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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°50'N latitude and lie between 74° E and 77°31'E longitude spanning over 560 Km with a maximum width of over 120 Km (Fig.1).

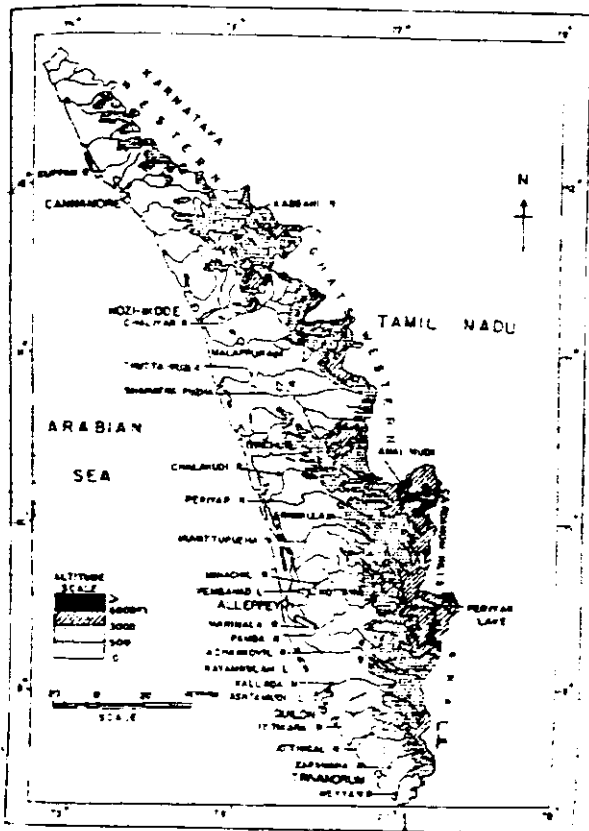


Fig 1. The coastline of Kerala

The beaches of Kerala can be classified under barrier beaches following the definition of Zenkovich (1967). This barrier land 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 submergent 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 Manasserry 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

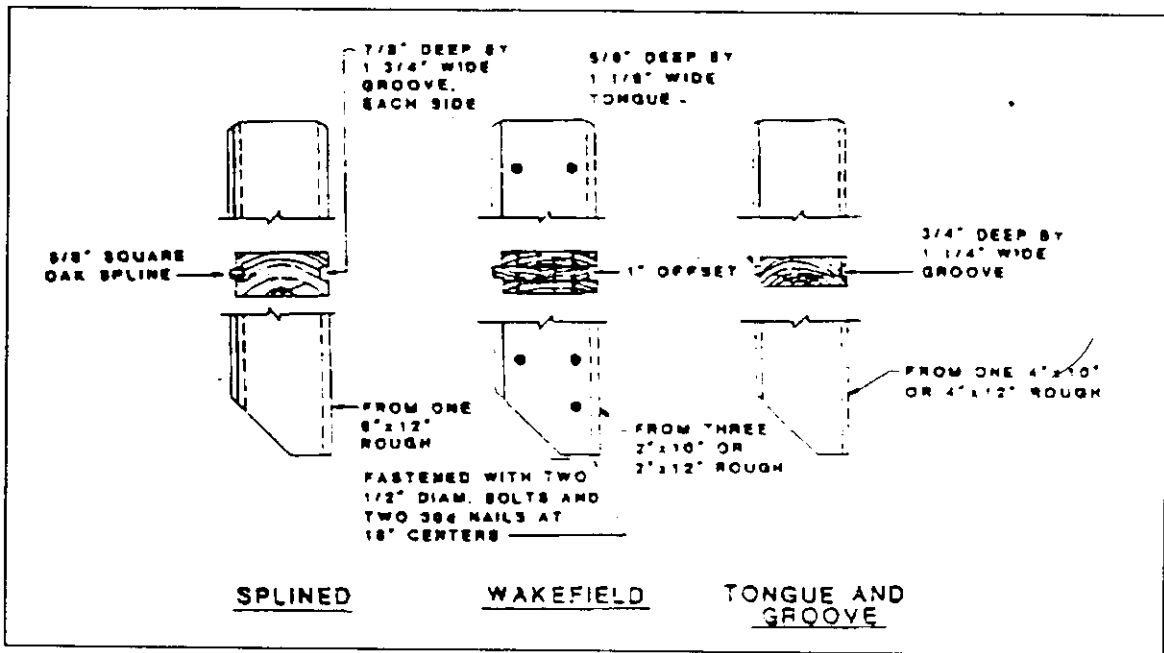


Fig 2. Typical timber sheet sections (after Winterkorn H.F et al, 1975)

ed for suitable filters. Aluminium sheet pile sections are similar steel. Its primary advantage over steel is the lighter weight and superior corrosion resistance. The main disadvantage is that it is rugged when driven and can't penetrate logs or rocks.

Well designed timber structures have long been recognized available and economical materials for bulkhead construction. Fig. illustrates the common types used. The actual dimensions will vary depending upon the site characteristics.

Hogwire fencing attached to posts can be used to support sand bags stacked on the landward side of the fence to form a relatively inexpensive structure where wave height ranges below 0.75m. Tearing of the front row of bags can be prevented by filling them with a sand cement mixture. Placing the bottom bags and facing in a trench, providing adequate drainage of the retained seabank and using the mesh wire with a PVC coating will give better results.

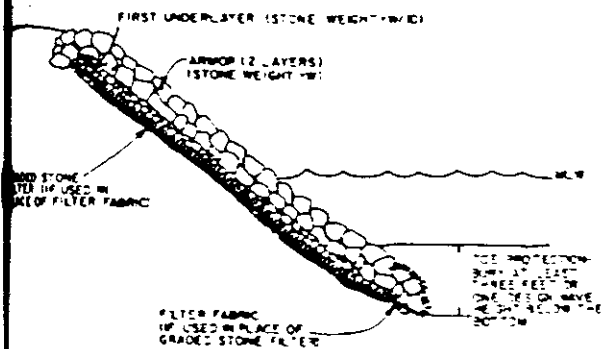


Fig 3 Typical quarrystone revetment

Used concrete pipes also can be used, by keeping them on end, side-by-side, and filling them with granular soil. This is practical only in areas when there is enough 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 constructed 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 advantageous where fixed breakwaters are expensive and offshore slopes 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 does not lose their shape even after the outer fabric is torn. If the wave height ranges above 1.75m, quarrystone breakwater is 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.

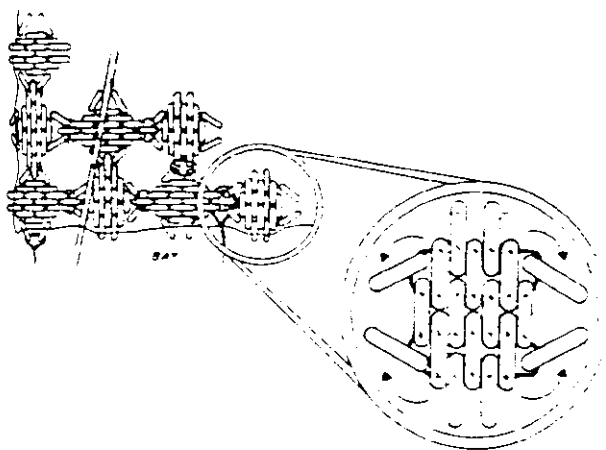


Fig. 4. Floating tyre breakwater modules

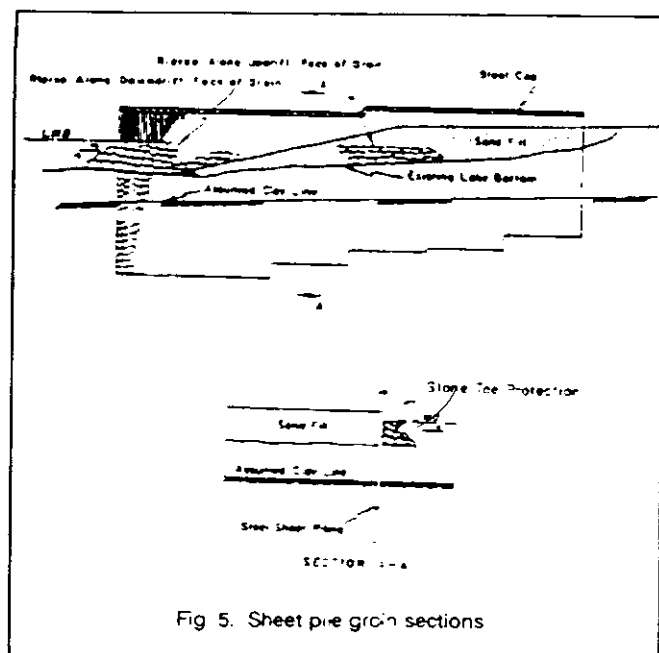


Fig. 5. Sheet pile groin sections

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 equisetifolia* which grows well in Indian climatic conditions is found suitable for Kerala coast too. Recently the usage of mangrooves are 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.

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Groins

Groins can be built either high or low with respect to the existing beach profile. A groin must be built to resist wave forces, currents, the impact of floating debris, and earth pressures created by the 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 ratio fairly high. Quarrystone and sheet pile groins also can be used for similar wave conditions, which is time tested. Fig. 5 shows a section and profile of a typical sheet pile groin

Vegetation

Vegetation is an inexpensive and generally easy approach to prevent coastal erosion. Even though vegetation does provide significant contribution into preventing erosion, they alone cant