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NCMA is the national trade association representing the producers and suppliers of concrete masonry products, including concrete block, manufactured stone veneer, segmental retaining walls and articulating concrete block. The Association's mission, through nearly a century of advocacy, remains to advance, protect and promote the common interests of its members. Through leadership, promotion, education, research, government relations and partnering, NCMA ensures that members' products are the building materials of choice.

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VERSION 2.0

Segmental Retaining Walls: Residential Applications

A guide for residential segmental retaining wall systems

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NCMA SRW



How can a Segmental Retaining Wall System be used in a Residential Application?

Segmental retaining walls (SRWs) can be used in any number of applications. Residential projects can range from a structural application, which may include extending a patio, or creating space for a pool, to a non-structural application, such as planters, fire pits, or seating areas throughout a yard. This document provides information on SRW systems used in non-structural applications. If an SRW system is to be used in a structural application, please refer to NCMA's *SRW Best Practices Guide*, which is available for free download at www.ncma.org.

In addition to understanding the wall's application, homeowners will also need to know the desired height of the retaining wall. This is defined as the measured height between the bottom of the bottom row of blocks and the top of the top row of blocks as depicted in Figure 2. Table 1 provides the industry recommendations for the design of an SRW system based on the height of the wall.

Table 1: Design Guidance for Segmental Retaining Walls

Design Method	Wall Height	Allowable Soil Foundation Conditions	Recommended Engineering Course of Action
Method 1: Engineered Design Not Required	Less than or equal to 4 ft (1219 mm) from top of leveling pad to top of wall	Sand/gravel, silty sands, silt/lean clays	Use design chart provided by SRW system provider
Method 2: Engineered Design Required	Greater than 4 ft (1219 mm) from top of leveling pad to top of wall	Sand/gravel, silty sands, silt/lean clays	Have the design section reviewed/prepared by a registered professional

NOTE: Table provided is based on industry recommendations. Local building codes must be reviewed for any variations from these recommendations.

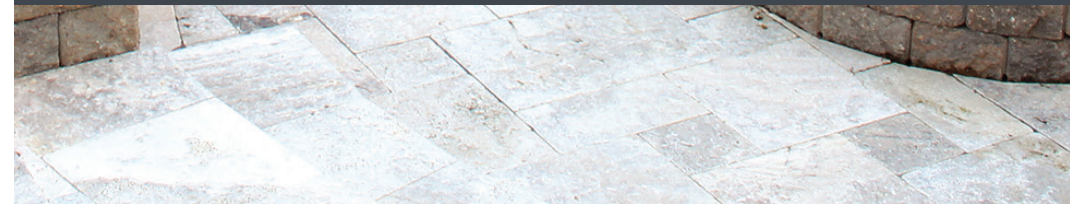
Special Application—Tiered Walls

An SRW does not have to be a single, vertical wall. It can be broken into tiers that are offset from one another as shown in Figure 1. If a tiered wall is being considered, it is important to note that tiered walls can also fall under a structural or non-structural application, as described in the previous section. Please refer to Table 2 to determine the appropriate industry recommendations for the tiered wall system.



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Visit the NCMA TEK Solutions Center, www.ncma.org/resources/tek-solutions-center/, for additional resources on SRWs.



Inspection

During the installation and at the wall's completion, the homeowner and the contractor should follow the construction checklist, provided in NCMA TEK 18-11B, *Inspection Guide for Segmental Retaining Walls* (available in the NCMA TEK Solutions Center, www.ncma.org/resources/tek-solutions-center/), together. This allows both parties to visually confirm everything meets the owner's expectations before the contractor leaves the site. Items covered in the checklist include, but are not limited to:

- Design (if applicable)
- Materials
- Site Conditions
- Placement of Materials
- Testing
- Finish Grading
- Construction Tolerances (as illustrated in Figure 5)



NCMA recommends the owner requests a copy of the documentation the contractor kept during the construction process for their records.

Figure 5: NCMA Recommended Construction Tolerances for an SRW system

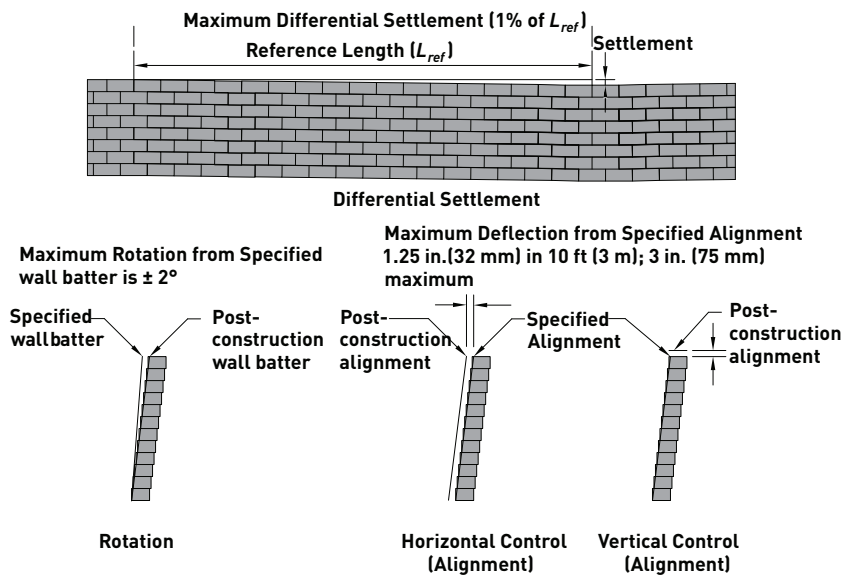
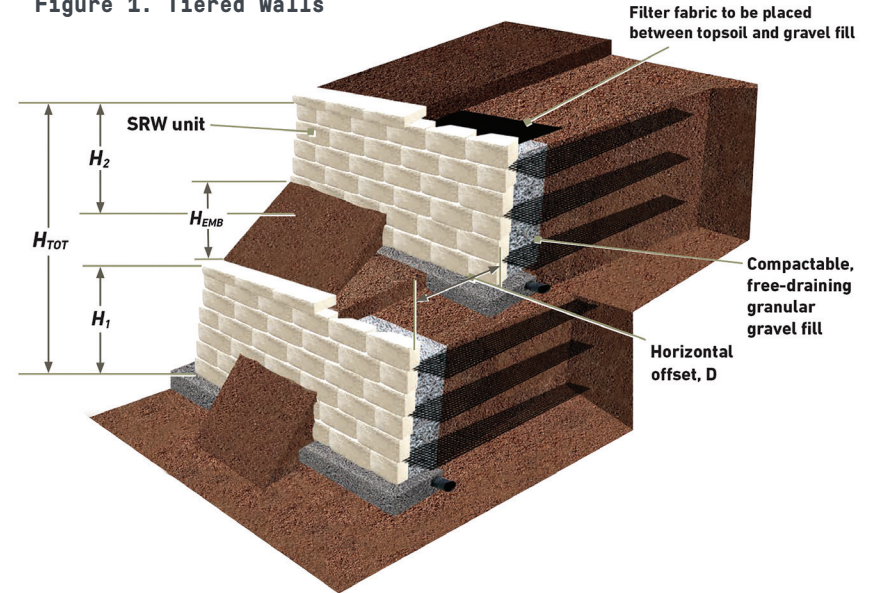


Figure 1. Tiered Walls



NOTE: The scope of this guide applies to non-structural projects where an engineer is not involved. If an engineer is needed, refer to *NCMA SRW Best Practices Guide*.

Table 2: Design Guidance for Tiered Segmental Retaining Walls

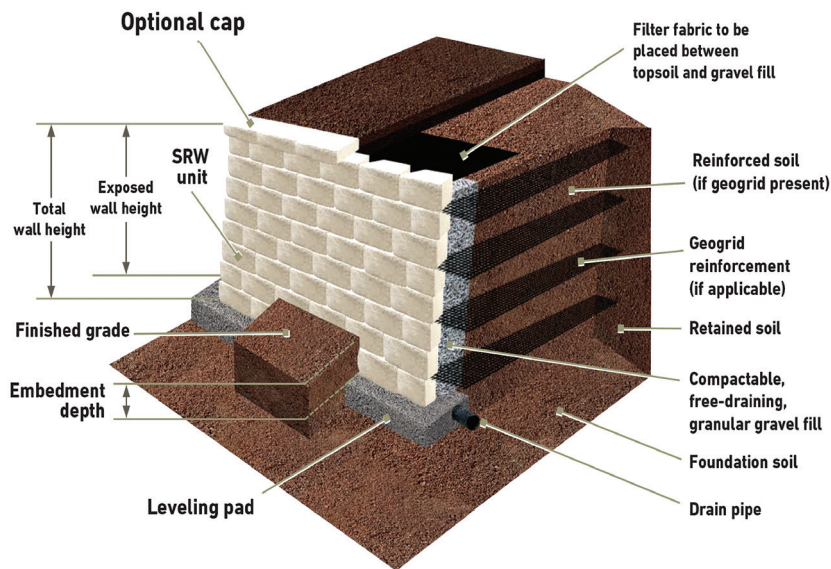
Design Method	Stipulations
Method 1: Engineered Design Not Required	<ul style="list-style-type: none"> • Total combined height (H_{TOT}) is less than or equal to 4 ft (1219 mm) • Horizontal spacing between walls (D) is at least twice the height of the lower wall (D greater than $2H_1$) • No additional loads are imposed on the walls • The lower tier is taller than the upper tier (i.e. H_1 greater than H_2). • No slope is present above, below, or in between the walls.
Method 2: Engineered Design Required	If any of the stipulations above are not met, the wall must be designed by an engineer.

NOTE: H_1 is the total height of the lower tier, H_2 is the total height of the upper tier, H_{TOT} is the total height of the entire tiered wall system, and D is the distance between the front of the lower tier to the front of the upper tier.

Materials for a SRW

An SRW is constructed using both manufactured and naturally occurring materials. The appropriate use of each of these materials in a wall can ultimately determine whether a given wall is structurally sound or not, similarly to any other constructed walls. Figure 2 provides a visual representation on how all of the materials for an SRW interconnect with one another to create a stable wall. If questions or concerns arise about the materials discussed in this section, consult with the certified professional installer for more information.

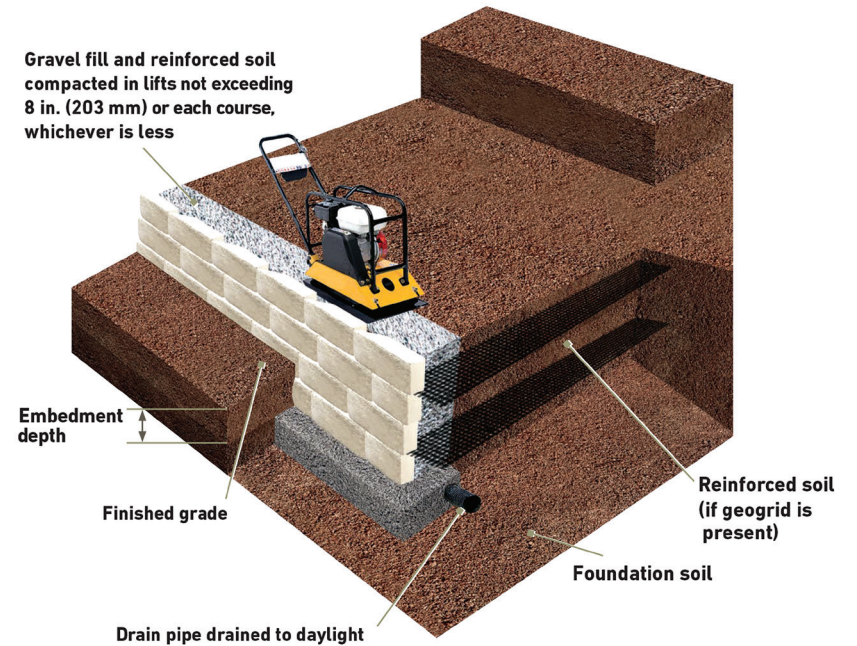
Figure 2: Segmental Wall Components



SRW Units—The front (also known as facing) of an SRW system is constructed using dry-cast concrete SRW units. These blocks are manufactured to industry standards and quality assurance verifies the units meet the necessary strength requirements to ensure a lifetime of maintenance free performance.

Soil—Soil is an important component to ensuring successful wall performance. When used as backfill, soil must be granular and have the ability for water to drain freely through it, such as gravel and sand. If soil is found to be organic (like top soil) or consisting mainly of clay, then outsourced granular, well-draining soil must be brought

Figure 4: Segmental Wall Construction



Step 6: Finish Wall

- If desired, place the selected wall cap on top of the SRW with the use of concrete masonry adhesive
- Place, compact and grade soil around the system as needed
- Install landscape (if applicable)

Step 7: Clean the Site

Installation

With the appropriate contractor, designer (if needed) and material selected, the installation of the SRW system can begin. NCMA recommends the homeowner review the NCMA *SRW Installation Guide* as well as the manufacturer's recommendations to become knowledgeable on the work the contractor will be performing. The following are the recommended steps for construction of a non-structural residential SRW system.



Step 1: Site Preparation and Excavation

- Removal of existing vegetation
- Excavation to desired elevation

Step 2: Install Leveling Pad

- Compact trench
- Place/compact gravel for trench
- Place drainage pipe per plans



Step 3: Place Base Course (First Row)

- Place units side by side individually
- Ensure each unit is level

Step 4: Place gravel and backfill materials (Figure 4)

- Place gravel in cores, between the units and specified distance behind units
- Place soil behind gravel zone
- Compact at a maximum of 8 in. (203 mm) lifts
- Ensure proper compaction is achieved

Step 5: Install Additional Courses

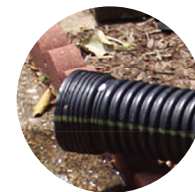
- Repeat Steps 3 and 4 until the specified height of the wall is achieved
- If applicable, place geogrid per approved plans at required rows

in. For acceptable foundation soil types, refer to Table 1 and/or NCMA *SRW Best Practices Guide*, Chapter 3. In the event the local soil is desired to be used but the type is unknown, consult a local design professional.

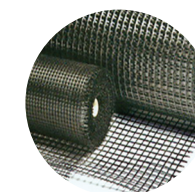
Gravel Fill—Gravel fill is a crushed, clean, free-draining material that is placed between and behind the SRW units. The gravel fill acts as a buffer between the soil and the SRW units. It facilitates compaction at the face of the wall and acts as a drainage zone to remove incidental water behind the wall. Due to the lack of small shaped particles present in the gravel, incidental water is able to flow freely through the gravel fill and into the drainage pipe where it is drained away from the system. Despite its draining capabilities, the gravel fill is not meant to be used as a primary drainage method without the use of drainage pipe.



Drainage Pipe—The most important consideration during the design and construction of a retaining wall is the drainage. To aid in the drainage and removal of incidental moisture around the wall, a drainage pipe is typically placed along the bottom of the wall behind the first row of units. For other optional drainage pipe locations, refer to Figure 2 or Chapter 4 of the NCMA *SRW Best Practices Guide*. A drainage pipe is typically either a perforated corrugated plastic pipe or perforated PVC pipe. The drainage pipe provides a path for the water to travel away from the interior of the wall by either removing water through the facing or out from the side of the wall.



Geogrid—Geogrid is a synthetic material that in some applications is placed within the layers of the wall as it is being built. Geogrid provides extra support to the system by unifying the soil and facing into one cohesive unit. It is important to refer to the manufacturer's recommendations prior to the use of geogrid. When placed, geogrid must not overlap with adjacent geogrid segments. If curves or corners exist in the proposed wall, please refer to Chapters 6 and 14 of the NCMA *SRW Best Practices Guide* for details on how it should be properly installed in those situations.



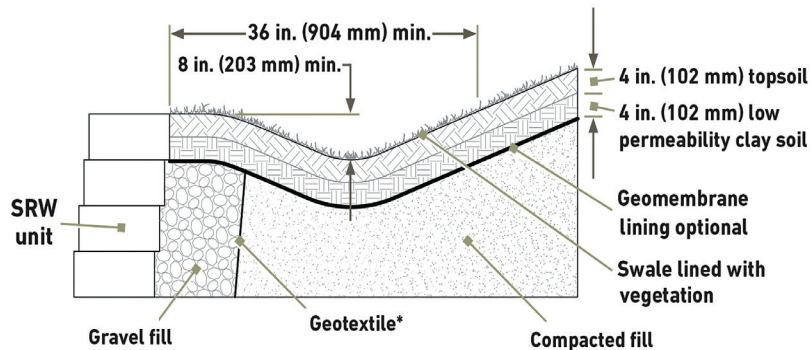
Water Management

One of the biggest potential impacts on any retaining wall structure is the infiltration and presence of water within the system. When water is not properly drained, the wall has the potential to retain water like a pool. If water is not able to disperse in a reasonable time frame, water pressure begins to build and push against the wall, which could result in failure. To prevent this from occurring, both granular, well-draining soil and the drainage pipe are used in the wall system to easily remove any presence of water that may occur.



Not only should water management occur at the bottom and inside of the wall, but it also needs to occur above the wall. At the top of the wall, it is recommended that the water is drained away from the face of the wall, such as a drainage swale behind the SRW facing, as shown in Figure 3, or sloping the surface away from the face of the wall to prevent water from flowing over the facing. Clay soils are only permitted to be used during the construction of an SRW system when the top of the wall is being completed and/or when a drainage swale is being installed. As with any structure, it is always important to maintain proper water management methods in and around the structure to prevent future problems, such as erosion, from occurring.

Figure 3: Drainage Swale Detail



*Geotextile may be necessary when the infill soil includes fine-grained sand that have the potential to infiltrate the gravel fill

Designer/Contractor

Now that the required materials for an SRW have been identified, it is time to discuss the process of selecting the appropriate designer and contractor. Industry recommendations do not require a designer as long as the wall is a non-structural application as described in Table 1. However, it is *important* to always consult with your local building code and confirm this is the case.

Choosing the Right Engineer (If Required)

If required by building code or industry recommendations, a segmental retaining wall designer may be needed in some applications. They must use their best engineering judgment to account for the project's specific situation(s) and provide an efficient and safe design for the homeowner. It is recommended that the homeowner hires a local SRW design engineer to work with directly and not the contractor. When contracting the designer, make sure the designer is familiar with segmental retaining wall design methodology and the building codes where the project is located. For a full design checklist, review TEK 18-11B, *Inspection Guide for Segmental Retaining Walls*, provided in the NCMA TEK Solutions Center (www.ncma.org/resources/tek-solutions-center/).



Choosing the Right Contractor

Certified installers who specialize in SRW installation are the best to install your segmental retaining wall. These specialized contractors can complete a high-quality job efficiently and safely because they have the right equipment, materials, skills and knowledge for the project. NCMA recommends always using NCMA Certified SRW Installers (or equivalent) as they possess the knowledge and installation experience for a successful outcome. A list of certified installers in your area can be found at: www.ncma.org/srw-contractors. For a detailed checklist and questions to ask a contractor during the searching process, refer to the NCMA *Selecting the Correct Installer for Segmental Retaining Walls* brochure.

NOTE: To find a local NCMA Certified SRW Installer in your area, visit www.ncma.org/srw-contractors