Qualifying Examination (Finite Element Method)

1. Evaluate $\int_0^{\pi/2} \sin^2 x \, dx$

   (1) by an exact analytical method (10%)

   (2) using four-point Gaussian quadrature (10%)

   (3) by dividing the interval $0 \le x \le \pi/2$ into two linear elements. (10%)

2. Solve the boundary value problem:

$$\frac{d}{dx}\left(x \frac{du}{dx}\right) = \frac{2}{x^2} \quad 1 \le x \le 2$$
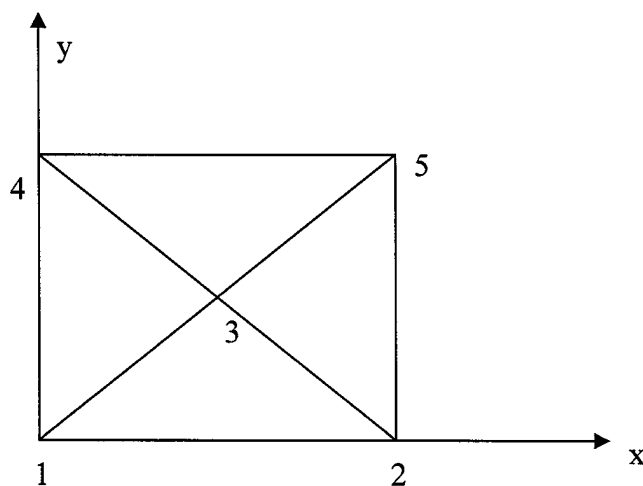
$$u(1) = 2 \qquad \frac{du(2)}{dx} = -\frac{1}{4}$$

   using two equal length linear elements.(20%) Compare your solution to the exact solution of the equation.(10%)

3. Consider the boundary value problem:

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} = 0 \quad 0 \le x, y \le 1$$

   with all boundary conditions essential. Using the four element model shown in Figure deduce that the value at the center (nodal point 3) is equal to
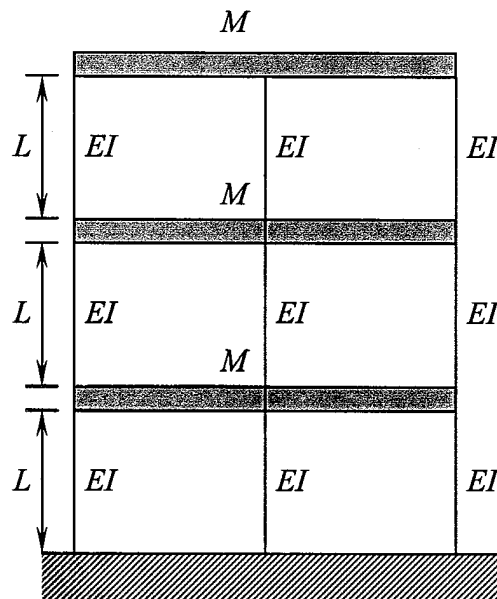
$$u_3 = (u_1 + u_2 + u_4 + u_5)/4 \quad (40\%)$$

1. (30%)For a linear system, the equations of motion are given by
$$M\ddot{y} + C\dot{y} + Ky = f(t)$$
   (a) How to find the normal modes and frequencies of the system.
   (b) What is the method of modal superposition.

2. (30%)The three-story building has mass and stiffness shown. Determine the normal modes and frequencies of the building.

3. (40%)For a cantilever beam with length L, the flexural rigidity EI and the mass per unit length m, subject to a load $f(t)$ at free end as shown, find the relation between the maximum end deflection and the loading duration t_0.

$m=0.1$, $EI=10^6$, $L=10$.
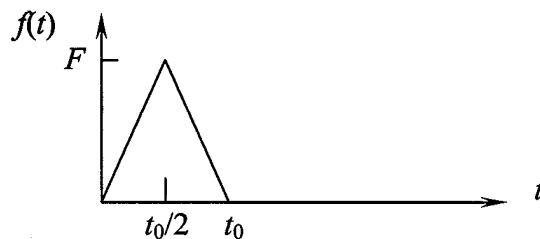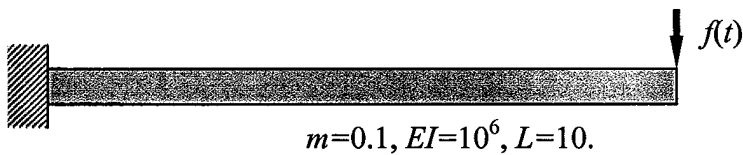
Elasticity
## (Ph. D. Qualify Exam, Fall 2005)

1. The generalized Hooke's law is

   $$\tau_{ij} = C_{ijkl}\varepsilon_{kl}$$

   where τ_{ij} = stress tensor, ε_{ij} = strain tensor, C_{ijkl} = fourth-order tensor with 81 elements. Derive the Hooke's law of isotropic material. (40%)

2. A steel rod A and aluminum sleeve B are held by an immovable wall D at one end and at the other, through a stiff plate E, to a spring having a spring constant K, which in turn is held by immovable wall G. Initially, the spring is unstretched and the temperature is uniform at 60°F. If the temperature of the rod and sleeve goes to 100°F throughout, what are the stresses in the rod and sleeve? Assume that τ_{xx} is the only nonzero stress, where x runs along the center of the steel rod. (30%)
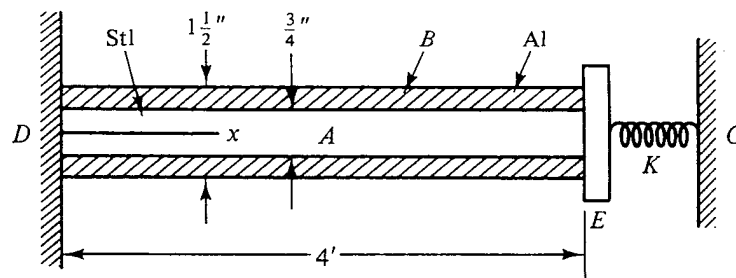
$$E_{Al} = 15 \times 10^6 \text{ psi}$$
$$\alpha_{Al} = 12 \times 10^{-6}/°F$$
$$E_{Stl} = 30 \times 10^6 \text{ psi}$$
$$\alpha_{Stl} = 6.5 \times 10^{-6}/°F$$
$$K = 10,000 \text{ lb/ft}$$

3. Show that the stress concentration for a very small hole in the elastic plate loaded as shown in Fig. is 4. The quantity S is a stress magnitude. (30%)
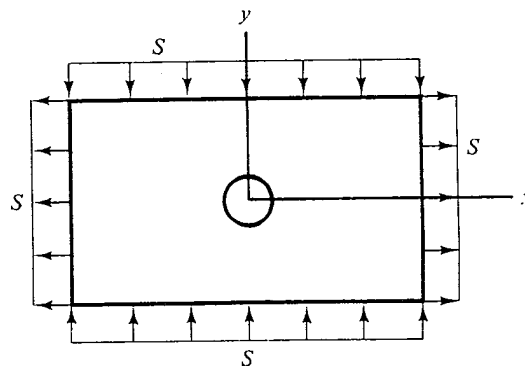
九十四年度第一學期博士候選人資格考<u>土壤力學</u>試題

1. 翻譯及解釋下列名詞: (25%)
   (1) consistency
   (2) thixotropy
   (3) hydraulic gradient
   (4) specific gravity
   (5) specific surface

2. Derive the equation for computing hydraulic conductivity from a falling head permeability test for the case of radial flow in a soil sample with a central sand drain. (assume the radius of sand drain and sample are r_w and r_o, respectively, and the height of sample is H) (15%)

3. The following question pertains to a consolidated-undrained test on a normal consolidated clay. The specimen was first consolidated isotropically under a total confining (cell) pressure of 80 kPa and a back pressure (initial pore water pressure) of 35 kPa. The total confining pressure was then increased to 100 kPa with the drainage line to the base of the specimen closed in order to check the degree of saturation of the specimen. The specimen was determined to be fully saturated. The specimen was then sheared by increasing the axial load to failure under the total confining pressure of 100 kPa. The principal stress difference at failure was 27 kPa and the total pore water pressure at failure was 85 kPa (including the pore water pressure before shear).
   (a) Calculate the major and minor effective principal stresses at failure.
   (b) Calculate the value of φ' at failure assuming zero effective cohesion.
   (c) What was the pore water pressure just before shear?
   (d) Calculate the pore water pressure coefficient A at failure?
   (e) Does the value of A calculated in part (d) seem reasonable? Explain. (25%)

4. What is Mohr's strength envelope?   What does the K_f line represent? What is the significance of each? (15%)

5. Assume that the e-log p relationship shown in figure shown represents the laboratory results of a one-dimensional consolidation test. The clay stratum from which the test sample was extracted was 3.5 m thick, totally saturated. Assume the clay is normally consolidated. How much additional effective pressure can the clay withstand if the ultimate expected settlement is not to exceed 12 cm? (20%)
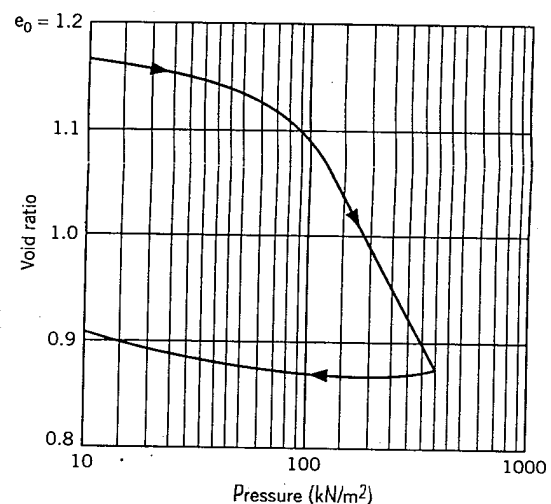
1. 如下圖所示之方形基礎位於一無限高度邊坡之頂部，試以 Terzaghi、
   Meyerhof、Hansen or Vesic 之基礎承載力公式及修正係數，討論如何估計此
   一基礎之承載力，q_u。(20%)
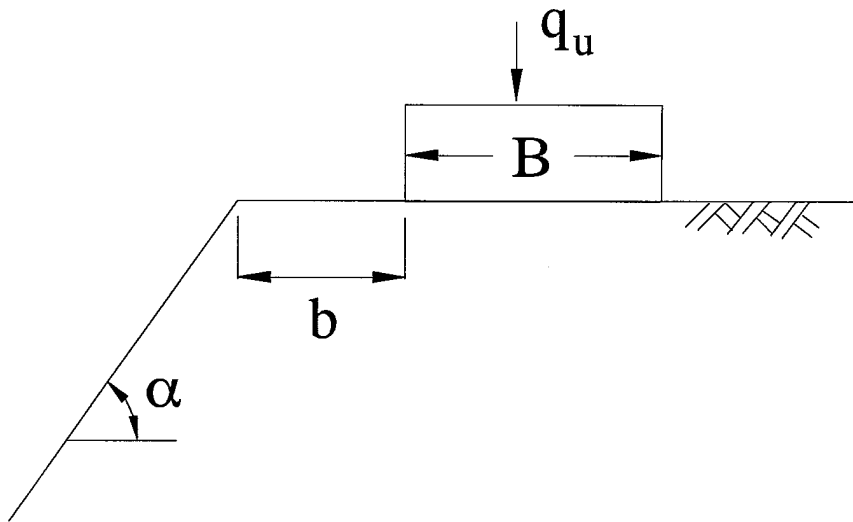
2. 試述 Coulomb 與 Rankine 土壓力理論之異同點(10%)及實用上之優缺點
   (10%)。除了上述兩種土壓理論外，列舉一種土壓力理論，並簡單說明(10%)。

3. 試對下列之地盤改良工法分類，各列舉一種以上之工法，並說明為何該工法
   可歸於該分類。

   (1) 以增加全應力(Total stress)為主之工法(10%)

   (2) 以促進壓密為主之工法(10%)

   (3) 以降低水位為主之工法(10%)

   (4) 以夯實或壓實為主之工法(10%)

   (5) 以提高土壤凝聚力(或膠結力)為主之工法(10%)

九十四學年度第一期博士學位候選人資格考試

考試科目: 工程地質

一. 解釋名詞 (15%)

    (1) 何謂交角不整合、假整合、非整合與局部不整合? (3%)

    (2) 何謂斷層? 何謂節理? (3%)

    (3) 何謂岩石地層單位? (3%)

    (4) 何謂走向、傾角、傾向? (3%)

    (5) 何謂 Rock Quality Designation (RQD)? (3%)

二. 試述不同的隧道通過斷層方式所可能造成的工程問題。(10%)

三. 進行野外調查時容易發現露頭的地點為何? (10%)

四. 試述不連續面的種類與特性。 (15%)

五. 試述不連續面與邊坡破壞幾何形狀的關係。 (15%)

六. 試述地質構造與壩址的關係。 (15%)

七. 請敘述臺灣之地形分區與各區的特徵。 (20%)

道路工程

(Ph.D. Qualify Exam.)

(Total 100%, 20% each)

1. Briefly describe the historical developments of pavement design. (Flexible pavement and Rigid pavement)

2. Describe the major distresses of the flexible pavement.

3. What is the purpose of the road test? Describe the AASHO road test also.

4. What are the serviceability/performance concepts?

5. Briefly describe the concept of pavement management.

1. 請以右圖解釋軌道車輛 hunting stability 的現象。 (20%)

2. 鋼輪在遭遇軌道接頭不平整時產生的衝擊力可以分為 P1 力與 P2 力，請說明這兩個力的特性。(20%)

3. 請說明 conicity, velocity, stability 間之關係。[可參考 Section2, Figure10] (20%)

4. 請推導 Nadal's limit 表示式。(20%)

$$\frac{Y}{Q} = \frac{tan\alpha - \mu}{1 + \mu \cdot tan\alpha}$$
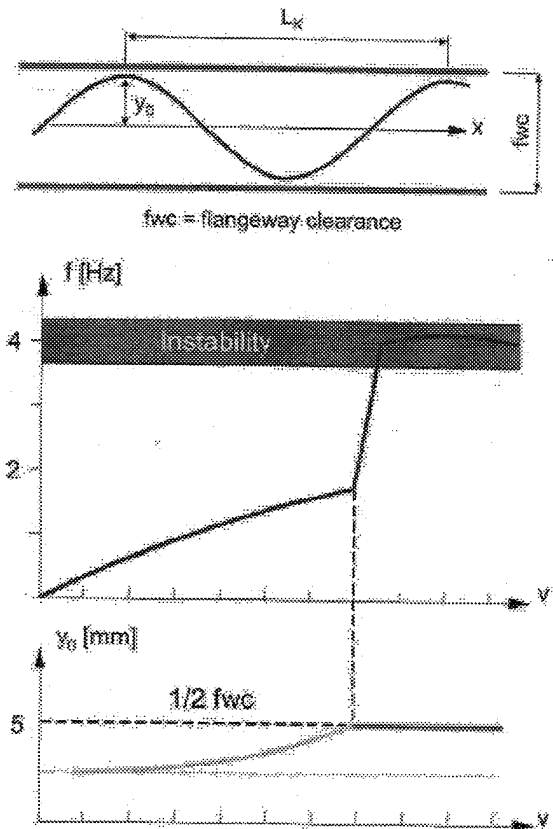
5. 常見的鋼軌銲接方式有哪四種？請說明其優缺點。(20%)

fwc = flangeway clearance

Figure 2.6: Increase in amplitude and frequency with speed and the development of instability

1. What admixture can be added to the concrete to provide protection from deterioration in each of the following situations? Explain how the admixture protects the concrete?

(a) Exposure to high sulfate level

(b) Exposure to deicing salts

(c) Subjected to frequent freezing and thawing

(d) Use of aggregate containing reactive silica

(30%)

2. (a) Explain the mechanisms of sulfate attack in concrete.

(b) Explain the mechanisms of creep in concrete.

(20%)

3. A tank wall is to be designed against water pressure as shown. Determine the flexural reinforcement needed (per foot of wall length) for choosing No.7 steel bar. Also show the steel arrangement in sketch including a qualitative anchorage detail.

Given f_c' =4000psi, f_y =60000psi, water weighs =62.5 pcf (30%)
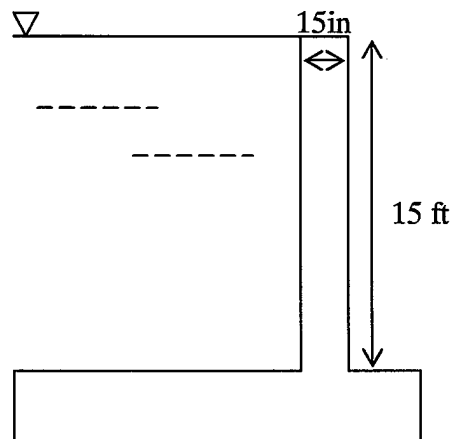
4. Explain the differences in appearance of flexural cracks, shear cracks, and torsional cracks in concrete structures.(20%)

STEEL & STEEL STRUCTURES
(PhD Qualifying Exam)
Note: Please solve the following problems in US units (i.e. inch ("), foot ('), kip, lb, ksi, psi ....)

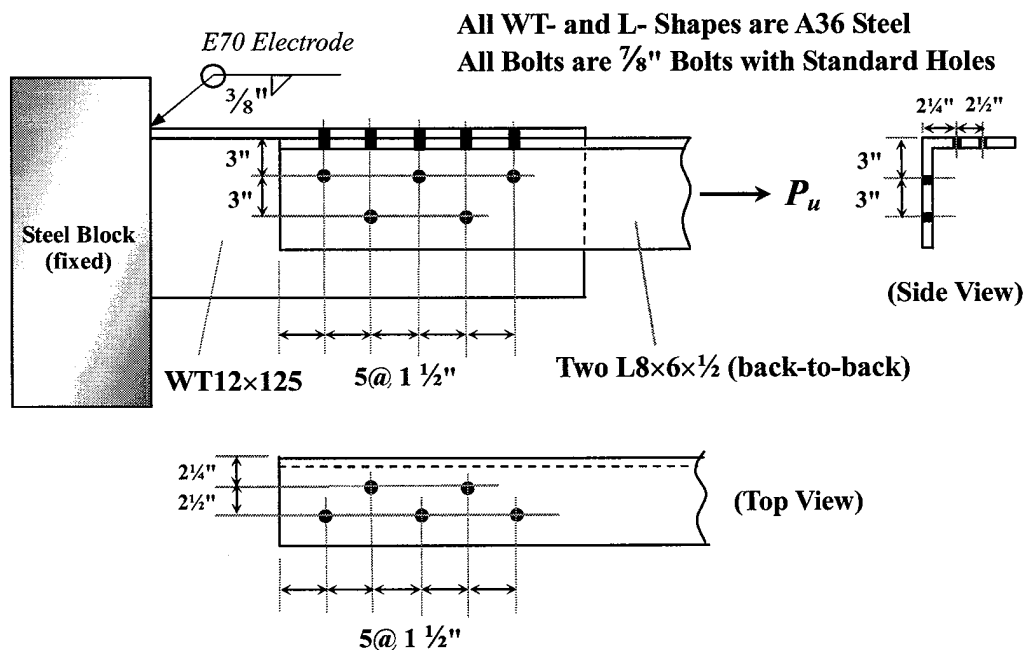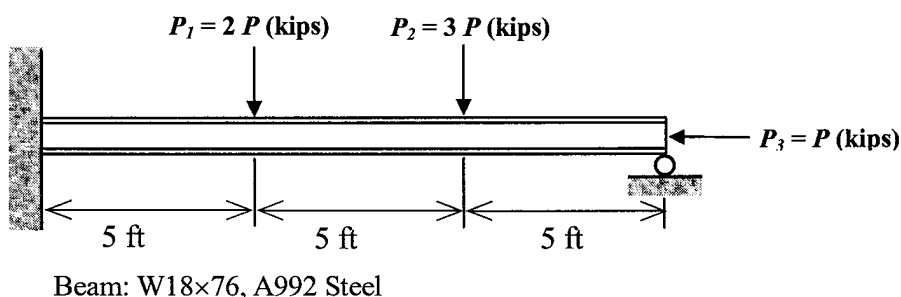1. Please give <u>detailed</u> explanations for the following questions:
   a.) What is "transition temperature" in the impact tests? Why is it important?
   b.) What is "Whitmore section?" How does it affect steel design?
   c.) What are "compact section" and "non-compact section?" How are they defined in the AISC-LRFD Specifications?

2. Please estimate the maximum factored load P_u of the following tension member by the AISC-LRFD specifications (You have to check <u>**all**</u> of the limit states for <u>**all**</u> the components in this tension member). Is this tension member a good design? If yes, explain the reasons. If not, explain the reasons and show your modification.

All WT- and L- Shapes are A36 Steel
All Bolts are ⅞" Bolts with Standard Holes

E70 Electrode

Steel Block (fixed)

WT12×125   5@ 1 ½"

Two L8×6×½ (back-to-back)

P_u

(Side View)

(Top View)

5@ 1 ½"

3. Please determine the maximum P (kip/ft) that the steel beam (see the figure below) can safely support. (Neglect the beam self-weight)

$P_1 = 2P$ (kips) $P_2 = 3P$ (kips)

$P_3 = P$ (kips)

5 ft   5 ft   5 ft

Beam: W18×76, A992 Steel

工程成本與財務　博士資格考　94 年 10 月

1. 某大型工程進行至 50%時，成本似已超支，請說明如何檢討成本問題，從估價開始，施工日報，估驗月報，數量報告，功率分析，成本預測及變更，到公司會計與財務等，整體說明。(40 分)

2. Ichiban construction company's 6 transactions in 2004 are given as follows:
   (1) Ichiban paid $70 labor cost for Project A.
   (2) Ichiban was billed $45 by a subcontractor for Project A.
   (3) Account receivable of $20 was collected for Project A.
   (4) Ichiban received $100 from client for Project A.
   (5) Ichiban received $60 from client for Project B.
   (6) Equipment depreciation of $30 recognized for Project B.

   1) 做分錄
   2) 過帳
   3) 做 2004 年損益表
   4) 做 2004 年資產負債表(增減多少)
   (30 分)

3. 承續上題數據，若考量認列收入，及預收工程款與在建工程之餘額，請填入下列空格。若有需要，並修改上述損益表及資產負債表。(30 分)

<u>2004 年底資料</u>

|	合約價格$	成本 2004	成本 2005	總成本	完工% 2004	認列收入	利潤	請款額	預收-在建
A	200	115	60	___	___	___	___	100	___
B	100	30	50	___	___	___	___	60	___
合計	___	___	___	___	___	___	___	___	___

1. Your bonding company has asked for the status of a telecommunications revitalization project. You decided to calculate Schedule Variance (SV), Schedule performance Index (SPI), Cost Variance (CV), and Cost performance index (CPI) as performance indicators. Your cost accounting system section and project manager have provided you with the following information (in Table 1):

Table 1

Activity #	Description	Total cost forecast	Scheduled percentage complete	Percentage complete	Actual cost to date	BCWS	BCWP
1	Building permits*	2000	100	100	1253.75		
2	Temp. networks*	25000	100	100	26497.83		
3	Order cable trays	8000	100	100	7907.27		
4	Order routers, cabling	10000	100	100	9017.32		
5	Remove ceilings*	18000	100	100	11427.49		
6	Install cable trays*	28000	100	100	19743.19		
7	New servers*	20000	100	70	11271.25		
8	Cable TV	10000	100	10	793.21		
9	Backbone and routers	20000	100	5	327.19		
10	LANs	17500	20	0			
11	Connect and test*	15000	0	0			
12	New Ceilings*	20000	0	0			
		193500			88238.5		

* Asterisks indicate the critical path for this project

1.1. Find the BCWS and BCWP of **each activity** (fill them in the table) (15%)

1.2. Calculate the SV, CV, SPI, and CPI of the project (15%) and determine the performance of the project in terms of schedule and budget. (10%)

1.3. Please explain the status of the project in terms of budget and schedule. What possible actions will you take to speed up the project without increasing the project cost if the project is delay? (10%)

作業名稱　　　完成每單元之作業天數
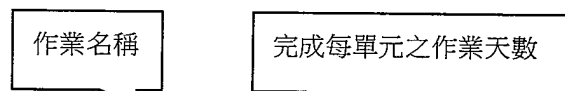
2. 假設一工程專案有A(1)、B(6)、C(2)、D(3)、E(5)、F(2)及G(1)等7項作業，而每一作業項目均有4個單元需完成，作業間的關係如Table 2所示，每一單元之施作均須滿足作業間之關係

2.1. 若要求每一作業一旦開始便連續施作4個單元至完成為止，請(1)畫出此專案之條狀圖，並(2)說明專案最少需要多少天完成？ (20%)

2.2. 假設專案須於38天內完成，請問你會如何改進此專案排程？(1)說明你的假設條件 (2)圖示改進後之專案排程 (20%)

Table 2

前置作業	後續作業及關係
A	B(FS)
B	C(FS), D(FS)
C	E(FS)
D	E(FS)
E	F(FS)
F	G(FS)
G	---

3. 請問總浮時與自由浮時應用在專案管理上的差別為何？(10%)