

國立交通大學 103 學年度第 1 學期 博士班資格考筆試考試試題

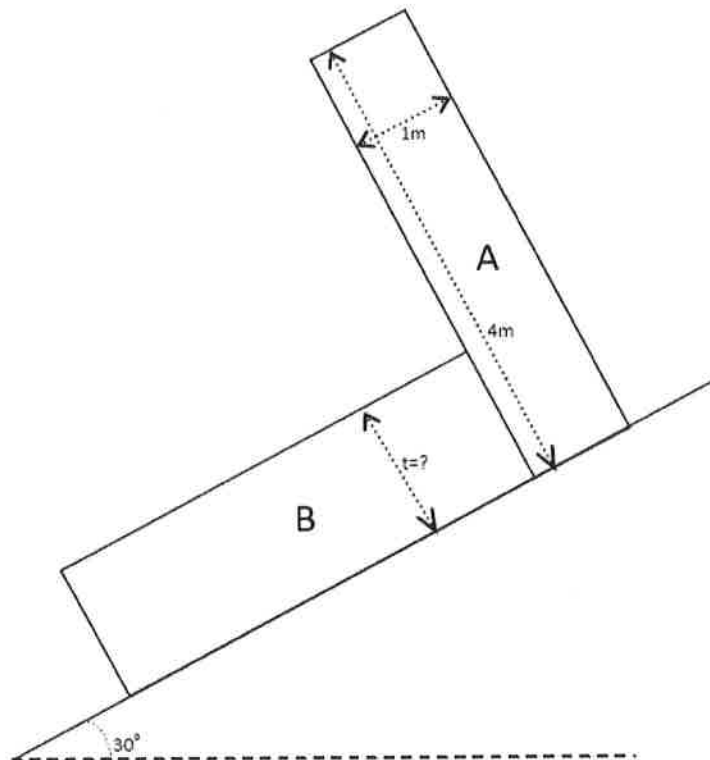
土木工程學系 大地組(丁) 科目：岩石力學與工程地質學 選考學生數：1 考試時間：180min

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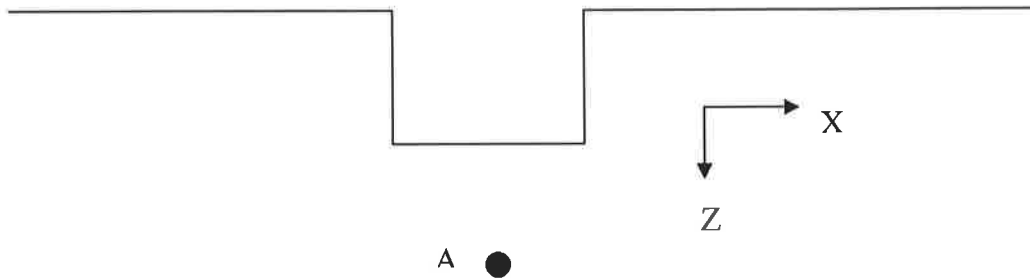
1. Many large scale landslides are attributed to regional geological structures. Sometimes, engineering construction may also cause slope instability. Elaborate these issues supported with proper examples. (15%)

2. A circular unlined tunnel is excavated in massive rock; the overburden is 400 m. The tunnel is 10 m in diameter. Given the following rock properties: unit weight, $\gamma = 25 \text{ kN/m}^3$; the strength parameters, $c = 5 \text{ MPa}$ and $\phi = 30^\circ$. The in-situ lateral stress ratio K is 0.8. Assume the massive rock behave as an elastic material. Will there be a fracture zone surround the tunnel's rim? If any, what will be the maximum thickness of the fracture zone around the tunnel? Where is it? (15%)

3. As shown in the following figure, the rectangular blocks A and B are in contact and are sitting on a 30° inclined plane. The height and the width of block A is 4m by 1m, respectively. Block B is twice as heavy as block A. The shear resistance on all faces is purely frictional with frictional angle $\phi = 35^\circ$. Providing these two blocks are in limit equilibrium, what are the most possible failure mode for block A and block B, respectively? What is the thickness t of block B? (20%)



4. At a particular site, the surface topography can be represented in a vertical cross section by a rectangular type valley (100m x 100m) separating horizontal, planar ground surface, as shown in the attached figure below. If the unit weight of the rock is 25 kNm^{-3} and the stress at a point, remote from the toe of the valley, with 200 m depth is $\sigma_{xx} = 9.0 \text{ MPa}$, $\sigma_{zz} = 6.0 \text{ MPa}$, $\tau_{xz} = 0$, estimate the stresses at the points A (100m below the center of valley bottom) considering the topographic effect. (15)



5. What is the GSI (Geological Strength Index) ? How is GSI applicable in Rock Engineering? Why and how the disturbance effect is considered in GSI? (15)

6. A restaurant with a parking lot locates on a potential failure slope as shown in the attached figure below. Based on literature and site reconnaissance results, the restaurant was excavated to form a level ground. The abandoned excavated material is one kind of colluvial deposit. The outcrop of the level ground is still the colluvium. Then, the footing of the restaurant was built on the level ground. It was found the depth of the rock surface is about 10 m below ground surface. The rock outcrops at the area s are sandstone, shale, and the interbeds of sandstone and shale. The orientation of the bedding planes is NS, 25oW. Propose a site investigation plan for slope stability analysis and mitigation approach suggestion. The locations of and types of site investigation should be shown on the attached figure. The goals and quantity of each investigation method should be described. (20)

Problem 1. (25%)

Explain how you would use cone penetration test (CPT) result to determine the drained shear strength of a sand. What factors should be considered and why?

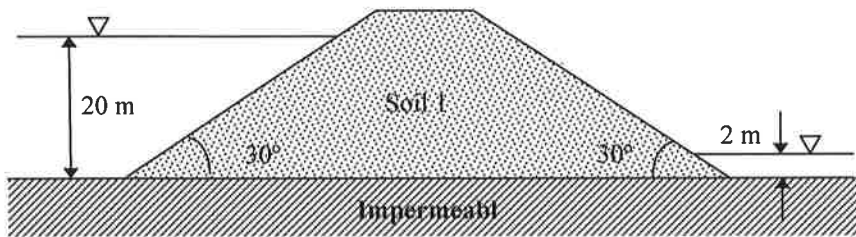
Explain how you would use CPT result to determine the undrained shear strength of a saturated clay. What factors should be considered and why?

Remember “why” is more important than “how” and “what” in you answer.

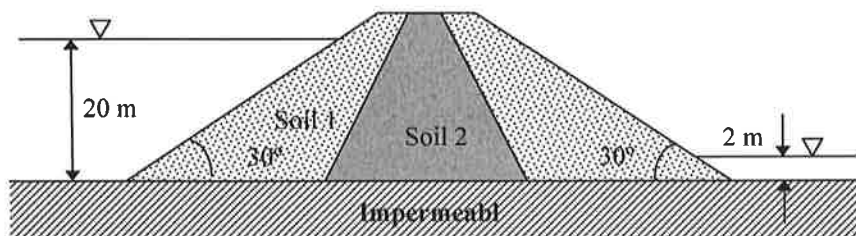
Problem 2. (25%)

為了一個水資源計畫，在一河道中要興建一座水壩。請針對以下問題回答：(a)一均質土壩，壩頂寬度 15 m、壩高 25 m。土壤為含砂之粉土(Sandy silt)，導水度 1×10^{-5} cm/s。上下游水位如圖所示，試繪製水流經過壩體的流網，並估計每單位長度壩體的滲流量。(b)若為降低流量，在設計時評估土壩中施做低透水性壩心，採用的黏土導水度為 1×10^{-7} cm/s。請繪製流網，並估算每單位長度壩體的滲流量。壩心位於土壩中間，頂寬 5 m，底寬 15 m。

[流網請在答案卷上自行繪製，圖可放大。壩體的比例精確度不嚴格要求。可看出流網繪製的重點與概略正確性即可。]



(a)均質壩



(b)具低透水材料壩心的土壩

Problem 3 (25%)

(a) How do you control the quality of compacted soil? Describe the controlling parameters and the destructive or non-destructive methods associated with them. (10%)

(b) A compressible clay layer extends from the ground surface to a depth of 20 m and its initial saturated unit weight is 18 kN/m^3 . After consolidation due to an added fill, the final saturated unit weight became 18.2 kN/m^3 . The unit weights were determined at the middle of the clay layer. Assume the specific gravity of solids is 2.7 and the compression index C_c is 0.4. The water table is at the surface. Determine the total amount of settlement of the ground surface using two methods: 1) treat the clay as one layer; 2) break the clay into 2 sublayers. Why are these answers different? (15%)

Note:

- Assume that the given C_c is applicable to in situ conditions (i.e., the clay was not deposit very slowly)
- Some phase relationship: $Se = wG_s$, $\gamma_d = \frac{\gamma_s}{1+e} = \frac{\gamma_m}{1+w}$

Problem 4 (15%)

某一質量為50 kg之小型垂直振動起振機 (exciter)，安裝在質量為500 kg之方形(1 m x 1 m)混凝土基礎上，此起振機輸出之垂直力 $Q(t) = Q_0 \sin \omega t$ ， $Q_0 = 100 \text{ N}$ ，假設地面為剛性基面(rigid base)。基礎與剛性基面間將放入可忽略質量之兩片塑膠墊片，當放入第一片膠墊時，發現膠墊產生6 mm垂直變形，加放入第二片膠墊時，則膠墊總變形為9 mm，假設系統阻尼比為 0.10，試求：

- (1) 各膠墊之k值。
- (2) 系統之自然頻率 f_n 、阻尼自然頻率 f_D 、及共振頻率 f_m (resonant frequency)。
- (3) 起振機振動頻率分別為0 Hz、 $0.7f_n$ 、 $1.4f_n$ 、 $2.0f_n$ 狀況之基礎垂直振幅(mm)。
- (4) 請繪出起振機振動頻率從0 Hz到 $2.0f_n$ 之振動反應曲線 (MF vs. β curve)。(15%)

Problem 5 (15%)

- (1) 試說明為何在受到地震力作用後，擋土結構物可能逐漸產生側向位移。
- (2) 為何濱水擋土結構物(waterfront retaining structures)在地震後，常發生重大損壞？(10%)