unsuitable as a foundation material. Alternatively the footings will be placed below this material since bearing capacity on these soils is essentially nonexistent. Foundations on sanitary landfills is another hazard for the unwary. With the trend towards this means of refuse disposal and the need for land near urban areas, these old filled-in areas may be used as building sites. Only borings may disclose the prior use of the land as a sanitary fill. Footings on this unconsolidated and/or still-to-decompose material could result in a disaster.

Location of water table is important for construction as well as to make allowance for loss of bearing capacity and possible buoyant effects on the footing and building.

It is the owner's responsibility to maintain adjacent structures against damage due to his own construction. This means that footings should be placed approximately the same depth and the sides of excavations adjacent to or below the adjoining building footings will have to be guarded against instability from loss of lateral support or overburden pressure (Fig. 15.11). Footings within the site, if they must be placed at different elevations, should be spaced approximately as shown in Fig. 15.11c.

Footings located in streams, on waterfronts, or other locations subject to wave action and scour should be placed and protected such that washout of material (undermining) does not occur. Scour problems have been studied by Lane and Bourland (1954) and Laursen and Toch (1956). The latter reference presents some design charts for use in bridge pier design. A recent failure was reported in ENR (1970) of a bridge abutment which became undermined due to stream scour. Since this bridge had been in service since 1901 and had been inspected the month before the failure occurred, it would seem that some caution must be exercised with foundations where scour can occur. Terzaghi (1936) reported on five bridge pier failures both in the United States and abroad; from the reported data it appeared that one could estimate the depth of scour as 3 to 4 times the river rise.

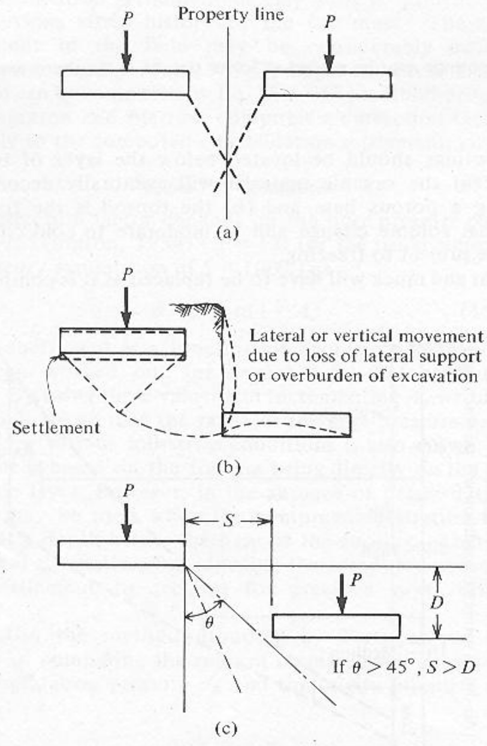

Fig. 15.11 (a) The situation usually allowed by local building codes. (b) This situation, which causes the original footing to settle, usually results in a liability against the owner of the new construction. (c) Generally, $\theta > 45°$ as a rule of thumb to avoid overlap of stresses.

15.6 FOOTING CONTACT PRESSURE

A problem which has occupied many researchers theoretically (Cummings, 1936; Borowicka, 1937, 1938; Krynine, 1938; Benscoter, 1944; Casagrande and Fadum, 1944; Timoshenko and Goodier, 1951) and a lesser number of experimental researchers (Ho and Lopes, 1969 with several references, and Schultze, 1961) has been to evaluate the actual contact pressure of the soil against the footing.

Boussinesq (ca. 1885) showed that the contact pressure for a rigid circular footing could be written as

$$q_0 = \frac{P}{2\pi\sqrt{r^2 - nr^2}} = \frac{P}{2A_f\sqrt{1 - n}} \tag{15.14}$$

For $n = 0$ the contact pressure at the center of the footing is one-half the nominal value of P/A. With $n = 1$ the edge of pressure is ∞.

Borowicka (1936) expressed the rigidity of a circular footing in terms of Poisson's ratio, modulus of elasticity ratios, footing thickness t_f, and its radius r in the following equation:

$$R = \frac{1 - \nu_s^2}{1 - \nu_f^2}\left(\frac{E_f}{6E_s}\right)\left(\frac{t_f}{r}\right)^3 \tag{15.15}$$

with the resulting condition that if

$R = 0$, footing is fully flexible and $q_0 = P/A$

$R = \infty$, footing is fully rigid and $q_0 = P/2A$ at center

Figure 15.12 displays Borowicka's curves for a circular (1936) and infinitely long footing (1938) for various rigidity factors.

Based on these curves *and for cohesive soil* an alternative footing contact pressure can be used which is somewhat more conservative than current procedures. However, with the more liberal load factors of the ACI 318-71 Code and since the ACI Committee 436 (1966) did refer to this type

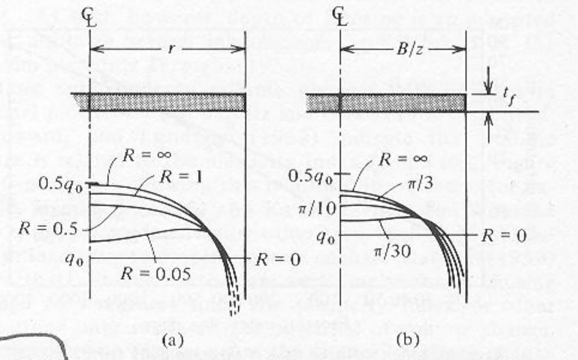

Fig. 15.12 Contact stresses for various degrees of flexural rigidity R and uniform footing load. (a) Circular plate; (b) infinitely long strip footing. (After Borowicka, 1936, 1938.)