LONG GCL ROLLS AND HORIZONTAL OVERLAPS ON SLOPES

CETCO is often requested to provide extra-long rolls for projects with slopes longer than the standard roll length of 150-ft (45.7 m). The reasons for such a request usually relate to the designer's preference of not having any seams on the slope. This discussion examines the reasons why this request technically and logistically undesirable in most cases.

Roll Weight

The weight of a 150 foot-long roll of GCL is approximately 2,600-2,800 pounds. Experience has shown that this is very close to the maximum weight that can be safely accommodated by typical installation equipment (spreader bars and core pipes). Unlike an HDPE geomembrane, where the roll is self-supporting due to the rigidity of the membrane, the full weight of a GCL roll must be supported by the core pipe and spreader assembly. The dynamic loads which these units encounter in normal site conditions (traveling with a full GCL roll across a bumpy access road, for example) are far greater than might be anticipated as based on the static load. In addition to the extreme dangers associated with outright equipment breakage, an overstressed core pipe will bend excessively, which will place enormous tensile stress on the central portion of the geotextiles of the GCL. This can cause rupture of the geotextiles, which can in turn lead to bentonite displacement or migration.

Logistical Considerations

Another factor discouraging the use of longer rolls is the logistical difficulty of manufacturing a special run of GCL, which results in higher production cost and longer lead times. These factors often negate the perceived advantage an installer may desire through handling fewer rolls at the job site.

Design Issues

Given the above difficulties, it makes sense to examine whether standard length GCL rolls with horizontal end-of-roll overlaps can be used on the slopes. An engineer might prefer a continuous run of liner in order to provide stability. But with most long slopes, slope stability is provided by interface friction, not by tension carried on the liner system. This means that the weight of a cover soil layer is transmitted through the liner system. In these cases, the interface shear strength between the GCL and the subgrade is quite high and will not allow downslope movement of the GCL. This means that horizontal overlaps on slopes are acceptable.

Horizontal overlaps should only be a concern if the GCL is expected to slide down the slope; in other words, if the interface shear strength under the GCL is quite low. Since most landfill bottom liner and cap designs utilize a composite liner concept where the GCL is placed on a soil subgrade, the GCL will typically not be in tension. Thus, the GCL will not be expected to slide and horizontal overlaps are acceptable.

In the rare case where a GCL is placed on a long slope over another geosynthetic material such as a drainage geocomposite, the potential for GCL movement exists and the use of horizontal overlaps should be examined more carefully.

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Safety Factors

Short-term dynamic loads should be examined in addition to the long-term static design loads. Standard GCL installation practice dictates that cover material is placed directly over the GCL from the bottom upward. Thus, there should be no downward drag placed upon the GCL during cover placement, and no excessive loads from stockpiles of cover soils being pushed from the top of the slope.

Similarly, in most landfills, the lower portion of the lined slope will be buttressed upon the placement of the waste. This will provide an additional factor of safety. Canyon fills and severely seismic areas are special situations where a conservative approach is warranted. However, the liner system can still be designed without a requirement of GCL rolls greater than 150 feet.

Drainage Considerations

In final cover applications, the design of the drainage system over the geosynthetic clay liner is typically the overriding factor in determining total slope length. Since the required drainage flux is cumulative over the length of the slope, longer slopes require larger capacity drainage systems. Geosynthetic Research Institute (GRI) studies reveal that in non-arid environments that typical drainage designs can safely accommodate only a 100-foot (30 meter) slope length. Thus, longer slopes should be segmented by benches. The bench can incorporate a mid-slope anchor trench if required by the stability analysis.

References:

The Design of Drainage Systems Over Geosynthetically Lined Slopes, GRI Report #19, Geosynthetic Research Institute, June 17, 1997.

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