Best Practices for Segmental Retaining Wall Design and Construction
Course Description

This presentation introduces the best practices for design, construction and inspection of segmental retaining walls (SRW).
Learning Objectives

At the end of this program, participants will:

1. Understand the industry recommendations for SRW Design and Construction
2. Understand the industry recommendations for SRW Inspection
3. Be familiar with the SRW roles and responsibilities
4. Understand material specifications for Commercial SRW projects
SRW Best Practices

ncma.org/resource/srw-best-practices-guide/
What is a Segmental Retaining Wall?

Earth retention wall comprised of dry-stack, modular concrete block units and compacted soil fill with or without the inclusion of soil reinforcement.

- Two types:
  - Conventional gravity retaining wall
  - Geosynthetic reinforced soil retaining wall
Conventional vs. Reinforced SRW

Earth pressures, loads
Roles and Responsibilities
Roles and Responsibilities

Owner/Developer

Site Civil

Owner/Owner Rep.

Design Team

Structural Eng.
SRW Design Engineer
Geotechnical Eng.
Inspection Agency

Construction/Inspection Team

All Contactors
SRW Contractor

Inspection Agency
Hired by Owner

TEK 15-03
Best Practices Chapter 1
SRW Designer

- SRW design engineer works for and is paid by the owner
- Designs SRWs for structural stability
- Designs the geosynthetic reinforcement layout, strength, and wall embedment
- SRW design engineer should account for all design variables within the design envelope
SRW Design Envelope Limits
SRW Contractor

- The wall contractor should not be responsible for the engineering services or quality assurance.
- The contractor needs an installer credential, relevant experience, performance bond, and a minimum warranty.
Design
Design Method

Design Manual for Segmental Retaining Walls
National Concrete Masonry Association
3rd Edition

5th Printing

AASHTO LRFD Bridge Design Specifications
National Cooperative Highway Research Program
Publication Date: LRFD Bridge Design Specifications, 7th Edition
Publication Number: 602-6-5
Publication Date: November 2017
# CMHA Minimum SRW Design Requirements

<table>
<thead>
<tr>
<th>Minimum Safety Factor</th>
<th>Static</th>
<th>Dynamic (Seismic)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sliding (Base/Internal)</td>
<td>1.5</td>
<td>75% of Static</td>
</tr>
<tr>
<td>Overturning</td>
<td>2.0</td>
<td>75% of Static</td>
</tr>
<tr>
<td>Geogrid Overstress</td>
<td>1.5</td>
<td>75% of Static</td>
</tr>
<tr>
<td>Pullout from Soil/Block</td>
<td>1.5</td>
<td>75% of Static</td>
</tr>
<tr>
<td>Internal Compound Stability</td>
<td>1.3</td>
<td>1.1</td>
</tr>
<tr>
<td>Global Stability</td>
<td>1.3</td>
<td>1.1</td>
</tr>
<tr>
<td>Bearing Capacity</td>
<td>2.0</td>
<td>75% of Static</td>
</tr>
</tbody>
</table>

## Additional Detailing Criteria

<table>
<thead>
<tr>
<th>Minimum Reinforced Zone Width</th>
<th>60% of Wall Height ($H$)</th>
<th>60% of Wall Height ($H$) for Bottom and Middle Layers; 90% of Wall Height ($H$) for Upper Layers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Minimum Wall Embedment</td>
<td>6 inches (152 mm)</td>
<td>6 inches (152 mm)</td>
</tr>
<tr>
<td>Minimum Anchorage Length</td>
<td>12 inches (305 mm)</td>
<td>12 inches (305 mm)</td>
</tr>
<tr>
<td>Maximum Wall Batter</td>
<td>20 degrees</td>
<td>20 degrees</td>
</tr>
<tr>
<td>Maximum Geogrid Spacing</td>
<td>See Table 1.3-2</td>
<td>16 inches (406 mm)</td>
</tr>
</tbody>
</table>

* See section 12.1 for conditions where seismic design should be considered
What Impacts the Design

In order of importance:

• Soils and water: affect everything in the design
• Loads: structures, traffic loads, etc.
• Slopes:
  — Top slope: adds loads to the wall
  — Front slope: reduces the stability of the wall
Larger aggregate size can be considered if the reinforcement has been tested with that size material for installation damage.

- For wall heights less or equal than 10 ft \((H\leq10\text{ft})\) \(\Rightarrow\) moderate plasticity \((\text{PI}<20\text{ and LL}<40)\)
- For walls between 10 ft and 20ft \((10 \text{ft}<H\leq20 \text{ft})\) \(\Rightarrow\) low plasticity \((\text{PI}<6)\)

\(H=\) total wall height \hspace{1cm} \text{PI} = \text{Plasticity Index}

<table>
<thead>
<tr>
<th>Sieve Size</th>
<th>Percent Passing</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 in. (25 mm)</td>
<td>100%</td>
</tr>
<tr>
<td>No. 4</td>
<td>100–0%</td>
</tr>
<tr>
<td>No. 40</td>
<td>0-60%</td>
</tr>
<tr>
<td>No. 200</td>
<td>0-35%</td>
</tr>
</tbody>
</table>

1” and under crushed well graded gravel
Materials
SRW Components

- SRW Units
- Geosynthetic Reinf.
- Soils
  - Gravel Fill
  - Reinforced Soil
  - Retained Soil
  - Foundation Soil
- Drainage Pipe
SRW Units

ASTM C1372
- Dimensional tolerances: ±1/8 in. (except for architectural finished surfaces)
- Minimum Compressive Strength = 3,000 psi
- Maximum Absorption = 15 – 18 pcf
Freeze Thaw Durability Based on Local Conditions

30 year average temperature data (Dec/ Jan/Feb)
Average low winter temperature
Zone 1: > 28 degrees F
Zone 2: ≥ 18 degrees F and ≤ 28 degrees F
Zone 3: < 18 degrees F
Geogrid Reinforcement

• Many types of reinforcement
• Should meet FHWA requirements (see NTPEP REGEO reports)
• For polyesters the quality of the original fiber will determine the quality and durability of the reinforcement

See Article PET Requirements for SRW Construction

NTPEP National Transportation Product Evaluation Program
Soil

• Soils represent about 90% of the system
• All soils should be compacted to a min. 95% Standard Proctor density (or as directed by the project geotechnical engineer)
• The soils should be compacted in ≤ 8 in. (203 mm) compacted lift thickness
Gravel Fill

What are the purposes of gravel fill?
• Helps draining incidental water build up behind SRW units
• Provides zone of frost protection
• Aids compaction of soil behind the SRW units
• Fills voids in SRW unit
# Gravel Fill Recommendations

## Materials

<table>
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<tr>
<th>Sieve Size</th>
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<tbody>
<tr>
<td>1 inch</td>
<td>100 %</td>
</tr>
<tr>
<td>¾ inch</td>
<td>75 – 100</td>
</tr>
<tr>
<td>No. 4</td>
<td>0 – 60</td>
</tr>
<tr>
<td>No. 40</td>
<td>0 – 50</td>
</tr>
<tr>
<td>No. 200</td>
<td>0 - 5</td>
</tr>
</tbody>
</table>

Pea gravel (single size, round gravel) is not recommended.
Retained Soil

• Usually undisturbed native soil at the back of a cut slope
• When backfilling is needed,
  — Granular soils are preferred and
  — On-site soil can be used if they can be adequately compacted
• When a slopes exists above the wall, the slope soil should be compacted with the same care as the other soils
Foundation Soil

- Soil under SRWs
- Need to provide support the structure without excessive settlement
- The geotechnical report needs to include parameters and recommendations for this soil before the design starts
- If there are problem areas, the geotechnical eng. needs to address them
Drainage Pipe

- To remove incidental water
- Slope to drain
- Daylight to drain every 50 ft max. at the wall face
- Tie into a stormwater
Water Management
Water Management

• Should be a primary design consideration
• It is necessary during and after construction
• Designer must identify sources
  – Surface runoff
  – Groundwater
  – Water bodies
Water Management
Additional Resources

Free access to NCMA/CMHA

- TEK
- Manuals and Guides
- Software
- And much more...

FAQ 08-14 What are the basic components of an SRW system?

TEK 02-04C SEGMENTAL RETAINING WALL UNITS

TEK 18-11B INSPECTION GUIDE FOR SEGMENTAL RETAINING WALLS
Questions

Thank you for your time!