SCHOOL OF CIVIL ENGINEERING
ENGINEERING CAMPUS
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ACADEMIC SESSION SEM 1 2021/2022
EAL 431 HIGHWAY DESIGN

ASSIGNMENT 1

Question 1

[a] Sight distance can be defined as the road distance ahead that is visible to the driver. With consideration on the eye height of a driver can see an obstruction object that is remains stationary, you are asked to answer the following questions based on the underneath situation:

Parameter	Highway Section		
	X	Y	Z
Design Speed (km/h)	80	100	120

   Perception-reaction time = 3 seconds
   Vehicle Mass = 400kg
   Coefficient of friction = 0.300
   Gradient: 6.5%

   i. Determine the stopping sight distance required at each highway section with different design speeds **[18 Marks]**
       - while moving down a slope
       - while moving up a slope

   ii. Determine the difference of stopping sight distance for each car moving down a slope and moving up a slope with the same gradient **[3 Marks]**

   iii. Plot separate correlation diagram and discuss the effect of design speeds on the stopping sight distance, in terms of: **[9 Marks]**
       - while moving down a slope
       - while moving up a slope
       - Its difference

[b] A two-lane rural highway with a design speed of 27.8 m/s goes from normal crown with 2.5% cross slope to 6% super-elevation by means of a spiral transition curve. The spiral curve is 90m long. If the super-elevation is attained by rotating the road section around the centreline, sketch a cross-section diagram of the road at 15, 30, 45, 60, and 75m from the tangent to spiral (TS). **[20 Marks]**

Lane width = 3.3m / lane
Carriageway type = Single

Question 2

[a] Vertical curves are the second of the two important transition elements in geometric design for highways, the first being Horizontal Curves.

   i.   Based on your understanding, explain the importance of a proper design of the vertical curve for highway network design in rural area. Your explanation must define the vertical curve and it uses, important parameters considered during vertical curve design for road or highway network, and brief description on the types of vertical curve (with sketches). **[10 Marks]**

   ii.   The parabolic curve is adopted in the vertical alignment design to provide a safe and comfort ride for the road users. Sketch a parabolic vertical curve (show relation between driver's sight, object height, required sight distance, and road surface level). Next, state the basic equation of a parabolic curve and justify why this curve type is preferred for the safe and comfort travel experience. **[10 Marks]**

   iii.   With proper sketches, explain **FIVE** general controls for vertical alignment that must be considered for road user's safety and comfortable ride experience. **[15 Marks]**

[b] As a road design engineer, you are required to design a vertical curve for an expressway located at rural area. The design speed is 65 mph, the grades are +4% uphill and 2% downhill. Determine the minimum length of the vertical curve. (Refer design controls for stopping sight distance and for crest and sag vertical curves, available in AASHTO guideline). **[5 Marks]**