

GUIDELINE

**Professional Engineers–
Temporary Works**

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1. INTRODUCTION

Few construction, renovation or demolition projects are completed without some form of “temporary works” being required. Because of the temporary nature of these installations, designers and constructors may not give their design and construction the attention they require. This can cause temporary works to fail, which can lead to loss of life and property.

The purpose of this guideline is to bring to the attention of those professional engineers who specify, design, or take part in the construction of temporary works the basic requirements, procedures and duties which Professional Engineers Ontario considers necessary to achieve the proper design and construction of temporary works.

Professional engineers can perform several different roles with respect to temporary works. The roles of prime responsibility considered by this guideline are constructor, designer of temporary works, designer of permanent works and field review engineer. It would not be unusual for one professional engineer to be responsible for more than one of these roles, but for the purposes of this guideline, each role has been dealt with as though it were performed separately.

2. DEFINITIONS

(a) “*Temporary works*” are installations required to provide access, protection, support, or services for workers, equipment and materials during the construction, renovation, retrofit, maintenance, or demolition of permanent works. Temporary works are also required to provide temporary service, repair, or support for any part of permanent works, until the permanent works have achieved a state of completion allowing temporary works to be removed.

Some typical examples of temporary works are:

- u formwork and falsework for structures;
- u shoring and temporary bracing for masonry walls and structural frames, and shoring for excavation and trenches;
- u temporary underpinning and guying, and roof and parapet anchors;
- u caissons, cofferdams and tunnels;
- u access scaffolding for construction purposes;
- u swingstaging, stirrup supports and bosun’s chairs;
- u cranes and crane foundations;
- u reshores for multistorey concrete structures;
- u field offices and portable classrooms;
- u environmental encapsulation during the removal of hazardous materials;
- u protection of vehicular and pedestrian traffic during construction;
- u provisions for loading testing, and
- u temporary piping, electrical, mechanical and heating services.

(b) The “constructor” is defined in the *Occupational Health and Safety Act* (OHSA) as a person who undertakes a construction project for an owner, and includes an owner who undertakes all or part of a project alone or by more than one employer. Under the act, the constructor has ultimate authority over the construction project.

For all construction projects exceeding \$50,000, the OHSA requires the posting of a “Notice of Project.”

This notice identifies the constructor by name and address.

(c) For the purpose of this guideline, the “*contractor of temporary works*” is defined as the person or

company charged with erecting, installing, constructing, maintaining, or demolishing temporary works.

Note: The terms *constructor* and *contractor of temporary works* are mutually exclusive. *Constructor* generally refers to the person or company responsible for the erection and maintenance of temporary works, while the *contractor of temporary works* is the person or company that physically erects or maintains temporary works. These two roles may be performed by the same party, but these functions are separate in most cases. When employed by the *constructor*, the *contractor of temporary works* is usually called a subcontractor. A professional engineer must always keep one or both parties informed of new conditions that arise, as outlined in this guideline.

(d) The “designer of temporary works” is the professional engineer responsible for the design of temporary works and the preparation of the drawings the constructor will use.

(e) The “designer of permanent works” is the professional engineer responsible for the design of permanent works, which may require the installation of temporary works.

The “*field review engineer*” is the professional engineer responsible for the review of the construction of temporary works.

PART II. PRACTICE

1. DESIGN

1.1 Designers of Permanent Works

Designers of permanent works are not usually responsible for the design or field review of temporary works required during the construction of permanent works. However, permanent works designers should state in specifications for permanent works whether they or other engineers are responsible for the design and field review of temporary works. When regulations state that design and review of temporary works must be performed by a professional engineer, the specifications for permanent works should clearly state this. Further, it is recommended that even when not required by regulation, design and review by a professional engineer should be specified.

Professional engineers responsible for temporary works design are usually employed or retained by contracts of temporary works. Permanent works designers may be required to assume responsibility for the design of part or all of temporary works. Where more than one engineer is involved in temporary works for a specific construction project, the engineers’ roles should be clearly laid out, to ensure that they assume amongst themselves responsibility for all portions of temporary works.

Specifications for permanent works should clearly state all standards and codes, special design requirements, monitoring techniques and methods of reporting for temporary works that the permanent works designer requires.

Some regulations require that permanent works designers review temporary works designs. Even when this is not required by regulation, it is recommended that they review temporary works designs for compliance with specifications for permanent works, so that temporary works will not have an adverse effect on permanent works.

1.2 Designers of Temporary Works

In terms of design parameters, codes regulating temporary works may not be as specific as codes for permanent works. Rather than prescribe specific design criteria, these regulations may specify acceptable factors of safety and allowable stresses. Professional engineers responsible for designing temporary works will find it necessary to research particular design problems in detail, to determine the design criteria and unique conditions that apply to temporary works.

Temporary works designers should be familiar with all relevant standards, regulations and factors of safety. They should design temporary works such that they will not have an adverse effect on permanent works.

Temporary works designers are also expected to be cognizant of the effects that changes in the con-

struction of permanent works could have on temporary works design. Even though many contractors of temporary works are specialists in their particular fields, they may not understand the relationship between temporary and permanent works. Therefore, temporary works designers should communicate with contractors and, where appropriate, permanent works designers, to clearly establish the purpose, mended use, method of construction and staging of temporary works. Further, they must be aware that temporary works used by temporary works contractors are based on standard practice, and must in every case be justified by rational analysis of the loadings during all stages of construction.

Temporary works designers should review the specifications for permanent works. When appropriate, they should also discuss the requirements for installation, use and removal of temporary works with permanent works designers and temporary works contractors, to ensure that each party understands their responsibilities and the requirements of the specifications.

2. DRAWINGS AND SPECIFICATIONS

Temporary works designers should become thoroughly knowledgeable about the design documents for the proposed permanent works, and the site conditions that existed before the preparation of documents for temporary works. Drawings for temporary works must clearly communicate design requirements and installation details to temporary works contractors. Temporary works designers should not assume that contractors will know all of the required details; they should ensure that design drawings and specifications are complete and capable of standing on their own.

In addition to defining the layout, sizes, materials, proprietary equipment and other relevant details of temporary works, design drawings should clearly show or note:

- u all live and dead loads or service conditions for which temporary works were designed;
- u any required staging of the construction, all modifications required during construction, and special precautions required during erection and dismantling;
- u any adverse effects that exposure to the elements will have on any part of temporary works;
- u special tolerances and clearances, particularly where eccentric effects are significant;
- u necessary inspection, testing or monitoring equipment, and procedures;
- u appropriate safeguards in the use of proprietary components, and
- u all relevant standards or codes to which temporary works have been designed, and the requirements with which the contractor of temporary works must comply during construction.

Note: Certain regulations contain specific requirements for the content of design drawings and specifications. These requirements are in addition to the above list.

Historically, there have been two weak links in the design, erection and use of temporary works, which field review engineers should pay particular attention to. First, since design drawings and specifications are not always followed explicitly, drawings must clearly indicate to contractors of temporary works that the design is dependent upon compliance with all of the conditions and specifications they contain. Second, since the inadequate communication of changes in field conditions affects temporary works' performance, field review engineers must assess any conditions found to be different from those assumed in the design. They should consult with the designers of temporary and permanent works when their respective designs are affected by altered field conditions.

Preliminary drawings and specifications not intended for use during construction should be clearly marked "Preliminary–Not for Construction," or words to that effect. Temporary works designers *should not* seal preliminary drawings, but *should* sign and seal final drawings and specifications. When temporary works drawings form only part of a set of drawings, or part of a single drawing prepared by other designers, temporary works designers must ensure that the application of their seal will not be interpreted as applying to the entire drawing or set of drawings. To do so, they should make a note adjacent to the seal indicating which part of the work is their responsibility.

Temporary works designers must identify those areas of the design which fall outside their scope of work, yet require professional design by virtue of their relationship to temporary works. They must notify contractors of temporary works and constructors about areas requiring professional design that will be another designer's responsibility, by using the note: "This Portion of the Works to be Designed and Approved by Others," or words to that effect.

3. CONSTRUCTION AND FIELD REVIEW

Contractors of temporary works are responsible for constructing temporary works in conformance with design drawings and specifications. Some regulations require that professional engineers be retained to carry out field reviews, and to verify that temporary works are constructed in general conformance with designs. It is recommended that all such field review work be carried out by the designer of temporary works, but another professional engineer may perform this function. When field review engineers are reviewing temporary works they did not design, they must become familiar with the temporary works design.

When conducting field reviews, field review engineers should comply with the following procedures, as a minimum.

- (a) Establish the terms of reference relating to works and maintain clear lines of communication with contractors, temporary works designers and, where appropriate, permanent works designers and constructors, to ensure that temporary works have been built as designed.
- (b) When required, prepare a statement identifying critical stages for field review and sampling of temporary works, which must be submitted to contractors of temporary works and, where regulations require, constructors, before the erection of temporary works. Usually, contractors of temporary works are responsible for notifying field review engineers of upcoming milestones, making it important that both parties have a clear understanding of notification procedures and responsibilities.
- (c) Determine what testing of sampled material and equipment is necessary, and ensure that a testing agency has been hired to carry out this work.
- (d) Make field reviews at the critical stages as identified in section (b), which may include installation, use and removal of temporary works. As a minimum, field reviews must be performed before putting temporary works into operation. After each field review, a written report must be issued to contractors of temporary works, and where regulations require, to constructors.
- (e) When reviewing temporary works that they did not design, field review engineers should inform the designers of any conditions found that differ from those assumed in the temporary works design. Temporary works designers, or field review engineers in consultation with temporary works designers, should assess the effects of these differences.
- (f) When proprietary equipment is specified, field review engineers should confirm that it is being used and maintained according to the temporary works designer's and manufacturer's recommendations, as indicated in the project documents.
- (g) When field review engineers have reason to doubt the adequacy of any equipment, they should request tests, specifying in writing a standard testing procedure where such exists, or specifying an appropriate testing procedure. They should ensure that such tests are carried out by qualified personnel, and that copies of all test reports are made available to themselves, temporary works contractors and, where appropriate, temporary works designers and constructors. When necessary, these tests should be performed under a professional engineer's supervision.

APPENDIX A. REGULATIONS, CODES AND STANDARDS

The following partial list of regulations, codes and standards is provided to assist professional engineers responsible for the design, construction and field review of temporary works. Notwithstanding the importance of the references below, professional engineers are responsible for familiarizing themselves with these documents and should pay particular attention to the legal responsibilities and penalties they outline. Where reference is made to a specific act, code, or regulation, the version effective at the time this guideline was published has been used. Engineers are advised to call the contact numbers listed with each reference to ensure that they are using the latest version of these documents.

1. *Occupational Health and Safety Act* (OHSA). Ministry of Labour, Professional Specialized Services (engineers and offices are listed in the Appendix), (416) 326-7770 or 1-800-268-8013.

The following sections of the OHSA either make specific references to professional engineers or may involve them.

RSO 1990 Reference	Detailing	RSO 1990 Reference	Detailing	RSO 1990 Reference	Detailing
S. 1	Definitions of constructor, construction, employer, projects and a number of other items which may be relevant, depending on the project	S. 23-32	Duties of a constructor, employer, employee, supervisor, worker, owner, project owner and supplier and, contravention by engineers and architects	S. 54 S. 62 S. 66-69	Powers of an inspector Interference with an inspector Offenses and penalties
S. 3	Self-employed persons	S. 51-53	Notices and reports		

The following section of the *Regulations for Construction Projects* made under the OHSA require that certain services be provided by a professional engineer.

O. Reg. 213/91 Reference	Detailing	O. Reg. 213/91 Reference	Detailing	O. Reg. 213/91 Reference	Detailing
S. 12(2)	Accidents and incidents—written opinion on cause	S. 139(5)	Inspection; suspended scaffold/platform	S. 236(1)	Design drawings; prefabricated, hydraulic or engineered excavation support systems
S. 87(3)	Certification; formwork, falsework and re-shoring loads	S. 144	Design drawings; elevating work platform	S. 236(5,6)	Approval of variation; design drawings, specifications, and soil conditions
S. 89.3	Inspection; formwork and falsework	S. 144(4)	Certification; elevating work platform	S. 242(2)	Certification; trench jack and trench brace loads
S. 92(1)	Design drawings; formwork, falsework and re-shoring	S. 157(2,3)	Design drawing; tower crane foundation, shoring and bracing	S. 245	Design support system for tunnel, shaft, caisson or cofferdam
S. 127(2)	Certification; scaffold loads	S. 159(1,3)	Inspection; tower crane	S. 280	Design of shoring and bracing
S. 130(1)	Design drawings; scaffold	S. 166(2)	Design drawings; explosive drill hole	S. 300	Design of headframe
S. 130(3)	Inspection; scaffold before use	S. 204(3,5)	Design drawings; explosive drill hole	S. 307	Cut in solid rock
S. 132(1)	Inspection; silo before construction	S. 234(2,5)	Inspection; excavation		
S. 139(2)	Design drawings; suspended scaffold/platform	S. 234(2)h	Certification; excavation wall stability		

Although the following sections of the *Regulations for Construction Projects* do not make specific references to professional engineers, they have a bearing on design, specifications and field review decisions.

O. Reg. 213/91 Reference	Detailing	O. Reg. 213/91 Reference	Detailing	O. Reg. 213/91 Reference	Detailing
S. 1	Definitions, including definition of a competent worker, formwork, falsework and professional engineer	S. 64-65 S. 73-74 S. 75-77	Public-way protection Platforms, runways and ramps Stairs and landings	S. 154 S. 157-165	Set up and materials specified by manufacturers for cranes Design of foundations, set up, testing and inspection of tower cranes
S. 3	Alternative methods and procedures	S. 78-84	Ladders	S. 166	Design, supports, set up and inspections of derricks and stiff-leg derricks
S. 6	Notice of project	S. 85-86	Guardrails and protective coverings	S. 169	Wire rope used for a crane or similar hoisting device, and safety factors
S. 7	Notification of trenching	S. 87-92	Concrete formwork, shoring and re-shoring	S. 204	Drilling adjacent to a drill hole being loaded with explosives
S. 11-12	Accident notices and reports	S. 95	Equipment modification and safety factors	S. 209-210	Design of a roofer's hoist
S. 19	Records and reports	S. 108	Blocking to prevent a collapse	S. 212-221	Demolition of a building or structure renches and excavations
S. 31	Loads and structures	S. 109	Guarding of equipment	S. 229	Excavations protecting adjacent structures
S. 32	Temporary flooring	S. 125-136	Scaffolds and work platforms	S. 234-242	Trench and excavation support systems
S. 34	Overhead protection	S. 137-142	Suspended scaffolds		
S. 51	Temporary steampiping	S. 143-148	Powered elevating work platforms		
S. 56-57	Fire protection in buildings	S. 151	Cranes and rated load carrying capacity		
S. 60-63	Work in confined spaces				

The *Regulations for Construction Projects* identify conditions where a professional engineer may be required to design, inspect or test such temporary works and equipment as: formwork, falsework and re-shoring; scaffolds; suspended platforms; powered elevating work platforms; tower cranes for shoring and foundations; bracing and anchorage; derricks and hoists; supports for excavations, and shafts and tunnels.

The OHSA permits an Ontario Ministry of Labour inspector to order a professional engineer's report on the adequacy of a temporary work, for which the inspector has a concern respecting worker safety. It is imperative that professional engineers who design or inspect temporary works be familiar with the act and regulations. When they design, inspect or test, they must ensure that the act's and regulations' minimum requirements are met.

There are other regulations under the OHSA which may require design, inspection or testing of temporary works by professional engineers, such as:

- u *Regulation for Window Cleaning* (O. Reg 527/88), the accompanying guide to *Window Cleaning Regulations and Guidelines; Roof Anchorage for Fall Arrest Systems*, and
- u *Regulation Respecting Asbestos on Construction Projects and in Buildings and Repair Operations* (O. Reg 529/88).

These can be obtained from the Ministry of Labour, Construction Health and Safety Program, (416) 326-7770 or 1-800-268-8013.

2. The *Building Code Act* and *Ontario Building Code* (as amended), Ministry of Housing, Buildings Branch, (416) 585-6666.

The building code contains the basic design requirements for temporary works used in construction and demolition projects. Specific attention should be paid to sections on requirements for design and field review by a professional engineer (section 2.3, article 4.1.1.3 in O. Reg 413/90).

3. *Boilers and Pressure Vessels Act* and the *Operating Engineers Act*, Ministry of Consumer and Corporate Affairs, Pressure Vessels Safety Branch, (416) 234-6000.

Professional engineers dealing with temporary works related to boiler and pressure vessels must be familiar with these acts. Engineers should also refer to the appropriate American Society of Mechanical Engineers and American Petroleum Institute standards, when required.

4. *Ontario Energy Act, The Propane Storage, Handling and Utilization Code* and *Natural Gas Code*, Ministry of Consumer and Commercial Relations, Fuels Safety Branch, (416) 2346030.

Professional engineers must be familiar with these acts and regulations when addressing temporary works related to Propane and natural gas use and storage.

5. *Elevating Devices Act*, Ministry of Consumer and Commercial Relations, Elevating Devices Branch, (416) 234-6060.

The following sections of the *Elevating Devices Act*, RSO 1990, and *Regulation 229/81* either make specific references to professional engineers or may involve professional engineers.

Act	S. 1	Definitions of design submission, elevating device, professional engineer and other items which may be relevant, depending on the project.
	S. 2	Exemptions for powered platforms and automated window cleaning systems
	S. 11(3)(a)	Requirement for design submission by professional engineer
	S. 12	Requirement that design must adhere to codes listed in regulations
	S. 31	Permission for director to adopt new (edition) of standard before regulation is revised

O. Reg.	S. 3	Definition of construction hoist, material construction hoist, temporary elevator, hoists used in construction of chimneys, etc.
	S. 4(l)	Design must be per code
	S. 7-11	Prescription of design submissions
	S. 7(6&7)	When a professional engineer is required
	S. 34,37	Specific technical standards
	S. 57-60	Specific requirements for construction hoists

The *Elevating Devices Act* applies to temporary construction, including elevators, manlifts, platform lifts and construction hoists.

6. *Environmental Protection Act and Regulations*, and related policies, Ministry of the Environment and Energy, (416) 323-4321.

Temporary works designers will, in some instances, require a certificate of approval for temporary works from the environment and energy ministry. Temporary works requiring certificates of approval include, but are not be limited to, those which would cause sewage discharge as defined by the *Ontario Water Resources Act*, and the discharge of airborne contaminants as defined by *Regulation 308*, under the *Environmental Protection Act*.

The application of the requirements for a certificate of approval are very broad. The following is an excerpt from the *Environmental Protection Act*, RSO 1990:

“9.(1) No person shall, except under and in accordance with a certificate of approval issued by the Director,

- (a) construct, alter, extend or replace any plant, structure, equipment, apparatus, mechanism or thing that may discharge or from which may be discharged a contaminant into any part of the natural environment other than water; or
- (b) alter a process or rate of production with the result that a contaminant may be discharged into any part of the natural environment other than water or the rate or manner of discharge of a contaminant into any part of the natural environment other than water may be altered. 1988, c.54, s.5(1).”

The terms “contaminant” and “adverse effect” are quite broadly defined by the act. Professional engineers should contact the environment and energy ministry for assistance in determining whether a certificate of approval is required for a specific project. When a certificate is required, the ministry provides guidelines on how to apply for it.

7. *Ontario Highway Bridge Design Code* and Commentary, and *Traffic Control Manual for Roadway Work Operations*, Ministry of Transportation, Structural Office, (416) 235-4959.

The *Ontario Highway Bridge Design Code* contains the requirements and guidelines for temporary support of permanent structures, and for such temporary structures as falsework and formwork caissons, cofferdams, and earth retaining structures.

8. Canadian Standards Association (CSA) publications are referenced in many codes, and provide design procedures for some materials normally used in temporary works. Tel: (416) 747-4058.

Standard	Subject
CAN3-Z271	Safety Code for Suspended Powered Platforms
CAN/CSA-C225	Vehicle mounted aerial devices
CAN3-ZI80.1	Compressed breathing air and systems
CAN/CSA-Z91	Safety Code for Window Cleaning Operations
CSA-B140.8	Portable industrial oil-fired heaters

CSA-S269.1	Falsework for construction purposes
CSA-S269.2	Access scaffolding for construction purposes
CSA-S269.3	Concrete formwork
CSA-C22. 1LL	Canadian Electrical Code, Part 1, Standard for Electrical Installation
CSA3-B354 Series	Elevating work platforms
Z150	Safety Code for Mobile Cranes
CAN/CSA-Z185	Safety Code for Personnel Hoists
Z248	Code for Tower Cranes
CAN/CSA-Z256	Safety Code for Material Hoists
Z259.1	Fall arresting safety belts and lanyards
S350	Code of Practice for Safety in Demolition of Structures
Z259.10	Full body harness

9. *Scaffolds*, Construction Safety Association, (416) 366-1501.

This guide provides valuable insight into the appropriate use of scaffolds on construction sites.

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