Introduction:

This comprehensive five-day course on **structural analysis and design for concrete buildings** is designed to equip professionals with the knowledge and skills to understand, design, manufacture, and maintain concrete structures. Concrete is a ubiquitous material in modern construction, used in everything from pavements to large infrastructure projects. Understanding its properties, production methods, and design is essential for engineers and architects involved in construction and building design.

The course covers everything from the chemistry and ingredients of concrete to the advanced methods used in concrete structure design. It also delves into modern concepts such as ready-mix concrete, precast and prestressed concrete, as well as the challenges related to concrete defects, repairs, and maintenance.

Targeted Groups

This course is ideal for:

- **Engineers**: Especially those working in civil, structural, or construction engineering roles.
- **Architects**: Professionals involved in the design and planning of buildings and other structures.
- **Designers**: Individuals responsible for designing and analyzing concrete structures.

Course Objectives

Upon completing this course, participants will be able to:

- Understand what concrete is and why it is essential in construction.
- Study the ingredients of concrete, including their characteristics, and their importance in ensuring high-quality concrete.
- Learn the chemistry of concrete, including cement hydration, strength development, and durability.
- Conduct simple concrete mix designs based on different project requirements.
- Learn concrete manufacturing processes, including quality control and testing.
- Understand the common defects that can occur in concrete and how to remedy them.
- Study modern concrete technologies like ready-mix concrete, precast concrete, and prestressed concrete.
- Learn about concrete protection and maintenance strategies to prolong the life of concrete structures.
- Understand safety precautions and proper handling methods when working with concrete.

- Identify special purpose concretes and the admixtures that enhance specific properties of concrete.

Targeted Competencies

By the end of this course, participants will have acquired the following competencies:

- **Design of Concrete Structures**: Understand how to design concrete structures with the requisite strength and durability.
- **Concrete Manufacturing**: Gain practical knowledge in the manufacturing process, including batching, mixing, and transportation.
- **Testing, Inspection, and Quality Assurance**: Develop skills in testing concrete for quality control, using both destructive and non-destructive methods.
- **Ready-Mixed Concrete (RMC)**: Understand the advantages, specifications, and quality control of ready-mix concrete.
- **Concrete Admixtures**: Knowledge of different admixtures and their effects on concrete properties.
- **Concrete Defects and Remedies**: Learn how to identify and correct common concrete issues such as cracking, crazing, and shrinkage.
- **Protection from Damage**: Learn how to protect concrete from abrasion, corrosion, and chemical attacks.
- **Concrete Repair**: Understand repair techniques such as pressure grouting, shotcrete, and encasing to restore damaged concrete.
- **Special Purpose Concrete**: Study high-strength, fiber-reinforced, cellular, and polymer concrete for specialized applications.

Course Content

Unit 1: Understanding Concrete

- History of concrete and its development.
- Constituents of concrete: Cement, aggregates, mineral additions, and water.
- Cement chemistry: Chemical properties and hydration of cement.
- Concrete characteristics: Strength, durability, workability, permeability.
- Common deterioration causes: Ingredient issues, climate factors, and poor manufacturing practices.

Unit 2: Design of Concrete with Requisite Strength

- Specifications, codes, and guidelines for concrete design.
- Key factors in concrete mix design: Target strength, water-cement ratio, aggregate size.
- Concrete mix design procedures and specification development.

Unit 3: Concrete Manufacturing

- Handling raw materials: Storage and quality control of ingredients.
- Concrete mixing processes, including transportation and temperature control.
- Formwork influence on durability and proper placement techniques.
- Procedures for curing and protecting green concrete.

Unit 4: Testing, Inspection, and Quality Assurance

- Laboratory and full-scale trial mixes.
- Quality assurance processes: Sampling, testing, and acceptance criteria.
- Non-destructive testing methods for concrete.

Unit 5: Ready-Mixed Concrete (RMC)

- Types and advantages of ready-mixed concrete.
- Specifications and tolerances.
- Production and transportation of RMC.
- Quality control procedures in RMC production.

Unit 6: Concrete Admixtures

- Types of admixtures and their benefits: Water-reducing agents, accelerators, retarders, air-entraining agents, and waterproofing agents.
- How admixtures alter concrete properties.

Unit 7: Concrete Shortcomings

- Common issues in concrete: Cracking, crazing, shrinkage, and creep.
- How to manage and mitigate these issues in design and construction.

Unit 8: Protection from Concrete Abrasion, Corrosion, and Chemical Attack

- Developing protection strategies against wear, corrosion, and chemical attacks.
- Surface preparation, coatings, and sealers to enhance concrete durability.
- Cathodic protection techniques and metalizing for corrosion prevention.

Unit 9: Concrete Repair

- Investigation techniques to assess damaged concrete.
- Concrete repair methods: Pressure grouting, shotcrete, and encasing.
- Techniques for repairing delaminated structures and performing demolition and reconstruction.

Unit 10: Special Purpose Concrete

- High-strength concrete applications.
- Fiber-reinforced concrete and its benefits.
- Cellular concrete and its uses in construction.
- Polymer concrete for specialized applications.

Conclusion

This course on **structural analysis and design for concrete buildings** will provide participants with essential knowledge and practical skills for working with concrete in a variety of construction contexts. Whether you are involved in the design, manufacturing, or maintenance of concrete structures, this course will deepen your understanding of concrete’s properties, applications, and the latest developments in concrete technology. By the end of the training, you will be fully equipped to work with concrete in all stages of a project, from initial design to long-term maintenance and protection.