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UNIVERSITI TUN HUSSEIN ONNMALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2013/2014

COURSE NAME	:	TRANSPORTATION ENGINEERING
COURSE CODE	:	BFT 40303
PROGRAMME	:	4 BFF
DATE	:	JUNE 2014
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **THIRTEEN (13)** PAGES

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Q1 The Government is planning to construct a new high-speed railway track class-II from City A (Kluang) and City B (Tanah Tinggi) along rural area. In conjunction with that, Station 1 has been built at City A and Station 2 at City B and both station will be connected with a double railway track with a curve located at **I** and **II**. The track will be designed with the degree of transitioned curve (D) of 2^{o} with the *design speed* of 137.5 km/h. The speed for calculating the equilibrium superelevation as decided by the railway engineer is 80 km/h, gauge (G) is 1750 mm and booked speed for goods trains is 30 km/h slower than speed of equilibrium superelevation. Based on all information above:

(a) Plan/draw route of horizontal alignment of the railway track from Station 1 to Station 2 and a horizontal curve at the area of **I** and **II** (Figure **Q1**) and explain why you chose that route

(3 marks)

(b) Determine superelevation for equilibrium speed

(4 marks)

(c) Determine superelevation for maximum sanctioned speed (maximum speed)

(5 marks)

(d) Determine superelevation for goods trains with booked speed

(5 marks)

(e) Determine maximum speed potential or safe speed

(5 marks)

(f) Determine maximum permissible speed on the curve

(3 marks)

Q2 New airport is designed for design aircraft of Boeing B747-200. The basic runway length is based on reference field length of Boeing B747-200 as 3,150 meters. The runway is located at the elevation of 120 m + MSL. Mean of average daily temperatures for the hottest month: 18°C and the mean of maximum daily temperatures is 31° C. The construction plan includes the following data in Table **1**. Based on above information you are asked to answer the following questions:

(a) Determine the actual length of runway

(15 marks)

The actual length of runway is assumed to be the field length (FL) of runway. It is known that FL is equal to the normal Landing Distance (LD) and Take Off Distance (TOD), FL = LD = TOD. It is provided the CLearway area (CL) as 185 m. Based on all information:

(b) Determine the Stopping Distance (SD) and Distance to clear an 11 m obstacle (D35)

(5 marks)

(c) Determine the Full Strength pavement distance (FS)

(5 marks)

Q3 Local Government is planning to construct an Airport with the standard for Boeing 747-100, Boeing 737-200 and Boeing 727-200. The following Table **2** gives the average annual departures and maximum take-off weight of each aircraft type expected to use an airport pavement. Conversion factors for converting from one aircraft type to another can be seen in Table **3**. The runway Airport pavement will be constructed using flexible pavement with three layers: Hot-mix asphalt, Base course and Sub-base course (Figure **Q3(a)**). CBR subgrade is 6% and CBR for Sub-base is 20%. Based on all information above

(a) Determine Wheel load for each aircraft (note that the 727-200 is the design aircraft)

(10 marks)

(b) Design the total thickness of pavement and thickness of each layer (use Figure **Q3(b)** and Figure **Q3(c)**).

(15 marks)

Q4 Water perform in the wave field orbital motions in two different conditions such as large depth/short waves and short depth/long waves (Figure **Q4(a)** and Figure **Q4(b)**). Studies like JONSWAP have shown that wind-generated wave properties depend on wind speed V_W and fetch F, the length of water over which a given wind blown is 35 km. Based on the data collection, maximum height of wave is 2.0 meters with the angle of 35° and data of wind speed are10 m/sec, 15 m/sec and 20 m/sec (Figure **Q4(c)**). $k = 0.301\ m^{-1}$.You are asked to

(a) Determine wave dispersion and phase speed for short wave and long wave

(10 marks)

(b) Determine average wave height and wave period due to the wind

(15 marks)

- END OF QUESTIONS -

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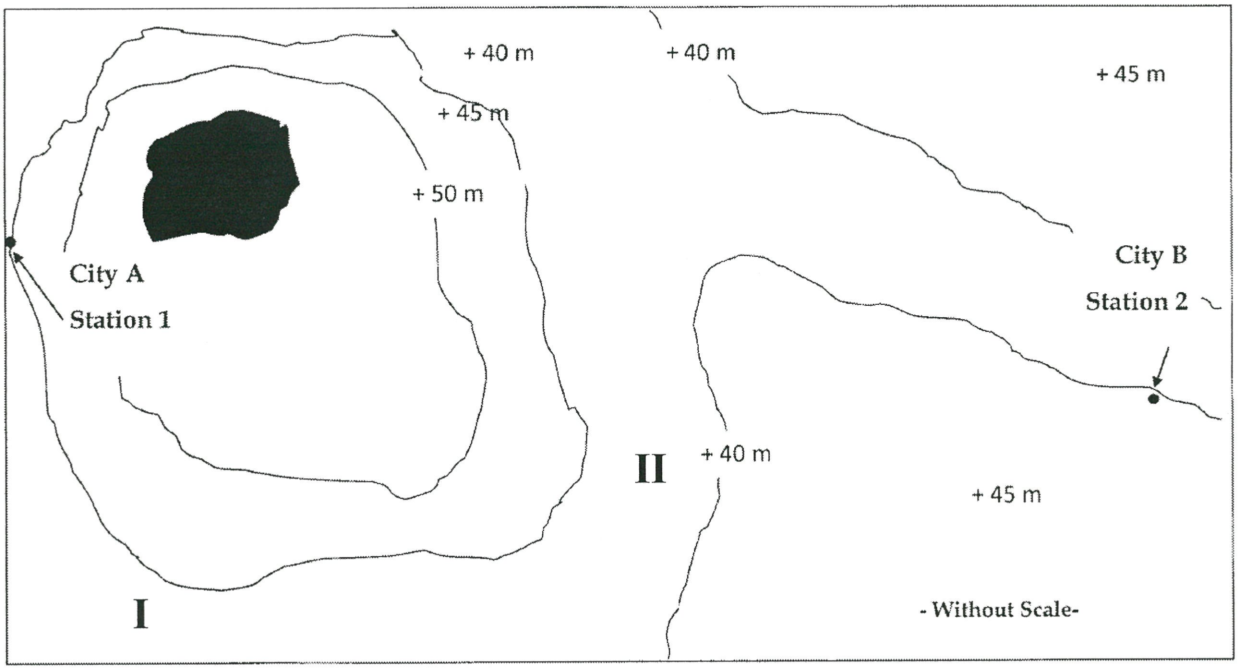

FIGURE Q1: Contour of railway track route

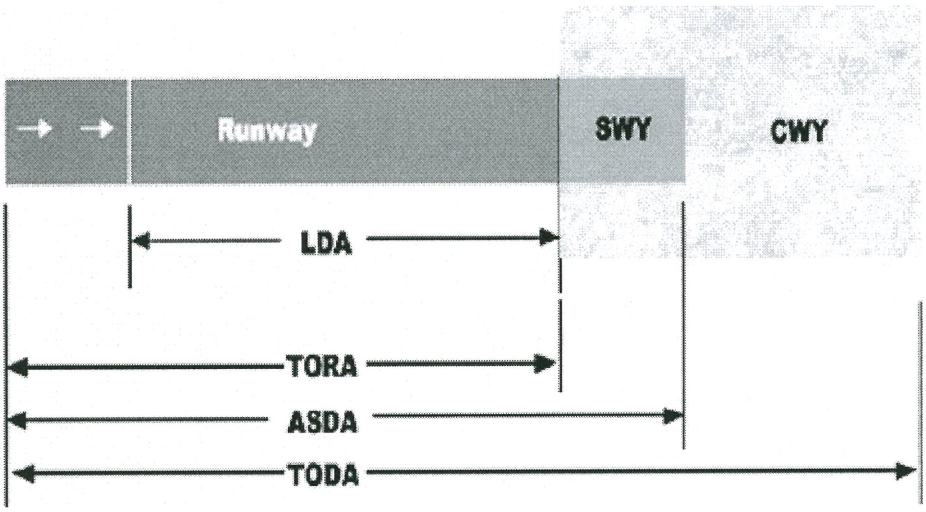

FIGURE Q2: Declared distance

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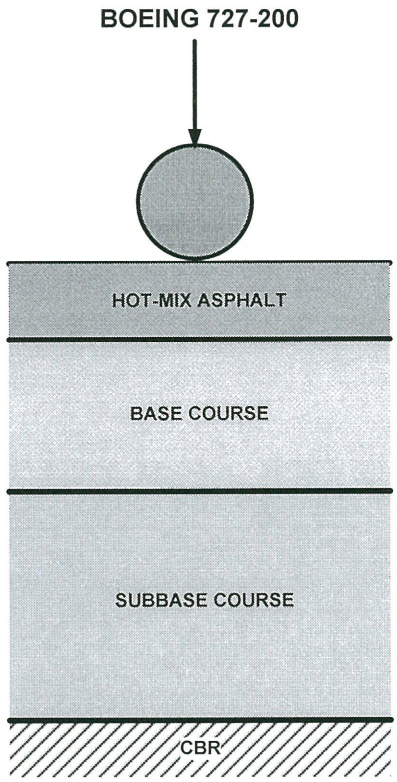

FIGURE Q3 (a): Pavement structure for Boeing 727-200

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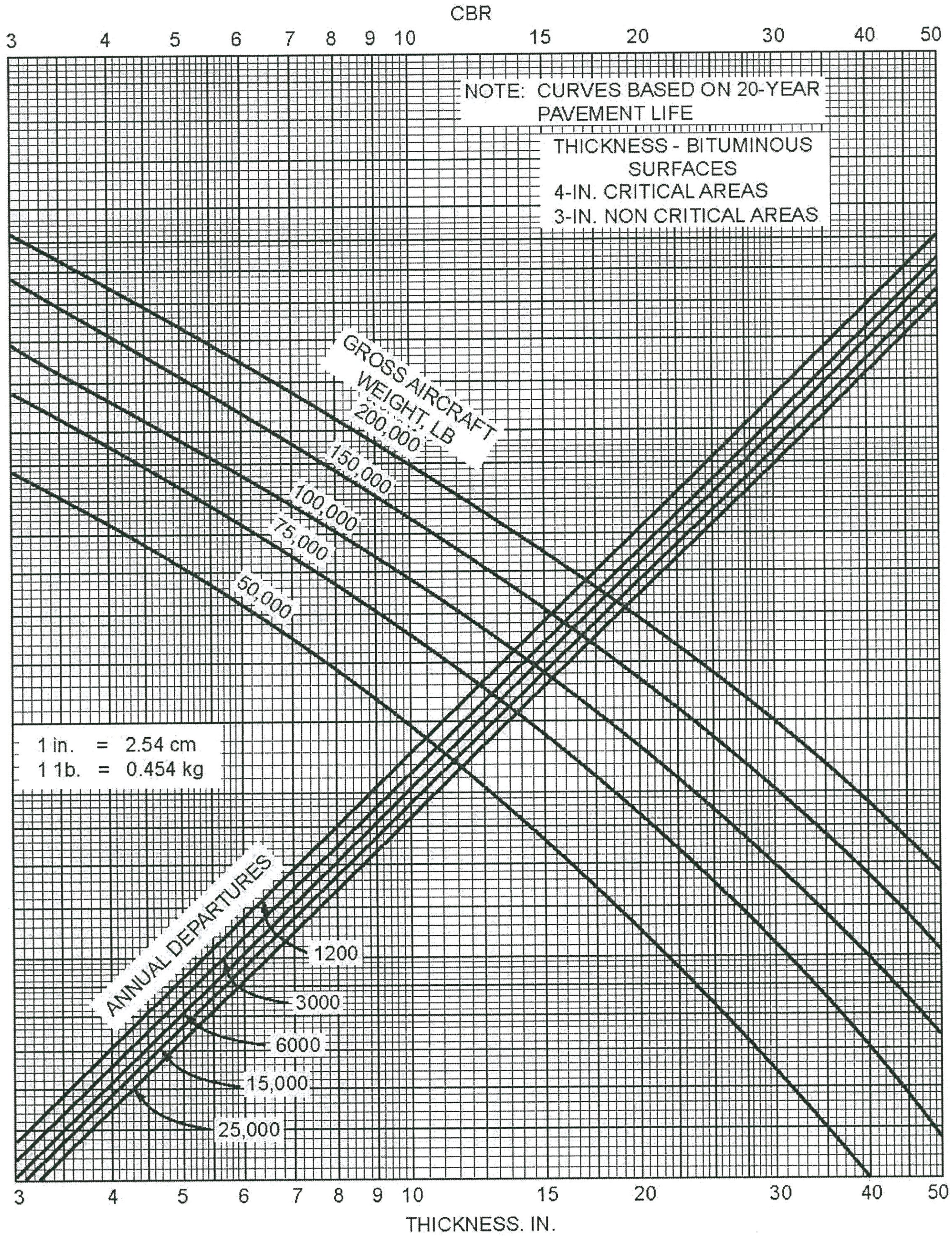

FIGURE Q3 (b): Graph of flexible pavement thickness for dual-wheel gear

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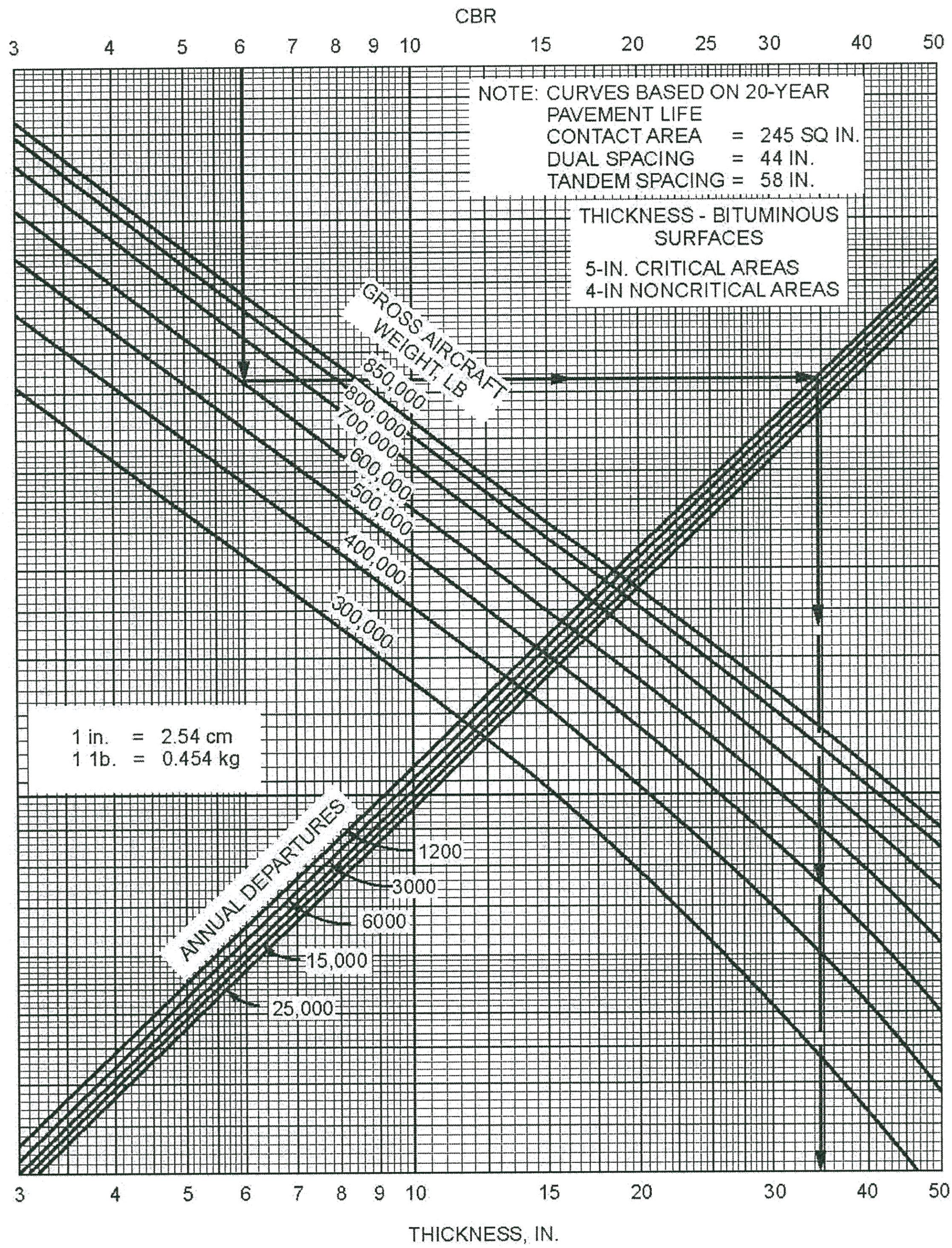

FIGURE Q3 (c): Graph of flexible pavement thickness for Boeing 747-100

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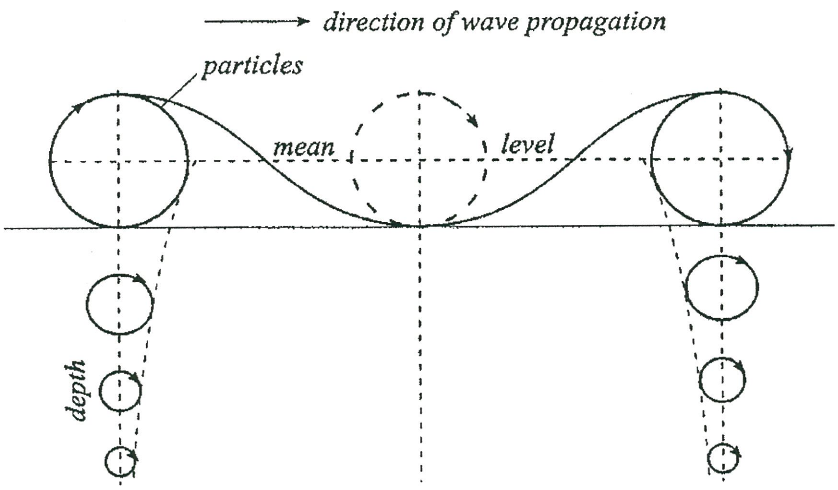

FIGURE Q4 (a): Large depth/Short wave

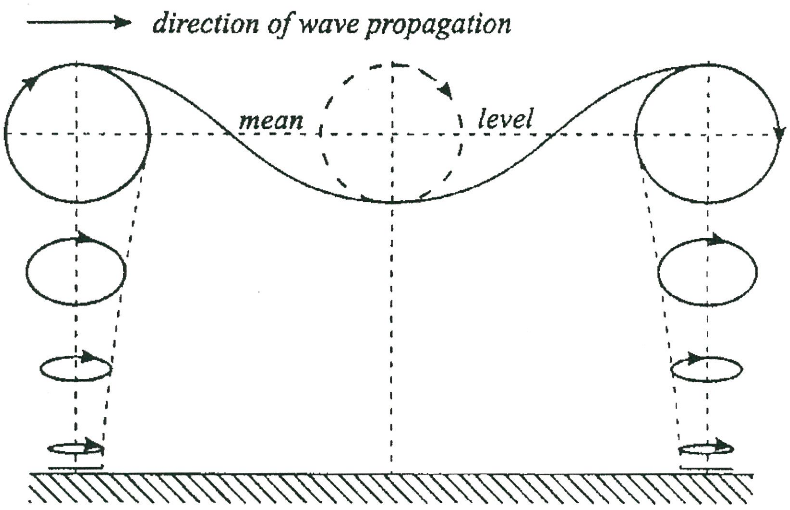

FIGURE Q4 (b): Small depth/Long wave

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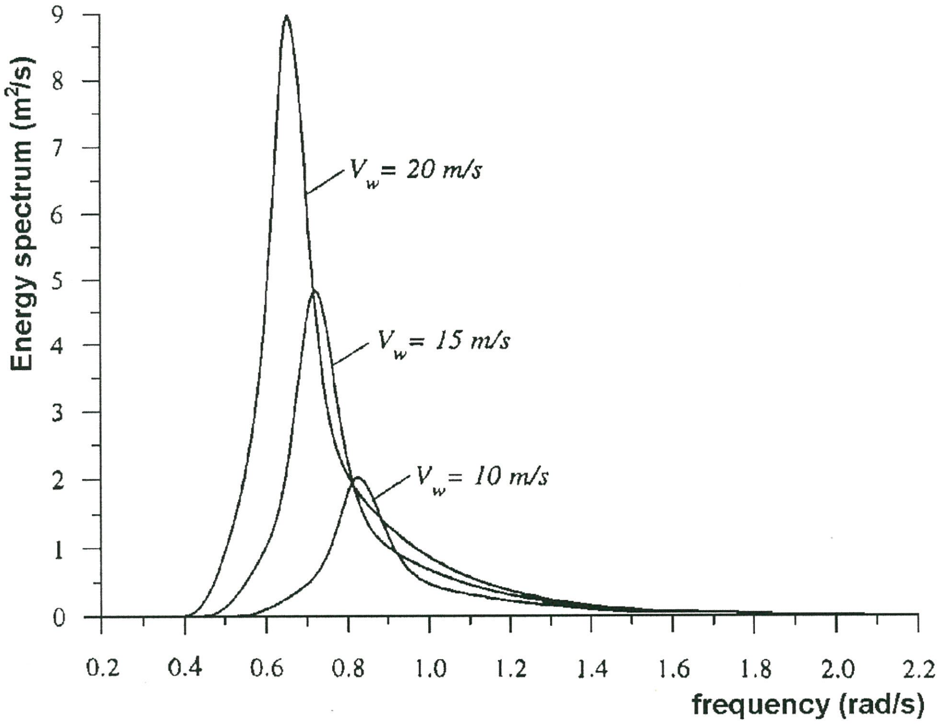

FIGURE Q4 (c): Wind speed – frequency – energy data

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TABLE 1: Gradient of the construction plan

Station to Station	Gradient (%)
0 – 300	0.5
300 – 900	-0.3
900 – 1500	1.2
1500 – 1800	-07
1800 – 2100	-0.3

TABLE 2: Data average annual departures and maximum take-off weight of each aircraft

Aircraft	Gear type	Average annual departures	Max Take-Off Weight (lb)
727-200	Dual	9100	190,500
737-200	Dual	2650	115,500
747-100	Double dual tandem	80	700,000

TABLE 3: Conversion factors for converting from one aircraft type to another

To convert from	To	Multiply departures by
Single wheel	Dual wheel	0.8
Single wheel	Dual tandem	0.5
Dual wheel	Single wheel	1.3
Dual wheel	Dual tandem	0.6
Dual tandem	Single wheel	2.0
Dual tandem	Dual wheel	1.7
Double dual tandem	Dual tandem	1.0
Double dual tandem	Dual wheel	1.7

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FORMULAS:

$$R = \frac{1750}{D}$$

$$SE = \frac{GV^2}{127R}$$

$$V = \sqrt{\frac{(C_a + C_d) \times R}{13.76}}$$

$$2\pi R = (360/D) \times 100.007$$

$$LD = FL = TOD$$

$$LD = 1.667 * SD$$

$$TOD_{normal} = D35 * 1.15$$

$$T = T_1 + \frac{(T_2 - T_1)}{3}$$

$$Wheel\ load = 95\% \frac{maximum\ take-off\ weight}{number\ of\ wheels\ on\ landing\ gears}$$

$$\log R_1 = \left(\frac{W_2}{W_1}\right)^{\frac{1}{2}} \log R_2$$

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$$\omega = \sqrt{gk \tanh(kH)}$$

$$c = \frac{\omega}{k} = \sqrt{\frac{g}{k} \tanh(kH)}$$

$kH >> 1$ then $\tanh kH \approx 1$

$$\omega = \sqrt{gk} \quad , \quad c = \sqrt{\frac{g}{k}} = \sqrt{\frac{g\lambda}{2\pi}}$$

$kH << 1$ then $\tanh kH \approx kH$

$$\omega = \sqrt{gH}k \quad , \quad c = \sqrt{gH}$$

$$h_s = 0.0016\, V_W \sqrt{\frac{F}{g}}$$

$$T = 0.286\left(\frac{V_W F}{g^2}\right)^{\frac{1}{3}}$$