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INDUSTRIAL PLANTS

Chapter ten:

Industrial warehouses – first part

DOUBLE DEGREE MASTER IN

“PRODUCTION ENGINEERING AND MANAGEMENT”

SEAT OF PORDENONE

UNIVERSITY OF TRIESTE

Generality

The functions of the **industrial warehouses** are:

- protect goods in stock
  You must keep the materials and components used in production, those made during the production cycles (WIP) and finished products;
- ensure the continuous of the flows
  The materials must be available for the production and sale, so as to ensure flow of production and uninterrupted delivery;
- trasform the flows
  The assembly of the units load (UDC) for the production cycles and for deliveries must be done efficiently.

The unit load (UDC) is a grouping of materials arranged in such a way that they can be handled and transported by means of mechanical means of transport, for example through the use of containers of various kinds or pallets of wood or metal.

Generality

The **industrial warehouses** can be classified into:

a) warehouse of a manufacturing plant (out)

Often it is the interface between production and wholesalers with:

- low number of orders for large quantities;
- information on orders is known to be prepared in advance;
- objectives: costs and accuracy of construction;

b) distribution warehouses

They serve a number of centers affiliated with:

- the information about orders to be prepared are known in advance;
- objectives: cost, accuracy and percentage of demand met (without backlog - fill rate);

Backlog is the set of orders (tail), that a company has already received orders from customers, but that must still meet

Fill rate is the fraction of the demand for long-term currently satisfied from the warehouse without the use of backlogging. The sales that were not made in the i-th period are not lost, but they become orders not processed in the following period: allows you to have of the arrears (backlogging)

Generality

The **industrial warehouses** can be classified into:

c) warehouses for the service of detail

They report orders for items in the catalog with:

- large number of orders for small quantities;
- information is known only on the basis of forecast;
- objectives: cost and response time;

d) warehouses of support the production

They serve a number of centers with:

- many orders of magnitude smaller;
- information is known only on the basis of forecast;
- goals: response time (soon), accuracy and cost.

Generality

The **warehouses interoperational** (**production**) are divided into:

a) **warehouses of receipt** in which:
- the semi-finished products are received at input and recorded;
- you make the unitization of the UdC;

b) **warehouses of storage** in which:
- at the UdC are assigned the storage areas;
- the UdC are located in areas assigned;

c) **warehouses of drawing** in which:
- pick orders are received;
- operations are performed of picking;
- the items are sent to the next step.

The unitization is simply to "consolidate" more goods in proper conditioning units, such as containers, pallets, unit swap, etc. to accelerate the operations of loading/unloading and reduce the cost of handling of goods and to allow continuity of flow.
The picking is an operation of "breaking" of the UdC, in order to associate groupings of different materials, to meet or work orders shipping inside or outside the establishment. The reverse operation for the restructuring is called of refilling

Generality

The **terminal warehouses** are divided into:

a) **warehouses of receipt** in which:
- the goods are unloaded input;
- are make the necessary checks (quality and quantity);
- are recorded the goods;
- are make the unitization of the UdC;

b) **warehouses of storage** in which:
- at the UdC are assigned to storage areas;
- at the UdC are located in areas assigned;

c) **warehouses of alignment of the orders** in which:
- are performed the operations of picking;
- packaging (warehouses in output);
- the orders are consolidated;
- are made the final check;
- the UdC are unitized;

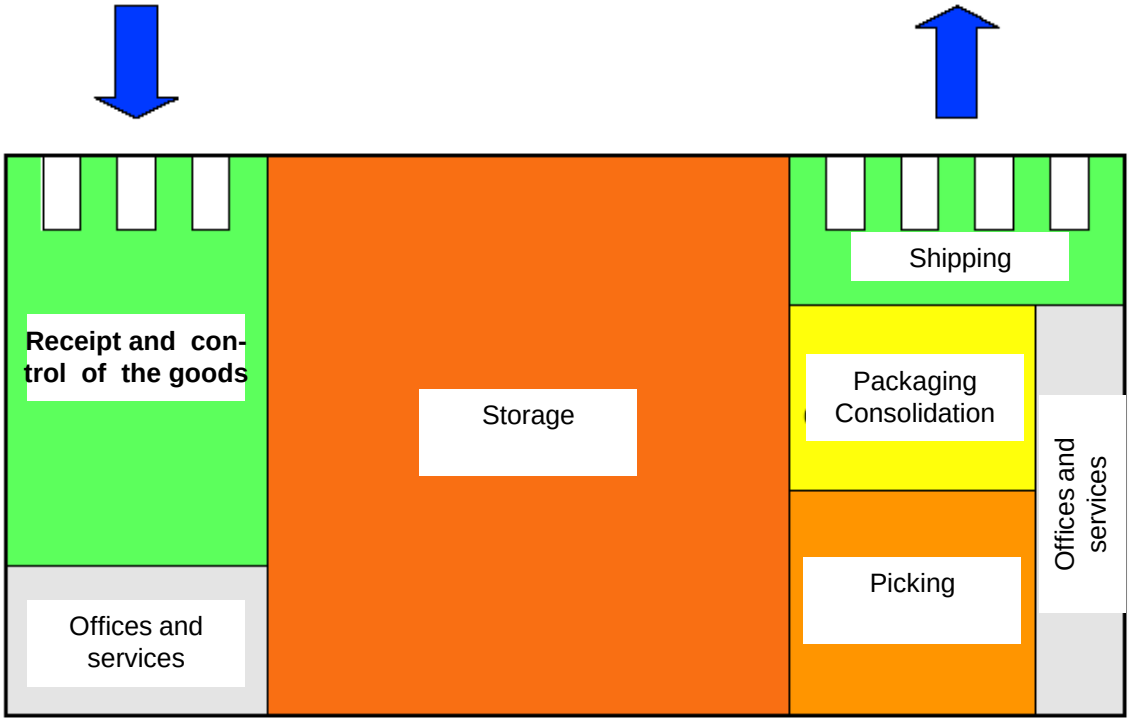
The packaging is the set of elements and materials used to manufacture the product

Generality

The **terminal warehouses** are divided into:

d) warehouses awaiting of shipment in which:

- the UdC are grouped scheduling the departures;
- the UdC are loaded on means.



Generality

The **terminal warehouses** have the following activities:

- ***customization of products*** (in particular through the packaging);
- ***technical assistance on products***;
- ***handling returns*** **and** ***discontinued products***.

The main issues of interest are:

- the existence of costs attributable to stock (assets);
- the use of resources of space, which implies the need to effectively exploit this resource;
- the special needs of the company that lead to the design layout details and specific management arrangements.

Generality

The warehouses have to deal with two phases:

- ***design***, with the sizing, the study of plant layout and the study of the location;
- ***management and operation***, in which you evaluate inventory levels and space allocation.

Significant parameters

The **significant parameters** of the warehouses are:

a) potential receptive (PR)

Is a measure of the static capacitance of the warehouse, which represents the number of UdC (of a certain size) storable in the storage;

b) selectivity (S)

Is given by the ratio between the number of UdC that can be withdrawn or deposited in the warehouse without having to move other UdC and the total of UdC storable.

$$S = \frac{number\ of\ UdC\ movable\ directly}{PR}$$

For two-faced warehouses accessible from both sides S = 1

Significant parameters

The **significant parameters** of the warehouses are:

c) potentiality of handling (PM)

Is a measure of dynamic capacity of the warehouse. It can be expressed as the maximum number of UdC in input (PMI), in transit or exit (PMU) of the property unit of time (UdC/h or pallets/h). That is:

PM = PMI + PMU

if you use the same systems for storage and withdrawals;

PM = max(PMI, PMU)

if you do not endeavor the same handling systems;

d) coefficient of utilization superficial (CUS)

is given by the ratio between the area of the warehouse used A_u and the total area of the warehouse A_t (always <1):

$$CUS = \frac{A_u}{A_t}$$

Significant parameters

The **significant parameters** of the warehouses are:

e) coefficient of utilization volumetric (CUV)

Is the ratio between the volume occupied by the stored goods *Vu* and the total volume of the warehouse *Vt*:

$$CUV = \frac{V_u}{V_t} < 1$$

f) coefficient of saturation of the potentiality receptive (CSPR)

Is the percentage of potentiality receptive theoretical (PR) that would normally be used without compromising the functionality of the warehouse:

$$CSPR = \frac{UdC\ to\ deposit}{PR}$$

Significant parameters

The **significant parameters** of the warehouses are:

g) cost/compartment (€/anno)

Included are:

- amortized costs for buildings, shelving and handling systems;
- operating costs due to general services;

h) cost/UdC moved (€/UdC moved)

Includes allowances for:

- at staff engaged in handling;
- at the energy consumption for the handling;
- maintenance of facilities of handling.

Storage systems

The **systems of storage** may require the use of equipment or not, with a direct bearing on the cost per location.

Upon variation of the system are obtained different results in terms of selectivity and utilization superficial or volumetric.

For UdC palletized, will have type systems:

a) static

- merchandise on the floor: single units or stacks;
- stock on shelf: at cell (single or double depth) or shelves (*drive-in* and *drive-through*)

b) dynamic

- movable shelves: translating or carousels (horizontal or vertical);
- fixed shelves: at gravity (live storage) or counter slope (push-back).

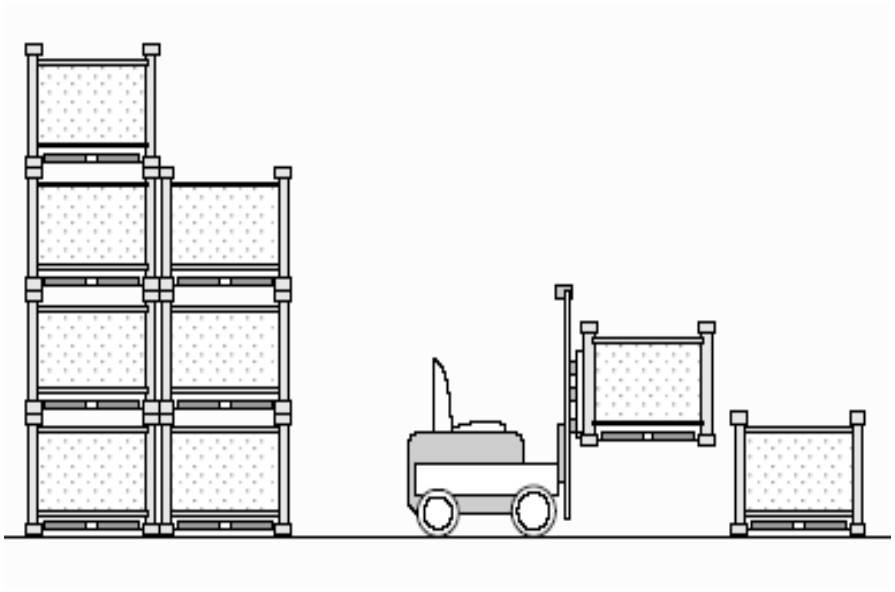
Storage systems

The **static systems to pile** are such:

- the palletized UdC are stacked in single-product separated from each other by corridors to allow movement;
- the cost for UdC stored is minimal because there is a good saturation surface and it takes special equipment;
- the system is quite flexible and requires only the signaling on the floor of the storage areas, on the other hand the selectivity is low and for this reason the system is suitable for articles of high stock, for which the input and off takes place according to significant loads in number of UdC;
- the height of the stacks should be limited to ensure stability (5-6 levels);
- there may be loss of space due to withdrawals and input unordered.

Storage systems

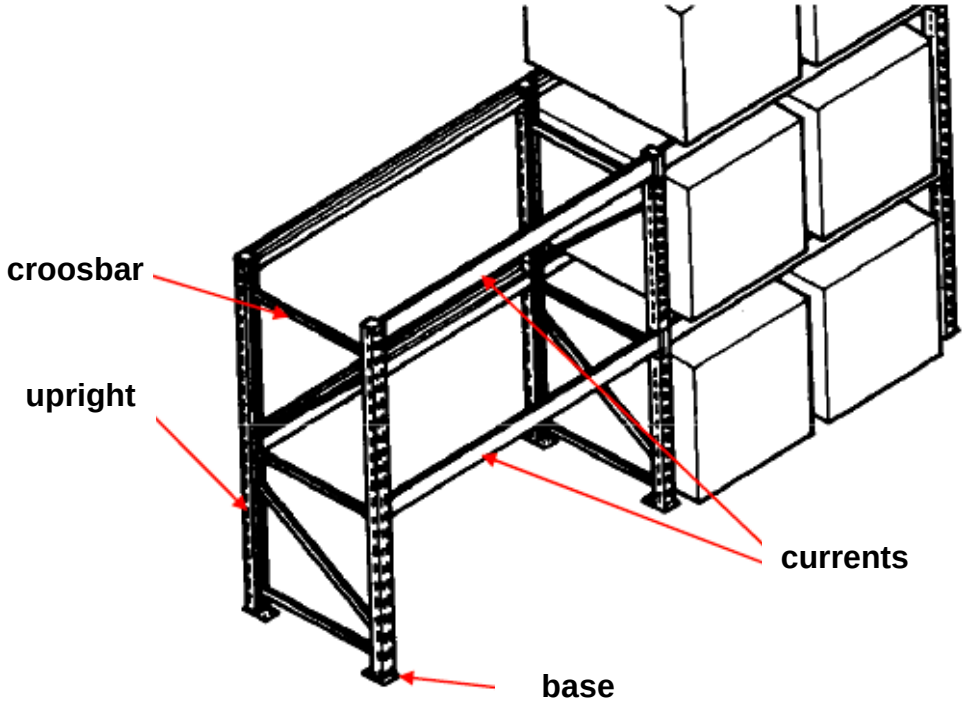
The **static systems to pile** these are:



Storage systems

The **static systems to cells** have the following characteristics:

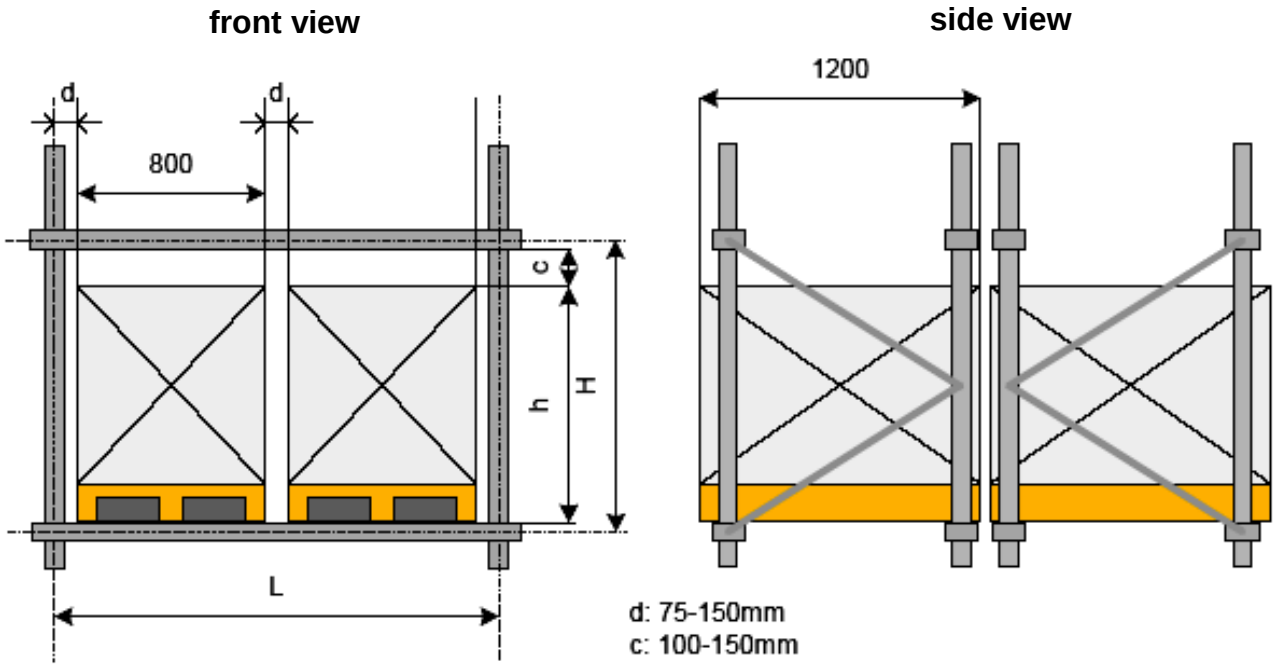
- the palletized UdC are supported on bearing currents of metal shelving;



Storage systems

The **static systems to cells** have the following characteristics:

- the system includes shelvings to single or double depth;
- in the case of single depth and of double depth accessible from both sides, the selectivity is unitary;



Storage systems

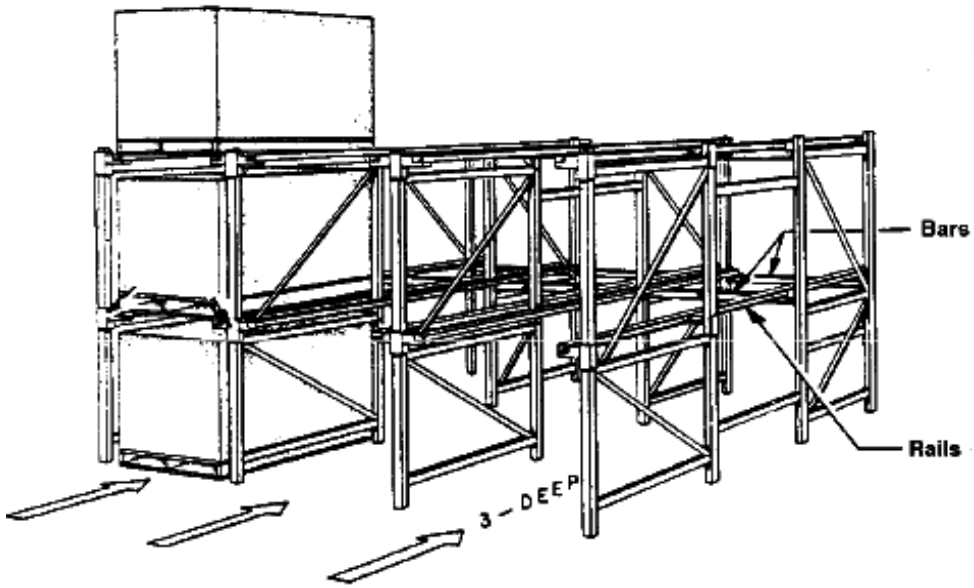
The **static systems to cells** have the following characteristics:

- generally have low costs;
- can support UdC with weight and volume limited;
- in the case of shelving individual, the presence of too many lanes leads to an inefficient use of space;
- for the double shelving, there is a reduction around of 50% of the lanes, but are necessary means for moving the ad hoc.

Storage systems

The **static systems to shelving** (**drive-in** and **drive-through**) have the following characteristics:

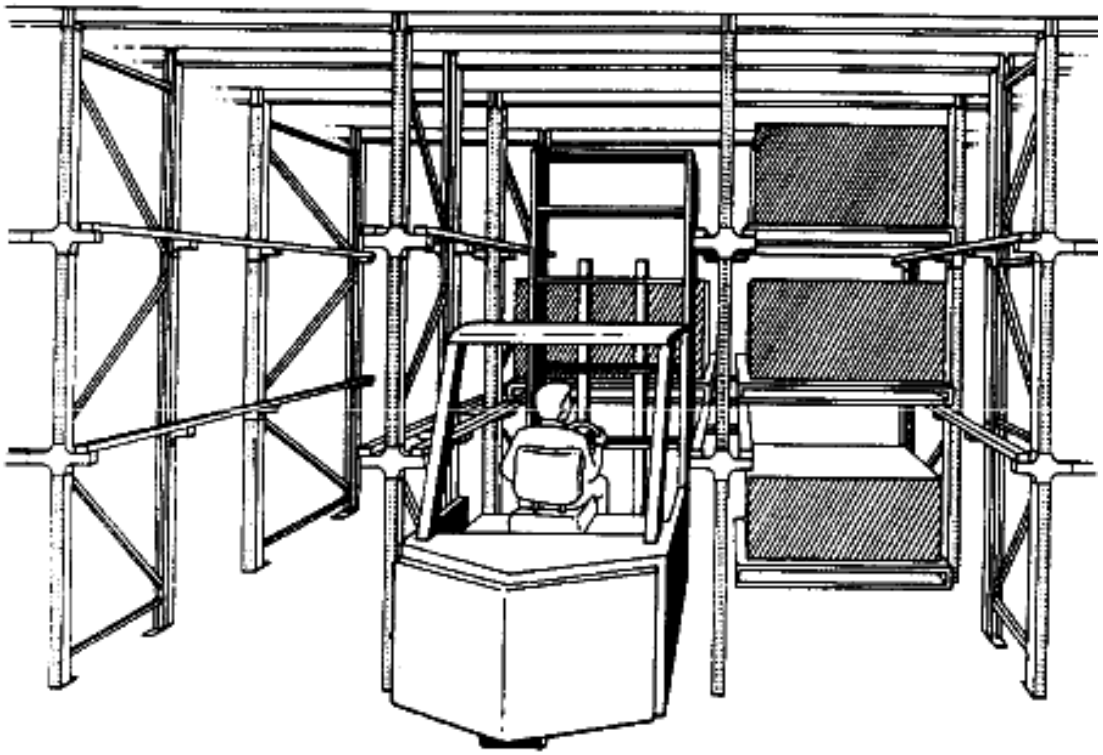
- the system is similar to that to pile, but the UdC is supported by ***currents carrying pallets*** **and** ***shelves bolted to the back of the property***;



Storage systems

The **static systems to shelving** (**drive-in** and **drive-through**) have the following characteristics:

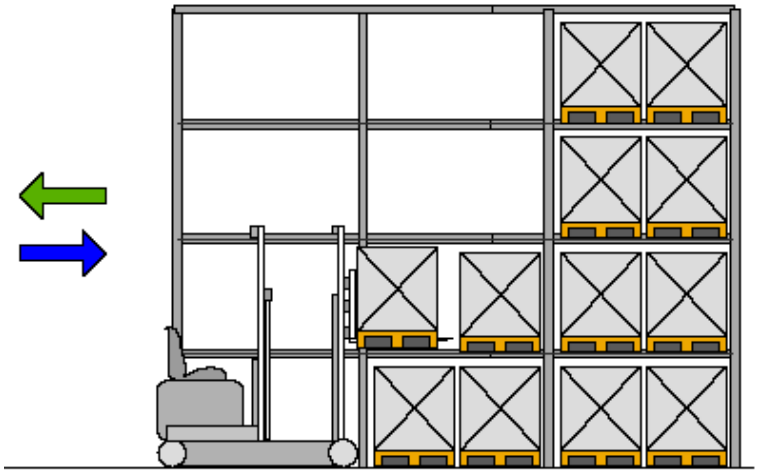
- the forklifts can access the inside of the structure through the corridors that exist between the uprights;

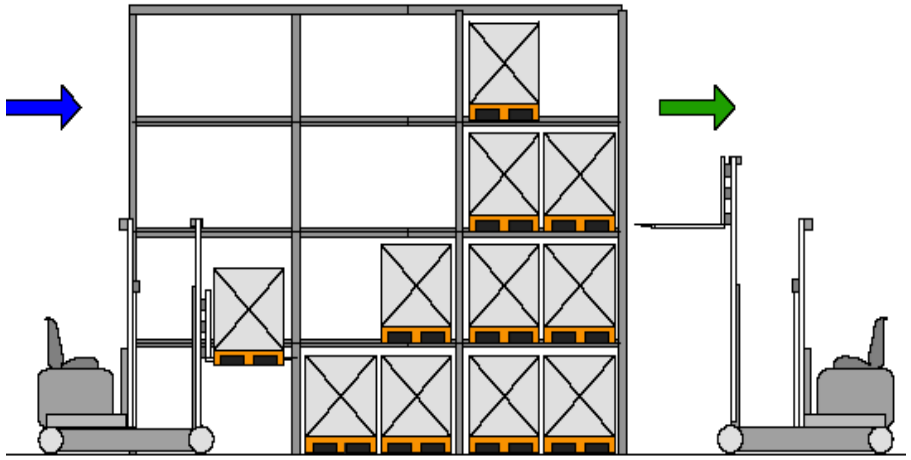


Storage systems

The **static systems to shelving** (**drive-in** and **drive-through**) have the following characteristics:

- if the access is on one side it has a drive-in system, while from both sides if it has a drive-through system. In the drive-in, the management logic of the UdC is of type LIFO, while in the drive-through logic is of type FIFO;





Storage systems

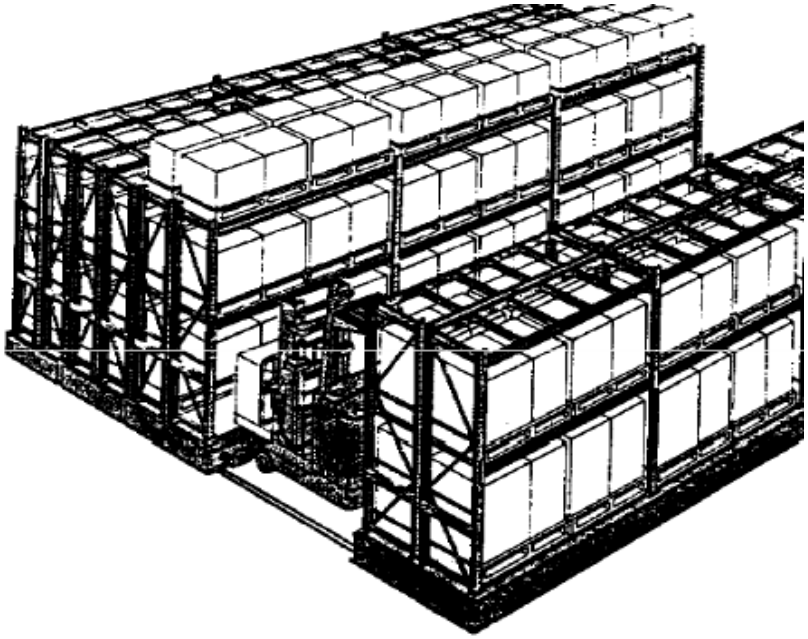
The **static systems to shelving** (**drive-in** and **drive-through**) have the following characteristics:

- is required to reserve at least one corridor per item;
- the system offers a high coefficient of surface use, but has a much lower selectivity to 1;
- the UdC must then be of such dimensions as to allow the placement within the structure.

Storage systems

The **dynamical systems to movable shelves** have the following characteristics:

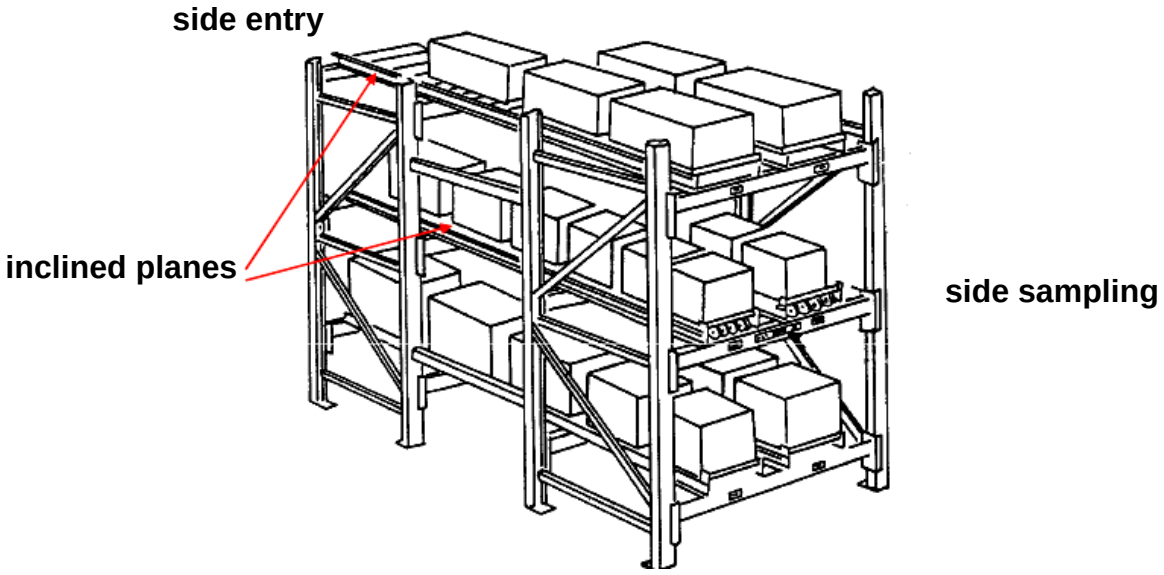
- are constituted by shelves that can translate laterally to allow the opening of an access corridor to the UdC;
- establishment costs are high, but the usage superficial is high;
- the systems are used when available space is reduced and the frequency of handling is low.



Storage systems

The **dynamical systems to fixed shelves at gravity** (**live storage** or **flow-through**) have the following characteristics:

- the UdC are placed on an inclined plane which allows to exploit the gravity through a conveyor roller or wheels;
- the UdC may be managed in logic FIFO;
- the selectivity is low.



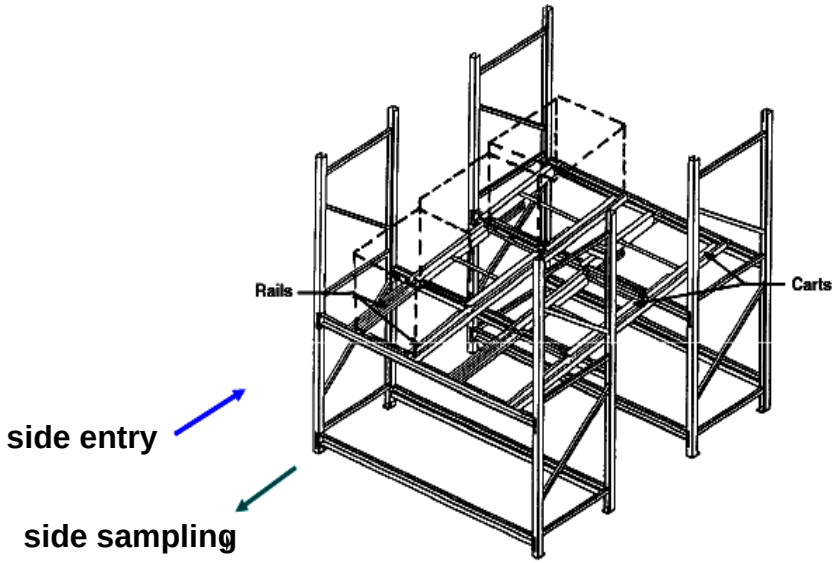
Storage systems

The **dynamical systems to fixed shelves at gravity** (**live storage** or **flow-through**)

Storage systems

The **dynamic systems a fixed shelves in counterslope** (**push-back**) with the following characteristics:

- the UdC are placed on an inclined plane and thrusts counter slope; a system of trolleys or rollers allows the arrangement without impacts or rollovers;
- the materials management is according to a logic LIFO.



Storage systems

The **dynamic systems a fixed shelves in counterslope** (**push-back**)

Storage systems

The **cantilever systems** have the following characteristics:

- the UdC shall be suspended on cantilever arms supported by uprights;
- the system is highly customizable;
- the system allows the storage of UdC of different sizes, but is often used for packages in which the length is prevalent (bars, tubes, plates, etc.).