Caskanette Udall
CONSULTING ENGINEERS

FORENSIC ENGINEERING NEWS AND VIEWS

Fall 2021

Presidents Box

By Rene Caskanette

Work from home is the new reality. The silver lining is improved time efficiency and lower fees for our clients as we eliminate travel time to trials and meetings. We have always been a work from home organization, and now the support staff have transitioned to that model as well.

We have seen an increase in assignments from lawyers who represent injured people and people charged with arson and fire related crimes. Seems like we are one of only a few engineering firms willing to accept jobs funded by legal aid. Many people charged with arson appear to have no money and go through this program. The rates paid by legal aid are well below our normal rates, but we continue to work on these files, similar to lawyers who call it pro bono work.

It is very rewarding when an innocent person can get justice with our help. Recently a lady in London who was charged with burning her house had all charges against her dropped prior to trial. Our testing and reporting identified a probable accidental cause for the fire which started as she was smudging the home. We plan a more detailed article on this case later after the civil case settles as well.

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Stave Silo Collapse

By Jeff Udall

Agricultural silos come in a variety of shapes and sizes and materials. As with all structures, bad things can happen that compromise the structural integrity of the shell and cause a collapse of the silo. Steel reinforced poured concrete silos tend to be the most resilient structures against fires, impacts, and age related distress. It's common to see an empty field with an old concrete silo sticking up as a memory of a farm long since passed. Metal silos are cheap, durable and easy to erect, but they require extra attention to maintenance and proper operation. Stave silos are silos that are built with interconnecting blocks that are held together in a circular shape using steel rods around the perimeter. While these silos often endure the ages, they have a specific weakness that can cause sudden catastrophic collapses. Corrosion of the steel rings.

When a silo is full, there is a large internal pressure pushing out on the shell. The pressure increases as the silage or grain level gets higher and higher. On a stave silo, this pressure is held almost entirely by the steel rings. The spacing of the rings gets tighter near the bottom of the silo because of this increased pressure. If a ring fails for any reason, the stave blocks can easily push outward from the internal pressure. With the loss of a few blocks near the bottom, the weight of the silo above is no longer fully supported in that area and the silo can begin to tip. The tipping adds further stress to the remaining rings and blocks and the entire silo fails in a rapid collapse.

The rings are more closely spaced near the bottom of the silo since the bottom sees the highest internal pressure. The rings are spaced further and further apart as you go higher towards the top. Access doors at the bottom of the silo are generally larger than the spacing of the rings, and therefore require bridging for the rings. The rings that cross over the doors connect to straight metal bridge sections that carry the load from the rings above and below the door. These bridge sections are critical to the entire silo. Should one of these bridge sections fail, the ring tension is lost, stave blocks push out, and the silo collapses. The rings and bridges are exposed to the elements and are subject to long term corrosion which is a slow but steady process. The moment when the strength of the rings becomes 'just' below the internal pressure of the silo is impossible to predict.

Stave silos are an efficient design for constructing silos. They have been around for many years and have stood the test of time. However, they require extra attention to corrosion issues. The steel rings and access door bridges are a critical element for the entire silo structure. Failure of the ring assemblies is sudden and unpredictable. Even if the silo does not completely collapse, the shell is generally sufficiently compromised that it cannot be repaired.

Caskanette Udall Consulting Engineers has investigated several silo collapses over the years for a variety of different types of silos. If you have a silo claim, contact our team of experts to assist.

At this time, our offices continue to operate as an essential service, conducting site visits while following health and safety guidelines including the use of PPE and physical distancing.

Damage Assessments of Older Residential Buildings

By Micheka Kostyniuk

In a perfect world, every building that is insured would be in pristine condition pre-loss. The structural elements would all be up to Code, the concrete would be in excellent condition, the building would have been maintained over the years to upgrade any items that were deteriorating due to natural processes, contractors would have properly tied in new renovations/additions into existing structures, etc.

But, we live in the real world. I'm sure we've all walked into buildings and thought, "oh wow, this is going to be a big/complicated job". This is typically a phenomenon in older buildings, though sometimes you run across this in newer buildings, as well.

Often, these less-than-ideal conditions are hidden behind finishes and aren't obvious until there's tear out. Other times, the issues are very obvious. So, what do you do when you get into an older building and start looking around and trying to sort out what's loss related damage, what's pre-existing damage, and how to handle repairs to get the building back to a pre-loss and acceptable condition?

We typically will start by looking at the area of the loss and sorting out the magnitude of repairs required as a result of the loss. This includes consulting with the contractor to find out just how far they need to go with tear out to remediate non-structural elements (smoke, mould, moisture damage, etc). Then, when applicable, we will assess the structure as a whole for any pre-existing issues that may become a factor in restoration or in considering the options.

We will typically work our way up from the basement. Some of the main things we will look at include:

- What is the foundation type (e.g. rubble/stone, concrete block, brick, poured concrete)
- What is its general condition and is there any pre-existing damage
- How deep below grade does the foundation extend (full basement, crawl space, partial basement, approximate depth below grade, etc)
- Where are the load bearing walls? Have they been compromised in the past (e.g. holes opened up in load bearing walls to provide access into an addition, ducting, etc)
- Are the floor joists properly supported at the foundation walls/interior beams

We will then move our way up to the above grade levels and the roof, looking at where the load bearing walls in the superstructure would be located and if the components that need to be there, are there. Is there a beam installed where they knocked out a wall in the past to make their kitchen and dining room open concept? Is there pre-existing damage to framing that has been improperly repaired or renovated in the past? Are the walls in good condition or have they rotted or deteriorated over time? Are the walls plumb (straight up and down) or are they tipping in/out? If they're out of plumb, why and is this something that's a complicated or straightforward repair? What about the exterior walls? It's not uncommon to find that structural sheathing was installed on the inside of the home in older buildings. Is there wet or smoky insulation hidden in behind there that needs to be dealt with? How is the existing roof construction? Are the rafters sagging, twisted, or rotted? Is there proper lateral support for roof framing? There are so many other considerations, some common and some unique, this list is by no means completely comprehensive.

When the damage is widespread and there's a lot of pre-existing damage that needs to be accounted for, often it becomes necessary to undertake an economic and practical assessment to determine whether to demolish the building or repair it. This is typically done via cost estimates by contractors and/or appraisers. We will typically prepare a written preliminary structural report to assist with determining the scope of repairs for estimating purposes for the contractor and/or appraiser.

Other considerations need to be taken in these situations. Can the foundation be rebuilt on? Is there loss related or pre-existing damage that would render the foundation unsuitable to rebuild on? What kind of damage to the foundation is anticipated or possible if demolition of the superstructure is undertaken and leaves the foundation intact? We often find that concrete block foundations do not hold up well during demolition, as the necessary care is rarely taken to protect the concrete block from damage during demolition. Rubble stone foundations are usually in poorer condition and it's rare we ever find a rubble stone foundation worth rebuilding on.

There is so much to consider in older buildings. We have extensive experience in assessing older buildings and can help you sort out what repairs and upgrades are needed.

Presidents Box

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We have recently added a new structural engineer to our team in London. Jason Richards is a big asset to the team. We are currently planning a new hire in the Kitchener area for the new year, any civil/ structural engineers with building science experience, or architects are encouraged to send in a resume.

Our last year end during covid showed a small revenue decline, but this year we are on track to replace that lost revenue and grow to new heights. We thank all our regular and reliable supporters for their confidence in our work as we navigate through the changes the pandemic brings. Dr. Tam is now sounding optimistic that the worst is over, and here in Ontario spring may bring us back to near normal. We shall see.

I turned 65 in November and have been reducing my work schedule. I still act as the president, and handle management duties, with cutbacks on field work. Let the younger people crawl around attics and shovel out fire scenes.

I will be travelling to Florida after Christmas to spend a few months out of the cold. Our place down there sat empty last year as we remained in Canada, so we look forward to being snowbirds again.

Merry Christmas and Happy New Year. Stay healthy and happy.

Post-Fire Smoke and Soot Mapping Analysis, IAQ and Clearance Sampling

By Bob Caskanette

After a fire loss, issues often arise pertaining to smoke odour and soot residue within a building and on contents. How far has the contamination reached? Have wall or ceiling cavities been compromised? What pathways are present? What building materials and contents require removal and replacement? What items can be cleaned and salvaged? Should sealing and encapsulation of some areas be considered? What about HVAC? Undertaking professional smoke and soot contamination mapping within a building will help answer these questions and establish a restoration protocol for the contractor to administer.

A detailed assessment and understanding of the building and building construction is essential. We offer a combination of qualitative sampling and quantitative air sampling and surface sampling services that give an overall analysis of the level of contamination within a building and/or on contents in question. We can assess quantitatively if incomplete products of combustion (broken down by smoke/soot/ash/charred material) are present on a material or surface or in an air space to establish how far the restoration needs to go to help avoid unnecessary costs, which can be significant.

For surface sampling there are two common options. The first is undertaking surface swab samples using laboratory grade Kimwipes saturated in either laboratory grade Hexane or Isopropyl Alcohol, depending on the surface material being sampled. Tape lift samples for microscopic evaluation of smoke/soot are also a very useful option, which can typically be analyzed by the laboratory more quickly and cost effectively and can offer a quantitative breakdown of what is present within a sample (by percent). This is helpful prior to a fire restoration being completed to establish the scope of work required and following the restoration to identify if the project was completed successfully.

For air sampling and screening there are several methods available. Solid Phase Micro Extraction Fibre (SPME) sampling and more conventional Charcoal Tube sampling are viable options prior to the fire restoration being completed. In an area close to where the fire occurred, often our eyes, a qualitative white glove or wet wipe test or even our olfactory systems are enough to tell what is contaminated as gross levels of contamination are often present. However, further away from the loss area is where it gets much more complicated and costs can balloon out of control. We use a portable photoionization detector (PID) for initial screening of the entire building (every room, closet, nook and cranny) to gather total volatile organic compounds (TVOC) readings down to parts per billion (ppb) concentrations in all areas prior to a fire restoration and often save the more costly air testing for final clearance. Laboratory calibrated SUMMA air canisters for TVOC's and EPA target list of volatile organic compounds (VOC's) can be collected for an 8 hour or more conventionally a 24 hour air sample. This is a very useful tool to establish if building clearance has been achieved following the fire restoration prior to the building being reoccupied. A re-screening of the building following restoration using a PID is another step we undertake during clearance in addition to air sampling or if air sampling is not desired.

The results of a 24 hour air clearance air test can be compared to available Health Canada Residential Indoor Air Quality Guidelines and other guidelines or industry recognized levels where available. Even if contents have been removed from the building and cleaned and building restoration was properly completed, occupants may still think an issue exists. Whether the issue is psychosomatic or legitimate, we can assess buildings and contents to get you the answers you need. There will always be persons that want everything brand new no matter what and costs can rise very quickly if a proper assessment and alternative explanation is not offered. There are also persons who may have hypersensitivities to certain contaminants or special medical considerations, which needs to be evaluated. A consultation with a medical doctor (MD) in that instance may also be required.

Most samples (other than surface tapelift samples) are analyzed by Gas Chromatography Mass Spectrometry (GCMS) at an accredited laboratory. Our laboratory experts can identify the compounds found within the samples down to parts per million (ppm) or parts per billion (ppb) concentrations and can even assist us with determining the source of the particular compounds identified in special or more unusual circumstances such as industrial/commercial fire losses.

Professional reports are completed outlining the results of the assessment to assist you with making an informed decision. A detailed restoration and cleaning protocol is established at the beginning of the project. These may be the critical answers you need to handle a claim both quickly and economically.

In addition to smoke and soot assessments following fire claims, we offer pre-remediation and post-remediation assessments and sampling of marijuana grow ops and clandestine drug labs such as structures used for the manufacture or storage of methamphetamine or other narcotics, including fentanyl. Following a pre-remediation assessment, a remediation protocol can be provided for contractors when problems are identified.

We also offer professional consultation, sampling, remediation protocols and clearance sampling for fuel oil (home heating oil) spill cleanups, roadside emergency spills, mould and asbestos claims, designated substance surveys (DSS's), hazardous material projects and microbial jobs such as sewer backups. We even offer professional radon assessment and sampling services.

At the conclusion of any project involving a professional consultant, homeowners and building occupants can have the peace of mind they need prior to re-establishing occupancy of a building and insurers, contractors and other stakeholders can find themselves better protected from potential future liability. Our team are always here to answer your questions and hope to see you on your next project.

Introducing Jason Richards

Hi, my name is Jason Richards and it is my pleasure to formally introduce myself to those of you I have not yet had the opportunity to meet (and those of you who I have already met in the field!).

This past June I joined the Caskanette Udall team offering Structural Engineering support and expertise out of the London office. I have been working in the consulting engineering industry for the past 7 years in many capacities, growing my knowledge of Structural Engineering theories, principles, practices, and standards. In 2018 I was licensed as a Professional Engineer by PEO. I have a diverse educational background having graduated From the University of Western Ontario with concurrent degrees in Civil Engineering (Structural option) and Earth & Planetary Science in 2013. Prior to this I attended Fanshawe College and received a diploma in Architectural Technology in 2008.

Since joining Caskanette Udall I have had the opportunity to use my experience in the field, providing Structural Engineering support after events such as fires, collapses, vehicle impacts, tree impacts, and tornados. The fantastic team at Caskanette Udall has been a wealth of support as I have been getting up to speed in such a dynamic industry. I have enjoyed working with everyone and am appreciative of all the guidance that they have provided!

It has been my pleasure working with all of you who I have met so far and am eager to work with you all more going forward.

Wind Storm Damage Assessments

By Jason Richards

Damaging storms have been increasing in frequency over a number of years which has been cause for concern for insurers. Not surprisingly, we see a big influx in assignments after wind storms. Tree impact claims which occur when a building or surrounding structure, such as a deck or porch, is struck by a falling tree or tree branch, make up a large portion of these post-storm claims.

Our first step upon arriving on site after a tree impact is to do an initial exterior inspection of the home and property to locate the main point(s) of impact and document any damage. Fallen trees are often removed from the property before we arrive as part of the emergency clean up efforts, so reviewing photographs of the tree on the building is helpful.

Typically, the main point of impact to a home will occur to the side of a sloped roof, a roof ridge, or at a roof/exterior wall interface. Depending on where the main point of impact is located, different damage visible from the exterior can be expected in the immediate area of the impact. For instance, when a tree impacts a sloped side of the roof you can expect to see roof penetrations where branches were able to puncture through the roof and an overall sagging/deformation of the roof slope. When a tree impacts a roof ridge you will often see local crushing at the ridge. And, when a tree impacts the roof/exterior wall interface you can expect to see damage to the roof overhang framing, soffit, fascia, and eavestrough. All of these can be concerning to homeowners and should be addressed and identified as soon as possible.

Once the exterior inspection is complete, we enter the home and attempt to access the main point of impact if it is safe to do so. This often involves entering attic spaces to inspect the roof structure for damage. We look for cracked or crushed rafters/trusses or any other damage that requires a structural repair. If impact occurs near the roof/exterior wall interface there may be cracking and/or crushing damage to the roof truss tails that frame the roof overhang. This damage may not always be easily visible due to the attic insulation and the overall sloping of the roof towards the exterior walls. We will typically identify damage to the truss tails from the exterior by looking for deformation to the roof overhang and/or exposed areas where the soffit is removed. Often, when a tree impacts a roof, damage to roof sheathing or strapping occurs - this damage can easily be repaired by a roofing contractor during repairs of the roof covering.

When the impact occurs to the roof/exterior wall interface there may also be damage to the exterior wall structural framing. For this type of damage, we would look for areas where the interior finish may be displaced as a result of a cracked framing member. This type of damage is not seen as often as roof damage because the walls are typically protected by a roof overhang.

When walking around the interior and exterior of homes after tree impacts it is common to see cosmetic damage within and outside the area of impact. Inside the home there may be cracking to the plaster or gypsum board ceiling and wall finishes. Doors or windows that were operating properly prior to the impact may now be out of alignment and unable to open and close properly. Outside the home there may be step cracking within the mortar joints of a brick or stone veneer.

These types of damages often lead homeowners to fear that tree impact has caused their home to shift or twist on the foundation below, or that the tree impact has caused the foundation to crack or settle. These problems rarely occur after tree impacts.

When the tree impact occurs, flexing occurs to the wood framing of the home. This can include the roof, floor, and wall framing. Flexing is the framing's response as it attempts to absorb the impact. While wood is a flexible building material capable of significant deflection without failure before returning to its original shape, most interior and exterior finishes are not. A wide variety of interior and exterior cosmetic damage can occur. For instance, a rigid door or window can cause the framed opening to come out of alignment when the surrounding wall flexes. A flexing roof truss can cause an interior gypsum board ceiling finish to crack. Flexing wall framing can cause brick veneer to crack along mortar joints. While this damage can be alarming, it is rarely structurally significant. A full scope of cosmetic damage can be prepared as part of our report.

We are always happy to assist with these claims. We can provide a structural scope of repair and, if necessary, drawings for building permit to repair the damage. Feel free to contact us!

Why Do Fasteners Loosen?

Alex Caskanette

With winter fast approaching many of us are lining up to replace our summer tires with winter tires. Tires are mounted on rims which are then secured to a vehicle's wheel hub with lug nuts. These lug nuts are threaded onto the wheel hub's studs. Tightened lug nuts clamp the wheel assembly to the wheel hub forming a bolted joint. Lug nuts are generally conically shaped on the surface that contacts the wheel. This conical profile positions the tapered portion of the nut during tightening into contact with the rim, which centers the stud inside the hole and prevents the wheel studs from directly contacting the rim.

Proper lug nut torque is necessary to ensure that the wheel is properly mounted to the vehicle. Vehicle manufacturers typically specify the type of lug nuts that should be used to secure the rim, the tightening pattern that should be used, and the amount of torque that should be applied. Have you ever wondered why you are told to go back to the mechanic for a retorque after a tire change? The retorque is an important safety step that many people skip at their peril.

For a bolted joint to function properly it must maintain a constant clamp load. One drawback with bolted fasteners is that they can self-loosen under vibration. Self loosening has been studied and was documented in the research paper written by Junker Gerhard in 1973, "Criteria for self loosening of fasteners under vibration".

It has been determined that transverse vibrations are more severe than dynamic axial loads for bolt self loosening. This is the big problem for lugs nuts because they are subjected to repeated transverse movements during vehicle operation. The force from the transverse movement can be a greater than the frictional force created by the clamp resulting in the self-loosening of the lug nuts.

When a lug nut self-loosens the remaining lug nuts are require to bear a greater portion of the wheel's clamping load. This can introduce more vibration into the system which can accelerate the self-loosening of the other fasteners and can result in the overloading of the remaining studs. If this issue is not corrected immediately, the overloaded studs can fail catastrophically, allowing the wheel to separate from the vehicle. We have observed this exact phenomenon occur a number of times. Figure 1 below displays a wheel hub where 4 of the lug nuts were determined to have self loosened.

Loose bolts can result in major mechanical failures and personal injury. Our staff at Caskanette Udall Consulting Engineers specialize is both of these areas. Keep you and your family safe on the roads this holiday season. Get your lug nuts retorqued.

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