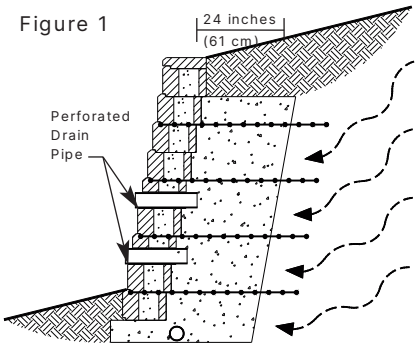
Proper Water Management

In previous articles we have written about the proper compaction, installation and drainage procedures need to insure a wall that will last a lifetime. What additional design procedures can be used to further improve MSE walls? The following details can greatly improve the performance of MSE walls, especially under adverse water conditions. These special applications may apply to the entire wall or may be incorporated for special localized conditions.

1. Increasing the drainage zone behind the wall can greatly increase the strength of the wall by (Fig. 1):

- **A.** Replacing some of the weaker backfill soil with a stronger granular material.
- **B.** Increasing the "holding capacity" of the drainage zone and thereby: increasing the area into which saturated soils can drain, thus preventing excess hydrostatic pressures. Each cubic foot of drain rock holds 2.5 gallons (9.5 liters) of water. Additional drainpipe can be installed in the wall face to increase the drainage rate of water in the drainage zone.
- **C.** Using the accumulated water to add to the weight of the drainage zone and thus increasing the resistance to sliding and overturning. The weight in the drain zone increases from 120 pcf to 141 pcf when fully saturated.

Figure 1

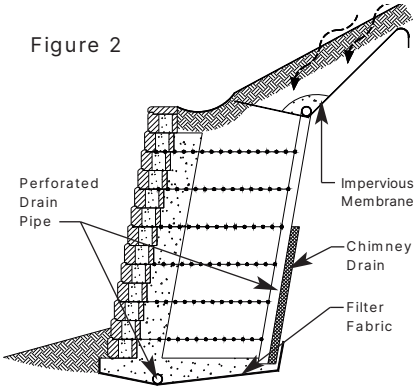


2. Lime treatment of the soil. This application has long been used to "dry" saturated and strengthen highly plastic clay soils. It may be more economical to treat the onsite clay soils with lime than to replace them with a more structurally acceptable material. This treatment has the effect of increasing the strength of clay soils, effectively increasing the friction angle of the soil.

3. Internal drainage is a "safety net" in the event surface water penetrates the wall area, or subsurface water from springs, water line breaks or other unanticipated sources should occur.

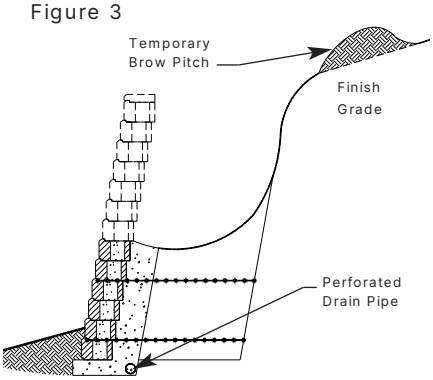
- **A.** A secondary drainage field can be placed at the back of the cut. This material should cover at least 50% of the cut face area; extending to 0.7 of the wall height with no more than 4 feet (1.2 m) of the horizontal area not covered. This vertical drain is then tied into a drain tile or blanket drain.
- **B.** A surface membrane may be used in pervious soils to intercept and drain surface waters. Collected water brought to the base via a chimney drain or non-perforated pipe to the base drain. (Fig. 2)

Figure 2



4. By routing water away from fill soils you can protect the material that will be used to build your soil mass. Temporary ditches or positive drainage away from the wall must be maintained daily to route rainwater from the wall area. Temporary ditches and protection of backfill materials will prevent using saturated soils in the wall installation. It may be necessary to use sheet poly to cover stockpiled backfill to prevent saturation. (Fig. 3)

Figure 3



5. Installing drainpipes for positive drainage is critical. All drainpipes must gravity flow to daylight or a storm sewer, and must be located at the lowest point of water collection. Drainpipe should outlet 30-50 feet OC (9.1-15.2 meters), for most applications. If drainage can not be placed at the lowest point of excavation, use an impervious fill to raise the drain field. (Fig. 3,4 & 5)

6. Increasing the strength of slopes above or below the wall can reduce the chances of shallow global (landslide) failure. Geogrid can be installed in such slopes to allow the slope to stand at steeper angles or to increase the strength of proposed slopes as a guard against water conditions which may weaken the surface soils. Primary, geogrids generally are at least 10 feet (3 meters) long extending from the face of the slope with a vertical spacing not exceeding 4 feet (1.2 meters). Secondary grids of 4.5 feet (1.37 meters) may be required for surface stability. The maximum vertical spacing between geogrids, both primary and secondary should not exceed 12 inches (30 cm). No geogrid should be located within the upper 1 foot (0.3 meters) of the finished slope. (Fig. 6)
7. Decreasing the spacing of geogrid will increase the performance of the reinforced mass under saturated conditions. This technique will reduce the effects of differential settlement as well as increase the internal stability of the reinforced mass. The strength of the geogrid may be reduced as more layers are added. (Fig. 7)
8. Extending the width, increasing the depth and installing geogrid in the base will create a reinforced platform, which increases the bearing capacity and adds to the over-all stability of the wall. (Fig. 8)

Because MSE walls are composite structures built in staged construction, it is vital that every component be installed properly. Soil is a particulate building material, whose strength is affected by static loads, dynamic loads, water, internal composition and proper compaction. Insuring that each element is addressed during design and construction requires precise design and installation. If any element of this composite structure is faulty, the entire structure will not perform up to expectations.

MSE walls in most applications will last a lifetime without special construction considerations. Critical walls in areas of potentially high rainfall, slopes or suspect soils, should be designed with a redundancy which will allow for such conditions as we have seen accompanying El Niño and thereby insure walls that are "built to last". Most of these details are relatively inexpensive in exchange for a wall that will last a lifetime and do so even when Mother Nature demonstrates control of the elements.

To insure that MSE walls will last a lifetime the following general guidelines must be followed.

- Follow the recommended installation procedures.
- Use drainage details to channel water away from the surface and interior of the wall.
- Follow proper methods of compaction.
- Keep heavy equipment away from the wall.
- Provide temporary drainage and water protection and the end of each working day.
- Check the wall after construction and correct any localized settlement.

Figure 4

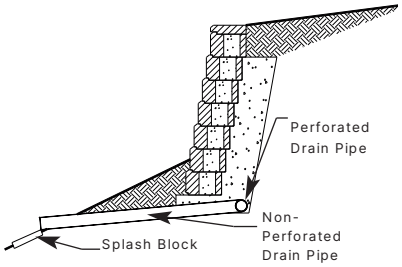


Figure 5

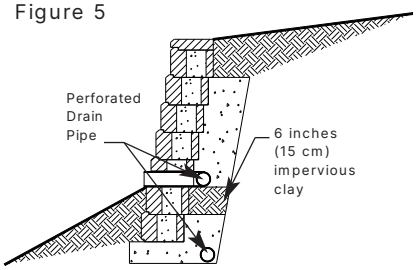


Figure 6

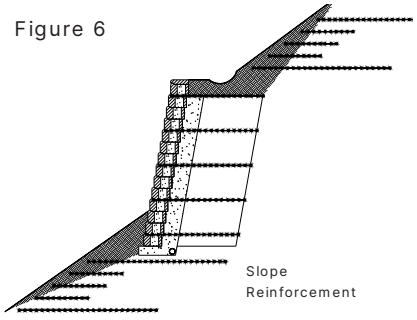


Figure 7

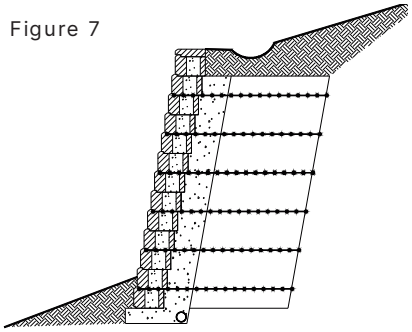
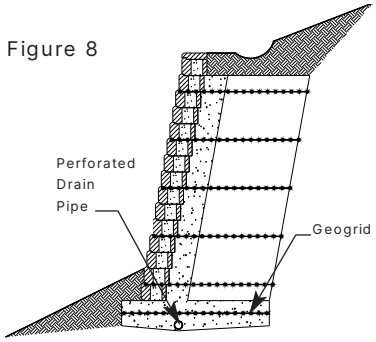


Figure 8



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