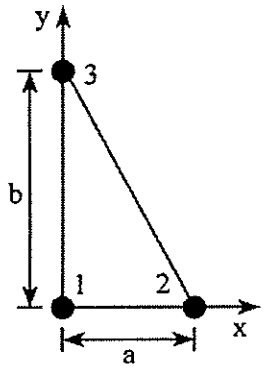
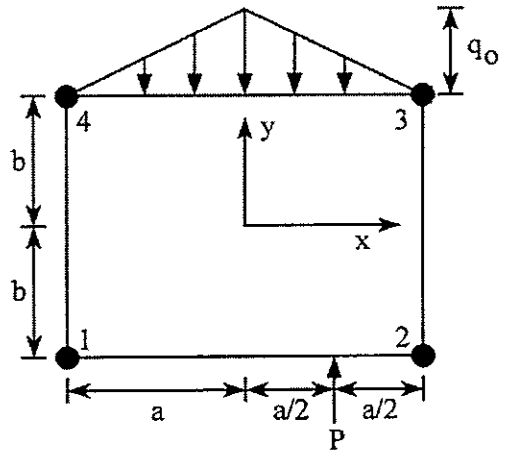
Finite Element Method

(Close book, 100 minutes, 70% to pass)

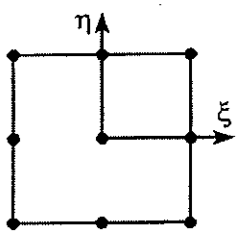
1. The displacement field u of the CST element can be expressed as $u=[N]\{d\}$, where $[N]=[N_1,N_2,N_3]$ and $\{d\}^T=\{u_1,u_2,u_3\}$. Find the expressions for N_1, N_2, N_3 and ε_x. (15%)



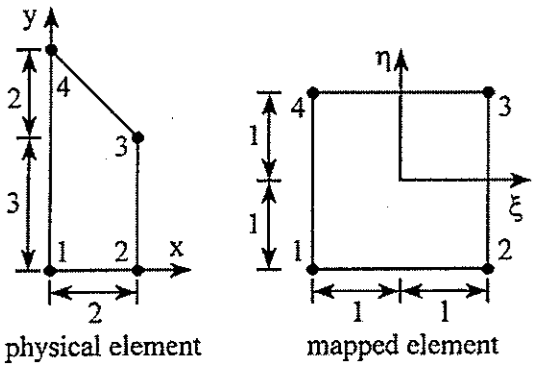
2. A Q4 element with constant thickness t is subjected to a distributed load q(x) (unit: force/length) and a concentrated force P as shown. Find the consistent nodal forces in y direction for all the nodes 1, 2, 3 and 4. (20%)



3. (i) Sketch one of the zero energy mode shape for a 9-node isoparametric plane element with reduced integration rule. (ii) Explain why the strain energy at the reduced integration point is zero? (15%)



4. Calculate the Jacobian matrix [J] and its determinant J of the 4-node element shown below. (15%)



physical element mapped element

5. Consider a flat-faced tetrahedron of volume V = 1/6, and the function:

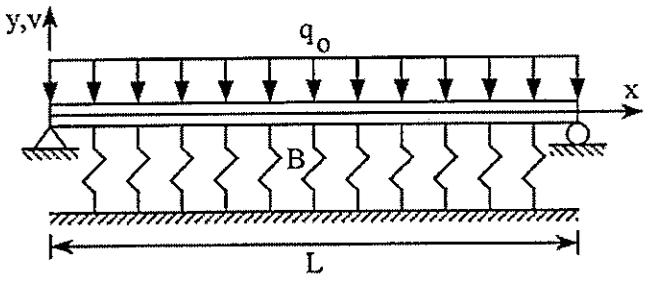
$$\phi = a_1 r + a_2 r^2 + a_3 rs$$

Where the a_i are constants. (a) obtain the integral $I = \int \phi dV$ over the volume V using the 4-point integration rule. (b) Is the solution obtained in (a) exact or not exact? (15%)

TABLE 7.4-2 SELECTED FORMULAS FOR NUMERICAL INTEGRATION OVER A TETRAHEDRAL VOLUME, EQ. 7.4-2 [7.11]

No. of points	Degree of precision	Coordinates (r_i,s_i,t_i)	Weights W_i
1	1	$\left(\frac{1}{4},\frac{1}{4},\frac{1}{4}\right)$	1.0
4	2	$(a,b,b),(b,b,b),(b,b,a),(b,a,b)$	$\frac{1}{4}$
		where $a = \frac{5+3\sqrt{5}}{20}$, $b = \frac{5-\sqrt{5}}{20}$	

6. A simply supported beam rested on elastic foundation (with foundation modulus B) is shown below. The beam is subjected to a uniformly distributed lateral load q_o. The differential equation of the beam can be written as: $EIv_{,xxxx} + q_o + Bv = 0$. Assume the approximate deflection of the beam is $\tilde{v}(x) = \alpha x(L-x)$. Use the Galerkin method to find the generalized d.o.f. α in the approximate deflection. (20%)



104 年度第一學期博士候選人資格
考<u>工程地質</u>試題

1. Translate following terminologies to Chinese and explain their meanings: (25%)
   (a) subduction zone (b) Shear Zone
   (c) Bowen's reaction series
   (d) soft fillings (e) unconformity

2. Distinguish among a joint, a fault, and a fold. How are they formed ? What are their effects on the rock mass ? (20%)

3. List three most popular rock mass classification systems. Also describe what parameters used in the Rock Mass Rating (RMR) system (Bieniawski, 1973). (18%)

4. List types of discontinuity of rock mass? (12%)

5. An Nx core of fine-grained granite, 5 cm in diameter and 10 cm long, is tested in unconfined compression. The modulus of elasticity for the rock is 63.4 GPa, Poisson's ratio is 0.21, and its unconfined compression strength is 169 MPa. If the core is loaded to one-quarter its unconfined compression strength, give the answer to the following questions:
   (1) What is the load on the sample in kN?
   (2) What axial strain occurs at this load, What deflection?
   (3) Whaat lateral strain occurs at this load, what lateral deflection? (15%)

6. What is rock quality designation (RQD)? Calculated the RQD for the rock coring shown in Fig. 1. (10%)

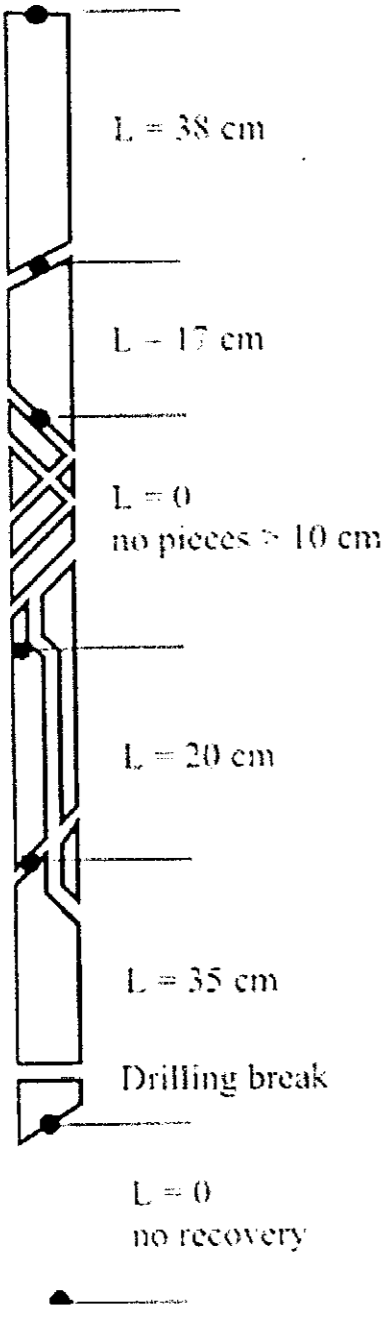


Fig.1

The Qualification Examination of Doctoral Program- October, 2015
Division of Geotechnical Engineering,
Department of Civil Engineering,
National Cheng Kung University

Foundation Engineering

1. List the types of shallow foundation(25 points)

2. List the conditions that require the use of pile foundations.(25 points)

3. Draw figures and describe three failure modes of theshallow foundation.(25 points)

4. A square foundation is 2m X 2m in plan. The soil supporting the foundation has a friction angle of $\emptyset' = 25^\circ$ and $c' = 20\ kN/m^2$. The unit weight of soil is $16.5\ kN/m^3$. Determine the allowable gross load on the foundation with a factor of safety (FS) of 3. Assume that the depth of the foundation D_f is 1.5m and the general shear failure occurs in the soil. (25 points)

Soil Mechanics

(Open book; 100 minutes; 60% to pass)

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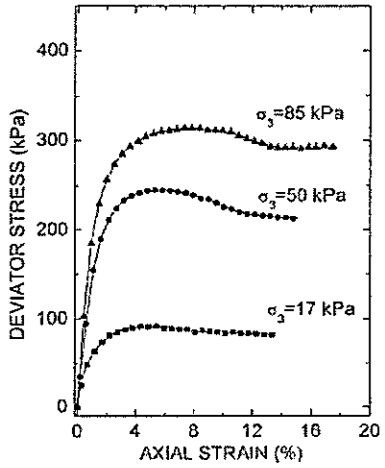
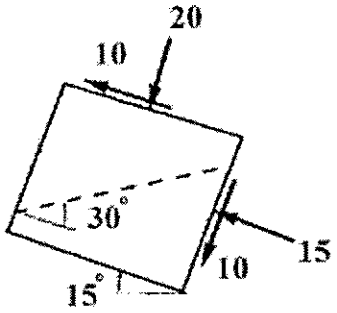
1. (45%) Given the stress-strain relationships for a series of drained triaxial tests, determine the strength parameters for the Mohr-Coulomb failure criteria.



2. (35%) Determine the maximum and minimum principal stresses for the soil element given below, and the direction of the major principal stress (the angle it makes with the vertical). Also determine the normal and shear stresses acting on the plane (dashed line) using the pole method (unit: kPa)



3. (20%) Briefly explain the following terms:
   (a) Thixotropy
   (b) Activity
   (c) Soil Consistency
   (d) Proctor test
   (e) ϕ=0 concept