

Best Practices for Segmental Retaining Wall Design and Construction



CONCRETE
**MASONRY &
HARDSCAPES**
ASSOCIATION



Course Description

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

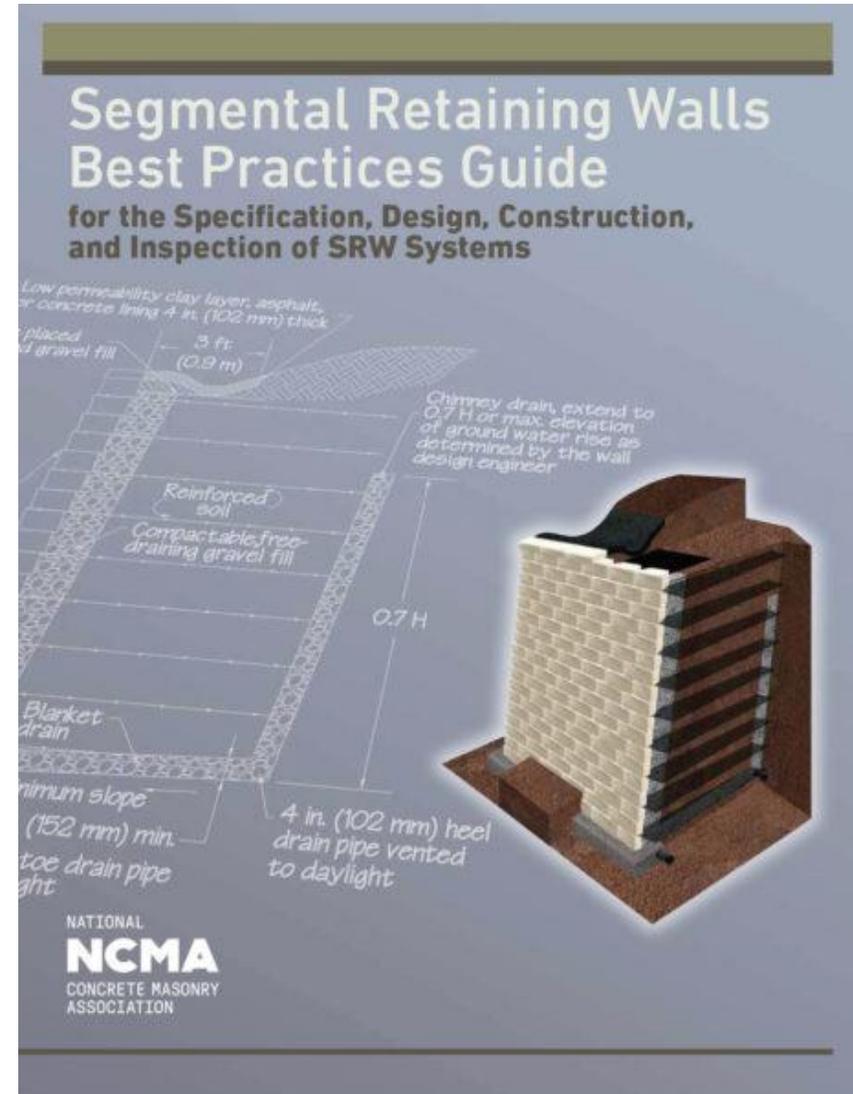
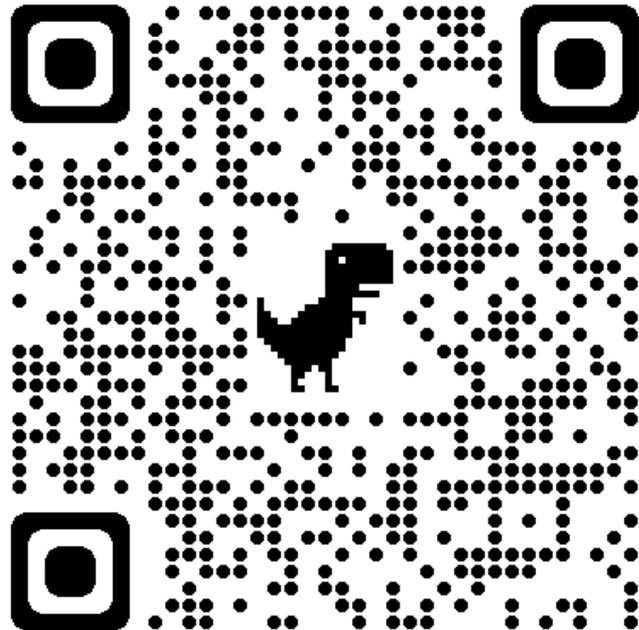
Learning Objectives

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/

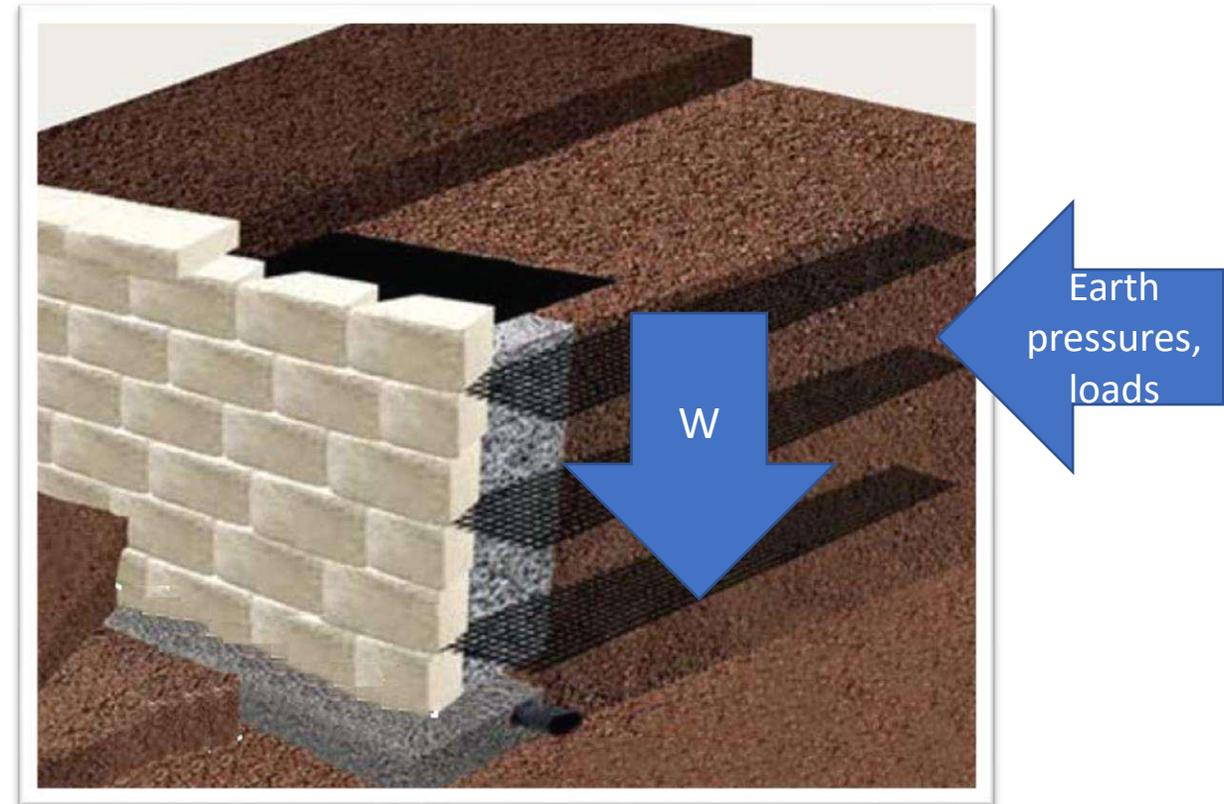
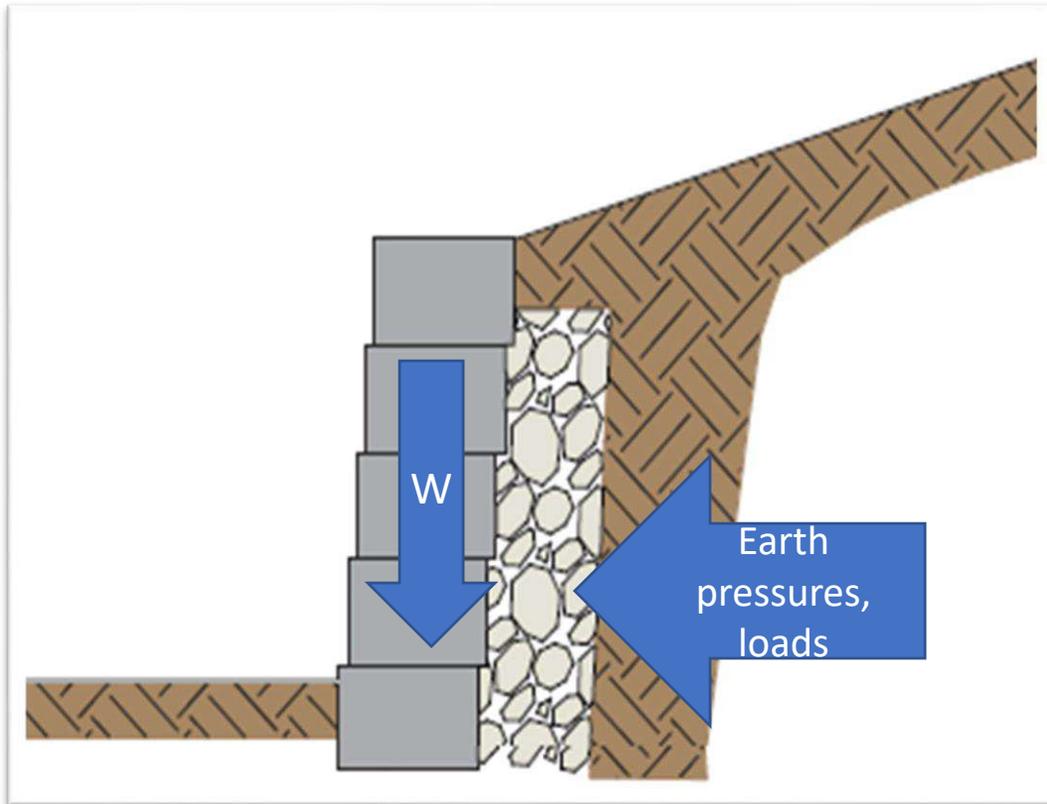


What is a Segmental Retaining Wall?

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

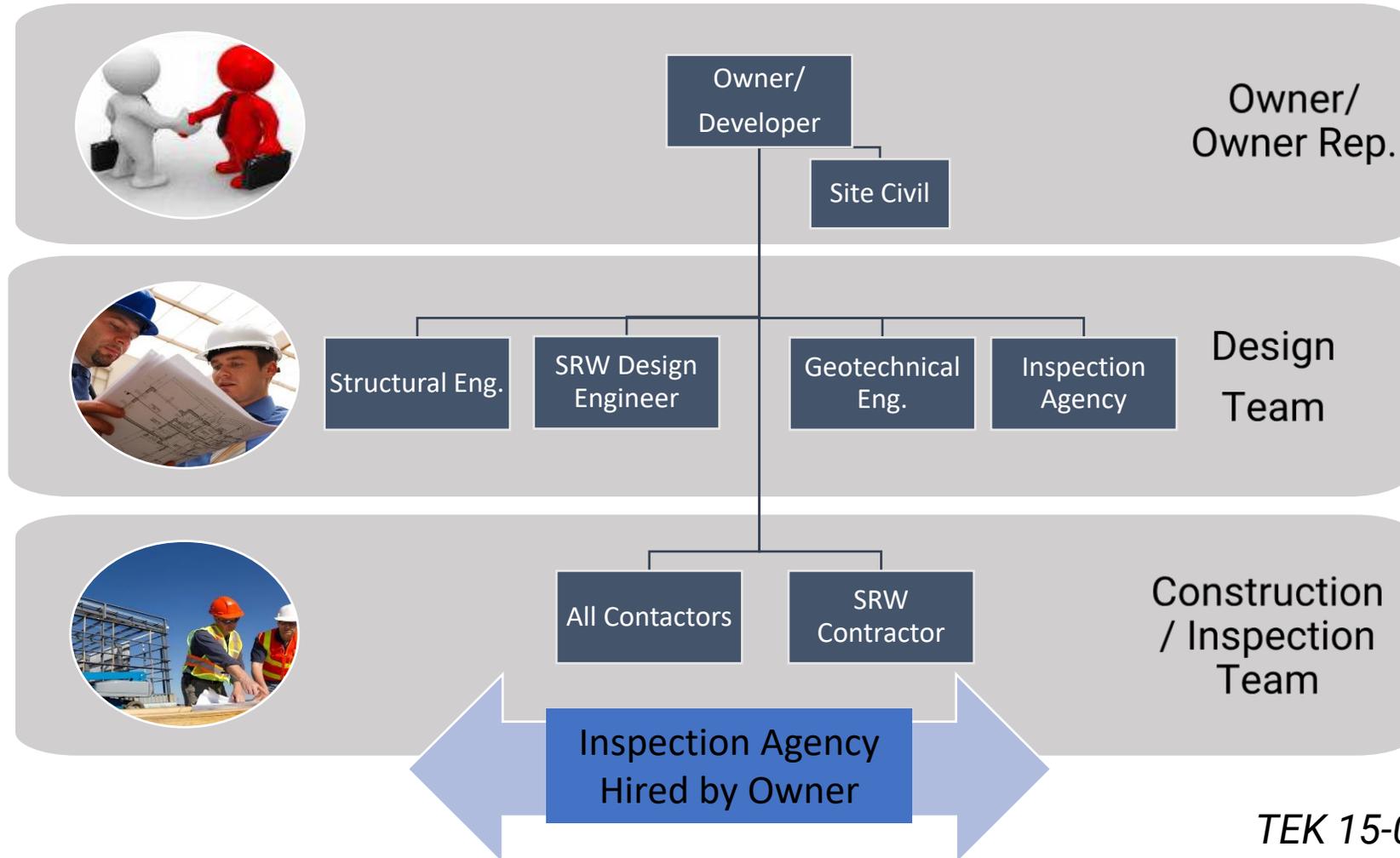
- Two types:
 - Conventional gravity retaining wall
 - Geosynthetic reinforced soil retaining wall

Conventional vs. Reinforced SRW



Roles and Responsibilities

Roles and Responsibilities

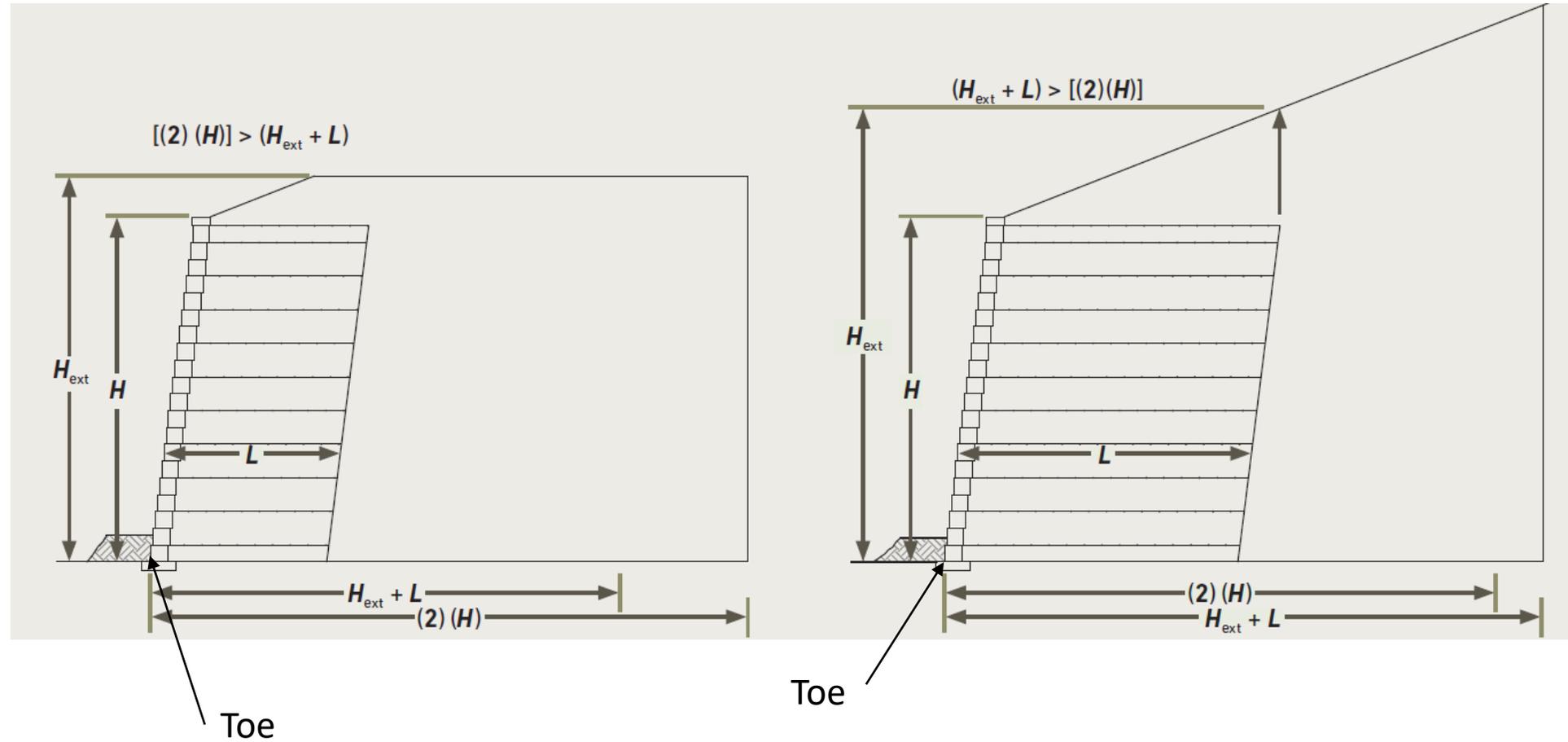


SRW Designer

- 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



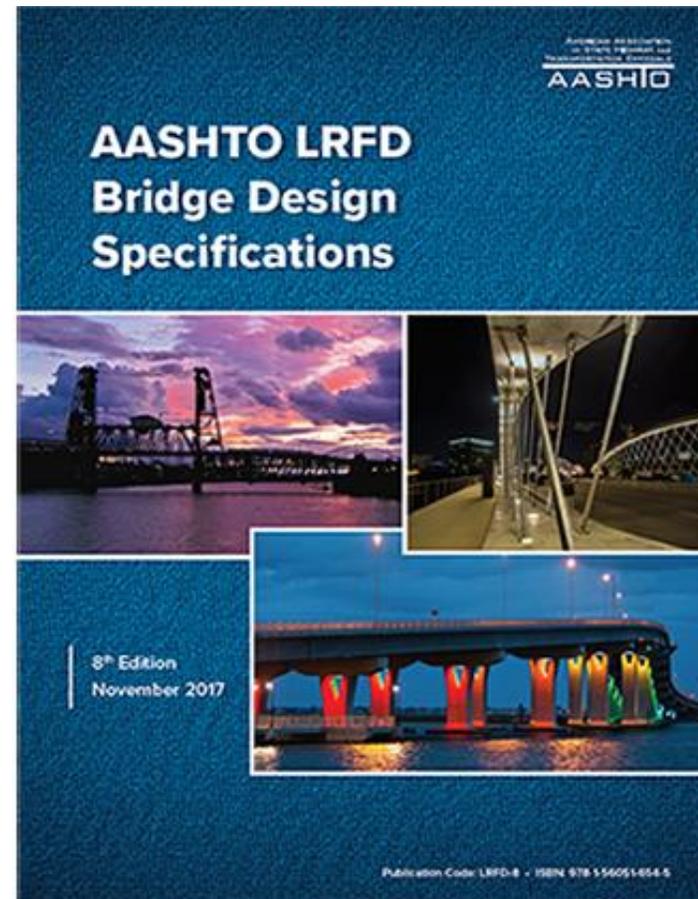
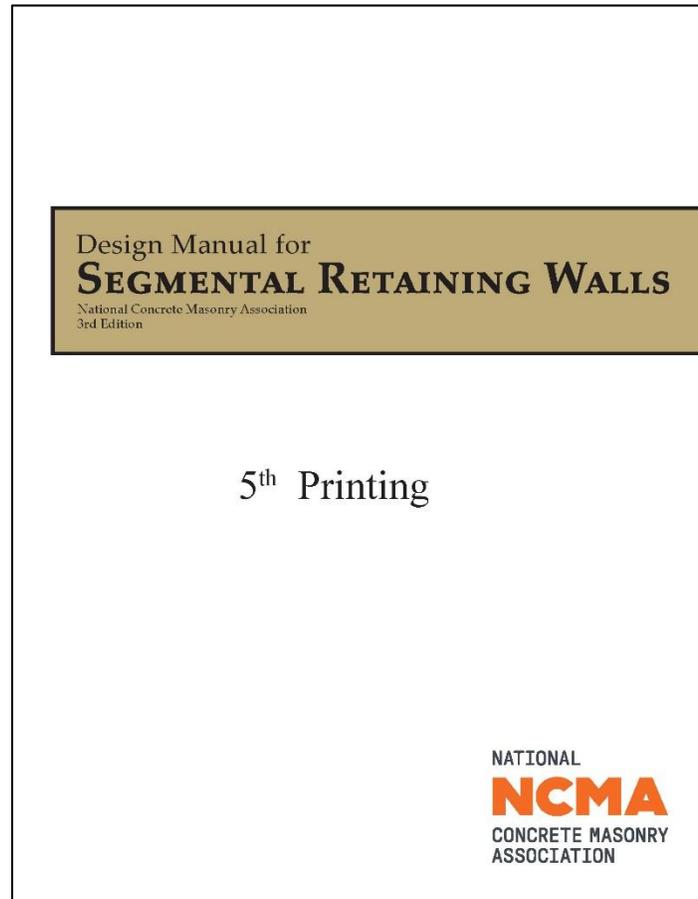
SRW Contractor

- 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



CMHA Minimum SRW Design Requirements

Minimum Safety Factor	Static	Dynamic (Seismic)*
Sliding (Base/Internal)	1.5	75% of Static
Overturning	2.0	75% of Static
Geogrid Overstress	1.5	75% of Static
Pullout from Soil/Block	1.5	75% of Static
Internal Compound Stability	1.3	1.1
Global Stability	1.3	1.1
Bearing Capacity	2.0	75% of Static
Additional Detailing Criteria		
Minimum Reinforced Zone Width	60% of Wall Height (H)	60% of Wall Height (H) for Bottom and Middle Layers; 90% of Wall Height (H) for Upper Layers
Minimum Wall Embedment	6 inches (152 mm)	6 inches (152 mm)
Minimum Anchorage Length	12 inches (305 mm)	12 inches (305 mm)
Maximum Wall Batter	20 degrees	20 degrees
Maximum Geogrid Spacing	See Table 1.3-2	16 inches (406 mm)

* 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

Soil Recommendations for Walls \leq 20 ft

Sieve Size	Percent Passing
1 in. (25 mm)	100%
No. 4	100–0%
No. 40	0-60%
No. 200	0-35%



1" and under crushed well graded gravel

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 ($H \leq 10$ ft) \rightarrow moderate plasticity ($PI < 20$ and $LL < 40$)
- For walls between 10 ft and 20ft ($10 \text{ ft} < H \leq 20 \text{ ft}$) \rightarrow low plasticity ($PI < 6$)

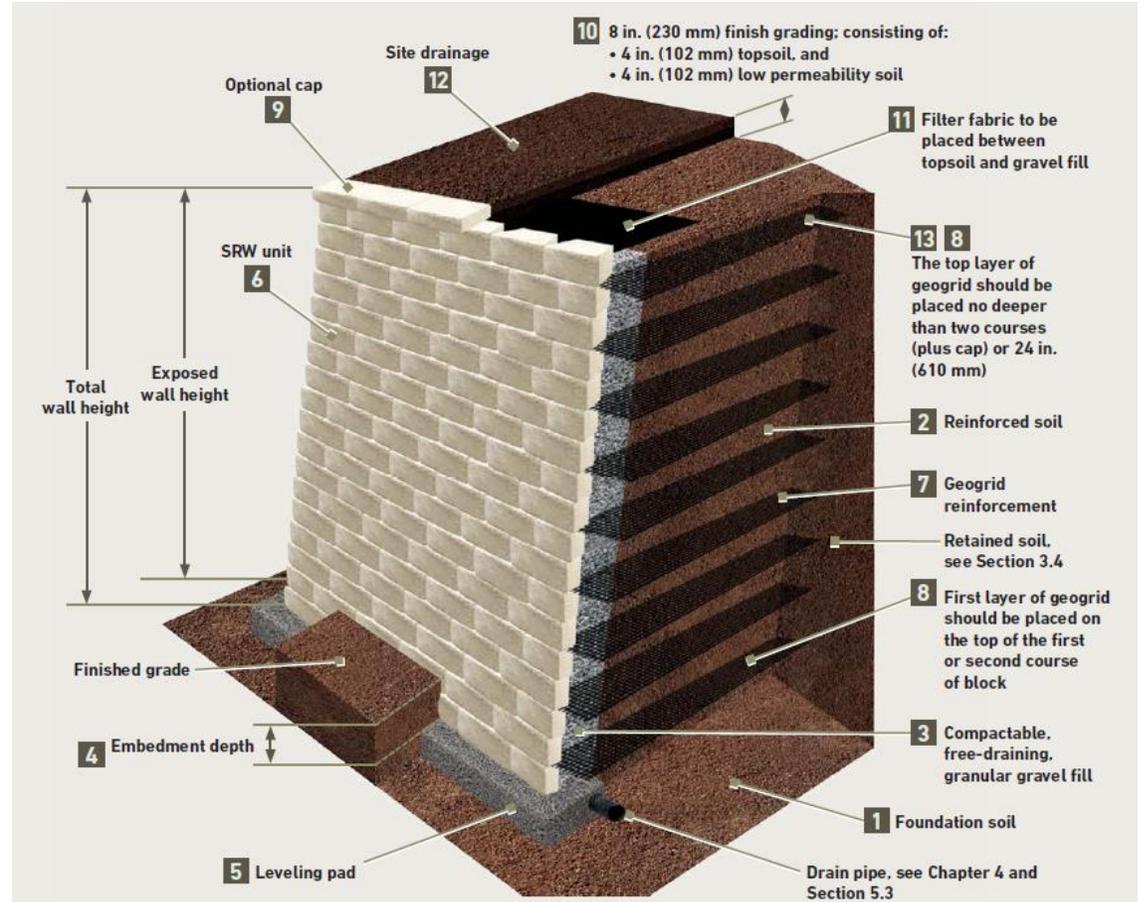
H= total wall height

PI = Plasticity Index

Materials

SRW Components

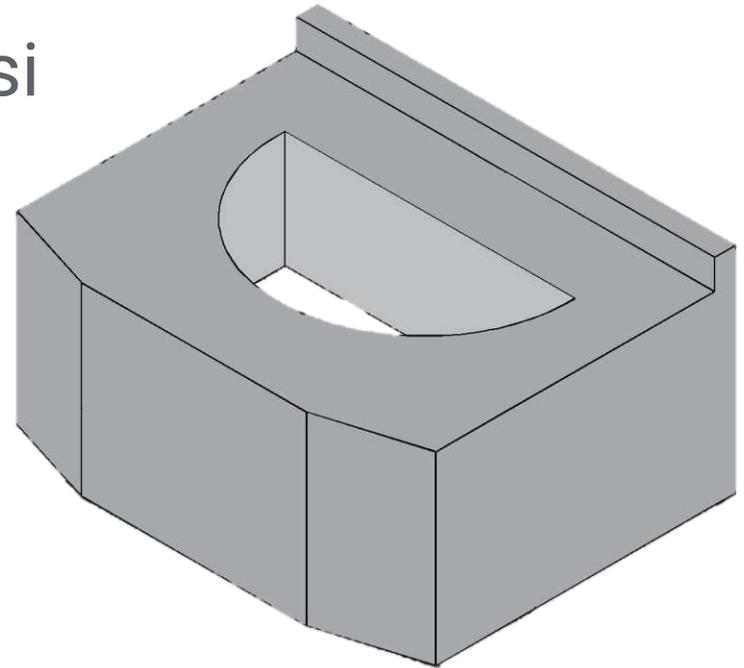
- SRW Units
- Geosynthetic Reinf.
- Soils
 - Gravel Fill
 - Reinforced Soil
 - Retained Soil
 - Foundation Soil
- Drainage Pipe



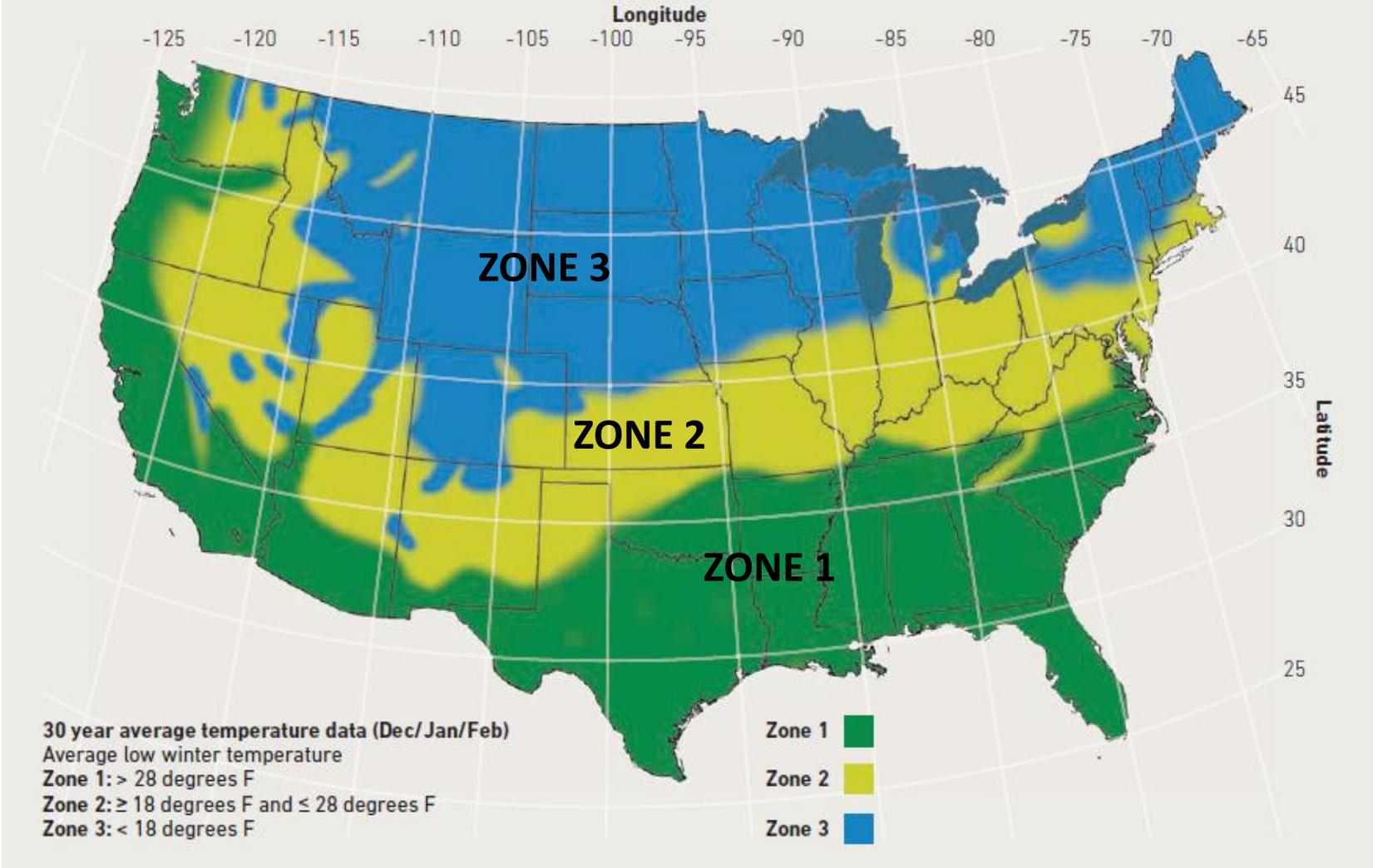
SRW Units

ASTM C1372

- Dimensional tolerances: $\pm 1/8$ in. (except for architectural finished surfaces)
- Minimum Compressive Strength = 3,000 psi
- Maximum Absorption = 15 – 18 pcf



Freeze Thaw Durability Based on Local Conditions

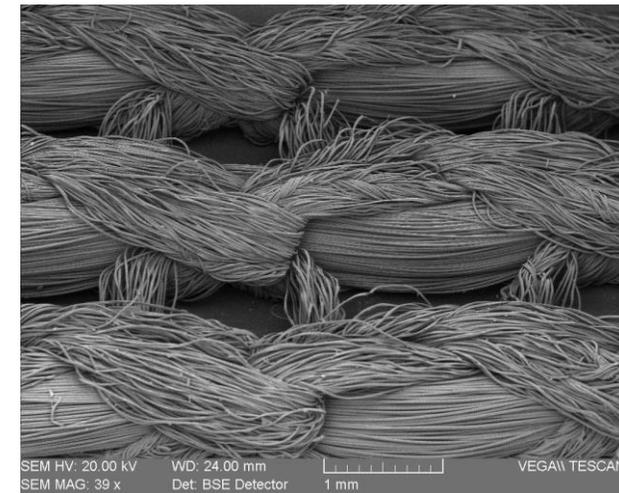


Geogrid Reinforcement

- 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](#)



Soil

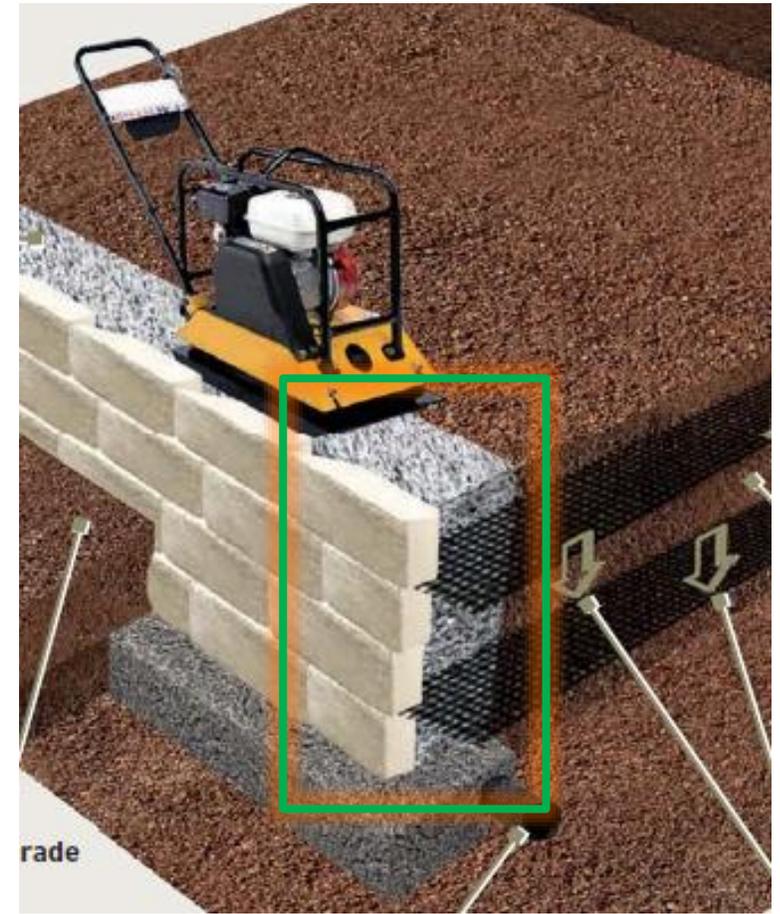
- Soils represent about 90% of the system
- All soils should be compacted to a min. 95% Standard Proctor density (or as directed by the project geotechnical engineer)
- The soils should be compacted in ≤ 8 in. (203 mm) compacted lift thickness



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

<u>Sieve Size</u>	<u>Percent Passing</u>
1 inch	100 %
¾ inch	75 – 100
No. 4	0 – 60
No. 40	0 – 50
No. 200	0 - 5



Pea gravel (single size, round gravel) is not recommended

Retained Soil

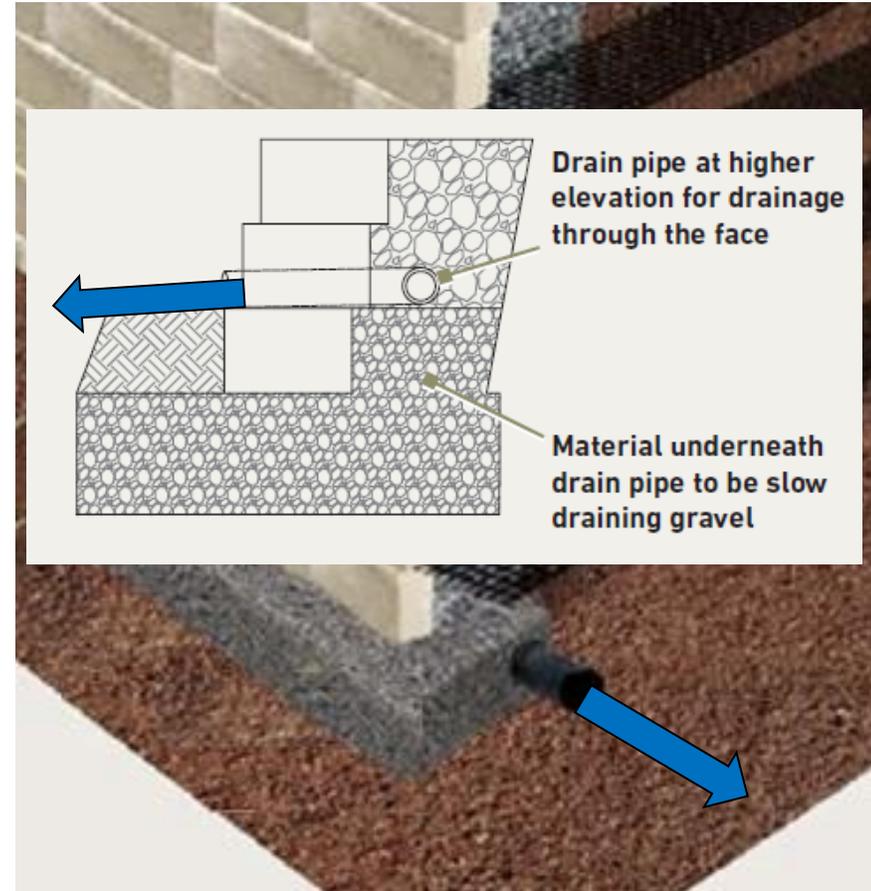
- Usually undisturbed native soil at the back of a cut slope
- When backfilling is needed,
 - Granular soils are preferred and
 - On-site soil can be used if they can be adequately compacted
- When a slope exists above the wall, the slope soil should be compacted with the same care as the other soils

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



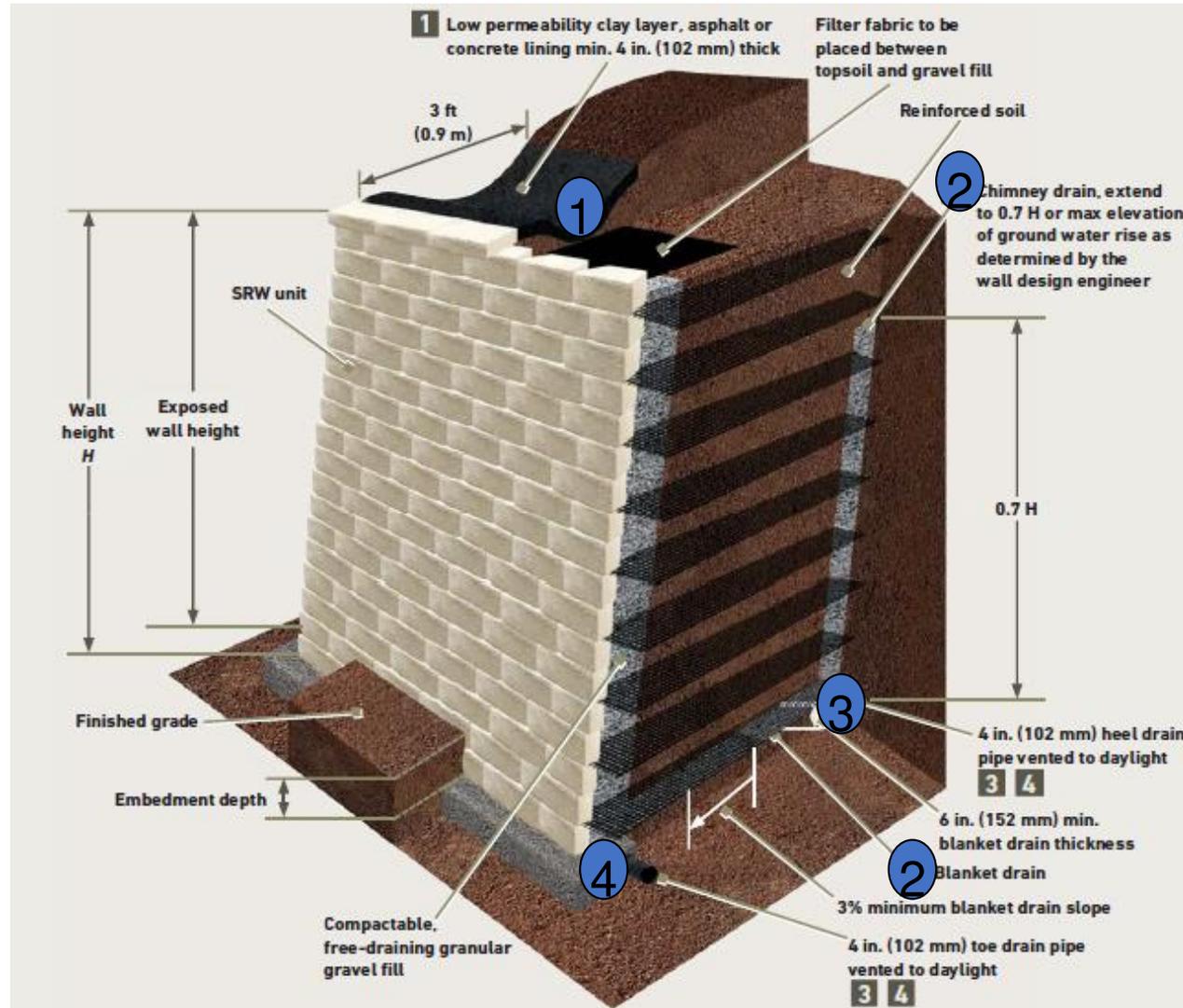
Water Management

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
- Software
- Manuals and Guides
- 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!



CONCRETE
**MASONRY &
HARDSCAPES**
ASSOCIATION

13750 Sunrise Valley Drive

Herndon, VA 20171

703.713.1900

e-mail info@masonryandhardscapes.org

www.masonryandhardscapes.org