



University of Technology
Building and Construction Engineering Department
Final Exam, 1st Attempt/ 4th class



Subject: Structural Defects & Remedies.

Division: Building Engineering & Project management.

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Year: 2014/2015

Time: 3 Hrs.

Date: 30/ 5/2015

Q1: What is meant by the following? answer only four (20 Mark)

- A- Detailed investigation
- B- Project feasibility
- C- Non- Destructive Tests
- D- Underpinning of Foundation
- E- Settlement shrinkage cracks

Q2: Answer two of the following (20 Mark)

- A- What are the most common defects for foundations constructed on sandy soil?
- B- Explain briefly epoxy injection method in crack repair.
- C- Explain the effect of dimensions standardization on defects treatment.

Q3: Answer two of the following (20 Mark)

- A- Suggest two methods to strengthen a reinforced concrete column, answer with drawing.
- B- Suggest a method to strengthen a two-way reinforced concrete slab.
- C- Suggest a method to strengthen reinforced concrete beam.

Q4: Answer the following (20 Mark)

- A- A reinforced concrete column was subjected to loads higher than the design load, what are the main expected defects?
- B- Explain in brief the UPV test method and its importance to assess defected R. C. structures.

Q5: Discuss the following statements briefly: (20 Mark)

- 1- It's necessary to repair cracks quickly as soon as possible
- 2- The periodical maintenance and monitoring system could significantly affect the cost

Q1: What is meant by the following? answer only four (20 Mark)

A- Detailed investigation:

A detailed investigation is performed when the initial site visit or preliminary investigation has identified a need for a more in-depth assessment of the concrete structure's behavior or condition to meet the owner's goals for the work and rehabilitation objectives.

B- Project feasibility:

An assessment based on technical and cost considerations should indicate whether a proposed rehabilitation is feasible. Points that should be considered in reaching a conclusion regarding project feasibility include the expected effectiveness of the rehabilitation and its estimated life-cycle cost. The effects of the rehabilitation on the structural system and the anticipated impact on the operation of the structure should also be considered.

C- Non- Destructive Tests:

They are tests for concrete structures to determine whether the structure is suitable for its designed use or not. Ideally such testing should be done without damaging the concrete. The tests available for testing concrete range from the completely non-destructive, where there is no damage to the concrete, where the concrete surface is slightly damaged, to partially destructive tests, such as core tests and pullout and pull off tests, where the surface has to be repaired after the test. The range of properties that can be assessed using non-destructive tests and partially destructive tests is quite large and includes such fundamental parameters as density, elastic modulus and strength as well as surface hardness and surface absorption, and reinforcement location, size and distance from the surface. In some cases it is also possible to check the quality of workmanship and structural integrity by the ability to detect voids, cracking and delamination.

D- Underpinning of Foundation

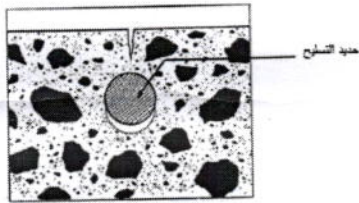
It's a method to repair the damages in foundations resulted from differential settlement by construct new foundation under the old foundation to support it. This is done by consecutive steps but with care not to cause any damage or failure to the building. Mostly, the reclamation is to the outer foundation.

E- Settlement shrinkage cracks:



they are classified into two branches

1-Cracks around steel bars, they occur when the concrete upper part partially sets while aggregate particles still in sedimentation, this sedimentation causes water rise between aggregate particles and then reduction in volume and concrete falling down in all form area except steel bars places, this leads to vertical cracks parallel to steel bars. These cracks may weaken or cause to lose the bond between concrete and steel bars. These cracks often occur in deep beams and within the early hours of casting.



2-Cracks around aggregate occur due to settlement shrinkage and the mechanism is similar to that of steel bars.

Q2: Answer two of the following

(20 Mark)

A- What are the most common defects for foundations constructed on sandy soil?

the dense sandy soil is very good base for foundation but the water table which takes the fine particles will make it unstable soil. Besides, freezing water in soil pores leads to increase volume, this may takes place from surface to 600mm depth and causes lifting pressure which affects soil surface, foundation, floors and corridors....etc. this phenomenon called Frost Heave.

B- Explain briefly epoxy injection method in crack repair.

this method is often used to seal and repair the narrow cracks of width (1–3) mm. As well as, it is used to repair the pre-cast concrete units, such as beams and piles or the insitu cast structural parts such as columns and slabs....etc. The procedures of this method are:

- The crack is well cleaned by compressed air, water or brushing or even using solvents sometimes.
- Close and seal crack surface by epoxy or special tap or any other suitable materials.
- Making holes along crack length and fix nipples (valves) in these holes to use them in injection process. Holes diameter and distance between holes depend

factors, among which, crack type and width, epoxy type and viscosity and injection device type...etc. anyway, the distance between two holes is (0.5–1) m.

- The epoxy is mixed and prepared according to producer instructions.
- Then, the epoxy injected through the fixed tubes with alternating pressure. Injection continues in the 1st hole till the epoxy comes out from the following hole, or the pressure becomes stable and no more epoxy is to be injected. And so on the process goes on. When the crack is perpendicular or inclined, the injection process starts from down upwards. When the crack is horizontal, the injection process is alternatively right and left.
- The surface sealant and nipples are removed.
- Crack is treated according to used material producer directions.
- The surface is to be finished by using the same type of the old materials.

C- Explain the effect of dimensions standardization on defects treatment.

Generally each of structural materials especially finishing materials and fittings has its life cycle according to its type and the way it is used. For this reason the companies produce standard dimension materials.

A good design must deal by high accuracy with this matter that it has a significant effect on the maintenance in the future. The designer must take the materials standard dimensions in his consideration during design process, this will participate in simplifying the materials getting process in future to substitute them in maintenance work and defects' treatment.

The interest in standardize the dimensions and the use of the available materials will undoubtedly; effect the inhabitation cost in the building and on maintenance simplicity and cost.

Q3: Answer two of the following

(20 Mark)

A- Suggest two methods to strengthen a reinforced concrete column, answer with drawing.

Ans. : case study 1, 2, 3 at pages 66, 68, 69.

B- Suggest a method to strengthen a two-way reinforced concrete slab.

Ans.: page 91

C- Suggest a method to strengthen a reinforced concrete beam.

Ans. Case study 1 or 2, pages 77, 78

Q4: Answer the following

(20 Mark)

A- A reinforced concrete column was subjected to loads higher than the design load, what are the main expected defects?

If a column is subjected to live or dead loads (or both) higher than the assumed design loads , some defects will appeared in this column immediately or with time. These defects could be one or more of the following:-

a-Crushing some parts of the concrete, if the applied compression stresses exceeds the loads which were considered in the design.

b-Buckling of longitudinal steel reinforcement, causing many defects in the column and the around area.

c- Cracks in the concrete surface of the column.

d-The general alignment , verticality and height of the column and the surrounding structural elements will be affected.

e-Others.

B- Explain in brief the UPV test method and its importance to assess defected R. C. structures.

Ans. : pages 49 and 50

Q5: Discuss the following statements briefly: (20 Mark)

1- It's necessary to repair cracks quickly as soon as possible

Its necessary to repair cracks quickly because some of cracks become more dangerouse if they neglected and they could seriously affect the structure, while in case of repair these cracks as soon as they appear that could reduce the damage in the whole structure as well as reduce the cost of maintenance.

2- The periodical maintenance and monitoring system could significantly affect the cost

With regard to building construction and use, the common mistake now is that there is no monitoring system for the building during use. Besides, no thinking in maintenance needs during design or execution processes. This affects the cost remarkably.

It's wrong to postponed defects maintenance after they take place. The problem will escalate. And this leads to increase maintenance cost. In other words, building cost increases with time. The following Fig. represents the relationship between cost and time with and without periodical monitoring system.

