UNIVERSITI SAINS MALAYSIA

1st. Semester Examination
2006/2007 Academic Session

October / November 2006

EAS 662/4 – Structural Retrofitting Technology

Duration: 3 hours

Instructions to Candidates:

1. Ensure that this paper contains **FOUR (4)** printed pages before you start your examination.

2. This paper contains **FIVE (5)** questions. Answer **FOUR (4)** questions only. Marks will be given to the **FIRST FOUR (4)** questions put in order on the answer script and **NOT** the **BEST FOUR (4).**

3. Each question carries equal mark.

4. All questions **CAN BE** answered either in English or Bahasa Malaysia.

5. Each question **MUST BE** answered on a new sheet.

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

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1. (a) List and explain in detail the data required for initial appraisal pertaining to surface deterioration of reinforced concrete structures.

(12 marks)

(b) Defects usually arise from a combination of causes. Therefore it is important to gather all relevant information for interpreting the findings. Discuss the procedure in the interpretation of the findings at the stage of investigation.

(13 marks)

2. (a) Describe the mechanism how plastic shrinkage crack occurs. Explain why the use of fly ash normally exacerbates (aggravates) the development of plastic shrinkage crack in concrete, particularly in hot and arid environment.

(7 marks)

(b) Explain how the combined use of superplasticiser and pozzolanic material could enhance the strength and durability performance of concrete.

(10 marks)

(c) Figure 1 shows the relative compressive strength development of concretes containing metakaolin (MK) in comparison to a control Ordinary Portland Cement (OPC) concrete. The MK was used as a partial cement replacement material at replacement levels of 5 and 10 %. Give the probable explanations to the different trend in relative strength development for the concretes containing MK.

(8 marks)

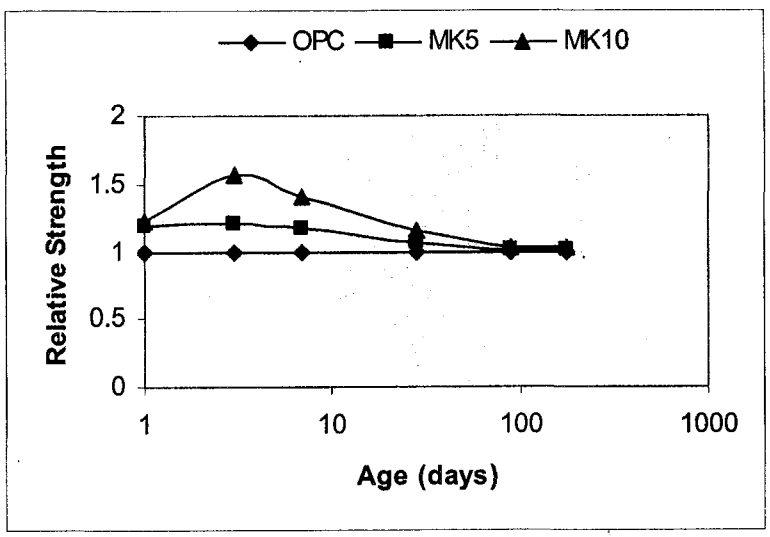

Figure 1: Relative compressive strength development of concrete containing MK.

3. Several piers of a reinforced concrete marine jetty have been observed to undergo corrosion of reinforcement and require immediate rehabilitation work. The worst affected areas are those located in the tidal zone; where they are submerged during high tide and exposed during low tide.

(a) Referring to the above problem, explain the mechanism of the corrosion problem at work. Explain why the areas exposed to tidal action are affected the most.

(7 marks)

(b) List and explain **FIVE (5)** important properties of the repair material to be used in repairing the affected piers.

(8 marks)

(c) If the affected piers are going to be repaired by pre-placed aggregate pressure grouting technique, explain the steps involved in the rehabilitation work.

(10 marks)

4. (a) List **FOUR (4)** modes of protection of surface treatment/coating. Provide an appropriate sketch for each mode.

(4 marks)

(b) Table 1 presents the experimental data, which was obtained in an attempt to assess the waterproofing efficiency of three types of surface treatments that have been exposed to Sodium Chloride (NaCl) solution.

Table 1: Mass of concrete specimens that have been immersed in NaCl (gram)

Age (months)	Surface treated			Controlled/ Untreated
	Silane	Epoxy	Sodium silicate	
0	*2416	*2450	*2430	*2412
1	2444	2460	2461	2475
3	2464	2462	2466	2486
6	2481	2463	2471	2499
12	2499	2465	2473	2510

* Note: Dry mass before immersion

Determine the water absorption for all specimens and then the waterproofing efficiency index for the treated specimens. Use suitable table/s for your answer. Compare and discuss the waterproofing performance of all surface treatments for the duration of the test period. If necessary, you could use an appropriate graph for the comparison.

(13 marks)

(c) With the aid of appropriate sketches, explain the principles how sacrificial anode and impressed current cathodic protection systems work.

(8 marks)