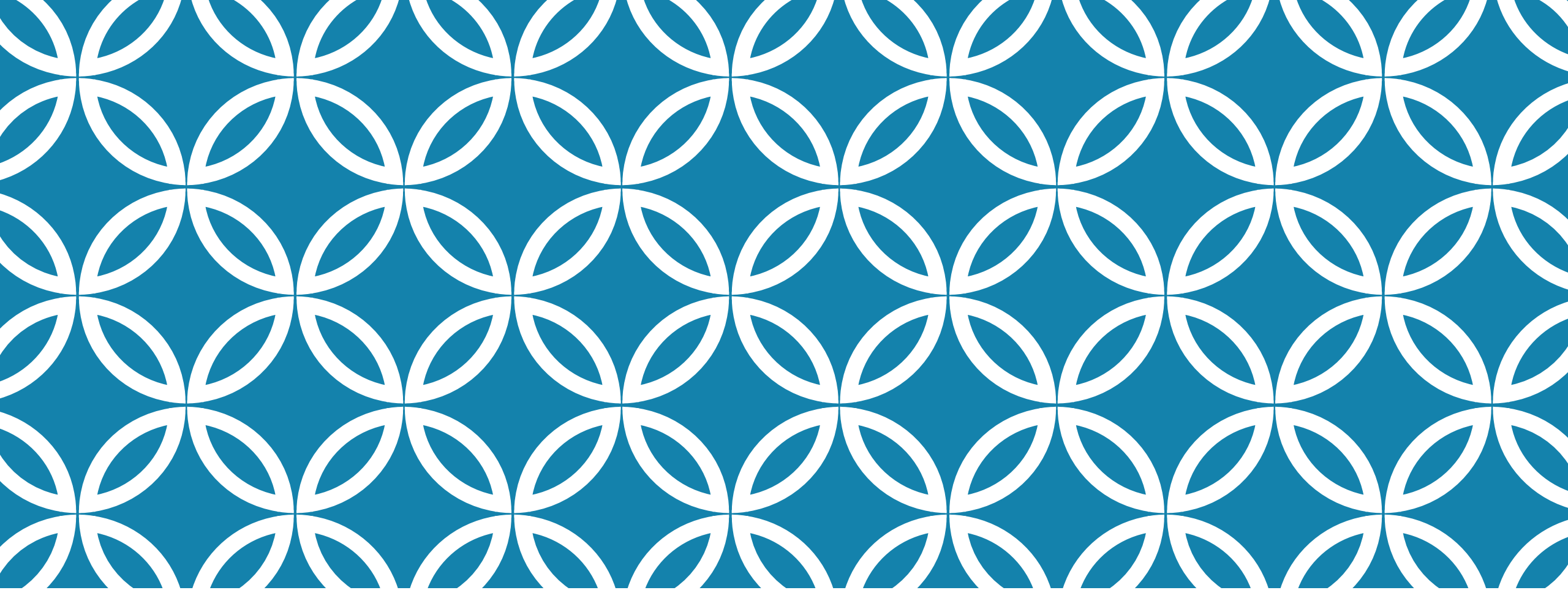


CONCRETE TECHNOLOGY MODULE SEMESTER 1 – LECTURE 6

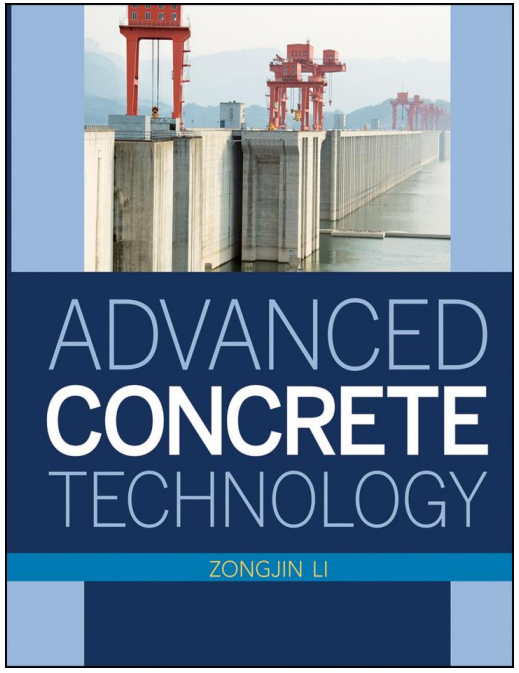
Dr. Khaldoon Shehab

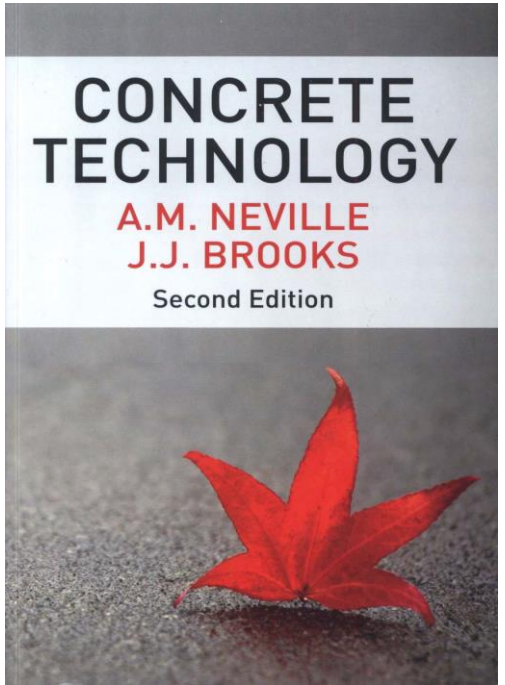
SEMESTER 1 OUTLINE

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. **Cementitious Binders**
   i. 2.2.3 Geopolymers
      a. 2.2.3.1 Advantages and applications of geopolymers
   ii. 2.2.4 Magnesium phosphoric cement (MPC)
      a. 2.2.4.1 Advantages and applications of MPC
   iii. 2.2.5 Magnesium oxychloride cement

2.2.3 Geopolymers

2.2.3.1 Advantages and applications of geopolymers

Compared with ordinary Portland cement, newly developed inorganic binder geopolymers possess the following characteristics:

- ***Abundant raw material resources***

Any pozzolanic compound or source of silicates or aluminosilcates that is readily dissolved in alkaline solution will suffice as a source for the production of a geopolymer.

- ***Energy saving and environment protection***

about 60% less energy is required, and 80–90% less CO2 is generated for the production of geopolymers than for Portland cement

- ***Good volume stability***

Geopolymers have 80% lower shrinkage than Portland cement. *Reasonable strength gain in a short time*: **Geopolymers can obtain 70% of the final compressive strength in the first 4 hrs of setting.**

➢ ***High fire resistance and low thermal conductivity***

Geopolymer cement possesses excellent high temperature resistance up to 1200◦C and can endure 50-kW/m2 fire exposure without sudden property degradation. In addition, no smoke is released after the extended heat flux.

The heat conductivity of geopolymers varies from 0.24 to 0.3 w/m-k, and compares well with that of lightweight refractory bricks (0.3 to 0.438 w/m-k).

Geopolymers are an abundant raw resource, and have low CO2 emission, less energy consumption, low production cost, high early strength, and fast setting.

These properties make geopolymers suitable for applications in many fields of industry, such as **civil engineering, automotive and aerospace industries,** nonferrous foundries and metallurgical industries, plastics industries, **waste management,** art and decoration, and retrofitting of buildings.

2.2.4 Magnesium phosphoric cement (MPC)

2.2.4.1 Advantages and applications of MPC

MPC concrete is a type of artificial stone made from an acid–base reaction of magnesia and phosphates. They possess some properties that Portland cements do not possess according to the previous studies. Therefore, they can be utilized in fields in which Portland cements are not suitable.

The applications of MPCs include the following:

(a) Due to its rapid setting and high early strength, MPC has been utilized in rapid repair of concrete structures, such as highways, airport runways, and bridge decks, for many years.

(b) MPC can be incorporated with nontoxic industrial waste, such as class F fly ash (FA) and be converted into useful construction materials.

(d) MPC can be used in the management and stabilization of toxic and radioactive wastes, including solids and liquids.

(e) MPCs are very suitable for repairing deteriorated concrete pavements in cold regions.

(f) The raw material of MPC is hard burnt magnesia, and is, in fact, a refractory material. Therefore, **MPC can be designed to be fireproof and/or as a cold setting refractory, according to practical need.**

2.2.5 Magnesium oxychloride cement

Magnesium oxychloride cement (MOC), also known as Sorel cement (Sorel, 1867), is a type of nonhydraulic cement. It is formed by mixing powdered magnesium oxide (MgO) with a concentrated solution of magnesium chloride ($MgCl_2$).

Magnesium oxychloride cement has many superior properties as compared to ordinary Portland cement: these include:

- **It has high fire resistance,**
- **low thermal conductivity,**
- **good resistance to abrasion,**
- **Is unaffected by oil, grease, and paint.**
- **It also has high early strength**
- **is suitable for use with all kinds of aggregates in large quantities,** including gravel, sand, marble flour, asbestos, wood particles, and expanded clays.
- **Has a lower alkalinity of magnesium oxychloride (pH of 10–11),** which makes it suitable for use with glass fiber.


Thank you for
your
attention!