QUALITY MANAGEMENT GUIDELINES

DOCUMENTED INDEPENDENT REVIEW OF STRUCTURAL DESIGNS

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ENGINEERS &
GEOSCIENTISTS
BRITISH COLUMBIA

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ABBREVIATIONS

ABBREVIATION	TERM
BC	British Columbia
CWC	Canadian Wood Council
QM	Quality Management
Struct.Eng.	Designated Structural Engineer

1.0 DEFINITIONS

The following definitions are specific to this Quality Management (QM) guideline.

TERM	DEFINITION
Act	*Engineers and Geoscientists Act* [RSBC 1996] Chapter 116.
Bylaws	The Bylaws of Engineers and Geoscientists BC made under the *Act*.
Engineering/Geoscience Professional(s)	Professional engineers, professional geoscientists, and licensees who are licensed to practice by Engineers and Geoscientists BC.
Engineering Professional(s)	Professional engineers, including licensees who are licensed to practice by Engineers and Geoscientists BC.
Engineers and Geoscientists BC	The Association of Professional Engineers and Geoscientists of the Province of British Columbia, also operating as Engineers and Geoscientists BC.
Independent Review	A documented evaluation of the structural design concept, details, and documentation based on a qualitative examination of the substantially complete structural design documents, before the documents are issued for construction, by an experienced Engineering Professional who has not been involved in preparing the design. Prior to December 2010, Bylaw 14(b) referred to Independent Review as "concept review."
Independent Reviewer	The Engineering Professional who completes the Independent Review.
Organization	Any firm, corporation, partnership, government agency, sole proprietor, or other type of legal entity that employs Engineering/Geoscience Professionals and provides products and/or services requiring the application of professional engineering and/or professional geoscience.
Professional of Record	The Engineering Professional or licensee with the lowest level of direct professional responsibility for the structural engineering work and any related engineering documents produced, and whose seal appears on the documents. A test of “direct professional responsibility” is the ability of that Engineering Professional to alter or revise the engineering content in the master documents.

2.0 PURPOSE AND SCOPE

2.1 Bylaw 14 states:

"(b) Members and licensees shall establish and maintain documented quality management processes for their practices, which shall include, as a minimum:

(4) documented independent review of structural designs prior to construction by members or licensees having appropriate experience in designing structures of a similar type and scale, and not involved in preparing the design. The reviewer shall examine representative samples of the structural assumptions, continuity of gravity and lateral load paths, stability and detailing. Where appropriate, the reviewer shall perform numerical calculations on a sample of gravity and lateral force resisting elements necessary to satisfy any reviewer concerns. The extent of the review shall be determined by the reviewer based on the progressive findings of the review. This review and any follow up action must be completed before the documents are issued for construction.

The independent review of structural designs shall evaluate the construction documents to determine if the structural systems appear complete, consistent, and in general compliance with applicable codes. The structural review may be part of, but is not intended to replace, the regular checks required in 14(b)(2).

Independent review of each instance of repetitive designs of individual structural components is not required, but documented initial independent review and independent review at intervals is required to confirm the maintenance of design quality."

2.2 Proper and appropriate Independent Reviews of structural designs are fundamental to upholding the Engineers and Geoscientists BC Code of Ethics, which requires that all Engineering/Geoscience Professionals hold paramount the safety, health and welfare of the public, the protection of the environment and promote health and safety within the workplace.

2.3 Engineering Professionals carrying out structural design must meet the requirement of Bylaw 14(b)(4) by having Independent Reviews of any structural designs they prepare carried out by another qualified Engineering Professional, before the documents are issued for construction. This QM guideline is intended to assist Engineering Professionals in establishing

and maintaining Independent Reviews that meet Bylaw 14(b)(4) by addressing the following:

- What is an Independent Review of structural design
- Purpose of an Independent Review
- Extent of Independent Review required
- What should be Independently Reviewed
- When an Independent Reviews should occur
- What an Independent Review includes
- Checking compared to an Independent Review
- Documents required for an Independent Review
- Who is responsible for ensuring that an Independent Review occurs
- Who is qualified to carry out an Independent Review
- How are issues identified in an Independent Review addressed
- Records that are required to be kept following an Independent Review

2.4 To comply with the Bylaws, Engineering Professionals must have established, or have access to, a documented QM process that includes having their structural designs independently reviewed by another qualified Engineering Professional before the documents are issued for construction.

2.5 A "documented QM process" is one that has been carefully thought out and reduced to writing in suitable form. The process may be captured in a written procedure, process flowchart, checklists, forms to record Independent Reviews, or other documentation developed to suit the nature of the work undertaken by Engineering Professionals.

2.6 These obligations apply to Engineering Professionals acting in their professional capacities in all sectors where structural design is being carried out, when their work applies to or is used in any of the following circumstances:

- Ongoing engineering and geoscience work
- Projects with a defined start and finish
- Products and services requiring structural design
- Permanent or temporary structures including those related to construction
- Independently supported structures designed in BC such as retaining walls, large signage, and support towers
- Construction carried out by others
- Construction being carried out by the Engineering Professional's Organization's own forces
- Structural design carried out for use internally by the Engineering Professional's Organization
- Structural design carried out for others

2.7 Terminology used across sectors may vary from terminology used in this QM guideline. However, the intent and obligations of Engineering Professionals in all sectors remain the same. Sectors may include but are not limited to the following:

- Aerospace
- Construction
- Consulting
- Education
- Government
- Healthcare
- High technology
- Light and heavy industry
- Manufacturing
- Marine engineering and naval architecture
- Natural resources
- Operations
- Research and development
- Utilities

2.8 This QM guideline must be read in conjunction with the other requirements of Bylaw 14(b) and the Engineers and Geoscientists BC *Quality Management Guidelines – Documented Checks of Engineering and Geoscience Work* (Engineers and Geoscientists BC 2018a).

2.9 This QM guideline is a minimum standard for Engineering Professionals. Failure to meet the intent of this QM guideline may be evidence of unprofessional conduct and may give rise to disciplinary proceedings by Engineers and Geoscientists BC.

3.0 GUIDELINES FOR PRACTICE

3.1 WHAT IS INDEPENDENT REVIEW OF STRUCTURAL DESIGN

3.1.1 An Independent Review is a documented evaluation of the structural design concept, details, and documentation based on a qualitative examination of the substantially complete structural design documents before the documents are issued for construction by an experienced Engineering Professional who has not been involved in preparing the design. Engineers and Geoscientists BC previously referred to Independent Review as "concept review."

3.1.2 Independent Reviews are not the same as checks of engineering and geoscience work. For information about checking, refer to the Engineers and Geoscientists BC *Quality Management Guidelines – Documented Checks of Engineering and Geoscience Work* (Engineers and Geoscientists BC 2018a).

3.2 WHAT IS THE PURPOSE OF INDEPENDENT REVIEW OF STRUCTURAL DESIGN

3.2.1 Engineering Professionals who undertake structural design have a professional responsibility to complete their assignments so as to minimize risk to the public and the environment. Bylaw 14(b)(4) recognizes the fact that virtually all structural designs, by their nature, present some risk to the public. As a result, an Independent Review of the structural design is required. The Independent Review process is intended to produce a professional assessment of the adequacy of the structural design approach, its execution, and the documentation. It evaluates the construction documents to determine whether the structural systems appear complete, consistent, and in general compliance with relevant code and design requirements. The Independent Review may be part of, but is not intended to replace, the regular checks of engineering and geoscience work required by the Bylaws.

3.3 WHAT EXTENT OF INDEPENDENT REVIEW IS REQUIRED

3.3.1 The extent and level of detail examined in an Independent Review will vary, depending on the experience of the Independent Reviewer and the complexity and risk associated with the project. Questions to be considered when determining the extent of the Independent Review:

- What are the consequences of errors or incompleteness in the engineering work?
- How complex is the design and the product of the design?
- Is the engineering innovative or does it incorporate departures from the previous practice?

3.3.2 The Independent Reviewer must be satisfied that he or she has examined the design in sufficient detail to make an informed judgment as to the adequacy of the design for its intended purpose. The Independent Reviewer is required to re-evaluate and extend the review when his or her evaluation suggests there might be problems with the design.

3.4 WHAT SHOULD BE INDEPENDENTLY REVIEWED

3.4.1 GENERAL

3.4.1.1 Except for conventional one- or two-family homes that fall under the prescriptive requirements of Part 9 of the *British Columbia Building Code*, the *Vancouver Building Bylaw*, or the *National Building Code*, all structural designs prepared in BC in any sector must undergo an Independent Review that complies with the intent of the Bylaw before the documents are issued for construction.

3.4.2 STRUCTURES NOT REQUIRING INDEPENDENT REVIEW

3.4.2.1 Many conventional, wood-frame, one- and two-family dwellings fall entirely within the prescriptive requirements of Part 9 of the *British Columbia Building Code*, the *Vancouver Building Bylaw*, or the *National Building Code* and do not require a structural design to Part 4. Where the structural design of a one- or two-family dwelling is based on Part 9, and includes a design for lateral resistance, which conforms to the prescriptive requirements in The Canadian Wood Council (CWC) *Engineering Guide for Wood Frame Construction* (CWC 2014), an Independent Review of the design is not required. Where the CWC lateral resistance evaluation indicates that a structural design conforming to Part 4 is required, an Independent Review is required.

3.4.2.2 Members designing Part 9 residential structures should follow the Engineers and Geoscientists BC *Guidelines for Professional Structural Engineering Services for Part 9 Buildings in British Columbia* (Engineers and Geoscientists BC 2014) and this QM guideline. A documented check of all engineering work, including Part 9 buildings, is required. Refer to Engineers and Geoscientists BC *Quality Management Guidelines – Documented Checks of Engineering and Geoscience Work* (Engineers and Geoscientists BC 2018a).

3.4.3 STRUCTURES REQUIRING PERIODIC INDEPENDENT REVIEW

3.4.3.1 Repetitive Design

The Bylaw exempts “each instance of repetitive designs of individual structural components” from Independent Review. However, to confirm the maintenance of design quality, the Bylaw requires an “initial” Independent Review of a typical component design with Independent Reviews at “intervals.”

3.4.3.2 Manufactured Structural Components

Many projects incorporate structural components that are designed by Engineering Professionals retained by the component manufacturer or contractor (e.g., open web steel joists, pre-cast concrete beams, wood trusses). Periodic Independent Reviews of these structural component designs are required. The Professional of Record for the primary structural system for a structure is not responsible for ensuring Independent Reviews are carried out on all individual structural components designed by others and incorporated into the primary structural system. However, the Professional of Record for the primary structural system for a structure is responsible for confirming that the components are in general conformance with the design concept and general arrangement of the primary structural system.

3.5 WHEN SHOULD INDEPENDENT REVIEW OF STRUCTURAL DESIGN OCCUR

3.5.1 To avoid surprises, Independent Reviews may be performed in stages as portions of a design are completed. However, the final Independent Review must be completed after checking and before the documents are issued for construction. Construction must not proceed on any portion of the structure until an Independent Review of that portion has been completed. The Professional of Record should consider having the Independent Review of the concept and approach before starting the detailed design, to minimize possible rework.

3.6 WHAT DO INDEPENDENT REVIEWS OF STRUCTURAL DESIGN INCLUDE

3.6.1 The steps for Independent Review of a structural design include but are not limited to the following:

1. Review the design criteria, loads (including loads imposed by components designed by other disciplines and loads from adjacent structures), and performance requirements.
2. Review geotechnical requirements and material properties.
3. Review the concept and integrity of the gravity and lateral load resisting system.
4. Review the continuity of load paths for both gravity and lateral loads.
5. Review the structural plans and supporting documents to determine whether they are sufficient to identify the essential components of the structural system, and provide sufficient information to guide the construction of the structure.
6. Where appropriate, perform design calculations on a representative sample of structural elements to determine whether the analysis, design, and detailing generally comply with the appropriate codes and standards.
7. Discuss any concerns with the Professional of Record. It is the responsibility of the Professional of

Record to adequately resolve concerns noted in the Independent Review.

8. Provide a formal record of the Independent Review to the Professional of Record highlighting any concerns (see **Appendix A: Checklist and Signoff for an Independent Review**). If significant concerns are noted, the Professional of Record must revise the structural design and resubmit the revised structural design for an Independent Review, preferably by the same Independent Reviewer.

3.7 HOW DOES CHECKING COMPARE TO AN INDEPENDENT REVIEW

3.7.1 Structural design checks do not generally satisfy the requirements of an Independent Review. A design check identifies deficiencies, but may be limited to the evaluation of individual components by different individuals, some of whom may have been involved in the detailed design of other portions of the project. Conversely, an Independent Review does not satisfy the requirements of a structural design check as it does not include detailed evaluation of all components.

3.7.2 While checking and Independent Review are distinct activities, if an Engineering Professional is suitably experienced and independent, he or she could complete both processes, that is, completing a design check and an Independent Review.

3.7.3 The extent of numerical checking and level of detail examined in an Independent Review will vary depending on the experience of the Independent Reviewer, the complexity and risk associated with a given structure, and the extent of concerns that develop as the Independent Review proceeds.

3.8 WHAT DOCUMENTS ARE REQUIRED FOR AN INDEPENDENT REVIEW

3.8.1 Independent Reviews may occur in stages as portions of the design are completed. However, the final Independent Review should be based on the substantially complete construction documents that are to be issued for construction.

3.8.2 The Professional of Record must provide the following documents to the Independent Reviewer:

- Structural plans and supporting documents, plus plans and supporting documents of other disciplines that may be necessary to review the structural design, or that the reviewer requests.
- Structural specifications, plus specifications of other disciplines that may be necessary to review the structure, or that the reviewer requests.
- All geotechnical reports and any follow-up documentation between the Professional of Record and the geotechnical engineer.

- If it is not incorporated in the drawings and specifications, a summary sheet documenting:
  - the structural system and design approach in sufficient detail to identify the lateral and vertical load resisting systems, including any special or unconventional aspects;
  - site-specific design data, including climatic and seismic criteria;
  - project-specific design data such as seismic parameters, soil-bearing capacity, lateral soil pressure, and pile capacity;
  - the design loads from use and occupancy, snow, rain, wind, superimposed dead loads, mechanical and electrical equipment, and architectural features such as cladding, window-washing equipment, and landscaping; and
  - any special loading conditions or performance criteria.
- Structural design notes and calculations when requested by the Independent Reviewer.

3.9 WHO IS RESPONSIBLE FOR ENSURING THAT AN INDEPENDENT REVIEW OCCURS

3.9.1 The Professional of Record must ensure that an Independent Review of structural designs is completed before the final documents are issued for construction. The Independent Reviewer's responsibility is limited to completing the Independent Review in accordance with this QM guideline. Independent Reviews of structural designs do not relieve the Professional of Record of his or her professional responsibility for the structural design.

3.10 WHO IS QUALIFIED TO CARRY OUT AN INDEPENDENT REVIEW OF A STRUCTURAL DESIGN

3.10.1 The Independent Reviewer must be an Engineering Professional with appropriate experience with the type of structure being reviewed. The level of experience required for a specific structure will depend on the risk and complexity of the structure. The Independent Reviewer's experience must be sufficient to critique concepts and identify deficiencies in structures with complexity equal or greater than the structure being reviewed. Experienced Engineering Professionals in the commercial building sector suggest that a minimum of six years of experience with a particular structural system would be appropriate for most projects in that field.

3.10.2 The Independent Reviewer must be suitably experienced, but is not required to be registered as a Struct.Eng.

3.10.3 The requirement for independence is intended to provide an unbiased review, which critically evaluates the design concept and approach selected by the Professional of Record.

3.10.4 To maintain independence, the Independent Reviewer must not have been involved in preparing the structural design. The Independent Reviewer may, however, be a member of the same Organization.

3.10.5 Although checking and Independent Review are distinct processes, if an individual is suitably experienced and independent, the two processes can be completed by the same individual.

3.11 HOW SHOULD ISSUES IDENTIFIED IN AN INDEPENDENT REVIEW BE ADDRESSED

3.11.1 The Independent Reviewer is required to communicate issues found during the Independent Review to the Professional of Record. The Professional of Record is required to document which actions were taken or not taken as a result of the Independent Review and the rationale for his or her decisions.

3.12 WHAT RECORDS OF AN INDEPENDENT REVIEW SHOULD BE CREATED AND RETAINED

3.12.1 The Independent Reviewer must document the results of his or her Independent Review, and confirm that the results have been conveyed to the Professional of Record. The Independent Reviewer must retain his or her calculations, check prints, and records of communications concerning the Independent Review. Refer to **Appendix A: Checklist and Signoff for an Independent Review** for an example of a suitable record and signoff.

3.12.2 The Professional of Record is required to keep a record of the actions taken or not taken as a result of the Independent Review.

4.0 REFERENCES AND RELATED DOCUMENTS

Engineers and Geoscientists Act [RSBC 1996], Chapter 116.

BC Office of Housing and Construction Standards. 2012. BC Building Code. [accessed: 2018 Jan 2]. http://www.bccodes.ca/.

Canadian Wood Council (CWC). 2014. Engineering Guide for Wood Frame Construction. 2014 edition. Ottawa, ON, Canada: CWC.

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Engineers and Geoscientists BC. 2014. Guidelines for Professional Structural Engineering Services for Part 9 Buildings in British Columbia. Version 3.0. Burnaby, BC, Canada: Engineers and Geoscientists BC. [accessed: 2018 Jan 2]. https://www.egbc.ca/Practice-Resources/Professional-Practice-Guidelines.

5.0 APPENDIX

Appendix A: Checklist and Signoff for an Independent Review

CHECKLIST AND SIGNOFF FOR AN INDEPENDENT REVIEW

[Print clearly and legibly]

PROFESSIONAL OF RECORD

RE:

Name of project or work

P.Eng. or Licensee name

Address of project or work

Firm name

Legal description of project or work

Address

ITEM	REVIEWED	REMARKS
	INITIALS	
1. Design code loadings and serviceability limits		
2. Material specifications and geotechnical recommendations		
3. Concept and integrity of the gravity load resisting system		
4. Concept and integrity of the lateral load resisting system (e.g., wind, seismic)		
5. Drawing completeness and continuity of load paths		
6. Design check of representative structural elements		
7. Review of representative structural details		
8. Concerns discussed with the Professional of Record		

INDEPENDENT REVIEWER

P.Eng. or Licensee name

Firm name

Address

Date: (yy/mm/dd)

Signature

CHECKLIST AND SIGNOFF FOR AN INDEPENDENT REVIEW

[Print clearly and legibly]

TO: **PROFESSIONAL OF RECORD** DATE: _____

_____
P.Eng. or Licensee name

_____
Firm name

_____
Address

_____

RE: _____
Project name

_____
Address of project

_____
Legal description of project

The undersigned hereby records that an Independent Review of the project or work, based on the attached list of the structural plans and supporting documents prepared by the Professional of Record for the structural components, has been completed by this Independent Reviewer.

I certify that I am an Engineering Professional as defined below.

DATE: _____

_____
Name

_____
Signed

_____
Address

_____

_____

_____ (Affix PROFESSIONAL SEAL here)
Telephone

(If the Independent Reviewer is a member of a firm, complete the following.)

I am a member of the firm _____
and I sign this letter on behalf of the firm. (Name of firm)

NOTE:

1. The above letter must be signed by an Engineering Professional (professional engineers, licensees, including limited licensees, licensed to practice by Engineers and Geoscientists BC) qualified to conduct an Independent Review on the structural design being reviewed.
2. This letter is endorsed by Engineers and Geoscientists BC.

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