**Chapter 16: Working in Suspension**

Chapter Overview

Working in suspension, which is inherent to rope rescue, presents unique challenges and risks for rescuers. Navigating the slope and edges of a rescue environment is difficult on its own and made even more difficult when managing a litter or a subject. Suspended work requires coordinated communication, clearly defined roles and expectations, an ability to anticipate needs, and an understanding of how to work in a free-hanging condition.

Both rescuers and subjects can experience suspension-induced injury as a result of hanging upright and motionless from an attachment point. Suspension-induced injury can result in serious injury and even death; therefore, it is critical that rescuers become knowledgeable about how to prevent such injury, identify risk factors and symptoms, and treat suspected cases. Edges also represent a significant risk to those involved in rope rescues. A rescuer’s ability to navigate edges and the team’s ability to support the suspended worker are crucial to the success of every operation. Communication and knowledge of techniques and equipment are key to mitigating risks.

Objectives and Resources

**Knowledge Objectives**

After studying this chapter, you should be able to:

 Recognize the risks and signs and symptoms of suspension-induced injury. (pp. 322–323)

 Describe the role of the third man in rope rescue. (pp. 323–326)

 Describe the methods a rescuer on a rope can use to negotiate an edge. (NFPA 1006: 5.2.19, pp. 326–327)

 Describe rigging a litter for a high angle lower or raise. (NFPA 1006: 5.2.12, 5.2.13, pp. 327–330)

 Explain how to tend a litter moving over an edge. (NFPA 1006: 5.2.21, 5.2.22, 5.2.23, pp. 330–335)

 Describe the methods of attaching a litter to a lowering system. (NFPA 1006: 5.2.21, 5.2.22, 5.2.23, pp. 327–330)

 Explain the duty of an edge attendant. (NFPA 1006: 5.2.14, 5.2.19, pp. 324, 331, 334, 335)

 Describe rigging to a horizontal high line. (pp. 335–336)

**Skill Objectives**

After studying this chapter, you should be able to:

 Navigate an edge while suspended. (NFPA 1006: 5.2.19, pp. 326–327)

 Configure a litter attachment for a horizonal lower. (NFPA 1006: 5.2.12, 5.2.13, pp. 328–330)

 Configure a litter attachment for vertical lower or raise. (NFPA 1006: 5.2.12, 5.2.13, pp. 332–334)

 Manage a litter while suspended. (NFPA 1006: 5.2.21, 5.2.22, 5.2.23, pp. 331–332)

 Direct a litter raising and lowering operation in a high-angle environment. (NFPA 1006: 5.2.23, pp. 332, 335)

Support Materials

 Dry-erase board and markers or chalkboard and chalk

 LCD projector, slide projector, overhead projector, and projection screen

 PowerPoint presentation or slides

 **Navigate for Students**

 **Advantage**

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Reading and Preparation

Review all instructional materials, including *Rope Rescue: Principles and Practice,* Fifth Edition, Chapter 16, and all related presentation support materials.

Chapter Presentation Overview

Pre-lecture

I. You Are the Rescuer

Small-Group Activity/Discussion

Purpose

The purpose of this activity is to introduce students to concepts surrounding the understanding and management of water rescue incidents.

Instructor Directions

1. Direct students to read the “You Are the Rescuer” scenario found at the beginning of Chapter 16 (p. 322).

2. You may assign students to a partner or a group. Direct them to review the discussion questions at the end of the scenario and prepare a response to each question. Facilitate a class dialogue centered on the discussion questions.

3. You may also assign this as an activity and ask students to turn in their comments on a separate sheet of paper.

Lecture

I. Introduction

A. Review the learning objectives.

B. As a basic function, being lowered and raised by rope is an operations-level skill.

C. Managing a subject while suspended is considered to be a technician-level skill.

1. An operations-level rescuer is expected to be capable of moving a subject from one stable location to another, but is not expected to accompany a subject on rope, nor to be able to ascend and descend on rope themselves.

2. Developing a knack for functioning effectively while being lowered takes time and practice—especially when it comes to working in a free-hanging condition, with no surface on which to exert friction to help control body position.

3. Ascending and descending require strength and stamina; suspended work requires coordinated communication and the ability to anticipate needs.

II. Suspension-Induced Injury

A. Concerns over the hazards and potential for suspension-induced injury have risen to prominence in recent years.

B. Various terms are used to describe the phenomenon; however, the term *suspension-induced injury* will be used in this text.

C. Various instances of suspension-induced injury have been noted over the years.

1. The concept gained traction when the Federation Francaise de Speleologie conducted research in an effort to determine clues as to the cause of death in apparently healthy, otherwise uninjured, suspended cavers who had expired while awaiting rescue.

a. Before the project was halted due to perceived risk to test subjects, researchers did confirm a clear correlation between motionless suspension and severe physical response.

2. Later, the National Institute for Occupational Safety and Health (NIOSH) in the United States performed tests related to harness suspension, confirming the findings of previous studies and emphasizing that keeping the legs elevated and moving is a key to survival.

D. Risk factors

1. While anyone suspended in a harness is potentially at risk of experiencing the effects of suspension-induced injury, hanging upright and motionless from an attachment point, especially the dorsal attachment point, appears to be a key factor in the slowing of circulation in the legs, leading to shock.

a. Other factors, such as weight, overall physical fitness, harness fit, fall distance, and other medical history, may affect a person’s risk level, but do not seem to have a direct impact as to whether a person experiences the signs and symptoms of suspension-induced injury.

E. A suspended person who is conscious and who can move their hands and feet has a distinct advantage over an unconscious subject.

1. Rescuers working while suspended in a harness should stay active while on the rope, flexing their feet and legs periodically either against a vertical surface or in a footloop or etrier, and even keeping their legs elevated, if possible.

2. Indications of any of the following should be taken increased as an early warning sign to get off the rope and stretch a bit to avoid injury:

a. Difficulty in breathing while suspended

b. A growing discomfort in extremities

c. Tingling or numbness in the legs

F. A person who is suspended motionless, particularly after a significant fall and/or in a compromised environment, is in imminent danger.

1. This represents a true emergency.

2. Personal escape becomes increasingly difficult as the condition progresses, and the subject may eventually lose consciousness.

G. Prompt rescue should be provided to anyone who is suspended in a harness, particularly if they are unconscious or unable to move.

1. Rescuers responding to a person who is experiencing suspension-induced injury may observe symptoms including:

a. Swelling of the face and hands

b. Puffiness around the lips and eyes

c. Shallow breathing

d. Extreme lividity (purple skin)

2. On the other hand, symptoms may not be seen.

a. An absence of symptoms does not necessarily mean an absence of the condition, and subjects should be closely observed during and after an incident.

H. Treatment protocols

1. Treatment for the condition was once believed to be to keep the subject upright, in a seated position, even after they are on the ground.

2. More current protocols suggest that treating for shock, including providing high-flow oxygen and fluid replacement, is the preferred approach.

3. The local protocols, as crafted by a medical director, and the level of medical training of the rescuer should be followed.

III. Third Man Operations

A. *Third man* a term derived from a phenomenon in which an unseen being is sensed as intervening in a critical moment of distress.

1. In rope rescue vernacular, it is used to describe a rescuer whose role it is to:

a. Access the subject quickly

b. Assess the situation, help with packaging and preparation

c. Generally anticipate and assist with the many tasks required

2. They are typically not the primary rescuer, nor the rescuer who takes direct contact and control with the subject, though they are usually the first person over the edge in a rope rescue operation.

a. Equipped with basic technical and medical gear to stabilize and assess the subject, they set the stage for the rest of the operation with the resources and evacuation recommendations they request.

b. The third man need not have extensive medical skills but should be capable of providing basic life support assistance to the subject.

c. More importantly, the third man should have a strong understanding of rope rescue systems and be capable of securing the subject to prevent further harm.

3. When accessing the subject from above, the third man must first prioritize their own safety.

a. Although there may seem to be a sense of urgency to reach the subject, it is important to set the stage for a successful rescue by:

i. Evaluating site hazards

ii. Donning proper personal protective equipment (PPE)

iii. Selecting appropriate equipment to carry

iv. Establishing appropriate position relative to the impending operation

v. Setting up an appropriate lowering/raising system

4. When the third man reaches the subject, their initial role is to assess the subject’s physical predicament and medical condition.

a. They should provide relevant information back to site management and the primary rescuer to assist with ongoing evacuation and rescue planning.

b. While the third man may initiate urgent medical interventions, the most urgent of interventions involves readying the subject for extrication and transport.

5. To the best of their ability, the third man should prepare the subject for the next phases of the rescue.

a. In addition to immediate lifesaving medical measures, this includes having them ready for arrival of the primary rescuer and, if applicable, a basket litter for transport, which may include the following:

i. Providing physical protection or shielding if required

ii. Determining where the litter should be positioned

iii. Having the subject completely ready for loading into the litter by the time the primary rescuer and litter arrive

iv. If the subject is suspended on rope or unable to move themselves, the third man may need to create a pickoff system to help extricate and move them into the litter.

6. When the primary rescuer arrives, the third man’s role becomes that of an assistant, specifically:

a. Their role then is to support the efforts of the primary rescuer in any way needed.

b. If a litter is being used, the third man may even continue to be lowered and raised alongside the litter so that they may continue their support role.

c. Particularly in the case of a lower with obstructions, it can be very helpful to have an extra set of hands to help maneuver the patient.

7. In some cases, it may be prudent to run an adjustable tether between the third man and the primary rescue system or litter, to help keep them close. If such a contraption is used, it should be set in such a manner that it can be quickly detached as needed.

B. Communications

1. With system operation at the discretion of a brakeman or haul team, good communication between the rescuer who is on rope and the person controlling their progress is key.

a. If possible, direct voice communication between these two individuals is preferable.

b. When conditions such as distance, line of sight, or ambient noise preclude direct communication, a relay person may be employed.

c. Where available, an edge attendant can serve double duty with this assignment.

d. Over longer distances, radios may be beneficial.

2. Many rope rescue professionals choose to use a radio secured to their body by way of a radio chest harness to facilitate more efficient radio communications.

a. A radio chest harness may integrate with the full-body rescue harness, or it may be a completely separate configuration of straps. In either case, it should be secured in a location where the rescuer can easily hear the speaker and key the mic, as needed.

3. Some rescuers use voice-activated radio systems for the hands-free convenience they offer, but these have some clear disadvantages including a tendency to pick up and transmit unwanted sounds, including:

a. Ambient noise

b. Rescuer grunts and mutterings

c. Private conversation

4. Voice communications between rescuer and brakeman should be limited to a few simple, predetermined commands.

5. If there are to be multiple rope rescue operations occurring simultaneously—such as a third man system and a litter system—each system should be assigned an identity, and each radio communication prefaced with that identity. For example:

a. The third man system may use language such as, “Third man brake, third man rescuer, on belay?”

6. The litter system communications may progress as follows: “Litter brake, Litter, on belay?”

7. Using different radio channels for the different systems is also considered good practice, but once a rescue is underway, operators should not need to change channels to communicate.

a. Setting the radio at a primary communications channel while continuing to monitor other relevant channels is one way to help ensure adequate communications.

b. When a rescue operation is in a critical phase, all other radio traffic should be held.

8. During the operation, no conversation or communications should be taking place except between the suspended rescuer and the brakeman or haul team captain.

9. Commands should be crisp, effective, and to the point.

10. Communications should be discussed and agreed in advance, that is, the words or terms to be used for specific actions.

a. The specific verbiage used may vary depending on local protocol or preference.

b. Of most importance here is that the brakeman and the suspended rescuer have the opportunity to identify and agree in advance to the sequence of communications and the words that will be used.

c. In any case, the suspended rescuer should be in primary control, and all communications should be repeated by the hearer (i.e., “closed-loop communications”) to ensure precision and accuracy.

C. Connecting to the rope rescue system

1. Typically, the third man (or other suspended rescuer) makes connection to the lowering rope by clipping into their harness waist attachment with a locking carabiner.

a. Attaching to the waist attachment is generally more effective than clipping into the sternal connection on the harness, as the latter tends to place the center of gravity below the connecting point, thereby reducing mobility.

b. The use of a locking carabiner for the connection (rather than a direct tie-in) also improves mobility, allowing for quick attachment to or detachment from the rope.

c. If a secondary system is used for belay or backup, it may well be attached to the sternal, dorsal, or even the same waist attachment point.

i. A belay line is generally kept slack during operation, and should not interfere with mobility.

2. As with other systems, choice of whether or not to belay a suspended rescuer is a matter of probability versus consequence of failure.

a. An autolocking descender or progress capture system can mitigate hazards associated with human error, making a secondary belay system arguably less imperative.

b. Risks associated with secondary systems should be considered—especially taken in context with the incident at hand, where the scene may be cluttered by other lines such as a litter lowering/raising system, edge lines, and even the subject’s rope(s).

3. When possible, a safety officer should check the connection of the rescuer prior to their being suspended on rope, as well as the rigging and operation of the raising or lowering system to be used.

a. Although any rescuer should take first responsibility for their own safety during an operation, assigning a safety officer who can check the rigging before the system is loaded, and who can monitor the system as it is loaded, is very helpful.

b. In small team operations, it may be necessary for the safety officer to perform some other function as well, such as belay or communications.

IV. Negotiating Edges

A. Lowering over an edge

1. A rescuer whose progress is being controlled by another faces the challenge of needing to direct their own progress, while at the same time being able to react and respond appropriately to sudden changes in rope control.

2. With communications agreed in advance, the next step is simply to execute those communications smoothly and accurately to avoid misunderstanding.

3. The person being lowered should be the initiator of any actions or movement of the system.

a. There are exceptions, of course—for example, if something just does not feel right to the brakeman or belayer, or if anyone on site observes or anticipates a hazardous situation brewing.

i. In these cases, the word “STOP” should be announced loudly and clearly, so that the brakeman, haul team, and belayer (if applicable) bring the system to a complete halt until the situation is examined and corrected.

4. It is generally best that the rescuer avoid descending (or ascending) straight in line with a subject, to avoid dropping debris, objects, or themselves onto them.

5. When initiating the descent, the suspended rescuer should rig into their system well away from the edge; when everyone is ready, the rescuer can start the process by verifying that the belay is on.

a. With the brakeman and belayer in place, the safety officer should analyze the system and declare it ready for use.

i. The brakeman should respond to or even repeat commands as they are heard to ensure harmony.

b. Rescuer commences the process and remains in command throughout.

i. When the rescuer is ready, they should pull backward on the system, hard, toward the edge, and call for the system to begin moving.

ii. When the rescuer reaches the edge, they may call for a slowdown or even a stop so that they can carefully negotiate the edge.

6. Getting over the edge is the most difficult part of any suspended rope operation.

a. A sharp edge is more difficult to get over smoothly than a sloping one.

b. For a sharp or undercut edge, the rescuer may wish to call for a full stop just as their heels overlap the edge.

7. The most graceful way to get over an edge is to use a high point anchor or multi-pod to keep the horizontal path of the rope above the height at which it connects to the rescuer, but with practice these skills can be mastered even without a high point.

a. Most rescuers will choose to attach at the waist, which allows good balance when using the legs to pull backward.

b. With the rope taut, and the edge behind, the rescuer should keep their feet shoulder width apart as they allow the harness attachment point to apply as much force as possible in the direction of pull.

c. Leaning into the system, the rescuer should call for the brakeman to lower slowly.

d. As the rope begins to move, the rescuer keeps their feet still and bends at the waist over the edge.

e. When the rescuer is in a seated position, with feet at about waist level, the rescuer can begin taking small steps backward.

f. The rescuer should keep their body in a seated position, feet in front, throughout the entire descent.

g. When the rescuer is ready, they can call for a faster decent to the brakeman.

8. A good brakeman will be responsive to commands, and will maintain a consistent speed unless requested otherwise.

9. A skilled rescuer will perform smoothly and avoid any uncontrolled or loading or swing.

10. If using a high point to get over an edge is too difficult for a rescuer, the rescuer can instead downclimb from a seated position.

a. To negotiate an edge in this manner, the rescuer initiates the operation as described previously, but when the rescuer reaches the edge, they call for a full stop and then sit down with their legs dangling over.

b. Then, the rescuer rolls over from the seated position onto the belly, and braces against the edge with their knees.

i. Alternatively, an etrier can be hung over the edge and used as a ladder to downclimb.

c. Once over the edge and in a stable position with knees against the vertical surface, the rescuer calls to be lowered down very slowly.

i. As the rope begins to move, the rescuer extends their legs to press against the vertical surface with their feet instead of their knees.

ii. Once on their feet, the rescuer keeps their feet at or above waist level to maintain maximum stability, and proceeds with the lower.

B. Raising over an edge

1. Raising over an edge is similar to lowering over an edge, but requires practice to execute smoothly.

2. Slowing down before getting to the edge will help to prevent dragging the rescuer nose first when they reach the point at which the rope travels in a horizontal position.

3. As soon as the rescuer can see up and over the edge, there is a natural tendency for them to want to shift into a more vertical stance and “climb” over the edge.

a. Resisting this urge and maintaining a seated position, with legs horizontal, for as long as possible will make it much easier to get up and over.

C. Landing

1. As the suspended rescuer reaches their landing zone, they should call for the brakeman (whether raising or lowering) to move more slowly.

2. If rescuer and brakeman are out of sight of one another, calling distances helps. For example, the rescuer may call out, “10 feet from landing.”

3. As they approach the final landing zone, the rescuer should survey the situation to ensure safety and to more specifically plan their approach.

a. It may be necessary to call for a full and complete stop while still some distance away, and take time to observe.

b. If the subject is ambulatory, it may be necessary to speak to them to calm and direct them. In any case, it is best to intentionally stay out of their reach so that they do not lunge toward the rescuer.

4. The rescuer should call out progress as they near the end of the lower.

a. Communicating progress as the rescuer reaches their destination can be instrumental in success of the entire operation, for example:

i. Rescuer: “Five feet to landing; four feet; three feet; two feet; one foot; stop”

5. Even though the rescuer may have called that they have reached the landing area, the brakeman should not go “off belay” until specifically directed to do so.

a. This helps to ensure the safety of the rescuer in the event that they need to anchor themselves at the location for protection, or if the subject makes some sudden motion that could create a hazard.

6. Upon reaching the landing area, the rescuer should determine whether to stay attached to the line on which they were lowered, secure it for later use, or release it.

V. Moving a Litter While Suspended

A. The operations-level rescuer may be called upon to transport an empty litter from one stable location to another by rope, for example to reposition it nearer the subject in preparation for a rescue lower.

1. In this case, the rescuer will attach to the litter in much the same way as they might if tending a loaded litter, but without the added degree of difficulty created by a heavy litter or by the need for patient care.

2. Managing a litter down a vertical surface is arguably easier if rigged in a horizontal configuration.

B. It is also possible to lower a vertically oriented litter, which may be necessary in a confined space or where obstructions require a narrow profile.

1. Moving a litter in this configuration is a little less graceful an endeavor, but quite feasible.

C. Horizontal litter, single attachment point

1. The simplest method of configuring a litter for lower is to attach a four-legged litter bridle, sometimes called a litter spider, to the top rail of the litter at four equilateral points to create a stable platform of the litter.

a. Each of the legs meets at a main attachment point (MAP) a couple of feet above the litter.

b. Rescuers may choose to use a manufactured litter spider for this purpose, or may devise one out of webbing or rope.

c. Although a quick and simple litter spider can be created from a bowline on a coil with four loops, with each of the loops serving as a litter spider leg, a much more adaptable and versatile version can be created relatively simply.

i. Features such as adjustable legs, tie-in points for litter attendant, and subject safety tether are nice to have.

ii. Most rescuers who construct their own litter spider make them from rope because it is easier to handle and allows for a greater variety of knots.

2. See Skill Drill 16-1: Constructing the Litter Spider.

3. Consider the following with regard to safety:

a. Some litters have connecting points on the rails; attachment to other litters is made by clipping directly over the large rail.

b. Not all large locking carabiners fit easily over litter rails.

i. Before purchasing carabiners for this use, measure the diameter of the rail and check the specifications of the carabiner’s manufacturer or distributor.

4. Using the litter spider

a. Regardless which type of litter spider is used, the rescue system rope can be attached to the MAP either with a direct loop or with a carabiner.

i. The advantage of tying directly into the rigging ring is that this reduces complexity and opportunity for failure.

ii. However, a carabiner allows for faster connection/disconnection, if this is a priority.

iii. See Skill Drill 16-2: Attach a Rescue Line to a Litter.

b. The spider legs should not be tied directly into the litter rail because rope or webbing may abrade through when rubbed over the face of the vertical surface.

i. Carabiners give greater flexibility for attaching or detaching from the litter rail. This may become important during subject loading.

c. If a belay line is to be used, it may be tied or connected directly to the main attachment point in the same manner as the primary rescue system.

i. Some rescuers may be reluctant to connect the belay to the main attachment point, as this then creates a potential single point for failure.

ii. If, upon consideration, probability warrants use of other alternatives these may include attaching the belay directly to a point on the litter, using a second MAP, or rigging the belay to the spider legs with a carabiner.

iii. Some organizations choose to connect both the primary and secondary lines to the main attachment point about 6 feet (1.8 m) from the end, and then tie the remaining tail directly to the head of the litter.

iv. As with any belay, the authority having jurisdiction (AHJ) should make this determination based on the risks and the consequences if the risks impact the rope rescue system.

d. Consider the following with regard to safety:

i. The belay line is never tied directly onto the subject in the litter.

ii. If the belay line caught the subject directly, it would pull on the person’s harness while the subject supported the remainder of the load (litter and tender[s]).

e. Carabiner gates should be set inward toward the center of the litter.

i. This helps prevent the lock nut on the locking carabiner from being rubbed open or damaged on the face of the cliff or wall.

ii. The gates also should be oriented so that the locking nuts close with gravity and cannot vibrate to an unlocked position.

f. The rescuer may also be attached to the MAP with an attendant rig, also sometimes called a pigtail.

i. While a fixed lanyard will work for this, an adjustable system is preferred.

ii. See Skill Drill 16-3: Crafting the Attendant Rig.

g. The attendant rig should be of sufficient length to permit freedom of movement, allowing the attendant to move all the way around the litter as needed.

i. In this role, the rescuer is called a litter attendant, even if the litter they may be attending does not have a subject.

h. Rescuers should always consider their own safety as being of primary importance.

i. Before committing themselves to the rope rescue system, the litter attendant should make a final check of all rigging—even if there is a safety officer already assigned to do the same.

5. Commencing a lower

a. Litter movement should always be at the discretion of and on the command of the litter attendant.

i. If more than one litter attendant is utilized, one should be deemed litter captain and take command.

b. After confirming with the brakeman that the system is “On Belay,” the litter attendant will call for “Tension,” which simply means that the brakeman should hold the system stationary.

i. This affords the litter attendant a moment to lean into the system to remove any slack, ensuring that the direction of pull is as anticipated, no lines are tangled, and to make any last-minute adjustments to body position.

c. With practice, the litter attendant will be able to accurately predict the best length for their attendant rig so that they are most effective after getting over the edge.

i. When suspended vertically, the attendant should hang so that their legs extend just below the litter so that they can push against the vertical surface on the other side of the litter.

ii. The top litter rail should be somewhere between belly button and chest height, depending on the rescuer.

iii. The attendant can make a good estimation while still on the horizontal surface by lifting the litter by the closest rail and tilting it so that both the attendant rig and the spider legs are taut.

d. No further changes should be made to the rigging or to anything in the rope rescue system after it has been inspected by the safety officer or while the system is on belay.

i. If there becomes a need to make such an adjustment, the rope rescue system should go off belay until all is satisfactorily ready.

ii. Before going back on belay, the system should be re-evaluated by the safety officer. When the litter attendant is ready, litter movement will commence on their command.

e. Sometimes it can be a bit of a challenge for the litter attendant to move the unloaded litter horizontally across a surface to reach the edge of the planned vertical drop.

i. The brakeman may need to feed rope through the brake device as the litter attendant leans back hard, pulling the litter.

ii. Once the litter and attendant are over the edge, there will be greater weight on the system and the brakeman will need to apply more friction.

f. As previously noted, getting over the edge is usually the most difficult part of any lowering or raising operation. This is true with or without a litter.

i. Close communication and teamwork between the litter attendant and brakeman are crucial to a successful outcome.

ii. The litter attendant should feel free to call for a “Stop” at any time, and the brakeman should be alert and responsive.

g. The process is quite similar to that of lowering a lone rescuer, except in this case the rescuer happens to be toting a 20- to 50-pound (9.1- to 22.7-kg) litter and gear.

i. It is important to have all of the slack out of the rope system before the litter attendant tries to get over the edge. Otherwise, when gravity takes hold the load will drop, possibly shock loading the system and equipment, not to mention giving a fright to rescuers.

h. Holding the litter by its nearest top rail so that the litter harness legs are taut, the litter attendant leans back hard into their spider connection to maintain constant tension on the system.

i. The brakeman lowers very slowly as the litter attendant backs toward the edge.

ii. When the attendant’s heels are just over the edge, they will lean back into the system, knees bent and feet widely spaced.

iii. As the line is lowered, the litter attendant slowly transitions to a seated position, just below the litter.

i. If personnel are in ready supply, positioning one or two edge attendants at the transition can be very helpful.

i. Edge attendants should be on safety lines that permit them to just reach the edge, but not to fall over it. The edge attendant(s) can help the litter attendant to carry the litter across the horizontal surface, maintain adequate tension on the system, and provide balance as the litter goes over the edge.

j. Undercut edges and 90-degree transitions can be among the most difficult to get over.

i. If the standard approach proves too challenging, it may be possible to set the litter on the edge of the drop, maintaining as much tension as possible on the rope system, while the litter attendant maneuvers into place around the head or foot of the litter.

k. Raising a litter over an edge is also quite similar to the methods used for a raise of a lone rescuer—again, the difference being the 20- to 50-pound (9.1- to 22.7-kg) appendage.

i. It is especially important to approach the raise over an edge slowly, and with caution.

ii. The litter attendant must be especially diligent to continue pulling back and out over the edge as much as possible for as long as possible, to avoid a nose-first drag.

6. Body management with litter movement

a. The litter attendant is most functional if they are able to assume a natural, seated position, legs extended, with the litter just a few inches above their lap.

i. The litter should not be resting on the attendant’s legs, as this could create a hazard.

ii. The attendant grasps the litter with both hands, either at the nearest top rail or at the closest rail underneath, leveraging with their feet to pull the litter away from the vertical surface.

iii. Taking small, backward steps down the vertical surface, the attendant continues to prevent the litter from bumping or snagging against it as they move.

b. If, at any point, the litter attendant wishes to stop—or, when they have reached their desired location—they simply request that the brakeman “Stop!”

i. If the stop will be for an extended period of time, the brakeman can tie off the braking device.

ii. When the litter attendant is ready to move again, they commence lower once again using the same commands as before.

c. Practicing the skill of managing a litter while suspended should first be performed with an empty litter, before attempting to manage a loaded litter.

d. See Skill Drill 16-4: Managing a Litter while Suspended.

e. Personnel requirements and positions should be similar to those used for basic lowering systems, except that there is a rescuer attached to the litter.

f. Execute the lower as follows:

Operations leader: Roll call! *(general statement to entire site, and radio if applicable)*

Operations leader: Safety ready?

Safety officer: Safety ready!

Operations leader: Brakeman ready?

Brakeman: Brakeman ready!

Operations leader: Rescuer ready?

Rescuer: Rescuer ready!

Operations leader: Litter operations commence when ready.

i. From this point, communications will be primarily between the rescuer and the brakeman. Any team member can call, “Stop.”

D. Vertical litter configuration

1. A litter can also be rigged to hang in a vertical orientation, either to avoid obstacles, to get through a confined space, or for whatever reason.

a. High directionals make the vertically rigged litter much easier to manage, but are by no means mandatory.

2. When using a vertically oriented litter, it is particularly important to pay close attention to securing the patient in such a way that they will not slide down toward the foot end when the litter goes vertical.

a. This may be accomplished with foot loops, a seat harness, or other means.

3. The litter bridle for a vertical rig needs only to have two points, one on each side of the head of the litter.

a. Bridle systems used for low-angle litter rigging often serve well for vertically rigged high-angle rope rescue systems.

b. Keeping the attachments wide, on either side of the litter, will help improve stability.

c. This presents a new challenge, however, in that when the main attachment point of the litter is at the edge transition, the weight of the remains well below the edge. Therefore, it becomes particularly challenging to get the litter over the edge when lowering without shock loading the system, and it becomes nearly impossible to get the litter over the edge at all during a raise.

4. If a high directional is not going to be used, rigging the system in advance with a pike and pivot in mind will make all the difference.

5. Pike and pivot litter bridle

a. The pike and pivot bridle is used for the vertically oriented litter only during edge transitions.

i. During the remainder of the rope lowering and raising operation, a standard two-point bridle (or direct tie-in) to the head of the litter will suffice.

1 The pike and pivot litter bridle should be rigged in advance, and stored on the litter for when it is needed.

2 Using a 25-foot (7.6-m) piece of 8-mm or 9-mm (0.31- or 0.35-in.) cord and a carabiner, rescuers can tie a knot (butterfly or figure 8 on a bight) into the middle of the cord so that it creates a V shape, and clip into it with a locking carabiner to create a pike and pivot bridle.

b. To store the bridle for later use:

i. The rescuer should attach it loosely to the main attachment point of the litter bridle, but be sure to clip it behind the mainline so that when it is employed it will be nearer the ground than the primary rope rescue system and belay.

ii. It should be clipped in such a way that it can be disconnected while the primary system is under load.

iii. The rescuer should run the two loose ends of the bridle cord behind the litter, and tie them to the litter rail, one on each side, at a point that will be at about waist level of the subject when packaged into the litter.

iv. A tie-in point should be selected between two uprights so that these cannot slide up or down. This is the pike and pivot bridle. It should be just long enough to rest loosely when not in use, but not long enough to drag or snag on obstructions.

c. See Skill Drill 16-5: Rigging a Pike and Pivot Litter Bridle.

d. When it comes time to employ the system, rescuers will also need a short, 50-foot (15.2-m) rescue line of a chosen diameter (11 or 12.5 mm [0.43 or 0.5 inch) and a separate device for lowering/raising of this part of the system.

i. A figure 8 knot should be tied into the end of the rope, and rig the other end into the anchored raising/lowering system.

6. Pike and pivot lower

a. To lower the vertically oriented litter using the pike and pivot system:

i. Unclip the pike and pivot bridle from the MAP and connect that carabiner to the knotted end of the short lowering system. There is no need to tension this part of the system until the litter and attendant reach the edge of the drop.

ii. As the foot of the litter nears the drop, the rescuer begins to take tension on the pike and pivot system. The rescuer slides the foot of the litter out over the edge so that it protrudes into the air.

iii. While maintaining tension on the pike and pivot bridle with it right at the edge of the drop, the rescuer extends the primary system at the main attachment point so that the vertically oriented litter begins to tip foot down over the edge.

iv. The litter attendant and edge attendants (if present) can help maneuver the litter into this configuration. When the litter is vertically oriented, on the command of the litter attendant the entire litter can be lowered from this pike and pivot bridle until the head of the litter reaches the edge.

v. When the head of the litter is at the edge, take the load back onto the primary system and loosen the pike and pivot system.

vi. When the load is fully on the primary system, the rescuer calls for an all-stop so that the pike and pivot lowering/raising system can be released and disconnected.

vii. The rescuer stores the V-point of the pike and pivot bridle at the main attachment point, as before, in case it is needed later.

b. See Skill Drill 16-6: Negotiating the Edge Using the Pike and Pivot.

7. Pike and pivot raise

a. During a raise with the litter in a vertical orientation, the pike and pivot can be used to help get the litter up and over the edge.

i. Without it, the litter would stall just below the edge, with no way to get it the rest of the way other than to lift it manually—a task that would be difficult at best, and perhaps even impossible.

ii. Such an approach would also place the rope rescue system at risk of shock load with the litter in its most precarious position.

b. This maneuver works best when the pike and pivot bridle is pre-attached to the litter.

i. While it is possible to configure the bridle as an afterthought, the necessity of rigging behind/below the mainline and belay make this especially difficult.

c. With the pike and pivot bridle pre-attached and loosely at the ready at the MAP, simply raise the litter until it is just a couple of feet below the edge transition.

i. Either the litter attendant or an edge attendant needs to be able to reach the MAP, but be sure to stop before the MAP is jammed up against the transitional point of the edge.

ii. Lower the short raise/lower system to the litter. With the load still taken by the primary raise/lower system, the assigned person should disconnect the pike and pivot carabiner from the MAP and connect it to the short raise/lower system.

iii. Upon command of the litter attendant, the top will begin raising again, but this time with the short system.

iv. Raise as far as possible with this system, until the attachment points at the sides of the litter are as high as possible at the edge.

d. It may be necessary to temporarily loosen the primary raising system (the one attached at the head of the litter) to prevent contradictory forces.

i. Before the primary system is slacked, the litter attendant should carefully climb up and over the edge so that their weight is off the system.

ii. They should, however, remain at the edge to assist in positioning the litter and should remain tied-in for safety.

e. When the pike and pivot bridle is as high as it will go on the edge, hold it steady and once again begin to tension the primary system so that the head end of the litter begins to tilt horizontally toward the ground.

i. Here the litter attendant and/or edge personnel can assist in pivoting the litter over the edge as appropriate.

ii. When the heaviest part of the litter is over the edge and the litter is near horizontal, properly secured rescuers can manhandle it the rest of the way.

f. The pike and pivot should be practiced first with an empty litter, as this technique becomes increasingly difficult with additional weight in the litter.

g. See Skill Drill 16-7: Performing a Pike and Pivot Raise.

VI. Suspended Work on A Highline

A. Working in suspension along a horizontal system differs from working in a vertical system in many ways, not the least of which is the complexity involved in the system.

B. Horizontal systems are typically built and operated by technician-level personnel, although operations-level personnel will likely help build the system and may well be moved across it to reach a rescue site or subject.

1. A rescuer at the operations level is not expected to move themselves along the system, nor to manage a patient during movement, but they may find themselves in a position to be moved from one stable location to another by riding the line of a horizontal system.

C. Rigging to a horizontal system

1. Rigging to a horizontal system is really as simple as clipping a pulley onto the track line (e.g., Kootenay or Knot Passing Pulley).

a. The rescuer is connected to the pulley with a sling that runs between their seat harness and the pulley.

b. The sling is usually just long enough to preclude any temptation toward grabbing the track line (in which case fingers could be pinched and injured in the pulley) with locking carabiners at both the pulley end and at the harness end.

c. Still, the rescuer riding the highline should wear gloves to help prevent rope- or pulley-induced injuries.

d. Often, a slightly longer sling will be clipped as a “backup” from the rider directly to the track lines so that it may trail the pulley.

2. Highline pulleys generally have multiple tie-in points in addition to the central notch where the rider will be clipped in.

3. Tag-lines are generally connected, one fore and the other aft, to help provide control and a means of hauling and lowering the load.

4. An operations-level rescuer will generally not be managing a rescue subject while riding a highline, but at times multiple rescuers may be pulled across a line simultaneously.

a. In this case, the other person may be attached directly to the same pulley with a separate sling.

D. Riding with a litter

1. At times, an operations-level rescuer might be asked to transport an empty litter across a highline.

2. When attaching a litter to a highline system, it should first be rigged with a litter spider, just as for a vertical lower.

a. The spider is connected to a highline pulley at the MAP, just as an individual might be.

b. As with a litter spider for vertical lower, the attendant rig (also called a pigtail) consists of a short (6-foot [1.8-m]) length of 9- or 10-mm (0.35- or 0.4-in.) rope connected from the MAP to the waist harness attachment point of the attendant.

c. A short sling on an ascender, along with an etrier, complete the setup and add versatility.

3. When riding with a litter across a highline, the position of the litter attendant is quite similar to that used for vertical lower: litter at about chest height, legs beneath the litter.

I. Summary

 **Rescuers at the operations level may work in suspension as they are lowered or raised from one stable location to another.**

 **Operations-level rescuers are not expected to manage a subject while suspended, nor to manage their own ascent/descent on rope.**

 **In order to prevent suspension-induced injury, rescuers should move their legs and stretch regularly and unresponsive subjects should be rescued as promptly as possible.**

 **In rope rescue vernacular, the term *third man* is used to describe a rescuer whose role it is to access the subject quickly, assess the situation, help with packaging and preparation, and generally anticipate and assist with the many tasks required. They are typically not the primary rescuer, nor the rescuer who takes direct contact and control with the subject.**

 **All commands should be discussed and agreed in advance before rope operations begin.**

 **Getting over the edge is the most difficult part of any suspended rope operation. A sharp edge is more difficult to get over smoothly than a sloping one.**

 **If a sloping edge is gentle enough, a slowdown may not even be required.**

 **For a sharp or undercut edge, the rescuer may wish to call for a full stop just as their heels overlap the edge.**

 **The most graceful way to get over an edge is to use a high point anchor or multi-pod to keep the horizontal path of the rope above the height at which it connects to the rescuer.**

 **Raising over an edge is similar to lowering over an edge, but requires practice to execute smoothly. Slowing down before getting to the edge will help to prevent dragging the rescuer nose first when they reach the point at which the rope travels in a horizontal position.**

 **As soon as the rescuer can see up and over the edge, there is a natural tendency to want to shift into a more vertical stance and “climb” over the edge. Resisting this urge and maintaining a seated position, with legs horizontal, for as long as possible will make it much easier to get up and over.**

 **As the suspended rescuer reaches their landing zone, they should call for the brakeman (whether raising or lowering) to move more slowly. If rescuer and brakeman are out of sight of one another, calling distances helps.**

 **As they approach the final landing zone, the rescuer should survey the situation to ensure safety and to more specifically plan their approach. It may even be necessary to call for a full and complete stop while still some distance away, and take time to observe the situation.**

 **Upon reaching the landing area, the rescuer should determine whether to stay attached to the line on which they were lowered, secure it for later use, or release it.**

 **The operations-level rescuer may be called upon to transport an empty litter from one stable location to another by rope.**

 **Managing a litter down a vertical surface is arguably easier if rigged in a horizontal configuration.**

 **Horizontal systems are typically built and operated by technician-level personnel, although operations-level personnel will likely help build the system and may well be moved across it to reach a rescue site or subject.**

 **At times, an operations-level rescuer might be asked to transport an empty litter across a highline.**

Post-lecture

I. After-Action Review

Individual/Small-Group Activity/Discussion

On Scene

This activity is designed to help the student understanding how to approach a fire investigation. This activity incorporates both critical thinking and the application of basic trench rescue knowledge.

Purpose

To allow students an opportunity to develop responses to critical thinking questions.

Instructor Directions

1. Direct students to read the “On Scene” questions located in the After-Action Review section at the end of Chapter 16 (p. 337).

2. Direct students to read and individually answer the discussion questions. Allow approximately 10 minutes for this part of the activity. Facilitate a class review and discussion of the answers, allowing students to correct responses as needed.

3. You may also assign these as individual activities and ask students to turn in their comments on a separate piece of paper.

Answers

1. Under what circumstances might an operations-level rescuer need to be suspended and moved on a roped system?

- When the subject can only be reached by rope, and only Operations level rescuers are present.

- When operating as a “third man” to assist in a litter lower

2.How much of a risk to rescuers is suspension-induced injury, and how can it be avoided?

- Unlikely unless rescuer is suspended motionless for a period of time, as though unconscious. Can be avoided by ‘flexing’ leg muscles and moving frequently while on rope.

3.Under what circumstances might a vertically ori­ented litter be preferred for rescue operations?

- In a confined space or where obstructions require a narrow profile

4.How might techniques for negotiating an edge while being lowered differ from negotiating the same edge while being raised?

- During a raise, there is a tendency to want to move the body to a vertical orientation and “climb” over the edge; negotiating an edge while being raised requires patience and application of intentional effort to try to keep the feet as high as possible for as long as possible.

II. Lesson Review

Discussion

Note: Facilitate the review of this lesson’s major topics using the review questions as direct questions or slides. Answers are found throughout this lesson plan.

1. Identify risk factors for suspension-induced injury. (Lecture II D)

2. What is the current treatment protocol for suspension-induced injury? (Lecture II H)

3. Identify symptoms that might indicate an individual may be experiencing suspension-induced injury. (Lecture II G)

4. Define the roles of the third man in rope rescue. (Lecture III A)

5. What steps must the third man take in order to set the stage for a successful rescue? (Lecture III A)

6. Who initiates communication when lowering over an edge? (Lecture IV A)

7. What is the simplest method of configuring a litter for vertical lower? (Lecture V C)

8. What is a pike and pivot litter bridle? (Lecture V D)

9. Which level rescuer typically builds horizontal systems? (Lecture VI B)

III. Assignments

Lecture

A. Advise students to review materials for a quiz (determine the date/time).

B. Direct students to read the next chapter in *Rope Rescue: Principles and Practice,* Fifth Edition, as listed in your syllabus (or reading assignment sheet) to prepare for the next class session.