

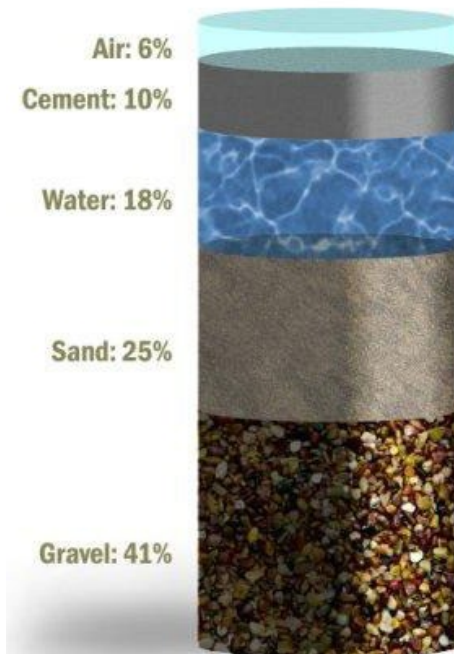
# Concrete Technology

Lecture No. 1

# Concrete

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- ▶ Concrete is a composite construction material composed primarily of aggregate, cement and water.



# Why Concrete?

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- ▶ Concrete is one of the most versatile, durable, and cost effective building materials known to man.
- ▶ Excellent thermal mass energy consumption.
- ▶ Concrete is completely non-combustible and has a slow rate of heat transfer, making it highly effective against the spread of fire.
- ▶ Concrete requires very little maintenance and is easy to clean.
- ▶ Concrete is exceptionally durable.
- ▶ Concrete allows endless possibilities for creative custom design



# History of Concrete

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- ▶ The word concrete comes from the Latin word "concretus" (meaning compact or condensed)
- ▶ During the Roman Empire, Roman concrete was made from quicklime, pozzolana and an aggregate of pumice.
- ▶ An analysis of mortar from the Great Pyramid showed that it contained 81.5 per cent calcium sulphate and only 9.5 per cent carbonate.



# History of Concrete

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- ▶ The Indian practice of thorough mixing and long continued ramming of lime mortar with or without the addition of Surkhi yielded strong and impervious mortar which confirmed the secret of superiority of Roman mortar.
- ▶ It is learnt that the Romans added blood, milk and lard to their mortar and concrete to achieve better workability. Haemoglobin is a powerful air-entraining agent and plasticizer, which perhaps is yet another reason for the durability of Roman structures.



# History of Concrete

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**In Serbia, remains of a hut dating from 5600 BC have been found, with a floor made of red lime, sand, and gravel. (3000BC)**



**Cementing material, used in the construction of the cities of Harappa and Mohenjadaro. (3300–1300 BC)**



# History of Concrete

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**Hadrian's Pantheon in Rome is an example of Roman concrete construction. 126 AD**



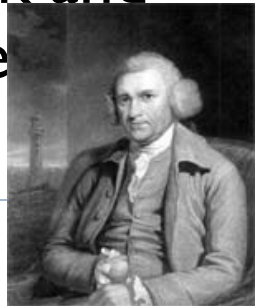
**The multiple arches of the Pont du Gard, in Roman Gaul. Its lower tiers carry a road across the river, and the upper tiers support an aqueduct conduit that carried water to Nimes (300AD)**



# History of Concrete

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- ▶ The first recorded fact points to the year 1756 when John Smeaton, an engineer made the present day concrete by mixing coarse aggregate (pebbles) and powdered brick and mixed it with cement.
- ▶ In 1793, he built the Eddystone Lighthouse in Cornwall, England with the use of hydraulic cement.
- ▶ Another major development took place in the year 1824. An English inventor Joseph Aspdin invented Portland cement. He made concrete by burning grounded chalk and finely crushed clay in a limekiln till the carbon dioxide evaporated, resulting in strong cement.





# History of Concrete

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- ▶ Concrete that uses imbedded metal is called reinforced concrete or Ferroconcrete. It was Joseph Monier who first invented reinforced concrete in 1849.
- ▶ In 1886, the first rotary kiln was introduced in England that made constant production of cement.
- ▶ In 1891, George Bartholomew made the first concrete street in Ohio, USA.



# History of Concrete

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- ▶ There has been no looking back for concrete since its modern development. Known as the strongest building material, concrete has found major uses in dams, highways, buildings and many different kinds of building and construction.
- ▶ As of 2006, about seven billion cubic meters of concrete are made each year, more than one cubic meter for every person on Earth. Concrete powers a \$US 35-billion industry which employs more than two million workers in the United States alone. More than 55,000 miles of highways in America are paved with this material.



# History of Concrete

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- ▶ The People's Republic of China currently consumes 40% of the world's cement/concrete production.
- ▶ India is one of the fastest growing cement markets in the world, even ahead of China and emerging African countries.



# History of Concrete

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# Concrete Technology

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Teaching Scheme	Examination scheme
Lecture: 3 hours per week	Theory paper: 100 marks
Practical: 2 hours per week	Term Work: 25 marks



# UNIT 1: Ingredients of Concrete

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- a) Cement: Physical properties of , Hydration of cement, chemical compounds of cement, Grades of cement, Types of cement etc.
- b) Aggregates: Physical properties, Mechanical properties, Grading of Aggregate, Artificial and recycled aggregate.
- c) Water: Specifications of water as per IS 456 – 2000.



# UNIT 2: Fresh Concrete

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- ▶ Batching, Mixing, Transportation, Placing of concrete including pumping and compaction techniques for good quality concrete, Workability of concrete and methods of measuring workability, Factors affecting workability, Segregation and bleeding, Curing of concrete, Different methods of curing, Temperature effects on fresh concrete.



# UNIT 3: Admixtures

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- ▶ Types of admixtures, Plasticizers and superplasticizers and their effects on workability, Air entraining agents, Retarders, their effects on proportion of concrete, Pozzolanic admixtures, Fly ash, fly ash on fresh concrete, Silica fume, Metakaolin, Ground Granulated Blast Furnace Slag.





# UNIT 4: Hardened Concrete

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- ▶ Strength of concrete, w/c ratio, Gel-space ratio, Effect of maximum size of aggregate, Factors affecting strength of concrete, Characteristic strength - compressive, tensile and flexure strength, Relation between compressive & tensile strength.
- ▶ Modulus of elasticity, Relation between modulus of elasticity & strength, Creep and shrinkage of concrete



# UNIT 5: Concrete Mix Design

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- ▶ Nominal Mix Concrete, Objectives of mix design, Factors governing mix design, Methods of expressing proportions, statistically quality control. Mix design by ACI 211.1-91 method, IS code method as per 10262 & 456, DOE method and acceptance criteria



# UNIT 6: Durability of concrete

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- ▶ Minimum & Maximum cement content, Strength & durability relationship, Volume change in concrete, Impact of w/c ratio on durability, permeability, Exposure to different conditions as per IS 456, Sulphate attack, Alkali aggregate reaction, Chloride attack, Corrosion of steel (chloride induced), Corrosion Control.



# UNIT 7: Special concrete

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- ▶ Light weight concrete, No fines concrete, High density concrete, Fibre reinforced concrete and different types, Polymer concrete, High performance concrete, Self compacting concrete, Cold weather concreting, Hot weather concreting, Vacuum concrete, Shotcreting,



# UNIT 8: Non-destructive testing

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- ▶ Schmidt's rebound hammer – Mechanical & digital, Ultrasonic pulse velocity method, techniques of measuring & factors affecting the measurement of pulse velocity, Corrosion meter, Cover meter.



# TERM WORK:

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1. Testing of cement: Consistency, fineness, setting time, Specific Gravity, Soundness and strength.
  2. Testing of fine aggregate: Specific Gravity, sieve analysis and zoning, bulking of fine aggregate, bulk density, silt content.
  3. Testing of coarse aggregate: Specific Gravity, sieve analysis, bulk density, flakiness index, elongation index, water absorption & moisture content, soundness of aggregate.
  4. Concrete Mix design by ACI 211.1-91 method, IS code method as per 10262- 2007 & 456-2000, DOE method
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# TERM WORK:

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1. Tests on Concrete- Workability tests – Slump cone test, compaction factor test, Vee-bee consistometer test, flow table test, strength tests- compressive strength, flexural strength, split tensile strength.
2. Effects of Admixture - Accelerator, Retarder, Super Plasticizer.
3. Nondestructive Testing - Rebound Hammer test, Ultrasonic Pulse Velocity test.



# REFERANCE BOOKS:

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1. Concrete Technology by M. S. Shetty (S. Chand & Company Ltd, New Delhi)
  2. Concrete Technology by M. L. Gambhir (Tata McGraw-Hill publishing Company Ltd, New Delhi)
  3. Concrete Technology by A. M. Neville (Pearson Education, New Delhi)
  4. Concrete Technology by R. S. Varshnay (New Chand & Brathers, New Delhi)
  5. Concrete Technology by K. T. Krishnaswamy (Dhanpat Rai Publication, New Delhi)
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