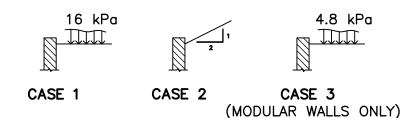
- 1.1 THE METHODS OF ANALYSIS FOR STABILITY, GEOTECHNICAL AND STRUCTURAL DESIGN WERE:
- ALLOWABLE STRESS DESIGN (ASD) BASED ON AASHTO 17TH
- LOAD RESISTANCE FACTORED DESIGN (LRFD) BASED ON
- CANADIAN HIGHWAY BRIDGE DESIGN CODE CAN/CSA S6-06.

1.2 THE CURRENT VERSION OF CITY OF VANCOUVER'S STREET RESTORATION

- DISPLACEMENT—BASED DESIGN METHOD FOR SEISMIC ANALYSIS BASED ON MONONOBE-OKABE ANALYSIS.
- MANUAL SHALL BE FOLLOWED. 1.3 THREE GENERAL LOAD CASES WERE USED, AND THEY REPRESENT THE
 - CASE 1: SURCHARGE LOADING IS 16 kPa, WITHOUT BACKSLOPE &=0°. CASE 2: NO SURCHARGE LOADING, AND THE BACKSLOPE IS 2:1
 - $(\beta = 26.6^{\circ}).$ • CASE 3: SURCHARGE LOADING IS 4.8 kPa, WITHOUT BACKSLOPE



1.4 LOAD COMBINATIONS:

FOLLOWING:

- BASED ON CAN/CSA S6-06 LOAD COMBINATION TABLE (SECTION 3). • COMPACTION WAS CONSIDERED AS A SEPARATE LOAD CASE AND WAS NOT COMBINED WITH LIVE LOAD SURCHARGE OR
- EARTHQUAKE LOADING. • COMPACTION WAS NOT CONSIDERED FOR MODULAR WALLS.

2. LOADS:

- 2.1 SELFWEIGHT AS DEAD LOAD.
- 2.2 VERTICAL AND LATERAL EARTH PRESSURE. WATER PRESSURE WAS NOT CONSIDERED.
- 2.3 LIVE AND/OR DEAD LOAD SURCHARGE LOAD AS 16 kPa OR 4.8 kPa UNIFORMLY DISTRIBUTED BEHIND THE WALL. CURB LOAD AND GUARDRAIL LOAD WAS NOT CONSIDERED.
- 2.4 COMPACTION—INDUCED LATERAL EARTH PRESSURE (NOT INCLUDED IN MODULAR DESIGN).
- 2.5 EARTHQUAKE-INDUCED LATERAL EARTH PRESSURE FOR EARTHQUAKE MAGNITUDE OF 975 YEARS RETURN PERIOD (7% PROBABILITY OF ACCIDENCE IN 75 YEARS). THE WALLS WERE ALLOWED TO MOVE (ROCKING / SLIDING) NOT MORE THAN 200 mm. Δ Kae = 0.087 FOR CASE 1; Δ Kae = 0.200 FOR CASE 2)

Jesign Parameter:

- 3.1 INTERNAL FRICTION ANGLE OF BACKFILL $\emptyset = 30^{\circ}$ FOR CASE 1. $\emptyset = 37^{\circ}$ FOR CASE 2 AND $\emptyset = 30^{\circ}$ FOR CASE 3.
- 3.2 BACKFILLING MATERIAL UNIT WEIGHT 1900 kg/m³.
- 3.3 THE SUBGRADE FRICTION COEFFICIENT 0.466 BASED ON SILTY-SAND NATIVE SUBGRADE. COHESION WAS NOT CONSIDERED.
- 3.4 MODULES-SOIL FRICTION ANGLE $\sigma = 3/40$
- 3.5 THE ULTIMATE UNFACTORED BEARING CAPACITY IN ALL CASES AND FOR ALL METHOD OF ANALYSIS USED WAS Quit = 450kPa (i.e. Qall = 150kPa FOR ASD METHOD).

4. GENERAL NOTES:

- 4.1 ALL DIMENSIONS ARE IN MILLIMETER. QUANTITIES ARE IN kg AND
- 4.2 THE BEARING CAPACITY OF THE SUBGRADE IN THE PROPOSED SITE SHALL BE LESS THAN THE MAXIMUM APPLIED PRESSURE (q.max) LISTED IN THE TABLE OF THE SELECTED RETAINING WALL AT THE SPECIFIC CASE. THE MAX UNIFORM APPLIED PRESSURE Qmax WAS BASED ON ULTIMATE LIMIT STATES (ULS) LOAD COMBINATIONS. SPECIAL FOUNDATION DESIGN IS REQUIRED WHERE THE SUBGRADE IS INCAPABLE OF SUPPORTING TOE PRESSURE LISTED IN THE
- 4.3 FOR CAST-IN-PLACE RETAINING WALLS, DESIGN GRADE DIFFERENCE MAY BE EXCEEDED BY ONLY 100 mm BEFORE GOING TO THE NEXT SIZE.
- 4.4 GUARD RAILING SHALL BE USED FOR ALL "DESIGN GRADE DIFFERENCE" MORE THAN 1.2m.
- 4.5 A HORIZONTAL DISTANCE EQUAL TO THE "TOTAL HEIGHT H" OF THE WALL WAS CONSIDERED AS THE CLEAR ZONE. PLANTING LARGE TREES OR CONSTRUCTING FOOTINGS WITHIN CLEAR ZONE (THAT MAY PRODUCE SURCHARGE LOADING MORE THAN 16 kPa FOR CASE 1 ONLY) IS PROHIBITED.
- 4.6 WEEP HOLES ARE CONSIDERED HAZARDOUS IN SOME LOCATIONS. CITY ENGINEER IS TO PROVIDE GUIDANCE REGARDING DRAINAGE SYSTEM, CASE 1 OR CASE 2.
- 4.7 WEEP HOLES OPTION: Ø100mm HOLES SPACED NO MORE THAN 4

m, C/W GALV. WIRE MESH COVER.

- 4.8 100mm DIA. PERFORATED PVC PIPE WITH MIN. 1% SLOPE TO BE PROVIDED AND PLACED ACCORDING TO CITY ENGINEER'S INSTRUCTIONS.
- 4.9 DRAINAGE LAYER IS WELL DRAINED, NONFREEZE-SENSITIVE 9.5 mm MINUS ROUNDED GRANULAR AGGREGATE (PEA-GRAVEL, CITY OF VANCOUVER SPEC. 2.12 OR APPROVED BY THE CITY ENGINEER).
- 4.10 300mm LAYER OF DRAIN ROCK SHALL SURROUND THE PERFORATED PIPE (OR WEEP HOLE WHEN JUSTIFIED). (CITY OF VANCOUVER SPEC. 2.6 OR APPROVED BY THE CITY ENGINEER)
- 4.11 CASE 1 AND CASE 3 BACKFILLING MATERIAL COULD BE ANY ALTERNATE MATERIAL THAT IS READILY AVAILABLE AT TIME OF CONSTRUCTION THAT SHALL COMPRISE OF WELL-DRAINED, NONFREEZE-SENSITIVE GRANULAR MATERIAL WITH MINIMUM EFFECTIVE FRICTION ANGLE $\emptyset = 30^{\circ}$, THIS ALTERNATE MATERIAL IS SUBJECTED TO APPROVAL BY GEOTECHNICAL ENGINEER. (PIT RUN MATERIAL AS SPECIFIED BY THE CITY OF VANCOUVER COULD BE CONSIDERED)
- 4.12 CASE 2 BACKFILLING MATERIAL SHALL BE WELL-DRAINED, NONFREEZE-SENSITIVE 19 mm MINUS COMBINED CRUSHED AGGREGATE (MULCH) FILL (CITY OF VANCOUVER SPEC. 2.10) OR APPROVED BY THE CITY ENGINEER. MINIMUM EFFECTIVE FRICTION ANGLE $\phi = 37^{\circ}$.
- 4.13 BACKFILLING MATERIALS SHALL BE PLACED IN THIN LOOSE LIFTS NO GREATER THAN 300 mm, AND COMPACTED TO A MINIMUM OF 95% OF MAXIMUM MODIFIED PROCTOR DRY DENSITY WITH SMALL SUITABLE EQUIPMENT, DENSITY TESTING IS JUSTIFIED BY THE CITY ENGINEER.
- 4.14 COMPATIBILITY BETWEEN BACKFILL MATERIAL AND NATIVE SOIL SHALL BE REVIEWED BY GEOTECHNICAL ENGINEER, OTHERWISE FILTER FABRIC OR GRANULAR SEPARATOR SHALL BE PROVIDED BETWEEN MATERIALS.
- 4.15 FOR ZERO PROPERTY LINE RETAINING WALLS:
 - THE WIDTH OF THE FOUNDATION IS LIMITED TO MINIMIZE THE EFFECTS OF THE TRAFFIC LOADING. THE MAXIMUM DISTANCE THAT CONTROLS THE DESIGN WIDTH OF THE FOUNDATION IS 1.9m, MEASURED FROM THE FACE OF THE CURB TO THE FRONT FACE OF THE RETAINING WALL.
 - IN THIS TYPE OF RETAINING WALLS THE TOP SOIL OVER THE FOUNDATION PLAYS A MAJOR ROLE IN STABILIZING THE ENTIRE RETAINING WALL (i.e. OVERTURNING AND SLIDING). DURING DESIGN STAGE, ONLY 25% OF THE TOP SOIL QUANTITY WAS CONSIDERED AS EXCAVATED OR REMOVABLE. THE CONTRACTOR SHALL PROVIDE STABILIZING MEASURES (i.e. WEIGHTS SUCH AS SAND BAGS) TO BE CENTERED OVER THE FOUNDATION WIDTH IF SOIL IS REMOVED. IN THE CASE WHERE THE EXCAVATION OF THE TOP SOIL IS AT THE MIDDLE OF THE FOUNDATION THE ADDED WEIGHT SHALL BE STAGGERED TO BOTH SIDES IN SUCH A WAY TO PROVIDE A CENTRAL REACTION.
 - A CONCRETE BLOCK WITH A PIN CONNECTION WAS ASSUMED TO BE CONSTRUCTED ALONG THE FOUNDATION TIP TO TRANSFORM THE UNFAVORABLE VERTICAL VEHICLE INDUCED PRESSURE INTO FAVORABLE LATERAL PRESSURE THAT MIGHT ENHANCE THE STABILITY AND MINIMIZE THE RISK OF RETAINING WALL
- 4.16 PINNED CONNECTION VERTICAL CONCRETE BLOCK TO PREVENT DIVERSE EFFECT FROM SURCHARGE TRAFFIC PRESSURE. IT IS REQUIRED WHEN EDGE OF WALL FOUNDATION LOCATED UNDER THE CURB (i.e. NOT REQUIRED WHEN Bf < SIDE WALK WIDTH)

6. DETAILING NOTES:

- 6.1 CONCRETE COVER FOR THE BOTTOM BARS OF THE FOUNDATION SHALL BE 75 mm, USE 50 mm ELSEWHERE. CITY ENGINEER TO JUSTIFY IF WALL THICKNESS NEED TO BE INCREASED TO ACCOUNT FOR CONCRETE COVER THICKNESS INCREASE IN CASES WHERE THE DURABILITY OF THE WALL IS PARAMOUNT.
- 6.2 VERTICAL GROOVE OF THE CONTROL JOINTS SHALL BE 1/4 OF THE WALL THICKNESS. THE CONTROL JOINT SHALL BE LOCATED AT CHANGES IN CROSS SECTION. PROVIDE 2 CONTROL JOINTS 3m AWAY FROM THE WALL ENDS, OTHER CONTROL JOINTS SHALL BE GROOVED EVENLY ON THE REMAINDER DISTANCE ALONG THE WALL WITHIN A RANGE BETWEEN 3 TO 4.5m.
- 6.3 HORIZONTAL CONSTRUCTION JOINTS, OTHER THAN BETWEEN THE WALL STEM AND FOUNDATION, IS NOT ALLOWED.
- 6.4 ALL CONSTRUCTION JOINTS SHALL BE VERTICAL. PROVIDE 10M DOWELS @ 1000mm SPACING OR ROUGHEN THE SURFACE ALONG THE VERTICAL JOINT.
- 6.5 REINFORCEMENT BENDS AND SPLICE LENGTHS ARE AS FOLLOWS UNLESS NOTED OTHERWISE:

AR SIZE	BEND D (mm)	SPLICE LENGTH (mm)
10	70 ` ´	350
15	100	530
20	120	680
25	160	800

- 6.6 SPLICES FOR VERTICAL BARS SHALL BE STAGGERED. NO SPLICES ARE PERMITTED FOR THE VERTICAL BARS WITHIN THE FIRST THIRD OF THE WALL STEM HEIGHT.
- 6.7 LENGTH OF K BARS SHALL BE THE FULL LENGTH OF THE RETAINING WALL. WHEN WALL LENGTH EXCEEDS 12m, THE LENGTH OF THE K BARS (IN THE TABLES) NEED TO BE MODIFIED TO ACCOUNT FOR SPLICE LENGTHS.
- 6.8 REVEALS IN CONCRETE FACADE SHALL HAVE A DEPTH OF NO GREATER THAN 19mm. IF REVEALS ARE USED, MINIMUM CONCRETE COVER SHALL BE MAINTAINED TO OUTSIDE FACE OF THE WALL.

7. GUARDRAIL NOTES:

- 7.1 GUARDRAIL, POST AND ANCHORAGE DETAILS SHOWN ARE FOR GUIDELINE PURPOSES ONLY AND SHALL BE DESIGNED BY THE CONTRACTOR'S ENGINEER. SUBMIT SHOP DRAWINGS FOR REVIEW PRIOR TO FABRICATION. SHOP DRAWINGS SHALL INCLUDE DESIGN LOADS, EXPANSION JOINT LOCATIONS AND DETAILS AND ALL OTHER RELATED DETAILS. THE SHOP DRAWINGS SHALL BE SIGNED AND SEALED BY A PROFESSIONAL STRUCTURAL ENGINEER REGISTERED IN THE PROVINCE OF B.C..
- 7.2 ALL FASTENERS TO BE AISI TYPE 316 STAINLESS STEEL
- 7.3 DRILL 8 mm WEEP HOLES AT ALL LOW POINTS IN RAILS AND AT BASE OF POSTS WHERE NECESSARY.

8. CONSTRUCTION SEQUENCE:

- 8.1 LOCATE THE NEW PROPERTY LINE ON THE PROPOSED SITE.
- 8.2 DEMOLISH AND REMOVE OLD RETAINING WALL IF EXIST.
- 8.3 EXCAVATE THE SOIL BEHIND THE NEW PROPERTY LINE, TEMPORARY WORK MIGHT BE REQUIRED.
- 8.4 MAKE SURE THAT THE BEARING CAPACITY OF THE SUBGRADE IS LESS THAN q.max SHOWN IN THE TABLE FOR EACH SPECIFIC CASE.
- 8.5 PROVIDE 300 mm COMPACTED GRANULAR PAD.
- 8.6 DON'T DISTURB THE SOIL IN FRONT OF THE FOUNDATION FACE AND SHEAR KEY (WHEN REQUIRED).
- 8.7 INSTALL FOUNDATION FORMWORK AND STEEL CAGE, AND CAST CONCRETE. FOUNDATION FACE AND SHEAR KEY SHALL BE CAST AGAINST NATIVE SOIL.
- 8.8 INSTALL WALL STEM FORMWORK, REINFORCEMENT, AND CAST THE CONCRETE. PROVIDE WEEP HOLES.
- 8.9 FINISH AND CURE, THEN INSTALL THE GUARD RAIL IF REQUIRED.

9. DESIGN SEQUENCE AND DRAWING USE (INSTRUCTIONS):

DISCLAIMER: THE STANDARDIZED RETAINING WALL DESIGN DRAWINGS WERE COMMISSIONED TO INCREASE EFFICIENCY AND ESTABLISH DESIGN STANDARDS RELATED TO SHORT TO MEDIUM HEIGHT RETAINING WALLS (UNDER 2.4m). THE DESIGN DRAWINGS ARE TO BE USED BY QUALIFIED PERSONNEL (PROFESSIONAL ENGINEER). AN APPROPRIATE LEVEL OF DUTY AND CARE (APPROPRIATE DESIGN CHECKS) SHALL BE EMPLOYED. ALL DRAWINGS ARE TO BE SIGNED AND SEALED PRIOR TO DISTRIBUTION AND USE.

INSTRUCTIONS: PLEASE COMPLETE THE FOLLOWING STEPS AND RECORD (CLOUD), INITIAL AND DATE ALL DECISIONS ON THE STANDARDIZED RETAINING WALL DESIGN DRAWINGS AND SITE SPECIFIC PLANS (IF REQUIRED).

9.1	LABEL ALL DESIGN DRAWINGS WITH SITE ADDRESS		
9.2	LOCATE PROPERTY LINE ON THE PROPOSED SITE, AND SELECT DESIGN WALL TYPE		
9.3	DETERMINE MAX GRADE DIFFERENCE AND SELECT DESIGN LOAD CASE		
9.4	CONFIRM SOIL BEARING CAPACITY. IT IS ADVISED TO RETAIN THE SERVICES OF A GEOTECHNICAL ENGINEER TO CONFIRM SITE SPECIFIC SOIL PROPERTIES		
9.5	IF GEOTECHNICAL ENGINEER RETAINED, ATTACH GEOTECHNICAL INFORMATION.		
	_		
	(COMPANY) (REPORT TITLE AND DATE) (VANDOC #)		
9.6	SELECT DRAINAGE SYSTEM, AND CONFIRM TIE IN LOCATIONS (AS REQUIRED)		
9.7	SELECT HANDRAIL DETAILS AND EXTENT		
9.8	SIGN AND SEAL FINAL DESIGN DRAWINGS	П	

ENGINEERING SERVICES - STRUCTURES

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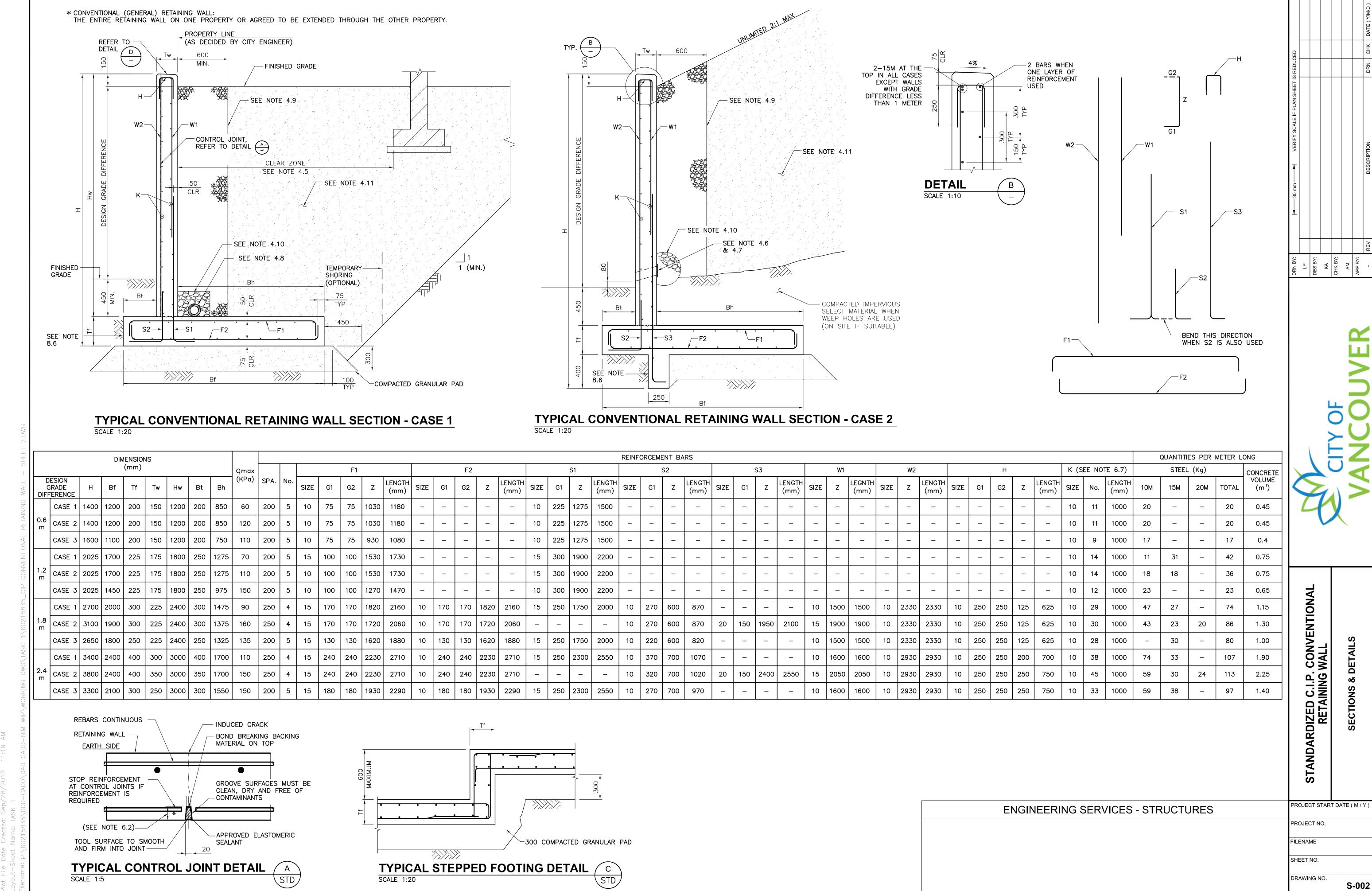
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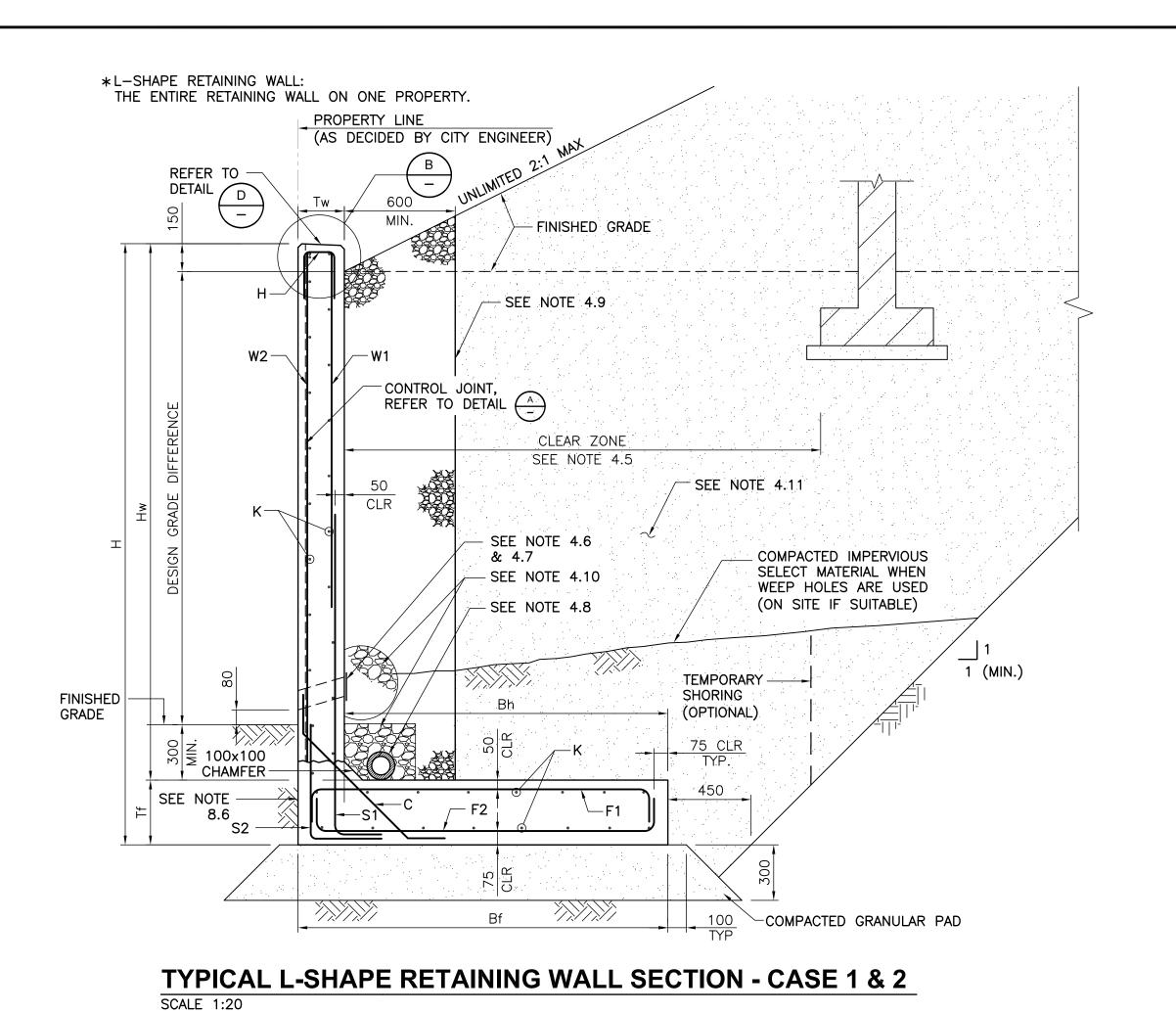
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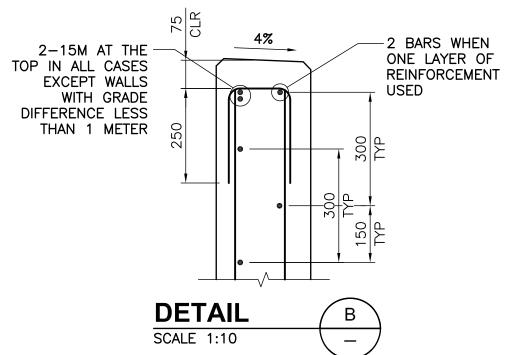
S-001

5. WALL MATERIAL:

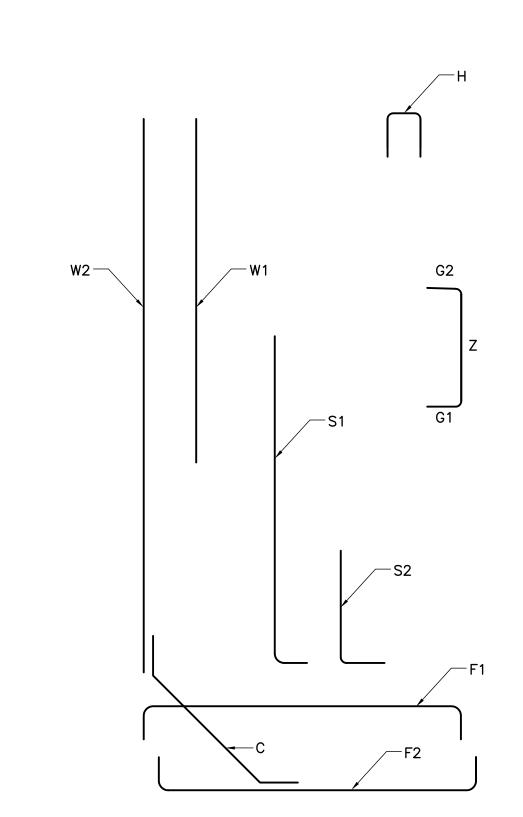
- 5.1 ALL CONCRETE SHALL HAVE A COMPRESSIVE STRENGTH OF NOT LESS THAN fc' = 30MPa
- 5.2 EXPOSED EDGES TO BE CHAMFERED 20mm.
- 5.3 REINFORCING STEEL TO CONFORM TO CSA G30.18M GRADE 400.







DIMENSIONS (mm)											
G	ESIGN GRADE ERENCE	Н	Bf	Tf	Tw	Hw	Bh	(KPa)			
	CASE 1	1250	1000	200	150	1050	850	150			
0.6 m	CASE 2	1250	1100	200	150	1050	950	180			
	CASE 3	1250	1000	200	150	1050	850	150			
	CASE 1	1900	1450	250	200	1650	1250	130			
1.2 m	CASE 2	1900	1550	250	225	1650	1325	170			
	CASE 3	1900	1450	250	200	1650	1250	130			
	CASE 1	2550	1750	300	225	2250	1525	170			
1.8 m	CASE 2	2550	2000	300	250	2250	1750	150			
	CASE 3	2550	1750	250	225	2250	1525	160			
	CASE 1	3200	2200	350	250	2850	1950	140			
2.4 m	CASE 2	3200	2600	350	350	2850	2250	150			
	CASE 3	3150	2100	300	225	2850	1875	160			



																							REINF	ORCEMEN [®]	T BARS																		QUANTIT	TES PER	METER L	ONG
	DESIGN GRADE FERENCE	qma					F1					F2	2				S1				S2				С				W1			W2				Н			K (S	EE NOT	NOTE 6.7)		STEE	L (Kg)		CONCRE
DIF	FERENCE	(KPa	a) SF	PA. N	o. SIZ	E G1	G2	Z	LENGT	rH s	SIZE G1	G2	Z	LENG (mm	TH SIZ	Œ G1	Z	LENG [*]	TH SIZ	ĽE C	G1 Z	LENG (mm	TH SIZE	G1	G2	Z	LENGTI (mm)	H SIZE	E Z	LEGNTH (mm)	SIZE	Z	LENGTH (mm)	SIZE	G1	G2	z L	ENGTH (mm)	SIZE	No.	LENGTH (mm)	10M	15M	20M	TOTAL	VOLUN
	CASE 1	1 150) 2	200	5 10) 75	75	85	0 1000)		_	_	_	10	300) 110	1400) –	. -	_ _	_	_	_	_	_	_	_	_	_	_	_	_	-	-	-	-	_	10	10	1000	18	_	_	18	0.38
0.6 m	CASE 2	180) 2	200	5 10) 75	75	95	0 1100)		-	_	-	10	300	0 110	1400) –	. -	_ _	_	_	_	-	_	_	_	_	_	_	_	-	_	-	-	-	_	10	11	1000	24	_	_	24	0.40
	CASE 3	150) 2	200	5 10) 75	75	85	0 1000)		_	_	_	10	300) 110	1400) –	. -	_	_	_	_	_	_	_	_	_	_	_	_	_	_	-	-	-	_	10	11	1000	18	_	_	18	0.40
	CASE 1	1 130) 2	200	5 10) 120	120	130	00 1540)		_	_	_	10	300	0 175	2050) 10) 50	00 175	0 225) –	_	_	_	_	_	_	_	_	_	_	10	250	250 1	00	600	10	13	1000	36	_	_	36	0.70
1.2 m	CASE 2	2 170) 2	200	5 10) 120	120	140	00 1640		_ _	_	_	_	10	300	175	2050) 10	5 50	00 175	0 225) –	_	_	_	_	_	_	_	_	_	_	10	250	250 1	25	625	10	14	1000	37	_	_	37	0.80
	CASE 3	3 130) 2	200	5 10) 120	120	130	00 1540			_	_	_	10	300	0 175	2050) 10) 50	00 175	0 225) –	_	_		_	_	_	_	_	_	_	10	250	250 1	25	625	10	14	1000	36	_	_	36	0.80
	CASE 1	170) 2	250	4 15	5 170	170	160	00 1990) .	10 170	170	160	0 194) 15	300	150	1800) 10	7:	50 700	145	10	200	200	600	1000	10	1550	1550	10	2075	2075	10	250	250 1	25	625	10	26	1000	48	22	_	70	1.05
1.8 m	CASE 2	150	2	250	4 15	5 170	170	185	50 2190)	10 170	170	185	0 219) 20	300	130	1600) 15	5 7:	50 87	5 162	5 10	200	200	600	1000	15	1900	1900	15	2075	2075	10	250	250 1	50	650	10	28	1000	34	49	16	99	1.20
	CASE 3	3 160) 2	250	4 15	5 120	120	160	00 1840) .	10 120	120	160	0 184) 15	5 300	150	1800) 10	7!	50 70	145) 10	200	200	600	1000	10	1550	1550	10	2075	2075	10	250	250 1	25	625	10	26	1000	27	29	_	56	0.95

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15 | 2200 | 2200

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750

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32

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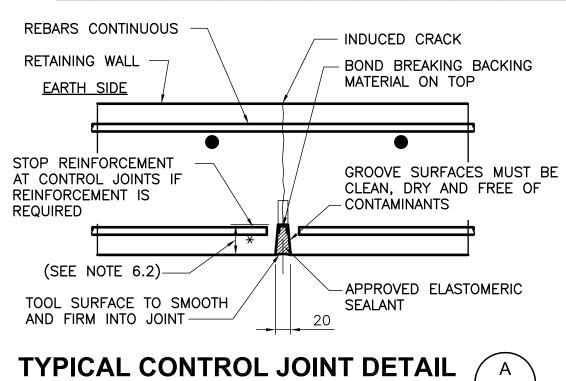
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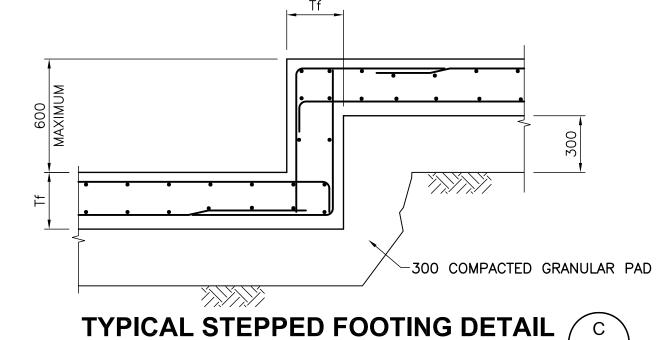
CASE 1

CASE 3

SCALE 1:5

| 2.4 | CASE 2 | 150 | 200 | 5 |

160 | 200 |



1550

15

15 | 220 | 220 | 2050 | 2490 | 20 | 300 | 1250 |

SCALE 1:20

15 | 220 | 220 | 2450 | 2890 | 20 | 300 | 1650 | 1950

| 15 | 170 | 170 | 1950 | 2290 | 15 | 300 | 1250 | 1550 |

ENGINEERING SERVICES - STRUCTURES	PROJECT START DATE (M/Y)
	PROJECT NO.
	FILENAME
	SHEET NO.
	DRAWING NO. S-002

CONCRETE VOLUME (m³)

0.38

0.40

0.40

0.70

0.80

0.80

1.05

1.20

0.95

1.50

1.95

1.30

131

159

135

23

L-SHAPE

STANDARDIZED C.I.P. RETAINING WAL

250 | 4 | 20 | 220 | 220 | 2050 | 2490

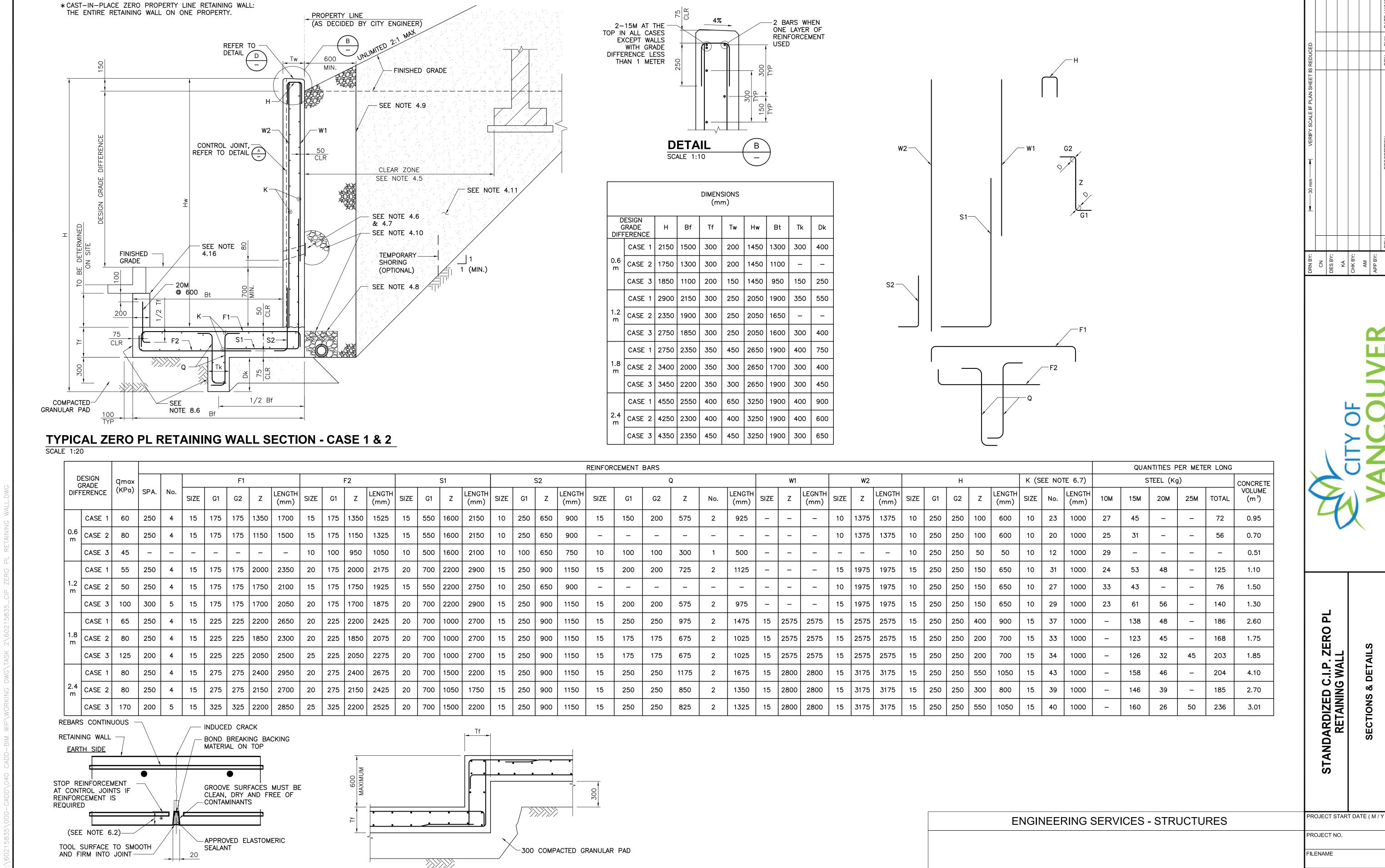
15 | 220 | 220 | 2450 | 2890

| 170 | 170 | 1950 | 2290 |

STD

15 | 800 | 925 | 1725

800 925 1725



TYPICAL STEPPED FOOTING DETAIL

STD

SCALE 1:20

SHEET NO.

DRAWING NO.

S-002

File Date Created: Sep/28/2012 11:27 AM

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TYPICAL CONTROL JOINT DETAIL