



## Evaluation of Concrete Structures (Sheet 1) – 1/2

- What are the objectives of the evaluation of concrete structures. Describe using clear sketches different methods used for in situ evaluation of concrete structures showing the objectives and the outcomes from each of them.
- State all different cases in which we need to carry out non-destructive tests for concrete structures?
- What are the different properties obtained from non-destructive testing for concrete structures?
- Discuss results obtained from *Schmidt Hammer Test*. State all factors affect test results.
- Explain how we can use *Ultrasonic Pulse Velocity Test* to evaluate the quality of concrete and determine also the depth of cracks.
- Draw relations between each of rebound number and pulse velocity with concrete compressive strength.
- Discuss results obtained from compression test on concrete samples extracted from concrete elements (*Core Test*). State how we can calculate the grade of concrete from test results.
- Draw the relations between each of the following:
  - Density, Carbonation of Concrete and Rebound Number.
  - Voids Ratio, Water content of Concrete and Pulse velocity.
  - Angle of Inclination of Hammer and Rebound Number for Concrete.
  - Length/Diameter Ratio for Concrete Core Samples and Compressive Strength.
- The following results were obtained during carrying out *Hammer Test* on reinforced concrete columns. Show how to use these results to evaluate the concrete columns.

| Col. No.            | 1  | 2  | 3  | 4  | 5  | 6  | 7  | 8  |
|---------------------|----|----|----|----|----|----|----|----|
| Average Rebound No. | 38 | 36 | 31 | 30 | 37 | 32 | 36 | 37 |

- During carrying out *Pulse Velocity Test* to calculate crack depth for a reinforced concrete raft foundation the following results were obtained:
  - Distance between pulses sender and receiver (perpendicular to crack) = 300 mm and value of transit time = 106 Msec.
  - Distance between pulses sender and receiver (perpendicular to crack) = 600 mm and value of transit time = 200 Msec
 Calculate the crack depth.
- During the evaluation of a reinforced concrete flat slab (thickness 25 cm and span 7 m in long direction and 6 m in short direction) the following results were obtained:
  - Three cores of diameter 10 cm and height after capping 12.3 cm were drilled, and then tested in compression. Failure loads were 16 – 14.8 – 14.2 ton respectively. The average 28 days compressive strength = 300 kg/cm<sup>2</sup>.
  - Loading test was carried out for the slab and deflections were recorded at four points. Test results were as follows:



## Evaluation of Concrete Structures (Sheet 1) – 2/2

| Position        |                             | 1    | 2    | 3    | 4    |
|-----------------|-----------------------------|------|------|------|------|
| Deflection (mm) | After 24 hours of loading   | 16.6 | 30.3 | 20.3 | 14.9 |
|                 | After 24 hours of unloading | 3.32 | 2.4  | 4.47 | 2.23 |

- Sketch test set-up for loading test.
- Discuss the safety of the tested slab according to the requirements of the Egyptian Code for Concrete Structures.
- If the tested slab failed to verify the requirements of the Egyptian Code for Concrete Structures, what are the possible solutions to make it safe?

12. The following results were obtained during carrying out *Compression Test on Core* samples extracted from reinforced concrete columns, calculate:
- The compressive strength for all tested specimens.
  - If test results are accepted according to the Egyptian Code for Reinforced Concrete Structures given that the grade of tested columns = 250 kg/cm<sup>2</sup>.

| Sample No.                 | 1    | 2   | 3    | 4    |
|----------------------------|------|-----|------|------|
| Diameter (mm)              | 7    | 7   | 10   | 10   |
| Height before capping (cm) | 10   | 9   | 12   | 15   |
| Height after capping (cm)  | 10.5 | 9.6 | 12.4 | 15.7 |
| Failure load (ton)         | 6.9  | 7.5 | 18.3 | 16.5 |

13. Loading test was carried out on three reinforced concrete solid slabs of thickness = 12 cm, the following readings of deflection were obtained at mid-span of each slab

| Place   | 1   | 2    | 3   |
|---|-----|------|-----|
| Span (m)  | 4.5 | 3.75 | 5.0 |
| Deflection after 24 hours of loading (mm)         | 9.0 | 6.4  | 8.0 |
| Deflection after 24 hours of release loading (mm) | 2.0 | 2.5  | 2.9 |

Discuss the safety of tested slabs according to the Egyptian Code for Reinforced Concrete Structures.

14. Discuss each of the following for the loading test carried out for a reinforced concrete cantilever slab of free span length = 2.0 m, thickness 20 cm, floor cover equivalent load = 150 kg/m<sup>2</sup>, live load = 300 kg/m<sup>2</sup>:
- Test load.
  - Test procedure.
  - Measurements.
  - Results obtained and final conclusion.