DEPARTMENT OF CIVIL ENGINEERING: IIT DELHI

MAJOR EXAM

CEL 727: DESIGN OF INDUSTRIAL STRUCTURES SEMESTER I, 2006-2007

Max Marks = 40 **Time limit: 2 hrs. Course Coordinator: Dr. Alok Madan**

Instructions: ***1. This is a 'closed book' exam. Only design codes may be referred***
2. Assume M 25 concrete and Fe415 High yield strength deformed (HYSD) steel (f_{pu} = 415 Mpa) where material grades are not specified.
3. Make suitable assumptions wherever necessary.

1. The single bay inverted V-shaped folded plate roof shown in Figure 1 covers a 4 m wide bay and spans 5 m in the longitudinal direction between end diaphragms that are infinitely rigid in their own plane but flexible out-of-plane. As shown in the figure, the folded plate has a height (depth) of 1.0 m with a plate thickness of 100 mm and is subjected to the following loading in addition to self weight (unit weight of concrete = 25 kN / m^3):

   Dead load = 1.0 kN/m^2 (over the surface area)
   Finish = 0.8 kN/m^2 (over the surface area)
   Live load = 1.5 kN/m^2 (over the surface area)

   Analyze the folded plate to obtain the
   (a) transverse moments at the edges of the plate due to slab action (4 marks)
   (b) longitudinal normal stresses at the edges of the plates due to plate action (6 marks)

2. The bin shown in Figure 2 for storage of a granular material is rectangular in plan and is provided with a hopper at the base. Assuming that the hopper has a concentric discharge opening and the angle of repose ρ for the stored material is 25°,

   (i) Classify the bin as silo or a bunker based on Coulomb theory. Also mention the criteria used for elassification. (3 marks)
   (ii) Determine the hydraulic radii R_a and R_b to be used for calculating the static unit pressures on the shorter side 'a' and longer side 'b' respectively. The outlet dimensions at the location of concentric discharge may be taken as 2.5 x 1.5 m. (2 marks)

   (iii) If the vertical static unit pressure at the junction of the bin and hopper is 70.0 kN/m^2 and the overpressure factor during discharge is 1.4, calculate using Janssen's method the (a) design pressure in the vertical direction, (b) design pressure in the horizontal direction and, (c) design pressure in the direction normal to the shorter inclined face of the hopper at that location.
   (5 marks)

3. An industrial chimney of 100 m height is to be constructed for a thermal power station in Delhi as a reinforced concrete prismatic cylindrical shell of uniform eross-section with an internal diameter of 12m and wall thickness of 300 mm. The horizontal cross-section of the

chimney at a height of 50m above the base has a single opening that subtends an angle of 30° at the center of the cross-section. The unit weight of chimney material is 25 KN/m^3.

(a) Using the simplified procedure detailed in IS: 4998 (Part 1) - 1992, calculate the sectional shear force and bending moment due to the along wind and across wind loads at the cross-section of the chimney located at 50 m height. (12 marks)

(b) Using IS: 4998-1975 or 1962, calculate the maximum vertical stresses in the concrete at the cross-section located at 50 m height due to the combined effect of dead load, wind load and temperature load. (8 marks)

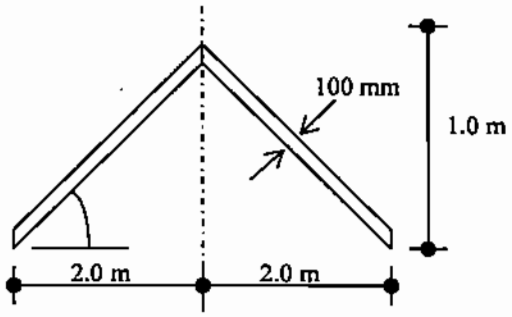

Figure 1

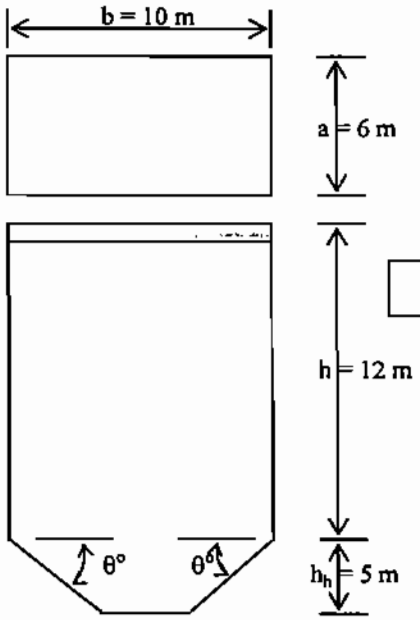

Figure 2