SHORE PROTECTION STRUCTURES ALONG KERALA COAST-LOW COST ALTERNATIVES

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Abstract: Several studies over the last two decades on low cost shore protection measures are reviewed to have an integrated profile with a point on application to the sheltered coasts of Kerala. It is emphasised that these alternative are generally not intended for open coast sites and contrary to the belief that they are cheap, the total cost of implementation will vary with different options.

1. Introduction

The coastal area of Kerala-the emergence of which is legendarily ascribed to Lord Parashurama-extends from 8°15'N to 12°30'N latitude and lie between 74°E and 77°E longitude spanning over 560 Km with a maximum width of over 120 Km (Fig1).

Fig 1. The coastline of Kerala

The beaches of Kerala can be classified under barrier beaches following the definition of Zenkovich (1967). This barrier and separates the Arabian Sea from a chain of long irregular estuaries and lagoons with a remarkably straight outer shoreline of emergent nature and a highly irregular inner shoreline of subemergent nature representing the eastern margin of the lakes and lagoons. Systematic efforts in shore protection works were initiated in early fifties as could be seen from the first experimental seawall and groin assembly at Manassery near Cochin. Initially these structures have shown some effectiveness but subsequent failures have been reported apart from their adverse impact to the nearby beaches. Studies relative to shoreline deformations in relation to shore protection structures along Kerala coast has undertaken (Murty et al. 1980). The marked differences in the behaviour of beaches at some locations are explained in terms of reflection of waves, the alongshore flows alternating in direction with the changing wave field and the presence of diamond patterned short crested waves resulting from the presence of seawalls. Mud banks are frequently reported in the nearshore regions of Kerala coast and it is possible that coastal process are closely related to these. Due to wave refraction in the mud bank region, waves approach the coast at an angle on either side, thus producing littoral currents directed to the shadow zone on either side, and favouring accumulation of sediments which gives rise to changes in slopes of the inshore regions and wave breaking. Thus in locations where the shoreline deformations are due to formation of mud banks etc the remedial measures also should be transient.

2. The low cost alternatives

Even if low cost and cheap, practically any shore protection method, if properly implemented is expensive. The methods suggested here are usually appropriate for use only in sheltered waters and are generally not intended for open coast sites.

Bulkheads

If the wave height ranges above 1.75m, sheet piling bulkheads made of steel, aluminium or timber can be used. They can be used in structures which may be either cantilevers or anchored. Detailed design procedures are available (Anonymous, 1975).

As bulkheads normally have vertical faces for ease of construction which result into wave reflections, thus increase the potential for overtopping and scour in front of the structure. Connections between the anchors and walls should be done and horizontal wales are to be provided. The advantages of sheet pile bulkhead is its relatively long and maintenance free life and uniform appearance.

Steel sheet piling, probably the most widely used bulkhead material provide a relatively sand tight fit which precludes the
Fig. 2. Typical timber sheet sections (after Winterkorn H.F. et al., 1975)

Fig. 3. Typical quarrystone revetment

used for suitable filters. Aluminium sheet pile sections are similar
in shape, its primary advantage over steel is the lighter weight and
tenacity and corrosion resistance. The main disadvantage is that it is
more rugged when driven and can't penetrate logs or rocks.

Well designed timber structures have long been recognized
as an economical and relatively simple material for bulkhead construction. Fig.
illustrates the common types used. The actual dimensions will
depend upon the site characteristics.

Hogwire fencing attached to posts can be used to support
at the front of the construction where wave heights range below
2.0m. Tearing of the front row of bags can be prevented by filling
in with a sand-cement mixture. Placing the bottom bags and
in a trench, providing adequate drainage of the retained
and using the mesh wire with a PVC coating will give

First layer (stone weight)

Second layer (stone weight)

Third layer (stone weight)

Fourth layer (stone weight)

Fig. 3. Typical quarrystone revetment

Used concrete pipes also can be used, by keeping them on
end, side-by-side, and filling them with granular soil. This is prac-
tical only when there is a strong supply of used pipes and
where a low structure is adequate (wave height range: Below
0.75m). If the wall is more than twice the diameter of the pipe, an
anchoring system is to be attached. This method is meant only for
temporary protection as rapid deterioration of concrete takes
place.

Revetments

Rubble revetments are constructed of one or more layers of
stone or concrete pieces derived from the demolition of sidewalks,
streets or buildings. Stone revetments are constructed of either
two or more layers of uniform sized pieces (Fig. 3) or a gradation
of sizes between upper or lower limits (rip rap). Graded rip rap
revetments are to be used with caution, as they are difficult to
design and inspect but are acceptable for all low cost shore
protection applications. If the wave height range above 1.75m,
quarry stone revetments can be used. They are durable and
relatively inexpensive when available locally. The individual unit
should be determined depending upon the wave condition
(Anonymous, 1977). A concrete rubble revetment also have the
advantage of utilizing a waste product which is otherwise difficult
to dispose of in an environmentally acceptable manner.

Breakwaters

Breakwaters are either floating or fixed. By trapping sand on
their landward side, they protect the shore while simultaneously
enhancing recreational uses. Floating breakwaters are con-
structed in areas where height ranges below 1.75m using any
buoyant material like used rubber tyres, logs, timbers and hollow
concrete modules. Floating breakwaters are particularly ad-
advantageous where fixed breakwaters are expensive and offshore
spills are steep. The normal arrangement of rubber tyres are
shown (Fig. 4). Virtually and floating material can be used in place.
of scrap rubber tyres. Modules of light weighted concrete filled with flotation foam also found to be successful.

The important feature of a fixed type breakwater is its height, which determines how much wave energy passes over it. In locations where the wave height range is below 1.75m, sand filled or grout filled bags can be used. Sand filled bag breakwaters are constructed of stacked bags in a staggered pattern. The major advantage of grout filled bags over sand filled bags is that the units do not lose their shape even after the outer fabric is torn. If the wave height ranges above 1.75m, quarrystone breakwaters are constructed which is structurally similar to a stone revetment both in design and appearance. Over the years, stone has been used for constructing breakwater than any other material.

Fig. 4. Floating type breakwater modules

Groins

Groins can be built either high or low with respect to the natural beach profile. A groin must be built to resist wave forces, currents, the impact of floating debris, and earth pressures created by differences on both sides. Important design considerations for groins include the height, length, spacing and the littoral transport rate (Anonymous, 1977).

Similar to a stacked bag breakwater, a stacked bag groin can either be sand or grout-filled. They are meant only for short term applications, but have performance ratios fairly high. Quarrystone sheet pile groins also can be used for similar wave conditions, which are tested. Fig. 5 shows a section and profile of a typical sheet pile groin.

Vegetation

Vegetation is an inexpensive and generally easy approach to coastal erosion. Even though vegetation does provide a significant contribution into preventing erosion, they alone cannot prevent movement of the shoreline. It is usually used as a supplement to existing structures. The most important factor in dune management is vegetation cover of the dunes. The suggested species, Casuarina equisetfolia which grows well in Indian climatic conditions is found suitable for Kerala coast too. Recently, the usage of mangroves has also started on an experimental basis. The protection of the upland portions of sandy shorelines can be accomplished through the creation of barrier dunes and the stabilization of the present dunes.

References


