

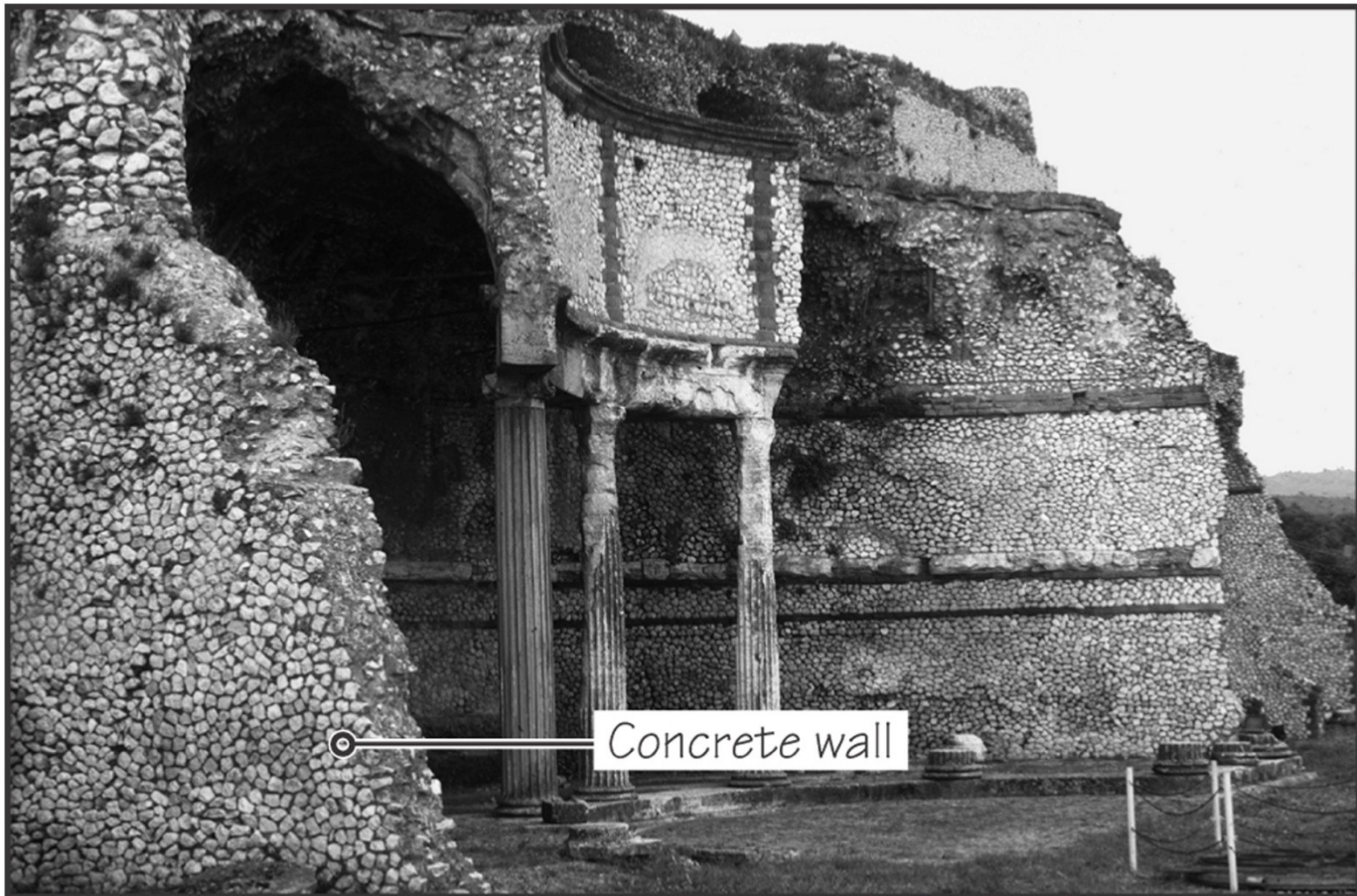
INTRODUCTION TO CONCRETE

Prepared by:

MD TAHIR RAHMAN

ASSISTANT PROFESSOR(CE)

Concrete has deep roots in history:
Wall at Palestrina, Italy, 1st Century BC



Roman Aqueduct & Pantheon



Concrete

- ▣ The word “concrete” originates from the Latin verb “concretus”, which means to grow together.

Advantage of Concrete

- We have the ability to cast desired shapes
 - Arches, piers, columns, shells
- Properties can be tailored according to need (strength, durability, etc.)
- Ability to resist high temperatures
 - Will maintain structural integrity far longer than structural steel
- Does not require protective coatings
- Can be an architectural & structural member at the same time

Sculptural Qualities of Concrete at Chapel at Ronchamp (France)



Concrete Structural Frame

City of Arts and Sciences,
Valencia, Spain



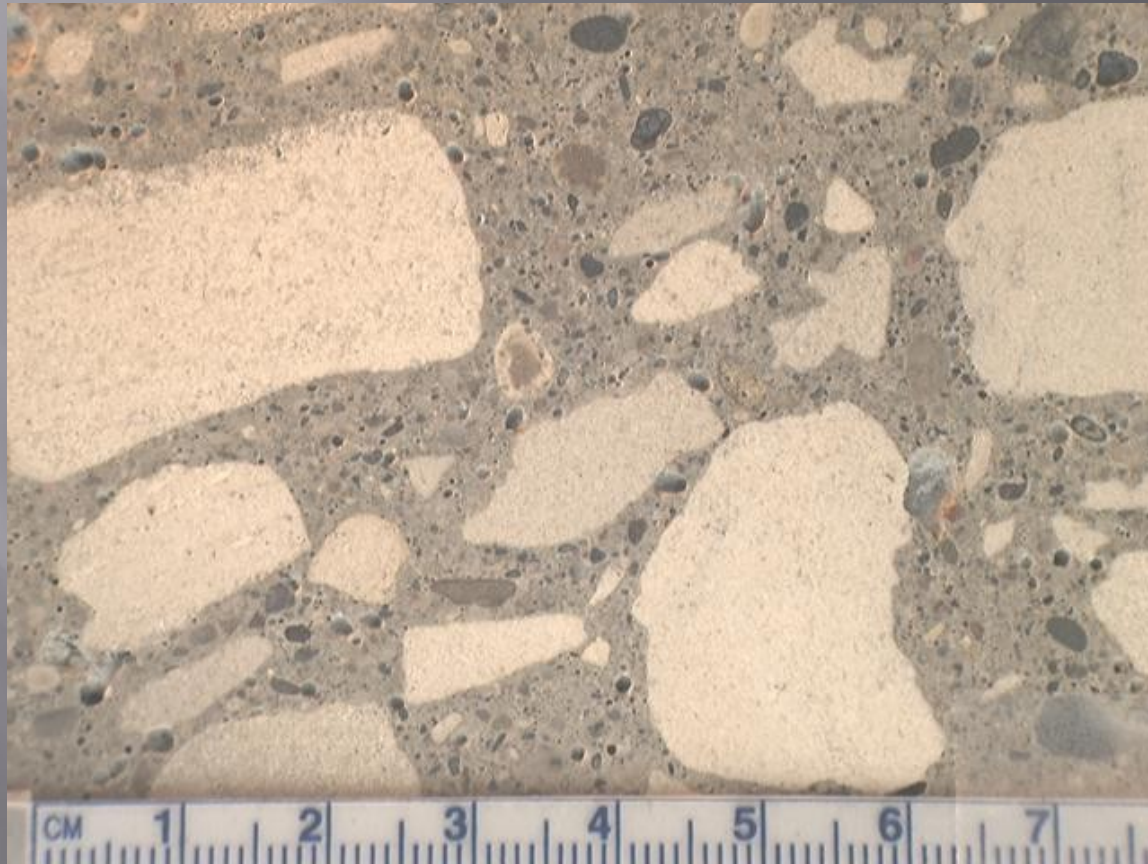
Properties of Quality Concrete

- ▣ Workability
- ▣ Durability
- ▣ Strength
- ▣ Chloride Penetration Resistance
- ▣ Abrasion Resistance

The Nature of Concrete

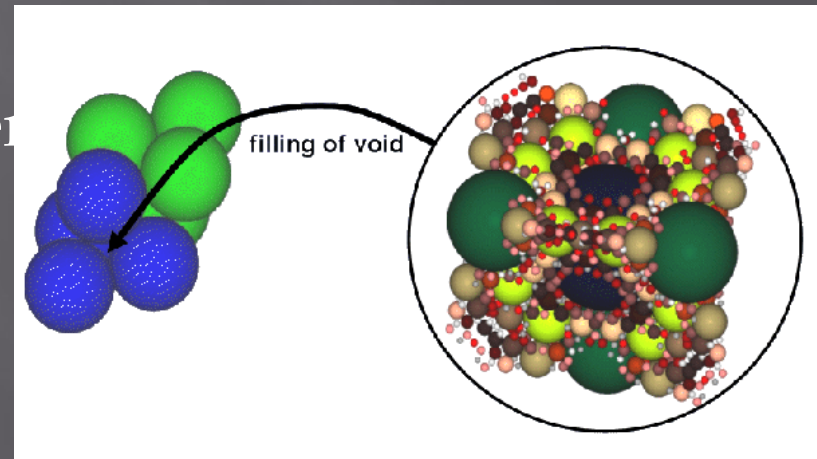
- ▣ It is a composite material
- ▣ Aggregates are 65% - 80% of the volume
 - Fine aggregate: sand
 - Coarse aggregate: stone
- ▣ Cement: General term & applies to any binder
 - Portland cement
 - fly ash
 - ground slag
 - silica fume
- ▣ Water

Concrete Microstructure



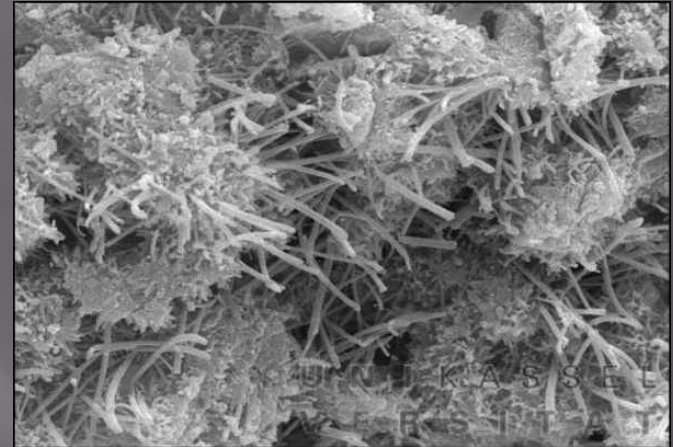
The Purpose Of The Aggregates

- Large aggregates:
 - provide density (fill space)
 - provide strength
- Fine aggregates:
 - fill small voids between large aggregates
 - Increases strength of the cement binder



The Cement Matrix

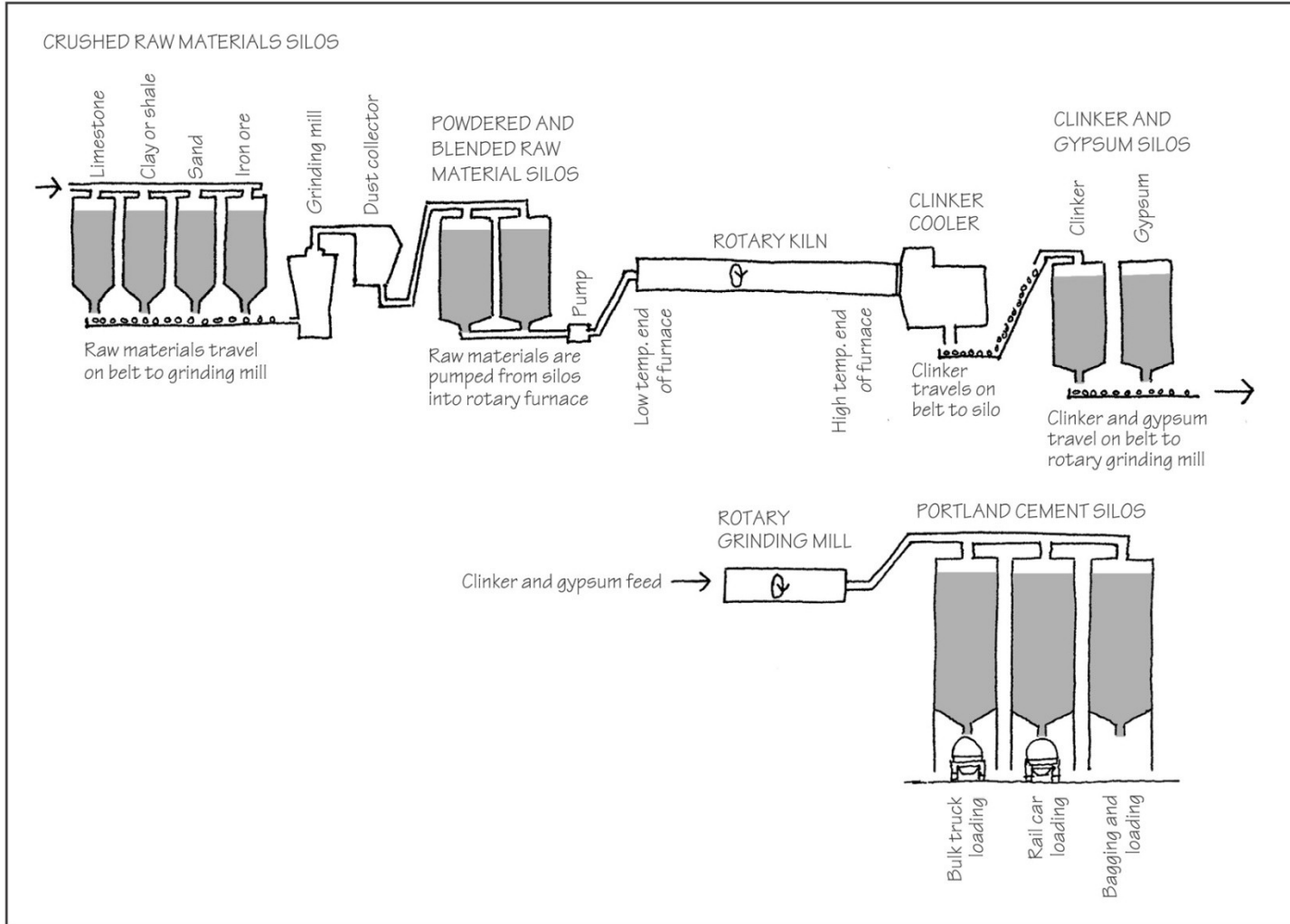
- ▣ Cement:
 - produces a crystalline structure
 - binds aggregates together
- ▣ Water
 - causes chemical reaction to occur
 - water/cementitious “react”
 - produces workability



What is Portland Cement?

- ▣ Raw limestone, clay & gypsum minerals are ground into powder & heated in kiln (1600 ° C)
- ▣ Minerals interact at that temperature to form calcium silicates (clinker)
- ▣ Available in five types, each with varying performance characteristics and uses

Portland Cement Manufacturing

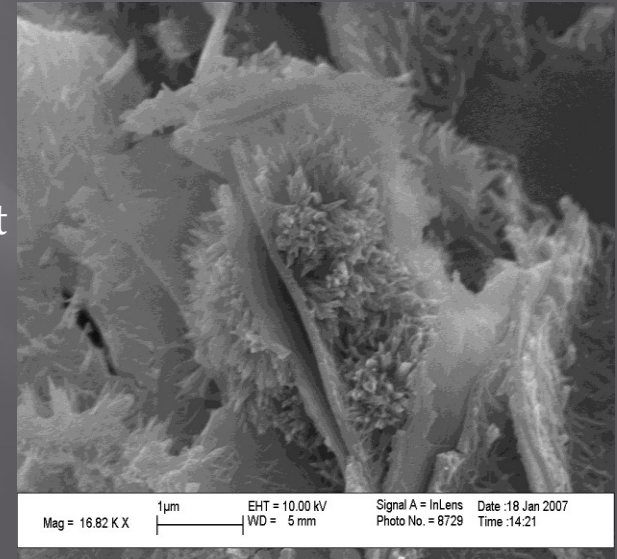


Clinker



Hydration

- Portland cement becomes cementitious when mixed with water
- This reaction is referred to as hydration.
- During hydration, a crystalline structure grows to form bonds
- Hydration begins as soon as water meets cement
- Rate of hydration increases with increased cement fineness



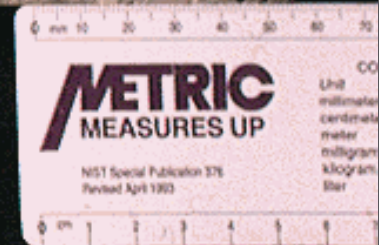
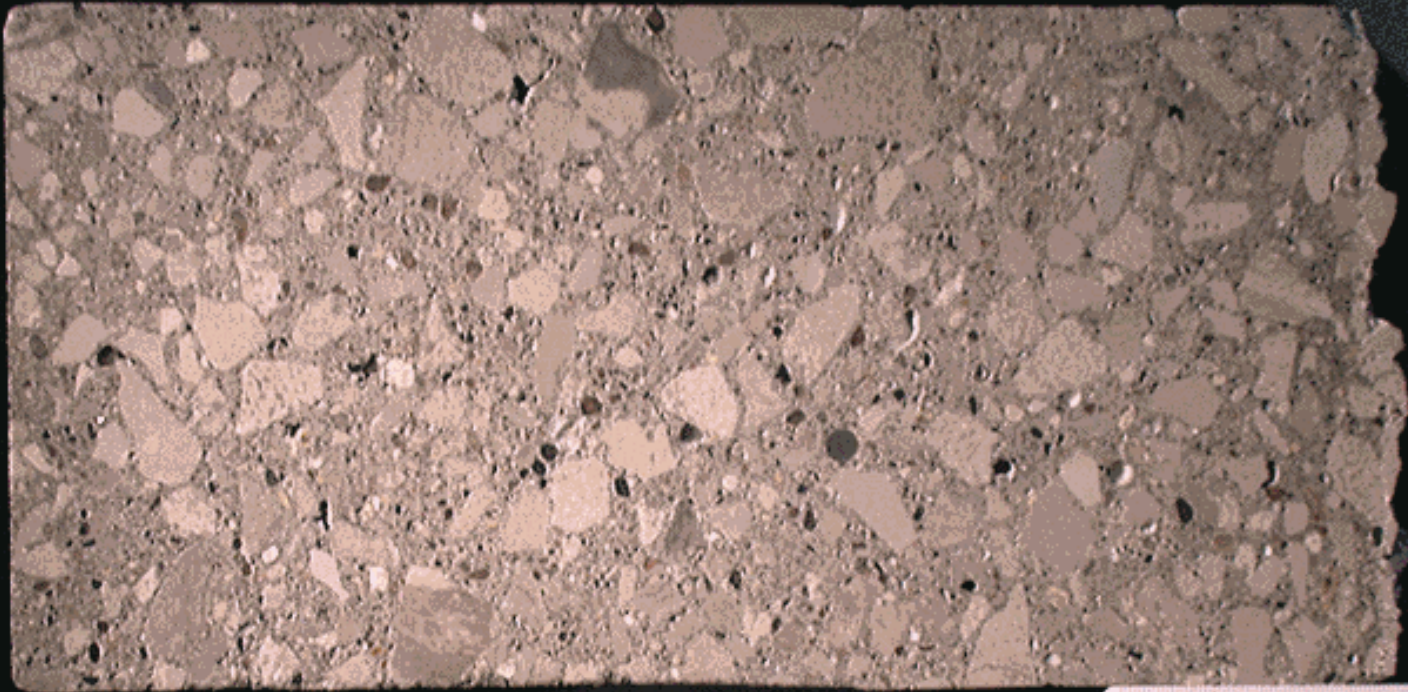
In Fact.....

- ▣ Concrete does not gain strength by “drying out”
- ▣ Concrete must have continuous free access to water to achieve its ultimate strength!!

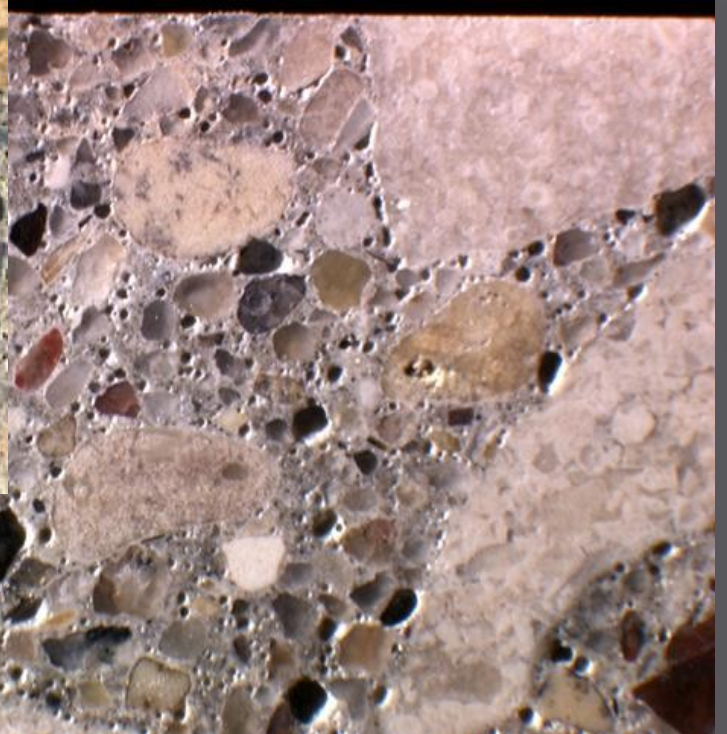
Air Entrainment Admixtures

- ▣ All concrete contains “entrapped” air
 - ▣ Large bubbles
 - ▣ Large voids are undesirable for durability & permeability
- ▣ Entrained air
 - ▣ Bubbles are microscopic in size & distributed through out concrete
 - ▣ Increases durability by providing “escape route” for freezing water as it expands

ENTRAPPED AIR VOIDS



Entrained Air



When Do We Use Air Entrained Concrete?

- ▣ Concrete to be placed in exterior locations requires air entraining (water/freeze/thaw)

Water Reducers (Super-Plasticizers)

- ▣ Increases viscosity
- ▣ Water can be reduced
- ▣ Results in higher strength and more durable concrete due to reduced water