CE 315- Design of Concrete Structure – I
Instructor: Dr. E. R. Latifee

Suggested Text Books:

1. "Design of. Reinforced Concrete"- Jack C. McCormac, Clemson University Russell H. Brown. Clemson University.

2."Design of Concrete Structures"- Arthur H. Nilson. Professor Emeritus. College of Engineering. (Cornell University) David Darwin (University of Kansas), Charles Dolan (University of Wyoming)

What is Design?

Design is to come up with the size and the detailed specifications, dimensions of the particular member or structure, so that it will be sufficient to withstand the influences of dead loads, live loads etc.

What is Analysis?

Analysis of a beam/column refers to finding out the capacity of that member given the dimensions and other properties. Also, Analysis of a member/structure can be to find out the effect, such as stress, strain due to external loads on all or part of it.

Structural Analysis- A detailed evaluation intended to assure that the deformations will be sufficiently below allowable values that structural failure will not occur.

What is the difference between Stress and Strength?

Stress = Any Load/Cross sectional area

Strength= Failure Load/ Cross sectional area

What is Concrete?

Concrete is the world's single most widely used construction material and after water, it is the most consumed (used) material on earth.

Concrete: *According to ASTM C125 "a composite material that consists essentially of a binding medium within which are embedded particles or fragments of aggregate; in hydraulic-cement concrete, the binder is formed from a mixture of hydraulic cement and water."*

[ASTM C125 Standard Terminology Relating to Concrete and Concrete Aggregates]

What is Reinforced Concrete?

Reinforced concrete: Plain concrete does not easily withstand tensile stress, very weak in tension, only about ten percent of its compressive strength. Therefore reinforcement is provided mainly to resist internal tensile forces. Also, reinforcement is provided in compression zones to increase the compression capacity, enhance ductility, reduce long term deflections or increase the flexural capacity for beams. Lateral reinforcement (stirrups, ties and hoops) are used to resist shear stresses.

What is a Structure?

Structure is something, as a bridge or building that is built or constructed and designed to sustain a load.

Progress of Internal Micro-cracking in concrete: The **Progress of Internal Micro-cracking** in concrete goes through various stages, which depend on the level of applied stress. It reflects four stages of concrete behavior:

Stage 1:

Even before the application of external loads, microcracks already exist in the transition zone between the matrix mortar and coarse aggregate.

The number and width of these cracks depend on:

- Bleeding characteristics
- Strength of ITZ (Interfacial Transition Zone)
- Curing history of concrete
- Below 30% of the ultimate load, the transition zone cracks remain stable.

Stage 2:

- Above 30% of f'_c, as the stress increases, the ITZ microcracks begin to increase in length, width and numbers.
- Until about 59% of the ultimate stress, a stable system of microcracks may be assumed in ITZ.
- At 50 to 60% of f'_c, cracks begin to form in the matrix.

Stage 3:

- Increase the stress up to 75% of f'_c.
- The ITZ cracks become unstable.
- The cracking in the matrix will increase.
- At 75 to 80% of f'c the rate of strain energy release reaches the critical level necessary for spontaneous crack growth.

Stage 4:

Above 75% of f'_c bridging of cracks in matrix and ITZ

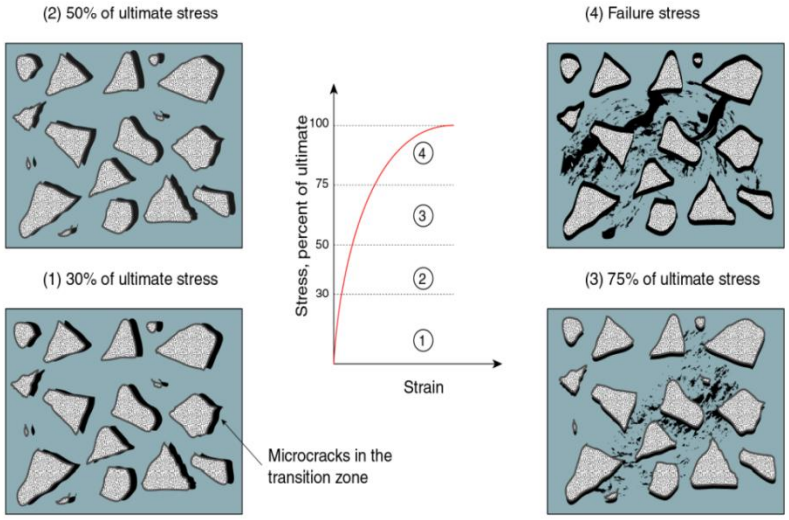

Figure: Diagrammatic representation of the stress-strain behavior of concrete under uniaxial compression.