

Cihan University Sulaymaniya
Engineering Faculty
Architectural Engineering Department



Building Materials

Chapter One

(Introduction To Building Materials)

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Chapter One Introduction to Building Materials

Introduction:

Engineering consists of the design, construction, maintenance, inspection and management of projects, from railroads, to high-rise buildings to sewage treatment centers. Their construction may be under or above ground, offshore or inland, along valleys or flat terrain, and upon rocky mountains or clayey soils.

The core of engineering is to carry out the investigation of materials and methods that can satisfy the needs of the community.

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Materials engineers : are those engineers who are responsible for the selection, specification, and quality control of materials to be used in construction of structures. These materials should meet certain classes of criteria of materials properties. These classes of criteria include:

1. Economic factors.
2. Mechanical properties.
3. Physical properties.
4. Production / construction considerations.
5. Aesthetic properties.



3

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Civil and construction engineers must be familiar with materials used in the construction of a wide range of structures.

- Materials most frequently used include steel, concrete, wood, masonry, and asphalt.



4

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- ❑ Materials used to a lesser extent include aluminum, glass, plastic, and fiber reinforced composites, soil (Geotechnical Engineering).



5

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- Recent advances in the technology of building construction materials have resulted in the development of better quality, more economical, and safer materials. These materials are commonly called high-performance materials.
- More is known about molecular structure of materials and because of continuous research efforts by scientists and engineers, new materials such as polymers, adhesives, composite, geotextiles, coating, cold-formed metals, and various synthetics products are competing with traditional civil engineering materials.

6

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Economic Factors :

The economics of the material selection process are affected by much more than just the cost of the material. Factors that should be considered in the selection of materials include:

1. Availability and cost of raw materials.
2. Manufacturing costs.
3. Transportation.
4. Placing.
5. Maintenance.

All materials deteriorate over time. This deterioration requires maintenance. Therefore; in the economic selection of a material, life cycle cost should be evaluated in addition to initial cost of the structure.

7

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Materials and Types:

A material is defined as a substance or thing from which something else can be made. Cement, brick, aluminum, soil, and water are all examples of materials.

In engineering, materials are employed to design and build structures, elements, or products.



8

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Materials and Types:

Buildings are made of concrete, tennis rackets are moulded out of reinforced plastics, boats are carved out of wood, and roads are made from asphalt concrete. The subject of materials science examines the whys and hows of materials, making it possible to advance the development of new materials. The term *materials engineering* refers to the understanding and review of properties and uses of materials commonly used in engineering.

9

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Materials can be divided into several categories; some of the common groups of materials are introduced in the following.

Building Materials:

Materials that are used in the building industry, such as cement, steel, brick, plastics, wood, glass, ceramics, and concrete, are called building materials.



10

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Cementitious Materials:

- Materials in which the principal binder is Portland cement or another type of hydraulic cement are called cementitious materials.
- Concrete, mortar, grout, and roller-compacted concrete, which are obtained by combining cement, aggregates, and water, are the most common cementitious materials.
- The products of the reaction between cement and water form compounds that bind the aggregate particles together, so that the resulting material can be considered homogeneous.
- The aggregates are two types, **fine (sand)** and **coarse (gravel)**; and both contain particles of various sizes, from large to small. All cementitious materials are porous, the **porosity** depending upon many factors, such as the **amount and type of cement**, and the **amount of water**.

11

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Masonry Materials:

A mason is one who builds with bricks, stones, and blocks. Masonry is the part of a building or structure that is made from combining the masonry units: stone, block or brick, and mortar.



12

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Masonry Materials:

Egyptians built their pyramids (called mastabas) first using mud brick masonry and later (around 2500 B.C.) with stone masonry using gypsum mortar. Romans employed a type of masonry construction for walls in which the space between two parallel layers of burned brick was filled with concrete. Mortar from bitumen was used to bond the 3 bricks in some early masonry construction.



13

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Masonry Materials:

Masonry was also used for building columns and towers, such as the Tower of Pisa, and arches, such as the 83-ft span semicircular arch in the Basilica of Constantine (A.D. 313). Masonry walls are erected today using the same two types of materials: masonry units and mortar. The common masonry units are clay bricks and concrete blocks, although stones.



14

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Masonry Materials:

- Masonry units can be solid (such as burned clay bricks) or hollow (such as hollow concrete blocks).
- The hollow spaces, called cells, in hollow-block masonry can be kept hollow or filled with grout.



15

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Ceramic Materials:

- The word “ceramic” comes from the Greek, meaning “burned earth”
When something is burned, it combines with oxygen in the air; ceramic materials are nonmetallic materials often based on clay (silicate mineral).
- They are usually crystalline and brittle, do not conduct heat or electricity very well, and can withstand high temperatures. Many ceramic materials are used for insulation— thermal (firebricks), building (fiberglass), and electrical. Examples: glass, cement, stone, and brick.

16

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Main Features of Ceramic Materials:



17

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Clay Brickwork:

- Brick is a burned clay masonry unit, generally rectangular and solid. The term “brickwork” refers to masonry built with bricks and mortar, primarily as vertical members subjected to compressive and bending forces.
- The coefficient of thermal expansion of brickwork is 7.5×10^{-6} per °C. Which in concrete is approximately about half of that, and twice of that of limestone.



18

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Insulating Materials:

- Materials that reduce or prevent the transmission of sound, thermal (heat), or electrical insulation are called insulating materials.

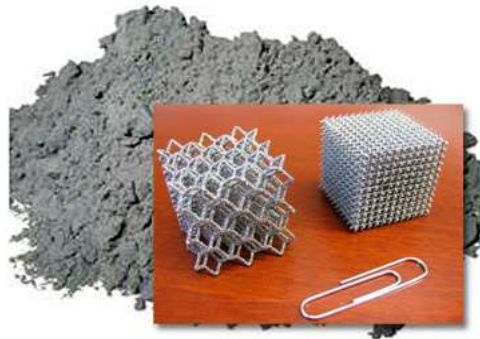


19

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Manufacturing Materials:

- These are materials used in machinery or in manufacturing industries—industries that make products. Examples: metals, plastics, ceramics, and rubber.



20

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Raw Materials:

- Natural products or materials that are transformed through manufacturing processes are called raw materials. Examples: Coal, petroleum, iron ore, and limestone.



21

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Repair Materials:

These are materials used to repair a deteriorating structure of concrete, masonry, or steel. Such as fillers (materials used as the base for the sealant in full- movement joints), sealants (to seal the joints), waterproofing compounds, and materials for general repair work. Examples: rubber (filler), mastics such as asphalt (sealant) and hot- applied rubber-bitumen compound (sealant), cement mortar, and concrete.



22

Chapter One

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Building Construction Materials:

- The basic materials used in building construction applications or in construction projects are:
 - Wood
 - Cement and concrete
 - Bitumen and bituminous materials
 - Structural clay and concrete units
 - Reinforcing and structural steels
- These are sometimes called structural materials. Added to these are plastics, soils, and aluminum. All these materials are employed in a variety of building construction structures such as:
dams, bridges, roads, foundations, liquid-retaining structures, and retaining walls.

23

Thank You.....

24

Next Lecture:

Properties of Engineering Materials:

- 1- Mechanical Properties
- 2- Physical Properties
- 3- Chemical Properties