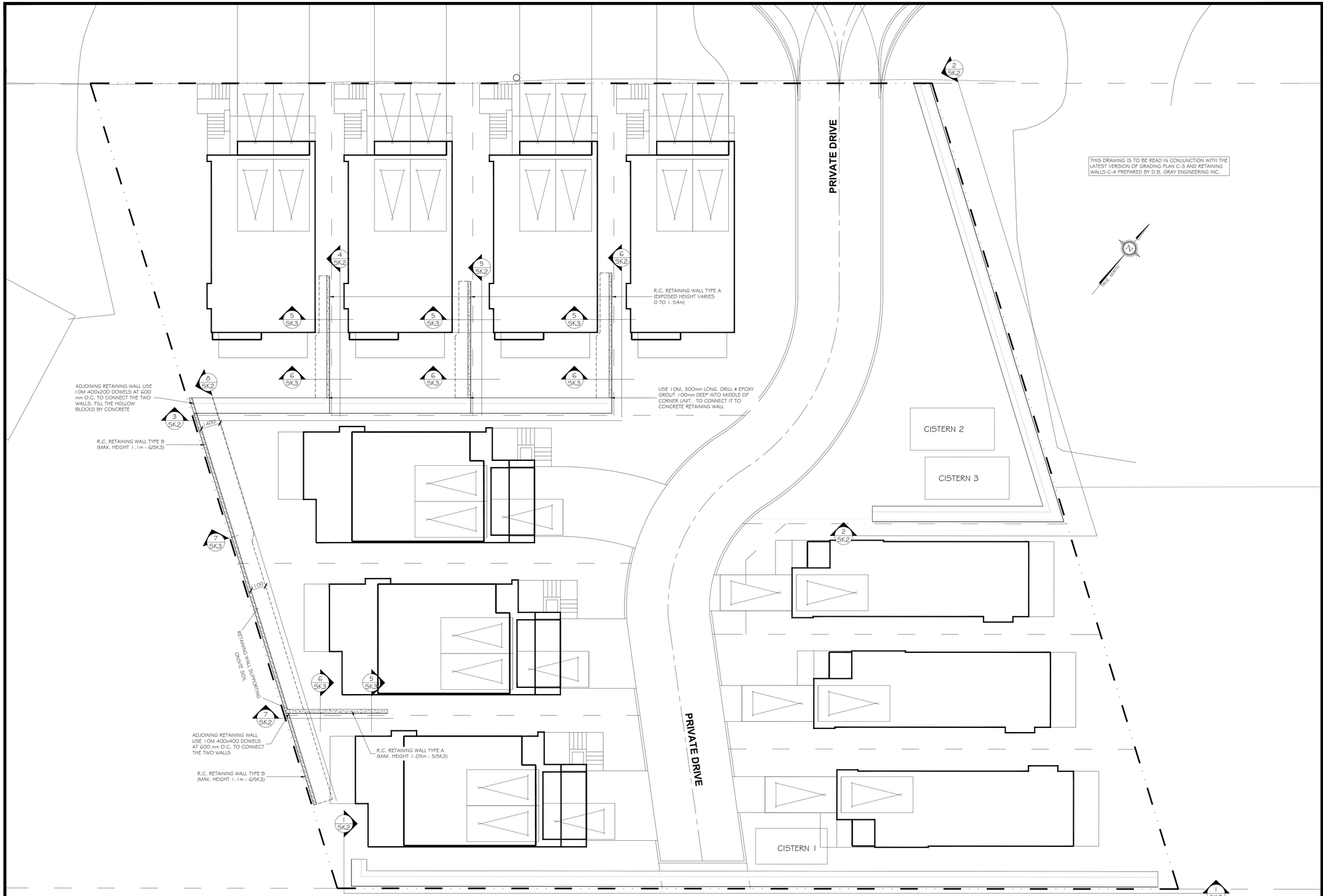


1 SK1 RETAINING WALL LOCATION PLAN 1:125

1:125

5m 0 5m 10m 15m 20m 25m

REVISED FOR SITE PLAN CONTROL APPROVAL APPLICATION	MARCH 11, 2021
ISSUE FOR PERMIT	MAY 27, 2020
REVISION	DATE

LAMPKIN
Structural Services Ltd.
34– 5330 CANOTEK ROAD
OTTAWA, ONTARIO K1J 9C4
PHONE: (613) 745–6437

CLIENT

NIVO DEVELOPMENTS INC.

PROJECT

1164-1166 HIGCROFT DRIVE

OTTAWA ONTARIO

TITLE

NEW RETAINING WALL

PROJECT #	DRAWN BY	DRAWN BY
20-14289	R.L.	R.H.

STAMP

LICENSED PROFESSIONAL ENGINEER
R. HASHEMIAN
100219333
11/03/2021
PROVINCE OF ONTARIO

SCALE AS NOTED

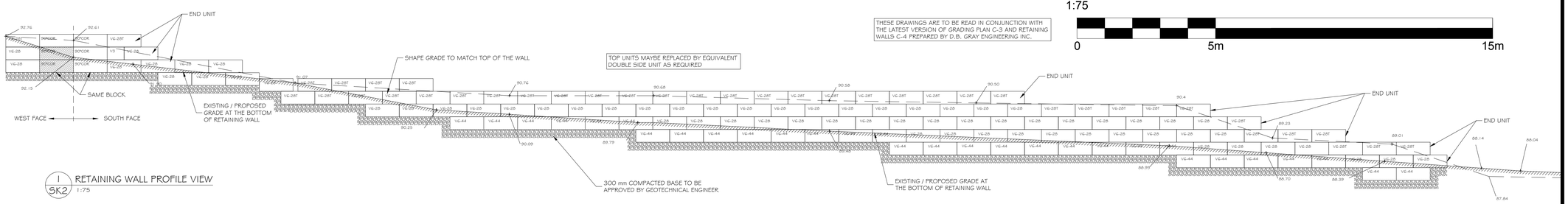
DATE 11/03/2021

DRAWING # SK1

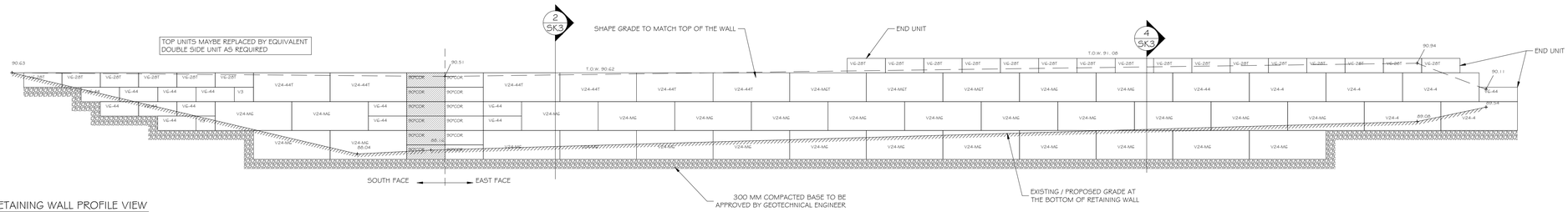
THESE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF GRADING PLAN C-3 AND RETAINING WALLS C-4 PREPARED BY D.B. GRAY ENGINEERING INC.

1:75

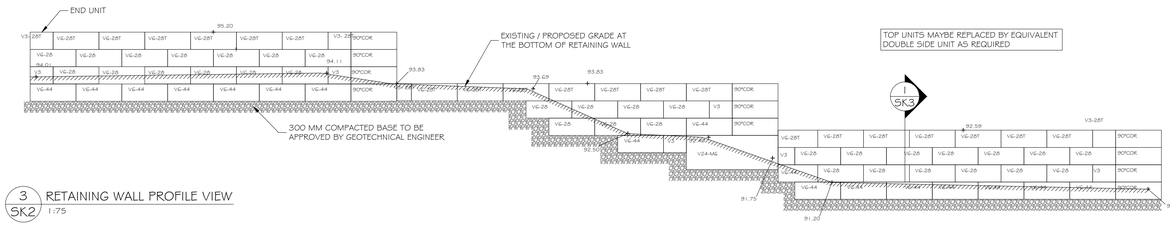
0 5m 15m



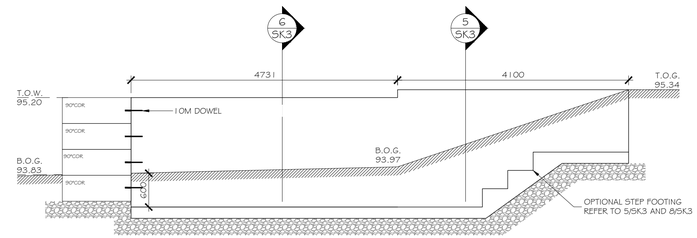
1 / SK2 RETAINING WALL PROFILE VIEW
1:75



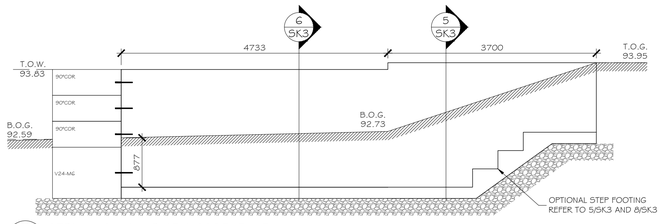
2 / SK2 RETAINING WALL PROFILE VIEW
1:75



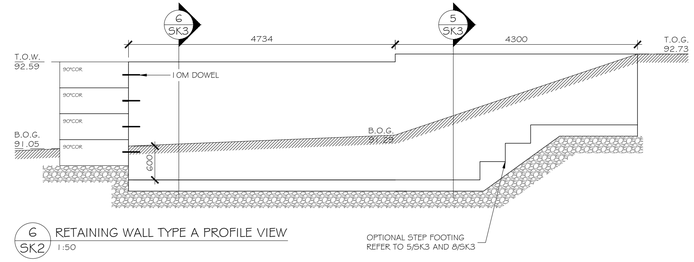
3 / SK2 RETAINING WALL PROFILE VIEW
1:75



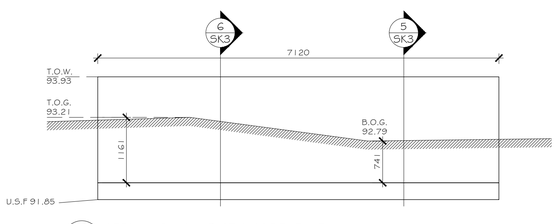
4 / SK2 RETAINING WALL TYPE A PROFILE VIEW
1:50



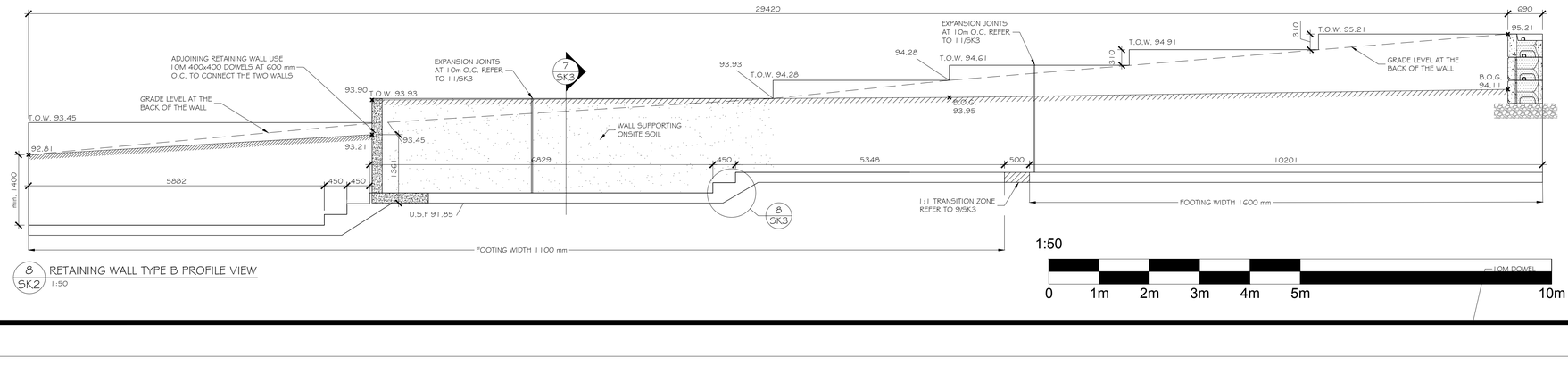
5 / SK2 RETAINING WALL TYPE A PROFILE VIEW
1:50



6 / SK2 RETAINING WALL TYPE A PROFILE VIEW
1:50



7 / SK2 RETAINING WALL TYPE A PROFILE VIEW
1:50



8 / SK2 RETAINING WALL TYPE B PROFILE VIEW
1:50

1:50

0 1m 2m 3m 4m 5m 10m

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PROJECT

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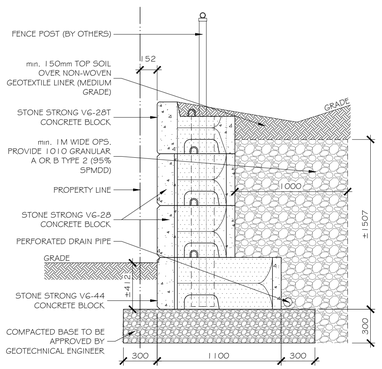
LICENSED PROFESSIONAL ENGINEER
R. HASHEMIAN
100219333
11/03/2021
PROVINCE OF ONTARIO

SCALE AS NOTED

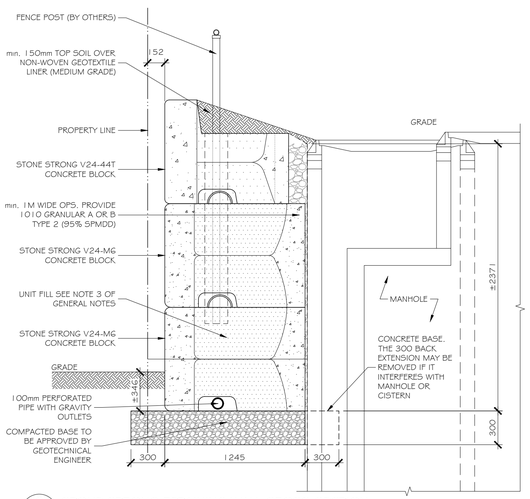
DATE 11/03/2021

DRAWING # SK2

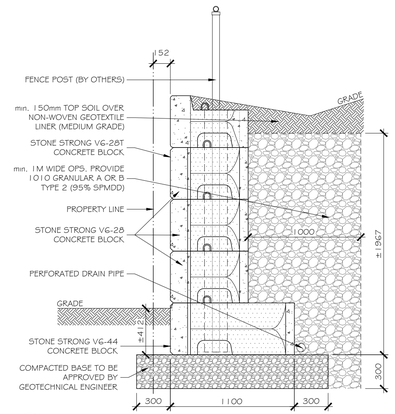
THESE DRAWINGS ARE TO BE READ IN CONJUNCTION WITH THE LATEST VERSION OF GRADING PLAN C-3 AND RETAINING WALLS C-4 PREPARED BY D.B. GRAY ENGINEERING INC.



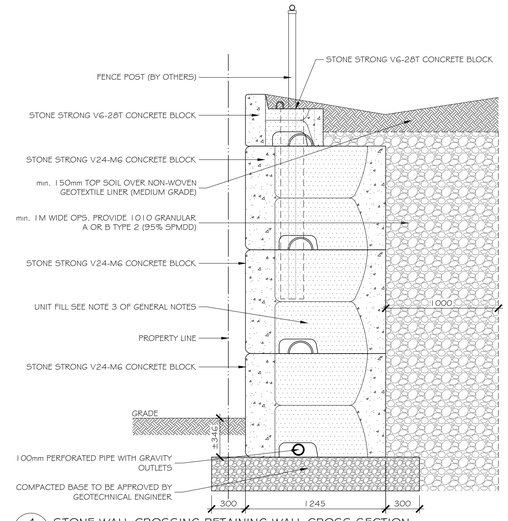
1 SK3 STONE STRONG RETAINING WALL CROSS SECTION
1:25



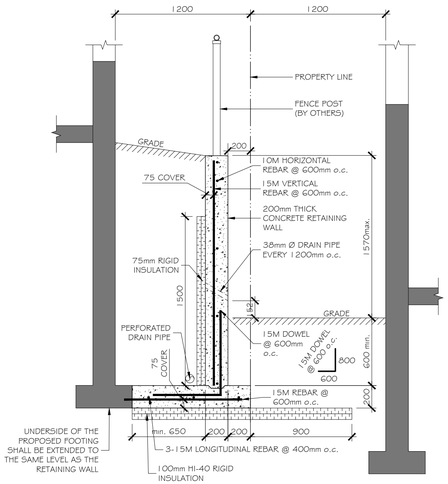
2 SK3 STONE STRONG RETAINING WALL CROSS SECTION
1:25



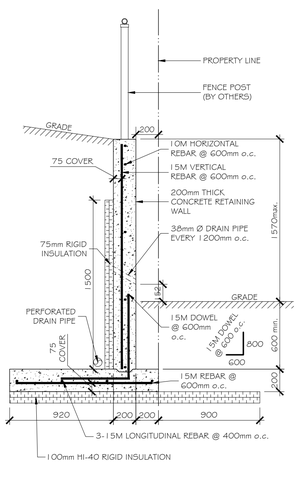
3 SK3 STONE STRONG RETAINING WALL CROSS SECTION
1:25



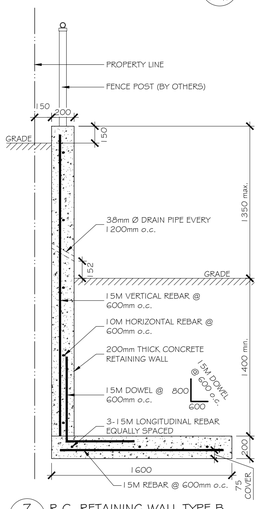
4 SK3 STONE WALL CROSSING RETAINING WALL CROSS SECTION
1:25



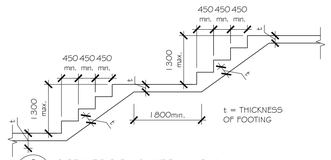
5 SK3 R. C. RETAINING WALL TYPE A #1
1:25



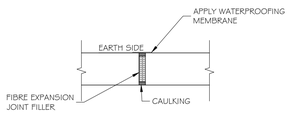
6 SK3 R. C. RETAINING WALL TYPE A #2
1:25



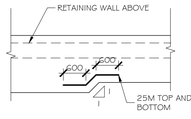
7 SK3 R.C. RETAINING WALL TYPE B
1:25



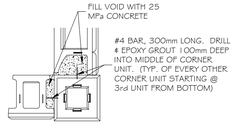
8 SK3 STEP FOOTING DETAIL (TYP.)
1:75



11 SK3 PLAN EXPANSION JOINT DETAIL
1:75



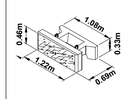
9 SK3 FOOTING WIDTH TRANSITION DETAIL PLAN (TYP.)
1:75



10 SK3 90° CORNER TIEBACK
N.T.S.

STONE STRONG V3-44 UNIT

STONE STRONG V6-28 TOP UNIT

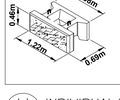


STONE STRONG V24-44 UNIT

STONE STRONG V24-44 UNIT

STONE STRONG V24-M6 UNIT

STONE STRONG V6-28 UNIT



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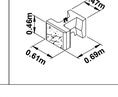
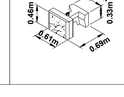
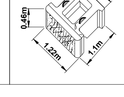


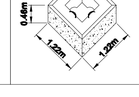
STONE STRONG V3-28 TOP UNIT



STONE STRONG V6-44 UNIT



90° CORNER UNIT



11 SK3 INDIVIDUAL UNITS VIEW
N.T.S.

GENERAL NOTES:

1) ANY DEVIATION FROM CONDITIONS SHOWN ON THESE DRAWINGS, SHALL BE REPORTED TO THE ENGINEER.

2) DESIGN LOADS:

SOIL PRESSURE Kp=3.0
Ka=.33
δ =20kN/m³
SURCHARGE (q) = 3.6 kPa
LATERAL LOAD ON FENCE (LL) = 0.75 kN/m
FACTOR OF SAFETY: 1.5

SEISMIC:
PEAK GROUND ACCELERATION = 0.28G
SITE CLASS D

3) MATERIALS:
A) CONCRETE STRENGTH AT 28 DAYS TO BE 28 MPa w/ 5% TO 8% AIR ENTRAINMENT.
B) REINFORCING STEEL TO BE DEFORMED TYPE Fy = 400 Mpa
C) UNIT FILL SHALL BE CLEAN COURSE GRANULAR MATERIAL. UNIT FILL SHALL FILL CAVITIES WITHIN ABD BETWEEN THE UNITS
D) STONE STRING (S, S.) BLOCKS AS SHOWN IN SECTION DETAILS.

4) ALL WORK TO BE CONDUCTED IN ACCORDANCE WITH THE ONTARIO BUILDING CODE (2012).

5) ALL CONCRETE WORK TO BE CONDUCTED IN ACCORDANCE WITH CSA A23.3-19.

6) SOIL BEARING TO BE 90kPa AS PER GEOTECHNICAL REPORT DATED FEB. 22, 2019 BY LRL ASSOCIATES LTD.

7) SITE REVIEW OF STRUCTURAL ITEMS, AS NOTED ON THESE DRAWINGS, SHALL BE COORDINATED WITH LAMPKIN STRUCTURAL SERVICES LTD. THROUGH THE DURATION OF THE PROJECT.

8) PROVIDE 75mm CONCRETE COVER FOR REBAR

9) min. LAP LENGTH TO BE 800mm FOR 15M & 500mm FOR 10M.

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OTTAWA, ONTARIO K1J 9C4
PHONE: (613) 745–6437

CLIENT
NIVO DEVELOPMENTS INC.

PROJECT
1164-1166 HIGCROFT DRIVE
OTTAWA ONTARIO

TITLE
NEW RETAINING WALL

PROJECT #	DRAWN BY	DRAWN BY
20-14289	R.L.	R.H.

STAMP
LICENSED PROFESSIONAL ENGINEER
R. HASHEMIAN
100219333
11/03/2021
PROVINCE OF ONTARIO

SCALE AS NOTED
DATE 11/03/2021
DRAWING # SK3

INPUTS

PROJECT NAME **1164-1166 HIGCROFT DRIVE - TYPE A**

Wall Geometry

Height of Wall stem:	H=	7.12	ft
Thickness of Base:	t=	8	in
Width of wall @ Top:	t_1=	8	in
Width of wall @ Base:	t_2=	8	in
Length of heel	t_3=	36	in
Length of toe	t_4=	8	in
Width of Base:	B=	4.33	ft
depth of shear key	d=	0	in
width of shear key	t_5=	0	in
Weight of Wall	W_1=	712.00	lb/ft
	W_2=	0.00	lb/ft
Weight of Base	W_3=	433.33	lb/ft
	a_1=	1.00	ft
	a_2=	3.67	ft
	a_3=	2.17	ft
Weight of Shear-key	W_8=	0.00	lb/ft

Soil Information

Height of soil above heel	H_1=	7.00	ft
Height of soil above toe	H_p=	2.00	ft
Unit weight of soil:	γ_a=	100	lb/ft^3
	γ_p=	100	lb/ft^3
Active earth-pressure coeff	K_a=	0.33	
Weight of soil above heel	W_4=	2100	lb/ft
	a_4=	2.83	ft
Weight of soil above toe	W_5=	133.33	lb/ft
	a_5=	0.33	ft
Resultant Horiz. Active Force	P_{H1}=	969.83	lb/ft ($K_a * \gamma * H_1 * H_1/2$)
height of resultant	h_{p1}=	2.56	ft ($H_1+t_1/3$ above base)
Passive earth-pressure coeff	K_p=	3	
Resultant Horiz. Passive Force	P_{Hp}=	1066.67	lb/ft ($K_p * \gamma * H_p * H_p/2$)
height of resultant	h_p=	0.89	ft ($H_p+t_1/3$ above base)
Coefficient of friction	tan δ=	0.4	

Soil Type	**tan δ**
GW, GP, SW	0.55
SP, SM, GC, GM	0.45
ML, SC	0.35
CL (very stiff to hard)	0.4

Surcharge Loading

Uniform surcharge	q=	75	lb/ft^2
Resultant horiz. force	P_{H2}=	189.75	lb/ft ($K_a * q * H_1$)
height of resultant:	h_{p2}=	3.83	ft ($H_1/2$ above base)
Weight of surcharge above heel	W_6=	225.00	lb/ft
	a_6=	2.83	ft

Uniform dead loads on wall	W_7=	0.00	lb/ft
Line load	Q_L=	0	lb/ft
distance from wall:	x_3=	0.8333333	ft
x_3/H_1	m_3=	0.12	
Resultant horiz. force	P_{H3}=	0	lb/ft
height of resultant:	h_{p3}=	9.00	ft (above base)
Point load	Q_P=		lb
distance from wall:	x_4=		ft
x_4/H_1	m_4=		
Resultant horiz. force	P_{H4}=		lb
height of resultant:	h_{p4}=		ft (above base)

OUTPUTS

Total weight of retaing wall	W=	3603.67	lb/ft
	β	0.21	
	λ	1.00	
	Φc	0.65	
	fc	28.00	Mpa
	dv	128.20	mm
Resistance to Punch Shear		6232.33	lb
Punch Shear		536.25	lb
Sliding Factor of Safety	F_S=	11.62	
Resistance to sliding	F=	2508.13	lb/ft (P_{Hp}+W_{1-8} * tan δ)
Sliding force (P_{H1}+P_{H2}+P_{H3})	P_H=	1159.58	lb/ft (not including point load surcharge)
Sliding Factor of Safety	F_S=	2.16	if < 2.0 make wall larger or provide other resistance
Resisting moment	M_{RM}=	8282.83	ft-lb/ft
Overturning moment	M_{OT}=	3205.84	ft-lb/ft
Overturning Factor of Safety	F_M=	2.58	if < 1 make wall larger ;if < 2 make wall larger or reinforce wall for $2M_{OT}$ - M_{RM}
$2M_{OT}$ - M_{RM}	=	-1871.16	ft-lb/ft
	B/6=	0.72	ft
Limits: location resultant force	1.44	< d <	2.89 (idealy wa
Location of resultant force	d=	1.41	ft (from toe of wall)
eccentricity in base	e=	0.76	ft (B/2-d)
Effective base width	B'=	2.82	ft (B-2e)
Moment in base (W_{1-6}*e)	M_{base}=	2730.95	ft-lb/ft (design for ($2M_{OT}$ - M_{RM}) if larger)
Required soil bearing capacity using effective footing width	q_a=	1278.9467	lb/ft^2 (Min.) (W_{1-6}/B')
using P/A + M/S	q_{max}=	1704.2263	lb/ft^2
	q_{min}=	-40.995562	lb/ft^2

INPUTS

PROJECT NAME **1164-1166 HIGCROFT DRIVE - TYPE B**

Wall Geometry

Height of Wall stem:	H=	8.20	ft
Thickness of Base:	t=	8	in
Width of wall @ Top:	t_1=	8	in
Width of wall @ Base:	t_2=	8	in
Length of heel	t_3=	0	in
Length of toe	t_4=	55	in
Width of Base:	B=	5.25	ft
depth of shear key	d=	0	in
width of shear key	t_5=	0	in
Weight of Wall	W_1=	820.00	lb/ft
	W_2=	0.00	lb/ft
Weight of Base	W_3=	525.00	lb/ft
	a_1=	4.92	ft
	a_2=	4.58	ft
	a_3=	2.63	ft
Weight of Shear-key	W_8=	0.00	lb/ft

Soil Information

Height of soil above heel	H_1=	9.00	ft
Height of soil above toe	H_p=	4.60	ft
Unit weight of soil:	γ_a=	100	lb/ft^3
	γ_p=	100	lb/ft^3
Active earth-pressure coeff	K_a=	0.33	
Weight of soil above heel	W_4=	0	lb/ft
	a_4=	5.25	ft
Weight of soil above toe	W_5=	2108.33	lb/ft
	a_5=	2.29	ft
Resultant Horiz. Active Force	P_{H1}=	1541.83	lb/ft ($K_a * \gamma * H_1 * H_1/2$)
height of resultant	h_{p1}=	3.22	ft ($H_1+t_1/3$ above base)
Passive earth-pressure coeff	K_p=	3	
Resultant Horiz. Passive Force	P_{Hp}=	4160.67	lb/ft ($K_p * \gamma * H_p * H_p/2$)
height of resultant	h_p=	1.76	ft ($H_p+t_1/3$ above base)
Coefficient of friction	tan δ=	0.4	

Soil Type	**tan δ**
GW, GP, SW	0.55
SP, SM, GC, GM	0.45
ML, SC	0.35
CL (very stiff to hard)	0.4

Surcharge Loading

Uniform surcharge	q=	75	lb/ft^2
Resultant horiz. force	P_{H2}=	239.25	lb/ft (K_a * q * H_1)
height of resultant:	h_{p2}=	4.83	ft (H_1/2 above base)
Weight of surcharge above heel	W_6=	0.00	lb/ft
	a_6=	5.25	ft
Uniform dead loads on wall	W_7=	0.00	lb/ft
Line load	Q_L=	100	lb/ft
distance from wall:	x_3=	0.8333333	ft
x_3/H_1	m_3=	0.09	
Resultant horiz. force	P_{H3}=	55	lb/ft
height of resultant:	h_{p3}=	11.20	ft (above base)
Point load	Q_P=		lb
distance from wall:	x_4=		ft
x_4/H_1	m_4=		
Resultant horiz. force	P_{H4}=		lb
height of resultant:	h_{p4}=		ft (above base)

OUTPUTS

Total weight of retaing wall	W=	3453.33	lb/ft

	β	0.21	
	λ	1.00	
	ϕc	0.65	
	fc	28.00	Mpa
	dv	128.20	mm
Resistance to Punch Shear		6232.33	lb
Punch Shear		428.34	lb
Sliding Factor of Safety	F_S=	14.55	

Resistance to sliding	F=	5542.00	lb/ft (P_{Hp}+W_{1-8} * tan δ)
Sliding force (P_{H1}+P_{H2}+P_{H3})	P_H=	1836.08	lb/ft (not including point load surcharge)
Sliding Factor of Safety	F_S=	3.02	if < 2.0 make wall larger or provide other resistance

Resisting moment	M_{RM}=	10241.39	ft-lb/ft
Overturning moment	M_{OT}=	6740.50	ft-lb/ft
Overturning Factor of Safety	F_M=	1.52	if < 1 make wall larger ;if < 2 make wall larger or reinforce wall for 2M_{OT} - M_{RM}

Bearing Capacity Check		
Soil bearing capacity	90.00	kPa
toe length	1.60	m
Height of exposed wall	1.35	m
Height of soil above toe	1.40	m
Base Depth	0.20	m
Unit weight of soil:	20.00	kn/m3
K_a	0.33	
K_p	3.00	
Resultant Horiz. Active Force	28.72	kN
Arm to pivot point	0.98	m
Weight of soil	44.80	kN
Arm to pivot point	0.80	m
Resultant Horiz. Passive Force	76.80	kN
Arm to pivot point	0.53	m
Required resisting moment from soil		
Force equilibrium in z		
Soil reaction	44.80	kN
Moment equilibrium about pivot point		
Resisting moment due to reaction	23.12	kN.m
Arm of soil reaction to Pivot	0.52	
Max stress below footing	82.19	ok
Min stress below footing	-26.19	

STONE STRONG GRAVITY CALCULATIONS - ver 5.9

Project Name: Nivo Developments Inc
Location: 1164-1166 Higcroft Dr.
Job#: 20-14289
Section: Stone Strong 1.6 m TYPE 1
Calc by: R.H.

(incorporates CAN/CSA-S6-06, Canadian Highway Bridge Design Code requirements)

3/8/21 13:52

Notes

Wall Configuration

			setback (mm)		modular units		unit fill		soil wedge		CIP Extension		
unit	w (mm)	h (m)	face	tail	Wb (kN)	xb (mm)	Wa (kN)	xa (mm)	Ws (kN)	xs (mm)	we (mm)	h_t	Internal
V6-28	686	0.46	0	-407	3.47	324	2.55	356	0.01	693			Internal Stability OK!
V6-28	686	0.46	0	-407	3.47	324	2.55	356	0.67	737			Internal Stability OK!
V6-28	686	0.46	0	-407	3.47	324	2.55	356	1.69	796			Internal Stability OK!
V6-28	686	0.46	0	-407	3.47	324	2.55	356	2.71	859			Internal Stability OK!
V6	1093	0.46	0	0	5.84	533	4.25	597	0.00	0			
													External Stability OK!
	1093	2.29	0	-407	19.70	386	14.46	427	5.08	822			

backfill height **1.90** m
exposed height 1.60 m

ω= 0.00 deg
ω'= -12.09 deg

interface friction angle
δ 22.5 deg

lateral load above wall **1** kN/m
height above top of wall **1** m

Retained Soil
γ **20** kN/m3
ϕ **30** deg

Foundation Soil
γ **20** kN/m3
ϕ **30** deg
c' kPa

base embedment **300** mm
base thickness **200** mm
base material **agg**
toe slope H:1V slope

bearing pressure **90** kPa
(if specified) (net)

Aggregate Unit Fill
γ **17.3** kN/m3

composite friction coefficient μ_b 0.69

STONE STRONG SYSTEMS®

STONE STRONG GRAVITY CALCULATIONS - ver 5.9

Project Name:	Nivo Developments Inc
Location:	1164-1166 Higcroft Dr.
Job#:	20-14289
Section:	Stone Strong 1.6 m TYPE 1
Calc by:	R.H.

3/8/21 13:52

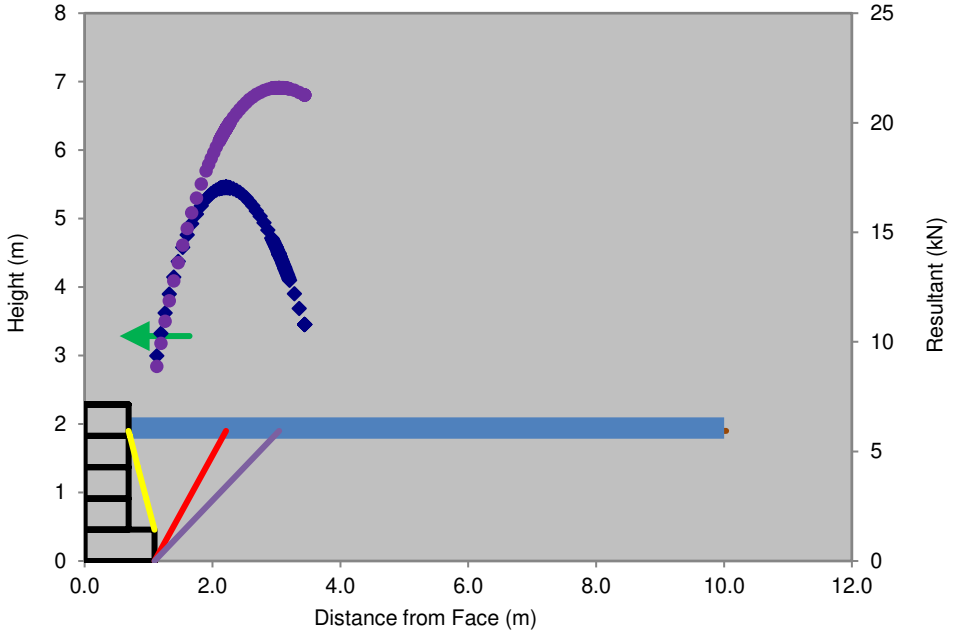
Seismic Load PGA 0.28 G site class (A to E or 1) D Fpga 1.24 Fa 1.58 k_h 0.21

Backfill Slope & Surcharge

		rise in grade	LL surcharge	tier height
length 1	10 m (horizontal)	0 m	3.6 kPa	m
length 2	m (horizontal)	m	kPa	m
length 3	m (horizontal)	m	kPa	m
length 4	m (horizontal)	m	kPa	

effective slope H:1V slope β 0.0 deg avg q 4 kPa

failure plane α 59.52 deg zone of influence 2.21 m



Ground Surface & Trial Wedge Plot

Unfactored Loads

K_a =	0.397	K_{AE} =	0.599
P_h =	11.80 kN	ΔK_{AE} =	0.201
P_v =	8.14 kN	P_{IR} =	8.35 kN
Q_{lh} =	1.86 kN	ΔP_{AEh} =	5.99 kN
Q_{lv} =	1.28 kN	ΔP_{AEv} =	4.13 kN

STONE STRONG SYSTEMS®

STONE STRONG GRAVITY CALCULATIONS - ver 5.9

Project Name: Nivo Developments Inc
Location: 1164-1166 Higcroft Dr.
Job#: 20-14289
Section: Stone Strong 1.6 m TYPE 1
Calc by: R.H.

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	Load Cases:	ULS 1-a	ULS 1-b	ULS 5-a (EQ)	ULS 5-b (EQ)	ULS 8 (Coll)	ULS 9	SLS 1	
Factored Loading	*Overturning (kN-m):*	12	12	18	19	11	9	9	**OK!**
	Sliding (kN):	18	18	21	23	13	15	13	**OK!**
	Bearing (kPa):	61	74	98	98	61	69	59	**OK!**
	e (m):	0.23	0.19	0.44	0.38	0.23	0.16	0.18	**OK!**
	Bf' (m):	0.84	0.90	0.42	0.53	0.83	0.98	0.93	
Factored Resistance	*Overturning (kN-m):*	27	34	22	27	26	34	28	
	Sliding (kN):	23	31	25	31	24	32	31	
	Bearing (kPa):	140	143	140	141	141	143	276	
	(@ top of base) Max e (m):	0.33	0.33	0.44	0.44	0.44	0.33	0.33	
Load & Resistance Factors	L	1.70	1.70	0.00	0.00	0.00	0.00	0.90	
	E	1.25	1.25	0.80	1.00	1.00	1.25	1.00	
	EQ	0.00	0.00	1.00	1.00	0.00	0.00	0.00	
	H	0.00	0.00	0.00	0.00	1.00	0.00	0.00	
	LL Surcharge over Wall	0.00	1.70	0.00	0.00	0.00	0.00	0.90	
	DC	0.95	1.10	0.80	1.00	1.00	1.35	1.00	
	DE	0.80	1.25	0.80	1.00	1.00	1.35	1.00	
	BC	0.50	0.50	0.50	0.50	0.50	0.50	1.00	
	ϕt precast to agg	0.80	0.80	1.00	1.00	0.80	0.80	1.00	
	ϕt CIP to agg/soil	0.80	0.80	1.00	1.00	0.80	0.80	1.00	
	ϕt soil to soil	0.80	0.80	1.00	1.00	0.80	0.80	1.00	
	ϕt precast to precast	0.80	0.80	1.00	1.00	0.80	0.80	1.00	
	concrete interface - eccentricity limit	0.30	0.30	0.40	0.40	0.40	0.30	0.30	
	bearing on soil - eccentricity limit	0.30	0.30	0.40	0.40	0.40	0.30	0.30	

STONE STRONG SYSTEMS®

STONE STRONG GRAVITY CALCULATIONS - ver 5.9

Project Name: Nivo Developments Inc
Location: 1164-1166 Higcroft Dr.
Job#: 20-14289
Section: Stone Strong 2.35 m
Calc by: R.H.

(incorporates CAN/CSA-S6-06, Canadian Highway Bridge Design Code requirements)

3/8/21 14:12

Notes

Wall Configuration

			setback (mm)		modular units		unit fill		soil wedge		CIP Extension		
unit	w (mm)	h (m)	face	tail	Wb (kN)	xb (mm)	Wa (kN)	xa (mm)	Ws (kN)	xs (mm)	we (mm)	h_t	Internal
V6	1093	0.46	0	-152	5.84	533	4.25	597	0.00	0			
V24	1093	0.91	0	-152	10.94	513	8.65	605	1.08	1144			Internal Stability OK!
V24-M6	1245	0.91	0	0	14.58	952	8.86	618	0.00	0			Internal Stability OK!
V24-M6	1245	0.91	0	0	14.58	952	8.86	618	0.00	0			
													External Stability OK!
	1245	3.20	0	-152	45.94	794	30.63	611	1.08	1144			

backfill height 2.65 m
exposed height 2.35 m

ω= 0.00 deg
ω'= -4.75 deg

interface friction angle
δ 22.5 deg

lateral load above wall 1 kN/m
height above top of wall 1 m

Retained Soil
γ 20 kN/m3
ϕ 30 deg

Foundation Soil
γ 20 kN/m3
ϕ 30 deg
c' kPa

base embedment 300 mm
base thickness 300 mm
base material agg
toe slope 5 H:1V slope

bearing pressure 90 kPa
(if specified) (net)

Aggregate Unit Fill
γ 17.3 kN/m3

composite friction coefficient μ_b 0.68

STONE STRONG SYSTEMS®

STONE STRONG GRAVITY CALCULATIONS - ver 5.9

Project Name:	Nivo Developments Inc
Location:	1164-1166 Higcroft Dr.
Job#:	20-14289
Section:	Stone Strong 2.35 m
Calc by:	R.H.

3/8/21 14:12

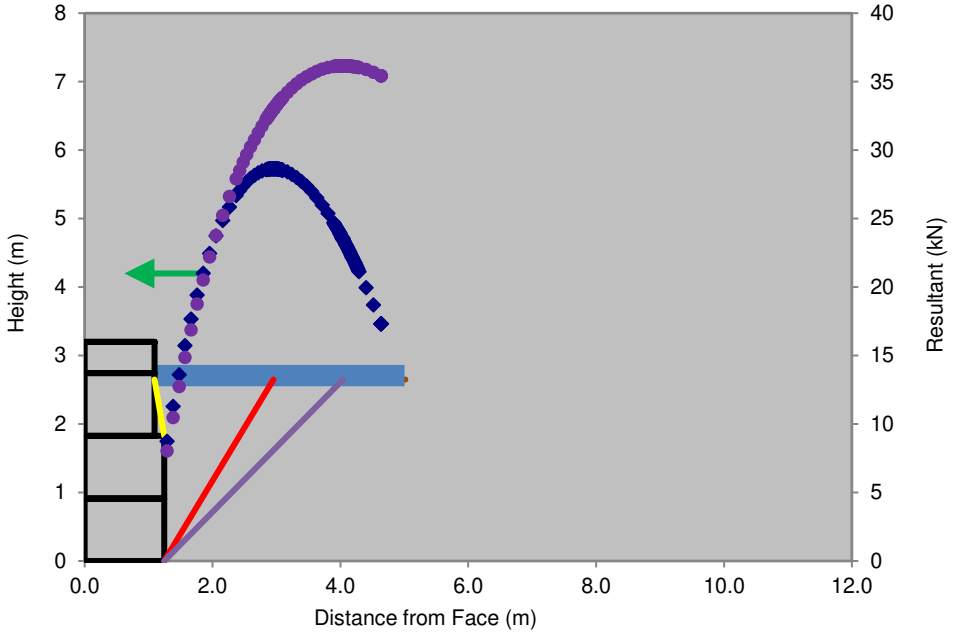
Seismic Load PGA 0.28 G site class (A to E or 1) D Fpga 1.24 Fa 1.58 k_h 0.21

Backfill Slope & Surcharge

		rise in grade	LL surcharge	tier height
length 1	5 m (horizontal)	0 m	6 kPa	m
length 2	m (horizontal)	m	kPa	m
length 3	m (horizontal)	m	kPa	m
length 4	m (horizontal)	m	kPa	

effective slope H:1V slope β 0.0 deg avg q 6 kPa

failure plane α 57.20 deg zone of influence 2.95 m



Ground Surface & Trial Wedge Plot

Unfactored Loads

K_a =	0.333	K_{AE} =	0.515
P_h =	20.76 kN	ΔK_{AE} =	0.182
P_v =	10.70 kN	P_{IR} =	16.49 kN
Q_{lh} =	4.66 kN	ΔP_{AEh} =	11.38 kN
Q_{lv} =	2.40 kN	ΔP_{AEv} =	5.86 kN

STONE STRONG SYSTEMS®

STONE STRONG GRAVITY CALCULATIONS - ver 5.9

Project Name: Nivo Developments Inc
Location: 1164-1166 Higcroft Dr.
Job#: 20-14289
Section: Stone Strong 2.35 m
Calc by: R.H.

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	Load Cases:	ULS 1-a	ULS 1-b	ULS 5-a (EQ)	ULS 5-b (EQ)	ULS 8 (Coll)	ULS 9	SLS 1	
Factored Loading	*Overturning (kN-m):*	33	33	49	53	23	23	24	**OK!**
	Sliding (kN):	34	34	39	43	22	26	25	**OK!**
	Bearing (kPa):	82	100	138	132	71	88	77	**OK!**
	e (m):	0.19	0.13	0.50	0.41	0.10	0.04	0.10	**OK!**
	Bf' (m):	1.17	1.28	0.55	0.72	1.35	1.47	1.35	
Factored Resistance	*Overturning (kN-m):*	71	91	58	72	69	92	75	
	Sliding (kN):	42	59	45	56	44	59	59	
	Bearing (kPa):	140	143	140	141	141	143	276	
	(@ top of base) Max e (m):	0.37	0.37	0.50	0.50	0.50	0.37	0.37	
Load & Resistance Factors	L	1.70	1.70	0.00	0.00	0.00	0.00	0.90	
	E	1.25	1.25	0.80	1.00	1.00	1.25	1.00	
	EQ	0.00	0.00	1.00	1.00	0.00	0.00	0.00	
	H	0.00	0.00	0.00	0.00	1.00	0.00	0.00	
	LL Surcharge over Wall	0.00	1.70	0.00	0.00	0.00	0.00	0.90	
	DC	0.95	1.10	0.80	1.00	1.00	1.35	1.00	
	DE	0.80	1.25	0.80	1.00	1.00	1.35	1.00	
	BC	0.50	0.50	0.50	0.50	0.50	0.50	1.00	
	ϕt precast to agg	0.80	0.80	1.00	1.00	0.80	0.80	1.00	
	ϕt CIP to agg/soil	0.80	0.80	1.00	1.00	0.80	0.80	1.00	
	ϕt soil to soil	0.80	0.80	1.00	1.00	0.80	0.80	1.00	
	ϕt precast to precast	0.80	0.80	1.00	1.00	0.80	0.80	1.00	
	concrete interface - eccentricity limit	0.30	0.30	0.40	0.40	0.40	0.30	0.30	
	bearing on soil - eccentricity limit	0.30	0.30	0.40	0.40	0.40	0.30	0.30	

STONE STRONG GRAVITY CALCULATIONS - ver 5.9

Project Name: Nivo Developments Inc
Location: 1164-1166 Higcroft Dr.
Job#: 20-14289
Section: Stone Strong 2.35 at Corner
Calc by: R.H.

(incorporates CAN/CSA-S6-06, Canadian Highway Bridge Design Code requirements)

3/8/21 14:54

Notes

Wall Configuration

			setback (mm)		modular units		unit fill		soil wedge		CIP Extension		
unit	w (mm)	h (m)	face	tail	Wb (kN)	xb (mm)	Wa (kN)	xa (mm)	Ws (kN)	xs (mm)	we (mm)	h_t	Internal
V24	1093	0.91	0	-152	10.94	513	8.65	605	0.51	1117			Internal Stability OK!
V6	1093	0.46	0	-152	5.84	533	4.25	597	0.73	1140			Internal Stability OK!
V6	1093	0.46	0	-152	5.84	533	4.25	597	1.04	1160			Internal Stability OK!
V24-M6	1245	0.91	0	0	14.58	952	8.86	618	0.00	0			
													External Stability OK!
	1245	2.74	0	-152	37.19	692	26.02	607	2.28	1144			

backfill height **2.65** m ω= 0.00 deg interface friction angle lateral load above wall **1** kN/m

exposed height 2.35 m ω'= -3.28 deg δ 22.5 deg height above top of wall **1** m

Retained Soil
γ **20** kN/m3
ϕ **30** deg

Foundation Soil
γ **20** kN/m3
ϕ **30** deg
c' kPa

base embedment **300** mm
base thickness **300** mm
base material **agg**
toe slope **5** H:1V slope

bearing pressure **90** kPa (net)
(if specified)

Aggregate Unit Fill
γ **17.3** kN/m3

composite friction coefficient μ_b 0.68

STONE STRONG SYSTEMS®

STONE STRONG GRAVITY CALCULATIONS - ver 5.9

Project Name:	Nivo Developments Inc
Location:	1164-1166 Higcroft Dr.
Job#:	20-14289
Section:	Stone Strong 2.35 at Corner
Calc by:	R.H.

3/8/21 14:54

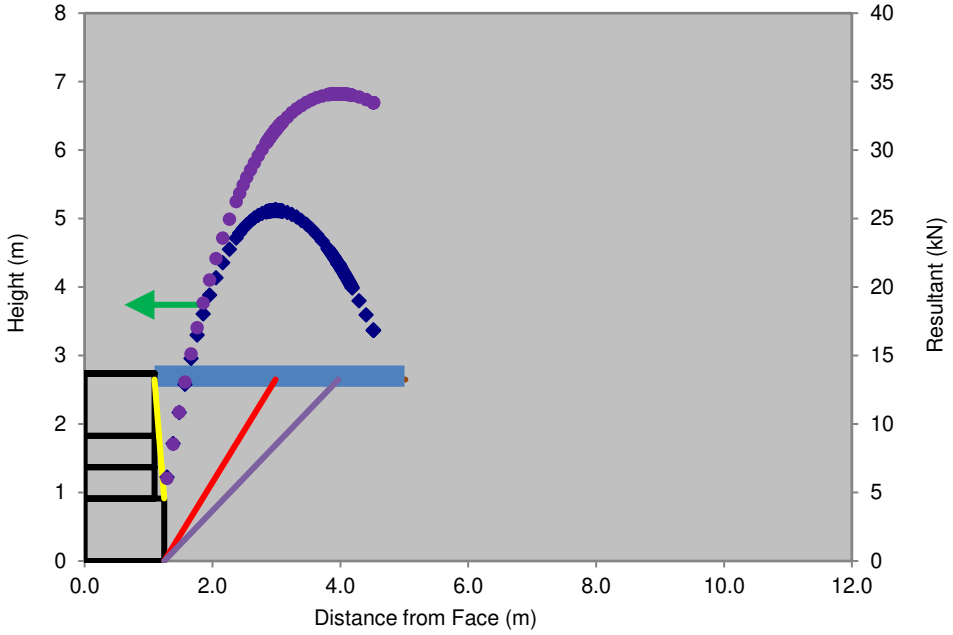
Seismic Load PGA 0.28 G site class (A to E or 1) D Fpga 1.24 Fa 1.58 k_h 0.20

Backfill Slope & Surcharge

		rise in grade	LL surcharge	tier height
length 1	5 m (horizontal)	0 m	3.6 kPa	m
length 2	m (horizontal)	m	kPa	m
length 3	m (horizontal)	m	kPa	m
length 4	m (horizontal)	m	kPa	

effective slope H:1V slope β 0.0 deg avg q 4 kPa

failure plane α 56.70 deg zone of influence 2.99 m



Ground Surface & Trial Wedge Plot

Unfactored Loads

K_a =	0.330	K_{AE} =	0.486
P_h =	20.87 kN	ΔK_{AE} =	0.156
P_v =	10.08 kN	P_{IR} =	13.04 kN
Q_{lh} =	2.83 kN	ΔP_{AEh} =	9.85 kN
Q_{lv} =	1.37 kN	ΔP_{AEv} =	4.76 kN

STONE STRONG SYSTEMS®

STONE STRONG GRAVITY CALCULATIONS - ver 5.9

Project Name: Nivo Developments Inc
Location: 1164-1166 Higcroft Dr.
Job#: 20-14289
Section: Stone Strong 2.35 at Corner
Calc by: R.H.

3/8/21 14:54

	Load Cases:	ULS 1-a	ULS 1-b	ULS 5-a (EQ)	ULS 5-b (EQ)	ULS 8 (Coll)	ULS 9	SLS 1	
Factored Loading	*Overturning (kN-m):*	29	29	40	44	22	23	22	**OK!**
	Sliding (kN):	31	31	35	39	22	26	23	**OK!**
	Bearing (kPa):	77	90	119	118	69	84	71	**OK!**
	e (m):	0.25	0.18	0.50	0.43	0.17	0.11	0.15	**OK!**
	Bf' (m):	1.05	1.18	0.55	0.69	1.20	1.32	1.24	
Factored Resistance	*Overturning (kN-m):*	57	73	48	59	56	75	60	
	Sliding (kN):	36	49	39	49	38	51	50	
	Bearing (kPa):	140	143	140	141	141	143	276	
	(@ top of base) Max e (m):	0.37	0.37	0.50	0.50	0.50	0.37	0.37	
Load & Resistance Factors	L	1.70	1.70	0.00	0.00	0.00	0.00	0.90	
	E	1.25	1.25	0.80	1.00	1.00	1.25	1.00	
	EQ	0.00	0.00	1.00	1.00	0.00	0.00	0.00	
	H	0.00	0.00	0.00	0.00	1.00	0.00	0.00	
	LL Surcharge over Wall	0.00	1.70	0.00	0.00	0.00	0.00	0.90	
	DC	0.95	1.10	0.80	1.00	1.00	1.35	1.00	
	DE	0.80	1.25	0.80	1.00	1.00	1.35	1.00	
	BC	0.50	0.50	0.50	0.50	0.50	0.50	1.00	
	ϕt precast to agg	0.80	0.80	1.00	1.00	0.80	0.80	1.00	
	ϕt CIP to agg/soil	0.80	0.80	1.00	1.00	0.80	0.80	1.00	
	ϕt soil to soil	0.80	0.80	1.00	1.00	0.80	0.80	1.00	
	ϕt precast to precast	0.80	0.80	1.00	1.00	0.80	0.80	1.00	
	concrete interface - eccentricity limit	0.30	0.30	0.40	0.40	0.40	0.30	0.30	
	bearing on soil - eccentricity limit	0.30	0.30	0.40	0.40	0.40	0.30	0.30	