

# CARVAJAL STRUCTURAL ENGINEERS INC.

## CSE STRUCTURAL FORENSIC & REHABILITATION SERVICES CORPORATE SERVICES

CARVAJAL STRUCTURAL ENGINEERS INC. (**CSE**) is a Canadian based company founded in 2004 in the Province of Ontario . **CSE** is a structural firm dedicated to the investigation, restoration and forensic examination of normal, post-tensioned, concrete, steel, wood and masonry structures.

**CSE** expertise extends into all aspects associated/related to the forensic and structural rehabilitation of existing structures to include:

- ▶ Forensic Construction - Failure Evaluation Services
- ▶ Forensic Service - Failure Evaluation Services
- ▶ Forensic Maintenance - Failure Evaluation Services
- ▶ Structural Evaluation Services
- ▶ Structural Demolition Design Services
- ▶ Vibration Zone of Influence & Vibration Monitoring
- ▶ Pre-Construction and Post-Construction Surveys
- ▶ Building Monitoring Surveys
- ▶ Structural Health & Safety & Emergency/ 1st Response Services
- ▶ Pre and Post Construction Review Services
- ▶ Structural Shoring and Re-Shoring Design Services
- ▶ Structural Decommissioning Design Services
- ▶ Parking Structure & Balcony Evaluation Services
- ▶ Roofing Design and Evaluation Services
- ▶ Preliminary and Detailed Condition Evaluation Services
- ▶ Structural Pre-Design Services
- ▶ Structural Design Services
- ▶ Contract Specifications and Plan Preparation Services
- ▶ Construction Review Services
- ▶ On Site Review and Monitoring Services
- ▶ General Structural Design Services

### CARVAJAL STRUCTURAL ENGINEERS INC

Toronto Office - 605-3500 Dufferin St. Toronto, Ontario, M3K 1N2, Fax: 416-398-2634

Barrie Office - 36 MacMillan Cres. Barrie, Ontario, L4N 7H1, Fax: 705-725-9949

Phone: [416-876-4357](tel:416-876-4357) e-mail: [george@carvajalengineers.com](mailto:george@carvajalengineers.com) [www.cse-structural.com](http://www.cse-structural.com)

## **CSE CORPORATE SERVICES**

### **SUMMARY OF CSE SERVICES**

CSE is a specialized firm dedicated to the structural forensic and structural rehabilitation of existing steel, reinforced concrete (normal and post-tensioned), wood and masonry structures. CSE's expertise extends into all aspects related to structural forensics and rehabilitation to include; forensic construction failures, forensic service failures, forensic maintenance failures, emergency structural reviews, pre-construction reviews, visual surveys, detailed condition surveys, pre-designs, detailed structural designs, contract preparation, construction review services, health and safety reviews, emergency first response failure services, emergency shoring, shoring, re-shore, scaffolding design and structural demolition design and more.

Typical facilities include; building structures, parking structures, building balconies, flat roof structures, subway tunnel structures, running structures, vent shafts, above & below facilities, retaining walls, bridges, historical buildings, arenas, structural paving and post-tensioned & pre-stressed concrete structures. A brief listing of our services from the beginning of a typical structural rehabilitation project to its completion can be summarized as follows:

#### **1.0 *Health and Safety/Emergency Services***

- 1.1 24hr-7days a week on call service.
- 1.2 Health and safety/emergency structural visual evaluations.
- 1.3 Health and safety/emergency shoring designs.
- 1.4 Health and safety/emergency material deterioration/evaluations.

#### **2.0 *Pre and Post Construction Reviews***

- 2.1 Visual or detailed residential existing condition surveys.
- 2.2 Visual or detailed commercial existing condition surveys.

#### **3.0 *Material Evaluation and Testing Services (third party)***

- 3.1 CSA certified laboratory material testing services to include;
- 3.2 Air void testing.
- 3.3 Carbonation testing.
- 3.4 Soluble chloride ion testing.
- 3.5 Compressive strength testing.
- 3.6 Non-destructive on-site testing to include.
- 3.7 GPR (ground penetration radar).
- 3.8 Impact Echo.
- 3.9 Yield strength testing of existing reinforcing steel.
- 3.10 Concrete embedded cable/conduit location services.
- 3.11 Metallic metal (normal reinforcing steel) locations.
- 3.12 Non-metallic metal (copper, aluminum) pipe locates.

**4.0 Forensic Structural Review Services**

- 4.1 Visual and detailed investigations on the cause of structural rehabilitation failures.
- 4.2 Forensic construction failures.
- 4.3 Forensic service failures.
- 4.4 Forensic service failures.

**5.0 Preliminary/Visual Condition Survey**

- 5.1 Visual surveys in accordance to M.T.O. Inspection manual.
  - 5.2 Preliminary structural evaluations.
- 6.0 Detailed Condition Survey
- 6.1 Detailed condition surveys in accordance to M.T.O.'s structural rehabilitation manual, to include;
    - Visual surveys.
    - Delamination surveys.
    - Covermeter surveys.
    - Corrosion activity surveys.
    - Concrete testing & laboratory work.

**7.0 Pre-Design Services**

- 7.1 Pre-Design services.
- 7.2 Repair alternative formulation.
- 7.3 Construction sequencing and logistics evaluation.
- 7.4 Constructability reviews.
- 7.5 Construction scheduling.
- 7.6 Repair cost estimations.
- 7.7 Life Cycle Cost Analysis.
- 7.8 Repair recommendations.

**8.0 Detailed Design Services**

- 8.1 Structural replacement design services.
- 8.2 Structural Rehabilitation design services.
- 8.3 Tender support/evaluation services.

**9.0 Construction Review Services**

- 9.1 General contract administration services.
- 9.2 Contract initiations services.



- 9.3 Regular site review services.
- 9.4 Shop drawings review services.
- 9.5 Monthly progress billing reviews.
- 9.6 Contract changes evaluation/initiations.
- 9.7 Change directive evaluation/initiations.
- 9.8 Progress reports.
- 9.9 Construction testing services.
- 9.10 Contract schedule preparation and tracking.
- 9.11 Contract arbitration and dispute services.
- 9.12 Contract deficiency reports.
- 9.13 Contract commissioning services.
- 9.14 Contract close-out services.

## **10.0 TEMPORARY WORKS - STRUCTURAL SHORING**

- 2.1 Temporary Works is a reality in any construction project. If you are a Builder, a Contractor or an Owner constructing a large or small structure, you will need temporary works to bridge the path between the construction time and the final installation.
- 2.2 Temporary works is most often under estimated and costly and safety-related issues frequently take place at the construction site. CSE will ensure that your temporary work's requirements are properly understood, designed and installed to ensure the safety of all parties relying on them.
- 2.3 Low Load Proprietary Shoring Designs use propriety shoring systems, which are typically less than 250-500KN. In today's environment where very inexpensive shoring systems are available, there is a big concern with the quality and capacity of these shoring systems. CSE only designs using reputable shoring supplier.
- 2.4 High Load Structural Steel Designs are typically shoring requirements greater than 500KN. These shoring designs need to be pre-loaded for them to work properly and there are many situations where we have witnessed these shoring systems not being properly preloaded. Pre-loading using hydraulic jacks is the best options. If the shoring system is not pre-loaded, then your shoring system will deflect beyond an acceptable level leading to possible structural damage. Structural steel shoring with hydraulic jacks are the solution to ensure your structure does not move.

## **11.0 DECOMMISSIONING / DEMOLITION SERVICE**

- 11.1 Demolition projects can vary from very small projects to large multi-structural projects, which require a complex understanding of how buildings are built and more importantly how buildings react as they are slowly dismantled. This knowledge cannot be gained from just a formal education of structures. Good Demolition Engineers are usually engineers that have been actively enrolled in demolition projects for a very long time and have paved their road to a successful carrier in demolition and have a sound technical knowledge of structural design.
- 11.2 A good sign of a good Demolition Engineer is by the reputation they carry and their successful record of completing demolition projects without any critical incidences.

- 11.3 Demolition can be undertaken using conventional hand demolition methodologies, to machine demolition to specialized high-reach demolition to mechanical control drops and implosions. CSE can be considered a specialist in the field of Demolition.
- 11.4 The standards and codes requirements for Structural Demolition are sparse and are not detailed in any significant way in the Buildings Codes and related standards. Most codes and standards are “geared” towards new construction and do not address the special needs for a Demolition Engineer.
- 11.5 In Ontario, the Association of Professional Engineers has recognized this lack of information, and they have prepared Demolition Guidelines that any engineer engaged in Structural Demolition should be aware of and should follow. A copy of “Professional Engineers Providing Services for Demolition of Buildings and other Structures” has been included in this brochure since we believe it forms the basic core in which CSE follows when offering our services in Structural Demolition.

## **12.0 MONITORING SERVICES**

- 12.1 Although CSE is not a specialized monitoring firm, we offer the basic services related to structural monitoring using in-house equipment and staff. Monitoring offered by CSE includes:
  - 12.2. Tell-Tale Monitoring – CSE can install and monitor specific crack movements and or joint movements using simple Tell-Tale plates or sophisticated Tell-Tale Monitoring equipment. Tell-Tale monitoring provides a quick and low-cost monitoring option to our clients.
  - 12.3 Total Station Monitoring (Target Monitoring) – CSE can install and monitor building movements during construction and demolition work. Total Station monitoring to within a few millimeters is possible with today’s modern and sophisticated equipment. Sometimes, our clients require that the Monitoring be performed by Registered Ontario Land Surveyors. At CSE, we can retain Third Party Registered land surveyors, or we can direct you to firms that we have dealt with in the past.
  - 12.3 Tilt Meter & Stain Gauge Monitoring – CSE can install and monitor sophisticated Tilt Meter & Stain Gauge Monitors to measure very small movements typically less than 1mm. These projects require data collection devices and expensive equipment, but will provide the necessary information for critical projects.
  - 12.4 Vibration Monitoring – Vibration monitoring has become an integral part of any Demolition activity. Demolition permits will usually place the responsibility of monitoring for vibrations with demolition projects that are close to other buildings or critical structures. A vibration monitoring plan will require a study on the “Zone or Influence” which is typically prepared by a qualified engineer in the field. All zone of influence investigations are performed by a qualified third-party firm, but the actual vibration monitoring is performed by CSE using our in-house monitors and staff.

\*\*\*\*\* END OF DOCUMENT \*\*\*\*\*



**Professional Engineers  
Ontario**

**E  
N  
I  
L  
E  
D  
I  
U  
G**

**Professional Engineers  
Providing Services for  
Demolition of Buildings  
and other Structures**

**Contributors:** Ken Andrus, CBCO, / Neil Kennedy, P.Eng. / Gabriel Mansour, P.Eng. / Peter Sheffield, P.Eng. / Andrew Steen, P.Eng.

**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 professional engineers engaged in this area of practice. Users of this guideline who have questions, comments or suggestions for future amendments and revisions are invited to submit these to PEO using the form provided in Appendix 5.

**April 2011**

# Contents

- 1. PEO Mandate and Criteria for Guidelines . . . . . 3
- 2. Preface . . . . . 3
- 3. Purpose and Scope of Guidelines . . . . . 4
- 4. Regulatory Environment . . . . . 5
- 5. Demolition Assessment, Planning and General Review . . . . . 6
  - 5.1 Demolition Contract Documents and Demolition Permits . . . . . 6
  - 5.2 Project Assessment . . . . . 6
  - 5.3 Defining Method of Demolition . . . . . 7
  - 5.4 General Review of Demolition . . . . . 8
  - 5.5 Demolition of Structures other than Buildings . . . . . 10
  - 5.6 Procedure for Handling Projects Proceeding without Demolition Permits. . . . . 11
- 6. Additional Considerations . . . . . 12
  - 6.1 Liability . . . . . 12
  - 6.2 Legislation . . . . . 13
- Appendix 1. Definitions . . . . . 14
- Appendix 2. Standards For Demolition–Excerpt from O. Reg. 260/08 . . . . . 15
- Appendix 3. Reference Sources . . . . . 17
- Appendix 4. Commitment to General Review of Demolition . . . . . 18
- Appendix 5. Amendment and Revision Submission Form . . . . . 19
- Appendix 6. PEO Professional Practice Guidelines . . . . . 20

# 1. PEO Mandate and Criteria for Guidelines

Professional Engineers Ontario (PEO) produces guidelines for the purpose of educating both licensees and the public about standards of practice. This is done to fulfill PEO's legislated objectives. Section 2(4)2 of the *Professional Engineers Act* states: "For the purpose of carrying out its principal object" PEO shall "establish, maintain and develop standards of qualification and standards of practice for the practice of professional engineering". PEO's Professional Standards Committee is responsible for developing practice standards and preparing guidelines.

This guideline has been developed by a task group of the Professional Standards Committee, reviewed and approved for publication by the full Professional Standards Committee and by PEO Council.

Professional Engineers Ontario produces guidelines to meet the following objectives, which were used to develop the content of this document.

1. Guidelines are intended to aid engineers in performing their engineering role in accordance with the *Professional Engineers Act* and all regulations made under the Act.
2. Guidelines are intended to describe processes required by regulatory, administrative or ethical considerations associated with specific professional services provided by engineers. They do not aim to be short courses in an engineering subject.
3. Guidelines provide criteria for expected practice by describing the required outcome of the process, identifying the engineer's duty to the public in the particular area

of practice, and describing the relationships and interactions between the various stakeholders (e.g. architects, other engineers, clients).

4. Guidelines add value to the professional engineer licence for licensed engineers and for the public by outlining criteria for professional standards of competence.
5. Guidelines help the public to understand what it can expect of engineers in relation to a particular task within the practice of professional engineering. By demonstrating that the task requires specialized knowledge, higher standards of care, and responsibility for life and property, guidelines help reinforce the public perception of engineers as professionals.

This guideline is not intended to establish a "one method of practice for all" approach to the practice of professional engineering. This guideline is not intended to replace a practitioner's professional judgment when providing professional engineering services. Subject to provisions in the guideline that incorporate professional conduct requirements or legal requirements, a decision by a practitioner not to follow the guideline will not, in and of itself, indicate that a member has failed to maintain an acceptable standard of work. Following the guideline may not ensure that a member has provided services conforming to an acceptable standard. Determining whether a practitioner has provided quality service will depend upon the circumstances of each case.

See Appendix 6 for a list of PEO professional practice guidelines.

## 2. Preface

Following the collapse during demolition of a former movie theatre in Toronto (the Uptown Theatre collapse) that resulted in loss of life, the Registrar of PEO wrote to the Minister of Labour offering PEO's assistance in improving the legislation and practices under which demolition is carried out. At the same time, the Professional Standards Committee (PSC) investigated issues surrounding the role of professional engineers in demolition and found that the role,

though a legislative requirement, was not well defined or understood.

Section 1.2.2.3, Division C, of the *Ontario Building Code 2006* (OBC) states that, for four defined situations, an "applicant for a permit respecting the demolition of a building shall retain a professional engineer to undertake general review of the project during demolition". However, the OBC does not explain the purpose of demolition general review or the role of the review engineer.



The *Construction Projects Regulation* (O. Reg. 213/91) under the *Occupational Health and Safety Act* (OHSA) (Construction Regulation) stipulates requirements for ensuring the safety of workers during demolition; however, it makes no reference to the role of professional engineers in a demolition project. A review of other standards that deal with demolition, such as the *National Building Code*, *Ontario Fire Code* and *CSA S350-M1980 Code of Practice for Safety in Demolition of Structures* found these documents also deferred to the engineer to determine the extent of his or her role and responsibility.

Because there is no explicit description in any legislation of the role of professional engineers providing services for demolition projects, PSC concluded that a guideline for this activity is necessary. Simultaneously, the Ministry of Labour and the Ministry of Municipal Affairs and Housing came to the same conclusion and requested that PEO consider preparing a guideline for that purpose.

PSC formed a subcommittee comprising practitioners with demolition experience, as well as representatives from the two participating ministries and the Ontario Building Officials Association. PSC tasked this group

with addressing questions regarding the proper role and responsibility for professional engineers providing services for demolition projects. The subcommittee was also instructed to prepare a guideline.

The subcommittee met for the first time on July 12, 2005, and submitted a completed draft of this document to the PSC for approval on May 14, 2009.

During the course of the committee's work, PEO Council adopted a policy promoting the use of professional standards. Under the *Professional Engineers Act*, professional (i.e. performance and practice) standards are legislated requirements imposing specific duties on professional engineers. Based on input from the coroner's inquest of the Uptown Theatre collapse, a decision was made to produce two standards: 1) general review of demolition, and 2) preparation of demolition plan. These standards were approved by Council on March 28, 2008 and were filed as Regulation 260/08 on July 25, 2008.

Development of the guideline continued after the filing of the regulation. Following consultation with practitioners, review by PEO legal counsel and other considerations, the final draft was approved by Council at its meeting on April 8, 2011.

### 3. Purpose and Scope of Guideline

Demolition projects can range from destructive collapse of an entire structure to the removal of all or most mechanical, electrical and other fitments from within a space for purposes of renovation or altering the use of the space. This document applies only to demolition projects with a structural component or where demolition could adversely affect the structure. These projects require the intervention of a professional engineer to ensure the integrity and stability of remaining components of a structure during progressive demolition.

The purpose of this guideline is to offer professional engineers providing services for the demolition of structures, including buildings, with guidance on the level of diligence that is commensurate with the responsibility expected in their work. The guideline also suggests practices that are a professionally accept-

able means of fulfilling this responsibility. Though the guideline refers extensively to demolition of buildings and requirements under the *Ontario Building Code* (OBC), the practice standards in O. Reg. 260/08 and the recommended practices provided in this guideline apply to all structural demolition projects.

In particular, the guideline refers to the responsibilities of professional engineers providing general review of the demolition of certain types of buildings stipulated in Section 1.2.2.3, Division C, of the OBC. The performance standards for general review of demolition and preparation of demolition plans given in O. Reg. 260/08 describe the mandatory steps that must be taken by the practitioner engaged to carry out this work.

This guideline and the performance standard refer only to the demolition of the structure. Removal

of mechanical and electrical systems, architectural features and elements that have no bearing on the structural integrity and stability of the building are not subject to the requirements given in the performance standards.

## 4. Regulatory Environment

Section 8 of the *Building Code Act* stipulates that permits are required for the demolition of all buildings, except those cases described in sentence 1.3.1.1(1), Division C, of the OBC. Where a permit is required for the demolition of a building, sentence 1.3.1.1(3), Division C, of the OBC states that a description of the structural design characteristics of the building and the method of demolition are to be included with the permit application.

Sentence 1.2.2.3(1), Division C, of the OBC requires the applicant seeking a permit to demolish certain types of buildings to retain a professional engineer to undertake the general review of demolition of the project during demolition. Subsection 3(2) of the Performance Standards (O. Reg. 260/08) stipulates in effect that this review can proceed only if a professional engineer has prepared a description of the structural design characteristics and demolition methodology required as part of the permit application, and a detailed demolition plan.

Demolition general review is intended to protect the public and workers by ensuring the activities being undertaken are safe as covered by the regulations of the *Building Code Act* and the *Occupational Health & Safety Act*, and other applicable standards. This is consistent with the aim of the *Building Code Act*, which establishes in subsection 34(5) that "...the purposes of the regulations made under this section are to establish standards for public health and safety, fire protection, structural sufficiency, conservation ... and environmental integrity ...with respect to buildings and to establish processes for the enforcement of the standards and requirements." and that of the *Occupational Health & Safety Act*, which addresses the health and safety of people in or about a workplace and the public protection intent of the *Professional Engineers Act*.

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

It is not necessary for the same engineer to provide all the services associated with demolition, although it is common practice. This guideline is written assuming that the review engineer is not the same practitioner as the design engineer of the project. The responsibilities of these engineers are quite different. An engineer providing only a portion of the services should recognize the differences between the responsibilities of the various roles and act accordingly. Design engineers are responsible for pre-demolition assessment of the structure and for preparing the demolition plan. Review engineers are responsible only for observing the demolition process and making judgments regarding the general conformity of that work to the plan outlined in the permit documents.

In cases where the demolition plan indicates that aspects of the project, such as temporary works, will be designed by others, the review engineer will be responsible for this design only if this work is identified in the contract between the demolition engineer and client. Otherwise, the client or contractor must retain the services of another design engineer or must revise the contract for professional engineering services by adding these services to the review engineer's scope of work.

For the purposes of this guideline, the client may be the person or entity who owns the building or structure to be demolished; it may be the demolition contractor; or it may be an architect. The engineers are the professional engineers who undertake the assessment, planning or review of the demolition work. These engineers can be either independent providers of engineering services or employees of the demolition contractor. Any reference to client in this guideline applies equally to employer. The form of the relation-

ship between the engineer and the client or employer does not change the role or duties of the engineers.

There is no professional obligation for professional engineers to complete a project if the client has breached the contract through non-payment or other issues. Professional engineers undertaking, or signing a form of commitment to undertake, general review

of demolition projects are obliged to notify the chief building official immediately in the event that their services are terminated. The notice to the chief building official should state that the practitioner is no longer able to fulfill the general review as agreed to by signing the municipality's commitment form.

## 5. Demolition Assessment, Planning and General Review

### 5.1 Demolition Contract Documents

There are three different types of documentation produced by professional engineers providing services for demolition of buildings and structures: description of structural characteristics, demolition plans, and general review reports.

*Description of Structural Characteristics:* Clause 1.3.1.1(3), Division C, of the OBC requires that where a permit is required for the demolition of a building, descriptions of the structural design characteristics of the building and the method of demolition must be included in the application for permit. This information is given to the chief building official by the permit applicant.

*Demolition plan:* The purpose of the demolition plan is to describe building systems as needed for bidding and for the contractor's use to plan and execute the work. The plan shall be a written description of the demolition procedure, or drawings illustrating the procedure, or a combination of both. Where original construction documents for the building are available, including copies in the document package is recommended. The report from the designated substances audit should also be in the demolition documentation so that appropriate procedures for removal and disposal can be planned and implemented by the contractor. The demolition plan is not given to the chief building official unless the engineer is specifically asked to do so.

*General review reports:* These reports are records of the engineer's observations regarding the contractor's adherence to the demolition plan made during visits to the demolition site.

### 5.2 Project Assessment

The purpose of the project assessment phase is to gain sufficient understanding of the building systems to be demolished so that adequate information can be transferred by way of demolition documents to the demolition contractor for the work to proceed in a safe manner. The two usual methods for professional engineers involved in a demolition project to gain this understanding are reviewing the construction documents for the building and by site inspection of existing conditions. Often, documents will not exist; therefore, site inspection will be the sole source of information. Even when documents are in hand, site inspection must be done to verify that information contained in the documents reflects current conditions. The practitioner should be familiar with the practices for preliminary surveys given in Section 3.1.1 of the CSA *Code of Practice for Safety in Demolition of Structures (S350-M1980)*.

The following quotes are taken from paragraph 1 of Section 3(3) of O. Reg. 260/08, the performance standard for preparation of a demolition plan. The non-italicized text are PEO's recommended best practices for these tasks.

1. *The professional engineer, limited licence holder or provisional licence holder shall, before preparing a demolition plan with respect to the demolition of a building or structure,*
  - i. *visit and examine the demolition site in order to assess site limitations and adjacent conditions that may affect the content of the demolition plan, and*

The design engineer must make at least one site visit at which he or she assesses the condition and characteristics of the structure. The engineer shall also survey the

site and neighbouring properties to ascertain the locations of other buildings, public thoroughfares, utilities.

*ii. verify the structural characteristics and condition of the building or structure by conducting one or more inspections of the building or structure and by reviewing any existing drawings or specifications relating to the building or structure.*

Sufficient investigation is required to determine the design parameters of the various structural elements so that demolition documents can be adequately detailed for the contractor to understand the systems and plan the demolition activities. The engineer may be required to provide, either directly or through subcontractors, such services as x-ray examination, coring, and partial demolition (e.g. removal of interior drywall) to properly evaluate the characteristics of the structure.

### 5.3 Defining Method of Demolition

The following quotes are taken from Section 3(3)2 of O. Reg. 260/08, the performance standard for preparation of a demolition plan. The non-italicized text are PEO's recommended best practices for these tasks.

The standard requires that the practitioner responsible for preparing the demolition plan for a building or structure include in that plan,

*i. a description of the structural characteristics and condition of the building or structure as verified by the professional engineer, limited licence holder or provisional licence holder under subparagraph 1i,*

Adequate detail of the building's structural design characteristics needs to be included in the demolition document for the contractor to understand fully the structural system. Areas of uncertainty, due to concealed conditions or other reasons, should also be noted. Should conditions warrant, a phased demolition approach, where the extent of demolition is matched to the extent of systems knowledge, may be advisable to enable further investigation and demolition planning for remaining building components.

*ii. the methodology a contractor should follow in demolishing the building or structure,*

Though the design engineer is responsible for preparing the demolition plan, the engineer should work closely with the contractor (if the contractor has already been hired) to develop the plan.

The demolition plan must include descriptions of demolition procedures where structural conditions indicate that a specific sequence of actions is required for safe demolition. For example, the plan should indicate the sequence in which structural elements are cut or removed if the engineer decides that an alternative sequence could result in unplanned collapse or loss of structural integrity.

*iii. a description of the measures necessary to ensure that the health or safety of any person, including an occupant of a building being demolished if the building is not vacated before the demolition commences as permitted by the building code, is not endangered as a result of the demolition,*

Some projects involve demolition of only a portion of an existing building or structure that may continue to be occupied or utilized during the demolition process. For example, the project may involve demolition of a wing of a hospital that will continue to carry out all of its usual functions. The design engineer may need to retain (or confirm that the client hires) an architect or other experts to provide, for example, designs for systems to maintain envelope integrity or for temporary fire exit plans. The design engineer may need to retain (or confirm that the client hires) mechanical and electrical engineers to prepare plans for revisions to HVAC, power, lighting, and alarm systems. The design engineer shall work with these other professionals to ensure the demolition of a portion of the building does not cause safety, health or, ideally, operational problems for the occupied or utilized portions of the building.

*iv. a description of the measures necessary to ensure that the integrity of any other buildings, structures, buried or above ground utilities or any other real property is not negatively affected as a result of the demolition,*

The design engineer shall identify the need for barriers, hoarding, removals, relocations and other measures that need to be taken to ensure third party property is not adversely affected by the demolition

work. The design engineer does not need to show the details of protection measures on the plan; however, the plan must identify the property to be protected, the potential hazards to be avoided and the steps proposed to deal with these.

*v. identification of all buried or above ground utilities under or at the demolition site and a description of the requirements for their safe disconnection, removal or protection before the commencement of the demolition,*

The design engineer shall ask utilities to locate all utility services and equipment that serve the property or may be affected by the demolition work. Identify both services and equipment that will remain and those that will be removed. Confirm with utilities their requirements for disconnection, removal or protection.

*vi. a description of any environmental hazard that would or could arise as a result of the demolition, and of the measures necessary to address the hazard, with reference to the applicable municipal, provincial or federal statutes, regulations, rules, by-laws, codes, standards or other legislation, and*

Before beginning a project, the owner shall determine whether designated substances (as defined in the *Occupational Health and Safety Act* or its regulations) are present, and prepare and distribute a list of all designated substances present at the site. The design engineer does not need to carry out the environment audit. The client may retain another firm to do this. The design engineer needs only to confirm that the audit has been done and to obtain the report from the client.

The report from the designated substances audit should be included in the demolition document so that appropriate procedures for removal and disposal can be planned and implemented by the contractor.

It is very common for asbestos to be found in older buildings slated for demolition. The *Designated Substance—Asbestos on Construction Projects and in Buildings and Repair Operations* (O.Reg 278/05) under the OHSA sets out the requirements for the safe removal of this material.

*vii. identification of any inspection or testing to be carried out by an independent company during the demolition.*

Occasionally, the nature of the structure precludes carrying out testing for environmental hazards or other purposes during the assessment phase. In these cases, the design engineer shall instruct the contractor to carry out this testing during the demolition phase. The design engineer does not need to provide instructions for safely carrying out the demolition required to expose potential hazards or how to carry out the testing. The contractor or the contractor's environmental consultant is responsible for these operations.

## 5.4 General Review of Demolition

The *Ontario Building Code* states that applicants for a demolition permit must retain a professional engineer to carry out general review of the demolition work. Professional engineers who have agreed to undertake general review of demolition by signing a municipality commitment form have a responsibility to fulfill that commitment. These engineers should inform the owner or contractor of the practitioner's responsibilities given in O. Reg. 260/08 and must inform the contractor, in writing, that demolition cannot begin until the practitioner is notified.

According to article 3(2)1i, of O. Reg. 260/08, the review engineer cannot attend the site and carry out general review until he or she is satisfied that a demolition permit has been issued by the municipality.

Article 3(2)1ii of the performance standard for general review (O. Reg. 260/08) indicates, in effect, that a demolition plan must be prepared for every demolition project employing a review engineer. Practitioners shall refuse to carry out general review if the building owner or contractor has not had a plan prepared by a professional engineer.

The following italicized portions are the requirements for general review of demolition given in Paragraph 3(2), O. Reg. 260/08. The non-italicized text are PEO's recommended best practices for these tasks.



*The professional engineer shall,*

*i make periodic visits to the demolition site to determine whether the demolition is proceeding in general conformity with the demolition plan,*

The demolition review engineer shall attend or, as allowed by article 3(4), O. Reg. 260/08, delegate a suitable person to attend at the site to observe the demolition underway at appropriate intervals to review the work and ascertain that it is being executed in general conformance with the plan. The nature of an appropriate review program will vary, based on the complexity and characteristics of the work being undertaken. There should be a sufficient number of visits scheduled at intervals over the complete demolition period to ensure that the engineer can monitor all aspects of the work.

Visits do not take place on a predetermined routine, such as on a fixed day every two weeks. Instead, review engineers are expected to visit the site at intervals that enable them to view critical elements of the work. There should be a sufficient number of visits scheduled at intervals over the complete demolition period to ensure the engineer can monitor all aspects of the work. Before the work begins, establish and communicate to the contractor a plan for periodic visits to the site during construction. The review engineer must instruct the contractor to inform him or her prior to the start of each significant phase of the work, so that field visits can be properly scheduled.

The number, duration and frequency of visits are left to the discretion of the review engineer. If a client suggests limiting the duration or the frequency of site visits, the engineer should inform the client that it is the engineer's, not the client's, responsibility to determine the criteria for sufficient review. Similarly, reports generated by a professional engineer following these site visits are documentation of the engineer's professional judgment and cannot be edited by the client.

During these visits, the review engineer must observe the work underway, with particular attention directed to any specific aspects deemed appropriate by the review engineer, to ensure the procedures used by the contractor comply with the directions given in the

demolition plan. Deviations must be noted and, if the review engineer believes the actual method employed by the contractor is unsafe, the engineer shall advise the contractor to halt work, undertake remedial action, if required, and alter demolition method as directed.

*ii record any material deviation from the demolition plan found during a site visit and as soon as reasonably possible notify the client, the contractor and the owner in writing of the deviation and of the professional engineer's opinion on the impact the deviation may have on the health or safety of any person or the integrity of any other building, structure, buried or above ground utility or any other real property,*

The review engineer must prepare a report for each site visit. The report must contain opinions only for the work that was actually observed during the particular visit for which the report was issued. Each report should describe briefly the progress of demolition since the last visit and the work underway during the current visit, and list tests observed, samples inspected, and any other third-party contribution used in determining general conformity of the project to the demolition plan. The review engineer should record any observed conditions that might affect public or worker health and safety, as well as structural integrity and environmental concerns. The review engineer must report to the client and contractor all observed deviations from the demolition plan.

Written reports, sequentially numbered, must be forwarded to the permit applicant, contractor and others as agreed at the beginning of the project. During subsequent visits, the review engineer reports on the condition of previous deficiencies and problems to assess whether the condition has been or will be made good. Due to the compressed time scale of demolition as compared to construction, time is of the essence when it comes to writing and forwarding the general review reports, especially as related to noted concerns.

General review reports, describing progress, noted concerns, if any, and recommended corrective actions are to be forwarded to the client, contractor and the owner of the building or structure.

*iii. record any site condition or other issue relating to the demolition identified during a site visit that may endanger the health or safety of any person or the integrity of any other building, structure, buried or above ground utility or any other real property and as soon as reasonably possible notify the client, the contractor and the owner in writing of the condition or other issue,*

A typical site visit by a review engineer should include an observation that good construction safety practices are being followed. Construction safety is the contractor's responsibility but reporting on observed breaches of safety standards is consistent with an engineer's paramount duty to protect the public welfare.

Review engineers must record observed conditions that might affect health and safety of workers and others. Written reports of these deficiencies, sequentially numbered, must be sent to the client, contractor, owner and others as agreed at the beginning of the project. During subsequent visits, the review engineer reports on the condition of previous deficiencies and problems to assess whether the condition has been or will be made good.

Where conditions warranting concern for worker or public safety are not directly addressed by the contractor, the practitioner must notify the Ministry of Labour. This should be done by the most expedient means. Proper documentation, while important, can follow at a later time.

*iv. notify the client, the contractor and the owner in writing about any site condition or other issue that requires the demolition plan to be changed,*

Due to site conditions or other factors, the review engineer or contractor may decide that changes to the proposed demolition methodology are necessary to complete the project safely. Prior to commencement of the project, the review engineer should discuss with the client whether the design engineer, the review engineer or another engineer will be asked to make the changes.

In those cases where the review engineer or another engineer makes the changes, he or she takes respon-

sibility for these design changes and any impact they have on other components of the project.

*v. review the reports of any independent inspection and testing companies called for in the demolition plan and which pertain directly to the work being reviewed, and*

The demolition plan may identify the requirements for inspection and testing (e.g. for asbestos) to be carried out by certified testing laboratories in accordance with recognized test methods. Review engineers must ensure the testing is carried out and must review any reports prepared by independent testing companies that pertain directly to the work being reviewed and should attach copies of these reports to the review report. These reports should be accompanied by comments by the general review engineer, where appropriate.

*vi. interpret the demolition plan in writing when requested to do so by the client, the contractor or the owner.*

Review engineers are not responsible for the engineering content of plans and specifications prepared for the project. The designer of the demolition is responsible for interpreting and clarifying the work during demolition, unless the design service is terminated, or the contract with the client has been breached. When requested by the client or contractor, or when dictated by lack of clarity in the project documentation, general review engineers should seek written interpretation or clarification of requirements from the design engineer. If that practitioner is no longer involved in the project, the general review engineer should, where feasible, advise contractors on the interpretation of demolition documentation, and issue supplementary details and instruction during the demolition period as required. These interpretations and clarifications should be confirmed in writing and become an integral component of the project documentation.

## 5.5 Demolition of Structures other than Buildings

Many demolition projects involve structures, such as bridges, that are not regulated by the *Ontario Building Code*. For these projects, Section 2 of O. Reg. 260/08

does not apply because general review is an activity created by the *Building Code Act*.

However, depending on the complexity of the demolition, the contractor or property owner may decide to retain a professional engineer to prepare a demolition plan. When preparing a demolition plan for these structures, the practitioner shall follow, as far as possible, Section 3(2) of O. Reg. 260/08. The owner or contractor may also retain an engineer to observe the work and assist the contractor during demolition. In these cases, PEO expects that professional engineers will apply good professional practices similar to those given in the standard for general review of demolition.

It should be noted that the Construction Regulation does apply to demolition of structures as well as to buildings.

## 5.6 Procedure for Handling Projects Proceeding Without Demolition Permits

Undertaking demolition before a permit is issued is illegal; however, owners and contractors occasionally do not wait, regardless of provincial laws. Professional engineers retained to provide general review of the construction in this circumstance might feel compelled to conduct general review as the contractor proceeds. This, however, facilitates illegal construction and demolition and contravenes 8(1) of the *Building Code Act*, which states that “[n]o person shall construct or demolish a building or cause a building to be constructed or demolished unless a permit has been issued therefore by the chief building official”. Any person in violation of the *Building Code Act* may be subject to prosecution and on conviction of the offence liable to a significant fine. It is also impossible to conduct a proper general review for the purpose set out in the *Building Code* and the *Professional Engineers Act*, if there are no approved drawings against which to evaluate the construction.

The following have been proposed by PEO as a performance standard regulation. Until the regulation is enacted, PEO considers it to be a standard of practice by which members can achieve the professional expectations placed upon them.

The *Professional Engineers Act* also imposes on professional engineers a professional duty to comply with all statutory requirements. Section 72(2)(d) of Regulation 941, under the *Professional Engineers Act* defines “failure to make responsible provision for complying with applicable statutes, regulations, standards, codes, by-laws and rules in connection with work being undertaken by or under the responsibility of the practitioner” as professional misconduct. In other words, by failing to comply with any law affecting the work, a professional engineer could face discipline by Professional Engineers Ontario, in addition to the *Building Code Act* penalties. Therefore, for their own protection, reviewing engineers must not perform site review unless the client has obtained a demolition permit.

Recognizing the legitimate concerns of professional engineers facing a conflict between their professional obligations to protect the public and faithfully serve clients and their legal obligations to comply with all applicable laws, PEO has developed a procedure that strikes a balance between these various duties.

Should an engineer discover on arrival at a demolition site that no permit has been issued for the work, the engineer must immediately:

- i) inform the contractor and the client that the work cannot be reviewed until such time as a permit has been obtained and that this fact must be reported to the building department;
- ii) leave the site and not return until the contractor can confirm that a permit has been obtained and is displayed at the site;
- iii) contact the building department and inform the chief building official that the practitioner cannot at this time provide general review as required by the *Ontario Building Code*;
- iv) if, while at the site but without conducting a review, the engineer observes an unsafe condition or practice that might be hazardous to the health or safety of any person on or near the site, advise the contractor or, if there is none, another appropriate person orally of the danger or dangers associated with the condition or practices;
- v) notify the client and chief building official of any unsafe condition or practice reported to the contractor or other appropriate person;

- vi) confirm, in writing, notifications made in iv) and v) as soon as possible; and
- vii) advise the client that work undertaken during the period the practitioner is not conducting general review might, during future site visits, need to be uncovered, disassembled, removed or otherwise made available for inspection by the practitioner.

This standard of practice strikes a balance between a professional engineer's duty to comply with applicable law and the duty to report unsafe conditions. An engineer must inform the chief building official that the engineer cannot provide general review services because an agreement is in place between the engineer and the municipality based on the signing of the commitment form. The chief building official must also be notified if for any other reason, such as termination of contract, the engineer cannot fulfill the terms of this agreement, i.e. to carry out general review.

The chief building official oversees the enforcement of the *Building Code Act*, including acting on known instances of significant illegal construction. Chief building officials and inspectors are subject to the Code of Conduct required under the *Building Code Act*, which requires appropriate standards of enforcement. Licensees should notify Professional Engineers Ontario if they have concerns that the chief building official or inspectors are not adhering to the relevant Code of Conduct. Any concern brought to

the attention of Professional Engineers Ontario will be forwarded to Engineers, Architects and Building Officials, an industry group that deals with issues of mutual concern.

Professional engineers are not violating their duty to protect the public welfare if they refuse to conduct a general review of construction under these circumstances. In fact, professional engineers should consider assuring compliance with all laws to be an essential part of their protection of public welfare, since enforcing laws, acting against offenders and taking corrective action where necessary are extremely costly in both time and public funds.

### 5.6.1 Projects in Unorganized Territories

There are many areas of the province, primarily in northern Ontario, that do not have a region-wide government structure. Building permits are not issued in these unorganized townships, as there is no municipal authority to do so. However, the *Building Code Act* is applicable to all lands, whether in municipalities or in unincorporated areas. The *Building Code* applies to all buildings, even when a person is exempt from the requirement to obtain a permit. Since a permit is not required for demolition of buildings and other structures in these territories, the requirements in this section do not apply. Professional engineers may attend at these sites even though no permit has been issued.

## 6. Additional Considerations

### 6.1 Liability

Practitioners should not confuse general review with inspection. It is not the duty of the review engineer to ensure all aspects of the work meet the details of the plans. They must observe the work sufficiently frequently to ensure the contractor is carrying out the work in accordance with the plan.

Review engineers should not make any statements "certifying" that the demolition is in conformance with the design documents, since this implies a guarantee of the work, which cannot be supported by field observation alone.

It is the contractor's responsibility to ensure adherence to the regulations made under the *Building Code Act*, *Occupational Health and Safety Act* and any other applicable law, including municipal bylaws. It is the responsibility of the professional engineer(s) involved with the project to follow the practices described in Sections 2 and 3 of O. Reg. 260/08. The review engineer's role is to monitor the demolition activities and report any observed breaches of the permit documents or lack of general conformity with the demolition plan. The review engineer is not called upon to supervise the demolition work.

A professional engineer undertaking a demolition assignment must be aware that the *Occupational Health and Safety Act* sets out personal liabilities, such as fines and imprisonment, that may be incurred by an engineer who gives flawed advice. Particular attention should be paid to section 31(2) of the OHSA: “a professional engineer as defined in the *Professional Engineers Act*, contravene[s] this Act if, as a result of his or her advice that is given or his or her certification required under this Act that is made negligently or incompetently, a worker is endangered.”

## 6.2 Legislation

In addition to the *Professional Engineers Act*, *Ontario Building Code* and the *Building Code Act*, professional engineers undertaking demolition projects should be familiar with the Construction Regulation, and the Asbestos Regulation

The applicant, as defined in the *Ontario Building Code*, is responsible for obtaining the permit and ensuring compliance with all applicable law. Responsibility for safety on site and collateral damage during demolition resides with the contractor as specified by the Construction Regulation. The demolition contractor is responsible for workplace safety.

Other federal and provincial laws and municipal by-laws may apply in particular cases and compliance with them may be a responsibility of the engineer(s) engaged in the project. All municipalities require certification that utilities to the demolition site have been disconnected before any work commences. Some municipalities have additional requirements, such as site plans, health and environmental assessments. Practitioners should ask authorities for information on any rules that may apply to their projects and, in consultation with the client, should determine whether compliance with these rules is the responsibility of the engineer, contractor, permit applicant or another party.

### 6.2.1 Personal Safety

Sections 23 through 32 of the *Occupational Health and Safety Act* impose specific duties on such workplace parties as owners, employers, workers and supervisors. Professional engineers are generally considered to be “workers” under the OHSA and, as such, will attract the workers’ duties (Section 28 of

the OHSA) and rights (to know the hazards in the workplace, to be represented, and to refuse unsafe work) apply to them. Depending on the role they assume on a construction project, professional engineers may also be considered employers or supervisors.

The Construction Regulation prescribes in more detail some of the requirements outlined in the *Occupational Health and Safety Act*. A professional engineer should be aware of the following specific requirements prescribed in the Construction Regulation:

1. Every constructor and employer engaged in the construction of the project must complete an approved registration form to be filed on the project before work on the site begins (Section 5). This form must include the Workplace Safety Insurance Board (WSIB) number and rate category for the employer. Most engineering practices with full or part-time employees must be registered with WSIB.
2. When on site, professional engineers must wear appropriate protective headwear and footwear at all times and must wear protective eyewear where there is a risk of eye injury. Furthermore, any worker who may need to enter an area where fall arrest equipment is required must have had appropriate training (Sections 21 to 27).
3. There are a number of situations where a professional engineer must design, inspect or certify cranes, work platforms, and temporary works, such as scaffolding, shoring, formwork or falsework. These services may be part of the design engineer’s involvement preparing demolition plans; they are not the responsibility of the professional engineer providing general review of demolition. However, the review engineer should be aware of the regulations covering these activities and bring to the attention of the site superintendent any observed non-compliance with these requirements.

### 6.2.2 Construction and Demolition Safety

The professional engineer designing or reviewing demolition should be very familiar with Sections 213 to 221 of the Construction Regulation. These sections deal with the specific safety requirements for the demolition of buildings and other structures. In addition, the remainder of the Construction Regulation applies to demolition projects. One of the most important provi-



sions of the Construction Regulation is that precautions must be taken to prevent injury to a person on or near a project or adjoining property that may result from the

demolition of a building or structure (Section 214(2) of the for Construction Regulation).

## Appendix 1. Definitions

For the purposes of this guideline:

### **Assessment**

An evaluation by a professional engineer of the structural characteristics of the building or structure that is to be demolished

### **Building**

A structure comprising one or more wall, roof and floor that is regulated under the *Ontario Building Code*

### **Demolition**

The removal of any material part of a building or other structure

### **Demolition documentation**

Refers to the documentation prepared by professional engineers carrying out assignments in accordance with O. Reg. 260/08. The three categories of documentation: demolition plan, the description of structural design characteristics and general review reports.

### **Demolition contractor**

The person or firm carrying out the demolition of the building or structure

### **Design engineer**

The professional engineer providing the design services for demolition of a building or structure. This work will involve assessment of the building and structure as defined in CSA S-350 and preparation of the demolition plan in accordance with the requirements given in Section 3(3)2 of O. Reg. 260/08.

### **Demolition general review**

An inspection and reporting process required by the *Ontario Building Code* undertaken by a professional engineer to ascertain the general conformity of the contractor's work with methodology given in the demolition plan

### **Demolition methodology**

A detailed description of the systematic and sequential procedure for cutting, destroying, removing or other-

wise demolishing a building or structure in a manner that does not endanger the health or safety of any person or negatively affect the integrity of any other buildings, structures, buried or above ground utilities or any other real property

### **General conformity**

The "general conformity" opinion is a professional judgment by the reviewing engineer that the standard of the construction work fulfills the essential requirements of the plans and other documents that were the basis for issuing the building permit. The reviewing engineer must ensure the work has at least been done in accordance with normally accepted industry standards with a limiting criterion being the risk to public safety. To ascertain this, the engineer should observe whether the contractor has fulfilled the majority of requirements, including all the major requirements, specified in the drawings, specifications or standards for all products, processes or services provided by the contractor.

### **Method of demolition**

The means used for demolishing the building or structure, e.g. explosives, manual labour, mechanical equipment

### **Review engineer**

The professional engineer carrying out general review of the demolition as required by Section 1.2.2.3, Division C, of the *Ontario Building Code* to ascertain the general conformity of the work with the plans and specifications that formed the basis for issuing the demolition permit.

### **Structure**

Any permanent assembly of fabricated or constructed components other than a building, including a bridge, tower, dam or lock