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# To Analysis the Feasibility of Rubble Mound Sea Wall at Mumbai Costal Road Project

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***Abstract - The impact of seawalls on nearby beaches and the dynamics of the coast has not been adequately studied in the literature. The purpose and function of coastal buildings, particularly seawalls, are sometimes misinterpreted since, in certain situations, they actually contribute to coastal erosion instead of safeguarding the beach as intended. By influencing the onshore/offshore and, to some extent, the longshore sand transport, seawalls are purportedly changing the near-shore process, notably the sediment dynamics. Therefore, it is crucial to comprehend how seawalls affect the nearby beach in order to ensure that installation selections are made with more knowledge. A seawall is built along the coast, maybe at the base of cliffs or dunes. A seawall is often a concrete structure with a slope; its surface may be smooth, stepped, or curved. A seawall can also be constructed as a block seawall, a rubble-mound construction, a steel or timber structure. The fact that the building is built to resist powerful wave action and storm surge is a defining trait. Such rigid seawalls are frequently protected at their foot by a rubble-mound revetment. A rubble-mound revetment and a rubble-mound seawall are quite similar, although a revetment is frequently utilised as an addition to a seawall or as a stand-alone building in less vulnerable regions. A seawall is occasionally used to refer to an exposed dike that has been reinforced to withstand wave action.This report discuss the Construction techniques of Rubble Mound Sea wall , also its types, and Failure Pattern for this the Mumbai costal road case study taken in to consideration***

***Keywords - Sea Wall, Erosion, Rubble Mound Sea wall, Mumbai costal road***

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## INTRODUCTION

When the water and related coastal processes directly affect the landforms along the shore, a seawall (or sea wall) is built as a kind of defence. A seawall is built to shield populated regions, natural areas, and recreational places from the effects of tides, waves, and tsunamis. The seawall's static design will clash with the coast's dynamic features and prevent silt from moving freely between land and sea. Hard-engineered shore-based structures called seawalls prevent coastal erosion.

**Use of Sea Wall Seawalls** are built using a variety of materials, most frequently gabions, boulders, steel, or reinforced concrete. Vinyl, wood, aluminium, fibreglass composite, and biodegradable sandbags made of jute and coir are further potential building materials. In the UK, a seawall can also be an earthen bank that is used to build a polder or a dike. Although the specific process is yet unknown, it is hypothesised that the type of building material has an impact on how coastal creatures settle.

At the base of potential cliffs or dunes, a seawall is built along the shoreline. A seawall is often a concrete structure with a slope; its surface may be smooth, stepped, or curved. A seawall can also be constructed as a block seawall, a rubble-mound construction, a steel or timber structure. The fact that the building is built to resist powerful wave action and storm surge is a defining trait. Such rigid seawalls are frequently protected at their foot by a rubble-mound revetment. A rubble-mound revetment and a rubble-mound seawall are quite similar, although a revetment is frequently utilised as an addition to a seawall or as a stand-alone building in less vulnerable regions. Sometimes referred to as a, an exposed dike that has been reinforced to prevent wave action.

The almost vertical seawall, which was mostly employed in the past, had the negative effect of reflecting part of the wave energy, which intensified the erosion and hastened the beach's demise. However, because they are employed where the shoreline is vulnerable to erosion, all types of seawalls result in beach damage. The seawall will realign the shoreline, but it won't stop the coastal profile's continual erosion. Instead, it will, to a different extent, speed up the degradation. It is relatively usual for the beach to disappear in front of a seawall, and after a few years it will typically be necessary to reinforce the seawall's foot with a rubble revetment.

**Significance:** While monolithic buildings are frequently unyielding, structures made of rock and sand are somewhat flexible. We concentrate on the rubble-mound seawall in this essay. When opposed to monolithic constructions, these structures have the following key advantages: flexibility - the ability to accept (minor) variations in the seabed's or the beach's elevation; the capacity to disperse wave energy, which would reduce the structure's burden from the waves and also lessen the likelihood of scouring; the (relatively) inexpensive costs of building, maintaining, and adapting, particularly for structures in shallow water.

## LITERATURE REVIEW

*Griggs, Gary B.2014,* The authors have examined seven years of bi-weekly to monthly monitoring of beaches next to and in front of seawalls in order to address the topic of whether coastal constructions cause or accelerate erosion. We looked for any seasonal or long-term trends or impacts in the seven years of data. This investigation revealed some seasonal differences between the summer and winter profiles on both the nearby beaches and those with seawalls. There was, however, very little difference between the profile fronting the seawall and that of the neighbouring beach once the summer berm on the adjacent beach had receded back to or land-ward of the barrier. The authors claimed that the seven had no appreciable long-term consequences or implications.

*Dyer, Mitchell J., 2014* The thesis seeks to document, monitor, and measure the many components of coastal processes in order to evaluate their potential impact on geomorphic development. High water mark retreat and sediment volume removal are used to gauge beach erosion. Volume erosion in St. Clair was localised near the seawall, but beach retreat was more evident in non-stabilized regions. At each location, the beach began to recover, although it did so more quickly in front of the wall. More study is needed, according to Dyer, on regional dynamics and geomorphic alteration. The beach alteration in front of the St. Clair barrier is documented in pictures and descriptions in the thesis, but no in-depth analyses are provided.

*Basco, David R., 2014* The authors have statistically evaluated field data from Sandbridge, Virginia in an effort to shed some light on the issue of the interaction between beaches and seawalls. They used profile section volumes, berm elevation, and coastline location to assess the quantitative change in beach profile. According to this investigation, there isn't enough solid data to back up the assertion that Sandbridge's seawalls have accelerated coastline erosion. The seawalled beach saw more seaward sediment loss, but less landward sediment loss than the nearby beach. Because more sand was kept behind the wall, less sediment was lost overall on the seawall-protected beach.

*Basco, David R., 2019,* This study investigates the long-term interactions between offshore bathymetry, wave climate, shore boundary conditions, and shoreline reaction. To determine if the 50 years of barrier construction along the Virginian coastline had affected the rate of shoreline recession, 120 years of shoreline recession rates were examined. It was discovered that the seawalls had not sped up the surrounding shoreline's pace of recession while preventing retreat at the seawall places. This coastline's offshore bathymetry, deep water, and high intensity wave environment all had a significant impact on erosion. The authors urge field research to take into account offshore boundary circumstances as a result, to prevent mistakes in judgement.

## PROBLEM STATEMENT

Rocks, soils, and/or sands near the coast are destroyed or carried away by the process of coastal erosion, which is caused by local sea level rise, strong wave action, and coastal flooding. Both erosion and accretion benefit from one another. If they have moved from one side, sand and other sediments must have accumulated elsewhere.Soil erosion is the loss of land and human settlement as a result of seawater washing away some of the soil near the shoreline. On the other side, soil accretion increases the area of the land.

## OBJECTIVES

1) To Study the need of Protecting Structure at Sea Shore

2) To analysis the effectiveness of Rubble Mound Sea Wall for Costal Protection

3) To Study the Construction Techniques for Rubble Mound Sea Wall

## METHODOLOGY

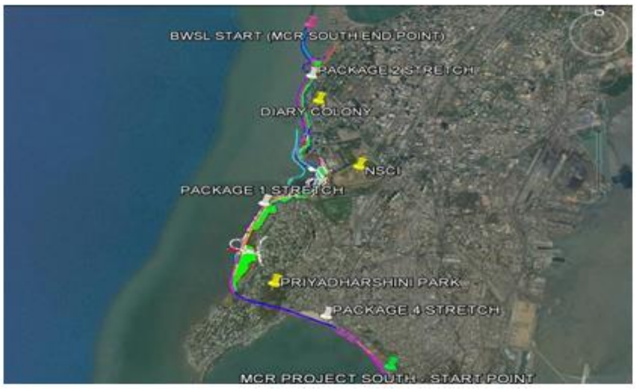
Step No 1: By literature review Study the need of Protecting Structure at Sea Shore

Step No 2: To Understand the Rubble Mound Sea Wall structure by site visits

Step No 3: By taking actual vase study understand the Construction Techniques of Rubble Mound Sea Wall

Step No 4: By taking suitable case study of Mumbai Costal Road evaluate the feasibility of Rubble Mound wall and also study the failure reason

## DATA COLLECTION




The projected seawall, reclamation, and associated works at Mumbai are part of the Mumbai Coastal Road Project, which was created by the Municipal Commissioner, Municipal Corporation of Greater Mumbai. According to Figure 1, Package I stretches from Priyadarshini Park to Baroda Palace from chainage CH 5+900 to CH 9+720. Fig. presents the general project layout and typical job details.

## DATA ANALYSIS

### Work Scope

Survey, rock placement, core profiling, armour placement, geotextile installation, and filing with appropriate material are all included in the scope as part of reclamation..

The scope of work, which is described in this method statement, covers the following works:

| Package | Seawall Length (m) | Activities |
|---|---|---|
| Package I | CH: 5+900 to CH:8+700<br>CH: 9+100 to CH:9+720 | Quarrying rock, Transporting, Stockpiling, Placing |

| Package | Reclamation Area | Activities |
|---|---|---|
| Package I | 6,00,000 m$^2$ | Fill Material sourcing, Transporting, and Filling |

### Rock / Reclamation Fill Stockpile

The stockpile area will be levelled and graded correctly. There will be built inside temporary access roads to the stockpile. Rock will be heaped up in various grades at the quarry or source. The stockpile of rock will be handled with the appropriate machinery.

Depending on the site characteristics and design specifications, seawall construction and reclamation will be carried out in a combination of marine and land modes. Whenever feasible, depending on the accessibility of the work fronts, material will be immediately deployed without stockpiling at the site.

### *Quantity of Seawall*

| Rock types | Grade limit | Qty ( MT) |
|---|---|---|
| Core | 1 to 500 Kg | 633,000 |
| Armour | 2 to 4 MT | 269,800 |
| Filter- Toe bund | 0 to 250 mm | 48,480 |
| Filter- Soil replacement | 0 to 250 mm | 348,500 |
| **Total Quantity of Seawall** | **approx** | **13,00,000** |

### Seawall Construction

The ideal structural system for Seawall is Rubble Mound. To build the seawall, various grades of rocks will be utilised, as planned. Dump trucks will be utilised to bring rocks of varying grades to the project site for the coastal road. These rocks will be used to build the seawall. The building of the seawall will mostly use land modes of transportation in accordance with the project specifications. Trucks will deliver the rock needed for the seawall works directly from the quarry or stockpile, as the case may be.

### Reclamation

According to project specifications, fill material to be utilised for reclamation will be procured from an appropriate site. To get the fill material to the project site for the coastal road, dump trucks or dredgers will be used. In order to complete the reclamation, a combination of marine and land modes of transportation is proposed.

### Marine Mode

Pumped dredged material will be placed in layers at the reclamation site according to requirements. The sites for the dredging are shown below.:-

The dredger will be 3 km from the shoreline's edge when it is pumping, and the material will be transferred by pipes.

### Land Mode

Dump trucks will be utilised to deliver some of the fill material needed for reclamation to the project site. Regulations pertaining to transportation and time windows shall be followed.

Due to the volume of work required, there will be substantial activity overlap and work will be done on several fronts. It is anticipated that the work will be done around the clock based on the site condition and schedule need with typical 6-day work weeks due to the amount of work and short project length. However, wherever necessary, work will also be done continuously over the weekends.

**Detailed Construction Process of Rubble Mound Sea wall at Mumbai Costal Road Projects DETAILED METHODOLOGY AND SEQUENCE**


Identified Borrow Areas of Dighi and Jaig

**SETTING OUT**

Control points and any required interim benchmarks will be created based on authorised construction plans and a thorough survey. During construction, these control points and benchmarks will serve as a guide.

**SURVEYS**

The survey's tools will all be calibrated equipment. Periodic surveys will be done to make sure that different classes of rock materials are deposited where and to the slopes, lines, and levels shown on the drawings. The current/certified benchmarks will be used to create temporary benchmarks. A coordinate approach will be used to lay out the seawall's centre line. Once the coordinates are established, the same method will be used to monitor alignment and adjust levels using a total station or GPS. Equipment supported by GPS will lay rock material for placing below water. Base stations can be established and calibrated at the site to facilitate the placement of rock and armour using DGPS. To get the actual depths along the alignment, a bathymetry survey of the seawall region will be done, and the alignment of the seawall will be superimposed. The quick procedure is explained here.

**Stage 1:**

Using excavators and dumpers, core rock will be positioned up to (+) 5.5 m CD in areas with sufficient water depth. By distributing the large rock pieces equally and placing the smaller ones to fill the crevices between the larger rock fragments, core material will be installed. Wheel loaders or cranes can also be used to dump material straight from barges at specific areas when there is an appropriate draught.

**Stage 2 (Not applicable for sections on rocky strata):**

After completion of core placing for a height of (+) 5.5 m CD, Primary filter layer will be placed using crane over the completed bund

**Stage 3 (Not applicable for sections on rocky strata):**

After the primary filter layer is finished for the necessary length of seawall, the seawall core layer will be built using a crane over the finished bund as illustrated.

**Stage 4**

Following stages 2 and 3, an armour layer up to (+) 5.5 m CD will be put on the finished core bund part of a seawall on mixed soil strata. If a seawall is built on a rock stratum, a toe armour bund will be set up right on the ocean floor. To reduce disruption to previously placed rock and to prevent damage to any existing buildings, the armour layer will be carefully installed.

**Stage 5:**

Following stage 4, Core layer up to crown wall base (+6.59 m CD) will be completed using dumpers and excavators, over completed core bund portion.

**Stage 6:**

After stage 5 is finished and extended enough, a geotextile membrane will be installed with the aid of divers and the appropriate tools. The bed will be cleaned of any potential hazards, such as stones and tree roots, before the geotextile is laid down. After the slope has been graded and trimmed, the geotextile that was installed using a land-based approach is unwound downward from the top of the slope. After unwinding, divers use sandbags, stones, or pegs to secure the geotextile at the bottom of the slope.

The geotextile membrane will be laid out freely, without creases or folds, and wrapped in a direction that is normal to the shoreline. Geotextile strips can be joined by sewing along the coast or by 500 mm of overlap between the two sections.

At the seams, extra geotextile with a minimum thickness of 10 mm will be placed to allow for mobility. Geotextiles shall be ballasted with filter rock and pinned in place with steel pins; wooden pegs are not permitted.

**Stage 7:**

Depending on the site's conditions and the timeline, a portion of reclamation will be finished using dumpers and wheel loaders or pumped by dredgers after a sufficient length of geotextile layer has been laid.

**Stage 8:**

After stage 7, a crown wall will be built over the top of the seawall using either an in-situ approach utilising formwork and a concrete placer or a pre-cast method employing a crane to install the crown wall in place on reclamation fill.

**Stage 9:**

Following stage 8, remaining reclamation fill will be executed up to formation level and compacted.

**Stage 10:**

Following stage 9, Armour Layer will be placed up to crest level using cranes over completed reclamation as shown.

## CONCLUSION

There are negative repercussions of seawalls, which are more well acknowledged. End effect is when a seawall behaves like a groyne, causing erosion or beach displacement on the downdrift side of the direction of wave approach more frequently than on the updrift side. Although a seawall does not stretch as far into the surf zone as a groyne does, its localised influence at the intersection of the wall and the nearby dune or cliff can be felt for some distance away from the wall.

No matter what kind of coastal protection is installed, it is emphasised in the literature that extensive design and planning must go into such a construction. To prevent overtopping, design parameters must take into account the predicted maximum wave runup as well as the seawall's bathymetry and geological context. Many seawalls have been overtopped or undermined as a result of base material failure. Additionally, walls have sunk into the subsurface.

A rigorous inspection process should be implemented both during and after construction. In order to include all maintenance into the overall protection strategy, monitoring should also be a need. The successful operation of a seawall in defending a beach and the property behind it may be secured by the adoption of stringent design requirements, planning, and monitoring processes.

The relative lack of research on the impacts of seawalls on the beach is one of the key findings from the literature review. In Mumbai, this is a study area that has not received much attention.

The most prevalent maritime constructions are seawalls, whose construction is more influenced by the natural characteristics of the water than by shore impacts. Work performance, construction quality, and worker and construction equipment safety will all suffer while building seawalls during extremely rough seas.

The primary function of the seawall is to operate as a sort of protective structure to stop the erosion of the coastlines. To achieve this goal, a variety of seawall types can be built according on the site's characteristics..

It may obtain inaccurate results while assessing erosion in the coastal region due to the complex interactions between natural erosion and shoreline nourishment. In short, the research helped to highlight and pinpoint the issues with ordinary seawalls and confirmed that additional repair is not necessary when building suitable barriers.

Sea walls contribute to the community's infrastructure's improved resilience to severe storm-induced erosion. The study found that the typical seawall structure designs matched the specifications for the structure's performance.

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