A Case History of Geogrid versus Aggregate Piers for Settlement Mitigation

Djan Chandra, P.E., G.E.[1]

[1]Leighton and Associates, Inc., 17781 Cowan, Irvine, CA 92614; dchandra@leightongroup.com

Two neighboring sites in Irvine, California, with challenging geotechnical conditions were developed for a multi-family complex with several residential buildings surrounding a 7-level parking structure. The sites are underlain by 6 m (20-foot) thick compressible and expansive clay with groundwater table as shallow as 1 m (3 feet) below the ground surface. Conventional removal and recompaction below foundation elements for site preparation were limited in depths due to the presence of the shallow groundwater table. Innovative approaches were used for development of each site to reduce impact of the adverse site conditions.

Figure 1. Elevation View

SITE 1 (GEOGRID)

At Site 1, the residential buildings and parking structure were designed to be supported on post-tensioned slab and mat foundation, respectively, and underlain by compacted fill reinforced with geogrid (see Figure 2). The selected foundation types had less embedment depth compared to conventional shallow footings and the geogrid reinforcement reduced thickness of the compacted fill below the foundation elements to keep the earthwork above the groundwater table.

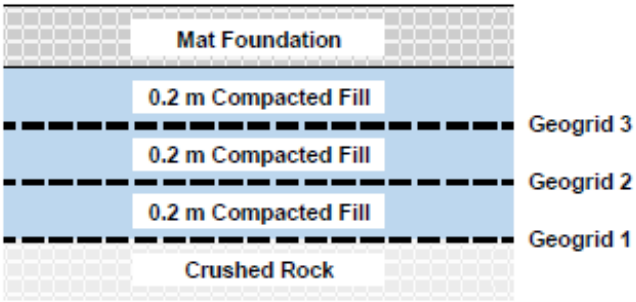

Figure 2. Schematic Design

Even so, wet and pumping soils were encountered at the removal bottom. A layer of rock was placed to stabilize the removal bottom prior to placement of the first geogrid layer. Since the parking structure was significantly heavier, differential settlement was expected between the parking structure and residential buildings. Construction of the parking structure was deliberately scheduled to begin three months ahead of the residential buildings to allow the parking structure settlement to partially occur in advance.

Figure 3. Geogrid Layers within Compacted Fill

SITE 2 (AGGREGATE PIERS)

A different approach was used for the site preparation at Site 2 immediately to the east. Compacted aggregate piers were installed below footings of the buildings and parking structures to transfer loads to a deeper layer. Over 600 aggregate piers with a diameter of 0.75 m (30 inches) and depth of 3 m (10 feet) were installed for each parking structure. The aggregate piers enabled the parking structures to be supported on shallow footings instead of a mat foundation system and eliminated the need for over-excavation.

SUMMARY

Both developments were successfully constructed and have performed well to date. The advantages of geogrid are relatively inexpensive and ease of installation. However, successful use of geogrid reinforcement for settlement mitigation requires careful construction planning and sequencing. Deep utility lines should be installed prior to placement of geogrid to prevent trenching through the geogrid layers and the resulting elaborate repair. Additionally, varying loads of adjoining structures may result in excessive differential settlement, which may require construction of the heavily loaded structure first and a waiting period before construction of the lightly loaded structure. If such construction sequencing and schedule cannot be afforded, compacted aggregate piers are a technically and economically viable option for settlement mitigation, even for a site with shallow groundwater table.