Warehousing Techniques

for Imported Goods

(Guide No. 8)

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Textbook on warehousing operations (in a series on import management and purchasing techniques, prepared for developing country importers) discusses warehousing of imports: objectives and functions of warehousing; warehouse planning, costs and economics; building and stockyard design, layout and structure; warehousing of hazardous goods; warehouse structure; warehouse administration and control; training and staff development. Annexes include reference data.

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(Free to developing countries)

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CONTENTS

Introduction

CONTENT AND SCOPE OF THIS GUIDE

Warehousing Techniques **are the systematic ways and means of receiving, storing, protecting and issuing articles and commodities for future use. This Guide covers most stages in the process of warehousing imported goods and shows how good techniques can improve the efficiency and economy of a warehousing organisation. The main topics are listed in the box:**

The Guide is directed particularly to organisations in developing countries and considers the kind of problems that many of them have to face. Warehouses in these countries generally contain a high proportion of imported goods - chemicals, foodstuffs, industrial equipment, pharmaceuticals, spare parts and accessories. Imports may have to be transported over great distances, often on surface routes of poor quality. They sometimes need to be transshipped several times from one type of carrier to another. Delays in transportation are common. Delays in delivery or difficulties with customs clearance can make matters worse.

With these problems in mind, importers may order more goods at a time than

are needed for immediate use. Sometimes goods are bought in bulk because bulk orders offer better purchase terms. This "excess" stock has to be stored. If goods are to remain safe and in good condition, they must be stored with the greatest care.

Efficient warehousing is therefore extremely important if the precious foreign exchange invested in imported goods is not to be wasted. Techniques for more efficient warehousing will reduce the amount of loss, damage and waste which add to the cost of imports and slow down industrial production. The techniques suggested do not require enormous investments of capital; they are largely organisational and can be adopted in most places.
Although it covers most of the warehousing process, a short guide like this cannot deal with every aspect of this broad subject. For instance, it does not consider the storing of special items for which manufacturers give explicit instructions.

It is intended primarily for people working in the public sector, but will be equally useful to those in private organisations.

PART I

PURPOSE, OBJECTIVES

AND

TYPES OF WAREHOUSING

Chapter 1

WAREHOUSING:

A PART OF MATERIALS MANAGEMENT

Warehousing **is just one element in the chain of interdependent activities known as** ***materials management.*** **Warehousing is the part of materials management concerned with the storage of the kind and quantity of goods that consumers and users require.**

Materials management includes:

- **inventory control**
- **customs clearance**
- **purchasing**
- **handling**
- **inspecting goods**
- **storage**
- **insurance**
- **internal distribution to users**
- **transportation**
- **recycling/disposal of scrap and waste**

As one stage in the process of managing materials, warehouses must work in co-operation with other departments. The aims of warehouse managers must therefore be in line with the policies of other departments, such as finance and marketing.

The main aim of warehouse management will therefore be for the warehouse to fulfil its functions with economy, speed and efficiency. A logical layout will help. This should be designed to suit the types of goods in store and the patterns in which they are received and issued. Storage location systems should enable orders to be put together and made ready for distribution when they are wanted. Stock has to be maintained in good condition and handled with care. Arrangements have to be made to dispose of damaged or obsolescent items.

Good warehousing techniques can contribute greatly to the effective use of finance made available for imports. If fewer goods are lost, damaged, allowed to deteriorate or go to waste, great savings can be made to a country's economy.

Chapter 2

PURPOSE AND OBJECTIVES

OF WAREHOUSING

2.1 Why are goods stored in warehouses?

The purpose of any warehouse or storage area is to store materials and products of the type and value that users want and in the quantities they need. Materials should be available in stock at the time and place they are required. The reasons for holding materials in stock can be grouped into six main categories:

(1) To create a buffer stock

Buffer stock is the most common type. This is stock which may be bought from suppliers in large, convenient or economic quantities - by ship or full container load, for instance.

It is held in store as a buffer between supplier and user. In this way warehouses try to keep materials in stock which are needed for production. The aim is to avoid hold-ups between one assembly operation and another.

(2) To create a safety stock

Deliveries may be uncertain and demand for materials may be unpredictable. Delays due to transport or other difficulties may mean the lead time between ordering and receiving goods is long or irregular. A certain quantity of materials is usually held as safety stock to ensure that enough is available for users as they need it. The amount of an item retained as safety stock is often relative to its importance to continuing operations.

(3) To hold insurance stock

Large electric motors in operating machinery or engine blocks may not wear out or need to be replaced regularly. Their sudden failure, however, could cause a major breakdown and replacements would then be a matter of great urgency. Items like these are held as *insurance stock*.

(4) To store seasonal stock

Storage space is given to commodities which are produced or imported seasonally - maize, rice, millet or wheat, for example. Other supplies which are received in bulk but issued usually over a short season only have also to be accommodated. Seeds and fertilisers are examples of products usually needed at set times of the year.

(5) To accommodate strategic stock

Strategic stocks are local or imported items stored in readiness for a future project. Cement for a planned building project, bitumen for road construction or vaccines for a forthcoming health campaign would all be regarded as strategic stocks. The term *strategic stocks* also often refers to inputs and products critical to the needs of core industry or to the health and security of the country. Life-saving drugs would fall into this category.

(6) To hold trading stock

Sometimes large quantities of a product or commodity are bought because their market value is expected to increase. Prudent buyers may do this to avoid the higher prices which may come. Speculators may buy in the hope of making a greater profit later on.

"Dead stock" - the negative side

Unfortunately, a lot of warehouse space is taken up with neglected or obsolete items. Too often unwanted items accumulate for which no-one will take responsibility. This *dead stock* should not be allowed to take up valuable warehouse space. It should be removed.

2.2 The objectives of good warehousing

The 4 main objectives of a warehouse must be:

(1) To protect goods

- To protect all categories of stock from damage by careful storage and handling.

- To prevent goods deteriorating by providing the correct storage conditions.

- To prevent goods being lost or stolen by adhering to strict security regulations.

(2) To keep records

- To keep an accurate and updated record of items received, items in stock and items issued.

- To keep management informed of all movements of stock.

- To give an account of transactions to users on request.

(3) To provide a service

- **To issue goods quickly and efficiently to users.**

- **To distribute goods efficiently to other places.**

(4) To ensure a steady supply

- **To provide a constant source of supply of consumer items in short supply - sugar, kerosene, grain, textiles etc. [This discourages people from hoarding goods or profiteering].**

- **To provide materials, equipment and spares to industry so that production is not held up.**

Chapter 3

WAREHOUSING IMPORTS

AT POINTS OF ENTRY

3.1 Causes and costs of delay

Imported goods arrive at seaports, airports, and at border points on rivers, canals or land routes. Goods may be delayed at any of these entry points and at any stage between their initial arrival and their delivery to their final destination. There may be delays in off-loading, in sorting and inspecting, in storing or in delivering them to the consumer or user.

Some of the most common reasons for delay are:

- **Complex documentation**
- **Slow procedures for clearing and forwarding**
- **Poor warehouse organisation**
- **Inadequate transport or infrastructure**

The cost of such delays hits importers particularly hard for two main reasons:

- **Importers often pay for their goods months before they receive them.**
- **Importers make no return on their expenditure until the goods are available for use.**

How can warehouse personnel help reduce delays and keep costs down? They can improve efficiency at each stage:

- **by liaising closely with suppliers and purchasing departments;**
- **by co-operating with clearing and forwarding personnel;**
- **by improving inventory control;**
- **by siting warehouses in strategic places;**
- **by competently storing and handling goods.**

3.2 Shipment, specification, packing, documentation*

A good inventory control will reveal which products are needed and what quantities are the most viable. From this, purchasing departments should be able to specify exactly what goods they wish to order, the type and dimensions of packing and the documents that will be required.

*** For more information about *Purchasing, Inventory Control* and *Shipping* see other ITC Guides on these subjects.**

(1) Specification

To avoid mistakes, purchasing departments must give suppliers precise specifications about the goods they order. They must describe every item in detail on the order form, clearly writing down any catalogue or other reference number.

(2) Packing

Details of packing should be conveyed to the supplier. What type of packaging is required? What are the dimensions needed for both individual packages and outer container? If purchasing departments are well-informed, they will know the preferences of their customers. They will also know which shapes and sizes can be stored and handled the most easily. Do the boxes fit in the bins? Does the port of entry have the handling facilities to unload a forty-foot container?

Instructions should be given to the supplier or forwarder about how the packages should be marked. Many a delay has been caused because the name and location of the receiver had not been marked clearly or correctly.

(3) Documentation

Again, the purchasing department must give precise directions about all the documents that will be needed. To whom and where should invoices be sent? What are the instructions about bills of lading, waybills, certificates of inspection and certificates of origin?

3.3 Warehousing at seaports

In an ideal world, warehouses would not be needed at seaports. Consignments would be off-loaded directly onto waiting trucks, railway wagons or barges and taken straight off to their ultimate destinations. This would be particularly true for commodities or goods arriving as full container loads (FCLs).

In the real world things do not always run so smoothly. Goods may have to be accommodated temporarily in the port area for two main reasons:

- **The right number or type of trucks or railway wagons are not available for onward transportation at the time a ship is discharging its cargo.**

- **There may be delays in completing documents or satisfying port or customs formalities. For example, goods may have to wait before they are assessed for import duties. Damaged consignments may have to wait before they are inspected for insurance purposes. The documents themselves may not be in order.**

Delays are costly. Holding up a ship in port incurs expensive demurrage charges. Keeping goods "stored" in railway wagons also runs up charges. In addition to these direct costs are the indirect costs accruing to the importer who is not receiving any return on his goods and who may well be paying interest on the investment. Delays are even more disastrous for cargoes which can perish or deteriorate.

Fast off-loading and streamlined onward transportation will benefit importers, end users and a country's economy as a whole.

(1) Types of warehousing at sea ports

Transit warehouses or sheds

As more and more goods are transported in containers, and particularly of the Roll-on/Roll-off type, portside warehouses are used less and less. More typically, these port warehouses are used today for storing smaller items or packages *destuffed* from LCL* containers until they can be removed to other or final destinations. Seaports also have storage tanks for liquids and elevators for solids.

Bonded warehouses

Dutiable items for which the levy has to be paid before they can be removed are stored in bonded warehouses. A charge is made for this facility. Some ports limit the time in which goods can remain in bonded warehouses for the set rental. After the given period, interest may be charged on the outstanding duty.

Damaged packages may stay in bonded warehouses until they are inspected by port authorities, customs or insurance assessors.

Container yards

A great deal of quayside space is often needed for storing containers awaiting their onward journeys or return.

Open yards

Ports usually have an open area for cargoes which can be stored outside without deterioration - steel sheets or metal ingots, for instance. These yards must be kept secure.

(2) Storage charges

Port authorities make a charge for goods stored in warehouses, open yards or container areas. These demurrage rates are usually based on a shipping ton per day and chargeable after a period of free time (often 3 or 7 days, following the discharge of cargo from vessels).

On top of these rates, a *movement* charge, calculated in the same way, is made for moving cargo from the unloading to the storage area. A "customs warehouse" charge is also made for goods stored over an extended period.

The rising scale of charges aims to deter importers from using port facilities as temporary warehouses and to encourage speedy clearance. The revenue goes to port authorities.

*** LCL = less than container load**

3.4 Warehousing at airports

At airports, both handling and storage facilities are generally more sophisticated than they are at sea ports. Some reasons for this are:

- Goods have to be removed quickly from transit warehouses.
- Penalties for goods in storage are higher.
- Handling has to be more careful as packaging for airfreight is generally more delicate.
- Goods are often of greater value.

- The main documents needed for clearance usually accompany the goods, so clearance is fast - provided the importer has been informed of their arrival time.

3.5 Import Warehouses

Import warehouses are situated near sea ports, international airports and at overland entry points. The warehouse space and distribution services, particularly for bulky items, are usually cheaper than those within the port area.

Some warehouses are owned by large importing organisations for their own use; others lease out storage space. Whether an importer builds his own warehouse or leases space depends on how often he uses it and how much space he requires. He must analyse the relative costs over a period of time.

Import warehouses sometimes offer office accommodation for clearing and forwarding personnel. They can provide a base for monitoring incoming consignments.

3.6 At ports of entry for land-locked countries

Countries that are land-locked, or without direct access to the sea, have special problems in handling and warehousing imports. They have to make agreements with the country whose port of entry they use. Arrangements must be made about:

- the use of port facilities
- charges levied
- customs procedures
- the clearing and forwarding of goods

Such countries should investigate ways of streamlining the onward transportation of their imports from the foreign port of entry to their own warehouses at points of final distribution or use. To reduce cost and delay they might consider these alternatives:

- Setting up their own clearing and forwarding operation at the port of entry;
- Establishing their own warehouse there;
- Employing a reputable agent to undertake these services on their behalf;
- Finding other routes;
- Using alternative modes of transport.

Air transport, for suitable consignments, may prove more efficient and of comparable

cost in the long term. Loss and damage, and therefore insurance, are often less. Complications tend to be fewer and delays less likely.

If port handling facilities and road conditions allow, multi-modal transport, like Roll on/Roll off (Ro/Ro) containers, have advantages. A full container load (FCL) is less likely to suffer damage or theft than break bulk cargo. Handling costs and transit time will also be reduced.

3.7 Warehousing in Free Trade Zones

Free Trade Zones (FTZ) are generally close to import points. Imports which will be used within the FTZ for goods to be re-exported are allowed out of the port area and into warehouses in the FTZ without incurring customs duty or other import taxes. These warehouses are carefully controlled; their stocks are constantly monitored.

PART II

FUNCTIONS OF WAREHOUSING

Chapter 4

IDENTIFYING, INSPECTING AND RECEIVING GOODS

4.1 At marshalling areas

Before goods are received into the main storage area of a warehouse, they are placed in a "goods-in" marshalling area. Here they wait to be identified and inspected either by the officer in charge of this area, by a designated quality control inspector or by the user's representative.

Goods are checked to see that they comply with the specifications laid down in the order form. This is particularly important for goods which have been ordered for a specific purpose rather than for general stock and also for goods which will be issued directly to users without being entered into normal stock records and which are received only occasionally. Sometimes users will ask to inspect their own items at this stage - before they are accepted into stock.

An experienced storeman can do the job of inspecting low-value items which are ordered regularly - pipe fittings, bolts, tools, paints, hardware, to name a few. He can check these by comparing them with type sample items kept for this purpose.

Inspections should be quick and thorough. Goods should be kept in this marshalling area for as short a time as possible. There are good reasons for this:

- **Goods in marshalling areas are often not accepted as the responsibility of warehouse management, unless the marshalling area is within the bounded area of the warehouse and incoming carriers are checked at the gate.**

- **Goods cannot generally be issued until they are inspected and placed in stock.**

- **Items are more likely to be pilfered or damaged in the marshalling area.**

If delays are unavoidable at this point, goods should be held temporarily in a secure place of storage near the main warehouse. This may also apply to goods

waiting to be reclaimed or repacked or those for which an insurance claim has not been finalised. Some goods may need to be kept in a quarantine store before they are cleared and placed in stock.

4.2 Inspecting delivery vehicles

To enforce security at a warehouse, a duty officer should man a Gate Office. This Gate Officer would be responsible for:

- Completing meticulous records about vehicles entering or leaving the warehouse area. This applies to both suppliers' and the warehouse's own vehicles. In the record should be each vehicle's registration number, details of the delivery note, the name of the supplier and the times of arrival and departure.

- Giving all drivers clear directions. Drivers employed by external suppliers should be supervised all the time they are inside the warehouse security area.

- Searching departing vehicles to ensure they contain no unauthorised load.

4.3 Central receiving departments

(1) In a warehouse complex

Large organisations may have many warehouse buildings within a secure compound. Each may handle different commodities or groups of items. The advantages in having one Central Receiving Department are:

- **Small consignments awaiting inspection can be stored in a central receiving warehouse controlled by the Central Receiving Department. Once inspected, they can be taken to the warehouse allocated for that product.**

- **Vehicles delivering bulk or larger items - steel sections, pipes, cement, fuel oil or fertiliser, for example, - can be accompanied to their storage place by officers from the Central Receiving Department. These people would check the particulars on the delivery note against the order specification during off-loading, decanting or stacking.**

- **Delayed consignments awaiting the outcome of claims against supplier, carrier or insurance company would be received into safe custody by the central receiving department.**

Position of the Central Receiving Warehouse

Ideally this would be close to the entrance of the warehouse complex. It would then be in sight of security guards and the weighbridge, if there is one. Delivery vehicles would then report to the central receiving warehouse. Drivers would be supervised during their time in the complex by personnel from the Central Receiving Department.

(2) Receiving centres for subsidiary warehouses

In developing countries, bulk imports are often made for government ministries or large parastatal organisations. These bodies may have multiple distribution warehouses a long way from the point of import or production. Frequently goods are first accepted, inspected and sorted by a central warehouse complex. The required amounts of the bulk product are then sent to each subsidiary warehouse.

A major advantage of a central receiving centre is the control of shipping containers. Containers are released from port by the shipping lines on payment of a returnable deposit or some form of guarantee. Shipping companies charge high penalties for misplaced or delayed containers.

4.4 Receiving goods into main warehouses

Every item entering the warehouse must be properly documented. Usually a Goods Receipt Report is filled in; this is sometimes referred to as a Goods Receiving Note (GRN). [See Figure 1 for a simple example]. Precise records are needed for stock control, for accounts, for the purchasing department and any other department concerned.

Packages or individual items should be clearly marked with identification codes or descriptions, according to the stock control system in operation. They should also be marked with any information about restriction of issue.

Figure 1. Receiving report

4.5 Damage/shortage reports for insurance

Goods, in transit or in store, have to be insured against loss or damage. If the full complement of items ordered is not received (shortage) or if goods arrive damaged, compensation has to be claimed from the insurance company. Securing a satisfactory settlement, particularly against Marine Insurance, can be time-consuming and frustrating. However, the quicker the claim is put in and the more accurate the report, the greater is the chance of the claimant being compensated within a reasonable time.

(1) Damaged or short items supplied locally

If, on receiving goods from a local source, some items are found to be missing or damaged, the first thing to do is to segregate the defective unit or packages. This is the responsibility of the person authorised to sign for the receipt of the consignment.

Where packages are obviously damaged on the outside, the contents should be checked carefully. If it is not possible to check the contents immediately, the receiver should endorse the delivery note "damaged and unexamined". The transporter's representative should then countersign the endorsement.

The authorised receiver may choose to send the goods back. Alternatively, he may have been instructed to qualify his signature on the delivery note by writing a comment. If he has received the cases unopened, he may write "unexamined" or "are said to contain" on the document. It is doubtful whether such comments have any legal validity, but they may give the receiver some protection if the claim is disputed.

Once the loss or damage has been verified, it is best to notify the supplier straight

away. He can then make a claim against the carrier, the port authority or other parties. In many organisations, it is up to the purchasing department responsible for the commodity and for placing the order to contact the supplier. The earlier this is done the better. The "small print" on the back of the conditions of sale or the delivery note will normally stipulate a time limit in which claims should be made. Delaying beyond that time limit will invalidate any claim for compensation or replacement. To avoid time bar, a provisional claim could be lodged within the prescribed time with available details.

(2) Damaged or short imports

Damage/shortage discovered at port of entry

Any damage to or shortage of imported items discovered at the port of entry should be dealt with by the person in charge of Clearing and Forwarding. First he should verify the extent of the problem. Then he should follow the claim procedures according to the clauses set out on the Insurance Certificate.

Claim procedures normally require:

- A survey report from a Lloyd's or other specified agent for claim values above a stated amount.
- Notification of an intent to claim on all parties concerned.
- Examination and certification of loss or damage by customs authorities - this may help the receiver to have refunded some proportion of duties paid.
- Securing a shortlanding (shortage)/damage certificate from the carrier
- Any other action needed depending on the type of consignment.

Once these procedures have been completed and permission given by insurers, the consignment should be removed from the port area and taken to the receiving warehouse. With the defective consignment should go any instructions which might help protect the claim.

Too often consignments subject to insurance claims clutter up warehouse receiving areas for long periods. Closely co-operating with insurance agents can sometimes avoid having to retain goods in this way. However, if they have to be stored temporarily in receiving areas, they should be placed in the secure quarantine section.

Damage/shortage discovered on arrival at the warehouse

If there is nothing apparently wrong with the packaging, any damage, shortage or deterioration may not be discovered until the consignment reaches the warehouse.

Once evident, the defect should be verified immediately and claim procedures followed without delay.

Some large import organisations employ a permanent insurance or claims officer. Others employ one from a specialist firm. In either case it helps to have a trained person to see claim formalities through to their settlement.

(3) Reporting damage or shortage

The fact that goods have been lost or damaged may affect future plans for purchasing, finance and other departments. The consequences may also be of great significance to users. Reports of lost or damaged items should be detailed and accurate; they may have to be circulated to a number of interested parties. A simple Shortage/Damage Report is shown at Figure 2.

Figure 2. A simple shortage/damage report

Figure 2. A simple shortage/damage report

Chapter 5

STORING GOODS

5.1 Location of stock in a warehouse

(1) Questions discussed in this section

- Where shall we store different commodities and items of stock so that they are kept safe and in good condition?

- What storage system will make it quick and easy to retrieve goods for issuing to users?

- Which system will ensure that the items received first are issued first?

These issues are fundamental to good warehouse practice. They are related to warehouse design and layout [See chapters 14 and 15 in Part III].

The location of different items in a warehouse needs to be reviewed from time to time. A location pattern suitable for the past may not be suited to present volumes of goods or patterns of movement in and out of the warehouse. Demands change and so do products. To have high-demand items tucked away in inaccessible places means more time and effort is spent retrieving them. To have one building crammed and another with large empty
areas is hardly an efficient use of space.

(2) Storing different types of stock

Here are some criteria for positioning stock of various kinds.

Exterior or interior storage?
Whether to store an item inside the building or in a stockyard will depend on three things: the nature of the product, the climate and the amount of space available. Storekeepers need to know which materials can and which cannot withstand exposure to the local climate. Plastic pipes may be fine outside in temperate climates, but can distort in extreme heat. Other products may dissolve, rust, rot or crack if they are kept outside.

Bulk or *break-bulk* storage?
If goods are normally issued in bulk, they will be repacked and stored in cases or on pallets after checking. If other items are normally issued individually, it will be better

to *break bulk* after checking, and store them as individual packages or separate items. It may be necessary to store a product both ways to cater for the needs of different users.

If delivery of a small quantity from a counting or handling unit of a package becomes unavoidable, only one package should be opened at a time. The contents of this should be accounted for before the next package is opened.

What sized units?

Goods will be stored in units of issue that customers need most. Sometimes items may need storing in units of several sizes. If goods are ordered in quantity, manufacturers may agree to pack them in the units required.

5.2 Systems of stock location

The most common methods for storing goods are:

(1) By frequency of movement
(2) By groups of commodities
(3) By random, free space or spot location
(4) By a mixture of storage systems

(1) By frequency of movement - ABC method

The ABC, or Pareto, method of analysis is often applied to inventory control and also to sales and general management decision-making. In warehouse management, it is a means of grading groups of items according to their frequency of movement - how often they are brought in and issued out. The normal frequency pattern of movement often looks like this:

- A low percentage of the total number of items represents a high percentage of the total number of movements.

- Conversely, a high proportion of the total number of items represents a low percentage of the total number of movements.

Table 1 illustrates this pattern. It shows the movement of twenty commodity groups within a warehouse complex run by a Public Works Department. You will see that 10% of the listed items account for 70% of the total number of movements. These are classed as Category A items. Category B consists of 30% of the listed items which represent 20% of all movements. Category C, made up of the remaining 60% of all items, accounts for only 10% of the total number of movements. This pattern of movement suggests the following storage arrangement:

Category A items:
most accessible parts of warehouse
(greatest movement
closest to the distribution point.
frequency)

Category B items:
mid-accessibility points
(medium movement
frequency)

Category C items:
least accessible parts of warehouse
(infrequent movement) furthest from distribution point

NOTE: This analysis refers only to the frequency of movement of items in stock. It does not necessarily relate to their value, the storage capacity they occupy nor to their weights. It is possible that a high-value, bulky item may be issued to a user once a month, whereas a low-value, small item could move daily.

TABLE 1. ABC analysis of the movement of commodities in a Public Works Department warehouse

(2) By grouping commodities

Well-defined commodities of a reasonable and stable range could usefully be arranged in a logical sequence by commodity. Commodities needing special storage facilities, such as fuels, lubricants are often grouped in this way. So are various kinds of bulk grain or bulk cement. Grouping products of a technical nature is always advisable.

NOTE: It is most important that only compatible commodities are stored next to each other. Otherwise there is a risk of contamination, fire or deterioration - an appalling waste to users and commercially disastrous for the warehouse.

(3) Random, free space or spot location

Random stock location means stock is placed where there is space available for it in the warehouse. If this system is to work well, precise records must be kept. There are various means of controlling stock:

<u>By computer</u>
Computer software exists which can:
- record empty spaces
- place new intake close to existing stock of the same item
- regulate the pattern of outward movement to follow a first-in/first-out sequence

<u>By wall diagrams and charts to show stock movement</u>
Chart and diagrams can work with:
- movable tags
    - magnetic boards
- slotted or felt boards
    - *knobs* on wall boards and Lego-type blocks

The utmost care and supervision is needed to control any one of these stock record systems. Otherwise this random way of using space would result in chaos. While this method may achieve maximum use of space, it takes more time to locate random items than grouped items when staff are assembling an order (*order picking*).

(4) A mixture of storage systems

It may suit a multi-purpose warehouse to have a different location system for separate groups of goods or for different buildings. Some flexibility will be inevitable: heavy

or very bulky items cannot be placed safely on high shelves, for instance.

5.3 Location, coding and marking

Whichever location system is used, each area and each unit of storage must be immediately identifiable. All sections must be marked with a logical code number.

Two popular marking methods are:

<u>Alpha-numeric coding</u>: This can be used for racks, floor areas and stockyard spaces. Each section is numbered, so is each shelf and the storage space or bin on each shelf. [See Figure 3]

<u>Colour coding</u>: Shelf sequence and position, storage areas and hazard points are marked in coded colours.

An international colour code already exists to distinguish certain items. For transmission pipes, yellow is used for gas, blue for water and brown for diesel oil etc. Valves on tank chamber covers should always be painted in the correct colour to indicate their contents - mistakes are costly and dangerous.

FIGURE 3. Front elevation of a portion of racking, showing location marking

Chapter 6

STORAGE CONTROL

6.1 Marking stock

All stock received into the warehouse must be marked to identify each lot or consignment. The marked items will then be placed according to the location system selected, and according to size, packing, volume or type of material.

Details to be marked should include a description of the contents or a catalogue code number plus the quantity and date (or date code). This information may be written on a label attached to the item or on a bin tag on the place where the item will be stored. Closed cases should be marked on two adjacent sides.

Goods can be marked by manufacturers or suppliers according to the purchaser's instructions. Given precise instructions, they can print the necessary details on the labels, including an alpha-numeric code or a bar code (or both).

Bar code marking

Bar code technology has advanced a lot in recent years and is now used regularly in developed countries to identify products and speed up stock control.

A series of wide and narrow bands and spaces represent numbers and letters. These bar codes, in machine-readable format, can be printed on package labels or cases. They can also be specially printed on labels by a dot matrix, ink-jet or full character impact printer.

The codes are read by three main devices: a light pen, a fixed-beam reader and a moving-beam laser scanner. The readers are interpreted by a micro-processor decoder. Decoders can be used in a warehouse to record and identify goods received and goods issued. They can be linked to a computer which updates the inventory control data base, adjusting records of stock levels automatically. At any time, management can access data showing the current level of stock for each item.

6.2 Storage facilities

Each industry or organisation has particular requirements for storage. Whatever these requirements are, storage facilities must be adequate to hold the type, volume and

quantity of items to be stored.

In general, the main groups of imported items to be stored are:

- small components and accessories
- long loads - steel sections and the like
- loose bags, drums and cases
- palletised unit loads
- bulk liquids
- bulk solids

Suppliers offer an enormous range of products for storage and handling. Some are complex; most are expensive. Sturdy racks, pallets and shelves needed for storing most items can normally be made locally, using local materials.

(1) Bins

Steel shelving in the form of bins is popular for storing small components and accessories. Bins can be of various sizes, with or without dividers. Each bin usually has a label holder to take the bin tag which identifies the contents. Often constructed in fixed tiers on vertical supports with sliding runners, bins tend to be inflexible units of storage. More flexible are tote pans or boxes supported on shelves. These can be freely moved vertically or horizontally to accommodate items of different dimensions.

(2) Shelving

Many existing shelving units are rigid. They are often made of one of the following:

- Steel angles or tubular sections
- Timber vertical supports with wooden shelves (either self-supporting or braced with horizontal frame members)
- Slotted steel angles with corner brackets, locating nuts and bolts and other accessories to simplify erection
- Slotted steel angle sections with shelves of different materials according to the weight load

In theory, shelves of slotted steel angle are adjustable. In practice, their solid construction makes them difficult to dismantle. So much time and hard work has to go in to adjusting them that only the most determined storeman will bother to adapt them to suit changing storage needs.

More versatile is shelving designed so that the space between shelves can be easily changed. Some manufacturers make "boltless" shelf supports. These have horizontal

members with self-locking brackets which slot into specially designed vertical supports. Although these are usually well designed and finished, a do-it-yourself shelf structure could be made quite simply - given a little ingenuity and a few brackets and pins!

(3) Racking

Racking is made for two basic types of materials:

Simple materials: steel bars, rolls of material, pipes, shafting etc.
For unit storage: crates, cases and pallets

Racking for simple materials can be planned to suit the items to be stored. It can also allow for the space available and the handling facilities used. Long length sections can be stored vertically or horizontally. Racking can be of the cantilever type or honeycomb style.

Pallet racking can be fixed or adjustable. The fixed type has horizontal beams which will take most horizontal loads. Adjustable pallet racking can be space-saving. [See Figure 4]. However, if racking is adapted for pallets of different heights, planning the location of pallet loads could be a problem.

Figure 4. Fixed and adjustable racking

(4) "Live" storage racking

"Live" racking is constructed on a slope (approximately 5cm in 1m) so that each item in turn is fed by gravity to the point of issue. The horizontal members may have a sliding surface or be fitted with steel or plastic rollers or wheels. By keeping up a steady flow of the same item, live racking is an efficient way of storing goods which are issued constantly. [See Figure 5].

(5) Mobile storage racks

Hand-wheel track storage:
Some forms of mobile storage allow racks to be moved by hand-wheel along tracks set in a base plinth. This track system takes up little floor space. As only two faces of the rack are accessible at a time, space for one aisle only is needed.

This type of mobile storage is particularly useful in a large office for record files, stationery, reference books, catalogues or documents. If mobile storage racks are to be installed on an upper floor, the floor structure must be strong enough to take the load.

Power-driven storage:
Pallets can be stored on much larger power-driven racks with wheel bases or rail tracks set in the floor. These may be complete with infra-red safety beams, warning beacons and sophisticated controls. Advantages:

easier movement of large pallets

less floor space needed

Disadvantages: expensive and need maintaining

more difficult to load pallets on and off racks

Figure 5.
Storage systems

(6) Platform or mezzanine storage

Storage space on a platform or mezzanine floor makes good use of the height of a warehouse by adding a level. Storemen can usually reach even the top shelves of the racks to retrieve items by hand. Step ups can be fixed or portable.

Figure 6 shows high density storage racks on a platform or mezzanine floor. Normally there would also be racks on the ground floor, but for clarity these have been omitted. This illustration shows a solid mezzanine floor; an open mesh or grid floor would allow light and ventilation to the floor below. If the load of the mezzanine storage is not too great, racks on the ground floor could be used in part to support the mezzanine floor. This example has an independent beam support.

Mezzanine storage is ideal for small items, such as vehicle spare parts, which would be *picked* by hand.

(7) High bay racking

High bay racking is another way of using building height, although normal practice is to construct buildings to suit storage facilities. In some warehouses the racking actually forms part of the building structure.

This kind of racking, which can reach to heights of over 12 metres, is used in large industrial and commercial enterprises where space is at a premium. It is normally used for pallets or bulk containers, but can be adapted for many purposes. To conserve space even more, the access aisles are kept as narrow as possible. Along these aisles order-picking machines (either fixed-path or free-range) may run along rails at the base of the racks. This equipment costs a lot in capital investment. It is also costly to install as the floor and vertical tolerances have to be to exact specifications.

Figure 6.
High-density platform or mezzanine storage

(8) Automated storage systems and carousels

Some specialists design and supply automated storage retrieval systems for various specific tasks. The advanced technology they employ lies outside the scope of this Guide. Complex computer control systems, remote-controlled vehicles, automatic conveyors and pallet-loading carousels can be found in highly-automated warehouses in developed countries where labour costs are high. These high-tech *search retrieve and record systems* aim to improve efficiency and continuity of operations. This they may do. They also call for an immense investment of capital and sometimes a long period of frustrating trials before they are fully operational. Facilities for service and spare parts have also to be accessible.

(9) Drive-through pallet racking

This type allows for *block* racking of pallets. Here the pallets slide upon narrow shelves without horizontal bars. This means the fork-lift truck can drive right into (or through) the racks, providing the lower tiers are not full.
This saves space as fewer aisles are needed for handling. Racks must be erected with

great care as clearances and alignments have to be exact.

This system is useful only when a small range of stock is housed and where its pattern of movement is predictable as pallets at the back cannot be retrieved until those in front have been removed.

(10) Racks for specific purposes

Most warehouses will have some racks specially designed for storing particular products. Here are some examples:

- Formed racking for difficult shapes like vehicle exhaust systems
- Tubular racks for stacking tyres
- Drum racks with shaped stirrups or chocks for added stability

6.3 Strength and stability of racking

Every type of racking must be designed to fulfil its purpose safely. Faulty racking is a real hazard in a warehouse. An even greater danger comes from racking which has been assembled incorrectly, overloaded or used to do a job it was not designed for.

Following are some cautionary notes on the design and use of racking.

- **The higher the rack, the greater the cumulative load on the vertical columns.**

- **All sections used, be they timber or steel, and all fastenings and brackets must be strong enough to withstand the loads anticipated.**

- **Racks will be unstable if they are too high in relation to their depth or width. A rule-of-thumb ratio is:**
  16:1 (height:width) where two racks are fixed back to back
  8:1 (height:width) where they stand alone for double-entry

- **The safe working load should be clearly marked on all racks. This load should NEVER be exceeded.**

- **Adequate cross-bracing should be used at the sides and at the back of each rack.**

- **Floors must be strong enough to take the point load of the rack footing. It is wiser to spread the point load by using footplates of adequate size connected to the vertical support by gusset plates.**
- **Where possible, racks should be tied to the main building structure. Other racks should be tied to each other, either back-to-back or across the aisles.**
- **Where pallets are supported only by side rails (eg.drive-through racking), the pallets themselves must be strong enough to support the load they are carrying. A multi-point entry pallet shown as (d) in Figure 7 does not have the strength of a two-way entry pallet with solid side members.**

Figure 7. Pallets for storage

6.4 Free stacking

(1) Points to note

Stacking on the floor with or without dunnage is taken by many as *free stacking*. In many developing countries, a large variety of goods are commonly stacked this way. Developing countries have advantageously used this system to stack many commodities, including those stored in very large quantities. This system has merits depending upon local requirements and practices related to handling, transport, packaging, storage and distribution of goods. Millions of tonnes of goods of every description packed in bags, drums, tins, cartons, wooden boxes etc. are warehoused on the floor in India and remain safe and secure for long periods.

However, placing one item on top of another, or in layers, without any supporting structure can cause accidents. Just imagine a bag bursting or a case strap snapping as more weight is placed on top of it. What if the contents are harmful? Internal

combustion can occur in some substances if they are compressed for a long time - a fire risk to the whole warehouse.

To stack single items one upon the other in a column, or to place them in a row just one item wide with layers added on top is a recipe for disaster. Unless each item is wide with a low centre of gravity, the stack is bound to topple. Stacking items in blocks, pyramids, lean-to or spirals may be safer, but all free stacking should be done with thought and skill. Here are a few basic rules.

- Make sure the floor is strong enough to support the stack.
- Check that the floor is level.
- Protect the product from seepage from the floor.
- Use dunnage (wooden planks, used pallets, PVC sheeting, or other impervious inert materials) to arrest moisture and let in the air.
- Make sure the height of the stack is no more than three times greater than the narrow side of the base. Check stability regularly while stacking and particularly at five layers high.
- Assess how much load the lower layers will bear. If packages in the stack are of unequal size, the load applied to the larger packages in the bottom layer will be greater.
- Leave aisles on either side wide enough to allow handling equipment (particularly powered machines) or lorries to pass easily.
- Construct a tidy stack. Even a tidy stack can be badly designed and dangerous. However, neat stacks are easier to count and issue.

(2) Stacking bags

Organisations importing, storing and distributing large quantities of bagged products would benefit from having a warehouse designed specially for this purpose. National Storage Agencies, India, have designed such a warehouse of five thousand tonnes capacity. Originally developed to house foodgrains, it can be modified to accommodate many other commodities. The specifications for this structure allow for:

- proper ventilation
- moisture-proof floors
- leakproof roof
- protection against rodents
- fire precautions
- flood precautions
- disinfestation system
- easy

movement of vehicles

A large warehouse can be designed to comprise various compartments so that non-compatible grains and other commodities are segregated according to a prescribed code of storage practice for commodities. The floor of a compartment can be divided into stack or block areas of uniform size. These areas would be marked out on the floor by 2" lines painted in black or white. Generous aisle space must be left between the stacks and between the stack areas and the walls. The main aisle should be wide enough for haulage and any disinfestation operations.

A neatly built stack of bags should be a solid, compact cuboid shape. The stitched mouths of the bags should not face the outside perimeter of the stack. The height of the stack should be limited. Stack height depends on:

- physical and chemical properties of the commodity,
- packing material,
- height of the warehouse,
- load-bearing capacity of the floor, commodity & package,
- code of practices prescribed for the stored commodity (these will take local conditions into account).

Annex 1 lists the recommended maximum stack heights for different commodities stacked by hand in a standard warehouse (or godown) meant for storing foodgrain.

Three systems for stacking bags

These systems are also valid for wooden cases, bales or cartons.

Simple stacking Bags are stacked one upon the other as for column stacking. This is unstable for many layers.

Criss-cross stacking Bags are placed lengthwise and widthwise in alter nate layers. This is better for longterm storage and is also used for cover and plinth (CAP) storage.

[See 13.3(1)]

Block stacking Each layer is made of bags placed lengthwise and widthwise. The pattern of lengthwise and width wise bags is reversed in alternate layers. If a

stack is partly dismantled, the remaining bags are

left in a neat, compact, countable position.

A well-designed neat stack helps to preserve the commodity as well as making accounting easier.

(3) Bag-cum-bulk storage

Warehouses of suitable size and construction can be used for bag storage alone and for both bagged and bulk goods. For bag-cum-bulk storage, three or more rows of bagged goods are placed round the perimeter to form a holding wall. First, this "wall" should be covered with a PVC sheet (or similar material). Loose grain (or whatever product is also in the bags) is then poured into the contained area. Filling and emptying can be by hand or by mechanical contrivances.

(4) Stacking tins (eg. edible oil)

Edible oils are usually contained in tins or *debbies* of 17 kilos (4 imperial gallons approx). These flimsy containers of light-gauge metal tend to leak. To prevent oil leaking everywhere, the floor should be covered with PVC sheeting. On this should be placed galvanised steel (or similar) trays large enough to hold layers of thirty tins. The tins of oil will then be stacked in the trays in layers of 30 by 5 tins high. Oil leaking into the trays should be collected periodically and kept in drums for processing if it is permissible or possible. Otherwise it should be disposed of. Aisle space between the trays should allow enough room for the spillage to be collected. Sometimes tins are stored on dunnage of PVC sheet only. In this case, tins are better stacked pyramid fashion. Leaked oil should be mopped up from around the base.

(5) Stacking drums

Drums are made of steel, fibreboard, plastic or other materials. The strength of all drums lies in their circular cross section. If drums are stacked more than three tiers high, they should be placed horizontally. Oil drums should be laid with bungs upwards. To prevent them rolling sideways, they should be wedged with chocks or placed in drum pallets.

Drums stacked vertically should go up in reducing layers, each drum resting across more than one of the drums in the layer below. Checks for leakage should be made constantly. Drums should be handled with care, preferably with drum clamps. They can easily be damaged by fork-lift truck tines.

(6) Stacking pallets

Exporting countries ship unit loads on pallets as a standard procedure. If this is not

clear on the quotation, purchasing officers should specify pallet packing as a condition of the order - that is if this will make for simpler storage and the warehouse has the right handling equipment.

Pallet loads should first be checked to see that they are secure. All pallet loads must be properly strapped, banded and fastened to the pallet with net or stretch or shrink wrap film according to the type of product. Bagged goods should be laid with the necks inwards. The bags themselves should be strong enough to withstand the weight of superimposed loads; double nylon reinforced polythene sacks can stand considerable pressure and handling.

Pallet loads should be stacked in a stable pattern. Figure 8 shows a simple pallet stacking pattern where successive layers are interlocked. All the points made so far about stacking principles should be heeded and the best use made of warehouse floor space.

Figure 8. A typical pattern for loading pallets

(7) Stacking box and post pallets

Box and post pallets (illustrated in Figure 7 (a) and (b)) are generally supported on four legs with cup-shaped feet for easier stacking. They are used for storing crushable or irregular-shaped items which cannot be stacked on flat pallets. Box pallets with mesh or solid sides can hold small items. If they are fitted with drop or hinges side panels, items can be retrieved from them without extracting the pallet from the stack. The material a pallet is made of must be suitable for the load it carries and be strong

enough to support similar pallets stacked above it.

Box pallets [Figure 7 (b)] have many uses, but are sometimes treated as permanent racking, which means the benefit of their versatility is lost.

Some box pallets have removable or collapsible sides [See Figure 7 (c)]. When collapsed they take up less room when stored empty. They can also be transported economically - less space, therefore less cost.

(8) Pallet convertors

Convertors are available which turn a flat pallet into a post-type pallet [Figure 7 (a)]. These are useful when a unit has to be stacked, even though it is not capable of supporting additional loads. This may be because the items on the pallet are not strong enough or because the top of the load is not flat. Pallet convertors are not attached to the pallet and can be removed when they are no longer needed. The pallet can then be handled and transported flat.

6.5 Storing bulk liquids

Bulk liquid products have their own characteristics and may present their own storage problems. It is best to seek professional advice about how to store a particular product. In general, bulk storage tanks are placed either above ground or below ground.

(1) Underground storage tanks

Inflammable liquids are safer stored in underground tanks. To resist corrosion and water penetration, they should be treated with a protective coating such as pitch-epoxy. Careful attention should be paid to drainage, particularly if the water table is high or variable. Delivery vehicles can discharge by gravity, but product issue needs mechanical means.

(2) Storage tanks above ground

Tanks above ground cost less to install than underground tanks. However, delivery is more expensive as tankers must pump the liquid into the tanks. They cannot fill by gravity feed.

Stringent safety measures must be taken wherever inflammable or dangerous liquids are stored. In the first place, these tanks should be segregated from the general stores and housed in areas that are walled or fenced in. Fireproof

barriers, ditches and bund walls (earth mounds) must be constructed around tanks as a precaution against leakage or spillage. Routine checks must be made for leaks; spillage must be cleared up immediately. The area should be kept clear of rubbish or long grass.

Tank levels have to be measured regularly with dipstick or tape. Water build-up can be tested by using a colour-change paste on the tape or dipstick. Stick or tape measuring instruments must be calibrated to suit the tank dimensions and in the right units of measurement. It has been known for liquids to be delivered and issued in litres where measuring instruments were calibrated in gallons!

(3) Other safety precautions include

- **Allowing only restricted access to the tank area**
- **Displaying hazard notices [See Figure 7]**
- **Having adequate fire-fighting appliances ready and trained people to man them**
- **Training people in emergency procedures**

Figure

9. Some hazard notices

6.6 Storing bulk solids

Bulk powders, grains and granules are stored in hoppers, silos or bunkers. Silos are usually vertical and round or square in section. They can often hold up to 10,000 tonnes of a product.

Storage requirements vary for different products. Bulk fertiliser, for example, should be stored in horizontal silos; in vertical silos it tends to cake. A code of practice exists for storing each commodity and this should be studied. Before making major decisions, it is always advisable to call in expert advice.

As with liquids, bulk storage of solids can be hazardous. There may be a risk of fire or explosion. There may also be risks of toxicity or contamination caused by careless handling or storage. Specialists can advise on what precautions to take to prevent accident.

Bulk solids can be shipped and stored in specially constructed containers or in intermediate bulk containers. [See Figure 10]. Most intermediate bulk containers hold one ton, but some hold more. They can be of rigid or flexible design. Flexible containers can have protective inner liners. Discharge spots can be at the top or bottom of the bag.

Figure 10. Intermediate bulk containers

6.7 Care of materials and the warehouse environment

(1) Care of stored materials

A clear, logical routine needs to be enforced for keeping stock safe and in good condition.

Some products need special periodic attention - paint tins need to be turned and oil drums rolled from time to time. Others may need more specific care. For instance, fertiliser must be kept at a certain relative humidity; rubber products must not remain in direct sunlight; textiles should not be placed on concrete surfaces.

All packages in stock must be kept in good condition. Any that have been damaged or have been opened for checking must be promptly repacked and sealed.

Regular checks are needed for spillage and waste. Any rubbish or waste paper is a fire risk and must be removed. Yards and access roads must be kept clear of grass and weeds.

(2) Controlling moisture content

To preserve the quality of stored goods the moisture content must be controlled. If the level of moisture is allowed to exceed the stated safe limit for storing a product, there is a risk of damage caused by heating and by attack from micro-organisms. Sometimes biological changes can occur. Too much moisture is a reason for the loss and deterioration of too many stored goods. Moisture level is affected by local climatic conditions, by the type of storage and by the moisture content of commodities in store. See Annex II for a list of safe limits for moisture content.

When goods are received at the warehouse, samples can be tested for moisture content. Various moisture meters (laboratory and battery-operated portable types) are available in most countries.
There are ways of reducing the moisture level if it is found to be too high:

- by building stacks which are hollow inside so that air can circulate;
- by turning products over periodically;
- by using dehumidifying materials;
- by using solar dryers or other drying equipment.

(3) Controlling insect pests

Food grains, pulses, fibres, spices, paper, forest produce, are some of the commodities susceptible to attack from insects. The loss and damage they cause can be avoided, or at least reduced, by taking informed measures.

Firstly, it helps if warehouse buildings have been designed so that commodities can be stored according to an accepted code of practice for each type. Guidelines for any code of practice should take into consideration the types of attack that each commodity would be prone to and allow for avoiding action. Secondly, specialist pest controllers can be asked for their advice on which commodities are subject to attack from which insects and at which stage in the insects' life-cycle.

If commodities infested by insects are expected to arrive in the warehouse, containers, dunnage and warehouse should be disinfested without delay. When the goods are inspected on arrival, infested lots should be segregated for quarantine treatment. From then on, stocks should be inspected fortnightly. Inspections will show what kind of curative measures should be taken - spraying, dusting or fumigating with pesticides. Annex III gives a list of some of the main pesticides used by the Central Warehousing Corporation, a Government of India undertaking. Before using pesticides in a particular area, it is best to seek expert opinion to ensure that there is no danger of toxic or other risks to stock or workers.

(4) Controlling rodents

Rodents account for a lot of damage to warehouse stock, particularly foodgrains. Simple ways of keeping rodents out are:

- raising the height of plinths
- having tightly fitted doors with screens
- screening ventilators and windows

Any infestation by rodents should be referred to rodent control specialists. They should clear not only the warehouse, but also the surrounding area using cages, traps, poisoned bait or electronic devices. Apart from rats and mice, other animals like squirrels and monkeys often have to be reckoned with - birds too on occasion.

(5) Care for seed storage

Before they are stored, seeds need to be cured and dried. Sometimes they are also treated with fungicides and insecticides.

Seeds are usually packed in small containers which in turn are placed in sacks for bulk storage. Some seeds can be stacked in their sacks on proper dunnage, but stacks should be small and not higher than 10 feet. Both temperature and humidity have to be carefully controlled if seeds are to stay viable. This is particularly important for foundation seeds.
Ideally seeds should be stored in a special-purpose warehouse. If this is not possible, the containing warehouse should have a flat reinforced concrete roof with exhaust fans and good ventilation for use when necessary.

Seeds in store need to be regularly tested for viability. Approved laboratories are best

equipped to determine if the germination rate is right for the species. If it is not, they will suggest a remedy.

(6) Maintaining the warehouse environment

Maintaining safety measures in the warehouse building is routine work:

- repainting floor markings
- keeping fire points clear and operational
- filling fire buckets with water or sand
- servicing fire extinguishers
- checking hoses and fittings
- maintaining correct water pressure
- checking sprinkler systems and alarms

Chapter 7

HANDLING GOODS

7.1 Time / efficiency

Efficient handling from the receiving to the issuing end will increase the speed of throughput and reduce the amount of loss or damage in the warehouse itself. Good handling and organised stock location are the two most important things that contribute to a well-run warehouse.

+)),
* BASIC PRINCIPLES *
*
*
* Handle goods as few times as possible. *
* Make full use of available equipment. *
.))-

The following study shows the time saved by using mechanical equipment for unloading and restacking packages. If one were to generalise from the results of this study [See TABLE 2] one would have to make allowance for downtime when equipment was out of service and when it stopped to refuel. The figures include the time taken to reloading the cartons on sack or platform trucks. They do not allow for the time it takes the supplier to load the packages on to pallets.

TABLE 2. T i m e study of four methods of handling materials

The study analyses the time needed to off-load 2000 cartons of fruit juice in cans from a lorry, carry it over a bridge plate and an off-loading dock to a storage area approximately 70 metres (230 feet) away and stack them six cartons high.

It would take 84 man/hours to complete this task carrying each individual carton by hand. By contrast, a powered fork-lift truck could complete the operation in less than an hour. However, the fork-lift truck had the great advantage that the cartons had already been palletised by the supplier. Had the driver had to stop to load the cartons on to pallets, the results would obviously have been less extreme.

Comparative handling costs

The study above analyses the time benefits of manual versus other forms of handling. To compare the costs of manual and mechanical handling we would also have to allow for:

- any delays in transport turnround
- the availability of materials
- the availability of skilled /unskilled labour
- costs of running the equipment and its operators
- the amount of time the equipment is constantly in use

If these factors are taken into account, mechanical handling has distinct economic advantages, provided equipment is in reasonably constant use and there are trained people to operate it.

7.2 Manual handling

Warehousemen should be trained how to lift and carry heavy packages correctly. They will then endanger neither their own health nor the safety of the products they are handling. Even simple hand equipment like sack trucks, trolleys and wheeled

crowbars [See Figure 11] will help them handle goods with less effort and greater speed.

Many goods are damaged through poor or careless handling. Here are some "Do's and Don'ts":

Figure 11. Basic handling equipment

7.3 Mechanical handling equipment

Manufacturers produce an immense range of mechanical handling gear from the simple items illustrated in Figure 12 to complex conveyors, container straddle cranes, high lift stacker cranes and remote-controlled equipment of all kinds. When making a selection it is important to match the equipment to the needs of the task in question.

Figure 12. Mechanical handling equipment

Away from port areas, sophisticated handling equipment is used relatively little in developing countries. Without the back-up facilities of service engineers and spare parts, high technology machines may not be a wise investment. However, less complicated hand-held, or hydraulic and electrically operated gear for lifting, moving and stacking are quite simple to operate and maintain. Equipment of the type shown in Figure 12 would ease the work load and improve handling efficiency. Permanent stirrups or overhead gantries with chain blocks or electric hoists are usually used where heavy loads have to be lifted constantly. Over recent years various systems have been developed which use low-pressure, high-volume compressed air. Some have special *skates* or platforms which operate on the Hovercraft principle. These lift and move heavy weights simply and easily.

7.4 Conveyors

Conveyors can be efficient and labour-saving devices for moving items from one section of the warehouse to another. Purpose-built conveyors of many kinds are commercially available. A research among manufacturers' catalogues will reveal their functions, principles, specifications and, of course, prices. Before making any investment, it is important to investigate the needs a conveyor is expected to fulfil and to assess the economies it may bring.

A useful conveyor to serve various purposes from off-loading goods from trucks to bringing goods to the order-picking and issuing table is the gravity roller type shown in Figure 13 (d). In fact, this simple conveyor can be made quite easily from light steel sections with adjustable legs made from graded sizes of steel tubing. Rollers of bushed tubing with a fixed centre shaft can be fitted into the frame section. These conveyors can be made in fixed or transportable versions.

Figure 13. Types of conveyor **7.5 Fork-lift trucks**

Fork-lift trucks of many kinds are used for handling goods just about everywhere. They can be powered by electric motors or by diesel, petrol or LPG engines. Their lift capacity ranges from one to forty tonnes and some have lifts of up to ten metres. The many variations include trucks with a single mast and rigid forks, to trucks with two- or three-stage telescopic masts with swivel forks to reach high-rise racks in narrow aisles. Multi-purpose fork-lift trucks can be fitted with different attachments to handle specific loads like carpets, drums, bales or tubes. In principle, there are two basic types: *counterbalance* and *reach*.

The counterbalance truck

This truck with three or four wheels is the more common type. Its stability depends on the counterbalance between the weight of the truck and the weight of the load on the forks.

The reach type of truck

This is more versatile. It can manipulate pallets two deep in a rack as the forks can thrust forward. Two types of reach truck are illustrated in Figure 14. Type (a) has forks mounted on pantograph arms which can move forward while the truck stays stationary. Type (b) has forks mounted on a mast which moves forward and back on the carriage.

Figure 14. Fork-lift reach trucks

Some form of equipment for handling pallets is essential for major importers in developing countries. Most shipping consignments are now either palletised or in cases blocked at the base to allow the ingress of fork-lift tines for handling.

Sales and service representatives for major equipment manufacturers are based in most countries. Many of these offer regular maintenance for the machines and also training for the operators - at a price, of course!

The number of manufacturers of handling equipment and the range of products on the market is vast and confusing. However, some professional bodies offer advice about supply sources and equipment suitable for specific needs. One of these is The National Materials Handling Centre, Cranfield Institute of Technology, Cranfield. Bedford MK43 OA, England.

Chapter 8

ORDER SELECTION AND ISSUE

Order selection, or *picking*, should be regarded as the end product of the warehouse function. End-users can only be served satisfactorily if the right goods are selected from stock and issued efficiently.

8.1 Authority to issue stock

Issues should only be made against orders which have been properly authorised. Sample signatures and initials of all authorised signatories must be made available to warehouse staff so that they can verify orders.

General managers should review lists of signatories regularly. They must inform warehouse staff about any changes in authority to sign, and about any limitation of authority according to value or range of materials.

Figure 15. Combined requisition/issue note

8.2 Order details

Items can only be ordered, or requisitioned, in the quantity units in which they are stocked and accounted for - by the kilo bag, by the packet or by the tonne etc. Each item will also have a stock reference number and/or catalogue reference plus an accepted description. All these details must be entered for each item on the requisition note, together with the quantity required.

To check that the information is correct is firstly the responsibility of the person authorised to sign the order. In larger organisations orders will be checked again by a separate department. If information is entered incorrectly, the order will be rejected and the authorised signatory held responsible for any resulting delay.

The system for completing and checking requisition notes may vary slightly between organisations, but a good system will be one that records precisely and accurately all items ordered from the warehouse. Some have separate notes for orders and issues; others have combined forms for both. The form shown in Figure 15 is a combined requisition and issue note.

8.3 The selection and issuing of orders

At this stage, ordered items are *picked* from shelves or racks and assembled in the goods-out marshalling area. Here they are packed, marked and loaded onto trucks for delivery or handed direct to waiting customers.

The aim should be to select and issue goods accurately and in as short a time as possible. In this way the throughput of goods is kept moving, customers are served efficiently, and half-assembled orders are not left taking up floor space.

What makes for efficient selection and issue?

- A meticulous stock location system
- Clear aisles and accessible stock
- Well-trained storemen
- Suitable handling equipment

How goods are selected will depend on the stock location system used in the warehouse. If items are stored in fixed positions, as in the frequency or commodity location systems [See 5.1 (1) and (2)], experienced storemen will know where items are located and plan a logical picking route. If items are stored according to the random location system [See 5.1 (3)], the storekeeper will have to identify where the oldest stock of each item on the picking list is housed before he can plan a route. Data for random location on computer can instantly be printed out as a list of selected items in whatever order is needed.

The storeman will go round with a suitable container or vehicle, collecting together the items for an order. He can simply put small items in a tote pan or transfer box [Figure 16]. For larger items, he may go round the aisles with a platform truck [See Figures 11 and 12] or a trolley with shelves. Some of the other handling gear shown in Figure 12 may be used to collect items of various sizes.

Picking machines are available to take items off even high racks. Sophisticated picking aids include *carousels* which allow the picker to stay in one position and enter commands on a console. A signal is relayed to the correct shelf and the item brought to him automatically.

Selecting goods is a time-consuming job. If stock is well-organised, aisles are kept clear and handling equipment is suited to the types of goods and the height and type of the racking, orders can be picked more efficiently. Well-organised layout and suitable storage facilities will also cut down the large number of accidents which occur as items are taken from shelves and racks.

Figure 16. Tote pan or transfer box

8.4 Estimating the level of customer service

A measure of the supply department's efficiency (rather than the efficiency of the warehouse as a whole) is to calculate the number of orders completed as a percentage of the total number of orders submitted during a set period. This gives an estimate of the level of service given to customers.

Order-picking performance can be measured by:

- **the number of orders dealt with**
- **the tonnage moved**
- **the number of coded items included in the orders**
- **a count of actual goods or items issued**

If storemen cannot complete an order because items are out of stock or the correct items have not been purchased, they should inform the stock control department. Further action should then be taken to speed up supplies or to make special purchase orders. Users should be informed if the goods they require are not available. This will help maintain their goodwill.

Chapter 9

PACKAGING AND DISPATCH

These points will be discussed in this chapter:

(1) Some types of packaging manufacturers use
(2) Security in receiving and dispatch departments
(3) The use and disposal of empty in-coming packaging
(4) Re-usable containers

9.1 Packaging - an industry

Be it simple or complex, packaging techniques aim to protect the product during transit at the most economical cost.

Today, packaging is a huge and sophisticated industry - too complex a subject to be fully covered in this Guide. So many kinds of materials and systems are obtainable that both suppliers and, sometimes importers, may look to packaging manufacturers for professional advice. There are also Packaging Advisory Centres in many parts of the world. A list is given in Annex IV.

Many developing countries have their own manufacturers who produce packaging from indigenous packaging products - jute, paper, hessian, metals, plastics, tin and other metals, glass, wood and textiles. These may be made into bags, cases, boxes (lined or unlined), bottles and so on.

New packaging techniques and materials, particularly with man-made fibres, are constantly being introduced. If packaging is a major activity in a warehouse, it would be worthwhile keeping acquainted with the latest packaging developments. The following forms of packaging are relatively cheap and widely used by manufacturers:

<u>Cling film</u>: is applied loose over a package or pallet and then heat-shrunk to fit the contours of the load. This seals and stabilises the package.

<u>Stretch film</u>: is applied under tension by hand or machine.

<u>Stretch netting</u>: is an effective way of covering uneven contours of bulk

consignments or palletised loads.

Machine strapping: various machines can band packages securely with metal or synthetic strapping.

Sealing Tapes: paper, vinyl, cellulose or polypropylene tapes can be used to seal cartons.

Cartons and boxes: can be rigid or collapsible and of many sizes and materials.

9.2 Security in receiving and packing areas

Security in receiving and packing areas must be as strict as in storage areas of a warehouse.

(1) Receiving areas

- No unauthorised people should be allowed in the area.
- Receiving staff should have clear instructions for checking packages on arrival.
- The receiving operation should be closely supervised.
- All incoming consignments must be inspected to see whether they bear any signs of having been tampered with beforehand.
- Any signs of interference should be noted on delivery documents.

(2) Packing areas

- No unauthorised people should be allowed in the packing area.
- Contents should be checked against packing lists and initialled by packer and supervisor.
- All crates, cartons and other containers must be strapped securely.
- If contents are valuable, they should be sealed with proprietary seals - heat seals, for instance, which cannot be re-sealed once they are broken.

9.3 Use and disposal of empty packages

As goods are unpacked, an enormous amount of unwanted packing materials accumulate - piles of paper, wood wool, synthetic fibre granules and the like. These must be disposed of promptly for various reasons:

- **They are a fire hazard.**
- **They can be a breeding ground for pests or micro-organisms.**
- **They are a security risk as stolen goods can be concealed in them.**

Sometimes these cartons, cases or bags are given or sold to warehouse employees. If so, for the sake of security they should be delivered to them outside the warehouse, not inside.

Empty pallets should be retained in a special area of the warehouse set aside for them. They can be used many times for dispatching outgoing goods. Pallets also make good dunnage or stillages on which to store heavy items.

9.4 Re-usable containers

When deliveries are made regularly between a central warehouse and sub-depots or between warehouse and users within the same organisation, it is time-saving and more economical to re-use strong lockable containers than to make up new packages for each delivery. Permanently marked with the addresses of consignee and consignor, these would carry goods from the warehouse to the user and then be returned empty ready for the next
delivery.
Other alternatives for continual re-use are:

- Lockable collapsible pallets of the type shown in Figure 7 (c).
- Collapsible "fold" boxes in hard-wearing plastic for smaller deliver ies.
- Steel containers on tractor-driven trailers for large-volume goods.

Chapter 10

DAMAGED AND OBSOLETE GOODS

10.1 Reasons for disposing of redundant stock

Redundant stock is made up of damaged goods or items which have become obsolete. Unwanted stock needs to be disposed of systematically. The main reasons for this are that redundant stock:

- Takes up valuable floor space;
- Has to be cleaned, cared for and counted as often as constantly moving items;
- Adds to the number of coded items on the inventory which have to be collated year after year;
- Increases the number of items from which ordered goods are selected, and therefore
- Slows down selection time;
- Clogs up record files in cabinets or computer disk space.

10.2 Ways of identifying redundant stock

At any time the inventory control department should be able to tell which items have not moved for a certain period. If stock is recorded on indexed cards or in ledgers, redundant items could be marked in some way - by coloured plastic tags, perhaps. If stock records are computerised, it is a simple matter to print out a list of stock that has not moved for, say six months or two years.

Records should distinguish between items purposely held for longer periods and those static items which are lying around in stock because they are no longer wanted. *Safety stock* is an example of stock purposely held longterm as a kind of "insurance" against delayed lead times. Safety stock would include essential items like engine blocks or machine spares.

10.3 Informing departments about obsolescent stock

Warehouse departments should work closely together so there is a constant information exchange about stock requirements and stock levels. The inventory control section must always be kept up to date with any changes in stock-holding

policy. For instance, if management decides to discontinue a vehicle or machine, the spares will become obsolete. Management must inform the inventory control department of this change in stock-holding and

of its plans for phasing out obsolescent spares. Stock lists should then be marked accordingly.

The various departments can cooperate more smoothly if stock is analysed regularly by a team representing management, inventory control and store supervisors. The team will aim to keep stock moving efficiently by standardising products and reducing the range held. It will decide which obsolescent items should be weeded out and the best way of dealing with damaged or redundant goods.

10.4 Disposing of redundant items

Stock which includes a large number of unsaleable items has a reduced value. Damaged or obsolete goods for which there is no demand must be sold off at a lower price or written off completely. In either case they offer no return on capital invested in their purchase.

People in authority are often reluctant to dispose of unwanted goods. Reasons for this reluctance may be:

- **A high proportion of redundant goods means wasted assets and reflects poor management. Organisations, therefore, do not like to reduce the book value of their stock holding by selling off cheaply or writing off redundant stock.**

- **Government and parastatal organisations have to justify the apparent waste of public funds - in the case of imported goods this means mis-spent foreign exchange. To dispose of goods is to draw attention to this waste.**

- **Private firms do not like reducing the balance of stock assets in their accounts.**

- **Officials responsible for recommending the disposal of redundant stocks sometimes fear they may be accused of colluding with pre-ordained buyers.**

It is understandable that Board of Survey recommendations for disposal are difficult to obtain and may take a long time to process. Vested interests restrain management from disposing of static items, despite the fact that redundant stock adds greatly to warehousing costs and creates further storage problems.

10.5 Storing redundant items separately

To ease the day-to-day running of a warehouse, one solution (unofficial at least) would be to identify all obsolete, damaged and static stock and transfer it to a *redundant store*. This separate store would be part of the stores complex but out of the way of the normal working system. All records for this redundant stock would be kept in a separate *static file*. To audit redundant stock would therefore be a simple matter.
Another advantage would be that all these items would be available in one place pending a survey before a disposal order could be given. Once disposal had been ordered, people interested in buying this stock could inspect it easily.

10.6 Collecting and recycling scrap and waste

Waste products like factory turnings, paper and used engine oil can be sold or re-used profitably. Unfortunately this source of income is seldom exploited. The reason is usually lack of internal organisation. Let us consider some positive ways of dealing with (and dealing in) waste materials and scrap.

(1) Appointing a responsible official

A single official should be given responsibility for organising the collection and recycling of waste products. His duties would include:

- **Seeing how the amount of scrap and waste could be reduced in the first place;**
- **Arranging collection points for scrap and waste;**
- **Organising the safest and most economical means of storing and handling waste and scrap materials;**
- **Arranging for waste to be recycled and re-used wherever this is practical and economic;**
- **Negotiating the most profitable deals for disposal.**

(2) Storing waste and scrap safely and economically

Warehouse staff are primarily concerned with the actual storage of scrap and waste. For its safe and economic storage:

- Specific areas should be set aside for storing waste.

- These storage areas should not intrude on valuable space needed for general stock items.

- Scrap items should be kept quite separate from new items in stock. (A favourite malpractice is to refit rejected vehicle parts and to sell the issued new parts for personal profit!)

- Vehicles taking waste and scrap in or out of the warehouse must be kept right away from receiving and dispatch bays.

- Valuable scrap like non-ferrous turnings should be in secure storage.

- Restrictions should be enforced for dangerous scrap.

(3) Involving purchasers in the removal of scrap

Purchasers may be persuaded to help with storing, handling or processing the scrap and waste they buy. If there is some advantage to themselves or if incentive clauses are written into a forward contract, purchasers may actually help save space and improve handling efficiency in the warehouse by:

- providing skips for steel scrap;
- providing drums for used engine oil or other liquids;
- setting up baling presses for turnings, textiles;
- installing paper-shredding machines.

(4) Getting rid of useless waste and scrap

Some waste and scrap cannot be salvaged or disposed of profitably. However, it must not be allowed to accumulate in or near the warehouse premises - it is unsightly, a health hazard and a waste of usable space.

Combustible materials can be incinerated, provided the process complies with clean air regulations. In other cases it may be necessary for waste materials to be taken away to a suitable tip site. The dumping of waste will be controlled by local health or planning restrictions. The dumping of toxic waste is now a major international issue. Warehouse managers and appointed waste disposal officials should keep themselves informed about acceptable procedures.

Two well-known sayings are worth quoting here:

"One man's waste is another man's labour."
"One man's waste is another man's living."

Chapter 11

STORING HAZARDOUS GOODS

11.1 Risks

Care and caution are essential for dealing with materials which by their nature are a potential danger to warehouse personnel and/or to the building and its fitments. Hazardous substances require special warehousing arrangements.

Whether in liquid, solid or gaseous form, hazardous substances may be inflammable and combustible, toxic, corrosive, explosive or have an adverse reaction to atmospheric conditions (air, water or temperature). Possible risks are from fire, explosion, instantaneous combustion, evaporation, decomposition, radiation, infection, spillage, contact and contamination.

The reactions of these substances to any or all of these risks may affect other substances, human beings, plants, machinery, and other things both in the warehouse and its locality. The effects may be evident instantly or over a period of time.

11.2 Precautionary measures

(1) Management responsibility

Warehouse managers are professionally responsible for the health, life and safety of people and property in their charge. If through negligence they fail to take all precautionary measures to provide against emergency, they should expect to face disciplinary, if not legal, action.

(2) Being informed

All senior warehouse personnel must know the physical, chemical and biological properties of *hazardous substances*. This term also covers extra-hazardous and explosive materials. They must also understand the risks and hazards that can arise during handling and storage.

Managers should obtain information from manufacturers and suppliers about safe methods for handling and storing specific hazardous substances.

(3) Special storage facilities and techniques

It is often necessary to construct separate and/or specialised warehouses (including tanks etc.) to store these potentially dangerous materials. Existing statutory regulations may require such substances to be stored in certain places or in specially designed storage facilities. Managers should be clear about these regulations and make sure that storage arrangements comply with them.

Hazardous materials should be clearly marked - both containers and storage areas. Directions for handling need to be displayed on containers and on the vehicles transporting them.

Temperature, humidity or ventilation needs to be controlled for some materials both during storage and while being moved in and out of the warehouse. Ambient environments should be regulated within the required limits and monitored regularly.

(4) Specialist handling

Staff should be trained how to use the correct handling equipment safely. Routes taken through the warehouse should have sufficiently wide aisles and high ceiling clearance. All routes and areas of restricted entry should be clearly marked.

Materials often need to be stored scientifically - with inert dunnage, away from non-compatible substances, or in stacks of restricted height. They should be given enough space and air.

(5) Protecting staff

Managers should instruct their staff in the risks these substances present and precautions to be taken when they are handling them. Every effort needs to be made to keep them alert to hazards. Warning signs, such as DANGER, NO SMOKING, NO ENTRY, should be prominently displayed.

Protective clothing - gloves, goggles, helmets, overalls and gas or face masks - should be issued and worn whenever necessary. All clothing and equipment of this kind need to be available and in working condition. Safety lamps and warning devices are sometimes needed.

Staff working with or near dangerous substances should have a medical check-up periodically.

(6) Emergency procedures

Staff should be trained how to deal with emergencies in the correct way. They should practise fire and other emergency drills from time to time.

Managers should alert local hospital, police and fire services to the presence of

substances in the warehouse which may be a public health risk. These services can then prepare themselves appropriately to combat any emergency.

Chapter 12

MAINTAINING EQUIPMENT AND FIXED ASSETS

12.1 Handling, laboratory and office equipment

Simple procedures should be laid down for regularly maintaining equipment used for handling goods and also for maintaining laboratory and office equipment. These would include the following tasks:

(1) Hand equipment for materials handling

Routine operations f o r :
- **checking wheel bearings**
- **tightening joints**
- **cleaning, greasing and re-painting**

(2) Powered handling equipment

Regularly maintaining equipment according to manufacturer's recommendations will keep it in working order and probably prolong its life. It would be wise to take advantage of a manufacturer's maintenance contract for fork-lift trucks, cranes and hoists, so long as there is a reliable agent locally.

In some countries, lifting and weighing equipment has by law to be examined and certified at regular intervals. This may also apply to some laboratory instruments.

12.2 Maintaining fire equipment

Fire extinguishers are best maintained and certified by specialists - often the supplier's representatives. As fire extinguishers generally have to be discharged to test them, it is worth taking the opportunity during testing to train warehouse personnel how to use them. There is no better way to train a fire fighter than to get him to put out a small blaze!

Fire hoses need to be treated with respect. Canvas hoses will rot or deteriorate if they are not properly drained and dried after use. They should then be re-stored correctly. Brass fire nozzles and foam mixer fittings need constant cleaning and oiling. Fire engines and other powered equipment should be started up and maintained regularly.

The pressure of operating water or inert gas in ring fire mains and sprinklers needs to be checked daily.

12.3 Maintaining buildings

Any damage caused by accident or climate should be reported straight away to the department responsible for repair and maintenance. This department should also keep its eyes open for signs of deterioration due to general wear and tear. Repairs or replacements should be carried out promptly to buildings, access roads and security gates and fences.

All services should be well-maintained: electricity, water, drainage, telephones. Any problems should be attended to without delay either by warehouse staff or engineers from the utilities.

Lighting in buildings or yards should always be kept in good working order to provide satisfactory work conditions and ensure security.

12.4 Maintaining storage fitments

Racks, shelves and bins must be kept safe and serviceable. People and materials can be put in danger if structures become distorted or weakened. Shelves and their horizontal supports can become horribly distorted where storemen continually climb on them to reach items on higher shelves. Serious accidents can be avoided if shelving is checked regularly. One way of estimating any distortion is to place a straight edge of sufficient length along a shelf; this will show how much the shelf itself has been pushed out of line. This is shown in Figure 17.

Figure 17. Using a straight edge to detect distortion

12.5 Maintaining security equipment

Security systems

Close circuit television (CCTV), infra-red beams, heat-sensitive devices, pressure pads and the like need to be maintained by specialists. The best way of ensuring that the system is regularly checked is to have a service contract with the security firm who installed it.

Time clocks and lighting

Like factories, many warehouses have time-clocks which punch workers' cards to record the time they clock in and out each day. These may be set for different schedules and need checking and maintaining at intervals. Spot lights, flood lights or sodium lights for security all need to be kept in working condition.

Locks and keys

Be they rim, mortice, strongroom or padlocks, all locks have to be checked and their keys accounted for. Any register to note the in and out movement of keys has to be kept up to date. An undisputed schedule should clearly indicate who is responsible for the warehouse when it is closed and on what days.

Security "cages"

***Cages* for protecting high-risk goods need to be examined regularly by nominated people to see they are completely secure - even against thieves agile enough to enter up through the floor or down through the roof. Items secured in cages may include precious metals and stones, valuable artefacts, arms and ammunition.**

12.6 Maintaining appearances

A well-kept building and neat surroundings give a warehouse a pleasing appearance and an air of efficiency. Good appearances are good for image. Visitors will receive a good impression; warehouse staff will take pride in their place of work.

PART III

PLANNING, BUILDING AND DESIGN

OF

WAREHOUSES AND STOCKYARDS

Chapter 13

PLANNING A NEW WAREHOUSE

13.1 Considering storage costs

Building a warehouse of any size or type will mean an outlay in time and money. This initial expenditure can seldom be recouped through the business of storing goods. (An exception might be the bonded or other warehouse which rents out storage space).

Only rarely do goods increase in value while they are in store. In fact, their value can be reduced by bad handling, inadequate storage conditions or slow turnover. It is not value that is added, but cost. The costs of storage have to be added to the initial cost of all items stored. These costs will be reflected in the added price the user must pay for the goods and materials he buys from the warehouse. These higher prices will in turn affect a country's economy adversely.

The costs of storage can be unnecessarily high if a warehouse is built:

- **in the wrong place,**
- **to an unsuitable design,**
- **to an over-elaborate specification.**

13.2 Defining storage needs

To reach the planning stage the need for a new warehouse must have been truly established. If goods were produced, imported or supplied exactly at the time and place they were required, there would be no need to store them for an interim period. In practice, goods are often produced at one place to be used at another or arrive at one time to be used later on.

What kind of function the new warehouse is to fulfil has also to be clearly defined. Obviously different volumes and types of goods require different types of storage facility. Some warehouses need to accommodate bulk goods and have the means of breaking bulk, weighing and repackaging. This is because savings can often be made by buying in long production runs or by receiving bulk goods at lower freight rates. Some warehouses may have to offer a final assembly or finishing service.

Warehouses also need to be sited in the most strategic places if goods are to be

distributed easily and economically.

Careful planning must precede any decision about providing a warehouse or series of warehouses. This is particularly important where public funds are at stake. Good planning means analysing carefully all the needs that a warehouse, or series of warehouses, has to provide for.
What those needs are will depend on:

- the type of goods or materials to be stored
- the type of storage facilities/services needed
- the average time for which goods are in store
- the speed/pattern in which goods move in and out
- the fluctuations of supply and user demand
- the existing transport infrastructure

13.3 What type of warehouse?

(1) Temporary storage?

A temporary structure may suffice until a more thorough evaluation can be made of its final function and purpose. It may cost more to re-design, dismantle or relocate a permanent structure than it cost to build it originally. Misjudgements can be expensive indeed!

<u>Alternative temporary structures</u>

- **Prefabricated sectional buildings - either in modules easy to erect or in wider free spans which allow more floor area.**
- **Fabric *air houses* supported by high volume/low pressure compressed air.**
- **Fabric supported on a light steel structure.**

<u>Cover and plinth (CAP) storage</u>

The CAP system is often used to store seasonal excess stocks of bagged agricultural produce. A solid plinth about 0.5m (18") high is laid in an open well-drained area. Bags are stacked neatly (criss-cross or block stacks) on suitable wooden dunnage to a height limited by the type of product - about 15-16 layers on average. The bags are then covered with heavy-gauge black PVC sheets, which can be heat-sealed at site to form a cover of the right size. The sheet is either firmly tied down with ropes to the plinth or pegged into the ground. For added protection against heavy rain, a further sheet, prepared as a cap, can be laid on the top area of the stack. As a precaution against high winds, the stack can be secured with more ropes spreading across the length and breadth of the stack and tied to rings provided on the sides of the plinth.

Alternatively an elasticised net of rope, hemp or nylon fibres can be used. Some precautions to take with CAP storage:

Ventilation: **Place relief pipes at intervals in the stack during its construction. Pipes should open to the outside air to take off any gases accumulating under the sheet. Roll up the bottom of the sheet to a height of about 2m (6') from the base. This will let in more air and let out any musty odours.**

Pests: **Take measures to eradicate rodents, insects or other pests. Stacks are prone to attack from pests of many kinds.**

Moisture: **Monitor and correct the moisture content both before and during storage.**

Security: **Build CAP stacks inside the secure warehouse compound if possible. If not, fence in and keep guarded. CAP storage plinths tempt thieves - human and animal.**

(2) Existing warehouses

On gaining political independence, many developing countries inherited warehouses built to store imports and market produce. Since then, their governments have acquired and built further warehouses - either for specific schemes or for general commercial or industrial purposes.

Before authorising plans for new building, it would be worth surveying all existing warehouses under public ownership. Are any parts of these under-used? Are any parts of these buildings likely to become unsuitable for their present purpose? Could they be converted to fulfil a present storage need? If so, why not save public money and make better use of existing premises instead of building new ones?

(3) Rented warehouse space

Shall we build or shall we rent? It is worth considering the option of renting warehouse space. For short-term storage, leased premises may be a good solution. It may also be better to rent space until exact storage requirements are worked out. The decision would depend on whether suitable leased storage space was available and how rental costs compared with the cost of building user-owned premises. Apart from the initial capital outlay, warehouse owners also have to pay for depreciation, salaries and wages, insurance, maintenance

and so forth.

Warehousing is an established, if not particularly profitable, industry in many countries. Some governments see the provision of storage space as an essential public utility. In India, for instance, the Central and State Warehousing Corporations operate public warehouses. Room still remains for private individuals and companies to run warehouses alongside the state system.

Be it public or private, a warehouse organisation leasing space must set out its terms and conditions clearly. These are normally printed on the back of acceptance documents. Terms may vary between organisations. Conditions applied by one national organisation are given as an example in Annex V. Every country would be advised to have legislation regulating warehouses. Typically this legislation would cover the activities listed below.

<u>Typical warehouse legislation</u>

- **Management procedures**
- **Licensing**
- **Rights/obligations of warehousemen & users**
- **Weighing procedures**
- **Protection of goods**
- **Sampling**
- **Stock accounting**
- **Soundness/suitability of building**
- **Inspection for licence**
- **Insurance of goods in store**
- **Accounting for loss/gain during storage**
- **Disposal of deteriorated or deteriorating goods**

13.4 A feasibility study

(1) A Distribution Analysis Team

If the intention is to distribute an import country-wide through a chain of main, intermediate and retail warehouses, a Distribution Analysis Team should be commissioned. Members of this team would include statisticians, economists,

engineers, and people with specialist knowledge of the products concerned, of the country's geography and of any distribution problems.

The Team's terms of reference would be to:

- analyse warehouse needs
- consider the warehouse alternatives
- choose the best site (or sites)
- study distribution opportunities & constraints
- decide on the economic number of warehouses
- investigate warehouse operations
- make a financial assessment
- reach conclusions and make recommendations

(2) Choosing the type and number of warehouses

Number, location and size of warehouses

The Team must consider how many warehouses to build, of what size, what type and where. Areas of investigation will include a study of:

- past patterns of demand
- forecast demand
- population density/trends
- transport costs
- geographical factors
- climatic conditions
- agricultural structure
- nature of industry

Types of warehouse

Would a chain of warehouses at different levels be most suitable - main, intermediate, regional, retail? What kind of personnel would be needed at each level? Are those skills available locally?

Warehouse technology

What facilities would be needed for handling and stock location? What allowance should be made for future development? Which warehouses should be geared to handling bulk goods or to assembling parts?

(3) Choosing a site or sites

Strategic location

Should warehouses be near specific users, near points of entry, near transportation

links or near population centres as a source of customers and labour?

Existing and planned infrastructure
Are there convenient and adequate road, rail or water routes? Are tele-communications sufficient to cope with telephone, fax, telex, computer linkage and radio? What are the future plans for the infrastructure?
Social and political development
Are political changes imminent? What are the trends in population growth and movement? Is any major economic expansion or decline expected?

Project logistics
Are land, labour, and building materials available for a new warehouse? Are all major services, like water and power, already installed in the vicinity of the planned site?

(4) Distribution

Modes of transport
Which types of transport would be available and the most suitable - air, sea, barge, road, rail or a combination of several?

Transport constraints
Does low specification road construction limit the size or axle loading of vehicles? Would there be any difficulties getting the right type of rolling stock for trains or handling facilities for aircraft? What are rail, sea or air schedules like?

Vehicle fleet mix
Should there be bulk delivery trucks and trailers, medium capacity lorries, 4-wheel drive vehicles and passenger buses for personnel? What size, type and make of vehicle should make up the fleet? This will depend on location, terrain, type of loads, availability of service and spares and, of course, cost.

Delivery policies
Should delivery be bulk or break bulk? Will the main supplier deliver straight to users or will an agent or wholesaler deliver to intermediate points?

Location constraints
Are there any restrictions or hindrances on warehouse approaches - steep hills, dangerous corners, railway crossings? Is adjoining land used for hazardous materials?

13.5 Inventory value / number of warehouse locations

The level of stock at a warehouse depends on the lead time and the demand. The

team should take into account the time relationship between goods entering and leaving the warehouse. This can have a crucial effect on cash flow; funds invested in new stock cannot be realised until those goods are delivered, issued and paid for. Should they have one or several warehouses? They may well consider the following theory.

The "Square Root Law"

The *Square Root Law* is a theory of inventory management which states:

> **"The total inventory in a system is proportional to the square root of the number of locations at which a product is stocked".**

An example of this theory

A parastatal importer of textiles and domestic requisites had one imports warehouse to store all imports, plus a distribution warehouse with an average stock holding of $90,000 covering the whole country.

Because communications were unreliable and the capacity of the infrastructure limited, it was difficult to provide goods efficiently to all regions. Understandably, customers complained and some hoarded goods against further delays.

After a Distribution Analysis Team study, it was recommended that five more distribution warehouses should be built - each at a major population centre.

The management of the parastatal organisation wanted to know how the increase from one to six distribution warehouses would affect the total value of their inventory. Obviously, the stock value would not increase to six times the holding of the existing warehouse. If they divided the total stock holding by six, would $15,000 per warehouse truly represent the holding at each distribution centre?

The answer is provided by the square root law of locations. The figures are set out in Table 3 below. Using the square root law, the table shows the percentage increase in inventory value as the number of warehouses is increased. An increase from one to six locations gives an increase in total inventory of 59%.

The parastatal organisation can therefore expect its inventory value to increase to $143,100, as:

$90,000 x 59 = $53,100
100

Revised inventory value:

$90,000 + $53,100 = $143,100

The square root law is important for inventory control because it shows the savings that can be gained by centralising or reducing the number of holding warehouses. Conversely, it shows the extra stock holding costs which result from increasing the number of warehouses.

Table 3. Percentage increase in inventory holding resulting from an increased number of stocking warehouses

13.6 Warehouse operations

The Distribution Analysis Team must consider in advance the varied operations that will take place in the planned warehouse.

Load planning
What proportion of loads are to be delivered in bulk, on pallets, in containers or in open trucks?

Warehouse replenishment
Is new stock to be ordered at regular intervals in set quantities or in a quantity to bring stock holding up to an agreed level? Alternatively, is stock going to be ordered as it is asked for and in the quantities asked for?

Vehicle routing and maintenance
What routes and their variations will be the most economic? What arrangements need to be made for both permanent and mobile fuelling and maintenance points?

Personnel
Are staff available? What will be the job descriptions for the various positions? Will staff need training either in an outside institution or an in-house training department? What pay and overtime levels will be set?

Factory and supplier lead time

Are major delays in lead time to be expected? How can these be reduced? What is the best way in which lead time can be regularly monitored and assessed?

13.7 Assessing finances

All planning has to be made within the limits of funds available both for the initial construction and for the continuing operation and maintenance of the warehouse. For developing countries, return on the capital invested may not be the only consideration; the new warehouse project may bring indirect economic and social benefits.

However, with sufficient data to estimate future performance, the Team should be able to assess the time it will take for the cost of the new warehouse to be covered. Any calculation of storage costs will take this time period into account.

In their feasibility study, the Distribution Analysis Team should have taken note of the many points we have touched on here. Whether a single warehouse or a multiple warehouse project is under scrutiny, the same areas of examination apply. From the information they have collected, the Team will draw their conclusions. Their feasibility study will make recommendations about the type of construction, the siting, storage capacity and operation of the new project.

Chapter 14

DESIGNING WAREHOUSE LAYOUT

14.1 Deciding what facilities are needed

When a warehouse is being designed from scratch, from a *green field* site, it is important that priorities are kept in the correct order. Once the feasibility study is complete, the warehouse personnel should produce a workable operating layout. This will be discussed with the architect, who must be informed of the critical dimensions, the types of equipment, working patterns and other details of the layout. Only then will he be able to recommend alternative building structures which meet these needs.

With the information from their study to hand, the architect and warehouse team will make decisions on these two key issues:

- **the types and number of storage facilities needed**
- **the approximate area to be devoted to each**

Once these are clarified, it will be possible to estimate the total floor area required.

Floor areas for racking and the height of the racking will be decided according to the product to be stored and the equipment used to handle it. The space and facilities for receiving and dispatch areas should allow for the maximum movement of vehicles and materials going in and out. The team will make similar estimates for other sections of the warehouse - bulk storage, stacked bags, offices and so on.

14.2 Making a scale plan with templates

The team will:

(1) Draw a working plan of the site to scale - a scale of 1/50e is ideal, but for larger areas 1/100 will do. The plan should show boundaries, access roads and rail spur lines plus any peculiarities like drainage ditches or rises in the land.

(2) Lay over the plan a transparent paper representing the area needed

for internal and external storage.

(3) From cardboard or thin coloured plastic sheet, make templates, to the scale of the plan, representing the various racks, storage areas and other facilities. The different unit loads, commodity groups or individual items will be marked. More ambitious would be wooden scale models for racks, bins, shelves, stacks etc.

(4) Move the templates or models around the plan to find the best position for fitments and facilities - both within the building and the stockyard outside.

(5) Cover the plan with a clear plastic sheet on which a grid has been drawn to scale. On this, storage modules, door widths and the positions and height of windows can be marked in.

14.3 Considering the flow of materials

A good layout should promote a smooth flow of materials through the warehouse. We have already referred to systems for locating stock in Chapter 5. For instance, the ABC theory of grading items by frequency of movement suggests placing in an accessible position the goods moved most often. To reduce the distance storemen or machines have to travel to collect items will increase the flow of materials. Routes and aisles should be designed to avoid bottlenecks.

Aisle space is expensive, however. Ideally aisles should take up the minimum space necessary to allow handling equipment to operate and turn in complete safety. Manufacturers advise on the optimum aisle width needed for fork-lift trucks to make straight runs and turn - assuming that loads do not hang over the edge of forks or racks. To allow for a margin of error, it is prudent to add an extra percentage to the manufacturers' recommendations. However, if trucks with swivel forks or narrow-aisle stackers are to be used exclusively, aisle widths can be reduced as these machines manoeuvre in less space.

Aisle boundaries can be marked on the plan. In the warehouse proper, they will be painted on the floor with instructions that all boundary lines must be kept clear at all times.

14.4 Designing loading and unloading docks

The location of loading and unloading docks will depend on the density and direction

of flow of goods coming in and out. At this stage in designing the layout, the transport officer should be brought in to guide the team on the following points:

Space and headroom

- Is there space for the largest vehicle to manoeuvre?
- Is there manoeuvring space for the largest number of vehicles expected in the warehouse area at one time?
- Are dock shelters provided?
- If so, are they big enough for easy entry?
- Does the highest vehicle, loaded or unloaded, have enough headroom under the cantilevered canopy protecting the dock?

Dock height and dock fixtures

- Is the dock height suitable for the average vehicle expected to use it?
- Will dock fixtures suit the heights of vehicle bed between empty and fully-laden?

[Dock fixtures include dock and bridge plates, loading dock plates and scissor lifts].

Safety

- Will adequate dock buffers protect dock and vehicles if they touch the dock face?
- Are safety devices sufficient to prevent vehicles moving during loading/unloading?
- Will wheel chocks be chained to the dock face?

Parking areas and services

- Will there be enough safe parking for trucks queuing or staying overnight?
- Will the surfaces of parking areas and approaches support the maximum axle loads anticipated?
- Are there facilities for refuelling and servicing?
- Are there toilets and rest rooms for drivers/crews?

Weighbridges and road surfaces

- Will weighbridges accommodate the biggest trucks?
- Are planned approaches clear and adequate?

The loading and unloading dock facilities shown in Figure 18 are representative of a wide range of types manufactured. The dock shelter at 18(b), for instance, is timber-framed with a PVC seal cover. Other designs use rubber or even inflatable tubes of rubber or PVC to form a perfect seal around the contours of a lorry. Seals like these are needed when there is no suitable form of airlock to protect goods as they are loaded or off-loaded into a cold store or a store with controlled temperature or humidity. They also prevent dust entering the store area.

Figure 18. Dock fitments for loading/unloading

14.5 Planning the stockyard layout

The layout of the stockyard needs to be planned with as much care as the warehouse itself. The design team will have to make basic decisions about the following questions.

(1) What items should be stored outside

Internal storage costs more than storage outside. Items which can be stored outside for a period without coming to any harm can be economically placed in the stockyard. Some products should never be stored in an enclosed space and must therefore be allocated to stockyard storage. These would include:

GOODS THAT MUST BE STORED OUTSIDE

Product	Reason
■ propane or butane gas	ample ventilation
■ chlorine in pressurised cylinders	store near water
■ other gases in pressurised cylinders	dangerous inside
■ fuel in drums	fire risk
■ timber	cover + ventilation

Other, often bulky, items suitable for outside storage are:

GOODS FREQUENTLY STORED OUTSIDE

- structural steel sections and plate
- heavy steel bar and shafting
- rails
- water and drainage pipes and large fittings
- large iron castings and outdoor plant
- sand, gravel, bricks and building blocks
- coal and coke
- heavy cable
- scrap of various kinds

(2) Preparing and organising a stockyard

Physically the area must be well-drained, securely fenced and well-lit. How the area is surfaced will depend largely on the materials to be stored and the handling equipment to be used. Concrete or tarmac laid on a consolidated base of hardcore makes a strong all-purpose surface.

Roads and gangways also need surfacing and should be strong enough to take the weight of handling equipment and trucks with a full load. The width and position of roads should facilitate the expected flow of goods and handling methods. One-way systems help the flow of traffic and reduce the risk of accidents.

Figure 19. Sample warehouse layout

The same logic will apply to the location of external goods as to those in the warehouse. Each block of goods should be clearly marked.

Storage racks and any roof cover supports or frames need to be weather-proofed by galvanising or painting them.

A sample warehouse layout is shown at Figure 19.

Chapter 15

DESIGNING THE BUILDING

15.1 Designing for a purpose

A well-designed warehouse is one that does its job efficiently - suits its purpose. Different warehouses may hold different goods, in different proportions, in different climates. One warehouse may hold a simple general range of products which need no special ambient environment. Another may need to hold perishable goods at constant low temperatures in a dry atmosphere. There is no one generally applicable perfect design. There are, however, some good design principles to be followed:

- **Experienced warehouse managers and their employees should work at the design stage with architects, engineers and equipment specialists;**
- **Together they should know exactly what has to be stored and how best to store it;**
- **Plan for the normal pattern of movement from reception to dispatch**
- **Design for the best affordable equipment that is likely to be used.**

Today there is a science of warehousing. Purpose-built structures house fixtures and machines which use the last possible cubic metre of space. Items can be located remotely and moved without the touch of human hand. The technology of high-rise, narrow-aisle, multi-million dollar buildings has been the developed countries' answer to soaring land and labour costs.

But advanced technology is not the answer everywhere. To install sophisticated machinery where there is inadequate expertise to operate or maintain it is a false economy. Spare parts may be expensive and hard to come by; breakdowns may demobilise the entire system for long periods of time. The wise design team will be discriminating about what would be a valuable innovation and what might turn out to be a costly liability. Whatever the situation, competent designers will spend time investigating the precise purpose and functions of the proposed project.

15.2 Preliminary investigations

Architects, engineers and warehousemen will have to exchange a great deal of information if they are to come up with a design that works well. The main points they need to be clear about are set out below:

- Types and amount of stock
- Tonnes received and issued daily
- Handling equipment used
- Number and type of vehicles and containers
- Number unloaded/loaded/turned around at one time
- Siding facilities for rail wagons

- Speed of turn around for rail wagons & containers
- Number and sex of permanent and casual staff
- Safety and security systems required

Types and quantities of stock will have to be broken down into more detailed groups, such as:

- Goods received/relocated or stored on pallets
- Small items stored in tote pans on shelves
- Small items stored in bins
- Heavy items stored on the floor
- Awkward items needing special racks or fitments
- Items in stackable boxes, cases or bags
- Special-care items - temperature or humidity control
- Special security goods - instruments, expensive tools
- Goods for outside stockyard storage
- Dangerous or inflammable items - fuels, paint

Only with detailed data can the designer select the type and number of storage racks, bins, shelves, stacking areas already discussed in Chapter 6. Once the architect knows what has to be stored, where and how, he can estimate the size and shape of the building and the stockyard.

15.3 A single or multi-storey building?

Preliminary investigations and discussions completed, the design team must consider what type of structure to erect - single- or multi-storey?

(1) Single-storey buildings

Cost: Per cubic metre of storage space the cost is less than for multi-storey structures. The shell can be of lighter construction as there are no load-bearing upper floors. The cost per cubic metre is even less where mezzanine storage is provided in the greater roof space. In fact, the cost per cubic metre decreases as the height of a

single-storey portal frame building increases. This is shown in the graph at Figure 20.

Figure 20. Cost curve for steel portal frame buildings

NOTE: Cost will vary but relationships will remain roughly constant.

Safety: Fire risks are less and fire fighting is easier.

Materials handling: Relatively simple and inexpensive equipment will suffice. A multi-storey building may require lifts, gravity chutes or conveyors for handling materials.

Lighting: Plenty of natural light and ventilation are provided in the roof.

Space: There are few, if any, support pillars to impede the movement of handling equipment or complicate the fitting of racks.

Future expansion: A single-storey building can be extended quite easily.

(2) Multi-storey buildings

The land available may not accommodate on one level all the warehouse facilities needed. Certainly where land is scarce or expensive, a multi-storey building may be the only sensible option.

Land use: A greater use is made of each square metre of land. Piling foundations may be necessary to support the heavy loads imposed.

Gravitational: Some industrial processes require materials to be fed by gravitational flow. Warehouse facilities attached to production lines may therefore need to have enough height to provide for this.

15.4 Building design and structure

Preliminary investigations will have revealed the requirements for height and floor area and the position of doors, docks, offices and other facilities. The next stage is to consider building specifications.

(1) Floors and foundations

Armed with details about the maximum loads anticipated, architects and engineers can work out the most suitable foundation, level and surface for flooring.

Strength

Warehouse floors must be strong enough to bear the point loading of racks and stacks and the dynamic loads imposed by moving trucks. Surfaces should be traction resistant.

Level above ground

Floors can be laid at ground level, but are more commonly raised to the same height as the loading platforms used by trucks and rail wagons. This makes for easier handling. Plinths should be high enough to deter rodents.

Flooring of even level

Building specifications for floor levels should be absolutely precise. Even small variations in level can destabilise fork-lift trucks or stackers with telescopic masts for lifting loads to high storage positions. Any error in floor level at the base of the truck will be magnified many times at the mast head.

Specifications for level normally define the extent of the depression beneath a three-metre straight edge both along the length of the aisles and across them. The most usual tolerance in the UK requires a flatness of ±3mm. For narrow-aisle high-lift trucks, the level is so critical that a tolerance of 1.5mm is hardly acceptable. One recent way of specifying level is to calculate an "F" number equation:

"F" equation

F40 = **normally**

acceptable rate

for aisle floors

F100 = where narrow-aisle

high-lift trucks are used.

Special electronic instruments can measure this level differential.

Floor surfaces

Concrete floors laid in slabs are common in developing countries. If expansion joints are set at an angle to the direction of travel, there will be less wear to the floor and less shock transmitted to loads.

Surfaces can be made skid-proof and dust-proof. To reduce dust, a proprietary substance or sodium silicate (waterglass) can be mixed into the final floor screed - with the approval of a flooring specialist. Alternatively, a special floor paint can be applied to the surface once it is cured. Paint is only a temporary means of combating rising dust; it wears after a while and repainting is tiresome and disruptive.

Where termites are a problem, the floor specification should include an anti-termite treatment.

(2) Walls and frame

Strength

The building wall or frame must be strong enough to withstand:

- **the weight of the roof structure**
- **any overhead cranes**
- **any monorails and loads**
- **wind force**

Building materials

Building materials specified for the walls and frames of the building will depend on:

- **the budget**
- **materials available**
- **local building regulations**

Walls

In many developing countries, cladding materials for the basic wall are most often of galvanised corrugated iron sheets (GCI), solid or hollow concrete blocks, stone or brick.

Portal frame structures

Frames are of pre-cast concrete, fabricated steel (RSJ, RHS or other sections and tubular steel) or timber. These structures should be built so that they are simple to extend if necessary. Internal partitions should be avoided unless they are needed for security or to separate incompatible commodities.

(3). Warehouse doors

The dimensions of door openings are decided at the design stage. To err on the large side will avoid the expense of extending them at a later date. Doors should be high enough and wide enough to allow all anticipated vehicles and handling equipment to pass through with ease. Common types of door include:

Sliding doors

These are the most common. They are simply constructed of GCI or flat galvanised sheet on a welded-steel framework. Either bottom-rolling or top-hung, in one or more sections, they normally incorporate a pedestrian-pass door.

Figure 21.

Warehouse doors

Top-hung doors [Figure 21 (a)] should have a channel set into the underside of the door which runs over a bottom guide fixed to the floor at the side of the opening. This is a better arrangement than having a raised guide set in the floor; this raised strip can damage tyres and trip people up. A disadvantage of this type is that walls have to be kept clear to accept the doors when they are open. They could be designed to slide into an opening between double walls. Locks can be floor-bolts (monkey-tail bolts), hasps and padlocks. Power-driven doors operated by push-button or electronic beam are more sophisticated, more secure - and more expensive.

Sliding screen doors

Additional light-weight screen doors can be fitted inside security doors. Their mesh/net material lets air in but keeps unwanted pests out - birds, squirrels or insects.

Roller shutter doors

As they roll up out of the way, these doors [Figure 21 (b)] allow an unobstructed passage through the opening. They should be designed to close into a channel at the base to seal off draughts or rain. Made of steel or tough fabric, they are heavy and slow to open, unless powered by electric motor. Roller doors need regular maintenance. It can be difficult to lock them securely from the outside.

Sliding, folding doors

These are a more sophisticated (and expensive) version of the sliding door. Sliding doors which also fold [Figure 21 (c)] take up no more space than the actual opening. They can be partially opened to allow people or vehicles through. They are relatively light to handle, but can also be operated automatically. If the end leaf is fixed, they can be locked with a sliding-door lock or hasp or with a padlock. If the end leaf swings, a standard mortice lock and floor bolts will do the job.

Hinged doors

Hinged doors take up a lot of floor space. Whether single-or double-leaf, they are unsuitable for the passing of heavy traffic (pedestrian or vehicular). Where they are installed, it is wise to have separate doors for entrance and exit.

Crash doors

Crash doors are of flexible rubber or synthetic material in either solid or strip form. [See Figure 21 (d)]. They bend or move out of the way as a truck strikes

them to pass through; neither truck nor door suffers damage. They are ideal to divide sections inside the warehouse and to prevent hot or cold air escaping.

Collapsible gates

Generally used for smaller openings (doors and windows), these gates lend extra security to more solid closures. Locking is by padlock or sliding bolts.

(4) Windows and ventilators

Warehouses in tropical countries need windows as much for ventilation as for light. Windows placed high above racks, on end walls will let in light and air. They must be of the type opened easily from below - with a long screw, a cord or pole. Glass louvres fitted into aluminium blades or wooden frames can also be effective. All windows must be secure; wrought iron bars or cast iron frames set in the masonry will keep out intruders.

Concrete louvre panels set in the wall can provide further ventilation. The snag is that they are difficult to clean and tend to collect rubbish and dirt. Roof ridge ventilators, properly designed and fitted, work well and need little attention. Flyscreens can be fitted to windows and louvres to keep out pests.

(5) Lighting

Sufficient windows give the best and cheapest light - natural light - but only if they are cleaned regularly! How often this chore is neglected in warehouses. Translucent panels set in the roof above aisles and marshalling areas will also add natural light.

Fluorescent tubes are most often used to provide artificial light. These should be so sited that workers can read even the small print on labels or picking lists both on ground level or mid-shelf. Loading and unloading docks should also be well lit, probably with spotlights or wall fittings.

Lighting for security and night working should illuminate stockyards. Lamp standards, sodium lights and possibly floodlights at security fences or walls are suitable.

Both inside and outside, it is better that a lighting specialist is called in to plan adequate lighting systems as part of the building design - lighting should not be a "hit or miss" affair.

(6) Roofs

Roof supports and cladding need to be designed and maintained as carefully as the building itself.

Roof supports

The strength of roof supports will depend on whether they are to hold the weight of the roof only, or whether they must bear overhead conveyors or lifting gear as well. An experienced architect, funds permitting, will design a roof structure that exceeds the normal safety allowance for a warehouse. It is not unknown for an unreinforced roof to be used for pulleys or winch chain blocks.

The strength of roof supports also depends upon the type, design and nature of the roof as well as wind pressure and seismic requirements.

Roof trusses can be made of steel sections, tubular steel or wood. Unless properly treated, wooden trusses are prone to attack from dry rot or termites; the effects of this can spoil goods stored below.

Roof cladding

Roof cladding for warehouses in developing countries is usually either galvanised steel (GCI) or corrugated sheets of aluminium or asbestos cement (AC). GCI sheets come in varying thickness down to 30 or even 33 gauge. Obviously it would be a false economy to use these thinner cheaper gauges of sheeting; roofing would need replacing before long and leaks could ruin goods in the meantime. The minimum thickness of GCI sheet for warehouse roofing is 26 gauge. Asbestos is no longer accepted in any form for building by many countries because it is now known to endanger health.

Other roofing materials, like slate, pantiles or mangalore tiles are more expensive to buy, but last a lot longer and are more attractive. They also provide better insulation against heat.

Roof treatments

All construction materials should be suitably treated when they are used. Surface areas can deteriorate as a result of weather conditions themselves or the effect of the weather on stored materials. Chemicals or fertilisers in the warehouse can have a corroding or contaminating effect on roofing.

Wooden trusses should be treated with preservative and against dry rot or termites. Other materials need galvanising or painting. Aluminium or corrugated iron roofs are often painted to prevent corrosion, to improve their thermal efficiency, to reduce glare and generally improve the appearance of a warehouse. Red or green oxide or other special paints are frequently used. Paint manufacturers may recommend that a mordant solution is applied beforehand. Warehouse owners would be advised to weigh the cost of painting or repainting against the benefits achieved.

Insulation

A controlled internal temperature is necessary for the proper storage of some goods. One way of improving insulation is to construct a second insulated ceiling below the roof. Exhaust fans and other devices to control temperature and humidity will also help.

PART IV

COSTS AND ECONOMICS

Chapter 16

WAREHOUSE CONSTRUCTION COSTS

The costs of constructing a warehouse include:

1. **Land and site costs**
2. **Design costs**
3. **Building costs**
4. **Cost of fixed storage facilities**

16.1 Land and site costs

(1) Buying the land

These costs include:

- **the sum paid for the land**
- **any compensation due to the owner and/or occupier**
- **legal fees for the land purchase**
- **any other statutory expenses - taxes etc.**

(2) Clearing the site

Contractors must be paid for demolishing any existing buildings and for clearing the site of bush or rubble.

(3) Site levelling and drainage

The site must then be levelled and the ground contoured to the specifications. Surface water must be drained off the site. If the water table (the normal water level below the ground surface) is high and impedes construction, it must be lowered temporarily or kept out of the work in some other way. Permanent drainage has to be installed.

(4) Site access

Roads will be needed for contractors' vehicles both within the site and on the approaches to it.

(4) Security walls and fences

A perimeter wall or fence will be erected around the site. This may be temporary to protect building materials and plant, or the permanent structure may be put up at this stage.

16.2 Design costs

The more complex the project, the higher will be the cost of its design. Fees for architects, structural engineers and quantity surveyors will probably be related to the value of the project and accord with the scale of fees recommended by their professional organisation. All design fees will have been agreed beforehand.

Manufacturers of equipment may not charge a fee as such, but their costs for design, research and development will form part of the price paid for their products.

16.3 Building costs

(1) Elements of building costs

Building costs will obviously depend on:

- **the sophistication of the design**
- **the size of the project**
- **the location and condition of the site**
- **the type of building materials and how close they are to the site**
- **labour costs**

(2) Estimates

<u>Quantity surveyor's estimate</u>

The quantity surveyor will base his estimate on current average prices for materials and on quotations received from manufacturers and suppliers. He may be instructed by the client to include the value of specialist items in the bills of quantity given to contractors to put into their estimates.

<u>Contractor's price</u>

Contractors' prices depend on the current price for men, materials and machines. The percentage they add as profit will depend on (a) the terms of the contract, (b) likely competition from other contractors and (c) any limits that have been set.

Validity periods

A contractor's price will be valid for a limited period only - often three months. Local and external suppliers will also quote within a certain validity period, reserving the right to increase rates after that time. Rates will change in line with costs of transport, fuel, labour and materials.

If construction decisions are delayed too long, the estimates on which the budget has been based will no longer be applicable.

Exchange rate fluctuations

When the design budget includes for a high proportion of imported materials or equipment, changes in the exchange rate can make a big difference to the actual cost of original estimates. One way of avoiding future currency fluctuations is to buy the required currency forward at the time the estimate is accepted. An alternative policy would be to buy imported materials in advance when the exchange rate is favourable and to store them until they are needed for the project. Storage costs will then have to be weighed up.

(3) Units for Costing

Units for assessing construction cost can be:

- **by area of floor space in square feet or square metres,**
- **by volume of storage space in cubic feet or cubic metres,**
- **by cost per unit (eg.tonne) of the product stored.**

If the warehouse is to contain a single product only, costing can be of the third type listed above - by unit of product stored. For instance, a warehouse to store 5000 tonnes of fertiliser may be costed at $x per tonne of fertiliser storage capacity.

An example of costing by unit of product stored

The Handbook of Fertiliser Warehousing **sets down a way of rating the size of a fertiliser *godown* by the cost per tonne of fertiliser storage capacity. The figure quoted is 400 Indian Rupees (US$ 33 at the time) per tonne of rated capacity.**

This costing is for a basic structure of brick walls, bitumen-treated concrete floor, steel roof structure with AC cladding. The building is single-storey with a floor area of 126m x 22m (2772 sq.m). The storage capacity is for 5000 tonnes of fertiliser. At $33 per tonne, therefore, the construction cost is approximately $60 per square metre.

Of interest are the quantities of materials needed to build a single-product warehouse of the size and specifications quoted in this example given in the

Handbook. They are set out in Table 4.

TABLE 4. Quantities of materials for the construction of a 5000-tonne fertiliser godown

16.4 Costs of fixed storage facilities

The cost of permanent fixtures and handling equipment (eg. conveyor belts and automated devices) will form part of the initial building costs. The selection made will depend on the budget as well as on the functions they have to perform. As we mentioned in Chapter 7 (7.3), sophisticated ways of storing and handling goods need qualified local engineers to maintain them and an accessible source for spares. Unless these can be guaranteed, it is best to avoid high technology design for facilities and fixtures.

Chapter 17

COST AND ECONOMICS OF OPERATIONS

In cost accountancy terms, the maintenance and operation of a warehouse is a *cost centre*. In the same terms, a warehouse linked to a series of warehouses forming part of a distribution chain is a *subsidiary cost centre*.
Figures showing the expenditure for these *cost centres* form the basis for any calculation of overheads and any comparative analysis of performance.

17.1 Fixed and variable costs

The costs of any operation fall into two main categories: *fixed* and *variable* costs.

Fixed costs are overheads which are incurred whatever the level of business - the throughput of goods in the case of a warehouse.

Variable costs relate to the level of business. These costs will increase if the throughput increases. They will decrease if the level of activity declines. Variable costs are determined by the amount of handling and the level of inventory holding.

The graph at Figure 22 shows a normal curve for fixed and variable costs in a warehouse.

Figure 22: Fixed and variable costs of running a warehouse

(1) Fixed costs

Fixed costs represent a major portion of total warehousing costs. The aim should be to keep these costs as low as possible.
They include:

- ground rent, rent, rates/local taxes
- interest paid on borrowed capital for construction
- loan capital pay-back
- depreciation of assets (machinery, vehicles etc)
- salaries and wages for permanent staff
- insurance on the property
- services - fixed meter rentals, telephone rental, security fixtures
- general office expenses
- training facilities

(2) Variable costs

The variable costs which increase or decrease according to throughput are:

- **operation and maintenance of handling equipment**
- **casual labour brought in at busy times**
- **power and utilities**
- **packaging materials**
- **collection, storage and disposal of scrap and waste**
- **damage, deterioration and obsolescence of stock**
- **insurance of warehouse contents**
- **special care for certain commodities**

17.2 Stockholding costs

Stockholding costs are all the fixed and variable costs mentioned so far plus the interest on blocked capital. We can see how high the cost of storing items is if we express storage costs as a percentage of the average stock holding of all items (sometimes groups of items) in the warehouse.

Example: If the total warehouse

operational costs are $20 000

$$\frac{20\,000 \times 100}{100\,000} = 20\%$$

and the total stockholding is valued at $100 000, the stockholding costs are 20% of the total.

To hold an excessive inventory or to have in stock goods which move slowly because there is little demand for them implies needlessly high storage costs.
Low inventories, on the other hand, may lead to stockouts which threaten the continuing production of a user. What to buy and how much to hold in stock are therefore key decisions for warehouse management. It is a question of balancing the objective of providing a service to users against keeping storage costs at an acceptable level. One technique which can help the decision-makers is known as the Economic Order Quantity (EOQ).

The Economic Order Quantity (EOQ) theory

This theory is most useful when imported supplies are delivered on a regular basis. In practice, and especially in developing countries, a constant flow of supplies is not always so easy. Even so, the EOQ technique offers an equation which shows us the value of keeping to a minimum the annual costs of ordering and storing goods. Too many orders incur high order-processing costs. Occasional orders of large quantities mean high storage costs.

For a fuller discussion of the EOQ theory refer to Chapter 7, pages 85-88 in *Guide to Import Management* by Hari K. Raina published in 1990 by the International Trade Centre, UNCTAD/GATT and PRODEC, the Programme for Development Cooperation at the Helsinki School of Economics.

17.3 Monitoring the use of warehouse space

In this Guide we have continually emphasised how crucial is the function that warehouses provide in protecting and distributing imported products. Warehouses provide essential services to industry, to commerce and to the community as a whole. It is the responsibility of warehouse managers to see that their organisations operate with economy and efficiency.

We have also seen how much care, professional experience and money goes into designing, building and equipping a good warehouse. If this outlay is to be justified, managers must do all they can to ensure that space and facilities are

used to the full. This will be another way to control storage costs.

How can a manager estimate whether space is being used in a cost-effective way? He must make a regular practice of monitoring the movement of goods. If he systematically analyses the records, he will be able to assess which goods are moving slowly, which areas of floor space are overcrowded and which are under-used. He should then find out why this is so and do something about it.

He may find that some areas are under-used because:

- **The layout does not work efficiently.**
- **A new policy has meant different goods are being stored.**
- **The unit size handled is too big or too small for the shelf or bin it has been assigned to.**

A manager should always keep himself up to date about warehouse systems elsewhere. He should not be afraid to try out new storage schemes. Part V looks more closely into the responsibilities of warehouse managers.

PART V

WAREHOUSE MANAGEMENT

Chapter 18

ADMINISTRATIVE RESPONSIBILITIES

18.1 Supplies Managers

Controlling materials efficiently is one of the most critical functions of warehouse managers. The importance of this is not always fully recognised. For developing countries, who rely so heavily on essential imported materials for industry and commerce, it is particularly important that precious foreign exchange should not be wasted through poor materials management.

For this reason, many large organisations - government, parastatal or private - have given a single person responsibility for controlling materials. We shall call this person the *Supplies Manager*, though his actual title may vary in different places.

To tighten up the control of materials and to coordinate their movement in and out of the organisation, this Supplies Manager is put in overall charge of the three main sections concerned: *Purchasing*, *Stock Control* and *Storage Control*. The chart at Figure 23, shows the Supplies Manager's coordinating function.

Figure 23. Basic supplies organisation

In some organisations the Purchasing Section is under the control of the Accountant or Finance Manager. There are arguments for the Supplies Manager being responsible to these people. In other organisations, the Supplies Manager is given the same status as the Accountant, the Sales Manager and the Distribution Manager. There are two

main reasons for this:

- The Supplies Manager's job is considered equally important.

- Having the Accountant, Sales manager, Distribution Manager and Supplies Manager as equal colleagues makes for better cooperation between the sections in an organisation.

18.2 What does warehouse management entail?

Warehouse managers are ultimately responsible for all the activities in a warehouse. A good manager will aim to have the best possible system for moving materials efficiently and profitably through his organisation. This means not only controlling stock and storage procedures, but also selecting and training staff to carry out clearly identified tasks in a competent way.

He will need perception and skill to delegate specified areas of responsibility to the right people and then to coordinate their efforts. Of the many functions that he has to perform, managing people is one of the most important.

The responsibilities of the warehouse manager can be divided into three broad categories:

Storage Control

- Storing and preserving stock efficiently
- Introducing systems for retrieving and issuing stock rapidly
- Making full and economic use of storage space
- Identifying and isolating redundant stock
- Maintaining buildings and equipment

Stock control

- Enforcing security procedures
- Keeping accurate stock records
- Conducting regular stock audits
- Updating any storage manual or warehouse catalogue

Managing Personnel

- Defining tasks and skills needed for these
- Training personnel
- Delegating authority wisely
- Coordinating the work of each section
- Evaluating and motivating staff performance

Communicating effectively with corporate management

In this Guide we have already discussed in Part II the storage and maintenance functions listed above under Storage Control. In Chapter 19 we look at measures for verifying and accounting for stock - ongoing records and occasional stock audits. The final two sections are concerned with managing people. Chapter 20 is concerned with staff recruitment, defining jobs and improving work performance. Chapter 21 considers staff training programmes and why they can be a worthwhile investment.

Chapter 19

CONTROLLING STOCK

Stock is normally controlled and verified at three levels:

(1) By carefully recording goods going in and out.
(2) Through constant internal store checks.
(3) By annual (or more frequent) stocktaking or stock audits.

19.1 Warehouse documents, records and reports

(1) Checking goods in and out

Routines for receiving and issuing goods [See Chapter 4] must be rigorously controlled. Lax habits are bound to encourage fraud or theft.

Every order and requisition must be signed by an authorised signatory. When an order is received, it should be checked for the correct signature. The person receiving the order should also always prove his identity. At all times, the warehouse manager must hold an up-to-date official list of signatories with their specimen signatures and any limits to their authority - upper limits for values or types of products they may authorise.

(2) Meticulous records

Records and documents need to be neatly and systematically filed either in binders or on computer. In this way documents can be easily verified and errors spotted at once. An efficient system will also deter anyone from trying to manipulate the records. There should be a system for replacing or registering any document that is taken out of its file - while the storeman is dealing with complaints or queries, for instance.

Documents needed for accounts have to be kept for a minimum number of years. However, they do not have to be kept indefinitely and can be disposed of when they are no longer wanted, or according to prescribed legislation. Unnecessary papers take up storage space - and collect dust!

(3) Reports

From time to time, corporate management may want reports on the amounts of different items received and issued, or about damaged or lost goods. Sometimes daily status reports are asked for. The better organised the records, the simpler will it be to pull out the information required. Even so, unless records are filed on computer, it can take time to compile a management report. Managers should therefore question whether all routine reports are really necessary. Are they worth the time they take to write?

(4) Communications

Lines of communication between administration, warehouse staff and user departments need to work smoothly. Requests and instructions, queries and responses have to be transmitted promptly and accurately. If inventory records are to be kept up to date, stock controllers must receive information from reports and movement documents.

Telephone, telex, fax and even radio links can now make the communication between individuals and offices a simple matter. Direct computer links can speed up the transmission of data both from and to the warehouse and between departments within it. Whatever system is used, good communication links within a warehouse complex will save time; instructions can be issued at once and staff will have to move around less.

However, oral instructions about the transfer of stocks and money should always be recorded. Confusion can be caused at a later date if no record exists. Some simple routine should be upheld for recording spoken instructions and any follow-up action.

19.2 Internal stock checks

The warehouse manager has responsibility for all goods and materials in stock. He will therefore make sure that security precautions and systems for checking stock are as thiefproof as possible. Security measures are part of the organisation of the warehouse and must always be strictly enforced. These measures aim to prevent theft by staff from the warehouse, from user departments or from suppliers.

The manager may keep under his personal control any items of particularly high value, checking them regularly. He will delegate to more senior staff members responsibility for verifying and checking other materials.

19.3 Stocktaking or stock audit

(1) Stocktaking procedures

Stocktaking is generally the province of the finance or internal audit section and not the responsibility of warehouse personnel. However, it is vital that the two sections co-operate.

A thorough physical check of the quantity and condition of stock is essential, often as an accounting necessity, at least once a year. This exercise needs careful planning and organisation, particularly if it is to support the stock value asset in the accounts.

Most accountants and auditors follow set procedures to ensure a defined cut-off date for an annual or half-yearly stocktake.

These are procedures for:

- **Identifying stock properly**
- **Making a correct count of stock**
- **Establishing true values of each item**
- **Reconciling errors between records and physical count above a stipulated value**

The verification of stock can be once a year or a continuing process. Teams may check items throughout the year so that each item is counted at least once during a financial year. Stock can be checked against lists prepared from stock records or by listing all items on the shelves without any reference to stock sheets. The traditional method of listing goods on the shelves takes longer and is more tedious, but is still commonly accepted.

(2) ABC or Pareto classification of stock

Any inventory will contain a variety of goods, some of high and others of low value. In a multi-purpose warehouse with a normal incidence of stock movement, items can be classified into three categories according to the relationship of their usage to their value. This pattern emerges:

Classi-fication	*Percentage of total stock items*	*Percentage Level of control*	*Percentage of stock value*
A	5	65	■ high usage value ■ frequent checks

■ close control

B
15
15 ■ control less

tight than "A"

tighter than "B"

C
80
20 ■ low usage value

■ high stock levels

■ periodic review

for stock control

About 20% of all individual stock items (A & B) in an inventory represent about 80% of the total inventory value. Conversely, the remaining 80% of all stock items make up only 20% of the total inventory value.

The implication of this ABC classification for stock control is that items in group A which amount to a very high percentage of total inventory value, need to be checked frequently. Items in class B need less frequent counting. Class C items, of low usage value but kept in the largest quantities, need to be verified only occasionally.

19.4 Warehouse Operations or Storage Manual

In a large warehouse organisation, the Operations, or Storage Manual, is just one section of a volume covering the activities of all departments. Other sections may be called *Governmental Orders* or *Operative Rules and Regulations*. Regulations covering stock assets may form part of a *Finance Act.*

The Storage Manual will generally be a section of the *Supplies Manual*. This will cover the complete supplies process from inventory control through purchasing contracts, storage control, administration and payment to suppliers.

Manuals are best printed in sections which can be distributed where they are needed. A manual in loose-leaf form allows any updates to be included simply by replacing the page concerned - more satisfactory than making often illegible alterations to existing pages.

(1) Purposes of a Storage Manual

A warehouse Operations or Storage Manual has two main purposes:

- **It defines staff rules.**
- **It is a step-by-step guide to warehouse procedures and can be used as a valuable training aid.**

(2) Difficulties in compiling a manual

Management and warehouse staff must work together to compile a Storage Manual and to keep it up to date. It is not an easy task for various reasons:

Standardisation: Standardising procedures is difficult where there are a number of warehouses with different functions.

Detail: Warehousing is a complex subject. What details should be included and in what form?

Recipients: The Manual must be clear and logical. It must be understandable to staff of all grades from trainee to manager.

Updates: An out-of-date Manual is pretty useless as a reference. It can even

lead to serious misunderstanding. However, for the writers to take time away from regular duties to update it is never easy. Nowadays word processors make lighter work of amending texts.

(3) Advantages of a Storage Manual

Nevertheless, compiling a Storage Manual is well worth the trouble. Why? Because:

<u>It is a reference</u> for "old hands" and a guide for newer employees.

<u>It is a basis for training</u>, particularly on-the-job schemes for recruits and for existing employees transferring to another section. It can also be used during a general training programme.
<u>A reason to review procedures</u> is implicit in the very act of having to update the Manual from time to time. Having to think about existing techniques and procedures will stimulate ideas about improving them.

(4) Disadvantages of a Storage Manual

<u>Costs</u>: Compiling, printing, distributing and updating cost money.

<u>A curb to initiative</u>: Conforming to the rule of the Manual may mean that workers become set in their ways and have little incentive to use their initiative.

Chapter 20

DEFINING JOBS

AND EVALUATING PERFORMANCE

20.1 Manpower requirements in a warehouse

The work load and the storage systems used in a warehouse will determine the type and number of workers needed and the skills required of them. Some may be permanent employees and others taken on temporarily at peak seasons. The Central and State Warehousing Corporations and many other storage organisations in India, for instance, do not employ their own labour for the handling and storage of goods. This job is done by engaging handling and transport contractors at competitive rates. The contractor engages his own workers. The work at many warehouses is often seasonal, odd and irregular. A system of contracted labour can have definite advantages in such circumstances.

If the warehouse deals with a single product only, the number of employees can be equated to the volume capacity of that warehouse. For example, manpower sufficient to provide adequate service in a 5000-tonne fertiliser warehouse in India is 1 supervisor, 1 typist/general clerk, 1 storekeeper and 4 assistants/watchmen. However, the fertiliser business is seasonal, so additional temporary labour is taken on during peak periods.

Salaries and wages are a continuing but necessary drain on the cash resources of any organisation, whatever its size. Managers should therefore consider carefully what permanent and pensionable staff they should take on. Overstaffing is expensive and idle hands are bad for moral - "He's not working, so why should I?"

Every job needs to be clearly defined. This means analysing the duties of each section. If a clear job description is presented to each employee when he is taken on the payroll, each person will know exactly what he has to do and be accountable for those specific tasks. Duties will vary in different organisations, but the job descriptions set out in the box on the next page are typical examples.

Some words of caution should be added here:

(1) If duties are too compartmentalised, there will be no-one to cover incidental jobs as they crop up. It is useful to have some people who can carry out a number of different functions.

(2) There may be a case in some places for changing the jobs of receiving

and dispatch personnel from time to time. This will limit any opportunity for collusion in falsifying receipt and issue documents.

20.2 Evaluating performance

How can work performance be evaluated? The best way is for the manager or his representative to make regular inspections. He can use a pre-printed questionnaire which covers all relevant activities. Suggested questions to be raised are given in a sample inspection schedule in Annex VI.

20.3 Warehouse inspections

A detailed system should be drawn up for spot inspections of each activity in the warehouse. This would set out guidelines for suitably qualified and experienced staff

members to conduct random checks and complete investigations of:

- record keeping
- the maintenance of stores and equipment
- sanitary conditions
- the quality and quantity of packages in stock
- safety and security arrangements
- quality control measures
- the efficiency of the warehouse as a cost unit

Managers should consider the results of these inspections carefully. The information from inspections will provide a factual basis for any proposed improvements to the working system and conditions of the organisation.

Spot investigations are also a discipline for everyone working in the warehouse.

Chapter 21

STAFF TRAINING AND DEVELOPMENT

21.1 Training is an investment

As systems and equipment become more complex, greater skills are needed to operate a modern warehouse. Progressive warehousing organisations now train their staff at all levels in practical and organisational skills that will improve the efficient running of their business. Training may be offered externally or in-house.

Managers should regard their workers as an asset. By training their workers they will add value to this asset. The time, money and energy invested in a training programme which extends personal abilities and improves work efficiency will increase work output and bring eventual cost savings.

Unfortunately, negative attitudes to staff training still persist among less far-sighted managers. One view is that training costs merely add to the operational budget and eat into profits. Resistance also comes from trained people. They feel their positions would be threatened if less-skilled people were offered greater training opportunities. Perhaps a bit of competition would keep everyone on their toes!

However, an increasing number of people feel that management has a duty to educate its staff to the personal and corporate benefits that come from a well-organised training programme.

21.2 The benefits of training

Training in the many varied activities which engage warehouse staff brings a host of benefits. These will be discussed under the following headings.

(1) Improved health and safety

Accidents and illness can cost an organisation dearly in lost working time and compensation. Training in good warehouse practice and in safety measures in particular can reduce the risk of accidents and avoid threats to health.

Training can be offered in:

- **safe stacking**
- **safe racking**

- **care and handling of hazardous materials**
- **manual handling of heavy and continuous lifts**
- **adherence to warning signs**
- **recognition of signals by operators of mechanical equipment**

(2) Increased efficiency

All warehouse operations - physical, clerical and managerial - can be made more efficient through proper training. Greater efficiency will reduce costs.

(3) Better care of stock

Specific training in how to care for different types of stock will prevent so much deterioration due to poor storage and handling. Millions of dollars are wasted every year in lost stock and, because of the delays this causes, in interrupted production and lost sales.

(4) Better staff loyalty

Training programmes are almost always motivating to employees. As people see their own job as a link in the total process, they become more involved in their work and feel a real part of the organisation. The greater the job satisfaction and the more loyalty they have to the organisation the less likely are they to leave or to take days off for "sickness". For the organisation, reduced staff turnover means maintained output and cost savings.

(5) Staff development

Warehouse managers need to impress upon general management the importance of developing well-trained and motivated staff. Particularly competent or gifted people should be encouraged to train for positions of greater responsibility. To promote people from within the organisation is not only an incentive to those concerned but is also a way of building on existing experience and maintaining continuity and stability in the work force. "From today's trainees come tomorrow's managers" is a sound working principle.

Much of the training for skilled and professional staff can be done on-the-job. Trainees should be rewarded for their achievements by pay increases or promotions as they attain higher levels of skill or pass certain examinations. As far as possible promotions should be internal. This will be encouraging as well as practical.

21.3 Types of training

Two basic types of training for warehouse staff are (a) by trial and error on the job and (b) a planned training programme. Training programmes of either type can be organised for every kind of warehouse operation - for physical, clerical, supervisory or judgmental tasks.

(1) Trial and error on the job

Trial and error training on the job can be slow and unstructured. Trainees can adopt bad habits as well as good ones. Learning on the job can be frustrating to the trainee and also to the experienced person guiding him, who may anyway be neither willing nor able to train someone else.

(2) Planned training programmes

A properly planned training programme will teach the trainee step by step all he needs to know to become competent in the job he is aiming for. Usually this programme will include some on-the-job training, but the "hands-on" experience will be one part of a broader learning framework.

A great deal of thought and knowledge of the subject must go into setting up a training programme. From the start, the course designers must be clear about their objectives and know what resources they will have to work with.
Training topics will depend on training goals. Topics will generally include a selection of those listed in Annex VII. Trainers must foresee the points at which they will need co-operation from other members of staff or outside educational organisations and prepare for this. They must also decide the best means of evaluating the success of the programme - this may require feedback from a number of sources.

Training events can be run in-service by an established training department or provided externally by colleges or other training centres. For basic warehouse principles, trainers in many developing countries follow the syllabuses set by the Institute of Purchasing and Supply or the Institute of Materials Management. These Institutes provide training and examinations for all grades of personnel.

Training programmes should be designed, coordinated and conducted by a Course Director who is a warehouse specialist. The Course Director may be assisted by subject specialists from different institutions.

21.4 Training methodology

Course planners should put together a mix of training method which will best suit the trainees and the characteristics of the skills in question. For this they will need to know how much knowledge trainees already have of the subject to be studied and related fields. They should also know about their trainees' educational background so that they can pitch the level correctly.

A training programme should not only teach *how* to do things but also *why* it is important to do something in a particular way. For instance, if storemen are being taught how to care for different kinds of stock, they should also learn that stock that is allowed to deteriorate represents a loss to the organisation.

A training course should be paced carefully. Information needs to be presented bit by bit in a logical sequence. Too many facts cannot be absorbed at one time, otherwise there is a danger of *information overload*.

Training methods need to be varied, lively and as realistic as possible. They must be suited to the status and work needs of the trainees. An experienced trainer will draw on the methodology commonly used in training events of all kinds.

Training methods frequently include:

- **Lectures and presentations with handouts**
- **Discussion/problem-solving groups**
- **Case studies**
- **Examples and demonstrations**
- **Individual assignments or research projects**
- **Practical work**
- **Visual aids - overhead projectors and transparencies, slides, films and videos, audio tapes, close circuit television, magnetic and blanket boards and the perennial black (green or white) board**

21.5 Evaluating training programmes

All courses should be thoroughly and honestly evaluated to check that they are on target in the eyes of the trainee, the trainer and the organisation.

Each trainee's progress should be assessed continuously during the course and at the end by test or examination (internal and/or external). After the course there should be some way of assessing feedback about his or her competence on the job. This evaluation will come mainly from supervisors and managers.

The course itself should also be evaluated by the trainees. Was it in line with the stated objectives? Were the content and methods really suited to needs? Was the trainer effective? How could the course have been improved?

Trainers and managers should be sensitive to the reports that come back after a course and ready to amend, modify and improve where necessary. Training programmes will only be an investment if they really do fulfil their objectives of the trainees and the organisation.

No. of orders	*Quantity of Average Ordering ordered*	*Value of Average stock*	*Storage costs per year*	*Total*
	s t o c k s t o c k	*e a c h*		
			(Units)	
	costs (Units) order ($)			
(Units)	*($)*			
	($)			
1	**6000**			
	12000	**3 0 0**		
0	**6000**			
	15			
2	**3000**			
	6000			
1500	**3000**			
	30			
3	**2000**			
	4000			
1000	**2000**			
	45			
4	**1500**			
	3000			
750	**1500**			
	60			
5	**1200**			
	2400			
600	**1200**			
	75			
6	**1000**			
	2000			
500	**200**			
	90			

cost ($)	*cost*
300	**315**
150	**180**
100	**145**
75	**135**
60	**135**
50	**140**

Assume the following:

+))),
*** Q = the economic purchase order quantity ***
*** >Q = a small (infinitesimal) increase in the quantity ***
*** A = annual usage (quantity requirement) in units ***
*** (metres, gallons, tonnes etc.) ***
*** C = order processing costs (clerical and others) ***
*** I = inventory carrying costs (expressed as a percentage - ***
*** fraction - of the average value of inventory) ***
*** P = purchase price per unit ***
.))-

Thus since A is annual requirement and Q the quantity per order,

the number of orders = $\frac{A}{Q}$

and the average inventory = $\frac{Q}{2}$

If, however, the order quantity is increased to Q+>Q the number of orders will be reduced and be

$= \frac{A}{Q+>Q}$

and the average inventory will go up and be

$= \frac{Q+>Q}{2}$

With C as the processing cost per order, the reduced number of orders will yield a saving on order processing costs of

$$\frac{AC}{Q} - \frac{AC}{Q+>Q} \text{ or } \frac{>QAC}{Q(Q+>Q)}$$

Increased average inventory, with I as the carrying costs and P as purchase price per unit, will raise holding costs by

$$\frac{(Q+\Delta Q)PI}{2} - \frac{QPI}{2} \text{ or } \frac{\Delta QPI}{2}$$

Thus an increase in the order quantity, from Q to Q+ΔQ will be justified only if the consequent increase in holding costs is balanced by the reduction in ordering costs. That is, if

$$\frac{QPI}{2} = \frac{\Delta QAC}{Q(Q+Q\Delta Q)}$$

$$\text{or } \frac{PI}{2} = \frac{AC}{Q^2+\Delta QQ)PI}$$

$$\text{or } (Q^2+\Delta QQ)PI = 2AC$$

If ΔQ is infinitesimally small (that is, it is almost zero), then

QΔQ = 0 in the above equation,so that

we get $Q^2PI = 2AC$

$$\text{or } Q^2 = \frac{2AC}{PI}$$

$$\text{or } Q = \frac{2AC}{^1PI}$$

NOTES

1. **No allowance made for rest periods.**

2. **Includes time for reloading sack truck and platform truck.**

3. **Does not include time for loading the packages on pallets by supplier.**

Annex I

THE MAXIMUM STACK HEIGHTS FOR VARIOUS COMMODITIES

Commodity		Number of layers	Stack height metres
1.	Arecanut		
15	4.2		
2.	Cashewnuts (pods)	15	4.2
3.	Cement		
20	3.0		
4.	Chillies (in bags)	12	3.0
5.	Coffee seed	14	4.2
6.	Coir yarn		Subject to
packing	3.6		
7.	Cotton bales	8 bales	3.6
8.	Cumin seed	15	4.2
9.	Fertilisers (50kg packing)	24	3.6
10.	a) Foodgrains (whole)	18	4.5
	b) Paddy		
16	4.5		
	c) Wheat		
18	4.5		
11.	Jaggery lumps	4 bags (40kg)	1.5
12.	Jaggery chips	8 bags (40kg)	1.8
13.	Jute bales	10 bales	4.5
14.	Leather bales	subject to	
packing	3.6		
15.	Fine wheat flour	12	3.0
16.	Newsprint reels	5	4.2
17.	Oil (in tins)	5	3.0
18.	Oil (in drums)	2	2.1
19.	Oil seeds		
15	4.2		
20.	Paper (flat packages)	subject to	

packing	4.2		
21.	Pulses (whole)	16	4.2
22.	Pulses (milled)	12	3.0
23.	a) Rice (milled)	16	4.2
	b) Rice (50kg packing)	24	4.2
24.	Rice bran (de-oiled)	16	4.2
25.	Safety matches	14	4.2
26.	Sugar		
20	4.5		
27.	Tamarind		
8	1.8		
28.	Wool		5
bales	3.6		

Source: Central Warehousing Corporation, New Delhi.

Annex II

SAFE LIMITS OF MOISTURE CONTENT FOR STORAGE

Commodity	**Maximum moisture limit %**
1. Cereals	
a) Paddy	16
b) Maize, Barley, Bajra (peach millet), Wheat	12
2. Pulses	
Whole and broken	12

3. Milled products

a) Rice (raw and boiled)	14
b) Wheat and gram flour	12.5

4. Oil seeds

a) Groundnut pods	7
b) Fennel seed	11
c) Mustard seed	7
d) Milling copra grade 1 and below	5-8

5. Spices

a) Coriander, Chillies, Fenugreek, Black pepper, Cumin	10
b) Tobacco	11

6. Oil cakes

a) Groundnut oil cake	10
b) Castor seed oil cake	8
c) Mustard oil cake/coconut oil cake	12

7. Miscellaneous

a) Coffee beans	10
b) Arrow root/edible tapioca	13
c) De-oiled rice bran	10
d) Raw cashewnuts	12

Source: Central Warehousing Corporation, New Delhi, India

Annex III

OPTIMUM DOSES OF PESTICIDES FOR USE IN WAREHOUSES

Name	***Dosage***	***Interval of***	***Remarks***

treatments

A) PROPHYLACTIC TREATMENT

1. Pyrethrum dust	0.250 kg per 10 sq. metres	3 - 4 weeks For surface area of stacks
2. Pyrethrum dust	0.125 kg per 10 sq. metres	3 - 4 weeks For alleyways & vacant area
3. Malathion E.C. 50% dilution	3 litres per 100 sq. metres	3 - 4 weeks For surface treatment
1:100 ratio in water	1 litre per 100 cu. metres	3 - 4 weeks For air charging
4. DDVP dilution 1:150 ratio in water	3 litres per 100 sq. metres	2 weeks For treating alleyways, walls & vacant areas only
5. Smoke generators (aerosols)	125 gr. per 300 cu. metres of 6 hours	3 - 4 weeks Minimum exposure period
6. Aldrin 30% E.C. dilution 1:59 in water	5 litres per 100 sq. metres	As and when required for termite control For surface treatment

Name	*Dosage*	*Interval of treatments*	*Remarks*
B) CURATIVE TREATMENT			
1. Aluminium phosphide	a) 3 tablets per tonne	As and when required	Minimum exposure period not less than 5 days for cover fumigation
	b) 120 - 140 tablets per 100 cu. m.	As and when required	Minimum exposure period not less than 7 days for room/shed fumigation
	c) 1 tablet per burrow	As and when required for fumigation for rodent control	
2. Methyl Bromide	1.5 to 2.2 kg. per 100 cu. metres	- do -	Minimum exposure period not less than 12 hours
3. Ethylene Dibromide (EDB)	2.2 kg. per 100 cu. m.	- do -	Minimum exposure period of 7 days
4. EDB + Carbon tetrachloride (CT)	9 kg. per 100 cu. m. (1 kg. EDB + 9 kg. CT)	- do -	Minimum exposure period of 7 days

Source: Central Warehousing Corporation, New Delhi, India

Annex IV

PACKAGING ADVISORY CENTRES

Secretaria de Agricultura
e Abastecimento
Instituto de Tecnologia e
Alimentos
Caixa Postal 139
Campinas SP
Brazil

Emballageinstituttet
Meterbuen 15
2740 Skovlunde
Denmark

Laboratoire National d'Essais
11-13 Avenue George-Politzer
F-78190 Trappes
France

Indian Institute of Packaging
E-2 Marol Industrial Estate
P.O. Box 9432
Andheri East
Bombay 400 093
India

Japan Packaging Institute
Honshu Building 5-12-8
Ginza, Chuo-ku
Tokyo 104, Japan

Laboratorios Nacionales de
Fomento Industrial (LANFI)
Av. Industria Militar no. 261
Lomas de Tecamachalco
Mexico 10 D.F.

Institute TNO for Packaging
Research
P.O. Box 169
2600 AD Delft

Netherlands

Swedish Packaging Research
Institute
Box 9, 163 93 Spanga
Sweden

Institut Belge de l'Emballage
rue Picard 15
1020 Brussels Belgium

Beratungs und Forschungsstelle fur
Versandverpackung e.v. (BSFV)
Lohbrugger Kirchstrasse 65
2050 Hamburg
Federal Republic of Germany

Hong Kong Packaging Council
407-411 Hankow Centre
5-15 Hankow Road
Kowloon
Hong Kong

Jamaica Bureau of Standards
6 Winchester Road
Kingston 10
Jamaica

Korea Design & Packaging Centre
C.P.O. Box 2325
Chongro-Ku
Seoul 110
Korea

Institut Marocain de l'Emballage
et du Conditionnement (IMEC)
Boite Postale 8006 Casa Oasis
Casablanca
Morocco

Pakistan Packaging Industries
202-I-D Block II
PECHS
Karachi 29
Pakistan

The Research Asscn. for the Paper
& Board Printing & Packing Ind.
Randalls Road
Leatherhead, Surrey KT22 7RU
United Kingdon

Annex V

GENERAL CONDITIONS FOR STORAGE AT LEASED WAREHOUSES

1. TENDER FOR STORAGE

a) All goods for storage shall be delivered at the warehouse properly marked and packed for handling. When the warehouseman considers it necessary to sort out and standardise the packages, he will be entitled to do so at the time of receipt and the depositors shall be liable to pay the charge on that account. The warehouseman may, at his discretion, refuse to accept goods which are in a condition not fit for storage. The warehouseman shall give an identity code mark to each package of consignment received wherever possible or on a prescribed percentage of packages.

b) The word "lot" as used herein means the unit or units of goods for which a separate account is to be kept by the warehouseman. Delivery of all or any units of a lot shall be made without quality segregation except by special arrangement and in that event the warehouse receipt will be amended accordingly.

c) The warehouse undertakes to store and deliver goods only in the package in which they were received (unless otherwise provided by arrangements in writing between the depositor and warehouseman).

2. STORAGE CHARGE

a) Storage charges will be made on a monthly basis and the number of days in excess of a month will be charged on a weekly basis. Unless otherwise provided, where storage is for less than a month the charge will be for the whole month.

3. MANNER IN WHICH PERISHABLE OR DETERIORATING GOODS ARE TO BE DEALT WITH

a) Where goods are of a perishable nature, or which by keeping will deteriorate greatly in value or injure other property, the warehouseman may give such notice as is reasonable and possible under the circumstances to the holder if known to the warehouseman, or if not known to him, then to the depositor, requiring him to satisfy the lien upon the goods and to remove them from the warehouse. On the failure of such person to satisfy the lien and to

remove the goods within the time prescribed within the notice, the warehouseman may sell the goods by public sale at the risk and cost of the depositor.

b) If the warehouseman after a reasonable effort, is unable to sell the goods, he may dispose of them in any manner he may think fit, and shall incur no liability by reason thereof.

Source: Central Warehousing Corporation, New Delhi, India

c) The warehouseman shall, from the proceeds of any sale made pursuant to this provision, satisfy his lien and shall hold the balance, if any, in trust for the holder of the receipt.

4. DELIVERY REQUIREMENTS

a) Instructions for delivery or transfer of goods shall always be in writing and signed by the depositor or his authorised agent.

b) When a warehouse receipt has been issued, no goods covered by that receipt shall be delivered unless the receipt, properly endorsed, is surrendered for cancellation or for endorsement of partial delivery thereof.

c) Should a warehouse receipt be lost or destroyed, goods covered by it shall not be delivered until the person lawfully entitled to possession of the goods obtains and surrenders a duplicate receipt. The duplicate will be issued on such terms and conditions, and on furnishing a bond, to indemnify a warehouseman against any liability according to statutory requirements.

5. LIABILITY

a) The warehouseman undertakes to exercise reasonable care and diligence in keeping the goods.

b) The warehouseman's liability is limited to the value of goods on the date of deposit.

c) Perishable goods or goods which are susceptible to damage through temperature or humidity changes are accepted only at owner's risk for such damage as may result from general storage conditions.

d) The depositor of goods shall examine them at the time of taking delivery and shall give notice in writing with full particulars

of any loss or damage caused to the goods to the warehouseman forthwith, or within 72 hours of taking delivery. A copy of the notice shall also be sent to the prescribed authority. No claim against the warehouseman shall be valid if such notice of loss or damage has not been given by the depositor as aforesaid. Similar notice for claim of damage shall be given to the warehouseman by the depositor in case he (depositor) comes to know of the loss or damage whilst the goods are in the warehouse.

e) The warehouseman is not responsible for the usual and customary shrinkage in weight and effect on quality during storage due to natural causes.

f) The quality, condition value and contents of goods are unknown to the warehouseman except when specifically mentioned in the warehouse receipt.

6. SCHEDULE OF CHARGES AND INSURANCE

a) Whenever provision is made in these contract terms and conditions for a charge or charges by the warehouseman, such charge or charges will not exceed the warehouseman's tariff in effect at the time the charge accrues or the service is performed.

b) The schedule of maximum tariff to be charged shall be that approved by the prescribed authority.

c) All goods stored in the warehouse will be insured against the risks of fire, theft, burglary and floods and other risks as pertinent and as agreed between the warehouseman and the depositor.

7. EXPLANATION

a) The expression "depositor" includes any person or bank that lawfully holds or is holder in due course of the receipt issued by the warehouseman in respect of the goods and derives title thereto by endorsement or transfer by the depositor or his lawful transferee.

b) When goods are transferred from one room to another or from one warehouse to another at the request of the depositor a charge for handling and transport, if any, will be made.

c) The warehouseman may transfer at his own expense, without notice, any goods in storage from one room to another in the

warehouse providing transfer involves no change in class of storage.

d) Charges for handling, loading, unloading and extra service rendered in the interests of the depositor are to be paid for by the depositor of the goods in addition to the usual warehouse charges.

Annex VI

PERIODIC INSPECTION OF WAREHOUSES CONTAINING IMPORTED BAGGED FOOD GRAINS

SOME SUGGESTED STANDARD QUESTIONS

1. Are the prescribed registers being properly maintained?
2. Is the procedure followed for locking and opening of warehouses in accordance with that laid down?
3. What are the security arrangements; are these adequate?
4. Is the warehouse provided with the necessary fire fighting equipment and is it properly maintained?
5. Are the stack/bin cards properly maintained on each stack in respect of receipt and issue of stocks?
6. Are the warehouse buildings properly maintained?
7. Is proper and stable stacking being carried out?
8. Is there any mixed stacking of different commodities; if so, why?
9. Is there a fortnightly inspection of stocks to determine condition?
10. Are there any stocks with initial moisture content more than optimum percentage in storage; if so, what precautions are being taken and what is the stock condition?
11. Is regular prophylactic treatment being given and lapses recorded?
12. Is the programme for fumigation being strictly adhered to?
13. Are there any signs of infestation by rats, squirrels or birds in the warehouse; if so, what steps have been taken to combat them?
14. Do any stocks require turnover because of deterioration in storage?
15. Are the facilities provided for storage sufficient for maintaining stock condition?
16. Are sweeping/spillages cleaned at once and accounted for?
17. Is adequate attention given to recording weights and moisture content?
18. Is technical equipment adequate to provide the service needed?
19. Is there adequate record maintained of items retained in quarantine area and has every relevant action been taken?
20. Has any transit loss in respect of stocks handled been

promptly reported to the concerned officers?

21. Is adequate care being taken of hazardous stock?

Annex VII

TRAINING OF WAREHOUSE MANAGEMENT PERSONNEL

Suggested topics for including in the syllabus

1. Materials management, an overview of inventory control, purchasing, storage and distribution economics and practices, particularly applied to imports.

2. Introduction to storage, warehouses and warehousing techniques.

3. The systems approach to warehousing and its socio-economic impact on the national economy.

4. The role of warehousing in materials management.

5. The functions, objectives and types of warehouses.

6. Determination of location, size, type and capacity of warehouses.

7. Selection of sites for warehouse construction.

8. National, municipal and international conventions governing warehousing activities.

9. Factors affecting goods in storage; codes of storage practices for certain commodities.

10. Warehousing management procedures and systems and audit of warehouse transactions.

11. Storage pests and their control; use of pesticides, fumigation and other control methods.

12. Packaging techniques including

containerisation, pallet design and usage and intermediate bulk containers.

13. Materials handling techniques and equipment.

14. Safety and security principles and practices in warehousing.

15. Logistics management and the role of warehouses.

16. Identification, coding, labelling and marking materials stored.

17. Quality control, inspection of inputs, standardisation and value analysis techniques.

18. Location of products within warehouse. ABC analysis and movement flow data usage, coding of location points.

19. Storage facilities, their range, design and application.

20. Warehouse and stockyard layout and storage facilities; their range, design and application.

21. Selection and maintenance of office and laboratory equipment.

22. Computers and their application to warehouse control and operation.

23. Fire protection equipment and techniques.

24. Insurance and warehousing; property and contents, transit and marine insurance overview and claims procedures.

25. Warehouse manpower determination and deployment. Job descriptions, local labour laws and regulations. Overview of personnel management.

26. Formulation and usage of storage manuals.

27. Training decision and evaluation. On-the-job training organisation and techniques.

28. Stocktaking, accounting of sound, damaged and salvaged products.

29. Loss prevention methods and storage loss and/or gain conciliation.

30. Management information systems; design, control and evaluation of returns and reports.

31. Warehouse performance indicators, effectiveness evaluation.

32. Budgeting and control of expenses. Costing of warehouse facilities and operations.

33. Maintenance of buildings and stockyards. Good housekeeping practices.

34. Operation and management of bonded warehouses, cold stores, air cargo complexes, container freight depots, commodity and other specialist warehouses.

35. Evaluation through discussion and group reporting of experience and data gained from field trips to major warehousing complexes.

36. Work study and method study techniques and application.

37. Leased (or public) warehouses. Advantages, disadvantages, terms and conditions.

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