UNIVERSITI SAINS MALAYSIA

1st. Semester Examination
2004/2005 Academic Session

October 2004

EAP 586/4 - Sustainable Drainage System

Duration: 3 hours

Instruction to candidates:

1. Ensure that this paper contains **FIVE (5)** printed pages, including appendices, before you start your examination.
2. This paper contains **FOUR (4)** questions. Answer **ALL (4)** questions.
3. All questions carry equal marks.
4. All questions **MUST BE** answered in English.
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 differences between an on-site detention facility and community pond, and give **FIVE (5)** types of OSD which can be used as a water quantity control.

(7 marks)

(b) Stormwater generated from 1.0 hectare development lot will be discharged into 4000m engineered waterway. The predevelopment and post development discharge are 150 l/s and 200 l/s, respectively. The engineered waterway has a following characteristic: height h = 1.0, bottom width w = 1.5m, side slope 1:3, n = 0.1 and S_0 = 0.01. Given that the point of inflow into the engineered waterway is 2000m from the upstream. Determine the following for above ground storage (used the critical storm Q_d = 300 l/s and t_d = 30 min):

i. permissible site discharge PSD
ii. site storage requirement SSR
iii. give a new location of the development lot so that the SSR is a minimum along the engineered waterway, and also determine the new size of SSR for the new location.

(18 marks)

2. (a) The flow and sediment characteristics for Kulim River at Serdang is as follows:

Flow discharge	= 20 m^3/s
Flow depth	= 1.5 m
Mean velocity	= 1.0 m/s
Channel width	= 18.0 m
Channel slope	= 0.00125
Mean sediment size	= 4.0 mm
Total Load	= 8.0 kg/s

If the station is a rectangular channel,

i. Compute the bed load predicted by Einstein-Brown equation.

(5 marks)

ii. Compute the total load predicted by Graf equation. Determine if the equation is suitable for predicting the total load at the station.

(5 marks)

(b) Discuss the sediment transport process as described by Shields diagram.

(5 marks)

(c) Discuss four factors that affect river equilibrium.

(10 marks)

3. (a) The Best Management Practices have been successfully implemented in western countries such as US, Germany, Australia, Britain and etc. In MSMA, the practices have been discussed in depth. Discuss three best methods to be implemented in Malaysia for reducing the occurrences of flash flood.

(10 marks)

(b) Describe the methodological concept of structural and non-structural planning of stormwater management in urban areas.

(8 marks)

(c) Discuss the processes that reduce and remove pollutants in the extended detention pond or retention pond.

(7 marks)

4. (a) State briefly the importance of monitoring storm water quality. Name the essential considerations for adopting a storm water quality monitoring program?

(5 marks)

(b) Name the filtration techniques used to treat pollutant from storm water. What are the parameters that affect the performance of a biofiltation swale?

(5 marks)

(c) 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.

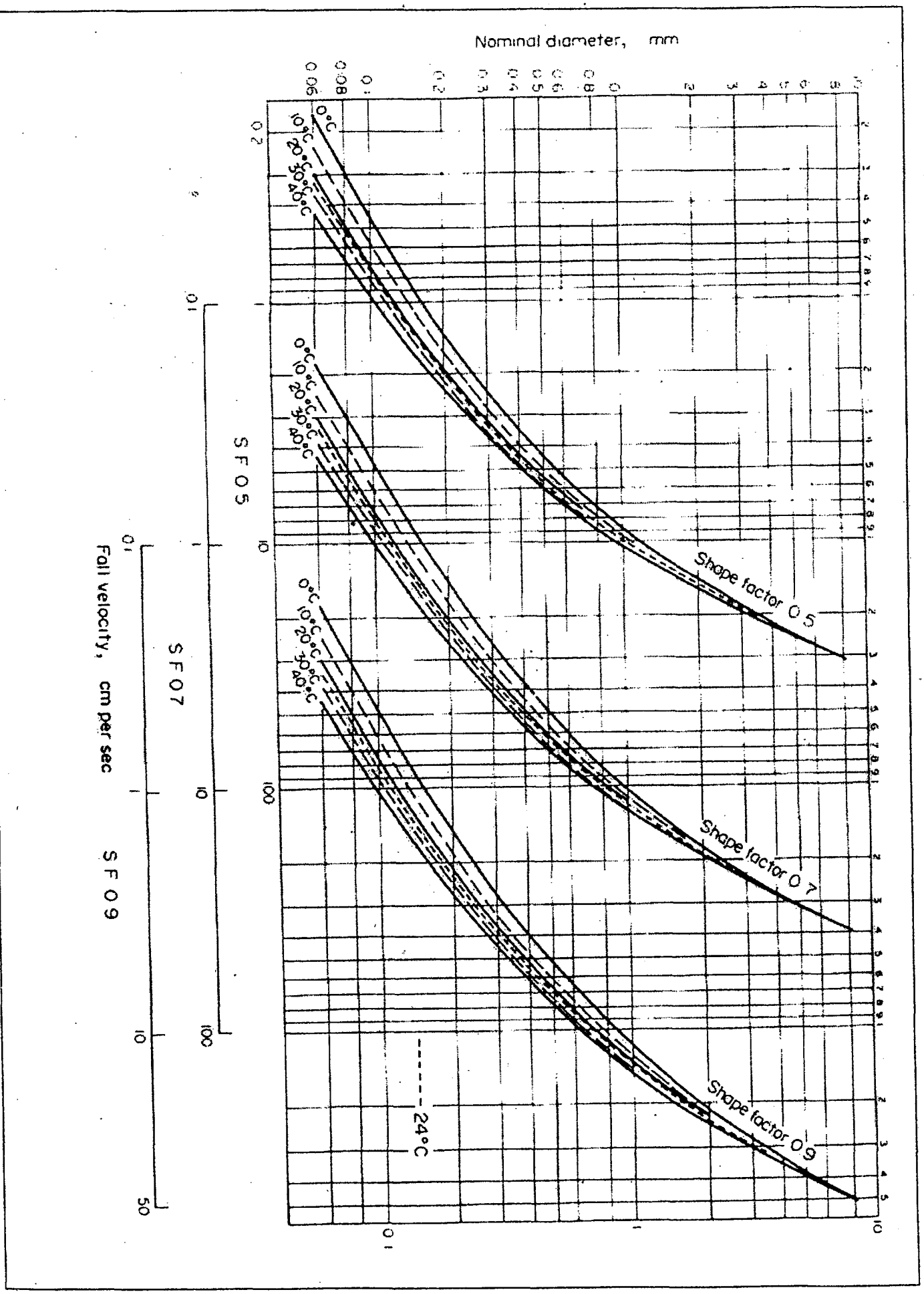
(5 marks)

(d) An infiltration trench is proposed for a semi-detached bungalow in Parit Buntar area. The bungalow catchment area is 171 m^2. 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

(10 marks)

- ooo O ooo -


Nominal diameter, mm
0·06
0·08
0·1
0·2
0·3
0·4
0·5
0·6
0·8
0
2
3
4
5
6
8
0·2
0·1
1
10
100
0°C
10°C
20°C
30°C
40°C
SF 05
SF 07
SF 09
Shape factor 0·5
Shape factor 0·7
Shape factor 0·9
24°C
Fall velocity, cm per sec
0·1
1
10
50