Structural Rigidity in Calculating Settlements

The continuity among various members of the structure gives an actual rigidity. The differential settlement becomes smaller than the calculated without considering rigidity.

Chamerski’s solution:

The relations established make possible an exact consideration the rigidity of the structure in calculating foundation settlements, without risk of being affected by modifications which are likely to occur in consequence of progress in soil mechanics.

1- Calculate the settlements without considering rigidity:

Contact pressure at any footing (i) \( q_{oi} = \frac{R_{oi}}{A_i} \)

\( R_{oi} \) : reaction at any support with consideration of continuity.

\( A_i \) : contact area of any footing (i).

In case of the two span beam, \( q_{oa} = \frac{R_{oa}}{A_a} \), \( q_{ob} = \frac{R_{ob}}{A_b} \), \( q_{oc} = \frac{R_{oc}}{A_c} \)

Where \( R_{oa} \), \( R_{ob} \), \( R_{oc} \) are the reactions of footing a, b and c.
if the footing (a) settle a complete amount Sa the resulting reaction will be = Qaa.Sa + Qab.Sa - Qac.Sa

support b settlement

support c settlement
\[ R_a = R_{oa} - Q_{aa}S_a + Q_{ba}S_b - Q_{ca}S_c \]
\[ R_b = R_{ob} + Q_{ab}S_a - Q_{bb}S_b + Q_{cb}S_c \]
\[ R_c = R_{oc} - Q_{ac}S_a + Q_{bc}S_b - Q_{cc}S_c \]

In general for any support (i)
\[ R_i = R_{oi} - Q_{ii}S_i + \sum Q_{ji}S_i \]

Where \( Q_{ji} \) : elastic constants of the entire structure

2- Recalculation of the settlement resulting from a first

These settlements resulting from a first correction \( S_i \)

In other words

Use \( R_o \), calculate \( S_o \)

Use \( S_o \), calculate \( R_i \)

Use \( R_i \), calculate \( S_i \)

3- Successive corrections due to rigidity of the structure:

New column loads are to be calculated by means of the settlement resulting from the prior correction and recalculation of the settlements so many times that they result to be equal in two successive approximations with desired approximation

Use \( S_o \), calculate \( R_{II} \)

Use \( R_{II} \), calculate \( S_{II} \)

Use \( S_{II} \), calculate \( R_{III} \)

Until a reasonable approximation is reached
In order to eliminate the necessity of a large number of corrections, one should apply a second correction, after the first one,

\[ S_m = \frac{S_0 + S_I}{2} \]

In most practical problems, there won't be any necessity of further corrections

- \( R_o \rightarrow S_o \)
- \( S_o \rightarrow R_i \)
- \( R_i \rightarrow S_i \)
- \( S_m = \frac{S_0 + S_I}{2} \rightarrow R_{II} \)

\( S_m \) & \( R_{II} \) may be assumed as final values