Caskanette Udall
CONSULTING ENGINEERS

FORENSIC ENGINEERING NEWS AND VIEWS

Fall 2019

Presidents Box

By Rene Caskanette

Over the past 20 years our firm has provided many training sessions to our clients, both adjusters and lawyers, to help them understand forensic engineering services, to help them do their jobs. We continue to offer these seminars as requested and we will tailor them to any specific needs or topics of interest. If you are looking for a speaker for a seminar, a lunch and learn presentation on an engineering topic or would like an in-house presentation we are happy to make ourselves available to help out.

We have many Power Point presentations all ready to go on standard forensic engineering topics such as investigation of fires, failure analysis, oil tank spills- both cause and effect, environmental cleanups, accident reconstruction, and the list goes on. Please contact us if you are interested in this free service.

We are very pleased to announce some recent manpower changes, to expand our expertise. Sadie and Justin Breg recently added a baby to their family, so Sadie is now on maternity leave. Justin was with us part time as he completed his PhD thesis at the University of Waterloo, and he has now joined us full time in Waterloo. His extensive background in architecture and building science upgrade our skills in those areas.

With the increase in property claims we have experienced over the last few years we had reached full capacity, so we hired Farhad Habibi, who recently achieved his PhD in civil engineering to expand our skills in that area. He is based in Burlington.

We are pleased to have found these 2 great additions to our engineering team.

We also hired a new architectural draftsman John Wells, working from London. John has many years of experience and works well with our team of engineers to get drawings out quickly for remedial work on damaged buildings.

Bob Caskanette has successfully completed additional examinations with the Professional Engineers of Ontario (PEO), and has been licenced in the areas of Environmental Engineering and Fire Investigation, so he now has the professional seal and credentials required to practise as a qualified person (QP) in those areas.

We continue to grow thanks to our dedicated client base, and be assured we will continue to strengthen our expert team as needed to ensure the level of service provided remains at the current excellent level.

House Explosions

By Jeff Udall

On August 14, 2019 a vehicle struck the front of a house in London, Ontario and severed the natural gas line. The gas accumulated inside the house which eventually resulted in an explosion that demolished the house and severely damaged several houses around it.

On August 22, 2018 a house exploded in Kitchener from an intentional release of natural gas into the house. The explosion demolished the house and severely damaged several houses around it.

On June 28, 2016 a house in Mississauga exploded, also from a gas release in the home. The damage to surrounding properties was extensive.

On August 10, 2008 a massive explosion in a propane storage yard in North York devastated many houses in the neighbouring residential area.

Natural gas accumulation in a house can result in a blast that has a significant energy release. In each of the cases above, the blast was enough to leave only a shattered foundation where there was once a family home. The houses immediately next door will often sustain enough damage that they are not repairable and need to be demolished. Beyond that, the amount of damage will vary and depends on various factors.

The most common damage to a property that has been affected by a blast is movement of walls and cracking drywall. The blast creates a sudden high pressure wave that acts to inflate enclosed spaces. The high pressure wave is immediately followed by a low pressure wave which reverses the affects of the inflation forces. Damage resulting from the high and low pressure waves can present in different ways depending on the location and construction features. It is not uncommon to see attic hatches lifted into the attic or aluminum soffits blown out or lifted into the attic when there is no other visible damage. These items are generally the lightest components of construction that move with a pressure wave. Other parts of the house like walls and roofs require more energy to be damaged. Damage to roof trusses is usually from uplift when the attic is inflated under positive pressures. At the same time, ceiling drywall is separated from the ceiling framing.

The pressure wave will travel throughout all the cavities in the house, including chimneys. Fireplace doors in basements can be blown open, or closed doors between rooms pushed open.

After a nearby explosion, it is essential to assess damage to a house to determine if the building has been compromised. We can also separate pre-existing problems from loss related damage. There are clear unique damage patterns that are caused from explosions. Reported damages different from these patterns can be ruled out.

Being able to determine these patterns comes from experience with reviewing several recent explosions. Also being able to identify explosion damage that may not be otherwise obvious comes from such experience. Caskanette Udall Consulting Engineers has extensive experience with explosion damage that can help with working through claims.

Fentanyl and Narcotics Contamination Assessments in Buildings and Vehicles

By Bob Caskanette

There is an ever growing awareness and concern of Fentanyl use and the resultant contamination in buildings and vehicles from illicit drug use. Fentanyl is a highly potent synthetic opioid which rapidly acts to depress the central nervous system and respiratory function. Opioids interact with opioid receptors in the brain and elicit a range of responses within the body; from feelings of pain relief, to relaxation, pleasure and contentment.

Fentanyl and its analogues pose a potential hazard to persons who could come into contact with these drugs. Possible exposure routes to fentanyl and its analogues can vary based on the source and form of the drug. Persons are most likely to encounter illicitly manufactured fentanyl and its analogues in powder, tablet, and liquid form. Potential exposure routes of greatest concern include inhalation, mucous membrane contact, ingestion, and percutaneous exposure (e.g., needle puncture). Any of these exposure routes can potentially result in a variety of symptoms that can include the rapid onset of life-threatening respiratory depression.

Skin contact is also a potential exposure route, but is not likely to lead to overdose unless large volumes of highly concentrated powder are encountered over an extended period of time. Brief skin contact with fentanyl or its analogues is not expected to lead to toxic effects if any visible contamination is promptly removed.

Currently, there are no established federal or consensus occupational exposure limits for fentanyl or its analogues. However, the Canadian Centre for Occupational Health and Safety (CCOHS) states the lethal dose of fentanyl is approximately 2 milligrams (mg) of pure fentanyl, roughly equivalent to four grains of salt, which would kill the average adult. However, this varies and is subject to many other factors, such as the persons weight and opioid tolerance.

A building or vehicle can become easily contaminated with fentanyl and other illicit narcotics from drug users. This is a concern for all persons entering a building or vehicle where such drug use has taken place and those environments need to be assessed prior to entry to ensure the safety and wellbeing of those persons. A small accidental exposure can lead to significant adverse health effects which could be fatal in persons unaware there is a hazard or who are not properly safeguarded against the hazard.

We have recently begun a working relationship with a specialty narcotics restoration company and have access to real-time portable scanning equipment to test for a library of narcotics in a building or vehicle, including fentanyl. Swab samples can be collected on surfaces and analyzed within one minute in real time down to the nanogram in detection sensitivity. Additional narcotics that can be assessed and identified include but are not limited to; amphetamine, buprenorphine, cocaine, ephedrine/pseudoephedrine, heroin, ketamine, MDA, MDMA, methamphetamine, morphine, papaverine, pethidine, THC, tramadol, acetylfentanyl, butyrfentanyl, carfentanyl, furanylfentanyl, 3-methylfentanyl and W-18. There is also the capability to test for the qualitative presence or absence of fentanyl and other compounds in the air in addition to surface samples. This is key in identifying if contamination is present within a building or vehicle so proper safeguards can be put into place for persons that may be exposed.

We undertake assessments of buildings and vehicles for fentanyl and other narcotics contamination and can fully scan all areas of either to determine if concerns are present. We can also collect additional samples to be submitted to the laboratory if required for additional confirmation. We provide professional reports with detailed remediation and abatement protocols to be followed by certified contractors which are based on industry best practices currently available.

There are currently no established standards or guidelines in place for Fentanyl, although some are to be developed shortly. We have reviewed the drafts of some of these proposals, but cannot reference them at this time as more work is required to finalize this framework.

In general, there are three levels of required work procedures, depending on the level of fentanyl contamination present:

- Level I – Low Level of Contamination
- Level II – Moderate/Medium Level of Contamination
- Level III – High Level of Contamination

Following our report outlining the required remedial scope of work, we undertake any additional inspections required throughout the project until it is completed. We then re-attend at the site to reassess the building or vehicle involved and collect additional swab samples to analyze in real time to ensure no remaining contamination or hazards are present on any surface, including building HVAC systems. Additional clearance samples are also typically collected as an additional measure and are submitted to a laboratory for analysis to ensure the remediation was fully completed. A final clearance report is then authored outlining the results of our assessment and testing and the project is complete when the environment is deemed safe. This is critical to protect the future liability of homeowners, insurers and other stakeholders involved. We are always here to answer any questions you may have. Our team looks forward to assisting you on your next project.

Caskanette Udall congratulates Justin & Sadie Breg on the arrival of their beautiful daughter Meira, on October 13, 2019. We are all looking forward to Meira joining our firm as a structural engineer in 2042!

Designing Refrigerated Buildings

By Justin Breg

Canada, it is said, has only two seasons: Hockey season, and Construction. So what could be a more Canadian topic than the construction of hockey arenas? In this article, we'll take a look at some of the challenges related to designing ice arenas and other refrigerated buildings.

Enclosure

The world's first indoor hockey game took place on March 3rd, 1875, at the Victoria Skating Rink in Montreal. Two teams of nine players faced each other in this unfamiliar game imported from Nova Scotia. The teams used a wooden puck instead of a ball, to avoid injuries to the interested crowd. The game ended in a fight, when members of the skating club protested the damage that was being caused to the rink's surface.

Prior to this, life was simpler. Hockey happened outside, on ponds and lakes, between the months of November and March. Games were limited by snowstorms, rain, and warm weather. The hockey season lengthened, however, as our ability to condition cold indoor environments improved. Over the years, numerous technologies and techniques were added to the mix.

Foundations

An important innovation was the use of refrigerated lines running beneath a concrete slab, to distribute a cool temperature evenly across the surface of the rink. An example is shown in Figure 1.

This system was used in many early community arenas. Initially, these community ice rinks were not used year round. In the summer, the ice was removed, and the concrete slab floors were used for other activities. During these warm months, the ground beneath the slabs would warm up again, and the system was kept in balance.

Eventually, however, many communities tried to extend their skating season, sometimes year-round. The ground no longer had an opportunity to warm up. Moisture in soil will tend to move from a higher energy state, to a lower energy state; consequently, moisture in the ground would migrate and accumulate in the cold region immediately below the chilled slab. The water would freeze and form 'ice lenses', heaving and cracking the slab.

The modern solution to this problem is to keep the ground beneath the chilled slab warm, using a set of heating tubes (Figure 2). Occasionally, these heating tubes can fail, allowing ice lenses to grow and heave the slab.

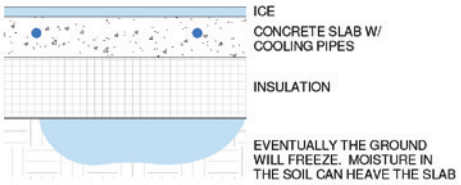


Figure 1: Ice could only be maintained for part of the year in early community areas, to avoid frost heave.

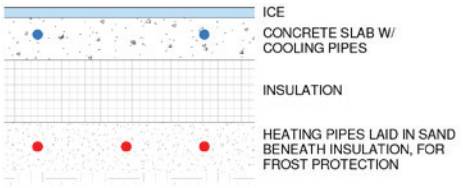


Figure 2: In today's areas, heating pipes below the insulation help avoid frost heave.

Walls

In a refrigerated building, many of the assemblies (e.g. walls, roof, etc.) must be designed 'inside-out'.

In Canada, we normally assume that the interior of a building is warm and humid (occupied by moving, breathing humans), while the outside is cold. Moisture vapour tends to move from the warm side of an assembly to the cooler side. This phenomenon is known as 'vapour drive'. For this reason, we typically install 'vapour barriers' on the inside of walls (the 'warm side'). The vapour barrier keeps moisture from entering into the assembly, helping to avoid mould, rot, and mildew.

For a hockey arena in early September, however, the inside can be much colder than the outside weather. In this situation, the 'vapour drive' direction is reversed. Sometimes, designers of refrigerated buildings make the mistake of installing vapour barriers on the inside of a wall or roof (the 'cold side'). Vapour drive forces moisture through the assembly, where it gets trapped against the inside of the plastic vapour barrier. The condensed water leads to deterioration.

There are proven strategies for designing robust wall assemblies for refrigerated buildings, to minimize the risks of moisture accumulation in all seasons. Air tightness is critical.

Roofs/ceilings

Heat can be transferred by **conduction** (think of a pot on a hot stove) or convection (think of a warm breeze, moving heat from one region to another). Heat can also be transferred by **radiation**: think of the warmth of a campfire, even on a cool night. 'Heat waves' are emitted from one surface (the burning log), and travel through space until they hit another surface (your face).

Heat transfer by radiation can significantly affect the energy efficiency and performance of a skating arena. Any warm surface will direct heat at the cold ice slab, and begin to thaw it. The walls of arenas don't matter as much – the ice doesn't "see" the walls, except at a sharp angle. But the ice is facing right up at the ceiling, taking any heat that is directed down (Figure 3).

For this reason, it is advantageous to use a low-emissivity material on the ceiling of an arena. A low-emissivity ceiling will reflect the cold of the ice back to the rink, reducing cost and improving performance. (In a similar way, low-emissivity [or "Low-e"] windows reflect heat back into a room). Generally, shiny materials like foil-faced insulation will be low-emissivity.

In one arena project, contractors installed an insulated ceiling with the white side down, facing the ice, and the shiny side up. Energy modelers showed that installing the insulation with the shiny side down would save thousands of dollars each month in operating costs. The contractor ended up redoing the ceiling.

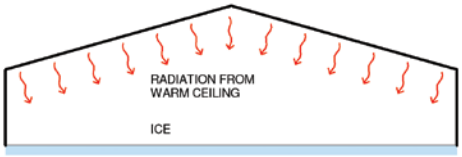


Figure 3: Heat radiation from an arena ceiling can significantly affect operating costs and performance.

Commissioning

When a refrigerated building is built or repaired, the temperature of the building may be lowered gradually according to a 'pull-down schedule'. This gives time for materials to contract and adjust to the new temperature, and avoids structural damage or the creation of unexpected gaps or cracks in assemblies. This process also gives time for mechanical equipment to reduce internal humidity, avoiding frost build-up.

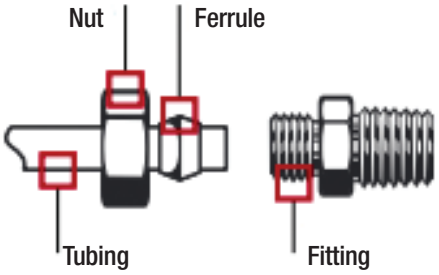
There are approximately 1050 ice pads in Ontario, each of which consumes approximately 1,500 to 2,400 MWh of energy per year. A still greater number of refrigerated buildings in the province are used for food processing and food storage. These buildings must be designed, constructed – and when necessary, repaired – with care to ensure years of safe and efficient service.

Under Tight, Over Tight, or Just Right

By Alex Caskanette

Compression fittings are common plumbing connections. One of the advantages of compression connections is that the joints are easy to assemble and disassemble. This is why these connections are often found beneath your bathroom vanity, under your dishwasher, or behind your refrigerator.

Typical Compression Fitting Installation Instructions:

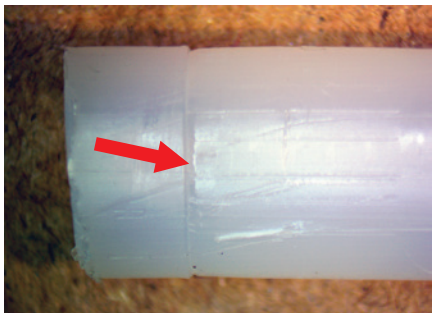


Cut the end of the tubing square. Slide the nut and ferrule onto the tubing. Insert the tube insert into the waterline and push it to the stop. Use a wrench to tighten the connection approximately 1.5 to 2 turns beyond finger tight.

Compression connections allow do-it-yourself homeowners and plumbers to easily install various appliances and fixtures. The problem with compression connections is ensuring proper tightening. Both under tightening and over tightening can cause joint failure, resulting in substantial water damage and often insurance claims. Tightening the fitting requires a fine balance of torque which is crucial to the integrity of the joint. Under tightening fails to create sufficient clamping force (generated when the ferrule is squeezed by the coupling nut), allowing the water line to pull free from the connection. Over tightening can damage the ferrule or tubing, resulting in a leak.

In 2019 we have observed an increase in compression fitting failures installed by both home owners and seasoned plumbers. Examining the surface of the plastic tubing located below the ferrule can provide insight into the installation.

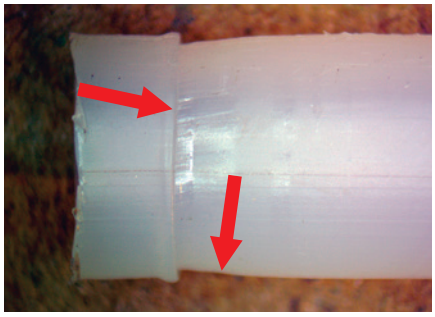
Under Tightened (1 Turn Past Finger Tight)



Features:

- Single line of deformation running around the circumference of the tubing.
- Lack of taper.

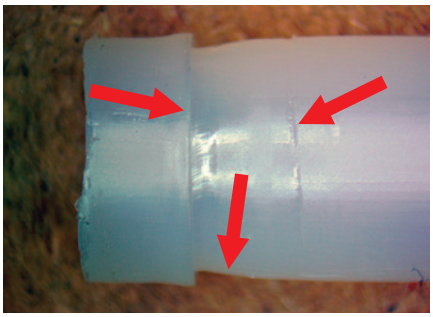
Just Right (2 Turn Past Finger Tight)



Features:

- Ledge running around the circumference of the tubing.
- A distinct taper.

Over Tightened (3 Turns Past Finger Tight)



Features:

- Ledge running around the circumference of the tubing.
- A distinct taper.
- A second line of deformation.

The majority of the compression fitting failures that we have investigated this year were caused by under tightening during installation. Some other common compression fitting installation errors include:

- Using a metal ferrule with plastic tubing.
- Using Teflon tape or pipe sealant when assembling the connection.
- Placing the ferrule on the tubing backwards.
- Failing to cut the tubing square.

So, when working with compression fittings, aim for the "just right" amount of tightening to avoid leaks and water damage to your home.

PRODUCT RECALL

Mastercraft Construction Heater recalled due to fire hazard

Summary

- Product: Mastercraft Construction Heater, 4800W.
- Issue: The heaters could overheat, posing a burn and fire hazard.
- What to do: Immediately stop using the recalled product and return it to the place of purchase for a store credit or to obtain a replacement unit

This recall involves the Mastercraft Construction Heater, 4800W. The Mastercraft Construction Heater is blue in colour.

The recalled products have item number 052-2604. The item number and certification file number can be found on the label affixed to the back of the heater.

Non-Destructive Testing Methods Used in Forensic Engineering Investigation of Concrete Structures

By Farhad Habibi

Any test that does not impair the intended performance of the studied member is classified as non-destructive testing (NDT). In the field of forensic engineering, NDT has been used widely in critical industrial sectors such as nuclear power plants, gas pipelines, and petrochemical facilities. Recently, NDT methods were adopted in the field of civil engineering as a valuable and cost-effective method to assess the quality and safety of structures built with plain or reinforced concrete without enducing any damage.

Easy workability, low cost and high strength, when combined with reinforcing steel bars, has made concrete one of the most widely used materials in construction of buildings, foundations, parking garages, dams and tunnels. However, reinforced concrete elements may suffer various deterioration due to chemical attack, fire, physical and mechanical degradation, shoddy workmanship, or corrosion. These deteriorations can eventually weaken the building to the point of failure.

Below are a few simple cost-effective NDT methods that can be used to examine the current condition or the integrity of concrete structures after a loss. Especially, when destructive testing methods are not possible due to their disruptive nature or building occupants.

Chain Drag and Hammer Tap: Surface delamination can be detected in concrete by interpreting the pitch of the sound that reflects off the concrete. In this method, low pitch sounds can be an indication of surface delamination.

Ultrasonic Pulse Velocity: Quality and inner condition of the concrete and masonry elements can be assessed using Ultrasonic Pulse Velocity (UPV) test. This technique utilizes the ultrasonic waves and measures the speed at which those waves travel through a concrete or masonry element. Higher velocities are the indication of good and dense concrete, while lower velocities usually indicate presence of voids and cracks inside the concrete.

Concrete Hammer Test: Also known as Schmidt hammer or rebound hammer is a device that estimates the elastic properties of the concrete by measuring the rebound of a spring-loaded mass impacting the surface of the concrete element. Using standard conversation charts, these values will correlate to the compressive strength of concrete. Using this technique eliminates or minimizes the need for taking core samples to evaluate the compressive strength of the concrete.

Impulse Radar Testing: Commonly used on masonry vertical elements such as walls to illustrate different layers within the assembly, including air. This method categorizes materials used in the element based on the unique response of each material to an imposed energy wave. The presence and depth of reinforcing bars can also be determined by this technique.

Infrared Testing: One of the most cost-effective and simplest ways to identify areas with voids. Every material has a unique thermal property that distinguishes it from the surrounding area. Using infrared testing method, the variation of the temperature in an element (inconsistent materials) can be detected.

Surface Electrical Resistivity Test: Electrical resistivity test can be used to evaluate the quality and durability of concrete. This NDT technique can provide insight into the water absorption, chloride diffusion coefficient, and corrosion rate of the steel reinforcing bar inside the concrete.

With all the advantages these NDT testing methods provide, each of them has some limitations. Also, if not performed correctly, results may differ significantly from reality. Therefore, all the NDT tests mentioned above must be done and analyzed by a qualified professional.

References:

- D. Breysse, Nondestructive evaluation of concrete strength: an historical review and a new perspective by combining NDT methods, Construction and Building Materials, vol. 33, pp. 139-63, (2012).
- Professional Engineers Ontario, Structural Condition Assessments of Existing Buidlings and Designated Structures Guidline, Published on November 2016
- International Atomic Energy Agency, Guidebook on Non-Desturctive Testing of Concrete Structures, IAEA, Vienna, 2002

Building Permit Applications

By John Wells

Caskanette Udall Consulting provides Building Permit Application Submissions on behalf of our clients. We conduct site visits to determine the required scope of work, take measurements and prepare drawings for submission to the local Building Department.

Before a client decides to start a new project to improve their home, the homeowner should locate any existing survey of their property to save the time to remeasure everything to produce site drawings. If the client doesn't have a survey, try visiting a Land Registry Office in your area to determine if they have a survey of your property on record. If they do, you will be able to acquire one from them. A legal surveying company in your area can be hired to produce one for you.

Projects that will require a site plan are typically additions, accessory buildings, decks or any exterior work. If a client plans to do one of the four mentioned they will require a survey.

The majority of City Halls in Southern Ontario will have a zoning map on their website. On the zoning maps you can find crucial information pertaining to your property, such as front setback, rear setback, side setback, percentage of lot coverage, percentage of front yard coverage, to name a few.

When the client does the preliminary background work it saves them money. We can handle all of the work for clients who aren't interested in assisting. We prepare all necessary drawings that will be required to submit for permit, and will make the trip to City Hall on your behalf to apply for the permit.

To avoid delays in receiving a permit it is recommended that you hire a qualified professional to produce a proper submission package, so that all the relevant information is incorporated to verify to the examiner's that all drawings conform to the Ontario Building Codes and all Zoning By-Laws. Typically, the drawings in the package will be a site plan, foundation plan, floor plans for each level, elevations, roof plan, sections, details, and all required forms and applications that will need to be filled out.

What Projects DO NOT require a building permit.

Decks less than 24" above ground, fences, asphalt roof shingling, eaves troughs, minor repair to masonry, damp proofing basement, replacement of kitchen or bathroom cupboards, replace forced air furnace, air conditioning to existing forced air systems, replacing siding or windows (provided there are no structural changes), pool heaters, painting and decorating, landscaping.

Which Projects require a building permit.

Decks greater than 24" above ground, interior structural alterations, adding or removing walls, porches, basement or main floor walkout alteration, additions/ sunroom/ solariums, carports, attached or detached garages and sheds, replacement of brick veneer or installation of new brick veneer, replacement of masonry chimney (below roofline), dormers or finishing attic space, finishing a basement, new or structural alterations to windows or doors, insulating exterior walls, structural work related to fire damage.

Always contact your local Building Department to find out if you require a permit for any work being done to your building. They are the local authority who are responsible for interpretation and enforcement of the Ontario Building Code. For buildings that are damaged by a fire or windstorm, where remediation is planned, the City can accept some nonconforming items when conformance would not be practical. We can work with the municipality to determine what they need for each specific project.

Congratulations to Dr. Farhad Habibi on the successful defense of his doctorate thesis and achieving his Ph.D in Civil Engineering.

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