Plain & Reinforced Concrete-1

CE-314

Lecture # 1

Introduction

INTRODUCTION . . . . .

- Introduction of students.
- Introduction of subject.
- Introduction of instructors.
- Introduction of books and specifications.
- Introduction of concrete.
- Introduction of reinforced.
- Introduction of design.

SUBJECT:

PLAIN AND REINFORCED CONCRETE - I

- Course No. CE 314
- Teachers: Prof. Zahid Ahmad Siddiqi
  Dr. Asadullah Qazi
  Engr. Ali Ahmad

Theory Part

Quiz - I:	10 %
Quiz - II:	10 %
Class Participation (Assignments, Presentations and Attendance):	10 %
Mid-Semester Exam:	30 %
Final Exam:	40 %

Final grades are assigned according to the approved policy.

Practical Part

Quiz - I
Quiz - II

Class Design Calculations

Practical Reports

Home Assignments

Final grades are assigned according to the approved policy.

Grading Policy

0 - < 50 %	Grade - F
50 - < 55 %	Grade - D
55 - < 60 %	Grade - C^{-}
60 - < 65 %	Grade - C
65 - < 70 %	Grade - C^{+}
70 - < 75 %	Grade - B^{-}
75 - < 80 %	Grade - B
80 - < 85 %	Grade - B^{+}
85 - < 90 %	Grade - A
90 - 100 %	Grade - A^{+}

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- Text Books
  - Concrete Structures (Part-I), Chapters 1-7 by Zahid Ahmad Siddiqi
  - Concrete Structures (Part-II), Chapters 15, 20, 22 by Zahid Ahmad Siddiqi
  - Formula Sheets for Exams.
- References
  - Building Code Requirements for Structural Concrete (ACI 318-08)
  - Portland Cement Association (PCA) Notes on ACI Code.
  - Handbook by Khanna
  - Handbook by Reynold
  - Handbook by Mark Fintel

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Concrete

Concrete is a mixture of cement, fine and coarse aggregate.

Concrete mainly consists of a **binding material** and **filler material**. If filler material size is **< 5mm** it is fine aggregate and **> 5mm** is coarse aggregate.

In fresh state, concrete is plastic or fluid-like and may be molded in any shape.

With time, it hardens and becomes artificial stone-like material.

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- Plain Cement Concrete (PCC)
  - Mixture of cement , sand and coarse aggregate without any reinforcement is known as PCC.
  - PCC is strong in compression and week in tension. Its tensile strength is so small that it can be neglected in design.
- Reinforced Cement Concrete (RC)
  - Mixture of cement , sand and coarse aggregate with reinforcement is known as RC. (Tensile strength is improved)

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Mix Proportion

Cement : Sand : Crush

1	:	1.5	:	3
1	:	2	:	4
1	:	4	:	8

Water Cement Ratio (W/C)

W/C = 0.3 – 0.7

For a mix proportion of 1:2:4 and W/C = 0.5, if cement is 50 kg

Sand = 2 x 50 = 100 kg

Crush = 4 x 50 = 200 kg

Water = 50 x 0.5 = 25 kg

Batching By Weight

(Also equal to 25 litres)

Size of Bricks

- The nominal standard size of burnt clay brick is 228x114x75mm.
- This size includes half of average mortar thickness (5-6 mm) on each side.
- The sizes of walls, beams and columns are usually kept multiples of half brick length (114 mm).

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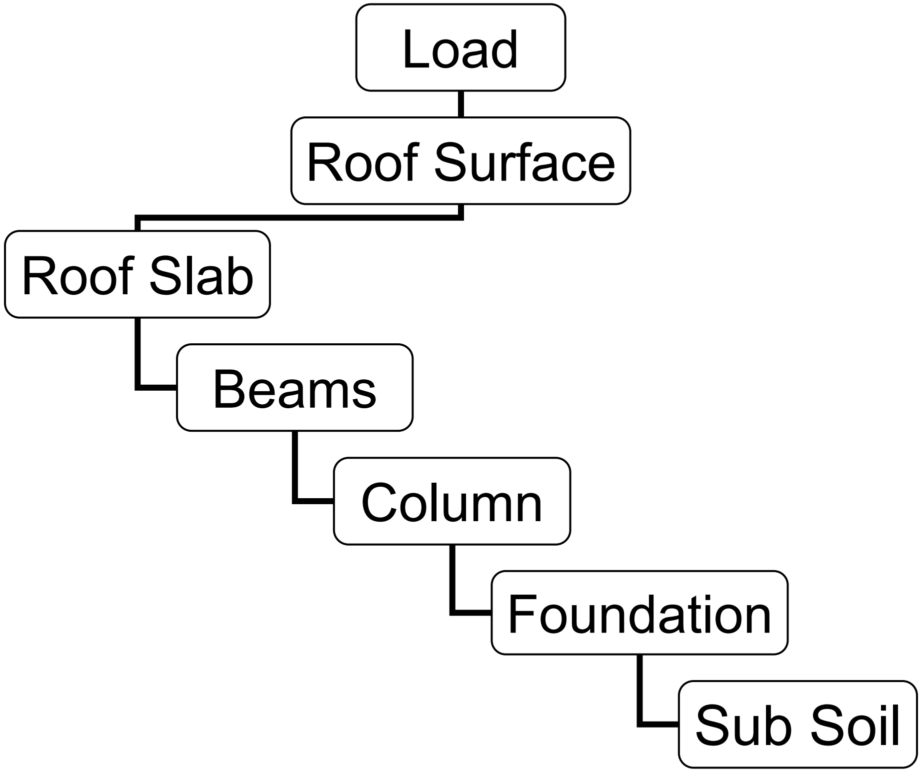
Mechanism of Load Transfer

Function of structure is to transfer all the loads safely to ground.

A particular structural member transfers load to other structural member.



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Merits of Concrete Construction

1. **Good Control Over Cross Sectional Dimensions and Shape**
   One of the major advantage of concrete structures is the full control over the dimensions and structural shape. Any size and shape can be obtained by preparing the formwork accordingly.
2. **Availability of Materials**
   All the constituent materials are earthen materials (cement, sand, crush) and easily available in abundance.
3. **Economic Structures**
   All the materials are easily available so structures are economical.
4. **Good Insulation**
   Concrete is a good insulator of Noise & heat and does not allow them to transmit completely.

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5. **Good Binding Between Steel and Concrete**
   there is a very good development of bond between steel and concrete.
6. **Stable / Ductile Structures With Warning Before Failure**
   Concrete is strong in compression but week in tension and steel as strong in tension so their combination give a strong stable structure.
7. **Less Chances of Buckling**
   Concrete members are not slim members (as in steel structures) so chances of buckling are much less.
8. **Aesthetics**
   concrete structures are aesthetically good and cladding is not required.

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9. **Lesser Chances of Rusting**
   steel reinforcement is enclosed in concrete so chances of rusting are reduced.

Demerits of Concrete Construction

1. **Week in tension**
   Concrete is week in tension so large amount of steel is required.
2. **Increased Self Weight**
   Concrete structures have more self weight compared with steel structures so large cross-section is required only to resist self weight, making structure costly.
3. **Cracking**
   Unlike steel structures concrete structures can have cracks. More cracks with smaller width are better than one crack of larger width.

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4. **Unpredictable Behavior**
   If same conditions are provided for mixing, placing and curing even then properties can differ for the concrete prepared at two different times.
5. **Inelastic Behavior**
   Concrete is an inelastic material, its stress-strains curve is not straight so its behavior is more difficult to understand.
6. **Shrinkage and Creep**
   Shrinkage is reduction in volume. It takes place due to loss of water even when no load is acting over it. Creep is reduction in volume due to sustained loading when it acts for long duration. This problem is absent in steel structures.
7. **Limited Industrial Behavior**
   Most of the time concrete is cast-in-situ so it has limited industrial behavior.

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Specification & Codes

These are rules given by various organizations in order to guide the designers for safe and economical design of structures

Various Codes of Practices are

1. ACI 318-08 By American Concrete Institute. For general concrete constructions (buildings)
2. AASHTO Specifications for Concrete Bridges. By American Association of State Highway and Transportation Officials.
3. ASTM (American Standards for Testing and Materials) for testing of materials.

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Design Loads

- **Dead Load**
  "The loads which do not change their magnitude and position w.r.t. time within the life of structure"
  Dead load mainly consist of superimposed loads and self load of structure.

  - **Self Load**
    It is the load of structural member due to its own weight.
  - **Superimposed Load**
    It is the load supported by a structural member. For instance self weight of column is self load and load of beam and slab over it is superimposed load.

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Design Loads (contd…)

- **Live Load**
  "Live loads consist of occupancy loads in buildings and traffic loads on bridges"
  - They may be either **fully** or **partially** in place or not present at all, and may also change in location.
  - Their magnitude and distribution at any given time are uncertain, and even their maximum intensities throughout the life time of the structure are not known with precision.
  - The minimum live loads for which the floor and roof of a building should be designed are usually specified in the governing building codes at a particular location.

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- Service or Characteristic Load

  The maximum intensity of load expected during the life of the structure, depending upon a certain probability of occurrence, without any additional factor of safety.

- Factored Load

  Service loads increased by some factor of safety (overload factors).

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Densities of Important Materials

Material	Density (Kg/m^3)
PCC	**2300**
RC	**2400**
Brick masonry	**1900-1930**
Earth/Sand/Brick ballast	**1600-1800**

Intensities of Live Loads

Occupancy / Use	Live Load(Kg/m^2)
Residential/House/Class Room	**200**
Offices	**250-425**
Library Reading Room	**300**
Library Stack Room	**730**
Warehouse/Heavy storage	**1200**

Limit States

- Limit state is defined as the stage in the loading after which the structure cannot fulfill its intended function.
- Strength limit states deals with maximum ductile flexural strength, ultimate shear strength, buckling, fatigue, fracture, progressive collapse, formation of plastic mechanism, over-turning and sliding, etc.
- Serviceability limit states are related with occupancy, such as excessive deflections, undesirable vibrations, permanent deformations, deterioration, excessive cracking, corrosion of steel and behavior under fire.

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Basic Design Equation

Applied Action x F.O.S = Max. Internal Resistance

Factor of Safety

F.O.S. = Expected Failure load/Maximum Service Load

Following points are relevant to F.O.S:

1. It is used to cover uncertainties due to
   1. Applied loads
   2. Material strength
   3. Poor workmanship
   4. Unexpected behavior of structure
   5. Thermal stresses
   6. Fabrication
   7. Residual stresses
2. If F.O.S is provided then at service loads deflection and cracks are within limits.
3. It covers the natural disasters.

Concluded