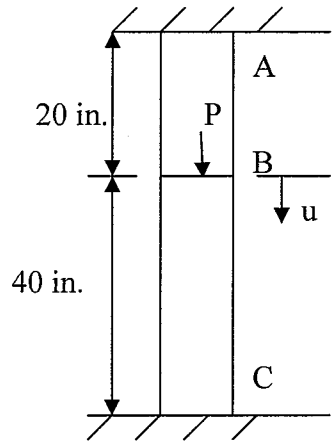
Ph. D. Entrance Examination

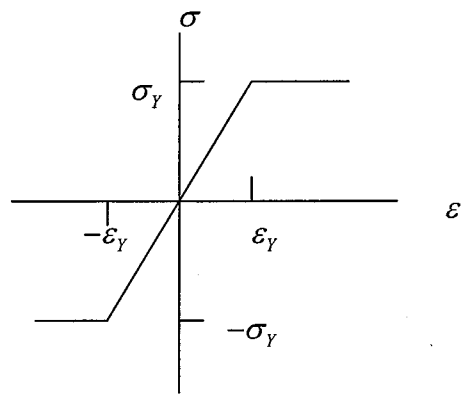
May 29, 2004

1. **(20%)** Bar A-B-C has a constant cross-sectional area A=0.8 in^2. The material has an elastic, perfectly-plastic stress-strain behavior as shown in Fig., with $\sigma_Y = 36\ ksi$ and $E = 30\times10^3\ ksi$

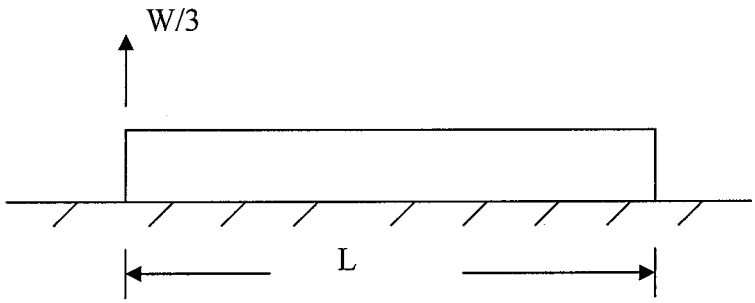
(a) Determine the load P_Y at which first yielding occurs, and determine the corresponding displacement u_Y of section B where the load P is applied.

(b) Determine the load P_U at which yielding occurs in the remaining segment of the bar, and determine the corresponding displacement u_U of section B.





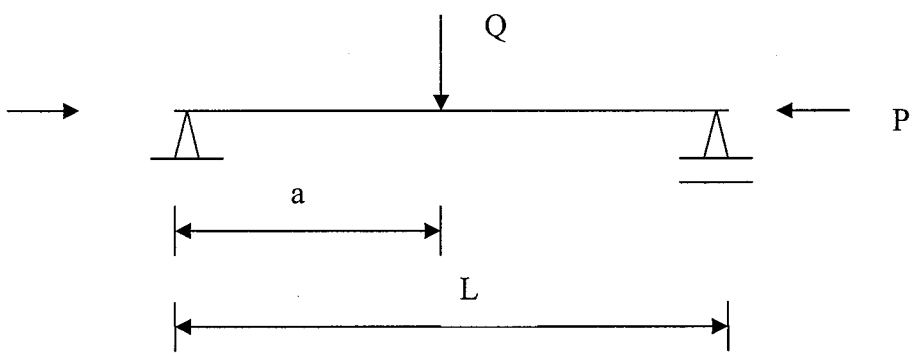
2. **(15%)** A homogeneous straight beam of length L and total weight W (weight density q per unit length is q=W/L) rests on a smooth rigid plane. Determine the length of the left-hand part of the beam leaving the rigid plane when a force W/3 is applied to its end.



3. The ideal beam-column is subjected to the force Q and the axial load P. EI is constant.

(a) **(20%)** Derive the expression for the deflection of the beam-column.

(b) **(15%)** Determine the maximum displacement and the maximum moment in the beam-column.



4. For a delta strain rosette in the position shown

(a) **(10%)** Show that the maximum principal strain is located at angle, counterclockwise to the x axis, where

$$\tan 2\theta = \frac{\sqrt{3}(\varepsilon_b - \varepsilon_c)}{2\varepsilon_a - \varepsilon_b - \varepsilon_c}$$

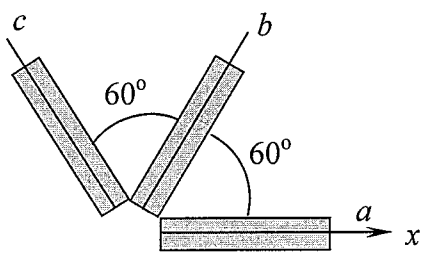
(b) **(10%)** Shown that the two principal strains 1 and 2 are given by

$$\varepsilon_1 = \frac{\varepsilon_a + \varepsilon_b + \varepsilon_c}{3} + R, \qquad \varepsilon_2 = \frac{\varepsilon_a + \varepsilon_b + \varepsilon_c}{3} - R$$

Where

$$R = \tfrac{1}{3}[(2\varepsilon_a - \varepsilon_b - \varepsilon_c)^2 + 3(\varepsilon_b - \varepsilon_c)^2]^{1/2}$$

(c) **(10%)** Construct the corresponding Mohr's circle for the delta rosette.



九十三學年度博士班入學考試「大地工程學」試題

1. Following are the results of a sieve analysis. Make the necessary calculations and draw a particle-size distribution curve. (25%)

U.S. sieve size	Opening (mm)	Mass of soil retained on each sieve (g)
4	4.75	0
10	2.00	40
20	0.850	60
40	0.425	89
60	0.250	140
80	0.180	122
100	0.150	210
200	0.075	56
Pan	—	12

And then, determine a. D_{10}, D_{30}, D_{60}
b. Uniformity coefficient, C_u
c. Coefficient of gradation, C_z

2. A consolidated-drained triaxial test was conducted on a normally consolidated clay. The results were as follows: (25%)
$\sigma_3 = 250\ kN/m^2$
$(\Delta\sigma_d)_f = 275\ kN/m^2$
Determine the following:
a. Angle of friction, ϕ'
b. Angle θ that the failure plane makes with the major principal plane
c. Normal stress, σ', and shear stress, τ_f, on the failure plane

3. (a) Draw curves of load versus settlement for circular foundation under four conditions (1) surface foundation on loose sand (2) surface foundation on dense sand (3) deep foundation on loose sand (4) deep foundation on dense sand. Put curve 1 and curve 2 on one diagram, and curve 3 and curve 4 on another.
(b) In what might be termed classical bearing capacity (Fellenius, Prandtl, Terzaghi, etc.), what assumptions are made regarding soil properties themselves? Think in broad terms and don't leave out "obvious" factors. Note that the question relates to soil properties. (25%)

4. (a) Describe the load transfer mechanism from a pile to the soil, and how to model this transfer mechanism? (b) Describe how to construct a representative t-z curve. (c) What is the principal theoretical objective to the t-z approach and practical objective to use the t-z approach? (25%)

國立成功大學土木系九十三學年度博士班入學考試運輸工程試題

Part I. Please translate the following paragraphs into Chinese, and briefly elaborate your thoughts on each paragraph.

1. Scientific knowledge is defined collectively through discussion and debate. Group discussion—whether in seminars, orientations, research settings, or informal settings—can demonstrate how different individuals would react in specific situations, often leading to conclusions that no one would have arrived at individually.
2. Methods are important in science, but like scientific knowledge itself, they are not infallible. As they evolve over time, better methods supersede less powerful or less acceptable ones. Methods and scientific knowledge thus progress in parallel, with each area of knowledge contributing to the other.
3. There are many right problems, but very few people search carefully for them. Rather they simply drift along doing what comes to them, following the easiest path to tomorrow. Great scientists all spend a lot of time and effort in examining the important problems in their field.
4. Deep emotional commitment seems to be necessary for success. The reason is obvious. The emotional commitment keeps you thinking about the problem morning, noon and night, and that tends to beat out mere ability.

Part II.

5. Briefly describe the Superpave mix design method. (35%)
6. Describe the two principal types of HMA mixing facilities in use today. (35%)
7. What kind of properties should the ideal pavement binder have? (30%)

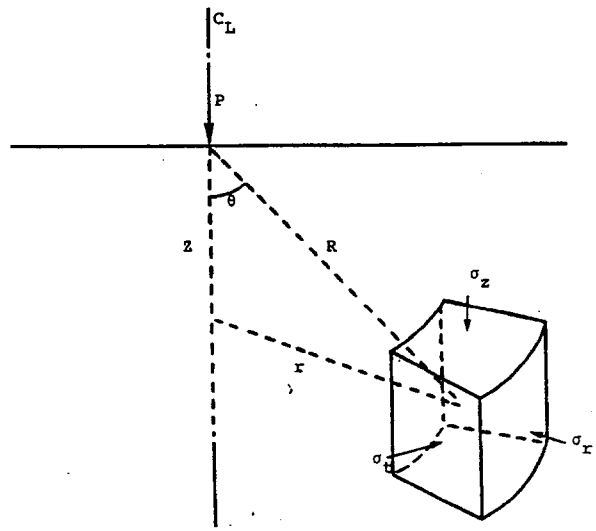
Part III

In 1885, Boussinesq formulated a set of equations for calculating the stress, strains and deflections of a homogeneous, isotropic, linear elastic semi-infinite space under a point load. The equation for vertical displacement for a point load is shown as

$$\delta = \frac{(1+\mu)P}{2\pi RE}\left[2(1-\mu)+\cos^2\theta\right]$$

Please derive the equation below for vertical displacement for a circular distributed load, σ, with loading radius a)

$$\delta = \frac{(1+\mu)\sigma \cdot a}{E}\left[\frac{1}{\sqrt{1+\left(z/a\right)^2}} + (1-2\mu)\left(\sqrt{1+\left(z/a\right)^2} - z/a\right)\right]$$



Note :

$$\int \frac{x}{\sqrt{x^2+a^2}}dx = \sqrt{x^2+a^2}, \quad \int \frac{x}{\left(x^2+a^2\right)^{3/2}}dx = -\frac{1}{\sqrt{x^2+a^2}}$$

結構材料組博士班入學考試 (Closed Book)

(A) 25%

Describe briefly the following terminologies:

1. The **softening effect** of reinforced concrete beams subjected to shear;
2. The **unified theory** of reinforced concrete structural components;
3. The **secondary moment** of prestressed concrete structures during the prestressing;
4. The **tension stiffening effect** of reinforced concrete beams;
5. The **tension shift effect** of reinforced concrete beams.

(B) 25%

(a)碳鋼之楊氏模數(Young's Modulus)、降伏強度(Yielding Strength)、抗拉強度(Tensile Strength)及延展性(Ductility)等性質，如何隨其含碳量之多寡而改變？為什麼？

(b)淬火(Quenching)與回火(Tempering)熱處理，如何影響碳鋼之楊氏模數、降伏強度、抗拉強度及延展性？

(C) 25%

請寫出下列各項物理量之單位:

(a) Bulk Modulus _____

(b) Stress Intensity Factor _____

(c) Coefficient of Thermal Expansion _____

(d) Dilatation _____

(e) Atomic Packing Factor _____

(D) 25%

就你所知, 試舉例說明如何利用動態檢測來測試材料特性及損壞

成大土木系工程管理組　九十三學年度博士班入學考　93 年 5 月 29 日

一、 請就你的碩士論文，重點說明研究的問題、問題的重要性、過程中所碰到的困難、解決的方法、解決與否、爲何未解決。(40 分)

二、 營造行業爲人詬病進步緩慢，請問你的看法如何，請就理論面及實務面說明。理論有否不足，實務面可從國內市場、政府政策、業主、設計者、施工者等角度探討。(30 分)

三、 關於時程規劃與控制，實務上有不同程度做法，有的工程可能只畫個桿狀圖，有的工程可能只在最初畫一網圖，後續也不再更新。請對中大型工程，說明正規做法。(30 分)