Incident Summary #II-1892563-2025 (#57220) (FINAL)

SUPPORTING INFORMATION	Incident Date			April 9, 2025
	Location			Vancouver
	Regulated industry sector			Elevating devices - Elevator
	Impact	Injury	Qty injuries	0
			Injury description	N/A
			Injury rating	None
		Damage	Damage description	An elevator collided with the passenger car during the elevator operation. The counterweight guide assembly was bent and broken, and the metal frame of the car was bent and torn. Two 50lb balancing weights from underneath the car dislodged and fell down the elevator shaft into the pit from the 17th floor.
			Damage rating	Major
	Incident rating			Major
	Incident overview			The counterweight for a freight elevator in a 32-floor high-rise office building came off of the guide tracks. While the elevator was traveling downward without any passengers, the rising free-swinging counterweight collided with the bottom of the passenger car. The collision damaged the counterweight guide wheel assembly and the metal c-channel structure on the bottom of the car. The collision tripped the elevator overspeed safety circuit, stopping the operation of the elevator.
INVESTIGATION CONCLUSIONS	Site, system and components			The building was constructed and completed in 1974. It is 32 stories tall and has a total of ten passenger elevators and one freight elevator. The freight elevator has a weight capacity of 3000-lbs, accesses all floors, and is used for moving personnel, equipment, furniture, and construction materials. The elevator is not generally accessible to the public, and only workers and others with special access cards can use it for work duties and moving freight. A basic electric traction elevator with a counterweight operates using a system of pulleys (sheaves), a motor, and steel ropes designed to move a cab (the passenger compartment) vertically in a building. The elevator and counterweight are connected by cables over a drive sheave and a secondary sheave. A control system operates an electric motor and drive sheave, which moves the steel ropes. As the motor rotates the sheave, the steel rope raises or lowers the elevator cab. When the cab travels, the counterweight goes in the opposite direction. The counterweight helps balance the system and typically weighs about the same as the cab plus 40-50% of its maximum load. This reduces the energy needed to move the elevator, since the motor only needs to overcome the difference in weight and friction. The car and counterweight both ride on guide rails which are mounted to the inside of the hoistway shaft in the building. The guide rails allow for controlled movement while maintaining required clearances to avoid collisions. The hoistway shaft in the building is constructed of concrete and the guide rails are affixed to concrete with the use of metal brackets with concrete anchors and bolts or threaded rods and nuts. The concrete anchors used for the counterweight guide rail brackets in the hoistway shaft of the building are ½” drop-in insert style anchors. They use a drop-in insert which is placed into a 5/8” drilled hole in the concrete, then an insert tool specific for the size and style of insert is placed into the insert and stuck with a hammer.

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The force from the hammer blow is transferred through the insert tool, to the insert which forces the pin into the insert, expanding it into the surrounding concrete hole, setting it in place. Once the insert is set, a threaded rod is inserted into the anchor with a nut and washer to secure the guide rail brackets in place (Image 13).

The elevator is equipped with several monitoring and safety devices for safe operation, including an overspeed governor. The overspeed governor prevents elevators from exceeding their maximum allowable speed while travelling. It monitors the speed through a sheave and rope system and activates using a centrifugal force mechanism. If the speed surpasses the set limit, it engages a safety which grips the guide rails, bringing the elevator to a controlled stop.

CSA B44 Safety Code for elevators and escalators

- The code specifies several requirements for car and counterweight guide-rails, supports and fasteners, including specifications for guide rail dimensions and materials, bracket spacing, and fastener size and strength based on calculated static and dynamic loads from the car and counterweight during operation and the application of safety devices.
- Since the adoption of the 2000 edition on the B44 code in BC in June 2003, seismic requirements have applied to all new elevators in seismic risk zones. The requirements include failsafe counterweight displacement detection devices that are activated by derailment of either side of the counterweight at any point in the hoistway to provide information to the control system that the counterweight has left the guides.
- Section 8.6 of the current code requires a maintenance control program (MCP) to be in place to maintain elevating equipment in compliance with the requirements. The MCP must include examinations, tests, cleaning, lubrication, and adjustment to applicable components at regular intervals.
- The requirements for an MCP include maintenance of counterweight displacement detection devices when they are installed but does not specifically include inspection or testing of guide rail fastening and anchors including when a counterweight displacement detection device is not used.

The ASME A17.2 *Guide for Inspection of Elevators, Escalators and Moving Walkways* is a non-mandatory guide intended to assist qualified inspectors in performing routine inspections and tests. Item 3.19.1(b)(2) recommends periodically checking that the fastenings are *sound* and *tight* and that there are no missing bolts or guide clips on the rails to the brackets, and the brackets to the building construction.

Item 3.19.1 from the ASME A17.2 guide is present in the B44-2016 safety code in sections 8.10 (Acceptance inspections and tests for new or altered installations) and 8.11 (Periodic inspections and tests of existing installations), which relate to inspections of equipment by authorities having jurisdiction (AHJ) as required by the *Elevating Devices Safety Regulation (EDSR*). When the B44-2016 code was adopted in British Columbia by the *EDSR* on April 30, 2020, several sections and clauses of the code were not adopted, including section 8.11 which has never been adopted by the *EDSR*. Therefore, the *EDSR* requires the inspection of the guide rail fasteners for new installations and alterations but not for periodic inspections. Details of the sections and clauses that were excluded from the code adoption can be found in the Technical Safety BC information bulletin:

Amendments to the Elevating Devices Safety Regulation

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	It is a requirement of the *EDSR* in BC that any major alterations to an elevator require a submitted technical package verified and sealed by a professional engineer approving the manufacture's specifications for the alteration. A major alteration may require aspects of the elevator to be upgraded to comply with current adopted elevator safety codes.
Failure scenario(s)	During the original elevator construction, the counterweight guide rails were installed with support brackets anchored to the rear of the concrete hoistway. The brackets were spaced out at 12 feet at the top of the hoistway and increasing to 16 feet near the bottom. The brackets were held in place with concrete anchors and inserts that are driven into place with a pin tool. Threaded rods were then threaded into the inserts with nuts and washers to fasten the guide rail brackets to the concrete hoistway wall. During its original construction there were no requirements for counterweight displacement detection devices, and one was not installed. The elevator had a required MCP for maintenance and inspection that was completed and documented on a regular basis by qualified elevator technicians. The MCP included several tests, inspections and examinations but did not include the tightness of the elevator and counterweight guide rail brackets or anchors. Although there is a general requirement for inspection and testing of "[a]ny device on which the safety of users is dependent", the current elevator safety code and regulation do not have any specific requirements for the guide rail brackets and anchors to be included in the MCP. Several floors in the building had been under renovation over the past three years, and the elevator had been in heavy use by construction crews and materials. An insert on one of the brackets at the 5th floor pulled out of the concrete which allowed the guide rail to pull away from the wall. As the counterweight passed over that area, the force of the counterweight eventually broke a second bolt off from the guide bracket below the 4th floor. With two consecutive brackets detached from the wall the guide rail bowed outwards. As the counterweight passed over the bowed-out area, the guide wheels eventually detached from the rail and the counterweight began to hang freely out of the guide in the hoistway. While hanging freely, the counterweight naturally rotated away from the wall into the path of the elevator car. As the elevator car continued to operate, the free hanging counterweight struck and bent seven other counterweight guide rail brackets bending them either upwards or downwards depending on the direction of travel. The elevator continued to operate with the free hanging counterweight until it struck the bottom of the car resulting in the collision and the tripping of the elevator overspeed governor which engaged the safeties and stopped the operation of the elevator. Although Vancouver is in a high seismic risk zone, the requirement for a counterweight displacement device is not a retrofit requirement for elevators unless a major alteration takes place. The elevator had not undergone any major alterations since the requirement came into effect in 2003. As a result, it did not have a counterweight displacement detection device installed and remained compliant with current code because this device was not required at the time of the initial installation. Without the device, the elevator continued to operate once the counterweight came off the rails.

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	Timeline - April 9, 2025 • 2:12pm - Three occupants were travelling down in the freight elevator when they heard a large bang that "sounded like it was metal clashing on metal" and a large shudder during the elevator's operation. The passenger elevator continued to operate and came to a smooth stop at the designated floor, the doors opened, and the three occupants exited the car. • 2:13pm - Two other occupants entered the elevator and experienced the elevator shuddering while traveling. The elevator continued to run and both occupants exited the elevator to their destination floors. • 2:15pm - A lone occupant entered the elevator and rode it to their destination floor without incident. • 2:17pm – While the elevator was descending without any occupants in it, the counterweight, which was ascending from below, collided with the bottom of the downward traveling passenger car at the 17th floor. The force of the collision tore a section of 5" c-channel from the frame of the car that housed two 50-pound balancing weights for the car. The weights were torn free and fell from the 17th floor crashing down to the elevator pit below. The collision between the counterweight and the car triggered the elevator overspeed governor which engaged the safeties and stopped the operation of the elevator.
Facts and evidence	**Interview statements** • Over the past three years, improvements have been ongoing in the building, and the elevator has seen extremely high use with staff and construction materials being constantly transported to the upper floors. • Inspection and testing of the guide rail brackets and fasteners are not part of the MCP periodic maintenance and inspection of the elevators in the building. • After the collision of the counterweight with the passenger car, the overspeed governor tripped stopping the operation of the elevator. • A major upgrade had been in the planning stages for the elevator prior to the incident. • A structural engineer hired by the building management company inspected the condition of the concrete hoistway and stated they did not find any evidence of issues with the concrete structure that they believed contributed to the failure of the concrete insert and they believed the insert may have never been correctly set inside the drilled hole. **Site observations** • On floor 5, the guide rail bracket bolt and anchor on the right side pulled away from the concrete with no visible bending or contact from the counterweight (Image 6). • On floor 4, the counterweight guide bracket on the right side had been severely bent up and the anchor bolt securing it to the concrete wall had sheared off flush with the concrete while the remainder of the bolt and the anchor insert remained in the concrete wall (Image 7 and Image 8). • A total of eight counterweight guide rail brackets were observed to have been contacted by the counterweight and bent to varying degrees either up or down. • The metal c-channel that held the balancing weights on the bottom of the passenger car had been severely bent outward from contact with the counterweight (Image 11).

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Documents

- The MCP document onsite detailed all the periodic inspection and testing for the elevator and did not include inspection of the guide rail fasteners.
- CCTV surveillance video of the elevator car showed the times, occupants and occurrences of the elevator shaking from counterweight collisions on the day of the incident.
- Online earthquake tracking websites did not show any significant seismic activity in the Vancouver area around in the immediate time leading up to the incident although three significant events were measured in the two months prior to the incident. The 4.8 magnitude was the largest measured earthquake in the area in the last 9 years.
  - A 4.8 magnitude earthquake was measured on February 20, 2025, in Sechelt BC approximately 50km away from the incident location.
  - A 4.5 magnitude earthquake was measured on March 3, 2025, in Anacortes Washington approximately 75km away from the incident site.
  - A 3.9 magnitude earthquake was measured on March 5, 2025, in Sequim Washinton approximately 140km from the incident site.

Testing and examination

The rail bracket assembly with the concrete insert, threaded rod, washer and nut that had pulled out from the hoistway were examined, measured and tested.

- The pin from the inside of the insert that forces it outward to clamp onto the drilled concrete hole was no longer attached to the insert and was observed remaining on the inside of the drilled hole (Image 8).
- The treaded rod, washer and nut were still tight clamping the insert against the bracket. The insert was 3.5mm larger in diameter than the width of the slotted hole in the bracket. This allowed the insert to contact the bracket when the threaded rod was tightened. This created a torque force on the nut that did not loosen when the insert came loose from the wall. (Image 16)
- The nut was tested with a torque wrench to measure how much force was needed to move the nut. 82 foot-pounds of force was required to move the nut in a right-hand tightening rotation.
- The diameter of the insert was measured at multiple locations and was found to have expanded approximately 1mm (17.5mm-18.5mm) in diameter from the diameter at the neck (bracket side) to the opposite end at the furthest depth of the drilled hole.
- Visual examination suggests the shiny areas at the end of the insert where it was contacting the inside of the drilled concrete hole. The contact areas were non-consistent around the circumference of the insert and measured 8mm at the end of the insert (Image 17).
  The clamping force of the inserts on other concrete inserts for other rail brackets remained tight and in place even after the brackets had been struck by the counterweight. Forces from the counterweight strikes were strong enough to bend the brackets holding the rail but failed to pull out the inserts (Image 4). In one other location the threaded rod sheared off flush with the insert while leaving the insert securely anchored in place (Image 9).
- The contractor performed pullout tests on multiple concrete fasteners for the guide rail and measured pullout forces up to 1374 pounds.

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Summary

Inspections

The maintenance and inspection program for the elevating system did not include specific requirements for periodic visual inspection or testing of the structure and anchor points, including the counterweight guide rail brackets and concrete anchors. The visual condition of the failed bracket to the wall was unknown prior to the incident as it was not part of any MCP inspection or testing. Acceptance inspections and periodic inspections by the authority having jurisdiction may follow the guidance from The ASME A17.2 *Guide for Inspection of Elevators, Escalators and Moving Walkways* to inspect that the fastenings are *sound* and *tight* and that there are no missing bolts or guide clips on the rails to the brackets, and the brackets to the building construction. This type of inspection may not have reasonably identified a problem with a failed insert until very recently prior to the incident as the threaded rod and nut remained tight to the bracket even after the insert had pulled out from the wall.

Counterweight displacement detection devices

Counterweight displacement devices are critical safety components in traction elevator systems. The requirement for elevators in high seismic risk zones in BC, such as Vancouver, to have counterweight displacement detection devices was adopted in 2003 and is an ongoing requirement for new installations. The elevator involved in the incident did not require such a device as defined in the code as it was designed and built prior to the requirements. Although the main intent for the devices is related to counterweights which may detach due to seismic activities, there are several other reasons a counterweight may detach including building construction failures, or the failure or loosening of guiderail brackets or fasteners. When detached from the guide rails, a counterweight can swing freely into a hoistway and collide with the elevator car traveling in the opposite direction causing serious damage or injuries. Counterweight displacement devices can detect when a counterweight has derailed and send a signal to the control system and stop the elevator immediately preventing collisions such as the one that happened in this incident. Although there was no significant seismic activity identified in the recent days leading up to the incident there were three notable events measured within two months. This included an event on February 20th, 2025, that was the highest measured seismic event recorded in the area for the past 9 years. Lateral forces eventually led to the failure of the guiderail bracket fastener which caused the counterweight to displace. This hazardous condition may have been identified and the incident prevented had such a device been present.

Causes and contributing factors

The counterweight guide rail bracket concrete anchor was likely installed correctly and failed when a significant lateral force was applied to it. The required inspections and testing may not have identified the failed anchor during their regular intervals. It is unclear what the origin of the lateral force was although it is possible that recent seismic activity may have contributed. This allowed the guide rail to deflect and the counterweight to detach from the rail. The counterweight then detached from the deformed guide rails allowing it to swing freely and go undetected by the elevator control system. The free-swinging counterweight contacted several of the rail brackets then eventually the bottom of the passenger car during elevator operation.

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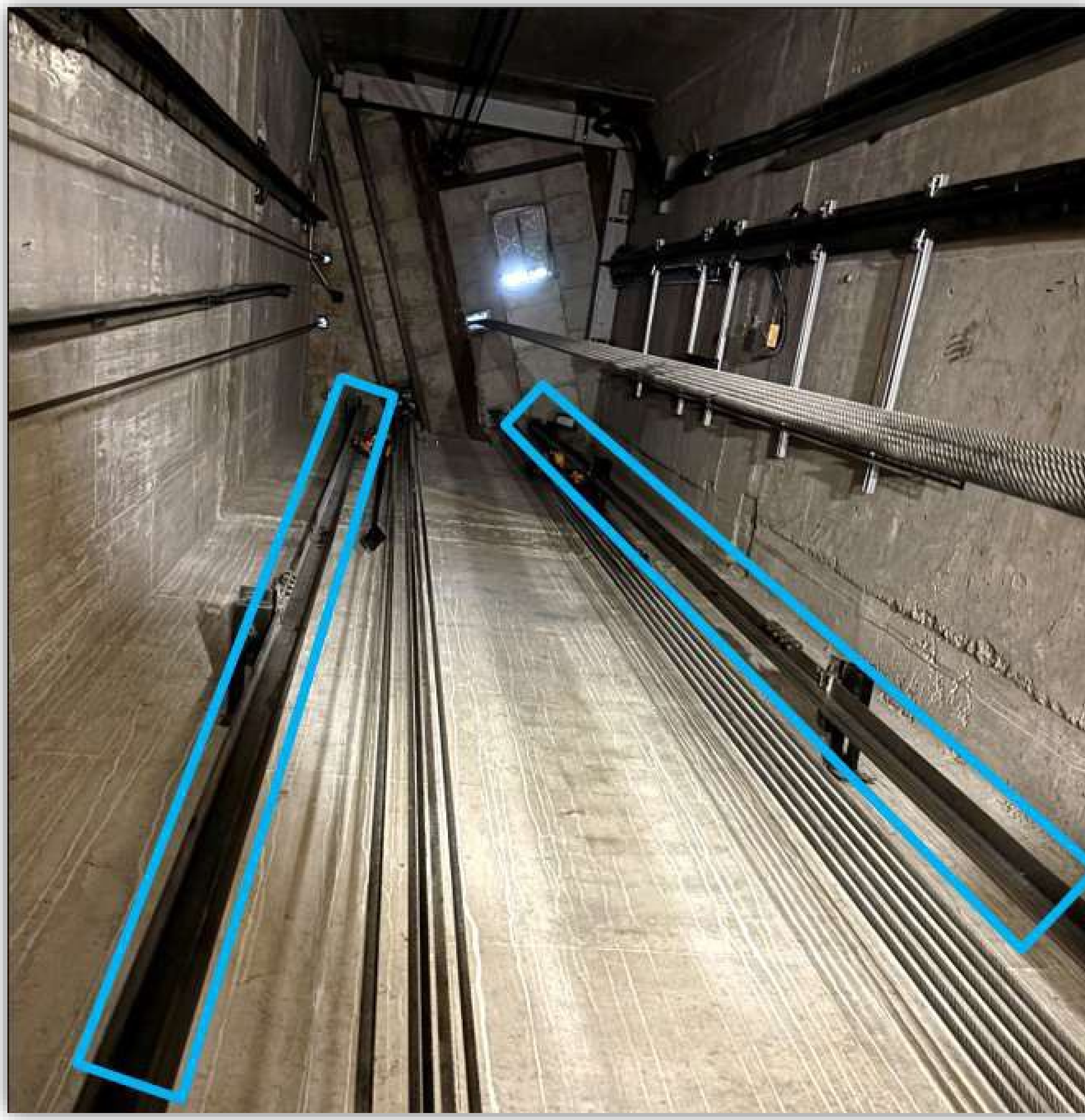

Image 1 – Top of hoistway. [Boxes] The counterweight guide rails.

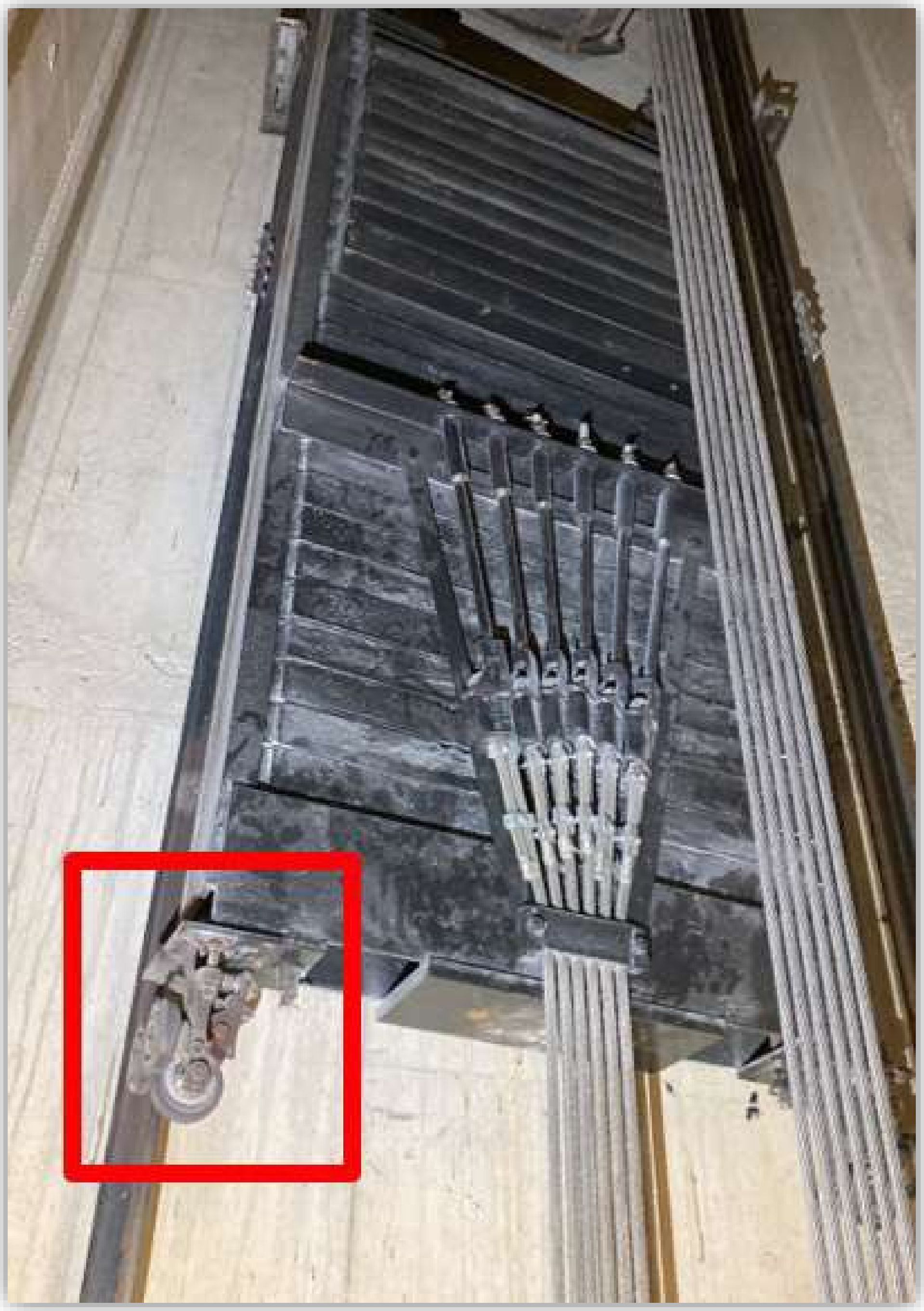

Image 2 – Elevator counterweight. [Box] An undamaged counterweight guide assembly off of the guide rail. The counterweight typically utilizes a guide assembly on the bottom and top of the counterweight for each guide rail.

Image 3 - Counterweight guide rail bracket bent up from contact with the traveling counterweight.

Image 4 – Another counterweight guide rail bracket bent up from contact with the traveling counterweight.

Image 5 – Free hanging elevator counterweight derailed from guide rails showing angle away from wall [lines] and location of damage on elevator car [box].

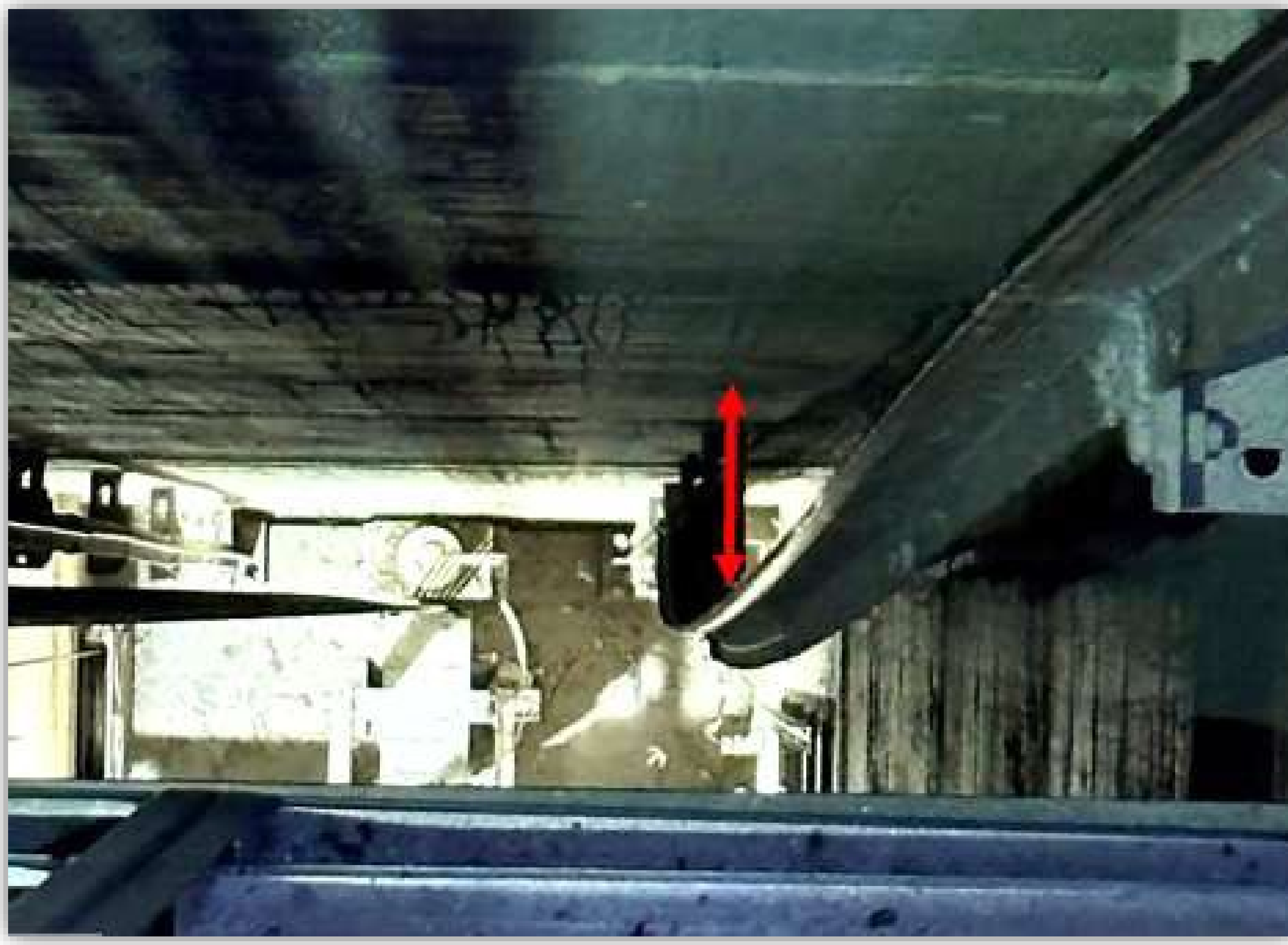

Image 6 - Counterweight guide rail bowed away from the wall.

Image 7 – Counterweight guide rail bracket from the 5th floor with concrete anchor insert that had pulled out from the wall.

Image 8 – Concrete holed for failed anchor. Anchor set pin shown still attached to the center of the hole.

Image 9 – Counterweight guide rail bracket anchor location on the 4th floor with a portion of the broken threaded rod still in the insert.

Image 10 – The other half of the broken threaded rod recovered from the elevator pit after the incident.

Image 11 – The damaged upper lefthand counterweight guide assembly removed from counterweight after incident.

Image 12 – Second view of the damaged counterweight guide assembly.

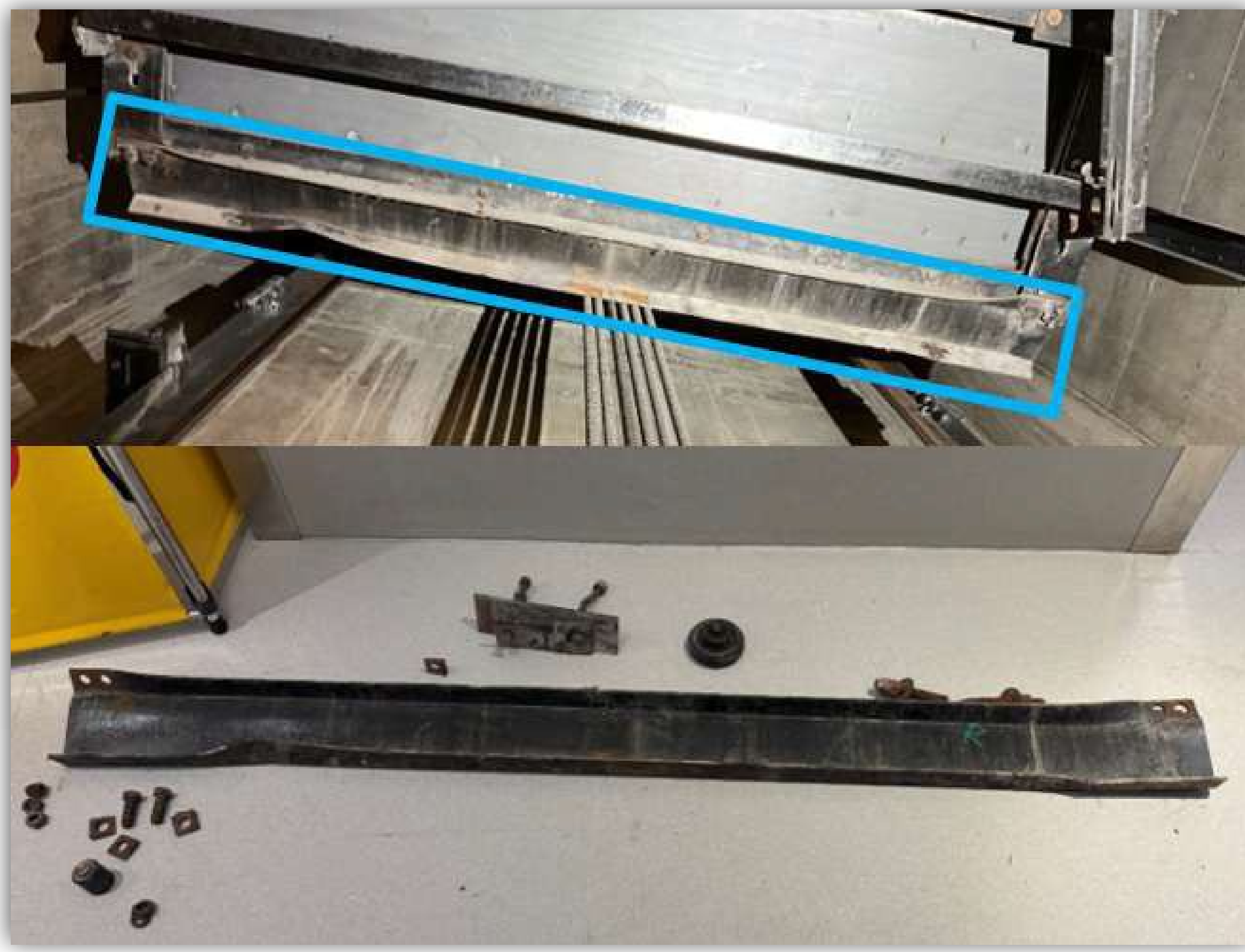

Image 13 – [Top] The bottom of passenger car with bent up c-channel from collision with counterweight. [Bottom] C-channel removed after incident.

Image 14 – The two 50lb balance weights and damaged hardware that were torn from the bottom of the passenger car and crashed into the bottom of the elevator pit from the 17th floor.

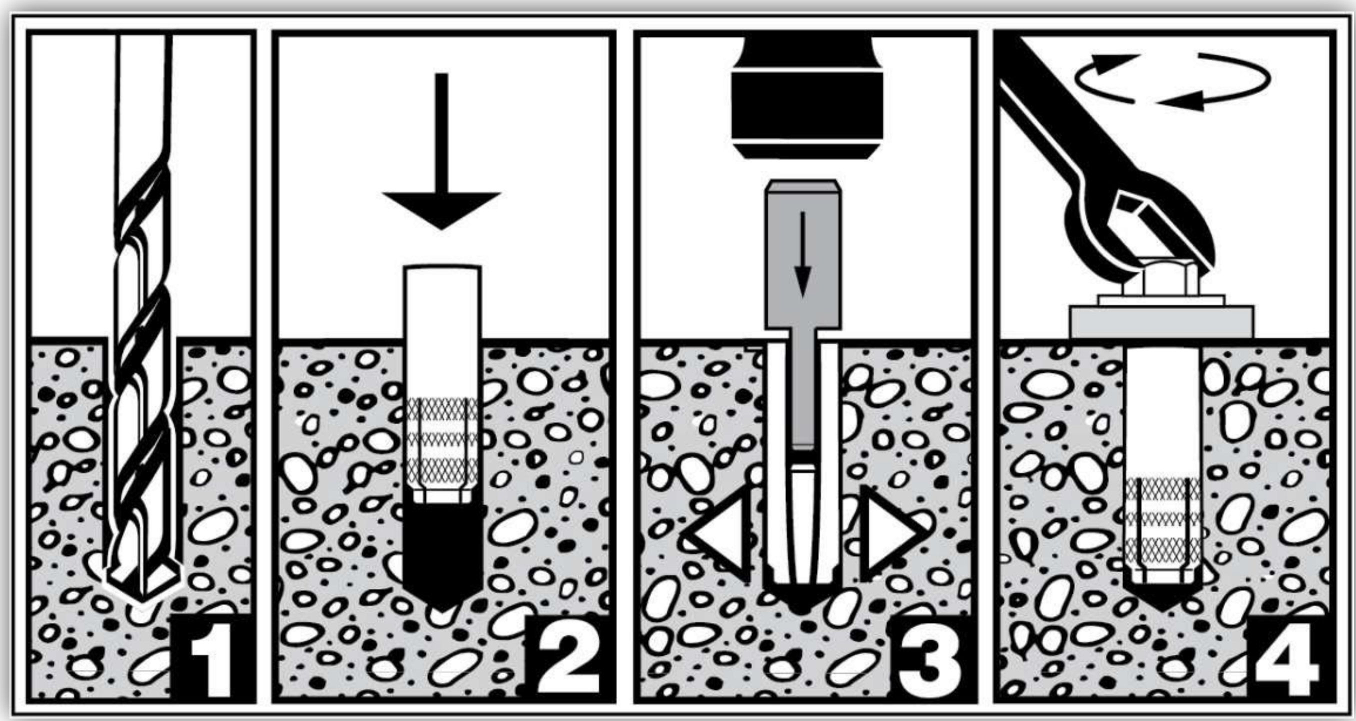

Image 15 – Illustration of the use of a drop-in style concrete anchor system (*https://cobraanchors.com/en/drop-in-stainless-steel-11789.html*).

Image 16 – Counterweight guide rail bracket with concreate anchor still attached.

Image 17 – Closeup images of the failed concrete anchor.

Image 18 – Closeup of threader rod, nut and washer still tight to bracket after concrete insert failure.