# APPENDIX Z

## Structural Design Criteria




**G3 Terminal Vancouver**

**Port Metro Vancouver Project Permit Application**

Kiewit

G3 Terminal Vancouver

Ibberson Canada Company
A Nova Scotia Company

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## PART 2 – STRUCTURAL DESIGN CRITERIA

2.01 GENERAL

A. Design and construction shall comply with codes, specifications, and recommendations issued by the following agencies:

1. NBCC 2010 - National Building Code of Canada
2. British Columbia Building Code 2012
3. CSA - Canadian Standards Association
4. CSA A23.3 – Design of Concrete Structures
5. CSA S16 – Design of Steel Structures
6. CSA S304.1-Design of Masonry Structures

B. Seismic Design according to the 2010 National Building Code of Canada (NBCC)

1. Site Latitude: $49.302382^0$; Longitude: $-123.043785^0$
2. See Appendix A for Zones and North-South Site Portions Line.
3. Site Class F for All Structures
4. Seismic Acceleration Coefficients – for **Unoccupied Structures**
    - Minimum Return Period = 475 Years (10% in 50 years)

| T | $F_a$ | $F_v$ | Sa (**Offshore**) |
|---|---|---|---|
| 0.00 | 0.89 | | 0.425 |
| 0.20 | 0.89 | | 0.425 |
| 0.32 | 0.89 | | 0.420 |
| 0.50 | 0.89 | | 0.390 |
| 0.67 | 0.89 | | 0.270 |
| 1.00 | | 1.61 | 0.270 |
| 1.25 | | 1.61 | 0.270 |
| 1.50 | | 1.61 | 0.250 |
| 2.00 | | 1.61 | 0.155 |
| 3.00 | | 1.61 | 0.085 |
| 4.00 | | 1.61 | 0.055 |
| PGA | 0.89 | | 0.425 |

| T | $F_a$ | $F_v$ | Sa (**South** of Transition Line) |
|---|---|---|---|
| 0.00 | 0.82 | | 0.390 |
| 0.20 | 0.82 | | 0.390 |
| 0.50 | 0.82 | | 0.390 |
| 0.65 | 0.82 | | 0.390 |
| 0.83 | 0.82 | | 0.290 |
| 1.00 | | 1.73 | 0.290 |
| 1.50 | | 1.73 | 0.290 |
| 2.00 | | 1.73 | 0.200 |
| 2.50 | | 1.73 | 0.140 |
| 3.00 | | 1.73 | 0.105 |
| 4.00 | | 1.73 | 0.060 |
| PGA | 0.82 | | 0.390 |

| T | $F_a$ | $F_v$ | Sa (**North** Side of Transition Line) |
|---|---|---|---|
| 0.00 | 0.78 | | 0.370 |
| 0.20 | 0.78 | | 0.370 |
| 0.50 | 0.78 | | 0.370 |
| 0.55 | 0.78 | | 0.370 |
| 0.80 | 0.78 | | 0.210 |
| 1.00 | | 1.25 | 0.210 |
| 1.50 | | 1.25 | 0.210 |
| 2.00 | | 1.25 | 0.180 |
| 2.50 | | 1.25 | 0.125 |
| 3.00 | | 1.25 | 0.090 |
| 4.00 | | 1.25 | 0.055 |
| PGA | 0.78 | | 0.370 |

5. Seismic Acceleration Coefficients – **Occupied Structures**
   - Structures Defined as Occupied

| Occupied Structures | |
|---|---|
| Rail Unloading and Receiving Building | Longshoreman's Breakroom |
| Cleaning Building | Grading, Sampling, Breakroom Building |
| Cleaning Building Breakroom | Maintenance, Compressor, Warehouse Building |
| Administration and Control Building | |

Minimum Return Period 2475yrs (2% in 50 years)

| T | $F_a$ | $F_v$ | Sa (**Offshore**) |
|---|---|---|---|
| 0.00 | 0.71 | | 0.640 |
| 0.20 | 0.71 | | 0.640 |
| 0.36 | 0.71 | | 0.640 |
| 0.50 | 0.71 | | 0.580 |
| 0.65 | 0.71 | | 0.520 |
| 0.75 | 0.71 | | 0.435 |
| 1.00 | | 1.33 | 0.435 |
| 1.60 | | 1.33 | 0.435 |
| 2.00 | | 1.33 | 0.340 |
| 2.5 | | 1.33 | 0.230 |
| 3.00 | | 1.33 | 0.160 |
| 4.00 | | 1.33 | 0.110 |
| PGA | 0.71 | | 0.640 |

| T | $F_a$ | $F_v$ | Sa (**South** of Transition Line) |
|---|---|---|---|
| 0.00 | 0.51 | | 0.460 |
| 0.20 | 0.51 | | 0.460 |
| 0.50 | 0.51 | | 0.460 |
| 0.90 | 0.51 | | 0.460 |
| 1.00 | | 1.29 | 0.420 |
| 1.10 | | 1.29 | 0.380 |
| 1.25 | | 1.29 | 0.380 |
| 1.50 | | 1.29 | 0.360 |
| 2.00 | | 1.29 | 0.360 |
| 2.50 | | 1.29 | 0.315 |
| 3.00 | | 1.29 | 0.215 |
| 4.00 | | 1.29 | 0.130 |
| PGA | 0.51 | | 0.460 |

| T | $F_a$ | $F_v$ | Sa (**North** of Transition Line) |
|---|---|---|---|
| 0.00 | 0.64 | | 0.580 |
| 0.20 | 0.64 | | 0.580 |
| 0.50 | 0.64 | | 0.580 |
| 0.60 | 0.64 | | 0.500 |
| 0.90 | 0.64 | | 0.320 |
| 1.00 | | 0.98 | 0.320 |
| 1.30 | | 0.98 | 0.320 |
| 1.50 | | 0.98 | 0.320 |
| 2.00 | | 0.98 | 0.320 |

| | | | |
|---|---|---|---|
| 2.30 | | 0.98 | 0.290 |
| 3.00 | | 0.98 | 0.190 |
| 4.00 | | 0.98 | 0.120 |
| PGA | 0.64 | | 0.580 |

- Reduction Factors:

Reduction Factors: Conventional Braced Frames, Moment Frames, Shear Walls:

- $R_d = 1.5$
- $R_0 = 1.3$

Moderately Ductile Moment Frames:

- $R_d = 3.5$
- $R_0 = 1.5$

Ductile Eccentric Braced Frames:

- $R_d = 4.0$
- $R_0 = 1.5$

Concrete Silos, Shear Walls:

- $R_d = 1.5$
- $R_0 = 1.3$

Concrete Silos Moderately Ductile Shear Walls:

- $R_d = 2.0$
- $R_0 = 1.4$

Concrete Silos Ductile Shear Walls:

- $R_d = 3.5$
- $R_0 = 1.6$

Category: Normal

Importance Factor $I_E = 1.0$ ULS

a. Each concrete foundation shall be analyzed as a foundation on soil springs or a pile cap on pile springs
b. The foundations shall be proportioned such that the dynamic response of the equipment shall be within its allowable operating parameters.

2.04.1.1 Miscellaneous Equipment Foundations:

a. All miscellaneous equipment shall be designed to project specific criteria.
b. Miscellaneous equipment foundations shall meet all applicable codes and standards as well as the individual manufacturer's standards.
c. All equipment foundations and supports shall be designed to resist project specific loadings and the loadings furnished by the equipment manufacturer.

2.04.1.2 Foundation Loads: Foundation loads shall be furnished by the equipment manufacturers and shall be superimposed with loads for the foundation itself. Typical loadings supplied by the manufacturer include the following:

a. Dead Load
b. Groundwater Loads
c. Live Load
d. Temperature Loads
e. Wind Load
f. Operating Loads
g. Seismic Load
h. Impact/Vibration Loads
i. Temperature and Pressure Test Loads (when applicable)
j. Mechanical and Electrical Loads

2.04.1.3 All miscellaneous equipment shall utilize galvanized or stainless steel anchor bolts, fasteners, welds, and other equipment anchorage devices to resist equipment-induced forces.

2.04.1.4 Structural Criteria: All miscellaneous equipment shall be designed to the resist project specified loads and loads from other applicable codes and standards.

a. The seismic loading and design of miscellaneous equipment shall be in accordance with project specific criteria.

b. Seismic loading shall be calculated using static equivalent lateral forces applied to the center of gravity of the equipment or component in accordance with the specified criteria.
c. All settlement sensitive foundations will be supported on piles, vibro-replacement stone columns, rapid impact compacted soil, preloaded soil, pipe piles, or a combination of these.

2.04.1.5 A housekeeping pad shall be provided under equipment. Isolated equipment not in a containment area with stand-off legs will not require housekeeping pads. Each pad shall extend a minimum of 150 mm (6 inches) above finished grade or top-of-concrete slab. Chamfer all edges.

2.04.1.6 All post-pour anchors shall be either Hilti Kwik-Bolt TZ or Hilti HIT HY 200 injection adhesive anchors, using galvanized or Hilti Has Rod, or stainless steel (AISI 304/316SS) all threaded rods or engineered pre-approved equal.

2.04.1.7 Thickened slabs shall be utilized for foundations to the extent possible in locations where numerous structures, equipment and pipe supports are located immediately adjacent to each other. The slab shall be sloped for surface drainage.