

## Geotechnical Design Specifications for Subdivisions

The developer of a subdivision is responsible for all aspects of the geotechnical design for that subdivision. Any geotechnical design completed for a subdivision must be completed by a Qualified Professional, registered with the Association of Professional Engineers and Geoscientists of BC (APEGBC). The Qualified Professional completing the geotechnical design, except in special circumstances must follow applicable sections of the following documents:

- Ministry of Transportation Technical Circulars including only the following:  
([http://www.th.gov.bc.ca/publications/Circulars/technical\\_circulars.asp](http://www.th.gov.bc.ca/publications/Circulars/technical_circulars.asp)).
  - T10-99 “Foundation Design”
  - T16-00 “Cold Weather Paving”
  - T01-04 “Pavement Structure Design Guidelines”
  - T10-04 “ARD Testing at Quarry and Rock Cut Sites”
  - T01-10 “Rock Stacked Retaining Walls”
- Ministry of Transportation Technical Bulletin GM2001 Rock Slope Design  
([http://www.th.gov.bc.ca/publications/eng\\_publications/geotech/TB\\_GM02001\\_Rock\\_Slope\\_Design.pdf](http://www.th.gov.bc.ca/publications/eng_publications/geotech/TB_GM02001_Rock_Slope_Design.pdf) )
- CSA S6-06 (Canadian Highway Bridge Design Code, CHBDC)
- BC Ministry of Transportation Supplement to CHBDC S6-06. This also includes the BC Ministry of Transportation Seismic Retrofit Criteria (June 2005).  
([http://www.th.gov.bc.ca/publications/eng\\_publications/bridge/bridge\\_standards.htm#manual](http://www.th.gov.bc.ca/publications/eng_publications/bridge/bridge_standards.htm#manual)).
- AASHTO “Standard Specifications for Highway Bridges,” Seventeenth Edition, 2002
- ATC-49 “Recommendations LRFD Guidelines for the Seismic Design of Highway Bridges”
- Design Build Standard Specifications (Current Version)  
[http://www.th.gov.bc.ca/publications/const\\_maint/contract\\_serv/standardspecs.htm](http://www.th.gov.bc.ca/publications/const_maint/contract_serv/standardspecs.htm)
- APEGBC “Guidelines for Legislated Landslide Assessments for Proposed Residential Development in British Columbia” (May 2008)  
<http://www.apeg.bc.ca/ppractice/documents/ppguidelines/guidelineslegislatedlandslide1.pdf>
- BC Ministry of Transportation “Manual of Control of Erosion and Shallow Slope Movement”  
[http://www.th.gov.bc.ca/publications/eng\\_publications/environment/references/Man\\_Control\\_Erosion.pdf](http://www.th.gov.bc.ca/publications/eng_publications/environment/references/Man_Control_Erosion.pdf) (August 1997)

The Qualified Professional completing the geotechnical design, as the designer shall perform Engineer of Record requirements for the design and the construction as outlined in the Ministry’s Technical Circular T06-09 “EOR & Field Review Guidelines”

([http://www.th.gov.bc.ca/publications/Circulars/All/T\\_Circ/2009/t06-09.pdf](http://www.th.gov.bc.ca/publications/Circulars/All/T_Circ/2009/t06-09.pdf)).

Prior to the construction of a subdivision, the developer may be required to submit a Quality Management Plan (QMP). The QMP must follow the requirements outlined in Section 101 of the Ministry’s Design Build Standard Specifications.

Aspects of a geotechnical design that may be included as part of the subdivision design include, but is not limited to:

- **Seismic Design:**

Seismic design is required on all structures that will be on/or adjacent to numbered highways. This includes walls retaining an embankment supporting a highway or walls that are supporting a cut above the highway where failure of the wall or cut will enter Ministry right-of-way. The 10% in 50 year event shall be considered for these structures and a pseudo-static analysis is acceptable to determine stability. Otherwise, structures are to be analyzed for the 2% in 50 year probability of occurrence must be used, as stated in the BC Supplement to the National Building Code of Canada. Additionally, inertia forces of the facing component on a structure shall be accounted for during seismic loading.

For preliminary screening, the seismic coefficient used in the analysis should be equal to the 2% in 50 year Peak Ground Acceleration (PGA) (i.e.  $k=1.0(PGA)$ ). If the Factor of Safety (FS) is  $> 1$ , when  $k=1.0(PGA)$  is used no further stability analyses are required. However, if the Factor of Safety is  $< 1$ , then the further stability analyses are required as outlined in the APEGBC “Guidelines for Legislated Landslide Assessments for Proposed Residential Development in British Columbia.” (May 2008)

Performance levels for structures are defined in the BC Ministry of Transportation Supplement to CSA S6-06 and CSA S6-06 documents. For site specific numerical analyses of site response and soil structure interaction, a site specific seismic hazard value can be obtained from the Geological Survey of Canada

[http://earthquakescanada.nrcan.gc.ca/hazard/interpolator/index\\_e.php](http://earthquakescanada.nrcan.gc.ca/hazard/interpolator/index_e.php).

Liquefaction potential of the subsoil shall be evaluated for structures, walls and embankments and the design will incorporate ground improvements and other methods of addressing potential liquefaction in accordance with ATC-49.

Seismic design of the stability of any retaining walls and embankments will be done in accordance with AASHTO, Standard Specifications for Highway Bridges, Seventeenth Edition, 2002.

- **Soil and/or Rock Slope Design:**

A rock slope design must meet, as a minimum, the design guidelines in the BC Ministry of Transportations Technical Bulletin GM2001 Rock Slope Design. Where failure of the slope may impact roadway operations, the slope must be designed to a minimum Factor of Safety

	<b>Soil Slopes</b> Minimum Factor of Safety	<b>Rock Slopes</b> Minimum Factor of Safety
Static Conditions	1.5	1.3
Already Constructed Slopes under Pseudo-static Seismic Analysis*	1.0	1.0
Newly Constructed Slopes under Pseudo-Static Seismic Analysis*	1.1	1.1

Alternatively, dynamic analysis or displacement based methods may be used to determine specific displacement values acceptable for the subdivision.

- Foundation:

Foundation designs must follow the appropriate sections of the Canadian Bridge Design Code CSA S6-06 and the BC supplement to CSA S6-06. A foundation design for any piers and abutments, including axial and lateral capacity, must consider the effects of scour, as produced by a Hydraulic Engineer.

- Retaining Walls:

Slope angles steeper than 70 degrees shall be designed as walls. Wall design must follow the methods outlined in AASHTO Standard Specifications for Highway Bridges, Seventeenth Edition, 2002, Section 5. The design life for retaining structures is to be 75 years; however the minimum design life of all components shall be 100 years, wherever there is a time-dependent calculation. The following minimum Factors of Safety shall be used for external stability of MSE wall design:

Condition	Minimum Factor of Safety
Bearing Capacity	2.5
Sliding	1.5
Overturning	2.0
Global Stability	1.5

Wall heights, proprietary wall systems and geosynthetic materials are restricted to those shown in the BC Ministry of Transportation Recognized Products List on the website:

<http://www.th.gov.bc.ca/siteindex.htm>

- Roadway Pavement Structure:

Roadway pavement structures shall meet the minimum standards of the BC Ministry of Transportation Technical Circular T01-04 “Pavement Structure Design Guidelines”.

- Natural Hazard Risk:

It is most important that natural hazards be identified on land that is about to be subdivided. Natural hazards may include, but are not limited to flooding, land slip, or avalanche. For assessing landslide hazards the most recent version of the APEGBC Guidelines for Legislated Landslide Assessment for Residential Developments in BC must be followed. This includes fully executing the Landslide Assessment Assurance Statement in Appendix D. Also, the criteria outlined in the Subdivision Preliminary Layout Review – Natural Hazard Risk document should be followed.

- Culverts:

Culverts shall adhere to the design requirements of the Canadian Highway Bridge Design Code, CSA S6-06, the BC Supplement to CSA S6-06 and/or AASHTO Standard Specifications for Highway Bridges Seventeenth Edition. Consideration shall be given to hydraulic design, and the structural design. As a minimum sub-division roads shall be constructed with minimum 600mm culverts with 2.8mm minimum wall thickness, and shall comply with the Ministry’s Recognized Product List.