Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	TRANSPORTATION ENGINEERING
COURSE CODE	:	BFT 40303
PROGRAMME	:	BACHELOR OF CIVIL ENGINEERING WITH HONOURS
DATE OF EXAMINATION	:	JUNE 2015 / JULY 2015
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FIFTEEN (15)** PAGES

Q1 The local authority in Batu Pahat is planning to construct an airport for standard aircraft of Boeing 727-200 (design aircraft). The following **Table 1** gives the average annual departures and maximum take-off weight of each aircraft type expected to use the airport pavement. **Table 2** shows conversion factors for converting from one aircraft (landing gear) type to another. The airport will be designed using three layers: Hotmix-asphalt, Base- course and Sub-base course (CBR 25%) with CBR Sub-grade of 6% (**FIGURE Q1(a)**). Based on current situation

(a) Determine Equivalent Dual-Gear Departures, Wheel load and Equivalent Annual Departures for Design Aircraft (each of aircraft)

(15 marks)

(b) Determine the total thickness of pavement and thickness of each layer (using **FIGURE Q1(b)** and **FIGURE Q1(c)**)

(10 marks)

Q2 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 40,000 D.W.T. with characteristic in **Table 3**. It is known that the water density is 1.025 tonnes/m^3. The Navigation condition systems are *Difficult Docking*: Exposed. Based on all data collection

(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, at the Typical Seawater with a = 0.25L

(8 marks)

(c) Determine Virtual Mass Coefficient

(3 marks)

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

(8 marks)

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

(3 marks)

Q3 Local Air Transport authority is constructing Runway pavement design based on the following data. The runway pavement will be constructed using flexible pavement with three layers: Hot-mix asphalt, Base-course and Sub-base course (**FIGURE Q3(a)**). CBR Sub-grade is 8% and CBR for Sub-base is 25%. It is assumed that total load on assembly is 358,000 lb with contact pressure of 150 lb/in^2 (1 lb = 0.453592) and the maximum ESWL at a depth equal to 3 times radius of contact area (3r = 25.8 in) and tire contact area is 232 in^2 (1 inch = 2.54 cm). The dual-in-tandem systems is in **FIGURE Q3(b)** and Aircraft Traffic Volume Factor = 100. Based on all information above

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

(10 marks)

(b) Determine the thickness of each layer

(15 marks)

Q4 Railway transport is one of the transport modes. You are asked to construct a railway class-II track with maximum speed of 112 km/h. Locomotive axle load = 18 tonnage with stiffness modulus of 180 kg/cm^2 and the rail type *R.54* with elasticity modulus = 2 x 106 kg/cm^2 and inertia moment is 2346 cm^4. Based on the above information, you are asked to answer the following questions:

(a) Explain briefly railway loading design concepts

(3 marks)

(b) Explain briefly the concept of beam-on-elastic-foundation model. Complete your explanations with the sketches of moments, shear force and deflection

(3 marks)

(c) Determine load components and the maximum moment.

(5 marks)

(d) Determine the deflection and shear force at 3.50 meters from the center load.

(4 marks)

(e) Determine the slope at 2.50 meters from the center load.

(4 marks)

(f) Determine Modulus Track Elasticity with tie spacing 55 cm

(3 marks)

(g) Determine Rail Seat Load

(3 marks)

- **END OF QUESTION –**

FINAL EXAMINATION

SEMESTER/SESSION	:	II/ 2014/2015	PROGRAME	:	4 BFF
COURSE NAME	:	TRANSPORTATION ENGINEERING	COURSE CODE	:	BFT 40303

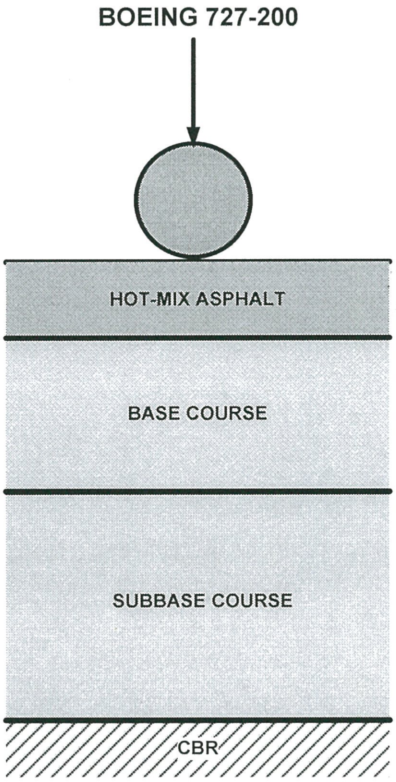


FIGURE Q1(a): Pavement structure for Boeing 727-200

FINAL EXAMINATION

SEMESTER/SESSION	:	II/ 2014/2015	PROGRAME	:	4 BFF
COURSE NAME	:	TRANSPORTATION ENGINEERING	COURSE CODE	:	BFT 40303

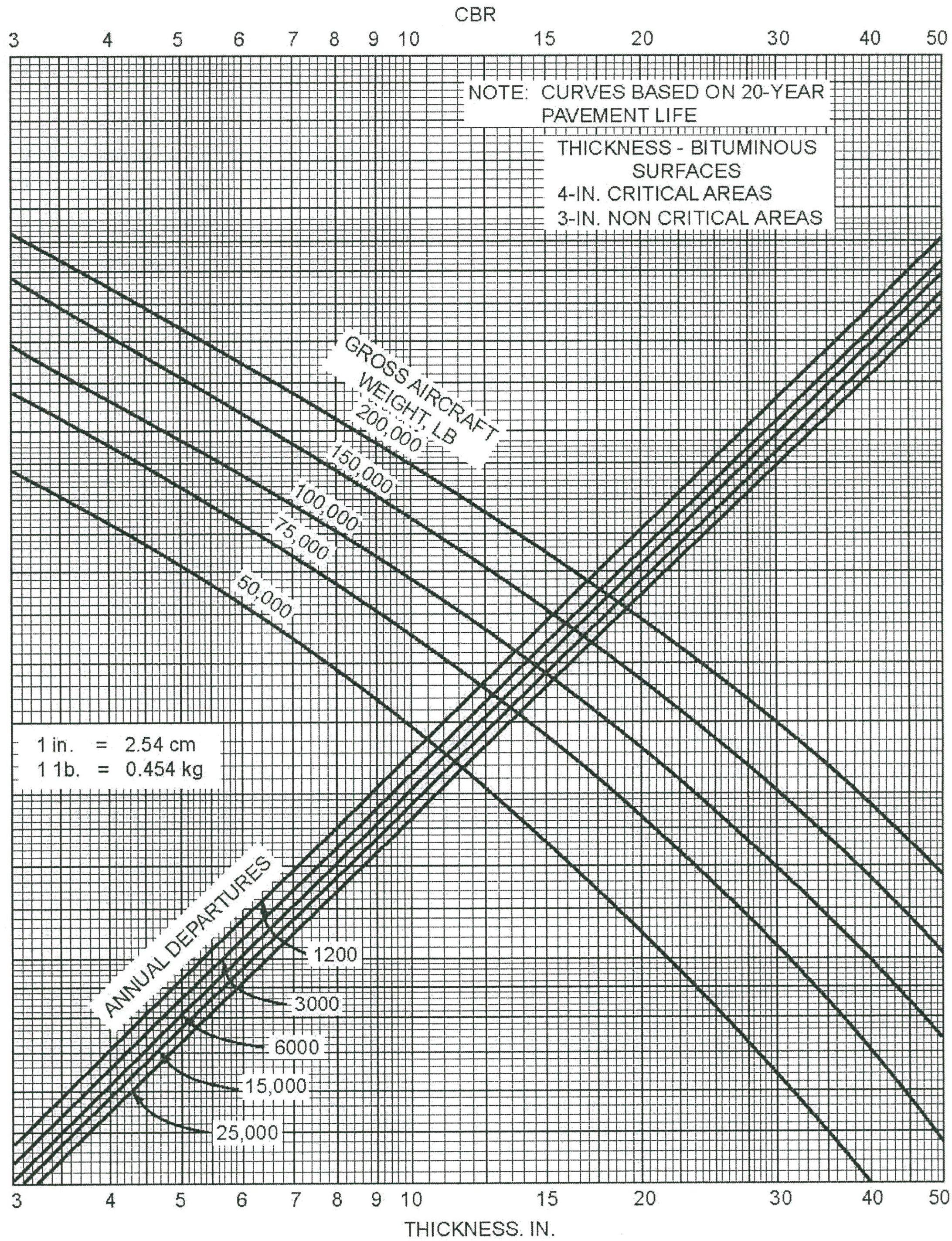


FIGURE Q1(b): Graph of flexible pavement thickness for dual-wheel gear

FINAL EXAMINATION

SEMESTER/SESSION	:	II/ 2014/2015	PROGRAME	:	4 BFF
COURSE NAME	:	TRANSPORTATION ENGINEERING	COURSE CODE	:	BFT 40303

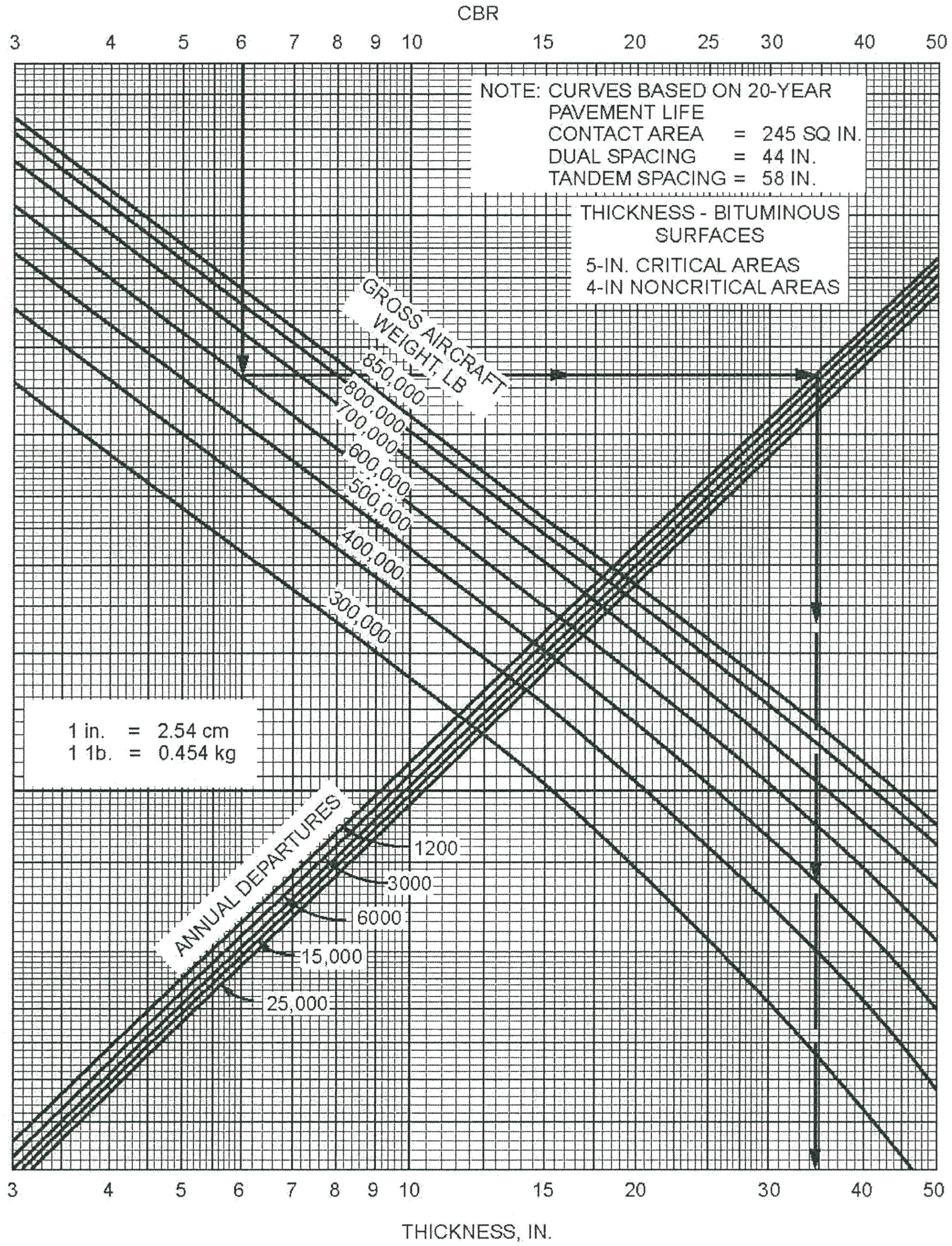
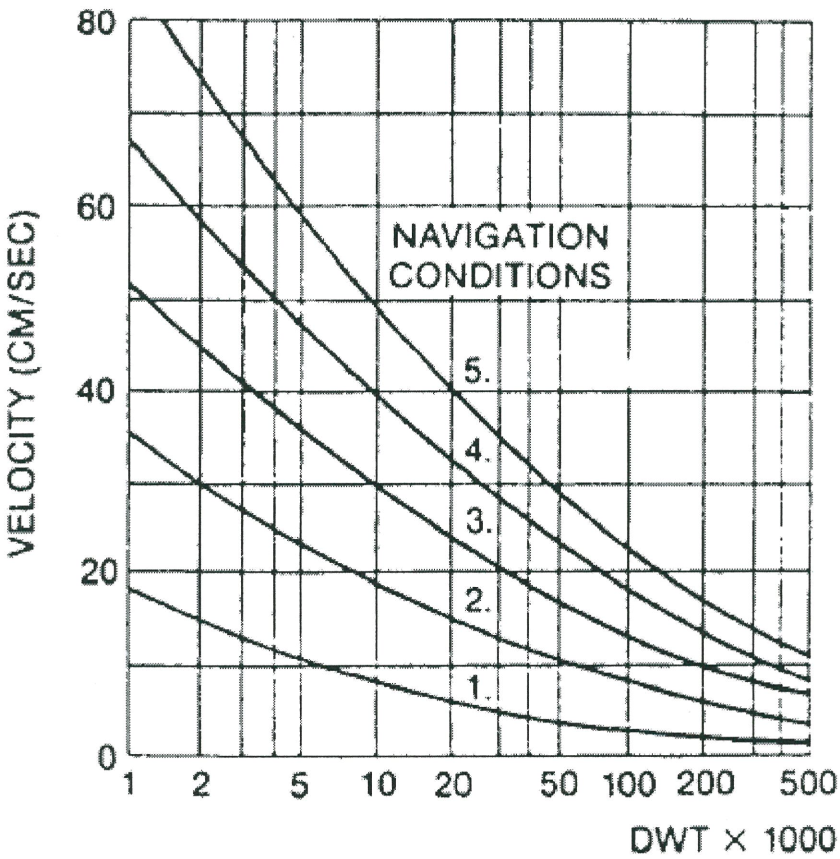


FIGURE Q1(c): Graph of flexible pavement thickness for Boeing 747-100

FINAL EXAMINATION

SEMESTER/SESSION	:	II/ 2014/2015	PROGRAME	:	4 BFF
COURSE NAME	:	TRANSPORTATION ENGINEERING	COURSE CODE	:	BFT 40303



<u>Navigation Conditions:</u>

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

<u>FIGURE Q2</u>: D.W.T. versus Ships Velocity based on Navigation Conditions

FINAL EXAMINATION

SEMESTER/SESSION	:	II/ 2014/2015	PROGRAME	:	4 BFF
COURSE NAME	:	TRANSPORTATION ENGINEERING	COURSE CODE	:	BFT 40303

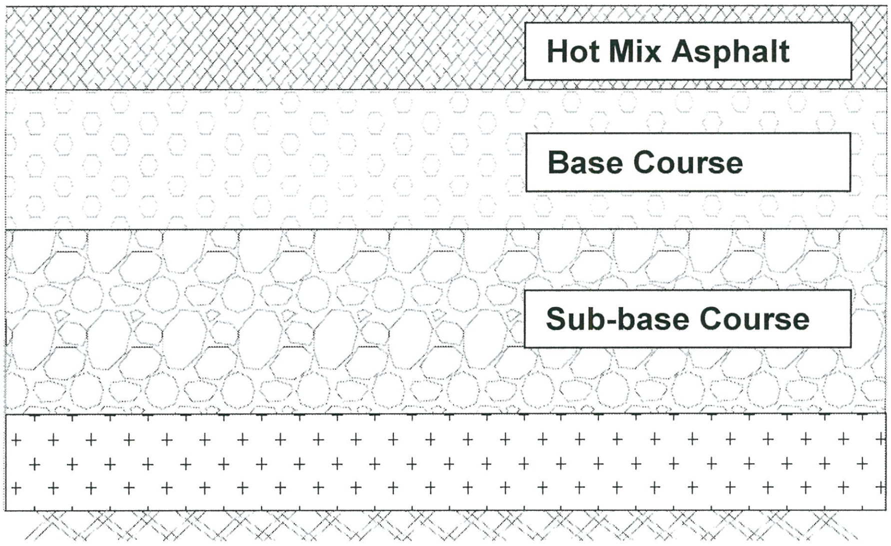


FIGURE Q3(a): Airport Runway Layers

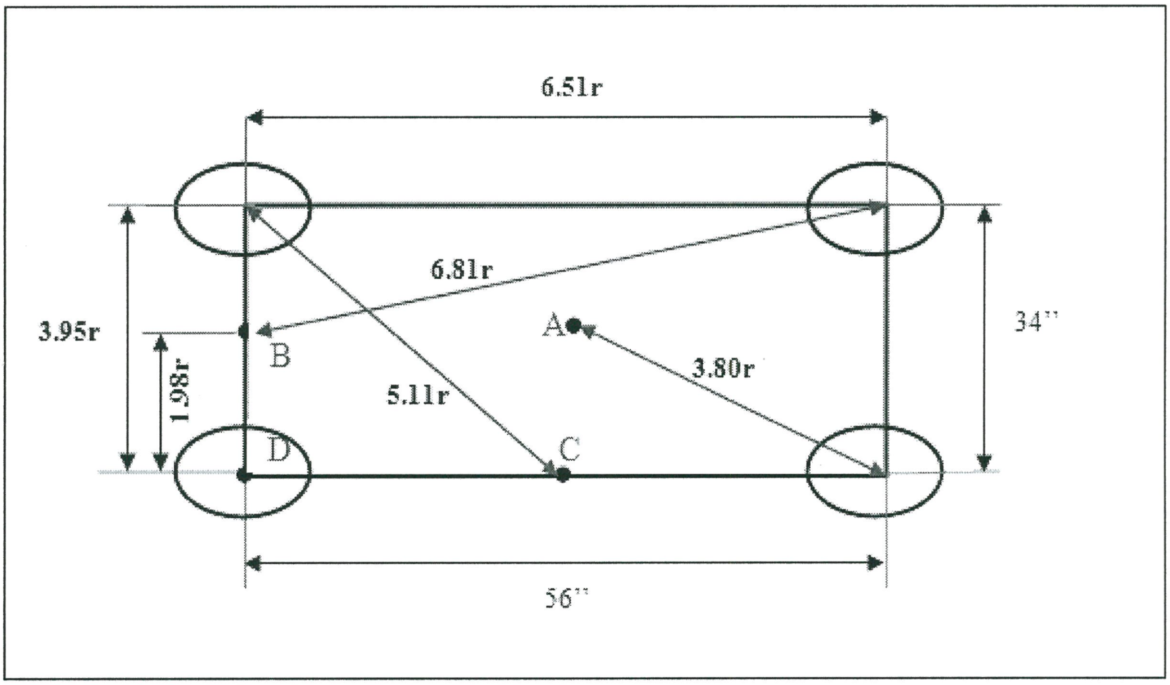


FIGURE Q3(b): Dual-in-Tandem – Reanalysis

FINAL EXAMINATION

SEMESTER/SESSION	:	II/ 2014/2015	PROGRAME	:	4 BFF
COURSE NAME	:	TRANSPORTATION ENGINEERING	COURSE CODE	:	BFT 40303

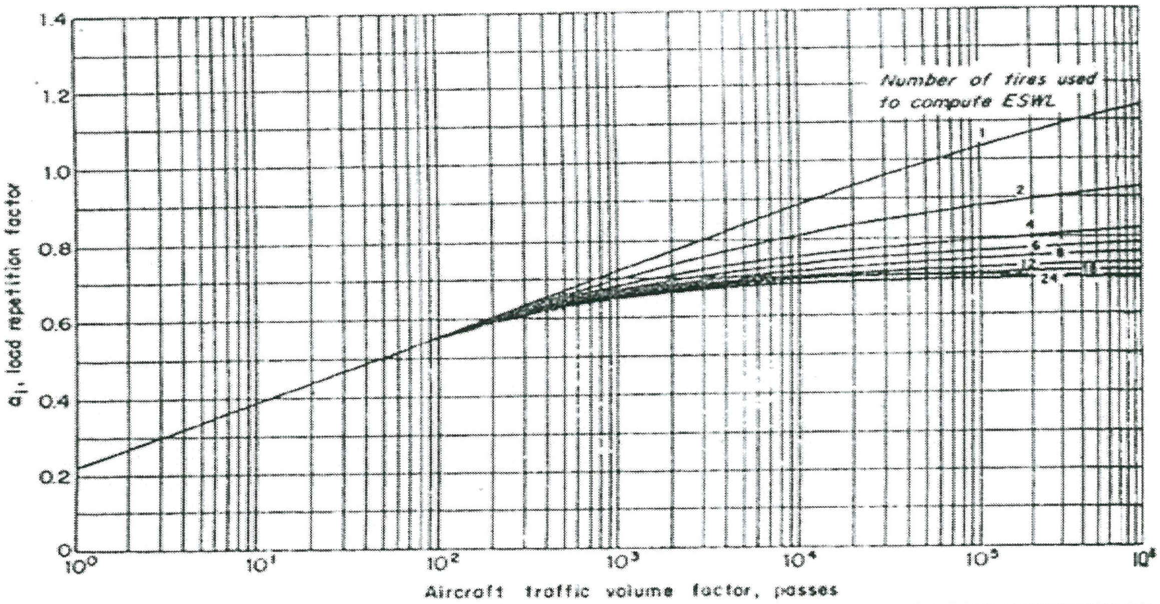


FIGURE Q3(c): Composite Plot of Load Repetition Factors versus Passes

FINAL EXAMINATION

SEMESTER/SESSION	:	II/ 2014/2015	PROGRAME	:	4 BFF
COURSE NAME	:	TRANSPORTATION ENGINEERING	COURSE CODE	:	BFT 40303

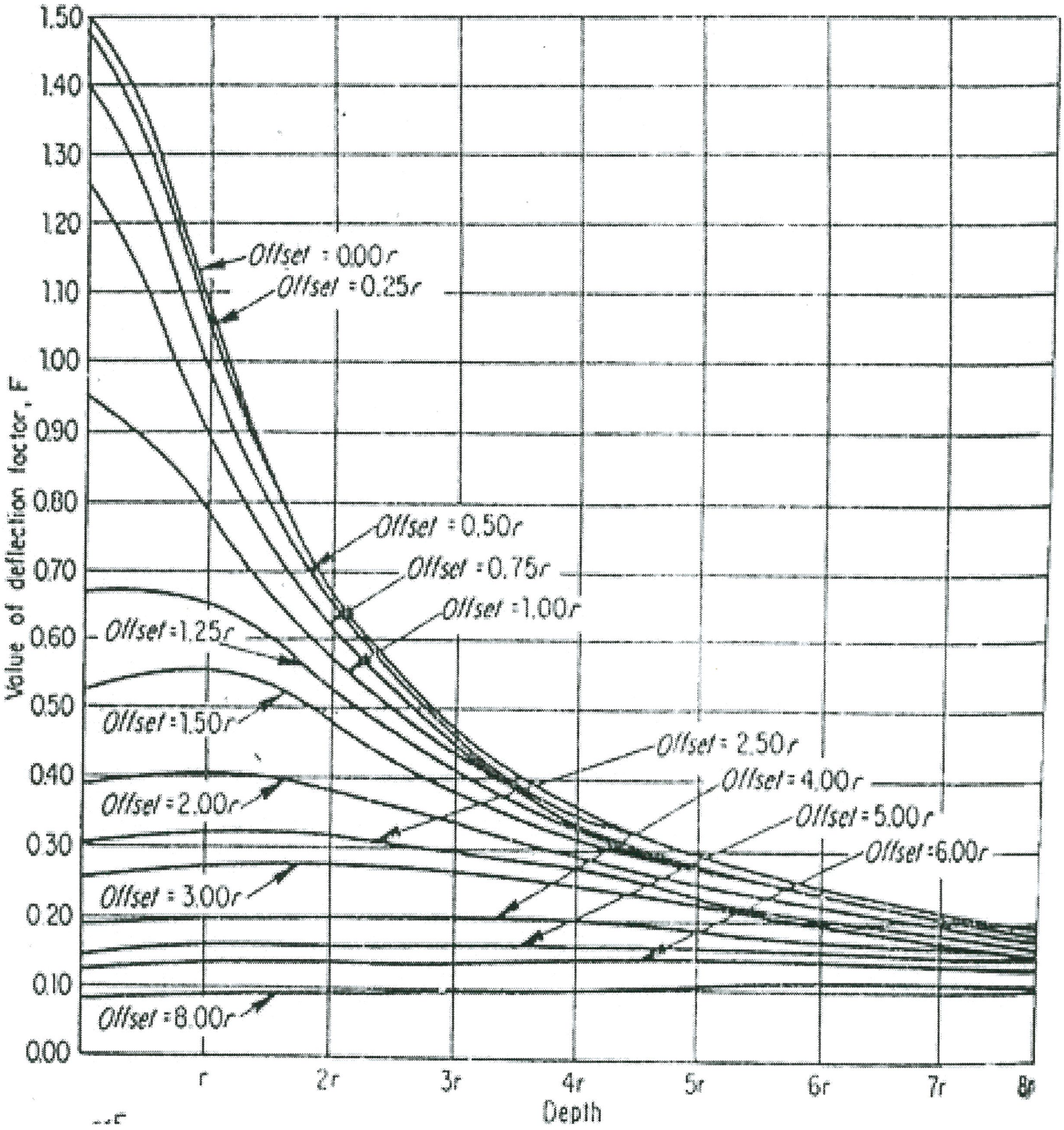


FIGURE Q3(d): Deflection Factor F for Uniform Load of Radius r

FINAL EXAMINATION

SEMESTER/SESSION	:	II/ 2014/2015	PROGRAME	:	4 BFF
COURSE NAME	:	TRANSPORTATION ENGINEERING	COURSE CODE	:	BFT 40303

Table 1: Data average annual departures and maximum take-off weight of each aircraft

Aircraft	Gear type	Average annual departures	Max Take-Off Weight (lb)
727-100	Dual	3500	150,000
727-200	Dual	9100	190,500
707-320B	Dual tandem	3000	327,000
DC-10-30	Dual	5800	108,000
737-200	Dual	2650	115,500
747-100	Double dual tandem	80	700,000

Table 2: 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

FINAL EXAMINATION

SEMESTER/SESSION : II/ 2014/2015 PROGRAME : 4 BFF
COURSE NAME : TRANSPORTATION ENGINEERING COURSE CODE : BFT 40303

Table 3: Vessel Dimension and Typical Energy Requirements

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

FINAL EXAMINATION

SEMESTER/SESSION	:	II/ 2014/2015	PROGRAME	:	4 BFF
COURSE NAME	:	TRANSPORTATION ENGINEERING	COURSE CODE	:	BFT 40303

Table 4: Fender Types with Energy Range

ENERGY RANGE (Tonne-m)	FENDER TYPE	FEATURES	BENEFITS	RESTRICTIONS	REF. PAGE
50 & Larger	 Epshield V-Flex (1) V - SHAPE	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	Epshield V-Flex	SEE ABOVE			
	 Super Cylinders (4) CYLINDERS	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	Epshield V-Flex	SEE ABOVE			
	Large Profile Fenders (3) COLUMN	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	(2) PROFILE  Profile Fenders	A large selection of shapes and sizes.	Economical protection against wharf face damage	Mounting hardware is exposed	

FINAL EXAMINATION

SEMESTER/SESSION	:	II/ 2014/2015	PROGRAME	:	4 BFF
COURSE NAME	:	TRANSPORTATION ENGINEERING	COURSE CODE	:	BFT 40303

EQUATIONS:

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

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

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

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

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

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

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

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

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

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

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

FINAL EXAMINATION

SEMESTER/SESSION	:	II/ 2014/2015	PROGRAME	:	4 BFF
COURSE NAME	:	TRANSPORTATION ENGINEERING	COURSE CODE	:	BFT 40303

EQUATIONS:

$$P_d = P_s\left[1 + 0.01\left(\frac{v}{1.609} - 5\right)\right]$$

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

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

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

$$\theta(x) = -\frac{P\lambda^2}{k}e^{-\lambda x}(sin\lambda x)$$