STRUCTURAL ENGINEERING DESIGN BY PROFESSIONAL STRUCTURAL ENGINEERS

Providing structural engineering designs of structural framings, footings, and foundations, to general building structure across Ontario including Acton, Alliston, Angus, Aylmer, Ayr, Barrie, Beamsville, Beeton, Belleville, Blue Mountains, Bobcaygeon, Borden, Brant, Brantford, Bracebridge, Brighton, Caledonia, Cambridge, Campbellford, Collingwood, Cobourg, Crystal Beach, Delhi, Dunnville, Elmira, Erin, Exeter, Fergus, Fort Erie, Georgetown, Grand Valley, Gravenhurst, Greater Napanee, Grimsby, Guelph, Haldimand County, Hanover, Huntsville, Ingersoll, Innisfil, Kawartha Lakes, Kitchener, Lincoln, Lindsay, Listowel, London, Meaford, Midland, Mono, Mitchell, Mount Forest, New Hamburg, New Tecumseth, Niagara Falls, Niagara-on-the-Lake, Norfolk County, Orangeville, Orillia, Owen Sound, Paris, Parry Sound, Pelham, Penetanguishene, Peterborough, Picton, Port Colborne, Port Dover, Port Elgin, Port Hope, Prince Edward County, Quinte West, Rockwood, St.Catharines, St. Marys, St. Thomas, Shelburne, Simcoe, Southampton, South Bruce Peninsula, Stayner, Stratford, Strathroy, Sutton, Tay, Thorold, Tillsonburg, Tottenham, Vineland, Walkerton, Wasaga Beach, Waterloo, Welland, and Woodstock is a core component of our practice.

We work closely with architects, planning consultants, developers and architectural designers and we have been recognized as one of the top structural engineering partners by leading architects and interior designers across Ontario.

The Council of American Structural Engineers (CASE) defines a structural engineer as: "An engineer with specialized knowledge, training, and experience in the sciences and mathematics relating to analyzing and designing force-resisting systems for buildings and other structures."

Our licensed professional structural engineers are trained to understand, predict, and calculate the stability, strength and rigidity of built structures for buildings to develop designs and integrate our structural engineering design with that of other designers, and to supervise construction of projects on site.

Structural engineering is based upon applied physical laws and empirical knowledge of the structural performance of different materials and geometries. Structural engineering design utilizes a number of relatively simple structural elements to build complex structural systems. Structural engineers are responsible for engineering design and structural analysis. Entry-level structural engineers design the individual structural elements of a structure, such as the beams and columns of a building. More experienced engineers are responsible for the structural design and integrity of an entire system, such as a building.

Structural engineering has existed since humans first started to construct their own structures. It became a more defined and formalized profession with the emergence of the architecture as distinct profession from the engineering during the industrial revolution in the late 19th century. Until then, the architect and the structural engineer were usually one and the same thing – the master builder. Only with the development of specialized knowledge of structural theories that emerged during the 19th and early 20th centuries, did the professional structural engineers come into existence.

The role of a structural engineer today involves a significant understanding of both static and dynamic loading, and the structures that are available to resist them. The complexity of modern structures often requires a great deal of creativity from the structural engineer in order to ensure the structures support and resist the loads they are subjected to.

Structural engineering dates to 2700 B.C.E. when the step pyramid for Pharaoh Djoser was built by Imhotep, the first engineer in history known by name.

Pyramids were the most common major structures built by ancient civilizations because the structural form of a pyramid is inherently stable and can be almost infinitely scaled as opposed to most other structural forms, which cannot be linearly increased in size in proportion to increased loads. The structural stability of the pyramid, whilst primarily gained from its shape, relies also on the strength of the stone from which it is constructed, and its ability to support the weight of the stone above it. The limestone blocks were often taken from a quarry near the build site and have a compressive strength from 30 to 250 MPa. Therefore, the structural strength of the pyramid stems from the material properties of the stones from which it was built rather than the pyramid's geometry.

Throughout ancient and medieval history most architectural design and construction was carried out by artisans, such as stonemasons and carpenters, rising to the role of master builder. No theory of structures existed and understanding of how structures stood up was extremely limited, and based almost entirely on empirical evidence of 'what had worked before'. Knowledge was retained by guilds and seldom supplanted by advances. Structures were repetitive, and increases in scale were incremental.

In 1638, Galileo Galilei published the book Two New Sciences in which he examined the failure of simple structures and 50 years later Isaac Newton published Philosophiae Naturalis Principia Mathematica which contains the Newton's laws of motion. Daniel Bernoulli (1700–1782) introduced the principle of virtual work.

Leonhard Euler (1707–1783) developed the theory of buckling of columns. In 1826 Claude-Louis Navier published a treatise on the elastic behaviors of structures. In 1873 Carlo Alberto Castigliano presented his dissertation "Intorno ai sistemi elastici", which contains his theorem for computing displacement as partial derivative of the strain energy. This theorem includes the method of "least work" as a special case. Next year Otto Mohr formalized the idea of a statically indeterminate structure. In 1922 Timoshenko corrected the Euler-Bernoulli beam equation which was published in 1750.

In 1936 Hardy Cross published the moment distribution method, an important innovation in the design of continuous frames. 5 years later Alexander Hrennikoff solved the discretization of plane elasticity problems using a lattice framework. Next year R. Courant divided a domain into finite subregions. In 1956 J. Turner, R. W. Clough, H. C. Martin, and L. J. Topp's published a paper on the "Stiffness and Deflection of Complex Structures" introducing the name "finite-element method" and is widely recognized as the first comprehensive treatment of the method as it is known today. The physical sciences underlying structural engineering began to be understood in the Renaissance and have since developed into computer-based applications pioneered in the 1970s.

The history of structural engineering contains many collapses and failures. Sometimes this is due to obvious negligence, as in the case of the Pétion-Ville school collapse, in which Rev. Fortin Augustin "constructed the building all by himself, saying he didn't need an engineer as he had good knowledge of construction" following a partial collapse of the three-story schoolhouse that sent neighbors fleeing. The final collapse killed 94 people, mostly children. In other cases, structural failures require careful study, and the results of these inquiries have resulted in improved practices and greater understanding of the science of structural engineering. Some such studies are the result of forensic engineering investigations where the original engineer seems to have done everything in accordance with the state of the profession and acceptable practice, yet a failure still eventuated.
A famous case of structural knowledge and practice being advanced in this manner can be found in a series of failures involving box girders which collapsed in Australia during the 1970s.

Structural engineering is primarily driven by the creative manipulation of materials and forms and the underlying mathematical and scientific ideas to achieve an end which fulfills its functional requirements and is structurally safe when subjected to all the loads it could reasonably be expected to experience.

This is subtly different from architectural design, which is driven by the creative manipulation of materials and forms, mass, space, volume, texture and light to achieve an end which is aesthetic, functional and often artistic. Many structures are structurally simple, such as multi-storey office buildings and housing, while other structures, such as tensile structures, shells and gridshells are heavily dependent on their form for their strength, and the structural engineer may have a more significant influence on the form, and hence much of the aesthetic, than the architect.

The structural design for a building must ensure that the building is able to stand up safely, able to function without excessive deflections or movements which may cause fatigue of structural elements, cracking or failure of fixtures, fittings or partitions, or discomfort for occupants. It must account for movements and forces due to temperature, creep, cracking and imposed loads. It must also ensure that the design is practically buildable within acceptable manufacturing tolerances of the materials. It must allow the architecture to work, and the building services to fit within the building and function (HVAC, electrical, plumbing, lighting etc.). The structural design of a modern building can be extremely complex. The Structural Engineers are required to understand the interaction of structures with the shaking ground, foresee the consequences of possible earthquakes, and design and construct the structures to perform during an earthquake typically using base isolation, which allows the base of a structure to move freely with the ground. Civil engineering structures are often subjected to very extreme forces, such as large variations in temperature, dynamic loads such as waves or traffic, or high pressures from water or compressed gases. They are also often constructed in corrosive environments, such as at sea, in industrial facilities or below ground. The principles of structural engineering are applicable to variety of mechanical (moveable) structures. The design of static structures assumes they always have the same geometry (in fact, so-called static structures can move significantly, and structural engineering design must take this into account where necessary), but the design of moveable or moving structures must account for fatigue, variation in the method in which load is resisted and significant deflections of structures.

The structural design must ensure that such structures are able to endure such loading for their entire design life without failing.

Columns are elements that carry only axial force (compression) or both axial force and bending. The design of a column must check the axial capacity of the element, and the buckling capacity.

The buckling capacity is the capacity of the element to withstand the propensity to buckle. Its capacity depends upon its geometry, material, and the effective length of the column, which depends upon the restraint conditions at the top and bottom of the column. The effective length is K*l where l is the real length of the column and K is the factor dependent on the restraint conditions.

The capacity of a column to carry axial load depends on the degree of bending it is subjected to, and vice versa. This is represented on an interaction chart and is a complex non-linear relationship.

Structural Column information, prepared by our licensed professional structural engineers usually provided in tables or line diagrams include

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

A beam is an element in which one dimension is much greater than the other two and the applied loads are usually normal to the main axis of the element. Beams and columns are called line elements and are often represented by simple lines in structural modeling. Cantilevered beams are supported at one end only with a fixed connection.

Simply supported beams are fixed against vertical translation at each end and horizontal translation at one end only, and able to rotate at the supports. Fixed beams are supported in all directions for translation and rotation at each end. Continuous beams are supported by three or more supports. Beams are elements which carry pure bending only. Bending causes one part of the section of a beam divided along its length to go into compression and the other part into tension. The compression part must be designed to resist buckling and crushing, while the tension part must be able to adequately resist the tension. A truss is a structure comprising members and connection points or nodes. When members are connected at nodes and forces are applied at nodes members can act in tension or in compression. Members acting in compression are referred to as compression members or struts while members acting in tension are referred to as tension members or ties. Most trusses use gusset plates to connect intersecting elements. Gusset plates are relatively flexible and unable to transfer bending moments. The connection is usually arranged so that the lines of force in the members are coincident at the joint thus allowing the truss members to act in pure tension or compression. Trusses are usually utilized in large-span structures, where it would be uneconomical to use solid beams.

Plates carry bending in two directions. A concrete flat slab is an example of a plate. Plates are understood by using continuum mechanics, but due to the complexity involved they are most often designed using a codified empirical approach, or computer analysis. They can also be designed with yield line theory, where an assumed collapse mechanism is analyzed to give an upper bound on the collapse load. This technique is used in practice but because the method provides an upper-bound, i.e. an unsafe prediction of the collapse load, for poorly conceived collapse mechanisms great care is needed to ensure that the assumed collapse mechanism is realistic.

Shells derive their strength from their form and carry forces in compression in two directions. A dome is an example of a shell. They can be designed by making a hanging-chain model, which will act as a catenary in pure tension, and inverting the form to achieve pure compression.

Arches carry forces in compression in one direction only, which is why it is appropriate to build arches out of masonry. They are designed by ensuring that the line of thrust of the force remains within the depth of the arch. It is mainly used to increase the bountifulness of any structure.

Catenaries derive their strength from their form and carry transverse forces in pure tension by deflecting just as a tightrope will sag when someone walks on it. They are almost always cable or fabric structures. A fabric structure acts as a catenary in two directions.

Structural Framing plans of floors, roofs and elevations of walls prepared by our licensed professional structural engineers typically include

- grid lines and structurally derived dimensions, dimensions to outside of structural floor plate from grid or overall dimensions of floor plate;
- 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;
- slopes and depressions, or references to drawings by others that show that information;
- sizes, locations, dimensions and details of structural elements;
- for cantilever suspended span (Gerber) systems, include beam cantilever lengths and splice locations;
- locations, sizes and framing details or reinforcing around major member openings;
- reference elevations of floors or roof(s);
- wall framing elevations showing girts and bracing, including calculated forces, for steel framed buildings;
- reinforcing bar sizes and spacing for concrete members, with fabrication and placing criteria;
- conditions at change of elevation of the structure, conditions at intersections of different structural materials, and at interaction of structural and non-structural components;

- calculated member end forces, moments, shears or torsion required for connection design by others (governing combined factored connection forces should be provided);
- locations and details of control, construction and expansion joints; and
- provision for future extensions

Structural engineering depends upon a detailed knowledge of applied mechanics, materials science and applied mathematics to understand and predict how structures support and resist self-weight and imposed loads. To apply the knowledge successfully a structural engineer generally requires detailed knowledge of relevant empirical and theoretical design codes, the techniques of structural analysis, as well as some knowledge of the corrosion resistance of the materials and structures, especially when those structures are exposed to the external environment. Since the 1990s, specialist software has become available to aid in the design of structures, with the functionality to assist in the drawing, analyzing and designing of structures with maximum precision including StaadPro, ETABS, Prokon, Inducta RCB, etc. Such software may also take into consideration environmental loads, such as from earthquakes and winds. **Our licensed professional structural engineers use state of the art technology including STAAD PRO software.**

Structural engineering depends on the knowledge of materials and their properties, in order to understand how different materials support and resist loads. Common structural materials are:

- Masonry
- Concrete: reinforced concrete, prestressed concrete
- Alloy: steel, stainless steel
- Iron: wrought iron, cast iron
- Aluminium
- Timber: hardwood, softwood
- Composite materials: plywood
- Other structural materials: adobe, bamboo, carbon fibre, fiber reinforced plastic, mudbrick, roofing materials

Providing structural engineering designs of structural steel framings, reinforced concrete floors and walls, masonry and wood framed structures, footings, and foundations in is a core component of our practice. Our licensed Professional Structural Engineers have continued to pioneer in structural engineering analysis and structural engineering design services including seismic design for new construction projects including structural steel framings, reinforced concrete floors and walls, masonry and wood framed structure, foundation and footings including pre-engineered building foundation design and rehabilitation of existing buildings including balcony & parking garage repairs (ledger beams, deck re-design, bearing pads, drainage remediation, slabs and columns).

Our licensed professional structural engineers and support staff are committed to services of the highest quality and respond inventively, regardless of whether the project is a small or a huge complex long-span structural engineering project.

Regardless of the nature of the project whether the project is rehabilitation of structures, replacement of structures, or new structures, our licensed professional structural engineers are well experienced in distinctive creative designing with a variety of building materials for structures, including steel, concrete, masonry and wood.

Our licensed professional structural engineers combine structural engineering analysis with experience and knowledge to create strong, durable, elegant and economic structural engineering designs that integrate the demands of building materials (shrinkage, temperature, creep and stressing), building geometry, gravity, wind, snow & seismic loads. Our licensed professional structural engineers also prepare structural engineering drawings indicating the location, sizes and quantities of materials, and specifications indicating the quality of materials and required performance of structural systems.

Our well experienced licensed professional structural engineers keep up to date with structural engineering concerns so that they can innovate in response to site specific challenges and constraints to provide innovative and cost-effective structural engineering design solutions to commercial, industrial, institutional and multi residential projects, primarily by reducing the quantity of concrete and reinforcement steel required for structural stability to reduce construction costs and increase the usable floor space . Detailed accurate structural engineering specifications prepared by our licensed professional structural engineers with decades of experience, reduce or prevent unexpected additional costs.

Our licensed professional structural engineers prepare required stamped structural engineering drawings for

- Foundation Designs including Pre-engineered Building Foundations
- Retaining Walls
- Structural design for Office Buildings, Commercial Retail Buildings, Restaurants, Gas Station Canopies, Low Rise freestanding Industrial Buildings, Multi-Storey Apartment Buildings

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Our licensed professional structural engineers also 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. Our licensed professional structural engineers' typical structural engineering work includes:

- Engineering design of the primary structural system for gravity and lateral loads;
- Design of proprietary components to be incorporated into the primary structural system;
- 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 engineering and architectural drawings that form the basis for the issuance of the permit

Our licensed professional structural engineers work with the clients and the design/build contractor to define a scope of work that enables them to provide the required structural engineering designs, specifications, contract documents, and/or contract administration and applicable codes and standards—especially where they affect the structural integrity of the building.

While incorporating the requirements our clients, our licensed professional structural engineers

- establish the loads and structural resistance for the structural design;
- optimize structural efficiency;
- recommend any specialized services related to the structural design process that are required for completion of the project; and
- abide by the requirements of the current applicable building codes, acts and regulations, usually includes, but is not limited to, the National Building Code of Canada; National Building Code structural

commentaries; the Ontario Building Code; CSA standards, as appropriate; and publications and design guides from trade associations such as Canadian Institute of Steel Construction (CISC), The Canadian Sheet Steel Building Institute (CSSBI), Canadian Portland Cement Association (CPCA), Canadian Wood Council (CWC), Canadian Prestressed Concrete Institute etc.

In preparing final plans and specifications, our licensed professional structural engineers

- analyze and design the structural system in conformity with applicable codes and regulations;
- analyze and design each element of the system or, where elements are to be designed by others, provide appropriate design criteria;
- prepare clear design briefs stating the applicable codes, loads, assumptions and design criteria for the structural analysis and design of the system and its components;
- cooperate with the other design professionals during system design, taking into account their requirements, respond to their requests by improving the structural performance of our designs, advising them of functional aspects of the system that may affect the design of the systems and respond 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; and
- advise the client and/or the general contractor that structural elements designed by others are to be designed by engineers according to specifications and Ontario Building Code requirements

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, our licensed professional structural engineers,

- attend meetings with the client and other stakeholders to coordinate the flow of design information among the other design team members;

- cooperate with the other stakeholders, responding to their requests, taking into account their requirements, and advising them of functional aspects of the primary structural system that may affect the design of their components;
- analyze and design the structural system in conformity with applicable codes and regulations;
- review serviceability limits, such as: defections, vibration, lateral drift, concrete and masonry crack control, foundation settlement and soil-structure interaction;
- review reports by specialized services such as geotechnical, vibration analysis and wind tunnel testing, and incorporate recommendations into the primary design;
- prepare structural analysis and design calculations for the primary structural system components;
- prepare foundation designs based on recommendations in the geotechnical investigation report;
- prepare the framing design and design detail sketches showing layouts of typical areas
- prepare or edit outline specifications for structural components; and
- coordinate the structural design with defection and lateral movement criteria to meet requirements of other specialty engineers.

In conjunction with designing the primary structural system, our licensed professional structural engineers, with respect to primary structural elements, connection details and proprietary products, specify types of elements, their positions within the structure and methods of connecting to the primary structural system; and 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 other specialty engineers in their design. With respect to non-structural elements attached to the primary structural system, our licensed professional structural engineers design the primary structural system to accept and support such elements; and indicate the assumed design loads applied to the primary structural system by the non-structural elements.

Our licensed professional structural engineers prepare calculations to support the structural design of the primary structural system. The structural calculations contain a table of contents or index and clearly show and delineate service loads, factored loads and factored load combinations. The structural calculations are retained in a project file. A copy of input and output of computer analysis is included in the project file, along with a description of the software used. In general, structural calculations by our licensed professional structural engineers typically include:

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

Our licensed professional structural engineers provide the technical sections of specifications for all structural design work including

- the scope of work;
- standards, codes and bylaws governing the work;
- submittals required;
- quality control requirements;
- materials and tolerances;
- workmanship and fabrication;
- criteria for temporary works;

- field review of construction, inspection and testing;
- provisions for the contractor to provide notification before commencing;
- significant steps of the work;
- trade warranties; and
- erection information, where necessary, to ensure the intent and integrity of the design.

Structural Foundation Design prepared by our licensed professional structural engineers typically include

- grid lines and grid line dimensions as well as overall dimensions and structurally derived dimensions;
- the types, sizes, locations and details of foundations for columns, walls, piers, equipment and any other structural loadbearing components;
- the anticipated bearing elevations for foundations;
- any drainage or dewatering system or requirements;
- the foundation system installation sequence, if important to the structural design;
- sub-grade preparation for slabs-on-grade, as well as the thickness, reinforcing and elevation of the slabs-on-grade;
- estimated pile lengths and capacities, or a source for this information;
- frost-safe soil cover or equivalent insulation requirements for shallow foundations;
- the approximate location of existing services and foundations, or any other relevant site information that may conflict with the proposed foundations and
- allowable ultimate limit states (ULS) and serviceability limit states (SLS) soil or rock-bearing capacity, pile capacities and lateral earth pressures for retaining structures with reference to pertinent geotechnical reports.

Depending on the materials used, detailed structural engineering drawings prepared by our licensed professional structural engineers (depending on the materials used) typically include

- masonry bearing and shear wall details, including masonry unit and mortar strengths, details of reinforcing, support of loads, lintels and grouting procedures;
- 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;
- wood shear wall details, including nailing patterns and end anchorages or factored anchorage forces if connectors are to be designed by other specialty engineers;
- 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
- timber members and connection details, or end forces

Our licensed Professional Structural Engineers provide the required stamped engineering drawings to obtain municipal building permits for rehabilitation and restoration of structural elements of the buildings such as foundations, floors, walls, parking garages, and balconies.

Our Licensed Professional Structural Engineers prepare stamped engineering drawings for restoration and rehabilitation of both contemporary commercial structures and valued historical landmarks – ranging from commercial buildings to industrial buildings to institutional buildings to residential apartment buildings across Ontario including Acton, Alliston, Angus, Aylmer, Ayr, Barrie, Beamsville, Beeton, Belleville, Blue Mountains, Bobcaygeon, Borden, Brant, Brantford, Bracebridge, Brighton, Caledonia, Cambridge, Campbellford, Collingwood, Cobourg, Crystal Beach, Delhi, Dunnville, Elmira, Erin, Exeter, Fergus, Fort Erie, Georgetown, Grand Valley, Gravenhurst, Greater Napanee, Grimsby, Guelph, Haldimand County, Hanover, Huntsville, Ingersoll, Innisfil, Kawartha Lakes, Kitchener, Lincoln, Lindsay, Listowel, London, Meaford, Midland, Mono, Mitchell, Mount Forest, New Hamburg, New Tecumseth, Niagara Falls, Niagara-on-the-Lake, Norfolk County, Orangeville, Orillia, Owen Sound, Paris, Parry Sound, Pelham, Penetanguishene, Peterborough, Picton, Port Colborne, Port Dover, Port Elgin, Port Hope, Prince Edward County, Quinte West, Rockwood, St.Catharines, St. Marys, St. Thomas, Shelburne, Simcoe, Southampton, South Bruce Peninsula, Stayner, Stratford, Strathroy, Sutton, Tay, Thorold, Tillsonburg, Tottenham, Vineland, Walkerton, Wasaga Beach, Waterloo, Welland, and Woodstock.

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We diagnose building issues and design a repair strategy tailored to the specific needs.

Our Licensed Professional Structural Engineers conduct building investigations and field reviews to determine design and repair options for building envelopes, balconies and parking garages.

Our Licensed Professional Structural Engineers also provide technical advice to clients and direct project teams (consultants and contractors). Our Licensed Professional Structural Engineers also manage the contract administration and quality of restoration projects at the construction stage and evaluate contractor performance to ensure project deliverables and quality standards are achieved.

As per OPSS 353, concrete shall not be placed until the surface on which the concrete is to be placed, and the forms, have been inspected by the Geotechnical and/or Structural Engineer.

Before placing concrete, the Contractor shall wet down the sub-grade immediately ahead of concrete placing by means of a uniform spray of water sufficient to wet the sub-grade thoroughly without leaving standing water. The concrete shall be placed and compacted in a manner such that segregation of the aggregate does not occur.

As per OPSS 350, concrete shall not be placed when the ambient air temperature is below 0ºC and shall not be placed against any materials whose temperature is below 5ºC. The concrete temperature at the time of discharge from the truck shall be between 10ºC and 28ºC as per OPSS MUNI 1350..

The Contractor shall provide protection to ensure the minimum in place temperature of the concrete pavement or concrete base is 15ºC for the first three days of curing, and at 10ºC for the subsequent 4 days. As per OPSS 314, winter grading of granular dictates all ice and snow shall be removed from all portions of the work area. Frozen material shall not be incorporated into the work. Materials shall not be placed over frozen ground, except at the Contractor's option and reviewed by the Geotechnical Engineer, Structural Engineer and Municipality. Should this scenario be accepted, a single lift may be placed over frozen ground; in which case final grading and compaction shall be done after the underlying material has thawed.

Building or structural foundations and concrete pads/platforms are to be constructed per Municipality approved design drawings and OPSS 350 (construction specifications of concrete works) and OPSS 1350 (concrete materials and production). The Consultant Engineer is to ensure the Structural Engineer and/or the Geotechnical Engineer reviews the formworks and mix designs prior to concrete being poured. The Structural/Geotechnical Engineer is to inspect the works during construction to ensure reinforcing steel or other concrete base structure materials meet the materials, size and spacing specifications as outlined in the design or per recent OPSS structural standards. As per OPSS 353, the concrete on the upper surfaces shall be floated to a smooth uniform finish of the required cross section, free of open texturing, plucked aggregate and local projections. Only hardwood or magnesium trowels shall be used for hand finishing. Sidewalks are to be broom finished.

Our Licensed Professional Structural Engineers offer Structural Engineering Design and Stamped Structural Engineering Drawings to obtain site plan approval and building permits to construct commercial, industrial, institutional and multi residential new construction in Ontario including Acton, Alliston, Angus, Aylmer, Ayr, Barrie, Beamsville, Beeton, Belleville, Blue Mountains, Bobcaygeon, Borden, Brant, Brantford, Bracebridge, Brighton, Caledonia, Cambridge, Campbellford, Collingwood, Cobourg, Crystal Beach, Delhi, Dunnville, Elmira, Erin, Exeter, Fergus, Fort Erie, Georgetown, Grand Valley, Gravenhurst, Greater Napanee, Grimsby, Guelph, Haldimand County, Hanover, Huntsville, Ingersoll, Innisfil, Kawartha Lakes, Kitchener, Lincoln, Lindsay, Listowel, London, Meaford, Midland, Mono, Mitchell, Mount Forest, New Hamburg, New Tecumseth, Niagara Falls, Niagara-on-the-Lake, Norfolk County, Orangeville, Orillia, Owen Sound, Paris, Parry Sound, Pelham, Penetanguishene, Peterborough, Picton, Port Colborne, Port Dover, Port Elgin, Port Hope, Prince Edward County, Quinte West, Rockwood, St.Catharines, St. Marys, St. Thomas, Shelburne, Simcoe, Southampton, South Bruce Peninsula, Stayner, Stratford, Strathroy, Sutton, Tay, Thorold, Tillsonburg, Tottenham, Vineland, Walkerton, Wasaga Beach, Waterloo, Welland, and Woodstock.

Having vast experience in structural engineering design, our licensed professional structural engineers offer effective, innovative and cost-efficient structural engineering designs and stamped structural engineering drawings to our clients.

Our well experienced structural engineers’ proficiency in generating new ideas and conceptualizing designs in accordance with our clients' requirements has made us very successful.

Our licensed professional structural engineers prepare thorough, detailed, and clear stamped structural engineering drawings to suit your needs while also adhering to design requirements of the municipality and submit to municipality for review and approval to obtain site plan approvals and building permits.

BUILDING EXPERTS CANADA

Edgar Labuac, P.Eng. or Joo Min Park, M.Eng

CALL ANYTIME: (416) 332 1743

Text Message 416 727 8336

Email: buildingexpertscanada@yahoo.com

Our Service Area in Ontario includes Acton, Alliston, Angus, Aylmer, Ayr, Barrie, Beamsville, Beeton, Belleville, Blue Mountains, Bobcaygeon, Borden, Brant, Brantford, Bracebridge, Brighton, Caledonia, Cambridge, Campbellford, Collingwood, Cobourg, Crystal Beach, Delhi, Dunnville, Elmira, Erin, Exeter, Fergus, Fort Erie, Georgetown, Grand Valley, Gravenhurst, Greater Napanee, Grimsby, Guelph, Haldimand County, Hanover, Huntsville, Ingersoll, Innisfil, Kawartha Lakes, Kitchener, Lincoln, Lindsay, Listowel, London, Meaford, Midland, Mono, Mitchell, Mount Forest, New Hamburg, New Tecumseth, Niagara Falls, Niagara-on-the-Lake, Norfolk County, Orangeville, Orillia, Owen Sound, Paris, Parry Sound, Pelham, Penetanguishene, Peterborough, Picton, Port Colborne, Port Dover, Port Elgin, Port Hope, Prince Edward County, Quinte West, Rockwood, St.Catharines, St. Marys, St. Thomas, Shelburne, Simcoe, Southampton, South Bruce Peninsula, Stayner, Stratford, Strathroy, Sutton, Tay, Thorold, Tillsonburg, Tottenham, Vineland, Walkerton, Wasaga Beach, Waterloo, Welland, and Woodstock.