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UNIVERSITI SAINS MALAYSIA

2<sup>nd</sup>. Semester Examination  
2001/2002 Academic Session

FEBRUARY / MARCH 2002

**EAS 552/3 – Advanced Concrete Technology**

Time : 3 hours

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**Direction to student:-**

1. Ensure that this paper contains **FOUR (4)** printed pages include appendices.
2. This paper contains **SIX (6)** question. Answer **FOUR (4)** question only. Marks will be given to the **FIRST FOUR (4)** question put in order on the answer script and **NOT** the **BEST FOUR (4)**.
3. All questions carry the same mark.
4. All questions **MUST BE** answered in Bahasa Malaysia.
5. Write answered question number on the cover sheet of answer script.

1. (a) In the western countries, it has been realised that the cement currently produced has undergone some gradual changes if compared to cement produced in 1950's. The most obvious change is the relative proportions of  $C_3S$  and  $C_2S$ . The  $C_3S$  content has increased from about 50% to 65%, while the  $C_2S$  content has reduced from about 25% to 10%.

Write the equation for the reaction of both compounds. Discuss the effect of the observed change towards the content of CH and C-S-H, heat of hydration, strength and strength development, and durability. Also, state the advantages and disadvantages from this change towards the concrete construction industries.

(20 marks)

- (b) What are the components of hardened cement paste? For each component, explain briefly its influence on deformation.

(5 marks)

2. (a) Explain and compare the mechanisms which air entraining agent and superplasticiser work.

(17 marks)

- (b) State the effects of both admixtures on fresh and hardened concrete. Give typical examples where both materials could be used.

(5 marks)

- (c) State the effects of overdosing concrete with both admixtures.

(3 marks)

3. (a) Explain on the advantages and disadvantages of using fly ash and GGBS in hot and aggressive environment, giving emphasis on construction practice, strength and strength development, as well as durability.

(17 marks)

- (b) Explain briefly how silica fume and metakaolin can improve the strength and durability of concrete.

(4 marks)

- (c) The use of fly ash at replacement level between 25 to 40% can reduce the risk of sulphate attack for concrete that will be exposed to sulphate environment. State **FOUR (4)** effects of fly ash inclusion which can improve the sulphate resistant of concrete.

(4 marks)

4. (a) Aggregates can influence deformation of concrete. Besides aggregates, discuss **FOUR (4)** other factors that could affect deformation of concrete. (10 marks)
- (b) State the effects of creep on concrete structures. (3 marks)
- (c) Assuming that concrete can be represented by a two-phase composite model as shown in Figure 1, obtain a relationship between elastic modulus of concrete with elastic modulus of aggregate and hardened cement paste. (6 marks)
- (d) If the elastic modulus for a concrete is 33 GPa and the concrete consists of 70% aggregate with an elastic modulus of 50 GPa, determine the specific creep for the concrete using 'effective modulus method' if the specific creep of the hardened cement paste is  $100 \times 10^{-6}$  per MPa. Assume that the aggregate does not creep. (6 marks)

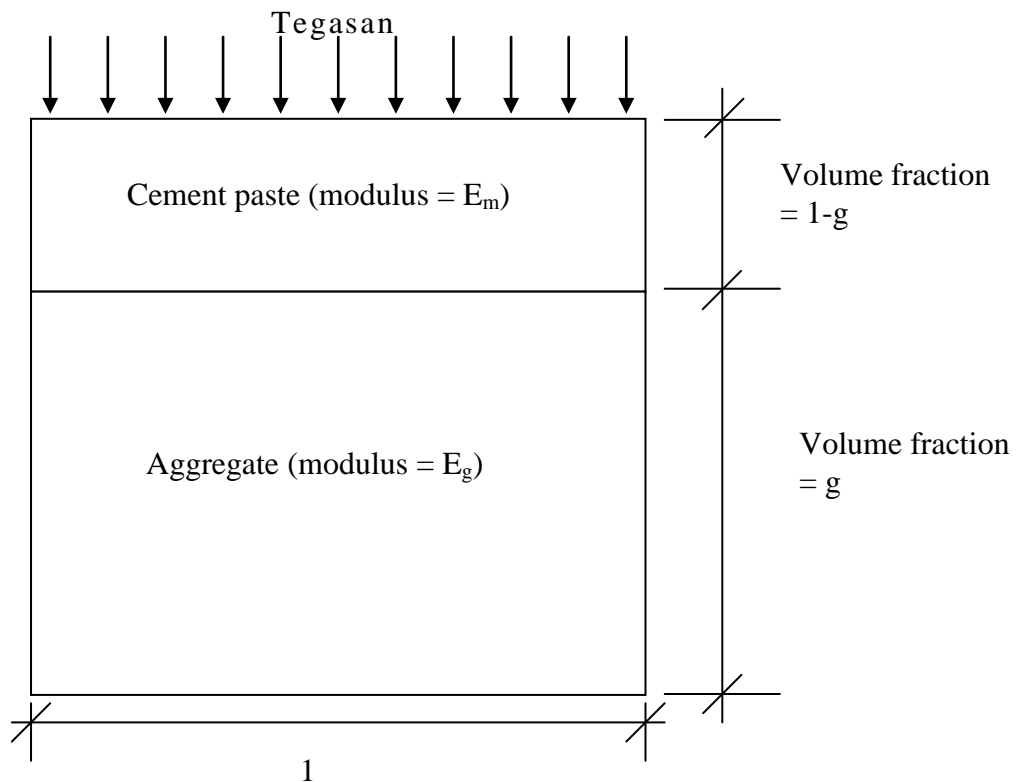


Figure 1

5. The most common problem encountered by reinforced concrete structures is reinforcement corrosion. Discuss the mechanism on how this phenomena happen and the influencing factors.

(25 marks)

6. Concrete is a construction material that is produced on-site, either ready mixed or mixed on-site. The quality of the concrete depends on the method it is produced. Since the production of concrete is exposed to various influencing factors, unlike the production of steel, produced in factory, the quality of concrete can change significantly.

To ensure that the concrete produced will have good and consistent quality, you are required to prepare guidelines for production of good quality concrete. The guidelines should take into consideration materials, concrete mixture and construction aspects.

(25 marks)

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