

Does your site have excessive slopes? What to consider when developing land with steep slopes

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In developing a vacant piece of land, steep slopes are often an issue. And, the more prevalent the steep slopes are on a site, the greater the likelihood that retaining walls will be part of the Approved Site Plan. Let us consider three municipalities which regulate the final allowable slopes for land which is filled, cut, or graded.

The first municipality we will consider is the town of Oyster Bay. The town of Oyster Bay zoning code prescribes that access drives for parking lots not be steeper than 7% and that the parking areas, themselves, not be steeper than 5% (Section 246-7 of the Town Code). So, if you are developing a site in Oyster Bay which has slopes in excess of 7%, you may need a retaining wall along one, or more, sides of your parking lot.

Another example of a municipality which regulates the final slopes of developments is the city of Peekskill. That city (Section 510-18 of the City Code) requires that the slopes of all graded areas not exceed the "slope of repose" of the soil. If a steeper slope would be necessitated by the development of the site, then a retaining wall must be used so that the final ground slopes remain at, or shallower, than the slope of repose of the soils.

Putnam Valley is a bit less theoretical. Instead of allowing a disturbed slope to be set at, or shallower than, the soil's slope of repose, that township (Section 103-26 of the Town Code) simply requires that the final grades of cuts and fills not be steeper than 50% (i.e., 1:2). Where this cannot be achieved through normal grading, a retaining wall must be installed.

And, for all of New York state at large, the state's Building Code (Section 3304.1.1) clearly dictates that "slopes for permanent fill shall not be steeper than one unit vertical in two units horizontal (50% slope). Cut slopes for permanent excavations shall not be steeper than one unit vertical in two units horizontal (50% slope)."

So, in most municipalities, there are specialized regulations which control the maximum permissible slopes for cuts, fills, and parking lots. For the entire state, the Building Code dictates a maximum permissible slope for cuts and fills of 50%. If the requirements promulgated by a local municipality are less severe than that promulgated in the state's Building Code, then the

developer must follow the slope parameters specified in the State Code. If the standards of a local municipal code are more severe than the standards of the State Building Code, then the local, more restrictive, requirements must be followed.

If the site you plan to develop has steep slopes, you will probably have to break-up some of the sloped areas so that you can construct parking lots, sidewalks, etc. If you want areas where people can sit and contemplate the environment, you may also have to cut some areas and fill others to create relatively level areas where the users of the site can sit and enjoy their external surroundings. If you find that you have to engage in cutting and filling operations on your site, it is a fair possibility that you may have to erect one or more retaining walls to break-up the steep slopes.

The Building Code of N.Y. state (Section 1806) provides some very specific parameters for the design and construction of retaining walls. They must be able to resist toppling forces with a safety factor of 1.5. They must be able to resist sliding, again with a safety factor of 1.5. The wall must also be designed such that the pressure on the soil which supports the wall is not excessive. Finally, the wall must be able to resist up-lift from water pressure.

Concrete retaining walls are, in general, the easiest to design. Most engineers who are familiar with retaining walls use the Rankine Method of Analysis to determine the force with which the retained soils will push against the backside of the wall. Those forces are, of course, trying to overturn the wall. In trying to over-turn the structure, those lateral forces cause a rota-

tional force to develop around the heel (or, rear lower edge) of the wall. Not only is this rotational force trying to topple the wall, but it is also "grinding" the wall into the soil which supports the wall. The soils which support a wall must have enough strength to resist the weight of the wall and the "grinding" rotational force which the retained soils exert on the wall. In addition to trying to topple the wall and grind it into the dirt, so to speak, the forces from the retained soil are also trying to slide the wall. Of course, if the wall supports a parking lot, roadway, or other area used by people, the wall must also be able to support the live and dead loads caused by those uses.

A gravity retaining wall is designed such that its shear bulk can withstand the forces which are trying to drive it to failure. These

walls are usually composed of concrete. Gravity walls are very useful in areas where bedrock may be shallow since such walls can be easily pinned to the bedrock. Another type of retaining wall is the cantilevered retaining wall. Once again, this wall type is usually composed of concrete. Cantilevered walls have a very large horizontal footing and a narrow stem. The large footing is designed in such a way that the retained soil works against itself, providing stabilizing forces as well as driving forces on the wall. My firm has designed both types of walls.

Part 2 of 3 will appear in the July Hudson Valley section.

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