
UNIVERSITI SAINS MALAYSIA

1st Semester Examination
2006/2007 Academic Session

October / November 2006

EAP 586/4 – Sustainable Drainage System

Duration: 3 hours

Instructions to Candidates:

1. Ensure that this paper contains **THREE (3)** 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 **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.

1. (a) Briefly describe the rapid disposal and control at source concepts in the designing an urban stormwater drainage system. (5 marks)
- (b) Describe and discuss **FIVE (5)** tasks to be carried out in the preparation of stormwater strategy Plan. (10 marks)
- (c) Describe and discuss **FIVE (5)** tasks to be carried out in the preparation of stormwater master Plan. (10 marks)
2. (a) Describe the following: i) on-site storage; ii) community storage; iii) regional storage. (5 marks)
- (b) Post development time-area curve and design rainfall (50 yr ARI) for area with 20 hectare and time of concentration 30 min (for post development condition) are given in table below. Derive the post development hydrograph for the developed area.

Design Rainfall Isohyet (50 year ARI)

Time (min)	Rainfall (mm)	Losses (mm)
5	18.0	5.0
10	25.0	2.5
15	30.0	2.5
20	32.5	2.5
25	20.0	2.5
30	16.0	2.5

Time-area Curve

Area (m ²)	Time (min)
26000	5
56000	10
106000	15
146000	20
176000	25
200000	30

(10 marks)

- (c) Make a preliminary estimate of the community pond to control the post development flow from 20 hectare of developed area given in part (b) above. The community storage will be used to reduce the peak post development discharge by 50%. Use the post development hydrograph derived in part (b) above as an inflow to the community storage and the equation below in the calculation.

$$V_s = 1.291 V_i \left(1 - \frac{Q_p}{Q_i}\right)^{0.753} \left(\frac{t_i}{t_p}\right)^{-0.411}$$

(10 marks)

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3. (a) Discuss the **TEN (10)** principles of river rehabilitation. (15 marks)
- (b) River Muda experience **THREE (3)** major floods since 1988. What are your recommendations to alleviate the problems? (10 marks)
4. (a) State briefly the importance of monitoring storm water quality. Name the essential considerations for adopting a storm water quality monitoring program? (9 marks)
- (b) Name the different types of storm water quality monitoring schemes and briefly describe the objectives of each of them. (8 marks)
- (c) Name the filtration techniques used to treat pollutant from storm water. What are the parameters that affect the performance of a biofiltration swale? (8 marks)
5. (a) What are the different types of infiltration facilities used in storm water management practices? List the general criterion for site selection for an infiltration facility. (10 marks)
- (b) An infiltration trench is proposed for a semi-detached bungalow in Parit Buntar area. The bungalow catchment area is 171 m². From initial site investigations it was found that the site soil has an infiltration capacity $f_c = 0.035$ m/hr and the water table is 3m below the ground surface. Design the infiltration trench for the following recommended values
Design factor of safety $FS = 1.5$
Porosity of fill material $n = 0.35$
Time of concentration pre-development $t_{cs} = 30$ min
Time of concentration after development $t_c = 15$ min
Runoff coefficient pre-development $C_{CS} = 0.48$, and
Runoff coefficient post-development $C_C = 0.76$
Maximum storage time $T_s = 24$ hr
Effective filling time $T_f = 2$ hr
- For 5 year ARI rainfall, use the rainfall intensity-time of concentration relationship: $\ln(I) = a + b[\ln(t)] + c[\ln(t)]^2 + d[\ln(t)]^3$; where I is the rainfall intensity (mm/h) and t is the time (min) of concentration. The coefficients a , b , c and d for the proposed area are; $a = 4.924$, $b = 0.690$, $c = -0.261$, $d = 0.014$. (15 marks)