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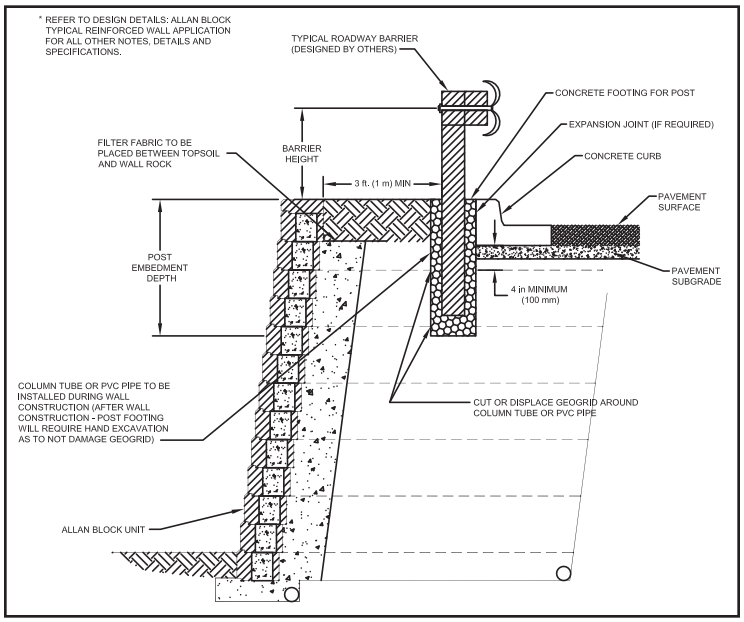
Guardrail Design and Installation

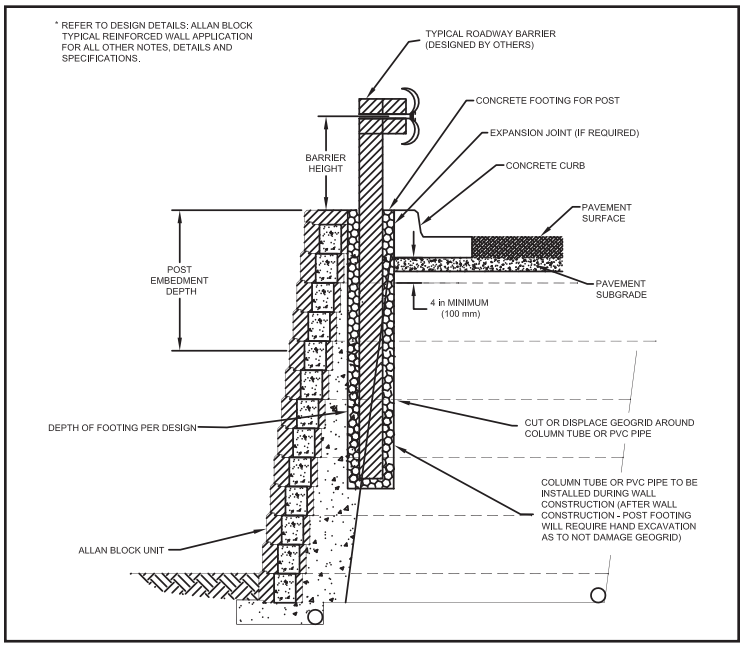
Top of wall overturning is a very common question that comes into the Allan Block Engineering Department each year. We have two Tech Sheets discussing common fence and railing applications; Top of Wall Fence Overturning – Tech Sheet #1113 and Fences Above Retaining Walls – Tech Sheet #1213. These two tech sheets cover residential and commercial fence and railing applications. However, they do not cover vehicle guardrails which are also very common but can be much more complicated.

Vehicle guardrails, like fence applications, come in many forms. Segmental Retaining Walls (SRW's) can be designed to work with most application and we will cover the most common applications here. Using this information, you will be able to derive variations to fit your site-specific application.

Commercial property parking lot guardrails are designed to prevent vehicles, at low speeds, from going past the guardrail location. In retaining wall applications, we are trying to prevent the vehicle from going over the top of the wall. In these applications the engineer should determine the local municipality requirement for applied force to determine an overturning moment the wall needs to resist. A common load is between 3000 lbs (13.34 kN) and 6000 lbs (26.69 kN) depending on the application. This load is commonly distributed over a length of 5 ft (1.5 m) to 10 ft (3.0 m) (check local requirements).



Aside from applied load requirements the most important thing the engineer needs to know is the location of the guardrail posts behind the back of the wall. AASHTO – Section 11.10.10.2 provides guidance on installing guardrail posts behind a wall. They suggest that any post placed 3 ft (0.9 m) or further back will apply virtually no load to the facing and that the embedment and lateral resistance provided by the soil between the wall and post is sufficient to carry the impact load. Therefore, not transferring force into the wall facing. For any posts placed closer than 3 ft (0.9 m), the engineer must consider lateral overturning forces in the wall.



SRW's by nature are incapable of resisting moment forces because they are not physically connected in a ridged configuration. Therefore, moment forces are transferred into each of the grid layers the embedded post intersects. Each grid layer has a certain amount of residual force that is not being used for internal wall stability. That residual force multiplied by the embedment depth of the post relative to its embedded position (moment arm), provides the resisting moment. The more grid layers intersected, the more resisting moment.

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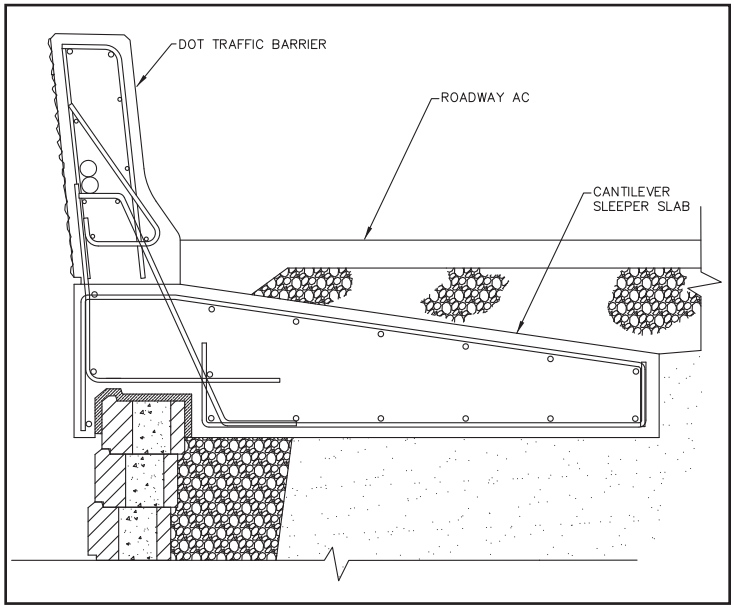
Therefore, the engineer iterates between the applied force, the post spacing distribution, embedment depth and number of grids intersected to determine the required safety factor for overturning. This is similar to how you would approach a fence overturning design but with higher lateral forces.

DOT impact barriers are on another level but can be incorporated into an SRW design. This sleeper slab detail shows just one way of isolating the impact moment into the barrier/slab construction and not into the top of the SRW. The engineers working on these designs are more concerned with the lateral force transfer due to sliding at the surface. The sleeper slab is typically constructed large enough to resist the sliding or the engineer can add a vertical keyway in the bottom of the slab to gain a great amount of resistance from the soil's passive resistance, not just surface sliding.



By far the easiest way to incorporate an impact barrier into a traditional geogrid SRW is to have enough room for the barrier to be outside of the influence zone of the wall. Even if the barrier is directly behind the wall, there are ways to approach the design in a very positive way to satisfy the needs of the client and their project.

Installation of guardrail posts

The guardrail installer will automatically want to auger the post holes through the geogrid layers, but this is often not recommended because damaging the grid is a very likely possibility. Therefore, if the posts are installed after wall construction it is recommended to hand dig the holes or to use a post system that can be driven through the grid layers. The contractor should take care while driving posts to ensure that the process is not dislodging the block or causing them to vibrate out of alignment. Installing construction tubes during the wall construction process will ensure the wall is built and not damaged by post driving. However, the wall installer and post installer must coordinate the post position to ensure proper depth and spacing are met for post installation after the wall is completed.