**Soil Engineers Ltd.**
CONSULTING ENGINEERS
GEOTECHNICAL • ENVIRONMENTAL • HYDROGEOLOGICAL • BUILDING SCIENCE
90 WEST BEAVER CREEK ROAD, SUITE 100, RICHMOND HILL, ONTARIO L4B 1E7 · TEL: (416) 754-8515 · FAX: (905) 881-8335

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| TEL: (705) 721-7863 | TEL: (905) 542-7605 | TEL: (905) 440-2040 | TEL: (905) 853-0647 | TEL: (705) 684-4242 | TEL: (905) 777-7956 |
| FAX: (705) 721-7864 | FAX: (905) 542-2769 | FAX: (905) 725-1315 | FAX: (905) 881-8335 | FAX: (705) 684-8522 | FAX: (905) 542-2769 |

April 30, 2024 Reference No. 2006-S167



Balbir Babra & Harvinder Babra
45 Timberlane Drive
Brampton, Ontario
L6Y 4B3

Attention: Mr. Balbir Babra

**Re: Armourstone Retaining Wall Design**
**Proposed Residential Development**
**44-45 Longview Place**
**City of Mississauga**

Dear Sir:

In accordance with the written authorization of Mr. Harminder Singh dated December 14, 2023, we have reviewed the site grading and servicing plan, in conjunction with the previous soil report (Ref. No. 2006-S167) prepared by Soil Engineers Ltd. and herein present our Armourstone Retaining Wall Design.

## Site Description

Based on the Site Grading and Servicing Plan (Project No. 219-M117 – Dwg. Nos. C101 and 102), prepared by Skira & Associates Ltd., dated November 23, 2023, the retaining wall is proposed at the terminus of a common access laneway, in front of the proposed Building 2, having an approximate length of 25 m and a maximum height of 1.8 m. The location of the proposed retaining wall and design cross sections are presented on Drawing No. 1.

## Wall Design

The wall system is designed using Armourstone units, having dimensions of 0.45 m (H) x 1.00 m (W), 0.40 m (H) x 1.00 m (W) and 0.40 m (H) x 1.75 m (W), with the length of stone units varying between 1.50 m and 2.50 m. The wall design was carried out based on the following information:

Gradient above the wall: flat
Gradient below the wall: maximum 3H:1V
Embedment depth: minimum 0.20 m
Wall Inclination: vertical

A design surcharge load of 6 kPa is applied at the top of the retaining wall, representing snow load and live load behind the top of wall. Details can be found in the typical wall details presented on Drawing No. 1.

## Stability Analysis

The stability of the retaining wall is designed to have minimum factors of safety (FOS) of 1.5 and 2.0 against sliding and overturning failures. Furthermore, the global stability of the wall is also analyzed using force-moment-equilibrium criteria at the most critical section of the wall. The soil shear strength parameters used for the design and stability analysis are summarized in the following table.

| **Material Type** | **Unit Weight γ (kN/m$^3$)** | **Cohesion c' (kPa)** | **Internal Friction Angle Ø'** |
|---|---|---|---|
| Engineered Fill | 20.0 | 0 | 28º |
| Native Soil | 22.0 | 5 | 30º |
| Armourstone Wall | 24.0 | 200 | 45º |
| Infill: Granular 'B' | 21.0 | 0 | 35º |
| Leveling Pad: Granular 'A' | 21.0 | 0 | 38º |

Based on the analytical result, the proposed retaining wall will have FOS exceeding 1.5 against global stability failure and is considered geotechnically acceptable. The result of the analysis is presented on Drawing No. 2.

**Wall Construction**

All excavation should be carried out in accordance with Ontario Regulation 213/91.

The design bearing pressure exerted onto the foundation soil at the base of retaining walls are anticipated to be 50 kPa (SLS). The founding subgrade must consist of undisturbed native subsoil or engineered fill. It must be inspected by a geotechnical engineer to ensure that it is suitable for providing the specified allowable bearing pressure.

In preparation of the subgrade, any topsoil, loose earth fill or weathered soil must be completely removed. Any soft or loose areas must be subexcavated and replaced with inorganic fill, compacted to at least 98% SPDD.

The retaining wall will be erected on a 200 mm thick leveling pad consisting of Granular 'A', compacted 100% Standard Proctor Dry Density (SPDD). The backfill behind the wall should consist of Granular 'B' compacted to at least 98% SPDD, placed in lift no more than 200 mm in thickness. A perforated subdrain wrapped with filter sock, connected to a positive outlet, is to be provided at the base of the wall. A non-woven geotextile filter fabric is to be installed between the retaining wall, the granular backfill and the retained soil, to prevent the migration or loss of fine particles.

Any gaps or voids between and behind the Armourstone retaining wall units should be filled with gabion stones with a filter-cloth behind the wall to prevent the washout of infill material.

Since the embedment depth of the wall is less than the regional frost depth of 1.2 m, minor wall movement resulting from frost heave during the cold weather is expected, and routine maintenance may be required. However, since the Armourstone retaining wall is relatively flexible in nature, minor frost heave movement would not jeopardize the structural integrity of the wall.

Where fences are proposed and installed on the wall; it is recommended that the fence loading will be independent from the retaining wall where the foundation of the fence will be founded at or below the wall subgrade.

It should be noted that engineering inspection and material testing must be performed to ensure the construction of the wall is completed as per the design specification and for the issuance of the as-built certification.

We trust this letter satisfies your present requirements; however, should any queries arise, please feel free to contact this office.

Yours truly,
**SOIL ENGINEERS LTD.**

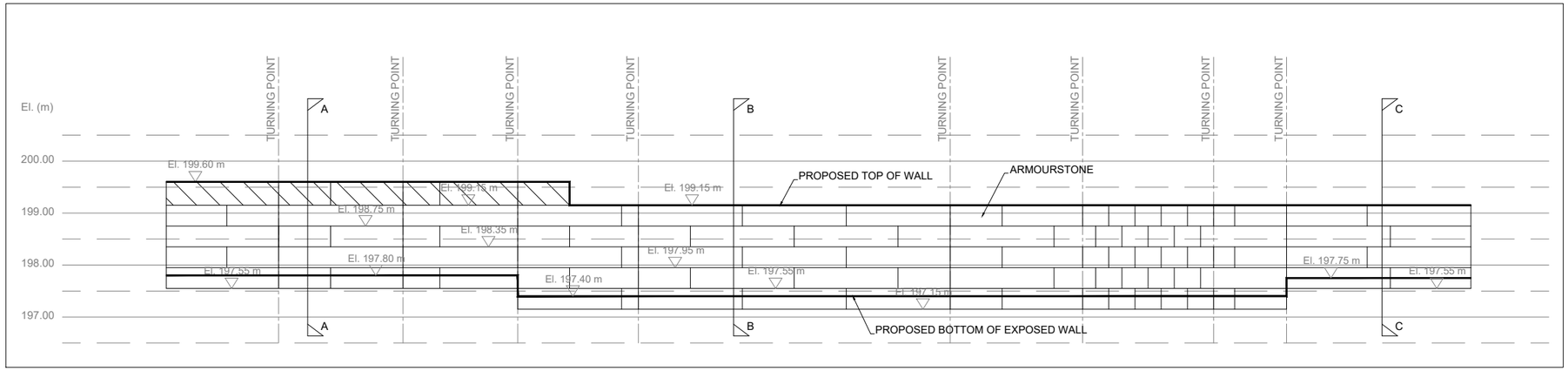

Poh Fung Kwok, M.Sc.

Kin Fung Li, P.Eng.

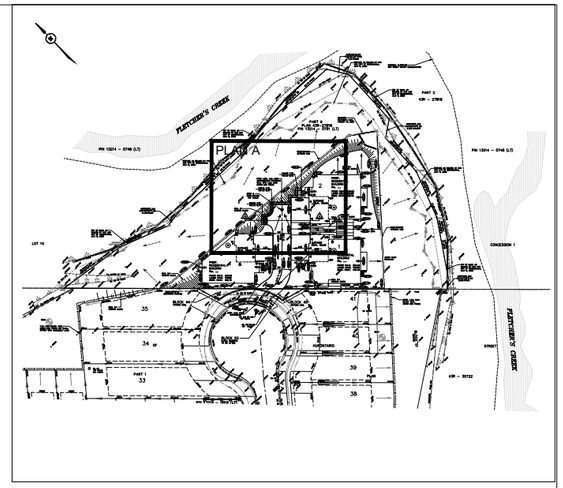
PK/KL

**ENCLOSURES**

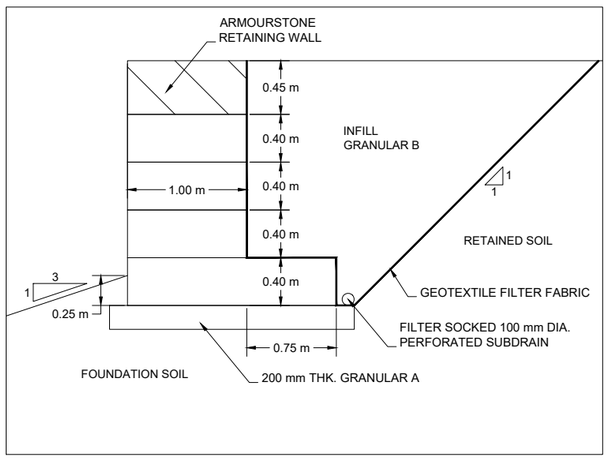
Location Plan and Wall Details ..... Drawing No. 1
Global Stability Analysis ..... Drawing No. 2



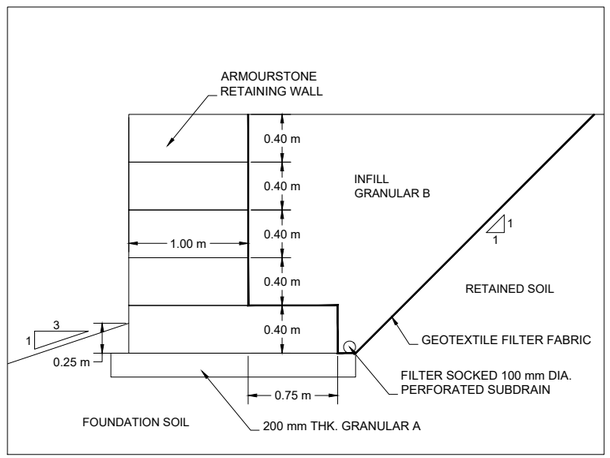

## ELEVATION
1:100



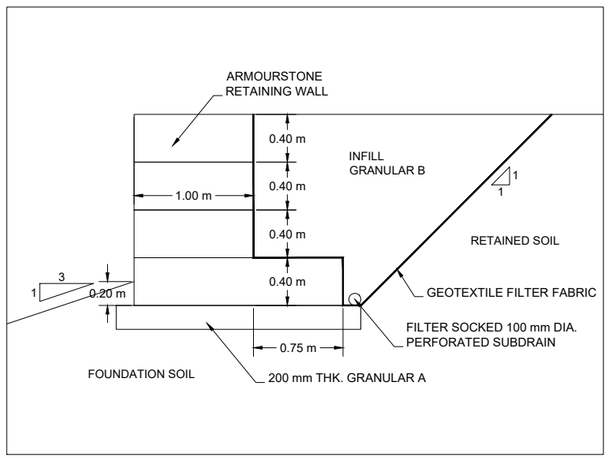

## SITE PLAN
1:2000



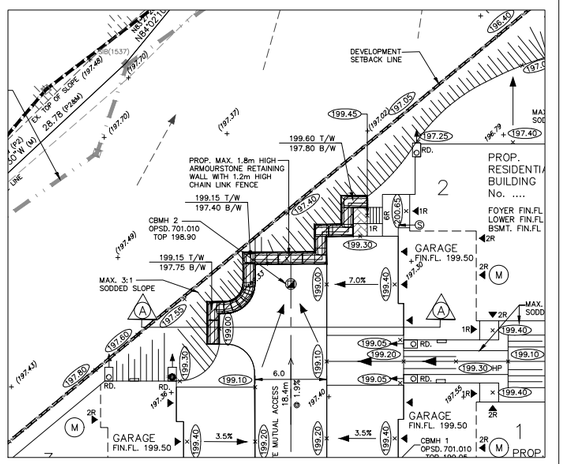

## SECTION A-A
1:50




## SECTION B-B
1:50




## SECTION C-C
1:50




## PLAN A
1:500

GENERAL NOTE:

1. EXCAVATION SHOULD BE IN COMPLIANCE WITH O.REG. 213/91. WHERE SAFE SLOPED EXCAVATION CANNOT BE ACHIEVED, TEMPORARY SHORING
2. NO WALL BATTER IS REQUIRED FOR THE RETAINING WALL AS ILLUSTRATED ON SECTION A, B AND C.
3. THE RETAINING WALL SHOULD BE FOUNDED ON UNDISTURBED NATIVE SOIL OR ENGINEERED FILL CAPABLE OF SUPPORTING THE DESIGN SOIL BEARING PRESSURE 100 kPa.
4. THE LEVELING PAD, 200mm THICK, SHOULD CONSIST OF GRANULAR 'A' COMPACTED TO AT LEAST 100% OF ITS SPDD IN LIFTS NO MORE THAN 200 MM THICK.
5. THE INFILL BEHIND THE WALL SHOULD CONSIST OF GRANULAR 'B' COMPACTED TO AT LEAST 98% OF ITS SPDD IN LIFTS NO MORE THAN 200 MM THICK.
6. PERFORATED SUBDRAIN SHOULD BE WRAPPED IN FILTER SOCKS AND CONNECTED TO POSITIVE OUTLETS.
7. ANY LARGE GAP OR VOIDS BETWEEN THE ARMOURSTONE UNITS AT THE BACK OF THE WALL WILL NEED TO BE FILLED WITH SMALLER RIP-RAP OR GABION SIZED STONES.
8. A GEOTEXTILE FABRIC FILTER, TERRAFIX 270R OR EQUIVALENT, SHOULD BE PLACED BETWEEN IN RETAINING WALL AND THE INFILL, AND BETWEEN THE INFILL AND THE RETAINED SOIL.
9. WHERE APPLICABLE, TOPSOIL, TYP. 300 MM IN THICKNESS, SHOULD BE EITHER SEEDED OR SODDED AND MUST BE COVERED WITH EROSION CONTROL BLANKET PRIOR TO VEGETATION GROWTH.
10. THIS DRAWING SHOULD BE READ IN CONJUNCTION WITH THE LETTER REPORT DATE APRIL 30, 2024 (REFERENCE NO. 2006-S167).

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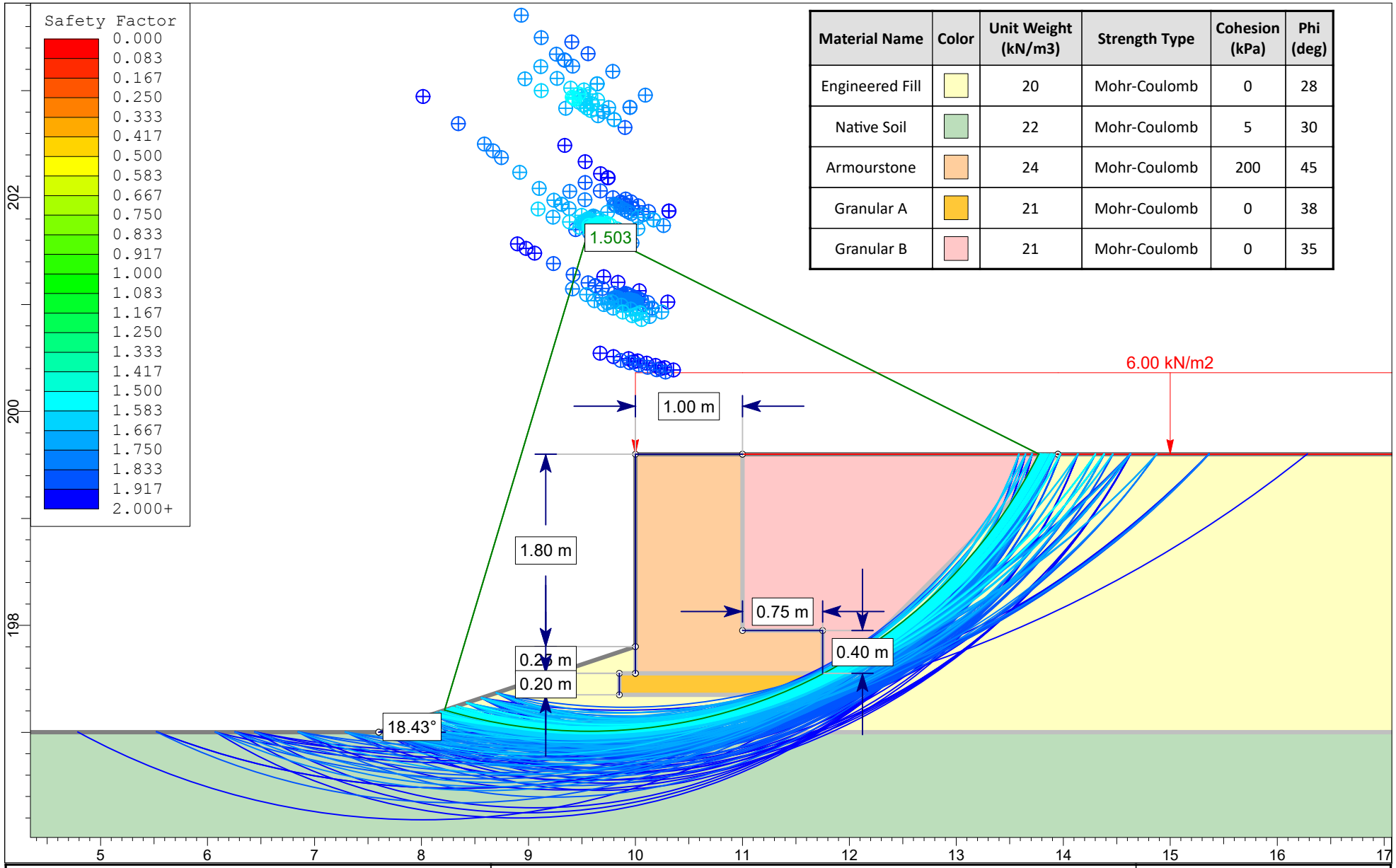
# Armourstone Retaining Wall Design

| | | | |
|---|---|---|---|
| **SITE:** 44-45 Longview Place, City of Mississauga | | | |
| **DESIGNED BY:** P.K. | **CHECKED BY:** K.L. | **DWG NO.:** 1 | |
| **SCALE:** As Shown | **REF. NO.:** 2006-S167 | **DATE:** April 2024 | **REV** - |




| Material Name | Color | Unit Weight (kN/m3) | Strength Type | Cohesion (kPa) | Phi (deg) |
|---|---|---|---|---|---|
| Engineered Fill | | 20 | Mohr-Coulomb | 0 | 28 |
| Native Soil | | 22 | Mohr-Coulomb | 5 | 30 |
| Armourstone | | 24 | Mohr-Coulomb | 200 | 45 |
| Granular A | | 21 | Mohr-Coulomb | 0 | 38 |
| Granular B | | 21 | Mohr-Coulomb | 0 | 35 |

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| | | | |
|---|---|---|---|
| Project Title: Proposed Residential Development | | | Load Case: Retaining Wall Design |
| Location: 44-45 Longview Place, City of Mississauga | | | |
| Drawn By: P.K. | Checked By: K.L. | Scale: 1:50 | Revision: - |
| Date: April 2024 | | Reference No.: 2006-S167 | Drawing No.: 2 |