Second Semester Examination
2020/2021 Academic Session

July/August 2021

EAS357 – Sustainable Concrete Materials and Practices

Duration : 1 hour

Please ensure that this examination paper contains **FOUR (4)** printed pages before you begin the examination.

Instructions: This paper contains **THREE (3)** questions. Answer **TWO (2)** questions.

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

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1. The Klang Port Commission has decided to build a new container terminal to cater for the increasing demand in container space from the escalating number of ships and vessels loading and unloading cargo containers at the port. Due to the potentially aggressive marine exposure, the concrete to be used in the construction of the new container terminal should comply with very stringent durability requirements based on the Rapid Chloride Permeability Test (RCPT) with 28-day total charge passed value of smaller than 1000 coulombs and the Initial Surface Absorption Test (ISAT) with 28-day ISAT value of smaller than 0.02 ml/m^2/s, besides complying with 28-day strength of at least 60 MPa and workability of 180 mm.

   (a). By providing appropriate justifications, suggest a suitable combination of admixtures that could be utilized together with ordinary Portland cement (OPC) which would better ensure the total compliance of the concrete with the whole stipulated requirements.

   [10 marks]

   (b). Explain in detail the associated mechanisms on how the combination of materials [OPC and the suggested admixtures in (a)] contribute towards the compliance of the concrete with all the stipulated strength, workability and durability performance requirements.

   [32 marks]

   (c). Discuss the probable durability performance of the concrete if it is only prescribed based on strength and workability requirements (28-day strength of 60 MPa and workability of 180 mm).

   [8 marks]

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2. Several piers of a reinforced concrete marine jetty located in Labuan, Sabah have been reported to undergo corrosion of reinforcement and in need of urgent repair. In order to ensure effective and lasting repair work, appropriate appraisal and testing should be carried out prior to undertaking the repair.

(a). Suggest suitable tests that should be carried out in the appraisal process of the affected piers of the jetty. For each test, explain why it is required and discuss how the whole tests facilitate the repair process and ensure effective as well as lasting repair work.

[30 marks]

(b). With justification, identify and explain **FIVE (5)** most important properties that the repair material to be used in the repair work of the corrosion damaged piers should have to better ensure effective and durable repair work. Include appropriate sketches to elucidate your answer.

[20 marks]

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3. (a). The main specialties of fiber concrete are possessing superior tensile and flexural characteristics. Its advantages include improving the post-cracking behavior of concrete besides making it much tougher and more resistant to impact load. However, the use of fiber will definitely increase the density of concrete. Justify the above-mentioned advantages and disadvantages of fiber concrete.

[20 marks]

(b). It is well known that ultra high-performance fiber reinforced concrete (UHPFRC) has numerous important engineering properties. Categorize and briefly describe **FIVE (5)** of the important engineering characteristics of UHPFRC as a construction material.

[16 marks]

(c). Self-compacting concrete possesses features and properties which are exceptionally different from those of conventionally vibrated concrete with the capability to perform in the fresh as well as hardened states. Briefly describe **FIVE (5)** great benefits derivable from its utilization.

[14 marks]

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