# Report Information Form

Engineer: Jagdish Motiani, P.Eng.

Email: jagdish@risistone.com

Date: November 14 2019

## Project Details

Report Type: For Approval

Product: Durahold

Job Name: Mars Canada - Boltcol Holdings North

Job Location: George Bolton Pkwy., Bolton ON

Project No.: 201910030

Distribution: Unilock Ltd, Metric Contracting Services Corporation

## Customer Details

Name: Jack Moncada

Company: Metric Contracting Services Corporation

Address:

GRE Name:

GRE Company:

RisiStone®
retaining wall systems

For Approval Report on Proposed

# Durahold

Segmental Retaining Wall

## Mars Canada - Boltcol Holdings North

George Bolton Pkwy., Bolton ON

Project No.
**201910030**

Distribution

Unilock Ltd, Metric Contracting Services Corporation

Unilock Ltd, Metric Contracting Services Corporation

**Risi Stone Inc.**
10-480 Harry Walker Pkwy S.
Newmarket ON Canada L3Y 0B3
**P** 905.868.9255 | **F** 905.868.9254
**E** jagdish@risistone.com
**www.risistone.com**

RisiStone
retaining wall systems

# Contents

RisiStone®
retaining wall systems

**Risi Stone Inc.**
10-480 Harry Walker Pkwy S.
Newmarket ON Canada L3Y 0B3
**P** 905.868.9255
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www.risistone.com

November 14 2019

**Attn:** Jack Moncada
Metric Contracting Services Corporation

**Re:** Mars Canada - Boltcol Holdings North
**Proposed SRW:** Durahold
**Project No.:** 201910030

Please find enclosed the Wall Design for the above noted project. Information on the design is provided in the Drawings.

A qualified Professional Engineer must be retained to provide Geotechnical Inspection of the Wall and General Review of Construction in accordance with Division C – Part 1, Section 1.2.2 of the Ontario building Code. Risi Stone Inc. does not provide these services. Refer to the Specification for further explanation of these requirements.

**Included in this report are:**

1 **VESPA Report:** Contains wall layout information and quantity calculations for wall face area, geogrid requirements, infill quantities (Estimate based on infill required within the reinforced zone. Does not account for other infill that may be required beyond the infill zone), base quantities, drainage quantities, coping quantities, etc. Contractor must review the layout information provided and ensure the wall dimensions (lengths, TW/BW elevations) match the most recent grading and site information available. (all quantities can be found on the first page of the Vespa Report)

2 **Construction Review & Inspection Guidelines:** Guidelines provided by Risi Stone Inc. to aid in the Geotechnical Inspection, General Review, and Contractor Quality Assurance of the Wall(s).

3 **Design Drawings & Specifications:** These must be sealed by a Professional Engineer to be used for Construction. If these drawings are not sealed, they are Preliminary only and can not be used for Construction.

Please advise this office if further design services are required.

Sincerely,

Jagdish Motiani, P.Eng.

# Letter of Intent for General Review Engineer

**Project Name:** Mars Canada - Boltcol Holdings North
**Project Number:** 201910030
**Date:** November 14 2019

**General Review Engineer:**
**Company Name:**

Has been retained to provide the General Review of the wall(s) in accordance with the Design, Notes, and Specifications contained with this.

In addition, I undertake to ensure that the overall Global Stability of the proposed wall/slope configuration will be addressed by this firm or the Site Geotechnical Engineer (if they are not the same) prior to construction.

Signature

Date

*Please provide a completed copy of this letter of intent to the Contractor, Site Civil Engineer, and Risi Stone Inc.*
*Please send to Risi Stone Inc. via fax 905.882.4556 or email julie@risistone.com*

RisiStone®
retaining wall systems

# Vespa Output

# Project: George Bolton Parkway

**Site: Bolton,Ontario**

**Date: 2019-11-15**

**Wall: RETAINING WALL B (90.0m Long)**

# Risi Stone Inc

# Project Summary

## Quantities

| | |
|---|---|
| **Wall Length** | 89.67 m |
| **Steps in Top of Wall** | 4 |
| **Total Wall Area** | 90.1 m² |
| **Cap Area** | 27.3 m² |
| **Exposed Area (includes cap)** | 53.0 m² |
| **Embedded Area** | 37.1 m² |
| **Tallest Panel Height** | 1.22 m |
| **Longest reinforcement length** | 1.65 m |
| **Base soil volume** | 33.4 m³ |
| **Infill soil volume ‡** | 87.0 m³ |
| **Gravity Face Drain** | 0.0 m³ |

**Reinforcement**

| | |
|---|---|
| SG200 - StrataGrid 200 | 191.1 m² |

**Note †:** **Total Facing Unit quantity is based on using full-sized units only on bottom course and an even mix of defined facing sizes, as identified elsewhere in this report, on remaining courses of each Section. The use of corners, tapered or cut units is not reflected in this quantity.**

**Note ‡:** **Reinforced fill values are calculated based on the average geogrid length in each Section. They do not account for anything beyond the reinforced zone (end of the geogrids). Actual infill values may be significantly higher.**

**Note Δ:** **Drainage fill does not include the drainage stone within block. Core fill are calculated based on the percentage hollow core of the wall unit selected. If the percentage hollow core is not defined then the Core fill value within block will not be calculated.**

# Project Design Inputs

## Selected Facing Unit

**Licensor/Product Line:** Risi Stone Systems
**Name:** Durahold

| | | | |
|---|---|---|---|
| **Facing Height** | Hu | 0.31 | m |
| **Facing Width** | Lu | 1.83 | m |
| **Facing Depth** | Wu | 0.61 | m |
| **Facing Weight** | Xu | 23.0 | kN/m³ |
| **Center of Gravity** | Gu | 0.31 | m |
| **Setback** | Δu | 0.04 | m |
| **Batter** | ω | 7.12 | ° |
| **Cap Height** | Hcu | 0.31 | m |
| **Initial Shear Capacity** | au | 75.20 | kN/m |
| **Apparent Shear Angle** | λu | 43.00 | ° |
| **Maximum Shear Capacity** | Vu(max) | 163.20 | kN/m |

## Selected Reinforcement Types

### Reinforcements

**SG200 - StrataGrid 200** **Supplier: Strata Systems, Inc., Fill Type: 38mm- gravels or aggregate**

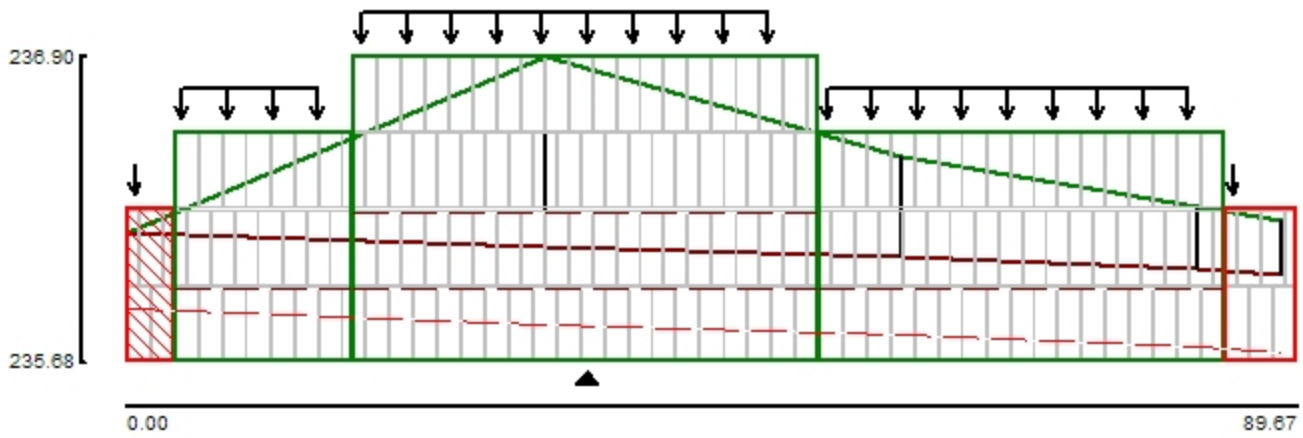
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Tult | 52.55 kN/m | RFcr | 1.55 | RFd | 1.10 | LTDS | 22.83 kN/m |
| RFid | 1.35 | Cds | 0.80 | Ci | 0.80 | | |

**Connection/Shear Properties**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| αcs1 | 10.30 kN/m | IP-1 | 25.60 kN/m | αcs2 | 25.70 kN/m | IP-2 | 25.60 kN/m |
| αcs max | 25.70 kN/m | au | 75.20 kN/m | λu | 43.00 kN/m | Vu(max) | 163.20 kN/m |

# Section Geometry

## Section Drawing




## Section Extents

| Section | Top Elevation [m] | Base Elevation [m] | Left Side [m] | Right Side [m] | Bottom Grade Elevation [m] |
|---|---|---|---|---|---|
| 1 | 236.29 | 235.68 | 0.00 | 3.66 | 236.19 |
| 2 | 236.60 | 235.68 | 3.66 | 17.38 | 236.17 |
| 3 | 236.90 | 235.68 | 17.38 | 53.07 | 236.11 |
| 4 | 236.60 | 235.68 | 53.07 | 84.18 | 236.04 |
| 5 | 236.29 | 235.68 | 84.18 | 89.67 | 236.03 |

## Section Measurements

| Section | Height [m] | Design Height [m] | Width [m] | Face Area [m²] | Embedment [m] | Infill Volume [m³] |
|---|---|---|---|---|---|---|
| 1 | 0.61 | 0.61 | 3.66 | 2.2 | 0.51 | 0.0 |
| 2 | 0.92 | 0.92 | 13.72 | 12.6 | 0.49 | 12.2 |
| 3 | 1.22 | 1.22 | 35.68 | 43.5 | 0.43 | 45.3 |
| 4 | 0.92 | 0.92 | 31.11 | 28.5 | 0.36 | 29.5 |
| 5 | 0.61 | 0.61 | 5.49 | 3.3 | 0.35 | 0.0 |

## Section Slopes

| Section | Crest Slope [°] | Crest Offset [m] | Toe Slope [°] | Toe Offset [m] |
|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 0.00 | 0.00 | 0.00 | 0.00 |
| 4 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 |

## Section Loads

| Section | Live Load [kN/m²] | Live Offset [m] | Dead Load [kN/m²] | Dead Offset [m] |
|---|---|---|---|---|
| 1 | 36.0 | 0.00 | 0.0 | 0.00 |
| 2 | 36.0 | 0.00 | 0.0 | 0.00 |
| 3 | 36.0 | 0.00 | 0.0 | 0.00 |
| 4 | 36.0 | 0.00 | 0.0 | 0.00 |

NOTE: THESE CALCULATIONS, QUANTITIES, AND LAYOUTS ARE FOR PRELIMINARY DESIGN ONLY AND SHOULD NOT BE USED FOR CONSTRUCTION WITHOUT REVIEW BY A QUALIFIED ENGINEER

| Section | Live Load [kN/m²] | Live Offset [m] | Dead Load [kN/m²] | Dead Offset [m] |
|---|---|---|---|---|
| 5 | 36.0 | 0.00 | 0.0 | 0.00 |

## Reinforcement Details

| Section | Course | Length [m] | Area [m²] | Reinforcement |
|---|---|---|---|---|
| 2 | 1 | 1.60 | 21.96 | SG200 - StrataGrid 200 |
| 3 | 2 | 1.65 | 58.88 | SG200 - StrataGrid 200 |
| | 1 | 1.65 | 58.88 | SG200 - StrataGrid 200 |
| 4 | 1 | 1.65 | 51.33 | SG200 - StrataGrid 200 |

# Project: George Bolton Parkway

**Site: Bolton,Ontario**

**Date: 2019-11-15**

**Wall: RETAINING WALL C (32.0m Long)**

# Risi Stone Inc

# Project Summary

## Geogroups

| Geogroup | Layer | Length (m) |
|---|---|---|
| **A** | All | 1.65 |
| **B** | All | 1.85 |
| **C** | All | 1.65 |

## Quantities

| | |
|---|---|
| **Wall Length** | 32.94 m |
| **Total Wall Area** | 54.1 m² |
| **Cap Area** | 10.0 m² |
| **Exposed Area (includes cap)** | 41.2 m² |
| **Embedded Area** | 12.9 m² |
| **Tallest Panel Height** | 2.14 m |
| **Longest reinforcement length** | 1.85 m |
| **Base soil volume** | 12.3 m³ |
| **Infill soil volume ‡** | 58.5 m³ |
| **Gravity Face Drain** | 0.0 m³ |

**Reinforcement**

| | |
|---|---|
| SG200 - StrataGrid 200 | 110.1 m² |

**Note †:** **Total Facing Unit quantity is based on using full-sized units only on bottom course and an even mix of defined facing sizes, as identified elsewhere in this report, on remaining courses of each Section. The use of corners, tapered or cut units is not reflected in this quantity.**

**Note ‡:** **Reinforced fill values are calculated based on the average geogrid length in each Section. They do not account for anything beyond the reinforced zone (end of the geogrids). Actual infill values may be significantly higher.**

**Note Δ:** **Drainage fill does not include the drainage stone within block. Core fill are calculated based on the percentage hollow core of the wall unit selected. If the percentage hollow core is not defined then the Core fill value within block will not be calculated.**

# Project Design Inputs

## Selected Facing Unit

| | | | |
|---|---|---|---|
| **Licensor/Product Line:** | Risi Stone Systems | | |
| **Name:** | Durahold | | |
| **Facing Height** | Hu | 0.31 m | |
| **Facing Width** | Lu | 1.83 m | |
| **Facing Depth** | Wu | 0.61 m | |
| **Facing Weight** | Xu | 23.0 kN/m³ | |
| **Center of Gravity** | Gu | 0.31 m | |
| **Setback** | Δu | 0.04 m | |
| **Batter** | ω | 7.12 ° | |
| **Cap Height** | Hcu | 0.31 m | |
| **Initial Shear Capacity** | au | 75.20 kN/m | |
| **Apparent Shear Angle** | λu | 43.00 ° | |
| **Maximum Shear Capacity** | Vu(max) | 163.20 kN/m | |

## Selected Reinforcement Types

### Reinforcements

**SG200 - StrataGrid 200** **Supplier: Strata Systems, Inc., Fill Type: 38mm- gravels or aggregate**

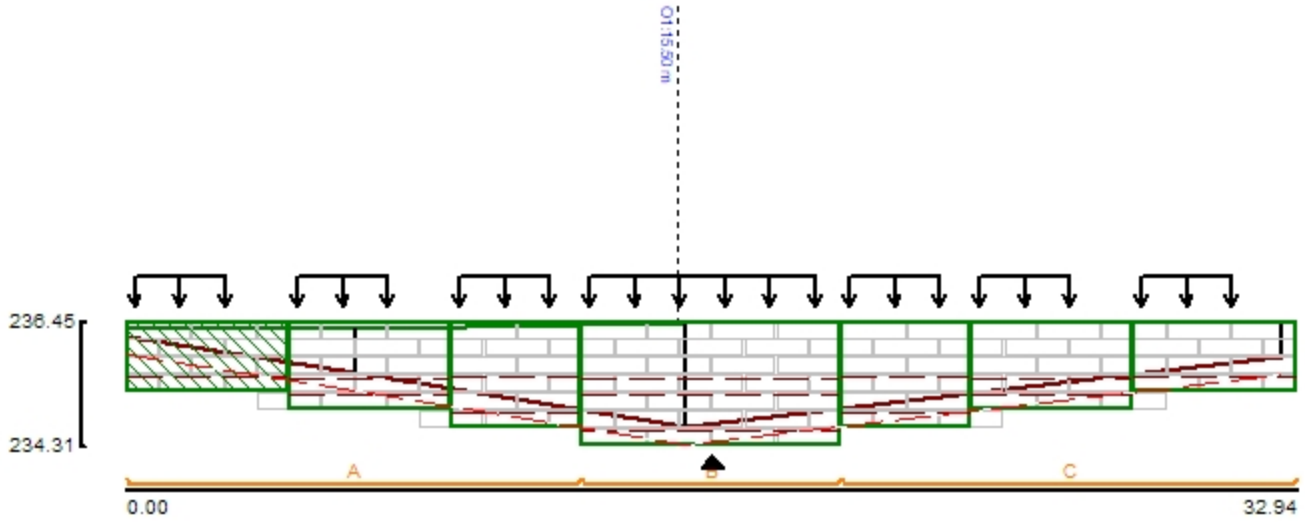
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Tult | 52.55 kN/m | RFcr | 1.55 | RFd | 1.10 | LTDS | 22.83 kN/m |
| RFid | 1.35 | Cds | 0.80 | Ci | 0.80 | | |

**Connection/Shear Properties**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| αcs1 | 10.30 kN/m | IP-1 | 25.60 kN/m | αcs2 | 25.70 kN/m | IP-2 | 25.60 kN/m |
| αcs max | 25.70 kN/m | au | 75.20 kN/m | λu | 43.00 kN/m | Vu(max) | 163.20 kN/m |

# Section Geometry

## Section Drawing




## Markers

| No. | Station | Code | Note |
|---|---|---|---|
| 1 | 15.50 | O1 | Outside Corner |

## Section Extents

| Section | Top Elevation [m] | Base Elevation [m] | Left Side [m] | Right Side [m] | Bottom Grade Elevation [m] |
|---|---|---|---|---|---|
| 1 | 236.45 | 235.23 | 0.00 | 4.58 | 235.93 |
| 2 | 236.45 | 234.92 | 4.58 | 9.15 | 235.30 |
| 3 | 236.45 | 234.62 | 9.15 | 12.81 | 234.94 |
| 4 | 236.45 | 234.31 | 12.81 | 20.13 | 234.67 |
| 5 | 236.45 | 234.62 | 20.13 | 23.79 | 234.97 |
| 6 | 236.45 | 234.92 | 23.79 | 28.36 | 235.24 |
| 7 | 236.45 | 235.23 | 28.36 | 32.94 | 235.57 |

## Section Measurements

| Section | Height [m] | Design Height [m] | Width [m] | Face Area [m²] | Embedment [m] | Infill Volume [m³] |
|---|---|---|---|---|---|---|
| 1 | 1.22 | 1.22 | 4.58 | 5.6 | 0.70 | 5.3 |
| 2 | 1.53 | 1.53 | 4.57 | 7.0 | 0.37 | 6.9 |
| 3 | 1.83 | 1.83 | 3.66 | 6.7 | 0.32 | 6.8 |
| 4 | 2.14 | 2.14 | 7.32 | 15.6 | 0.35 | 19.4 |
| 5 | 1.83 | 1.83 | 3.66 | 6.7 | 0.35 | 7.0 |
| 6 | 1.53 | 1.53 | 4.57 | 7.0 | 0.31 | 7.3 |
| 7 | 1.22 | 1.22 | 4.57 | 5.6 | 0.34 | 5.8 |

## Section Slopes

| Section | Crest Slope [°] | Crest Offset [m] | Toe Slope [°] | Toe Offset [m] |
|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 0.00 | 0.00 | 0.00 | 0.00 |
| 4 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 |

| Section | Crest Slope [°] | Crest Offset [m] | Toe Slope [°] | Toe Offset [m] |
|---|---|---|---|---|
| 6 | 0.00 | 0.00 | 0.00 | 0.00 |
| 7 | 0.00 | 0.00 | 0.00 | 0.00 |

## Section Loads

| Section | Live Load [kN/m²] | Live Offset [m] | Dead Load [kN/m²] | Dead Offset [m] |
|---|---|---|---|---|
| 1 | 12.0 | 0.00 | 0.0 | 0.00 |
| 2 | 12.0 | 0.00 | 0.0 | 0.00 |
| 3 | 12.0 | 0.00 | 0.0 | 0.00 |
| 4 | 12.0 | 0.00 | 0.0 | 0.00 |
| 5 | 12.0 | 0.00 | 0.0 | 0.00 |
| 6 | 12.0 | 0.00 | 0.0 | 0.00 |
| 7 | 12.0 | 0.00 | 0.0 | 0.00 |

## Reinforcement Details

| Section | Course | Length [m] | Area [m²] | Reinforcement |
|---|---|---|---|---|
| 1 | 1 | 1.65 | 7.55 | SG200 - StrataGrid 200 |
| 2 | 2 | 1.65 | 7.55 | SG200 - StrataGrid 200 |
| | 1 | 1.65 | 7.55 | SG200 - StrataGrid 200 |
| 3 | 3 | 1.65 | 6.04 | SG200 - StrataGrid 200 |
| | 1 | 1.65 | 6.04 | SG200 - StrataGrid 200 |
| 4 | 4 | 1.85 | 13.54 | SG200 - StrataGrid 200 |
| | 3 | 1.85 | 13.54 | SG200 - StrataGrid 200 |
| | 1 | 1.85 | 13.54 | SG200 - StrataGrid 200 |
| 5 | 3 | 1.65 | 6.04 | SG200 - StrataGrid 200 |
| | 1 | 1.65 | 6.04 | SG200 - StrataGrid 200 |
| 6 | 2 | 1.65 | 7.55 | SG200 - StrataGrid 200 |
| | 1 | 1.65 | 7.55 | SG200 - StrataGrid 200 |
| 7 | 1 | 1.65 | 7.55 | SG200 - StrataGrid 200 |

# Project: George Bolton Parkway

**Site: Bolton,Ontario**

**Date: 2019-11-15**

**Wall: RETAINING WALL D (86.0m Long)**

# Risi Stone Inc

# Project Summary

## Geogroups

| Geogroup | Layer | Length (m) |
|---|---|---|
| **A** | All | 1.65 |
| **B** | All | 2.10 |
| **C** | All | 2.50 |
| **D** | All | 2.75 |
| **E** | All | 2.50 |

## Quantities

| | |
|---|---|
| **Wall Length** | 85.10 m |
| **Total Wall Area** | 241.4 m² |
| **Cap Area** | 26.0 m² |
| **Exposed Area (includes cap)** | 208.6 m² |
| **Embedded Area** | 32.8 m² |
| **Tallest Panel Height** | 3.66 m |
| **Longest reinforcement length** | 2.75 m |
| **Base soil volume** | 31.7 m³ |
| **Infill soil volume ‡** | 436.6 m³ |
| **Gravity Face Drain** | 0.0 m³ |

**Reinforcement**

| | |
|---|---|
| SG200 - StrataGrid 200 | 802.8 m² |

**Note †:** **Total Facing Unit quantity is based on using full-sized units only on bottom course and an even mix of defined facing sizes, as identified elsewhere in this report, on remaining courses of each Section. The use of corners, tapered or cut units is not reflected in this quantity.**

**Note ‡:** **Reinforced fill values are calculated based on the average geogrid length in each Section. They do not account for anything beyond the reinforced zone (end of the geogrids). Actual infill values may be significantly higher.**

**Note Δ:** **Drainage fill does not include the drainage stone within block. Core fill are calculated based on the percentage hollow core of the wall unit selected. If the percentage hollow core is not defined then the Core fill value within block will not be calculated.**

# Project Design Inputs

## Selected Facing Unit

| | | | |
|---|---|---|---|
| **Licensor/Product Line:** | Risi Stone Systems | | |
| **Name:** | Durahold | | |
| **Facing Height** | Hu | 0.31 m | |
| **Facing Width** | Lu | 1.83 m | |
| **Facing Depth** | Wu | 0.61 m | |
| **Facing Weight** | Xu | 23.0 kN/m³ | |
| **Center of Gravity** | Gu | 0.31 m | |
| **Setback** | Δu | 0.04 m | |
| **Batter** | ω | 7.12 ° | |
| **Cap Height** | Hcu | 0.31 m | |
| **Initial Shear Capacity** | au | 75.20 kN/m | |
| **Apparent Shear Angle** | λu | 43.00 ° | |
| **Maximum Shear Capacity** | Vu(max) | 163.20 kN/m | |

## Selected Reinforcement Types

### Reinforcements

**SG200 - StrataGrid 200** **Supplier: Strata Systems, Inc., Fill Type: 38mm- gravels or aggregate**

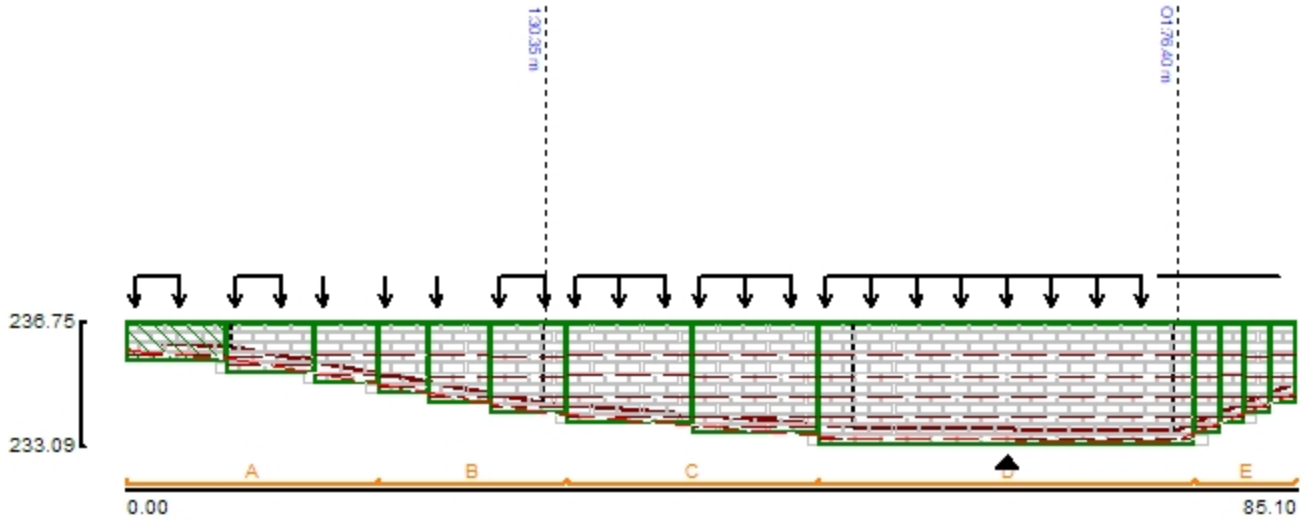
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Tult | 52.55 kN/m | RFcr | 1.55 | RFd | 1.10 | LTDS | 22.83 kN/m |
| RFid | 1.35 | Cds | 0.80 | Ci | 0.80 | | |

**Connection/Shear Properties**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| αcs1 | 10.30 kN/m | IP-1 | 25.60 kN/m | αcs2 | 25.70 kN/m | IP-2 | 25.60 kN/m |
| αcs max | 25.70 kN/m | au | 75.20 kN/m | λu | 43.00 kN/m | Vu(max) | 163.20 kN/m |

# Section Geometry

## Section Drawing




## Markers

| No. | Station | Code | Note |
|---|---|---|---|
| 1 | 30.35 | 1 | Section 1-1 |
| 2 | 76.40 | O1 | Outside Corner |

## Section Extents

| Section | Top Elevation [m] | Base Elevation [m] | Left Side [m] | Right Side [m] | Bottom Grade Elevation [m] |
|---|---|---|---|---|---|
| 1 | 236.75 | 235.53 | 0.00 | 7.32 | 235.88 |
| 2 | 236.75 | 235.22 | 7.32 | 13.72 | 235.56 |
| 3 | 236.75 | 234.92 | 13.72 | 18.30 | 235.24 |
| 4 | 236.75 | 234.61 | 18.30 | 21.96 | 234.99 |
| 5 | 236.75 | 234.31 | 21.96 | 26.53 | 234.67 |
| 6 | 236.75 | 234.00 | 26.53 | 32.02 | 234.34 |
| 7 | 236.75 | 233.70 | 32.02 | 41.17 | 234.04 |
| 8 | 236.75 | 233.39 | 41.17 | 50.32 | 233.73 |
| 9 | 236.75 | 233.09 | 50.32 | 77.78 | 233.55 |
| 10 | 236.75 | 233.39 | 77.78 | 79.61 | 233.81 |
| 11 | 236.75 | 233.70 | 79.61 | 81.44 | 234.10 |
| 12 | 236.75 | 234.00 | 81.44 | 83.27 | 234.39 |
| 13 | 236.75 | 234.31 | 83.27 | 85.10 | 234.68 |

## Section Measurements

| Section | Height [m] | Design Height [m] | Width [m] | Face Area [m²] | Embedment [m] | Infill Volume [m³] |
|---|---|---|---|---|---|---|
| 1 | 1.22 | 1.22 | 7.32 | 8.9 | 0.35 | 9.3 |
| 2 | 1.53 | 1.53 | 6.40 | 9.8 | 0.34 | 10.1 |
| 3 | 1.83 | 1.83 | 4.57 | 8.4 | 0.32 | 8.6 |
| 4 | 2.14 | 2.14 | 3.66 | 7.8 | 0.37 | 11.4 |
| 5 | 2.44 | 2.44 | 4.57 | 11.2 | 0.36 | 16.2 |
| 6 | 2.75 | 2.75 | 5.49 | 15.1 | 0.34 | 21.8 |
| 7 | 3.05 | 3.05 | 9.15 | 27.9 | 0.34 | 51.4 |
| 8 | 3.36 | 3.36 | 9.15 | 30.7 | 0.34 | 57.1 |
| 9 | 3.66 | 3.66 | 27.45 | 100.5 | 0.46 | 212.1 |
| 10 | 3.36 | 3.36 | 1.83 | 6.1 | 0.42 | 11.3 |

**NOTE: THESE CALCULATIONS, QUANTITIES, AND LAYOUTS ARE FOR PRELIMINARY DESIGN ONLY AND SHOULD NOT BE USED FOR CONSTRUCTION WITHOUT REVIEW BY A QUALIFIED ENGINEER**

| Section | Height [m] | Design Height [m] | Width [m] | Face Area [m²] | Embedment [m] | Infill Volume [m³] |
|---|---|---|---|---|---|---|
| 11 | 3.05 | 3.05 | 1.83 | 5.6 | 0.40 | 10.2 |
| 12 | 2.75 | 2.75 | 1.83 | 5.0 | 0.39 | 9.1 |
| 13 | 2.44 | 2.44 | 1.83 | 4.5 | 0.37 | 8.1 |

## Section Slopes

| Section | Crest Slope [°] | Crest Offset [m] | Toe Slope [°] | Toe Offset [m] |
|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 0.00 | 0.00 |
| 2 | 0.00 | 0.00 | 0.00 | 0.00 |
| 3 | 0.00 | 0.00 | 0.00 | 0.00 |
| 4 | 0.00 | 0.00 | 0.00 | 0.00 |
| 5 | 0.00 | 0.00 | 0.00 | 0.00 |
| 6 | 0.00 | 0.00 | 0.00 | 0.00 |
| 7 | 0.00 | 0.00 | 0.00 | 0.00 |
| 8 | 0.00 | 0.00 | 0.00 | 0.00 |
| 9 | 0.00 | 0.00 | 0.00 | 0.00 |
| 10 | 0.00 | 0.00 | 0.00 | 0.00 |
| 11 | 0.00 | 0.00 | 0.00 | 0.00 |
| 12 | 0.00 | 0.00 | 0.00 | 0.00 |
| 13 | 0.00 | 0.00 | 0.00 | 0.00 |

## Section Loads

| Section | Live Load [kN/m²] | Live Offset [m] | Dead Load [kN/m²] | Dead Offset [m] |
|---|---|---|---|---|
| 1 | 12.0 | 0.00 | 0.0 | 0.00 |
| 2 | 12.0 | 0.00 | 0.0 | 0.00 |
| 3 | 12.0 | 0.00 | 0.0 | 0.00 |
| 4 | 12.0 | 0.00 | 0.0 | 0.00 |
| 5 | 12.0 | 0.00 | 0.0 | 0.00 |
| 6 | 12.0 | 0.00 | 0.0 | 0.00 |
| 7 | 12.0 | 0.00 | 0.0 | 0.00 |
| 8 | 12.0 | 0.00 | 0.0 | 0.00 |
| 9 | 12.0 | 0.00 | 0.0 | 0.00 |
| 10 | 12.0 | 0.00 | 0.0 | 0.00 |
| 11 | 12.0 | 0.00 | 0.0 | 0.00 |
| 12 | 12.0 | 0.00 | 0.0 | 0.00 |
| 13 | 12.0 | 0.00 | 0.0 | 0.00 |

## Reinforcement Details

| Section | Course | Length [m] | Area [m²] | Reinforcement |
|---|---|---|---|---|
| 1 | 1 | 1.65 | 12.08 | SG200 - StrataGrid 200 |
| 2 | 2 | 1.65 | 10.57 | SG200 - StrataGrid 200 |
| | 1 | 1.65 | 10.57 | SG200 - StrataGrid 200 |
| 3 | 3 | 1.65 | 7.55 | SG200 - StrataGrid 200 |
| | 1 | 1.65 | 7.55 | SG200 - StrataGrid 200 |
| 4 | 4 | 2.10 | 7.69 | SG200 - StrataGrid 200 |
| | 2 | 2.10 | 7.69 | SG200 - StrataGrid 200 |
| | 1 | 2.10 | 7.69 | SG200 - StrataGrid 200 |
| 5 | 5 | 2.10 | 9.61 | SG200 - StrataGrid 200 |
| | 3 | 2.10 | 9.61 | SG200 - StrataGrid 200 |
| | 1 | 2.10 | 9.61 | SG200 - StrataGrid 200 |
| 6 | 6 | 2.10 | 11.53 | SG200 - StrataGrid 200 |
| | 4 | 2.10 | 11.53 | SG200 - StrataGrid 200 |
| | 2 | 2.10 | 11.53 | SG200 - StrataGrid 200 |
| | 1 | 2.10 | 11.53 | SG200 - StrataGrid 200 |
| 7 | 7 | 2.50 | 22.87 | SG200 - StrataGrid 200 |
| | 5 | 2.50 | 22.87 | SG200 - StrataGrid 200 |
| | 3 | 2.50 | 22.87 | SG200 - StrataGrid 200 |

| Section | Course | Length [m] | Area [m²] | Reinforcement |
|---|---|---|---|---|
| | 1 | 2.50 | 22.87 | SG200 - StrataGrid 200 |
| 8 | 8 | 2.50 | 22.87 | SG200 - StrataGrid 200 |
| | 6 | 2.50 | 22.87 | SG200 - StrataGrid 200 |
| | 4 | 2.50 | 22.87 | SG200 - StrataGrid 200 |
| | 2 | 2.50 | 22.87 | SG200 - StrataGrid 200 |
| | 1 | 2.50 | 22.87 | SG200 - StrataGrid 200 |
| 9 | 9 | 2.75 | 75.49 | SG200 - StrataGrid 200 |
| | 7 | 2.75 | 75.49 | SG200 - StrataGrid 200 |
| | 5 | 2.75 | 75.49 | SG200 - StrataGrid 200 |
| | 3 | 2.75 | 75.49 | SG200 - StrataGrid 200 |
| | 1 | 2.75 | 75.49 | SG200 - StrataGrid 200 |
| 10 | 8 | 2.50 | 4.57 | SG200 - StrataGrid 200 |
| | 6 | 2.50 | 4.57 | SG200 - StrataGrid 200 |
| | 4 | 2.50 | 4.57 | SG200 - StrataGrid 200 |
| | 2 | 2.50 | 4.57 | SG200 - StrataGrid 200 |
| | 1 | 2.50 | 4.57 | SG200 - StrataGrid 200 |
| 11 | 7 | 2.50 | 4.57 | SG200 - StrataGrid 200 |
| | 5 | 2.50 | 4.57 | SG200 - StrataGrid 200 |
| | 3 | 2.50 | 4.57 | SG200 - StrataGrid 200 |
| | 1 | 2.50 | 4.57 | SG200 - StrataGrid 200 |
| 12 | 6 | 2.50 | 4.57 | SG200 - StrataGrid 200 |
| | 4 | 2.50 | 4.57 | SG200 - StrataGrid 200 |
| | 2 | 2.50 | 4.57 | SG200 - StrataGrid 200 |
| | 1 | 2.50 | 4.57 | SG200 - StrataGrid 200 |
| 13 | 5 | 2.50 | 4.57 | SG200 - StrataGrid 200 |
| | 3 | 2.50 | 4.57 | SG200 - StrataGrid 200 |
| | 1 | 2.50 | 4.57 | SG200 - StrataGrid 200 |

# Project: George Bolton Parkway

**Site: Bolton,Ontario**

**Date: 2019-11-15**

**Wall: RETAINING WALL E (35.0m Long) JUST NEAR WALL D bw call outs not provided**

# Risi Stone Inc

# Project Summary

## Quantities

| | |
|---|---|
| **Wall Length** | 35.68 m |
| **Total Wall Area** | 32.7 m² |
| **Cap Area** | 10.9 m² |
| **Exposed Area (includes cap)** | 12.4 m² |
| **Embedded Area** | 20.2 m² |
| **Tallest Panel Height** | 0.92 m |
| **Longest reinforcement length** | 1.65 m |
| **Base soil volume** | 13.3 m³ |
| **Infill soil volume ‡** | 30.0 m³ |
| **Gravity Face Drain** | 0.0 m³ |

**Reinforcement**

| | |
|---|---|
| SG200 - StrataGrid 200 | 58.9 m² |

**Note †:** **Total Facing Unit quantity is based on using full-sized units only on bottom course and an even mix of defined facing sizes, as identified elsewhere in this report, on remaining courses of each Section. The use of corners, tapered or cut units is not reflected in this quantity.**

**Note ‡:** **Reinforced fill values are calculated based on the average geogrid length in each Section. They do not account for anything beyond the reinforced zone (end of the geogrids). Actual infill values may be significantly higher.**

**Note Δ:** **Drainage fill does not include the drainage stone within block. Core fill are calculated based on the percentage hollow core of the wall unit selected. If the percentage hollow core is not defined then the Core fill value within block will not be calculated.**

# Project Design Inputs

## Selected Facing Unit

| | | | |
|---|---|---|---|
| **Licensor/Product Line:** | Risi Stone Systems | | |
| **Name:** | Durahold | | |
| **Facing Height** | Hu | 0.31 m | |
| **Facing Width** | Lu | 1.83 m | |
| **Facing Depth** | Wu | 0.61 m | |
| **Facing Weight** | Xu | 23.0 kN/m³ | |
| **Center of Gravity** | Gu | 0.31 m | |
| **Setback** | Δu | 0.04 m | |
| **Batter** | ω | 7.12 ° | |
| **Cap Height** | Hcu | 0.31 m | |
| **Initial Shear Capacity** | au | 75.20 kN/m | |
| **Apparent Shear Angle** | λu | 43.00 ° | |
| **Maximum Shear Capacity** | Vu(max) | 163.20 kN/m | |

## Selected Reinforcement Types

### Reinforcements

**SG200 - StrataGrid 200** **Supplier: Strata Systems, Inc., Fill Type: 38mm- gravels or aggregate**

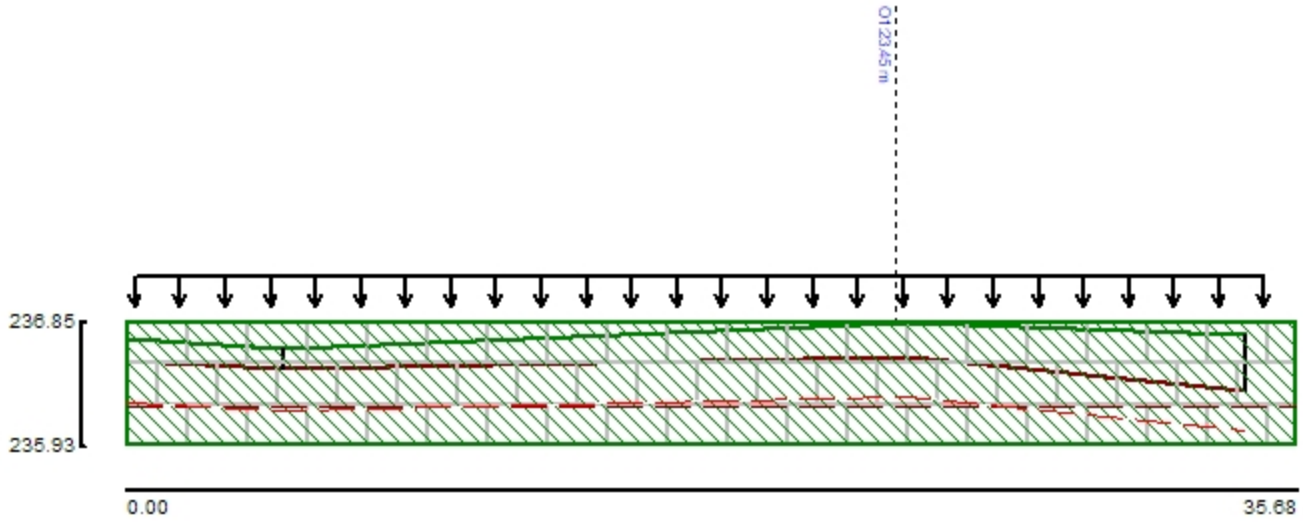
| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Tult | 52.55 kN/m | RFcr | 1.55 | RFd | 1.10 | LTDS | 22.83 kN/m |
| RFid | 1.35 | Cds | 0.80 | Ci | 0.80 | | |

**Connection/Shear Properties**

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| αcs1 | 10.30 kN/m | IP-1 | 25.60 kN/m | αcs2 | 25.70 kN/m | IP-2 | 25.60 kN/m |
| αcs max | 25.70 kN/m | au | 75.20 kN/m | λu | 43.00 kN/m | Vu(max) | 163.20 kN/m |

# Section Geometry

## Section Drawing




## Markers

| No. | Station | Code | Note |
|---|---|---|---|
| 1 | 23.45 | O1 | Outside Corner |

## Section Extents

| Section | Top Elevation [m] | Base Elevation [m] | Left Side [m] | Right Side [m] | Bottom Grade Elevation [m] |
|---|---|---|---|---|---|
| 1 | 236.85 | 235.93 | 0.00 | 35.68 | 236.50 |

## Section Measurements

| Section | Height [m] | Design Height [m] | Width [m] | Face Area [m²] | Embedment [m] | Infill Volume [m³] |
|---|---|---|---|---|---|---|
| 1 | 0.92 | 0.92 | 35.68 | 32.7 | 0.57 | 30.0 |

## Section Slopes

| Section | Crest Slope [°] | Crest Offset [m] | Toe Slope [°] | Toe Offset [m] |
|---|---|---|---|---|
| 1 | 0.00 | 0.00 | 0.00 | 0.00 |

## Section Loads

| Section | Live Load [kN/m²] | Live Offset [m] | Dead Load [kN/m²] | Dead Offset [m] |
|---|---|---|---|---|
| 1 | 12.0 | 0.00 | 0.0 | 0.00 |

## Reinforcement Details

| Section | Course | Length [m] | Area [m²] | Reinforcement |
|---|---|---|---|---|
| 1 | 1 | 1.65 | 58.88 | SG200 - StrataGrid 200 |

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retaining wall systems

# Construction Review & Inspection Guidelines

# Inspection Checklist

(To be Used in Conjunction with Project Design, Specifications, and Sound Engineering Judgement)

| Steps | Inspection Items | Remarks |
|---|---|---|
| **Survey** | ☐ All stake locations and elevations in agreement with design. | |
| **Excavation** | ☐ All utilities, structures, etc. are located prior to excavation and approval granted from governing bodies. | |
| | ☐ Excavation requirements are met or exceeded to allow for construction of wall, including required wall embedment and base depth. | |
| | ☐ The exposed retained and foundation soil conditions meet or exceed design requirements (internal friction angle, soil type, and unit weight). | |
| | ☐ All excavations conducted in accordance with regulatory requirements In areas where safe excavations are not possible due to property line constraints/other structures, etc., temporary shoring may be required. | |
| | ☐ Presence of existing or proposed structures relative to the wall noted and designer is notified if these lie within impact zone of wall. | |
| | ☐ If water encountered, proper dewatering techniques used to ensure dry base construction. | |
| **Foundation Preparation** | ☐ The foundation soil (sub-grade) meets minimum allowable bearing capacity stated in the design. | |
| | ☐ Unsuitable soil removed and replaced under direction of Site Geotechnical Engineer. For geogrid reinforced structures, replacement of unsuitable material must include entire footprint of wall (facing AND geogrid reinforced zone). Replacement material must extend at 1H:1V from front and back of footprint to suitable founding depth. | |
| | ☐ Engineered fill material compacted to 95% SPD or as specified in the design. | |
| **Base Preparation** | ☐ Base material is as specified in the design (well-graded angular gravel). | |
| | ☐ Compaction density not less than 98% SPD. | |
| | ☐ Base dimensions are as specified in the design. | |
| | ☐ The surface is level front to back and side to side. A 50mm (2in) unreinforced concrete leveling pad may be placed on top of the gravel base. | |
| | ☐ Base stepping as per design to ensure minimum required embedment is maintained at all times. | |

## Risi Stone Segmental Wall Units

- ☐ The SRW system as per design. Units meet dimensional tolerances outlined in the specification – random check combined with contractor input.
- ☐ Necessary corners, tapered units, coping, etc. on site to meet the alignment requirements.
- ☐ Wall construction should start from lowest vertical location and step up as required.
- ☐ First course of units in full contact with the base material.
- ☐ Units leveled side to side and front to back.
- ☐ All debris to be cleaned off the top of the units before installing the subsequent course.
- ☐ The side of a unit should fall above the middle 1/3 of the SRW unit on the course below.
- ☐ The level and alignment of the units, especially at curves, corners, as per design.
- ☐ Install no more than 3 courses before backfilling behind the wall.
- ☐ Check the alignment at least once in 3 courses. Horizontal and vertical alignment must be checked early on and meet the minimum allowable tolerances outlined in the specification

## Backfill Materials

- ☐ The backfill material meets the design requirements (specified gradation/material properties).
- ☐ Maximum compaction lift thickness is 6in–12in (150mm–300mm).
- ☐ Compaction density not less than 95% SPD.
- ☐ No heavy equipment within 1m (3ft) of the back of the wall (hand-operated compaction equipment only).
- ☐ Backfill placed near face of wall and raked towards rear of reinforced zone.

## Drainage Materials/ Conduits

- ☐ The size and type of drainage pipes as per design.
- ☐ The width of drainage fill at the wall back not less than 12in (300mm). In cases where the reinforced zone is composed of free-draining gravel material, a separate drainage layer is not usually required (see design).
- ☐ The drainage pipe elevation meets design.
- ☐ The longitudinal grading of the pipe not less than 2%.
- ☐ Outlet spacing as per design drawing (or connection to approved storm sewer or other open outlet).
- ☐ Openings in facing filled to prevent washout of backfill (including drainage outlets).
- ☐ The type of filter fabric as per design.
- ☐ Filter fabric is pulled taut and placed as per design drawing (where required).

## Geogrid Type/ Installation

- ☐ The geogrid type and strength as per specification requirement.
- ☐ Geogrid placed with strongest direction perpendicular to wall face and installed/handled in accordance with manufacturer's specifications.
- ☐ The length and elevation of each geogrid layer as per design.
- ☐ The compacted fill materials at geogrid placement elevations to be level with the top of the units.
- ☐ The geogrid offset from the unit face not more than 1in (25mm).
- ☐ Adjacent geogrid pieces are placed immediately next to each other with no overlap.
- ☐ Geogrid to be tensioned while fill is placed on top.
- ☐ No tracked equipment driven directly on the laid geogrid.
- ☐ Geogrid placement at curves and corners as per design details.
- ☐ Backfill materials placed (dumped) near wall face and spread away from wall to ensure tension in geogrid. Geogrid must be fully tensioned before backfilling or wall will creep out until tension is achieved.

## Coping Units

- ☐ The debris at the top of the units to be cleaned off.
- ☐ The adhesive is as per specification requirement.
- ☐ Apply adhesive on dry and clean unit surface.

## Cap Soil

- ☐ The material is as per specification requirement.
- ☐ Final grading to prevent water from collecting behind wall (i.e. proper swale/use of impervious clay layer or asphalt).
- ☐ Clean up the site to finish the construction.

## Handrails/ Fences/ etc.

- ☐ All other elements to be incorporated as per design.
- ☐ Contractors installing other non-wall related structures that impact the wall (e.g. placement of asphalt behind the wall) must be notified of potential impacts and limitations of wall prior to commencing work.

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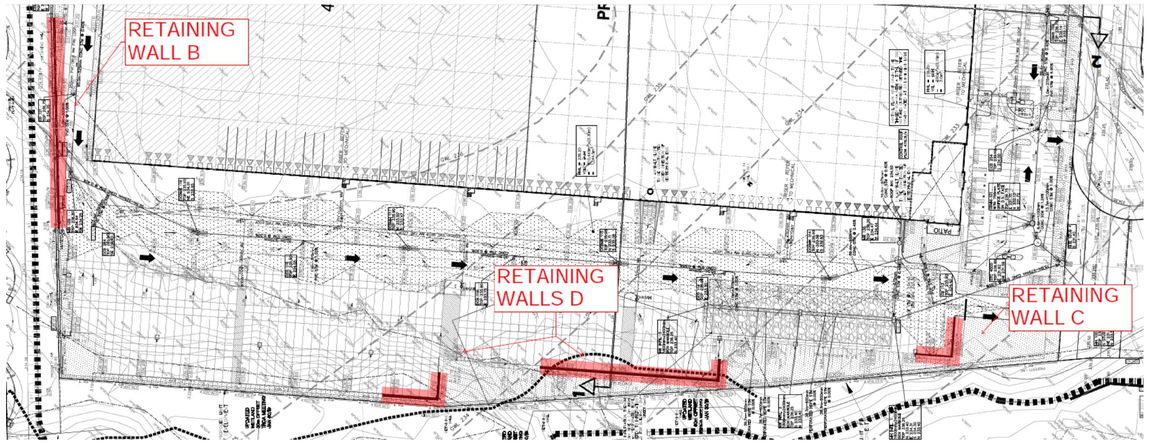
# Design Drawings

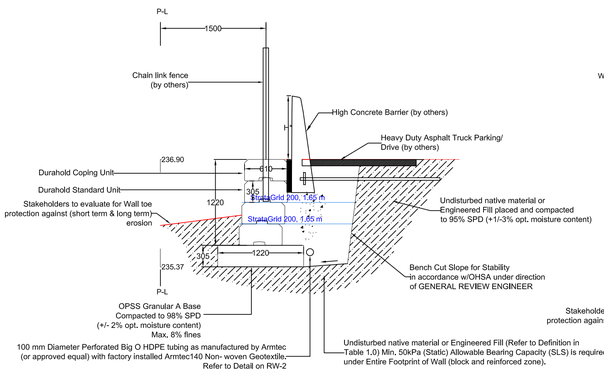
FOR GRADE CALL OUTS PLEASE REFER TO G-2 GRADE PLAN DRAWING DATED SEPT 5 2019 BY AM CANDARS ASSOCIATES INC TO GO ALONG WITH CIVIL & LANDSCAPE PACKAGE PREPARED (BY OTHERS)

TYP. MAX. HEIGHT SECTION
1:40

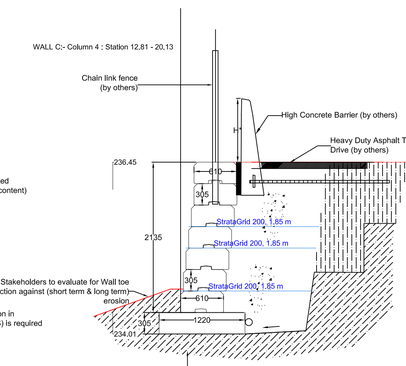
## WALL KEY PLAN (NTS) REFER GRADE PLAN PREPARED BY OTHERS



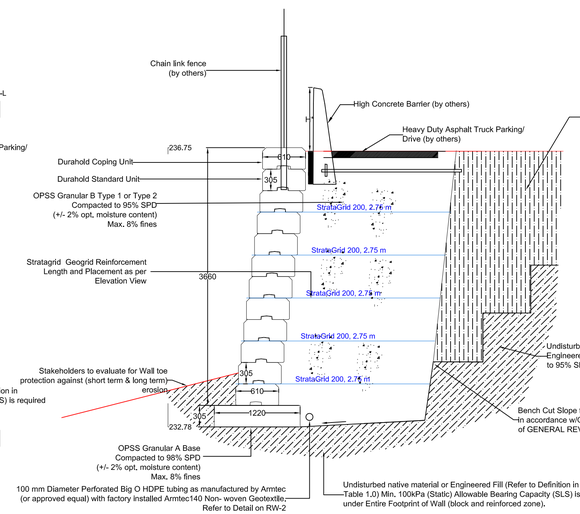

WALL B:- Column 3 : Station 17.38 - 53.07



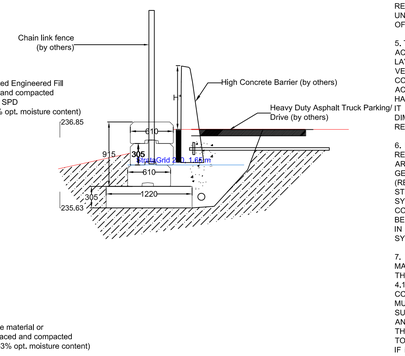

WALL C:- Column 4 : Station 12.81 - 20.13




WALL D:- Column 9 : Station 50.32 - 77.78




WALL E:- Column 1 : Station 0.00 - 35.68




## GENERAL NOTES

1. THE INFORMATION PROVIDED ON THIS SHEET MUST BE USED IN CONJUNCTION WITH THE ATTACHED SPECIFICATIONS.

2. THIS DESIGN IS BASED ON INFORMATION PROVIDED IN SITE GRADING PLAN DRAWING G-2 DATED AUG 08 2019 BY A M CANDARAS & ASSOCIATES INC, WOODBRIDGE,ON . THESE WALL DESIGN DRAWINGS ARE NOT INTENDED TO BE "STAND ALONE" DRAWINGS, THE WALL CONTRACTOR AND GENERAL CONTRACTOR ARE REQUIRED TO HAVE A COMPLETE UNDERSTANDING OF ANY AND ALL OTHER STRUCTURES THAT MAY INTERACT WITH THIS SEGMENTAL RETAINING WALL. THE WALL CONTRACTOR AND GENERAL CONTRACTOR MUST REFER TO A FULL SET OF CIVIL, STRUCTURAL AND ARCHITECTURAL DRAWINGS (AS APPLICABLE) FOR THE PROJECT TO ENSURE SUCCESSFUL CONSTRUCTION AND PERFORMANCE OF THE WALL SYSTEM. THIS WALL DESIGN DRAWING SHOULD NOT BE REFERRED TO FOR MANHOLE LOCATIONS, ELEVATIONS, OR ANY OTHER CIVIL OR SITE INFRASTRUCTURE INFORMATION BECAUSE DATA MAY HAVE BEEN SELECTIVELY REMOVED FROM THIS DRAWING FOR CLARITY OF WALL ILLUSTRATION.

3. DESIGN ASSUMPTIONS:
THE SRW DESIGN ASSUMES THE FOLLOWING,
A) THE FOUNDATION SOILS WILL PRODUCE ACCEPTABLE TOTAL AND DIFFERENTIAL SETTLEMENT GIVEN THE APPLIED LOAD OF THE SRW (MAX. 25 mm TOTAL OR DIFFERENTIAL SETTLEMENT AS VERIFIED BY GRE),
B)THE MAXIMUM GROUNDWATER ELEVATION IS BELOW THE BASE OF THE SRW,
C)THERE WILL BE NO HYDROSTATIC PRESSURE WITHIN OR BEHIND THE SRW,
D) THE SURROUNDING STRUCTURES WILL NOT EXERT ANY ADDITIONAL LOADING ON THE SRW (I.E, AN ADJACENT STRUCTURAL FOUNDATION IS AT OR BELOW PROPOSED LEVELING BASE OR OUTSIDE OF A THEORETICAL ZONE OF INFLUENCE AS DETERMINED BY THE GENERAL REVIEW ENGINEER),
E) THERE ARE NO STRUCTURES (UTILITIES SUCH AS GAS/WATER MAINS, STORM SEWERS, ELECTRICAL/COMMUNICATIONS CABLES, ETC) TO BE PLACED WITHIN OR BELOW THE REINFORCED FILL DURING OR AFTER CONSTRUCTION.

4. AT THIS STAGE IN THE DESIGN, RISI STONE SYSTEMS HAS BEEN PROVIDED WITH THE SITE GEOTECHNICAL REPORT BY EXP, BRAMPTON,ON(REPORT NO, BRM-00603520-C0). THIS REPORT PROVIDES GENERAL SITE GEOTECHNICAL INFORMATION, DUE TO THE SPORADIC NATURE OF BOREHOLE LOCATIONS THROUGHOUT THE SITE, THE INFORMATION PROVIDED MAY NOT ACCURATELY REPRESENT THE SPECIFIC LOCATION OF THE PROPOSED WALL(S) ALONG THE ENTIRE LENGTH OF THE STRUCTURE. FOR DESIGN PURPOSES, WE HAVE ASSUMED A SET OF GEOTECHNICAL PARAMETERS BASED ON THE TYPES OF SOILS INDICATED IN THE REPORT. UPON EXCAVATION OR FURTHER EXPLORATION IN THE WALL LOCATION(S), THESE DESIGN PARAMETERS MUST BE VERIFIED AS BEING ACCEPTABLE BY THE GENERAL REVIEW ENGINEER (REFER TO NOTE 6) OR REVISED PARAMETERS MUST BE PROVIDED FOR A REDESIGN. PRIOR TO BIDDING, THE CONTRACTOR MUST SATISFY THEMSELVES BASED ON INFORMATION AVAILABLE AND/OR THEIR OWN INVESTIGATION OF THE GEOTECHNICAL CONDITIONS. THE CONTRACTOR IS SOLELY RESPONSIBLE FOR ANY ASSUMPTIONS MADE DURING THE BIDDING PROCESS REGARDING SITE CONDITIONS. BOTH THE CONTRACTOR AND THE PRIME CONSULTANT MUST BE ADVISED THAT THE DESIGN MAY HAVE TO BE ALTERED BASED ON ACTUAL CONDITIONS FOUND ON SITE. ALTERATION OF THE DESIGN MAY RESULT IN ADDITIONAL CONSTRUCTION COSTS AND PROJECT DELAYS. IT IS RECOMMENDED THAT CONTINGENCIES BE ADDRESSED IN THE CONTRACT TO UNDERTAKE THE WALL CONSTRUCTION FOR DEALING WITH THE DISCOVERY OF UNFAVORABLE SOIL CONDITIONS.

5. THIS DESIGN MUST BE CHECKED WITH THE FINAL GRADING PLAN TO VERIFY ACCURACY. IT IS THE CONTRACTOR'S RESPONSIBILITY TO ENSURE THE WALL LAYOUT(S) PROVIDED MATCH THE FINAL SITE GRADING. CONTRACTOR MUST VERIFY ALL DIMENSIONS AND ELEVATIONS PRIOR TO BIDDING / CONSTRUCTION. RISI STONE SYSTEMS MAKES EVERY EFFORT TO ENSURE ACCURACY OF THE DESIGN, HOWEVER, AS INFORMATION PROVIDED MAY HAVE BEEN UNKNOWINGLY OUT OF DATE, UNCLEAR IN AREAS, OR INCORRECT, IT IS ULTIMATELY THE CONTRACTOR'S RESPONSIBILITY TO VERIFY THE DIMENSIONS AND ELEVATIONS (QUANTITIES) OF THE WALL(S) WITH THE MOST RECENT GRADING PLAN AND ACTUAL SITE CONDITIONS.

6. DIV.C - PART 1, SECTION 1,2,2 OF THE ONTARIO BUILDING CODE 2012 REQUIRES THAT THE CONSTRUCTION OF EVERY BUILDING DESIGNED BY AN ARCHITECT AND/OR PROFESSIONAL ENGINEER IS TO BE REVIEWED FOR GENERAL CONFORMITY TO THE APPROVED DESIGN BY PROFESSIONALS (RETAINING WALLS FALL UNDER THE CATEGORY OF DESIGNATED STRUCTURES AND THEREFORE INCLUDED UNDER THE OBC). RISI STONE SYSTEMS AND/OR THEIR LICENSEE DOES NOT PROVIDE THIS SERVICE. THE CONTRACTOR MUST ENSURE THAT A THIRD THIRD PARTY ENGINEER HAS BEEN RETAINED TO PROVIDE GENERAL REVIEW OF THE WALL CONSTRUCTION IN ACCORDANCE WITH PART 3 EXECUTION SUB SECTION 3.03 OF RISISTONE SYSTEMS STANDARD SPECIFICATIONS.

7. THE DESIGN IS IN ACCORDANCE WITH THE NATIONAL CONCRETE AND MASONRY ASSOCIATION DESIGN MANUAL FOR SEGMENTAL RETAINING WALL, THIRD EDITION AND COMPLIES WITH PART 4 STRUCTURAL DESIGN SECTION 4.1.1.4 OF THE ONTARIO BUILDING CODE 2012. SEISMIC ANALYSIS HAS BEEN CONDUCTED AND ASSUMES A PGA OF 0.13 APPROPRIATE SEISMIC SITE CLASS MUST BE VERIFIED BY GENERAL REVIEW ENGINEER UPON INSPECTION OF SUBGRADE (AS DETAILED ON SECTION). ANALYSIS OF OVERALL GLOBAL AND/OR COMPOUND STABILITY HAS NOT BEEN CONDUCTED. IT IS REQUIRED THAT THE PROJECT GEOTECHNICAL ENGINEER BE RETAINED BY THE OWNER TO ASSESS THE NEED FOR A GLOBAL STABILITY ANALYSIS AND PROVIDE THIS, IF NECESSARY. RISI STONE SYSTEMS CAN WORK WITH THE GEOTECHNICAL ENGINEER TO PROVIDE DETAILS OF THE WALL DESIGN TO BE INCORPORATED INTO THE GLOBAL STABILITY ANALYSIS.

8. THE LOCATION OF EXISTING OR PROPOSED UTILITIES MUST BE VERIFIED PRIOR TO CONSTRUCTION, GENERALLY IT IS RECOMMENDED THAT UTILITIES BE OFFSET FROM THE WALL TO A) PREVENT ADDITIONAL LOADING ON THE CONDUIT (I.E, A 1H:1V LINE OF INFLUENCE FROM THE BASE OF THE WALL SHOULD BE ASSUMED) UNLESS ACCOUNTED FOR IN DESIGN OF THE UTILITY B) TO ENSURE FUTURE ACCESS TO THE UTILITY WITHOUT UNDERMINING THE WALL. THE ENGINEERED FILL ABOVE THESE UTILITIES MUST BE COMPACTED TO 98% SPD. THE CIVIL ENGINEER MUST REVIEW THE DESIGN TO VERIFY THE ABOVE (REFER TO NOTE 9 AND SPECIFICATION FOR FURTHER DETAILS).

9. THE RETAINING WALL DRAWINGS AND SPECIFICATIONS MUST BE REVIEWED BY THE CIVIL ENGINEER, LANDSCAPE ARCHITECT/ARCHITECT, AND GENERAL REVIEW ENGINEER PRIOR TO THE GENERAL REVIEW ENGINEER AUTHORIZING THE DRAWINGS TO BE USED FOR CONSTRUCTION IN ACCORDANCE WITH SECTION 3.02, SEGMENTAL RETAINING WALL DESIGN REVIEW, OF THE SPECIFICATIONS.

10 . WHEN ASSESSING SUBGRADE BEARING CAPACITY, THE GENERAL REVIEW ENGINEER MUST ACCOUNT FOR THE MAXIMUM ANTICIPATED GROUNDWATER ELEVATION AS PER LOCAL CODE REQUIREMENTS.

## TABLE 1.0 - SOIL ZONES AND ASSUMED PROPERTIES

MUST BE VERIFIED BY GENERAL REVIEW ENGINEER - REFER TO SECTION 3.03 OF SPECIFICATION

| Soil Region | Reinforced Fill | Retained Fill/Soil** | Foundation Soil** | Base | Drainage Fill (as req. - ref to section) |
|---|---|---|---|---|---|
| Description (by USCS) | GW | ML-CL | ML-CL | GW | GP |
| | Well graded gravel Max. 8% fines | Lean Silty Clay Low Plasticity | Lean Silty Clay Low Plasticity | Well graded gravel Max. 8% fines | Gap graded, rapid draining gravel |
| Effective Internal Friction Angle (Deg.) | 35* | 28* | 28* | 39* | NA |
| Compaction Requirement (Eng. Fills Only) | 95% SPD (+/- 2% opt. moist.) | 95% SPD (+1/-3% opt. moist.) | 98% SPD (+1/-3% opt. moist.) | 98% SPD (+/- 2% opt. moist.) | Dense State |
| Moist Unit Weight (kN/cu.m) | 22 | 20 | 20 | 22 | 18 |
| Effective Cohesion (kPa) | NA | NA | NA | NA | NA |
| Soil Notes | Max. 150-200mm Compaction Lifts | Max. 150-200mm Compaction Lifts | See Section for req. ALLOW Bearing Capacites | Max. 150-200mm Compaction Lifts | Max. 150-200mm Compaction Lifts |
| Geotextile at Interface | Interface: Reinforced/Retained Geotextile Not Req. If gradations listed below are met, Otherwise : TBD | | NA | NA | NA |
| Assumed Gradation for Filtration Req.* | **D(15) <0.3mm D(50) <1.18mm MAX 8% FINES** | **D(85) >0.075mm D(15) >0.002mm D(50)>0.05mm** | NA | NA | NA |

* If the above gradation requirements are not met, an alternative filter fabric will be required. Contact RSS to discuss alternatives.

** Engineered Fill is defined as Clean earth fill placed and compacted in maximum lift thicknesses of 150mm to at least 98 percent Standard Proctor Density for Foundation Soils and 95 percent Standard Proctor Density for Retained Soils, under the full-time inspection and testing of a geotechnical engineering firm who provides written confirmation and certification of the completed Engineered Fill.

## TABLE 2.0 - DESIGN INFORMATION

| | | | |
|---|---|---|---|
| Retaining Wall System | Durahold Manufactured by Unilock | Geogrid Type | Stratagrid 200 |
| Max. Slope Above Wall | None | Min. Geogrid LTDS (kN / m) | 22 |
| Max. Surcharge Above Wall (kPa) | 12 GRE to verify | Max. Slope Below Wall | refer section |
| Batter of Wall (Degrees) | 7.12 | Depth of Embedment (mm) | See Elevation |
| Maximum Height (mm) | refer section | Compacted Base Dimensions (mm height x mm width) | 305 x "refer section" |

## TABLE 3.0 - DRAINAGE PROVISIONS

| Potential Water Source | Drainage Measures (To be Verified by General Review Engineer) | Add. Notes |
|---|---|---|
| **Surface Infiltration** Above Reinforced Zone and beyond. Rainfall, normal snow melt, run-off, etc. If irrigation systems are used immediately above the reinforced zone of the wall, additional measures will be required in case of leakage/failure of the system.<br><br>Contractor must verify that area above wall is not used for storage of snow during winter months. Drainage system and assumed loading conditions do not account for this use. | Grade behind must direct water away from back of wall. If slope toward wall exists, swale system must be implemented to carry water at min. 2% grade to positive drainage area. Dimensions of swale will be based on anticipated water collection requirements as specified by the Civil Engineer as part of the overall site drainage plan. The swale system must be constructed with a low permeability layer (100-150mm) of engineered fill material compacted to 95% SPD to act as a conduit for the surface water and prevent infiltration behind the wall facing and into the reinforced zone. | **Other structures and paved surfaces adjacent to Wall.** Other structures adjacent to the retaining wall must have independent drainage systems. For example, pavements must have independent collection systems (perimeter drains) to collect water that penetrates cracks in the surface, etc. Building downspouts must not direct water towards the walls and must be connected to independent outlets. |
| **Lateral Underground.** Design assumes that groundwater is below bottom of wall. The following drainage measures address other potential sources of lateral groundwater that may be the results of infiltration through the surface (i.e, cracks in asphalt beyond the reinforced zone) or other below grade sources. | The reinforced zone of the wall is specified as a well graded gravel with a maximum of 8% fines with a collection pipe at the bottom. The retained zone (up stream source of potential water) is assumed to be of a lower permeability as compared to the imported infill. The reinforced zone is therefore assumed to allow for the drainage of potential water seepage as discussed in Column 1. The perforated collection pipe (Min. 100mm dia. at 2% grade) must be connected to a positive outlet as determined by the Civil Engineer prior to construction.<br><br>NOTE: These drainage measures are provided as an extra precaution against the possibility of an unknown water source that may or may not occur at some point during the life of the structure. If, upon excavation, a specific water source is identified (perched water condition, sand seams, etc) in the cut or is anticipated, additional drainage measures will be required (i.e. chimney drains). | **Water Management Durlng Construction.** At all times the contractor must ensure measures such as temporary swales and drainage ditches are employed to manage surface water and seepage during and after the construction of the wall. If final grading is not part of the contractors scope of work, the area around the wall must still be properly graded to ensure water does not collect behind or is directed toward the wall. |

ISSUED FOR APPROVAL

LICENSED PROFESSIONAL ENGINEER
J. I. MOTIANI
100067622
2019-11-14
PROVINCE OF ONTARIO

SEALED FOR DESIGN ONLY
Contingent on general review as detailed in 1.05b and 3.02b in SPECIFICATIONS

RSS Project No: 201910030
Mars Canada - Boltcol Holdings North
George Bolton Pkwy.,
Bolton ON

RisiStone ®
Segmental Retaining Wall

| | |
|---|---|
| Drawn By: | JM |
| Design: | JM |
| Check: | * |
| Date: | Nov 2019 |
| Dwg No. | 1 |
| Dwg. File: | 201910030 RW1 |

RisiStone
retaining wall systems
http://www.risistone.com

| No. | Date | By | Revisions |
|---|---|---|---|
| | | | |

WALL B TO WALL E:- RETAINING WALL DESIGN

LEGEND
Durahold SRW System 305mm Between Courses
Stratagrid 200 Geogrid
Top/Bottom of wall grade profile

SHEET
RW-1

DWG NO.
1

# Detail - Pedestrian Handrail Installation
## Chainlink Fence /Pedestrian Guardrail Design by others

Notes:

1. Pedestrian Handrail or Chain Link Fence
(Designed by others).

a) Must be non-wind bearing

b) Max. Post O/D = 75mm (3")

c) It is highly recommended that the Post shape be circular. Square posts are permitted, however, extra care and attention must be taken to ensure all procedures detailed here and the Grout Specifications are followed due to the potential for stress concentrations created by the post geometry.

d) Grouted portion of the post must be unpainted.

e) Post must be sealed or capped from the top to prevent infiltration of water.

f) Post must be filled with grout inside and outside to crowing elevations (just above top of block)

g) Max. 1.8 m post spacing.

2. Grouting and Core Drilling

a) Grout manufacturers specifications must be adhered to. Failure to follow these specifications may lead to failure of the SRW block.

b) Holes are to be core drilled. Use of percussion type instrument is not allowed.

c) Core drill hole to extend completely through the specified number of courses to allow high pressure water jet (or other suitable means) to clean hole of dust and debris prior to grouting.

d) O/D of core drill hole not to exceed 100mm. Core drill hole O/D to exceed post O/D by min. 25mm. Core drill hole to be centered midway through block as shown. Min. 300mm offset to either end of block.

e) Installation must take place during the grout manufacturer's recommended temperature ranges.

f) The core drilled holes must be cleaned and free of dust and debris prior to pouring of the grout.

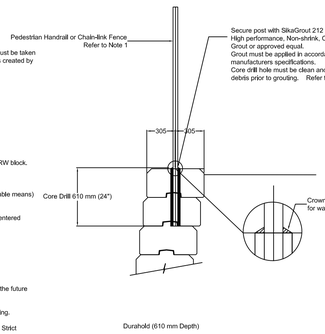
g) The core drill holes must be wet down prior to pouring the grout to promote a damp curing environment.

h) The grout must be brought up to just above the top of the coping unit and sloped away (crowned) from the post to prevent the future infiltration of water into the core drill hole. Contractor must ensure water is prevented from infiltrating post hole.

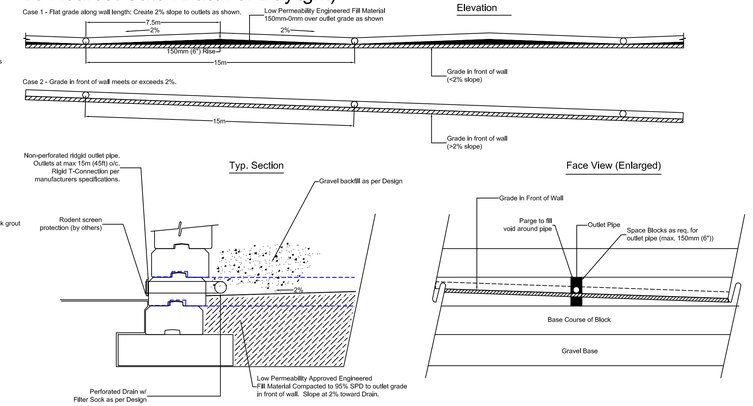
i) All contaminated water (used in cleaning the hole or core drilling) must be washed from the face of the wall to prevent staining.

j) Additional requirements and provisions are required by Grout manufacturer for proper performance than those noted here. Strict adherance to specifications required.

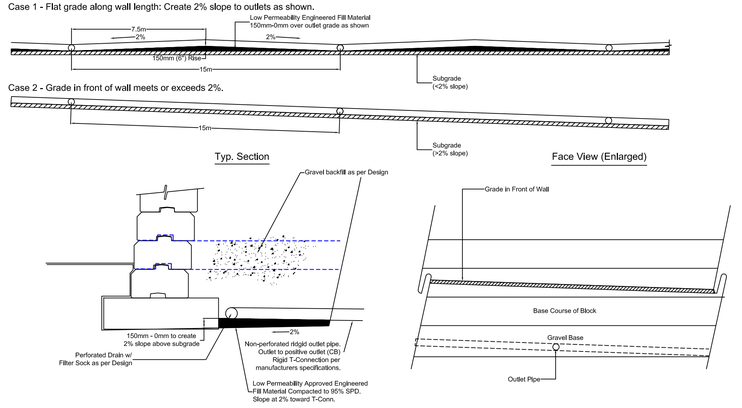
k) 2012 Ontario Building Code requires that the contractor retain a General Review Engineer to ensure Installation is in compliance with design and specifications (Wall and grout manufacturers specs).



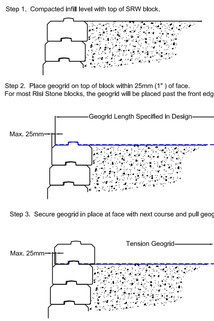

# Detail - Either Drainage Outlet Option
## a) Drain Outlet at /near or Just above the Base of Wall (as shown) Outlet Thru Block Face To Nearest Catch Basin or Daylight)




# Detail - Or Drainage Outlet Option
## b) Drain Outlet at /near base of the wall (as shown) or Just above the Base of Wall Outlet from Behind (To Nearest Catch Basin)




# Detail - Geogrid Installation




Notes:

1. Follow geosynethic manufacturer's installation instructions and specifications. Care must be taken to ensure geogrid is not damaged during construction or subject to UV exposure.

2. Do not allow ANY tracked equipment directly on top of the geogrid. For necessary travel on the geogrid, use only lightweight rubber tired equipment operating at slow speeds (less than 10 mph); do not allow braking or sharp turning.

3. Geogrid length, placement and type shall be as indicated in the Wall Design.

4. Geogrid must be placed in direction of highest strength (roll direction) perpendicular to face of wall. (i.e. - Do not roll out geogrid along the length of the wall).

5. Compacted infill must be level with the top of the block prior to placement of geogrid.

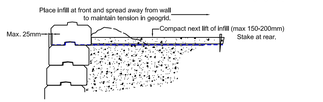
6. Remove all debris from the top of the SRW block prior to placement of geogrid.

7. Geogrid must be placed within 25mm (1") of the front face of the block.

8. Geogrid must be pulled taut, removing any slack or wrinkles prior to the placement of infill material. The use of temporary stakes to maintain tension of the geogrid is good practice. Infill material should be dumped close to the face of the wall and raked away from the wall to maintain tension in the geogrid during backfilling. When infill material is placed, caution must be used to ensure hand equipment (shovels and rakes) does not contact the geogrid or cause damage.

9. Adjacent sections of geogrid shall abut eachother (not overlap or gap) at the face of the wall to ensure continuous geogrid coverage. Geogrid cannot be spliced to create the required length into the back - the geogrid must be one continous piece.

10. Do not stack more than two (2) courses of block prior to backfilling wall.




# Detail - Inside Corner Construction

**DuraHold Inside Modified Corners**

Imperial dimensions

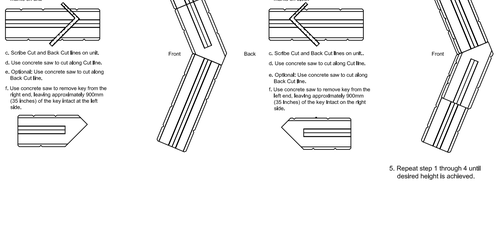
| Angle [degrees] | Front [inches] | Back [inches] | Back Cut [inches] *1 | Cut [inches] | Unit to Modify |
|---|---|---|---|---|---|
| 5 | 36 | 37 1/8 | 1 | 24 | Standard |
| 10 | 36 | 38 1/8 | 2 1/8 | 24 | Standard |
| 15 | 36 | 39 1/8 | 3 1/8 | 24 | Standard |
| 20 | 36 | 40 1/4 | 4 1/4 | 24 | Standard |
| 25 | 36 | 41 3/8 | 5 3/8 | 24 | Standard |
| 30 | 36 | 42 1/2 | 6 3/8 | 24 | Standard |
| 35 | 36 | 43 5/8 | 7 5/8 | 24 | Standard |
| 40 | 36 | 44 3/4 | 8 3/4 | 24 | Standard |
| 45 | 36 | 46 | 10 | 24 | Standard |
| 50 | 36 | 47 1/4 | 11 1/4 | 24 | Standard |
| 55 | 36 | 48 1/2 | 12 1/2 | 24 | Standard |
| 60 | 36 | 49 7/8 | 13 7/8 | 24 | Standard |
| 65 | 36 | 51 3/8 | 15 1/4 | 24 | Standard |
| 70 | 36 | 52 7/8 | 16 7/8 | 24 | Standard |
| 75 | 36 | 54 1/2 | 18 3/8 | 24 | Standard |
| 80 | 36 | 56 1/8 | 20 1/8 | 24 | Standard |
| 85 | 36 | 58 | 22 | 24 | Standard |
| 90 | | Use manufactured 90° corner unit | | | |
| 91>180 | | Not recommended | | | |

Metric dimensions

| Angle [degrees] | Front [mm] | Back [mm] | Back Cut [mm] *1 | Cut [mm] | Unit to Modify |
|---|---|---|---|---|---|
| 5 | 915 | 942 | 27 | 610 | Standard |
| 10 | 915 | 968 | 53 | 610 | Standard |
| 15 | 915 | 995 | 80 | 610 | Standard |
| 20 | 915 | 1023 | 108 | 610 | Standard |
| 25 | 915 | 1050 | 135 | 610 | Standard |
| 30 | 915 | 1078 | 163 | 610 | Standard |
| 35 | 915 | 1107 | 192 | 610 | Standard |
| 40 | 915 | 1137 | 222 | 610 | Standard |
| 45 | 915 | 1166 | 253 | 610 | Standard |
| 50 | 915 | 1199 | 284 | 610 | Standard |
| 55 | 915 | 1233 | 318 | 610 | Standard |
| 60 | 915 | 1267 | 352 | 610 | Standard |
| 65 | 915 | 1304 | 389 | 610 | Standard |
| 70 | 915 | 1342 | 427 | 610 | Standard |
| 75 | 915 | 1383 | 468 | 610 | Standard |
| 80 | 915 | 1427 | 512 | 610 | Standard |
| 85 | 915 | 1474 | 559 | 610 | Standard |
| 90 | | Use manufactured 90° corner unit | | | |
| 91>180 | | Not recommended | | | |

Inside Right corner unit

Inside Left corner unit




# Detail - Outside Corner Construction

**DuraHold Outside Modified Corners**

Imperial dimensions

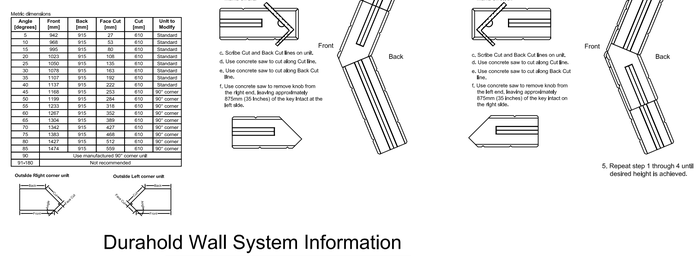
| Angle [degrees] | Front [inches] | Back [inches] | Face Cut [inches] | Cut [inches] | Unit to Modify |
|---|---|---|---|---|---|
| 5 | 37 1/8 | 36 | 1 | 24 | Standard |
| 10 | 38 1/8 | 36 | 2 1/8 | 24 | Standard |
| 15 | 39 1/8 | 36 | 3 1/8 | 24 | Standard |
| 20 | 40 1/4 | 36 | 4 1/4 | 24 | Standard |
| 25 | 41 3/8 | 36 | 5 3/8 | 24 | Standard |
| 30 | 42 1/2 | 36 | 6 3/8 | 24 | Standard |
| 35 | 43 5/8 | 36 | 7 5/8 | 24 | Standard |
| 40 | 44 3/4 | 36 | 8 3/4 | 24 | Standard |
| 45 | 46 | 36 | 10 | 24 | 90° corner |
| 50 | 47 1/4 | 36 | 11 1/4 | 24 | 90° corner |
| 55 | 48 1/2 | 36 | 12 1/2 | 24 | 90° corner |
| 60 | 49 7/8 | 36 | 13 7/8 | 24 | 90° corner |
| 65 | 51 3/8 | 36 | 15 1/4 | 24 | 90° corner |
| 70 | 52 7/8 | 36 | 16 7/8 | 24 | 90° corner |
| 75 | 54 1/2 | 36 | 18 3/8 | 24 | 90° corner |
| 80 | 56 1/8 | 36 | 20 1/8 | 24 | 90° corner |
| 85 | 58 | 36 | 22 | 24 | 90° corner |
| 90 | | Use manufactured 90° corner unit | | | |
| 91>180 | | Not recommended | | | |

Metric dimensions

| Angle [degrees] | Front [mm] | Back [mm] | Face Cut [mm] | Cut [mm] | Unit to Modify |
|---|---|---|---|---|---|
| 5 | 942 | 915 | 27 | 610 | Standard |
| 10 | 968 | 915 | 53 | 610 | Standard |
| 15 | 995 | 915 | 80 | 610 | Standard |
| 20 | 1023 | 915 | 108 | 610 | Standard |
| 25 | 1050 | 915 | 135 | 610 | Standard |
| 30 | 1078 | 915 | 163 | 610 | Standard |
| 35 | 1107 | 915 | 192 | 610 | Standard |
| 40 | 1137 | 915 | 222 | 610 | Standard |
| 45 | 1168 | 915 | 253 | 610 | 90° corner |
| 50 | 1199 | 915 | 284 | 610 | 90° corner |
| 55 | 1233 | 915 | 318 | 610 | 90° corner |
| 60 | 1267 | 915 | 352 | 610 | 90° corner |
| 65 | 1304 | 915 | 389 | 610 | 90° corner |
| 70 | 1342 | 915 | 427 | 610 | 90° corner |
| 75 | 1383 | 915 | 468 | 610 | 90° corner |
| 80 | 1427 | 915 | 512 | 610 | 90° corner |
| 85 | 1474 | 915 | 559 | 610 | 90° corner |
| 90 | | Use manufactured 90° corner unit | | | |
| 91>180 | | Not recommended | | | |

Outside Right corner unit

Outside Left corner unit




# Durahold Wall System Information

| DURAHOLD® System Units | Face Width | Back Width | Height | Depth | Weight |
|---|---|---|---|---|---|
| Standard Unit | 72" | 72" | 12" | 24" | 1740 lbs |
| | 1830 mm | 1830 mm | 305 mm | 610 mm | 790 kg |
| Tapered Half Unit | 36" | 34" | 12" | 24" | 870 lbs |
| | 915 mm | 876 mm | 305 mm | 610 mm | 395 kg |
| Left Corner Unit | 60" | 60" | 12" | 24" | 1450 lbs |
| | 1525 mm | 1525 mm | 305 mm | 610 mm | 658 kg |
| Right Corner Unit | 60" | 60" | 12" | 24" | 1450 lbs |
| | 1525 mm | 1525 mm | 305 mm | 610 mm | 658 kg |
| 45 Degree Left Corner Unit | 60" | 60" | 12" | 24" | 1265 lbs |
| | 1525 mm | 1525 mm | 305 mm | 610 mm | 575 kg |
| 45 Degree Right Corner Unit | 60" | 60" | 12" | 24" | 1265 lbs |
| | 1525 mm | 1525 mm | 305 mm | 610 mm | 575 kg |
| Tie-Back Unit | 72" | 72" | 12" | 24" | 1740 lbs |
| | 1830 mm | 1830 mm | 305 mm | 610 mm | 790 kg |
| Coping Unit | 72" | 72" | 12" | 24" | 1720 lbs |
| | 1830 mm | 1830 mm | 305 mm | 610 mm | 780 kg |

| DURA-HOLD® System Design/Construction Information | | |
|---|---|---|
| Minimum Inside/Outside Radius | Standard Units | 269' 82 m |
| | Tapered Half Units | 66' 20 m |
| Stacking Alignment | Battered/Vertical* | |
| Facing | Smooth Chamfered Face | |
| Placement Method | Machine | |

* -Tapered Half Units cannot be constructed vertical when used in a curve

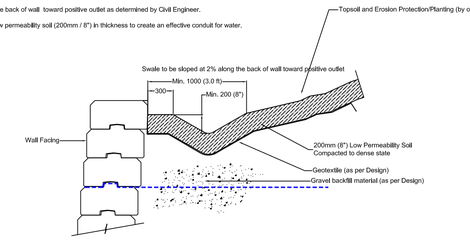
# Detail - Swale Detail (Typical - Dim. to be provided by Civil Engineer)

Notes:

1. Swale to be dimensioned by Civil Engineer based on site drainage plan.

2. Swale to slope at min. 2% along the back of wall toward positive outlet as determined by Civil Engineer.

3. Swale must be constructed with low permeability soil (200mm / 8") in thickness to create an effective conduit for water.




To be used in conjunction with RW1 Sheet.

ISSUED FOR APPROVAL

CENSED PROFESSIONAL ENGINEER
J. I. MOTIANI
100067622
2019-11-14
PROVINCE OF ONTARIO

SEALED FOR DESIGN ONLY
Contingent on general review as detailed in 1.05b and 3.02b in SPECIFICATIONS

RSS Project No: 201910030
Mars Canada - Boltcol Holdings North
George Bolton Pkwy.,
Bolton ON

Risi Stone®
Segmental Retaining Wall
Typical Details

| | |
|---|---|
| Drawn By: | JM |
| Design: | JM |
| Check: | TM |
| Date: | Nov 14 2019 |
| Dwg No. | 2 |
| Dwg. File: | 201806010 |

RisiStone
retaining wall systems

| No. | Date | By | Revisions |
|---|---|---|---|
| | | | |

RETAINING WALL
DETAIL SHEET

SHEET
RW2

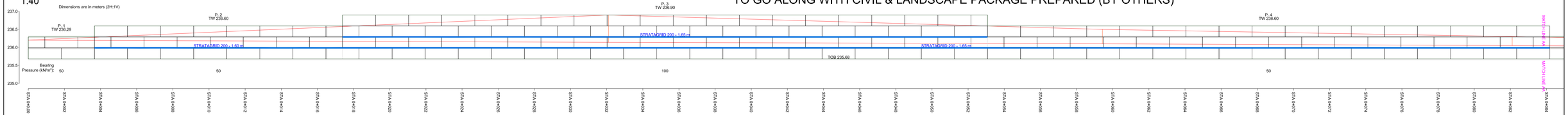
DWG NO.
2

# TYP. MAX. HEIGHT SECTION

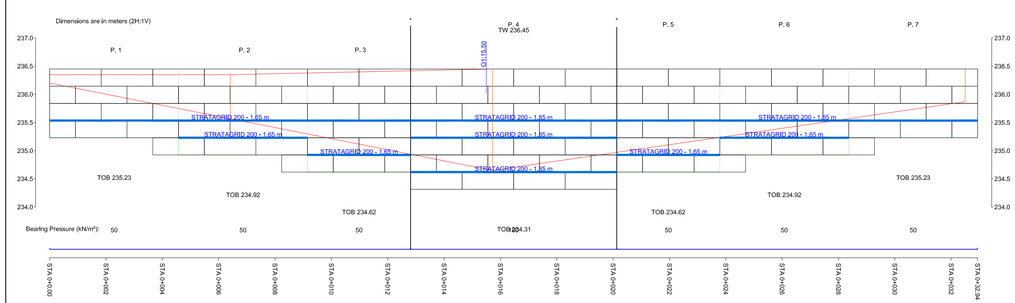
1:40

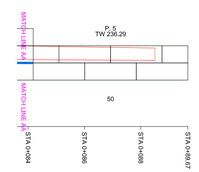
## WALL B

FOR GRADE CALL OUTS PLEASE REFER TO G-2 GRADE PLAN DRAWING DATED SEPT 5 2019 BY AM CANDARS ASSOCIATES INC TO GO ALONG WITH CIVIL & LANDSCAPE PACKAGE PREPARED (BY OTHERS)




## WALL C




Reinforcement Legend
SG200 StrataGrid 200

| Station No. | Origin | Top Elev. | Bottom Elev. |
|---|---|---|---|
| 1 | 0.00 | 236.35 | 236.20 |
| 2 | 6.41 | 236.35 | 235.57 |
| 3 | 15.72 | 236.45 | 234.65 |
| 4 | 32.50 | 236.45 | 235.87 |

Column Geometry

| Column No. | Top Elev. | Base Elev. | Left Stn. | Right Stn. | Width in Blocks |
|---|---|---|---|---|---|
| 1 | 236.45 | 235.23 | 0.00 | 4.58 | 2.50 |
| 2 | 236.45 | 234.92 | 4.58 | 9.15 | 2.50 |
| 3 | 236.45 | 234.62 | 9.15 | 12.81 | 2.00 |
| 4 | 236.45 | 234.31 | 12.81 | 20.13 | 4.00 |
| 5 | 236.45 | 234.62 | 20.13 | 23.79 | 2.00 |
| 6 | 236.45 | 234.92 | 23.79 | 28.36 | 2.50 |
| 7 | 236.45 | 235.23 | 28.36 | 32.94 | 2.50 |

Markers

| Marker | Station | Note |
|---|---|---|
| O1 | 15.50 | Outside Corner |

Geogroups

| Group | Layer | Length (m) | Panels | Wall Span (m) |
|---|---|---|---|---|
| A | All | 1.65 | 1 - 3 | 0.00 - 12.81 |
| B | All | 1.85 | 4 - 4 | 12.81 - 20.13 |
| C | All | 1.65 | 5 - 7 | 20.13 - 32.94 |

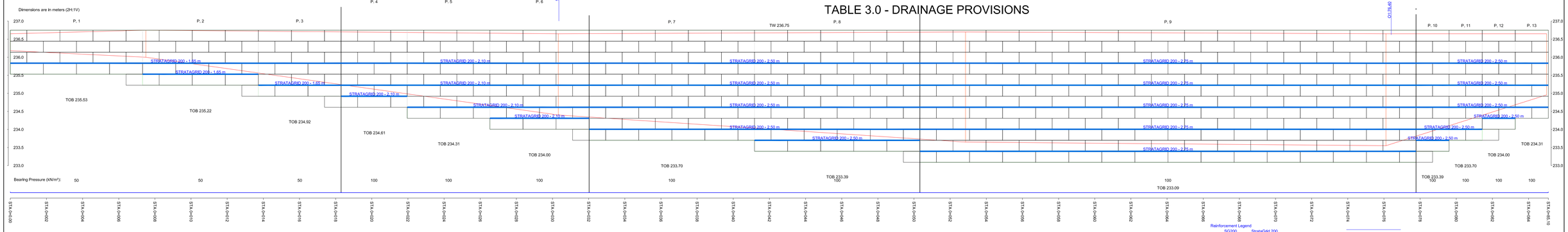
Reinforcement Legend
SG200 StrataGrid 200

| Station No. | Origin | Top Elev. | Bottom Elev. |
|---|---|---|---|
| 1 | 0.00 | 236.20 | 236.20 |
| 2 | 32.10 | 236.90 | 236.14 |
| 3 | 59.43 | 236.50 | 236.10 |
| 4 | 82.10 | 236.30 | 236.05 |
| 5 | 88.50 | 236.25 | 236.03 |

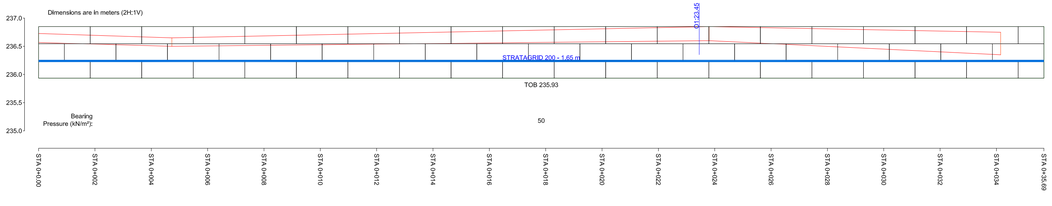
Column Geometry

| Column No. | Top Elev. | Base Elev. | Left Stn. | Right Stn. | Width in Blocks |
|---|---|---|---|---|---|
| 1 | 236.29 | 235.68 | 0.00 | 3.66 | 2.00 |
| 2 | 236.60 | 235.68 | 3.66 | 17.38 | 7.50 |
| 3 | 236.90 | 235.68 | 17.38 | 53.07 | 19.50 |
| 4 | 236.60 | 235.68 | 53.07 | 84.18 | 17.00 |
| 5 | 236.29 | 235.68 | 84.18 | 89.67 | 3.00 |

## WALL D




## WALL E




Reinforcement Legend
SG200 StrataGrid 200

| Station No. | Origin | Top Elev. | Bottom Elev. |
|---|---|---|---|
| 1 | 0.00 | 236.73 | 236.57 |
| 2 | 4.73 | 236.65 | 236.50 |
| 3 | 23.80 | 236.85 | 236.60 |
| 4 | 34.15 | 236.75 | 236.35 |

Column Geometry

| Column No. | Top Elev. | Base Elev. | Left Stn. | Right Stn. | Width in Blocks |
|---|---|---|---|---|---|
| 1 | 236.85 | 235.93 | 0.00 | 35.68 | 19.50 |

Markers

| Marker | Station | Note |
|---|---|---|
| O1 | 23.45 | Outside Corner |

Reinforcement Legend
SG200 StrataGrid 200

| Station No. | Origin | Top Elev. | Bottom Elev. |
|---|---|---|---|
| 1 | 0.00 | 236.65 | 236.18 |
| 2 | 7.50 | 236.75 | 236.00 |
| 3 | 30.32 | 236.65 | 234.40 |
| 4 | 52.85 | 236.70 | 233.65 |
| 5 | 76.11 | 236.65 | 233.55 |
| 6 | 85.00 | 236.65 | 234.96 |

Column Geometry

| Column No. | Top Elev. | Base Elev. | Left Stn. | Right Stn. | Width in Blocks |
|---|---|---|---|---|---|
| 1 | 236.75 | 235.53 | 0.00 | 7.32 | 4.00 |
| 2 | 236.75 | 235.22 | 7.32 | 13.72 | 3.50 |
| 3 | 236.75 | 234.92 | 13.72 | 18.30 | 2.50 |
| 4 | 236.75 | 234.61 | 18.30 | 21.96 | 2.00 |
| 5 | 236.75 | 234.31 | 21.96 | 26.53 | 2.50 |
| 6 | 236.75 | 234.00 | 26.53 | 32.02 | 3.00 |
| 7 | 236.75 | 233.70 | 32.02 | 41.17 | 5.00 |
| 8 | 236.75 | 233.39 | 41.17 | 50.32 | 5.00 |
| 9 | 236.75 | 233.09 | 50.32 | 77.78 | 15.00 |
| 10 | 236.75 | 233.39 | 77.78 | 79.61 | 1.00 |
| 11 | 236.75 | 233.70 | 79.61 | 81.44 | 1.00 |
| 12 | 236.75 | 234.00 | 81.44 | 83.27 | 1.00 |
| 13 | 236.75 | 234.31 | 83.27 | 85.10 | 1.00 |

Markers

| Marker | Station | Note |
|---|---|---|
| 1 | 30.35 | Section 1-1 |
| O1 | 76.40 | Outside Corner |

Geogroups

| Group | Layer | Length (m) | Panels | Wall Span (m) |
|---|---|---|---|---|
| A | All | 1.65 | 1 - 3 | 0.00 - 18.30 |
| B | All | 2.10 | 4 - 6 | 18.30 - 32.02 |
| C | All | 2.50 | 7 - 8 | 32.02 - 50.32 |
| D | All | 2.75 | 9 - 9 | 50.32 - 77.78 |
| E | All | 2.50 | 10 - 13 | 77.78 - 85.10 |

FOR ALL BELOW ITEMS PLEASE REFER TO RW-1 SHEET DWG NO 1

GENERAL NOTES

TABLE 1.0 - SOIL ZONES AND ASSUMED PROPERTIES

TABLE 2.0 - DESIGN INFORMATION

TABLE 3.0 - DRAINAGE PROVISIONS

ISSUED FOR APPROVAL

LICENSED PROFESSIONAL ENGINEER
J. I. MOTIANI
100067622
2019-11-14
PROVINCE OF ONTARIO

SEALED FOR DESIGN ONLY
Contingent on general review as detailed in 1.05b and 3.02b in SPECIFICATIONS

RSS Project No: 201910030
Mars Canada - Boltcol Holdings North
George Bolton Pkwy.,
Bolton ON

RisiStone ® Segmental Retaining Wall

| | |
|---|---|
| Drawn By: | JM |
| Design: | JM |
| Check: | * |
| Date: | Nov 2019 |
| Dwg No. | 3 |
| Dwg. File: | 201910030 RW1 |

RisiStone retaining wall systems

http://www.risistone.com

| No. | Date | By | Revisions |
|---|---|---|---|
| | | | |

WALL B TO WALL E:- RETAINING WALL DESIGN

LEGEND

Durahold SRW System
305mm Between Courses

Stratagrid 200 Geogrid

Top/Bottom of wall grade profile

SHEET
RW-1

DWG NO.
3

RisiStone®
retaining wall systems

# Specifications

# SECTION 32 32 23 - SEGMENTAL RETAINING WALL

July 2014

## PART 1 GENERAL

### 1.01 Description

A. The work covered by this section includes the furnishing of all labour, materials, equipment, and incidentals for the Design, inspection, and construction of a modular concrete Segmental Retaining Wall ("SRW") including drainage system and geosynthetic reinforcement as shown in the Construction Documents and as described by this Specification. The work included in this section consists of, but is not limited, to the following:

1) Design of an SRW system.
2) Review of the site conditions with respect to suitability of the SRW Design.
3) Inspection of all construction operations and materials related to the SRW.
4) Excavation and foundation soil preparation.
5) Furnishing and placement of the Leveling Base.
6) Furnishing and placement of the Drainage system.
7) Furnishing and placement of Geotextile Filter (if applicable).
8) Furnishing and placement of SRW units.
9) Furnishing and placement of Geosynthetic Reinforcement.
10) Furnishing, placement, and compaction of Reinforced, Drainage, and Retained Fills.
11) Furnishing of final grading.

### 1.02 Related Work

A. Section 31 10 00 - Site Preparation
B. Section 31 20 00 - Earth Moving

### 1.03 Reference Standards (Refer to most recent versions)

A. Segmental Retaining Wall Design
   1) Design Manual for Segmental Retaining Walls, National Concrete Masonry Association, Third Edition which will be referred to as the "NCMA Design Manual"

B. Segmental Retaining Wall Units

   1) ASTM C140, "Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units"
   2) ASTM C1262, "Standard Test Method for Evaluating the Freeze-Thaw Durability of Manufactured Concrete Masonry Units and Related Concrete Units"
   3) ASTM C1372, "Standard Specification for Dry-Cast Segmental Retaining Wall Units"

4) ASTM D6638, "Test Method for Determining Connection Strength Between Geosynthetic Reinforcement and Segmental Concrete Units (Modular Concrete Blocks)"
5) ASTM D6916, "Standard Test Method for Determining the Shear Strength Between Segmental Concrete Units (Modular Concrete Blocks)"

C. Geotextile Filter

1) ASTM D4491, "Standard Test Methods for Water Permeability of Geotextiles by Permittivity"
2) ASTM D4751, "Standard Test Method for Determining Apparent Opening Size of a Geotextile"
3) ASTM D5261, "Standard Test Method for Measuring Mass per Unit Area of Geotextiles"

D. Geosynthetic Reinforcement

1) ASTM D4595, “Standard Test Method for Tensile Properties of Geotextiles by the Wide-With Strip Method”
2) ASTM D5262, "Standard Test Method for Evaluating the Unconfined Tension Creep Rupture Behavior of Geosynthetics"
3) ASTM D5321, “Standard Test Method for Determining the Coefficient of Soil and Geosynthetic or Geosynthetic and Geosynthetic Friction by Direct Shear Method”
4) ASTM D5818, “Standard Practice for Exposure and Retrieval of Samples to Evaluate Installation Damage of Geosynthetics”
5) ASTM D6637, "Standard Test Method for Determining Tensile Properties of Geogrids by the Single or Multi-Rib Tensile Method"
6) ASTM D6706, "Standard Test Method for Measuring Geosynthetic Pullout Resistance in Soil"
7) ASTM D6992 – Standard Test Method for Accelerated Tensile Creep and Creep-Rupture of Geosynthetic Materials Based on Time-Temperature Superposition Using Stepped Isothermal Method.

E. Soils

1) ASTM D422, "Standard Test Method for Particle-Size Analysis of Soils"
2) ASTM D698, "Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft3 (600 kN-m/m3))"
3) ASTM D1556, “Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method”
4) ASTM D1557, “Standard Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft3 (2,700 kN-m/m3))”
5) ASTM D2487 "Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System)"

6) ASTM D6938, “Standard Test Method for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods”
7) ASTM D4318, "Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils"
8) ASTM D6919, “Standard Test Methods for Particle-Size Distribution (gradation) of Soils Using Sieve Analysis”
9) ASTM G51, "Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing”

F. Drainage Pipe

1) ASTM F758, "Standard Specification for Smooth-Wall Poly(Vinyl Choride) (PVC) Plastic Underdrain Systems for Highway, Airport, and Similar Drainage"
2) ASTM F405, "Standard Specification for Corrugated Polyethylene (PE) Pipe and Fittings"

G. Where specifications and reference documents conflict, the Owner or Owner's Representative shall make the final determination of applicable document.

## 1.04 Delivery, Material Handling, and Storage

A. The Installer shall check all materials delivered to the site to ensure that the materials specified in the Construction Documents have been received and are in good condition.
B. The Installer shall store and handle all materials in accordance with manufacturer's recommendations and in a manner to prevent deterioration or damage due to moisture, temperature changes, contaminants, handling, or other causes.

## 1.05 Roles and Responsibilities

Although other parties may have responsibilities related to the Retaining Wall, the following Four (4) main entities have direct responsibilities for the Design, Review and Construction of the Segmental Retaining Wall. This outline of roles and responsibilities is based on Section 3 and Section 12 of the NCMA Design Manual for Segmental Retaining Walls, 3rd Edition.

A. The term **Installer** shall refer to the individual or Firm that will construct the SRW. The Installer must have the necessary experience and understanding of SRWs for the project and have successfully completed projects of similar scope and size.

B. The **Site Geotechnical Engineer** is the individual Professional Geotechnical Engineer or Geotechnical Engineering Firm that has been retained to provide all Geotechnical verifications for the Wall, including verifying Site Soils and Groundwater conditions, Materials testing, and Global Stability. Refer to Section 3.02 and 3.03.

C. The term **General Review Engineer** refers to the individual Professional Engineer or Professional Engineering Firm that has been retained to provide "General Review" of the Wall construction to ensure that the Wall is constructed in general conformance with the Design and Specifications. The General Review Engineer and the Site Geotechnical Engineer can be, and are often the same Party. Refer to Section 3.02 and 3.03.

D. The term **Wall Designer** refers to the individual Professional Engineer or Professional Engineering Firm that is experienced in the design of SRWs and is responsible for generating a sealed SRW Design based on information that is provided to the Designer, created in accordance with Section 3.01. The Designer may retain the services of other professionals to augment their own capabilities, skills, and knowledge. The Wall Designer and General Review Engineer (GRE) are not required to be the same individual or firm. Any issues in the field, such as differences between assumed Design conditions and actual field conditions, will be brought to the attention of the Wall Designer by the GRE.

1.06 Submittals - per Contract Documents.

1.07 Measurement for Payment - per Contract Documents.

1.08 Approved Segmental Retaining Wall System

The Segmental Retaining Wall (SRW) System shall be the Risi Stone SRW System noted in the attached Design.

## PART 2 MATERIALS

### 2.01 Definitions

A. Segmental Retaining Wall ("SRW") is the entire retaining wall structure(s) including: SRW Units, Coping, Drainage Pipe, Geotextile Filter, Geosynthetic Reinforcement and Drainage, Reinforced, Retained, and Base Fills. A Segmental Retaining wall structure can be classified as follows:
   1) Conventional SRW - SRW Units stacked on a Leveling Base with a Drainage system behind.
   2) Multi-Depth SRW - SRW Units of different depths with larger units at the bottom, and smaller units at the top, stacked on a Leveling Base with a Drainage system behind.
   3) Reinforced SRW - SRW Units stacked on a Leveling Base with a Drainage system, Reinforced Fill including Geosynthetic Reinforcement located behind.
   4) Crib SRW - SRW Units stacked parallel and perpendicular to the SRW direction forming bin like structures, built on a Leveling Base with a Drainage system behind.

B. Segmental Retaining Wall Units are modular, solid, dry-cast concrete blocks, designed specifically for the task of earth retention, that form the external facia of an SRW system.

C. Coping Units are the last course of concrete units used to finish the top of the SRW. Coping Units are also referred to as cap units.

D. Leveling Base is the compacted granular soil, or if specified in the Construction Documents, an unreinforced concrete footing, placed beneath the first course of SRW units.

E. Drainage Fill is a free draining aggregate with high permeability placed directly behind the modular concrete units. This will include a Drainage Pipe and may be separated from other Fill with a suitable Geotextile Filter.

F. Reinforced Fill is placed directly behind the Drainage Fill, placed in layers and compacted, that will include horizontal layers of Geosynthetic Reinforcement. If the Reinforced Fill is considered to be a “draining material”, the Drainage Fill may not be required.

G. Retained Fill is the soil placed between the Reinforced Fill and the Retained Soil in Reinforced SRWs or between the Drainage Fill and Retained Soil in Conventional SRWs.

H. Retained Soil in cut situations is the undisturbed native soil embankment. In soil fill situations this will be the compacted engineered site fill.

I. Foundation Soil is the undisturbed native soil or engineered fill beneath the SRW structure.

J. Drainage Pipe is a perforated pipe used to carry water, collected from within the SRW, to outlets, to prevent pore water pressures from building up within the SRW and specifically behind the SRW Units.

K. Geotextile Filter is a permeable planar polymer structure that will allow the passage of water from one soil medium to another while preventing the migration of fine particles that might clog the downstream fill. Selection of a Geotextile Filter is based on the characteristics of the different soils used in and surrounding the SRW.

L. Geosynthetic Reinforcement is an open planar polymer structure having tensile strength and durability properties that are suitable for soil reinforcement applications. Geogrid is a commonly used type of Geosynthetic Reinforcement.

M. All values stated in metric units shall be considered as accurate. Values in parenthesis stated in imperial units are the nominal equivalents.

## 2.02 Material Requirements

A. All approved products will be identified in the Construction Documents. No substitutions will be allowed unless approved in writing by the Designer.

B. The Risi Stone SRW units will be specified in the Construction Documents which shall include the manufacturer's name, product name, dimensions, colour, and finish. Additionally the SRW units must:

1) Meet the minimum standard as defined by ASTM C1372 for:
   a) Strength
   b) Absorption
   c) Freeze - Thaw durability
   d) Permissible variation in dimensions
   e) Finish and Appearance
2) Meet the physical properties listed below as tested using ASTM C140:
   a) Dimensional tolerance shall be +/- 3 mm (1/8 in.) for height, width, and length.
   b) The minimum 28-day compressive strength of 35 MPa (5000 psi).
   c) The maximum moisture absorption shall be 1.0 kN/cubic m (6.5 lbs/cubic ft).
3) Use an integral shear key connection that shall be offset to create, as specified in the Construction Documents, either:
   a) A minimum batter as stated in the Construction Documents, or
   b) A near vertical alignment. Special construction procedures are required for vertical SRWs. See Section 3.04.D.
4) If required, summary test data shall be provided with the SRW Design and shall include:
   a) SRW Unit shear strength as per ASTM D6916
   b) SRW Unit - Geosynthetic Reinforcement connection strength as per ASTM D6638

C. Reinforced Fill

1) If the SRW Units by themselves provide sufficient stability, the Designer may choose to omit the Reinforced Fill
2) The Reinforced Fill shall be specified in the Construction Documents as "select imported fill"
    a) Unified Soil Classification System designation as per ASTM D2487
    b) % passing #200 sieve
    c) Effective friction angle (direct shear or triaxial test)
    d) Minimum compacted density
3) Additional information may be required which could include:
    a) Soil gradation curve (ASTM D422)
    b) Liquid limit, plastic limit, and plasticity index (ASTM D4318)
    c) Soil pH (ASTM G51)
    d) Permeability coefficient "Q"

D. Leveling Base
1) The leveling base material shall be non-frost susceptible, well-graded, compacted angular gravel-sand mixture (GW as per ASTM D2487).
2) Additional information may be required which could include:
    a) Effective friction angle (direct shear or triaxial)
    b) Soil gradation curve (ASTM D422)
    c) Soil pH (ASTM G51)
    d) Permeability coefficient "Q"
    e) Potential for consolidation
3) Alternately, the Construction Documents may specify the leveling base shall be an unreinforced concrete footing with specified dimensions.

E. Drainage Fill
1) If the Reinforced Fill has adequate drainage characteristics, the Designer may choose to omit the Drainage Fill.
2) The Drainage Fill shall be a free-draining angular, gravel material of uniform particle size smaller than 25 mm (1 inch) and greater than 6mm (1/4 inch). If shown in the Construction Documents, the Drainage Fill shall be separated from the Reinforced Fill or Retained Fill by a specified Geotextile Filter.
3) Additional information may be required which could include:
    a) Effective friction angle (direct shear or triaxial)
    b) Soil gradation curve (ASTM D422)
    c) Soil pH (ASTM G51)
    d) Permeability coefficient "Q"
    e) Potential for consolidation

F. Drainage Pipe
1) The Drainage Pipe shall be specified in the Construction Documents and shall either be a perforated corrugated polyethylene or perforated PVC pipe, with a minimum diameter of 100 mm (4 inches), protected by a Geotextile Filter to prevent the migration of soil particles into the Drainage Pipe.

G. Geotextile Filter

1) If the gradation of adjacent soils permits, the Geotextile Filter may not be required per the Design.
2) If required, summary test data shall be provided with the SRW Design and shall include:
    a) Apparent opening size "AOS" (ASTM D4751)
    b) Unit weight (ASTM D5261)
    c) Coefficient of permeability (ASTM D4491)

H. Geosynthetic Reinforcement

1) If the SRW Units by themselves provide sufficient stability, the Designer may choose to omit the Geosynthetic Reinforcement.
2) The Geosynthetic Reinforcement shall be specified in the Construction Documents and shall include the manufacturer's name, product name, and Long Term Design Strength ("LTDS") as calculated according to section 3.01.A.5.
3) If required, summary test data shall be provided with the SRW Design and shall include:
    a) Tensile strength (ASTM D6637)
    b) Creep potential reduction factor (ASTM D5262)
    c) Installation damage reduction factor
    d) Durability reduction factor (chemical and biological)
    e) Soil pullout resistance (ASTM D6706)
    f) Connection strength (ASTM D6638)
    g) Coefficient of interaction "Ci"
    h) Coefficient of interaction "Cds"

I. Concrete Adhesive

1) If the Coping Unit by itself provides sufficient stability, the Designer may choose to omit the Coping Adhesive.
2) The adhesive is used to permanently secure the coping unit to the top course of the SRW. The adhesive must provide sufficient strength and remain flexible for the expected life of the SRW.

PART 3 EXECUTION

3.01 Segmental Retaining Wall Design

A. Design Standard

1) The Designer is responsible for providing an SRW Design based on the proposed site development documents. The design life of the structure shall be 75 years unless otherwise specified in the Construction Documents.
2) The Designer shall create the SRW Design in accordance with recommendations of the NCMA Design Manual for Segmental Retaining Walls, Third Edition, for Internal, External, and Internal Compound Stability under Static and Seismic conditions.
3) If required, an alternate design method may be used and must be identified in the SRW Design. The alternate design method must be comprehensive and adequately evaluate all possible modes of failure.
4) The Wall Designer is not responsible for analyzing the global stability of the SRW structure for circular slip failure planes that are completely external to the SRW structure. The Global Stability analysis is to be conducted by the Geotechnical Engineer (SGE) in accordance with NCMA guidelines. Refer to Section 1.05.

B. Design Assumptions – Refer to Notes on Design Drawing

C. Design Parameters

1) Site Parameters
   a) The length, height, and overall elevations of the SRW Design must be derived from the provided site grading plan, elevation details, cross-section details, and station information.
   b) Surcharges, anticipated usage and slopes above, as well as slopes below, all sections of the SRW must be indicated on the site grading plan.
   c) The minimum SRW embedment shall be the greater of:
      i. The height of an SRW unit, or
      ii. The minimum embedment required based on the slope below the SRW.

| Slope Below SRW | Minimum Embedment |
|---|---|
| No Slope | H/10 |
| 3 : 1 (18.4 deg) | H/10 |
| 2 : 1 (26.5 deg) | H/7 |

      iii. The Site Geotechnical Engineer may determine it is necessary to increase embedment due to erosion potential or global stability requirements.

2) Site Soil Parameters

a) All site soil parameters used in the design shall be stated in the SRW Design. This should include soil classification (ASTM D2487), effective friction angle, compacted density, and cohesion.

b) Site-specific soil parameters obtained from site geotechnical investigations shall be used in the design calculations. If a site geotechnical investigation is not available or does not provide specific parameters for the SRW, assumed soil parameters may be used and the SRW Design shall state the assumed values and that assumed soil parameters have been used.

c) If select on-site soils are to be used as SRW fill materials, additional testing of the re-compacted soil will be required for the design calculations. Soil parameters for the select on-site fill shall be used in the design calculations. If fill parameters are not available, assumed fill parameters may be used and the Design Drawings shall state the assumed values and that assumed fill parameters have been used.

3) Product Design Parameters

a) All relevant Product Design Parameters for materials incorporated in the SRW shall be obtained from the supplier or manufacturer and used in the design calculations. All values used shall be obtained from testing conducted in accordance with the Reference Standards identified in Section 1.03. If product test results are not available, assumed parameters may be used and the Design Drawings shall state the assumed values and that assumed product design parameters have been used.

## 3.02 Segmental Retaining Wall Design Review

This section states the minimum review process that is required prior to construction of an SRW. Other parties such as municipalities, architects, developers, owners, and other designers should review the SRW Design prior to acceptance to ensure specific requirements of each party are met.

A. Review of Design by the GRE (General Review Engineer). The General Review Engineer is not responsible for the Wall Design. The role of the GRE is to ensure that the Design produced by the Wall Designer is followed in the field. As such, the GRE must review and understand the Design. Refer to 1.05.C and 3.03.

B. Review of the Design by the SGE (Site Geotechnical Engineer). The SGE must review the Design to verify that the Site Soil and Groundwater Conditions assumed in the Design are correct for the Site, or provide new values/conditions to the Wall Designer. The SGE must also review the Design to determine if a Global Stability analysis is required based on soil conditions, Wall geometry and slopes, groundwater, etc.

C. Review of the Design by the Civil Engineer. The Project Civil Engineer must be provided with a copy of the SRW Design so they may review it for general compatibility with the site.

1) Review should include, but is not limited to, the following specific elements:
   a) All surface drainage must direct water away from the SRW including slopes and paved surfaces.
   b) The SRW drainage system delivers outflow to approved locations.
   c) All site services must be located outside of SRW construction area unless otherwise noted in Design.
   d) The SRW structure or excavation limits must not cross over property boundaries unless approved prior to construction.
   e) All structures located near the SRW must be shown in the Construction Documents.
   f) Anticipated use above wall during and after construction must be as shown in the Construction Documents.

2) The Project Civil Engineer must contact the Designer to address any outstanding issues, questions, or concerns regarding the SRW Design and resolve these issues prior to the General Review Engineer authorizing the SRW Design to be used as Construction Documents.

D. Review of the Design by the Landscape Architect. If applicable, the Project Landscape Architect must be provided with a copy of the SRW Design so they may review it for general compatibility with the site.

1) The review should include, but is not limited to, the following specific elements:

a) Ensure plant and tree species to be placed above the SRW are suited to the environment created by the SRW.
b) Limit irrigation near SRW structure.
c) Grading above and below the SRW structure.
d) It may be necessary to incorporate a root barrier (as required by others) to prevent the migration of tree roots into the drainage layer.
e) Larger plants and trees must be kept outside of the Reinforced Fill to ensure
    i. The Geosynthetic Reinforcement is not damaged by excavation for the root ball
    ii. The SRW is not subjected to any additional load from plants or trees.

2) The Project Landscape Architect must contact the Designer to address any outstanding issues, questions, or concerns regarding the SRW Design and resolve these issues prior to the General Review Engineer issuing Construction Documents or authorising the SRW Design to be used as Construction Documents.

## 3.03 Inspection

Wall Construction must be regularly inspected as follows.

A. Geotechnical Inspection. This is to be performed by a Geotechnical Engineer (SGE) retained by either the Installer or Owner (depending on the requirements of the Contract Documents). The Geotechnical Inspection includes, but may not be limited to, the following:

a. Verifying assumed Design soil parameters and groundwater conditions are acceptable for the Site, or provide the Wall Designer with alternate values/conditions.
b. Verifying subgrade Bearing Capacity meets or exceeds values required by the Design, or provide recommendations to the Installer to achieve the required values (i.e. removal and replacement of subgrade materials, foundation improvement, etc).
c. Determining the need for Global Stability Analysis, and supplying this analysis if necessary per the NCMA guidelines (Section 12).
d. Providing Construction inspection and testing of on-site and fill soils (i.e. compaction testing).
e. Ensuring groundwater conditions and/or other water sources have been identified and compared with the assumptions made in the design. Additional water sources noted on site such as seepage from the cut embankment must be identified and the Designer notified if these are not noted in the Construction Documents.

B. General Review of Construction. The General Review Engineer is retained by the Installer or Owner (depending on the requirements of the Contract Documents) to provide the

following services. (Note that the General Review Engineer may be the same individual as the Site Geotechnical Engineer. This is often the most efficient method of ensuring proper Inspection).

a. Inform the Designer in writing that they will be acting as the General Review Engineer for the project prior to construction.
b. The GRE is to ensure that the Site Geotechnical Engineer (SGE) has verified the Geotechnical conditions as noted above.
c. The GRE is to ensure that the SGE has determined if Global Stability analysis is required and conducted if need be.
d. Testing and acceptance of all materials used to construct the SRW.
e. Inspection of the methods used to construct the SRW.
f. Determine if the wall is constructed in general conformance with the Construction Documents.
g. The General Review Engineer must contact the Designer to address any outstanding issues, questions, or concerns regarding the SRW Design and resolve these issues prior to issuing Construction Documents or authorize the SRW Design to be used as Construction Documents. During construction, the GRE should notify the Designer of any discrepancies between the Design and actual Site Conditions.
h. Ensure the SRW and associated excavation remains outside of the loading influence of other adjacent structures, unless they have been specifically accounted for in the SRW Design and shown in the Construction Documents and ensure stability of excavations and conformance with applicable regulations.

i. Ensure that surface water runoff and/or other sources of water are being controlled during construction and directed away from the SRW to a functioning drain.

C. The Owner may engage a testing and inspection agency for their own quality assurance, but this does not replace the Site Geotechnical Engineer and General Review Engineer's inspection function described in Section 1.05 and Section 3.03.

D. Installer's Quality Assurance Program

1) The Installer is responsible to ensure the SRW is constructed in accordance with the Construction Documents. The Installer must be qualified in the construction of SRWs, knowledgeable of acceptable methods of construction, and have thoroughly reviewed and understood the Construction Documents.

2) It is recommended that the Installer shall keep a construction journal to document the construction of the SRW as part of a thorough quality control program. The

General Review Engineer shall be provided with copies of the construction journal throughout the construction process.

3) The Installer's field construction supervisor shall have demonstrated experience and be qualified to direct all work related to the SRW construction.
4) The Installer must notify the General Review Engineer of critical stages in the construction of the SRW in order that they may be present to observe and inspect the work. The General Review Engineer must be notified reasonably well in advance of the scheduled date(s) for construction.

E. Construction Tolerances

1) Installation of SRW facia shall be within all the following acceptable tolerances:

| | |
|---|---|
| Vertical Control | +/- 1.25 inches over a 10 ft distance |
| Horizontal Control | Straight lines: +/- 1.25 inches over a 10 ft distance |
| Rotation of the SRW face | Maximum 2.0 degrees from established SRW plan batter or +/-10.0% from total established horizontal setback |
| Bulging | +/- 1.25 inch over a 10 ft distance |

3.04 Construction

A. Site Preparation

1) Comply with all current Federal, Provincial/State, and local regulations for execution of the work, including local building codes and excavation regulations. Provide excavation support as required to maintain stability of the area during excavation and SRW construction and to protect existing structures, utilities, landscape features, property, or improvements.
2) Prior to grading or excavation of the site, confirm the location of the SRW and all underground features, including utility locations within the area of construction. Ensure surrounding structures are protected from effects of SRW excavation.
3) Coordinate installation of underground utilities with SRW installation.
4) Control surface water drainage and prevent inundation of the SRW construction area during the construction process.
5) The Foundation Soil shall be excavated or filled as required to the grades and dimensions shown in the Construction Documents.
6) The Foundation Soil shall be proof rolled and examined by the General Review Engineer to ensure that it meets the minimum strength requirements specified in the Construction Documents. If unacceptable Foundation Soil is encountered, the General Review Engineer should contact the Designer to discuss options and determine the most appropriate course of action.

7) In cut situations, the native soil shall be excavated to the lines and grades shown in the Construction Documents and removed from the site or stockpiled for reuse as

Reinforced or Retained Fill as identified in the Construction Documents. Care should be taken not to contaminate or overly saturate the stockpiled fill material.

B. Installing Drainage System

1) If specified in the Construction Documents, the approved Geotextile Filter shall be set against the back of the first SRW Unit, over the prepared foundation soil extending towards the back of the excavation, up the excavation face and eventually over the top of the Drainage Fill to the back of the SRW Units near the top of the wall or as shown in the Construction Documents. Geotextile overlaps shall be a minimum of 300 mm (1 ft.) and shall be shingled down the face of the excavation in order to prevent the migration of particles from one fill type to another.
2) The Drainage Pipe shall be placed as shown in the Construction Documents, in accordance with the overall drainage plan for the site. The main collection drain pipe shall be a minimum of 100mm (4 inches) in diameter. The pipe shall be laid to ensure gravity flow of water from the Reinforced Fill. Connect drainage collection pipe at a storm sewer catch basin or daylight along slope at an elevation lower than lowest point of pipe within Reinforced Fill mass, every 15 m (50 feet) maximum.
3) If other sources of water are discovered during excavation or anticipated, other drainage measures/systems such as chimney or blanket drains may be required. The General Review Engineer should contact the Designer to discuss options and determine the most appropriate course of action.

C. Leveling Base or Spread Footing Placement

1) The Leveling Base shall be the specified material placed in the location to the dimensions shown in the Construction Documents.

D. Installation of Segmental Retaining Wall Units

1) The bottom row of SRW Units shall be placed on the Leveling Base as shown in the Construction Documents. The units shall be placed in the middle of the Leveling Base. Care shall be taken to ensure that the SRW Units are aligned properly, leveled from side to side and front to back, and are in complete contact with the Leveling Base.
2) The SRW Units above the bottom course shall be placed to interconnect the shear key and then pushed forward, creating the specified batter of the SRW face.
3) The SRW Units shall be swept clean before placing additional courses to ensure that no dirt, concrete, or other foreign materials become lodged between successive lifts of the SRW Units.
4) Successive courses shall be placed to create a running bond pattern with the edge of all units being approximately aligned with the middle of the unit in the course below it. Cut SRW Units may need to be placed to ensure the vertical line between adjacent SRW Units remains within the middle third of the SRW Unit below.
5) A maximum of three courses of SRW units can be placed above the level of the Reinforced Fill at any time.
6) The Installer shall check the level of SRW Units with each lift to ensure that no gaps are formed between successive lifts that may affect the performance of the SRW.

7) Care shall be taken to ensure that the SRW Units and Geosynthetic Reinforcement, where applicable, are not damaged during handling and placement.
8) No heavy equipment, for compaction, fill placement or other, shall be allowed within 1 metre (3 ft.) of the back of the SRW Units.

E) Drainage Fill

1) Drainage Fill may not be required as indicated in the Construction Documents.
2) The Drainage Fill will be placed behind the SRW Units with a minimum width of 300 mm (1 ft.) and separated from other soils using the specified Geotextile Filter.
3) Drainage Fill shall be placed behind the SRW facing in maximum lifts of 150 mm (6 inches) and compacted to a minimum density of 95% Standard Proctor.

F. Reinforced Fill

1) Reinforced Fill may not be required as indicated in the Construction Documents.
2) Reinforced Fill shall be placed behind the SRW Units or Drainage Fill with a maximum lift thickness of 150 mm (6 inches) and compacted to a minimum density of 95% Standard Proctor Maximum Dry Density (ASTM D698) at a moisture content from 2% below to 2% above optimum.
3) The Reinforced Fill shall be placed and compacted level with the top of the SRW Units at the specified Geosynthetic Reinforcement elevations to ensure no voids exist under the Geosynthetic Reinforcement as it extends out over the Reinforced Fill.
4) Care shall be taken to ensure that the Geosynthetic Reinforcement lays flat and taut during placement of the Reinforced Fill. This is best achieved by placing the Reinforced Fill on top of the Geosynthetic Reinforcement near the SRW facia and spreading toward the back of the Reinforced Fill.
5) At the end of each day's operation, slope the last lift of Reinforced Fill away from the SRW facing to rapidly direct runoff away from the SRW facia. Do not allow surface runoff from adjacent areas to enter the SRW construction area.

G. Geosynthetic Reinforcement

1) Geosynthetic Reinforcement may not be required as indicated in the Construction Documents.
2) Verify type and primary strength direction of the Geosynthetic Reinforcement.
3) Cut Geosynthetic Reinforcement in sheets to the length shown in the Construction Documents.
4) Geosynthetic Reinforcement sheets shall be placed horizontally with the primary strength direction perpendicular to the SRW face, at the elevations shown in the Construction Documents. The sheets are to be placed adjacent to one another, without overlapping and without gaps between them.
5) Sweep the top of the SRW Units to ensure the SRW Units are clean and free of debris.
6) The Geosynthetic Reinforcement shall be placed over the compacted Reinforced Fill and the SRW Units with the outside edge extending over the shear key of the SRW Unit to within 25 mm (1 in.) of the front facing unit.

7) The next course of SRW Units shall be carefully placed on top of the lower course to ensure that no pieces of concrete are chipped off and become lodged between courses and the Geosynthetic Reinforcement is in complete contact with the top and bottom surfaces of the successive SRW courses.
8) With the Geosynthetic Reinforcement secured in place, the Geosynthetic Reinforcement shall be pulled taut away from the back the SRW Units during placement of Reinforced Fill. Alternatively, suitable anchoring pins or staples can be used to ensure that there are no wrinkles or slackness prior to placement of the Reinforced Fill. The Geosynthetic Reinforcement shall lay flat when pulled back perpendicular to the back of the SRW facia.
9) No construction equipment shall be allowed to operate directly on top of the Geosynthetic Reinforcement until a minimum thickness of 150 mm (6 inches) of fill has been placed. Equipment may drive on Reinforced Fill at slow speeds and should exercise care not to stop suddenly or make sharp turns. No heavy equipment shall be allowed within 1 metre (3 ft.) of the back of the SRW Units.

H. Retained Fill
1) Retained Fill may not be required as indicated in the Construction Documents.
2) Retained Fill shall be placed and compacted behind the Reinforced Fill or Drainage Fill in Conventional SRW applications, in maximum lift thickness of 150 mm (6 inches).

I. Continuing Wall Construction
1) Repeat section 3.04.D through to 3.04.H until the grades indicated in the Construction Documents are achieved.

J. Secure Coping
1) The Coping Adhesive may not be required as indicated in the Construction Documents.
2) If coping adhesive is required by Design, coping units shall be secured to the top of the SRW with two 10 mm (3/8 inch) beads of Concrete Adhesive positioned 50mm (2 inches) in front and behind the tongue of the last course of SRW units.

K. Finishing SRW
1) Finish grading above the SRW to direct surface runoff water away from the SRW. A swale system must be used above the SRW if the grade slopes toward the back of the wall. Construct the swale with the materials and to the dimensions specified in the Construction Documents. Final grading must be established immediately to ensure the Reinforced Fill is protected from water infiltration.
2) Upon completion of the SRW, additional structures (fences, handrails, vehicular guardrails, buildings, pools/ponds, etc.) or changes to grading/loading (increased height, slopes, parking areas, changes in proximity to water flow, etc.), other than those shown in the Construction Documents, cannot be installed/implemented without the review and consent of the General Review Engineer who will typically have to consult the Designer.
3) If the Installer is not responsible for the final landscaping and grading above or around the SRW, the Installer must ensure the firm who is responsible for the final landscaping and grading understands the SRW's limitations with respect to allowable

depth of topsoil, excavation behind the SRW for planting, offset for heavy equipment and allowable surcharge. This also extends to firms who will be responsible for installations like handrails, fences, and signs that will apply additional loads to the SRW and will impact the SRW's performance.

# Retaining Wall Budget & Design

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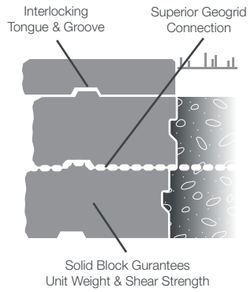
## Comparing the Installed Cost

The "**Installed**" Cost of a Retaining Wall will vary based on a number of factors including the Wall Height, Application (heavy loading, water & steep slopes), Site Access, Aesthetics, Etc. Usually, the higher the wall and more critical the application, the greater the Final Installed Cost. The **Installed** Cost should include the Block, as well as Infill/Drainage Materials, Base, Wall Excavation(within footprint), Drainage pipe and labour/machine time. It is always important to compare product design and quality, as not all products are correct for every application.

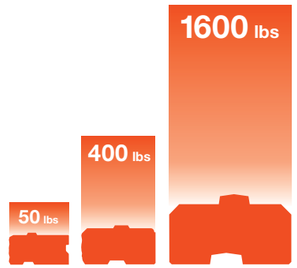
Light duty walls, like Rivercrest, Pisa2 and RomanPisa are great for complex layouts (tight radii, intricate geometries) and applications where site access may be limited for heavy equipment (residential). Heavy duty walls, such as SienaStone, SonomaStone, and DuraHold are ideal for more critical applications, commercial use, and large scale installations where machine placing can save time and labour costs. For additional detailed information about selecting the right product for your project, please contact your Unilock Sales Representative, or Risi Stone Engineer.


We have the longest, most proven track record in the SRW industry. The very first Concrete SRW System was invented by Angelo Risi in 1974.




Our simple solid block design ensures guaranteed performance. Block weight, shear strength, wall alignment & geogrid connection strength are all integrated right into the block.


Our Engineers have over 75 years of combined SRW design experience. We strive to provide you with precise, efficient information, advice & accurate Engineer Sealed designs.




We offer a complete range of product sizes, from hand-placed, to massive machine placed blocks. All of our products are purposely dimensioned for maximum versatily in any application.


Our SienaStone system has been evaluated & MTO approved against the most stringent design, manufacturing & quality checks.

## Budgeting & Selecting the Right Product

The chart below provides comprehensive details about products, wall height restrictions and optimal application.

| | Rivercrest® Natural | Pisa2® Classic | Architextures™ Modern | SienaSmooth Modern Colossal | SienaStone® Colossal | SonomaStone® Colossal | DuraHold® Colossal |
|---|---|---|---|---|---|---|---|
| | Hand-Placed 31 x 5.7 x 24 cm 7 Kg / 15 Lbs Vertical | Hand-Placed 20 x 15 x 30 cm 21 Kg / 46 Lbs Vertical / Battered | Hand-Placed 30 x 10 x 25 cm 18 Kg / 40 Lbs Near Vertical | Machine-Placed 120 x 18 x 37.5 cm 170 Kg / 375 Lbs Near Vertical / Vertical | Machine-Placed 120 x 18.5 x 50 cm 256 Kg / 570 Lbs Vertical / Battered | Machine-Placed 120 x 18.5 x 37.5 cm 175 Kg / 385 Lbs Vertical / Battered | Machine-Placed 183 x 30.5 x 61 cm 732 Kg / 1610 Lbs Vertical / Battered |
| Wall Height | < 0.6m | < 1.8m | < 1m | > 1m (+7m) | < 0.6m | < 2.5m | < 1.2m | > 1.2m (+12m) | < 1.5m | 1.5-3m | > 3m (+12m) | < 1.5-3m | > 3m (+12m) | < 1.8m | < 5.5m | > 1.8m (+12m) |
| Wall Configuration | Gravity | Reinforced | Gravity | Reinforced | Gravity | Reinforced | Gravity | Reinforced | Gravity | Gravity Multi-Depth | Reinforced | Gravity & *Multi Depth* | Reinforced | Gravity | Crib | Reinforced |
| Application | Complex Geometry, Residential | Complex Geometry, Commercial, Residential | Complex Geometry, Residential | Complex Geometry, Commercial, Residential | Complex Geometry, Residential | Complex Geometry, Commercial, Residential | Commercial, Machine Placed, Space Restictions *Property Lines* | Commercial, High Wall, Machine Placed, Space Restictions *Property Lines* | Space Restictions *Property Lines* | Higher Wall, Space Restictions *Property Lines* | **Critical Application,** Commercial, High Wall Machine Placed | Commercial, Machine Placed, *Higher Wall, Space Restictions Property Lines* | Commercial, High Wall, Machine Placed | Commerical, Space Restictions *Property Lines* | **Critical Application,** Commercial, High Wall, Machine Placed, Space Restictions *Property Lines* | **Critical Application,** Commercial, High Wall, Machine Placed |
| Style & Appearance | Natural | Classic | Modern | Colossal | | | | | | | | | | | | |

# Retaining Wall Design Process

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## Comprehensive Designs & Solid Support

At Risi Stone Systems, we know Wall Design and we know what a comprehensive Design involves. While many competitors offer some form of “typical” or preliminary design, we are able to offer complete Designs that are specific to your Project and Region. Our Engineers use Vespa.RS, a cutting edge SRW design software that can layout and analyze your wall design ensuring it’s fully compliant with NCMA or AASHTO Design Methodologies.

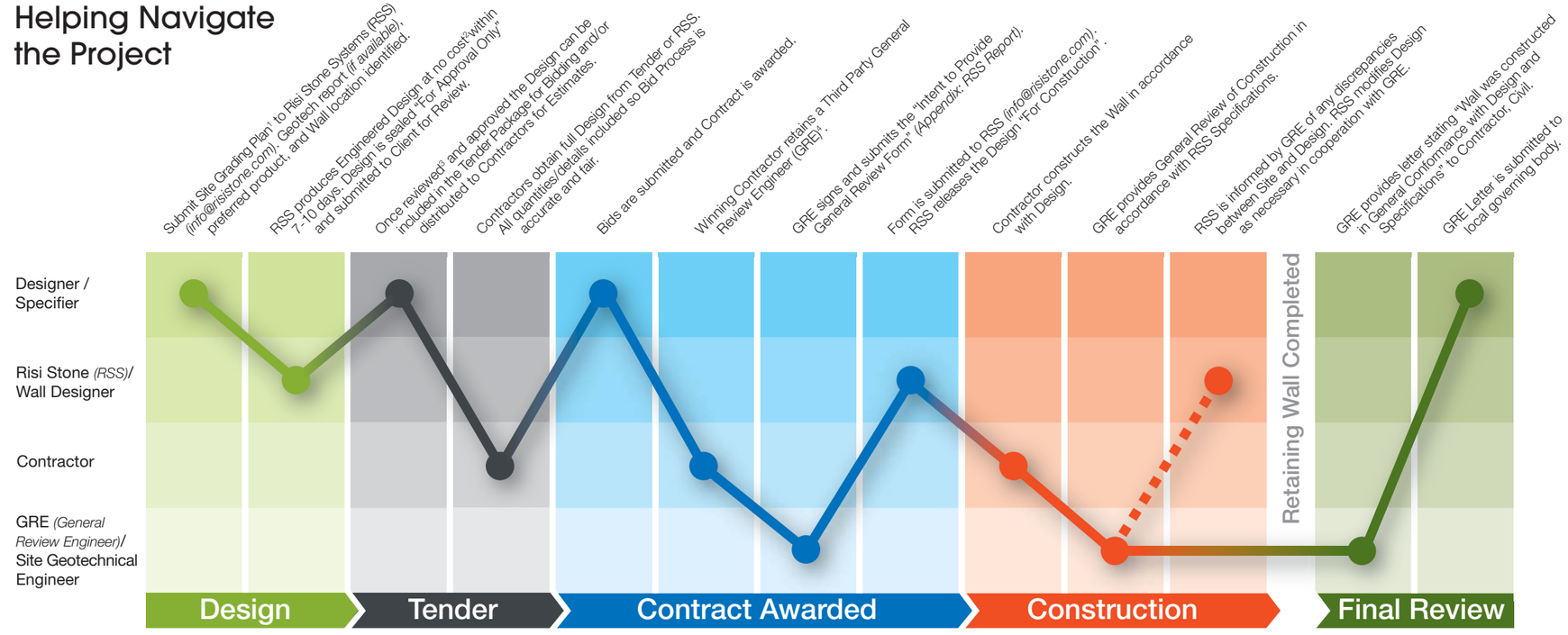
## Total Cost vs Block Cost

On any Wall Project, the actual cost of the block is approximately 25%-30% of the Total cost of the Installed Wall, therefore, minor differences in “block” price rarely have a significant impact on the Total Installed Wall Cost.

## Block Quality

Unilock blocks are the highest quality in the industry ensuring long term performace. With a minimum 5000 psi compressive strength and maximum 5% water absorption, our Systems are manufactured under the strictest quality control for proven long term durability and performance. Many other systems on the market are 2500-3000 psi compressive strength, are hollow, and require more labour time to place and level the units (core filling, shimming due to dimensional problems, addition of connectors). In the end, the “cheaper” alternative ends up costing about the same, but more of the project dollars are directed into the labour costs to install the block, not the quality of the block itself. And remember, it is the Block that will be there for the next 75+ years. The laborer leaves the site after the job is done.

## Helping Navigate the Project




[1] If you are requiring a Fully Engineered Wall Design, please provide us with what you consider to be a “Final” grading plan, so that we do not incur numerous and costly revisions as you continually revise the Plan. We appreciate it!
[2] A nominal fee is charged to the Contractor who is awarded the Project. For very complex Designs, with multiple revisions, a subsidized Design Fee may be negotiated between Risi Stone and the Client for Wall Design Services.
[3] Wall Design is not reviewed with respect to Structural Stability, Compliance with the Building Code, etc. Review is only to ensure the Design, as shown, fits within the constraints (space, property lines) of your Project and meets the Grading Plan requirements. RSS is the Structural Designer of the Wall and take full responsibility for the Wall Design.
[4] Ideally, the GRE is the same individual or firm providing Geotechnical Inspection on the Site. The GRE is not responsible to review the Design for Structural adequacy; they are only to ensure that the Wall is being constructed in General Conformance with the Design.

## Appearance