

To: All HQ Directors: Operations, Planning & Major Projects  
All Regional Directors  
All District Managers, Transportation  
All Regional Managers, Engineering  
All Regional Geotechnical and Materials Engineers  
All Subdivision Personnel

**Subject: Rock Stacked Retaining Walls**

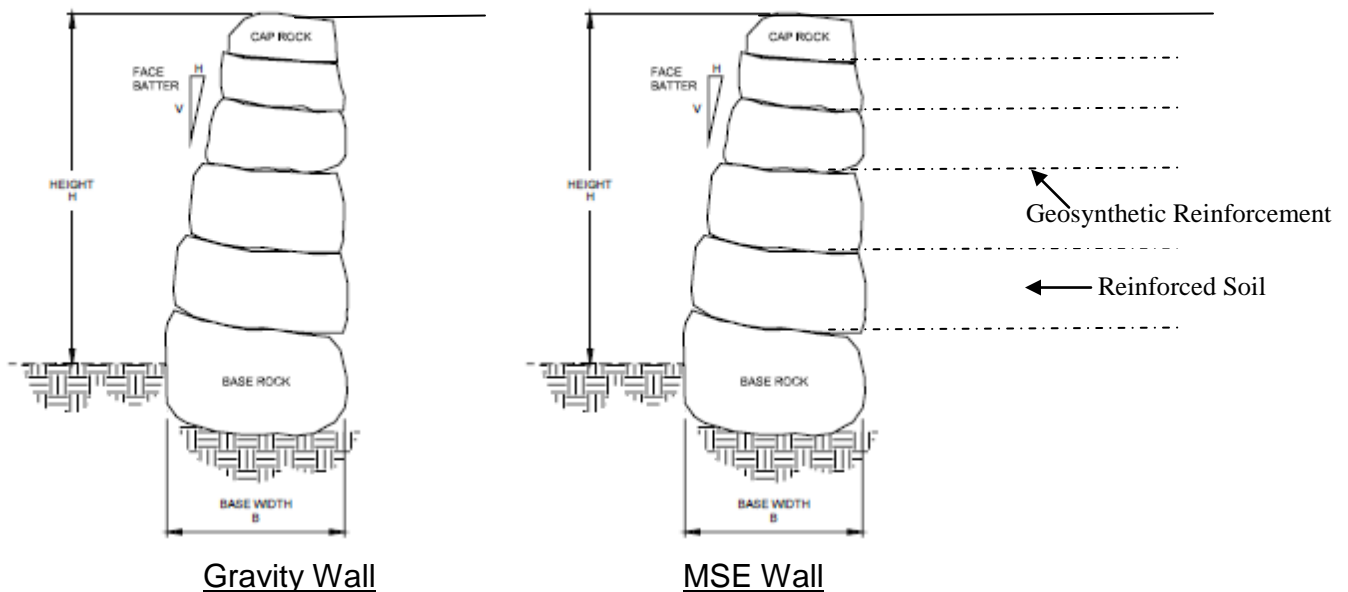
**Purpose:**

This Technical Circular provides guidance to Ministry geotechnical design engineers, Ministry subdivision personnel and the qualified professional regarding the design and construction of rock stacked retaining walls. All rock stacked walls that are proposed as part of the Ministry Subdivision Process shall meet the requirements of this Technical Circular.

Rock stacked walls are not allowed 1) on/or adjacent number highways and 2) in situations where failure of the wall would not allow adjacent or dependent structures to perform their intended function, as discussed in later sections of this document.

**Background:**

Rock stacked retaining walls have been widely used over several hundred years. More recently they have typically been used as part of subdivision development. A rock stacked retaining wall is built with no mortar to bind the rocks together. Wall stability is improved by interlocking of the rocks, and in some cases, addition of geosynthetic reinforcement. Rock stacked walls may be considered either gravity walls that rely on their weight or as Mechanically Stabilized Earth (MSE) walls with geosynthetic reinforcement.

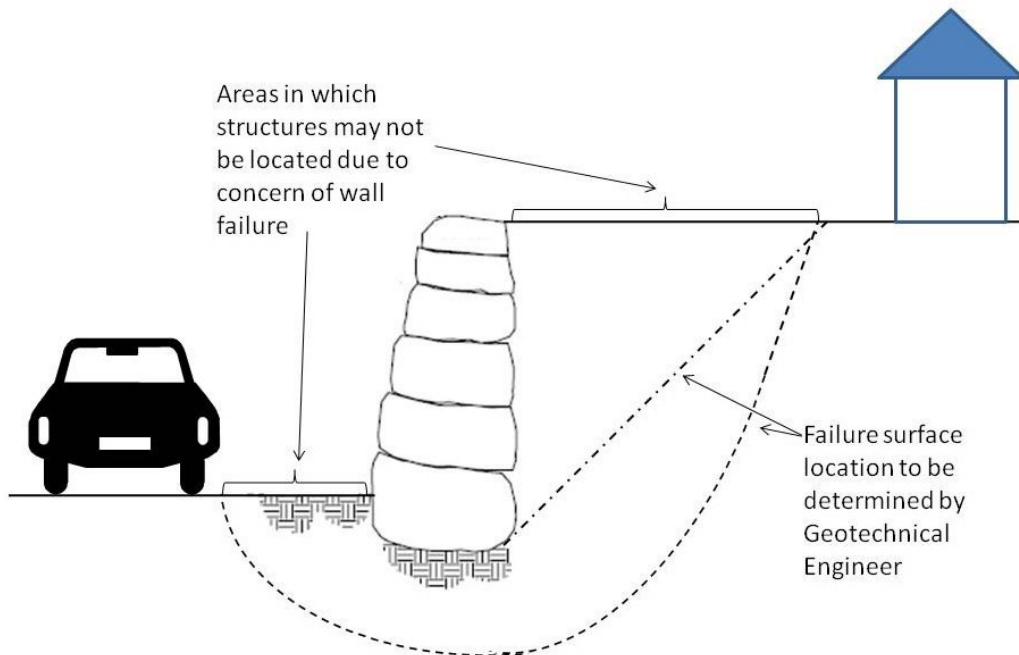


Rock stacked walls can be competent or incompetent structures depending on the quality of the design, construction and the drainage provisions. Proper engineering and construction is required to ensure a good product.

### **Scope and Application:**

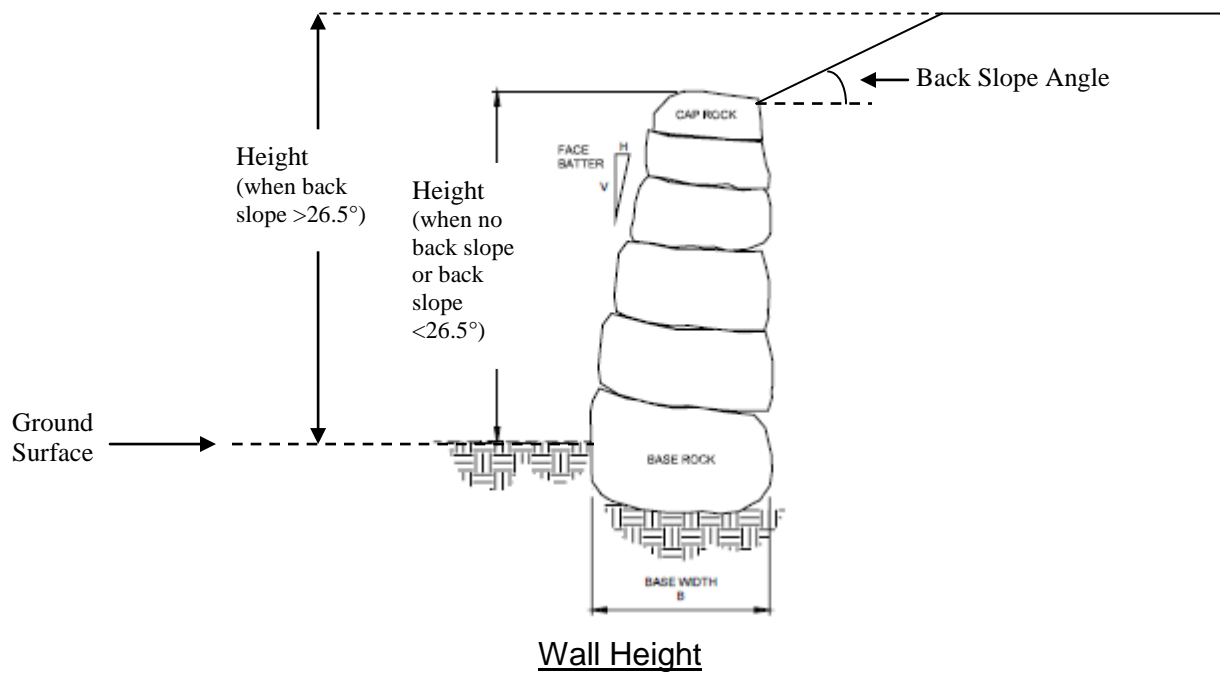
The Ministry does not allow the construction of rock stacked walls on/or adjacent to numbered highways. This means that walls retaining an embankment supporting a highway and walls that are supporting a cut above the highway where failure of the wall or cut will enter Ministry right-of way will not be allowed.

The Ministry does not allow the construction of rock stacked walls in areas where the location and performance of the rock stacked wall will prevent adjacent or dependent structures from performing their intended function in the event of wall failure, as shown in the figure below. Examples of structures may include a railway, utility line, habitable structure, etc.



The maximum height restriction is 3.7 m for gravity walls and 4.6 m for MSE walls, unless otherwise approved by Headquarters Engineering Branch (Geotechnical Section). These height restrictions apply to individual walls as well as the cumulative height for tiered walls.

The wall height is measured from the bottom of the exposed wall to the top of the wall. Where there is a slope above the wall, where the back slope is a natural slope or a constructed slope and where the back slope is greater than 2H:1V (26.5°), then the height of the back slope is included in the height of the wall. Section 5.8.2 of AASHTO Standard Specifications for Highway Bridges, Seventeenth Edition, 2002 provides guidance on external stability of walls with a back slope and tiered walls.



### **Design Requirements:**

Proposed rock stacked walls over 1.5 m in height must be designed by a qualified professional registered with APEGBC. Limit equilibrium global stability of the slope must meet a minimum factor of safety of 1.5. For slopes steeper than 70°, retaining wall design must follow all clauses for internal and external design outlined in AASHTO Section 5 Retaining Walls (design criteria for both gravity walls and MSE walls is provided). With respect to seismic design, the 10% in 50 years event shall be considered and a pseudo-static analysis is acceptable to determine stability. Additionally, inertia forces of the facing components shall be accounted for during seismic loading. Where stability is not achieved a mechanical connection shall be considered.

Slope angles flatter than 70 degrees shall be designed as reinforced soil slopes in accordance with FHWA-NHI-00-043 “Mechanically Stabilized Earth Walls and Reinforced Soil Slopes Design and Construction Guidelines” March 2001.”

For the design life of components, wherever there are time dependent calculations, use 100 years. Examples would be for corrosion and creep calculations.

For any application of stacked rocks over 1.5 m in height, where the rocks are used for aesthetic or erosion purposes, the qualified professional must show that the slope has a global factor of safety of 1.5 with and without the rocks.

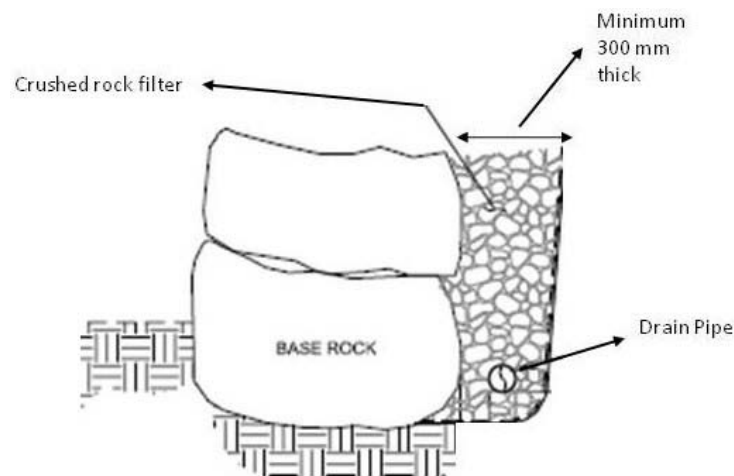
A checklist for the qualified professional to complete, sign and provide to the Ministry is attached. Where the wall is in conjunction with subdivision development, the checklist must be provided to Development Approvals personnel. Otherwise, the wall checklist must be provided to the Ministry Regional Geotechnical Engineer. The checklist should be used to ensure the qualified professional has followed this Technical Circular.

### **Construction Guidelines:**

Individual wall rock fragments shall have a weight exceeding 90 kg and dimensions (length, width and height) greater than 450 mm. Rocks shall be roughly rectangular, tabular or cubic in shape. Rounded rocks shall not be used. Rocks shall be intact and massive with no open fractures, foliation or other planes of weakness. Rocks must be hard and resistant to weathering.

No continuous vertical or horizontal joints are allowed in the construction of the wall.

A minimum 300 mm thick, granular filter is required between the rock layer and in front of the retained fill. A drainage system is also required to ensure adequate drainage.



**Drain and crushed rock filter Cross Section**

Voids left between rocks during the construction of the wall shall be filled with smaller pieces such that there is no concern for erosion of the filter.

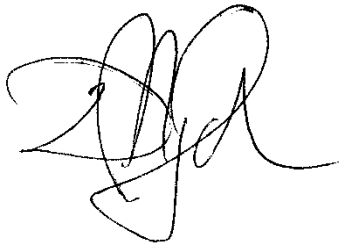
Care must be taken during construction to produce a rock layer in which there is good contact between adjacent rocks, especially on the front face of the wall.

Because the quality of construction is essential to the long-term stability of the wall, there is the requirement for design inspection and review by the qualified professional for walls higher than 1.5 m. The qualified professional is required to follow the requirements set out in MoT Technical Circular 06-09 Engineer of Record and Field Review Guidelines.

**Contact:**

Sarah Gaib, M.Eng., P.Eng.  
Senior Geotechnical Engineer  
Engineering Branch  
Telephone: (250) 356-0390

Ian Pilkington, P.Eng.  
Chief Geotechnical, Material & Pavement Engineer  
Engineering Branch  
Telephone: (250) 387-3353

A handwritten signature in black ink, appearing to read 'D. Nyland', with a horizontal line extending to the right from the end of the signature.

---

Dirk Nyland, P.Eng.  
Chief Engineer

## Rock Stacked Retaining Wall Checklist:

Note: This Checklist is to be read and completed in conjunction with this Technical Circular T-01/10

For the Property: \_\_\_\_\_

### Overall Design:

- Provide specifications on rock to be used in wall
- Drainage Filter (comprised of granular material and geosynthetic) minimum 300 mm thick behind rock facing.
- Drain pipe is included at the bottom of the drainage filter layer.
- Global stability of slope: minimum factor of safety  $\geq 1.5$
- Seismic global stability of slope: minimum factor of safety  $\geq 1.1$
- Accounted for inertia loads of the facing components in seismic design.
- Surcharge loads (traffic, sloped ground, etc) accounted for.
- Qualified professional has provided a plan for construction inspection.
- Ensure appropriate recommendations for construction of wall have been provided to Contractor.

### Specific to Gravity Wall Design:

- Analyzed for overturning, sliding and bearing capacity.
- Analyzed for overturning, sliding and bearing capacity under seismic conditions.

### Specific to MSE Wall Design:

- Analyzed for overturning, sliding, bearing capacity and pullout failure.
- Provide specifications on geosynthetic reinforcement
- Minimum geosynthetic reinforcement length is 70% of height or minimum 2.4 m.
- Minimum 1.2 m wide bench in front of walls on slopes
- Maximum 0.8 m vertical spacing of reinforcement
- Analyzed for overturning, sliding, bearing capacity and pullout failure under seismic conditions.

Name and Company Name \_\_\_\_\_

Signature and Stamp: \_\_\_\_\_

Date: \_\_\_\_\_