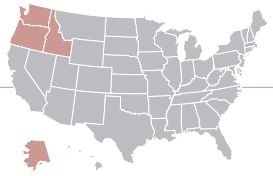

The Hills Are Alive

When retaining walls start moving, the details of their construction can really bury you. Backfill with knowledge before a claim hits.

By Kurt Ahlich

Mountainous or merely hilly—whether urban, suburban or rural—the Northwest's topography requires us to build roads, driveways, homes, businesses and yards on slopes. Often, these improvements or structures are built next to property lines or an adjacent structure, thus prohibiting simply grading the hillside soil back to a stable, maintainable slope. In these cases, the hillside soil is excavated to vertical face, or bank. These vertical soil faces, which are inherently unstable, must be retained against any future earth/soil movement that would adversely affect anything in front (downhill) of the soil face, as well as what might be behind, or uphill. The structure that is designed and built to retain this soil face is called, appropriately enough, a "retaining wall."

Kurt Ahlich

It should be noted that retaining walls can also consist of basement, underground parking, or roadway cuts/tunnel walls, to name a few. However, the focus of this article will be on walls that might be encountered at typical residential or light commercial developments.

From a general engineering standpoint, retaining walls are quite simple. Their function is to prevent movement of the soil that is intended to be retained—that is, the soil located behind the wall. This soil exerts a lateral (horizontal) force on the wall. In addition, other forces exert lateral loads on the wall. These consist of hydrostatic (water pressure) and surcharge forces related to loads located behind the wall, such as sloping or built-up soil, buildings or stored items. All of these horizontal loads tend to topple, rotate, deflect or otherwise destabilize the retaining wall. These forces are countered by the weight of the wall, a foundation system or some type of lateral bracing.

One dilemma is whether or not retaining walls need to be designed by an engineer and permitted by an appropriate authority. An adjuster may find that a retaining wall that has failed was "built-by-owner." Often, local building codes would require that the wall be designed and permitted; the general rule of thumb is that any retaining wall that is over four feet in height, as measured from the bottom of the retaining wall including footing, needs to be permitted. This rule can be restricted by the presence of local code requirements, site geometry and the presence of structures, including terraced retaining walls, located behind the retaining wall.

There are multiple types of retaining walls that are commonly constructed. However, these walls fall into a few basic categories, including gravity walls, walls that require some type of foundation, and mechanically stabilized earth. Gravity walls, with respect to residential and light commercial construction, are generally low in height. These walls rely on the weight of the wall itself to counteract the various lateral loads described above. These walls typically consist of landscaping retaining structures and are not intended to retain soil greater than a few feet in height. They typically consist of stacked block or rockeries (stacked rock).

A more common type of retaining wall is that which requires a foundation. This foundation can consist of a spread-type footing, often constructed of concrete and in a "T" or "L" configuration, or a drilled caisson (hole drilled into earth) backfilled with concrete and a vertical structural member (typically steel or pressure treated lumber). Another common retaining structure is what is known as a "mechanically reinforced earth"

New Demolition Rules Target Lead and Asbestos in Oregon

The Portland, Ore., city council adopted rules in February to reduce toxic emissions. The rules mandate that developers and renovators who are demolishing buildings that house one to four families search more thoroughly for lead paint and asbestos before beginning demolition. They must provide an asbestos survey to the city before getting a permit, and inspectors must visit the site before, during and after demolition. Inspectors are to ensure that the site plan includes dust controls and that exterior paint is removed before knock-down. All materials that might contain lead or asbestos must be wetted to reduce dust dispersal. Contractors must also give neighbors notice of the work to be performed. More cities in Oregon may adopt similar ordinances. A state senator who co-sponsored a bill passed last year giving cities more authority to regulate lead and asbestos in demolitions said he can see Portland's ordinance becoming a model for the rest of the state. The city's Bureau of Development Services says the rules will affect more than 700 demolitions each year. ■

wall. These are more common with commercial or multiple-family residential complexes and consist of horizontally placed synthetic membrane into a backfilled earth slope. These walls are faced with concrete blocks, which are the same or similar to blocks used in smaller, landscape-type walls.

Failure can occur as a result of a design or construction defect, a change in site conditions or, in some cases, deferred wall maintenance.

I Feel the Earth Move

Retaining wall failures ultimately are due to the inability of the retaining wall to resist the lateral (horizontal) loads to which they are subjected. Failure can occur as a result of a design or construction defect, a change in site conditions or, in some cases, deferred wall maintenance. Each of these conditions exhibits characteristics that can help an adjuster determine the underlying cause.

A common mode of failure is excessive rotation or deflection of the retaining wall. This can be observed or measured by checking the plumb (vertical alignment) of the retaining wall. A wall that is significantly out of plumb indicates it has rotated from its design alignment. Other indications of such rotation include surface subsidence behind the wall as well as distress to the surface immediately in front of the wall. This condition can be caused by an inadequate wall foundation, structural failure of certain wall elements, or excessive hydrostatic pressure. An inadequate foundation can be difficult to judge in the absence of destructive testing. Generally, in this case, the wall will appear intact and non-distressed but be excessively leaning.

Structural failures may be observed by decay (in wood) or corrosion (in steel) in the retaining wall structure itself. Typically this will occur near the base of the wall, where the bending moments are greatest. In addition, excessive bowing or distortion of the wall may be present in this circumstance. Similarly, in situations where there is excessive hydrostatic pressure, the wall may appear distressed, distorted and/or cracked. Often, water stains/soil deposits will be visible around any such cracks. In analyzing retaining wall failures, it is always important to note any drainage features, such as weep holes, gaps in the wall face, or a behind-the-wall drainage system.

General wall distortion, displacement or cracking can also be indicative of structural deficiencies in the wall above the foundation level. These deficiencies can consist of inadequate reinforcing steel, in the case of reinforced concrete walls, or bowing lumber, in the case of wood retaining walls. Decaying lumber can also indicate the improper use of non-pressure treated wood, which is highly susceptible to decay. Distortion in a mechanically reinforced wall is typically recognizable by movement in the blocks at the face of the wall. Distortion/failure in this type of wall can be difficult to determine and often requires engineering analysis. Failure modes for mechanically reinforced walls can include improper anchorage of the wall face blocks to the synthetic membranes behind the wall, improper placement or sizing of the membranes, or subsurface drainage issues.

Retaining wall failure can also be caused by changes in site conditions that occur after the retaining wall is built. Quite often a fence might be attached to or built into the retaining wall. As time goes on, soil can build up or be placed behind the fence, thus increasing the amount of soil retained by the wall. This soil acts as an unintended surcharge on the wall. This surcharge can then cause the wall to fail in the modes discussed above. Other surcharge loads that can occur are the addition of structures, vehicle parking or material storage behind the wall. The planting of trees may also exert excessive lateral pressures on the wall as the roots propagate. For walls built on a slope, long-term erosion of the soil from in front of the wall can cause wall failure by removing soil intended to buttress the wall from movement.

Once a wall has been determined to have moved and the mechanism causing the wall movement is understood, some mitigative measures can be taken. These measures may include controlling the build-up of hydrostatic forces behind the wall, buttressing or bracing the wall, or tying the wall back with some type of lateral anchor. The face of a wall can be reinforced with a structural concrete façade, and decayed or inadequately sized lumber can be removed and replaced. Generally, these measures will require an engineering analysis and design. Of course, in many circumstances, the most practical option may be to simply remove and replace the wall with one that is properly designed and constructed. ■

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