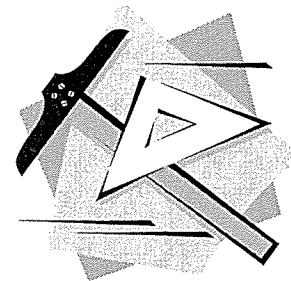


# City of Rolla CODE CHAT



February 2009

## THIS IS THE WINTER INSTALLMENT OF ROLLA'S NEWSLETTER PERTAINING TO BUILDING CODES AND THE EVER-CHANGING CONSTRUCTION TRADE.

### Segmental Retaining Walls

Segmental retaining wall systems are gravity retaining walls designed as mass walls (up to a certain height) and as geosynthetic reinforced walls. The National Concrete Masonry Association governs the design and installation of these walls. Below is some information from their TEK 18-11 tech sheet.

#### ENGINEERING REQUIREMENTS

##### Engineered Versus Non-engineered Retaining Walls

The *International Building Code*, Section 105 (refs. 6, 7), requires a building permit for earth retaining structures over 4 ft (1,219 mm) in total height. In addition, many local building codes or officials require a design prepared by a design professional, although there are many locations without provisions for engineered design. Where there is no specific requirement, NCMA suggests the guidelines listed in Table 1.

For tiered or terraced walls (i.e., those incorporating multiple walls to create a change in grade) NCMA suggests the following (Figure 1b illustrates the various design distances).

1. If the total combined height is less than 6 ft (1,829 mm) and the horizontal spacing between walls is at least twice the height of the lower wall (i.e.,  $H < 6$  ft (1,829 mm) and  $D \geq 2h_1$ ), follow Method 1 in Table 1.
2. In other cases, follow Method 2 in Table 1.

##### Foundation Evaluation

For walls founded on native sandy soils, dense silts and low plasticity stiff clays, and which are less than 6 ft (1,829 mm) in total height, local experience and visual inspection may be sufficient for design recommendations. For taller walls, walls founded on soft soil deposits, or walls founded on fill soils, test borings and/or a more detailed subsurface investigation may be required. For soft soils, organic soils, peat, high plasticity clay soil or for building over fill soils, professional engineering assistance is required. The reader is referred to *Design Manual for Segmental Retaining Walls* for more detailed classifications of these soil types.

#### DESIGN CHECKLIST

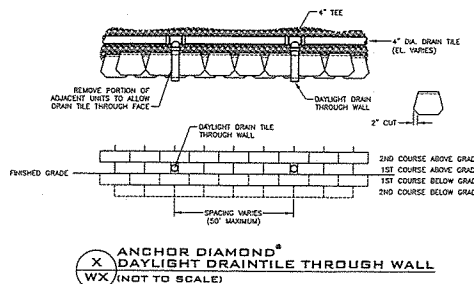
The SRW design should be reviewed for general conformance with applicable standards. Based on the design concepts presented in *Design Manual for Segmental Retaining Walls*, the following guidelines are recommended. Specific guidelines for conventional (i.e., those that do not incorporate geosynthetic reinforcement) and for soil-reinforced SRWs are in addition to the general requirements below.

##### General Requirements/All SRWs

- Granular leveling pad: minimum depth 6 in. (152 mm), extending 6 in. (152 mm) beyond the front and rear of the unit.
- Drainage aggregate: 6 to 12 in. (152 - 305 mm) minimum of drainage aggregate behind units. Drainage aggregate is typically  $1/2 - 3/4$  in. (13 - 19 mm) clean, free-draining crushed stone or crushed gravel.
- Embedment depth ( $H_{emb}$ ): minimum 6 in. (152 mm) or  $1/20$  the exposed wall height ( $H_{exp}$ ).

##### Conventional SRWs

- Wall height: not to exceed manufacturer's design chart maximums, or 2.5 times the unit depth [e.g. 2.5 ft (762 mm) max. wall height for a 1 ft (305 mm) deep unit; 5 ft (1524 mm) maximum wall height for a 2 ft (610 mm) deep unit].



### Geosynthetic-Reinforced SRWs

- Geosynthetic soil reinforcement: type, number of layers, layer length, and layer elevations clearly noted on the drawings or in the contract documents.
- Length of geosynthetic reinforcement ( $L$ ): minimum of 60% of the total wall height ( $H$ ) or 4 ft (1,219 mm), whichever is greater.
- Vertical spacing of geosynthetic reinforcement: Experience indicates that reinforcement spacing should be limited to a maximum of 24 in. (610 mm). Closer reinforcement spacing may be necessary in poor soil conditions. However, although some proprietary systems are capable of supporting larger spacing between reinforcement layers, at no time should the reinforcement spacing exceed 32 in. (813 mm).
- Height of unreinforced units at top of wall: maximum of twice the unit depth.
- Soil backfill compacted to 95% maximum dry density per standard Proctor moisture-density relationship (90% Modified Proctor Density) and compacted in 8-in. (203-mm) maximum height lifts. Moisture content of fill within +1/-3 percent of the optimum moisture content.

### CONSTRUCTION INSPECTION

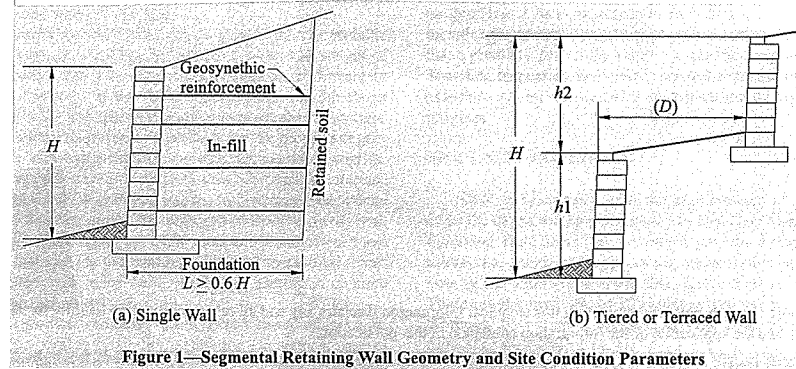
In addition to inspection, the success of any segmental retaining wall installation depends on complete and accurate field information, careful planning and scheduling, the use of specified materials and proper construction procedures.

It is good practice to have the retaining wall location verified by the owner's representative. Existing and proposed finish grades shown on the drawings should be verified to ensure the planned design heights are in agreement with the topographic information from the project grading plan. Materials delivered to the site should be accompanied by the manufacturer's certification that the materials meet or exceed the specified minimum requirements.

As with any structure used to retain soil, careful attention should be paid to the compaction equipment and procedures used during construction. To prevent overtopping during construction, heavy equipment should not be operated within 3 ft (914 mm) of the rear of the wall. Manually-operated compaction devices, such as vibrating plate compactors, should be used within this zone to ensure proper installation while maintaining safety requirements. Reinforced soil can be compacted with walk-behind or self-propelled riding compaction equipment.

### Installation

- Leveling pad: placed to plan dimensions and compacted
- Drainage aggregate: placed to thickness and depth shown on plans
- Drainage collection pipe: placed at plan location, sloped to create gravity flow of water
- Fill placement and compaction:
  - maximum 8 in. (203 mm) thick lifts
  - soil compacted to 95% maximum dry density per standard Proctor moisture-density relationship
  - moisture content of fill within +1/-3 percent of the optimum moisture content.
  - no heavy, self-propelled compaction equipment within 3 ft (914 mm) of the rear of the wall
- SRW unit installation:
  - units level from front-to-back and from side-to-side
  - proper alignment and batter
  - if unit is cored, unit cores filled with aggregate each course
  - shear connection between units properly engaged per SRW manufacturer's details
  - curves and corners installed per SRW manufacturer's details
- Geosynthetic reinforcement placement:
  - of the specified type and size
  - placed horizontally at plan location
  - proper length ( $L$ ) as shown on plans
  - placed in proper orientation, per geosynthetic manufacturer's details (highest strength direction placed perpendicular to the wall face)
  - placed to front of SRW unit and connected between units per manufacturer's details
  - nominally tensioned to remove any slack or wrinkles prior to backfilling
  - no excessive damage, for example tracked equipment has not been driven directly on geosynthetic
  - curves and corners installed per plan details or geosynthetic manufacturer's details
- Cap unit: adhered with specified adhesive.



Thank you,

Brian Epstein- Building Codes Administrator

Design method	Wall height	Allowable soil & foundation conditions	Recommended engineering required
Method 1: Non-engineered	Less than 6 ft (2 m) from leveling pad to top of wall	Sand/gravel, silty sands, silt/lean clays	Use design chart provided by SRW system supplier.
Method 2: Engineered	More than 6 ft (2 m) from leveling pad to top of wall	Sand/gravel, silty sands, silt/lean clays	Have the design section review by a registered design professional.