
UNIVERSITI SAINS MALAYSIA

3rd. Semester Examination
2004/2005 Academic Session

May 2005

EAS 664/4 – Principle of Structural Design

Duration : 3 hours

Instructions to candidates:

1. Ensure that this paper contains **FOUR (4)** printed pages before you start your examination.
2. This paper contains **FIVE (5)** questions. Answer **ALL (5)** questions.
3. All questions carry equal marks.
4. All questions **CAN BE** answered in English or Bahasa Malaysia or a combination of both languages.
5. Each question **MUST BE** answered on a new sheet.
6. Write answered question numbers on the cover sheet of the answer script.

1. (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 millscalls. (10 marks)
2. Figure 1.0 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
	Purlin spacing	=	1.25
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 1.0,

- i. Determine the values of full plastic moment for factored load M_p 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.

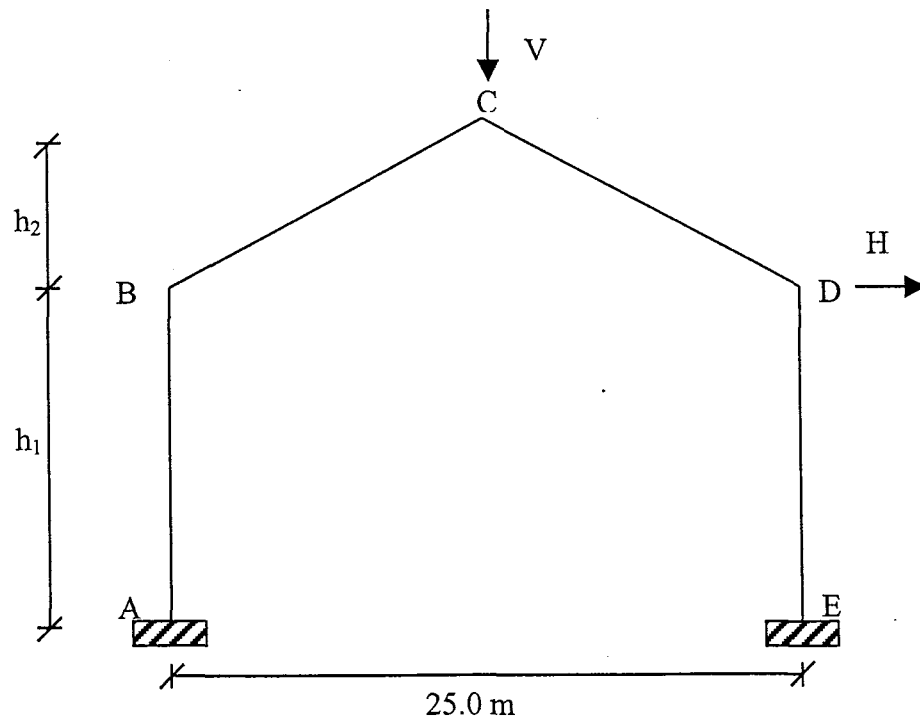


Figure 1.0

(20 marks)

3. (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

(9 marks)

(b) A eight storey rigid frames shown in Figure 2.0 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 2.0. The story height is typically 3.0 m, to give a total height of 24m. The frames are spaced at 10m. 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 3 (b) using Portal Method.

(2 marks)

Wind Load (kN)

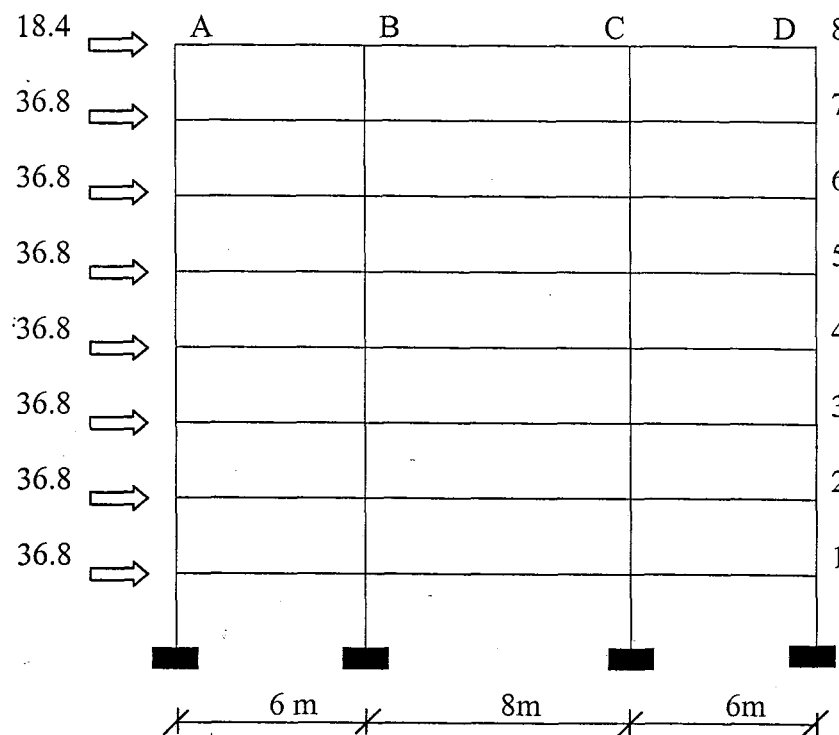


Figure 2.0

4. (a) Derive the equation of equilibrium for plane stress problems. (10 marks)
- (b) Briefly explain the Von Karman notation. (5 marks)
- (c) Under what condition would you recommended the application of Bauchinger effect. (5 marks)
5. (a) The stress tensor σ_{ij} at a point in a body is given by:

$$\sigma_{ij} = \begin{vmatrix} 2 & 3 & 4 \\ 3 & 3 & 2 \\ 4 & 1 & 3 \end{vmatrix}$$

Find:

- (i) Octahedral normal stress. (5 marks)
- (ii) Octahedral shear stress. (5 marks)
- (b) (i) Show the Von Mises Yield Criteria in σ_1, σ_2 plane is an ellipse. (5 marks)
- (ii) If $\sigma_3 \neq 0$, draw the loci of the Tresca Criteria in the two spaces and compared with the loci obtained using Von Mises Criteria. (5 marks)