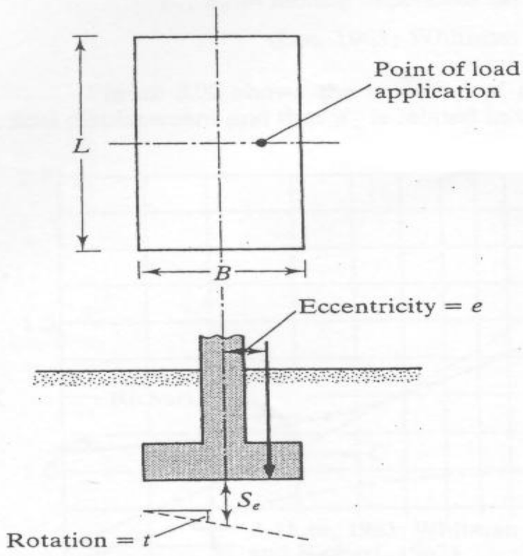
Advanced Geotechnical Engineering Mid Exam (2008.4.17)

※ After reading the procedure shown below, solve the problems attached at the end.

An eccentrically loaded foundation will undergo vertical settlement and rotation as shown in Figure 3.31. Georgiadis and Butterfield (1988) suggested the following procedure for determining the settlement and rotation of a foundation under such loading conditions.

1. Let the applied total load on the foundation, Q, and the load eccentricity, e, be known and determination of the settlement, S_e, and the rotation angle, t (see Figure 3.31 for notations) be required.



▼ **FIGURE 3.31** Elastic settlement of eccentrically loaded foundation

2. The ultimate load, $Q_{ult(e)}$, that the foundation can sustain is ~~can be~~ evaluated ~~by using Eq. (3.38) [Section 3.8; note the change of notation from Q_{ult} to $Q_{ult(e)}$]~~.
3. Determine the factor of safety for the eccentrically loaded foundation as

$$FS = \frac{Q_{ult(e)}}{Q} = F_1 \tag{3.87}$$

4. Determine the ultimate load $Q_{ult(e=0)}$ for the same foundation with eccentricity $e = 0$ [~~centrally loaded foundation; Eq. (3.17)~~].
5. Determine

$$\frac{Q_{ult(e=0)}}{F_1} = Q_{(e=0)} \tag{3.88}$$

Note that $Q_{(e=0)}$ is the allowable load for the foundation with a factor of safety $FS = F_1$ for central loading condition.

6. For the load $Q_{(e=0)}$ on the foundation, estimate the settlement ~~by using the techniques presented in Sections 3.13–3.15~~. Let the settlement ~~determined by any one of the methods~~ equal $S_{e(e=0)}$.

7. Now, use the following equations to determine S_e and t:

$$S_e = S_{e(e=0)}\left[1 - 2\left(\frac{e}{B}\right)\right]^2 \qquad (3.89)$$

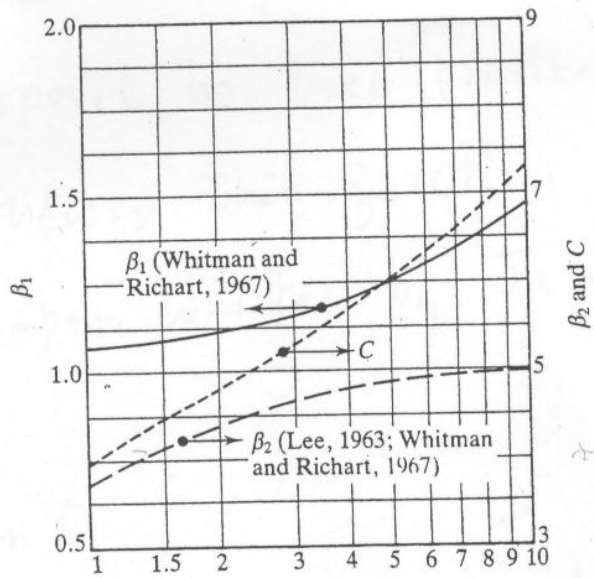
↑
Step 6

$$t = \tan^{-1}\left[CS_e\left(\frac{e/B}{\sqrt{BL}}\right)\right] \qquad (3.90)$$

where $C = \beta_1\beta_2$ (3.91)

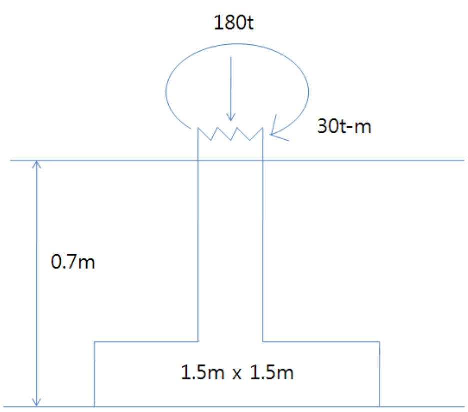
β_1, β_2 = factors dependent on the L/B ratio (Lee, 1963; Whitman and Richart, 1967) (3.92)

Figure 3.32 shows the variation of β_1, β_2, and C. Note that β_1 is related to vertical displacement and that β_2 is related to the rotation of the foundation.



▼ **FIGURE 3.32** Variation of β_1, β_2, and C with L/B

Problem 1,2 : Calculate the vertical settlement and rotation of the foundation shown below. (20/20)



1. Sand

γ = 1.8t/m^3

Φ = 30°

μ = 0.3

E_s = 1,500t/m^3

(no water table)

2. Caly

γ_{sat} = 1.6t/m^3

C_u = 10t/m^3

μ = 0.5

E_c = 750t/m^3

(water table = ground surface)

(20) Problem 3.

Explain the mechanism of progressive rupture of foundation soils and how it is related with the size of the foundations.

(20) Problem 4.

How can you determine whether a sand deposit has been prestressed ? Answer this question referring to the paper written by Jamiolkowski et. al (1985)

(20) Problem 5.

Compare the factored strength approach with the factored resistance approach, both of which belong to the partial sasfety factor method.