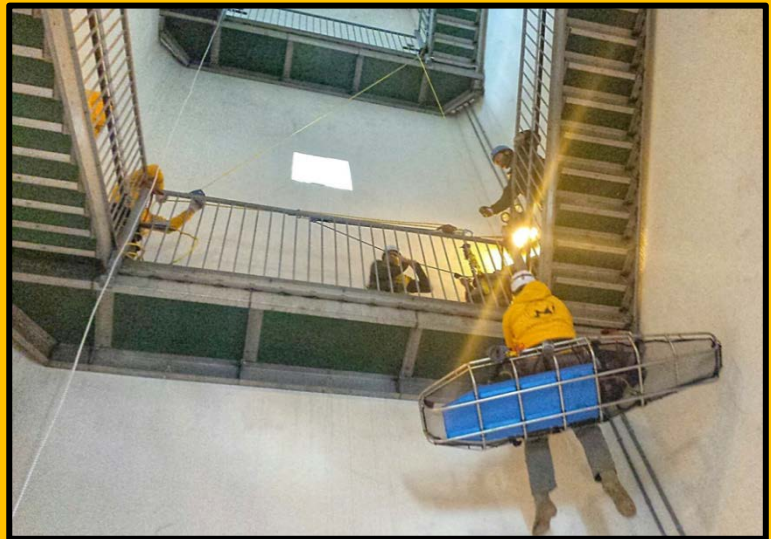


Delaware Water Gap National Recreation Area High Angle Rescue Training Accident Facilitated Learning Analysis High Point State Park (NJ)

Incident Date: April 8, 2015



US Department of the Interior
National Park Service



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INTRODUCTION

The simplest means to learn from an incident is to conduct an after action review (AAR). The AAR is a powerful tool to capture immediate local learning. However, the involved personnel go back to work, learning from identified deficiencies, and the information gleaned during an AAR is typically not shared more than locally.

A facilitated learning analysis (FLA) is more detailed than an AAR and less involved than a serious accident investigation (SAI). The FLA is a non-punitive accident review process which seeks to understand the events of an accident, through the process of “sensemaking”. The FLA process seeks to understand “how” it made sense to those involved, rather than “how” it makes sense in hindsight.

The FLA process supports a learning organization, which is one that completely values opportunities for continuous self-improvement through information and experiences gained in the work place. This is particularly true of safety related issues, particularly the examination of near-misses or accidents. A learning organization directly addresses identified deficiencies so they can be avoided in the future. The FLA process is focused on the lessons learned rather than determining the causal factors of an accident. Learning-focused accident investigations support a “Just Culture”.

Traits of Learning Organizations¹

1. Create a culture that encourages and supports continuous employee learning, critical thinking, and risk taking with new ideas
2. Allow mistakes, and value employee contributions
3. Learn from experience and experiment
4. Disseminate new knowledge throughout the organization for incorporation into day-to-day activities

¹ Business Dictionary. <http://www.businessdictionary.com/definition/learning-organization.html>

SUMMARY

On April 08, 2015, Delaware Water Gap National Recreation Area (PA) High Angle Rescue Team personnel were conducting a monthly scheduled joint-agency High Angle Rescue (HAR) training session at the High Point State Park in northwestern New Jersey. Due to inclement weather, the training was relocated inside the Monument tower structure on the high point summit. The Monument is a stone masonry obelisk standing approximately 226 feet high. This training session was dedicated to raising and lowering an empty basket stretcher with a litter attendant. There were eight participants, which included one Team Leader (TL) and one Assistant Team Leader (ATL). A pulley hauling system was rigged for use by rescuers situated on a horizontal landing that was approximately 26.5 feet above a concrete mezzanine. This configuration permitted raising and lowering each training participant through separate evolutions as the litter attendant.

The main line was routed from a hauling pulley system up through a high directional comprised of two locking carabiners anchored at the next level above with nylon webbing to the handrail structure. A separate managed belay line (backup) was not employed.

During the final training evolution, the ATL was serving as litter attendant, when the upper directional anchor attachment catastrophically failed causing the ATL to fall approximately 20 feet, initially colliding with a stair railing, and then directly on to the concrete surface. The rescuer was situated above the litter at the time and sustained significant injuries, including an obvious compound (open) arm fracture. The rescuer was immediately treated and stabilized by rescue team members on scene and an aeromedical helicopter was requested due to the fall. The aeromedical helicopter was cancelled prior to landing by local agency responding EMS personnel and the injured ATL was packaged and transported to a local hospital by ground ambulance.

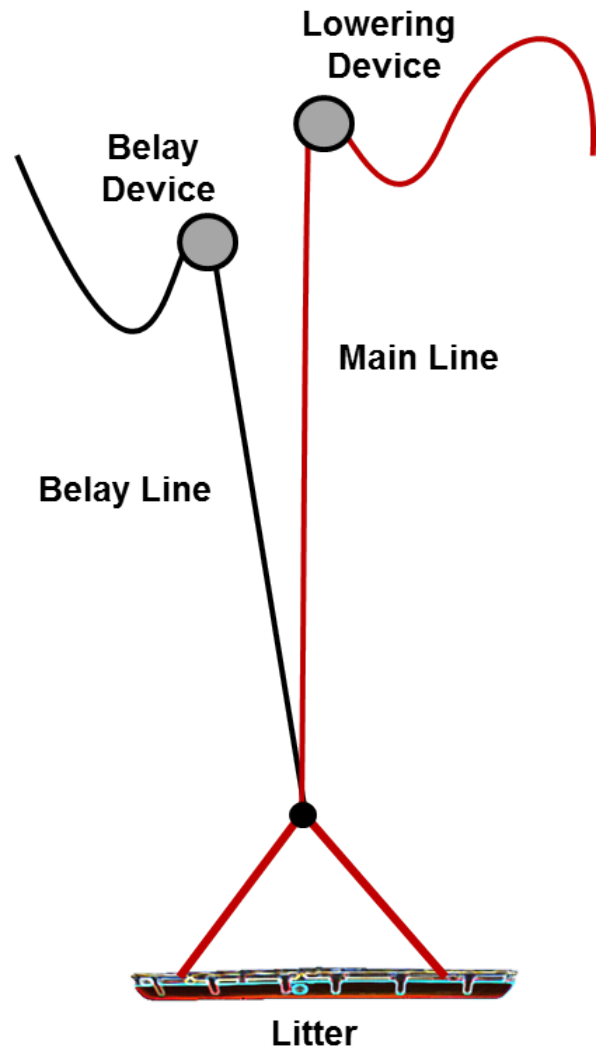


Figure 1- Two rope rescue system employing main line and belay line. Litter attendant not shown for clarity.

NARRATIVE

INVOLVED PERSONS

- **TL (Team Leader)**- DEWA HAR member 22 years and team leader for six years
- **ATL (Asst Team Leader)**- DEWA HAR member 12 years, previously instructed BTR-East²
- **Rescuer 3**- DEWA HAR member three years
- **Rescuer 4**- DEWA HAR member three years, previously instructed BTR-East
- **Rescuer 5**- DEWA HAR member six years
- **Rescuer 6**- DEWA HAR member- three months. Arborist for four years
- **Rescuer 7**- DEWA HAR member two years
- **Rescuer 8**- DEWA HAR trainee. Recreational climber five years

The April 8 technical rope rescue training session was planned well in advance. An email announcement was sent out to team members describing the anticipated training topic, which was litter raising and lowering to provide team members with practical experience as litter attendants. The last litter raising and lowering training session conducted by the team occurred in April 2014 and then followed in September 2014 with a rescue scenario. The joint-agency Delaware Water Gap (DEWA) HAR Team is comprised of 42 DEWA NPS personnel, NJ State Agency personnel, and NPS park volunteers.

Although some participants arrived late, the involved team personnel initially gathered at 0900 hours at High Point State Park Office. On April 8th the weather was cold and windy with freezing precipitation. The recorded high temperature at High Point State Park on that date was 32° F.

The initial plan called for utilizing a 40-foot tall cliff behind Park Headquarters, which has been previously cleaned and developed as a rope rescue training site. Due to the inclement weather, the training was relocated inside the Monument tower on the High Point Summit. Additionally, not all team members arrived properly equipped with adequate outerwear for the cold weather conditions.

Constructed in 1930, the masonry structure is 226 feet high. The interior of the Monument has a circular staircase that provides access up to a mezzanine on the second floor. The mezzanine level is decked with a concrete surface. The remainder of the interior of the monument is open to the top with a metal staircase wrapping around the inside walls. There are horizontal landings at each floor level. The ninth floor with a viewing platform is the top of Monument. The area in the center provided an unobstructed location for rope rescue training.

The Monument has been used previously for training. Twelve years ago a litter training session was conducted inside the Monument. At that time the full height of the structure was used for the exercise, which involved two litter attendants and no patient. A separate main line and belay line were employed at that time.

² BTR-East is the five-day NPS Basic Technical Rescue Course held in the eastern United States.

The ATL had experience rigging in the Monument for ascending and rappelling practice two years prior. No member of the current team had previous experience rigging within the Monument for a litter raise/lower evolution.

The Monument was not open to the public at the time of the training on April 8. It should be noted that in the event of a patient rescue inside the Monument the local plan of action is to use a stair chair, a standard EMS transport appliance, for an injured subject without the need for spinal immobilization. There still remains the possibility that a technical rope rescue lowering might be employed for a spinally immobilized patient evacuation.

Upon arrival at the Monument, rope rescue equipment was transported from a rescue team equipment trailer up the spiral staircase on to the mezzanine. A formal briefing was not conducted and a safety officer was not assigned. The interior of the structure created an echo, which impaired clear voice communications over a long distance.

As they were walking into the Monument, the TL told the ATL to “punch in the rigging above.” The TL reminded ATL that there were no rocks or trees, “you have the lead.” The ATL responded, “no problem, I got this.” The distance between floors (horizontal landings) is 26.5 feet. The ATL climbed up two levels above and set up rigging for a high directional, which would wind up being one level above the hauling system.

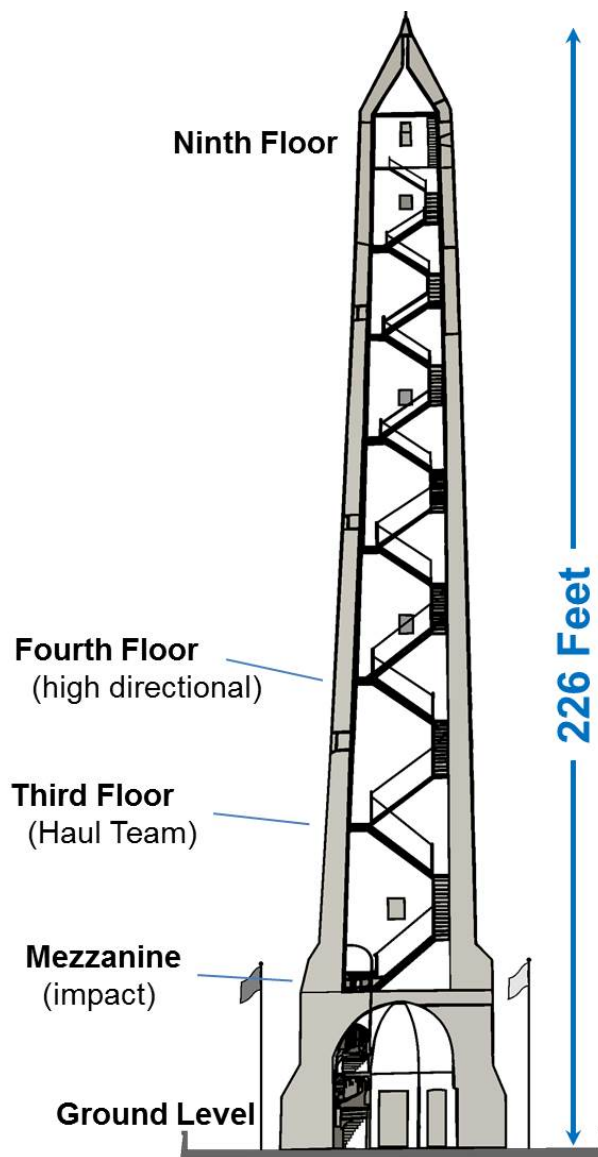


Figure 2- Structural diagram of Monument at High Point State Park (NJ).

RIGGING

A high directional was constructed that employed two rescue rated carabiners placed side by side, which provided a “change of direction” for the main line (11mm low stretch kernmantle nylon rope) as it came up from the hauling station one level below and then was redirected back down to the litter and attendant. Dual carabiners were used instead of a pulley, which is common in this application. The ATL said later, that the dual carabiners “gives you a little bit of friction, I don’t think it was a bad thing.”

The directional carabiners were held in place with an anchor attachment constructed with a single 25 foot long piece of one-inch tubular webbing. The webbing was successively wrapped around three separate structural points at the base of the hand railing, which includes a corner post and two railing balusters (thinner upright spindles). The narrow spacing between the balusters was about 3½ inches wide, making it awkward to reach through and perform the rigging tasks.

Initially Rescuer 3 rigged the upper anchor for the directional, however the ATL inspected the rigging and found it was tied incorrectly. The webbing was tied with an overhand on a bight (tails come out together). The anchor webbing was kept in place and the ATL re-tied the knot. The knot was properly retied with an overhand follow (ring bend) that is noticeably different (tails come out in opposite directions). The webbing tails were then secured with “half hitches on the tails”.

Canvas rope protection was wrapped around the base of the corner (stanchion) post to protect the metal edges from being in contact with the webbing. Rescuer 3 stated that he did not look down at the platform edge on the face and assess it for contact with the webbing. When positioned in place, the two directional carabiners were suspended on the webbing below the metal structural decking.

As the rigging was being completed up above, the TL looked over later and noticed that the designated belay gear bag was sitting untouched on the mezzanine level. Four labeled gear bags are normally deployed, which are pre-designated for the Main, Belay, Edge Pro, and Litter Rigging. The TL looked up above to the ATL and asked about the belay and the ATL responded that the belay was not needed.



Figure 3- Overhand on a bight and overhand follow through.

*“I gritted my teeth and let it slide. That right there was the worst decision of the day.”
They went on to say “I have been trying to let them grow. I knew it was a bad decision, but I let it slide.” -Team Leader*

The ATL later recalled that the factors for deciding not to have a belay, included:

- “Because of the situation.... tight parameters of the physical location”
- A belay would “cause confusion and there would be lines crossing”
- There was “a lot going on there” with the haul system and without a belay the system was “compact and smooth”
- It was “only a single person load”

"I told everyone that having a belay system would be safer"- Assistant Team Leader

Later the TL remarked, "If I had asked (ATL) to punch in a belay line, (they) would have done it."

BELAY (Definition) - The act of using a rope as a "backup" or "safety" to prevent a person or load from taking a serious fall. In rescue, a belay line provides a redundant safety backup in the event of main line failure.

The ATL and Rescuer 3 descended one level and rigged the hauling and lowering system. The haul system was a 4:1 simple pulley system that was ganged on (attached) to the main line by means of a Petzl Rescucender.³ A Petzl I'D (industrial descender) device was rigged on the

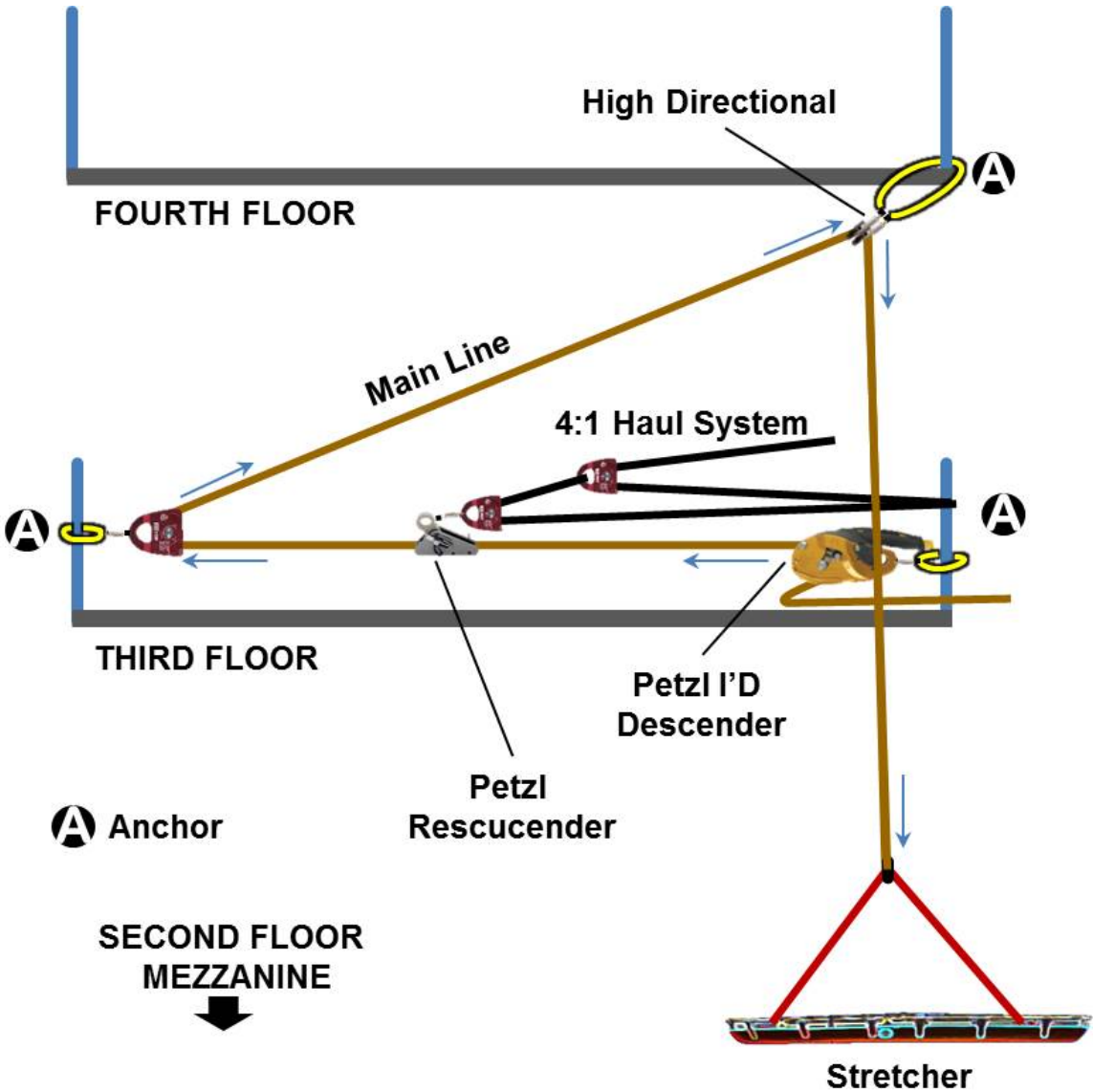


Figure 4- Schematic diagram of accident scene rigging. Not drawn to scale.

³ Petzl Rescucender is a commercial rope clamp (grab) device designed to operate on 9mm to 13 mm diameter ropes.

main line for a lowering system directly below the directional. A pulley was established on an anchor at the opposite end of the landing, which re-directed the main line up to the high directional. The HAR team members stated they routinely utilize a Petzl I'D for a two-person rescue load, however it is incorporated in a twin rope system employing two Petzl I'D devices.⁴

The ATL noted, at the time prior to the accident, that “this configuration introduced the potential for significant slack if the directional failed.”

Another rope was rigged off the side of the Monument interior for rappelling and ascending practice. This wound up being utilized only for a rappelling training opportunity by participants. This was used as single rope technique (SRT) without a separate belay line. The fixed ascending/rappelling rope was only used by two trainees.

The rigging process was described as having no associated time pressure and personnel were “taking our time.” The ATL later denied being fatigued and recalled they had obtained 7.5 hours of sleep on each of the two nights prior to the training.

Prior to the training commencing, the TL inspected the rigging of the lower station, but did not inspect upper station with the high directional. The TL was stationed on the mezzanine during the training, where they could assist with the attendant tie-ins. Team members received instructional briefings by the TL and ATL at the litter attendant position and haul system station respectively.

Personal rigging of attachment points for the attendant was normally accomplished with the “long tails from the main and belay lines.” On this date only a single rope was in use, which resulted in several different attendant attachments (e.g. Grigri, sewn daisy chain, and jigger with pulleys) being used by different personnel in a non-standardized manner.

OPERATIONS

The training commenced with litter attendants practicing operating in the lower traditional attendant position and more efficient upper attendant positions (Figure 5)

The rope, which was brand new, was becoming visibly frayed as the evolutions proceeded. The hauling evolution was stopped and personnel “looked at everything”. The team members noticed the exterior of rope sheath had developed cosmetic damage. There was open team discussion of this being caused by friction during the hauling as the rope moved through the double carabiners (directional). Personnel looked above at directional rigging without climbing up to that location, and noted that rope was not touching anything. Members of the team made the conclusion that this was the rope simply being “broken in.”

⁴ NPS Technical Rescue Handbook, 11th edition, reads: “Although the manufacturer permits the use of the I'D in controlled circumstances with a two person load, the parameters are restricted. This includes not permitting a shock load, which may be impractical to assure during a rescue. Due to the manufacturer restrictions, and inability to handle a shock load, the I'D should not be considered a practical two-person belay device for technical rope rescue operations.”

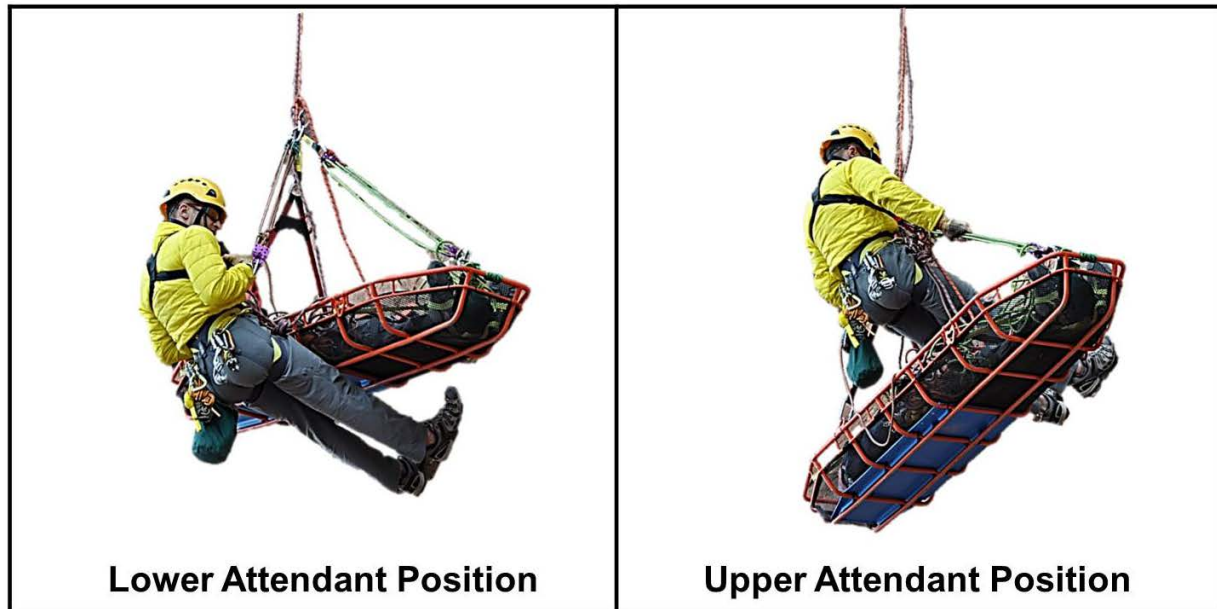


Figure 5- Example images of the lower and upper attendant positions.

The TL was the only member not serving as a litter attendant during the training. As the training progressed, it was noted that the “movement of litter attendant caused sway (at the upper anchor) and that was eating up webbing.” The seventh and final evolution involved the ATL as the attendant.

The ATL (43) is 6’1” tall and weighs 170 pounds. They were raised up by the haul team and just as the lowering phase was initiated, the ATL initiated a transition from the upper attendant position back down to the lower attendant position.

A “loud pop or bang” was heard as the upper anchor attachment point suddenly catastrophically failed.

The ATL stated, “It was like watching a fall on TV....With all the faces of everyone on the landing looking at me in disbelief. As I’m falling it was a blur having the feeling that you were about to die....I thought how can I lessen the impact?”

During the fall, the foot end of litter struck the stairway hand railing. The ATL said, “It probably saved my life by slowing the descent ever so slightly to the ground”

The ATL was conscious and breathing with pain following the accident. The ATL grabbed their deformed left forearm, which had an open (compound) fracture and reduced the angulation, and said later, “In disbelief I was still alive.”

The violent impact caused the left rail of the titanium litter to become dramatically bent and the mesh liner in the litter ripped. The ATL later observed, “If I was in the lower attendant position I’d be dead, I’m quite sure of that.”



Figure 6- Damaged rescue litter following accident.

The litter was located under the ATL as they lay slumped to one side. Team members immediately initiated medical care and removed the gear from the ATL's harness. The reaction to the reality of the accident was described as "professional" and with "controlled urgency."

The ATL was already situated in the litter, so they were simply realigned and packaged securely in the litter with available fleece clothing. The TL went outside to use radio to contact DEWA Dispatch. Based upon the circumstances a decision was made to immediately request an aeromedical helicopter response to the scene.

"After the accident, the whole team was right on with the medical attention provided to (ATL)"

The ATL was efficiently transported down the spiral stairway to the ground floor. This was an awkward maneuver with the litter scraping the railing and wall on the way down. The largest team members were used for the litter transport, and then the litter was staged inside the Monument entry area due to the inclement weather.

The aeromedical helicopter initially arrived over the scene; however local EMS personnel did not understand the magnitude of the potential injuries and cancelled the aircraft prior to landing. The injured ATL was subsequently transported to a local hospital by ground ambulance, where they were treated for four days prior to being released.

INJURIES INCLUDED

- Left arm fracture- midway between wrist and elbow
- Compound fracture near wristwatch- no bleeding
- Three fractured vertebrae
- Bruised hip
- Undiagnosed heel injury
- Fractured rib

POST-ACCIDENT FOLLOW-UP

Rescuer 4 ensured security of the scene, with no rigging equipment being disturbed prior to the arrival of an NPS Special Agent, who thoroughly documented conditions at the accident scene.

The two carabiners, which had been used as a directional, were found attached to the main line rope lying on the mezzanine floor.

Post-accident it was observed that the Petzl Rescucender, which was the attachment for the 4:1 hauling system to the main line, had a wire sticking out of it. The wire is a non-load bearing component that serves as a “keeper” to prevent the loss of the internal cam when the device is being loaded on the rope. Although not precisely known, this physical damage is assumed to have been caused by the sudden release of tension and the device striking the handrail structure. This likely occurred following the catastrophic anchor point failure above.

During the on-scene examination of the upper anchor point, it was observed that the nylon webbing had made contact with an exposed edge of angle iron. This occurred when the tensioned main line created a resultant force on the high directional that pulled it at an offset angle away from directly below the upright corner stanchion post.

Later it was summarized that the webbing anchor was also not securely tied off with a “master point” of attachment. It was described that “one cut could cause the whole system to fail.”



Figure 7- Carabiners, used for high directional, on the main line following the accident.



Figure 8- Damaged Rescucender showing broken retention wire.



Figure 9- Upper anchor point following failure of nylon webbing.

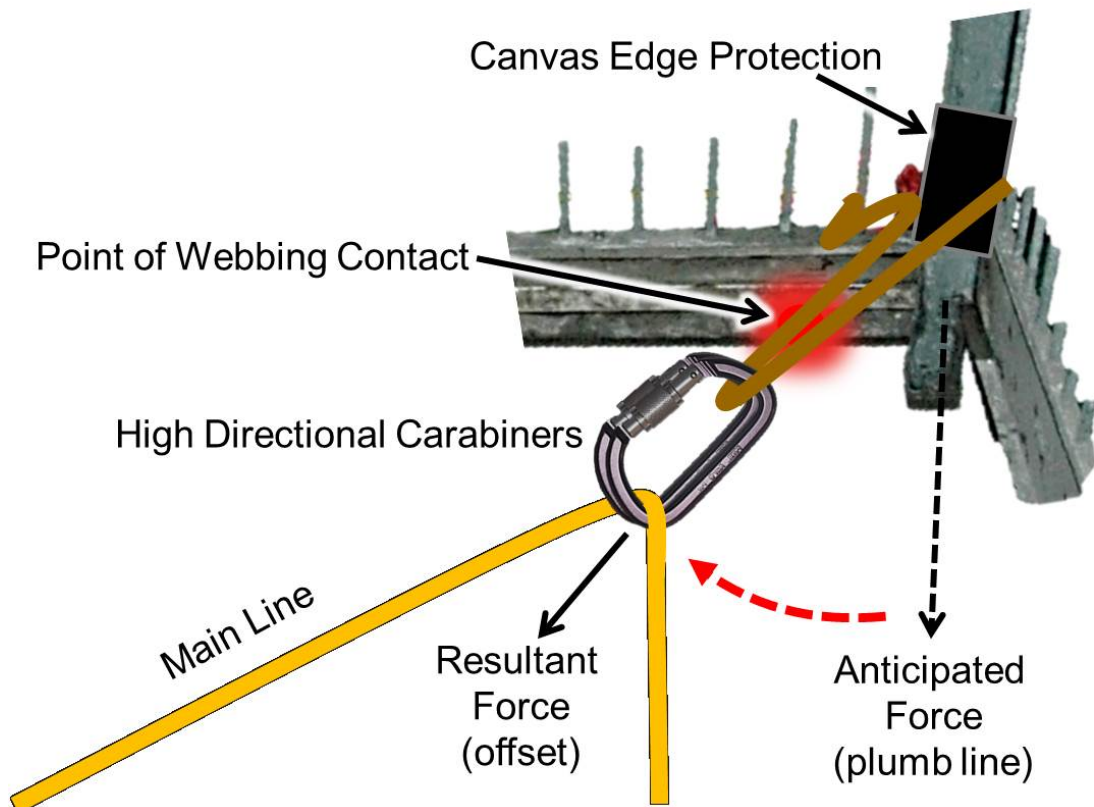


Figure 10- Diagram demonstrating offset resultant force created by tensioned main line.



Figure 11- Haul system and lowering rigging post-accident.

COMMENTS:

- “We were not that high up”
- “It’s a single (one-person) load”
- “We always use a belay- The one time you do not do something and something happens”
- “Using a belay is NPS protocol- I should have spoken up”
- “Setting up a belay, it would have been the smartest thing we could have done”
- “Everyone is in charge of safety. Speak up- It is all our responsibility”
- “Had we noticed it (the angle iron) we would have addressed it with more edge protection-”
- “People let their guard down a bit. When you get comfortable, that’s when you get hurt. I will never make that mistake again”
- “We all looked at anchor- it looked good. Inspect the anchors better- where things could rub-throughout the day-not just at the beginning.”
- “The change of location threw me a curve ball. We left the cliff and we were doing things differently...Train how you practice (on incidents).”

Through “shortcuts” an organization grows more accustomed to deviation from accepted behavior the more it occurs without negative consequences. To people outside of the organization, the activities seem deviant; however, people within the organization do not recognize the deviance because it is seen as a normal occurrence. This “normalization of deviance”⁵ is also referred to as “normalization of risk.”

Following standardized procedures in training improves operational responses. Like the mantra of military warriors, it is vital to *“train like you fight and fight like you train.”*

LESSONS LEARNED BY THOSE INVOLVED

- Conduct formal operational briefings prior to training operations so that all involved personnel understand assignments and procedures
- Actively seek team member feedback on operational decisions
- Designate a safety officer
- Employ a separate managed belay line on all loads in rescue or training, which includes one or two-person loads
- Check secondary edges for the need to have rope protection in place
- Review the NPS Technical Rescue Handbook for standardized accepted techniques

⁵ Vaughan, D. The Challenger Launch Decision: risky technology, culture, and deviance at NASA. Chicago: University of Chicago Press. 1996.

- Employ standardized litter rigging and attendant attachments, which provides for an consistent means to perform safety checks
- Training frequency needs to be at a suitable level to prevent erosion of skills

Conducting formal operational briefings is a standard practice that creates a natural “pause point” opportunity for feedback to be solicited from team members. This action serves to harness the collective intelligence of the group through the “wisdom of the crowd.”⁶

Designating a safety officer also creates oversight redundancy, since a team leader can easily become overtasked during an incident.

SUMMARY

This accident involved an event that could have been fatal. The patient care, rescue effort and investigation that occurred after the accident were carried out professionally.

The DEWA HAR Team immediately stood down all rope rescue operations and made a deliberate effort to review how operations were being conducted. They have had all team members review the established procedures found in the NPS Technical Rescue Handbook.

All involved team members provided frank and thoughtful feedback in reviewing this accident with a personal goal of helping others learn what happened, so that it is not repeated. As they become operational, the DEWA HAR Team is taking deliberate steps toward program improvement and enhanced operational safety.

This report provides valuable learning points, particularly about team communications and the need to speak up, for everyone involved in high risk training and emergency responses.

Definition of Just Culture

The “Just Culture” model maintains forward-looking accountability. It is concerned with preventing the next accident, not focused on correcting history.

Just Culture is a workplace where employees at all levels participate and are committed to the organization’s safety culture. In a Just Culture, Management purposefully and deliberately learns from workers how work gets done and how risks are perceived and managed. In a mature Just Culture, workers and administrators see information as the lifeblood of safety.

⁶ Surowiecki, James. The Wisdom of Crowds: Why the Many Are Smarter Than the Few and How Collective Wisdom Shapes Business, Economies, Societies, and Nations. 2004.

As organizational behavior and communication author Todd Conklin points out, organizations that manage safety performance well constantly work on these four things;⁷

- 1. We are fixated on where the next failure will happen**
- 2. We constantly strive to reduce complicated operations**
- 3. We respond to low level signals seriously**
- 4. We respond to events deliberately**

“Look for small signals that indicate system weakness or problems within the normal work procedures”

“Errors, near misses, good catches, close calls- any of these factors could indicate there is a no problem, without the actual consequences of failure. Safety professionals look on indicators of this type as “gifts.””

⁷ Conklin, Todd. Pre-Accident Investigations: An Introduction to Organizational Safety. 2012.

PROCEDURAL NOTE: A basic FLA, which can be described as an “After Action Review on Steroids,” can be led by as few as just a couple of people. The FLA process typically involves an assigned team of personnel with a formal delegation of authority. Based upon the circumstances NPS leadership concurred with the plan to have a basic FLA conducted by the NPS Branch Chief of SAR, who is responsible for program oversight of the national SAR program. Consultants with expertise in the FLA process reviewed the FLA report and the involved incident personnel also provided feedback on the final report for accuracy.

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REFERENCE

NPS Technical Rescue Handbook, 11th Edition

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