EXERCISE 1
2D ANALYSIS USING DIRECT STIFFNESS APPROACH
STEEL BUILDING

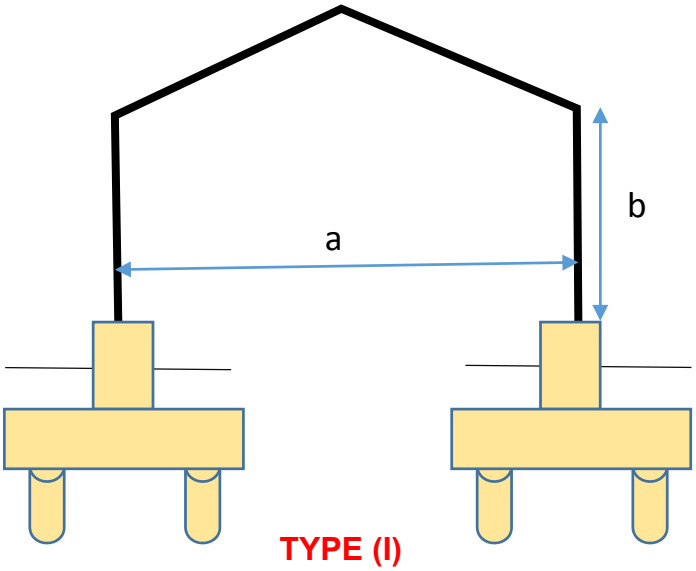
Relevant codes: IS 800, IS 875(I,II,III), IS 1893(I)

Last date of submission: 16 Aug 2019 (Total marks = 10 report + viva)

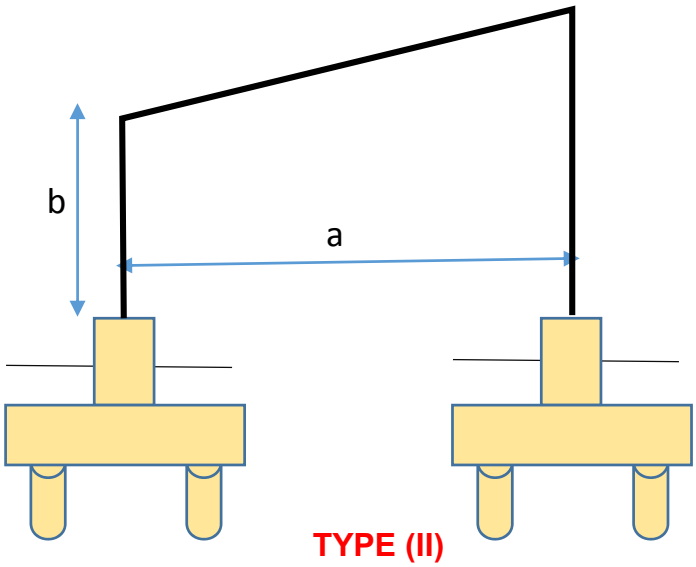
A client wants to erect an steel industrial shed building for a manufacturing unit with plan dimensions and other details as outlined in Table 1. The roof as well as side claddings shall be made up of GI sheets. The shop floor is 300 mm above the finished ground level (FGL), which is in turn 500 mm above the natural ground level (NGL). The RC pedestals project 250 mm above the shop floor with anchor bolts to support the superstructure columns. The geotechnical investigation report recommends pile type foundation, suggesting 15 m long and 0.5 m diameter piles with allowable loads of 500 kN, 100 kN and 20 kN in compression, tension and horizontal shear. The bottom of pile cap may rest 1 m below the NGL. Typical cross sections are shown in Fig. 1.

Table 1: Details of steel frames to be analysed

GROUP	STRUCTURAL SYSTEM	TYPE	a x b (m^2)	Building length (m)	Roof slope
1	Columns with trusses (fixed base)	I	15 x 5	40	1 in 3
2	Portal frame with fixed base	I	20 x 6	60	1 in 5
3	Portal frame with hinged base	I	20 x 6	80	1 in 3
4	Portal frame with fixed base	II	15 x 6	45	1 in 3
5	Portal frame with hinged base	II	15 x 6	45	1 in 3



TYPE (I)



TYPE (II)

For this building, carry out the following in your capacity as a qualified Structural Engineer:

1. Conceive a suitable 2D structural system of steel consisting of frame or trussed columns in accordance with your group (see Table 1).

2. Assume suitable member sizes and carry out estimation of all loads. Earthquake and wind load computation should be done manually. Perform 2D structural analysis of one typical frame for dead, imposed, earthquake/ wind (critical of the two) and various load combinations as per IS 800 using STAAD.

3. From STAAD analysis, find out the worst/ governing load combinations for:
   (a) Foundation
   (b) Steel column

   Prepare an **ANALYSIS REPORT (typed)** in following format.
   1. Sketch showing building plan and elevation
   2. 2D model of typical frame showing main dimensions
   3. Summary of main loadings (dead, imposed, earthquake and wind)-max 3 pages, reference to codes where necessary)
   4. Input text file (compact-max two pages, truncate if necessary)
   5. Output text file (compact-max three pages, truncate if necessary)
   6. Tables of critical/ governing load combinations for foundation and column design in following format.

Table 2: Critical load combinations for foundation design

S. No.	Load combination	Vertical force (kN)	Horizontal force (kN)	Bending moment (kN-m)

(Add more rows if necessary)

Table 3: Critical load combinations for column design

S. No.	Location	Load combination	Axial force (kN)	Shear force (kN)	Bending moment (kN-m)

(Add more rows if necessary)