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## **Sloping sites - maximizing the build out potential of marginal sites**

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The financial feasibility of a land development project is often driven by the designer's ability to maximize the build-out potential of the subject site. Sites with significant grade change over the developable area can present the designer with a number of obstacles to achieving this goal.

One way to improve the viability and increase the density of a project is to maximize the build-out horizontally. Of course most sites aren't level, particularly in non-urban areas, so the use of site retaining walls is becoming more common to maximize footprint. Today, cast-in-place concrete retaining walls are less common due to their cost and limited aesthetic appeal; mechanically stabilized earth (MSE) walls, precast concrete gravity walls, gabion walls, and other systems are becoming more commonplace.

Too often, designers will prepare a grading scheme that requires a massive wall or steep slope without enough consideration of the design and construction of these systems. Is the system in a cut or fill condition? How deep is groundwater? What is the system supporting? ...earth only? ...a parking lot? ...a building? These issues must be evaluated for each project to achieve a technically sound and cost effective wall system. If wall heights were less than 10 ft., most systems could be deployed with similar degrees of success. However, as the need for space has increased, so have the associated wall heights. Walls greater than 50 ft. high are now being routinely constructed.

**A Flawed Process** - The current trend seems to be to draw a line on a site plan labeled "retaining wall" with specifications noting that "...the wall shall be designed by the contractor and the contractor shall submit stamped drawings to the engineer for approval prior to construction". This approach presumes the contractor will research and determine the most economical system so that they can keep their costs down, which in turn provides the owner with the best price. In costing out a project, the contractor is often not afforded an opportunity (or incentive) to thoroughly research all of the variables required to achieve the ideal earth retaining solution.

Keep in mind, the bidder has not often been awarded the project at the time of bid preparation. After award, the successful contractor will bring a designer on board. Oftentimes, the designer is not from the region and has no knowledge of local geology or construction materials that are critical to proper design. Far too often, the designer excludes "global stability" of the wall - noting they are not the geotechnical engineers for the project. However, it's unlikely that the owner's geotech will be willing to take responsibility for another engineer's design.

As with all aspects of the project, if the site drawings and specifications are prepared well - and the contractor is experienced and conscientious - the wall will likely be constructed without issue. Disputes over the content and intent of contract documents are common - and can lead to change orders, delays, performance problems, or, in some cases, failure.

A Better Way - Owners could realize significant benefit by requiring that their engineer (not the contractor's) design the wall system and include the design on the contract drawings before it goes for contractor pricing. Ideally, the engineer designing the wall is also the one who provided geotechnical recommendations for site development and is familiar with the site's subsurface conditions. The engineer should perform sufficient subsurface exploration along the proposed wall. The engineer should also consider the availability of local materials, site constraints, aesthetics, constructability and cost when selecting a wall system.

The design is done, are we? - Make sure it gets built right. Now that you've got a design that you want, make sure the contractor provides what's on the drawings. The wall designer should be on-site to observe wall construction for compliance with their design. Unexpected conditions may warrant design changes and if the wall designer is familiar with the site conditions, resolutions can be made in a timely and cost effective manner. Moreover, local building departments often require "certification" for larger walls. These "certifications" must be stamped by a professional engineer registered in the state where the wall was built and must indicate that the wall was constructed in accordance with the design drawings. Good luck getting the vendor's designer from Minnesota to prepare such a statement.

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