



**SCHOOL OF CIVIL ENGINEERING  
ENGINEERING CAMPUS  
UNIVERSITI SAINS MALAYSIA  
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**EAL 337 PAVEMENT ENGINEERING**

**SEMESTER I [SESSION 2021/2022]**

**ASSIGNMENT 3**

During a site visit to a local quarry, you were taught aggregate composition, mix preparation and volumetric properties of a compacted Marshall sample. The aggregate composition in mix type asphaltic concrete AC10 incorporating hydrated lime as filler, is summarized in **Table 1**. Subsequently, asphalt mixtures were compacted and tested for volumetric properties and Marshall properties. The laboratory test results are shown in **Table 2**, while **Table 3** shows the Malaysian Public Works Department specification limits.

**Table 1**

Material	Percentage (%)	Specific Gravity
		(g/cm <sup>3</sup> )
Coarse Aggregate	46	2.66
Fine Aggregate	52	2.69
Filler (Hydrated Lime)	2	2.78
Bitumen	Variety	1.03

**Table 2**

Sample No.	Sample Height/ (mm)	Bitumen Content (%)	Mass in Air (g)	Mass in Water (g)	Mass Saturated Surface Dried (g)	Measured Stability (kN) - Corrected	Flow (mm)
1	58.7	4.5	1206.8	658.1	1176.2	7.2	2.0
2	63.5	5.5	1216.9	698.2	1211.9	13.9	2.8
3	66.1	6.5	1280.4	655.4	1199.6	8.3	3.9

**Table 3**

Property	Specification
Stability, kN	$\geq 8$
Flow, mm	$\leq 2 - 4$
Stiffness, kN/mm	$>2\text{kN/mm}$
Air Voids, %	3 - 5
Voids Filled with Bitumen, %	70 - 80

a) From the results shown in **Table 2** and **Table 3**, calculate the specific gravity of aggregate mixture. Specify any formula used in the calculate specific gravity of aggregate mixture. **[6 Marks]**

b) Plot the following relationships. Calculate any additional parameters needed prior to plotting the relationship (i.e Mix voids filled with bitumen). State any formula used to compute the required data. **[20 Marks]**

- Mix density versus bitumen content
- Mix air voids versus bitumen content
- Mix stability versus bitumen content
- Flow versus bitumen content
- Mix voids filled with bitumen versus bitumen content

c) From the graphs plotted, determine the Optimum Bitumen Content (OBC) and stiffness value at OBC. Compare the value obtained with the JKR specifications and write down your comments. **[9 Marks]**