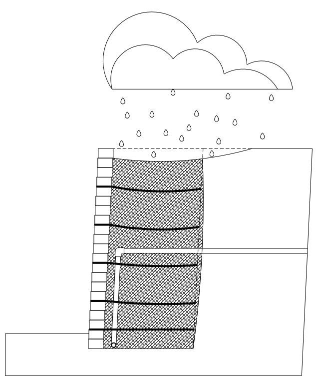
ALLAN BLOCK

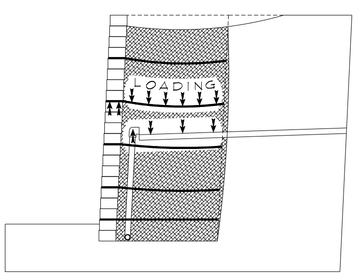
Lessons Learned from Wall Failure

What started out to be a typical site in need of a retaining wall, provided us with a wealth of information on how reinforced soil structures perform under less than optimum conditions. Picture a change in elevation of approximately 13 ft (4.0 m), between the side yard of a residential building and street adjacent to the property. A perfect project for Allan Block, and on the surface a typical retaining site. So goes the story that is seen in hundreds of towns around the world.

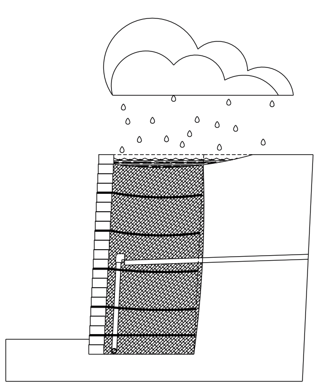
This particular retaining wall was designed by a professional engineer from the residence in need of site work. The design called for a three degree wall with grid lengths of 6 ft (1.8 m) at a maximum spacing of 4 courses for an exposed wall height of approximately 12 ft (3.7 m). A driveway was located at one end of the wall and a gradual slope to the residence located approximately 50 ft (15.2 m) from the back of the wall. A soils report was not obtained but experience indicated that this was a typical clay soil for the area. Little information is available on the method of construction, except that soils were placed in the infill zone in 2 ft (0.61 m) lifts with little if any compaction achieved. The following sequence of events outlines what transpired after the wall was completed.



- Heavy rain from the adjacent property saturated the fill area behind the wall. Settlement, averaging 8 in. (20.3 cm), extending approximately 9 ft (2.8 m) behind the wall was experienced because of the lack of water management and the resulting saturation of the soil. Surface water runoff from several lots simply followed a pre-existing grade and stopped at the back of the wall. A drainage outlet was not incorporated into the design.

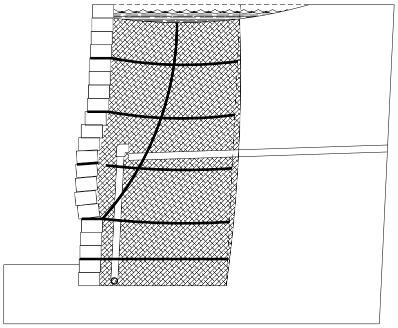


- During the construction care was taken to route down spouts from the house gutters through two, 4 in. (10.2 cm) rigid plastic pipes. Subsequent to the settlement the rigid plastic drain pipes broke directly behind the wall. It can be assumed that during the settlement the geogrid directly behind the wall experienced unanticipated loading, and possible damage, caused by the soil consolidation.

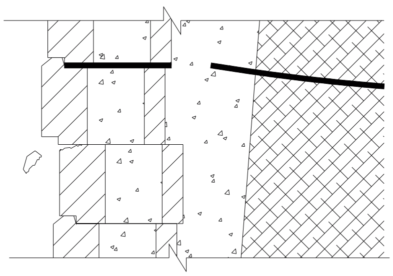


- During frequent rain falls that followed, the settlement area turned into a ponding area, holding water runoff. This inability for the site to effectively drain water away from the soil resulted in constant saturation of the soil.

- Continuing rain fall resulted in an internal stability failure. A localized slip plane materialized, caused by a build up of hydrostatic pressure and by a reduction in strength of the soil. These conditions undoubtedly created a bulge in the wall at approximately 4 ft (1.2 m) above grade.

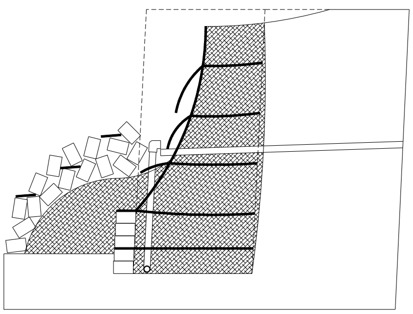


- With no way of determining what happened next, we can speculate that after an undetermined amount of bulging, shear lips failed at approximately 2 ft (0.61 m) above grade and the geogrid sheared behind the wall at the top three layers of grid. At each layer of grid that failed, a length of approximately 10 in. (25.4 cm) sheared away from the rest of the reinforcement mat.



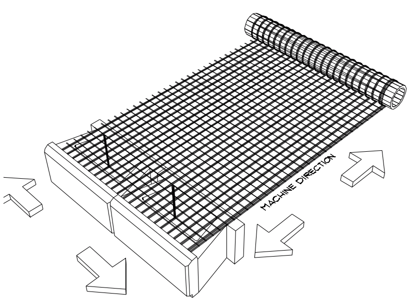
- An internal failure plane, following a log spiral configuration, resulted and a section of wall approximately 8 ft (2.4 m) high by 50 ft (15.2 m) long collapsed onto the street below.

- In addition to the conditions described it was determined that two of the layers of geogrid had been installed with the machine direction parallel to the face of the wall.



Now what lessons have been learned from this failure. First we need to summarize what went wrong.

1. Water was not diverted away from the wall.
2. Proper compaction was not achieved.
3. Grid was improperly installed.



Due to these conditions we have reaffirmed the several design assumptions and characteristics of Allan Block retaining walls. In particular we proved, in the field, the rock lock grid connection is in fact a positive connection. We also clearly were able to see that a failure plane follows a log spiral profile and that increased grid lengths at the top of the wall in no way would have increased the stability of this wall. As is the case in all retaining wall projects compaction is essential. The design used on this wall did not follow the guidelines that we use on a day in day out basis and by taking into account the incorrect placement of the grid design calculations indicate that a failure could be expected. This project presented a snapshot of real life and allowed us to take our nose out of the text books for a few moments and gain a perspective that can only be seen in real life.