



First Semester Examination
Academic Session 2021/2022

February/March 2022

EAS662 – Structural Retrofitting Technology

Duration : 2 hours

Please ensure that this examination paper contains **FIVE (5)** printed pages before you begin the examination.

Instructions: This paper contains **FIVE (5)** questions. Answer **FOUR** questions.

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

- (1). Al-Aqsa Mosque, originally built in 711 A.D., has not changed significantly in size or plan since the 12th century. The holy mosque is considered as historical structure in Palestine which is subjected to various types of damages due to the destructive war and violation from Israel since 1948 that result in destruction and progressive deterioration.

In order to assess the safety of the building and planning the rehabilitation measures, it is essential to perform complete analysis of historic structure. Rehabilitation of historical structures such as “Al-Aqsa” mosque has to be carried out carefully to conform to internationally recognized regulations concerned with architectural heritage.

- (a). List **FIVE (5)** reasons for structural appraisal.

[5 marks]

- (b). Explain in details, the **methodologies of intervention** for structural rehabilitation of heritage buildings.

[20 marks]

- (2). Kuala Sepetang jetty in Perak has been used for fishing industry over 55 years. Seven of the piers and a few locations underneath the concrete platform has severe structural damage such as reinforcement corrosion and concrete spalling. The need to repair is required for the safety of the people.

- (a). The affected concrete platform is to be repaired using reinforced concrete jacketing method. Provide a method statement for the repair of the concrete platform. Use a suitable sketch to explain your answer.

[10 marks]

- (b). Propose a method statement for the repair of the pier by using Fiber Reinforced Polymer (FRP) Jacketing. Use a suitable sketch in your answer.

[15 marks]

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- (3). (a). Discuss how the extensive use of certain supplementary cementitious materials could bring about better sustainability of the concrete industry.

[8 marks]

- (b). The construction of a new container terminal has been planned at the Butterworth Port to complement the existing terminal which has reached its maximum capacity. The concrete to be used for the construction of the new container terminal should be highly workable to facilitate placing and consolidation of concrete in very heavily reinforced structural members, has a characteristic strength in excess of 60 MPa and possesses very low chloride permeability value of not exceeding 500 coulombs to ensure superior chloride resistant performance in the aggressive marine exposure.

Suggest suitable admixtures that you would consider using in the concrete mix together with Portland cement, good quality aggregates and mixing water so that the resulting concrete meets the stipulated requirements. Discuss extensively how the suggested admixtures facilitate the achievement of the required attributes of the concrete.

[17 marks]

- (4). (a). Corrosion of reinforcement is indeed the main cause of deterioration to concrete structures in many parts of the world. Explain **TWO (2)** main causes of depassivation to concrete structure which lead to corrosion of reinforcement based on illustration in **Figure 1**.

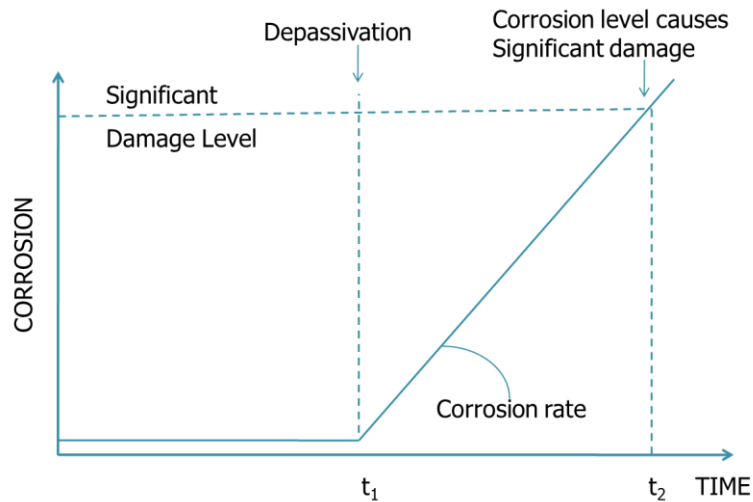


Figure 1: Graphical illustration of corrosion of steel in concrete

[13 marks]

- (b). The piers and girders of a corrosion damaged marine jetty have been repaired by patching. Several months after the repair was performed, some new corrosion problems have been observed at several places surrounding the previously repaired areas. Explain how this phenomenon could have occurred and suggest a suitable electrochemical technique to reduce the risk of it occurring. Use appropriate sketches to aid your explanation.

[12 marks]

- (5). Several piers of a reinforced concrete bridge crossing a channel have been observed to undergo corrosion of reinforcement and require rehabilitation work. The worst affected areas are those within the tidal as well as splash zones. The surrounding temperature is stable throughout the year.

- (a). Identify **FIVE (5)** important properties that the repair material to be used in repairing the affected piers should have to ensure effective and lasting repair work. For each identified property, justify its relevancy or importance to the repair work.

[10 marks]

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- (b). If significant depth of chloride contaminated concrete in the affected piers has to be removed and replaced with suitable repair material, suggest a suitable technique to repair the corrosion damaged piers. Explain the complete repair process with the help of suitable sketches.

[15 marks]

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