Breakwaters

Breakwaters are structures placed offshore to dissipate the energy of incoming waves. Large breakwaters suitable for protecting deep harbors are generally beyond the resources of the individual property owner. The breakwaters discussed in this section are smaller structures, placed one to three hundred feet offshore in relatively shallow water, designed to protect a gently sloping beach.

As shown below, the dissipation of wave energy allows drift material to be deposited behind the breakwater. This accretion protects the shore and may also extend the beach. The amount of deposition depends on the site characteristics and the design of the breakwater. Breakwaters may be either fixed or floating: the choice depends on normal water depth and tidal range.

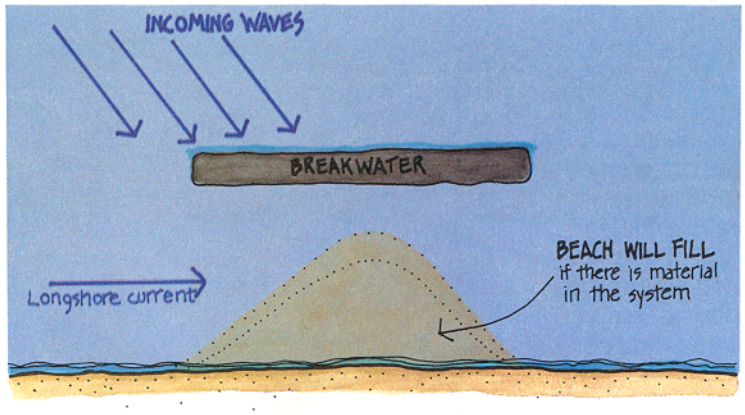
Design Considerations

The degree of protection desired from a breakwater must be carefully considered. If the breakwater is too high, it will seriously interfere with shoreline processes; too low, and the shore will be inadequately protected.

The height and porosity of a fixed breakwater determine the extent to which drift will be deposited behind the structure. It is generally desirable to allow some of the wave action to pass over or through the breakwater because many people value the waves as part of the natural beauty of the shore and as an essential ingredient in their recreational experience. This wave energy also helps to keep the area between the breakwater and the shore from becoming overfilled with littoral drift. Breakwaters that are too porous are ineffective, however.

The material that fills in behind the breakwater might otherwise be deposited on someone else's beach, which may erode due to the breakwater. If this is likely, beach fill can be added between the shore and the breakwater until the rate of longshore transport resumes an acceptable level.

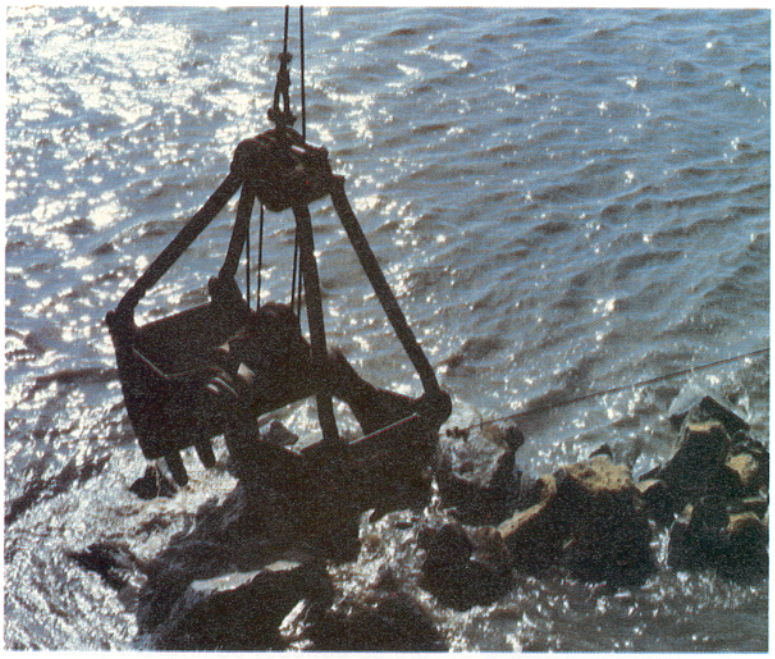
Like other vertical shoreline erosion control structures, fixed breakwaters are subject to



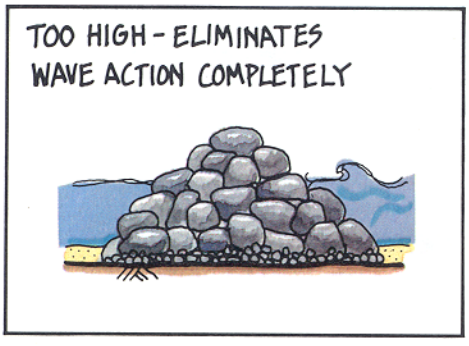
OVERHEAD VIEW

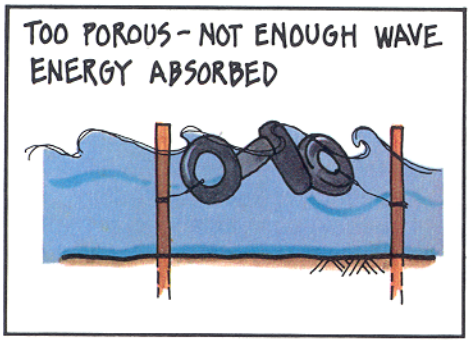
scour—erosion at the base of the structure, or the "toe," where the resistant construction material meets the erodible beach bottom. Extra width at the base of a stone rubble breakwater or a protective rubble apron along the toe of a sheet-piling breakwater can help prevent this erosion and keep the structure from tipping.

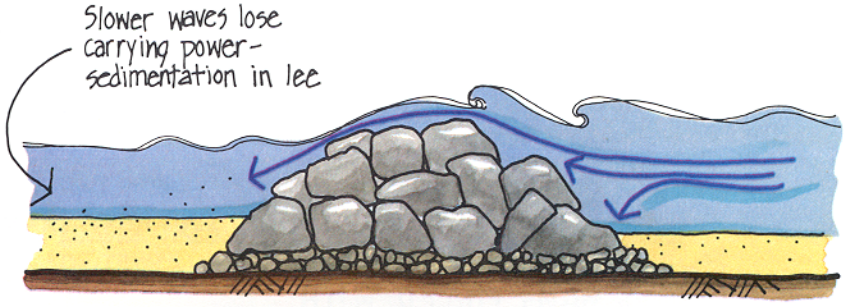
Because breakwaters are designed to receive much of the impact of incoming waves, they should be designed strong enough to remain in place during the usual local storms. Floating breakwaters must be firmly anchored to the bottom and adequately connected. They may be unsuitable where wave action is relatively heavy. Especially heavy or durable construction elements may be required for all breakwaters in areas where damage from vandalism in a problem.



Breakwater under construction



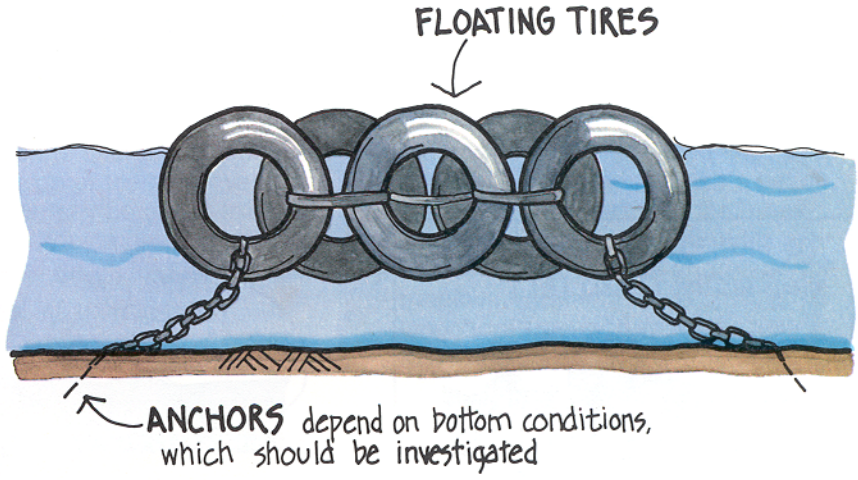


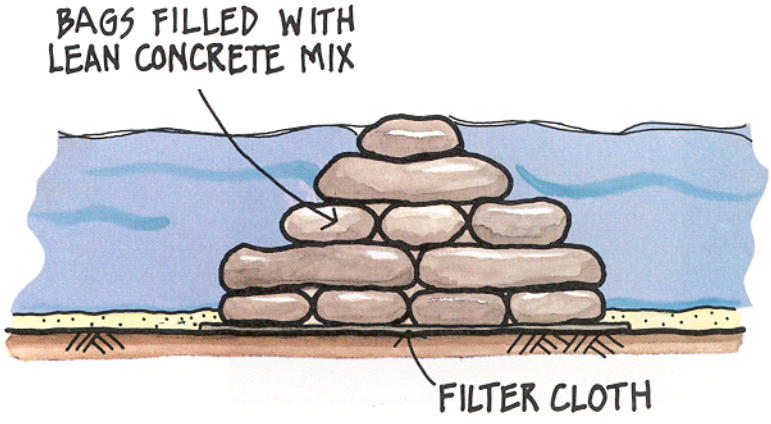


Site Characteristics

Fixed breakwaters are most economical when the slope is gentle and the high water level at the proposed site is less than about four feet deep. If the water at high tide is deeper than four feet, the fixed breakwater would need to be built so high that its cost would be prohibitive. Floating breakwaters can adjust to higher tides, but they are effective only against waves of short length. If these conditions do not match your site, you might consider an alternative structure such as a revetment, bulkhead, or groin field.

The nature of the bottom material is also important. Stone rubble or sandbag breakwaters can rest on any type of bottom, but they may settle if placed on soft earth or sand. A filter layer between the structure and the bottom can relieve this problem. Special attention should also be paid to the anchors that hold floating breakwaters in place in soft-bottom locations. While sheet piles can only be driven or jetted into relatively soft bottoms, scouring and tipping may create problems in areas where bottom material is very soft.





Construction Materials

Breakwaters can be constructed from many different materials. As well as the choices discussed here for fixed and floating breakwaters, there are a number of patented breakwater systems available.

Stone rubble is useful as a fixed breakwater material if it is available in the vicinity at reasonable cost. Filter material between the stones and the bottom sand or earth can help prevent settling and deformation of the structure. The stone material should be arranged so that the smaller stones are in the interior of the structure, armored and retained by the larger stones.

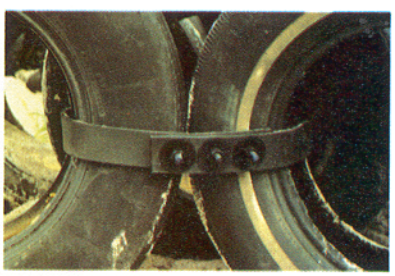
Rubber tires on treated-timber piles may also be used for relatively low cost, effective fixed breakwaters where timber piles can be driven deep enough to ensure stability. Horizontal rope or timber crosspieces are needed to keep the tires from floating off the tops of the piles in high water.

Treated-timber sheet piling performs well when used for fixed breakwaters and is applicable wherever the bottom will permit driving or jetting the piling to sufficient depth. This construction material is illustrated in the sections on sills and groins.

Burlap bags filled with a sand-cement mixture (lean concrete) are another low cost construction element. They are suitable only where the tidal range is moderate and the bottom slope is fairly flat. Filter material should be placed under the structure to prevent settling.

Fixed breakwaters can also be constructed with other materials that are only suitable in certain locations or require special installation or design adjustments. These materials include sandfilled bags, gabions, concrete boxes, and the patented Longard tube, Z-wall, Sandgrabber, and Surgebreaker concrete blocks. Patented systems are generally available only through franchised dealers and may require special equipment for installation, resulting in relatively higher initial costs.

Floating breakwaters can be built with tires bolted or tied together. The type and material of fasteners should be chosen in light of local conditions, the degree of up-and-down motion due to waves, and the flexibility that will be required as the completed structure rides on the water. The floating breakwater must also be anchored. The type of anchor depends on tide and bottom conditions: generally, piles remain in place longer than other anchors.



Fastening method for floating breakwater