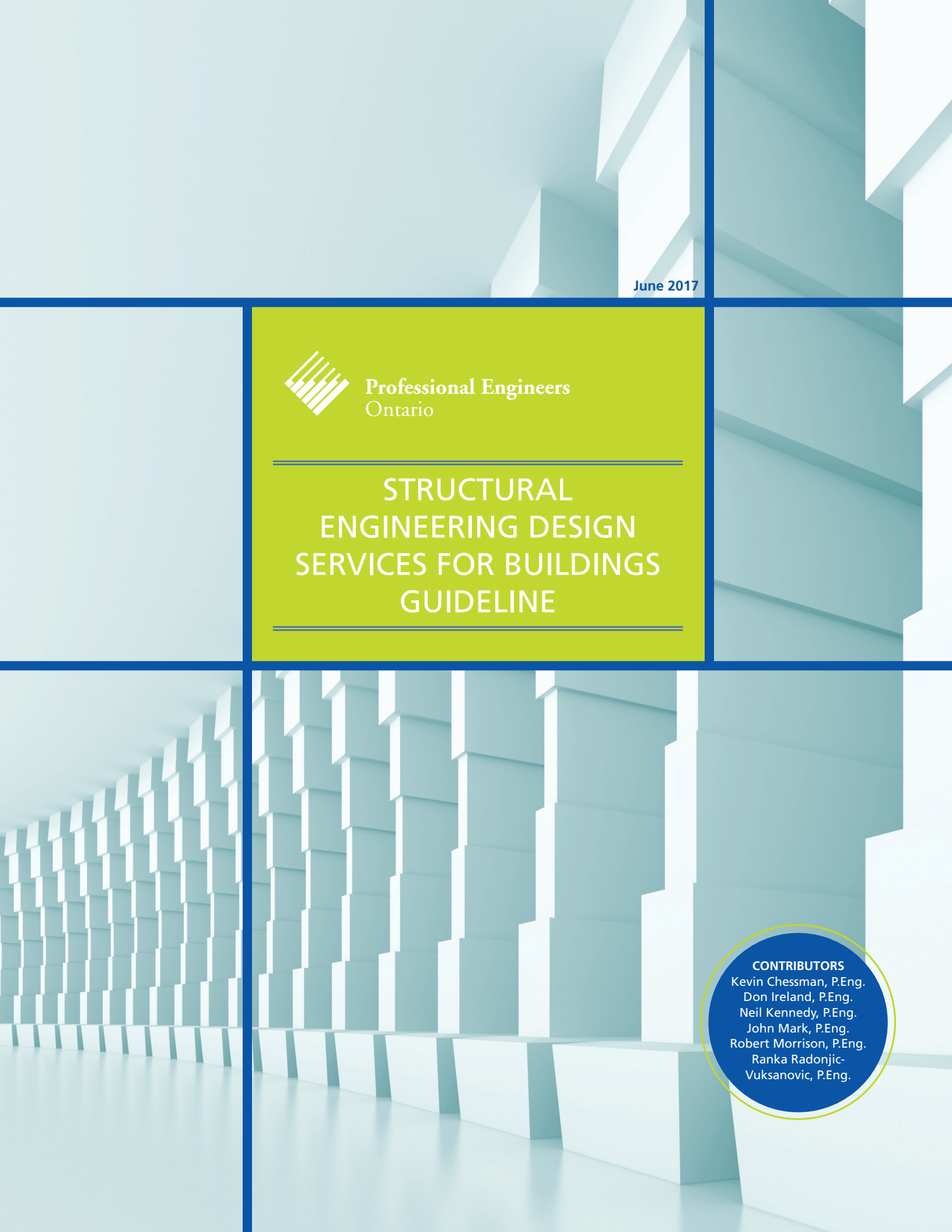

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STRUCTURAL ENGINEERING DESIGN SERVICES FOR BUILDINGS GUIDELINE

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CONTENTS

Notice: The Professional Standards Committee has a policy of reviewing guidelines every five years to determine if the guideline is still viable and adequate. However, practice bulletins may be issued from time to time to clarify statements made herein or to add information useful to those engineers engaged in this area of practice. Users of this guideline who have questions, comments or sug-gestions for future amendments and revisions are invited to submit these to PEO using the standard form included in the following Guideline Development and Maintenance Processes documents

ABSTRACT

The purpose of this guideline is to provide best practices for engineers providing structural engineering services in buildings. Special emphasis is placed on the duties to their employers, clients and the public. This guideline recommends methods for ensuring clarity of responsibilities between practitioners when two or more are providing structural engineering services for different aspects of a building. This guideline was developed for buildings required to be designed by an engineer as per the *Professional Engineers Act*; however, it may also be used by engineers providing services for other buildings and designated structures.

1.

PURPOSE OF PEO GUIDELINES

Professional Engineers Ontario (PEO) produces guidelines to educate licensees and the public on best practices.

For more information on PEO's guideline and development process, including PEO's standard form for proposing revisions to guidelines, please refer to the Guideline Development and Maintenance Processes document.

To view other PEO guidelines, please visit the Practice Advice Resources and Guidelines section of the PEO website.

2.

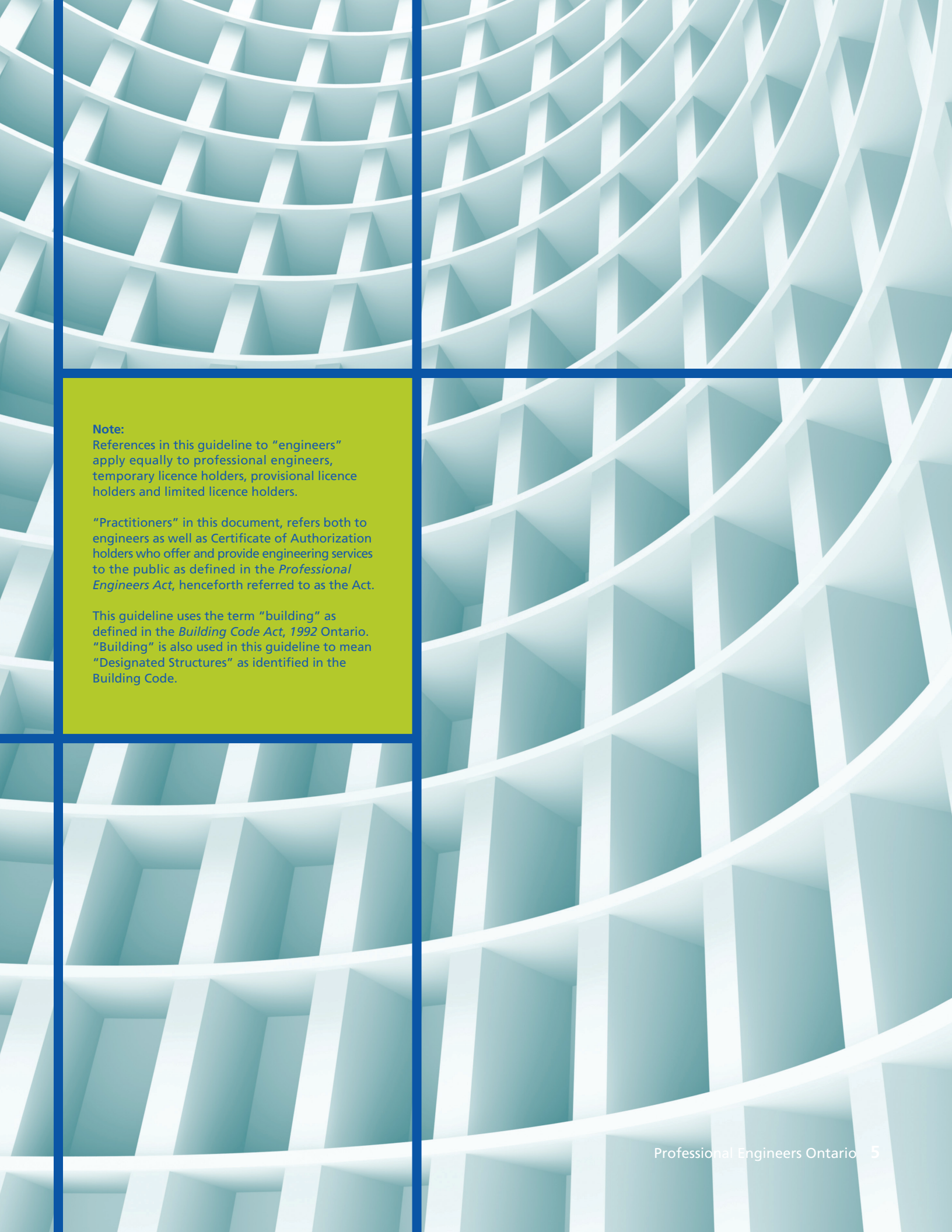
PREFACE

In April 2010, the Professional Standards Committee (PSC) formed a subcommittee of practitioners from both consulting engineering and steel fabricators. As per the Council-approved terms of reference, the subcommittee was directed by the PSC to revise the existing guideline for *Professional Engineers Providing Structural Engineering Services in Buildings* to prescribe and clarify the practitioner's responsibilities when providing these services. The previous edition of the guideline was published by PEO in 1995.

The subcommittee was asked to revise the guideline to deal with concerns raised by practitioners, building officials and contractors regarding the lack of coordination and improper division of responsibility between practitioners when two or more are providing structural engineering services for different aspects of the building. The subcommittee was asked to consider methods for ensuring clarity of responsibilities in order to mitigate problems associated with this division of services.

The subcommittee met for the first time on July 7, 2010, and submitted a completed draft of this document to the PSC for approval on April 5, 2016. During the course of their work, the subcommittee renamed the guideline to *Providing Structural Engineering Design Services for Buildings* to better reflect the nature of the guideline.

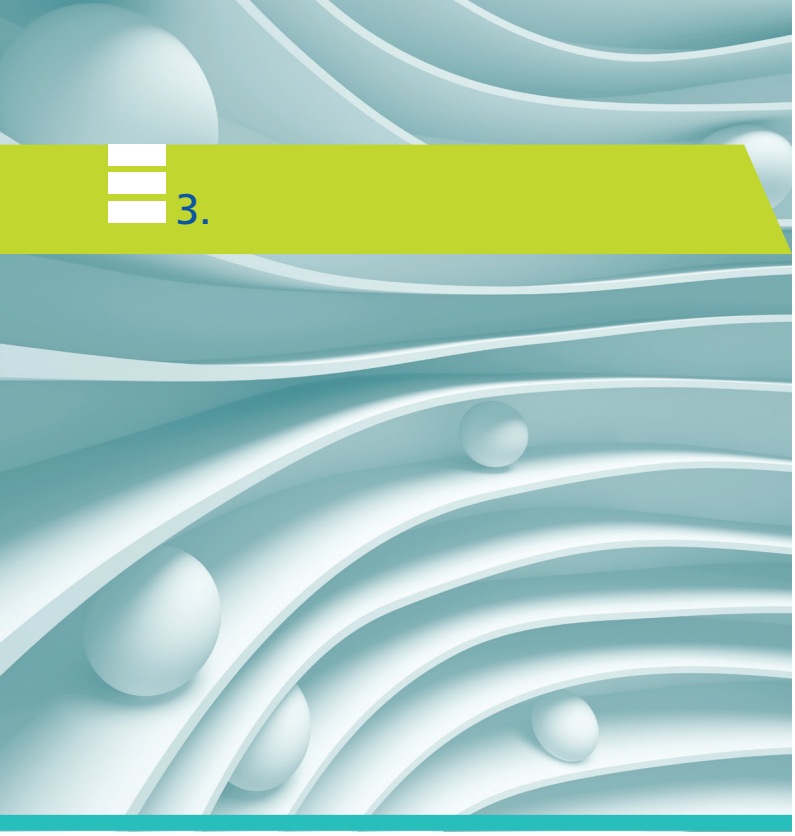
Following consultations with practitioners and stakeholders, the final draft was approved by Council at its meeting on June 24, 2016.



Note:
References in this guideline to "engineers" apply equally to professional engineers, temporary licence holders, provisional licence holders and limited licence holders.

"Practitioners" in this document, refers both to engineers as well as Certificate of Authorization holders who offer and provide engineering services to the public as defined in the *Professional Engineers Act*, henceforth referred to as the Act.

This guideline uses the term "building" as defined in the *Building Code Act, 1992* Ontario. "Building" is also used in this guideline to mean "Designated Structures" as identified in the Building Code.



3.

PURPOSE AND SCOPE OF THIS GUIDELINE

The purpose of this guideline is to provide best practices for engineers performing structural engineering design services in buildings, with special emphasis on the duties to employers, clients and the public. The guideline covers the following areas:

- examples of the division of structural engineering design in buildings where professional engineering work is carried out by different practitioners and the variations in their contractual relationships;
- difficulties associated with the division of structural engineering design for a building between multiple practitioners providing services for different clients and suggested procedures for mitigating risks of non-coordination, incomplete design and responsibility gaps;
- the term "structural integrity of the building" and how this term relates to the services provided by the various contributors to the overall structural design of building;
- limits of responsibility allocated to the various practitioners providing structural engineering services for the building structure and components;
- practitioner responsibility for review of shop drawings and the associated responsibilities for that review;
- identifying a single practitioner as the "primary structural engineer" responsible for coordinating all structural engineering design work done by the various practitioners; and
- PEO policies for sealing documents and identifying the proper procedures to be followed by the practitioners in various structural engineering design roles.

This guideline defines the role of a primary structural engineer (PSE) and delineates differences between the PSE and other practitioners. Furthermore, this guideline outlines the services that a PSE should consider providing as good practice, and may assist a PSE in explaining their services to a client, some of which may be in excess of the client's original expectation. These outlined services are not intended to be exhaustive. This guideline applies to buildings and designated structures as defined in the Building Code.

4.

INTRODUCTION

This PEO guideline covers the services offered by engineers with respect to structural engineering design work in buildings, including preliminary design, as well as preparation of final plans and documents.

The guideline also details the allocation of responsibilities generally undertaken by the various structural engineers involved on a building project. Given the wide variation in size and complexity of building projects, the number and organization of practitioners will vary; however, the outcomes described should remain constant.

Typical roles for structural engineers on a building design project that can be undertaken by various practitioners include:

- the design of the primary structural system for gravity and lateral loads;
- the design of proprietary components to be incorporated into the primary structural system;
- the design of secondary components not part of the primary system but requiring inherent structural integrity, such as cladding systems, roofing systems or balcony railings;
- review of shop drawings; and
- general review of construction as required by the Building Code, with the plans and other drawings that form the basis for the issuance of the permit.

On a typical project, it falls to the designer of the primary structural system to determine and communicate the extent of sub-contracted design work and the design criteria to be used (although this may vary). All practitioners involved in the project should confirm their scope and design criteria prior to undertaking their work.

These roles may be performed by a single individual, by several individuals within a single firm, or by several individuals working for different firms. Where major base building components are designed by two or more different engineering firms, this guideline recommends that a primary structural engineer (PSE) be assigned to the project.

When more than one practitioner is involved, it is critical that all structural engineers base their work on a clear understanding of the extent of their responsibility and of the design criteria on which their work is based. All structural engineers on a building project are responsible for clarifying these two points where any division of labour occurs. On a typical project, it falls to the designer of the primary structural system to determine and communicate the extent of sub-contracted design work and the design criteria to be used (although this may vary). All practitioners involved in the project should confirm their scope and design criteria prior to undertaking their work.

PART A.

PROFESSIONAL RELATIONSHIPS AND SCOPE OF WORK

Structural Engineers

Structural engineers combine structural analysis with experience and knowledge to create designs that meet Building Code and project requirements. They also prepare drawings indicating the location, sizes and quantities of materials, and specifications indicating the quality of materials and required performance of structural systems. In certain types of projects, a structural engineer may also be the prime consultant.

Primary Structural Engineer (PSE)

The PSE is responsible for the integrity of the primary structural system of the building. Although the PSE can rely on other structural engineers to be responsible for primary structural elements, the PSE has the overall responsibility to verify that the designs achieve a primary structural system that meets applicable standards. Structural engineers, other than the PSE, who are also engaged on a project in an ancillary role are to sign and seal the documents related to the structural components (either secondary or specialty structural elements) for which they are responsible. The PSE does not take professional responsibility for the work of others, but rather performs a coordinating role.

PSEs do not normally provide design services for building components such as stairs, miscellaneous metals, non-load bearing walls, steel member connections, timber connectors, light gauge steel connection details and metal stud back-up to veneer walls. However, when negotiated with clients, primary structural engineers may provide these services.

While the PSE may not be responsible for the design of secondary structural elements, specialty structural elements or non-structural elements, the PSE remains responsible for designing the primary structural system to accommodate these other elements, and for allowing for their effects on the primary structural system. For this purpose, the PSE is responsible for the review of these elements.

When engaged to perform engineering services, the PSE should negotiate the aspects of the work for which they will be responsible with their client. They may provide some or all of the basic services specified in Part B–Design and Construction of this guideline. Together, all of the services specified in Part B shall be considered to be full basic services. When required by clients, PSEs may also provide the additional services specified in Part D of this guideline.

The PSE should work with the client, the prime consultant or the design/build contractor to define a scope of work that enables him or her to provide the required designs, specifications, contract documents, and/or contract administration as described in this guideline and applicable codes and standards—especially where they affect the structural integrity of the building.

Although the PSE may have a contractual relationship directly with the client, the prime consultant or the design/build

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contractor, the PSE interacts mostly with other professionals, the general contractor and the testing and inspection companies associated with the building project.

Before commencement of services, the PSE should meet with the client to:
- develop the scope of work for basic services and additional services;
- reach agreement on fees, payment schedule and professional liability insurance; and
- reach agreement on, and complete a written contract.

For a "fast-track" project, in addition to the above, the PSE should:
- establish with the client, terms and conditions under which preliminary or partially completed contract documents can be issued in advance, and clearly define the requirements for partially completed contract documents;
- advise the client that no part of the designs or specifications is complete before contract documents, including those of other professionals, have been completed; and
- advise when scheduling may adversely affect the quality and safety of the services provided by the PSE and other professionals.

Basic services for a building project are generally organized in an agreement according to the sequential stages of a typical project. Although each stage of these basic services generally contain items pertaining to the progress of work at each construction stage, it is normal practice for certain basic services activities to be performed out of the normal sequence or in different stages than indicated in the scope of services due to the requirements of a specific project.

The typical stages of basic services for a building project may include:
- conceptual or schematic design;
- design development;
- contract documents, including designs for the primary structural system, structural calculations, structural design drawings and specifications;
- tendering; and
- general review of construction.

Specialty Structural Engineer (SSE)

In buildings, some structural elements may be designed by the fabricators of those components, and their specialty structural engineers (SSE) are responsible for those parts of the work. These elements include, but are not limited to, open web steel joists, steel connections, pre-engineered steel buildings, manufactured wood products, precast concrete and specialized foundations.

Where there is a gap in required design information, the SSE should communicate with the PSE. The SSE is responsible for the integrity of their designs and must sign, seal and date the documents prepared in their professional capacity or under their direct supervision.

Other Project Participants

While the client, prime consultant and general contractor are not the focus of this guideline, the following description of their roles is provided so as to properly identify, by exclusion, the role of the structural engineers engaged on a project. Items listed here are not the responsibility of the PSE or any other structural design team member unless they are explicitly identified as such in a written contract.

Client

In order that the design and construction of the project may be carried out in a manner that meets appropriate standards of public safety and the requirements of applicable building regulations, the client should:

1. retain, or cause to be retained, qualified design professionals, such as a PSE, a geotechnical engineer and a prime consultant;
2. before the commencement of the PSE's services, finalize, or cause to be finalized, a written agreement with the PSE (directly with the client or with the prime consultant or with another appropriate party);
3. cooperate with the PSE to set out a written description of the scope of the PSE's services as referred to in this guideline;

Before commencement of services, the PSE should meet with the client to:
- develop the scope of work for basic services and additional services;
- reach agreement on fees, payment schedule and professional liability insurance; and
- reach agreement on, and complete a written contract.

4. cooperate with the prime consultant so that an adequate written description of the project is developed;
5. cooperate with the prime consultant and the PSE to establish a realistic schedule for the provision of the PSE's services;
6. authorize, in writing, any additional services that may be required beyond the scope of the PSE's contract;
7. assure that all required approvals, licences and permits from the authorities with jurisdiction are obtained;
8. recognize that, since no design team or its designs are perfect, some errors or omissions may occur. Accordingly, a reasonable contingency should be included in the client's budget;
9. recognize that drawings, specifications and other documents prepared by the PSE are for the specific project and such documents should not be used or copied for other projects without the agreement of the PSE and without advice from a qualified design professional; and
10. recognize that, because code interpretation of the authority with jurisdiction may differ from the PSE, some changes may occur.

If the client fails or refuses to carry out the obligations as set out above, the PSE should:

(a) consider giving written notice to the client advising the client of the PSE's recommendations;
(b) consider whether the PSE can continue with the project; and
(c) if appropriate, consider notifying the authority with jurisdiction.

Prime Consultant

To enable the PSE to perform their duties properly, the prime consultant should:

1) interpret and define the needs of the client. The prime consultant should identify any special design criteria and advise the PSE accordingly;
2) outline the scope of assignment to each design professional for design, preparation of contract documents, general review of construction and contract administration;
3) provide timely information in sufficient detail to allow the PSE to adequately perform their duties;
4) coordinate and review the designs, drawings and other contract documents produced by all participants of the design team; and
5) coordinate communication of information between the client, the contractor and the design professionals, including the PSE, so that construction proceeds in a manner that complies with applicable codes and regulations, and meets their needs.

General Contractor

A general contractor has a contractual relationship with a client. This contract typically states that the general contractor is responsible for the labour, materials and equipment for the building project; and that they are responsible for the 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 their own work and the supervision, coordination, safety, quality assurance and inspection of the work of subcontractors, where applicable.

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PART B.

While incorporating the requirements, a PSE should:
- abide by the requirements of the current applicable codes, acts and regulations;
- establish the loads and structural resistance for the structural design; and
- recommend any specialized services related to the structural design process that are required for completion of the project. It is preferable that the PSE be engaged to prepare the terms of reference for these specialized services and comment upon the reports presented, when necessary.

DESIGN AND CONSTRUCTION

The following three sections (1–Preliminary Design, 2–Final Design and Documents, and 3–Tendering and Construction) outline the services that are usually appropriate for a PSE to provide for a building project. These sections can assist a PSE or SSE in explaining their services to a client, a prime consultant or a design/build contractor. These outlines are not intended to be exhaustive and should not detract from other provisions of this guideline.

1–Preliminary Design

The PSE should secure a definition of the requirements for, and establish the parameters governing, the structural design. The PSE should then develop a preliminary design concept for the structural system based on considerations of economy, performance, constructability, accepted safety standards and compatibility with other design elements and user requirements.

While incorporating the requirements, a PSE should:
- abide by the requirements of the current applicable codes, acts and regulations;
- establish the loads and structural resistance for the structural design; and
- recommend any specialized services related to the structural design process that are required for completion of the project. It is preferable that the PSE be engaged to prepare the terms of reference for these specialized services and comment upon the reports presented, when necessary.

PSEs should consult with the client, prime consultant and/or design/build contractor about proposed construction materials and techniques, and their alternatives (including explaining the short and long-term advantages and disadvantages of each choice), so they can make an informed decision before final plans and specifications are developed. PSEs should also assess whether new materials and proprietary products have been independently tested under conditions and loadings that correspond to those anticipated during use.

In the preliminary design stage, the PSE may:
- attend periodic meetings with the client and design team to obtain instructions on the project's functional, aesthetic, cost and scheduling requirements;
- establish dates by which information affecting the structural design will be needed from other disciplines, such as architectural and mechanical;
- conduct site inspections and review existing drawings for renovations or additions;

- establish criteria relating to the primary structural system for the geotechnical engineer and other consultants, as required. Comment on reports presented;
- check applicable codes, regulations and restrictions affecting the design of the project;
- develop the structural scheme for the primary structural system together with alternate schemes, where appropriate. Consider materials and systems suitable to the project requirements. Consider the requirements of the other design professionals and provide any information relating to the primary structural system they require;
- prepare a summary report that recommends the primary structural system selected for the project, outlines the reasons for the selection and comments on the effect of the selection on the structural budget for the project;
- provide brief outline specifications for the proposed materials; and
- explain in writing to the client the risks, advantages and disadvantages of any new construction materials or techniques the PSE proposes for use in the project;

Although not part of their usual duties, the PSE may also assist the client, prime consultant and/or design/build contractor to:

- determine the need for specialized services such as geotechnical soils investigation, vibration analysis or wind tunnel testing;
- develop or review the project schedule, including milestone dates;
- develop channels of communication with others to:
  - coordinate responsibility for showing overall and detail dimensions on the design drawings;
  - coordinate design drawing standards and specifications format; and
  - coordinate the timing of meetings during each stage of the project.

The client may assume responsibility for some or all of the foregoing preliminary design stage decisions that do not fall within the practice of engineering, provided:

- the responsibility for these decisions is clearly defined in writing and relieves the PSE of responsibility for the effects of such decisions on the selection of the primary structural system, costs and/or scheduling;
- the PSE can make appropriate decisions with regard to engineering and safety; and
- the PSE can satisfy the requirements of subsequent stages of these guidelines.

2–Final Design And Documents

The PSE should develop the structural system design based on the approved or accepted preliminary design report. The completed design is described by plans and specifications that are sufficiently detailed to ensure that the structural system, if built in accordance with the plans and specifications, will be in compliance with the Building Code at the time of design and will conform to the design intent.

In preparing final plans and specifications, structural engineers should:

a) analyze and design the structural system in conformity with applicable codes and regulations;
b) analyze and design each element of the system or, where elements are to be designed by others, provide appropriate design criteria;
c) prepare clear design briefs stating the applicable codes, loads, assumptions and design criteria for the analysis and design of the system and its components;
d) cooperate with the other design professionals during system design, responding to their requests, taking into account their requirements, and advising them (through the prime consultant) of functional aspects of the system that may affect the design of their systems;
e) cooperate with others in their preparation of cost estimates and schedules from time to time, based upon the most accurate information available as the design develops;
f) advise the prime consultant that structural elements designed by others are to be designed by engineers according to specifications and Building Code requirements; and
g) recommend to prime consultants, as appropriate, that an independent testing agency monitor the fabrication and installation of products, and test the materials used for compliance with specifications.

Design Development Stage

In the design development stage, the selected preliminary design is developed in sufficient depth to complete construction details and permit work on construction documents to begin. During this stage, the PSE should, as required:

a) attend meetings with the client and other stakeholders to coordinate the flow of design information amongst the other design team members;
b) cooperate with the other stakeholders, responding to their requests, taking into account their requirements, and advising them (through the prime consultant) of functional aspects of the primary structural system that may affect the design of their components;
c) analyze and design the structural system in conformity with applicable codes and regulations;
d) review serviceability limits, such as: deflections, vibration, lateral drift, concrete and masonry crack control, foundation settlement and soil-structure interaction;
e) review reports by specialized services such as geotechnical, vibration analysis and wind tunnel testing, and incorporate recommendations into the primary design;
f) prepare structural analysis and design calculations for the primary structural system components;
g) prepare foundation designs based on recommendations in the geotechnical investigation report;
h) prepare the framing design and design detail sketches showing layouts of typical areas;
i) prepare or edit outline specifications for structural components; and
j) coordinate the structural design with deflection and lateral movement criteria to meet requirements of other SSEs.

The PSE should have a quality assurance process to confirm the adequacy and appropriateness of the design, and also for the construction documents to confirm they convey the design intent and are sufficient for their intended use. The quality assurance documentation should identify the engineers who prepared the design and documents, and also those who carried out the quality assurance process.

Primary Structural System Design

In conjunction with designing the primary structural system, the PSE shall:

1. with respect to primary structural elements, connection details and proprietary products:
   a. specify types of elements, their positions within the structure and methods of connecting to the primary structural system; and
   b. determine and specify in the contract documents the elements that are to be designed by other specialty engineers, and specify loads and design criteria for use by SSEs in their design.
2. with respect to non-structural elements attached to the primary structural system, the PSE shall:
   a. design the primary structural system to accept and support such elements; and
   b. indicate the assumed design loads applied to the primary structural system by the non-structural elements.

Geotechnical Information

Unless they are qualified, structural engineers should not provide opinions on the bearing capacity of soils for foundation support. However, when clients or prime consultants have not retained a geotechnical engineering firm to prepare a geotechnical report, structural engineers may assume values based on their experience in the area and must clearly indicate on the drawings those design assumptions used to prepare foundation designs. When estimated geotechnical values are used, the PSE should advise the prime consultant that these selected design values must be verified by a geotechnical engineering firm prior to construction, and that if conditions are found to differ, the designs may have to be changed. The PSE should also advise the prime consultant that additional design and construction costs and project delays can result if site conditions that were assumed are not actually realized. As well, the documents must contain a specific reference to having a geotechnical engineering firm verify soil conditions under foundations prior to foundation placement. Although this "design-and-confirm" strategy is not ideal, clients may exercise that option and engineers should address it in a manner that preserves the safety and integrity of the foundation design.

For more information, refer to the practice guideline *Professional Engineers Providing Geotechnical Engineering Services*.

Design and Construction Documents

The PSE should oversee the creation of construction documents for the primary structural system that comply with the building codes and good engineering practice at the time of design. The construction documents include calculations, construction drawings and specifications.

Construction drawings are graphical and pictorial documents describing the design and characteristics of the elements necessary for construction of the primary building structure.

In preparing the final plans and specifications, the PSE should state on the drawings the design criteria (including applicable codes, materials and loads) used for the analysis and design. The PSE should also state in the specifications the overall structural intent of the design, the elements that are to be designed by specialty engineers, and specify independent testing and inspection of products and materials that would be required for quality assurance.

Structural Calculations

The PSE must prepare calculations to support the structural design of the primary structural system. The calculations should contain a table of contents or index and must clearly show and delineate service loads, factored loads and factored load combinations. The structural calculations should be dated, legible and retained in a project file.

A copy of input and output of computer analysis should be included in the project file, along with a description of the software used.

In general, structural calculations typically will include:

a) the design criteria;
b) a discussion and description of the design basis, including assumptions;
c) the standards referenced, with edition dates;
d) a list of live loads, environmental loads such as wind, snow and seismic criteria, and any other special loads;
e) specifications for materials used;
f) geotechnical report information and design criteria;
g) deflection limitations of structural elements and systems;
h) location diagrams for structural elements;
i) vertical load analysis and design of roof structures, floor structures, frames or trusses, columns, walls and foundations;
j) lateral load analysis and design for seismic and wind forces;
k) computer analysis and design results; and
l) special analysis, such as dynamic and vibration analyses.

The practice guideline *Professional Engineers Reviewing Work Prepared by Another Professional Engineer* states the following, "Clients or regulatory bodies might ask authoring engineers to submit design calculations and other information that is not normally considered part of the final documents. Unless there is a contractual or legislated obligation to do otherwise, authoring engineers should not provide documents generated during commission of the engineering services."

Specifications

Structural engineers shall provide the technical sections of specifications for all structural design work for which they are responsible. The specifications should cover:

a) the scope of work;
b) standards, codes and bylaws governing the work;
c) submittals required;
d) quality control requirements;
e) materials and tolerances;
f) workmanship and fabrication;
g) criteria for temporary works;
h) field review of construction, inspection and testing;
i) provisions for the contractor to provide notification before commencing;
j) significant steps of the work;
k) trade warranties; and
l) erection information, where necessary, to ensure the intent and integrity of the design.

Specifications are prepared using a format suitable for inclusion in the contract documents. On smaller projects and where appropriate, however, specifications can be abbreviated in an outline format and become part of the structural design drawings. Specifications should specify that the PSE's review of submittals and field reviews, as well as testing and inspection by independent companies reporting to the client, are carried out to inform the client of the quality of the contractor's performance, and that these reviews, tests and inspections do not relieve the builder of his/her responsibilities to build the project to conform to the structural drawings and specifications.

Specifications should specify that the PSE's review of submittals and field reviews, as well as testing and inspection by independent companies reporting to the client, are carried out to inform the client of the quality of the contractor's performance, and that these reviews, tests and inspections do not relieve the builder of his/her responsibilities to build the project to conform to the structural drawings and specifications.

The specifications should make it clear that:

a) the PSE's review of shop drawings is undertaken to determine whether they meet the intent of the design; and
b) the client should engage independent agencies to advise on the quality of the contractor's performance and whether the work meets the intent of the design.

Structural Drawings

When structural drawings are issued, they are intended to be used for a specific purpose, such as a building permit application, tendering of the work or construction. These drawings need to be sufficiently complete for the purpose for which they are issued and they are to be prepared under the direct supervision of the PSE or SSE who is responsible for the drawing and design content therein. Whenever structural drawings are issued, the drawings are to include the purpose of the issuance in the title block and are to be sealed as per the practice guideline *Use of the Professional Engineer's Seal*.

Working drawings are drawings-in-progress or supplementary sketches that are intended for use only by those involved with the design work during the design development and contract document stages of the project. Working drawings are not intended to be issued, except for coordination with others, and should normally not be sealed.

Best practice is for drawings to be fully coordinated and complete before they are issued for a building permit application, tender or construction. It may be necessary in some cases, however, to issue drawings that are not complete. Therefore, drawings issued for a building permit application or tender should not be used for construction. Furthermore, drawings that indicate an incomplete design should not be submitted for permit application.

Drawings issued for a building permit application must indicate the complete design intent but may require more details for pricing or clarification of the design intent as a result of questions raised during the tendering period. When numerous or significant modifications are made to the "Issued for Building Permit" drawings following the building permit application, notification of those alterations should be submitted to the building department as part of the permit application.

Prior to the start of construction, "Issued for Construction" drawings should be prepared by the PSE. These drawings incorporate all known modifications to the previously issued drawings. The design and related data will be conveyed in a combination of graphical representations, tables and notes that document the design standards, load criteria, member locations, orientations and sizes, and any other data required as per applicable CSA Standards. The design information on the drawing should be sufficiently complete so that the design can be fully understood and verified by another structural engineer. The drawings also need to include sufficient detail to enable the fabrication, installation and connection of the elements by the contractor.

When structural drawings are issued, they are intended to be used for a specific purpose, such as a building permit application, tendering of the work or construction. These drawings need to be sufficiently complete for the purpose for which they are issued and they are to be prepared under the direct supervision of the PSE or SSE who is responsible for the drawing and design content therein.

Working drawings are drawings-in-progress or supplementary sketches that are intended for use only by those involved with the design work during the design development

Specifically, the drawings prepared by or under the direct supervision of structural engineers should include, but not necessarily be limited to, the following:

1) Structural notes

a) codes and standards, with dates of issue, to which the design conforms;
b) design criteria indicating vertical and horizontal loads used in the design, clearly identified as factored or unfactored, including live loads, environmental loads and dead loads (such as landscape, partition and equipment loads);
c) reference to the geotechnical report on which the foundation design is based, design bearing pressure (SLS and ULS) and any other pertinent soil data;
d) brief material specifications;
e) absolute or relative deflection criteria for primary structural elements; and
f) sequence of construction notes, if critical to the construction or long-term performance of the structure.

2) Building Code analysis matrix

Section 12(6) of the Act governs the relationship between professional engineers and architects. Generally, professional engineers are restricted to preparing or providing designs for structural, mechanical, electrical and other systems in the building that involve the practice of professional engineering. However, for certain building classifications, professional engineers may prepare designs for all aspects of the buildings including those aspects that are normally designed by an architect, such as floor plans, exiting, fire separations and provisions for disabled persons. These are fairly common circumstances as section 12(6)2 allows professional engineers to prepare all drawings needed for factories, industrial units, parking garages and storage units, etc., within the noted boundaries. Professional engineers are also permitted to provide all drawings for buildings that are exempt from the *Architects Act*, R.S.O. 1990, c. A.26 such as commercial, mercantile or residential buildings of three storeys or less and not more than 600m² gross floor area.

A Building Code analysis matrix provides information needed for the evaluation of the permit application and also documents the design basis and expectations. For these reasons, where the PSE is the prime consultant, a Building Code analysis matrix is required on the drawings prepared as part of the application for a building permit as per Regulation 260/08. When the PSE is not competent to carry out a Building Code analysis, it is recommended that another design professional be engaged to provide that service.

For more information, refer to the practice bulletin *Use of Building Code Compliance Data Matrix by Professional Engineers Submitting Drawings for Building Permits*.

When the PSE is a sub-consultant, the Building Code analysis is usually the concern of the prime consultant.

3) Structural design data matrix

There is value for all parties, including government authorities, for the structural documents to also include a structural design matrix to summarize issues pertinent to Part 4 Division B of the Building Code. The matrix table should include all pertinent structural design load input assumptions and some of the basic output data. See Appendix 1 for an example of a standard structural design data matrix.

When the PSE is not competent to carry out a Building Code analysis, it is recommended that another design professional be engaged to provide that service.

4) Sections and details

Elevations, sections and details are to be at an appropriate scale to portray the relationship of structural elements to each other and their interconnection(s). Sections and details are to be in sufficient number to show all non-typical conditions, their locations and extent.

Typical details should be used where appropriate; however, care should be taken to determine that details noted as "typical" are applicable to the condition being portrayed and that their locations and extent are explicit.

5) General items

Include on the structural drawing set, graphically or by notes:

a) grid line dimensions (grid line dimensions may be shown on only one of the structural plans to avoid duplication errors);
b) structurally derived dimensions that are not shown on architectural drawings;
c) snow accumulation diagrams and wind pressures including pressure diagrams, if appropriate;

d) expansion, construction and control joint locations and details;
e) design loads, deflection criteria and any other relevant data for manufactured components;
f) the lateral load resisting system;
g) temporary bracing, if required; and
h) provisions for future extensions, if applicable.

Providing adequate dimensions on the drawings is one of the most important elements in the preparation of complete construction drawings and the mark of a well-executed project. The construction drawings should include dimensions that allow for the proper installation and assembly of the building structure. Although dimensioning of the building is usually provided by the prime consultant, and the primary source of dimensions occur on their drawings, the PSE is responsible for, and shall assist in, coordinating the dimensions needed for the accurate location and construction of the building structure. To that end, floor levels, column spacing, structural wall locations and offsets, and foundations and piers are to be coordinated with the prime consultant's drawings to confirm consistency of dimensions.

6) Foundation plans should show:

a) grid lines and grid line dimensions as well as overall dimensions and structurally derived dimensions;
b) the types, sizes, locations and details of foundations for columns, walls, piers, equipment and any other structural loadbearing components;
c) the anticipated bearing elevations for foundations;
d) any drainage or dewatering system or requirements;
e) the foundation system installation sequence, if important to the structural design;
f) sub-grade preparation for slabs-on-grade, as well as the thickness, reinforcing and elevation of the slabs-on-grade;
g) estimated pile lengths and capacities, or a source for this information;
h) frost-safe soil cover or equivalent insulation requirements for shallow foundations;
i) the approximate location of existing services and foundations, or any other relevant site information made known to the PSE, that may conflict with the proposed foundations. Service locates, however, are still the responsibility of the excavation contractor; and
j) allowable SLS and ULS soil or rock-bearing capacity, pile capacities and lateral earth pressures for retaining structures with reference to pertinent geotechnical reports.

7) Framing plans of floors, roofs and elevations of walls should show:

a) grid lines and structurally derived dimensions, dimensions to outside of structural floor plate from grid or overall dimensions of floor plate;
b) all pertinent design loads broken down into the various load cases. This includes uniform area loads, variable roof snow accumulations diagrams and point loads for equipment including the load positions. The drawings must indicate whether loads noted are service or factored loads;
c) slopes and depressions, or references to drawings by others that show that information;
d) sizes, locations, dimensions and details of structural elements;
e) for cantilever suspended span (Gerber) systems, include beam cantilever lengths and splice locations;
f) locations, sizes and framing details or reinforcing around major member openings;
g) reference elevations of floors or roof(s);
h) wall framing elevations showing girts and bracing, including calculated forces, for steel framed buildings;
i) reinforcing bar sizes and spacing for concrete members, with fabrication and placing criteria;
j) conditions at change of elevation of the structure, conditions at intersections of different structural materials, and at interaction of structural and non-structural components;
k) calculated member end forces, moments, shears or torsion required for connection design by others (governing combined factored connection forces should be provided);
l) locations and details of control, construction and expansion joints; and
m) provision for future extensions.

8) Column information, usually provided in tables or line diagrams, should show:

a) elevations of the bottom and top of columns;
b) member sizes;
c) reinforcing elements for concrete columns;
d) proposed splice locations and splice details for structural steel and concrete columns;
e) column axial loads and bending moments to be resisted at base and at splices; and
f) stiffeners, lateral bracing and local reinforcements for steel elements.

9) Structural detail drawings should show (depending on the materials used):

a) masonry bearing and shear wall details, including masonry unit and mortar strengths, details of reinforcing, support of loads, lintels and grouting procedures;
b) reinforced concrete member details, such as geometry, reinforcing, etc., sufficiently detailed to enable others to prepare reinforcing plans and details as well as bar lists;
c) wood shear wall details, including nailing patterns and end anchorages or factored anchorage forces if connectors are to be designed by other specialty engineers;
d) elevations and details of custom-designed trusses, including splice locations and calculated member forces for each member if specialty engineers are required to detail the interconnections between the members; and
e) timber members and connection details, or end forces if connectors are to be designed by a SSE.

10) Connections:

a) where connections are the responsibility of a SSE, design drawings should indicate required information and connection forces, and may include appearance criteria; and
b) where connections are the responsibility of the PSE, design drawings should show dimensions and specific connection details.

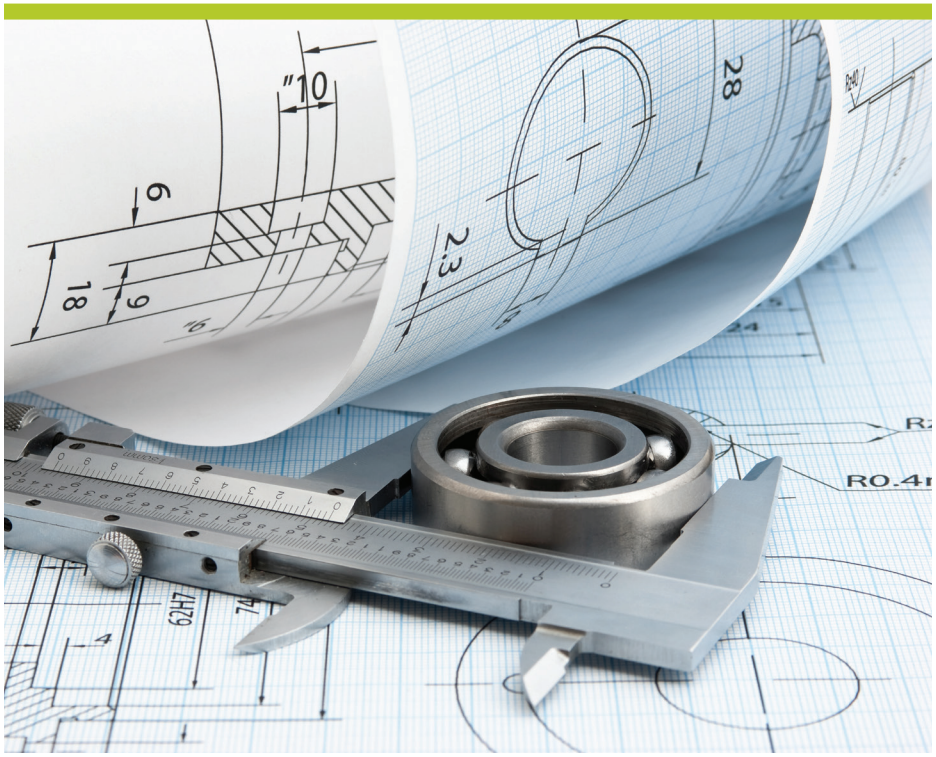
11) Temporary works

A sufficient design criterion to enable SSEs to design temporary works for which the contractor is normally responsible needs to be present on, or derivable from, the construction documents. Some temporary works, such as temporary bracing required to stabilize the structure for a specific duration during construction, is the responsibility of the PSE. Note that temporary bracing is not the same as erection bracing, which is the contractor's responsibility.

For more information, refer to the practice guideline *Professional Engineers–Temporary Works*.

12) Cold formed steel (CFS) components:

CFS structural members may be part of the primary structural system as beams, joists or load bearing studs. In such cases, the structural drawings should indicate all CFS member sizes according to standardized sizes developed by the CSSBI. When CFS members are used in non-load bearing systems, such as panelized wall cladding and curtain walls, the structural drawings should only indicate the maximum member depth and the design loads to be resisted so that the specialty engineer can design the system framing. In either case, the structural drawings should specify that specialty engineers are to design the member-to-member connections and prepare shop details.



3–Tendering and Construction

Tendering stage

The PSE may provide an "issued for tender" set of documents and this set is normally assumed to be substantially complete, and only lacking details that are not significant in the tendering process.

During the tendering period, the PSE should assist prime consultants in answering ques¬tions raised by the tendering contractors and, when necessary, prepare addendum (addenda) or clarification notes to the structural documents.

As additional services, the PSE may also assist the client, prime consultant and or design/build contractor to:

- prepare the tendering documents;
- prepare pre-qualification documents;
- review bidders' qualifications;
- obtain required approvals, licenses and permits; and analyze and evaluate tenders submitted; and
- review and analyze tender prices.

Construction stage

Prior to the start of construction, the PSE should provide an "issued for construction" set of documents. This set of documents is an update of the tendered documents and includes all items in the structural addendum, clarification memos and any other items that should be noted to coordinate with the documents of other disciplines.

For general review during construction, refer to the practice guideline *Professional Engineers Providing General Review of Construction as Required by the Ontario Building Code*. This guideline outlines services that should be provided as part of general review during construction.

Fabricator, Manufacturer, and Construction Drawings & Documents

Unless indicated otherwise in the contract, fabricators or manufacturers should produce drawings and documents for the work covered under their contract with the general contractor or sub-contractor. These drawings and documents should be prepared by the fabricators or manufacturers after reviewing the drawings, specifications and contract documents supplied by the PSE.

Typical fabricator or manufacturer drawings and documents may include:

- structural design drawings and documents for proprietary structural elements, such as open web steel joists;
- erection drawings and documents that specifically show the location of structural elements, connections and components to be supplied by the fabricator;
- shop fabrication/connection drawings and documents that provide information necessary for shop personnel to fabricate and assemble the items;
- reinforcing bar lists, placing diagrams and details;

- timber connector details and plans;
- cold formed steel plans and connection details; and
- shoring diagrams.

Any document or drawing that includes design work performed by the SSE shall be issued under seal in accordance with the Use of the *Professional Engineer's Seal* practice guideline. Any other documents without engineering design content carried out by the SSE should not be sealed by the SSE. The PSE should review all of the sealed documents for compliance with the specified structural requirements and all other documents for general conformance to the design intent.

It is always preferable that the PSE or a design engineer reviews the associated shop drawings. However, the PSE may delegate this task. The PSE should exercise their professional judgment and due diligence in determining what work should be delegated, the skill and knowledge required to review the shop drawings and how the work is delegated.

PART C.

Finally, structural engineering firms are strongly encouraged to refer to the practice guideline *Conducting a Practice Review*, which deals with the professionally acceptable manner of operating and managing a professional engineering practice.

OFFICE PROCEDURES

Structural engineering firms are required to maintain minimum standards in the organization and equipping of their offices.

At a minimum, the following actions should be undertaken by every office:

1. maintain a library of relevant codes and standards for the type of work being undertaken. This usually includes, but is not limited to:
   - the National Building Code of Canada;
   - National Building Code structural commentaries;
   - the Building Code;
   - CSA standards, as appropriate; and
   - publications and design guides from trade associations such as CISC, CSSBI, CPCA, CWC, CPCI, etc.

   It is recommended that obsolete versions of these documents be retained for reference when an existing building is being assessed or altered.
2. select and maintain computer software for use in the design process as well as for administrative activities.
3. document design procedures, including identifying communication needs and timeframes, and establishing a quality assurance process to be followed.
4. implement design and quality assurance procedures to ensure the PSE oversees the engineering and drawing preparation for which they are taking responsibility. This includes direct involvement in establishing the design parameters to be followed for the work, monitoring and reviewing engineering calculations, and reviewing the construction documents for accuracy and adequacy for their intended use.
5. maintain project files organized by project number. The project files, including calculations, correspondence, reports and shop drawings, must be maintained as per the practice guideline *Professional Engineering Practice*.
6. maintain a digital copy of project file folders and have a system of regular backups. It is good practice to keep the digital files for a set period of time.
7. maintain copies of original sealed drawings and documents as per the practice guideline *Use of the Professional Engineer's Seal*.

Finally, structural engineering firms are strongly encouraged to refer to the practice guideline *Conducting a Practice Review*, which deals with the professionally acceptable manner of operating and managing a professional engineering practice.

PART D.

OTHER SERVICES RELATED TO STRUCTURAL ENGINEERING IN BUILDINGS

In addition to the basic services described in Part B–Design and Construction, the PSE can provide additional services if it is agreeable with both the PSE and the client. Such an agreement should be in an additional services contract. These additional services may be related to a building project for which the PSE is already engaged, or they may comprise the entire scope of the services provided. Structural engineers should provide the following services only if they are engaged by prime consultants or clients and they have the experience and ability required to do so.

For a building project, additional services are typically not considered to be included in basic services and are not part of the basic services that a PSE should provide under this guideline. Additional services for a building can include design, preparation of documents and field review.

Additional services could include, but are not limited, to:

- changes in project scope or complexity due to choices or requirements of others;
- changes in time schedules, imposed by others, either reducing design time or extending construction time;
- activities related to existing buildings, including surveys;
- preparation of documents for demolition;
- filing applications for, and/or obtaining, project-related permits;
- seismic analysis beyond that required to meet the requirements of the relevant building code;
- seismic analysis and design of seismic restraints for non-structural elements;
- physical model analysis such as wind-tunnel tests or shaking table tests;
- dynamic analysis beyond that required by the Building Code (e.g. spectrum analysis or time-history response analysis);
- review and coordination of designs and specifications prepared by SSEs or other design professionals, which have not been specifically included in the basic services agreement, to confirm compatibility with the primary structural system (for more information please refer to the practice guideline *Professional Engineers Reviewing Work Prepared by Another Professional Engineer*);
- design of specialty structural elements and non-structural elements not specifically included in basic services agreement, such as: curtain walls, building facings, cladding, antennae, elevators, storage tanks and exterior landscape elements;
- determination of, or investigation into, structural fire-resistance requirements;
- preparation of alternate designs, or investigation into alternate products or systems requested by the client or the general contractor;
- preparation of, or assistance with, cost estimates, or reviewing cost estimates prepared by others;
- translation of contract documents, conversion into other units, or special preparation of design drawings for reduction in size;
- preparation of documents for tendering segregated contracts, pre-tendered contracts, phased or fast-track construction;
- review of the general contractor's design for or installation of temporary works for excavations and construction, underpinning of adjacent structures, or erection sequence instructions;
- review of the general contractor's methods, procedures or construction equipment;
- design changes due to construction cost over-runs not directly in the control of the PSE;
- design changes due to errors or omissions by the general contractor;
- additional work due to damage to the construction work resulting from either natural or human-caused events;
- continuous, unusually frequent, or unusually detailed field reviews during construction;
- review of re-submittals or supplementary submittals due to incorrect or incomplete submittals by the general contractor;
- preparation of quantity take-offs and/or bills of materials;
- preparation of fabrication drawings, reinforcing steel bending schedules or other types of shop drawings;
- preparation of record drawings;
- tenant-related design services; and
- services as an expert witness.

In addition to the basic services described in Part B–Design and Construction, the PSE can provide additional services if it is agreeable with both the PSE and the client. Such an agreement should be in an additional services contract. These additional services may be related to a building project for which the PSE is already engaged, or they may comprise the entire scope of the services provided. Structural engineers should provide the following services only if they are engaged by prime consultants or clients and they have the experience and ability required to do so.

Other services not part of the basic scope of work related to a building project, which may be in addition to a wider scope of service or be the entire scope of service in themselves, could include items such as those in the list that follows.

Advisory Services

Advisory services include testimony, consultation and advice, appraisals, valuations, research or other services leading to specialized conclusions and recommendations.

Feasibility Studies

Feasibility studies involve preliminary engineering studies and the collation and processing of information to recommend a plan or course of action for projects. They include exploration, gathering of topographical and other site-condition information, subsoil investigation, analysis of conditions, economic studies of capital, operating costs and other financial considerations, and similar studies on which recommendations for projects could be based.

Construction Cost Estimating

Construction cost estimating services include comparative cost estimates for preliminary and final designs as required by clients or prime consultants. Structural engineers should indicate that since actual costs are dependent on conditions beyond their control, they cannot guarantee the accuracy of such estimates. Prime consultants should engage cost consultants for cost estimating when it becomes a priority.

Structural Engineering Assessments of Existing Buildings

In certain circumstances, clients will hire individual engineers or engineering firms to conduct structural assessments of existing buildings or parts thereof. Generally, structural engineering assessments of existing buildings fall into one of two categories:

- assessments of the overall integrity of buildings; or
- assessments of buildings or parts thereof affected by structurally compromising events, such as fires, vehicle impact or flooding.

For more information, refer to the practice bulletin *Structural Engineering Assessments of Existing Buildings*.

Surveys of Existing Structures

Surveys of existing structures may include detailed condition surveys and/or dimensional surveys, as well as structural evaluations of existing buildings. These surveys may also include the gathering of information on unusual or specific existing loadings, such as process equipment, storage or effects from adjacent construction.

Search of Records

These may include searches of such records that may be held against the property as rights, restrictions and easements, and for information concerning underground services.

Revisions to Drawings and Specifications

These services include extensive revisions to drawings and specifications due to changes originated by prime consultants or clients after the commencement of final plans and specifications. Revisions to drawings and specifications may be necessary, for example, when clients or prime consultants do not obtain a geotechnical report before the design and construction phases begin.

Architectural Works

Architectural works include stairs and handrails, curtain walls, miscellaneous metals, building finishes and appendages, signage, poles, decorative walls, light metal framing, and waterproofing and moisture protection.

Mechanical and Electrical Works

Mechanical and electrical works include equipment supports, machine foundations and light standards.

Resident Inspection

Under the general review of construction, only periodic visits to the site are provided. When more detailed monitoring of field work is considered necessary, structural engineers should be retained to provide field staff on a part- or full-time basis, as required.

Provision of As-Built or Record Drawings

As-built drawings, when prepared by the PSE, consist of construction drawings revised in accordance with "as-built" marks provided by the contractor. There is no warranty of accuracy on the part of the PSE for the information provided by others. As-built drawings are not sealed by the PSE.

Record drawings consist of revised construction drawings, and possibly completely new drawings as required, to illustrate as-constructed conditions. Record drawings are prepared from field observations by the PSE who warrants that the information is accurate. Record drawings are to be sealed by the PSE.

Preparation of Erection and Fabrication Drawings

The preparation of erection and fabrication drawings includes shop drawings for structural steel, precast concrete, reinforcing steel, structural timber and other prefabricated components, and bills of materials and quantities. These drawings are normally provided by SSEs involved with the project.

Structural Modelling

The preparation of physical models and subsequent testing is an area of practice usually undertaken by firms that specialize in this service, or undertaken in an academic setting.

Building Information Modeling (BIM) Management

This service relates to the creation and management of a digital representation that is used as the authoritative source for all information about the project. This is dependent on compatible input (conforming to agreed standards) from all project stakeholders. While PEO does not have a specific guideline for BIM, the practice guideline *Professional Engineers Using Software-Based Engineering Tools* provides best practices that apply to BIM.

DEFINITIONS

For the purposes of this guideline the following terms and definitions apply:

Building
This guideline uses the term "building" as defined in the *Building Code Act, 1992* Ontario. "Building" is also used in this guideline to mean "Designated Structures" as identified in the Building Code.

Client
The person or organization that has commissioned the work and retains the prime consultant.

Constructability
The extent to which a design of a facility provides for ease of construction yet meets the overall requirements of that facility.

Contractor
The person, firm or corporation contracting with the client to provide labour, materials and equipment for the execution of the work. Contractors are responsible for coordinating and supervising sub-trades, and maintaining quality control and construction procedures.

Non-structural element
A design element of a building that is not a primary structural element, secondary structural element, or specialty structural element. Examples can include non-bearing partitions and suspended ceilings.

Primary structural element
A beam, column or other structural design element that forms a part of the primary structural system.

Primary structural engineer (PSE)
The person or organization responsible for the structural integrity of the primary structural system, and for general conformance and coordination of secondary structural elements and specialty structural elements with the primary structural system.

Primary structural system
A combination of primary structural elements that support a building's self weight and applicable live loads based on occupancy, use of the space and environmental loads, such as wind, snow and seismic forces.

Prime consultant
The person or organization responsible for coordinating the building design and liaison with the client and contractor. As necessary, prime consultants are also responsible for ensuring coordination between all design professionals, including architectural, structural, mechanical, electrical engineers and other specialists.

Secondary structural element
A structural design element that is structurally significant for the function it serves but does not contribute to the overall strength or stability of the primary structural system. The design and field review of secondary structural elements may fall under the responsibility of the PSE or the SSE. Examples can include elevator support rails and beams, curtain wall systems, cladding, and seismic restraints for architectural, mechanical and electrical design elements.

Specialty structural element
A structural design element that is designed and field reviewed by a speciality structural engineer providing structural engineering services as a supporting registered professional. These elements, normally fabricated off-site, typically require specialized fabrication equipment or a proprietary fabrication process not usually available at the project site. Examples can include open-web steel joists, wood trusses, combination wood and metal or plywood joists, precast concrete elements, seismic dampers and base-isolation devices and anchors, and other miscellaneous prefabricated structural components of wood or metal buildings.

Specialty structural engineer (SSE)
A member who designs and supervises the preparation of documents for a specialty structural element while acting as a supporting engineer providing supplementary supporting structural engineering services to the PSE.

Structural integrity
Structural integrity is defined in the Structural Commentary L of the 2010 edition of the National Building Code (Part 4 of Division B) to mean the ability of a structure to absorb local failure without widespread collapse.

Temporary works
Temporary works are installations required to provide interim access, protection, support or services for works and materials during the construction of permanent works. Contractors may be required by legislation or specifications to retain professional engineering services for certain types of temporary works. However, structural engineers shall include the responsibility for checking the temporary works design to ensure it meets the structural intent of the designer. For more information, refer to the practice guideline *Professional Engineers–Temporary Works*.

APPENDIX 1–STRUCTURAL DESIGN DATA MATRIX

STRUCTURAL DESIGN DATA MATRIX			
No.	**ITEM**	**DESCRIPTION**	
1.	**Primary Structural System**	Some options	
		(M1) Steel roof, Unreinforced load bearing masonry	
		(M2) Precast plank decks, Unreinforced load bearing masonry	
		(M3) Steel roof, Reinforced load bearing masonry	
		(M4) Precast plank decks, Reinforced load bearing masonry	
		(S1) Steel framing using tension only bracing and steel decks	
		(S2) Limited duct. M.R. frames and steel decks	
		(T1) Light timber framing and nailed shear walls	
2.	**Design Codes**	OBC (latest) Part: 4 or 9 All Codes as listed in OBC Article and Table 1.3.1.2 And as listed in other notes	
3.	**Dead Loads (may be shown on framing plans)**		
	a) Self Weight- Optional to include breakdown	---- kPa	
	b) Partition Allowance	---- kPa	
	Total Dead Load	---- kPa	
4.	**Live Loads (may be shown on framing plans)**		
		(Note: Loads on a floor may vary according to use and should be noted as such)	
	Ground Floor	---- kPa	
	Upper Floors	---- kPa	
5.	**Snow/Rain Loads**	(Note: See plan or schedules for snow accumulation loads at change of height or obstructions)	
	c) Import. (Is)	1.0 ULS, 0.9 SLS	
	d) Ground snow (Ss 1/50)	---- kPa	
	e) Ground rain load (Sr 1/50)	---- kPa	
	f) Roof drainage	One of 3 options (refer to EABO Flow Control Roof Drainage Declaration form): (A) No flow control drains M1 (B) Flow control system by engineer meets standard M2 criteria so that rain and snow loads are not considered simultaneously (C) Controlled flow, but rain and snow loads are considered as simultaneous M3	
6.	**Wind load**		
	c) Import. (Iw)	1.0 ULS, 0.75 SLS	
	d) Wind load (q 1/50)	___ kPa	Category (for Interior Pressure) 2
	e) Fact. Horizontal Shear (N-S)	___ kN (kips)	
	f) Fact. Horizontal Shear (E-W)	___ kN (kips)	

7.	**Seismic load**				
	a) Import. (Ie)	---			
	b) Seismic data	Sa(0.2)	Sa(0.5)	Sa(1.0)	Sa(2.0)
		xxx	xxx	xxx	xxx
	c) Site data	Site Class	Fa	Fv	
		xxx	xxx	xxx	
		IeFaSa(0.2) = xxx			
	d) Method of analysis	Equivalent Static or Dynamic			
	e) Equivalent static force procedure	B=	Ta=	Mv=	J=
		xxx	xxx	xxx	xxx
	1st direction	Type of SFRS		Rd=	Ro=
		Conv. Const. Shear Walls		xxx	xxx
		Shear	Moment	Maximum Deflection	
		xxx	xxx	xxx	
	2nd direction	Type of SFRS		Rd=	Ro=
	(usually the same as first direction)	xxxxxx		xxx	xxx
		Shear	Moment	Maximum Deflection	
		xxx	xxx	xxx	
8.	**Other Loads**				
9.	**Foundation**				
	Description	Shallow Foundations or Deep Foundations			
	Bearing (ULS)	xxxx kPa (psf)			
	Bearing (SLS)	xxxx kPa (psf)			
	Retaining Structures	Ka = xx, Kp = xx, Density = xx kN/CU.M. Surcharge = xx kPa(psf), Frict. Fact. = xx			
	Soil Report by:	--------			
10.	**Future Construction**				
	Allowances designed for on structure shown	Description			
	Future additions	Description			

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