PROFESSIONAL PRACTICE GUIDELINES

BUILDINGS

DESIGNING GUARDS FOR BUILDING PROJECTS

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ENGINEERS & GEOSCIENTISTS
BRITISH COLUMBIA

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PREFACE

These *Professional Practice Guidelines – Designing Guards for Building Projects* were developed to guide professional practice related to the design of Guards. Guards are considered secondary structural components of buildings that are critical to life safety, since they act as barriers to prevent people from falling from a height. Within these guidelines, a variety of issues such as design considerations, continuity of professional responsibility, and assurance pathways are discussed.

This update to these guidelines was undertaken to reflect current industry standards and practices. In particular, a new Canadian standard was published in 2016, CSA A500 Building Guards (CSA 2016), which is a comprehensive standard on the design, testing, and implementation of Guards and provides explicit guidance on the use of glass in Guards.

This document was prepared for the information of Engineering Professionals, Architects, designers, Authorities Having Jurisdiction, the public, and other stakeholders who might be involved in, or have an interest in, Guard design. These guidelines provide a minimum expectation for the various stakeholders with respect to level of effort, due diligence, and standard of practice to be followed when carrying out Guard design.

These guidelines outline the appropriate standard of practice to be followed at the time they were prepared. However, this is a living document that is to be revised and updated as required in the future, to reflect the developing state of practice.

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ABBREVIATIONS

ABBREVIATION	TERM
BC	British Columbia
BCBC	British Columbia Building Code
NBC	National Building Code of Canada
VBBL	Vancouver Building By-law

DEFINED TERMS

The following definitions are specific to this guideline.

TERM	DEFINITION
Act	*Engineers and Geoscientists Act* [RSBC 1996], Chapter 116.
Architect	An individual who is registered or licensed to practice as an architect under the *Architects Act*, which is administered by the Architectural Institute of British Columbia.
Association	The Association of Professional Engineers and Geoscientists of the Province of British Columbia, also operating as Engineers and Geoscientists BC.
Authority Having Jurisdiction	The jurisdictional body (usually municipal) with authority to administer and enforce the *BC Building Code* (BCBC), the City of Vancouver Building By-law (VBBL), the *National Building Code of Canada* (NBC), or a local building bylaw or code.
Base Building Structural Engineer	The Engineering Professional assuming responsibility for the structural integrity of the base building, including effects of secondary structural components such as Guards and their attachments to the base building.
Bylaws	The Bylaws of Engineers and Geoscientists BC made under the *Act*.
Design/Build Contractor	A contractor retained by an Owner to be responsible for both the design and construction aspects of a building project.
Engineers and Geoscientists BC	The Association of Professional Engineers and Geoscientists of the Province of British Columbia, also operating as Engineers and Geoscientists BC.
Engineering Professional(s)	Professional engineers and licensees who are licensed to practice by Engineers and Geoscientists BC.
General Contractor	A contractor who has a contract with an Owner for construction of all or a portion of a building project.
Guard	A protective barrier around openings in floors or at the open sides of stairs, landings, balconies, mezzanines, galleries, raised walkways, or other locations to prevent accidental falls from one level to another. Such a barrier may or may not have openings through it.
Letters of Assurance	Uniform, mandatory documents that are intended to clearly identify the responsibilities of key individuals in a building project.
Owner	A party who owns a building, or will own a building, once construction is complete.

TERM	DEFINITION
Registered Professional	Defined in the *BCBC* as: "a) a person who is registered or licensed to practice as an architect under the *Architects Act*, or b) a person who is registered or licensed to practice as a professional engineer under the *Engineers and Geoscientists Act*." For the purposes of the *Engineers and Geoscientists Act*, this can include professional engineers and licensees having the appropriate scope of practice, all of whom must be qualified by training or experience to provide designs for building projects.
Registered Professional of Record	Defined in the *BCBC* as a Registered Professional retained to undertake design work and field reviews in accordance with Subsection 2.2.7.3. of Division C.
Specialty Structural Engineer	The Engineering Professional taking responsibility for design and specification of Guards for buildings. The Specialty Structural Engineer may act as the Registered Professional of Record or as a Supporting Registered Professional.
Supporting Registered Professional	The Registered Professional providing supplementary supporting design and/or field review services for the Guard to the Registered Professional of Record. It is recommended that the Registered Professional of Record obtain Schedules S-B and S-C from the Supporting Registered Professional, as identified in Appendix A of *Practice Note 16: Professional Design and Field Review By Supporting Registered Professionals* (Engineers and Geoscientists BC and AIBC 2017). These schedules provide assurance confirming that the plans and supporting documents relating to the supporting engineering services for a Guard substantially comply, in all material respects, with the applicable requirements of the applicable building code.

1.0 INTRODUCTION

Engineers and Geoscientists British Columbia (the Association) is the regulatory and licensing body for the engineering and geoscience professions in British Columbia (BC). To protect the public, the Association maintains robust standards for entry to the professions, and comprehensive regulatory tools to support members and licensees in meeting professional and ethical obligations. If these standards are not met, the Association takes action through its investigation and discipline processes.

As part of its mandate to protect the public interest by setting and maintaining professional practice standards, the Association works with experts in their fields to develop professional practice guidelines on specific professional services or activities where additional guidance is necessary. Each guideline deals with the carrying out of specific activities in a manner such that the Association's members and licensees can meet their professional obligations under the *Engineers and Geoscientists Act* (the *Act*).

These *Professional Practice Guidelines – Designing Guards for Building Projects* provide guidance on professional practice for Engineering Professionals who design Guards for buildings. Guards are typically considered secondary structural elements of a building, because they do not support the primary structure; however, Guards play a significant role in public safety.

1.1 PURPOSE OF THESE GUIDELINES

The purpose of this document is to serve as a design guide for individual practitioners when preparing drawings and specifications in the design and implementation of Guards used in buildings.

These guidelines provide a common approach for carrying out a range of professional activities related to Guard design. These guidelines were first published in 2013; this revision reflects current industry standards and practices, the most notable being the introduction of the new Canadian standard CSA A500 Building Guards (CSA 2016).

Following are the specific objectives of these guidelines:

1. Describe the standard of practice that Engineering Professionals should follow when providing professional services related to Guard design.
2. Specify the tasks that Engineering Professionals should complete to meet the appropriate standard of care and fulfill their professional obligations under the *Act*. These obligations include the member's primary duty to protect the safety, health, and welfare of the public and the environment.
3. Outline the professional services that the Engineering Professional conducting this type of work should generally provide.
4. Describe the roles and responsibilities of the various participants/stakeholders involved in such work. The document will assist in delineating the roles and responsibilities of the various participants/stakeholders, which may include the Specialty Structural Engineer, Base Building Structural Engineer, Owner, Architect, General Contractor, and Design/Build Contractor.
5. Define the skill sets that are consistent with the training and experience required to carry out this professional activity.
6. Provide guidance on the use of assurance documents so the appropriate considerations have been addressed (both regulatory and technical) for the specific professional activity that was carried out.

7. Provide guidance on how to meet the seven quality management requirements under the *Act* and Bylaws when carrying out the professional activities identified in these professional practice guidelines.

1.2 ROLE OF ENGINEERS AND GEOSCIENTISTS BC

These guidelines were prepared by subject matter experts and reviewed at various stages by a formal review group. The final draft of these guidelines underwent a final consultation process with various committees and divisions of Engineers and Geoscientists BC. These guidelines and the current revision were approved by the Association's Council and, prior to publication, underwent final legal and editorial reviews. These guidelines form part of Engineers and Geoscientists BC's ongoing commitment to maintaining the quality of professional services that Engineering Professionals provide to their clients and the public.

An Engineering Professional must exercise professional judgment when providing professional services; as such, application of these guidelines will vary depending on the circumstances.

The Association supports the principle that appropriate financial, professional, and technical resources should be provided (i.e., by the client and/or the employer) to support Engineering Professionals who are responsible for carrying out Guard design, so they can comply with the standard of practice provided in these guidelines. These guidelines may be used to assist in the level of service and terms of reference of an agreement between an Engineering Professional and a client.

By following these guidelines, Engineering Professionals will fulfill their professional obligations, especially regarding the first principle of the Association's Code of Ethics, which is to "hold paramount the safety, health and welfare of the public, protection of the environment and promote health and safety in the workplace." Failure to meet the intent of these guidelines could be evidence of unprofessional conduct and lead to disciplinary proceedings by the Association.

1.3 INTRODUCTION OF TERMS

For the purpose of these guidelines, the Specialty Structural Engineer is the Engineering Professional taking responsibility for design, specification, and field reviews of Guards for buildings. The Specialty Structural Engineer may act as the Registered Professional of Record or as the Supporting Registered Professional (see **Section 2.0 Roles and Responsibilities**).

The term 'Guard' is defined in the *BC Building Code* (*BCBC*), Division A, Sentence 1.4.1.2.(1) to mean a protective barrier around openings in floors or at the open sides of stairs, landings, balconies, mezzanines, galleries, raised walkways, or other locations to prevent accidental falls from one level to another. A Guard may or may not have openings through it. A handrail, though not a defined term in the *BCBC*, functions to minimize the risk of injury to persons as a result of tripping, slipping, falling, contact, drowning, or collision, and may or may not function as a Guard.

As a note of clarification, the term 'guardrail' is not used in the *BCBC*, except in the Letters of Assurance, Schedule B, Assurance of Professional Design and Commitment for Field Review. The WorkSafeBC *Occupational Health and Safety Regulation* (WorkSafeBC 2018) also uses the term 'guardrail'. Other terms that are sometimes used to refer to structures that function as Guards are balustrades, parapets, walls, and windows. For the purpose of these guidelines, the term 'Guard' will be used throughout.

See the **Defined Terms** section at the front of the document for a full list of definitions specific to these guidelines.

1.4 SCOPE OF THE GUIDELINES

These guidelines apply to the practice of structural engineering as related to Guard design for buildings. They summarize the standard of practice for a Specialty Structural Engineer when preparing drawings and specifications in the design and implementation of Guards used in buildings.

Specific requirements for Guards may differ among Authorities Having Jurisdiction. It is the responsibility of the Engineering Professional to be familiar with local requirements.

These guidelines specify tasks that the Specialty Structural Engineer should perform to achieve designs that are in the best interest of the project and the public, and are properly coordinated with the work of other design and construction team participants (if applicable). These guidelines should assist in maintaining the integrity of the overall and detailed designs. The Specialty Structural Engineer responsible for Guards may work in conjunction with other design team members or contractors on certain projects; these guidelines should assist in the delineation of responsibilities among these parties.

These guidelines are not intended to be used as the standard for Guard design. Instead, they are intended to establish standards of practice that a Specialty Structural Engineer should meet to fulfill their professional obligations, especially regarding the primary duty to protect the safety, health, and welfare of the public. It is up to the individual to perform the required due diligence in preparing the drawings and specifications. This document must not be used in a way that reduces any requirement specified in any applicable code, bylaw, or standard.

1.5 APPLICABILITY OF THE GUIDELINES

These guidelines provide guidance on professional practice for Specialty Structural Engineers who carry out design of Guards for buildings. These guidelines are not intended to provide systematic instructions for carrying out this activity. Rather, these guidelines outline considerations for this activity.

A Specialty Structural Engineer's decision not to follow one or more aspects of these guidelines does not necessarily mean a failure to meet their professional obligations. Such judgments and decisions depend upon weighing facts and circumstances to determine whether other reasonable and prudent Specialty Structural Engineers, in similar situations, would have conducted themselves similarly.

1.6 ACKNOWLEDGEMENTS

This revision to these guidelines was prepared by Leonard Pianalto, P.Eng., M.Sc., LEED® AP, FEC, on behalf of Engineers and Geoscientists BC.

The document was reviewed by a group of technical experts, as well as by various Engineers and Geoscientists BC committees and divisions. Authorship and review of these guidelines does not necessary indicate the individuals and/or their employers endorse everything in these guidelines.

The Structural Engineers Association of BC and the Architectural Institute of BC reviewed these guidelines and provided their official endorsement.

Engineers and Geoscientists BC thanks the authors and reviewers of the original document, as well as the author and reviewers of this revision, for their time and effort in sharing their knowledge and experience.

2.0 ROLES AND RESPONSIBILITIES

2.1 COMMON FORMS OF PROJECT ORGANIZATION

Project organization can vary according to the needs of the project and the parties. Various parties can engage the Specialty Structural Engineer for designing Guards for buildings.

The following cases outline some of the typical project organization arrangements:

- The **General Contractor** engages the Specialty Structural Engineer either directly, through a subcontractor, or through a material supplier to act as either a Registered Professional of Record or a Supporting Registered Professional.
- The **Design/Build Contractor**, who could be a subcontractor such as a glazing contractor, railing installer, or other specialty trade, engages the Specialty Structural Engineer as part of the design/build team to act as either a Registered Professional of Record or a Supporting Registered Professional.
- The **Owner** engages the Specialty Structural Engineer directly to act as the Registered Professional of Record.
- The **Architect** engages the Specialty Structural Engineer to act as a Supporting Registered Professional.

2.2 RESPONSIBILITIES

The following sections outline the responsibilities of various potential project team members. Defining these responsibilities helps ensure that the design and construction of a Guard will meet the appropriate standard of practice and the requirements of the applicable building codes.

2.2.1 SPECIALTY STRUCTURAL ENGINEER

The Specialty Structural Engineer must:

- work with whomever engaged the Specialty Structural Engineer on the project to clearly develop a scope of work for the required designs, specifications, and field reviews for the Guard, as well as the connection to, and the effect on, the base structure;
- liaise with the appropriate Registered Professionals for the required services, but if the Specialty Structural Engineer is acting independent of any other Registered Professionals of Record, the Specialty Structural Engineer becomes the Registered Professional of Record;
- follow **Section 3.0 Guidelines for Professional Practice** when undertaking design, specifications, and field reviews of the Guard;
- provide Letters of Assurance, if appropriate (see **Section 3.5 Letters of Assurance** for more information); and
- comply with Engineers and Geoscientists BC Bylaw 14(b)(4) regarding the completion of documented independent reviews of structural designs (see **Section 4.1 Quality Management Requirements**).

2.2.2 OWNER

The Owner must:

- retain the appropriate Registered Professionals, as required, to complete the scope of the project, which may include a Specialty Structural Engineer who is responsible for the design, specifications, and field reviews of a Guard;
- obtain required approvals, licenses, and permits from the Authority Having Jurisdiction;
- ensure appropriate scopes of work and realistic schedules of work are developed, and the associated contracts are finalized with all Registered Professionals, including the Specialty Structural Engineer, before their services are required; and
- recognize that drawings, specifications, and other documents prepared by the Specialty Structural Engineer are for the project and should not be used or copied for other projects without the consent of the Specialty Structural Engineer.

2.2.3 GENERAL CONTRACTOR

A General Contractor has a contractual relationship with an Owner. This contract typically states that the General Contractor is responsible for labour, materials, and equipment for the building project, as well as construction methods, techniques, sequences, procedures, safety precautions, and programs associated with the construction as set out in the contract documents.

The General Contractor is responsible for its own work, the supervision and coordination of the subcontractors' work, and the inspection of the subcontractors' work prior to field reviews by the Specialty Structural Engineer (when applicable). The General Contractor is responsible for providing reasonable notice to the Specialty Structural Engineer when Guard components are ready for field review.

The General Contractor must communicate with the Owner and any Registered Professionals on a project to ensure Letters of Assurance are obtained in accordance with the project requirements.

The General Contractor may obtain a Schedule B or a Schedule S-B from the Specialty Structural Engineer for the design of the Guard, depending on how the project is organized (see Section 3.5 Letters of Assurance for more information). Where a Schedule B or Schedule S-B is not applicable, the Specialty Structural Engineer for the Guard should prepare and submit signed and sealed shop drawings and field review reports to the General Contractor.

2.2.4 DESIGN/BUILD CONTRACTOR

For design/build projects, the Design/Build Contractor may apply for the building permit and may engage the Specialty Structural Engineer directly for his or her services.

In cases when an Architect is required to be on the design/build project team, the Architect may engage the Specialty Structural Engineer (see Section 2.2.5 Architect).

2.2.5 ARCHITECT

If an Architect engages the services of a Specialty Structural Engineer, the Architect must:

- interpret the needs of the Owner so the Guard design will meet the intended form and function;
- identify and advise the Specialty Structural Engineer of special design criteria, such as equipment, loads, and span requirements;
- develop the scope of work with the Specialty Structural Engineer for the Guard design, specifications, and field reviews, as well as any contract administration requirements;
- provide timely and appropriately detailed information to allow the Specialty Structural Engineer to adequately carry out his or her scope of work;

- coordinate and review designs, specifications, and contract documents prepared by the Specialty Structural Engineer;
- coordinate the communication of information among the Owner, General Contractor, and other Registered Professionals, as appropriate, so the building project substantially complies in all material respects with the applicable building codes and meets the Owner's needs; and
- obtain a Schedule S-B and a Schedule S-C from the Specialty Structural Engineer who is acting as a Supporting Registered Professional for the Guard (see Section 3.5 Letters of Assurance for more information).

2.2.6 BASE BUILDING STRUCTURAL ENGINEER

If a Base Building Structural Engineer is engaged on the project, he or she should review shop drawings to ascertain the effect of the Guard on the base structure.

3.0 GUIDELINES FOR PROFESSIONAL PRACTICE

3.1 REVIEW OF CODES AND STANDARDS

The Specialty Structural Engineer is required to be aware of, and adhere to, the codes and standards applicable to Guard design, as outlined in the following sections.

3.1.1 NATIONAL BUILDING CODE OF CANADA 2015

The *National Building Code of Canada 2015* (abbreviated hereafter as *NBC 2015*) is an objective-based code (National Research Council Canada 2015). The relevant objectives and functional statements with respect to Guards are as follows:

- Objectives:
  - OS2: Structural Safety
  - OS3: Safety in Use
  - OP2: Structural Sufficiency of the Building
- Functional statements:
  - F10: To facilitate the timely movement of persons to a safe place in an emergency
  - F20: To support and withstand expected loads and forces
  - F30: To minimize the risk of injury to persons as a result of tripping, slipping, falling, contact, drowning, or collision

3.1.2 BRITISH COLUMBIA BUILDING CODE 2018

The *BC Building Code 2018* (abbreviated hereafter as *BCBC 2018*) is based on *NBC 2015*. The following summarizes selected criteria relevant to the design of Guards as presented in *BCBC 2018* (BC Office of Housing and Construction Standards 2018).

- *BCBC 2018*, Division B, Part 3 requirements cover the following:
  - Areas for which Guards are required
  - Requirement that a Guard be provided at a certain height
  - Limitations on the size of openings
  - Discussion on climbability
  - Dimensions for handrails
- *BCBC 2018*, Division B, Part 4 requirements cover the following:
  - Requirements for horizontal, concentrated, and uniform loads on a Guard
    - Note: The difference in load requirements, depending on location or other factors, can be critical to both the design of Guards and the structure to which Guards are attached. The load requirements should be carefully stated in the design requirements.
  - Instructions on how to apply concurrent loads on individual elements below or within the Guard
  - Requirements on how to apply the vertical load at the top of the Guard
  - Requirements for in-plane loads applied to vertical elements within Guards
  - Requirements for loads applied to handrails

- *BCBC 2018*, Division B, Part 9 requirements cover similar requirements to those described in Part 3 and Part 4, as referenced above.

It is the responsibility of the Registered Professional of Record and Supporting Registered Professional to read and understand the code requirements.

3.1.3 WORKSAFEBC

WorkSafeBC has requirements for the protection of workers. These legal requirements apply to all workplaces and arise from the *Occupational Health and Safety Regulation* (WorkSafeBC 2018). Enforcement of these regulations falls under the jurisdiction of WorkSafeBC. These requirements are intended to provide safe environments for workers in areas that are not specifically accessible to the public.

Some pertinent points from this regulation are summarized as follows:

- A guardrail consists of a top rail and an intermediate rail located at the appropriate heights above the work surface.
- It must be designed to withstand a load applied perpendicular to the span in a horizontal or vertical direction.
- It must not be made of fibre or wire rope unless it meets the requirements of the *Occupational Health and Safety Regulation*, Schedule 4-A, WorkSafeBC Standard – Guardrails Using Rope or Other Non-rigid Material.

3.1.4 OTHER CODES AND STANDARDS

3.1.4.1 CAN/CGSB-12.20-M89 Structural Design of Glass for Buildings

CAN/CGSB-12.20-M89 (Standards Council of Canada 1989) addresses the brittle nature of glass where used as a structural material by stipulating that support members be designed with a redundant load path. The underlying principle is that if one member fails, a cascading or catastrophic failure mechanism will not develop. This standard is referenced in the *NBC 2015*, and is also referenced in the new CSA A500 standard discussed below.

CAN/CGSB-12.20-M89 is an antiquated standard that has been withdrawn and is likely to be replaced by the ASTM E1300 (see **Section 3.1.4.2** below). Although the Canadian General Standards Board has withdrawn the CAN/CGSB-12.20-M89, it is still referenced in current codes and standards.

3.1.4.2 ASTM E1300 Standard Practice for Determining Load Resistance of Glass in Buildings

ASTM E1300 (ASTM 2016) is the American standard that describes the procedures to determine the load resistance of specified glass types, when exposed to uniform lateral load of short or long duration, for a specified probability of breakage. Historically it has been referenced by American building codes; however, more recently ASTM E1300-12ae1 (ASTM 2012) has been referenced by the *NBC 2015*.

3.1.4.3 CSA A500 Building Guards

CSA A500 (CSA 2016) is a Canadian standard that specifies requirements for the materials, design, construction, testing, and performance of Guards in buildings. A building Guard in this standard is defined as a protective barrier to prevent accidental falls from one level to another.

The requirements in this standard are not intended to supersede any provisions contained within a governing building code or regulation.

The design of Guards must follow one or more of the following:

- Engineering analysis based on first principles and recognized practices
- Testing of prototypes
- Testing of physical scaled models
- Computer simulations

When designing Guards, the risk of injury or property damage arising from a failure of Guard components must be considered, including the risks associated with components falling into a public space below.

Durability must be considered if Guards are exposed to environmental attack. The design must consider the service life of a Guard, which in these circumstances is a minimum of half the design life of the building, as defined in CSA S478 Guideline on Durability in Buildings (CSA 1995).

The substrate to which the Guard is attached needs to be of adequate strength to sustain all loads, and must be considered in the design of a Guard.

Guards must be designed to drain moisture and minimize the collection of debris.

Loads must include load combinations, importance factors, and companion loads, as well as the effects of impact testing, according to this standard. Vibration should also be considered, including fatigue and serviceability issues arising from noise. The design Guard load is classified as a live load. This standard defines different load combinations for ultimate limit states and serviceability limit states.

The height of the Guard should conform to the requirements set out in the governing building code. Usually, required heights are between 900 mm and 1,500 mm. The point of application of the load should correspond to the top of the Guard. All components of the Guard, including the supporting structure, must be designed to resist the applied loads.

Guards should be designed to meet the requirements for non-climbable Guards, as defined in the governing building code and this standard. Additionally, steps and curbs must be considered, and must not reduce the required height of the Guard. In general, the height of the Guard must not be less than the radial distance from the highest and nearest point on the step.

Balcony dividers that are not connected to the Guard must be designed to resist both wind loads and live loads.

Deflection limits are provided in this standard.

This standard defines load-testing protocols for Guard assemblies. This standard also suggests that confirmatory tests be carried out at representative areas on every Guard installation, including when reinstalling existing Guards. The number of test samples should reflect the number of Guards installed but should not be fewer than two. Pass-fail criteria is set forth in the standard.

Procedures are also described for impact testing for reviewing the performance with respect to post-breakage retention. Minimum impact energy levels are established to ensure elements do not fail and subsequently fall out of the assembly after impact.

This standard covers materials used for Guards, including concrete, masonry, wood, steel, aluminum, and glass.

In this standard, there are many special requirements for using glass in Guards:

- Criteria are established for the use of annealed, heat-strengthened, and fully tempered (heat-soaked or non–heat-soaked) glass, as well as soft versus stiff interlayers.
- Glass is designed according to CAN/CGSB 12.20-M89 or ASTM E1300, with special modifications outlined in this standard.
- A procedure for designing and constructing freestanding glass Guards is provided.
- Freestanding glass Guards may be designed without a top rail or cap if laminated glass with a stiff interlayer is used. However, protection of the top edge of glass may be required in certain circumstances.
- Infill tempered glass panels need not carry a load after breakage.
  - Note: While not required in all circumstances, it is recommended that the risk associated with a breakage should be assessed and that laminating these type of panels for safety purposes should be considered.
- After breakage of a freestanding monolithic glass Guard, the top rail must be able to resist the design load without load factors. After breakage of one or more plies of a freestanding laminated glass Guard, the assembly need not accommodate the full specified loads; rather, it must remain standing in place until it can be serviced.

3.2 DESIGN CONSIDERATIONS

A Guard is meant to prevent an individual from falling from a higher elevation to a lower elevation. A Guard should also create a sense of safety among building occupants.

Design of a Guard must consider the following:

- Where a Guard is required
- Dimensional requirements
- Strength design, including the load path to the primary structure
- Serviceability (deflection, graspability, climbability)
- Relationship to building enclosure
- Aesthetics

When using aluminum, the loss of temper and associated reduction in strength of any welded connections should be considered. Refer to CAN/CSA S157 Strength Design in Aluminum (CSA 2005).

Special consideration must also be given to using glass as Guard elements. Some means of structural redundancy must be built into the system to prevent progressive collapse of the assembly following the failure of a glass member. In particular, when using tempered glass, there is a potential for spontaneous breakage due to impurities (also referred to as nickel sulfide inclusions). Refer to the design guides entitled “Glass Design to Human Impact” and “Glass Guards and Balustrades” in the *Glazing Systems Specification Manual* (Fenestration Association of BC [formerly the Glazing Contractors Association of BC] 2010). These issues are also covered in more detail in the CSA A500 standard (CSA 2016).

Consideration should also be given to windows acting as Guards where the sill extends below 1,070 mm of the finished floor. In this instance, the window must be treated as a wall separating the elevation difference and be designed to withstand the appropriate Guard load. Further consideration should be given to operable sashes where there may be a risk of falling through the open window. Such windows must be equipped with a limiter to restrict the size of the opening. However, there may be cases where operable windows are required to allow egress during a fire, in which case there can be two contradictory code requirements.

In the cases of unique architectural designs, non-traditional construction methods, or use of exotic materials (such as art glass or reclaimed timber), where the available codes and standards do not provide adequate guidance, the designer may employ proof testing. It should be noted, however, that proof testing may be employed for any Guard design. In some instances where materials and methods deviate significantly from normal practice, an alternative solution may be required during the permit process. This involves a special application with the Authority Having Jurisdiction and can add time and cost to the project.

3.3 CONTINUITY OF RESPONSIBILITY

The supply and installation of Guards often involves multiple trade disciplines. In turn, several design professionals may be involved in the design oversight for individual elements of the Guard. For example, a typical glass Guard may include a specialty fitting supplier, a glass supplier, a glazing installer, a miscellaneous metals subcontractor, and a millworker.

Consider **Figure 1** below. In this type of scenario, there can be a discontinuity of responsibility arising from the diffusion of design oversight. Each element may be the responsibility of a different design professional with little or no coordination among them. Specialty Structural Engineers may oversee individual elements; however, each Specialty Structural Engineer is also responsible for ensuring their component fits into a complete assembly that is constructible and includes a competent load path. Taking professional responsibility for one component in an assembly does not nullify the responsibility to also ensure other components fit together to create a complete structural assembly, including an appropriate attachment to the base structure.

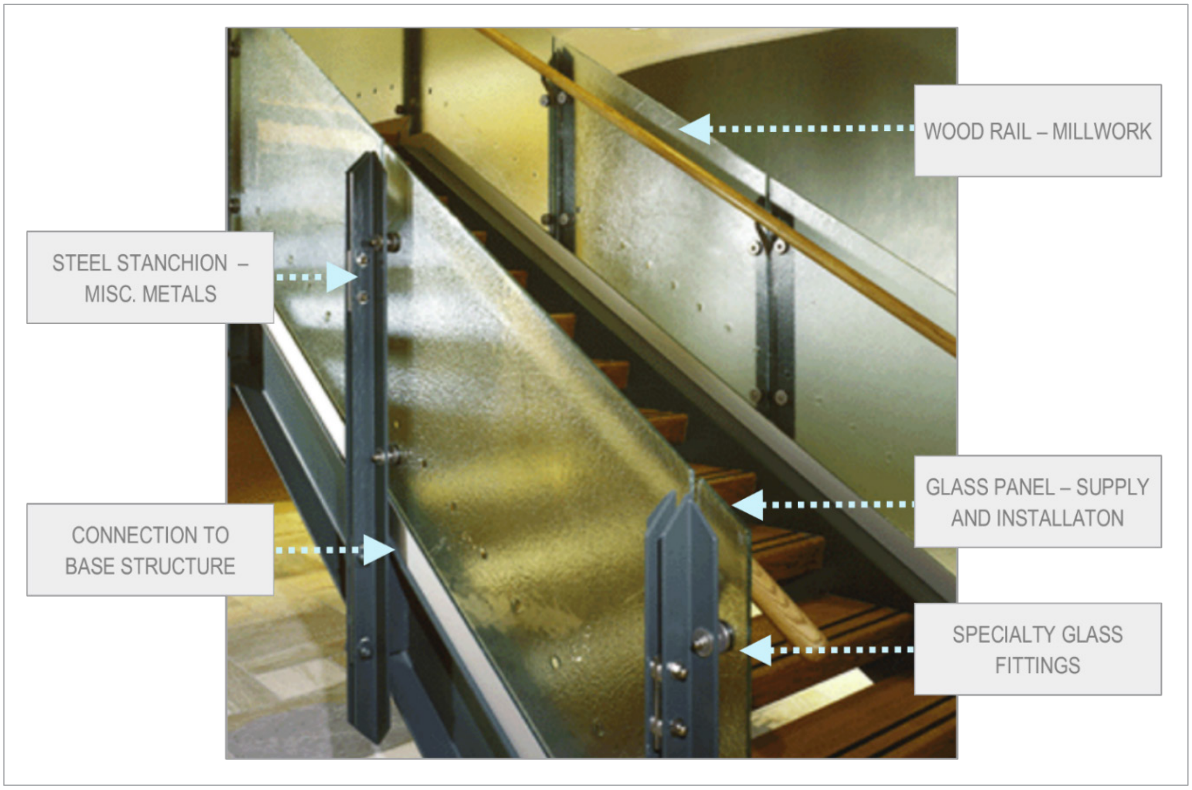

Figure 1: Continuity of Responsibility: Illustration showing a typical glass Guard, indicating how several trade disciplines and design professionals may contribute to the design of individual elements.

3.4 SHOP DRAWINGS

When preparing shop drawings, Specialty Structural Engineers must carefully and clearly define their scope of work to ensure connecting elements are suitable for the completed systems.

For example, if the scope of work is for reviewing shop drawings and taking responsibility for the glass elements only, it should be clearly stated that the design of the glass is based on the continuity of the Guard assembly, and that the other components must be designed accordingly. In such a case, the Specialty Structural Engineer, who would be acting as one of multiple Supporting Registered Professionals and providing Schedules S-B and S-C for the glazing component of the Guard, may insist on receiving copies of Schedules S-B and S-C for each of the other components of the Guard, up to and including that for the base structure. (See **Section 3.5 Letters of Assurance** for more information.)

Shop drawings should be prepared according to *Professional Practice Guidelines – Shop Drawings* (Engineers and Geoscientists BC 2015).

The following basic elements must be shown and identified on the shop drawings:

- Clearly delineated elements for which design responsibility is assumed (for example, by using darker line types)
- Completed Guard assembly, clearly identifying the structural function and requirement for those components for which design responsibility is assumed to be by others

- Intended load path to the base structure
- Reaction loads
- Connection details
- General notes indicating materials used, design codes referenced, and description of the scope of work
- Plan drawing showing the extent and location of items

3.5 LETTERS OF ASSURANCE

Part 9 of the building code, which applies to housing and small buildings, is primarily prescriptive. When followed in its entirety, this part of the code does not require that Registered Professionals provide professional design and review.

For the other parts of the building code, Letters of Assurance in the form of Schedules B and C-B are used to confirm appropriate professional design and review. Structural design of Guards and their attachments is covered under the architectural section of the Schedule B.

There are two main scenarios under which a Specialty Structural Engineer may be engaged to design a Guard for a building:

1. For a Part 3 building:
   - Under this Part 3 building scenario, when an Architect is engaged on the project, the Architect will sign the Letters of Assurance for the Guard and may use a Specialty Structural Engineer as the Supporting Registered Professional.
   - According to *Practice Note 16 – Professional Design and Field Review by Supporting Registered Professionals* (Engineers and Geoscientists BC and AIBC 2017), the Supporting Registered Professional must submit Schedules S-B and S-C to the Architect; however, Schedules S-B and S-C do not need to be submitted to the Authority Having Jurisdiction.
   - If an Architect is not required on a Part 3 building project, a Specialty Structural Engineer may act as the Registered Professional of Record and sign off on the architectural item for the structural capacity of the Guard on the Letters of Assurance.
2. For a Part 9 building:
   - Under this Part 9 building scenario, no Registered Professionals are required if the building follows the prescriptive requirements of Part 9.
   - If a Specialty Structural Engineer is engaged to design a Guard for a Part 9 building, in order to fulfill their professional obligation, the professional should prepare and submit sealed shop drawings and field review reports.
   - If an Authority Having Jurisdiction requires Letters of Assurance for a Guard on a Part 9 building where no Architect is required on the project, a Specialty Structural Engineer may act as the Registered Professional of Record and sign off on the architectural item for the structural capacity of the Guard on the Letters of Assurance, and may also modify the Letters of Assurance, as appropriate.

The following schedules are referred to in this practice guideline:

Table 1: List of Letters of Assurance Related to Guards

SCHEDULE	PURPOSE	SOURCE
Schedule B	Letter of Assurance Form: Assurance of Professional Design and Commitment for Field Review	*BCBC* or VBBL
Schedule C-B	Letter of Assurance Form: Assurance of Professional Field Review and Compliance	*BCBC* or VBBL
Schedule S-B	Intraprofessional Form: Assurance of Professional Design and Commitment for Field Review By Supporting Registered Professional	*Practice Note 16: Professional Design and Field Review By Supporting Registered Professionals* [a]
Schedule S-C	Intraprofessional Form: Assurance of Professional Field Review and Compliance By Supporting Registered Professional	*Practice Note 16 : Professional Design and Field Review By Supporting Registered Professionals* [a]

NOTE:

[a] Engineers and Geoscientists BC and AIBC 2017

4.0 QUALITY MANAGEMENT IN PROFESSIONAL PRACTICE

Engineering Professionals must adhere to the applicable quality management requirements during all phases of the work, in accordance with the Association's Bylaws. It is also important to be aware of whether additional quality management requirements exist from the Authority Having Jurisdiction or through service contracts.

4.1 QUALITY MANAGEMENT REQUIREMENTS

To meet the intent of the quality management requirements, Engineering Professionals must establish and maintain documented quality management processes for the following activities:

- The application of relevant professional practice guidelines
- Authentication of professional documents by the application of the professional seal
- Direct supervision of delegated professional engineering activities
- Retention of complete project documentation
- Regular, documented checks using a written quality control process
- Documented field reviews of engineering designs/recommendations during implementation or construction
- Where applicable, documented independent review of structural designs prior to construction

4.1.1 PROFESSIONAL PRACTICE GUIDELINES

Pursuant to the *Act*, s.4(1) and Bylaw 11(e)(4)(h), Engineering Professionals are required to comply with the intent of any applicable professional practice guidelines related to the engineering work they undertake. One of the three objectives of the Association, as stated in the *Act* is "to establish, maintain, and enforce standards for the qualifications and practice of its members and licensees". Practice guidelines are one means by which the Association fulfills this obligation.

4.1.2 USE OF SEAL

According to the *Act*, s.20(9), Engineering Professionals are required to seal all professional engineering documents they prepare or deliver in their professional capacity to others who will rely on the information contained in the documents. This applies to documents that Engineering Professionals have personally prepared and those that others have prepared under their direct supervision.

Failure to seal these engineering documents is a breach of the *Act*.

For more information, refer to *Quality Management Guidelines – Use of Seal* (Engineers and Geoscientists BC 2017).

4.1.3 DIRECT SUPERVISION

According to the *Act*, s.1(1) and 20(9), Engineering Professionals are required to directly supervise any engineering work that they delegate. When working under the direct supervision of an Engineering Professional, unlicensed persons or non-members may assist in performing engineering work, but they may not assume responsibility for it. Engineering Professionals who are limited licensees may only directly supervise work within the scope of their license.

With regard to direct supervision, the Engineering Professional having overall responsibility should consider:

- the complexity of the project and the nature of the risks;
- which aspects of the work should be delegated;
- the training and experience of individuals to whom work is delegated; and
- the amount of instruction, supervision, and review required.

Careful consideration must be given to delegating fieldwork. Due to the complex nature of fieldwork, direct supervision is difficult and care must be taken so delegated work meets the standard expected by the Engineering Professional with overall responsibility. Typically, such direct supervision could take the form of specific instructions on what to observe, check, confirm, record, and report to the supervising Engineering Professional. Engineering Professionals with overall responsibility should exercise judgment when relying on delegated field observations, and they should conduct a sufficient level of review to have confidence in the quality and accuracy of the field observations.

For more information, refer to *Quality Management Guidelines – Direct Supervision* (Engineers and Geoscientists BC 2018a).

4.1.4 RETENTION OF PROJECT DOCUMENTATION

Pursuant to Bylaw 14(b)(1), Engineering Professionals are required to establish and maintain documented quality management processes that include retaining complete project documentation for a minimum of ten (10) years after the completion of a project or ten (10) years after engineering documentation is no longer in use.

These obligations apply to Engineering Professionals in all sectors. Project documentation in this context includes documentation related to any ongoing engineering work, which may not have a discrete start and end, and may occur in any sector.

Many Engineering Professionals are employed by organizations, which ultimately own the project documentation. Engineering Professionals are considered compliant with this quality management requirement when a complete set of project documentation is retained by the organizations that employ them using means and methods that are consistent with the Association's Bylaws and guidelines.

For more information, refer to *Quality Management Guidelines – Retention of Project Documentation* (Engineers and Geoscientists BC 2018b).

4.1.5 DOCUMENTED CHECKS OF ENGINEERING WORK

As per Bylaw 14(b)(2), Engineering Professionals are required to undergo documented quality checking and review of engineering work appropriate to the risk associated with that work.

Regardless of sector, Engineering Professionals must meet this quality management requirement. In this context, 'checking' means all professional deliverables must undergo a documented checking and review process before being finalized and delivered. This process would normally involve an internal review by another Engineering Professional within the same organization. Where an appropriate internal reviewer is not available, an external reviewer (i.e., one outside the organization) must be engaged. Where an internal or external review has been carried out, this must be documented.

Engineering Professionals are responsible for ensuring that the checks being performed are appropriate to the level of risk. Considerations for the level of review should include the type of document and the complexity of the subject matter and underlying conditions; quality and reliability of background information, field data, and elements at risk; and the Engineering Professional's training and experience.

For more information, refer to *Quality Management Guidelines – Documented Checks of Engineering and Geoscience Work* (Engineers and Geoscientists BC 2018c).

4.1.6 DOCUMENTED FIELD REVIEWS DURING IMPLEMENTATION OR CONSTRUCTION

As per Bylaw 14(b)(3), field reviews are reviews conducted at the site of the construction or implementation of the engineering work. They are carried out by an Engineering Professional or a subordinate acting under the Engineering Professional's direct supervision.

Field reviews enable the Engineering Professional to ascertain whether the construction or implementation of the work substantially complies in all material respects with the engineering concepts or intent reflected in the engineering documents prepared for the work.

Engineering Professionals are required to establish and maintain documented quality management processes, which include carrying out documented field reviews of their domestic projects or work during implementation or construction. Domestic work or projects include those located in Canada and for which an Engineering Professional meets the registration requirements for the engineering regulatory body that has jurisdiction.

For more information, refer to *Quality Management Guidelines – Documented Field Reviews during Implementation or Construction* (Engineers and Geoscientists BC 2018d).

4.1.7 DOCUMENTED INDEPENDENT REVIEW OF STRUCTURAL DESIGNS

Bylaw 14(b)(4) refers to an independent review in the context of structural engineering. 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, which occurs before those documents are issued for construction. It is carried out by an experienced Engineering Professional qualified to practice structural engineering, who has not been involved in preparing the design.

For more information, refer to *Quality Management Guidelines – Documented Independent Review of Structural Designs* (Engineers and Geoscientists BC 2018e).

5.0 PROFESSIONAL REGISTRATION & EDUCATION, TRAINING, AND EXPERIENCE

5.1 PROFESSIONAL REGISTRATION

It is the responsibility of Engineering Professionals to determine whether they are qualified by training and/or experience to undertake and accept responsibility for carrying out the design of Guards for buildings (Code of Ethics Principle 2).

5.2 EDUCATION, TRAINING, AND EXPERIENCE

Design of Guards for buildings, as described in these guidelines, requires minimum levels of education, training, and experience in structural engineering. The Engineering Professional acting as the Specialty Structural Engineer and taking design responsibility must adhere to the Association's Code of Ethics (to undertake and accept responsibility for professional assignments only when qualified by training or experience) and, therefore, must evaluate his or her qualifications and must possess the appropriate education, training, and experience to provide the services.

The level of education, training, and experience required of the Engineering Professional should be adequate for the complexity of the project.

Typical qualifications for the Specialty Structural Engineer may include education and experience in the following areas:

- Structural engineering
- Materials engineering
- Designing secondary structural elements
- Designing with materials such as aluminum and glass

The academic training for the above skill sets can be acquired by taking formal university or college courses or through continuing professional development. There may be some overlap in courses and specific courses may not correlate to specific skill sets. An Engineering Professional should also remain current with evolving topics, through continuing professional development. Continuing professional development can include taking formal courses; attending conferences, workshops, seminars, and technical talks; reading technical publications; doing web research; and participating in field trips.

6.0 REFERENCES AND RELATED DOCUMENTS

Documents cited in the main guideline and related appendices appear here.

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VERSION HISTORY

VERSION NUMBER	PUBLISHED DATE	DESCRIPTION OF CHANGES
1.0	May 3, 2013	Initial version.
2.0	December 11, 2018	Revised to reflect current industry standards and practices, the most notable being the introduction of the new Canadian standard CSA A500 Building Guards.

7.0 APPENDICES

APPENDIX A: CASE STUDIES

The following case studies illustrate different scenarios that may be encountered when designing and constructing engineered Guard assemblies.

These cases are fictitious and are intended to provide examples that may be followed when partitioning design responsibility among different stakeholders in the construction team.

CASE 1: TRADITIONAL NEW CONSTRUCTION PROJECT

This case study discusses a traditional new construction project involving a Part 3 building with an Architect and Base Building Structural Engineer.

The building is a typical Lower Mainland concrete tower with Guards surrounding exterior balconies. The work is proceeding under a permit granted by the governing Authority Having Jurisdiction. The Guards proposed for this project include aluminum posts and top rail with glass infill.

Case 1 is likely the most common scenario that would be encountered in typical construction projects. However, there are also similar variants of this scenario that warrant further discussion, which appear below as Case 1A and Case 1B.

KEY ROLES DEFINING AREAS OF PROFESSIONAL RESPONSIBILITY

1. Architect
   - Contract is with the Owner
   - Signs the Letters of Assurance (Schedule B) assuming responsibility for the Architect's scope, which includes the purview over structural design and attachment of Guard components
2. Base Building Structural Engineer
   - Contract is with the Architect
   - Signs the Letters of Assurance (Schedule B) assuming responsibility for the structural integrity of the base building, including effects of secondary components such as Guards and their attachments to the base building
3. Specialty Structural Engineer
   - Contract is with the supplier or subcontractor who is, in turn, contracted to the General Contractor
   - Signs the Letters of Assurance as the Supporting Registered Professional (Schedules S-B and S-C, in accordance with the Association's *Practice Note 16* and *Bulletin K*).

KEY INTERACTIONS DURING THE COURSE OF CONSTRUCTION

1. The Architect provides architectural drawings and specifications with general details of the form of the proposed Guards, including shape, colour, overall dimensions, and materials of construction for the Guards.
2. The General Contractor engages a subcontractor to provide a proposed system that generally conforms to the architectural specifications. The subcontractor engages the services of a Specialty Structural Engineer to act as a Supporting Registered Professional, through a Schedule S-B. The Specialty Structural Engineer provides shop drawings detailing all aspects of the proposed Guard. An initial submission may not be sealed, as it may be incomplete and intended to solicit feedback from the Architect about specific design characteristics that may be entirely aesthetic.
3. Once the details are agreed on, the subcontractor submits a set of shop drawings that have been

sealed by the Specialty Structural Engineer. The shop drawings should include all relevant details for the structural function of the assembly, including the materials used, types of fasteners employed, and how the Guard will interact with the base building, including indication of the forces transferred to the base building. These shop drawings are forwarded to the Architect via the General Contractor.

4. The design by the Specialty Structural Engineer must provide connection to the primary structure and include the design of collateral secondary elements necessary to pass the load through to the primary structure. For example, if connecting to a steel stud, the shop drawings must indicate the requirement for the connection (e.g., that an 18-gauge steel stud is required at the Guard attachment).
5. The Specialty Structural Engineer follows the instructions for the connection to the primary structure, as provided in the structural drawings prepared by the Base Building Structural Engineer. The Specialty Structural Engineer should contact the Base Building Structural Engineer to discuss any anchorage concerns.
6. The Architect reviews the shop drawings and forwards a set of the drawings to the Base Building Structural Engineer, who reviews the Guards for their effect on the base building. The Base Building Structural Engineer reviews only the effect of the Guard on the base building structure, not the structural adequacy of the Guard assembly.
7. Once the shop drawings are reviewed and accepted, the installation proceeds. During the installation, the Specialty Structural Engineer acting for the subcontractor should visit the site at his or her discretion to conduct field reviews according to *Practice Note 16* and *Bulletin K*. The scope of the field review should align with the scope of responsibility defined in the sealed shop drawings.
8. At completion of the installation, the Specialty Structural Engineer submits the Schedule S-C, confirming that the obligation for field review has been completed. If required, the Specialty Structural Engineer contacts the Base Building Structural Engineer to clarify any matters relating to the structural interaction between the Guard assembly and the base building. This is in accordance with the following declaration that the Specialty Structural Engineer makes when signing the Schedule S-B: Assurance of Professional Design and Commitment for Field Review:

   "I confirm I have liaised as required with the appropriate Registered Professionals for the purposes of my services."

CASE 1A: GUARD ASSEMBLY WITH ENGINEERED COMPONENTS

Although Case 1 above is likely the most common scenario encountered in typical construction projects, the following case illustrates a similar variant, for a new construction project with a Guard assembly that incorporates several engineered components.

This case is similar to Case 1 but is more demanding for the Architect, as a number of specialty engineers are involved in defining the completed assembly. Some components interact with the base building, while others interact with other specialty components. Avoiding conflicting requirements as well as gaps in responsibility is a significant challenge in this case.

A modification to the definition of Key Roles Defining Areas of Professional Responsibility is required, as follows:

1. Multiple Specialty Structural Engineers
   - Contracts are with a number of the suppliers or subcontractors who are, in turn, contracted to the General Contractor
   - Each Specialty Structural Engineer signs the Letters of Assurance as a Supporting Registered Professional (Schedules S-B and S-C, in accordance with *Practice Note 16* and *Bulletin K*).

CASE 1B: GUARD ELEMENTS FABRICATED FROM A BASIC MATERIAL

Although Case 1 is likely the most common scenario encountered in typical construction projects, the following case illustrates another similar variant, when Guard elements are fabricated.

A common case for Part 3 buildings occurs when a variety of Guard elements are fabricated from a 'basic' material such as structural steel; for example, a common, steel, picketed Guard/handrail in a concrete stairwell, to be fabricated by a steel fabricator, or possibly by a miscellaneous metals fabricator if such a subcontract is in place.

The Base Building Engineer is responsible for these fabricated items if all the details of the Guard assembly are shown on the structural drawings or on the architectural drawings with some structural comments.

Alternatively, the steel fabricator may prepare shop drawings based on the Architect's drawings. Often, the shop drawings contain a variety of structural problems that are revealed following review by the Base Building Structural Engineer. In this circumstance, it is recommended that a Specialty Structural Engineer be engaged. The requirement for specialty engineering should be no different than the requirement for other pre-engineered components such as open web steel joists or commercial glazing assemblies.

This requirement for a Specialty Structural Engineer should be clearly defined in the specifications. Typically, miscellaneous metals are defined in the Division 5 specifications. However, any project that includes Guards should include a separate specification to cover all Guard assemblies. This would cover 'architectural' Guard assemblies that might be typically encountered in living spaces like balconies and mezzanines, as well as utilitarian Guards that might be typically seen in exit stairs and parkades.

See **Appendix B: Model Specification for Guards** for an example of a generic specification based on the Canadian National Master Specification (NMS).

CASE 2: PROPRIETARY GUARD SYSTEM INVOLVING A PRE-ENGINEERED GUARD ASSEMBLY

This case study discusses construction of a proprietary Guard system using a 'pre-engineered' Guard assembly (essentially ordered out of a catalogue).

KEY ROLES DEFINING AREAS OF PROFESSIONAL RESPONSIBILITY

1. Architect
   - Contract is with the Owner
   - Signs the Letters of Assurance (Schedule B) assuming responsibility for the Architect's scope, which includes the purview over structural design and attachment of Guard components
2. Base Building Structural Engineer
   - Contract is with the Architect
   - Signs the Letters of Assurance (Schedule B) assuming responsibility for the structural integrity of the base building, including effects of secondary components such as Guards and their attachments to the base building

KEY INTERACTIONS DURING THE COURSE OF CONSTRUCTION

1. The Architect provides architectural drawings and specifications for a specific product to be installed. Shop drawings may or may not be required, depending on the nature of the product and project. However, it is still essential for the Base Building Structural Engineer to be made aware of the fastening method and configuration, so he or she can provide a suitable base building structure to resist the Guard loads.
2. The General Contractor purchases the product and installs it according to the manufacturer's instructions.

3. The Guard supplier provides capacity criteria and installation details for all aspects, including the base connection (for example, to use Hilti products).
4. There is no need for a Specialty Structural Engineer, as the Architect assumes the design responsibility of the system. The Architect may rely on pre-engineering that has been completed by the manufacturer; however, this decision is entirely at the Architect's discretion. Regardless of what information the Architect relies upon, he or she will assume responsibility for providing assurance for all building code requirements related to the Guard assembly, including those defined in Part 4.

CASE 3: REPAIR PROJECT REQUIRING NO ARCHITECT

This case study discusses a repair project involving a Guard, where no Architect is required.

An Engineering Professional acts as the prime consultant, building enclosure engineer, and Base Building Structural Engineer.

KEY ROLES DEFINING AREAS OF PROFESSIONAL RESPONSIBILITY

1. **Prime consultant engineer**
   - Contract is with the Owner
   - Signs the Letters of Assurance (Schedule B) assuming responsibility for the Architect's scope, which includes the purview over structural design and attachment of Guard components
2. **Specialty Structural Engineer**
   - Contract is with the supplier or subcontractor who is, in turn, contracted to the General Contractor
   - Signs the Letters of Assurance as the Supporting Registered Professional (Schedules S-B and S-C, in accordance with *Practice Note 16* and *Bulletin K*).

KEY INTERACTIONS DURING THE COURSE OF CONSTRUCTION

1. The interactions in this case are similar to those defined in Case 1 above, with the prime consultant engineer acting in the role of the Architect.
2. The prime consultant engineer should also be aware of his or her responsibility as the Base Building Structural Engineer, to cover the review of structural effects of the Guard to the base building. The Base Building Structural Engineer is expected to sign Letters of Assurance to cover the Part 4 requirements of the permit application.

CASE 4: REPAIR PROJECT REQUIRING NO BASE BUILDING STRUCTURAL ENGINEER

This case study discusses a repair project involving a Guard, where no Base Building Structural Engineer is required.

This type of project might include a simple repair project where the permit application is made by a designer (i.e., not a Registered Professional), a General Contractor, or the Owner. Such projects would typically include a residential repair or upgrade (for example, addition of a balcony or patio).

KEY ROLES DEFINING AREAS OF PROFESSIONAL RESPONSIBILITY

1. **Designer, General Contractor, Owner**
   - No Letters of Assurance are required
   - The permit is granted under the purview of the building inspector (in some jurisdictions this is referred to as a 'field review' permit).
2. **Specialty Structural Engineer**
   - Contract may be with the Owner, General Contractor, supplier, or subcontractor
   - Takes responsibility for the specialty item, as well as the effect on the base building

3. Building inspector
   - Represents the Authority Having Jurisdiction
   - Conducts inspections to review for permit and building code compliance
   - Requests engineering on various components as determined during the course of his or her inspections

KEY INTERACTIONS DURING THE COURSE OF CONSTRUCTION

1. The Guard assembly is installed by the Owner directly or by a contractor.
2. Once complete and prior to granting occupancy (i.e., closing the permit), the building inspector may request Letters of Assurance. A number of components may require Letters of Assurance, such as Guards or engineered wood products (for example, a prefabricated roof truss).
3. The Specialty Structural Engineer submits Letters of Assurance, including Schedule B and Schedule C-B. These letters are different from Schedules S-B and S-C, because they require the Specialty Structural Engineer to take responsibility for the connection to the base building and for the effect on the base building. The Letters of Assurance are addressed to the building inspector.
4. The Specialty Structural Engineer should carefully and accurately define the Specialty Structural Engineer's scope of work and responsibility, as he or she may be the only Engineering Professional on the project.

APPENDIX B: MODEL SPECIFICATION FOR GUARDS

The following is an example of a specification that defines the requirements for a Guard assembly.

1.0 GENERAL

1.1 WORK INCLUDED

1.1.1 Guards, guardrails, and handrails indicated on the drawings.

1.1.2 Glass infill panels.

1.2 RELATED WORK

1.2.1 Section 09900 – Finish Painting

1.2.2 Section 08800 – Glass

1.3 REFERENCE STANDARDS (Most recent version unless noted otherwise)

1.3.1 CAN/CSA-S16.1 Limit States Design of Steel Structures.

1.3.2 CAN/CSA-S157 Limit States Design of Aluminum Structures.

1.3.3 CAN/CSA-O86.1 Limit States Design of Wood Structures.

1.3.4 CAN/CGSB-12.20 Structural Design of Glass for Buildings.

1.3.5 CAN/CGSB-12.1 Glass, Safety, Tempered or Laminated.

1.3.6 American Architectural Manufacturers Association.

1.3.7 ASTM A269 Specification for Seamless and Welded Austenitic Stainless Steel Tubing for General Service.

1.3.8 ASTM E1300 Standard Practice for Determining Load Resistance of Glass in Buildings.

1.3.9 CAN/CSA-G40.20/G40.21 General Requirements for Rolled or Welded Structural Quality Steel.

1.3.10 CAN/CSA-G164 Hot Dip Galvanizing for Irregularly Shaped Articles.

1.3.11 CSA A500 Building Guards.

1.3.12 CSA W47.1 92 Certification of Companies for Fusion Welding of Steel Structures.

1.3.13 CSA W59 Welded Steel Construction (Metal Arc Welding).

1.3.14 CSA W59.2 Welded Aluminum.

1.4 DESIGN CRITERIA

1.4.1 Loads and load factors are determined in accordance with the *National Building Code* and the bylaws of the local municipality. Resistances must be determined by the applicable material design standards.

<Specification Note: Is loading for egress from assembly areas required? If so there can be significant loads transmitted to the base structure. This should be coordinated with the base building structural engineer.>

1.5 SUBMITTALS

1.5.1 If requested, submit three (3) certified copies of mill reports covering chemical and mechanical properties, and coating designation of steel used in this work.

1.5.2 Submit samples of framing and fastener components to Consultant if requested.

1.5.3 Submit duplicate samples of joining and finishes to the Consultant for approval.

1.5.4 Product Data

.1 Submit product data for mechanical fasteners, indicating sizes, shear, and pull-over loading capacity where applicable. Provide data indicating thickness and type of corrosion protection coating.

.2 Submit product data indicating suitability of explosive powder actuated fasteners for application.

1.5.5 Shop Drawings

.1 Shop drawings must incorporate plans, all elevations, sections, and full size details for all work in this section. Completely detail items, indicating all dimensions and methods of fixing, field jointing, attachment to building structure, size, thickness, gauges of metals, and fasteners in accordance with Engineers and Geoscientists BC *Professional Practice Guidelines – Shop Drawings*.

.2 No work must be fabricated until the shop drawings and samples have been reviewed by the Consultant. The Consultant's review must be for conformity to the design concept, for general arrangement only and such review must not relieve the Contractor of any of their responsibilities.

.3 Shop drawings must be sealed by a Professional Engineer.

.4 The Professional Engineer who sealed the shop drawings must provide periodic field review. Written inspection reports of field review must be submitted to the Consultant promptly as field reviews are made.

1.5.6 Submit evidence of welder qualifications specified in this Section.

1.5.7 Maintenance Data:

.1 Submit data covering the care, cleaning, and maintenance of finishes for incorporation in maintenance manuals.

.2 Letters of Assurance: The Professional Engineer who sealed the shop drawings must submit to the Consultant, with the initial shop drawing submission, a Letter of Assurance for 'Structural Design' and a commitment for 'Field Review'.

1.6 QUALITY ASSURANCE

1.6.1 Contractor to provide proof of manufacturer training for installation of proprietary fastener systems.

1.6.2 Welding must be by a company certified by the Canadian Welding Bureau to CSA W47.1 92 Certification of Companies for Fusion Welding of Steel Structures.

1.6.3 Any glazed elements should be completed by Journeymen glaziers and be members in good standing with the provincial glazing contractors association.

1.7 DELIVERY, STORAGE, AND HANDLING

1.7.1 Exercise care in storing, handing, and erecting all material, and support all materials properly at all times, so no piece will be bent, twisted, or otherwise damaged structurally or visually.

1.7.2 Correct damaged material, and where damage is deemed irreparable by the Consultant, replace the affected item at no additional expense to the Owner.

1.7.3 Fabricate large assemblies so they can be safely and easily handled and moved to their place of installation.

1.8 MOCK-UP – GUARD AND HANDRAILS

‹Specification Note: Delete if not required.›

1.8.1 Provide a complete mockup of a guard and/or handrail on-site for review by the Consultant. Make revisions to mockup as required by the Consultant.

1.8.2 The mock-up must include all components of the system, including typical joints and connection hardware, and typical tie-ins to adjoining systems, all finished as specified.

1.8.3 Modify the mock-up at no additional cost to the contract, as may be required to meet design and performance requirements.

1.8.4 The mock-up, if deemed to be in general conformance with the Specifications and Drawings by the Consultant, must remain on-site as finished part of the work.

1.9 SITE CONDITIONS

1.9.1 Ensure temperature and ventilation conditions are maintained for various components and materials of the system, as required by manufacturer.

1.9.2 Protect the work of other sections and sub-trades from damage resulting from work of this section.

1.9.3 Take necessary care to avoid damage of adjacent surfaces.

1.9.4 Examine the underlying visible surfaces and adjoining work and report defects at time of installation, which might impair the work of this section to the Consultant, in writing.

1.9.5 Commencement of work must imply acceptance of surfaces.

1.9.6 Cooperate with other trades to accommodate fixtures and attachments in the system.

1.10 REVIEW

1.10.1 The Professional Engineer who is responsible for the production of the shop drawings must provide periodic field review during construction and must submit reports.

1.10.2 Additional inspection and testing of materials workmanship may be carried out by a qualified independent Inspection Agency appointed by the Consultant.

.1 The cost of this additional inspection must be paid by the Owner.

.2 Any testing or inspection required by the Consultant because of an error by the Contractor or due to departure from the contract documents by the Contractor, must be paid for by the Contractor.

1.10.3 Review must include:

.1 Checking that mill test reports are properly correlated to materials.

.2 Sampling fabrication and erection procedures for general conformity to the requirements of the specification.

.3 Checking that the welding conforms to the requirements of this specification.

.4 Checking fabricated members against specified member shapes.

.5 Visual inspection of all welded connections including sample checking of joint preparation and fit-up.

.6 Sample checking of screwed and bolted joints.

.7 Sample checking that tolerances are not exceeded during fit-up or erection.

.8 Additional inspection and testing of welded connections as required by CSA W59 Welded Steel Connections (Metal Arc Welding) and CSA W59.2 Welded Aluminum.

.9 General Inspection of field cutting and alternations required by other trades.

.10 Submission of reports to the Consultant, the Contractor, and the authorities having jurisdiction covering the work inspected with details of deficiencies discovered.

1.10.4 The Contractor must provide the necessary cooperation to insure that the review can proceed.

1.10.5 The review provided in this section does not relieve the Contractor of their responsibility for the performance of the contract. The Contractor is solely responsible for quality control and must implement their own supervisory and quality control procedures.

1.10.6 Materials or workmanship not conforming to the requirements of the contract documents may be rejected at any time during the progress or work.

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