

Lecture 1

General background about the course

Course title: Properties of Concrete

Course Code: CE 2311

Course instructor: Mahmoud Kh. Mohammed:

BSc - University of Anbar – Iraq- 1999

MSc - University of Technology – Iraq- 2002

PhD - University of Nottingham – UK- 2015

Course general description and course aim:

The current course is designed for the BSc candidate(s) in order to provide a well understanding of both properties of concrete (in fresh and hardened stages) and its raw materials. The main aim of this course is to enable the student to identify the basic and fundamental, theoretical and experimental, principles of concrete science with high quality of knowledge.

Course outcomes: (Please check yourself after completion of the course)

After completing the course, the student(s) should be able to:

1. Understand the fundamentals properties of concrete and its raw materials.
2. Introduce or propose critical thoughts in how to develop the characterizations of the concrete and its raw materials based on point number 1.

3. Prepare and conduct most of the important tests for the concrete and its raw materials. (This is from theoretical background and Properties of Concrete Lab.).
4. Deal with the problems of the concrete and its raw materials in the work site. This includes the concrete problems in fresh and hardening stages.
5. Develop different research skills in the course topics at BSc level (Course work).
6. Introduce critical thoughts in how to develop/invent new types of concrete/ cement.

Course evaluation Methods:

Written Exams, Quizzes, Home works, (Project/Small Report, Presentation, Poster

Group discussions - these are should be implemented in a course work).

Course Topics:

CH1: General background

CH2: Cement

CH3: Aggregate of concrete

CH4: Water in concrete works and Mixing of concrete

CH5: Fresh concrete

CH6: Design of concrete mixes.

CH7: Concrete admixtures

CH8: Strength and other strength types of concrete

CH9: Elasticity and Volume Changes (shrinkage and swelling)

CH10: Special and modified types of concrete (these topics will be covered by the course work)

References:

1- English:

- **Neville, A. M. 2011. Properties of Concrete, London, Pearson Education Limited. or any Edition.**
- **Mehta, P. K. & Monteiro, P. J. M. 2006. Concrete: Microstructure, properties and materials, McGraw-Hill.**

2-Arabic:

- **Concrete Technology , Dr Hana Abid and Dr Muyed Noori**
- **Concrete Technology, Dr Mahmood Alimam.**
- **Lecture notes:**

1-Mahmoud Kh. Mohammed

2- Dr Yousif Abdulwahid

3- Mr Mohammed Hmood

Good luck in this course

Mahmoud

General Background: *What is concrete and why is it important?*

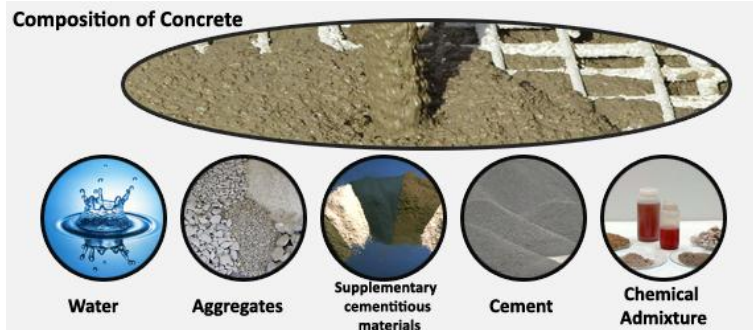
Concrete is one of the most important materials for building and construction over the world. The consumption of this material is estimated to be more than 25 billion tons/year in 2009. There are many important reasons that make it in the top rank of the worldwide consumption compared with other construction materials such as steel, bricks, timber and others. These reasons can be summarized as follows:

- It has an excellent resistance to water – a good example for this is the use of concrete in dams, water canals, water tanks and pipes.
- The availability of its raw materials worldwide with relatively low/cheap price – cement, fine and coarse aggregate and water.
- The ease of installation and formation – this is due to the plastic consistency at early stage.
- The production of concrete needs less energy compared with other construction materials.
- It has a good fire resistance up to high temperature level (complete decomposition at 910 °C).

However, the main drawback of this material is the prone to cracking (low tensile strength). Concrete is a brittle material and therefore, we need to use the steel reinforcement. (Think about more!)

Concrete ingredients and phases:

Concrete basically is a mixture of cement, aggregate (Fine/Coarse) and water. However, other cementitious materials and chemical admixtures can be used. It is important to differentiate between concrete raw materials and concrete phases.

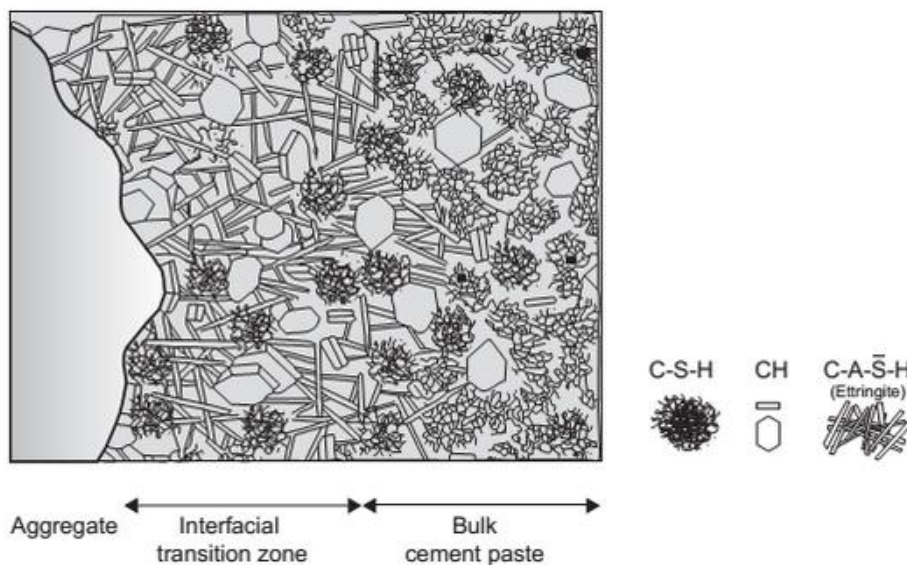


Plain Concrete ingredients

Modified Concrete ingredients

Concrete is a composite material consists of three main phases:

- Aggregate (Fine and coarse)
- Cement paste/binder (cement plus water and sometimes cement + filler + water + chemical admixture)
- Interfacial Transition Zone between (ITZ) between binder and aggregate.



Concrete Phases

Cement/cementitious material + water = cement paste (CP)

Cement/cementitious material + water+ Fine aggregate = cement mortar (CM)

Cement/cementitious material + water + Fine aggregate +coarse aggregate = concrete (C)

Classification of Concrete

Concrete can be classified according its compressive strength level and unite weight:

According strength:

- Low strength concrete (less than 20 MPa)
- Medium strength concrete (between 20-40 MPa)
- High strength concrete (greater than 40 MPa)

According density (Unite weight):

- Lightweight concrete- LWC (between 300-1850 kg/m³): **A-** Structural lightweight aggregate concrete (1600-1850 kg/m³) **B-** No fines concrete (800-1600 kg/m³) and **C-** Foamed/cellular/gas concrete (300-800 kg/m³)
- Normal weight concrete NWC (about 2400 kg/m³)
- Heavy weight concrete HWC (greater than 3200 kg/m³)

Types of Concrete:

Mainly concrete can be plain or reinforced concrete (In site, Precast or pre-stressed: what are the differences between them?). However, there are many types of modified/special concrete:

- Fibre Reinforced Concrete (FRC)
- Polymer and Geo-polymer Concrete (PC)
- High Performance Concrete (HPC)
- High Strength Concrete (HSC)
- Self-Compacting Concrete (SCC)
- Self-Healing Concrete (SHC)
- Shotcrete Concrete (ShC)

- Mass Concrete (MC)
- Lightweight Concrete (LWC)
- Sulfur Concrete (Su C)

Note: These topics will be covered by a course work for students. The tutor should explain the main idea of the course work (how to do a good course work and its benefit).

What is course work?

“Coursework is work performed by students or trainees for the purpose of learning. Coursework may be specified and assigned by teachers, or by learning guides in self-taught courses. Coursework can encompass a wide range of activities, including practice, experimentation, research, and writing (e.g., dissertations, book reports, and essays). In the case of students at universities, high schools and middle schools, coursework is often graded and the scores are combined with those of separately assessed exams to determine overall course scores. In contrast to exams, students may be allotted several days or weeks to complete coursework, and are often allowed to use text books, notes, and the Internet for research.

In universities, students are usually required to perform coursework to broaden knowledge, enhance research skills, and demonstrate that they can discuss, reason and construct practical outcomes from learned theoretical knowledge. Sometimes coursework is performed by a group so that students can learn both how to work in groups and from each other”.

Source: <https://en.wikipedia.org/wiki/Coursework>

Now, it is the time to choose your course work title!

Requirements of the coursework: (from structure and content aspects)

- 1- Report cover
- 2- List of content (including figure and tables)
- 3- Abstract
- 4- Definition of concrete type
- 5- Materials used
- 6- Production
- 7- Properties and uses
- 8- Advantages and disadvantages
- 9- Conclusion and suggestion to develop this type of concrete
- 10- References used