



Fire Investigation Report
Home Building Centre's Saw Shed
332 Old Airport Road
Yellowknife, Northwest Territories

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Table of content:

Overview	Page 3
Exterior examination of the structure	Pages 3-4
Interior examination	Pages 4-7
Findings	Pages 7-11
Cause determination	Page 12
Conclusion	Page 12
Recommendations	Page 13
Photographs	Annex A
A.D. Williams, Forensic Structural Report	Annex B
Sintra Engineering Inc, Forensic Electrical Report	Annex C

Overview

The fire occurred in the early morning of March 17, 2005 in the detached Saw Shed at the Home Building Centre located at 332 Old Airport Road in the City of Yellowknife, Northwest Territories. Legal description; Lots 13, 14-1, and 14-2, Block: Airport Road Sub-division 1.

The Saw Shed was located adjacent to the main building at a distance of approximately one (1) foot. The fire was confined to the Saw Shed and did not spread from that structure to exposures.

The Saw Shed was one (1) story, approximately fifty-three (53) meters square windowless structure with one access door and one overhead door, both located on the northern side of the building. Wall construction was two by four (2 X 4) framing at twenty-four (24) inches on-centre, insulated with fiberglass insulation and OSB for interior and exterior finishes, and the roof construction was engineered joists with one half (1/2) inch OSB on the ceiling and exterior covering of the roof, and insulated with fiberglass insulation. The roof was covered with roof sheeting.

The Fire Department received a call to respond at 07:04 and on arrival at the scene at approximately 07:09 reported "heavy smoke from the structure that's attached to the main building". During the fire fighting operations the roof of the Saw Shed collapsed while four (4) fire fighters were performing work on the roof, and two (2) interior attack fire fighters were inside the structure. The roof collapse sent four (4) fire fighters on the roof sliding inside the structure, and completely buried the two (2) interior attack fire fighters with roof debris and heavy snow accumulations. Tragically as a result of this fire and ensuing roof collapse, two fire fighters perished in the line of duty.

Exterior examination of the structure (Photos 1-10)

I attended the fire scene at 14:58 March 17, 2005. The Royal Canadian Mounted Police provided scene security and controlled access until the completion of the fire scene examination March 18, 2005 at approximately 15:00.

West side (adjacent to main building): The Saw Shed is detached from the main building at a distance of approximately one (1) foot. No sign of fire behaviour observed on the walls up to the exterior sheeting of the roof joists. The south portion of the roof joist exterior sheeting fell outward towards the main building as a result of the roof collapse. Signs of interior fire behaviour activity are noticeable from the discoloration of paint in the upper area of the exterior wall finish of the roof assembly, some of the discoloration may also be due to the venting of product of combustion. In the northwest area, an electrical service cable was provided from the main building and penetrating the Saw Shed exterior wall to the interior electrical service panel.

There was a significant amount of snow between the two buildings.

South side: Showed no sign of fire behaviour on the walls up to the upper area of the wall approximately four (4) to five (5) feet from the southwest corner. Signs of interior fire behaviour activity are noticeable from the discoloration of paint in two small spots in the upper area of the exterior finish. The roof exterior wood sheeting appears slightly elevated/displaced as a result of the roof collapse, and paint discoloration from interior fire behaviour is noticeable on some of the displaced sheeting of the roof.

East Side: Showed no sign of fire behaviour on the walls up to the upper area of the wall just below the roof assembly. The roof on the east side collapsed as an assembly with the eaves for almost the entire length of the east side with the exception of a small portion towards in the north end of the east wall where the eaves and roof assembly were slightly displaced by the collapse. The front of the east wall was cluttered with lumber storage and one storage shed.

North Side: Showed no sign of fire behaviour other than some discoloration of paint from the auto-venting of smoke from the upper areas of the access door, overhead door and where the roof assembly meets the wall above the overhead door area. The roof joist on that face are still in place but some edges of the roof sheeting are visible above the roofline due to the roof collapse. The front of the north wall was cluttered with a large pile of snow, building materials and debris and equipment all removed during the rescue efforts following the roof collapse. Also visible were fire-fighting equipment such as the attack hand line (hose) with foam nozzle, self-contained breathing apparatuses and fire fighter turnout gear.

There was no evidence found from the exterior examination to suggest this fire started from the outside and spreaded to the interior of the Saw Shed.

Interior examination (Photos 11-37)

The interior of the structure in terms of content, roof and building components were subject to displacement and relocation due to the roof collapse, and post collapse rescue efforts.

A portion of the roof was still attached/laying in most part from the east wall down inside the Saw Shed. Most of the roof assembly on the west wall had collapsed inside the building with the exception of a small portion of the north and south roof sections that remained secured to those end walls.

The accumulation of snow inside the structure was copious and found in most areas of the floor, an exception being under the work bench in the north area of the east wall, with a post rescue operation maximum height measured at fifteen (15) inches. Snow had already been removed during rescue efforts and a significant amount of snow was also piled up outdoors. Therefore the interior snow accumulation inside the structure post collapse can be summarized as significant as it completely buried the two (2) interior attack fire fighters and locating them during the rescue efforts took several minutes.

No signs of fire behaviour activity were noticed on the east and north walls other than smoke stain damages.

In the upper areas of the southwest corner of the structure a noticeable “V” burn pattern was observed. The burn patter moved from the upper area of the southwest corner upward and outward towards the south and west wall, and ceiling area.

The fire had breached the interior sheeting on the west and south wall and burning patterns were noticed of the wood studs and wall top plate. The exterior sheeting of the walls were not breached as a result of this fire. A section of the roof joist rim board on the west wall towards the south corner appears to have been consumed by fire. This is consistent with the exterior fire damages to the roof joist exterior sheeting in the same area and would indicate that this fire had reached the stage of breaching the building envelope.

The 240 volts electrical receptacle for the space heater was adjacent to the “V” burn pattern, the outlet was in the path of the fire and was damaged by the fire.

The plug for the space heater was no longer connected to the 240 volts electrical receptacle. The electrical conduit in that vicinity was still in place with but was subject to fire behaviour activity. The conduit was found in fair condition with the exception of a small gap in the continuity of the conduit of approximately one (1) inch, exposing the fire damaged electrical wires.

Some of the sheeting covering the ceiling were breached by fire and burn patterns on several wood joists and underside of the exterior roof sheeting were observed, some still in place, other laying on the floor in the shed or scattered to the exterior of the structure.

The news video footage taken just before the roof collapse confirms the fire behaviour activity within the roof cavity, as the interior attack team had reported at approximately 07:25; “we have no active burning on the inside of the structure of the frame, we can hear some crackling in the roof area but that’s about it for now”. This was the last radio transmission from the interior attack team.

That radio transmission was acknowledged by fire command that replied, as recorded on the radio audio log; “ I can still see the dark smoke coming out the eave there so it looks like its just traveling in the roof there but we’ll get that opened and get it under control.”

On the southeast portion of the roof, there was evidence of saw cuts made by fire fighters on the roof. On top of Joist # 3 from the south, it is noted that the saw cut severed the top chord of the roof joist. The location of the cut is consistent with the location of the fire fighters as viewed on a media footage of the fire operation. It is also consistent with directions given from Command as noted on the radio log at approximately 07:27; “Yeah the area on the roof where that thing should be opened up just by looking out there should be the corner where the owl is sticking up”. The board in the area of the cut was still in

place as fire fighters on the roof were in the process of dislodging the cut section board when the roof collapsed.

On the roof section inside the structure, several full depths saw cuts were observed but those were associated with the rescue efforts after the collapse.

Below southwest corner, and noted "V" type burn pattern, a portable electrical heater was noticed resting on building materials. The heater and electrical cord had sustained fire damages, and the electrical plug was not found. The plywood shelf held by "L" shaped metal brackets was not located and was presumably consumed by fire. The "L" shaped brackets were located in the snow below the general area of the shelf in the southwest corner.

The space heater exterior shell damaged by the fire, but the housing and internal components with the exception of slight damages and melting to the cooling fan appeared in relatively good condition.

The wood crates for the building materials in the southwest corner under the general area of the heater shelf sustained burn damages, and some melting of plastic materials from the surrounding heat.

A secondary burn pattern was found in the southwest corner floor, west wall and south wall. On the west wall floor area, melted metal residue that appeared to be a small pool of aluminum was found in the general area beneath the electrical outlet for the portable heater. This metal residue is believed to be the residual remains of the electrical plug of the heater that was not found. Due to the storage of building materials in that corner, the burn pattern was interrupted by obstruction but overall it is consistent with burn patterns caused by drop down ambers from the fire behaviour activity from the upper wall and wood heater shelf.

The plywood shelf on which the space heater had been mounted had been consumed during the fire and the space heater had dropped down on materials stored in the southwest corner.

A triangular shelf was in the opposite corner of the building and was, according to the owner, the same size to the one consumed in the fire. It was removed, measured, and dimensions and construction were provided to the forensic electrical engineer. The shelf measured 610 mm (24") by 610 mm (24") by 850 mm (33 ½").

At the ceiling area close to the west wall, the three (3) fluorescent light fixtures were located for examination. Fire damages found on the fixtures were found to be consistent with heat being applied from an outside source and are victim of this fire. There were no burn patterns found on the ceiling area that would suggest the fire started by the light fixtures therefore they are not considered as an ignition source for this fire.

The portable electric space heater was the only potential source of ignition found in the area of origin of this fire.

The Saw shed electrical services were subject to examination by the GNWT Chief Electrical Inspector from the Department of Public Works and Services.

The Saw Shed's electrical panel, which had four (4) tripped breakers as a result of this fire, one of the tripped breakers was for the space heater, the others being for the dust collector, table saw, and emergency light.

The electrical heater, remains of the power cord, and heater electrical female outlet were removed from the scene and subject to examination by a forensic electrical engineering firm. RCMP Cst. Eric McKenzie of the evidence section handled the chain of custody from the fire scene to the electrical engineering laboratory.

To this date the incident portable space electrical heater is being retained in the evidence locker at Sintra Engineering Inc.

The cause of the collapse and method of construction were subject to examination by a forensic structural engineering firm.

Findings

The fire was reported to fire dispatch at approximately 07:04 by Derick Softner? reporting a lot of smoke coming from a corner of the building just past Corother's Home Hardware.

The time as to when this fire actually started is not known. The early stages of interior flaming would not be readily apparent from the exterior of this windowless structure. Smoke showing on the exterior of the building as witnessed by the caller was the first reported indication of a fire in the Saw Shed.

Flames were not sighted on the exterior of the building during the fire operation. A news footage taken just before the roof collapse showed smoke escaping from to end the roof eaves vents, and small openings in construction, and from the two doors at the north end of the building. Visibility on the roof itself for the fire fighters appeared good, but visibility to the roof area was slightly reduced as the smoke was billowing upwards from the openings.

Some residual burning of the roof material was observed in a RCMP photograph taken post rescue efforts. A small area on the roof sheeting material was still burning in the southwest corner.

Once entry through the locked gate was gained by the fire department, the access door to the saw shed was found unlocked. This is consistent with a statement from Geoff Chambers, a worker at the Home Building Centre, who indicated he closed the shed door

the night before but the door does not lock, the heater was plugged in and the shed was warmer than outside.

The overhead door was in the open when the roof collapsed and subsequently removed from the structure during rescue efforts. Fire fighters had opened the door to assist in ventilating the structure.

The Saw Shed content, based on the owner's recollection, consisted of a stand up saw, a radial saw, a table saw, work bench, a dust collector, a plywood box, a garbage pail, and a small quantity of stored materials such as OSB plywood sheets and counter tops. The items observed on the interior and exterior of the building post rescue operation, are consistent with the stated content from the owner.

The fire load in the saw shed was low, and was not a factor in this fire as fire behaviour activity was mostly confined to the building envelope, more specifically in the upper area of the southwest corner, south and west walls, the ceiling and the roof cavity.

The snow loading on the roof at the time of the fire is unknown but the entire roof was snow covered. By viewing a media footage pre-collapse, it appears at the time of the fire the height of the snow was approximately one (1) metre high along the west wall, and descending in a slope to approximately point three (.3) metre high along the east wall.

Fire fighters were assigned by command to cut a ventilation hole in a specific area of the roof in the corner where the owl was located. The weight added to the roof with the four (4) fire fighters and equipment, as determined by WCB, was 460.85 kg (1,016 lbs).

There are no records held at the City of Yellowknife Building Inspection Division or Fire Division that could identify when the building was erected or if the building was ever inspected.

There are no records held at the GNWT Office of the Fire Marshal, both headquarter and regional offices that could identify when the building was erected or if the building was ever inspected.

According to information provided by the NWT Office of the Chief Coroner, the cause of death of both interior attack fire fighters, Cyril Fyfe and Kevin Olson, is attributed to compressional asphyxia. During the course of the fire the roof of the building collapsed burying them beneath a large amount of snow.

Following extracts from the A. D. Williams Engineering Inc report (Annex B)

"There was no indication that a Professional Engineer had reviewed the design of the Saw Shed." (A. D. Williams, Annex B p.3)

"What appears to be the second roof joist from the south end shows significant combustion damage to the bottom chord and the web. The top chord appears to have

separated from the web and the web splices has separated. The separation is probably as a result of damages associated with the roof collapse.” (A. D. Williams, Annex B p.3)

“The remnants of what appears to be the ninth roof truss from the south end remains partially attached to the rim board but has significant combustion damage to the bottom chord and web.” (A. D. Williams, Annex B p.4)

“Fire damages to the roof trusses between truss # 2 and truss # 9 are not clear, as this area was subject to significant disruption from the collapse and rescue efforts. Remnants of those trusses have not been examined, however the general fire damage profile created on the wall and visible damage to trusses # 2 and # 9 indicate that the intervening trusses would have been subject to combustion damage.” (A. D. Williams, Annex B p.4)

“On the lower portion of the roof near the southwest corner of joist # 2 and # 3, there was evidence of saw cuts presumably made by the firemen on the roof. On top of joist # 3, it is noted that the saw cut severed the top chord. In other locations, full depth saw cuts are assumed to be associated with the rescue efforts after the collapse.” (A. D. Williams, Annex B p.4)

“The roof joists were approximately 75% of the required design capacity.” (A. D. Williams, Annex B p.4)

“The actual snow loading on the roof is not known. Various statements were made to the effect that the roof snow was hip deep in some locations. The design specified snowdrift load of 3.9 kPa equates to approximately 1.3 metres of snow depth. Comparison of the reported snow depth to that recommended by the National Building Code of Canada and applying the industry standards for safety, indicates the undamaged roof was subject to a snow load near the recommended snow load.” (A. D. Williams, Annex B p.5)

“Analysis of the actual roof system with an average snow depth of 0.8 metres and a cluster of 4 firemen in full gear (estimated 225 pound each and two men aligned on a single roof joist), indicates an undamaged roof joist was below design capacity in the order of 50%.” (A. D. Williams, Annex B p.5)

“Analysis of the roof system, with an estimated snow load and a cluster of four firemen, plus a severed top chord joist, would result in joist strength several times less than required to support the load.” (A. D. Williams, Annex B p.5)

“Actual capacity of the roof system with combustion damages to the bottom chord and web of trusses 2 through 9 and carrying the snow load and fire fighters cannot be accurately calculated. However given the capacity margins noted in the previous calculations, the roof system as damaged by the fire was not capable of supporting the combined loading with the resulting collapse.” (A. D. Williams, Annex B p.5)

Following extracts from the Sintra Engineering Inc report (Annex C)

“The volumes of the saw shed was 163 cubic metres (5,760 cubic feet) and at one point heated by two (2) separate space heaters; however, one of the heater had been removed, and for the last months preceding the fire, only one space heater had been in use.” (Sintra, Annex C p.2)

“The only identification markings on the heater were located at the base of the heating element. The heating element data plate had a CSA stamp and indicated that the element was model number KXF-AC2098-02 B99S manufactured by Caloritech, that required 240 V with an output of 4800 W.” (Sintra, Annex C p.4) Follow up investigation with the manufacturer by Sintra confirmed the incident heater was manufactured in February 1999.

“The characteristics of the heater (rating, size and components) were consistent with that of a model PCH construction heater, manufactured by Stelpro Design Inc (Stelpro). According to the manufacturer’s instructions, the PCH construction heater was designed for temporary use. The Stelpro installation instructions repeatedly warned for the potential of fire or injury should the heater not be used and installed as per the manufacturer’s instructions. The Stelpro instructions indicated that combustibles should not contact or come in contact within 610 mm (24”) of the heater and that not heeding this warning could lead to a fire. The Stelpro instructions also indicated that obstructions in air flow (in or out) could overheat the unit and lead to a fire.” (Sintra, Annex C p.5)

“The Stelpro instructions stressed the importance of matching the heating capacity of the heater to heating needs of the room, as an undersized heater can operate continuously, which they are not designed to do. For ceiling height in excess of 2.4 m (8’), Stelpro recommend using 1.2 watts per cubic foot to calculate heating requirements.” (Sintra, Annex C p.5)

“The Stelpro instructions stated that activation of the thermal protection (high limit switch) was indicative of abnormal condition, and that an electrician should inspect the unit should this occur.” (Sintra, Annex C p.5)

“The fire was caused by a Stelpro electric space heater that repeatedly overheated in close proximity to a combustible wall. The contacts of the high limit switch on the heater were badly pitted, indicating that the heater had been repeatedly overheating while in operation. The heat generated during abnormal heater operations pyrolyzed the OSB wall finishing, leading to the eventual ignition of the wall. Once ignited, the fire spread up and out along the ceiling, which compromised the integrity of the roof structure and led to its collapse during the suppression of this fire.” (Sintra, Annex C p.5)

“The overheating of the space heater resulted from incorrect use of the unit. The installation was contrary to the manufacturer’s installation instructions. The clearances between the rear of the heater and wall ranged between zero and 224 mm (9”), which was substantially less than the 610 mm (24”) required by the manufacturer. The lack of