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INDUSTRIAL PLANTS

Chapter eight:

The industrial buildings – first part

DOUBLE DEGREE MASTER IN

“PRODUCTION ENGINEERING AND MANAGEMENT”

SEAT OF PORDENONE

UNIVERSITY OF TRIESTE

Generality

The choice of a type of **building** is determined by the plant layout, ad example by placement of the machines, departments and other necessary services, carried out earlier in the feasibility of an industrial plant.

Before you even choose the type of building, we must define two essential features of the building:

- ***mesh***: identified by the pillars forming the backbone, the dimensions of which correspond to the spacing between the pillars;
- ***height under chain wire***: the free height below the lower edge of the supporting roof structure.

In defining of the size and height of the mesh height under chain wire will be used, *preferably*, **standardized components** to reduce costs.

In particular industrial plants, you can waive this privilege to standardize the layout of machines and departments which correspond to lower operating costs. In any case we must perform a cost-benefit analysis.

Generality

The plant layout fixed also **other constraints** on the industrial buildings:

- runways for overhead cranes and other means of transport suspended;

- the load to the nodes for the suspension of overhead conveyors, overhead cranes suspended etc.;

Generality

The plant layout fixed also **other constraints** on the industrial buildings:

- the loading docks and unloading of road vehicles and rail;
- the doorway and access roads for trucks and railway wagons;
- the loads on the floor;
- the possibility of future expansion.

Generality

Additional constraints that must be taken into account *until the early stage* of the project are:

- natural and artificial lighting;
- heating;
- ventilation;
- air conditioning;
- risk of fires and explosions;
- production of noise;
- vibrations;
- smoke, dust and odors.

Generality

The main factors influencing the choice of the type of building are:

- ***plant layout***

  It depend on the operating costs, the required area developed, the possibility of extensions and changes etc.;
- ***construction costs of the building and of the ground required***;
- ***cost for managing*** (at example: heating, lighting, ventilation etc..);
- ***requirements of the machinery and processes*** (weight, vibration, noise, dust etc.).

Generality

The **industrial architecture** is constantly evolving and faces many difficulties and subject to certain *specific conditions*. The objectives which it proposes are:

- economy and speed of construction of the buildings;
- absolute adherence to functional and technological requirements;
- high quality of the working environment, with particular reference to health and safety;
- harmonic placement on the natural and socio-economic existence.

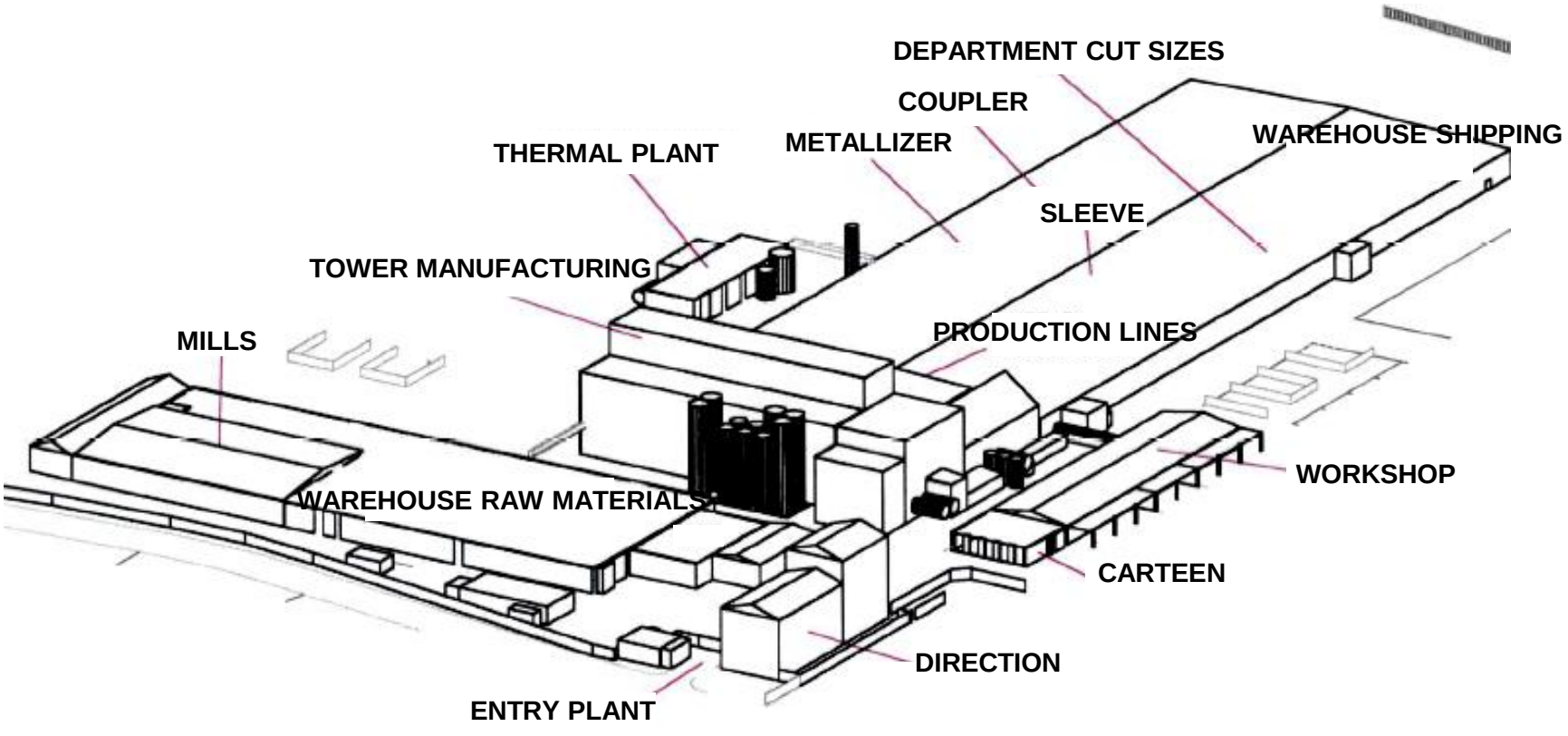
Classification of building

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

- **multi-storey**: develop *in height*, so that the work area, storage, services etc., are to be arranged on different planes. The connections between the various plans are insured by stairs, elevators, hoists etc.;
- **one-storey**: develop *in horizontally*, so all work areas, storage facilities and services are arranged on the same plane (usually coinciding with the ground surface or floor with a little higher).

Classification of building

Example of **industrial complex:**



Classification of building

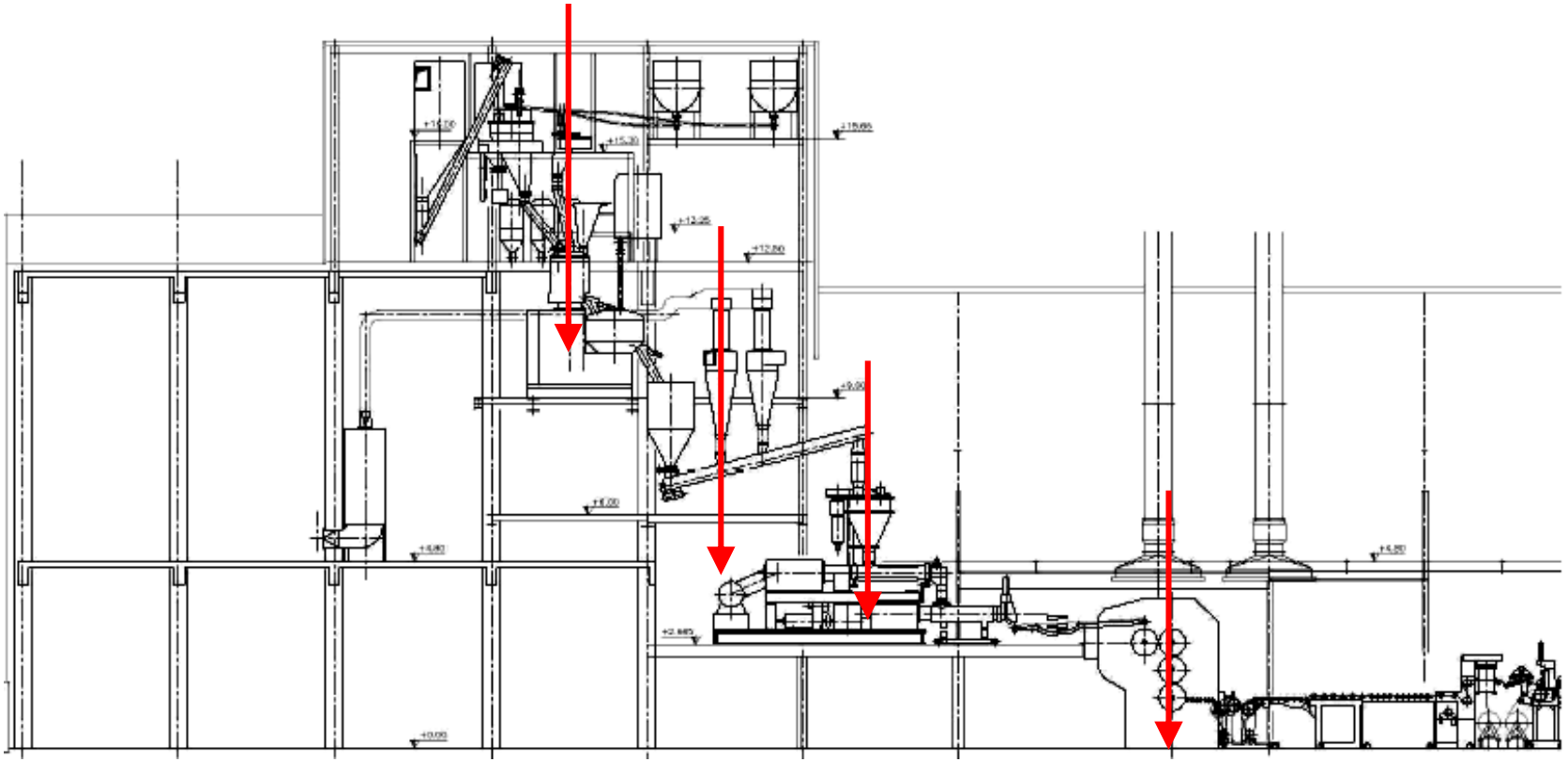
The **multi-storey buildings** are designed to:

- machining in which the materials can move by **gravity;**
- when **the load on the floor is very low;**
- when it already has available a **land insufficient** for the development in the horizontal.

The multi-storey buildings often in contrast with the requirements of a rational plant layout, as there is the impossibility of having a linear flow of materials, ad example, without crossings, returns, stops etc.

Classification of building

Example of solution intensive with **multi-storey building**



Classification of building

For **buildings with a plan** can be made larger mesh than in the case of multi-story buildings and shall be selected when:

- the load on the floor is high;
- have to carry heavy and bulky material**;**
- the availability of soil is high and its cost is low;
- the processing have dangers of fires and explosions, and cause vibration, dust etc.;
- lays down changes or additions to the layout of the facility;
- is can use natural light.

Classification of building

Is sometimes used in buildings for one or more floors with ***basements and/or mezzanines***. So, when you have to install equipment very high, the basement is necessary in order to get the workplace at the most appropriate height.

The mezzanines is used for toilets, changing rooms, canteens etc. Less frequently, are used to subassemblies and warehouses, which do not want to encumber the ground surface.

Constraction systems

The **industrial buildings** can be made of:

- **normal reinforced concrete or prestressed**;
- **steel**;
- **brick armed**.

Constraction systems

The **reinforced concrete structures** have the following characteristics:

a) ***light***: variable from 8 to 20 meters in the case of buildings with a floor and from 6 to 10 feet for multi-storey buildings;

b) ***forms*** of building at:

- *shed*: valid for the natural lighting of workplaces;
- *covers a pitched flat or sloping* with skylights longitudinal;
- *vaulted* (with or without skylights).

The advantages of this structure compared to alternative solutions are found in:

- good resistance to fire;
- are not attacked by corrosive agents;
- have good thermal capacity;
- transmit less vibration and noise.

Constraction systems

The **prestressed structures in reinforced concrete** with the following characteristics:

a) are ***prefabricated*** and cutlery in place using highly mechanized yards. Their fortune is tied to:

- need to make **buildings more and more large meshes** (more flexible arrangement of equipment);
- allows **better exploitation** of the area covered (each pillar occupies at least 0.80 ~ 1.50 square meters of floor);
- **rapid execution** of prestressed concrete structures and lower incidence of labor required for construction.

Constraction systems

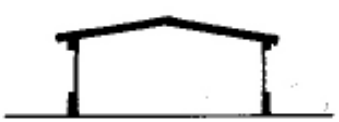
The **prestressed structures in reinforced concrete** with the following characteristics:

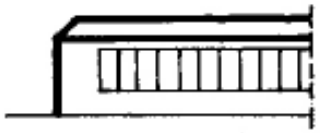
a) are ***prefabricated*** and cutlery in place using highly mechanized yards.

Constraction systems

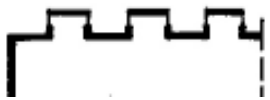
The **prestressed structures in reinforced concrete** with the following characteristics:

The eight types of current structures of industrial buildings are:

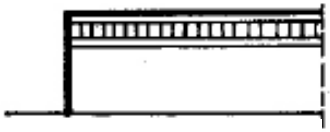




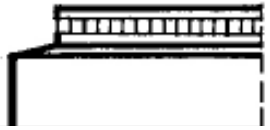
a) with a pitched roof and ribbon windows on the perimeter walls



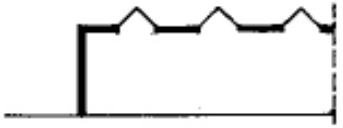
e) with flat roof and transverse skylights at rectangular cross-section



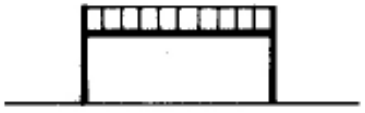
b) with a pitched roof and windowed bands on roof

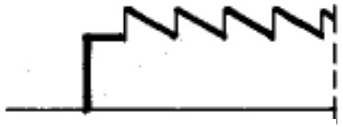


f) with a pitched roof and longitudinal skylights in the shape of parallelepiped

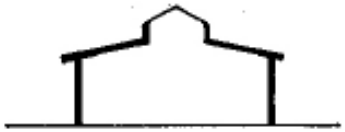


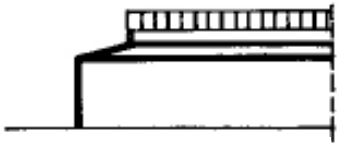
c) with flat roof and skylights a triangular section transverse



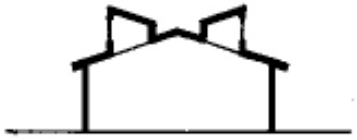


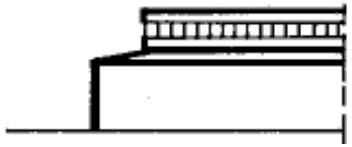
g) with roof to shed or saw tooth





d) with a pitched roof and skylights longitudinal a triangular section





h) with a roof with M

Constraction systems

The **steel structures** have the following characteristics:

- ***meshes*** of most frequently adopted (in meters): 10x10 – 12x12 – 14x14 – 16x16 – 8x12 – 12x16 – 12x24 – 20x20;
- ***constructive schemes***: at shed, at pitched flat or sloping with longitudinal skylights, at vaulted with or without skylights.

The tendency is to **simplify the constructive schemes** in order to limit the costs of construction and maintenance.

Constraction systems

In the industrial reality is possible to have composite structures, the figure shows in case of structural prestressed reinforced concrete and steel.

Constraction systems

The **structures in reinforced brick** were used essentially for sheds at vaulted, but today are rarely used.

They have the following characteristics:

- the **mesh** of reinforced concrete pillars, as the rest of the supporting beams, is **asymmetrical**: the lights transverse vary, in fact, from 10 to 20 m, while the longitudinal spacing of the pillars is generally comprised between 5 and 10 m.

Constraction systems

The **structures in reinforced brick** were used essentially for sheds at vaulted, but today are rarely used.

The ***advanteges*** attainable with the structures in reinforced brick are:

- *lower unit cost* than other types of structures (pre-fabrication of structures and the mechanization of work);
- *lower maintenance costs*.

The ***drawbacks*** achievable with the structures in reinforced brick are:

- *without use of the space* above the tie rods, which represents a considerable volume to be heated in the cold season: sometimes is used a special false ceiling;
- do not allow the suspension of means of transport;
- installation of air ducts and pipes (heating, ventilation, lighting, water, air, etc.) is more difficult than to buildings made of steel or reinforced concrete.