Worker fatally crushed between precast concrete panels

November 25, 2017

Alberta

The contents of this report

This document reports the Alberta Occupational Health and Safety (OHS) investigation of a fatal incident that occurred in November 2017. It begins with a short summary of what happened. The rest of the report covers this same information in greater detail.

Incident summary

Workers were using an overhead gantry crane to move a precast concrete panel from one set of storage racks on the west side of an aisle to a similar pair of racks on the opposite side of the aisle. The precast concrete panel was lifted and set down on the storage racks on the east side. Shortly after placement on the storage racks, the precast concrete panel began to tip west towards the aisle. A worker was standing on a ladder preparing the next precast concrete slab on the west side for a lift. The worker was struck by the fallen precast concrete panel and sustained a fatal crushing injury.

Background information

Employer

Lafarge Precast Edmonton (LPE) was a business unit of Lafarge Canada Inc. on the date of the incident. LPE started operations in 2005 and doubled its manufacturing plant size in 2014. Approximately 100 hourly waged workers were employed in the manufacturing and yard areas, administrative office and sales. In addition, there were 15 salaried management staff. All workers present at the work site on the day of the incident were employees of LPE.

LPE, located at 4425 92 Avenue Northwest (NW) in Edmonton (Figure 1), manufactured precast concrete products such as bridge girders, Hollowcore slab flooring, concrete beams, concrete spandrels, shear wall panels, columns, Jersey barriers and Insulcore sandwich wall panels. Workers were moving Insulcore panels at the time of the incident.

Labourer

Labourer was employed by LPE on short term intervals starting in April 2015. Labourer was laid off at the conclusion of each interval and then rehired as needed. Labourer returned to LPE on October 4, 2017. Labourer received orientation to the LPE work site on the first hire and each time that Labourer returned to LPE. Labourer had specific training on rigging and hoisting from a third party training provider. Labourer completed the Alberta Construction Safety Association Construction Safety Training System. Labourer was trained in safety procedures, work expectations, and procedures for multiple tasks including forklift operation, setting up yard storage racks, moving precast panels and working with a crane operator. One-on-one training by a competent worker and competency checks by a supervisor were used to train and confirm competency. Labourer was working in the gantry crane bay at the time of the incident (Figure 1J and Figure 1K).

Crane Operator

Crane Operator was employed by LPE starting in 1996. Crane Operator had performed several jobs in that time and most recently had been working as a crane operator. Crane Operator had taken a refresher course on crane operations from a third party training provider in September 2016. Crane Operator was trained in safety procedures, work expectations, and procedures for multiple tasks including setting up yard storage racks, moving precast panels and working with a rigger. One-on-one training by a competent worker and competency checks by a supervisor were used to train and confirm competency. Crane Operator was working in the gantry crane bay at the time of the incident (Figure 1J).

Other workers and managers

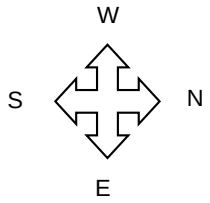
Six workers were located in the storage yard and three managers were in the office at the time of the incident. The location of the incident was out of sight for all yard workers and managers. The yard workers and managers responded to the emergency radio call immediately after the incident.

Work site, equipment and materials

Work site

Figure 1. Aerial view of Lafarge Precast Edmonton work site at 4425 92 Avenue NW, Edmonton. Photograph from OHS drone.

A. Shipping office
B. Storage yard loading/unloading area
C. Bay 7
D. Bay 6
E. Bay 4
F. Bay 3
G. Bay 2
H. Bay 1
I. Office
J. Gantry crane bay
K. Incident location



Equipment

Insulcor precast cement panels

Insulcore precast panels (precast panels) were engineered building panels consisting of foam insulation between two outer layers of cement and had structural members in the middle layer. Lifting rebar loops were built into the top and ends of each panel structure as per engineering specifications. There were multiple written procedures for manufacturing, curing, and lifting precast panels. Panels were constructed in one of several indoor bays in the main plant building. Panels were constructed in a pre-determined order matching a sequence for a specific job or project. Precast panels cured for a period of hours/days before being moved to storage (Figure 2A). Panels were moved using overhead cranes to a railway-cart system and then to storage locations in the yard. Panels were stored outdoors in the yard for weeks to months.

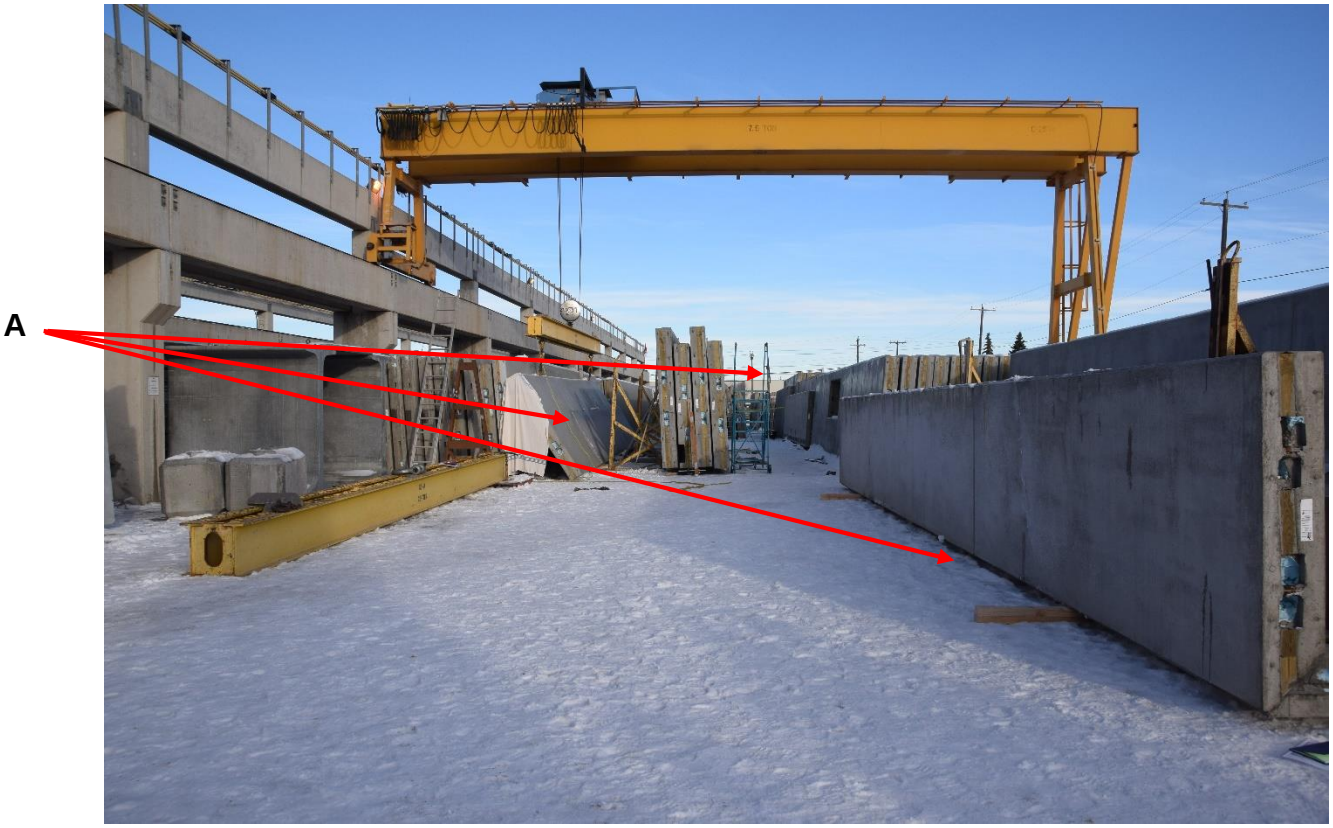


Figure 2. Insulcore precast panels in storage in gantry crane bay
A. Insulcore panels

Precast panels varied in height, length and depth. Precast panels each had a unique number and were labelled with an identification tag including the panel number, manufacture date, weight of the panel, job or project number as well as quality assurance confirmation noted by the initials of a quality assurance inspector (Figure 3). Precast panels weighed thousands of kilograms (kg). Examples of precast panels at the incident site weighed 11 156 kg, 15 690 kg and 18 050 kg.

Figure 3. Manufacturing labels affixed to Insulcore panels stored in the gantry crane bay

The precast panel (Panel 085-34) which tipped and fell was labelled: Job# 17085 Mark# 085-34 Piece 1/1 Cast 25 September, 2017 Mass 25420 LBS 11530 KG Quality Control Pre Pour AC (initials) Post Pour (initials) AC. The precast panel was 13.72 metres (m) long, 2.38 m tall and 0.25 m deep and weighed 11 530 kg (Figure 4).

Figure 4. Label on Insulcore Panel 085-34 that tipped and fell

The precast panel on which the Labourer was working at the time of the incident had no label affixed at the time of the incident. It was later identified through manufacturing records as Precast Panel Mark# 085-33 (Panel 085-33), part of the same Job# 17085 as the precast panel that tipped and fell. Panel 085-33 was cast on September 23, 2017. The precast panel was 13.96 m long, 2.39 m tall and approximately 0.25 m deep and weighed 11 156 kg (Figure 5).

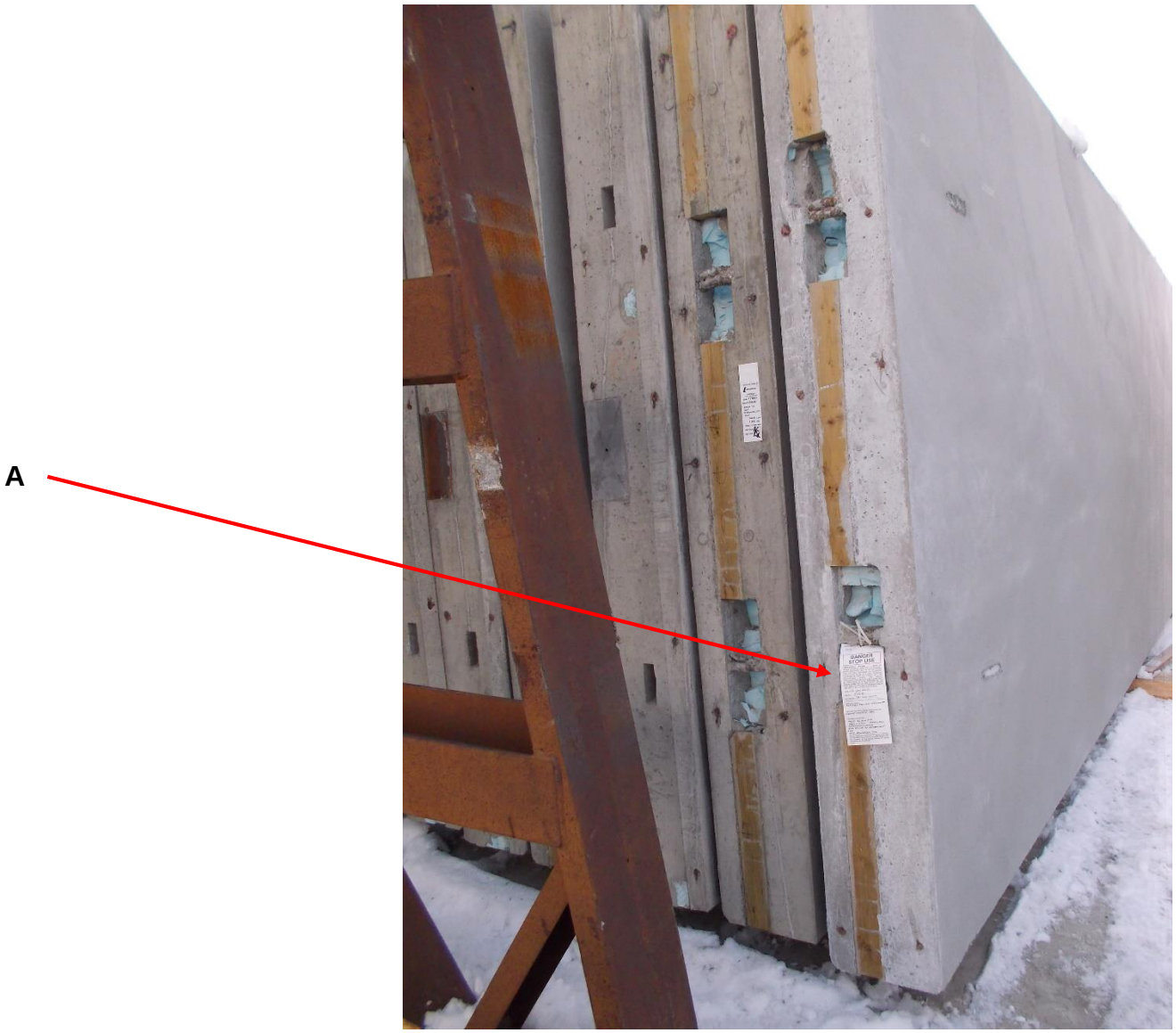


Figure 5. Insulcore panel 085-33. No manufacturing label was affixed at the time of the incident. The panel was identified by LPE. The Stop Use Tag #9606 was placed by OHS on November 26, 2017.

A. Stop Use Tag on Panel 085-33

Portable yard storage frames

Portable yard storage frames (storage frames) were used as supports to lean the Insulcore precast panels against during storage. The storage frames (Figure 6) had multiple names such as “lean-to", “A-frame" and "panel rack". The storage frames were purpose built for use with precast panels and designed by an engineer in 1997-2000. The storage frames were constructed of commercial grade steel members (CSA G40.21 300W) and were manufactured by LPE.

The storage frames consisted of a horizontal base, a back rest tilted at 85° to the horizontal base, a support member from the base to the rear of the back rest and two braces in the area between the base, back rest and support member. The storage frames were portable, frequently rearranged and moved using a forklift or crane. The surface on which they were to be placed was cleared of any debris, snow or ice. The storage frames were set up with the horizontal base and back rest with the 85° angle facing the aisle.

Rows of storage frames were in place facing in the same direction and parallel rows were placed in the opposite orientation. The distance between pairs of storage frames used for a given precast panel was determined by the location of the rebar lifting loops on the top edge of the precast panel being moved (the external visible marker for locating the engineered interior structural supports). The base supports of the storage frames overlapped at the ground level with a portion of the base from each storage rack protruding into the space of the other row. The exposed portions of the horizontal base collected debris, snow and ice that made those surfaces uneven and slippery.

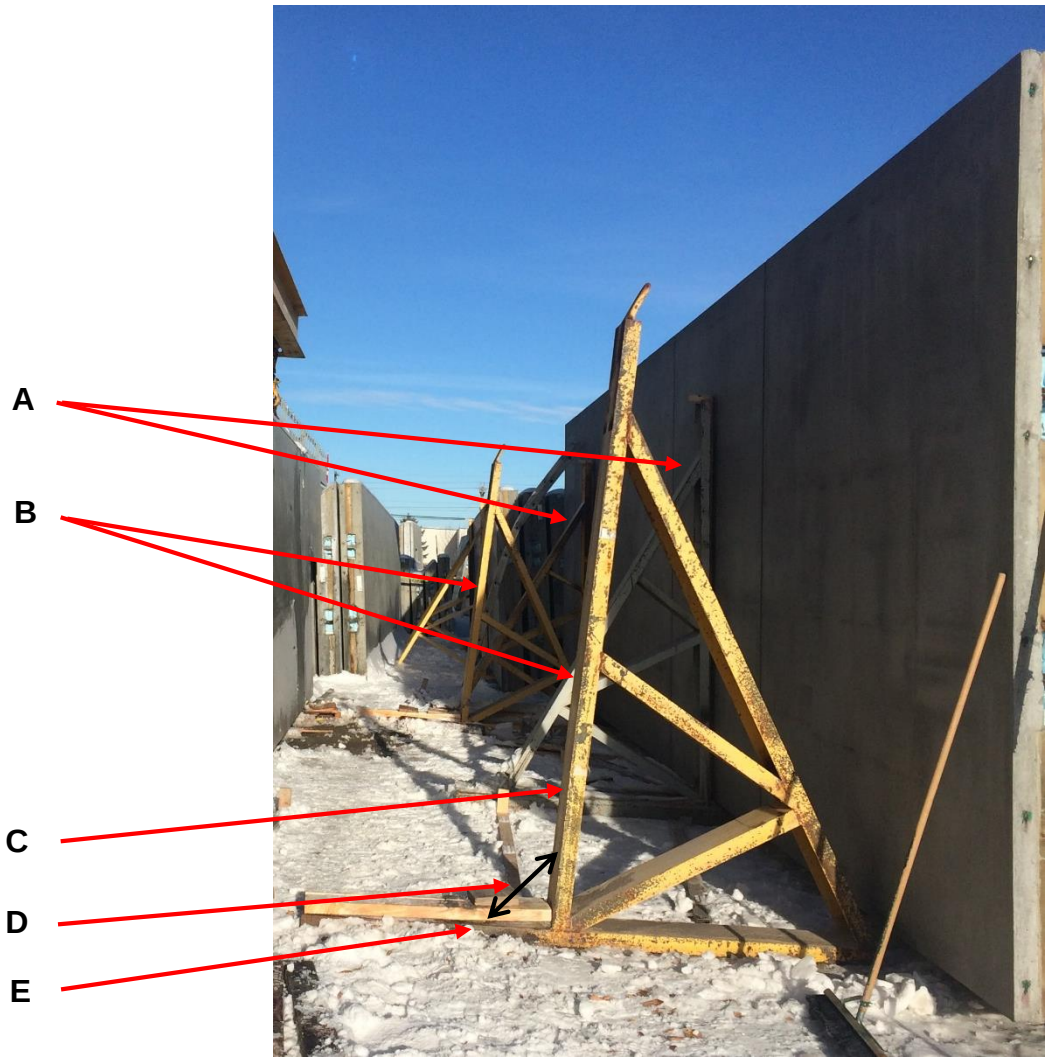


Figure 6. Storage frames in place in gantry crane bay
A. East facing storage frames
B. West facing storage frames
C. Storage frame back rest
D. Black arrow – 85° angle – back rest/foot
E. Storage frame foot

Precast panels were placed on the storage frames (Figure 7) with the panel leaning against the back rest. The back rest aligned with the rebar lifting loops on the top edge of the precast panel.

Figure 7. Storage frame demonstrating position of precast panel during loading

The angle of 5° between the base of the precast panel and back rest as well as the weight and dimensions of the precast panel kept the precast panel in place and stable (Figure 8).

Figure 8. Storage frame demonstrating position of precast panel after loading
A. Storage frame back rest and foot – blue arrow indicates 85° angle

To even the position of the precast panels horizontally, wooden dunnage (dimensional lumber such as 2x4 or 4x4 pieces) were used. Shop built wooden wedges were used to tip and support the precast panel towards the back rest, so that the precast panel flat surface was parallel to the back rest. Dunnage used to separate the precast panels leaning on each other (sticks) consisted of a length of dimensional lumber, usually 1x2 or 1x3 with plastic bubble protectors attached (Figure 9).

Figure 9. Dunnage used to level and separate precast panels

There were unwritten procedures for moving storage frames, determining the distance between pairs of storage frames, clearing the pockets where the rebar lifting loops were placed, moving the panels on to a pair of storage frames, using wooden blocks and wedges to level precast panels on the storage frames and setting up sticks between precast panels. Informal procedures were used for determining the distance between overlapping rows of storage racks, for determining the width of aisles between rows or for clearing debris, snow or ice from the tops of exposed storage frame bases.

Gantry crane and gantry crane bay

W.F. Welding & Overhead Cranes Ltd Crane - 25 Tonne Top Running Double Box 60 foot span - Lafarge Unit 6717

A 25 tonne gantry crane (gantry crane) with a span of 18.288 m was installed over the gantry crane bay (Figure 10). The gantry crane was regularly inspected, and serviced. Crane operators performed daily safety checks using a checklist on days when the gantry crane was in use. The gantry crane's capacity of 25 tonnes (25 000 kg) was substantially greater than the weight of the precast panels being moved. The gantry crane was controlled using a remote hand held device (Figure 11).

Figure 10. Overhead gantry crane

Figure 11. Remote controller for gantry crane

The gantry crane bay ground surface was concrete, flat, level and capable of supporting the weight of the stored precast panels. The gantry crane bay was outdoors with no roof and debris such as sand, dirt, concrete breakage, snow and ice accumulated on exposed surfaces including the storage frames and the precast panels placed in the gantry bay (Figure 12).

Figure 12. Aerial view of gantry bay with snow covering exposed surfaces. Photograph from OHS drone.

Sequence of events

Storage frames were placed in the gantry bay and moved as needed. Storage frames were placed on the clear gantry bay surface and loaded with precast panels for multiple projects.

Precast panel 085-33 was manufactured on September 23, 2017 and moved to the gantry bay for storage on September 24, 2017. Precast panel 085-33 was placed on a storage frame and was leaning against precast panel 085-42 already in place on a storage frame facing east and located at the south end and west side of the gantry crane bay. Precast panel 085-33 did not have a manufacturing label on it and was later identified by LPE. Precast panel 085-34 was manufactured on September 26, 2017 and moved to the gantry bay for storage on September 27, 2017. Precast panel 085-34 was placed on the same storage frame as and leaning against precast panel 085-33. No additional precast panels were placed on this storage frame.

A row of storage frames facing east and parallel to the row holding precast panels 085-33 and 085-34 was put in place at some time while the gantry bay surface was clear of snow and ice (Figure 13A).

Labourer returned to LPE on October 4, 2017 following a layoff and received re-hire orientation on that date. Labourer started work on October 8, 2017.

On November 1, 2017, Environment Canada (Blatchford Station) recorded a snowfall and as temperatures remained below freezing through November, snow remained on the ground. Additional snow fell through the month and accumulated up to 12 centimetres (cm) by November 22, 2017. Localized temperatures and snow accumulation varied slightly from the Blatchford Station records.

On November 24, 2017, management asked if workers were willing to work on a Saturday (November 25, 2017) to catch up with production orders, make room in the storage yard for new product and to ship product to customers. Work in the manufacturing plant was arranged for 30 workers. Crane Operator, Labourer and six other yard workers were assigned to move and load manufactured precast panels onto trucks waiting for dispatch to customers. Three management staff also planned to work on November 25, 2017.

On November 25, 2017, the workers arrived at LPE and started work at approximately 6:00 a.m. The 30 workers in the manufacturing plant and the plant supervisor were in a separate area and not involved with any of the work in the storage yard. Crane Operator and Labourer went to the gantry crane bay to prepare to move a series of precast panels. The gantry crane bay area was out of sight of the workers in the manufacturing plant, other parts of the storage yard and the office.

Crane Operator was given the list of precast panels in the gantry bay that needed to be shipped. The first precast panel to be shipped was located beneath three other precast panels stacked in the southwest corner of the gantry crane bay. Precast panel 085-34 needed to be moved first, followed by precast panel 085-33 and then one more precast panel to access the precast panel scheduled to be shipped.

Stored panels needed to be moved to allow access to panels that were stored between other panels by hooking up the crane to a precast panel and moving it from one side of a row of storage racks across an aisle and placing it on the opposite side of the aisle. The precast panel was not rotated. The face that leaned on another precast panel was now facing outwards into aisle.

Crane Operator performed an inspection of the gantry crane. Crane Operator and Labourer cleared snow and ice from the gantry crane bay surface in preparation to move two storage frames into place to hold the precast panels. Crane Operator directed the Labourer to use a forklift to bring two storage frames from the northeast area of the storage yard and move them to the north end of the gantry bay.

Crane Operator went into the office to get the remote control for the gantry crane. Labourer used the forklift to move two storage frames to the north end of the gantry bay. Then Crane Operator moved the gantry crane to the north end of the gantry crane bay. Together, Crane Operator and Labourer hooked up the storage frames to the gantry crane. Crane Operator moved the storage frames to the south end of the gantry crane bay and set them down while still hooked up.

Crane Operator and Labourer got a shovel and ice scraper, stored at the south end of the gantry crane bay, and used them to clear the surface of the gantry crane bay at the specific

locations where the storage frames needed to be placed. The locations for the storage frames was determined by the engineered internal structure of the precast panels and was marked by the location of the lifting rebar loops on the top edge of the precast panels. When the gantry crane bay surface was clear, Crane Operator used the gantry crane to move the two storage frames into place and set them down.

The storage frames were facing west with the feet of the racks extending underneath the previously placed east facing storage frames loaded with precast panels (Figure 13B). The feet of the east facing storage frames extended into the area of the just placed west facing storage frames and were covered with snow and ice (Figure 13A).

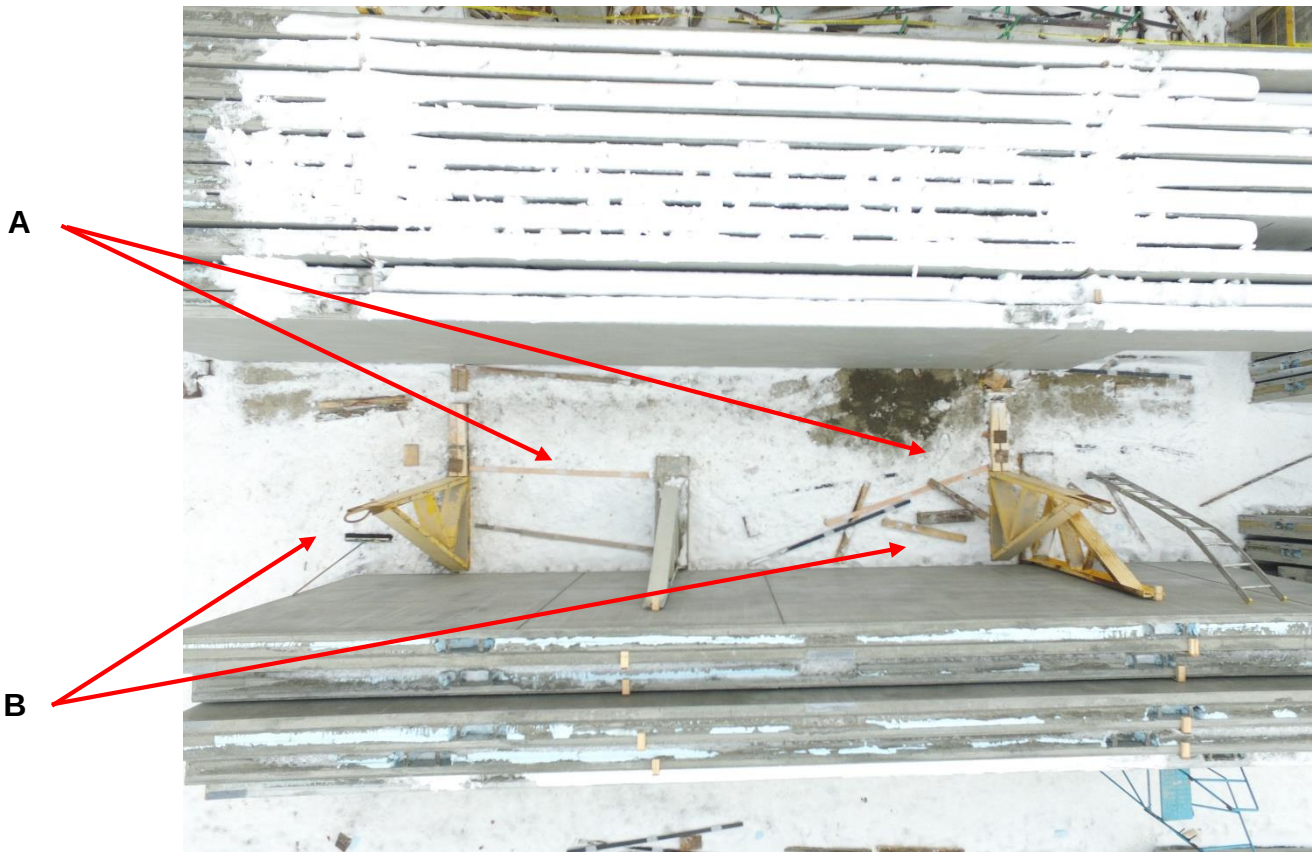


Figure 13. Aerial view of storage frames in use at the time of the incident. Photograph from OHS drone.

A. East facing storage racks placed prior to 25 November 2017.

B. West facing racks placed on 25 November 2017.

The Crane Operator and Labourer placed two pieces of dunnage (wooden 2x4 pieces) on the top of the west facing storage frames' feet. The Crane Operator noticed that the foot of one of the storage frames appeared a bit higher than the other. The Crane Operator sent the Labourer to get four pieces of 2x4 dunnage approximately 1 m long from the carpenter's shop. The Labourer went to the carpenter's shop, cut the required dunnage and brought the dunnage back to the gantry crane bay. A wooden wedge was placed on top of the dunnage on each storage frame foot.

The Crane Operator and Labourer left the ice and snow on top of the east facing storage frames' feet (Figure 14 and Figure 15).

Figure 14. Ice and snow on foot of east facing storage frame on north end of aisle involved in the incident

Figure 15. Ice and snow on foot of east facing storage frame on south end of aisle involved in the incident

The snow and ice accumulation added height to the top of the storage frame feet by approximately 7.5 cm above the top of the just placed west facing storage frames.

Crane Operator moved the gantry crane into position on the east side of precast panel 085-34. The Crane Operator lowered and measured the lift hooks, set the spreader bar to match the two lifting rebar loops on top of precast panel 085-34 and then moved the spreader bar away from precast panel 085-34.

Labourer used an aluminum extension ladder to the north end of precast panel 085-34 and climbed up to clear snow and ice from the pocket where the lifting rebar loop was located.

Crane Operator moved the gantry crane with spreader bar and chains above precast panel 085-34 and the Labourer hooked the chain to the lifting rebar loop at the north end of precast panel 085-34. Labourer climbed down the ladder.

Labourer moved the ladder to the south end of precast panel 085-34 and repeated the process of clearing snow and ice from the lifting rebar loop pocket, attaching the chains and climbing down to ground level. The ladder was moved out of the way.

Crane Operator lifted precast panel 085-34 and moved it east, moved the crane slightly south approximately 1.5 m and then placed the precast panel on top of the wedges on top of the west facing storage frames. Crane Operator moved the crane to the east and then down and stopped. Labourer reset the wedges placed on the feet of the storage frames. Crane Operator set precast panel 085-034 down on the wedges with its full weight. Crane Operator moved the crane slightly to the east so that precast panel 085-34 tilted to the east and was leaning on the back of the storage frame. Crane Operator asked Labourer to check if the set-up was good. Labourer checked and confirmed that the set-up was good. Crane Operator walked to the centre of precast panel 085-34 and looked underneath. The Crane Operator thought everything looked good.

Labourer moved the ladder to the north end of precast panel 085-34, climbed up and unhooked the crane from the north lifting rebar loop. The Labourer climbed down. Crane Operator used the ladder to climb up and unhook the crane from the south lifting rebar loop. Precast panel 085-34 was on the storage frame and leaning onto the back of the storage frame, apparently held in place by its own weight and the wooden wedges.

Crane Operator and Labourer prepared for the second lift. Precast panel 085-33 was next to be moved across the aisle to lean on precast panel 085-34 in the same procedure used for precast panel 085-34.

Labourer moved the ladder to the north end of precast panel 085-33 in alignment with the lifting rebar loop and set up facing west. Labourer was facing away from the just placed precast panel 085-34. Labourer climbed the ladder and started to clear snow and ice from the pocket of the lifting rebar loop.

Crane Operator was in the clear area at the south end of the gantry crane bay. Crane Operator pushed the up button on the gantry crane remote control and was looking north into the aisle between precast panel 085-34 and precast panel 085-33. Crane Operator had a clear field of view.

At approximately 7:28 a.m., Crane Operator saw precast panel 085-34 slowly tipping to the west, towards Labourer. Crane Operator shouted to the Labourer to jump off the ladder. Labourer started down the ladder. Precast panel 085-34 continued to tip and fell against precast panel 085-33. Labourer was part way down the ladder and was struck by precast panel 085-34 (Figure 16).

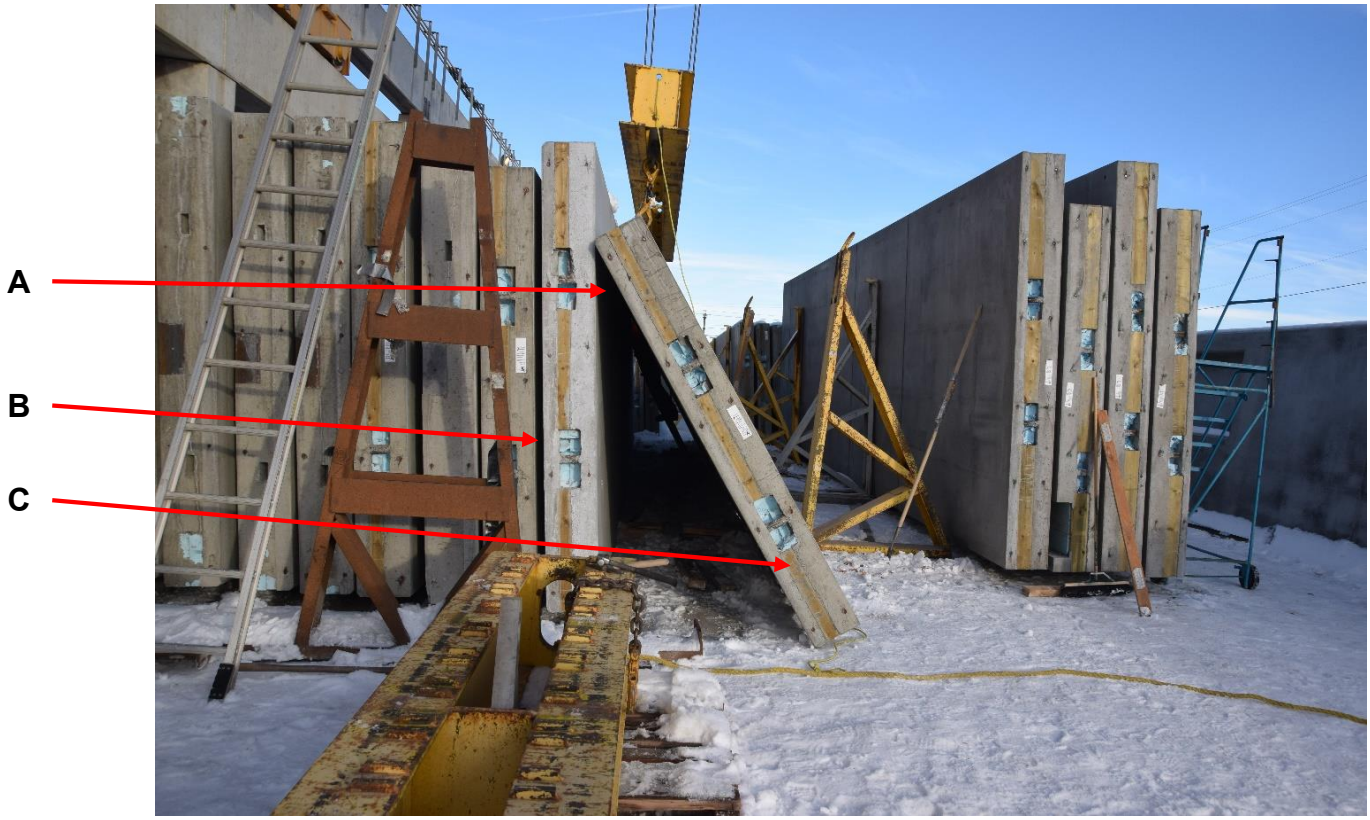


Figure 16. Gantry crane bay looking north. The gantry crane was re-attached to precast panel 085-33 post-incident.

A. Location of deceased worker

B. Precast panel 085-33

C. Precast panel 085-34

The Crane Operator used LPE radio to alert the work site to an emergency. Workers and managers came from other areas of the work site to assist. The plant foreman called 911. One of the yard workers used a second ladder to climb on top of precast panels 085-33 and 085-34 to check on Labourer. The plant foreman looked in the cavity between the lower parts of precast panels 085-34 and 095-34. Labourer's injuries were evident. Emergency Medical Services arrived on site and determined that the worker was deceased. The panels were left in place until Edmonton Police Service (EPS) and the Office of the Chief Medical Examiner

(OCME) investigator were at the work site. EPS notified OCME. EPS contacted Alberta OHS Contact Centre at 7:48 a.m.

Completion

A review for enforcement action was completed on May 29, 2019, and it was determined that the file would be referred to Alberta Justice for review. The entire file was sent to Alberta Justice on June 25, 2019. Charges were laid on August 23, 2019. On November 20, 2020, Lafarge Canada Inc. pled guilty to contravention of Section 2(1)(a)(i) of the *OHS Act*, failure to protect the health and safety of their worker by failing to ensure that storage racks used to hold concrete panels were free of snow and/or ice. At sentencing, Lafarge Canada Inc. was fined $320,000 in favour of Alberta Motor Transport Association (AMTA), in partnership with the Alberta Construction Safety Association (ACSA) and the Manufacturers Health and Safety Association (MHSA), to fund the development of a training course and educational resources focused on material handling and load securement.

This investigation was completed on March 24, 2022.

Signatures

ORIGINAL REPORT SIGNED — March 24, 2022

Lead Investigator — Date

ORIGINAL REPORT SIGNED — March 24, 2022

Manager — Date