Stormwater Best Management Practice

Soil Retention

Minimum Measure: Construction Site Stormwater Runoff Control
Subcategory: Erosion Control

Description

Soil retention measures are structures or practices that hold soil in place or keep it contained within a site boundary. They can include grading or reshaping the ground to lessen steep slopes but most commonly include shoring excavated areas with wood, concrete or steel structures. Design engineers can use structural soil-retaining measures (sometimes referred to as shoring or retaining walls) to control erosion or protect workers during excavation projects.

Applicability

Before breaking ground on any construction site, design engineers and contractors should assess site conditions and, where possible, reduce steep slopes by grading. In some cases, regrading in conjunction with low impact practices such as mulching, seeding or chemical stabilization may be sufficient to protect against erosion. However, for sites with very steep slopes or loose, highly erodible soils, design engineers and contractors should consider soil-retaining structures.

Siting and Design Considerations

Even for temporary applications, qualified professionals should design and install soil-retaining structures according to local construction codes. If retaining walls serve trenching or excavation purposes, Occupational Safety and Health Administration Trenching and Excavation Safety standards may apply, requiring the use of acceptable support techniques.

General categories of soil retention structures are braced, cantilevered and tied back systems, which refer to their method of support. Braced systems consist of sheeting, which holds the soil in place, and external struts or boards, which hold the sheeting in place. Braced systems are the most common for low-cost, short-term construction site applications. Examples of braced systems include:

A retaining wall supporting soil along a steep slope.
Photo Credit: Washington State Department of Transportation/ Flickr

- ***Skeleton sheeting*** – An inexpensive soil-bracing system consisting of construction-grade lumber that supports the excavated face of a slope. This method requires the soil to be cohesive.
- ***Continuous sheeting*** – A system that involves using a material, such as face-steel, concrete or wood, to cover the entire slope continuously and placing struts and boards along the slope to support it.

Cantilevered and tied back systems tend to be stronger and often have larger or longer-term applications. Because of their strength and life spans, they are also applicable when the post-construction site layout requires soil retention. Cantilevered systems are L-shaped and get their support from the horizontal component that extends into the retained soil, using the weight of that soil to keep the wall in place. Tied back systems, or anchored systems, receive support from an anchor buried deep into the base of the retained soil. Cantilevered and tied back systems generally consist of concrete, masonry, steel or corrugated metal.

Design considerations for soil retention structures include the nature of the soil, location of the ground water table and expected loads. Chini and Genauer

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(1997) provides a comprehensive overview of technical considerations for construction site soil support systems. The *Wisconsin Department of Transportation Bridge Manual* also contains additional types of soil retention structures and a table to help with design selection according to project requirements.

Limitations

To be effective, soil retention structures should have designs that can handle expected loads. Heavy rains can damage or destroy these structures, especially temporary braced systems. As soil retention structures are generally holding back large quantities of soil, their failures can result in significant sediment input to waterbodies. Construction staff should properly install and maintain these structures to avoid failure.

Maintenance Considerations

Construction staff should regularly inspect soil retention structures, especially after rainstorms, to check for erosion, damage or other signs of deterioration. Staff should repair any damage to site features upslope of the retaining structure, such as washouts or breakages of other sediment control practices, before reinstalling materials for the soil retention structure.

Effectiveness

Soil retention structures with proper design and installation can effectively prevent erosion in areas with steep slopes and erodible soils. The potential for failure depends on the design, installation and maintenance of the structures, as well as the likelihood of catastrophic events such as heavy rains, earthquakes and landslides.

Cost Considerations

Soil retention practice costs depend on a number of factors. Land grading costs depend on the size of the area construction staff are regrading and the amount of soil they need to move. Soil retention structure costs vary widely depending on project requirements such as the topography of the surrounding area, excavation requirements, the type of soil that needs stabilizing and the amount of time the structure will be in place. Each of these factors affects the size and type of system that design engineers and contractors implement. A 5-foot-tall temporary wood skeleton sheeting can cost as little as $5 per linear foot (RSMeans, 2020a). A cast-in-place concrete retaining wall can cost from on the order of $100 per linear foot for smaller 5-foot to 10-foot walls, to more than $1,000 per linear foot for a 20-foot-high wall (RSMeans, 2020b).

Additional Information

Additional information on related practices and the Phase II MS4 program can be found at EPA's National Menu of Best Management Practices (BMPs) for Stormwater website

References

Chini, S. A., & Genauer, G. (1997). Excavation support systems for construction operations. *Journal of Construction Education, 2*(3), 156-170.

RSMeans. (2020a). Building shoring data [Online data file]. RSMeans data from Gordian.

RSMeans. (2020b). Retaining walls data [Online data file]. RSMeans data from Gordian.

Wisconsin Department of Transportation. (2019). *WisDOT bridge manual*.

Disclaimer

This fact sheet is intended to be used for informational purposes only. These examples and references are not intended to be comprehensive and do not preclude the use of other technically sound practices. State or local requirements may apply.