

Brenton Suites Crane Collapse Report

Department of
Labour and Advanced Education

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Brenton Street Crane Collapse Report
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Summary

On September 7, 2019, a tower crane erected at 1452 Brenton Street, Halifax, collapsed during Post Tropical Storm Dorian. Winds at the time of the event were recorded at 97 – 107 km/h.

The collapse of the crane resulted in significant damage to public and personal property, including destruction of the crane. There were no injuries.

This report provides an overview of the investigation conducted by the Safety Branch of the NS Department of Labour and Advanced Education (LAE), the findings with respect to the cause of the tower crane collapse, and actions taken by owners and operators to prevent such an event from occurring, as required by legislation, regulation, and adopted safety standards.



Photo 1: Aerial View of 1400 block of South Park Street Halifax after the collapse. Credit: Halifax Regional Fire & Emergency

Background

In Nova Scotia, tower cranes are regulated under the Acts, Regulations, and adopted safety standards administered by the Occupational Health and Safety (OHS) Division and Technical Safety Division of the LAE Safety Branch.

INITIAL INSTALLATION OF CRANE

On January 7, 2019, a Manitowac Model Potain 8520P tower crane owned and operated by Lead Structural Formwork Ltd. was erected at 1452 Brenton Street, Halifax, Nova Scotia, to facilitate the construction of a multi-storey residential building by W.M. Fares and Associates Inc. at that location. The tower crane was free standing with a total height of approximately 73 metres (240 feet). As required by the *Occupational Safety General Regulations*, a non-destructive testing report and engineer certification were provided to the Safety Branch at the time the crane was placed into service, indicating that it complied with the applicable standards.

REPLACEMENT OF CRANE UPPER SECTIONS

On June 4, 2019, the Safety Branch was advised by the general contractor that the turntable at the top of the tower crane had seized, preventing it from “weather-vaning” when subjected to wind loads. Weather-vaning is the ability of the crane to rotate freely into the wind when not in use. This is intended to reduce the effect of the wind on the structure. The general contractor advised that the top section of the crane, consisting of the cabin, turntable, and jib would be repaired or replaced as soon as possible to deal with the inability to weathervane. Removal of the affected section was completed on June 7, 2019.

On June 17, 2019, a new transition section (Figure 1) was installed on top of the previously erected Potain 8520P tower section (which had been manufactured in approximately 1974) to allow for proper weather-vaning. At the same time, a newer Potain MDT 268A model turntable, cabin, and jib (manufactured in 2015) were installed on the older tower section. Additionally, on this date, all the required test and certification documentation was provided to the Safety Branch, including:

- Engineer certified design for transition piece
- Engineer approval for installation on tower section
- Non-destructive testing for existing tower completed in erected state
- Non-destructive testing completed for new sections being added
- Engineer certification for crane after installation of transition piece, cabin, turntable, and jib at time crane was placed into service

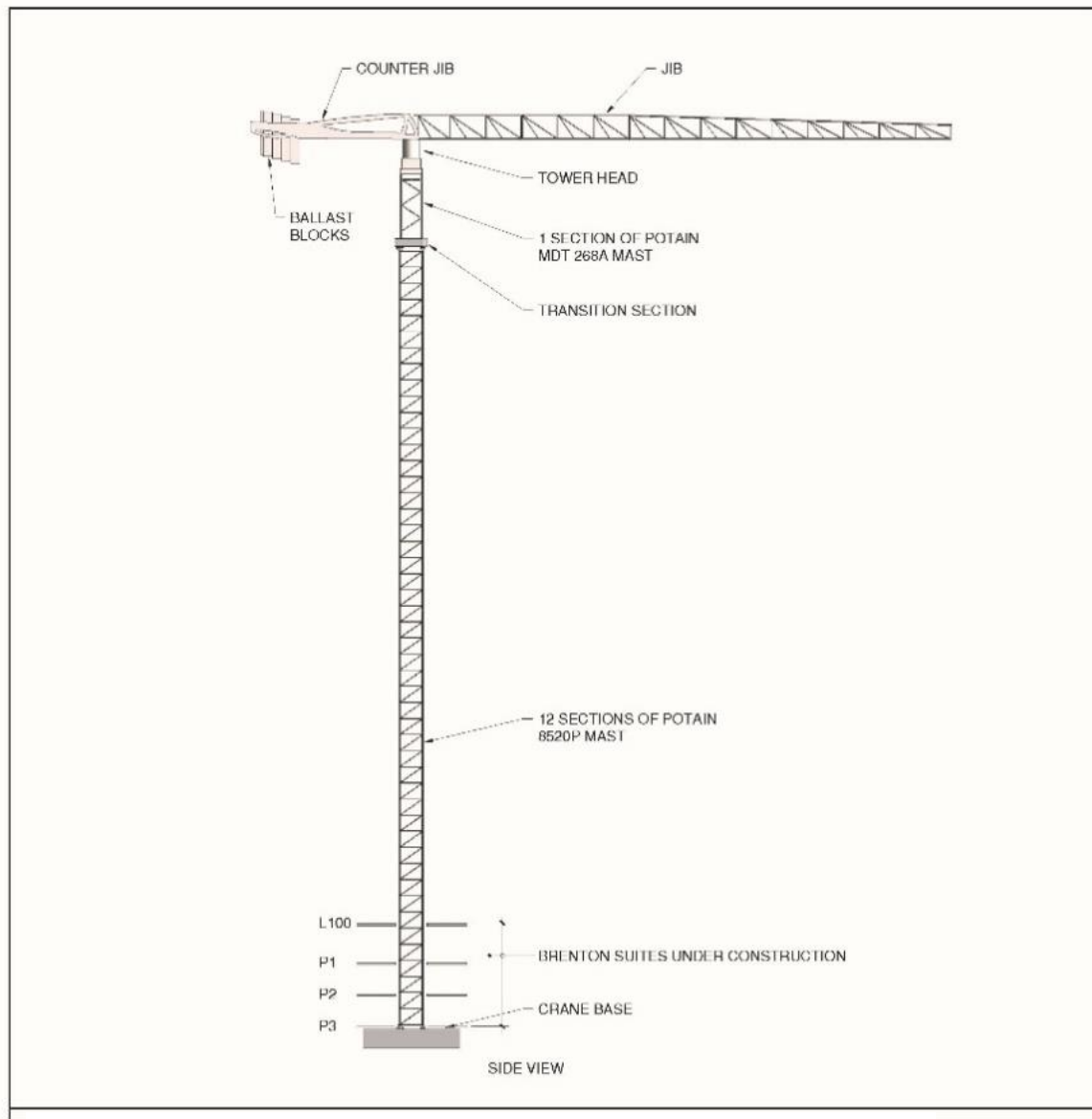


Figure 1: Crane sections.

Credit: BMR Structural Engineering for NS Department of Labour and Advanced Education

TROPICAL STORM DORIAN AND CRANE COLLAPSE

On September 6, 2019, because of impending high winds forecasted for Tropical Storm Dorian, OHS officers visited worksites where tower cranes were present in the Halifax Regional Municipality (HRM), including 1452 Brenton Street, to remind owners and operators to properly prepare cranes for wind conditions. On the same day, the Chief Crane Inspector provided letters to crane owners and operators reminding them of the requirement to properly prepare cranes for wind events by ensuring they are able to turn freely in the wind and align themselves with the direction the wind is blowing, thereby reducing the surface area of the structure exposed to the wind. A copy of this letter was provided to the crane owners at the 1452 Brenton Street worksite.

During the storm on September 7, 2019, at approximately 4:00 PM, the tower crane collapsed toward the north-west and struck the top corner and a balcony deck on the northeast corner of The Trillium Building located at 1445 South Park Street, causing damage to that building (Figure 2). The crane came to rest on the Olympus Building, an adjacent 13 storey building under construction in the 1400 block of South Park Street. The top three levels of the Olympus Building were significantly damaged. Counterweights from the tower crane fell to the ground, landing on the east side of South Park Street, causing significant damage to the sidewalk and street. This resulted in several businesses and residents being evacuated from the area under an order issued by Halifax Regional Fire and Emergency Services. Those evacuated returned only after it was determined safe to do so.

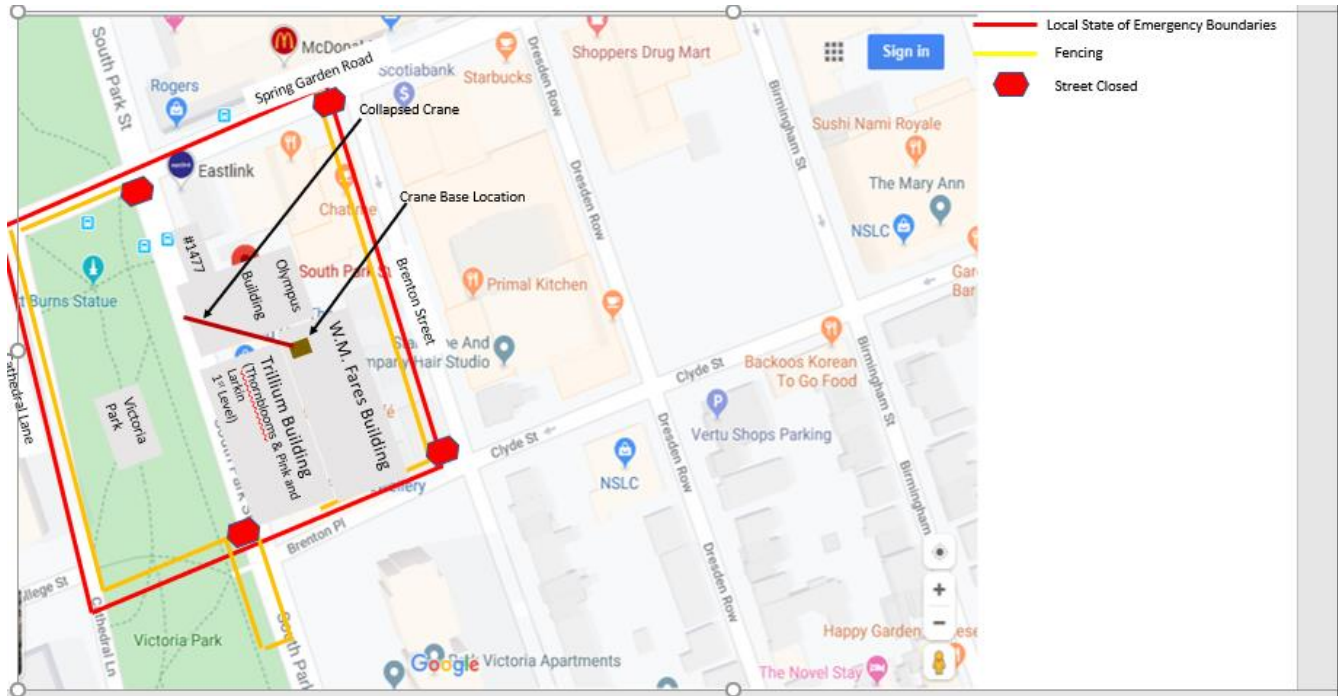


Figure 2: Crane collapse location

Credit: NS Department of Labour and Advanced Education

The Investigation

Following the incident, the Safety Branch of the Department of Labour and Advanced Education investigated to determine the cause of the collapse of the crane and to verify compliance with the applicable Acts, Regulations, and standards.

On September 8, 2019, Safety Branch inspectors and an officer attended the site and began the investigation. On September 12, 2019, once deemed safe to enter by a structural engineer, a more detailed examination of the crane from inside the structure at 1452 Brenton Street was undertaken.

A possible failure point was initially identified in a lower mast section at the northwest corner of the crane tower (later referred to as Section 2) where a hollow diagonal tube had become separated from a solid vertical post at a point where it had previously been welded together (Photo 2).

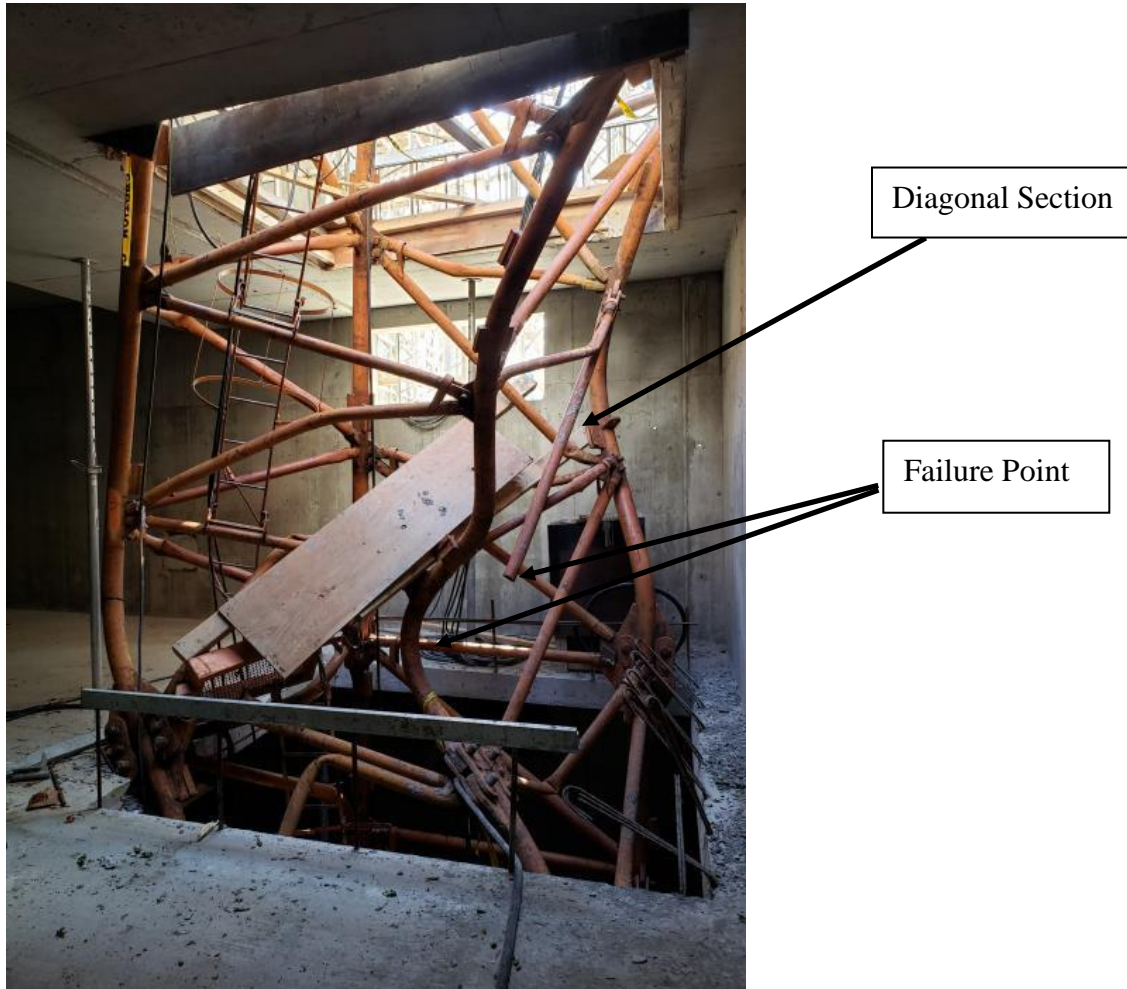


Photo 2: Crane section after collapse. Highlighting the diagonal section and failure point. Credit: NS Department of Labour and Advanced Education

ENGINEER REPORT

BMR Structural Engineering was hired by the Safety Branch to conduct a preliminary review of the tower crane equipment and information collected to that point related to the collapse. The engineer arrived onsite September 10, 2019. Following their review, the report prepared by the engineer determined:

- Generally, tower cranes are designed to sustain winds of 150-160 km/h. Wind speeds in the area at time of incident were 97 km/h sustained, with gusts of 107 km/h.
- The jib, top mast, transition piece, and mast sections directly below the transition piece were undamaged. Based on their examination and other information collected by inspectors, including videos taken just prior to the incident, the engineer determined there was no structural failure in the top sections prior to the incident.
- The bolts in the crane base were undamaged, indicating this did not contribute to the failure.

- The engineer's report concluded that the crane collapse was the result of the failure in the second section of the mast approximately 6 to 9 meters above the base (initially identified by inspectors in Figure 3).

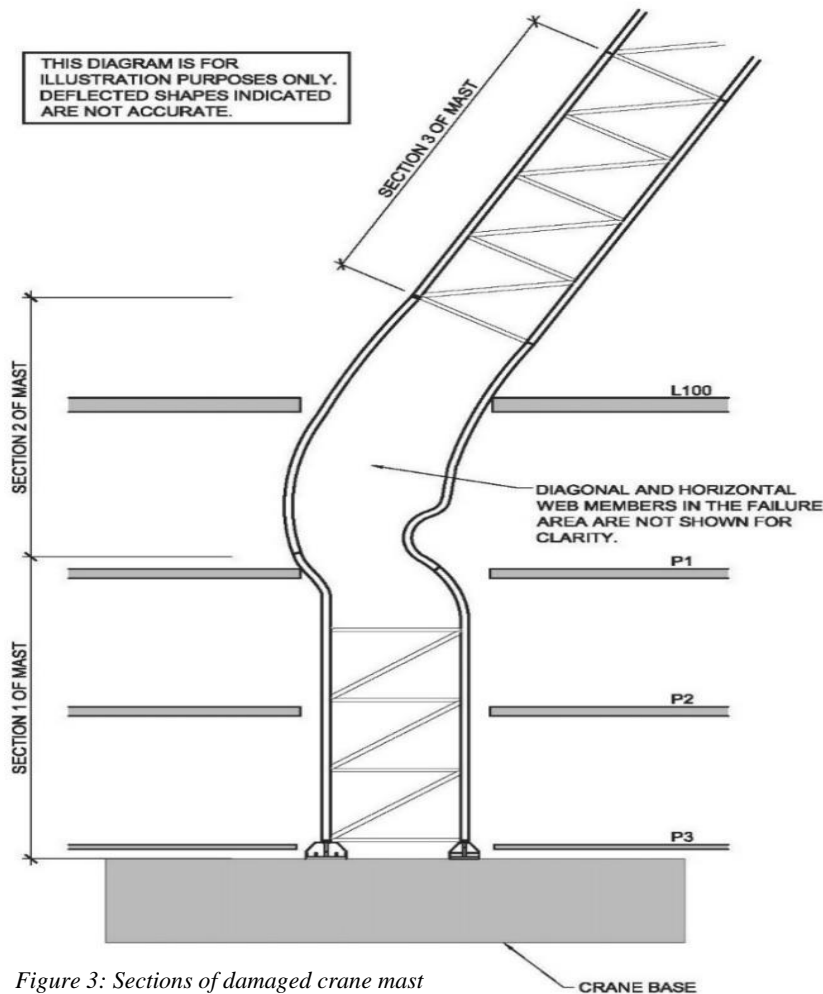


Figure 3: Sections of damaged crane mast
 Credit: BMR Structural Engineering for NS
 Department of Labour and Advanced Education

Interviews conducted following the incident confirmed that on September 6, 2019, the crane was prepared as follows for wind event forecast for September 6-7, 2019:

- Rigging was taken off the hook, the block was raised to its highest position, trolley was locked in place, the slewing brake was manually disengaged, and the counter jib was checked for any unsecured objects.
- The crane was placed in weather-vaning mode by computer and confirmed it would vane properly.

On October 1, 2019, Compliance Orders were issued under the *Occupational Health and Safety Act* and *Technical Safety Act* to the owner of the crane for a metallurgical assessment of the diagonal brace and

node identified as the point of failure and an assessment of the turntable. The node is the point of the weld where the diagonal connects to the vertical post.

Because of the travel and gathering restrictions imposed due to the COVID-19 pandemic, the ordered assessments and results were delayed until the latter part of 2020.

On August 7, 2020, the metallurgical testing report for the diagonal section, node and weld was received, indicating there was a lack fusion, corrosion, pores, and a crack, which propagated from the inside diameter to the outside diameter of the area of the weld. The report also mentioned other welding defects on other welded connections.

On September 15, 2020, the report for the mechanical assessment of the turntable was received. The engineering report identified no defect or abnormality that would have existed prior to the crane collapse or contributed to the collapse.

The two reports confirmed that there was no abnormality in the turntable that would have contributed to the incident and that the defect in the weld on the second mast section contributed to the collapse of the crane.

Regulatory Compliance

As per the requirements of the *Occupational Health and Safety Act* and *Technical Safety Act*:

- At time of the initial setup of crane January 7, 2019 and prior to the crane being placed back in service following the installation of the new top piece June 17, 2019, non-destructive inspections were completed in accordance with section 6.3.1 and 6.4.2 of CSA (Canadian Standards Association) standards *Code for Tower Cranes* CSA Z248-04 (reaffirmed 2014) and CSA Z248-17.
- Engineer inspections were completed prior to the crane being placed in service January 7, 2019 and June 17, 2019 in accordance with section 6.4.3 of CSA standards CSA Z248-04 (reaffirmed 2014) and CSA Z248-17 and section 72(1) of the *Occupational Safety General Regulations*.
- A certificate of inspection completed by an engineer was obtained by the crane owner on January 7, 2019 and June 17, 2019 prior to the crane being placed in service in accordance with section 73(4)(c)(i) of the *Occupational Safety General Regulations*.
- An engineer designed the transition piece and connections for that transition piece to allow for the newer top piece to be installed.
- A second engineer reviewed the design for the transition piece and advised the crane owner that the crane could continue to be operated in accordance with manufacturer specifications, which would include the wind speeds the original crane was designed to sustain.

- The investigation also identified that the crane operator's logbook did not document the daily inspections from August 15, 2019 to September 6, 2019 as required by the standards adopted under the *Crane Operators Regulations* of the *Technical Safety Act* and the *Occupational Safety General Regulations* of the *Occupational Health and Safety Act*.

ENFORCEMENT ACTION RELATED TO CRANE OPERATOR'S LOGBOOK

- The Chief Inspector, Crane Operators, issued a two-day licence suspension to the tower crane operator under the *Technical Safety Act* for failing to ensure the crane's logbook was used to record or document the operator's daily inspections from August 15, 2019 to September 6, 2019, as required by the safety standard.
- The Occupational Health and Safety Officer issued the tower crane owner, as the employer, an Order under the *Occupational Health and Safety Act* to ensure daily inspections are recorded in the operator's logbook for all tower cranes under its operation. An administrative penalty of \$500 was also imposed for the owner's failure to ensure the inspections were recorded in the logbook from August 15, 2019 to September 6, 2019, as required by the *Occupational Safety General Regulations*.
- Because neither CSA standard CSA Z248-04, nor CSA standard CSA Z248-17 require the operator to inspect the crane tower welds or structural components as part of the daily inspection, it was determined that the failure to complete the logbook was a deficiency, but did not contribute to the collapse of the crane.

Conclusion

The investigation by the LAE Safety Branch determined that the tower crane collapsed during the high winds of Post Tropical Storm Dorian on September 7, 2019, as a result of the failure of a weld where a diagonal tube had been connected to a vertical member of the crane mast between 6 and 9 meters from the base. The weld failure caused the diagonal tube to separate from the vertical member of the mast, transferring the weight supported by the mast's 4 vertical posts to only 3 of its posts, causing the tower section to rotate and fail, which resulted in the total collapse of the crane.

The investigation determined the tower crane owner and operator met the applicable legislative and regulatory requirements to prevent this event from occurring and no further regulatory action will be taken with regards to the collapse of the crane.

Immediate Next Steps

1. The Department of Labour and Advanced Education will meet with tower crane owners and operators to review the findings of this investigation and require structurally critical welds in the masts and booms of all tower cranes in Nova Scotia immediately undergo a thorough cleaning for visual inspection of welds, non-destructive testing on any welds as found to be necessary, and any deficiencies repaired by a person as specified in the regulations or standards.
2. The Department of Labour and Advanced Education will engage industry to develop and implement an industry leading code of practice or standard for enhanced tower crane mast and boom weld inspection, testing, and maintenance in Nova Scotia. The inspection and testing requirements and frequency will take into consideration all applicable factors including, but not limited to, environmental conditions, the age of the welds, maintenance of the structure, frequency of lifts being completed, weights of lifts, and cycling of the crane.