Recreation
Tech Tips

United States Department of Agriculture
Forest Service
Technology & Development Program
March 2004
2300 0423-2303–MTDC

Advanced Tree Climbing and Rigging Training for Trail Workers

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Trail maintenance and construction require moving heavy objects (figure 1) in a variety of settings and conditions. With the use of rigging (a system of ropes, cables, and hoists), trail workers can safely and efficiently move items. Trail workers climb spar trees to set blocks, lines, and other rigging equipment. Skylines set high above the ground help move heavy objects over long distances and across uneven slope and terrain. On any particular job, the qualified rigger and climber do not necessarily have to be the same

Figure 1—Moving a log suspended from an overhead cable.

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person, but workers need to be qualified for the tasks they perform.

Neither the Forest Service nor the U.S. Department of the Interior, Bureau of Land Management offers combined training in tree climbing and rigging. However, the California Department of Parks and Recreation offers a practical class that combines classroom instruction and "hands-on" experience through the William Penn Mott Jr. Training Center at Pacific Grove, CA. The State of California allows nonagency personnel to attend courses offered through the center, including *Advanced Climbing and Rigging.*

The Missoula Technology and Development Center was asked to locate sources of high-quality rigging training. The Advanced Climbing and Rigging course was the only regularly scheduled course we found for personnel involved in trails maintenance and restoration work. This tech tip's two primary authors attended the course in November 2001. This tech tip provides a review of the course and information on how Federal employees can attend. The course is open to a limited number of Federal employees and is offered every 2 years.

California State Parks Climbing and Rigging Training

During the past 30 years, the California Department of Parks and Recreation has improved its rigging and climbing procedures in cooperation with the U.S. Department of Labor, Occupational Safety and Health Administration, and timber industry personnel in logging systems and engineering. Changes were begun after safety reviews indicated that trail crews had the highest accidental and chronic injury rate of all field personnel (including firefighters) within the State. The listing of the spotted owl and marbled murrelet as endangered species, combined with tougher environmental laws, have increased the need for climbing and rigging skills.

Advanced Climbing and Rigging is a specialized course that provides technical training (figures 2a and 2b) in climbing and rigging, including the use of associated tools and equipment, with a strong emphasis on safety. The course covers: climbing using spurs or rope, Swedish ladders, arborist ascension methods, rigging sets, mechanical advantage, highleads and direct pulls, grip hoist applications, and mechanized winch applications. In addition, information is provided

Figures 2a and 2b—Detailed instruction in rigging is given in both classroom and field settings.

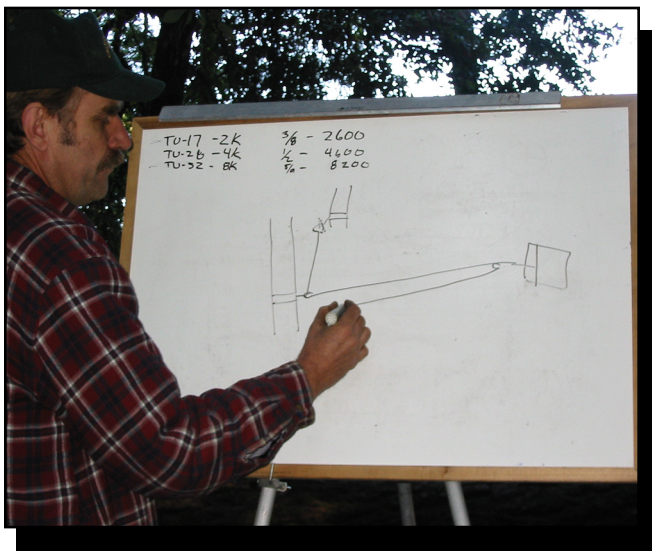

Figure 2b.

on setting bridge stringers and laying out skylines and haulback lines.

Course Evaluation

Ian Barlow and Susan Jenkins are trails and wilderness specialists on the Nez Perce National Forest. Both had experience with climbing and rigging. They felt that *Advanced Climbing and Rigging* was the most challenging and best-taught class they had taken during 35 combined years with Federal and State agencies.

The class they attended had 22 students, 9 instructors, and 4 extremely qualified assistants. Because of the low student-to-teacher ratio, all students had the time and opportunity to ask detailed questions regarding all aspects of the rigging and climbing applications. The student-instructor ratio is usually one instructor for every three students.

Course Components and Design

The success of the course lies in the combination of classroom teaching and practical training. Students learn the "big picture" of rigging applications and gain an appreciation for the range of possibilities that the equipment offers. Rigging is a viable alternative to the use of equipment such as helicopters for lifting heavy objects, at low cost with minimal resource impacts and minimal risk of injury for field workers, if conducted properly.

In the 12-hour classroom session, students are introduced to rigging and climbing equipment. Climbing and rigging safety are emphasized. As a group, students complete a thorough task hazard analysis (similar to the Forest Service's job hazard analysis) identifying major equipment safety concerns, such as cable tension, cable fly zones, system failures, equipment inspection, safe working loads for equipment, and the terrain at the worksite.

Lectures on rigging are combined with the principles of climbing because successful projects rely on both skills. The advantages and disadvantages of Swedish ladders, the use of spurs, and arborist methods are discussed as are climbing hardware, knot tying, and safety concerns for climbers and ground support personnel.

Climbing Labs

Rigging sets can be erected in a variety of ways, and the corresponding climbing methods may be selected by personal preference, impacts on the tree species, or the equipment that is available. The week of field training includes labs focused on three climbing methods: climbing with ropes, climbing with spurs or gaffs, and climbing with Swedish ladders (figure 3).

Figure 3—Increasing ladder heights by sections. The climber is secured to the tree by a climbing rope and the ladder is secured to the tree with a safety chain.

Rope Climbing

This method is common in urban forestry and also works well in backcountry settings, where it has less impact on trees than the other two techniques. It is a safe, effective way to haul and set rigging at any height. With the other methods, the climbers depend on a lanyard wrapped around the tree and need to use their legs at all times. With ropes, a climber is able to move up or down the rope (figure 4) with ease, independently of the tree. However, it is more difficult to move around the tree's bole to set rigging straps and blocks while suspended by a rope than with other climbing techniques. Equipment layout with this technique is slightly slower than when spurs or ladders are used.

Figure 4—Climbing and descending trees by ropes is covered extensively in this class.

Spurs or Gaffs

This technique may damage thin-barked trees, but is the fastest way to climb and to set rigging. With spurs and lanyards, an experienced climber can eliminate the time an arborist climber spends in setting up throw lines and rope sets. A great deal of proficiency is needed to throw a lanyard to scale large-diameter trees, such as redwoods, old-growth fir, and cedar. Both the rope-climbing method and spurs or gaffs have advantages for backcountry or wilderness projects because the equipment is lightweight and easy to pack.

Swedish Ladders

Swedish ladders provide another way to scale a tree with minimal impact. The ladders are light, come in 10-foot sections, and have a secure locking mechanism. These ladders are ideal for short-term hikes in and out of project sites. They are useful when climbing the same spars repeatedly during large projects, such as bridge construction. However, they may be a cumbersome addition to a packstring's load in wilderness or backcountry settings. The ladder sections are expensive, costing $300 apiece, but may be a practical purchase for highly accessible project sites. Many forests already use Swedish ladders.

Rigging Labs

During these labs, topics covered included the basics of rigging, forces, lines, and anchors. The goal was to give students a working knowledge of the use of equipment and rigging applications for field projects that require moving and placing heavy loads.

Mechanical Advantage—Students are introduced to rigging through the use of direct pulls, change of direction, choker rolls, and mechanical advantage (figure 5). Load calculations for tension are completed before each practice set and tested with a dynamometer to make sure that the sets are within the equipment's safe working capacity.

Figure 5—Grip hoists are used to tighten rigging cables.

High-Lead Systems

This type of system is used for bridge placement or other types of engineering and construction projects. As a rule, high-lead systems are more efficient for transporting and setting a limited number of logs, stringers, or timbers with extreme precision. A high lead uses at least two hoists placed at opposite ends of the system. Lines run from the anchored hoists up through blocks suspended from the spars or towers down to each end of the load being moved. The rigger in charge communicates with the hoist operators and directs individuals to tension or slack their equipment. Sometimes side or directional winches or hoists are added. The timbers or bridge stringers can be moved and placed close to the desired locations. During this set, instructors stressed the importance of lifting angles and anchor placement. Rigging straps were installed as high as possible and anchors were placed so that the tension of the load could be handled safely by the system. With these high-lead systems, students were able to move the load and place it in the desired location.

Skylines

A skyline is a length of wire rope suspended by rigging straps and blocks hung from spars or tripods. Often, skylines are used for moving many loads through the air from one location to another. A running block that straddles the line suspends loads beneath it as it travels by gravity in a downhill run or by being pulled by haulback lines in the other direction. Once a load is attached to the running block by a choker, drum, or basket, the hoist is anchored at one end of the system and tensioned. The load rises between the spars. This session was the most intricate lab, evolving from simple skylines to complex systems of skyline/high-lead combinations where loads became multidirectional and moved in several planes. Communication between operators and rigging masters was crucial and exact. These systems can be set up quickly. Rock, logs, gravel, fill materials, and construction materials can be moved considerable distances. Skylines excel in steep, rugged terrain where materials are rarely near the worksite. The work is demanding on muscles, but is easy on joints and tendons. In rugged terrain, a well thought-out skyline system is much cheaper than using helicopters or heavy equipment.

Tripods

Tripods (figure 6) are usually portable three-legged steel towers that can be used in sensitive riparian areas or other locations where spars are scarce. A block is mounted beneath the tripod and the skyline is run from the hoist or anchor, through the block, to the next tripod or spar and down to the ground. Tripods offer an alternative to spar trees for setting high leads and skylines. One of the instructors designed the system used in this session. It had footings that could be placed on wet or unstable ground. Students moved several objects, weighing between 200 and 400 pounds. The setup time is generally half an hour or less.

Safety was emphasized throughout the class. Every session started with the development of a sound plan for each rigging system, complete with a review to:

- Keep angles straight, reducing unwanted side pulls on trees.

- Place back ties properly.

Figure 6—Portable tripods can be used in areas where trees are scarce.

- Place rigging anchors as high and as level as possible.

Students were responsible for proper identification and communication of all cable fly zones and other potential hazards. The rigging boss was responsible for assigning tasks to each individual during the rigging process.

Availability of Training

To learn more about attending the Advanced Climbing and Rigging course, visit the California Department of Parks and Recreation's Web site at: http://www.parks.ca.gov. The William Penn Mott Jr. Center link provides up-to-date information on the enrollment process, directions to course locations, staff contacts, training catalogs, and training schedules. The center's phone number is: 831–649–2954.

Basic trail construction and maintenance classes are a prerequisite for the class in advanced climbing and rigging. Applicants from other agencies who have not attended the basic classes can submit a summary of their experience to determine their qualifications for admission to the class. The next class will be offered in the spring of 2005. Usually, half of the student slots are available to individuals from outside agencies.

Additional References

The *Riggers Bible* (figure 7) by Robert P. Leach is a good reference book on rigging. The book is sold by the Leach family for $35 and can be ordered by calling 417-869-9236. Copies may also be found by searching for used books on the Internet. While the *Riggers Bible* is an excellent source of technical information, individuals must make themselves aware of all current safety rules and regulations. Your regional safety officer may be able to help you find current rules and regulations.

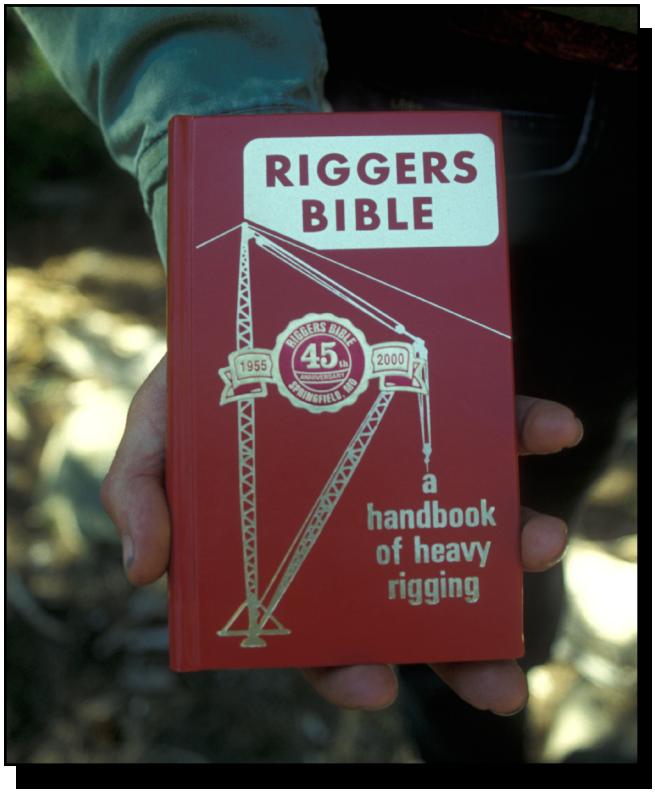

Figure 7—*The Riggers Bible* is an excellent source of technical information on the subject of rigging. Individuals must make themselves aware of current safety rules and regulations.

About the Author

Susan Jenkins began working for the Forest Service in 1994 and has spent most of her career working on fire assignments and trail projects. She has been instrumental in developing trail and watershed restoration projects that use dry stone masonry techniques and rigging applications. She has helped conduct training sessions and built strong partnerships across disciplines within agencies and with contractors, tribal organizations, and volunteers.

Ian Barlow began working for horse outfitters in the Canadian National Parks in 1973. He came to work in trails and horse packing for the USDA Forest Service in 1979. Traveling on foot and horseback for more than 17,000 trail miles while working has allowed Ian to develop a strong sense of what does and doesn't work in trail construction techniques. Fifteen years of teaching and continuing to learn from others has fostered Ian's strong desire to work with others in developing and improving trail construction techniques that meet new demands on our trail systems.

Bob Beckley received a bachelor's degree in political science from the University of Montana in 1982. He began his Forest Service career as a timber technician on the Nez Perce National Forest. Bob was a smokejumper when he came to the Missoula Technology and Development Center in 1990 to work as the center's public and governmental relations specialist.

Library Card

Jenkins, Susan; Barlow, Ian; Beckley, Bob. 2003. Advanced tree climbing and rigging training for trail workers. Tech Tip 0423-2303-MTDC. Missoula, MT: U.S. Department of Agriculture, Forest Service, Missoula Technology and Development Center. 8 p.

Describes the advanced tree climbing and rigging class taught at the California Department of Parks and Recreation's William Penn Mott Jr. Training Center at Pacific Grove, CA. Neither the USDI Bureau of Land Management nor the USDA Forest Service offers a combined class in climbing and rigging. Rigging, a system of ropes or cables and hoists, allows trail workers to move heavy objects safely. The class in advanced climbing and rigging is taught by the State of California every 2 years and is open to a limited number of employees from other agencies.

Keywords: high-lead systems, lifting, safety at work, skylines, tripods

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