

TECHNICAL NOTE NO. 2.1.6

Utility Support Considerations

Geopier Foundations
130 Harbour Place Dr.
Suite 280
Davidson, NC 28036

Tel. 704.439.1790
Fax 704.371.7470

Geopier soil reinforcing elements are often used to support utility lines and to support structures that include utility lines below floor slabs. This Technical Note provides design guidance for both of these sets of conditions.

DIRECT SUPPORT

Utility lines such as sewers, water lines, and gas lines, are rarely supported by deep foundations or ground improvement elements. This is because most utility lines are relatively light and the total weight of the installed lines and backfill approximates the weight of the soil removed prior to installation. Further, water lines and gas lines are typically not settlement sensitive and do not rely on gravity flow for functionality. Sewer lines, including sanitary sewers and sewers collecting surface runoff, can be sensitive to movements and may need to retain their design gradient for flow. When these lines are installed in soils containing very soft or organic soils, the loads imposed by construction may result in settlement requiring support. If Geopier ground improvement elements are used to support manholes and sewer lines directly, the Geopier design should consider:

- The geotechnical and structural capacity of the elements,
- The full applied weight of the trench backfill, the tributary load from any surficial structures, and the weight of the utility lines themselves,
- Providing support at the location of any sewer joints,
- Providing additional support as dictated by loading and capacity conditions, and considering the effects of construction dewatering that may impose significant hydraulic gradients through the piers during utility installation.
- For rigid inclusion (RI) supported utilities, the utility designer should consider whether uniform support is required. Typically, RIs do not provide a uniform support condition. However, elements can be spaced and/or the load transfer platform (LTP) designed such that the cones of arching are tangent/overlapping. If this is not possible, please discuss additional options/considerations with your Area Manager/Area Engineer.

INDIRECT SUPPORTSites in Which Settlement Occurs Quickly During or Immediately after Construction

Utility lines are often installed below building floor slabs for structures that are supported by Geopier soil reinforcing elements. Typically, the utility lines are not directly supported. Rather, they are installed in ground that is reinforced by Geopier elements. The piers are usually not aligned with the utility lines. In cases where immediate settlement of the

reinforced soil mass occurs quickly after loading, the settlement of the installed utility lines may be estimated as being equal to the settlement of the structure above the utility. For example, if a utility line traverses the soil adjacent to and near a building foundation, the utility line settlement will equal the building foundation settlement. Alternatively, if a utility line is placed below a floor slab, then the settlement of the utility line will be the same as the floor slab.

In some cases, however, the foundation materials are subject to long-term creep or consolidation settlements as the loads imposed by construction result in long term plastic strains.

Sites Subject to Long-Term Settlements

For sites subject to long-term settlements, the settlement of the utility line will be approximately equivalent to the settlement of the soil in which it is placed. This is illustrated, for example, by a site containing a layer of organic peat that is reinforced by RIs supporting grade raise fill, foundations, and floor slabs.

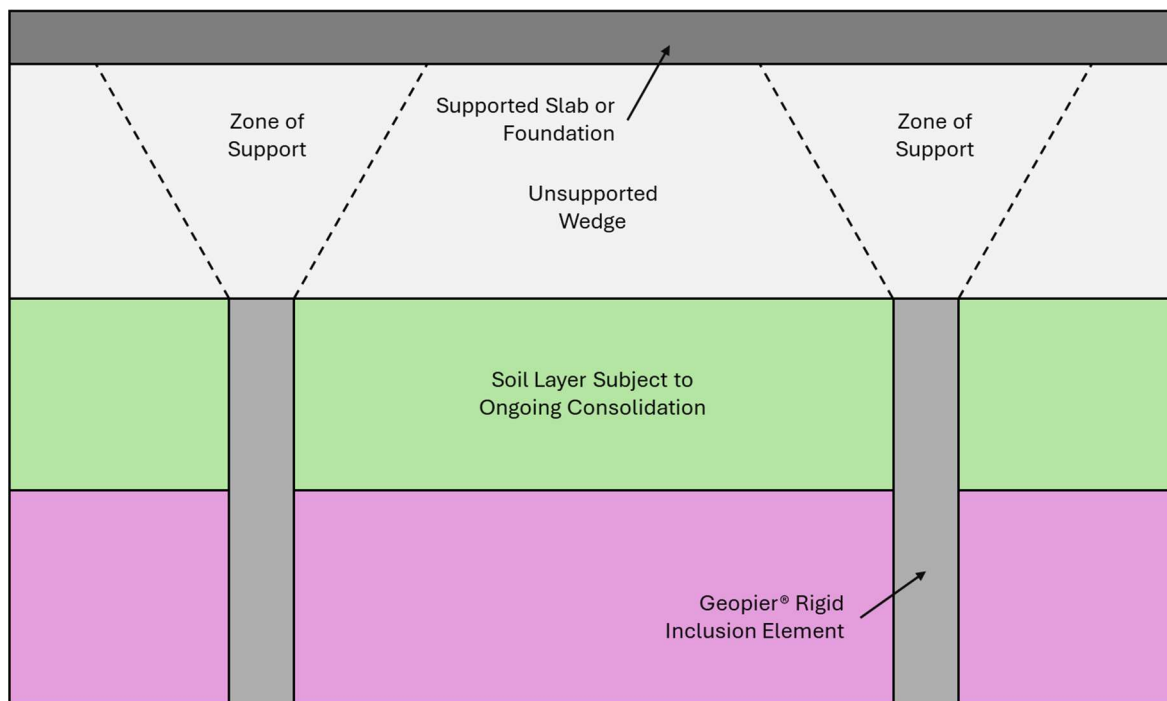


Figure 1.6.3-1. Unsupported wedge in which utilities may settle.

In the case illustrated by Figure 1.6.3-1 above, the placement of the grade raise fill results in the potential for long-term settlements of the organic peat layer. The relevant design considerations are as follows:

- As this layer settles with time, a cone of support develops over the tops of the elements whereby the settlement of the cone of soil is equal to the settlement of the Geopier element plus the settlement of the material within the cone.
- Utility lines that traverse this cone will be subject to this level of settlement. Also note that depending on the proximity of the utility to the top of the pier, there is potential for non-uniform and/or higher concentration of stresses due to stress attraction within this cone to the top of pier.
- The wedge of soil between the cones will continue to settle as the underling peat layer compresses. This settlement may lead to a separation between the soil subgrade and the bottom of the slab, resulting in an unsupported condition (denoted the " $k_m = 0$ " design condition). The floor slab is then designed to span from cone to cone.
- Utility lines that traverse the wedge of soil between the cones will settle the same amount as this wedge, which could be much greater than the settlement of the cone of soil.
- If the utility lines are not designed for these settlements, the utility lines may be structurally connected to the bottom of the supported slab, run overhead, sleeved through walls and/or foundations, or other means that create a separation of the utility from the settlement of the surrounding soil / structure.