Segmental Retaining Walls—Residential Applications

A guide for residential segmental retaining wall systems
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 is defined as an SRW system that is not supporting the weight of another structure, such as a building or house. These systems are also called “non-structural” or “decorative.”

If an SRW system is to be used in a residential application, please refer to NCMA’s Segmental Retaining Wall (SRW) Best Practices Guide, which includes extending a patio or creating space for a pool. This document provides information on SRW systems and contains a full online library of resources, including guidelines, project ideas, and more.

The following table provides the industry recommendations for the design of an SRW system based on the height of the wall. This table provides information on SRW systems and contains a full online library of resources, including guidelines, project ideas, and more.

<table>
<thead>
<tr>
<th>Design Method</th>
<th>Wall Height</th>
<th>Condition</th>
<th>Recommended Soil</th>
<th>Engineering</th>
<th>Coarse of Action</th>
<th>System provided by SRW system provider</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method 1:</td>
<td>Less than or equal to 4 ft (1219 mm) from top of leveling pad to top of wall</td>
<td>Sand/gravel, silts, sands, silt/clays, silts/lean clays</td>
<td>Use design chart provided by SRW system provider</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering</td>
<td>Required</td>
<td>Design</td>
<td>No engineering required</td>
<td>No engineering required</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Visit the NCMA Solutions Center, www.ncma-solutions.com, for additional resources on SRWs.

Resources on SRWs
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

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

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.

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.
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, 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.

For tiered walls, NCMA SWF Best Practices Guide applies. If the documentation the contractor kept during the construction process is not involved, an engineer is needed. Refer to NCMA SRW Best Practices Guide where an engineer is not involved. If an engineer is needed, refer to NCMA SRW Best Practices Guide.

<table>
<thead>
<tr>
<th>Method 1 (Design Not Required)</th>
<th>Method 2 (Design Required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total combined height (HTOT) is less than or equal to 4 ft.</td>
<td>If any of the stipulations above are not met, the wall must be designed by an engineer, if any.</td>
</tr>
<tr>
<td>Horizontal spacing between walls (D) is at least twice the height of the lower wall (D greater than 2H1).</td>
<td>The lower tier is either the same height or lower than the upper tier (H1 less than or equal to H2).</td>
</tr>
<tr>
<td>No slope is present above, below, or in between the walls.</td>
<td>No additional loads are imposed on the walls.</td>
</tr>
<tr>
<td>Horizontal spacing between walls (D) is greater than 2H1.</td>
<td>The upper tier is taller than the lower tier (H2 greater than 2H1).</td>
</tr>
<tr>
<td>Total combined height (HTOT) is less than or equal to 4 ft.</td>
<td>No slope is present above, below, or in between the walls.</td>
</tr>
<tr>
<td>No additional loads are imposed on the walls.</td>
<td>The lower tier is either the same height or lower than the upper tier (H1 less than or equal to H2).</td>
</tr>
</tbody>
</table>

**Design Guidance for Tiered Segmental Retaining Walls**

<table>
<thead>
<tr>
<th>H1</th>
<th>H2</th>
<th>HTOT</th>
</tr>
</thead>
<tbody>
<tr>
<td>1219 mm (48&quot;)</td>
<td>1492 mm (58&quot;)</td>
<td>2711 mm (107&quot;)</td>
</tr>
</tbody>
</table>

**Figure 5: NCMA Recommended Construction Tolerances for Tiered Segmental Retaining Walls**

**Figure 1: Tiered Walls**

**Note:** The scope of this guide applies to non-structural projects. For structural projects, refer to NCMA SWF Best Practices Guide.
**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 Solutions Center (www.ncma-br.org).

**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/SRWIdirectory. 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/SRWIdirectory

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**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.*
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 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 the manufacturer’s recommended prior to use the grill.

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 the installation:

1. Site Preparation and Excavation
   - Removal of existing vegetation
   - Excavation to desired elevation

2. Place base course (first row)
   - Place units side by side individually
   - Place leveling pad over plans
   - Place gravel/composite for trench
   - Compact trench

3. Gravel fill
   - Ensuring each unit is level
   - Place units side by side individually

4. Primary drainage
   - Installation of primary drainage pipe

5. Geogrid
   - Placement of geogrid

6. Grout
   - Installation of grout

7. Sizing and construction
   - Proper sizing and construction of a cohesive unit is the key to proper function and drainage.