

Sheet Pile Retaining Walls

Sheet pile retaining walls, are one example of a continuous wall system. They retain earth, water or other fill materials and are thinner in section compared to masonry walls. General uses include waterfront structures (seawalls, bulkheads), diversion dams (cofferdams), riverbank protection and temporary excavation support to retain the sides of cuts made in earth. Sheet piles are typically steel due to availability and higher strength. However, sheet piles may also be constructed with reinforced concrete or timber for some applications. Sheet pile walls are one example of a continuous wall system. Other examples include tangent or secant pile walls, slurry walls, or soil-mixed walls.



Relation to Adaptation and Resiliency

Addresses the increased risk of landslides, land subsidence and erosion washing away transportation infrastructure.

Benefits

Sheet-pile walls are typically constructed in one phase in which interlocking sheets are driven to a final design elevation. Sheet pile walls can be re-used when used for temporary excavation support or cofferdam construction which make them a sustainable retaining wall solution. They are an inexpensive option when continuous wall support is needed to resist hydrostatic pressures and/or reduce groundwater inflow such as for cofferdams or in areas with high groundwater levels. Vibratory hammers or hydraulic push systems are typically used to install sheet piles resulting in significantly less noise pollution than impact hammers. However, impact hammers are required when denser ground conditions are present near the sheet pile tip.

Limiting Factors (Constraints)

Sheet pile walls are less stiff and more flexible than other continuous wall systems. If lateral movements of the wall and subsequent settlement behind the wall are a design concern, a sheet pile wall may not be the best choice. Other continuous wall systems such as secant pile walls or slurry walls would be a better choice.

Design & Preliminary Costs

The MDOT 2018 Standard Specifications for Construction and Materials provide design requirements for sheet piles. The US Steel Sheet Piling Design Manual is a useful reference for design. The WMATA Adjacent Construction Manual requires that lateral soil pressures for sheet pile design should be based on undrained conditions. Steel sheet piles adjacent to WMATA structures should be hot-rolled steel sheet piles. For adequate stiffness, Z-profile sheet piles are recommended. WMATA recommends stiffness factors for sheet piles and slurry walls/secant pile walls as 1.25 and 1.5, respectively. WMATA recommends a maximum allowable deflection of 1/2 in. for sheet pile walls.

Unit cost of a sheet pile retaining wall in the continental USA would be between \$35 and \$80 per square feet of material installed, depending on the type of pile, thickness, depth of embedment, site access/conditions, and total quantity of piles (Source: WSP Cost Estimator).

Permits & Approvals

- Review/Approval by MDOT MTA Environmental Planning Division
- Maryland Department of the Environment (MDE) Permitting



Implementation

Sheet piles must be designed for the site-specific subsurface conditions, and temporary and permanent loads. A suitable subsurface investigation and evaluation are recommended during design to confirm suitable subsurface conditions for sheet piles. When cobbles, boulders or similar size material is present, sheet pile installation can be challenging if not impossible. The contractor will then order the appropriate sheet pile section size, material properties, and lengths for the project. For cases where excavations adjacent to sheet piles greater than approximately 15 to 20 ft. and are too deep for a cantilevered wall, lateral support by ground anchors, such as tiebacks, will be required. Once the sheet piles are delivered on site, sheet piles can be installed quickly and efficiently and are typically vibrated into place. Unlike other continuous wall systems (secant pile walls, slurry walls, or soil-mixed walls) that require curing time before they can support loads, sheet piles can support loads immediately after installation.

Maintenance Requirements

For permanent construction, periodic inspection of sheet piles to check on corrosion and loss of coatings should be performed on a routine basis.

Useful Life

A sheet pile retaining wall will become effective immediately after construction. Sheet pile walls are typically used for temporary purposes during construction and they will generally not require rehabilitation or replacement for that purpose. Where sheet piles are used for a permanent measure, the design should account for corrosion of the steel sheet piles. For the permanent use of steel sheet piles, protective coatings should be used to minimize corrosion. There are non-metallic coatings, metallic coatings (galvanizing, flame spraying – aluminum or zinc) and cathodic protection, among other methods.⁸ Generally, a steel sheet pile bulkhead in a saltwater environment should have a service life of at least 40 years. This can be increased by providing additional thickness of sacrificial steel and/or use of cathodic protection measures. Corrosion would need to be estimated based on site conditions and proposed sheet pile materials.

References/Specifications

- MDE** - Soil Erosion and Sediment Control Regulations
- MDOT** – US Steel Sheet Piling Design Manual, July 1984
- FHWA** - FHWA-IF-99-015 GEC No. 4 Ground Anchors and Anchored System, June 1999
- WMATA** - Adjacent Construction Project Manual, Revision 5a, September 21, 2015
- Other** - US Steel Sheet Piling Design Manual, July 1984

