UNIVERSITI SAINS MALAYSIA

First Semester Examination
2007/2008 Academic Session

October / November 2007

EAS 662/4 – Structural Retrofitting Technology

Duration: 3 hours

Please check that this examination paper consists of **THREE** pages of printed material before you begin the examination.

Instructions: Answer **FOUR (4)** questions only. All questions carry the same marks.

You may answer the question either in Bahasa Malaysia or English.

All questions **MUST BE** answered on a new sheet.

Write the answered question numbers on the cover sheet of the answer script.

1. Over the last 30 years, many concrete structures were built in the coastal area throughout Malaysia. These structures were designed to meet the durability requirements stipulated in the present code of practice. However, most of these structures have shown signs of premature deterioration. These show that the current practice of "deem-to-satisfy" approach of specifying concrete durability is not satisfactory.

   (a) List four (4) limiting values that are normally specified in the present code of practice to ensure durability of concrete structures.

   (4 marks)

   (b) By giving appropriate examples, explain the weakness of the "deem-to-satisfy" rule for concrete durability.

   (10 marks)

   (c) Describe the differences between the method-based specification and performance-based specification for concrete work. Why the method-based specification is inadequate in addressing concrete durability issues?

   (9 marks)

   (d) List two tests that have been used as quality control tools in the performance-based specification for accepting or rejecting in-situ concrete for some major projects under the Public Works Department (PWD) of Malaysia.

   (2 marks)

2. (a) With appropriate sketch, explain the mechanism of dry mix process of sprayed concrete repair technique.

   (8 marks)

   (b) State **FIVE (5)** demerits of using steel plates as an external reinforcement.

   (5 marks)

   (c) State the properties of different types of Fibre Reinforced Polymer composites. Describe the procedure of the manual lay-up for strengthening of a reinforced concrete structures with externally bonded Fibre Reinforced Polymer.

   (12 marks)

3. (a) Explain how the combined use of superplasticiser and silica fume could enhance the strength and durability performance of concrete.

   (10 marks)

   (b) Several piers of a marine jetty have been reported to undergo corrosion of reinforcement as a result of chloride penetration. List and explain the important properties of the repair material to be used in repairing the affected piers.

   (10 marks)

3. (c) Some of the repaired piers in (b) show some sign of distress a few months after being repaired. The concrete cracks, but the repair material seems to be intact. Explain the probable cause/s of the observed distress.

(5 marks)

4. (a) Discuss the principle of investigation pertaining to the assessments of deteriorated reinforced concrete structures.

(12 marks)

(b) Defects usually arise from a combination of causes such as cracks due to carbonation induced corrosion. Therefore, it is important to gather all the relevant information to interpret the investigated data and to come up with diagnosis. Discuss the procedure in the interpretation of the data and diagnosis at the stage of investigation.

(13 marks)

5. (a) Surface treatment is normally applied to newly built structures, to existing concrete structures or to newly repaired areas in existing structures. List **FOUR (4)** modes of protection of surface treatment. Provide an appropriate sketch for each mode.

(6 marks)

(b) By suggesting simple laboratory test, explain how the waterproofing efficiency of surface treatments in chloride containing environment for an exposure period of one year could be assessed.

(9 marks)

(c) Several piers of a marine jetty have been repaired by patching and pressure grouting as a result of reinforcement corrosion. Several months after the repair work was performed, some new corrosion problems have been observed at several places adjacent to the repaired areas. Explain how this phenomenon occur and describe a suitable technique to reduce the risk of its occurrence. Use appropriate sketches to aid your explanation.

(10 marks)

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