# 92.學年度博士班入學考試　土木工程學研究所結構工程組

材料力學試題

下列五題，每題 20 分，滿分為 100 分。

1. 一直桿長 L，變斷面之斷面積為 $A(x)$，材料楊氏係數為 E，單位長度之質量密度為 ρ。請推演：

   (i) 直桿軸向受靜態分佈荷重 $q(x)$ 作用下，直桿軸向靜態位移 $u(x)$ 之控制方程式。

   (ii) 直桿軸向受動態分佈荷重 $q(x,t)$ 作用下，直桿軸向振動位移 $u(x,t)$ 之運動方程式。

2. Describe what you know about the Saint-Venant torsion of a circular bar.

3. A cantilever beam of rectangular cross section (width b = 25 mm, height h = 100 mm) is loaded by a force P acting at the mid-height of the beam and inclined at an angle α to the vertical. Two strain gages are also placed at the mid-height of the beam.　Gage A measures the strain in the horizontal direction and gage B measures the strain at an angle $\beta = 60°$ to the horizontal. The measured strains are $\varepsilon_A = 125\mu$ and $\varepsilon_B = -375\mu$ ($\mu = 10^{-6}$).　Assume the material is steel with E = 200 GPa and $\nu = 1/3$.　Determine the force P and the angle α.
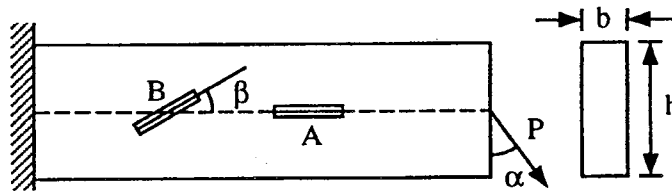
4. The leg in (a) acts as a column and can be modeled (b) by the two pin-connected members that are attached to a torsional spring having a stiffness k (torque/rad).　Determine the critical buckling load.　Assume the bone material is rigid.
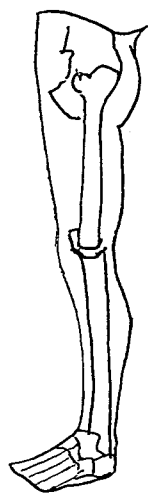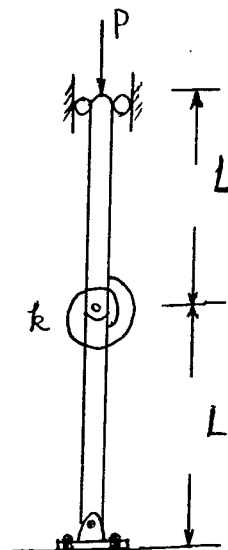
(a)　　　　　(b)

5. 一根懸臂梁長 L，正方形斷面，邊長為 h。若有一剪力作用於懸臂端點，求懸臂端點之變形，並說明只考慮彎矩變形之誤差。

成大土木研究所大地工程組博士班入學考試試題

1. The in situ moisture content of a soil is 16% and the moist unit weight is 1.95 g/cm^3. The specific gravity of soil solids is 2.70. This soil is to be excavated and transported to a construction site for use in a compacted fill. If the specifications call for the soil to be compacted to a minimum dry unit weight 1.9 g/cm^3 at the same moisture content of 16%, how many cubic meters of soil from the excavation site are needed to produce 10000 m^3 of compacted fill? How many 20 metric ton truckloads are needed to transport the excavated soil?

2. Refer to Fig. 1, Using the assumption suggested by Dupuit: the hydraulic gradient is constant with depth and $i \cong \dfrac{dz}{dx}$, derive the expression of the rate of seepage per unit length of the dam. Also, point out the shortcomings of Dupuit's assumption.
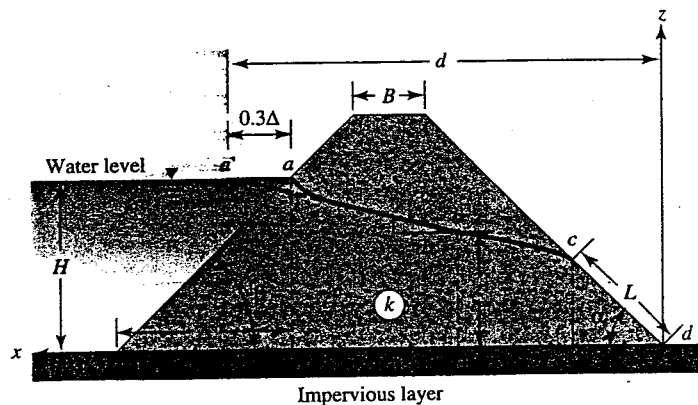

Fig. 1.

3. (a) What is the principal theoretical objection to the t-z approach and the p-y approach?
   (b) What is the principal practical objection to use of the t-z approach and the p-y approach?

4. What characteristics of the depositional environment influence the properties of sedimentary rocks? List as many ways as you can that folds and faults would be influence the construction of tunnels and dams.

5. Derive an analog to Equation (a) for the case where the strength envelope of the foundation rock has peak parameters ϕ_p, S_p and residual parameters ϕ_r, S_r. Where q_f and q_u are bearing capacity and unconfined compressive strength of rock, respectively.

$$q_f = q_u(N_\phi + 1)$$

where

$$N_\phi = \tan^2(45 + \phi/2)$$

1. 試列式說明鋼筋混凝土短柱受雙向彎曲之分析。 (20%)

2. 試列式說明鋼筋混凝土細長柱之分析。 (20%)

3. 鋼鐵，混凝土與木材為三種常用之結構材料，針對每一材料討論其抗拉強度與抗壓強度之大小比較，並說明原因。 (20%)

4. How many elastic constants for an anisotropic and orthotropic material do we have respectively ? why? (15%)

5. The following figure, as shown, represents a plate with a hole of radius b submitted to a uniform tension of magnitude P. By assuming an infinitely large plate, find the maximum stress around the hole. (25%)
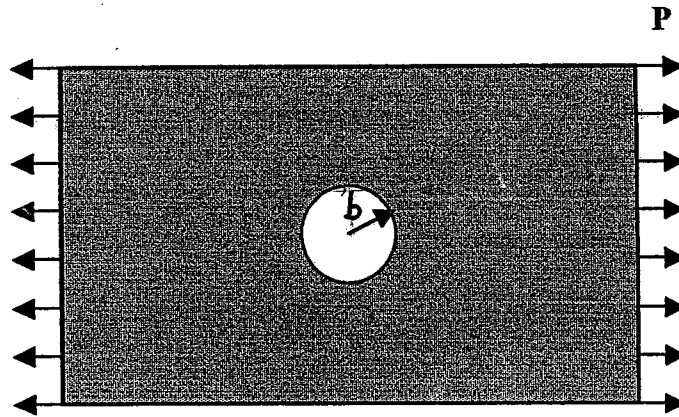
國立成功大學九十二學年度土木系博士班入學考試運輸工程試題
(道路工程部分)

1. 請推導公路免設超高彎道半徑。(參考變數：彎道半徑 R、重力加速度 $9.8m/sec^2$、路面摩擦係數 f、車速 v、路拱坡度 e) (20%)

2. PSI 與 PCI 是最常見的鋪面評估指標。請條列說明其本質上有何不同。(20%)

3. 彭柯曼樑是早期常用的儀器，請問它能量測什麼？(10%)
   近年來 FWD 大行其道，請說明他在哪些方面優於彭柯曼樑？(10%)

4. 路基在剛性鋪面分析或設計中常以 k 值代表強度，而在柔性路面中，AASHTO 設計規範以什麼試驗數值進行設計？(10%) 這兩項數值各有何特點，而分別適用於兩類鋪面設計？(10%)

5. (1)若以剛性鋪面中央載重公式分析瀝青路面變位，結果會比實際變位大或小？為什麼？(10%)
   (2)若以剛性鋪面邊緣載重公式分析瀝青路面應力，您又有何評論？(10%)

1. Describe the major Superpave physical tests for asphalt binders. (40%)

2. What kind of properties should the ideal pavement binder have? (30%)

3. Translate the following paragraph into Chinese. (30%)

Many engineers and technicians from all sectors of the asphalt business who entered the work force during the early days of the construction of the interstate system are reaching the end of their careers. These people must be replaced by engineers and technicians who are knowledgeable of asphalt materials and their proper use to successfully rebuild the highway sector of the transportation infrastructure.

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1 You are planning a construction project that will be performed from a remote camp. The estimators figure the job will require about 10,000,000 worker-hours to construct. The owner, a foreign government, has limited the construction of the base camp to a size that will accommodate 3,000 workers. It will take you about 6 months to phase up the worker force; the phase down can be done in three months. You decide to work 10 hours per day, 6 days per week, including holidays. What is an approximation of duration (months) of the project? The utilization profile of workers is shown in Figure 1. (25%)

Figure 1
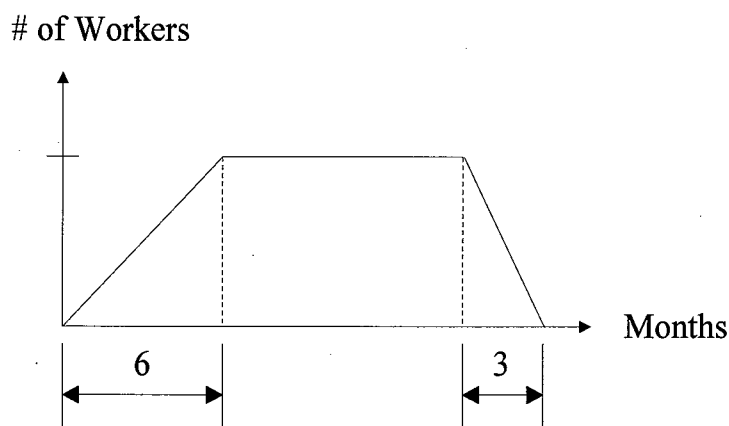
2 請就風險管理的原則(避免、降低、移轉、分配、自留)，分別舉例說明其在處理工程風險之應用？（25％）

3 現今已有許多的製造業利用『企業資源規劃，ERP』來整合工作流程與資訊，進而提升企業之競爭力，然而在營建業，仍只有少數廠商具體實行導入 ERP。請就你的觀察，分析營造業的特性，導入 ERP 的困難處，及可採取的因應方式？(20%)

4 請用中文簡述下列句子,須將內容表達清楚：(30%)

4.1 For example, location is fundamental to planning for a new industrial plant. Where can the plant be located to provide desirable, nearby employment for an adequate supply of skilled, productive workers? What are the present and projected costs and customs associated with the labor force? Depending on the nature of its raw-materials input and its products, will the plant have access to the most appropriate and economical forms of transportation, be they air, water, highway, rail, or pipeline? Does the location provide access to raw materials and to markets? Are there adequate sources of energy, including gas, oil, and electricity; and are there convenient communication facilities? What political or institutional factors may ease or impede the development and operation of the facility? What will be the sociological and economic impact of this plant on the community? What

will be the environmental impact? What do all these factors, taken as a whole, mean for the technical and economic feasibility of the project?

4.2 The Contractor shall be deemed to have satisfied himself as to the correctness and sufficiency of the Tender and of the rates and prices stated in the Bill of Quantities, all of which shall, except insofar as it is otherwise provided in the Contract, cover all his obligations under the Contract (including those in respect of the supply of goods, materials. Plant or services or of contingencies for which there is a Provisional Sum) and all matters and things necessary for the proper execution and completion of the Works and the remedying of any defects therein.