

## Profile

### Maximize Land Use With The Right Retaining Wall

As land values rise in Colorado, the use of retaining walls to optimize the amount of usable ground is on the increase. Developers of both commercial and residential properties are finding the value of usable space at a site more than offsets the cost associated with construction of retaining walls. Where sites were previously designed with sloping ground, walls are often constructed very near the property line.

There are a number of technologies available for construction of walls other than conventional cast-in-place concrete. These include mechanically stabilized earth walls, soil-nail walls, secant walls, soldier pile walls, and many more. Each of these technologies has unique applications that are dependent on the site layout, height of wall, site soil conditions, presence of nearby structures and underground utilities, and intended use of areas near the top and bottom of the wall.

CTLThompson has been involved in design and construction of retaining structures throughout Colorado, including projects in and around Colorado Springs over the past 21 years. In our capacity as geotechnical engineers, we have witnessed numerous problems resulting from specifying walls with lack of consideration for constructability, as well as failures of walls from poor design and improper construction. The solution has been to create a special projects group consisting of engineers with specialized expertise in earth retaining systems. This group specifically focuses on assisting owners and civil designers in avoiding the pitfalls in wall design and construction that lead to problems and excess costs associated with construction and maintenance.

Geologic conditions often have bearing on the type of wall selected at a particular site. At the Garden of the Gods Visitor Center, the bedrock consists of steeply dipping interbedded claystone bedrock. Where these upturned claystone beds are truncated at the surface, severe differential movements can occur due to the different swell characteristics of the beds, resulting in damage to structures and foundations constructed upon them. For this specific geologic setting, CTLThompson recommended construction of an MSE wall.

These walls, comprised of individual masonry block with reinforced earth backfill, are capable of withstanding much larger differential movements than conventional concrete walls. The wall at the Garden of the Gods Visitor Center has performed very well in the 10 plus years since its construction.

New construction at the Sky Sox Stadium will entail a 25-foot deep excavation directly adjacent to the existing stands, where an underground area for a batting cage and new clubhouse, as well as a "function" area will be constructed. Due to the presence of existing construction and underground utilities, a secant wall was constructed. Secant walls consist of drilled shafts called piers, which are constructed adjacent to one another to effectively create a wall. The piers are drilled and filled with concrete, and then the excavation is made on one side to expose the wall. The wall face can be finished with shotcrete or a variety of decorative facings. Secant walls have also been used extensively along the T-REX corridor of Interstate 25 in the southern portion of Denver.

A soil nail wall was used at the Navigators national headquarters building near Garden of the Gods Road and 30th Street in Colorado Springs. A deep cut was needed to create a thick fill mat below the north buildings. Calculations showed the cut might be unstable. Soil nails were used to create a vertical face. Soil nails are constructed by drilling near-horizontal holes into the face of the cut. Steel reinforcement is then inserted into the drilled boring, and the space surrounding the steel is backfilled with high-strength cement grout. Then, the excavation is extended deeper and another row of nails is installed. At the Navigators site, the lower 10 feet of the excavation was designed as a temporary wall to allow for overexcavation of the building pad for expansive soil mitigation. The temporary slope was constructed without corrosion protection of the steel nails. The permanent upper exposed portion of the wall was constructed with corrosion-protected nails, and faced with shotcrete stained to match the natural rock.

Similar to construction of MSE walls, soil-



*Above: Due to existing construction and underground utilities, Sky Sox Stadium in Colorado Springs is outfitted with a secant wall.*



*Right: William C. Hoffman Jr., PE Senior Principal Engineer, CTLThompson Inc., Colorado Springs*

nail walls and slopes create a reinforced mass of earth that resists movement. These approaches are very economical, but require some extra space behind the wall or slope where the reinforcing grid or nails will extend. This can be problematic if the site is obstructed with underground utilities or other structures. An easement may be required from adjacent landowners.

There are numerous other types of earth retaining systems with specialized applications that can be used to retain soil and/or provide added stability to marginally stable slopes. Understanding how each system is constructed and under what conditions their construction is imperative to successful and economical design and construction.

*Over the past 34 years, CTLThompson has built a reputable firm trusted for its expertise in geotechnical, materials and environmental engineering and testing. CTLT is based in Denver, Colorado, with additional offices in Colorado Springs, Glenwood Springs, Fort Collins, and Pueblo, Colorado, and Dallas and Austin, Texas. For more information, please visit [www.cltl.com](http://www.cltl.com) or call 719.528.8300.*