NATIONAL UNIVERSITY OF SINGAPORE

FACULTY OF ENGINEERING

EXAMINATION FOR

(Semester I: 2010-2011)

CE5312 River Mechanics

Nov/ Dec 2010 - Time allowed: 2.5 hours

INSTRUCTIONS TO CANDIDATES

1. This examination paper contains **THREE(3)** questions and comprises **FIVE(5)** printed pages.

2. Answer ALL **THREE(3)** questions.

3. All questions carry equal marks.

4. **Page 3 is detachable (Fig. Q1) and to be submitted together with your answer scripts.**

4. This is an "**OPEN BOOK**" examination.

Question 1 [25 marks]

(a) Water from a high level lake is conveyed by a concrete channel over terrain where the channel bed slope is changing as shown in Fig. Q1. The distances between all the sections are large. The channel ends in a free overfall. Sketch and name the possible flow profiles. Be realistic in your assumptions.

[7 marks]

(b) A straight 10 m wide rectangular channel is carrying a flow of 10 m^3/s at a depth of 0.73m. The channel has a slope of 0.0005, a Manning 'n' of 0.012 and a length of 1000m. Assume that the upstream end of the channel is at normal depth and there is a free overfall at the downstream end.

It is now proposed to build a transition consisting of a gradual rise in the channel bed to a height of Δ m followed by a gradual drop back to the original channel bed. The transition is located about 200 m from the overfall at the downstream end of the channel. Assume no losses in the transition.

i. Ascertain the maximum value of Δ without affecting the upstream flow.

[5 marks]

ii. If the transition is incorrectly built such that $\Delta = 0.32\ m$ from the channel bed, and if the flow is now 20 m^3/s, what is the water depth immediately upstream of the transition?

[8 marks]

iii. Hence, sketch (do not calculate) and name the resulting flow profiles from the far upstream, through the transition and all the way down to the free overfall at the downstream end when the flow is 20 m^3/s

[5 marks]

.../3

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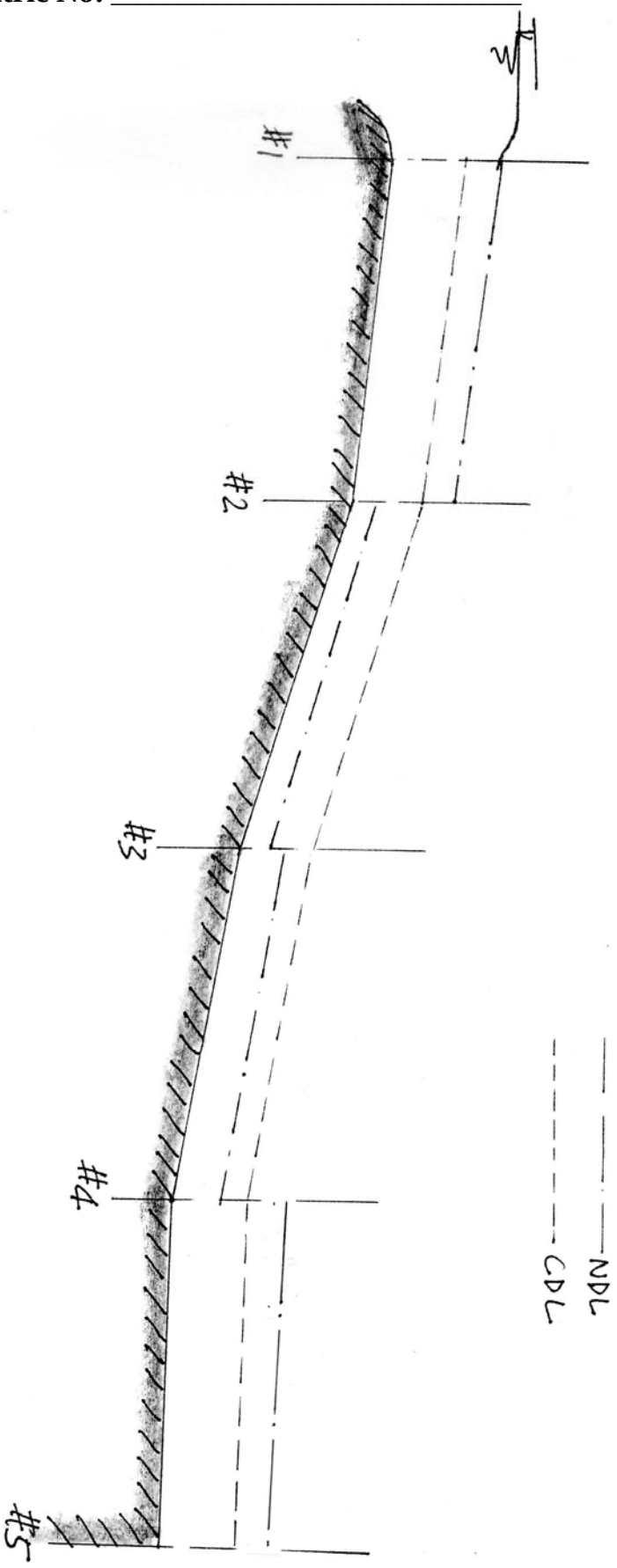

Fig. Q1

Question 2

A paved fringe car park outside the Central Business district is 60 m by 60 m square in plan as shown in Fig. Q2. The parking lot has a cross slope into a gutter 0.7 m wide running along one side of the parking lot. The gutter is rectangular in section and is lined with concrete for which Manning's 'n' value is 0.014 and the gutter empties into a deep drain. The gutter has a slope of 1:100

If rain falls on the parking lot with an intensity of 3 cm/hr, determine if the gutter flow terminates in a free overfall.

[15 marks]

If the gutter flow does not terminate in a free overfall, locate the position of the critical section and determine the critical depth at this location. Sketch the likely water surface profile and explain clearly, step by step, a scheme to estimate the water depth in the gutter at the overfall. You should show one iteration for a one-step estimate.

[10 marks]

The following equation may be used to locate the critical section

$$x_c = \frac{8q^2}{gB^2\left(S_0 - \frac{Pg}{C_c^2 B}\right)^3}$$

with the Chezy constant approximated with the Manning equation according to $C_c = \frac{R^{1/6}}{n}$

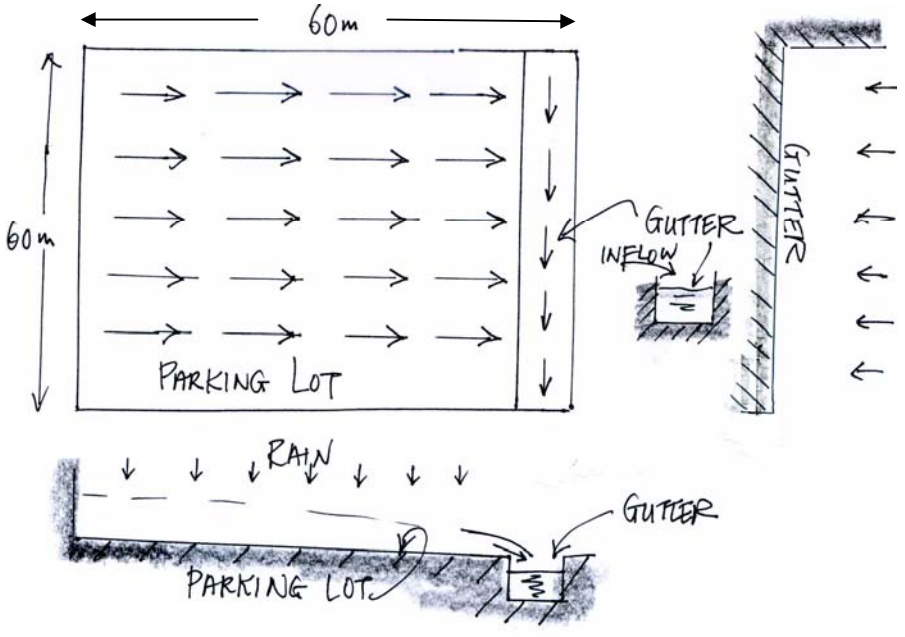

Fig. Q2

Question 3

A wide river discharges into the sea where the tidal range is 1.5 m and the tidal period is 12.5 hours. When the tide is at its mean sea level, the water depth at the river mouth is 5m. The initial river flow is uniform at 0.5 m/s when the tide starts to fall from its highest level. Assuming that the river bed is horizontal and neglecting flow resistance, determine

(a) the time it takes for the level of the river to fall by 0.5 m at a location 2 km from the river mouth

[8 marks]

(b) the drop in the water level at a location 10 km from the river mouth at this time

[12 marks]

(c) how far upstream will the river level starts to fall at this time?

[5 marks]

- END OF PAPER -