



Worker falls through roof insulation to concrete floor

Four workers were working on the relatively flat roof of a structural steel building. They were laying down metal roof panels over a layer of blanket insulation that had already been placed across the metal roof beams. One of the workers fell through the insulation to the concrete floor 17 feet (5.2 metres) below. The worker died in hospital from his injuries.



Purpose of this report

The purpose of this online incident investigation report is to identify the causes and contributing factors of this incident to help prevent similar incidents and to support preventive actions by industry and WorkSafeBC. This online version is not the official WorkSafeBC report. It has been edited to remove personal identifying information and to focus on the main causes and underlying factors contributing to this incident.

Notice of Incident information

Number: 2007157520114

Outcome: Fatal

Core activity: Applying roofing materials to building under construction

Region: Lower Mainland

Date of incident: March 2007

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1 Factual Information

1.1 The employer and the job site

At the time of the incident, Coastal Steel Systems was a subcontractor serving the self-storage building industry, primarily in the Lower Mainland of British Columbia. Coastal Steel provided labour for the installation of doors, hallway systems, framing, and roofing, and usually employed fewer than 10 workers.

The incident occurred at a self-storage facility that was under construction in Surrey, B.C. The facility consisted of four steel structural buildings. Construction began in July 2006. There was a prime contractor, and various subcontractors were working on the site. Coastal Steel started work on this site in December 2006 after the original subcontractor defaulted. Coastal Steel was contracted to install the doors, partitions, corridor systems, and roofing. At the time of the incident, the buildings were at various stages of completion.

1.2 Sequence of events

1.2.1 The roofing job

On the morning of the incident three of Coastal Steel's workers (Workers 1, 2, and 3) arrived at the job site. They were assigned to help with general yard cleanup and setting up doors. They had been at this job site for several weeks helping with inside work such as framing and installing doorways and hallway systems.

Charge Hand 1 arrived and observed that the job site supervisor for Coastal Steel was moving supplies and getting ready for roofing on Building C. It was a sunny day, and since it had been wet for several weeks, it was a good opportunity to work on the roof, which was now dry. The job was also behind schedule.

Charge Hand 1 had been away for several weeks, and he asked the job site supervisor if the three workers had any experience in laying down roof panels, and the supervisor answered that they did not.

Charge Hand 1 and the three workers started with the roofing preparation by connecting the power cords, setting up the ladder, and moving supplies and insulation. They accessed the roof by climbing a ladder on the lower side of Building C. The height from roof to grade varied between 11 feet (3.4 metres) and 17 feet (5.2 metres) as there was a lower floor level dug out under part of the building (see Figure 1).

There was no fall protection system in place. Charge Hand 1 explained to the three workers what they were to do, but he concluded that they did not understand him (because of language differences). He told them that they would "see it as they go." Charge Hand 1 told the three workers to stay away from the edge and work together.

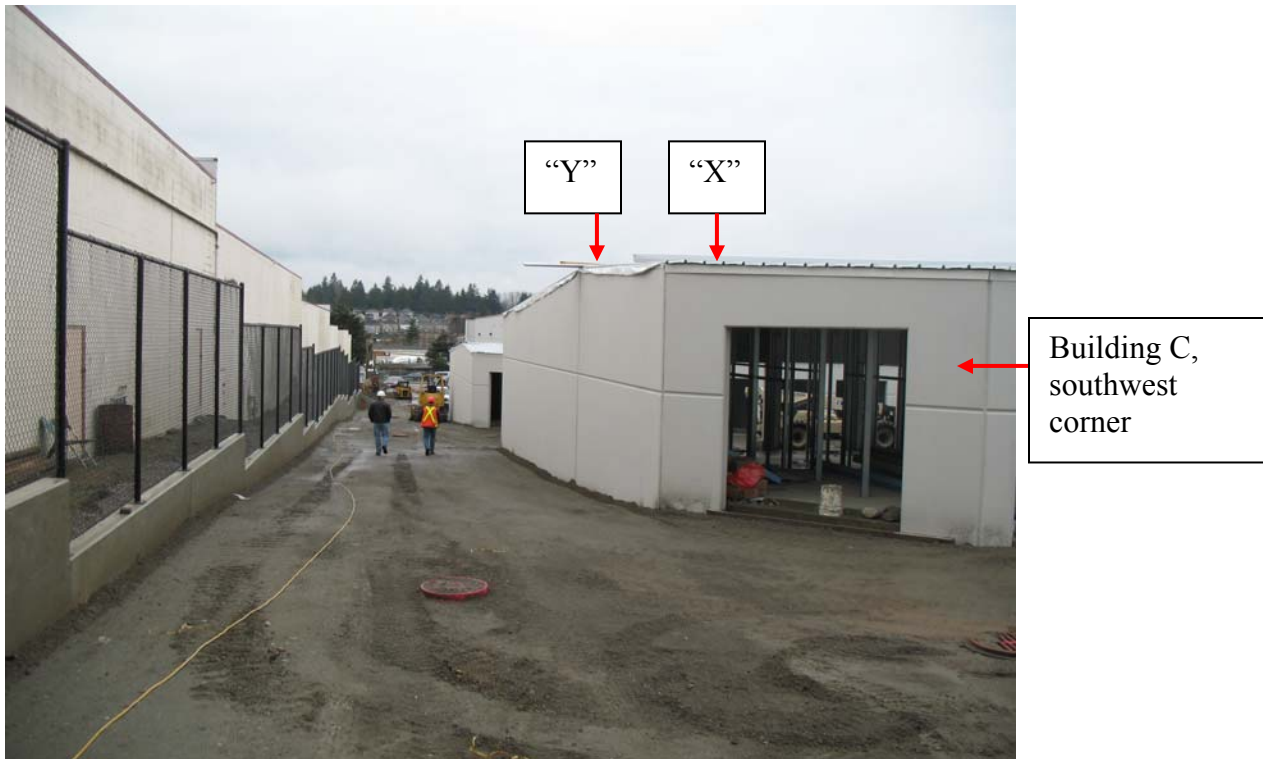


Figure 1: View of Building C, looking north. From the roof at “X” the distance to grade is 11 feet. From the roof at “Y” it is 17 feet to grade.

During the morning, they worked on the roofing job. They manually lifted the metal roof panels up to the roof and stacked them. The roof panels were 41 feet long and 16 inches wide with 26 gauge thickness. The roofing process consisted of several tasks:

- Laying out the rolls of insulation across the metal purlins (horizontal beams), which were spaced 5 feet apart.
- Carrying roof panels from the stack on the roof to the insulation
- Laying the roof panels in position over the insulation and between the metal purlins
- Stepping on the edges of the panels to ensure they are in place
- Fastening the roof panels to the metal purlins with 5-inch clips (done by Charge Hand 1)

1.2.2 *The incident*

In the afternoon, Charge Hand 1 and the three workers carried a roof panel to the edge of the previously laid panel and moved the new one into position, using the same procedure that they had repeated all morning. Charge Hand 1 and the three workers were positioned at equal distances along the 41-foot-long roof panel, with Charge Hand 1 at the lower end of the roof (north edge) and Worker 1 at the slightly higher end near the peak of the roof (see Figure 2).



Figure 2: After the incident, workers (wearing fall protection) show how the roof panels were held as they were laid down.

In the process of laying down the roof panel, Charge Hand 1 and Workers 2 and 3 were bending or kneeling, holding onto the panel, facing northeast. Worker 1 was gently guiding the upper end of the roof panel into position; he was facing north, holding the end of the panel.

There was nothing unusual while this panel was being placed into position. This same routine had been followed repeatedly since they started work that morning. Charge Hand 1 heard a crashing noise, turned around, and saw Workers 2 and 3 looking at a hole through the insulation near where Worker 1 had been working (see Figure 3).

The workers left the roof and called first aid. Worker 1 was lying on the concrete floor below the hole in the insulation (see Figure 4). He died later in hospital of his injuries.

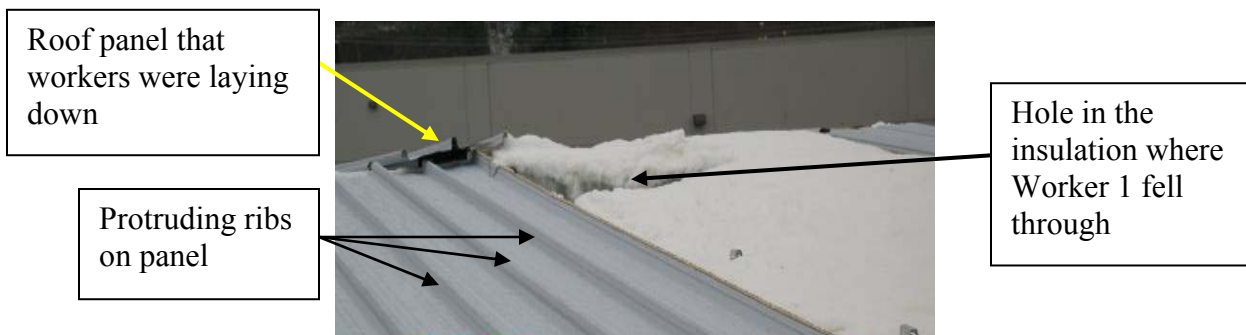


Figure 3: The site of the incident, showing the blanket insulation and the roof panels with protruding ribs.

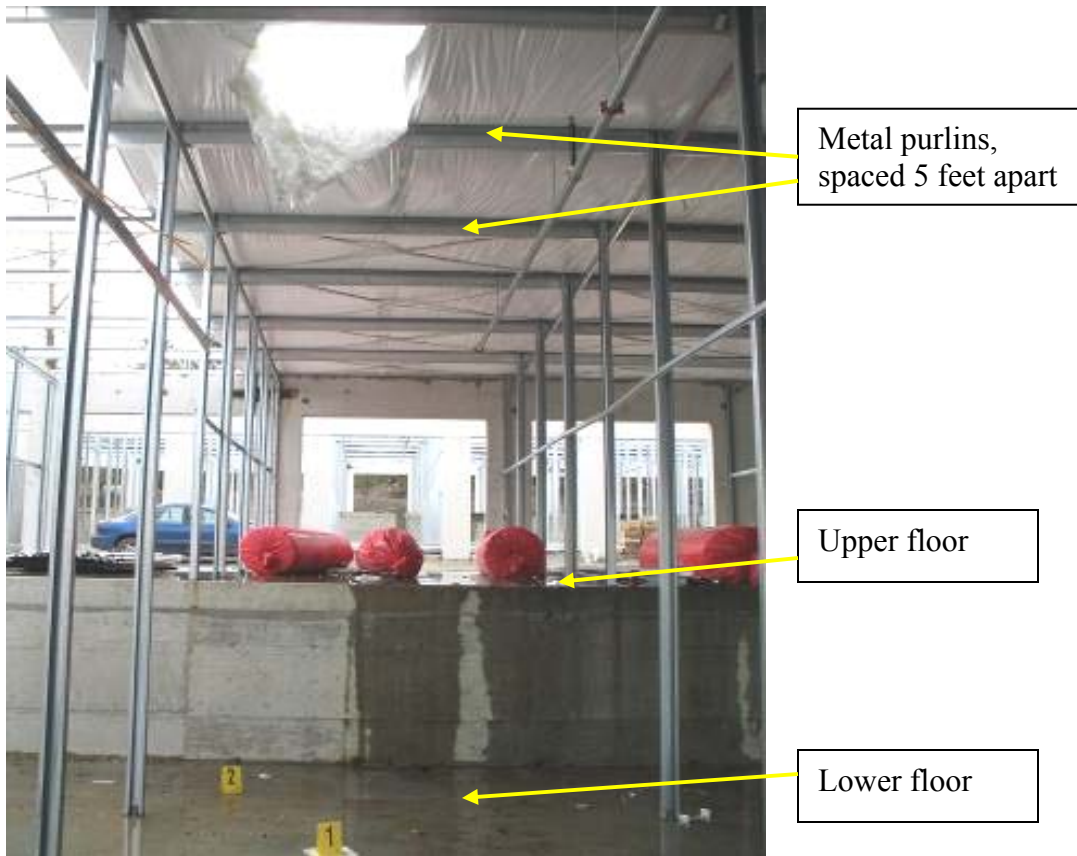


Figure 4: The hole in the insulation where Worker 1 fell to the concrete below. The red rolls of insulation are on the upper floor. The worker fell 17 feet to the lower floor level.

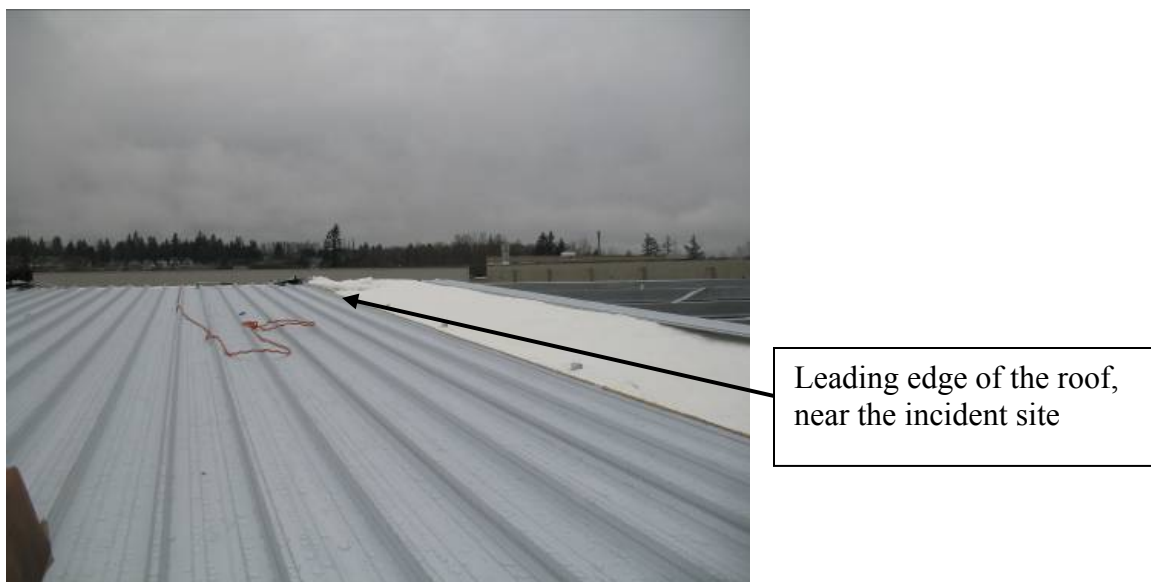


Figure 5: Roof of Building C, looking north.

1.3 The roof

The grade of the roof has a slight gradual pitch of 1:8. The height of the roof above grade varies from 11 to 17 feet. A standing seam panel system was being used for the metal roofing. Panels were placed on top of insulation, which the workers had previously laid out (see Figure 5). The 3-inch-thick blanket insulation was placed across metal purlins spaced 5 feet apart. The roof panels were 16 inches wide and arrived at the job site precut to roof length specifications. Workers were handling 41-foot-long panels on the roof of Building C. Where one panel is joined to another, there is a protruding rib.

1.4 Safe work procedures and fall protection equipment

At the time of the incident, Coastal Steel had a safety program in place that had been written in 2005 by a safety consultant. It included typical program elements but did not identify any safe work procedures for the roofing process.

There was a storage locker upstairs in Building A where construction tools and equipment were kept, including fall protection equipment. The fall protection equipment consisted of harnesses, lanyards, and rope. No other fall protection equipment was present. Workers had access to the locker during their shifts. The locker was unlocked in the morning and locked when work was finished. On the day of the incident, fall protection equipment was not used and there was no fall protection system in place.

1.5 Workers' experience

Charge Hand 1, Charge Hand 2, and the job site supervisor were long-term, experienced workers. Most of the remaining workers were recently-hired casual workers, who were new to the type of work and the job site and who had no previous construction experience. Trade qualifications were not required for Coastal Steel's work activity. Hiring suitable workers for construction jobs is a challenge in British Columbia as there are many construction jobs for workers to choose from. Worker 1 did not have a background in construction work.

1.6 Training and instruction

There is no documented evidence of any fall protection training for workers and supervisors. Some workers had been shown where the fall equipment was located and how to put it on.

Worker 3 and Charge Hand 2 had received an orientation to the job site, documented in the prime contractor's safety record book. However, Worker 1 did not receive any safety orientation at the site, nor is there any evidence that he received any fall protection training.

Documents show that the job site supervisor had an orientation of approximately three hours on Coastal Steel's occupational health and safety program, which included Coastal Steel's generic fall protection plan.

No other training documentation related to Coastal Steel employees, including the long-term workers, was produced by either Coastal Steel or the prime contractor on the job site.

1.7 Supervision and monitoring

1.7.1 *Coastal Steel*

Coastal Steel did not provide any documented evidence to show that the employer was conducting periodic checks of the supervisors' work performance and of compliance with Coastal Steel's safety program and the Occupational Health and Safety Regulation.

The chain of command on the day of the incident is unclear. The job site supervisor had been away and returned to the site two days before the incident. He usually provided site supervision for Coastal Steel. While he was away, Charge Hand 2 had been Coastal Steel's on-site contact and was acting as supervisor. Charge Hand 2 also hired casual labour for Coastal Steel and acted as a translator for the foreign workers.

The company owner had been away and had just returned to Vancouver on the day of the incident; he was not on-site at the time of the incident. He did not know whether the job site supervisor was in charge or what arrangement, if any, had been made between the job site supervisor and Charge Hand 2.

The job site supervisor stated that he was not the supervisor on the day of the incident. Charge Hand 2 could not be contacted for an interview. Both were working inside Building A, away from the high-risk activity in Building C. Charge Hand 1 was directly instructing Workers 1, 2, and 3 in the task of laying the roof panels.

1.7.2 *Prime contractor*

The site superintendent, an employee of the prime contractor, was not aware that Coastal Steel was doing roofing work that day. It was not scheduled work, and the work on the roof went unnoticed by the prime contractor.

2 Analysis

No one saw Worker 1 fall, and there is no conclusive evidence of what exactly triggered the fall. It is possible that while lowering and positioning the roof panel, Worker 1 tripped on the protruding roof panel ribs of previously fastened panels and lost his balance (see Figure 6). Unable to recover, he could then have fallen sideways onto the insulation, breaking through and landing on the concrete floor below.

This analysis will therefore focus on the following:

- Inadequate supervision and monitoring
- Lack of safe work procedures
- Inadequate worker training
- Lack of fall protection on the day of the incident



Figure 6: Close up view of the hole in the insulation where Worker 1 fell. The protruding ribs on the panel are visible.

2.1 Inadequate supervision and monitoring

The investigation found that supervision and monitoring of the work site was deficient and was a factor leading to the incident.

2.1.1 Coastal Steel

The owner of Coastal Steel (the employer) assumed that the supervisory personnel at the job site, as well as the prime contractor, were fulfilling their safety duties and responsibilities at all times. He had not done any formal inspections regarding the performance of key supervisors including the prime contractor and therefore mistakenly concluded that all his workers were being trained and were diligently following the employer's and prime contractor's safety program. If the employer had periodically asked his supervisors and the prime contractor for tangible evidence of training and work site safety inspections, it would have been readily apparent that not all his workers were receiving the necessary training in a timely manner.

Coastal Steel had a similar project at another site at the time of the incident and also had other business interests. The employer delegated many of the day-to-day operations to his long-term employees, and in particular allowed Charge Hand 2 to hire casual labour without his input and also to prepare the payroll. He stated that he had placed his full trust and confidence in this worker. It is apparent from the investigation that the employer had a hands-off relationship with regard to supervision of key employees and did not consistently check the job performance of key employees.

This particular job was an extra workload for Coastal Steel after the prime contractor invited Coastal Steel to take over the job when the original subcontractor defaulted on the contract. This placed added stress on an already busy firm. The job was also behind schedule, which may have added a sense of urgency to get the job done.

The employer and the job site supervisor were out of the province for several weeks before the incident. This left a gap in the chain of command and weakened the on-site face-to-face management supervision that was in place. Charge Hand 2 was the employer's contact at the job site, but management accountability was lacking during this period, thereby possibly setting the stage for the deterioration of safe work practices. The temporary absence of the employer and Charge Hand 1 also set the stage for the unclear chain of command that resulted when Charge Hand 1 returned to the job site two days before the incident. Discussions with Workers 2 and 3 and Charge Hand 1 revealed some conflicting information as to who the supervisor was on the day of the incident, and Charge Hand 2 could not be contacted. The chain of command was unclear, and even the employer was not sure who the site supervisor was that day. This lack of clearly communicated roles was instrumental in the breakdown of enforcement of safe work practices.

While Workers 1, 2, and 3 were on the roof, they were under the direct supervision of Charge Hand 1. A supervisor must ensure that workers under his or her direct supervision are made aware of all known or reasonably foreseeable health or safety hazards and that workers comply with the requirements of the Occupational Health and Safety Regulation. When interviewed after the incident, Workers 2 and 3 did not indicate that they had any awareness of the hazards of being on the roof. Charge Hand 1 had not been trained for his supervisory role on the roof since he did not know where to tie off the fall protection equipment.

2.1.2 The prime contractor

On the day of the incident, the prime contractor's site superintendent was not aware that work was being done on the roof of Building C. No one from Coastal Steel informed the prime contractor of the decision to work on the roof that day. The site superintendent and the first aid attendant were on-site, but their focus was on Building A as it was part of the scheduled work for the day. The site superintendent's daily inspections did not include the other buildings. If the site superintendent had been aware of the roofing work on Building C, he could have taken corrective measures, including ensuring fall protection was used.

2.2 Safe work procedures

At this job site, Coastal Steel had a safety program that included safe work procedures for many of the tasks performed by workers. However, a high-risk activity such as installing roofing panels was not part of the program. The company used the standing seam panel system. It came with manufacturer's instructions that are designed as a technical instruction manual. The manual is a helpful resource but it is not a substitute for site-specific safe work procedures.

Safe work procedures are intended to provide workers with guidance to perform their work safely at a given work site. The elimination or control of hazards is achieved through an analysis and detailed description of how the task is to be done. If a written safe work procedure had been developed for installing roof panels, it would have given workers an awareness of the hazards and step-by-step instructions to eliminate or reduce them. At this particular job site, the absence of site-specific written safe work procedures combined with an inexperienced crew compounded the risks.

The danger of falling off the edge of the roof was not the only hazard. The panels have 1 $\frac{5}{8}$ -inch protruding ribs spaced 7.5 inches apart, which can be a tripping hazard (see Figure 7). There was no support underneath the insulation other than the purlins (metal beams) spaced 5 feet apart. To place each

new roof panel, the workers were at the edge of the roof panel beside the insulation. If a worker stepped on the insulation, it would not support his weight.



Figure 7: The protruding ribs form a tripping hazard.

2.3 Worker experience and training

The investigation revealed that Worker 1 was not trained or experienced in the work being performed. He had not received a site safety orientation or fall protection training. In addition, he had no previous construction experience. This lack of construction experience made the required training especially critical.

2.4 No fall protection system at the time of the incident

Charge Hands 1 and 2 and the job site supervisor for Coastal Steel and the prime contractor were seasoned construction specialists and well aware of their respective fall protection plans and WorkSafeBC requirements. The investigation looked into why workers were allowed to work on the roof without fall protection. A possible chain of events surfaced that directly or indirectly was linked with the workers not wearing fall protection equipment:

- The decision to work on the roof of Building C was made on the day of the incident by either Charge Hand 1 or the job site supervisor. After several weeks of wet weather, this sunny day was a good opportunity to work on the roof, especially since the job was behind schedule. This spontaneous decision left the prime contractor's site superintendent unaware that work was to be done on the roof of Building C. If he had known, the site superintendent could have been a second set of eyes in identifying risk and taking corrective action.
- Workers did not have a good understanding of fall protection systems, especially the options for tying off and still allowing an efficient system for installing the panels. When interviewed, Charge Hand 1 showed a lack of understanding on where to tie off (attach his fall protection). This lack of understanding could have influenced the workers' decision not to use the available harnesses.
- The interviews with workers revealed that they did not appear unduly alarmed or threatened to be on the roof without fall protection. Workers accessed the building from the lower side of the building (11 feet), which could give the perception of not being very high even though the rise above grade varied from 11 to 17 feet. The roll of insulation that the roof panels were laid on could also have given a false sense of security as the workers could not see the floor below.

- As described in section 2.1 (pages 9–10), there was a deterioration of accountability at the job site, which encouraged workers and supervisors to perform their work without it being monitored for safety.
- As described in section 2.2 (pages 10–11), workers had no instruction on the correct and safe method of installing the roof panels. Coastal Steel had a generic fall protection plan. However, a fall protection plan included in a specific safe work procedure ought to have been in place.
- This job site was out of the ordinary for Coastal Steel and its workers. Normally Coastal Steel worked on one building or area at a time and kept the crew and supervisors together. At this job site, there were several buildings at various stages of construction, which at times made it necessary to divide the crew among different buildings. On the day of the incident, the key supervisors (the job site supervisor and Charge Hand 2) were inside Building A and not actively involved in the roofing job on Building C.

3 Conclusions

3.1 Findings as to causes

3.1.1 *Fall from height without fall protection*

Worker 1 suffered fatal injuries when he fell through a layer of insulation and hit the concrete floor 17 feet (5.2 metres) below. There was no fall protection system in place to stop his fall.

3.2 Findings as to underlying factors

3.2.1 *No safe work procedure for the task being performed*

Supervisors and workers did not have any written site-specific safe work procedures for installing the roofing panels.

3.2.2 *Inadequate supervision*

The employer did not adequately ensure that supervision at the work site complied with the site-safety program and WorkSafeBC requirements. The employer had a distant relationship with the on-site supervision and relied on the supervisors to ensure that the employer's due diligence requirement was being met. In addition, there was no adequate system to ensure that the supervisors were trained to perform their safety responsibilities and were carrying them out.

4 Orders Issued after the Investigation

WorkSafeBC issued one order after the investigation. An order requires an employer to take steps to comply with the *Workers Compensation Act* or Occupational Health and Safety Regulation, to take measures to protect worker health and safety, or to fix a hazardous condition. An order is not intended to identify fault on the part of the employer but to ensure that unsafe conditions are identified and corrected and that the employer complies with the Act and the Regulation. An employer may ask the Review Division to review an order; the Review Division may confirm, vary, or cancel an order.

In addition to issuing orders, WorkSafeBC may recommend proceeding with an administrative penalty against an employer. Penalties are fines for health and safety violations of the *Workers Compensation Act* and/or the Occupational Health and Safety Regulation. For information on when penalties are considered and how the amount of the penalty is calculated, see the [penalty FAQs](#) on WorkSafeBC.com. [Companies that have been penalized](#) are also listed on the web site.

4.1.1 Order to Coastal Steel

This section summarizes an order to the employer. The investigation found that this employer was in contravention of the *Workers Compensation Act*, [section 115\(2\)\(e\)](#), which states that an employer must provide to the employer's workers the information, instruction, training, and supervision necessary to ensure the health and safety of those workers in carrying out their work and to ensure the health and safety of other workers at the workplace.

In particular, this employer had not provided the following:

- The management supervision necessary to ensure that the safety responsibilities of supervisors are being followed.
- Records or evidence that the deceased worker had received training, including a site safety orientation, fall protection, or roofing procedures.
- Written safe work procedures for the roofing process at the site.

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