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Earth Retention Structures

Alternative Systems for Construction

INTRODUCTION

Excavation in urban areas can pose a number of construction related challenges. In some areas it may be necessary to use every square foot of land in a development plan. This often requires excavation in close proximity to existing property lines, utilities, and road right of ways. When excavation must take place adjacent to property lines, any nearby structures or utilities must be protected from damage resulting from undermining and earth movement.

Several earth retention techniques are available to fit unique site conditions and specific project requirements. Retention systems can include sheet piling, soldier pile-timber lagging walls, auger cast walls, soil nailing, and variety of grouting and soil improvement techniques. This newsletter will give a brief overview of some common earth retention systems.

SHEET PILE WALLS

Steel sheet pile walls are one of the most common earth retention systems. Sheet piling can be driven or vibrated in place along the building or excavation lines allowing excavation adjacent to an existing wall. For shallow walls, normally up to 10 high, self supporting or cantilevered sheeting can be used without tiebacks. As walls exceed 12 to 15 feet, tiebacks, bracing or anchors are often required to provide a stable excavation.

Sheet piling is durable and can be driven in a variety of alignments. Temporary shallow walls can be cost effective because the steel sheeting can be salvaged and reused. Permanent or deep walls with tieback and bracing systems tend to be more expensive because the steel cannot be salvaged.

Dynamic forces from driving or vibrating sheeting can be disruptive, damage nearby structures, or cause settlement of loose soils. If these conditions are of concern, other earth retention systems can be installed that are less disruptive.

SOLDIER PILE-TIMBER LAGGING WALLS

Soldier pile-timber lagging walls are a common and versatile approach for deep excavations in urban settings where minimal clearance to property lines is available. Soldier piles or H piles are installed along the excavation line at a regular spacing, normally 6 to 8 feet. The H plies can be driven or installed in an open grouted borehole in areas where disturbance from driving is of concern.

As the excavation proceeds, timber lagging is attached to the pile flanges to retain the soil. When the excavation nears the depth where lateral support is needed, drilled and grouted earth anchors are installed to tie back the H piles. The anchors are preloaded and tested by placing a load on them before being tied to the piles. The excavation, lagging installation, and anchor construction continues until the required depth is reached. Soldier pile walls are considered temporary support until the building is completed. However, the components normally remain in place after construction.

The cost of soldier pile walls is usually somewhat higher than sheet pile walls because few or none of the components are salvaged. As seen in the photo above, soldier pile walls can be installed in a variety of configurations to fit the construction site.

AUGER CAST OR SECANT WALLS

Secant walls are constructed by drilling a series of auger cast concrete piles side by side along the excavation line. Reinforcing steel cages or H piles can be inserted in the bore-hole prior to the concrete setting.

The secant piles effectively form a reinforced concrete wall along the side of the excavation. These walls can be installed with little or no vibration and minimal surface disturbance. The auger cast piles can be designed to resist the lateral earth pressure without additional support or as excavations get deeper, earth anchors can be installed. A secant wall can be incorporated in the final structure to serve as a basement or retaining wall for the project.

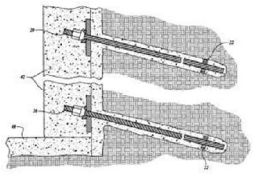
Secant walls are typically permanent with little or nothing to salvage. The cost is usually more than steel sheeting but some of these costs can be offset by utilization for permanent construction.

SOIL NAILING

Soil nailing is a technique used for earth retention or soil stabilization. This method can be used to stabilize a natural slope which is unstable or as a construction technique that provides a steeper slope than the native soil conditions will normally allow.

Soil nails are slender reinforcing bars or other elements that are drilled in or installed in pre-drilled holes that are grouted in place to develop pullout resistance. A reinforcing steel cage or mesh is installed over the soils nails which often are fitted with bearing plates. The wall surface is covered with a spray applied concrete or shotcrete layer to retain the soil slope. Sometimes, a flexible surface of wire mesh reinforcement with an erosion control mat or geotechnical fabric is used. Concrete surfaced walls can be finished to provide an aesthetic surface.

Soil nail walls can be installed relatively quickly in a variety of configurations. The walls are normally used as part of permanent installation and can be incorporated into the final design of the project. Soil nailing can be less costly that alternative means of earth support.



GROUTING TECHNIQUES

Soil stabilization can also be accomplished by a number grouting or chemical injection techniques. Cement grout can be injected to fill voids or to solidify a soil mass to permit excavation or underpin existing structures. Chemical grouts can be used to permeate a soil stratum to modify the mechanical properties to enhance earth support. Deep soil mixing can be used to add cement or other stabilizing materials to in-place soils modifying the existing properties. This technique can be used to improve stability, immobilize chemical constituents, or improve soil strength or permeability properties.

This newsletter has described a number of common techniques used to provide earth retention or improve soil stability. Each method has specific advantages and disadvantage depending on site specific conditions and the project objective. We can help you select the earth retention system that meets your unique project requirements.

For more information on geotechnical issues, contact Chuck Brumbaugh P.E., Manager of Geotechnical and Testing Services at Gosling Czubak Engineering Sciences, Inc.

Gosling Czubak
engineering sciences, inc.

Gosling Czubak
1280
Business Park Dr.
Traverse City, MI
49686-8607

Telephone:
231-946-9191
1-800-968-1062

Fax:
231-941-4603

Website:
goslingczubak.com