storage chamber should be connected with the alarm system which is monitored outside the storage chambers 24 x 7. The monitoring service is preferably carried out in a separate monitoring room.

If the warehouse is equipped with a security system, it is always advisable to have the alarm systems combined with the security system, in case of any unauthorized entrance inside the building or the individual storage chambers.



There should be appropriate numbers of thermal sensors installed in the storage chambers, delivery and shipping areas of the warehouse, all of these sensors are connected to the central alarm system.

Water Sewage

Periodic the storage chambers need to be thoroughly washed and cleaned when certain new products are accepted into the storage. Residue with the water contained from the washing and cleaning activities are required to be transfer or channel into the water sewage system. The water sewages draining channels should not be constructed under the working aisles but instead under the racks or along the adjacent side of the walls of the respective storage chambers.

Quality & Health Inspection Rooms

Larger cold storage facilities provide special areas for certain activities, such as quality and health inspection, by well-qualified personnel. In such cases, special inspection rooms should be designed for these activities to be carried out, in a more regulated and systematic manners, for certain health authorities to undertake their statutory duties. Such inspection rooms should be designed with doors wide enough to allow the movement of cargo handling equipment, like forklifts.

Storage Area Height Clearance

The warehouse's elevation is usually designed to achieve its optimal economic benefit of storage loads, in which case the height of loads should preferably be not higher than 4.5 meters, if no racking system is installed. With a racking system

installed, it is preferably be not higher 6 meters.

Width of Aisles in Storage Chambers

Most cold storage warehouses are designed with width of aisles in the storage chambers that do not exceed 2.5 m. When narrower aisles are preferred due to space constraint or space requirements, special type of forklifts should be employed for working in the tighter aisles in order to reduce the width of aisles.

Environmental Considerations for Food Storage

In the design of warehouse, especially for the cold storage types, the following additional features should also be considered:

- All storage chambers must be supported with efficient cooling or freezing units, with appropriate thermal measurement sensors/ devices installed, for the monitoring of the temperature from the outside, preferably in a separate monitoring room.
- When designing for the location of freezing storage chamber, it should be away from the direct exposure to the afternoon sunlight.
- In ensuring quality management, a list showing the quantity, quality as well as the dates showing the storage period and expected expiry dates of the stored food products, should be posted at the doors of the storage chambers.



- Cold storage chambers should always maintain its appropriate temperature, either at cooling temperature of 4 degree Celsius or sub-zero freezing temperature of minus 4 degree Celsius. As such, all food products must be stored at the adequate temperature, either at cooling or sub-zero freezing temperature.
- Stored food products must be organized in the storage so that its accessibility could be organised in a proper queueing system.
- During the storage of the products, sufficient distance between them should be provided in order to allow effective air circulation flowing between them and also those below them.
- Products with odours must be stored away and preferably be stored in special chambers with air-tight doors.
- During the storage of food products, there should be no contact with the walls of the storage chambers.
- In food storage warehouse, there should be absolute prohibition to store any house detergents, insecticides or poisonous chemicals.
- When storing foodstuff in cans, always organised its storage in a manner where the labels on the cans can be easily read.
- All food products should be organised in the storage with the "first-in, first-out" (FIFO) principle.
- When using any handling equipment, always avoid using the diesel or gas type forklifts. Using the battery-based type is always preferred.
- In compliance with local health regulations, all workers in food warehouses should be subjected to health screening, at least once a year, to avoid those with any infectious diseases.
- Proper uniform with proper sanitised shoes should be provided to all working inside a food warehouse. Shoes must be properly organised in bins when not in use. Warehouse areas restricted to those with such shoes.
- Any worker that shows any ill symptoms, wounds or skin ulcers, or appeared to have had a contact with a patient of an infectious disease must be kept away. Any incidence of worker showing symptoms of any infectious disease must be reported immediately to the competent health authorities.

5.2 Controlled Humidity Warehouses

In all tropical countries, humidity is always considered as one of important environmental factors affecting the overall operations of warehouses providing logistics services to the commercial entities. Humidity has great impact upon the structural facilities of the warehouses, which not only cause damages to roofing structures but also towards the surrounding walls of the warehouse and the components of the ventilation systems. This factor also has immerse impact upon the quality of the stored goods, if the storage facilities do not provide the necessary measures to eliminate the high



humidity, specifically within the storage areas.

Certain materials used in the warehousing facilities, such as iron structures, timber constructs, paper cartoons and cardboards, may deteriorate in its natural properties.

As such, the proper design of warehousing should address the humidity problem, where appropriate measures and designs are incorporated into the warehouse during its construction. Modern warehouses have taken up such measures in the early designing stages.

Level of CO2 in Warehouses

The ventilation system that supports the activities of the warehouse should be in the position to provide a humidity-free environment. In its capacity to generate a humidity-free environment, the level of CO2 concentration in the air inside the warehouse should not carry any particles of more than 50 parts per million (ppm). Having said this, any cargo handling trucks, such as the forklifts, should be recommended in using either gas or the battery operated type. The use of diesel in such trucks will provide smoke emission, thus contributing negative impact to the air quality index inside the warehouse.

5.3 Shed Storage

Shed storage space used for storage of goods or materials is usually made up of only the roof with no wall by the side of the storage spaces or decks. However, some of these shed storage may have additional canopies built to provide working spaces for trucks to work under these canopies, especially during raining seasons.

Due to the type of goods stored in these shed storage space, overhead travelling cranes may be installed to facilitate the handling, especially suited for standard lengths of steel structures, beams, channels or bars.

As this type of warehouse is mainly used to store goods or materials that require maximum ventilation or the goods or materials do not require the full protection of weather conditions. Such type of warehousing type may be located where the surrounding areas do not have any impact on the identified activities of these shed storage spaces.

Types of Shed Storage

Various forms of shed storage exist, each varying according to the type of goods or materials stored but can be generally categorised as follows:

1. Shed for general purpose use: this type generally have the least fixtures and service utilities installed, with minimum lightings and power supplies, except for those specifically designed facilities..
2. Shed for transitory purpose: this type is generally constructed with the pre-fabricated structures which can be assemble and dis- assemble in short times, allowing the shed to be re-located when not in used. Even the floors are constructed with standard panel or blocks of reinforced concert.
3. Shed for flammable or hazardous materials: Certain storage units containing flammable substance, like the gas cylinders, and hazardous material, like corrosive or acidic



barrels, can be stored. Usually, this type of shed is provided with ceiling-hung fans and roof-hung water fire-fighting sprinklers.

Shed Storage Areas

Storage spaces in the shed storage warehouses are mainly divided into specific segments through which specific products or materials are stored, segregating each segment, for reasons of security and safety.

The floor surfaces of shed storage can be either the enhanced surfaces type or the semi-enhanced type so as to provide adequate capacity to withstand the load-weights and to provide the control of water drainage.

Enhanced surfaces are usually the well treated type where its impermeable surface requires special design towards water draining specifications:

- Using cement concrete for the surfaces would provide a solid capacity to withstand heavy loads. Using cement concrete would be idea when traffic movements within the storage spaces are expected to be intensively heavy and where oil leakage risks from these heavy traffic movements are high, as well.
- Apart from cement concrete, asphaltic materials such as bitumen or cement blocks can alternatively be used for the surfaces, which have similar properties of cement concrete but with lower load strength and the risk of any oil leaks onto the surfaces will remain soaked permanently.

Partially or non-treated surfaces are usually not recommended for shed storage floors unless the structural building is considered temporary and may be relocated within a short period of time.

Security and Safety Requirements

For the purpose of security and safety of the goods or materials stored in the shed storage warehouse, the following factors should be considered when designing for it:

1. Sufficient lighting should be provided with a minimum illumination of 10 lux in the open areas surrounding the shed storage building areas, with the possibility to introduce additional lighting intensity when security requirement are needed by installing lighting devices along the underside of the external structural facilities.
2. The covered storage areas should be designed allowing the entry of natural light from the roof, bearing in mind the factors due to excessive natural lights, affecting the temperature inside the shed storage areas during hot seasons and wind directions factor, should be carefully considered.
3. Due the absence of walls, shed storage warehouse should take serious considerations on factors affecting the humidity and higher temperature inside the shed storage warehouse. When storing goods or materials that are sensitive to these factors, they should be protected with special packing materials and regular inspection activities to be carried out.



4. Storing liquids which are in containers should be organised in assigned areas of the shed storage areas, so as to contain any leakages that may occur. The assigned areas should have easy access for the entry of special material handling equipment or firefighting vehicles. Providing special drainage into a special catchment pond should also be considered.
5. In the consideration of storing certain goods or materials, design should include the provision of water sprinklers at the underside of the roofing structures and adequate water piping outlets inside the shed storage areas.
6. Should the shed storage areas are built next to a hazardous storage areas, an adequate fire-wall must be provided between them. Such fire-wall should be able to withstand a 4-hour fire-resistant.

5.4 Open Storage Areas

When there is a need for storage of goods that do not require comprehensive protection from natural factors like rainwater, strong winds or sunlight, the utilisation of open spaces within the warehousing boundary can suffice for such activity.

Therefore, such open storage areas are least provided with any kind of considerations and are usually without any cover. However, the perimeters of the open storage areas must be secured with protective barriers, such as low fencing or brick-lined walls. Entrance and exit to the open storage areas must be secured with

a simple gate-like structure, like a barrier-arm or swing gate.

Depending upon the types of goods to be stored in the open storage areas, the floor surface may be treated as follows:

- **Treated floor surface:** Such type of open storage areas are also provided with water sewage drain with proper ground gradient around its boundary. The surface is usually of the reinforced concrete type thus allowing the proper use of cargo handling equipment.
- **Semi treated surface:** Such type of open storage areas are very similar to treated floor type in terms of ground gradient and water sewage drainage but without any treated solid ground, i.e. without any concrete surface.
- **Untreated surface:** Such type of open storage areas are not subjected to any land gradient levelling or water sewage drainage process and its floor surface are not covered with solid materials, unlike the treated type where the surface floor is covered with concrete. Usually the surface is of the natural spoil type and water accumulation is among the problematic issues when using such type of open storage spaces.

Surface Levelling Requirements

In designing for the open storage areas and the selection of surface paving materials, several factors should be considered such as:

- Type of vehicles used



- The frequency of vehicle movements and flow pattern, and
- Types of materials to be stored.

The types of surface paving materials usually used for treated floor storage are:

- Solid reinforced concrete paving or
- Using pre-fabricated concrete paving panels

The above types are preferred as they are capable of withstanding large loads and are not affected by the natural fluctuation of weather across the year.

The thickness of the concrete paving or the concrete panel should be determined by load of the driving wheels and the number of wheel axles of the vehicles when using the open storage areas, as the wheels contact pressure and contact area shall determine the load weight on the concrete surface.

Another key consideration on the selection of type of surface paving is to determine the frequency of vehicle movements and its pattern of flows.

Aisle Planning in Open Storage Areas

Open storage areas require adequate planning for providing spaces appropriate for the storage aisles and as well as for the circulation patterns of the stored materials in the specific segment of the open storage areas.

Key consideration should be given the type of cargo handling equipment to be

employed in the open storage areas, the type used shall determine the dimension of the aisles and as well as to the manner of circulation of the material flows, inward and outward at the receiving and delivery points. Hence, the proper planning of the aisles can ensure maximum efficiency towards the usage of the provided paths by the vehicles.

In the above consideration, the planning of the aisles is best placed in a straight linear direction and the circulation path at the corridors of the storage areas.

5.5 Flammable/ Hazardous Material Warehouses

This kind of warehouse are built where its storage areas are designed in accordance to the standard specifications for storing hazardous or flammable materials, in which its nature of the materials may be harmful or dangerous towards the health, environments and safety of property. Such stored materials may include flammable solids or liquids, acidic or caustic or burning materials, oxidising materials, interactive materials with water and any other materials deemed hazardous as per international classifications.

Such storage facilities should be designed and built to standard specifications in order to provide protection of the materials towards health, safety and environmental hazards that may occurs. Therefore, storing and handling of these hazardous and flammable materials should be restricted to the premise or parts of the premise that have met the specified requirements as per following:



Conditions for Flammable / Hazardous Material Warehouses

- Standards issued by the NFPA may be used when designing storage facilities for the storage of flammable and/or hazardous materials.
- When designing facilities for storage for hazardous materials, it should not be combined with any processing activities in a same building. Always separate processing hazardous activities from a hazardous storage facilities.
- When designing such warehouses, serious considerations should be placed upon the compatibility of hazardous materials to be stored, as designs may vary to the types of stored materials. Prior approval must be obtained from the fire and safety departments, in respect to the structural design and fire control system.
- Following considerations may be used when designing storage facilities for storing hazardous/ flammable materials:
 - Prevention of pollution, in the event of any leakage, should be a prime consideration in the design of the storage areas. In this regards, each category of hazardous materials are to be stored separately.
 - When storing acidic or corrosive liquids above ground level, it should be stored at the level of vision of the handling driver's seat. In all respect, it is best to be stored at ground level of the storage areas.

- Only specially designed material handling equipment are allowed to work in areas designed for storing flammable and hazardous materials. In most cases, specially designed electrical powered equipment are used where all the electrical devices are completely turned off.

Separation of Materials Stored

It is always a prime consideration to provide separate storage areas for incompatible hazardous materials. There are six categories of flammable/hazardous materials that must be stored in separate storage areas within the flammable/hazardous material storage premise. There are other categories that require additional separate storage areas, which comprises of the following:

Flammable and Combustible Liquids

- Liquids are identified as per NFPA Code 30. This code 30 applies to the storage, handling, and use of flammable and combustible liquids, including waste liquids.
- Flammable liquids that have a flash point of less than 38 degrees Celcius and a steam pressure that does not exceed 275 kilopascal at 38 degrees Celcius.
- Flammable liquids have a flash point of 38 degree Celcius or above.



Acids

Acids, acidic fog, gas with arsenide, borides, carbides, cyanides, fluorides, phosphides, selenides, silicide, sulfide, sulfate and telluride when interacted generating poisonous vapours. These materials liberate hydrogen when in contact with metals and hydrides.

Oxides

Oxidizing materials are solvable chemicals, when interacted under certain conditions, producing oxygen. Such materials usually generate fire when in contact with any flammable materials and are highly interactive with water when ignited. Typical oxides include the following organic and nonorganic peroxides, permanganates, chlorate, perchlorate, sulphates, organic and non-organic nitrate, bromates and ultrabromate and, chromate and bichromate.

Toxins

Toxins are materials that causes poisoning, which may result in death through the respiratory system. When a spill, leakage, fire or mis-ventilation occurs, some chemical compounds maybe produced, such as ammonia, are considered toxic in nature.

Water-interacting Materials

When these materials come in contact with water, steam or with any water solutions, flammable gas, sometimes toxic in nature, and explosive heat are generated. Such materials include calcium, cobalt, hydrides, lithium, potassium, rubidium and sodium bullion. Other similar materials

but produces explosive gases include arsenides, borides, nitrides, phosphide, carbide, selenide, silicide, sulfide, and telluride. For the heat-producing materials, they include non-water acids, concentrated acids and alkalis.

Therefore, it is necessary not to use water-based fire-fighting systems in these water-interacting material storage areas. In this respect, use of carbon dioxide or halon fire extinguishers would be the better option.

Caustic or Burning Materials

Caustic alkalis may liberate hydrogen when in contact with aluminium. These materials must be isolated from acids so as to ensure safe and efficient operations.

Organic Peroxides

Organic peroxides should be stored in separated warehouses, totally isolated from other materials.

Conditions for Separation

Due to acute nature of hazardous materials, the following considerations shall be observed in the storage areas designed for hazardous materials:

- ALWAYS isolate acids from other materials, including chemicals that may cause surface erosion of storage areas
- ALWAYS isolate flammable liquids from acids and oxides
- ALWAYS isolate organic acids from oxides
- ALWAYS isolate oxides from flammable and combustible liquids



Tight Gas Cylinder

Tight gas cylinders are generally used for storage of flammable and non-flammable gas, and for gas classified as oxides. These tight gas cylinders are stored at ground level and should not be stored in the flammable/hazardous material warehouse.

Barrel-Packed Petroleum, Oil and Lubricant Products

Barrel-packed petroleum products, oils, and lubricants, having flashing point exceeding 38 degree Celsius may be stored in a level higher than the ground floor or in open storage facilities with hermetic dockings and sand bags or ponds to contain any leakage. Barrels-filled petroleum, oil and lubricant products may be stored in outdoor warehouse, provided the barrels are made of corrosion-resistant or thermally galvanized materials to withstand corrosion caused by weather.

Other Materials

Dry corrosive and other materials that are not radioactive in nature and without hazardous effects, may be stored in public warehouses. However, any radioactive materials should be stored in specific and separated areas.

Environmental Conditions

In addition to the conditions mentioned in aforesaid chapter, the following conditions shall apply to flammable / hazardous material warehouses.

Flammable Material Storage Conditions

- The warehouse shall be equipped with fire-fighting devices and equipment that are adequate to the storage areas and also to the nature of stored materials. Chemical material warehouses shall be equipped with an advanced fire-fighting system, given the nature of its high risk.
- Doors and openings at joints shall be fire-resistant and shall remain locked at all times.
- Periodic inspection shall be conducted on all electrical structures and equipment to ensure safety and prevention of occurrence of any electrical malfunction.
- Periodic maintenance for all devices and fire-fighting equipment in the warehouse shall be conducted.
- Flammable liquids such as gasoline, fuel oil, dyes and similar materials shall be stored in special containers and marked in writing indicating the content and nature of flammability. These containers shall be stored in specially designed areas.
- For storing volatile materials, appropriate chillers shall be used to provide special cooling support to the materials.
- All lightings and pipelines provided to electrical devices shall be fire-resistant and also properly contained so as to prevent occurrence of any electrical spark.



- Proper guidelines and signage shall be affixed near to the equipment on how to use fire-fighting equipment and also instructions in the case of a fire. These guidelines and signage shall be placed in appropriate places where easily visible and recognised.
- Material Safety Data Sheet should be provided (MSDS) for each hazardous / flammable material stored in the warehouse.
- Flammable and toxic gases storage shall ALWAYS be stored at ground level. Do not store in confined areas with no ventilation.
- The pathway to the storage areas of the cylinders shall be free of obstacles, enabling quick access in case of emergency.
- Only properly trained staff can be deployed to handle tight gas cylinders, as knowledgeable staff are able to understand the handling rules and the related emergency procedures.

Tight Gas Storage Conditions

- Tight Gas Cylinders should be painted with distinct colours, depending on its filled content.
- Each cylinder shall be marked as EMPTY or FULL and shall be easily visible and identifiable.
- The name of the material inside the cylinder shall be written clearly on the external body of the cylinder.
- ALWAYS isolate oxygen cylinders from acetylene or fuel cylinder unless totally isolated from each other by a fire-resistant barrier or wall.
- Tight Gas Cylinders should be stored vertically and fasten together with chains. Rolling the cylinders on the floor is strictly prohibited.
- To prevent any damage to the valve of the cylinders, a protective cover should be placed over the valve.



6. Sustainability Issues in Warehouses

6.1 Sustainability & Resource Conservation

Sustainability and resource conservation are currently considered key issues when warehouse designers are considering their inclusion in the development of warehousing facilities, which interest most management teams when looking for measures leading to savings in energy consumption. In addition to building a better working environment, conservation of natural resources should be considered.

A warehouse designed with sustainable features should be able to generate the following benefits:

- In achieving efficiency in the facilities and the building design, thus reducing energy consumption;
- In contributing to reduced sewage water production, the design in potable water consumption should be rationalize, thus saving cost in its treatment as well as disposal cost;
- In improving the building internal environment, features to achieve better air quality, optimal internal temperature and the proper management of the entry of natural light.
- In the protection of natural environment, the emission of harmful gases or disposal of toxic sewage water into the external environment,

should be reduced or managed using globally accepted pollution control devices or systems.

- One consideration to achieve higher revenue on the medium and long term is to reduce the costs of energy and other resources, and of buildings maintenance and operation, while also providing better production environment in the warehouse, in turn a better internal working environment for the workers.

6.2 Efficiency in Waste Management

Local authority usually encourages developers, investors, and contractors working in industrial areas to provide better solutions in garbage production reduction, beginning from the design stage of the warehouse, in provisioning the assigned spaces for waste collection and disposal once the construction of the warehousing starts, as well as during the whole period of construction.

During the construction stage, contractors are encouraged to prepare a waste management plan to reduce waste production and increase recycling activities on-site as it has many benefits, including:

- reducing waste production on construction site
- reducing construction time
- reducing construction cost and achieving quality construction.



In addition to the above, in order to reduce the environmental impact of warehouse operational activities, warehouse owners and workers are further encouraged to allocate dedicated spaces for the collection of recyclable waste. The total area dedicated for these areas would depend on the area of the warehouse, its facilities, type of materials stored and warehousing method employed.

6.3 Building Enclosure & Openings

Walls

All external walls of the warehousing building should consider to include thermal insulation material, which helps in reducing heat retention, especially in the hotter months of the year. Consult an insulation expert who would be in the position to advise on the types of insulation materials to be used.

Commonly used insulators include extruded polystyrene, mineral wool, rock wool and glass wool. These materials have high properties in the heat insulation.

Insulated panels are also among the most used insulation in cold storage warehouses and administrative buildings. They are constituted of extruded polystyrene covered from both sides by hot-dip zinc or thin galvanized steel.

Roof-tops

Roof tops of warehouses are usually constructed from corrugated rolled metal roofing sheets which generally provides strong roof tops. As such, it is customary to include heat insulations to reduce heat radiance into the warehouse.

Insulation type and thickness should be determined by insulation engineers in order to achieve a minimum Heat Transfer Index value

Considered as the best insulation material for concrete roof tops is the extruded polystyrene, whilst insulated panels being the best insulation system for steel buildings, especially warehouses, as the insulated panels are constructed from extruded polystyrene, covered from both sides by hot-dip zinc or thin galvanized steel.

Windows and Glass Usage

Using glass in walls and rooftops must comprise of several sheets of high performance glass to order to reduce heat radiance.

Translucent polycarbonate sheets are panels that allow certain intensity of light through, and these are usually recommended for warehouse with a minimum thickness of 38mm and a light transmission index of at least 55%.



7.

Design Guide for Warehouse and Utility Buildings

7.1 Location Studies & Preliminaries

As a general guide, this phase shall comprise of the following activities:

1. To necessitate identification of the ground properties, a professional soil engineer should be engaged to conduct the investigation of the soil properties to verify whether the identified land is suitable for construction works in building a warehouse building. Soil investigation should also cover the topology of the land and levels suitability for the building.
 2. Relevant approval from the local authorities granting the initial permission to begin with the construction works.
 3. To obtain the initial permission approval from the local authorities, a drawn plan showing the intended warehouse's general location as well as its surrounding roads, with the dimension and its intended activities in the warehouse buildings.
 4. With certain local authorities, a detailed submission indicating the components of the warehouse and its functional elements as follows:
 - The overall outlay of the warehouse building, indicating the dimensions and its activity spaces for storage, electricity rooms, guard's room as well as the internal road layout, waiting areas, loading bays, general facilities areas and other elements needed for supports, such as administrative block, resting areas for drivers and workers.
- A comprehensive layout of the doors, emergency exits, entrances and other gates.
5. The overall layout of the land use, including the provision of the setback areas for security and landscaping.
 6. Submission of the warehouse's needs in term of electricity requirements, potable and utility water and expected sewage quantities produced to the other relevant authorities.

7.2 Building Designing Phase

After the preliminaries and soil evaluation test stages have ended with satisfactory results, following which are the activities in the designing phase which shall comprise of several stages and levels:

Work Plans by Consulting Architect

The consulting architect's role, among his various duties, should be providing the work plans that are required to be submitted to the local authorities for their approval.



- A general location plan to show the building's location including the storage areas, loading and unloading work spaces, shipping and receiving office work spaces, workers and employees work spaces, required support services work spaces, and in addition to the loading and unloading bays, marshalling areas and truck parking spaces, internal roads and private car parks, entrance and exit roads for cars, workers, and truck. In this general location plan, details providing dimensions and sizes, using scale of at least 1:500. Details of the surrounding roads and adjacent land are to be provided to show its relationship to the proposed building plan.
- A location work plan showing the horizontal perspective of the warehouse's main building showing its dimensions and sizes as well as the levels of all the different sections, in addition to the columns and other load-bearing pillars.
- In addition to the above work plan, the horizontal perspective showing all floors of the administrative building and other utilities supporting services building should also be provided.
- In the work plan, a summary table detailing all openings designed for doors and windows and its description of these openings.
- Detailed providing the finishing for floors, walls, internal ceilings, and external facades for all the buildings, including the administrative building and utilities support buildings should be provided in separate work plans

showing its levels, heights, external finishing for facades, heat insulation, and rain protection structures.

- Electrical work plan and guard house should be provided showing its horizontal projections, sectors, and facades with sizes and levels, in separate work plans, showing the external perspectives of the fence and gates with details.

Work Plans by Construction Firm

Requirements relating to the construction works, including location and topographic maps, to show all elements of construction (both concrete and earth-works) should observe the following specifications:

- All designs in relations to the construction of the warehouse shall be in accordance with codes, standards and regulations adopted by the local authorities.
- All construction works shall conform to the detailed work plans approved, which may also include catalogues of approved materials and detailed drawings for the metal structures and pre-cast concrete slabs and other elements necessary to support its conformity from a construction point of view.

The conformity specifications should be presented in the construction work plans:

1. Horizontal perspective of all the foundations designed for all buildings, showing its axes as well as the symbols of bases and columns, detailing its reinforced steel, concrete stress, grade of cement used, in the foundations



and construction levels, taking into considerations of its load strength, and the insulation materials used in the foundations.

2. Work plans for all above ground level facilities showing its structures, ceilings, and main beams, metal or reinforced concrete. The plans shall provide details including the type and grade of steel used, and construction separators, etc.
3. Work plans to show distribution of arming iron for all vertical projections and sectors of beams and columns for main sections at an adequate scale.
4. Construction plans for ground and upper water tanks showing the reinforcing iron, dimensions, and levels.
5. Construction plans for perimeter fencing, guard room and the electricity room.
6. Plans showing dimensions of metallic structure of the main and secondary beams as well as its fixture method and turnbuckles.
7. In addition, construction plans shall bear all important remarks by the designing architect such as:
 - Maximum stress allowed for concrete;
 - Maximum stress allowed for reinforcing iron;
 - Specifications of iron/steel used in metallic structures;
 - Specifications of welding used in metallic structures;
 - Specifications of bolts used in

metallic structures;

- Necessary specifications and precautions to cast the concrete to be of the required quality;
- Necessary and sufficient time for keeping turnbuckles before removing them;
- Ways and methods of installing metallic structures;
- Requirements for general safety during execution;
- The difference of maximum landing below bases.

Plumbing Works Plans

The following plans are required for submission:

1. A topographic plan showing level of earth and the levels of surrounding streets with a contouring plan when the land is not flat;
2. A Plan showing the location of existing services on the surrounding streets such as water and sewage networks and defining the internal level and storm water network, stating the preferred level compared to the current levels;
3. Plans containing the following:
 - Horizontals sectors of roads showing locations of services installations with floor standard details;
 - Standard details for slopes, if any.



Water Tank Plans

Water tank plans shall include the following:

- Internal and external capacity of the tank according to the needs of the warehouse and its activities;
- Comparing the ground level and the final level of the bottom of the tank;
- The distance between the ceiling of the tank and the highest water level it contain shall not exceed 50 cm;
- The tank shall have an opening with a cover of a minimum of 60 x 60 cm;
- The tank shall have a ladder made from rust-proof material such as aluminium, stainless steel, and galvanized iron;
- A pipe to ventilate the tank with a net cover;
- Provide maximum insulation of the walls, ceiling and floor of the tank to prevent leakage into and out of the tank.

Potable/Utility Water Plans

A work plan showing potable water installations system for the warehouse shall include the following:

- Location, diameter, and layout of pipes;
- Water tanks sufficient to meet the needs of the warehouse which should last for 3 days with a minimum of 1 day;
- Pumps house;
- Capacity and horsepower of pumps with provision of a spare pump;
- The pump should include a water pressure tank;
- Providing necessary extensions with the pump showing with an illustration.

Sewage Tank Plans

Sewage tank plans shall include the following:

- Internal and external dimensions of the tank;
- Comparing the ground level and the final level of the bottom of the tank;
- The tank shall have an opening with a cover of a minimum of 60 x 60 cm
- A pipe to ventilate the tank with a net cover;

Sewage Plans

The plan must include locations and diameters of pipes and inspection rooms as well as the tank.

Storm Water Drainage Plans

- The work plans shall include the following:
 - Levels;
 - Drainage pipe diameters;
 - Inspection chamber showing its dimensions, internal bottom level and gradient, and distances between the chambers;
 - A drawing of plumbing works networks including rising pipes;
 - Various needed details for plumbing works;
 - Specifications of plumbing works and quantities table.



Plans of Electrical Works

Master Plans

- Various details needed for electrical works;
- Diagram for all floors for electricity supply works;
- Diagram for all floors for fire detection system works;
- Diagram for all floors for control camera system works;
- Diagram for electricity installations showing distribution boards, with details, emergency loads and all main cables for the building indicating sizes and linkage to electricity source;
- Specifications table for lighting units;
- Tables for electricity supply units;
- Specifications of electrical works and related units.

Lighting Plans

- Work plans showing details of lighting in the building, including lighting of emergency exits and evacuation paths;
- Work plans showing details of external lighting, lighting of the main areas of operations as well as the fence post lightings.

Electrical Power Plans

- Plans for showing details and location of electrical power sockets and circuits for the warehouse building;

- Plans for showing electricity sockets supply to air conditioning, cooling or chiller units and pumps as well, including control centres, distribution boards and supply line pathways for the warehousing building;
- Plans for showing the site's electrical supply indicating the main and subsidiary distribution boards as well as cable pathways between the main board and those in external locations such as the fire pump, potable water pump, etc and the location of the subsidiary auxiliary energy source for the warehousing building.
- Plans for earth grounding system for the warehousing building;
- Plans for lightning-protection system for the warehousing building.

Plans for Low Power Current

- Plans for showing the distribution of fire detection system for the warehouse building;
- Plans for showing the distribution of control cameras system for the warehouse building;
- Plans for showing the distribution of computing network system for the warehouse building.



8. Information on Equipment

8.1 Types of Forklift Trucks

Counterbalance Forklift Trucks

Counterbalance forklift trucks are the most common type of forklift truck, and the type most people instinctively think of when thinking of forklifts.

Counterbalance forklift trucks are available as electric, gas or diesel powered. Many have side-shifts, a mast tilt facility, and often driver cab.

Counterbalance forklift truck operates with a counterbalance weight at the rear of the truck in order to off-setting the load to be lifted at the front.



Three Wheels Counterbalance Forklift Trucks

Three wheels counterbalance forklifts work to the same premise as regular counterbalance machines but with the inclusion of a single drive wheel affixed in the centre of the rear of the machine in order to ensure maximum manoeuvrability.

Three wheels counterbalance machines are perfect for use in applications where space is limited due to their smaller turning circles and excellent manoeuvrability. They are also ideally suited to applications that require inside and outside use and also for rack loading. The combination of counterbalance under-clearance and tight manoeuvrability ensures maximum productivity.



Reach Trucks

Reach trucks are designed predominantly for warehouse operations installed with racking systems. They offer maximum height lift with excellent manoeuvrability.

Reach trucks has the ability to 'reach' out beyond the stabilising legs and therefore 'reach' into the racks. The combination of this reach capability and the stabilising legs means reach trucks can lift to great heights (in excess of 10 metres) while still operating in very tight working environments.

The stabilising legs and batteries within a reach truck negate the need for any counter-balance weight within the truck construct.

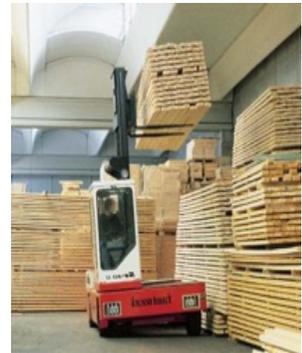
While excellent for use indoors, reach trucks are not ideally suited to work outside. Their low under-carriage clearance can cause problems on uneven surfaces, and their electric power systems are prone to malfunctions if regularly shaken due to working on uneven surface.



Side-loaders

Side-loaders are trucks that operate by picking up their load from the side, from the perspective of the driver of the machine.

Side-loaders are very good at handling wide (or long) loads that would otherwise be unstable on a conventional counterbalance machine. Side-loaders are excellent for handling lengthy materials such as timber, piping and sheets. However, side-loaders are weak in handling conventional loads.



9. References

9.1 APEC Building Codes, Regulations & Standards: Minimum, Mandatory & Green

Malaysia

1. Synopsis

Building Regulatory System

Malaysia's building regulatory system is similar to Singapore's, Brunei's, and Hong Kong China's. The federal government develops and implements regulations and there is no building code. The regulations refer to codes of practices (equivalent to guidelines or best practices), standards, and design guidelines developed, published and administered by the Department of Standards Malaysia, a government department under Ministry of Science, Technology and Innovation. These are mandatory if the regulations so specify, otherwise practitioners may use equivalents developed from other sources.

The federal government administers all building regulations and state and territorial governments enforce them in their building control departments. Review and revision of the regulations are the responsibility of the Ministry of Works. There is no mandatory time period for regulation review or revision. Reviews of codes of practices, standards, guidelines, and best practices depend on the agencies that administer them. For example, Malaysia Standards (MS) are usually

revised every three to five years, while codes of practices, guidelines and best practices administered by the Public Works Department do not have a mandatory time period for review and revision.

State and territorial governments conduct building inspection works and issue permits for their states, and municipal or city governments may also take responsibility for inspection works and permits for their areas. This depends on the arrangements between the state and territorial governments and the local governments.

Reference Standards

While reference standards are mainly from Malaysian Standards (MS), Malaysia draws from ASTM International, ASHRAE, the British Standards Institute, Australian and New Zealand Standards, Chinese Standards, and the American Institute of Steel Construction.

Pathways to Green: Federal Government

The government takes a voluntary approach to green features in buildings and no regulations require such features. Codes of practice and standards for indoor air quality, water efficiency, and resource efficiency are not mandatory; and policies on energy, water, and the environment have not affected building design and construction. Still, ASHRAE 90.1 (on energy efficiency) is widely applied in high-rise commercial buildings in Malaysia.



2. Code Development, Administration, and Enforcement

Like Singapore, Brunei, and Hong Kong, Malaysia does not have a building code system. The system relies on laws implemented by the government, and the laws require relevant standards and codes of practices pertaining to buildings. Engineers and architects determine standards and codes of practices relevant to their projects. Even if laws refer to a standard, an equivalent can replace the reference. While codes of practices, standards, and guidelines are generally not mandatory, they can be required if the laws make them mandatory.

Building Regulations

Malaysia's building regulations are based on the Street, Drainage and Building Act (1974), the Uniform Building By-Laws (1984), and Building (Federal Territory of Kuala Lumpur) By-Laws 1985. These legal instruments stipulate guidelines for the approval of building plans and prescribe the control of construction. In conjunction with these laws, the Fire Services Department prescribes requirements for fire safety in buildings through the provisions of the Fire Services Act 1988, and through its own guidelines. These guidelines and provisions specify the "passive" aspects of the laws, (i.e., structural requirements for fire containment and life safety precautions). The laws do not dictate the types of standards mandated by the regulations as long as there are equivalent standards.

Enforcement Procedures

Local authorities develop and enforce their own building codes, and are not required to follow the Uniform Building By-Laws (1984). Penalties for offenses committed by developers, contractors, owners, and occupiers are imposed by local building control officers. The federal building control department can apply to the court for a "Mandatory Order" requiring an offending owner or occupier to demolish an unauthorized building or to abate any nuisance or danger related to construction. The main functions of a local authority are planning and control of development and building control, while laws, bylaws, and standards development are the responsibility of the federal government. Local building control departments do not have jurisdiction over buildings owned by the federal government; their codes apply only to buildings in their state or territory.

Compliance Procedures

The Uniform Building By-Laws (1984) prescribes plan submission procedures, space provisions and design methods, provisions of temporary works, structural requirements, construction requirements, fire requirements, alarm, detection, extinguishment, and access, and other miscellaneous items. Building Bylaws 1985 specifies the enforcement and regulation for the Territory of Kuala Lumpur only. The federal government is the local authority for the Territory. The Street, Drainage and Building Act (1974) has provisions on street design and maintenance, plants management, drainage design and maintenance, back lanes provision, design and maintenance, and other administration procedures.



Law Administration and Revision

Local Authority under each states and territorial governments enforce the laws if they adopt them. They may choose to develop their own regulations. The local authority has control over the ordinances or regulations they wish to impose in their states, while the federal laws apply to federal projects built on non-federal lands. Most states and territories have adopted federal building regulations.

No time period for review or revision of law is specified, so laws are updated as and when needed by the Ministry of Works. Standards referred by the laws are updated by the Department of Standards Malaysia based on request from the Ministry of Works. All Malaysian Standards (MS) will be reviewed every 5 years.

Code Adoption and Evolution

Malaysia's federal government develops the Uniform Building By-Laws (1984), Building (Federal Territory of Kuala Lumpur) By-Laws, and the Street, Drainage and Building Act (1974) Act. Local authorities adopt these or develop their own enforceable codes. The bylaws and acts were originated by and are updated as needed by a panel of industry experts, academics, government officials, and representatives of various states and territories. Updates are reflected in later versions of legislation passed by Parliament. Local authorities enact their codes by making them laws for their own state or territorial government. The federal building control department enforces laws on behalf of the federal government (including federally owned buildings outside of Kuala Lumpur) and for buildings inside the Federal Territory of Kuala Lumpur. Local building control

departments enforce local building codes. No information is available on the development and evolution processes of the local codes.

Malaysian Standards (MS)

The Department of Standards Malaysia (STANDARDS MALAYSIA) under the Ministry of Science, Technology and Innovation (MOSTI), is the National Standards and Accreditation Body. In performing its duties and functions, STANDARDS MALAYSIA is governed by Standards of Malaysia Act 1996 (Act 549). As the National Standards Body, STANDARDS MALAYSIA through the Industry Standards Committee (ISC) develops Malaysian Standard (MS) in 24 sectors including for building, construction and civil engineering. The ISC consists of local industry experts, academics, government officials, and international experts. STANDARDS MALAYSIA recommends reviewing the MS every 5 years or earlier as necessary.

Reference Standards

Most reference standards are Malaysian Standards. Besides MS, the laws also referred to other standards such as British Standards, ASHRAE, AS/NZS, and ASTM. ISC D may refer to other source of standards (e.g., ASTM, ASHRAE, AS/NZS, BS) in developing MS. Local authorities are free to adopt their own standards.

Green Features of Mandatory Laws

Although Malaysia has developed MS related to 'green' such as on energy efficiency but the Uniform Building By-Laws (1984), Building (Federal Territory of Kuala Lumpur) By-Laws, and the Street,



Drainage and Building Act (1974) do not have green features. The bylaws only require compliance with MS developed by ISC D, and does not include other ISCs.

Types of Buildings

The Uniform Building By-Laws (1984), Building (Federal Territory of Kuala Lumpur) By-Laws, and the Street, Drainage and Building Act (1974) apply only to commercial, institutional, and industrial buildings. They do not govern housing and low-cost development. These are mandatory laws for federally owned buildings, and it is up to the state or territory to determine if the laws apply to them.

3. Code Details

Minimum Codes

Electrical. MS 1979 (Electrical Installations of Buildings – Code of Practice) has been developed by ISC E - Generation, Transmission and Distribution of Energy based on the source material as contained in the guide to MS IEC 60364 on electrical installations of buildings. The federal government and all states and territorial governments have made this standard as mandatory.

Energy. Currently there is no mandatory standard for building energy efficiency. However, ASHRAE 90.1 is widely applied and buildings that pursue LEED and Green Mark certifications must comply with ASHRAE 90.1. Although it is not mandatory standard, MS 1525 (Code of Practice on Energy Efficiency and Use of Renewable Energy for Non-Residential Buildings) is widely used in Malaysia.

The National Energy Policy of Malaysia was developed by the federal government and it addresses energy production, distribution, and consumption. It provides energy use guidelines and lays out renewable energy use and development guidelines for buildings. The policy is based on the 1974 Petroleum Development Act, 1975 National Petroleum Policy, 1980 National Depletion Policy, 1990 Electricity Supply Act, 1993 Gas Supply Acts, 1994 Electricity Regulations, 1997 Gas Supply Regulation, and the 2001 Energy Commission Act. The Government agencies such as the Ministry of Energy, Green Technology and Water, the Energy Commission, and the Malaysia Energy Center also Government-linked companies, like Petronas and Tenaga Nasional Berhad are contributed to the development of the National Energy Policy of Malaysia.

The Energy Commission is the regulator of the energy sector and service companies. The Malaysian Guidelines for Energy Efficiency in Buildings is a voluntary, set of building energy standards for non-residential buildings. They cover envelope, lighting, and HVAC systems. The guidelines are developed by industry experts, academics, and government officials. Currently, none of these guidelines had been made mandatory.

Water and Sanitation. Malaysia does not have a mandatory standard on plumbing but various piping standards are widely adopted. These include the MS 525 (Specification for Concrete Porous Pipes for Under Drainage), MS 881 (specification for precast concrete pipes and fittings for drainage and sewerage), and MS 1193 (Specification for Devices without Moving Parts for the Prevention of Contamination of Water by Backflow). MS 2015 (public



toilets), is a voluntary standard that has been widely adopted.

Standards on water and sewerage quality has been made mandatory in Water Services Industry Act and the National Water Services Commission Act for Peninsula Malaysia. These acts are not applicable in East Malaysia. The Sewerage Act 1994 (affects both), and the Ministry of Energy, Green Technology and Water Malaysia are implemented and enforceable in Malaysia. These regulations are enforced by the Ministry of Energy, Green Technology and Water Malaysia and required local governments to maintain certain levels of water and sewerage quality.

The National Standard for Drinking Water Quality (second version, January 2004) is issued by the Engineering Services Division of the Ministry of Health. The standards are adopted from the World Health Organization's guidelines for drinking water quality. The Concession Agreement of December 31, 2004, specifies that treated water supplied by SYABAS must comply with the standard stipulated in National Standard for Drinking Water Quality. The standard has 131 parameters. These standards has been made mandatory in Malaysia as the government obtains funding from the World Health Organization.

The National Water Services Commission Act and the Water Services Industrial Act 2006 (both by the Ministry of Energy, Green Technology, and Water) contain provisions for commissioning water treatment facilities. Both are mandatory only in Peninsula Malaysia. The Water Forum and the Ministry of Energy, Green Technology and Water Malaysia has developed guidelines on water savings and efficiency.

The most common voluntary standards on plumbing in Malaysia include MS 1058 (Polyethylene piping systems for water supply), SPAN Approval, Australia/NZ Joint Standard AS/NZS 2642, Australia/NZ Joint Standard AS/NZS 4129/4130, WaterMark AS/NZS 2642, WaterMark AS/NZS 4129, and United Kingdom BS 7291.

Mechanical Systems. There is no mandatory standard for mechanical systems in Malaysia as a whole, but guidelines for mechanical system design and installation has been made mandatory for all Federal Government according to the Public Works Department (Public Works Department, 2011).

Indoor Air Quality. Malaysia does not have a mandatory standard for indoor air quality. The standard on indoor air quality was issued by the Ministry of Human Resources, Department of Occupational Safety and Health, sets minimum standards but is only a guide. It sets standards for indoor air quality (oxygen, carbon dioxide etc.), zoning of indoor pollutant sources, and elimination of pollutants from indoor sources (DOSH 2005). All federal government buildings comply with this standard and thus this is somewhat mandatory for most federal buildings.

Lighting. The code of practice on occupational safety and health issued by the Ministry of Human Resources, Department of Occupational Safety and Health, is the minimum standard for lighting, but it is not mandatory. It sets minimum and maximum luminaries, and recommends types of luminaries, and colour use for office spaces. Malaysian Standards (MS) developed under ISC F also has voluntary standards on lighting design.



Security. Malaysia does not have a Malaysian Standard (MS) for building security.

Fire. Malaysian Standards (MS) for fire safety in building are referred in the Uniform Building By-Laws (1984), Building (Federal Territory of Kuala Lumpur) By-Laws (1984), and Fire Services Act (1988). These laws and act also include provisions for fire safety access, room plans, provision of fire extinguishing methods and systems, fire resistance of materials, and design methods etc.

Structural. The Uniform Building By-Laws (1984) and Building (Federal Territory of Kuala Lumpur) By-Laws (1984), have Malaysian Standard (MS) on structure. The standards cover loading requirements, material use, spatial loading standards, weight of partitions, stacking, roof design, dynamic loads etc. ISD D are focuses on design and construction methods of timber, concrete, steel and plastic materials (ICS D Section, MS 416, MS 977, MS IEC 8124, MS 544, MS 1294, MS 1057, MS 229, MS 1933, MS 1195, MS 1226, MS 1553, MS 1314, MS 1490 etc.).

Location / Siting / Zoning and Environment. Building zoning and siting is governed by the 10th Malaysia Plan, which is managed by the Economic Planning Unit of the Prime Minister's Office and the Malaysia Economic Planning Unit in the office of the Attorney General of Malaysia, and the Town and Country Planning Act (1976, amended in 2006). The 10th Malaysia Plan focuses on types of development, land use, and other land issues. The Town and Country Planning Act sets out the rule on planning authority, authorizations, and format.

Developed by the Ministry of National Resources and Environment in 2002, the National Policy on the Environment dictates environmental standards. The policy covers environmental stewardship, conservation of nature's vitality and diversity, continuous improvement in environmental quality, sustainable use of natural resources (including land), integrated decision-making, the role of the private sector, commitment and accountability, and participation in the international community. Other related regulations include the:

- Environmental Quality Act 1974-2011,
- Fisheries Act, Land Conservation Act,
- Local Government Act,
- National Forestry Act,
- National Park Act,
- Protection of Wildlife Act,
- Radioactive Substances Act,
- Water Enactment Act,
- Sarawak Biodiversity Center Ordinance,
- Sabah Biodiversity Enactment,
- Sarawak Natural Resources and Environment Ordinance,
- Sabah Environmental Protection Enactment, and
- Sabah Forest Enactment, Sarawak Forest Ordinance.

Safety. Occupational Safety and Health Act 1994 under purview of The Department of Occupational Safety and Health specifies minimum safety standards in Malaysia. It specifies the responsibilities and duties of employers and employees with regard to workplace safety and safety requirements for products and materials. The Uniform Building By-Laws and the Building By-Laws (1984) also have provisions for safety



during construction, fire exits, smoke detectors, obstructions, etc.

Other voluntary standards are including the Department of Occupational Safety and Health's guidelines for public safety and health at construction site, and code of practice for safe working in a confined space. The guidelines cover the duties of different parties, hazard identification, risk assessment and control, emergency response methods, hoarding, movement of traffic, utilities disconnection, demolition, explosive use, site clearance, safety measures for types of construction works, the use of hoisting equipment, and crane storage. The code of practice specifies approaches to working in confined spaces, permitting requirements, duties of various parties, ventilation standards, and safety protection methods.

Green Building Codes

Malaysia does not have a mandatory standard or code for green building standard but two green building rating systems are frequently used. The Green Building Index (GBI) is Malaysia's rating tool for buildings and towns. It is very similar to USGBC LEED. Buildings and townships can apply for certifications in non-residential, residential, industrial, and township categories. Certifications are at four levels (certified, silver, gold, and platinum) and take three steps: (1) application and registration, (2) design assessment, and (3) completion and verification assessment. A verifier visits the site to certify compliance with GBI standards for energy efficiency, indoor environmental quality, sustainable site planning and management, materials and resources, water efficiency, and innovation. The township assessment has one additional step for approval of final plans before verification.

9.2 General Safety Rules

The following are some important general safety rules that each employee is required to follow, regardless of work assignments.

1. Lifting improperly is a major factor of the tremendous number of claims for back injuries. The following procedures should be followed:
 - a. Size up the load; make sure it is stable and balanced. Test the weight to ensure you can lift it yourself.
 - b. Plan the job. Ensure that your path of travel is clear and that you have identified the location where you will place the load.
 - c. Establish a good base of support. Use a wide balanced stance with one foot ahead of the other.
 - d. Bend your knees and get as close to the object as possible. Lift with your legs and not your back.
 - e. Get a good grip on the object to be lifted. Make sure you can maintain your hold throughout the lift and won't have to adjust your hands later.
 - f. Lift gradually, don't jerk, but use a slow steady movement.
 - g. Keep the load close while carrying; this prevents you from arching your back and adding additional stress to your back.
 - h. Pivot; don't twist when you need to change directions. Move your feet in the direction of the lift. Twisting is especially harmful for your back.
 - i. If the load is too heavy either enlist another helper or use a mechanical device.



2. Good housekeeping is an aid to safety. All employees shall keep tools, equipment, and work areas clean and orderly.
3. Keep aisles stairways and exits clear of boxes and other tripping hazards. Do not obstruct exits.
4. Clean spills immediately. Mark the spill if you must leave to retrieve assistance or additional supplies.
5. Each employee should know the location of fire extinguishers in their work area. The area in front of a fire extinguisher should be kept clear for ready access. Employees should not fight fires that are beyond their fire training and limitations of the available fire-fighting equipment. When in doubt, call professional help and evacuate to a safe area.
6. Gasoline will not be used as a washing or cleaning fluid. When cleaning solvent is required, use an approved cleaning solvent.
7. Material will be stored in a safe and orderly fashion. Flammable liquids should be stored in an approved Flammable Storage Cabinet.
8. Any employee, while on duty or on district property, who possesses, sells, or receives any illegal drug or who is under the influence of drugs or alcohol, will be discharged and, in appropriate situations, referred to law enforcement authorities.
9. Smoking will not be allowed at any facility.
10. Use caution when opening doors which serve two-way pedestrian traffic.
11. Use a stepladder or a step stool for reaching above shoulder height. Never stand on the cap of a ladder.
12. While in a district vehicle, seat belts are required to be worn at all times. Do not disable airbags unless you have written permission from your Supervisor.
13. Do not operate machinery that you are not familiar with and have not been trained to use.
14. Inspect all tools and equipment prior to use to ensure they are in working order and do not present a hazard.
15. After use put all tools/or equipment back in their proper place.
16. Disconnect all electrical cords by grasping the plug and carefully disengaging; never yank by the cord. If an electrical cord is frayed or wires are exposed remove it from service.
17. Use handrails when using the stairways. Never take more than one stair at a time.
18. Only qualified, designated employees should work on electrical wiring and equipment.
19. Horseplay or practical jokes will not be tolerated.



20. Material Safety Data Sheets must be available, at the point of use, to any person who requests this information.
21. Report all accidents to your supervisor.
22. Report all unsafe or broken tools and equipment to your supervisor. Mark the tool or equipment so that no one else will use.
23. Observe all warning signs, safety bulletins and posters.
24. Do not do any job that appears unsafe; ask your supervisor for guidance.
7. Lower forks to the ground when the truck is not in use or the operator is more than twenty five feet away.
8. Always travel with the load lowered.
9. Check the trucks daily or after each shift.
10. Travel backwards if the view to the front is obstructed by the load.
11. Do not overload lifts or hoists.
12. Do not allow anyone to stand or walk under a load.
13. Do not jump off docks, pickup trucks, or other elevated surfaces.

Warehouse Safety Rules

The following are some important general warehouse personnel safety rules that each employee is required to follow:

1. Before loading and unloading a truck, set the brakes.
2. Do not move a truck before all persons are properly seated or protected from the hazards of a shifting load.
3. Do not misuse forklifts or pallet jacks.
4. High lift rider trucks must be provided with an overhead guard.
5. Know the location of eye wash stations when handling batteries to be charged.
6. < NO SMOKING > signs should be posted.
14. Keep aisles unobstructed.
15. Stow pallets flat.
16. Do not store highly combustible chemicals in a warehouse. These should be kept in a separate storage area.
17. Avoid stacking materials on the floor. Use shelves or pallets .
18. Forklift operators should be properly trained and qualified before using the vehicle.
19. Each forklift should have a horn and backup warning noise. The horn should be used at every intersection.
20. A seatbelt should be worn while operating a forklift.
21. When moving a load do not stop quickly; make turns slowly.



22. Never carry allow others to ride on any part of a forklift. Forklifts were made for one person.
23. Never run over objects lying in the floor and try to avoid chuck holes. These hazards could easily topple the load.

Safety Rules on Usage of Forklift Trucks

1. Forklift trucks shall be examined before being used. Check the operator controls, brakes, fluid lines and levels, lights, filters, safety devices (horn, fire extinguisher, etc.), backup horns, and the movement of the fork.
2. Unless qualified, the operator should not attempt to make any repairs.
3. Portable and powered dockboards shall be strong enough to carry the load imposed on them.
4. Portable dockboards shall be secured in position, either by being anchored or equipped with devices which will prevent their slipping.
5. Handholds, or other effective means, shall be provided on portable dockboards to permit safe handling.
6. Only stable or safely arranged loads shall be handled. Caution shall be exercised when handling off-center loads which cannot be centered.
7. Only loads within the rated capacity of the forklift truck shall be handled.
8. A load engaging means (forks) shall be placed under the load as far as possible; the mast shall be carefully tilted backward to stabilize the load.
9. Extreme care shall be used when tilting the load forward or backward, particularly when high tiering.
10. The operator shall:
 - a. Maintain a safe distance (recommended 3'-5') from the edge of ramps or platforms while on any elevated dock, or platform or freight car.
 - b. Assure efficient headroom under overhead installations, lights, pipes, sprinkler system, etc.
 - c. Observe all traffic safety rules, including authorized plant speed limits.
 - d. Maintain a safe distance, approximately three truck lengths from the truck ahead, and the truck shall be kept under control at all times.
 - e. Yield the right of way to pedestrians.
 - f. Yield the right of way to ambulances, fire trucks, or other vehicles in emergency situations.
 - g. Slow down and sound the horn at cross aisles and other locations where vision is obstructed.
 - h. Look in the direction of, and keep a clear view of the path of travel.



- i. Travel the load trailing if the load being carried obstructs forward view.
 - j. Cross railroad tracks diagonally whenever possible.
 - k. Operate at a speed, under all travel conditions, that will permit the forklift truck to be brought to a stop in a safe manner.
 - l. Slow down for wet and slippery floors.
 - m. Properly secure dockboard or bridge-plates before they are driven over. Dockboard or bridgeplates shall be driven over carefully and slowly and their rated capacity never exceeded.
 - n. Approach elevators slowly, and then enter squarely after the elevator car is properly levelled.
11. The operator shall not:
- a. Operate a forklift truck while using prescription or over the counter medications that may interfere with the safe operation of the forklift truck in any manner.
 - b. Drive forklift trucks up to anyone standing in front of a bench or other fixed object.
 - c. Run over loose objects on the roadway surface.
 - d. Allow persons to stand or pass under the elevated portion of any truck, whether loaded or empty.
 - e. Park closer than eight feet from the center of railroad tracks.
 - f. Allow any person to ride on forklift trucks except the operator, unless the forklift truck has provisions for passengers.
 - g. Place arms or legs between the uprights of the mast or outside the running lines of the truck.
 - h. Use forklift truck for opening or closing freight doors.
 - i. Block fire aisles, access to stairways, or fire equipment with the forklift truck or the load being handled.
 - j. Pass other trucks traveling in the same direction at intersections, blind spots, or other dangerous locations.
 - k. Participate in stunt driving or horseplay.
 - l. Push or tow other forklift trucks.
12. An overhead guard shall be used as protection against falling objects.
13. A load backrest extension shall be used whenever necessary to minimize the possibility of the load or part of it falling rearward.
14. Only approved industrial trucks shall be used in hazardous locations.
15. Lift truck operators should know the weight of the load prior to moving the load.



16. Standing on a truck or adding counterweights to compensate for an overload will not be permitted.
17. Operators should never attempt to operate a truck with an overload. Such a load is dangerous because it removes weight from the steering wheels, which affects the steering.
18. Extreme care must be taken when mast and load are raised high.
19. When lifting a load, always check for any overhead obstructions that might be damaged or cause the load to spill or topple the truck.
20. Always heed instructions about stacking height.
21. Never allow other workers to stand nearby when you stack materials.
22. Do not stack material in aisles or roadways.
23. Leave keys in forklift when parking for the day.
24. Leave forklift running when walking away from the truck.
4. Portable ladders are designed as one-man working ladders based on a 200 pound load. Do not load a ladder more than the rated limits.
5. Do not use metal ladders while working near electrical wires or electrical equipment. Use a wood or fiberglass ladder.
6. Be sure your shoes are free of any material which could cause you to slip while climbing.
7. Set the ladder base firmly on the ground or floor. Ladders must not be placed on boxes, barrels, or other unstable bases.
8. Do not climb a ladder if you are ill or afraid of heights.
9. Do not paint wooden ladders; this hides possible cracks. Use linseed oil instead.
10. Do not store wooden ladders where they will be exposed to the elements; store them where there is good ventilation.
11. Do not use a ladder which has been tagged <Dangerous. Do Not Use.

Safety Rules on Usage of Ladders

1. Completely inspect all ladder hardware and fittings before each use.
2. Inspect all ropes and cables and replace them if defective.
3. Do not use defective ladders; report them immediately to your supervisor.
4. Do not climb a ladder behind an unlocked door, doorway, or without someone standing guard.



The Following Rules Apply to Straight Extension Ladders.

13. Never stand above the top three rungs.
14. Secure the ladder to prevent it from slipping or falling by tying it off to a fixed object at the top at both rails or to a proper sized single support attachment. Choose a ladder equipped with non-slip safety feet. Since the ladder usually must be climbed to secure the top, someone should stand at the bottom and hold the ladder while this is being done. If the job is of short duration, it may not be feasible to tie the top. If this is the case, the ladder should be held by another person until the job is completed and the person is safely on the ground. Only when the top is secured should someone work from the ladder alone. When ladders with no safety feet are used on hard, slick surfaces, a foot ladder board or cleat should be used against the base.
15. Do not reach out from a ladder, even when it is being held. Move the ladder instead.
16. Keep your shoes and the ladder rungs free from grease, mud, ice, etc. Clean oily or greasy ladders with a safety solvent, or steam clean.
17. Do not use ladders or ladder sections upside down. Always use right side up. The extension ladder should always be erected so that the upper section is resting on the bottom section.

18. When working from a position on the ladder, always brace your knees against the side rails near the end of the ladder rungs to increase stability.
19. Do not climb ladders when wearing high heels, sandals, or thongs.
20. Position straight ladders so that the base of the ladder is 1/4 of the ladder length, or approximately 75o, with the horizontal.
21. Ladders must be 3½ feet taller than the building top.

The following safety rules pertain to stepladders.

22. Select a stepladder tall enough to reach the work. Never stand on the top two steps or on the bucket shelf.
23. Be sure the stepladder is fully spread and the spreaders are locked; be sure that the spreader is not bent or loose.
24. The bracing on the back legs of a stepladder is designed for stability and not for climbing.
25. Always have someone hold your stepladder if you are climbing higher than four feet.



9.3 United Kingdom Warehousing Association Standards of Warehousing

Reviewed: June 2013

This document, which has been compiled by the United Kingdom Warehousing Association, is an advisory one and must be read as such. It has no statutory force and nothing in it should be construed as conferring exemption from compliance with legal requirements. All reasonable care has been taken in its preparation and it is provided for general guidance, without liability on the part of the Association in respect of its application and use.

The 11 Critical Areas of Warehousing are:

1. The Warehouse Buildings
2. The Warehouse Site and Perimeter
3. Offices and Administration Facilities
4. Statutory Notices
5. Handling and Storage Equipment
6. Specialised Storage Amenities
7. Fire Protection Measures and Equipment
8. Health and Safety
9. Insurance
10. Environmental Considerations,
11. Pest Control

The Warehouse Buildings and its Working Environments

1.1 Maintenance of Workplace and of Equipment, Devices and Systems.

The warehouse and the equipment, devices and systems, shall be maintained (including cleaned as appropriate) to an efficient state, in efficient order and in good repair. This includes the warehouse roof which should be watertight with gulley kept clean of debris.

1.2 Ventilation

Effective and suitable provision shall be made to ensure that every enclosed workplace is ventilated by a sufficient quantity of fresh or purified air. Any plant used shall include an efficient device which gives a visible or audible warning of any failures.

1.3 Temperature

During working hours, the temperature in all workplaces inside buildings shall be reasonable. A method of heating shall not be used which results in the escape into the workplace of fumes, gas or vapour which may be injurious or offensive. A sufficient number of thermometers shall be provided.

1.4 Lighting

Every workplace shall have suitable and sufficient lighting, which, so far as is reasonably practicable, shall be by natural light. Sufficient emergency lighting shall be provided in any room where persons are exposed to danger if artificial lighting fails.



1.5 Cleanliness and Waste Materials

Every workplace, and the furniture, furnishings and fittings therein shall be kept sufficiently clean. Surfaces of floors, walls and ceilings shall be capable of being kept sufficiently clean. So far as is reasonable practicable, waste materials shall not be allowed to accumulate except in small receptacle.

1.6 Workstations and Seating

Every workstation shall be so arranged in a suitable manner for the person to work and for any work undertaken at the workstation.

1.7 Condition of Floors and Traffic Routes

Workplace floors and surface traffic routes shall be so constructed that they are suitable for the purposes. The floor or surface shall not have a hole or slope, or be uneven or slippery so as to expose a person to a risk to his health or safety and shall have effective means of drainage as appropriate. Suitable and sufficient handrails and guards shall be provided on all traffic routes which are staircases.

1.8 Windows and Transparent or Translucent Doors, Gates and Walls

Every window, transparent or translucent surface in a wall partition, door or gate, shall, where necessary for reasons of health and safety, be of safety material or protected against breakage and marked accordingly.

1.9 Organisation etc. of Traffic Routes.

Every workplace shall be organised in such a way that pedestrians and vehicles

can circulate in a safe manner. Traffic routes shall be suitable for the persons or vehicles using them, in sufficient number, in suitable position and of sufficient size. Suitable measures shall be taken to ensure that pedestrians or vehicles may use traffic routes without causing danger to persons at work nearby and there is sufficient separation between vehicles and pedestrians. Traffic routes shall be suitably indicated.

1.10 Doors and Gates

Doors and gates shall be suitably constructed and fitted with necessary safety devices. Locking arrangements to doors including fire doors should meet insurers' standards. Sliding doors or gates shall have a device to prevent them from coming off tracks during use, an upward opening door or gate shall have a device to prevent it from falling back. A powered door or gate shall have a suitable an effective feature to prevent it from causing injury by trapping any person and shall be capable of being operated manually (unless it opens automatically if the power fails) and a door or gate which is capable of being pushed from either side shall provide, when closed, a clear view of the space close to both sides. Where a perimeter fence exists, is it fit for that purpose?

1.11 Sanitary conveniences

Suitable and sufficient sanitary conveniences shall be provided at readily accessible places. They shall be adequately ventilated and lit, kept in a clean and orderly condition. Separate rooms containing conveniences shall be provided for men and women, except when each convenience is in a separate room, the door of which is capable of being secured from the inside.



1.12 Washing facilities

Suitable and sufficient washing facilities, including showers if required by the nature of the work for health reasons shall be provided at readily accessible places. These shall be provided in the immediate vicinity of sanitary conveniences and include a supply of clean hot and cold or warm running water. Soap or other means of cleaning and towels or other suitable means of drying shall be provided. The rooms shall be sufficiently ventilated and lit, kept clean and orderly and have separate facilities for men and women, except where they are provided in a room which is capable of being secured from inside.

1.13 Drinking Water

An adequate supply of wholesome drinking water shall be provided for all persons at work in the workplace. This shall be at readily accessible places and be conspicuously marked by an appropriate sign. A sufficient number of cups or other drinking vessels shall be provided, unless the supply is from a jet, from which persons can easily drink.

1.14 Accommodation for clothing

Suitable and sufficient accommodation for clothing shall be provided for clothing not worn during working hours, and for special clothing worn at work which is not taken home. The accommodation must be in a suitable location.

1.15 Facilities for rest and to eat meals

Suitable and sufficient rest facilities shall be provided at readily accessible places. In the case of new workplaces, extensions

or conversions one or more rest rooms shall be provided. In other cases, a rest room or rest area may be provided. Where food is eaten in a workplace which would otherwise become contaminated, suitable facilities shall be provided.

1.16 Visitors Book and site rules

All visitors including contractors must sign-in at reception or another suitable reporting area when visiting the site. They must be made aware of site rules and if necessary escorted throughout their stay. A visitor's book or other suitable method of recording visitors shall be made available. Warehouse Electricity

Warehouse Electricity

2.1 Construction and maintenance

Electrical systems must, as is reasonably practicable, be constructed and maintained so as to be safe, as must work activity and adequacy of protective equipment. The company shall be in possession of a 5 year fixed wiring test certificate. There is an absolute duty not to exceed the strength and capability of electric equipment so as to cause danger. Excess current protection must be efficient and suitably located and there must be provision for cutting off he supply and isolating it.

2.2 PAT Testing

All portable appliances shall be tested in accordance with the guidelines.

2.3 Competence

Those working with electricity must have sufficient technical knowledge and experience to prevent danger and



avoid injury. If they do not have such expertise then they must be supervised, as appropriate, for the work they are expected to carry out.

Storage of LPG and/or Oil

3.1 LPG Storage

It is preferable that all LPG is stored in the open air but where this is not practicable, particularly for cartridges, the quantities stored within the buildings should be restricted. Access to all storage places by unauthorised persons should be prevented and such places should be marked with notices prohibiting smoking and the use of naked flames. Refillable LPG cylinders are considered full whatever the state of their contents. LPG should not be stored in the vicinity of cylinders containing other gases or hazardous substances without specialist advice. The position chosen for storage should always be level and concreted, paved or compacted to provide a load-bearing surface. Outdoor storage areas should be slightly graded for drainage of surface water. LPG should never be stored below ground level in cellars or basements. The storage area should be kept free from weeds, long grass and accumulations of readily combustible material at all times.

3.2 Oil Storage

Oil containers that are strong enough and that are unlikely to burst or leak during ordinary use must be used. In Scotland this is the only requirement for portable oil containers with a capacity less than 200 litres. Containers within a drip tray, bund or any other suitable secondary containment system (SCS) must be used. This will contain any oil that escapes from

its container. For oil tanks, intermediate bulk containers and mobile bowsers, the SCS must be able to hold 110% at volume, or at least 25% of their total volume (whichever is greater). For drum storage the drip tray must be able to hold at least 25% of the total storage capacity of the drums.

3.3 Pipes and Gauges

The base and walls of the bunds must be impermeable to water and oil. The base and walls must not be penetrated by any valve, pipe or opening that is used for draining the system. If any fill pipe or draw-off pipe goes through the base or walls, then the junction of the pipe must be sealed with the base or walls to prevent oil escaping from the system. All valves, filters, sight gauges, vent pipes and other equipment, other than fill pipes or draw-off pipes or pumps must be located. Where a fill pipe is not within the SCS, a drip tray must be used to catch any oil spilled when the container is being filled. The drip tray must be cleaned clean and emptied before each delivery.

Battery Charging

4.1 Battery Charging Facility

Hydrogen and oxygen are usually produced inside a battery when it is being charged. A source of ignition – for example, a flame, a spark, a cigarette or any hot object, electrical equipment, a mobile phone – will often cause mixtures of these gases to ignite and explode. Explosions are often so violent that the battery shatters and produces a highly dangerous shower of fragments and corrosive chemicals. Hydrogen and oxygen are produced more quickly as the battery gets close to being fully charged. If you continue charging



after the battery is fully charged gas will be produced, greatly increasing the risk of explosion.

4.2 Some important rules to follow:

- Wear gloves and suitable eye protection, preferably goggles or a visor.
- Wear a plastic apron and suitable boots when handling battery chemicals such as sulphuric acid or potassium hydroxide.
- Empty pockets of any metal objects that could fall onto the battery or bridge across its terminals.
- Keep sources of ignition – such as flames, sparks, electrical equipment, hot objects and mobile phones – well away from batteries that are being charged, have recently been charged, or are being moved.
- Use suitable single-ended tools with insulated handles.
- Fit temporary plastic covers over the battery terminals.
- Charge batteries in a dedicated, well-ventilated area.
- When lifting batteries the weight should be shared with others if necessary – they can be very heavy.
- Use insulated lifting equipment and check for trip hazards especially tools, cables or other clutter.
- Wash hands thoroughly after working with batteries, especially before eating, smoking or going to the toilet.

And don't...

- Work with batteries unless properly trained.
- Smoke.
- Wear a watch, ring, chain, bracelet or any other metal item.
- Overcharge the battery – stop charging as soon as it is fully charged

Workplace Transport

5.1 Workplace Traffic General

Every workplace, including external, must be safe for the people and vehicles using it. Workplace traffic routes must be suitable people and vehicles using them. Where vehicles and pedestrians share a traffic route, there must be enough separation between them.

5.2 Traffic Routes

Every traffic route in a workplace must have a driving surface that is suitable for its purpose. The surface of any traffic route must not be uneven, potholed, sloped or slippery that any person could slip, trip or fall.

5.3 Driving Surfaces

Every workplace must be safe for people and vehicles using it. Workplace traffic routes must be suitable for people and vehicles using them. Where vehicles and pedestrians share a traffic route, there must be separation between them to minimise the risk of accident.

5.4 Vehicles and Loads

As far as possible, vehicles should be segregated from other users of the site during vehicle movement or loading/unloading. As far as possible make sure that companies and drivers visiting your site are aware of its layout and any limitations it has before arrival.



5.5 Speeds

Limiting the speed that vehicles move around the workplace is an important part of controlling traffic. The best way to do this is to use fixed features that mean drivers cannot move too quickly. Speed limits are also used widely, but they are not always appropriate or enforceable.

5.6 Traffic Management

As far as possible avoid reversing. But when this is unavoidable make sure you have effective systems in place to control it. As far as possible, schedule vehicle movements to prevent overcrowding, of the site and surrounding roads.

5.7 Separating Pedestrians

By law, pedestrians or vehicles must be able to use a traffic route without causing danger to the health or safety of people working near it. Roadways and footpaths should be separate whenever possible. Consider protection for people who work near vehicle routes. By law, traffic routes must also keep vehicle routes far enough away from doors or gates that pedestrians use, or from pedestrian routes that lead on to them, so the safety of pedestrians is not threatened.

5.8 Signs, Signals and Road Markings

By law, traffic routes must also be suitably indicated where necessary for reasons of health or safety. Install clear signs to tell drivers and pedestrians about the routes they should use. Where signposts are used, they should be constructed to Highway Code standards. Make sure signs are kept clean and visible. Access at all times should be safe and unobstructed.

5.9 Parking

As far as possible, keep parked vehicles out of the flow of traffic and people. Inform drivers of parking areas as soon as they enter the site. Lay out parking areas to reduce maneuvering and reversing for large vehicles.

5.10 Loading Areas

There should be enough space in loading areas for vehicles to move safely and for people to move around. Anyone not involved in loading or unloading should be kept away from loading areas. There should be sufficient turning space to allow an adequate turning circle for tractor and trailer. Any area of the site used for maneuvering, vehicle parking or open storage should be adequately surfaced for the intended purpose.

Statutory Notices

6.1 General

The management of Health & Safety at Work Regulations 1999, requires that employers shall make a suitable and sufficient assessment of the risk to staff, visitors and contractors which include Manual Handling, Display Screen Equipment, COSHH, First Aid and Working at Height Regulations. The following Health & Safety notices are required to be displayed, dated and relevant.

- i. Health & Safety Law Poster
- ii. Employers Liability and Public Liability Certificates
- ii. COSHH information signage
- iv. Electric Shock signage
- v. Safety Policy



All safety signage, i.e. First Aid, Fire Exits, No Smoking signs meet the standards of Health & Safety (Signs & Signals) Regulations 1996

Warehouse Racking

- 7.1 Racking should only be installed by competent people and in accordance with the manufacturer's instructions.
 - 7.2 Racking installation should be inspected on a regular basis by a trained nominated person responsible for racking safety.
 - 7.3 All damage to racking should be reported to the nominated person for inspection and or repair.
 - 7.4 A technically competent person should carry out inspections at intervals not exceeding 12 months with a written report submitted to the nominated person for actions. (Ref 6)
- 8.2 First aiders should be provided in sufficient numbers and at appropriate locations. High risk areas will need more than the one first aider to 50 personnel as suggested by the ACOP.
 - 8.3 Persons should be selected as first aiders depending upon reliability, skills, and ability to cope in an emergency. Training of first aiders should be by a Health and Safety Executive approved body.
 - 8.4 The level of equipment will depend upon a number of factors as identified in serial 8.1, but will range from a simple fully stocked, in-date first aid container to a suitable first aid room. An accident book in the approved format shall be available.

Health and Safety (First Aid) Regulations 1981

- 8.1 An assessment of the first aid needs appropriate to the circumstances of each workplace will be required. This should take into account factors such as, the workplace hazards and risks, the size of the organisation, the organisation's history of accidents, the nature and distribution of the workforce, the remoteness of the site from emergency services, the needs of travelling, remote and lone workers, employees working on shared or multi-occupied sites and annual leave/ other absences of first aiders and appointed persons.

Provision and Use at Work Equipment Regulations 1998

- 9.1 Work equipment shall be maintained in an efficient state, good working order and in good repair by competent persons. Maintenance logs are required to be kept.
- 9.2 All staff that use or manage work equipment will be required to have adequate information, instruction and training in its use. Instructors of work equipment shall be trained to a nationally recognised accredited training standard approved by the HSE.

Lifting Operations and Lifting Equipment Regulations 1998

- 10.1 Machinery for lifting loads shall be clearly marked to identify its safe working load.



10.2 Every lifting operations shall be planned by a competent person, supervised and adequately controlled.

10.3 All lifting equipment that lifts persons and lifting accessories must be thoroughly examined by an independent person every 6 months.

10.4 All defects on lifting equipment shall be reported to the employer and any person from whom the equipment was hired or leased. Once notified of a defect the employer shall not use the lifting equipment until the defect is rectified.

Display Screen Equipment Regulations 1992

11.1 The regulations are intended for those who are users i.e. using equipment for a significant part of their working day.

11.2 A suitable and sufficient analysis of all workstations is required to assess the health and safety risks to those who are involved with display screen work.

The Regulatory Reform (Fire Safety) Order 2005

12.1 A responsible person must make a suitable and sufficient risk assessment for the purpose of identifying general fire precautions.

12.2 When undertaking a fire risk assessment firefighting equipment must be protected against frost and accidental damage. There should be nothing stored against the side of the building both inside and out and all accesses must be kept free of obstructions. All flammable material

must be kept away from walls. Upon completion, the fire risk assessment findings must be recorded.

12.3 Consideration with regard to the size of the business and the nature of its activities. Effective planning, organisation, control, monitoring and review of preventative and protective measures shall be undertaken. A competent person must be appointed to assist in the measures to be undertaken.

12.4 Employees shall be provided with information on the risks to them as identified in the risk assessment, the preventative and protective measures, the procedures in place and the identities of persons nominated to implement safety measures.

12.5 All employees must be provided with safety training both at induction and updated at periodical intervals throughout a calendar year.

12.6 Records in an acceptable format and in accordance with the relevant regulations must be kept on fire bell testing, fire drills and portable fire-fighting equipment.

The Pollution Prevention and Control Act 1999

13.1 To regulate activities which are capable of causing any environmental pollution. To prevent or control emissions capable of causing any such pollution



The Environmental Protection Act 1990 Part II (Waste)

14.1 Section 34 imposes a "duty of care" on anyone that imports, produces, carries, keeps, treats or disposes of "controlled" waste. Controlled wastes are defined in section 75 as household, industrial or commercial wastes.

14.2 The Environmental Protection Act 1990 Part III Sets out the regime for local authorities (or individuals) to take action against a range of nuisances defined as statutory nuisances. The definition includes any dust, steam, smell, or other effluvia arising on trade or business premises; and also smoke emitted from premises, where it is prejudicial to health or a nuisance.

The Environmental Protection (Duty of Care) Regulations

15.1 Section 34 of the Environment Act 1990 imposes a "duty of care" on anyone who produces, imports, carries, treats, keeps or disposes of controlled wastes. This therefore includes industry and commerce as producers and holders of such waste, though householders are exempt from the duty (for their own household waste).

15.2 Controlled waste must only be transferred to authorised persons (e.g. registered waste carriers) and such transfers must be accompanied by "transfer note" documentation. The regulations set out the requirements for a mandatory system of transfer notes and record keeping

requirements. The regulations specify the details that are to be completed on the transfer note. They require that transferors and transferees retain the documentation for two years and to furnish copies to the regulator if required. The enforcing agency for this is the Environment Agency.

The Hazardous Waste Regulations

16.1 Sets out the technical procedures for determining which wastes are hazardous, together with the extra controls required for such waste. The definition is based on a set of procedures using the hazardous waste list, and/or the presence of prescribed hazardous properties. The regulations set out the procedures concerning the transfer of hazardous waste including the form of the consignment note (this replaces the "duty of care" transfer note) its unique coding and the pre-notification requirements. Consignors (producers) of hazardous waste must notify the Environment Agency at least three days before the waste is to be moved. The regulations allow a "season ticket" arrangement for repetitive movement of waste between the same parties. Producers and carriers must keep registers of consignment notes for five years.

Producer Responsibility Obligations (Packaging Waste) Regulations

17.1 Made under the Environment Act 1995 Part V. place obligations on certain businesses to register with the Environment Agency, to recover and recycle specific tonnages of



packaging waste to certify that these recovery and recycling obligations have been achieved. Obligated businesses are those undertaking prescribed packaging activities (material manufacture, converting, packing/filling and the sale of packaged products to the final consumer), own the packaging, supply another stage in the packaging chain and come above specified thresholds (based on annual turnover and materials handled).

Waste Management Licensing Regulations

18.1 These prescribe the waste disposal and waste recovery operations including certain waste storage, handling and treatment operations that require a waste management licence. The regulator is the Environment Agency.

Contaminated Land Regulations

19.1 Contaminated land is defined as land which appears to be in such a condition, that by any reason of circumstances in, on or under land, significant harm may be or is being caused, or pollution of controlled waters is being or is likely to be caused. "Harm" is clarified as actual or potential damage to the health of living organisms, interference with ecosystems and includes damage to property.

The Waste Electrical Equipment Regulations 2007

20.1 The Waste Electrical and Electronic Directive (WEEE Directive) aims to minimise the impact of electrical and electronic goods on the environment, by increasing re-use and recycling and reducing the amount of WEEE going to landfill. It seeks to achieve this by making producers responsible for financing the collection, treatment and recovery of waste electrical equipment, and by obliging distributors to allow consumers to return their waste equipment free of charge.

Miscellaneous

21.1 Office Administration

Evidence of documentation relating to accounting, stock control, inwards/outwards passage of goods. An up-to-date visitor's book shall be available.

21.2 Maintenance

Pallets, post pallets, racking, mezzanine floor equipment together with other small items of equipment should be kept in a clean sound condition and inspected regularly.

21.3 Specialised Storage

All specialised storage must comply with relevant regulations (e.g. COMAH)

21.4 Pest Control

Adequate measures for controlling pests, especially if food is stored.



21.5 Control of Major Accident Hazards Regulations 1999 (COMAH)

Operators of all establishments subject to the Regulations must notify certain basic details to the Competent Authority. The key points which have to be included in the notification are given below but full details are given in Schedule 3 to the Regulations.

- name and address of operator
- address of establishment
- name or position of person in charge
- details of dangerous substances on site (a breakdown is required for petroleum products)
- site activities
- environmental details



10. Major Resources

10.1 International Organizations

- World Health Organisation (WHO)
<http://www.who.org>
- American Society of Safety Engineers (ASSE)
<http://www.asse.org/>
- Council of Supply Chain Management Professionals (CSCMP)
<http://www.cscmp.org/>
- Institute of Industrial Engineers (IIE)
<http://www.iienet.org/>
- International Association of Refrigerated Warehouses (IARW)
<http://www.gcca.org/about-us/partners/iarw/>
- International Warehouse Logistics Associations (IWLA)
<http://www.iwla.com/>
- International Society of Logistics (SOLE)
<http://www.sole.org/>
- Occupational Safety and Health Administration (OSHA)
<http://www.osha.gov/>
- Warehousing Education and Research Council (WERC)
<http://www.werc.org/>

10.2 Local Authorities

- Economic Planning Unit (EPU), Prime Minister's Office
<http://www.epu.gov.my/en>
- Ministry of Energy, Green Technologies and Water (KeTTHA)
<http://www.kettha.gov.my/portal/index.php#>
- Ministry of Urban Wellbeing, Housing and Local Government
<http://jkt.kpkt.gov.my/english.php>
- Ministry of Works (KKR)
<http://www.kkr.gov.my/en>
- Ministry of Science, Technology and Innovation (MOSTI)
<http://www.mosti.gov.my/en/>
- Ministry of Health (KKM)
<http://www.moh.gov.my/english.php>
- Ministry of Human Resources (KSM)
<http://www.mohr.gov.my/index.php/en/>
- Ministry of National Resources and Environment (NRE)
<https://www.nre.gov.my/en-my/Pages/default.aspx>
- Department of Occupational Safety and Health (DOSH)
<http://www.dosh.gov.my/index.php/en/>

- Energy Commission, Malaysia
<http://www.st.gov.my/index.php/en/>
- Department of Standards, Malaysia
<http://www.jsm.gov.my/home>
- Malaysian Institute of Architects
<http://www.pam.org.my/>
- The Institution of Engineers, Malaysia
<http://myiem.org.my>
- Fire and Rescue Department of Malaysia
<http://www.bomba.gov.my/english.php>
- Petronas
<http://www.petronas.com.my/Pages/default.aspx>
- Tenaga Nasional Berhad
<https://www.tnb.com.my/>

- **Local Governments (City Hall or Council)**

1. Kuala Lumpur City Hall / Dewan Bandaraya Kuala Lumpur
2. Alor Setar City Council /Majlis Bandaraya Alor Setar
3. Penang Island City Council /Majlis Bandaraya Pulau Pinang
4. Ipoh City Council / Majlis Bandaraya Ipoh
5. Shah Alam City Council / Majlis Bandaraya Shah Alam
6. Petaling Jaya City Council /Majlis Bandaraya Petaling Jaya
7. Malacca City Council /Majlis Bandaraya Melaka Bersejarah
8. Johor Bahru City Council /Majlis Bandaraya Johor Bahru
9. Kuala Terengganu City Council /Majlis Bandaraya Kuala Terengganu
10. Kota Kinabalu City Hall / Dewan Bandaraya Kota Kinabalu
11. Kuching North City Hall / Dewan Bandaraya Kuching Utara
12. Kuching South City Council /Majlis Bandaraya Kuching Selatan
13. Miri City Council /Majlis Bandaraya Miri

- **Local Governments (Municipal Council)**

1. Kangar Municipal Council / Majlis Perbandaran Kangar
2. Kulim Municipal Council / Majlis Perbandaran Kulim
3. Langkawi Municipal Council / Majlis Perbandaran Langkawi
4. Sungai Petani Municipal Council / Majlis Perbandaran Sungai Petani
5. Seberang Perai Municipal Council / Majlis Perbandaran Seberang Perai
6. Manjung Municipal Council / Majlis Perbandaran Manjung
7. Kuala Kangsar Municipal Council / Majlis Perbandaran Kuala Kangsar
8. Taiping Municipal Council / Majlis Perbandaran Taiping
9. Teluk Intan Municipal Council / Majlis Perbandaran Teluk Intan
10. Ampang Jaya Municipal Council / Majlis Perbandaran Ampang Jaya
11. Kajang Municipal Council / Majlis Perbandaran Kajang
12. Klang Municipal Council / Majlis Perbandaran Klang



13. Sepang Municipal Council / Majlis Perbandaran Sepang
14. Selayang Municipal Council / Majlis Perbandaran Selayang
15. Subang Jaya Municipal Council / Majlis Perbandaran Subang Jaya
16. Seremban Municipal Council / Majlis Perbandaran Seremban
17. Port Dickson Municipal Council / Majlis Perbandaran Port Dickson
18. Nilai Municipal Council / Majlis Perbandaran Nilai
19. Hang Tuah Jaya Municipal Council / Majlis Perbandaran Hang Tuah Jaya
20. Alor Gajah Municipal Council / Majlis Perbandaran Alor Gajah
21. Jasin Municipal Council / Majlis Perbandaran Jasin
22. Johor Bahru Tengah Municipal Council
23. Batu Pahat Municipal Council
24. Kluang Municipal Council
25. Kulai Municipal Council
26. Muar Municipal Council
27. Pasir Gudang Municipal Council
28. Kuantan Municipal Council
29. Temerloh Municipal Council
30. Bentong Municipal Council
31. Kemaman Municipal Council
32. Dungun Municipal Council
33. Kota Bharu Municipal Council
34. Kudat Municipal Council
35. Sandakan Municipal Council
36. Tawau Municipal Council
37. Padawan Municipal Council
38. Sibu Municipal Council
39. Bintulu Development Authority

- **Local Governments (District Council)**

1. Baling District Council,
2. Bandar Baharu District Council,
3. Kubang Pasu District Council,
4. Padang Terap District Council,
5. Pendang District Council,
6. Sik District Council,
7. Yan District Council
8. Kampar District Council,
9. Grik District Council,
10. Kerian District Council,
11. Batu Gajah District Council,
12. Lenggong District Council,
13. Pengkalan Hulu District Council,
14. Perak Tengah District Council,
15. Selama District Council,



16. Tanjung Malim District Council,
17. Tapah District Council
18. Hulu Selangor District Council,
19. Kuala Langat District Council,
20. Kuala Selangor District Council,
21. Sabak Bernam District Council
22. Kuala Pilah District Council,
23. Jempol District Council,
24. Jelebu District Council,
25. Rembau District Council,
26. Tampin District Council
27. Kota Tinggi District Council,
28. Labis District Council,
29. Mersing District Council,
30. Pontian District Council,
31. Segamat District Council,
32. Simpang Renggam District Council,
33. Tangkak District Council,
34. Yong Peng District Council
35. Cameron Highlands District Council,
36. Jerantut District Council,
37. Lipis District Council,
38. Maran District Council,
39. Pekan District Council,
40. Raub District Council,
41. Rompin District Council,
42. Bera District Council
43. Bachok District Council,
44. Gua Musang District Council,
45. Ketereh District Council,
46. Dabong District Council,
47. Kuala Krai District Council,
48. Machang District Council,
49. Pasir Mas District Council,
50. Pasir Puteh District Council,
51. Tanah Merah District Council,
52. Tumpat District Council,
53. Jeli District Council
54. Besut District Council,
55. Hulu Terengganu District Council,
56. Marang District Council,
57. Setiu District Council
58. Beaufort District Council,
59. Beluran District Council,
60. Keningau District Council,



61. Kinabatangan District Council,
62. Kota Belud District Council,
63. Kota Marudu District Council,
64. Kuala Penyu District Council,
65. Kunak District Council,
66. Lahad Datu District Council,
67. Nabawan District Council,
68. Papar District Council,
69. Penampang District Council,
70. Ranau District Council,
71. Semporna District Council,
72. Sipitang District Council,
73. Tambunan District Council,
74. Tenom District Council,
75. Tuaran District Council,
76. Pitas District Council,
77. Putatan District Council
78. Bau District Council,
79. Betong District Council,
80. Dalat and Mukah District Council,
81. Kanowit District Council,
82. Kapit District Council,
83. Lawas District Council,
84. Siburo District Council,
85. Lubok Antu District Council,
86. Meradong and Julau District Council,
87. Lundu District Council,
88. Marudi District Council,
89. Matu and Daro District Council,
90. Samarahan District Council,
91. Saratok District Council,
92. Sarikei District Council,
93. Serian District Council,
94. Simunjan District Council,
95. Sri Aman District Council,
96. Subis District Council,
97. Limbang District Council

- **Local Governments (Special Authority)**

1. Labuan Corporation (PL)
<https://www.pl.gov.my/en/perbadanan-labuan>
2. Putrajaya Corporation (PPJ)
<http://www.ppj.gov.my/>



3. South East Johor Development Authority (KEJORA)
<http://www.kejora.gov.my/en/>
4. Tioman Development Authority (LPT)
<http://www.tioman.gov.my/index.html>
5. Kulim Technology Industrial Park Local Authority
<http://www.pbttphk.gov.my/en>

10.3 Publications

- 1) Guide to Sizing Warehouse Aisles for Various Types of Lift Trucks. by Edward Brown. WarehouseIQ.com, October 8, 2011.
<http://warehouseiq.com/forklift-aisle-dimensions-guide/>
- 2) Rules of Thumb for Warehousing and Distribution Equipment Costs by Gross & Associates.
<http://www.grossassociates.com/>
- 3) Time, Space & Cost Guide to Better Warehouse Design by Maida Napolitano and Gross & Associates.
<http://www.grossassociates.com/timespace.htm>
- 4) UFC 4-440-01 Warehouses and Storage Facilities
http://www.wbdg.org/FFC/DOD/UFC/ufc_4_440_01_2014.pdf
- 5) Warehousing Profitably by Kenneth Ackerman. Third Edition. The Distribution Group, 2011.
http://www.distributiongroup.com/warehousing_profitably.php

10.4 MS - Building Codes, Regulations & Standards: Minimum, Mandatory

Buildings

- Street, Drainage and Building Act (1974)
- Uniform Building By-Laws (1984)
- Building (Federal Territory of Kuala Lumpur) By-Laws (1985)

Malaysian Standards (MS)

- Standards of Malaysia Act (1996)

Minimum Codes

Electrical:

- MS 1979 - (Electrical Installations of Buildings – Code of Practice)



Energy:

- MS 1525 - (Code of Practice on Energy Efficiency and Use of Renewable Energy for Non-Residential Buildings).
- ASHRAE 90.1 is widely applied.
- Petroleum Development Act, 1974
- National Petroleum Policy, 1975
- National Depletion Policy, 1980
- Electricity Supply Act, 1990
- Gas Supply Acts, 1993
- Electricity Regulations, 1994
- Gas Supply Regulation, 1997 and
- Energy Commission Act, 2001

Water and Sanitation:

- MS 525 - (Specification for Concrete Porous Pipes for Under Drainage),
- MS 881 - (Specification for precast concrete pipes and fittings for drainage and sewerage),
- MS 1193 (Specification for Devices without Moving Parts for the Prevention of Contamination of Water by Backflow).
- MS 2015 (Public Toilets),
- The Sewerage Act 1994
- The National Standard for Drinking Water Quality (Version 2, Jan 2004) issued by Ministry of Health.
- The National Water Services Commission Act
- Water Services Industrial Act 2006
- MS 1058 - (Polyethylene piping systems for water supply),

Mechanical Systems:

- Guidelines for Mechanical System Design and Installation issued by Public Works Department, 2011

Indoor Air Quality:

- The Standard on Indoor Air Quality, issued by Department of Occupational Safety and Health, 2005

Lighting:

- Code of practice on Occupational Safety and Health, issued by Department of Occupational Safety and Health
- Lighting Design Standards developed under ISC F



Fire:

- Malaysian Standards (MS) for fire safety in building are referred in the Uniform Building By-Laws (1984), Building (Federal Territory of Kuala Lumpur) By-Laws (1984), and Fire Services Act (1988).

Structural:

- MS for Structural Standards are referred to in the Uniform Building By-Laws (1984) and Building (Federal Territory of Kuala Lumpur) By-Laws (1984), covering standards on loading requirements, material use, spatial loading standards, weight of partitions, stacking, roof design, dynamic loads etc.
- MS developed under ISC D: MS 416, MS 977, MS IEC 8124, MS 544, MS 1294, MS 1057, MS 229, MS 1933, MS 1195, MS 1226, MS 1553, MS 1314, MS 1490.

Location / Siting / Zoning and Environment:

- Town and Country Planning Act (1976, amended in 2006).
- National Policy on the Environment, 2002
- Environmental Quality Act 1974-2011,
- Fisheries Act, Land Conservation Act,
- Local Government Act,
- National Forestry Act,
- National Park Act,
- Protection of Wildlife Act,
- Radioactive Substances Act,
- Water Enactment Act,
- Sarawak Biodiversity Center Ordinance,
- Sabah Biodiversity Enactment,
- Sarawak Natural Resources and Environment Ordinance,
- Sabah Environmental Protection Enactment, and
- Sabah Forest Enactment, Sarawak Forest Ordinance.

Safety:

- Occupational Safety and Health Act 1994
- Uniform Building By-Laws and the Building By-Laws (1984)

Green Building Codes:

- The Green Building Index (GBI)





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ISBN 978-967-17330-2-8



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Ministry Of Transport A Practical Toolkit
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