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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2014/2015

COURSE NAME	:	TRANSPORTATION ENGINEERING
COURSE CODE	:	BFT 40303
PROGRAMME	:	4 BFF
DATE	:	DECEMBER 2014/JANUARY 2015
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

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

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Q1 Local Government is planning to develop a Port in Johor by using the general standard of design port as can be seen in Figure **Q1**. The Port is designed for Bulk Cargo ships of 200,000 tonnages D.W.T. as presented in Table **1**. The Bulk Cargo Port will be operated with four (4) ships per day (loading and unloading). The surrounding waves and winds at harbor are considered calm. Based on all information above

(a) Determine and sketch the width of entrance, stopping distance and turning area (with tug boats) of the ships (8 marks)

(b) Determine and sketch anchorage area and berthing area (pier berth) (10 marks)

(c) Determine and sketch the channel width for two ships parallel and the components of water depth (7 marks)

Q2 Local Air Transport authority is constructing Runway pavement design based on the following data. The average annual departures and maximum take-off weight of each aircraft can be seen in Table **2**. The runway pavement will be constructed using flexible pavement with three layers: Hot-mix asphalt, Base course and Sub-base course (Figure **Q2(a)**). CBR Subgrade is 10% and CBR for Sub-base is 30%. It is assumed that total load on assembly is 358,000 lb with contact pressure of 150 lb/in^2 and the maximum ESWL at a depth equal to 3 times radius of contact area (3r = 25.8 in) and tire contact area, A is 232 in^2. The dual-in-tandem systems is in Figure **Q2(b)** and Aircraft Traffic Volume Factor = 10. Based on all information above

(a) Determine the maximum deflection (at which point) (10 marks)

(b) Determine the thickness of each layer by using Figure **Q2(c)** and Figure **Q2(d)** (15 marks)

Q3 Local Government of Johor is planning to construct a railway track along Batu Pahat to Johor Baharu for train with *maximum speed* of 100 km/hr. The rail loading concepts can be seen at Figure **Q3**. Train axle load = 18 tonnage and stiffness modulus, $k = 170.5$ kg/cm^2. It is planned to use rail with elasticity modulus is 2×10^6 kg/cm^2 and inertia moment is 2346 cm^4. Based on above information and using Talbot equations, you are asked to:

(a) Determine *load components* (P and λ).

(2 marks)

(b) Determine rail maximum moment of rail, M.

(5 marks)

(c) Determine maximum deflection of rail (at loading point P), Y.

(4 marks)

(d) Determine deflection of rail 2.65 meters from loading point, $Y_{2.65}$

(4 marks)

(e) Determine *Modulus of Track Elasticity*, u (AREMA) if tie spacing is 55 cm.

(3 marks)

(f) Determine *Unit Track of Deflection*

(3 marks)

(g) Determine *Rail Seat Load*, Q

(2 marks)

(h) Determine unit load on ballast, Pa

(2 marks)

Q4 Local Water Transport Authority is planned to make a type of Fender at Port in Johor. The Port will facilitate for maximum size of ships as Containers Ships with 50,000 D.W.T. with characteristic in Table **3**. The Navigation condition systems are Easy Docking: Exposed. Based on all data collected,

(a) Determine the approach velocity of the ship at the moment of impact with the fender, V (m/sec)

(3 marks)

(b) Determine Eccentricity Factor, Ce at the Typical Seawater with a=0.25L

(8 marks)

(c) Determine Virtual Mass Coefficient, Cm

(3 marks)

(d) Determine Energy to be absorbed by the Fender system with softening effect, Cs=1.0 and cushion effect, Cc=0.8

(8 marks)

(e) Explain briefly the suitable type of Fender for the Port (Table **4**)

(3 marks)

- END OF QUESTIONS -

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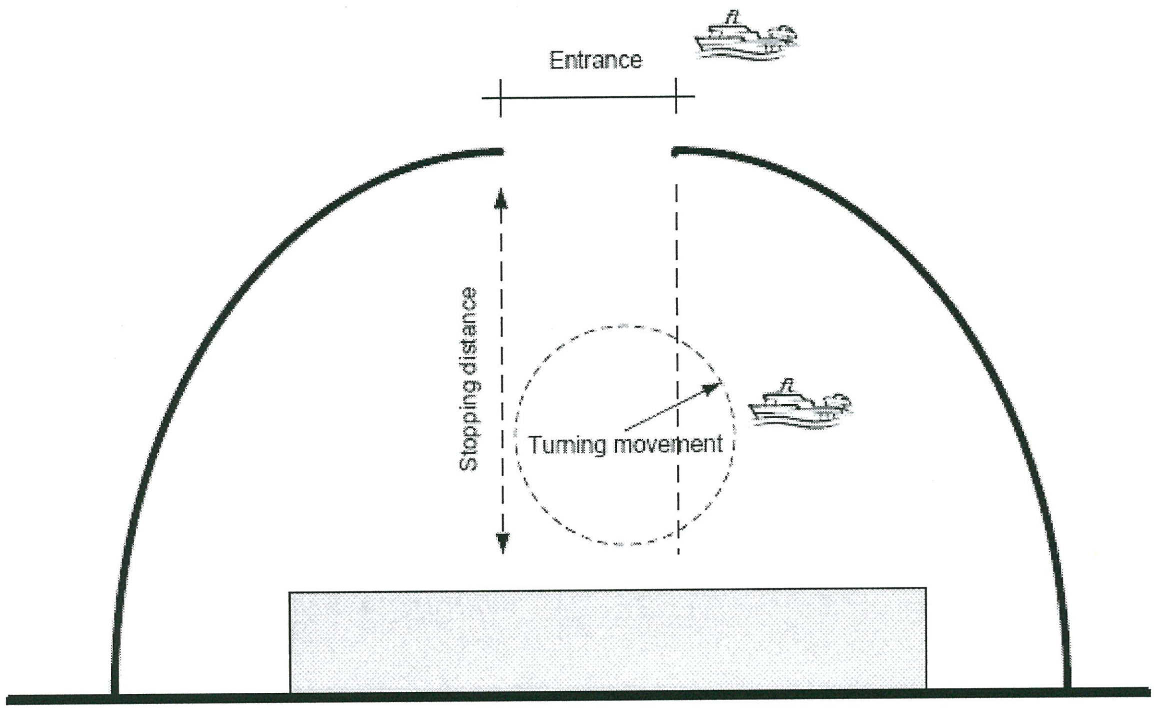

FIGURE Q1: Sketch of Port Design Standard

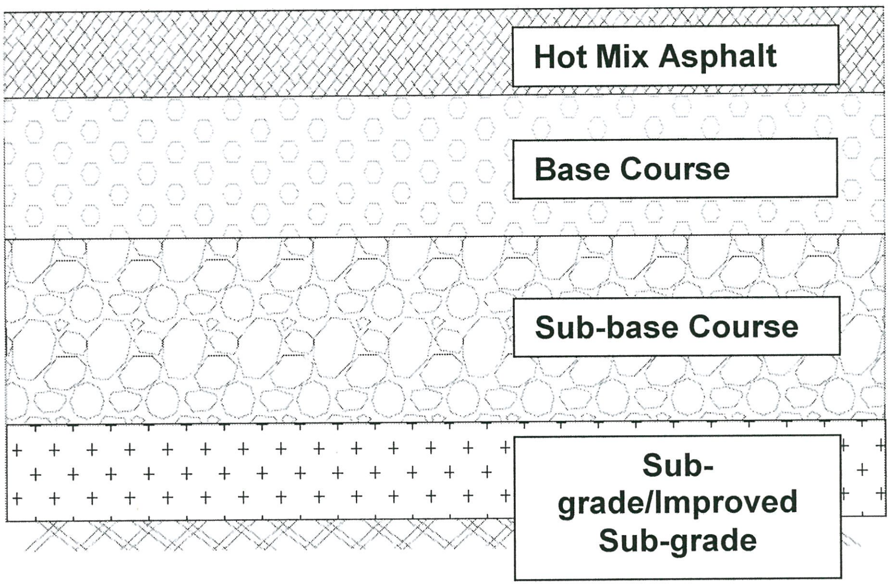

FIGURE Q2(a): Airport Runway Layers

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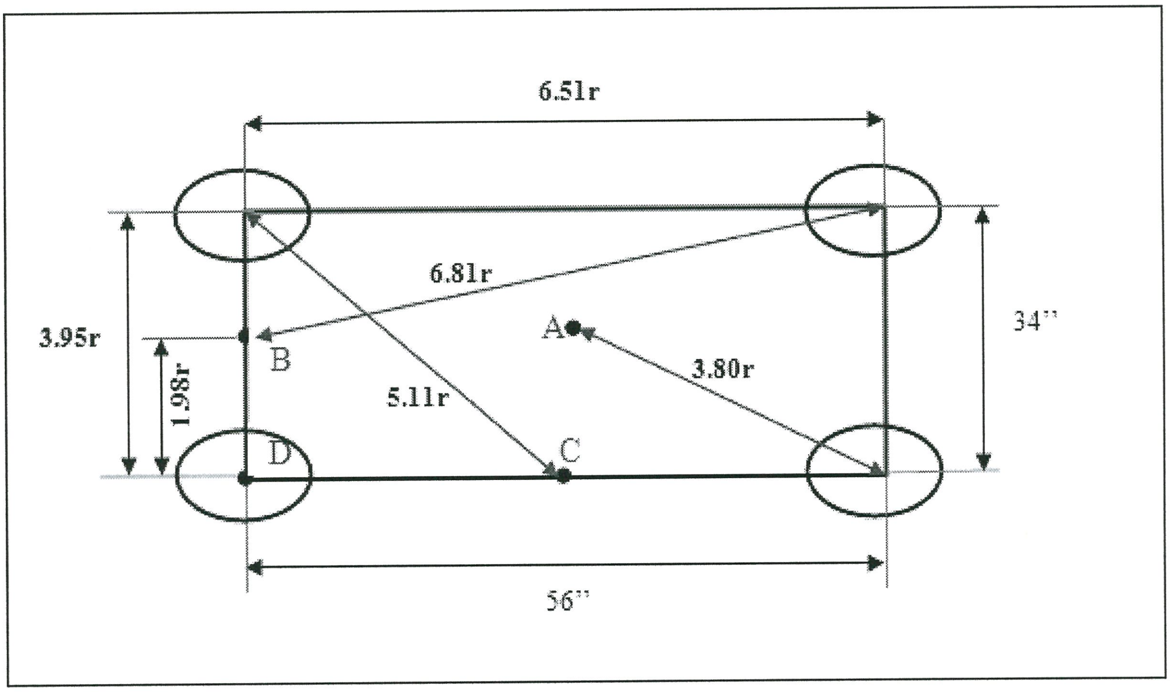

FIGURE Q2(b): Dual-in-Tandem - Reanalysis

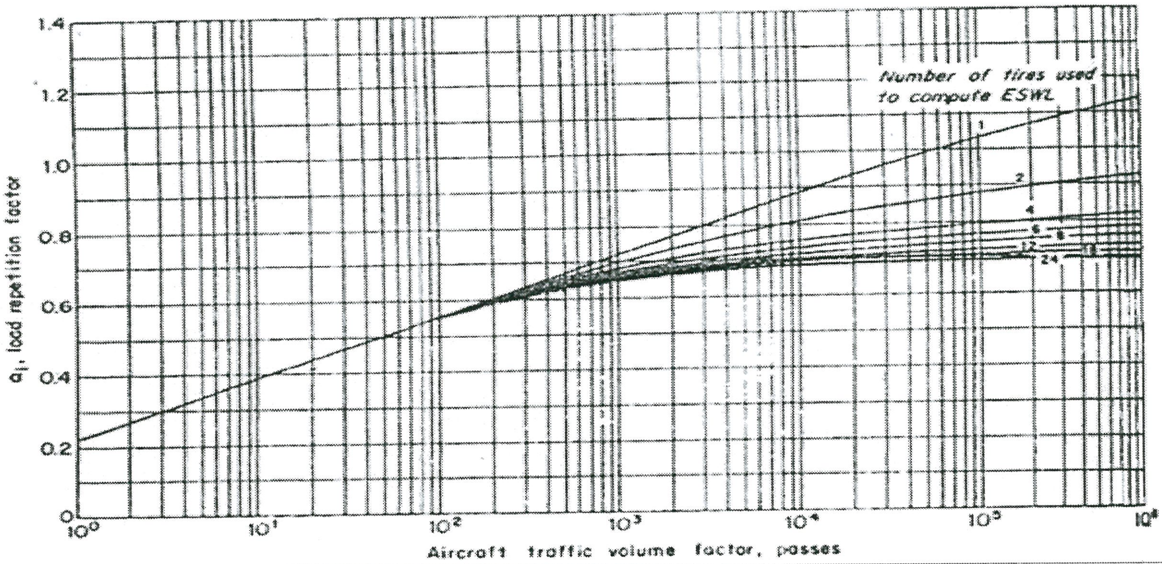

FIGURE Q2(c): Composite Plot of Load Repetition Factors versus Passes

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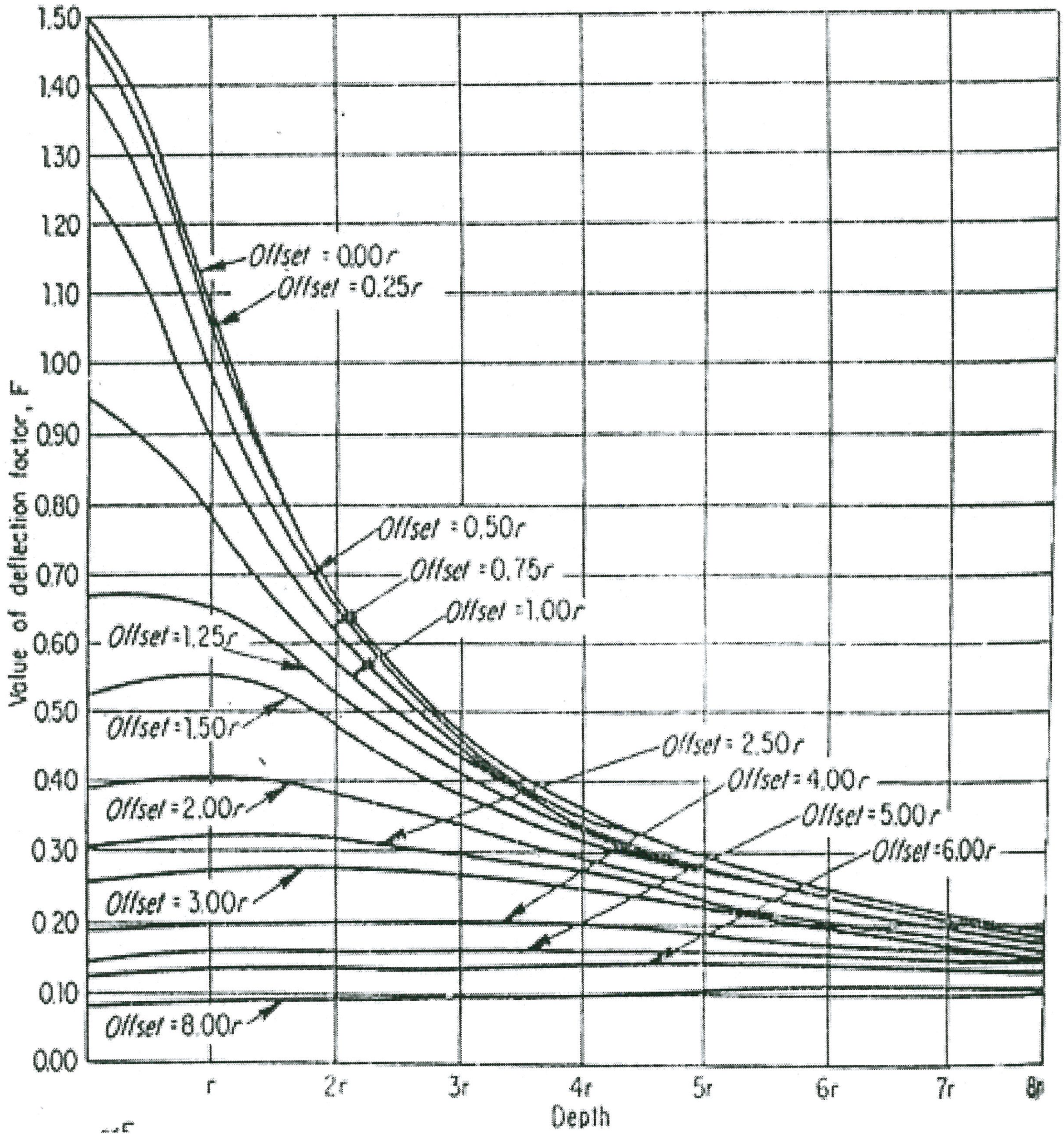

FIGURE Q2(d): Deflection Factor F for Uniform Load of Radius r

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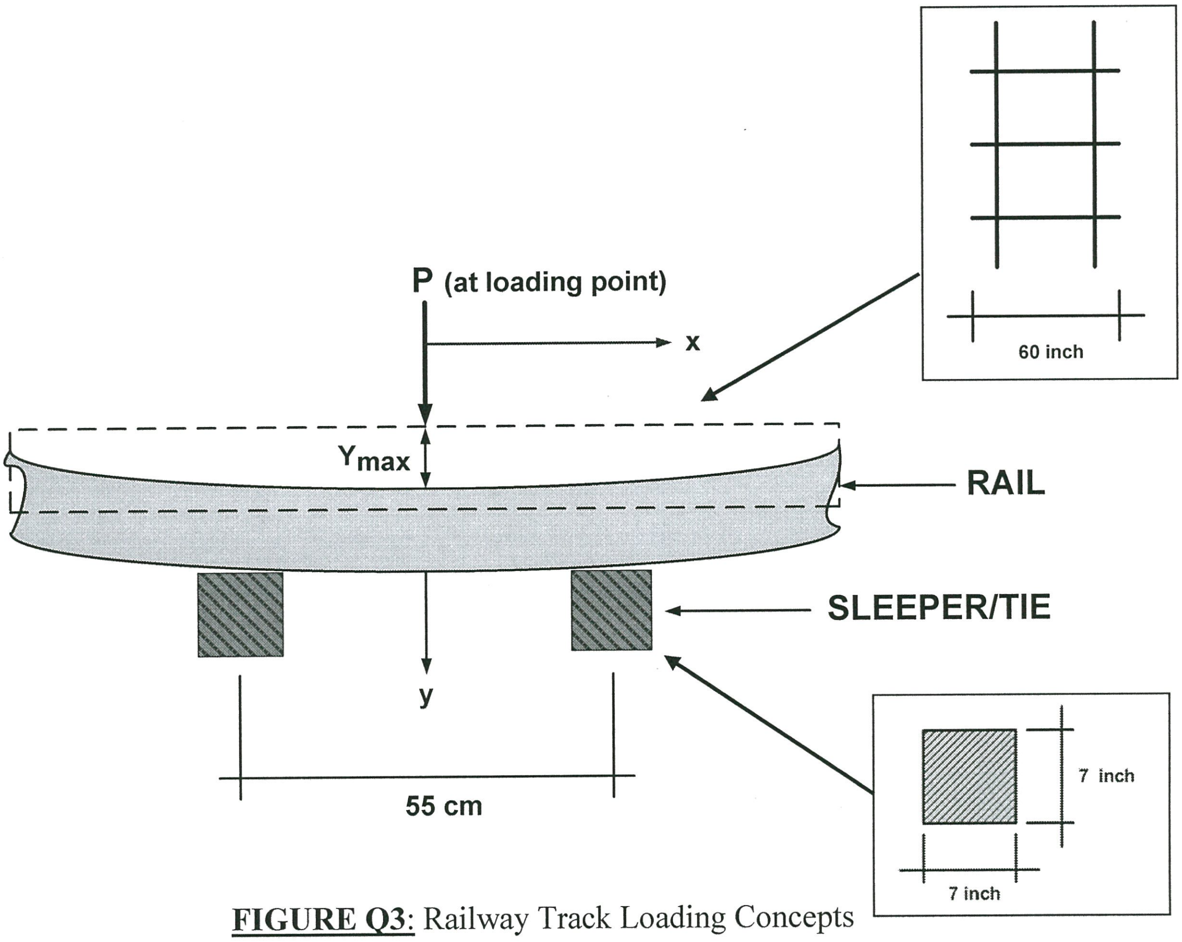

FIGURE Q3: Railway Track Loading Concepts

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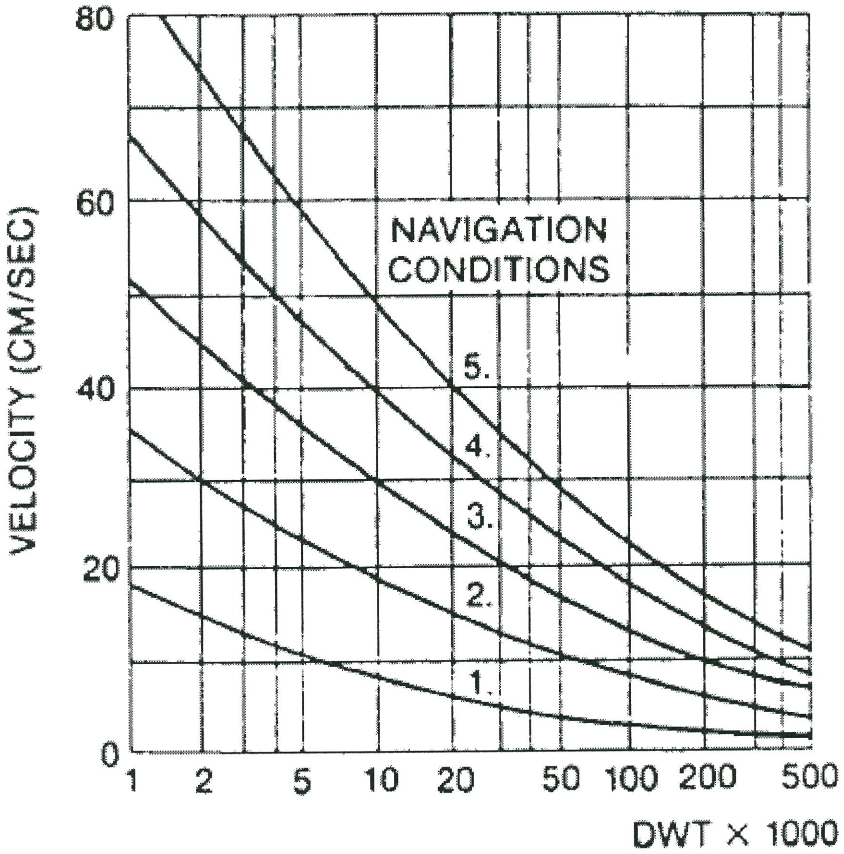

Navigation Conditions:

1. Easy Docking: Sheltered
2. Difficult Docking: Sheltered
3. Easy Docking: Exposed
4. Good Docking: Exposed
5. Difficult Docking: Exposed

FIGURE Q4: D.W.T. versus Ships Velocity based on Navigation Conditions

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TABLE 1: Dimensions of Various Types of Ships (Port Engineering, 1999)

Type	GRT	DWT	DT	Overall length	Beam width	Moulded depth	Max. draft
	ton	ton	ton	m	m	m	m.
Bulk cargo (oil, ore)		400000	460000	392	66.0	29.0	24.0
		300000	356000	364	59.5	27.0	22.0
		200000	240000	345	51.0	25.0	19.5
		100000	125000	280	41.0	21.0	15.0
		50000	60000	225	32.0	16.5	12.0
		15000	20000	165	21.0	12.0	9.5
Container		50000	73500	290	32.4		13.0
		42000	61000	285	32.3		12.0
		30000	41500	220	31.0		11.3
		20000	27000	198	28.7		10.0
		10000	13500	159	23.5		8.0
Mixed cargo (on deck)	10000	15000	20000	165	21.5	12.0	9.5
	7000	10000	14000	145	20.0	11.5	8.5
	4000	6000	8000	125	16.5	9.5	7.5
	1000	1500	2000	70	10.0	5.1	4.3
	500	700	1000	55	8.5	4.5	3.8

TABLE 2: Average Annual Departures and Maximum Take-off Weight

Aircraft	Gear Type	Average Annual Departures	Maximum Take-Off Weight (lb)
B-747-100	Double Dual Tandem	30.52	750,000
B-747-400	Two Dual Wheels in Tandem	166.8	800,000
B-737-200	Dual	3404	115,500
B-767-200	Two Dual Wheel in Tandem	3227	300,000
B-777-200	Three Dual Wheel in Tandem	7635.1	506,000

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TABLE 3: Vessel Dimension and Typical Energy Requirments

Tonnage (D.W.T.)	Length (m)	Width (m)	Height (m)	Loaded Draft (m)	Displacement Tonnage (DT)	Virtual Mass Coefficient	Berthing Energy (Tonne-M)*
10,000	175	25.6	15.8	9.8	14,030	1.96	15.77
20,000	200	27.3	16.8	10.4	27,940	1.62	25.95
25,000	213	30.1	16.3	10.5	34,860	1.54	30.78
30,000	290	32.0	19.8	10.3	41,740	1.60	38.29
35,000	265	32.8	20.5	11.6	48,600	1.59	44.31
40,000	279	32.5	22.8	11.0	55,430	1.49	47.36
50,000	290	32.4	24.2	11.3	69,000	1.43	56.58

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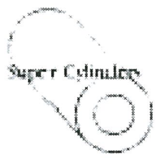
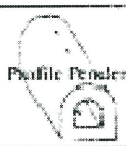
TABLE 4: Fender Types with Energy Range

ENERGY RANGE (Tonne-m)	FENDER TYPE	FEATURES	BENEFITS	RESTRICTIONS	REF. PAGE
50 & Larger (>50)	 Epshield V-Flex	A high efficiency fender which features rubber encapsulated steel mounting plates in its base. Rubber covered, slotted bolt holes are included. Available in a range of standard sizes and lengths.	High energy absorption capacity is obtained while minimizing the reaction load. No exposed metal and a secure mounting ensure low maintenance and a durable installation. Easily installed and the range of available lengths will fit most designs.	There are length restrictions.	
20 to 50 (20-50)	Epshield V-Flex	SEE ABOVE			
	 Super Cylinder	Good performance characteristics are achieved. Fender can roll for even wear. It is available in a wide selection of sizes.	Allows a wide range of ship sizes to use the pier. It is durable and easily accessible for maintenance or replacement.	Require large stand off distances. Exposed mounting hardware.	
	 Large Profile Fenders	Easily adaptable to specific mounting requirements.	These low initial cost fenders are well suited for parallel berthing in well protected conditions.	Mounting hardware is exposed.	
10 to 20 (10-20)	Epshield V-Flex	SEE ABOVE			
	Large Profile Fenders	SEE ABOVE			
	 Buckling Columns	Rubber encapsulated steel support plates. Good performance characteristics are achieved.	Excellent durability with no exposed metals. Mounted behind a protective fender pile system.	Cannot be used for direct contact.	
0 to 10 (0-10)	 Profile Fenders	A large selection of shapes and sizes.	Economical protection against wharf face damage.	Mounting hardware is exposed.	

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FORMULAS:

Port design:

$$(0.7{\sim}1.0)L$$

$$(7{\sim}8)L' \quad 2L$$

$$L + (0.2{\sim}0.5)L' \quad (0.5{\sim}1.0)L$$

$$2 \times \mathrm{B_{max}} + 30 \text{ meters}$$

$$(6.2{\sim}9.0)B$$

Airport design:

$$\frac{P_s}{P_d} = \frac{F_s}{F_d}$$

$$ESWL = Entire\ Assembly\ \times Total\ Load$$

$$Pavement\ thickness, t = \alpha_i \sqrt{\frac{ESWL}{8.1\ (CBR)} - \frac{A}{\pi}}$$

Railway design:

$$P_d = P_s \left[1 + 0.01\left(\frac{v}{1{,}609} - 5\right)\right]$$

$$\lambda = \left(\frac{k}{4EI}\right)^{\frac{1}{4}}$$

$$M_m = \frac{P_d}{4\lambda}$$

$$y(max) = \frac{P\ \lambda}{2\ k}$$

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$$y_x = \frac{P\lambda}{2\,k}\, e^{-\lambda x}\,(\cos\lambda x + \sin\lambda x)$$

$$u = \frac{P}{S}$$

$$u = \frac{P}{\Delta}$$

$$Q = 0.391\, P\, \frac{S}{x_1}$$

$$x_1 = \left(\frac{\pi}{4}\right)\left(\frac{4EI}{u}\right)^{\frac{1}{4}}$$

$$p_a = \frac{3Q_0}{Lb}$$

Fender design:

$$E_{Fender} = E_{ship} \times C_e \times C_m \times C_s \times C_c = \frac{1}{2} MV^2 \times C_e \times C_m \times C_s \times C_c$$

$$C_e = \frac{K^2}{a^2 + K^2}$$

$$K = (0.19\, C_b + 0.11) \times L$$

$$C_b = \frac{DT}{D \times B \times L \times W_o}$$

$$C_m = 1 + \frac{\pi}{4C_b} \times \frac{D}{B}$$

$$M = \frac{DT}{g}$$