UNIVERSITI SAINS MALAYSIA

1st. Semester Examination
2004/2005 Academic Session

October 2004

EAS 664/4 – Principle Structural Design

Time : 3 hours

Instruction to candidates:

1. Ensure that this paper contains **FIVE (5)** printed pages.
2. This paper contains **FIVE (5)** questions. Answer **ALL (5)** questions.
3. All questions **CAN BE** answered in English.
4. Each question carry equal marks.
5. All question **MUST BE** answered on a new sheet.
6. Write the answered question numbers on the cover sheet of the answer script.

1. (a) Briefly describe the following structural forms in order to provide functional spaces of high-rise building to suit the clients's requirement:

   i. Braced - Frame structures
   ii. Shear – Wall structures
   iii. Braced – Tube structures

(9 marks)

(b) A ten storey rigid frames shown in Figure 1.0 is situated at Penang in the terrain category 3 area with the basic wind speed of 33.5 m/s^2. The basic wind speed has been converted to equivalent horizontal force as shown in Figure 1.0. The story height is typically 3.5 m, to give a total height of 30m. The frames are spaced at 9m. Using the Portal Method, calculate :

   i. The horizontal external shear at mid-story level for each story.
   ii. The shear to half-columns above and below of fifth story
   iii. The maximum moment above and below joint at fifth story.
   iv. The shear in the girder at fifth story.

Indicates all values (i – iv) on the diagram.

(9 marks)

(c) Describe **TWO** advantages for the above analysis in 2 (b) using Portal Method.

(2 marks)

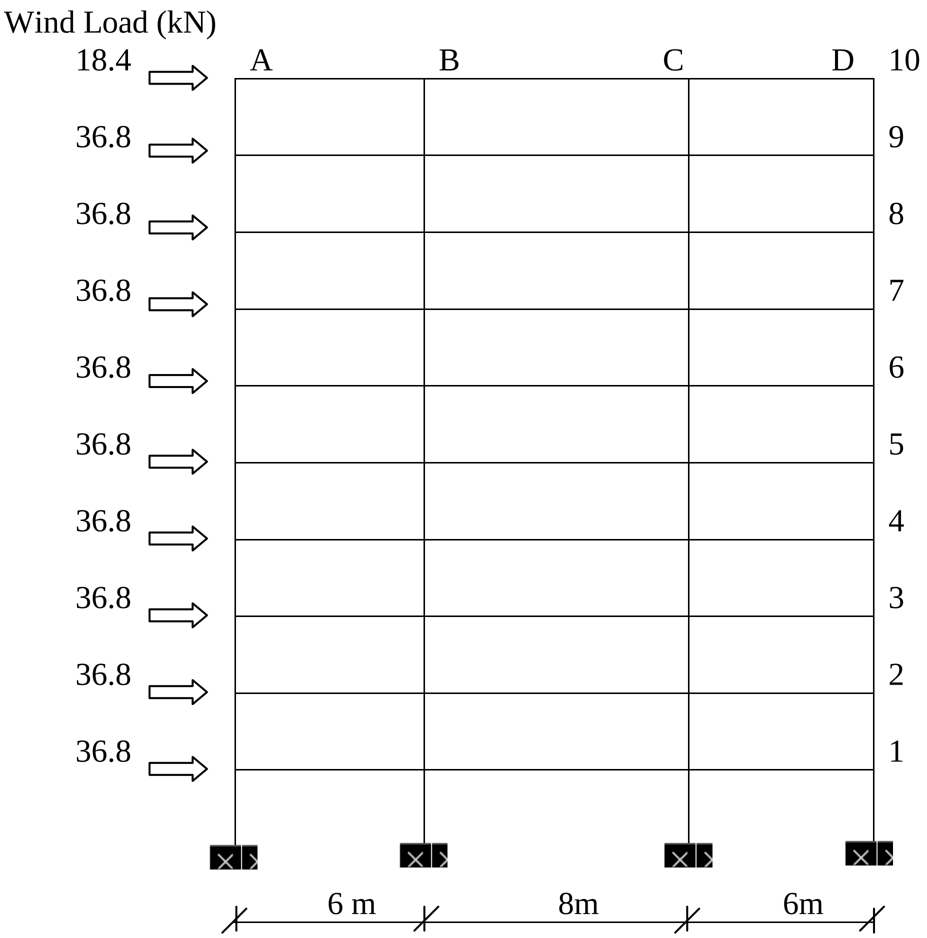

Figure 1.0

2. (a) Write the **SIX (6)** compatibility equations of deformed body or structure. Assume the deformation is small.

(6 marks)

(b) Show that Von Mises and Tresca Yield criteria in two spaces are elliptical and hexagon respectively. State the advantages of Von Mises Yield criteria compared to the Tresca Yield criteria.

(4 marks)

(c) Using stress- strain relationship, sketch the Bauchinger effect for homogenous material. Hence, explain what is homogenous material.

(4 marks)

(d) Derive *the partial differential equation* in X direction for two dimensional stress strain state.

(6 marks)

3. (a) Prepare the following basic data (i – iv) to design a cantilever retaining wall to support a road shoulder as shown in the Figure 2.0. The top surface of the concrete pavement is subjected to uniformly distributed load of 10kN/m and two point load P1 and P2 = 5kN. Assume the retaining wall is backfilled with granular material having a unit weight of 20 kN/m^3 and an internal angle of friction of 30. The bearing capacity from soil investigation is 200 kN/m^2, the coefficient of friction is 0.5 and the unit weight of concrete pavement is 24 kN/m^3.

Determine :

i. Determine the factors of safety against sliding
ii. Determine the factors of safety against overturning
iii. Determine the ground bearing pressures
iv. Check the design moment at base of stem

(16 marks)

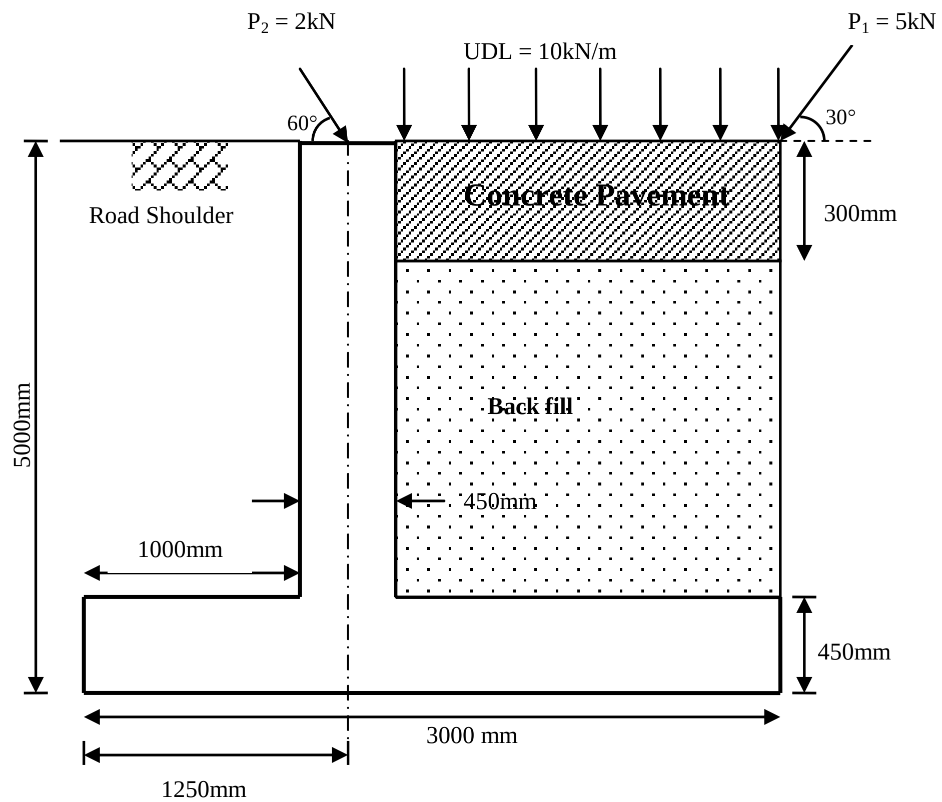

Figure 2.0

(b) A fixed end bar with cross section area A is subjected to an axial force P as shown in the Figure 3.0. Assume $A=15cm^2$, $E = 20 \times 10^6\ N/cm^2$. Determine the displacement at point C.

(4 marks)

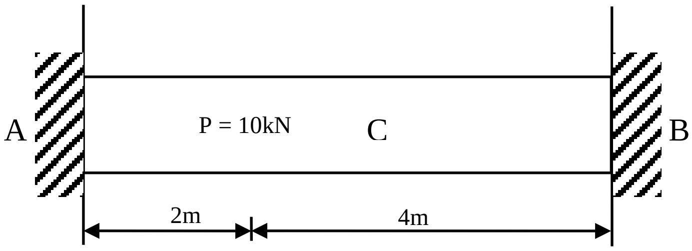

Figure 3.0

4. (a) List and explain the fundamental points to be taken into account in the design of steel structure for preventing corrosion.

(10 marks)

(b) Describe **THREE (3)** methods of cleaning steel structures for removing all millscales.

(10 marks)

5. Figure 4.0 shows a single bay fixed base portal frame which has been constructed with steel grade S275, using the plastic theory of design. Details of the frames and loading are given below :-

Data :	Frame centres	=	4.6 m
	Span of portal	=	25.0 m
	Height to eaves	=	7.6 m
	Rafter slope	=	3 : 10
Loading :	Imposed	=	$0.75\ kN/m^2$
	Sheets and insulation	=	$0.21\ kN/m^2$
	Purlins	=	$0.07\ kN/m^2$
	Frame	=	$0.15\ kN/m^2$

By assuming modes of failure as shown in the figure,

i. Determine the values of full plastic moment for factored load Mp elastic moment M and reaction forces R.
ii. Check the lateral stability on the heights of 7.6 m for a factored load of 1.91.

(20 marks)

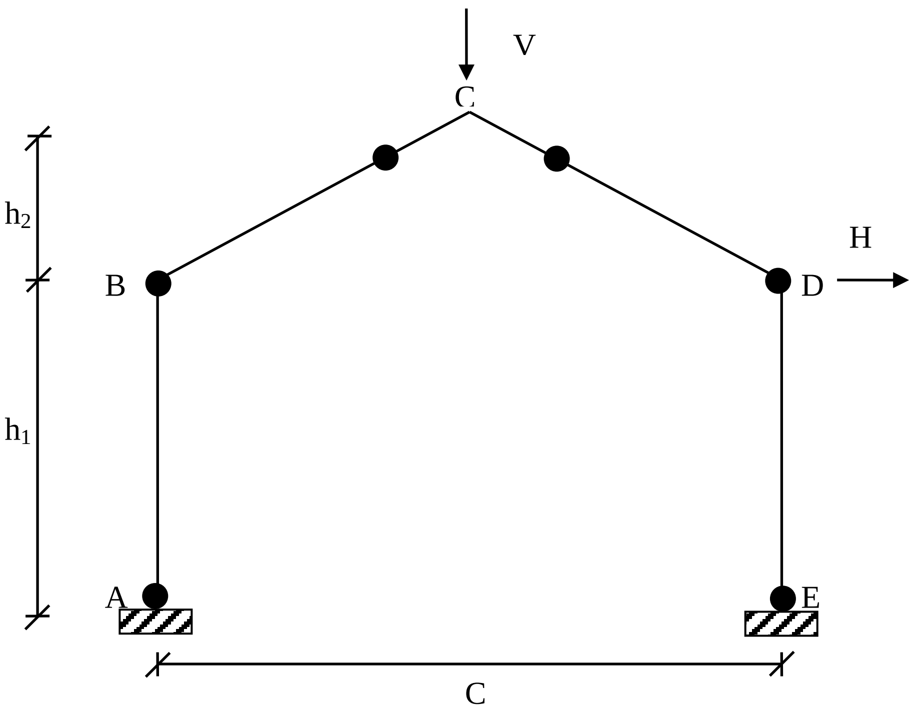

Figure 4.0

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