Revetments

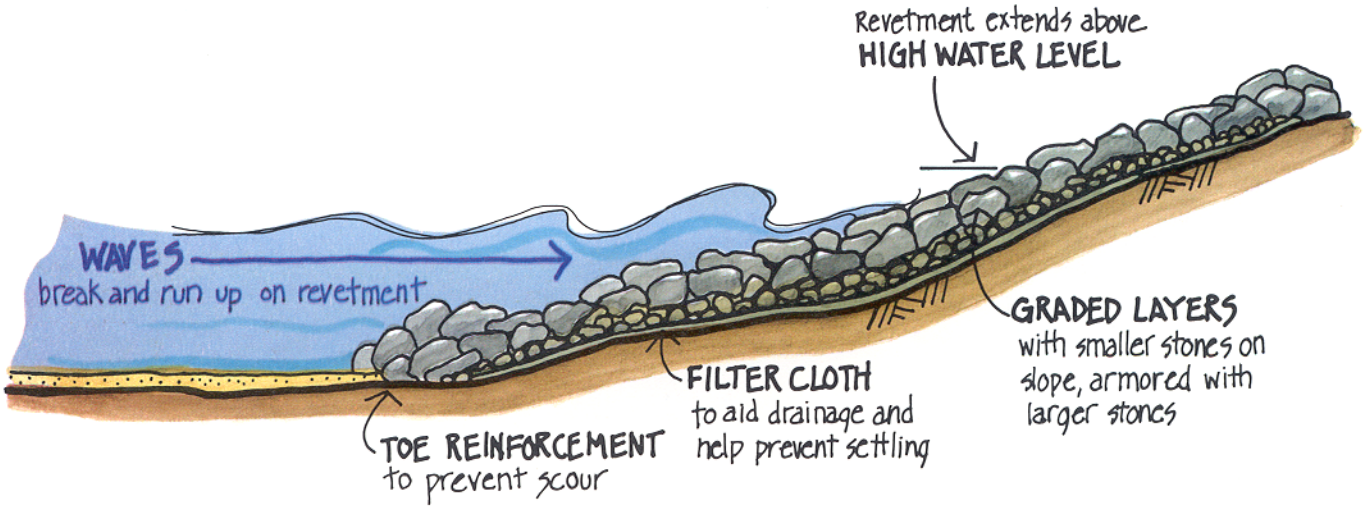
Revetments are structures placed on banks or bluffs in such a way as to absorb the energy of incoming waves. They are usually built to preserve the existing uses of the shoreline and to protect the slope. Like seawalls, revetments armor and protect the land behind them. They may be either watertight, covering the slope completely, or porous, to allow water to filter through after the wave energy has been dissipated.

Most revetments do not significantly interfere with transport of littoral drift. They do not redirect wave energy to vulnerable unprotected areas, although beaches in front of steep revetments are prone to erosion. Materials eroded from the slope before construction of a revetment may have nourished a neighboring area, however. Accelerated erosion there after the revetment is built can be controlled with a beach-building or beach-protecting structure such as a groin or a breakwater.

Design Considerations

Waves break on revetments as they would on an unprotected bank or bluff, and water runs up the slope. The extent of runup can be reduced by using stone or other irregular or rough-surfaced construction materials. A rough surface offers more resistance to the water's flow than the original shoreline surface, decreasing the energy of the wave more quickly and preventing the water from traveling as far.

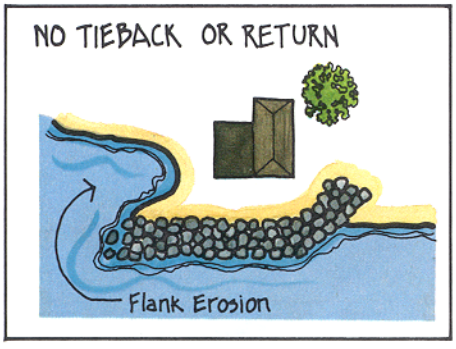
Important design considerations include providing appropriate height, width, and toe protection. Revetments should be high enough to prevent overtopping by high waves. To prevent flank erosion, the sides should be protected by tiebacks or returns. Scour at the toe can be prevented by a rock apron. Where there is a beach between the revetment and the water, access over the structure should be provided for beach users.

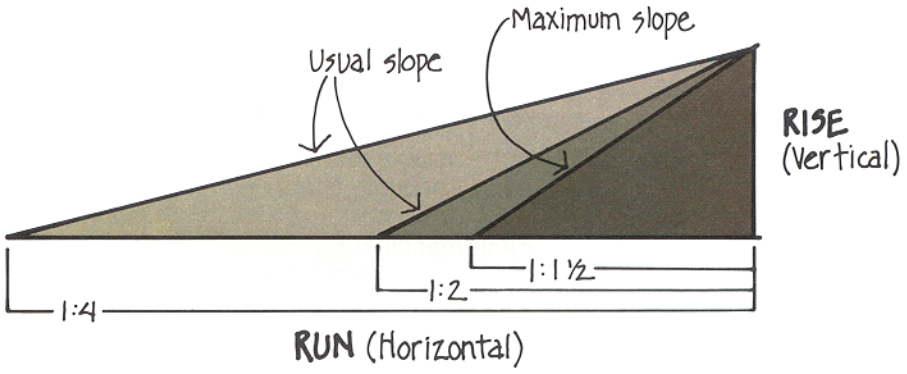


Revetment design should also allow for relief of groundwater pressure in the protected bank. Filters of cloth or small stones relieve water pressure in porous revetments, keeping drainage paths open and preventing settling. Solid revetments can be drained by evenly spaced "weep holes" along the bottom. This drainage channels the groundwater along noneroding paths and prevents it from seeking its own way along the softer material of the slope.

Revetments that are adequate under normal conditions may be damaged in severe storms, when the speed of water and carrying power of waves increase to several times their normal rates. Revetments must be thus strong enough to resist the battering action of waves and wave-carried debris. Heavy stones and an interlocking design in porous revetments can help prevent the construction material from being washed away.

Revetments can be adopted to a variety of local conditions and available materials. Some materials are more suitable to gentle slopes and light wave action, others are more sturdy. Armoring the revetment with a heavy face layer and providing drainage are key elements of success.





Site Characteristics

Revetments are stable if they are built on relatively gentle slopes, with two to four feet of run for every foot of rise. Revetments should not be built on slopes with less than a foot and a half of run per foot of rise. The slope on which a revetment is to be built may require grading or smoothing to prepare an adequate foundation for construction.

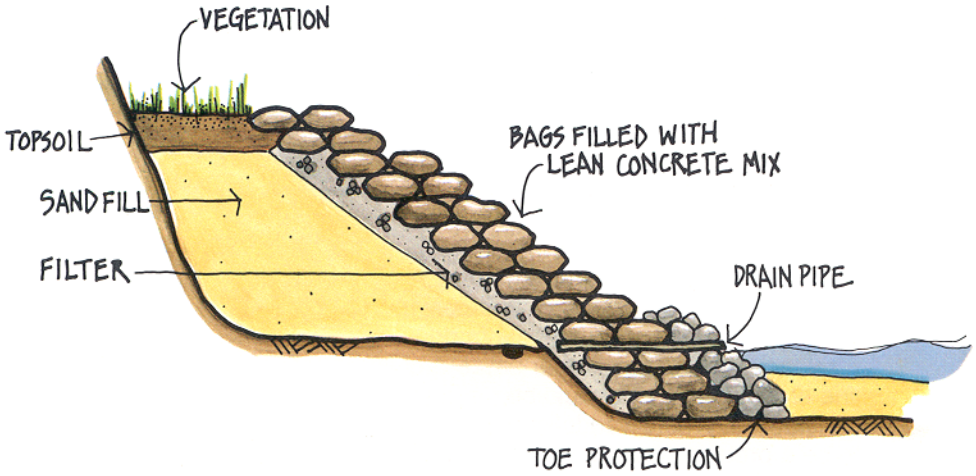
Erosion at the toe, common in steep revetments, further decreases the stability of the structure. In areas where unstable slope materials may displace the structure, other shoreline erosion devices should be considered. Where vandalism is likely to be a problem, especially heavy or durable construction elements are needed.

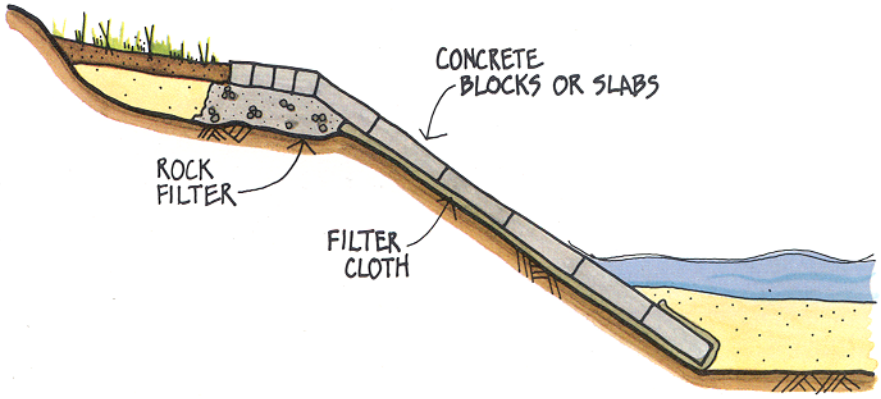
Construction Materials

Where they are readily available, rubble or quarrystone make the most reliable and economical revetments. Adequate filters and armor stone size are important. The cost of labor or machinery necessary for slope preparation or placement of the largest sizes of stone may be high even where material is available at reasonable cost.

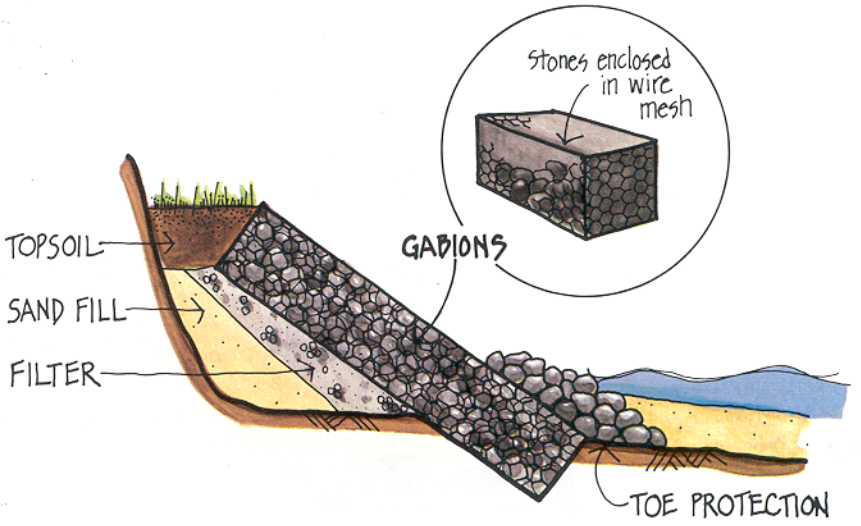
Burlap bags filled with sand or lean concrete mix are another low cost alternative, but they should be used only where waves are light. Bags filled with wet sand-cement mixture and piled two-deep on the face of the slope interlock somewhat, resisting removal or displacement.

Concrete blocks or slabs of many shapes have proved effective in revetments. Large blocks and interlocking designs are the most successful. Special concrete mixes must be used, however, since standard concrete is too weak and will deteriorate until it crumbles under wave attack. Wave-carried ice, cobblestones, or other debris damage concrete blocks, even those formed with special mixes. Concrete blocks should not generally be used in areas where such damage is likely to occur.





Gabions can also be used for revetments. The baskets must be solidly filled, or the wires will be abraded by movement of loose stones. The stones must be large enough, usually at least four inches in diameter, to prevent loss of stone through the gabion mesh. Maintenance may be required to refill baskets whose stones have settled or been lost. Gabions should not be used at all where damage from water-carried debris is likely or where foot traffic over the revetment is expected.



Gabion revetment