SCHOOL OF CIVIL ENGINEERING, ENGINEERING CAMPUS
UNIVERSITI SAINS MALAYSIA
14300 NIBONG TEBAL, PULAU PINANG

EAL 431 HIGHWAY DESIGN [SEM 1 2021/2022]

TEST 1

Question 1

[a] Elaborate the relationships between the design vehicle with the:

i. turning radius **(3 Marks)**

ii. driver eye height **(3 Marks)**

[b] 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 Sections	
	km98.7	km233.4
Gradient (%)	4.5	6.5

Perception-reaction time = 3 seconds
Design speed: 110 km/h
Vehicle Mass = 400kg
Coefficient of friction = 0.300

Determine the difference of stopping sight distance for a car moving down a slope and moving up a slope with different gradients **(14 Marks)**

Question 2

In Malaysia, a highway curve was designed based on the driver's height of eye to be 1.05 meter above the pavement layer, and 0.2 meter object height. This road network was provided with the highest geometric design standards for urban area with full access control and constructed on top of flat areas. The algebraic difference in grades is 3%.

Over time, the automobile design in this has country has evolved, where spot cars are more favorable among the younger citizens. With increased demand, directly, this transition has caused the average height of driver's eye reduced to 0.91 meter. Based on the general summary for geometric design criteria for roads in urban areas (Figure 1), answer the following questions.

i. Based on the information above and Figure 1, identify the design standard for the aforementioned road network. **(2 Marks)**

ii. Explain the relationship between the K value and the length of a crest curve. Include any related formula or equation in your explanation. **(6 Marks)**

iii. Discuss the implications regarding the geometric design (length) of the curve due to reduction in driver's eye height to 0.91 meter? Use Equation 1 to answer this question. **(12 Marks)**

Given:

$$L_{min} = \frac{AS^2}{200\left(\sqrt{h_1} + \sqrt{h_2}\right)^2} \qquad \text{Eq. (1)}$$

GENERAL SUMMARY - GEOMETRIC DESIGN CRITERIA FOR ROADS IN URBAN AREAS (METRIC)

DESIGN CONTROL AND CRITERIA	1	DESIGN STANDARD	-	U6			U5			U4			U3			U2			U1		
	2	ACCESS CONTROL	-	FULL			PARTIAL			PARTIAL/NIL			PARTIAL/NIL			NIL			NIL		
	3	AREA TYPE	-	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M	F	R	M
	4	DESIGN SPEED	km/hr	100	80	60	80	60	50	70	60	50	60	50	40	50	40	30	40	30	20
CROSS SECTION ELEMENTS	5	LANE WIDTH	m	3.65			3.50			3.50			3.25			3.00			(5.00) a		
	6	USABLE SHOULDER WIDTH	m	3.00	3.00	2.50	3.00	3.00	2.50	3.00	2.50	2.00	2.50	2.00	1.50	2.00	1.50	1.50	1.50	1.50	1.50
	7	MEDIAN WIDTH (MINIMUM)	m	4.00	3.50	2.00	3.00	2.50	2.00	2.50	2.00	1.50	2.00	1.50	1.50	N/A			N/A		
	8	MEDIAN WIDTH (DESIRABLE)	m	9.0	6.0	4.0	6.5	4.0	3.0	5.0	3.0	2.0	4.0	2.0	2.0	N/A			N/A		
	9	MARGINAL STRIP WIDTH	m	0.50			0.50			0.25			0.25			0.25			0.00		
	10	MINIMUM RESERVE WIDTH	m	65			65			40			40			30			25		
ELEMENTS OF DESIGN	11	STOPPING SIGHT DISTANCE	m	185	130	85	130	85	65	105	85	65	85	65	50	65	50	35	50	35	20
	12	PASSING SIGHT DISTANCE	m	670	540	410	540	410	345	485	410	345	410	345	270	345	270	200	270	200	200
	13	MINIMUM RADIUS (AT MAX SE 6%)	m	435	250	135	250	135	90	195	135	90	135	90	55	90	55	30	55	30	15
	14	MINIMUM LENGTH OF SPIRAL (AT MAX SE- 2 LANES)	m	48	43	36	43	36	33	39	36	33	36	33	31	33	31	29	31	29	25
	15	MAXIMUM SUPERELEVATION	Ratio	0.06			0.06			0.06			0.06			0.06			0.06		
	16	MAXIMUM GRADE (DESIRABLE)	%	3	4	5	4	5	6	5	6	7	6	7	8	7	8	9	7	8	9
	17	MAXIMUM GRADE	%	3	5	7	6	8	11	8	10	12	9	11	13	7	11	16	7	11	17
	18	CREST VERTICAL CURVE (K)	-	78	39	17	39	17	10	26	17	10	17	10	10	10	10	5	10	5	3
	19	SAG VERTICAL CURVE (K)	-	45	30	18	30	18	13	23	18	13	18	13	9	13	9	6	9	6	3

REMARK :
1) ALL VALUES SHOWN ABOVE ARE MINIMUM/MAXIMUM VALUES. ALL EFFORT SHOULD BE MADE TO ACHIEVE AS HIGH A VALUE AS POSSIBLE
2) FOR DEFINITION OF AREA TYPE, SEE TABLE 3 - 2
3) ABBREVIATION : N/A - NOT APPLICABLE
( )a - TOTAL WIDTH OF PAVEMENT
( )b - RESERVE WIDTH DEPENDS ON ROAD CATEGORY

Figure 1: general summary for geometric design criteria for roads in urban areas