

# Condition Assessment and Evaluation of Seawalls and Bulkheads

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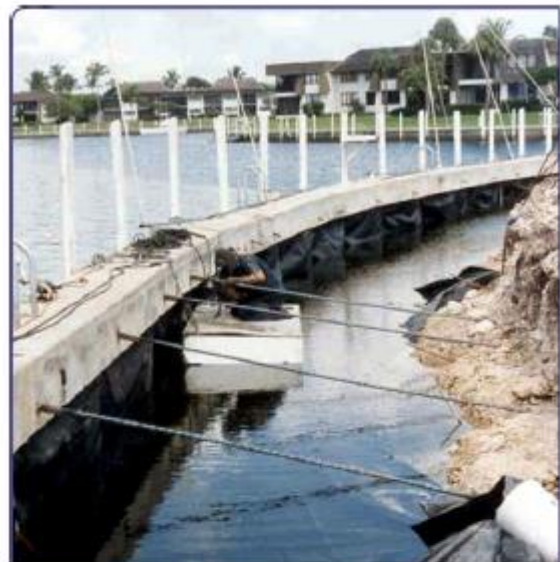


Seawalls and bulkheads (walls) provide shoreline stabilization for many coastal and waterfront properties throughout Florida and the Caribbean. The walls provide an economical approach for vertical shoreline stabilization, allowing owners to maximize upland property area, as opposed to other shoreline stabilization methods such as revetments or natural wetlands/mangroves. Existing walls were constructed of many different

structural configurations, and at various time periods. Coastal and waterfront properties are in high demand in Southern Florida and the Caribbean with an increasing coastal population. Developers and property owners are looking to rehabilitate existing properties and the condition of a coastal seawall or waterfront bulkhead can significantly impact the total cost of property development. Also, many waterfront property owners may have experienced problems with their existing structures, or have concerns regarding the structural integrity of their walls.

#### THIS REPORT WILL EXPLAIN:

- Difference between Seawall & Bulkhead
- Introduce Elements of Wall Design
- Present Materials of Construction with a Discussion of Material Performance
- Discuss Wall Structural Evaluation Methodology



Typical bulkhead under construction



Typical coastal seawall

## Seawall vs. Bulkhead?

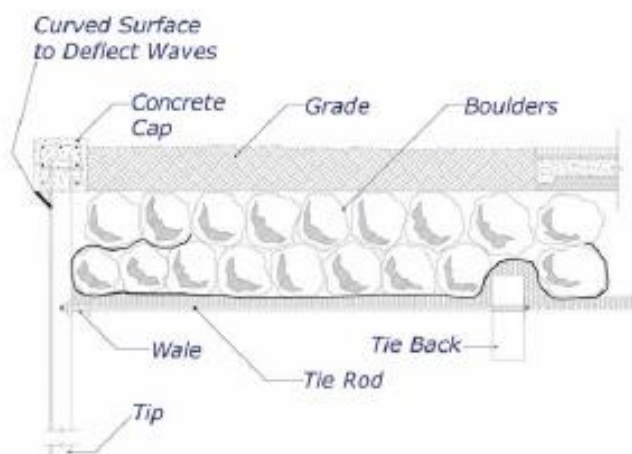
Many people refer to all vertical shoreline structures as “seawalls,” but there is a difference between a seawall and a bulkhead.

Seawall: structure that provides shoreline protection from waves but also retains soil.

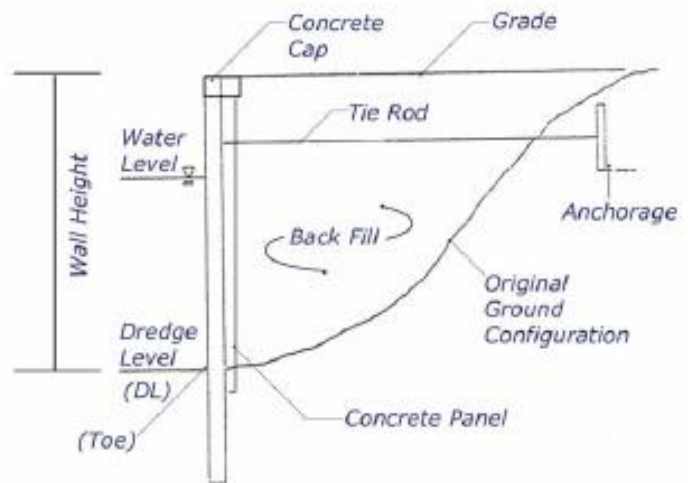
Bulkhead: vertical shoreline stabilization structure that primarily retains soil, and provides minimal protection from waves. Seawalls are typically located on the coast fronting beaches, and are subject to storm surges with pounding surf, eroding shorelines and wave overtopping from coastal storm events. Some localized waterfront properties may be subject to significant wave activity, even though they are not exposed to ocean waves. A coastal engineering study can provide seawall design information to ensure that they are designed properly to withstand the dynamic loading and overtopping effects of waves. The “rule of thumb” in bulkhead design is to account for wave impacts if the significant wave



Typical oceanfront seawall



Cross-section of typical seawall: Note use of boulders against wave overtopping



Typical bulkhead cross section

height at a project site is expected to be in excess of three feet (1 meter). Unfortunately, many existing walls on the coast were simply designed as bulkheads, and did not account for coastal storm impacts.



Failed bulkhead due to inadequate embedment of wall.



Deteriorated concrete pile/panel bulkhead. Note storm sewer outfall through bulkhead.

### **Elements of Wall Design**

Prior to evaluating a bulkhead or seawall, the following design considerations need to be addressed to be able to properly assess the condition.

Topography: elevations, grading, etc. Soil Properties: unit weight of soil, clay vs. sand, etc.

Embedment/Stability: depth of wall for stability

Water Table: differential water levels behind and in front of walls can introduce additional loading on the wall

Wall Material Properties: strength and performance in the marine environment

Surcharge: live loads behind the wall such as vehicles

These additional design considerations need to be addressed for seawalls:

- Wave Forces
- Toe Scour
- Wave Overtopping
- Storm Surge

If a wall is damaged or deteriorated, the original design may not have accounted for the above-listed design considerations. Original or “as-built” plans can provide a wealth of information including the age of the structure

and many of the design elements listed in the above paragraphs. The deteriorated condition of a wall may also be an indication that the wall is in need of maintenance, or that it has fulfilled its service life.

### **Materials of Construction**

Seawalls and bulkheads are constructed of similar materials. The material of the wall must be properly identified prior to assessing the condition. The following table presents common wall construction materials with comments regarding availability, construction issues, and general performance in the marine environment:

**Concrete:** Pile/panel and sheet piling configurations common in South Florida. Most common wall material in South Florida due to the locally available aggregate; provides service life of 30+ years if correct mix design and proper marine structural design implemented.

**Steel:** Steel sheet piling commonly used for bulkheads/seawalls. Material provides excellent strength characteristics for high wall exposure applications. Provides interlocking seal, and generally easy to install, even in harder substrate. Must be properly coated and maintained for long service life of 25+ years.

**Aluminum:** Sheet piling provides good corrosion resistance, but lighter sections allow for minimal exposed wall height. Recognize corrosion potential of dissimilar metal hardware, do not use in waters with low Ph or backfill with clay-mucky soils. Difficult to install in hard substrates.

**Timber:** Not often used in South Florida, but occasionally seen on inland waterways. Timber pile/wale/sheet system is common structural configuration. Generally economical material, but limited strength characteristics for high wall heights. Preservative treatment is essential for marine organisms. Difficult to install in hard substrates.

**Vinyl/Plastic:** Relatively new economical product with service life of 50+ years. Available in different colors. Limited strength characteristics for wall heights. Difficult to install in hard substrates.

## **Structural Evaluation**

The American Society of Civil Engineers (ASCE) Underwater Investigations Standard Practice Manual was released in 2001 and provides guidance for the evaluation of walls. Procedures are also applicable for above-water structures. Most bulkheads are along the waterfront, and should be evaluated above and below the water, whereas seawalls typically are not exposed to water on a regular basis. The following topics are covered related to structural bulkhead/seawall evaluation:

- Qualifications of Inspection Personnel
- Types and methods of inspections
- Typical forms of deterioration
- Condition Rating
- Frequency of Inspection

A comprehensive report is essential to document a proper bulkhead or seawall evaluation. All of the above items should be included along with photographs and sketches of the observed configuration with notes regarding deterioration. Comparison of previous reports provides an indication of the rate of deterioration.