CONCRETE TECHNOLOGY
تكنلوجيا الخرسانة 2

المرحلة الثالثة

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Syllabus

	Topic
Lectures Outline:	**Introduction about concrete**
	Properties of fresh concrete
	Properties of hardened concrete
	Types of strengths
	Concrete Mix Design

Lecture 1

Introduction about concrete

• *Introduction about concrete*

➢ Definitions of Concrete

What is concrete?

Concrete is a **composite construction material** made primarily from a mixture of several readily available constituents (cement, fine aggregate, coarse aggregate, water) and often additives or admixtures to modify its properties. The cement acts as a binding agent, initiating a chemical reaction with water called **hydration**, this reaction causes the mixture to harden and gain strength over time, resulting in a solid, stone-like mass.

Concrete's composition can be adjusted to meet specific performance requirements, such as workability, strength, and resistance to environmental factors. It is used in a variety of applications, including structural elements (e.g., beams, columns, and slabs), pavements, bridges, and foundations.

TABLE 1.1 Definitions for Concrete

Concrete	=	*Filler*	+	*Binder*
Portland cement concrete	=	Aggregate (fine and coarse)	+	Portland cement paste
Mortar	=	Fine aggregate	+	Paste
Paste	=	Cement	+	Water

- The ideal amount of cement, water, and aggregates, needed to produce a volume of concrete are selected based on a combination of experience and trial batches to meet four objectives:

1. The fresh concrete will be workable enough.

2. The hardened concrete will have strength and durability.

3. The mixture will be economical; and

4. Shrinkage will be minimized.

The strength and workability depend largely on the water-cement (or water- binder) ratio.

In order to increase the strength of concrete **chemical admixtures** and **mineral admixtures** are also added.

- **Chemical admixtures-** A substance added to concrete in small quantities during mixing to modify its properties, such as workability, setting time, strength, or durability. Common types include;

1. Air-Entrainment Admixtures

Introduce tiny air bubbles in the concrete, improving resistance to freeze-thaw cycles and enhancing durability.

2. Water-Reducing Admixtures

Reduce the amount of water needed while maintaining workability, increasing strength and durability.

3. Set-Retarding Admixtures

Slow down the setting time of concrete, useful in hot weather or for complex pours requiring extended working times.

4. Accelerating Admixtures

Speed up the setting and early strength gain of concrete, often used in cold weather.

5. Superplasticizers

Provide high fluidity to concrete without increasing water content, improving workability and allowing for high-strength concrete production.

- **Mineral Admixtures-** A finely divided material (Generally replace 10 to 50% of cement), often byproducts of industrial processes. These materials, such as fly ash, silica fume, slag, and metakaolin, added to concrete to enhance strength, durability, and workability while reducing the environmental impact of cement production.

➢ Advantages of Concrete

The major advantages and disadvantages of concrete are summarized in **Table 1.2.**

Advantages	Disadvantages
Low Cost	Low tensile strength
High Durability	Heavy
High Fatigue Resistance	Develops strength slowly
Easy to form/Shape	Dimensions can change with time

➢ Properties of concrete

- Density: *2240 - 2400 kg/m³*
- Compressive strength: *20 - 40 MPa*
- Flexural strength: *3 - 5 MPa*
- Tensile strength: *2 - 5 MPa*
- Modulus of elasticity: *14000 - 41000 MPa*
- Poisson's ratio: *0.20 - 0.21*
- Shear strength: *6 - 17 MPa*

➢ Stages of Concrete

When water is added to concrete, it goes through three stages during its lifespan:

1. Fresh Concrete

This refers to the concrete from the moment water is added to the dry components until the moment of initial setting (freshly mixed that does not set yet and still in its plastic state). During this stage, the concrete can be mixed, transported, and poured.

2. Green Concrete

This is the concrete in the period from the beginning of initial setting until the onset of hardening (it loses its plasticity gradually), typically within 24 hours, At this stage, the concrete cannot be mixed, transported, or poured, as it has set and cannot bear any stress.

3. Hardened Concrete

This stage begins after the hardening phase (i.e., after 24 hours) and lasts throughout the concrete's lifespan. It has the strength to resist the loads affecting the structure loads over time.

There are two sets of criteria that we must consider when making concrete:

- Short-term requirements of fresh concrete like workability.
- Long-term requirements of hardened concrete, such as strength, durability, and volume stability.

Do you have any Questions?