

**BC CODES AND PRACTICE
EXAMINATION GUIDE
DESIGNATED STRUCTURAL
ENGINEER PROGRAM**

May 2019



**ENGINEERS &
GEOSCIENTISTS**
BRITISH COLUMBIA

GUIDE	Designated Structural Engineer BC Codes and Practice Examination Guide
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DATE OF GUIDE	May 2019
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FOREWARD

The BC Codes and Practices Examination is for Professional Engineers (P.Eng.) who have the necessary skills and experience to take full responsibility for the structural design of Part 3 building structures in accordance with Part 4 structural requirements, and for the management of the structural design in accordance with the applicable laws and practices in British Columbia.

The exam covers key aspects of the structural design of buildings required to complete Part 4 of the 2018 BC Building Code. The emphasis of the exam is on seismic design and practice specific to British Columbia. The exam also covers structural design aspects of the primary specific materials; steel, concrete, timber and masonry.

Candidates must show competence in Part 4 requirements, including structural engineering design and analysis with an emphasis on seismic requirements. Competence in the specific design requirements of at least two of the materials sections from steel, concrete, wood, and masonry is expected. Candidates must choose to answer two or more material exam sections out of the four in order to complete the exam.

BC CODES AND PRACTICES EXAM

The intention of this guideline is to provide guidance and preparation to those writing the examination and does not represent complete coverage of all possible topics on the examination. Questions may cover any reasonable aspects that form a part of the practice of structural design for buildings in British Columbia. Specific requirements of the City of Vancouver By-Law are not tested.

WHAT TO EXPECT

A wide variety of questions with a strong emphasis on questions related to seismic analysis and design (50% of the exam). Experienced candidates who are very familiar with the structural analysis and design of buildings, as the Engineer of Record should expect to have sufficient time to complete the exam. Less experienced candidates or experienced candidates not regularly completing detailed structural analysis and design may find the time limitation a challenge. Questions will vary in degree of difficulty and vary in the anticipated time to complete. The exam committee follows a guideline of 1/3 simple questions, 1/3 medium difficulty questions, and 1/3 difficult questions. Some questions will not require calculations. Few of the questions require extensive calculations. Although, more than

one question may relate to a described problem or aspect of building design, each question will be independent with answers not reliant on a correct answer to a previous question.

The exam committee selects questions that cover the broad range of scope of practice that might be encountered by a Struct.Eng. in BC. Exam questions that test specific types of structures will be limited. Questions on specialized structural topics such as post-tensioned concrete or cable structures will not be on the exam.

Consistent with the 2018 BC Building Code and current material codes, all questions and answers are in Metric Units only. See Sections E, F, G, and H for the Edition of each material code utilized for the exam.

PREPARATION SUGGESTIONS FOR CANDIDATES

The exam is for Structural Engineers who are completing structural analysis and structural design of buildings to Part 4 requirements. All candidates should ensure they have complete familiarity and understanding of all aspects of Part 4 of the 2018 BC Building Code.

Candidates must select at least two primary materials for which they wish to be tested. Although candidates may write the exam for more than two sections, the exam committee believes most candidates will not benefit from this approach. Candidates are encouraged to study both the selected material codes and ensure that they have recent experience in applying the code requirements.

Previous candidates have found a benefit to study and challenge each other in small groups of colleagues.

FORMAT OF THE BC CODES AND PRACTICES EXAM

The exam will be open book and open notes. The time allotted for the exam is 7 hours (two – three and a half hour sittings). The exam will consist primarily of, but not limited to, multiple-choice questions with four choices.

The exam has eight sections, **A** through **H**. Where reference is made to the *National Building Code of Canada* (NBCC) or its commentaries, it is assumed that the 2010 Edition applies and that actual applications are to be in conformance with the *British Columbia Building Code 2018* (BCBC 2018). The NBCC is referred to because code development and discussion, and public comment, are in the context of the NBCC, hence it is a rich source for understanding principles used in the codes as they are introduced.

The first three and a half-hour session of the examination will cover sections A-D and the second three and a half-hour session will cover sections E-H. Candidates must submit their results at the end of each three and a half-hour session. In the second half of the examination, the candidate is only required to attempt two of the four sections. At the discretion of the candidate, he/she can elect to attempt more than two sections on material codes in the afternoon session. All attempted sections will be marked. However, only the best two sections are considered in the results.

MARKING

The marking distributions for each section are as follows:

First three and a half-hour session:

A. 2018 BCBC Administrative requirements	10%
B. Load Provisions	25%
C. Basic Seismicity and Seismic Principles	50%
D. Basics of Mechanics and Structural Behaviour, Building System, and Integrity	15%
Total Mark: (total of sections A, B, C, D)	100%

Second three and a half-hour session:

E. Concrete Code	50%
F. Structural Steel Code	50%
G. Timber Code	50%
H. Masonry Code	50%
Total Mark: (any 2 sections from E, F, G, H)	100%

A minimum average of approximately 70% in each of the first three and a half-hour session and second three and a half-hour session is required to pass the examination. If either the morning or afternoon session results in a failed grade, only that session needs to be re-written.

Members of the Exam Committee review the BC Codes & Practices exam objectives, content and distribution of questions and the degree of difficulty. The Committee revises the exam as necessary to provide for new material, test validity, and to incorporate feedback. In the process of post exam analysis, appropriate adjustments may be made in the interest of fairness to all candidates. Marking of the exam is closely reviewed, double-checked and adjusted where necessary before results are released to candidates. If questions are discarded the Exam Committee ensures that candidate final marks are not adversely affected.

RE-TAKING THE EXAM

A candidate who has failed the exam after three attempts is not permitted to re-take the exam prior to complying with the following.

The candidate is required to submit 2 to 3 projects and to make an oral presentation in front of a Review panel. The members of the panel will test the candidate's knowledge by asking relevant questions to determine whether he/she has satisfied the Review Panel that they are qualified to take the exam a fourth and fifth time if necessary. A fee is required for these proceedings.

Failure of a fifth attempt may disqualify the Candidate from the Struct. Eng. program and is considered on a case-by-case basis by the SQB.

A. 2012 BCBC ADMINISTRATIVE REQUIREMENTS

This section will examine candidates' understandings of basic administrative requirements of Municipal codes, BC Building Code 2018, and Engineers and Geoscientists Guidelines. Administration requirements specific to the City of Vancouver Building By-Law No. 9419 2014 are not included on the examination.

1. Defined Terms
2. Administrative requirements (e.g. parts 2,3,4 and 9 of BCBC and the relationship to local codes)
3. Letters of Assurance and Field Reviews
4. Guidelines for Professional Structural Engineering Services for Part 3 Building Projects of APEGBC
5. Responsibilities of the Struct.Eng.

B. LOAD PROVISIONS

This section examines the understanding of the loading and load combination requirements of the B.C. Building Code 2018, Part 4, including an understanding of the background to the code provisions contained in the Commentaries to NBCC 2015.

1. Knowledge of the principles of Limit States Design
 - serviceability
 - strength and stability
 - performance factors and load factors, reliability index
 - factored load effects
 - companion loads
 - load combinations
2. Dead Loads
 - load analysis, tributary areas
 - self weight
 - load allowances for undetermined items, partitions, and utilities
3. Live Loads
 - use and occupancy
 - pattern loads, concentrated load
 - load reductions
4. Snow, Ice, and Rain Loads

5. Wind Load
 - exposure
 - internal and external loads
 - directional loads

C. SEISMIC PRINCIPLES

The principles to be examined include the requirements of the BCBC 2018, the background material in NBCC 2015 Commentary J, in the context of fundamental principles, tasks, and knowledge in BC practice of seismic design, analysis, evaluation, and retrofit of buildings.

1. Seismology
 - earthquake characteristics and terminology
 - tectonic situation affecting British Columbia
 - earthquake magnitude, intensities, and related probability measures
 - accelerographs, ground acceleration and velocity, response spectra
 - geotechnical influences
2. Dynamics
 - Structural irregularities
 - basics of dynamics
 - relationship of sdof and mdof models to real structures
 - period, damping, mode shapes
3. Performance Goals
 - seismic design philosophy of the NBCC
 - capacity design principles
4. Seismic Analysis and Design
 - the principle of Ductility
 - the principle of Capacity Design
 - Part 4 provisions of the NBCC for seismic design and analysis
 - basics of mdof dynamic analysis
 - distribution of forces in lateral load resisting systems including torsion effects
 - internal forces in irregular systems, vertical and plan irregularities
 - attachments, parts and portions
 - anchorage requirements for non-structural elements
6. Seismic Behaviour of Building Systems
 - performance and limitations of systems and elements with varying degrees of ductility
7. Building details for seismic design

E. CONCRETE CODE (APPROXIMATELY 50% ON SEISMIC)

- diaphragm/wall connections and collector struts
 - footing ties
 - wall anchoring
 - connection design
8. Geotechnical and Foundation Issues
- Site Class, liquefaction, slope stability, settlement
9. Basics of probability dealing with return periods, expectation, and variance

D. BASICS OF MECHANICS AND STRUCTURAL BEHAVIOUR AND BUILDING SYSTEM AND INTEGRITY – STRENGTH AND SERVICEABILITY

This section will test the skills of the candidates in applying basics of Mechanics and structural behaviour, and will examine the candidate's understanding of areas in building system behaviour.

1. Mechanics and Analysis
- analysis and behavior of statically determinate and indeterminate structures
 - analysis of simple frames
 - analysis of simple trusses or arches
 - deflections
 - basic torsion analysis
 - P-delta analysis of simple column frames
 - stability analysis of beam and columns
2. Structural Behavior
- elastic and inelastic behaviour of materials
3. Deflection and compatibility of varying systems

E. Concrete Code (Approximately 50% on Seismic)

This section examines understanding of the principles and application of CAN/CSA A23.3 – 14- Design of Concrete Structures and CSA A 23.1/A23.2 – 14 - Concrete materials and methods of concrete construction/Test methods and standard practices for concrete.

F. STRUCTURAL STEEL CODES (APPROXIMATELY 50% ON SEISMIC)

This section examines understanding of the principles and application of CSA S16-14- Design of Steel Structures.

G. TIMBER CODE (APPROXIMATELY 50% ON SEISMIC)

This section examines understanding of the principles and application of CSA 086-14 - Engineering Design in Wood.

H. MASONRY CODE (APPROXIMATELY 50% ON SEISMIC)

This section examines the principles and application of CAN/CSA S304.1-14 - Design of Masonry Structures, and CAN/CSA A371-14 - Masonry Construction for Buildings.