

# ALASKA STATE PARKS

## TRAIL MANAGEMENT HANDBOOK

MAY 2015

### SECTION 6: TRAIL TOOLS AND SAFETY EQUIPMENT



**Section 6: Trail Tools and Safety Equipment.....3**

6.1 Safety Equipment and Practices..... 3

6.2 Common Trail Tools..... 4

    Figure 6.1 – Alaskan Saw Mill ..... 4

    Figure 6.2 – Bow Saw ..... 4

    Figure 6.3 – Drawknife..... 5

        Figure 6.4 – Gas Powered Rock Drill ..... 5

    Figure 6.5 – Gas Powered Wood Drill ..... 5

    Figure 6.6 – Cable Winch..... 6

    Figure 6.7 – Grubbing Hoe..... 6

    Figure 6.8 – Log Wizard..... 6

    Figure 6.9 - Loppers ..... 6

        Figure 6.10 – Machete ..... 6

    Figure 6.11 - McLeod..... 6

    Figure 6.12 – Peavey ..... 7

    Figure 6.13 – Pickaxe ..... 7

    Figure 6.14 – (Pick) Mattock..... 7

    Figure 6.15 – Pole Saw ..... 7

    Figure 6.16 – Pulaski ..... 8

    Figure 6.17 – Rock Bar..... 8

    Figure 6.18 - Shovels..... 8

    Figure 6.19 - Sandvik ..... 8

    Figure 6.20 - Sledgehammer..... 9

6.3 Using a Clinometer ..... 10

    Figure 6.21 – Holding a Clinometer ..... 10

6.4 Cable Winch and Rigging Systems..... 10

    Figure 6.22 – Cable Winch Rigging System ..... 11

    Figure 6.23 – Nylon sling around ..... 11

    spar tree with pulley and mainline..... 11

    Figure 6.24 – Logs on mainline with slings and pulleys ..... 12

    Figure 6.25 – Logs on mainline with slings and pulleys ..... 12

    Figure 6.26 – A linear rigging setup..... 12

    Figure 6.27 – Cable Winch and Common Accessories ..... 13

6.5 The Alaskan Saw Mill ..... 14

Figure 6.28 – Alaskan Saw Mill: 1 <sup>st</sup> Cut .....	14
Figure 6.29 – Alaskan Saw Mill: 2 <sup>nd</sup> Cut .....	15
Figure 6.30(a) – Alaskan Sawmill: 3 <sup>rd</sup> Cut.....	15
Figure 6.30(b) – Alaskan Sawmill: 3 <sup>rd</sup> Cut.....	16
Figure 6.30(c) – Alaskan Sawmill: 3 <sup>rd</sup> Cut.....	16
6.6 Plug and Feather Quarrying Techniques.....	16
Figure 6.31 – Plug and Feather Quarrying Technique .....	17
Figure 6.32 - A Plug and Feather Hand Splitting Tool Set .....	17
6.7 Trail Machinery .....	17
Figure 6.33 – Excavator.....	18
Figure 6.34 – Gravel Hauler .....	18
Figure 6.35 – ATV Belly Dump.....	18
Figure 6.36 – Skid-Steer Loader.....	18
Figure 6.37 – Trail Dozer .....	19

## Section 6: Trail Tools and Safety Equipment

This section contains tools and safety equipment that trail crews commonly work with. Safety guidelines are presented, followed by a list and a brief description of each tool. An overview of several tools and trail work systems are also given. All drawings in Section 6 are original artwork by Ted Kincaid.

### 6.1 Safety Equipment and Practices

(Adapted from the Appalachian Mountain Club's *The Complete Guide to Trail Building and Maintenance*.)

Although not comprehensive, the following paragraphs cover the basics when performing trail work. Specific certifications will also be necessary for performing some tasks and using particular tools.

A sturdy pair of leather steel-toed boots generally offers the best protection for your feet when performing trail work. Steel toed boots may not be the right choice for covering many miles in a day. At the very least, a well broken in pair of hiking boots is advisable. Your crew leader may require a particular type of footwear for trail work. Leather gloves will help guard hands from cuts splinters and sharp rocks, etc.

Eye protection is necessary during all trail work, and should be worn when using a chainsaw, axe, hammer, drill, or during rock splitting; other uses may also be prudent. The safety glasses should be ANSI/ISEA Z87.1-2010 compliant.

Before using a chainsaw for trail work, U.S. Forest Service Chainsaw Training, or equivalent, is required. Key points for chainsaw safety are hard hats, eye protection (in addition to a visor on a hard hat), ear protection, steel toed boots, chainsaw-specific *chaps*, and leather or Kevlar gloves are all required for chainsaw work. Using a chainsaw is potentially the most dangerous part of trail building and maintenance, so safety protocols need to be strictly adhered to. In addition to the risk of cutting yourself, falling timber and limbs crashing down are also a concern.

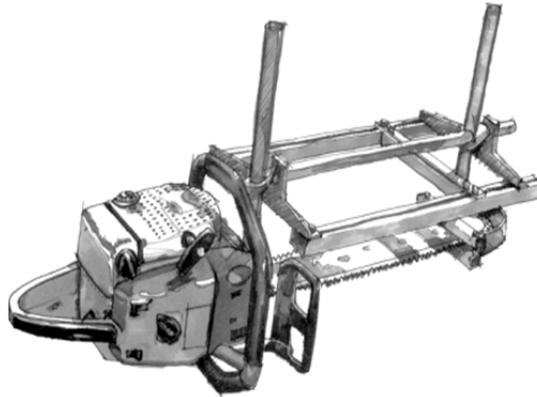
Long pants and long-sleeved shirts protect arms and legs from brush and insects. Thick tightly woven cotton offers the best protection, although this isn't the best choice for long multi-day trips, as cotton takes a long time to dry compared to synthetic materials.

Every group that is working together on trails should have at least one first aid kit. It should periodically be inspected to replace items that have been used or have expired. Preferably, all trail crew should be trained in basic first aid or wilderness first aid.

It is important to always carry tools with sheaths; if the tool doesn't have one, one can be made from used fire hose. All tools should be carried with the sharp end or blade away from your body. When using trail tools, such as a *Pulaski*, be aware of the "*Circle of Danger*." This is the perimeter around a person that a tool can reach during normal use, or if the person loses control of the tool. Always be outside of this area when you are near people working with tools. It is best to have people be at least 10 feet away from you in all directions when working with tools. Lifting heavy objects is a big part of trail work. Always lift with your knees rather than your back. It may be appropriate to ask others for assistance with very heavy items. Mechanical assistance may be required as well.

## 6.2 Common Trail Tools

**Alaskan Saw Mill** - the “Alaska Saw Mill” is an attachment that is fixed to the bar of a chainsaw and is commonly used for milling decking material in for boardwalk in remote locations. When properly assembled, a mill is guided along rails that are fixed to a downed, level log. The distance between the horizontal rails and the bar determine the thickness of the boards to be cut. The horizontal rails are adjusted vertically along posts at each end of the guide and are set into place using locking screws that clamp onto the bar of the chainsaw. This attachment creates evenly planed planks that can be cut into consistent dimensions. For additional information on milling, see the Section 6.5.



**Figure 6.1 – Alaskan Saw Mill**

**Bark Spud or Peeling Bar** - is a tool used to remove bark from felled timber. Most bark spuds are steel rods approximately 1.25” in diameter, 6’ long, and flattened laterally at the end. At the opposite end of some bark spuds, the tops will be flattened into a 3-4” perpendicular disc. When this is done, the tool can also be used as a tamping bar to crush and compact stone around fence posts.

**Bow Saw** - good for cutting low branches or brush. Larger saws (over three feet long) are best for cutting logs. Make sure to cover the blade with a sheath for transport. The blades are thin so they must be replaced rather than sharpened.



**Figure 6.2 – Bow Saw**

**Clinometer** - a handheld survey tool used in trail layout and design to measure grades of slopes and trails. For additional information on clinometers, see Section 6.3.

**Drawknife** - is a traditional woodworking hand tool used to shape wood by removing shavings. It is commonly used in trail construction to remove bark from logs. A drawknife consists of a blade with a handle at each end. It is pulled or "drawn" toward the user, hence the name.



**Figure 6.3 – Drawknife**

**Felling Wedges** – are wedge shaped pieces of hardened plastic used in the *kerf* of a chainsaw cut as levers to prevent the sides of a cut from pinching a saw blade before the cut is finished. Felling wedges are also used to persuade a tree fall a tree in a safe, intended direction.

**Gas Powered Rock Drill** - an ideal tool for drilling and chiseling rock and concrete when working on remote job sites. Rock drills are frequently used in trail construction to bore drill patterns for blasts, chiseling trail benches, and quarrying stones for masonry work. For additional information on quarrying, see Section 6.6.

**Figure 6.4 – Gas Powered Rock Drill**



**Figure 6.5 – Gas Powered Wood Drill**

**Gas Powered Wood Drill** – is a tool commonly used in trail construction for boring holes into logs or dimensional lumber for bridges and wooden retaining walls. Often times, stronger gas powered wood drills are needed to bore through large diameter logs or through multiple tiers of lumber to set all-thread, rebar, or wire cable. Gas powered tools such as the rock and wood drills are extremely valuable to perform trail work since in many remote settings electricity and the use of generators is not an option.

**Cable Winch** - are large-scale winches that instead of using spools to move rope or wire through the winch use self-gripping jaws. Powered manually by moving a handle back and forth they allow one person to move objects several tons in weight. In trail construction these are commonly used to move large logs, bridge stringers, stone, and building materials. The most commonly used is the *Griphoist* brand. For additional information on rigging and *cable winch* accessories, see Section 6.4.



**Figure 6.6 – Cable Winch**

**Grubbing Hoe** - are made for excavating trail in fine to medium-rocky soil. They are also used for removing sod and muskeg by scoring the turf and peeling up squares of organic matter. Also known as a “Hazel Hoe” or an “Adze Hoe,” they are fitted with curved square handles which are distinguishably different from a pick or pick mattock handle. The handles of all three can be removed to facilitate packing and replacement.

**Figure 6.7 – Grubbing Hoe**



**Figure 6.8 – Log Wizard**

**Log Wizard** - is a chainsaw attachment that is used for debarking, planing, jointing, and notching logs. The attachment is fitted with two 3 1/4" planer blades to give a wide cutting surface on logs. The blades are made to be re-sharpened several times in a lifetime (by the manufacturer) or replaced with replacement blades when necessary.

**Loppers** - are used for pruning brush and small branches. Some have telescopic handles which can be extended in order to increase leverage and to reach high branches on a tree. Figure 6.9 – Loppers



**Figure 6.9 - Loppers**

**Machete**- is often used in Alaska by trail surveyors and hand crews when brushing out new routes/trail corridors. The machete is best used in a vertical stroke rather than the low, horizontal swing required to cut vegetation at ground level.

**Figure 6.10 – Machete**

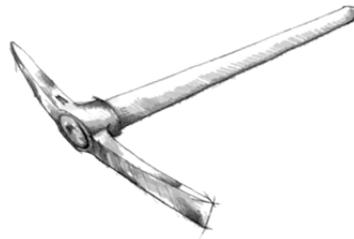


**Figure 6.11 - McLeod**

**McLeod** - is typically a wildland firefighting tool with a large hoe-like blade on one side and tined blade on the other. It is commonly used in trail construction and maintenance for removing slough and berms from a trail and tamping or compacting tread. It can also be used to shape a trail's backslope.

**Peavey** - is a tool that provides leverage for maneuvering logs. The spike at the end of the tool creates added length and leverage, and can be used to pry logs apart. A peavey works by sliding the hook across a log until it catches in the wood. Once the hook has cinched into the wood, the handle can then be lifted to hold or turn the timber.

**Figure 6.12 – Peavey**

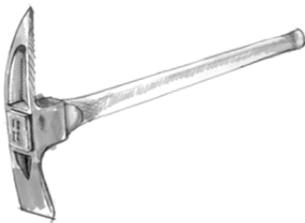


**Figure 6.13 – Pickaxe**

**Pickaxe** - is a hand tool with a hardened steel head attached perpendicular to its handle. Some make the distinction that a pickaxe has a head with a pointed end and a flat end, and a pick has both ends pointed, but most use the words to mean the same thing. The “head” is often a spike ending in a sharp point - it may curve slightly, and has a counter-weight to improve ease of use. The counterweight (as shown here) is composed of a flattened perpendicular chisel for prying.

**(Pick) Mattock** - is a hand tool similar to a pickaxe. It is distinguished by the head, which makes it particularly suitable for digging or breaking up moderately hard ground. A mattock has a broad chisel-like blade perpendicular to the handle. The reverse may have a pointed end, in which case the tool is called a pick mattock.

**Figure 6.14 – (Pick) Mattock**



**Figure 6.15 – Pole Saw**

**Pole Saw** - a tool that enables crews to prune branches high above ground that would otherwise be out of reach. The simplest of these tools consists of a cutting blade bolted onto a long pole. Some models also have a built-in lopper that can be operated from the ground with a rope. Another useful feature is a pole that will disassemble into several pieces for carrying.

**Pulaski** – combines the axe and a mattock into one tool. The Pulaski is considered one of the most versatile tools for constructing trail tread, as it can be used to dig soil and chop roots

**Figure 6.16 – Pulaski**



**Figure 6.17 – Rock Bar**

**Rock Bar** - a 5' long tempered steel bar with a beveled end weighing from 16-18 pounds. The length helps gain leverage when moving rocks while still maintaining its rigid shape. The bar is also ideal for breaking up rocky ground when digging holes that are problematic. Larger rock bars, such as the Peeler Bar run about 6 feet in length and often have a round disk on the end for tamping post holes. The longer bars are not designed for mechanical leverage as they are too pliable to move rock and still maintain its ridged shape.

**Sandvik** - is a brand name for a machete-like tool with a short replaceable blade. Because it has a smaller blade, the tool may be safer than a machete. Like the machete, the Sandvik is primarily used for removing brush and branches from trees when surveying or laying out trails.

**Figure 6.18 - Shovels**



**Figure 6.19 - Sandvik**

**Shovel** - a common tool for excavating organic material during the construction of trails. Shovels are often used for maintenance of drainages such as waterbars, swales, and slot-trench drains. Typically, wooden handled shovels are preferred by trail crew managers over fiberglass due to the ability for wood to better absorb shock and reduce the potential for carpal tunnel. The “R-5”, also known as a spade shovel is a more superior tool for digging than the flathead shovel, since it can be sharpened, dig with greater ease, and cut roots.



**Figure 6.20 - Sledgehammer**

**Sledgehammer** - For trail construction, sledgehammers, single and double-jacks, “chinkers”, straight-peen and cross-peen hammers are primarily used for breaking and shaping stone and driving rebar and spikes. As with shovels, it has been adopted and suggested by many other agencies to utilize wooden handles in order to reduce the potential for carpal tunnel. Wooden handles may require more frequent replacement, but will save time and money in the end with the prevention of long-lasting injuries.

## 6.3 Using a Clinometer



**Figure 6.21 – Holding a Clinometer**

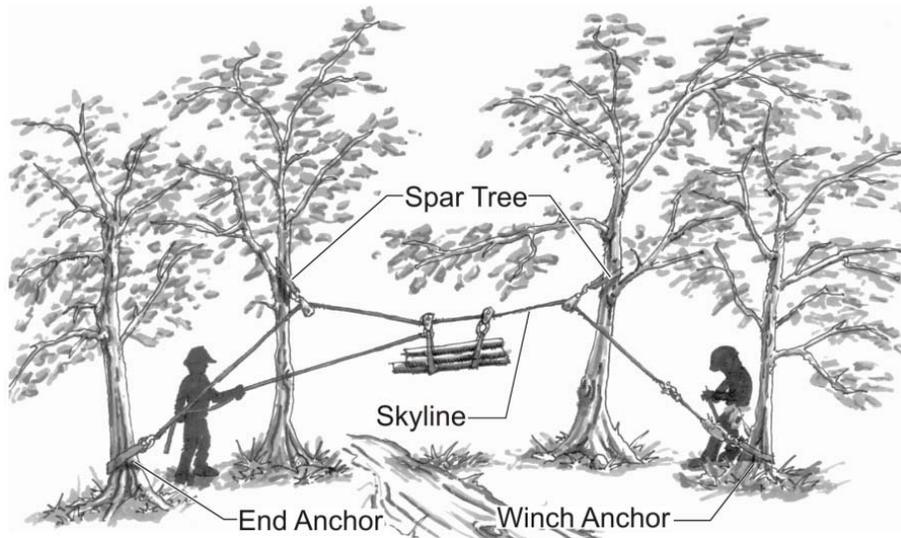
Clinometers can measure grades of existing trails as well as shoot grades for new trail construction. Prior to conducting a trail survey the layout team must “level-up” with one another to properly read grades with the clinometers. Grades can be read in percent or degrees of slope angle; for trails you will use percent.

To level up, first find level ground. Many surfaces outside that look level are not, so it is best to do this in a building. Stand 10-15 feet away from your partner. Look through the *clinometer* with your dominant eye and line up the zero with the horizontal line. Then open your other eye and notice which part of their head the horizontal line lines up with (nose, eyes, forehead, etc.); this is the “sight to equal height.” From now on when you shoot a grade with this person you will line up the horizontal line in the same place.

Some tips on using clinometers:

1. It is easiest to shoot grades with someone the same height. If you shoot grades with someone that is considerably shorter, you may have to shoot above them. To facilitate this you can either have them wear a pole, or decide that they can shoot the grades instead.
2. To find your dominant eye, line up your thumb at arm’s length with an object (tree, door knob, etc.); focus on that object in the background. Close each eye; the open eye that doesn’t appear to move your thumb is the dominant eye.
3. Never guess grades. Use your *clinometer*.
4. Don’t rush when shooting a grade. It may take a few seconds for the *clinometer* to settle. Wait that few seconds so your measurement will be accurate.

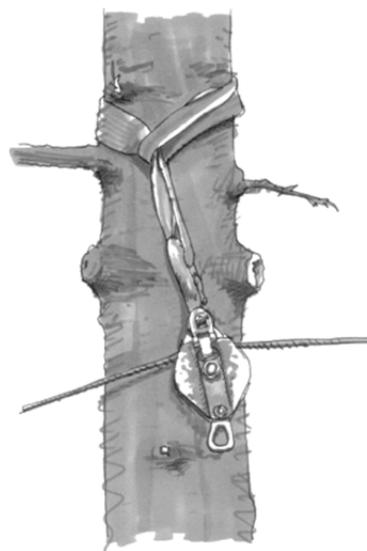
## 6.4 Cable Winch and Rigging Systems



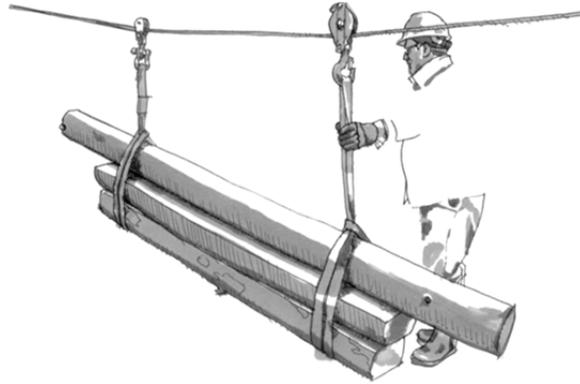
**Figure 6.22 – Cable Winch Rigging System**

Rigging systems can be set up in many ways. A wire rope is anchored at two trees. The *cable winch* (the most commonly used is Griphoist brand) *Griphoist* at one end, known as the *winch anchor*, augments the power of a trail worker to pull the slack out of the wire rope, in between the *spar trees*, lifting the load off the ground.

When determining where to place the rigging, make sure to analyze the layout, the intended payload, and placement of rigging before you proceed. A well placed *skyline* and *anchors* would put vertical force on the *spar trees*, so not to topple the trees from diagonal or horizontal pressure. To accommodate such a horizontal pressure will most likely be a *linear layout*, where the four trees are in alignment with one another so that the *anchors* do not lift the *pulleys* off of the *spar tree* adding sideways pressure.



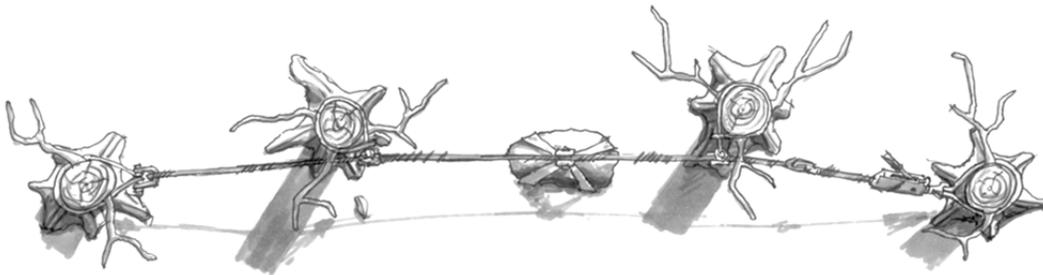
**Figure 6.23 – Nylon sling around spar tree with pulley and mainline**



**Figure 6.24 – Logs on mainline with slings and pulleys**

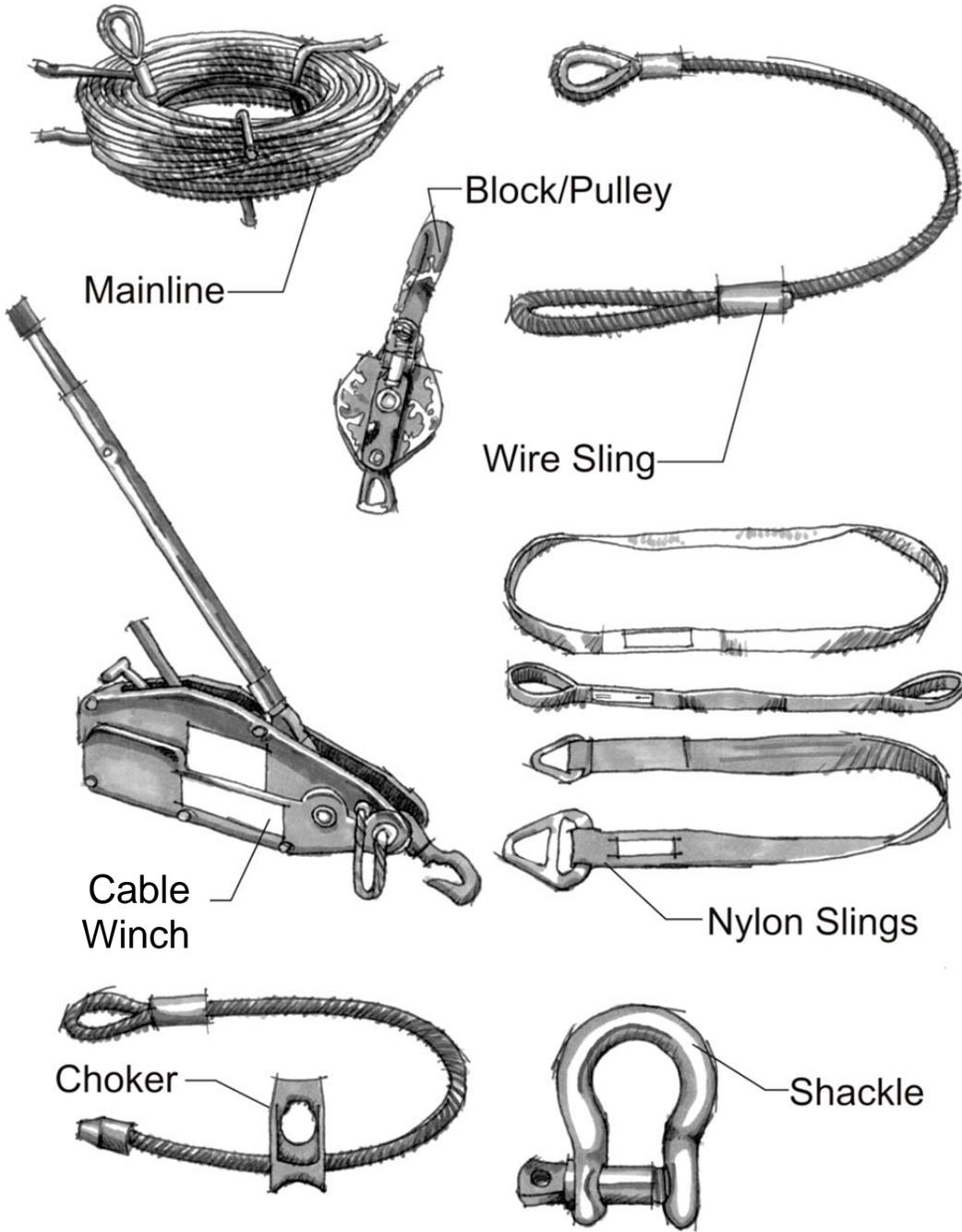


**Figure 6.25 – Logs on mainline with slings and pulleys**



**Figure 6.26 – A linear rigging setup**

In the event a *linear* set-up does not work use a *guy-line* or two to stabilize the *spar tree*. A *guy-line* is set up to pull the *spar tree* or *anchor tree* in the opposite direction than the *skyline* is pulling the tree in. Use a *slings* and a *cable* (chain would work as well) and fasten it to the same area of the tree as the *skyline* cable is wrapped. If the tree is being pulled in multiple directions, such as in a set up where a *non-linear rigging* pulls a *spar tree* in separate directions then two *guy-lines* may be necessary.



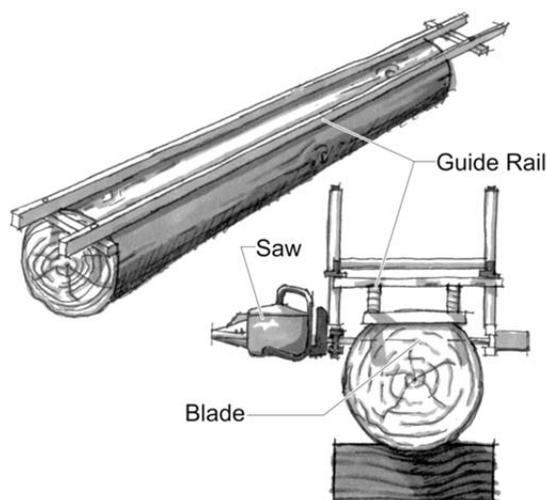
**Figure 6.27 – Cable Winch and Common Accessories**

## 6.5 The Alaskan Saw Mill

An *Alaskan saw mill* is a great tool for wood workers, builders, and outdoorsmen, giving them a way to turn a chainsaw into a lumber making machine. Whether milling beams in a remote site for a cabin, or harvesting wood for a puncheon, the *Alaskan saw mill* is a versatile tool.

### *Prepare the First Cut*

Set up the *guide rails*, these rails are what the mill rides on when making its first cut. Rails provide a flat and smooth surface that guides the mill. The *guide rails* should extend past the ends of the log so the mill can begin and end the cut consistent with the support of the guide rail. Use two long 2x4s or 2x6s, with *guide rail* brackets made of steel and nailed on the ends of the log to support the wood rails.



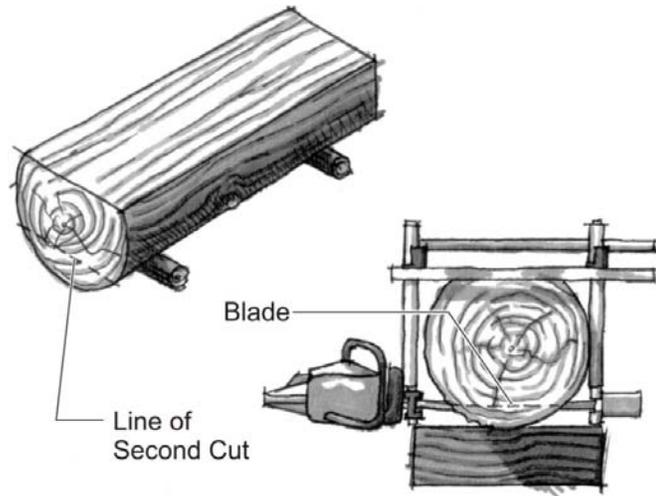
**Figure 6.28 – Alaskan Saw Mill: 1<sup>st</sup> Cut**

As you set up the rails, consider the log's taper and any other feature you wish to avoid or highlight. The first cut will determine the foundation from which the rest of the log is milled. Once you begin, it is helpful to insert small wedges in the cut behind the *saw*. Wedges will keep the log from collapsing binding up the saw. When the first cut is complete, the *guide rails* are removed.

### *The Second Cut*

With the second cut, use the surface you just created to support and guide the mill on. If the log is sawn into lumber or beams, the second cut is taken on the bottom of the log. The second cut will then produce a flat surface that is parallel to the first.

If the log is going to be made into partially finished lumber, the second cut can be set below the first at any distance.

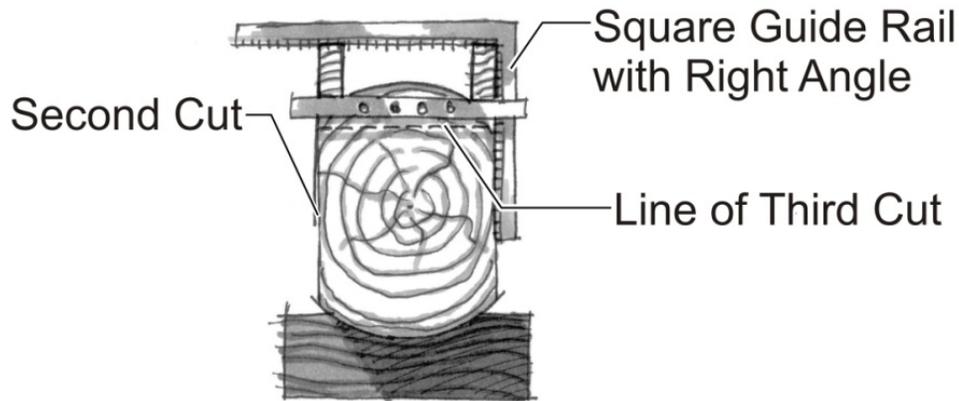


**Figure 6.29 – Alaskan Saw Mill: 2<sup>nd</sup> Cut**

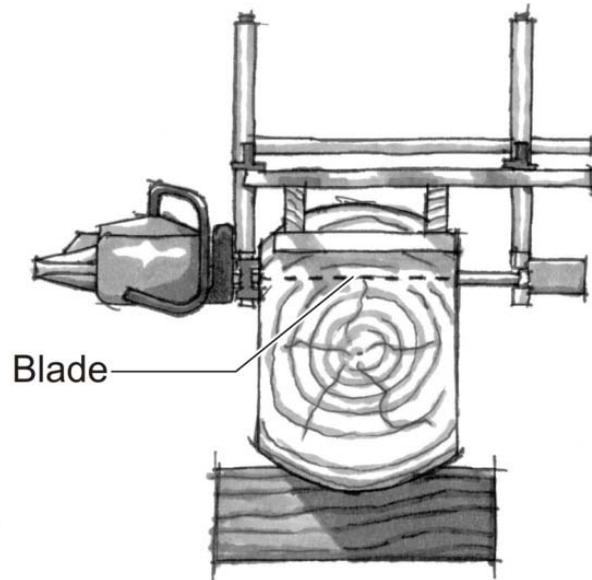
### ***The Third Cut***

When milling lumber to a finished product turn the log 90°. The *guide rails* are again placed on the top of the log. The rails should be squared with a carpenter's square to insure the sides will be at right angles to each other.

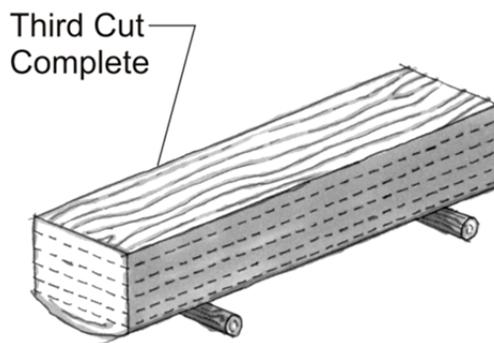
Once this is set up and checked, the third cut can begin. After the third cut is finished, remove the *guide rails* from the top "round," you should have a partially square log with three flat surfaces.



**Figure 6.30(a) – Alaskan Sawmill: 3<sup>rd</sup> Cut**



**Figure 6.30(b) – Alaskan Sawmill: 3<sup>rd</sup> Cut**



**Figure 6.30(c) – Alaskan Sawmill: 3<sup>rd</sup> Cut**

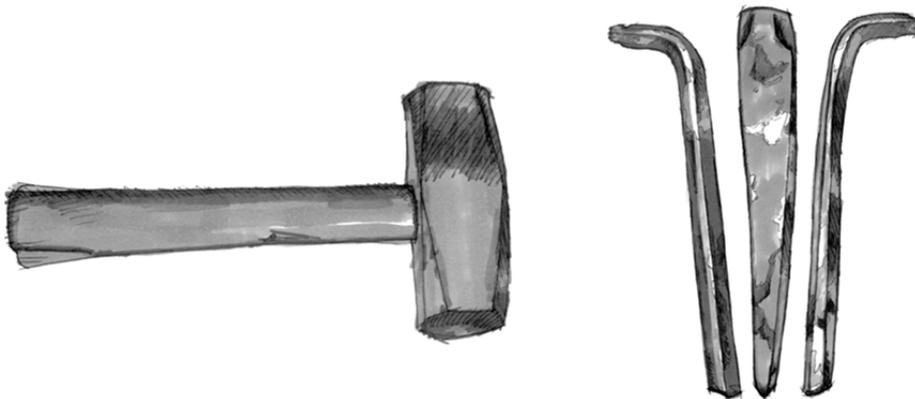
When cutting planks from this point, your mill will be guided by the surface of the cut you just made. Set the depth to the thickness you require and precede cutting boards.

## **6.6 Plug and Feather Quarrying Techniques**

The *plug and feather* method of splitting stone involves drilling a series of holes in a desired rock spaced every 6 to 12 inches apart. As the thickness of the stone thins it will become important to narrow the gap to ensure the control of the split. The diameter of the hole ranges for 1/2 inch to 1 inch and at least 4 inches deep. When a *gas-powered drill* is not available the holes can be drilled using either a single bladed plug drill or a star drill. The drill is struck by a *hammer*. The stone dust building up in the hole is removed using a tool called a spoon. Once the holes are drilled, two shims called *feathers* are placed in the hole and a wedge called a *plug* is placed between the two *feathers*.



**Figure 6.31 – Plug and Feather Quarrying Technique**



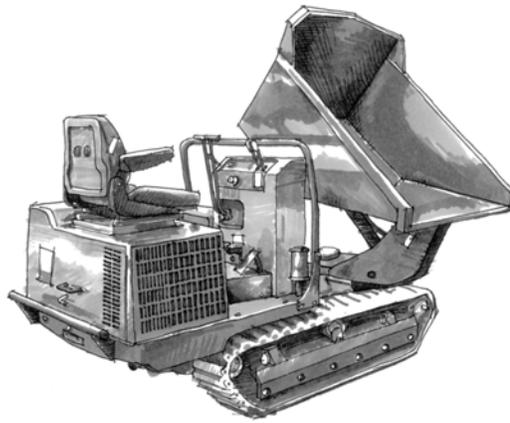
**Figure 6.32 - A Plug and Feather Hand Splitting Tool Set: 8lb Double Jack and Two Feathers (Shims) with Plug (Wedge)**

## **6.7 Trail Machinery** (Adapted from USFS *Mechanized Trail Equipment*)

### ***Excavator***

*Excavators* come in a wide variety of sizes. Excavators have an earth-moving bucket attached to a boom which allows them to dig and scoop. They usually have a blade on the front for trail finishing/smoothing the trail surface. Excavators have wheels or a track system that propels them. Smaller excavators are called mini or compact excavators. These smaller machines often don't have outriggers so are potentially tippy on hillsides with steep *sideslopes* and narrow trails.

**Figure 6.33 – Excavator**



**Figure 6.34 – Gravel Hauler**

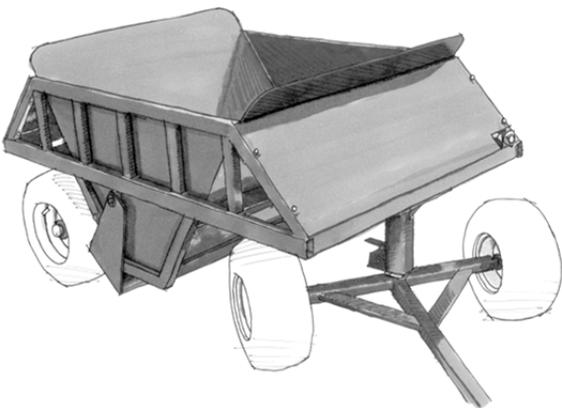
### ***Gravel Hauler***

There are many variations of the *gravel hauler*. In general the *gravel hauler* consists of a mechanized *dump bed*, motor, and wheels or track system. There are riding and walk-behind versions. These machines are a way to efficiently move large amounts of gravel, soil, etc.,. Some compact carriers offer a 180 degree swivel dump bed that gets the payload into the area of the trail difficult to achieve with minimal hand-work.

### ***ATV Belly Dump***

With a narrow profile a *belly dump* can get into areas skid steers cannot with minimal impact. It features an adjustable gate which allows it to haul materials ranging from sand, shale and gravel all the way up to eighth inch pit run. The gate can be tripped electronically or manually and requires very little maintenance.

**Figure 6.35 – ATV Belly Dump**



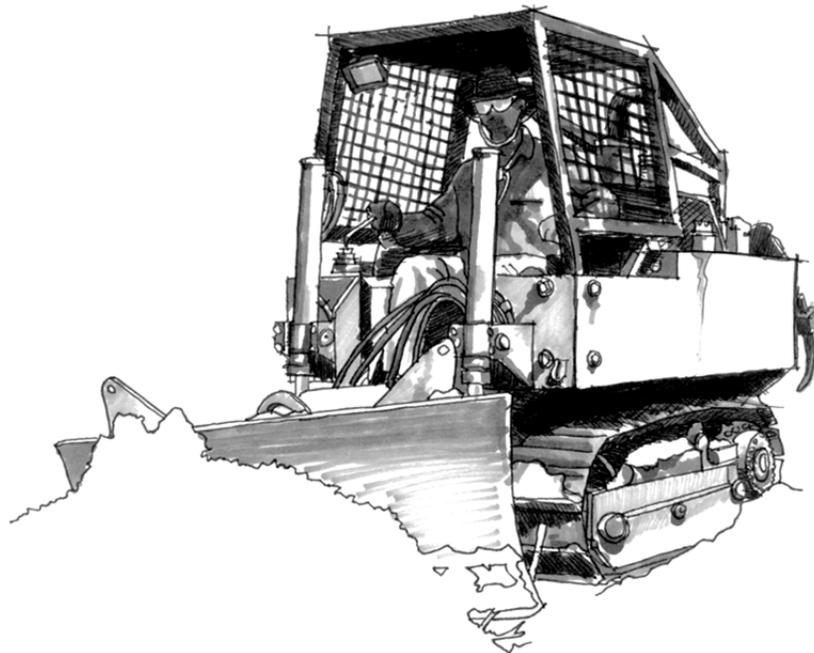
**Figure 6.36 – Skid-Steer Loader**

### ***Skid-Steer Loader***

A *skid-steer loader* is a vehicle maneuvered by skid steering, a method of steering through braking or engaging tracks or wheels on one side of a vehicle. These machines are equipped standard with a front end shovel, although the vehicle has other uses by using different attachments such as forks, tree spades, and compactors. A blade attachment makes it suitable for trail work. The skid-steering creates significant ground friction so may not be suitable for areas with sensitive vegetation or erodible surfaces.

### ***Trail Dozer***

Several manufacturers make small trail-specific dozers. These *trail dozers* make quick work of bench cut trails. Their large blade and pushing power easily move stumps and boulders. They can also use other attachments. Despite their efficiency, they produce fairly wide trails and aren't suitable for *singletrack*. They are also quite expensive.



**Figure 6.37 – Trail Dozer**