

Elasticity

(Ph. D. Qualify Exam, Spring 2004)

1. In a thick-walled cylinder subject to an inside pressure only, the following strains exist at point A in Fig. 1:

$$\varepsilon_{rr} = 0.002$$

$$\varepsilon_{\theta\theta} = 0.004$$

$$\varepsilon_{zz} = -0.001$$

- (a) What are the stresses τ_{rr} , $\tau_{\theta\theta}$, and τ_{zz} for $G = 1.0 \times 10^{11} Pa$ and $\nu = 0.3$? (15%)
 (b) What is the stress tensor τ_{ij} at A for the Cartesian coordinates shown in the figure? (15%)

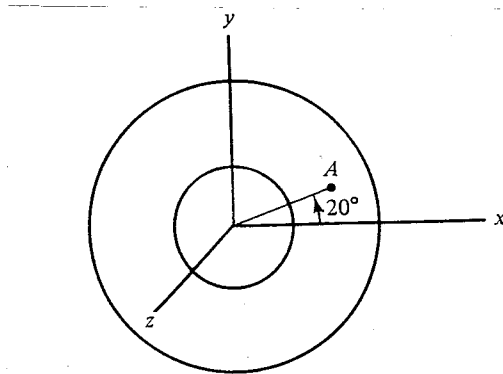


Figure 1

2. A solid three-dimensional linear elastic body is submerged in a fluid such that every point on its surface is subjected to uniform hydrostatic pressure p .
- (a) What is the state of stress at an interior point? (18%)
 (b) Using this state of stress, determine the displacements u , v , w . Set $u = v = w = \omega_x = \omega_y = \omega_z = 0$ at $x = y = z = 0$. Neglect the body forces. (17%)

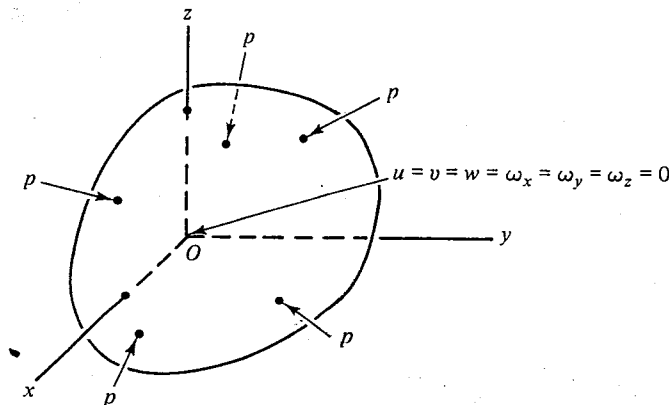


Figure 2

3. A long elastic cylinder with fixed ends is constructed from two hollow cylinders of the same material. Before assembly, the inner radius of the outside cylinder is 0.005 in. less than the outer radius of the inside cylinder. Assembly is accomplished by applying heat to the outside cylinder so as to produce thermal expansion, and then inserting the inside cylinder. After cooling the final dimensions are as shown in Fig. 3. Also, $E = 30 \times 10^6 \text{ psi}$ and $\nu = 0.3$.

- (a) What is the contact pressure between the outside and the inside cylinders? What are the stress distributions in both cylinders? (18%)
- (b) Now let a pressure $p = 30,000 \text{ psi}$ be applied at the inner radius of the inside cylinder. What are the new stress distributions? (17%)

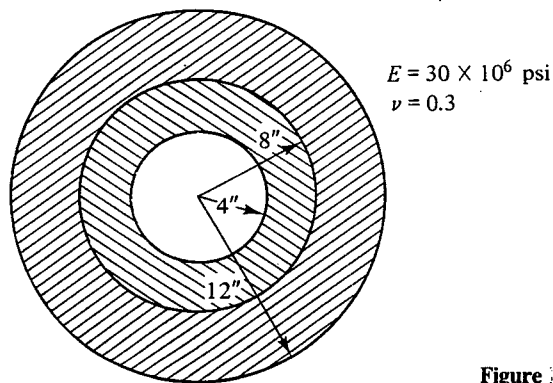
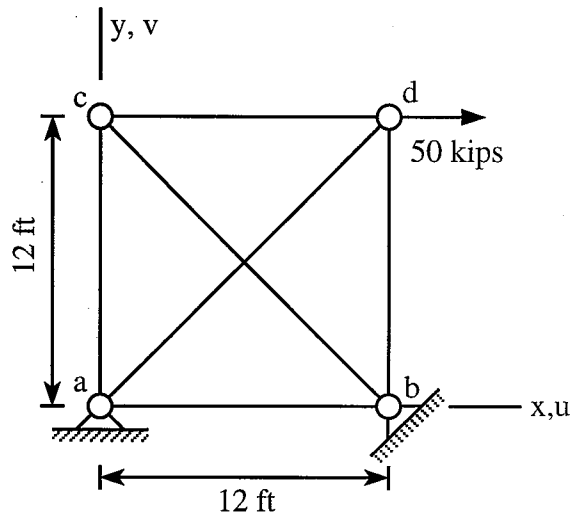


Figure 3

Finite Element Method

(Close book, 100 minutes, 60% to pass)

1. The structural stiffness equations of the truss is $[K]\{D\}=\{R\}$, where $\{D\} = \{u_a, v_a, u_b, v_b, u_c, v_c, u_d, v_d\}^T$ and $\{D\} = \{F_{xa}, F_{ya}, F_{xb}, F_{yb}, F_{xc}, F_{yc}, F_{xd}, F_{yd}\}^T$. The structure is subjected to a horizontal force of magnitude 50 kips at node d. In addition, the truss is subjected to the following support displacements: $u_a = -0.25$ in., $u_b = -0.5$ in., and $v_b = 0.25$ in. For all the members $E = 29000$ ksi and $A = 0.993$ in², the stiffness matrix $[K]$ is given as follows:

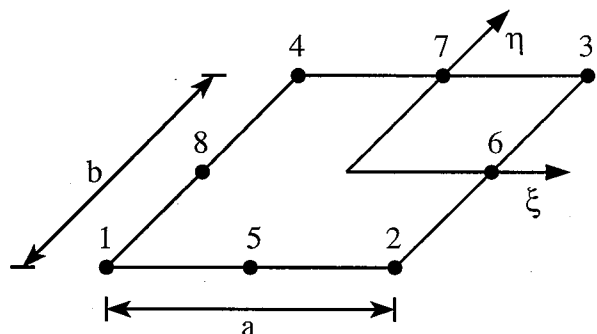


$$[K] = 200 \begin{bmatrix} 1.354 & 0.354 & -1 & 0 & 0 & 0 & -0.354 & -0.354 \\ & 1.354 & 0 & 0 & 0 & -1 & -0.354 & -0.354 \\ & & 1.354 & -0.354 & -0.354 & 0.354 & 0 & 0 \\ & & & 1.354 & 0.354 & -0.354 & 0 & -1 \\ & & & & 1.354 & -0.354 & -1 & 0 \\ & & & & & 1.354 & 0 & 0 \\ & & & & & & 1.354 & 0.354 \\ & & & & & & & 1.354 \end{bmatrix} \text{ (lb/in)}$$

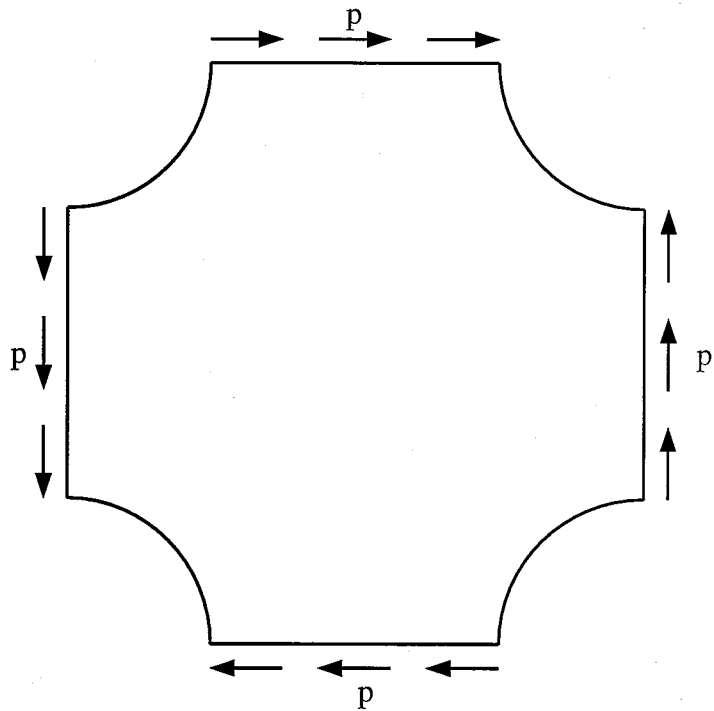
symmetric

Calculate (i) the displacements at nodes c and d, (ii) the reactions at nodes a and b, and (iii) the forces in members ab, ac and ad. (25%)

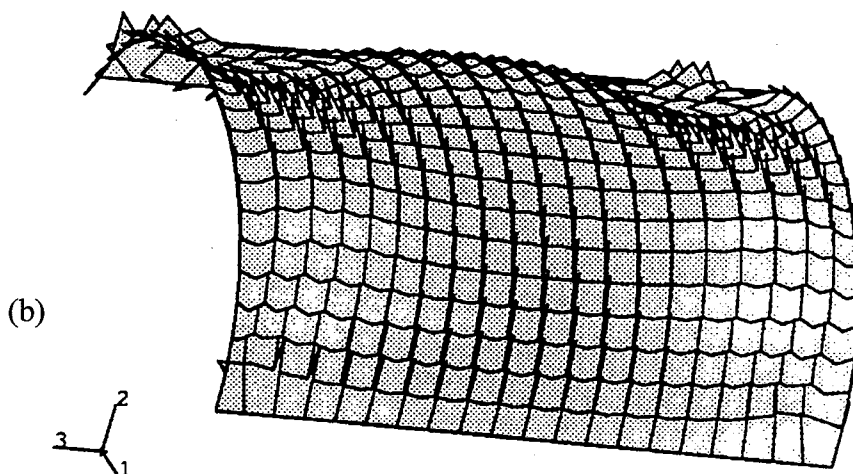
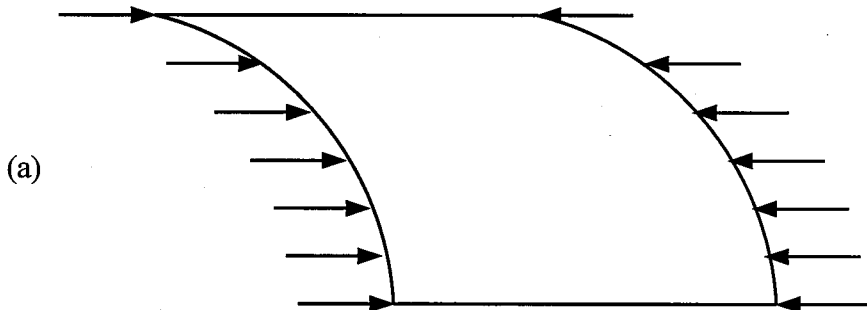
2. (i) What are the shape functions N_1, N_2 and N_5 for the eight-node isoparametric element in the natural coordinates (ξ, η) . (ii) The element is subjected to a downward uniform pressure of magnitude q . Find the consistent loads at all the nodes. Show their directions. (20%)



3. A steel plate with constant thickness is subjected to uniformly distributed tangential stress p as shown. (i) Sketch the mesh and describe the best type of element that you would use to analyze the plate (need to take the symmetric or antisymmetric conditions into account). (ii) Specify the boundary conditions on your mesh. (20%)



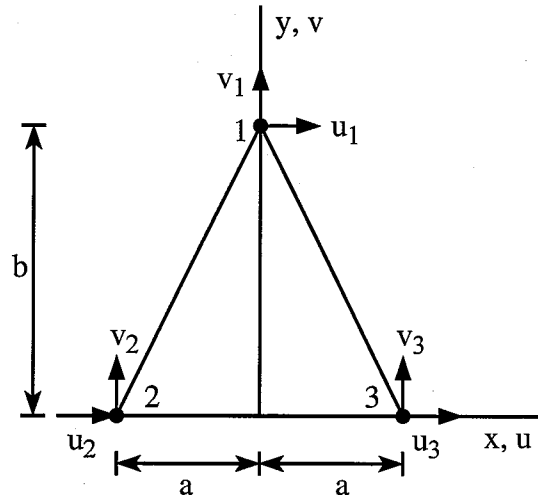
4. A shell roof is subjected to compressive force in the longitudinal direction as shown in Fig. (a). The shell is simply supported at four edges but motions in longitudinal direction are allowed. After the finite element buckling analysis, the critical buckling mode of the shell is shown in Fig. (b). In your judgement, the buckling mode looks correct or not? Why? (10%)



5. Assume the displacement fields of the constant strain triangle element shown below are:

$$u(x,y) = N_1(x,y)u_1 + N_2(x,y)u_2 + N_3(x,y)u_3$$

$$v(x,y) = N_4(x,y)v_1 + N_5(x,y)v_2 + N_6(x,y)v_3$$



Assume the element has constant thickness t and $v = 0$. (i) Obtain the shape functions $N_1(x,y)$, $N_2(x,y)$, $N_3(x,y)$, $N_4(x,y)$, $N_5(x,y)$ and $N_6(x,y)$. (ii) Determine the 2 by 2 submatrix $[k]_s$ of $[k]$ that operates at node 1. That is

$$[k]_s \begin{Bmatrix} u_1 \\ v_1 \end{Bmatrix} = \begin{Bmatrix} F_{x1} \\ F_{y1} \end{Bmatrix}$$

where F_{x1} and F_{y1} are nodal forces applied to node 1 in x and y directions respectively. (25%)

Qualifying Examination (Engineering Mathematics)

1. Solve the following differential equations (24%)

(a) $\frac{d^4 y}{dx^4} + y = 0$

(b) $y'' - 4y' + 4y = (x+1)e^{2x}$

(c) $(x-1)y'' - 2(x-1)y' - 4y = 0$

2. Find the eigenvalues and eigenvectors of the given matrix.

Check and explain the orthogonal property of these eigenvectors.

(16%)

(a) $\begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$

(b) $\begin{bmatrix} 0 & 0 \\ 4 & 0 \end{bmatrix}$

3. (a) If $\mathbf{F} = xy \mathbf{i} + y^2 z \mathbf{j} + z^3 \mathbf{k}$, evaluate

$$\iint_S \mathbf{F} \cdot \mathbf{n} dS$$

where S is the unit cube defined by $0 \leq x \leq 1, 0 \leq y \leq 1, 0 \leq z \leq 1$. (8%)

(b) Change the order of integration in

$$\int_0^6 \int_0^{4-2x/3} \int_0^{3-x/2-3y/4} F(x, y, z) dz dy dx$$

to $dy dx dz$ (10%)

4. (a) Show that the equation

$$\alpha^2 \frac{\partial^2 u}{\partial x^2} = \frac{\partial^2 u}{\partial t^2}$$

can be put into the form $\frac{\partial^2 u}{\partial \xi \partial \eta} = 0$

by means of the substitutions $\xi = x + at, \eta = x - at$. (10%)

(b) Show that a solution of the equation is (8%)

$$u = F(x + at) + G(x - at)$$

where F and G are arbitrary, twice-differentiable functions.

5. Evaluate

$$\oint_C \left(\frac{e^z}{z+3} - 3\bar{z} \right) dz$$

where C is the unit circle $|z| = 1$. (10%)

6. Consider

$$y'' + \lambda y = 0$$

subject to the periodic boundary conditions

$$y(-L) = y(L), \quad y'(-L) = y'(L)$$

Show that the eigenfunctions are

$$\left\{ 1, \cos \frac{\pi x}{L}, \cos \frac{2\pi x}{L}, \dots, \sin \frac{\pi x}{L}, \sin \frac{2\pi x}{L}, \dots \right\}.$$

This set, which is orthogonal on $[-L, L]$, is the basis for the Fourier series. (14%)

結構動力資格考題目

1. Please find (1) the mass and stiffness matrices (Fig.2a) 15%; (2) Find the natural frequencies and mode shapes 15%; (3) If the damping ratio is equal to 0.1, please find the displacements of the system under the loads shown in Fig.2b 20%; (4) If the response-spectrum figure is shown in Fig.2c. Please solve this problem by using response-spectrum analysis 20%. (Total 70%) 本題為兩個自由度之結構動力題目，是基礎的題型，有標準答案，請盡力答題。

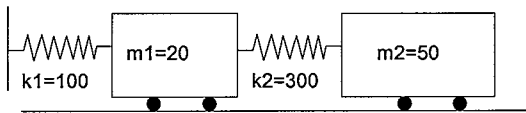


Fig.2a

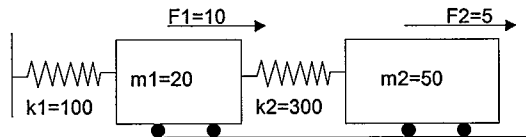


Fig.2b

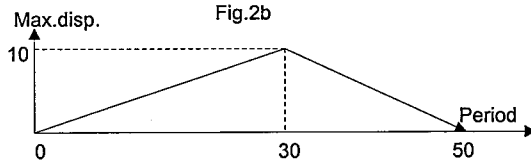


Fig.2c

2. 如果你有一個振動器(Shaker)，能產生規則之 Sine 外力，又有 15 個加速規，能量測振動(量測加速度及速度)，請規劃試驗及整理資料之方法，去量測一個十層樓結構之數個自然頻率。無標準答案，想像此題當成你的論文題目，請盡力答題。(30%)

國立成功大學土木工程學系博士班九十二學年度學科考試

工程地質學試題

March 26 2004

Note: 及格分數為 70 分

1. 說明活動斷層(active fault) 之定義。台灣活動斷層主要可分為那三類，試說明之。(15 分)
2. 在判讀地質圖時，對於地層與地形關係之判斷，常利用所謂的「V 字法則」。試說明此法則。(15 分)
3. 岩石依其成因及性質可分成三大類，說明此三大類岩石之成因。試就每一大類岩石列出三種較常見之岩石並說明每種岩石之工程性質。(15 分)
4. 岩體之弱面一般依其成因可分為兩大類，分別說明此兩大類弱面發生之原因。請依每一大類列出二種弱面並說明每種弱面對工程可能產生之影響。(15 分)
5. 說明地質構造對隧道工程之影響。(20 分)
6. 依工程地質觀點，水庫壩址之選擇要考慮那些條件。(20 分)

一、簡答題 (20%)

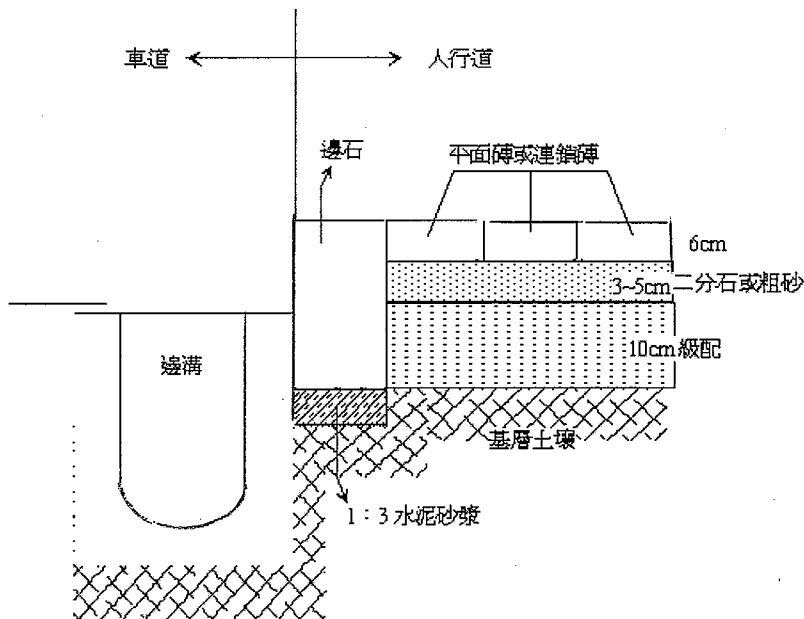
- (1) 說明何謂混凝土初凝、終凝、假凝？
- (2) 潛盾工法種類
- (3) 加速新生地壓密時效採行之紙樁工法(wick drain method)
- (4) 管幕工法

二、以文字輔以圖形說明敘述橫越大跨距峽谷拱橋之施工方法。峽谷深，無法於跨間落墩，其他條件請自行設定。(20%)

三、請以簡單圖示與文字說明混凝土壩施工巨積混凝土施工過程中(1)如何控制溫度(2)如何分塊澆置又能持壩體完整性之各項作法與施工要點。(20%)

四、請敘述並繪圖說明深開挖工程中順打工法與逆打工法之施工步驟，並說明各別優缺點。(20%)

五、為何廣場、人行道鋪設之平面磚或連鎖磚(如圖所示)常出現凹凸不平甚或是崩塌陷落現象？如何在設計或施工時加以改善(例如，施工重點、修改設計或增加其他材料)？(20%)



土木系博士資格考試 岩石力學試題(2004.3)

(1. Close Book

2. 試題與試卷一起交回)

1. 有一岩石試體在三軸試驗時受到 100 kgf/cm^2 的均向壓力後，再以 500 kgf/cm^2 的軸差應力將之壓壞，請問：

(a) 試體破壞時，其所受到的應力狀態 σ_{ij} 為何？

(b) 此應力狀態 σ_{ij} 之第 1、2、3 不變量， J_1 、 J_2 、 J_3 為何？(10%)

2. 解釋名詞(40%)

(a) RQD(Rock Quality Designation)

(b) RMR(Rock Mass Rating)

(c) 走向與傾斜(Strike and Dip)

(d) 崩解耐久指標(Slake Durability Index)

(e) 斷層與節理(Fault and Joint)

(f) Mohr-Coulomb Criteria

(g) 應變軟化(Strain Softening)

(h) Dilatancy

(i) 脆延性轉換壓力(Brittle to Ductile Transition Pressure)

(j) Deviatoric Compression

3. 請說明巴西試驗(Brazilian Test)之試驗方法與原理。(10%)

4. 何謂水力破裂法(Hydraulic Fracturing)，在使用上有否深度上之限制？(15%)

5. 有三處岩體 A、B、C 皆由層狀砂岩所構成，各層砂岩層厚相同，層面之位態如下：

岩體 \ 層面位態	走向	傾角	傾向
A	正北	30°	正西
B	正北	40°	正西
C	正北	60°	正東

若在 A、B、C 岩體中進行邊坡開挖工程，則：

(一) 在 A、B、C 岩體中應開挖何種坡面(走向、傾角、傾向)才會形成可能發生滑動的順向坡？

(二) 若在 A、B、C 岩體中各開挖二種坡面 a、b；其中 a 坡面之走向為正北，傾角 45° 、傾向正西；b 坡面走向正北，傾角 45° 、傾向正東，又以 Aa 表示 A 岩體之 a 坡面，Cb 表示 C 岩體之 b 坡面，則 Aa、Ab、Ba、Bb、Ca、Cb 坡面何者為順向坡？何者為逆向坡？順向坡的穩定性順序為何？逆向坡之穩定性順序為何？(25%)

九十二年度第二學期博士候選人資格考土壤力學試題

一·翻譯及解釋下列名詞:(25%)

- (1) sensitivity
- (2) thixotropy
- (3) critical void ratio
- (4) specific surface
- (5) specific volume

二·何謂 SHANSEP? 其目的為何? 試敘述如何使用 SHANSEP 法求取現場(field)之不排水剪力強度? (25%)

三·有一飽和砂土進行壓密排水〈CD, S〉試驗, 此土樣首先以圍壓 100kPa 和背水壓力〈back pressure〉70kPa 做同向壓密。壓密完成後, 此土樣緊接著進行以降低軸向壓力方式直至試體破壞為止。試驗完成後, 求得破壞時之有效摩擦角 $\varphi' = 35$ 度, 試求:〈a〉破壞時之最大和最小有效主應力=? kPa? 〈b〉繪製破壞時摩爾圓, 並標示其極點(pole point)位置。〈c〉繪其破壞面並標示破壞面之角度? (25%)

四·試寫出 Terzaghi 單向壓密理論之基本假設(至少五個), 並說明如何

導出壓密之基本方程式 $\frac{\partial u}{\partial t} = c_v \frac{\partial^2 u}{\partial z^2}$ 。(25%)

路面材料（總分 100 分，70 分及格）

1. Briefly describe the asphalt types and uses in flexible pavement. (14 分)
2. Describe how the pavement performance related to asphalt cement rheological properties. (16 分)
3. Describe the Superpave mix design method. (14 分)
4. What material characteristics should be evaluated for the suitability of aggregates for use in HMA? (14 分)
5. Describe the methods used to determine the optimum asphalt content in the Marshall mixture design. (14 分)
6. Describe the two principal types of HMA mixing facilities in use today. (14 分)
7. Describe the production of recycled asphalt mixtures. (14 分)

國立成功大學土木工程系 92 學年度第二學期博士班資格考試
鋪面工程試題

open book

- I. 在鋪面分析中，路基的強度常被假設為定值。但事實上並非如此，請至少舉出三種較接近實況的路基材料參數模式，並說明其特色。(20%)
- II. 請說明剛性路面分析中 Bradbury 應力修正係數圖的用途，並說明其缺點。(20%)
- III. 路基材料強度在一年四季會隨季節雨氣候而變動。請說明 AASHTO 設計規範中如何選擇將這個因素納入設計？(20%)
- IV. 請比較 PSI、PCI、IRI 等三種常見的鋪面品質評估指標在本質上獲反映的特性上有何不同？(10%)
您認為有沒有辦法在三個參數之間建立關聯，方便相互換算？(10%)
- V. 請分段闡釋下面段落的主旨意涵。(20%)

An engineered management system (EMS) is defined as a system that consists of a set of engineering tools for performing condition surveys and condition prediction, and developing work plans with the objective of optimizing spending. EMSs use engineering technology to determine when, where, and how to best maintain facilities. They provide the needed leverage to preserve the infrastructure investment.

A PMS is not a maintenance management system. A maintenance management system (MMS) is concerned with maintenance activities that apply from “property line to property line.” Such activities as little pick-up, vegetation control, culverts and routine maintenance of pavements are included in an MMS. Pavement management systems can provide information pertinent to the scheduling of routine pavement maintenance, but do not deal with other activities, such as little pick-up.

A PMS is not a substitute for good quality control. Pavements built poorly with substandard materials perform poorly regardless the best maintenance or rehabilitation policy. Developing a database of information for a PMS helps quantify performance predictions and cost consequences of using poor materials or reduced control.

A road inventory summarizing pavement conditions is not a PMS. Such information is inadequate for answering “what,” “when” and “where.” “Where” can be answered by a road inventory only if performance standards are set.

工程成本與財務 博士資格考 93 年 3 月

一、為了解公司之財務狀況，可就財務結構、償還能力、經營能力、獲利能力等四類財務比率數字分析。請說明這四類比率的特性，例如數字是從資產負債表或損益表來。並各舉二比率例子說明其數字變化代表之意義 (30 分)

二、Transactions during 1 January 2001 to 31 December 2001 are given below for a construction company:

(1) Material inventory purchased on account	80,000
(2) Total office rent paid	20,000
(3) Salaries paid to engineers	90,000
(4) Accounts receivable collected	60,000
(5) Accounts payable paid	30,000
(6) Subcontractor accounts paid	70,000
(7) Bidding expenses	20,000
(8) Dividends paid to stockholders	10,000
(9) Building depreciation	40,000
(10) Construction equipment depreciation	30,000

(a) Journalize all of the above transactions.

(b) Post journals entries to appropriate accounts.

(c) Develop income statement for period 1 January to 31 December 2001.

(d) Develop the balance sheet for the company as of 31 December 2001.

(共 40 分)

三、營造公司通常要準備兩種報告，一是財務報表，一是成本管理報告，請劃出這兩個報告的關係，並解釋其間需要經過的帳簿與資料。(30 分)

工程時程控制 博士資格考 93 年 3 月

- 一、何謂 CPI(Cost performance index), SPI(Schedule performance index)? 如何計算 CPI, SPI? 請說明產生過程。(30 分)
- 二、請敘述時程規範有何功用，一標準的時程規範應包含哪些內容。(30 分)
- 三、某工作有下列作業、需用資源與關係，工期中 a 為最樂觀，m 最可能，b 為最悲觀時間，資源 I 總數 10，資源 II 總數 15。請用最小總浮時規則(heuristic)，排資源負載進度表。(40 分)

作業	工期			資源單位		前置作業
	a	m	b	I	II	
A	1	2	4	3	0	
B	5	6	7	5	4	
C	2	4	5	4	1	
D	1	3	4	2	0	A
E	4	5	7	4	3	C
F	3	4	5	2	7	A
G	1	2	3	6	2	B, D, E

Construction Management Information System
Qualification

1. What is Data Mining? Please describe what kind of business operations that the real estate agent can apply Data Mining to. (15%)
2. What is ERP (Enterprise Resources Planning)? Please list three different approaches usually taken to introduce ERP to an enterprise? (15%)
3. Please explain INTERNET, INTRANET, and EXTRANET. (15%)
4. What is 3-tier approach for web applications.(10%)
5. Table 1 contains many unsatisfactory components and characteristics. (For example, there are several multi-valued attributes, naming conventions are violated, some attributes are not atomic, and so on.)

Table 1

Attribute name	Sample value
EMP_CODE	1003
LAST_NAME	Willaker
EDUCATION	HS, BBA, MBA
DEPT_CODE	MKTG
DEPARTMENT	Marketing
DEPT_MANAGER	Jill H. Martin
JOB_CLASS	23
TITLE	Sates agent
DEPENDENTS	Gerald (spouse), Mary (daughter), John (son)
BIRTH_DATE	12/23/65
HIRE_DATE	10/14/94
TRAINING	Level I, level 2
BASE_SALARY	\$32,255

- 5.1. Given this table, draw its dependency diagram. Label all transitive and/or partial dependencies. (10%)
- 5.2. Break up the dependency diagram you drew in problem 4.1 to produce dependency diagrams that are in 3NF. (10%) Hint: You might have to create a few new attributes. Also, make sure that the new dependency diagrams contain attributes that meet proper design criteria; that is, make sure there are no multi-valued attributes, that the naming conventions are met, and so on.
- 5.3. Using the results of 4.2, draw the E-R diagram. (10%)
- 5.4. Using the results of problem 4.2, draw the relational schema. (15%)