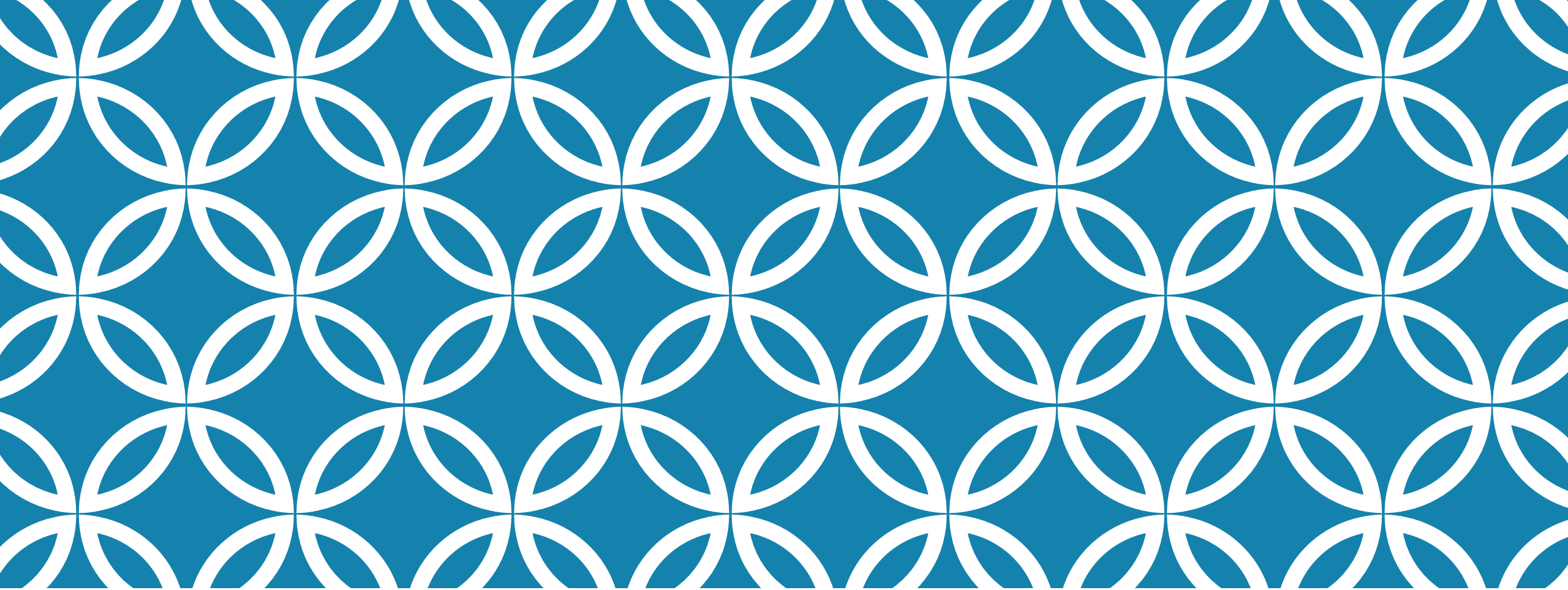


CONCRETE TECHNOLOGY MODULE SEMESTER 1 – LECTURE 1

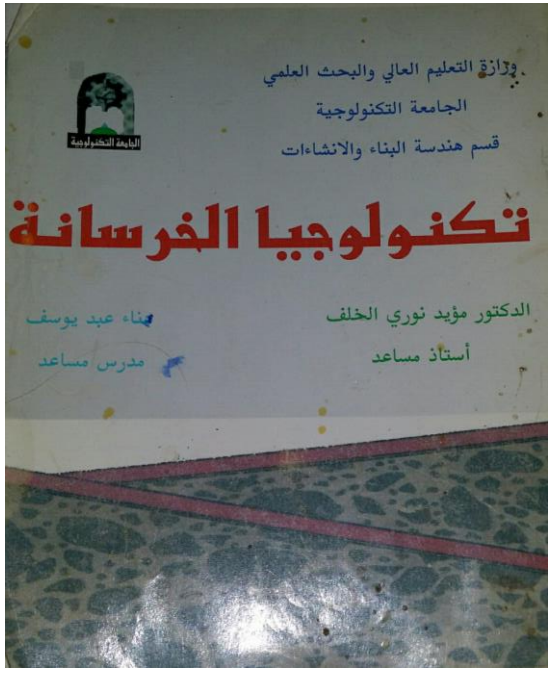
Dr. Khaldoon Shehab

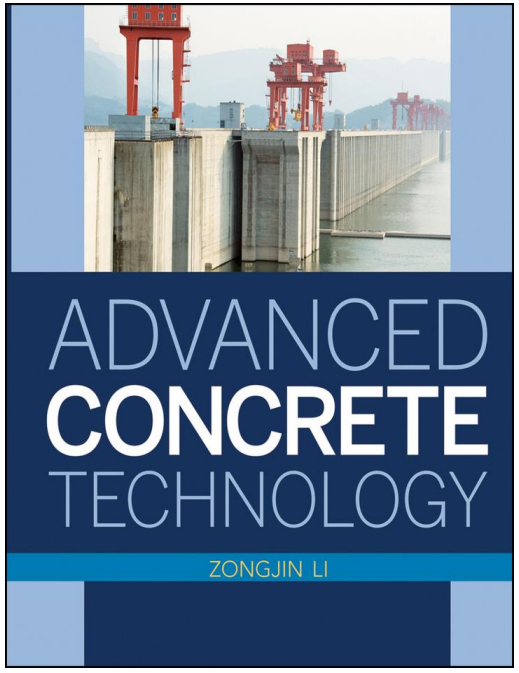
SEMESTER 1 OUTLINE

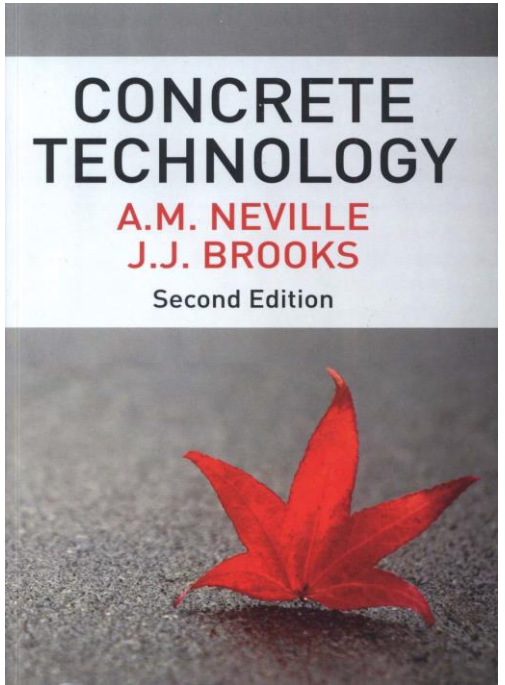
Item	Subject	Item	
1	**Introduction: Cement and Aggregate**		
2	**Manufacturing of concrete** - Mixing - Transportation - Placing and compaction - Curing - Finishing	**4**	**Strength of Concrete** - Compressive strength - Tensile strength - Modulus of rupture - Bond strength with steel reinforcement - Factors affecting concrete strength - Factor affecting concrete test
3	**Properties of Fresh Concrete** - Workability and Consistency - Segregation and Bleeding - Pressure on form work - Stripping of form	**5**	**Deformation of Concrete** - Creep - Shrinkage - Modulus of elasticity and Poisson's ratio

REFERENCES

- Concrete technology by Dr. Moaid Nory
- Advanced concrete technology by Zongjin Li
- Concrete Technology -2dn Ed by A.M. NEVILLE



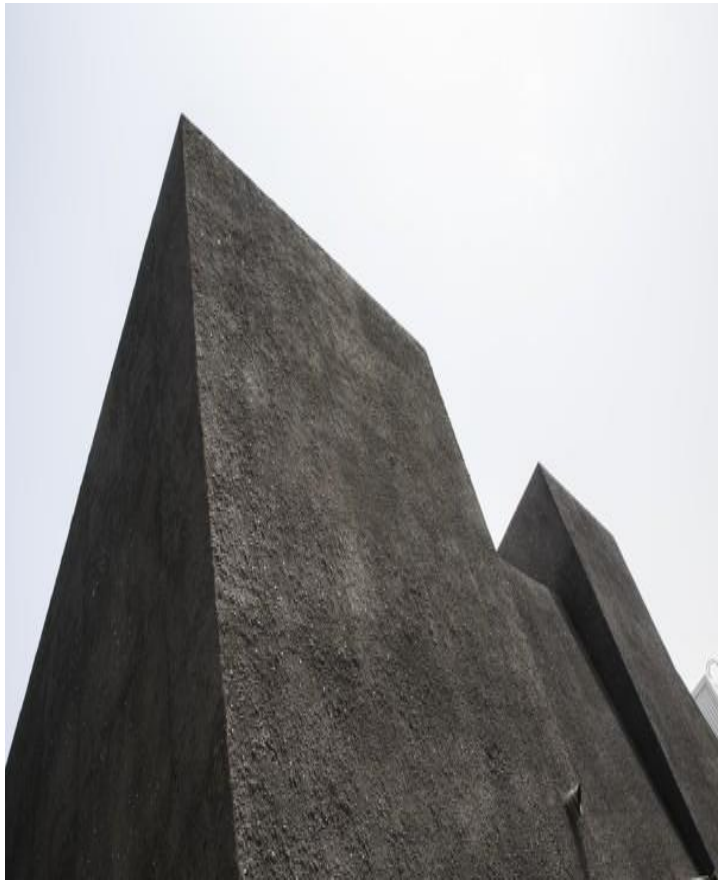




LECTURE CONTENTS

1. Concrete Definition and Historical Development
2. Concrete as a Structural Material
3. Characteristics of Concrete
4. Introduction to Concrete related Tests

1. CONCRETE DEFINITION AND HISTORICAL DEVELOPMENT



Concrete is a manmade building material that looks like stone.

The word “concrete” is derived from the Latin concretus,

meaning “***to grow together***.”

It can be said that the concrete is a composite material that consists essentially of a binding medium in which are embedded particles or fragments of aggregates Limitations.

The simplest definition:

concrete = filler + binder

Depending on what kind of binder is used, concrete can be named in different ways:

- Nonhydraulic cement concrete: Typical examples
- of nonhydraulic cement are: gypsum and lime.

- Hydraulic cement concrete
- Examples of hydraulic cement include:

hydraulic lime, pozzolan cement, and Portland cement

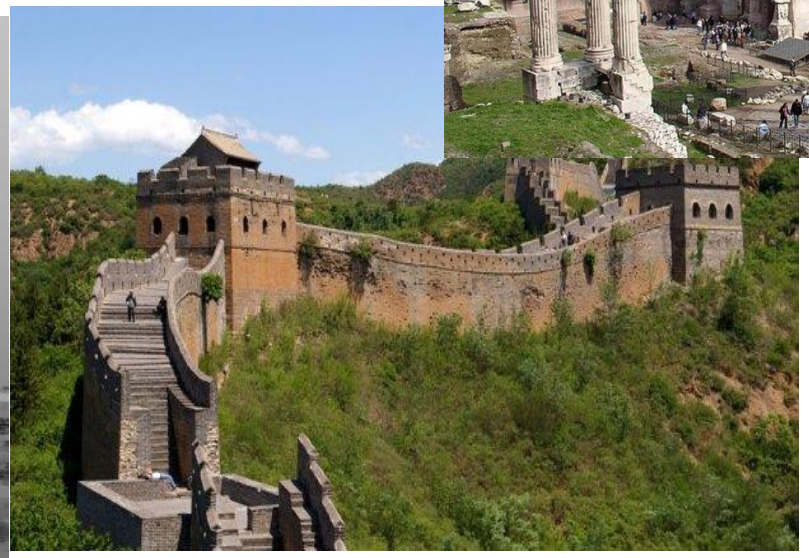
- asphalt concrete

- polymer concrete

Nonhydraulic cement concretes are the oldest used in human history

The nonhydraulic cements used at that time were gypsum and lime

- The Romans made concrete by mixing small pieces of gravel and coarse sand mixed with hot lime and water, and sometimes even animal blood.
- Assyrians and Babylonians used clay as the bonding material.
- The Egyptians used gypsum mortar in construction
- The Chinese also used lime mortar to build the Great Wall in the Qin dynasty



- In 1756, John Smeaton was commissioned to rebuild the Eddystone Light house off the coast of Cornwall, England
- Smeaton used a mortar prepared from a hydraulic lime mixed with pozzolan imported from Italy
- James Parker of England filed a patent in 1796 for a natural hydraulic cement made by calcining nodules of impure limestone containing clay.
- Vicat of France produced artificial hydraulic lime by calcining synthetic mixtures of limestone and clay
- Portland cement was invented by Joseph Aspdin of England in **1824**.
- Portland cement was prepared by calcining finely ground limestone, mixing it with finely divided clay, and calcining the mixture again in a kiln until the CO2 was driven off. This mixture was then finely ground and used as cement.
- Isaac Johnson who first burned the raw materials to the clinkering temperature in 1845 to produce modern Portland cement

Aggregates are another main ingredient of concrete, and which include sand, crushed stone, clay, gravel, slag, and shale.

- **First generation of concrete** = Plain concrete made of Portland cement and aggregate

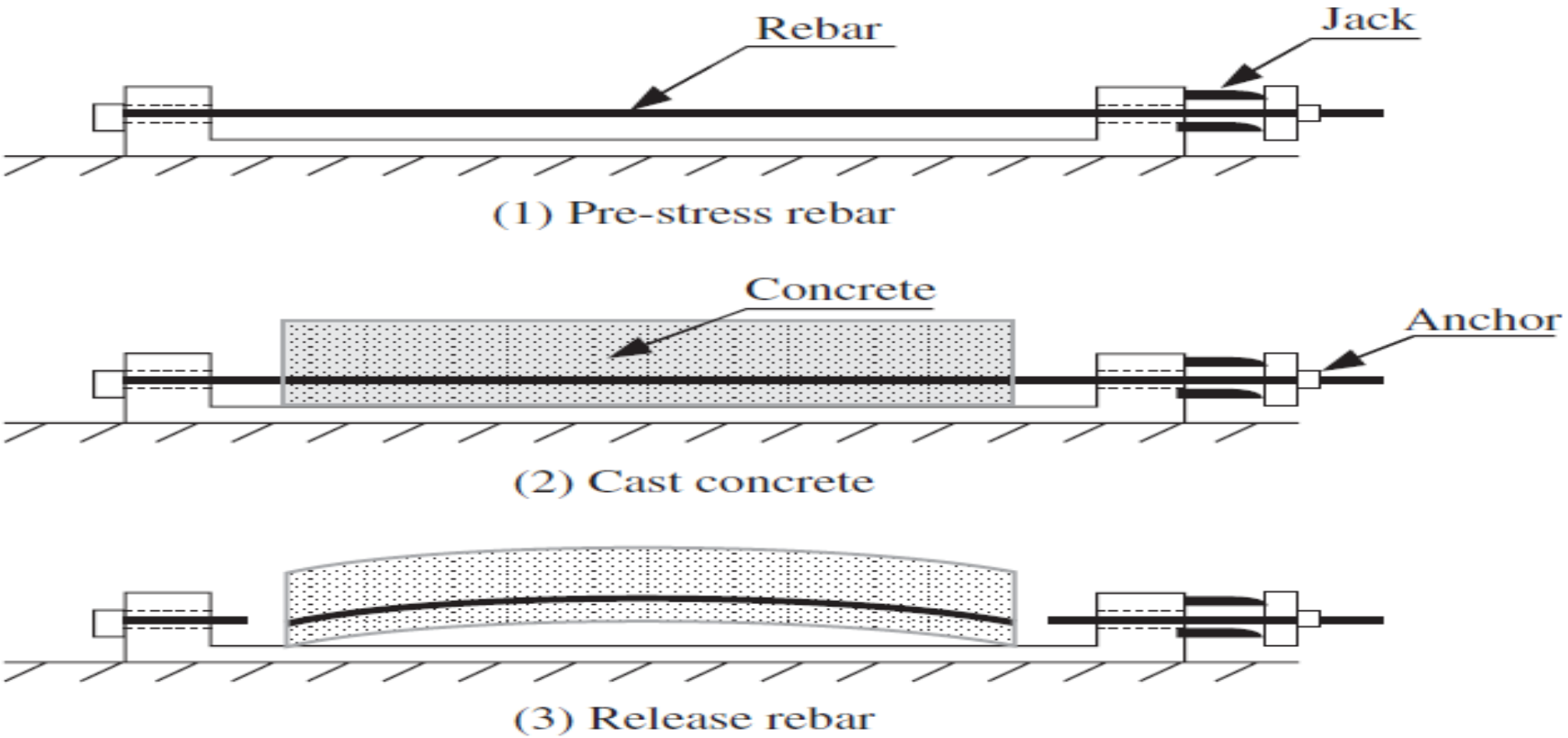
Joseph Aspdin 1824

- **Second generation of concrete** = steel bar-reinforced concrete

Invented by Joseph Monier on 16 July 1867

➢**Third generation of concrete = Prestressed concrete**

first patented by a San Francisco engineer P. H. Jackson in 1886.



PRESTRESSED CONCRETE

- As a structural material, the compressive strength at an age of 28 days is the main design index for concrete.
- There are several reasons for choosing compressive strength as the representative index.
- **First**, concrete is used in a structure mainly to resist the compression force.
- **Second**, the measurement of compressive strength is relatively easier.
- **Finally**, it is thought that other properties of concrete can be related to its compressive strength through the microstructure.
- As early as 1918, it was found that the compressive strength of a concrete was inversely proportional to the water-to-cement ratio.
- Since the 1960s, the development of high-strength concrete has made significant progress due to two main factors: **the invention of water-reducing admixtures** and **the incorporation of mineral admixtures**, such as silica fume, fly ash, and slag.
- Concrete produced after the 1980s usually contains a sufficient amount of fly ash, slag, or silica fume as well as many different chemical admixtures
- such concretes are referred to as **contemporary concretes**.

Contemporary concretes

Ultra-high-performance concrete (UHPC)

It is defined as a concrete that can meet special performance and uniformity requirements, which cannot always be achieved routinely by using only conventional materials and normal mixing, placing or curing practices.

self-compacting concrete (SCC)

Initially developed by Professor Okamura and his students in Japan in the late 1980s

Ultra-high-strength (performance) concrete (UHSC)

200 mpa +

footbridge built in Sherbrooke, Canada

2.CONCRETE AS A STRUCTURAL MATERIAL

At this stage, if not specified, the term concrete usually refers to Portland cement concrete. For this kind of concrete, the compositions can be listed as follows:

Portland cement
+ water (& admixtures) → cement paste
+ fine aggregate → mortar
+ coarse aggregate → concrete

Admixtures are almost always used in modern practice and essential component of contemporary concrete.

Admixtures are defined as materials other than aggregate (fine and coarse), water, and cement that are added into a concrete batch immediately before or during mixing. **Its benefits include:**

For instance, chemical admixtures can modify the setting and hardening characteristics of cement paste by influencing the rate of cement hydration.

Water-reducing admixtures can plasticize fresh concrete mixtures by reducing surface tension of the water.

Air-entraining admixtures can improve the durability of concrete, and

Mineral admixtures such as pozzolans (materials containing reactive silica) can reduce thermal cracking.

Concrete is **the most widely used construction material in the world**, and its popularity can be attributed to two aspects.

First, concrete is used for many different structures, such as dams, pavements, building frames, or bridges, much more than any other construction material.

Second, the amount of concrete used is much more than any other material.

Its worldwide production exceeds that of steel by a factor of 10 in tonnage and by more than a factor of 30 in volume.

As of now, the annual world consumption of concrete has reached a value such that if concrete were edible, every person on earth would have 2000 kg per year to "eat." You may wonder why concrete has become so popular.

- In a **concrete structure,** there are two commonly used structural materials:
  - concrete and steel.
- A structural material is a material that carries not only its self-weight, but also the load passing from other members.

- Steel is manufactured under carefully controlled conditions, always in a highly sophisticated plant; the properties of every type of steel are determined in a laboratory and described in a **manufacturer's certificate.**
- However, the quality of concrete is hardly guaranteed because of many other factors, such as aggregates, mixing procedures, and skills of the operators of concrete production, placement, and consolidation.

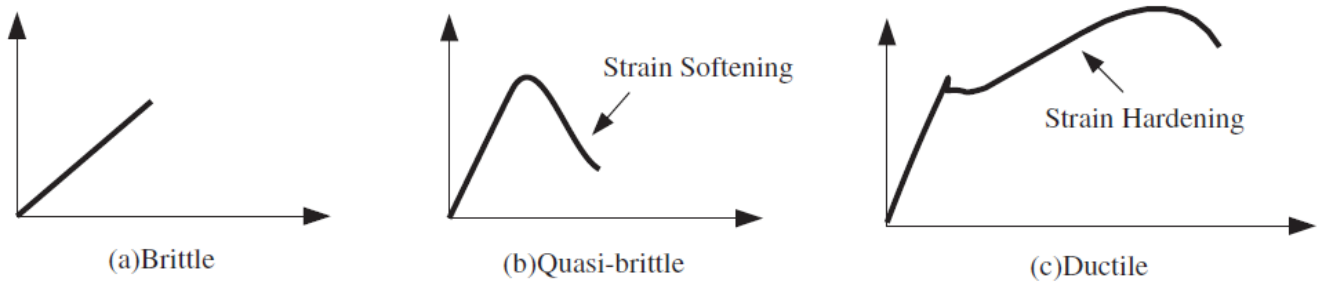
3. CHARACTERISTICS OF CONCRETE

Advantages of concrete

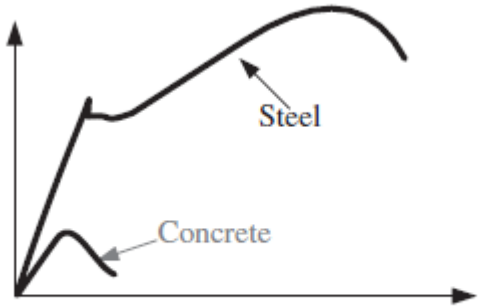
- Economical:
- Ambient temperature-hardened material
- Ability to be cast
- Energy efficient
- Excellent resistance to water
- High-temperature resistance
- Ability to consume waste
- Ability to work with reinforcing steel
- Less maintenance required

Limitations

- *Quasi-brittle failure mode*



- Low tensile strength



- Low toughness (ductility):
- Low specific strength (strength/density ratio):
- Formwork is needed:
- Long curing time
- Working with cracks


Thank you for
your
attention!

4. INTRODUCTION TO CONCRETE RELATED TESTS

الموضوع
اسلوب كتابة وتنظيم التقارير المختبريه
الاسمنت البورتلاندي
طريقة اخذ النماذج
الظروف القياسيه لأجراء فحص الاسمنت
الخواص الفيزيائية للاسمنت
نعومة الاسمنت
طرق قياس نعومة الاسمنت
طريقة نفاذية الهواء باستخدام جهاز بلين
قياس الاسمنت المتبقي على المنخل رقم (170) أو رقم (200)
القوام القياسي لعجينة الاسمنت
قياس زمن التجمد الابتدائي و النهائي
مقاومة الاسمنت
مقاومة الانضغاط
مقاومة الشد
الركام
طريقة اخذ النماذج حسب المواصفات العراقية رقم (29) لسنة (1980)
الظروف القياسية لفحص الركام
تحضير نموذج الركام في المختبر
الكثافة والكثافة النسبية (الوزن النوعي) وامتصاص الماء و الفجوات في الركام
الكثافة النسبية (الوزن النوعي) والامتصاص للركام الناعم
الكثافة النسبية (الوزن النوعي) والامتصاص للركام الخشن
الكثافة الكلية (الوزن لوحدة الحجم) للركام
التحليل المنخلي للركام
تدرج الركام الناعم
تدرج الركام الخشن