Modified Crib Wall

Coalition for the Upper South Platte,
Coalitions & Collaboratives, Inc.

40 Cherokee Ave.
P.O. Box 726
Lake George, CO 80827
(719) 748-0033

By Jason Moore and Theresa Springer

NOTE: Construct Modified Crib Walls with hazard trees in the project area. After a fire, many trees may be weakened from burning around the base of the trunk. The trees can fall over or blow down without warning. Shallow-rooted trees can also fall. Therefore be extremely alert when around burned trees.

WHAT ARE MODIFIED CRIB WALLS?

Modified Crib Wall (Mod-Crib Walls) are log structures placed in an ephemeral draw (drainage) to prevent or mitigate a *headcut*. Mod-Crib Walls intercept stormwater running down a slope and trap sediment. They direct the water into the soil protection blankets. Rarely is a Mod-Crib Wall a stand-alone structure, they are placed in series.

HEADCUTS DEFINED

According to the United State Department of Agriculture Research Service, a "headcut is an abrupt vertical drop, also known as a knickpoint in the stream bed or gully. Headcuts can range from less than an inch to several feet in height, depending on several factors. These factors include soil properties, such as density, moisture content and erodibility, as well as factors affecting the flow hydraulics, such as flow rate, overfall height, and tailwater conditions can have a large impact on the headcut advance rate" (USDA, 2008).

Headcuts form in areas where water will concentrate during a rain event. An area where two hill-slopes intersect each other is called an ephemeral draw. In ephemeral draws water only exists for a short period following precipitation or snowmelt. They are not the same as intermittent or seasonal water bodies, which exist for longer periods, but not all year round.

A headcut area is from the bottom of the drainage area to the cut at the top. Not just the area where the cut ends.

WHEN ARE MODIFIED CRIB WALLS USED?

Mod-Crib Walls are used on moderate to severely burned slopes with erosive soils where *headcuts* are or will occur, such as where erosion rates have increased significantly because of fire, and also where there are values at risk downstream. The higher in the watershed they are placed the greater the benefit. The site must have enough trees of adequate size to meet treatment objectives. The objectives can vary per specific drainage--degree of slope and size of headcut. Mod-Crib Walls increase infiltration, add roughness (to decrease velocity of flow), reduce erosion, and help retain large amounts of eroded soil on site. Mod-Crib Walls are an immediate protection step on slopes where permanent vegetation will re-establish and provide long-term erosion control.

CHOOSING THE SITE FOR A MODIFIED CRIB WALL INSTALLATION

The key to success is to start at the highest point in the drainage as possible. Plan work from the top down, installing the Mod-Crib Walls in a series with no more than a 5-foot elevation drop between structures with 4-foot spacing being ideal.

This recommendation is based on the fact that flood waters can move about 12 feet per second. For every 10 degrees of slope, the water moves faster until at an 80% grade the water can move at 22 feet per second. Speed combined with the volume of water equals damage to a watershed and downstream values. The harder the water has to work to get downhill the slower it will go which equals less damage to the landscape.

Technical drawings of a Modified Crib Wall

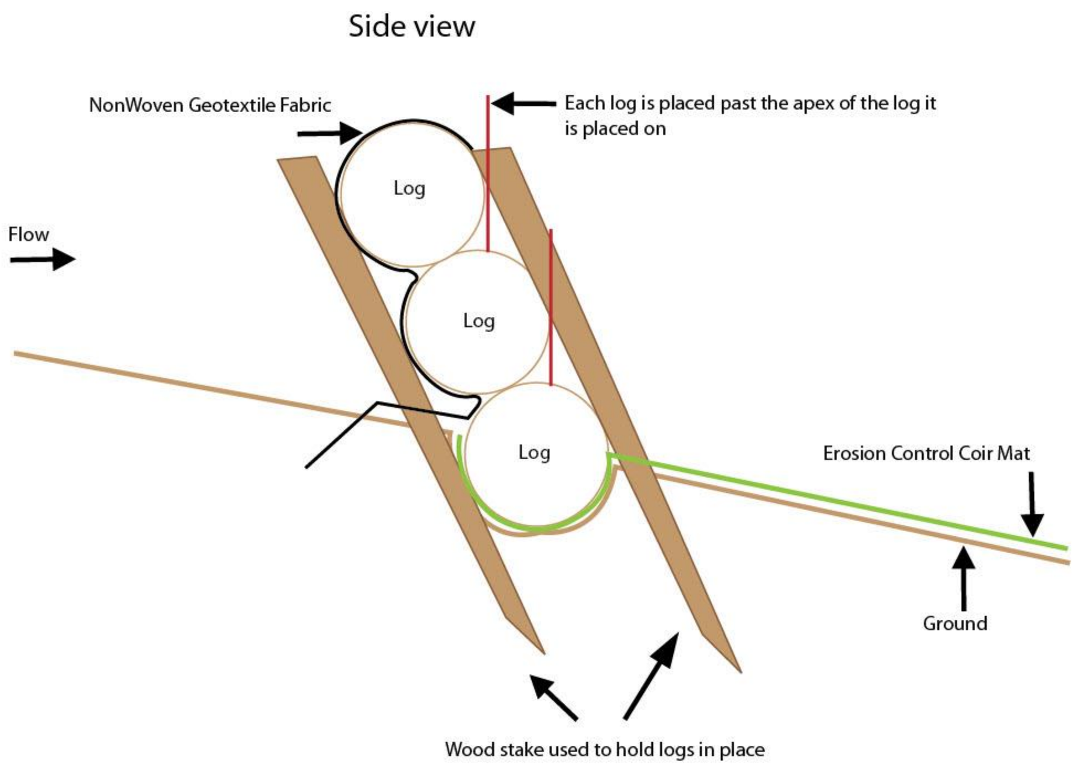


Diagram 1 *By Jason Moore*

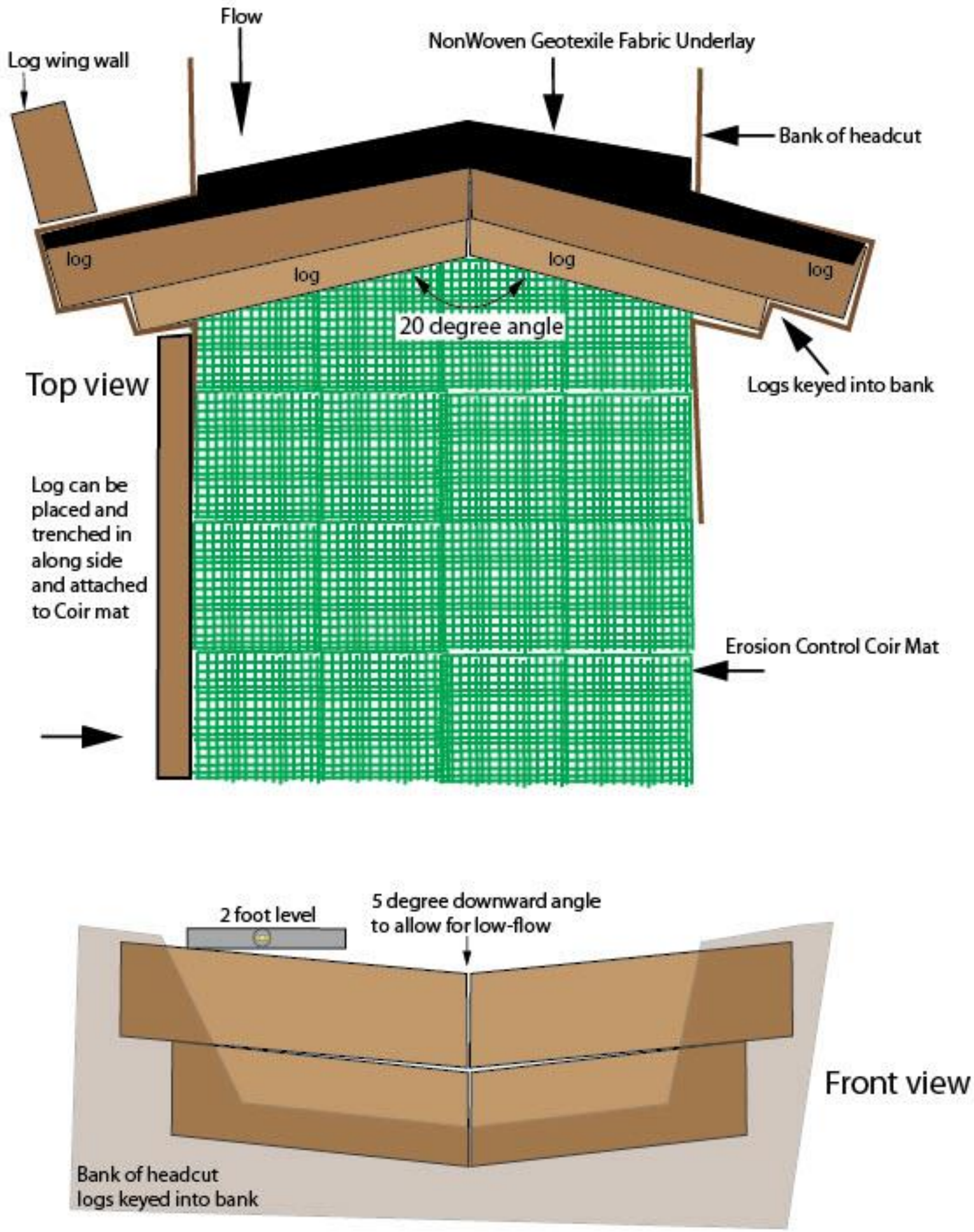


Diagram 2 *By Jason Moore*

HOW ARE MODIFIED CRIB WALLS INSTALLED?

1. Measure the width of the drainage where the structure will be constructed.
    a. Lay the 20-degree template on the ground where the logs will be installed.
    b. Measure the length of log needed- many times the two sides of the crib are not equal in length. Make sure they can be dug into the side banks. Add 6 inches for the miter cut.
2. Find solid trees that are greater than 5 inches in diameter.
    a. When the trees are cut, mark the center of the log where the cut was made on both sides, this is where the Miter cut will be, they will match up in diameter.
    b. Cut trees to the measured length. Choose trees that permit safe handling and placement for the crew (too big of a log will make for too heavy a move).
    c. Remove tree limbs to the extent necessary for the log to lie flat on the ground.

3. Lay the logs out at a 20° contour and mark their placement. Use the side of the shovel or pike to trace the line on the ground, thus marking the placement angle and spot. (See photo left)

4. Set the first row of logs
    a. Dig a trench along the 20° contour; the first row of logs should have ¾ of their size into the trench. This prevents undercutting. The log must be keyed into the bank.
    b. The center where the logs notch together must be 5° (at the center of the drainage) lower than the keyed in logs. Water needs to roll over the logs and into the center of the structure. This prevents flanking--water going around the end of the structure.
        i. Many structural failures are traced to not considering this step during installation.
    c. Set the logs in the trench,

d. Mark and cut a miter cut.

e. After the cut, make sure they fit correctly. Spin the logs if need be to ensure a tight fit.

f. Pull cut logs out and place carefully uphill to facilitate installation of Jute Mesh.

5. Seed the area directly below, downstream, of the trench which will be under Jute Mesh Erosion Control Mat.

Water flow is from the left to the right of the photo.

6. Cut and place Coir in the channel downstream of the structure.
    a. Coir is tucked under the first layer of logs.
7. The cut logs are then placed back in the trench on top of the in-channel Coir,

a. Tap the logs in tightly. (left photo)

b. *Important note: Jute mat cannot be used in place of the Coir. Coir does not have the strength to withstand a direct flow of water. Jute can be used on steep side banks to help hold seed during germination.*

8. With the first layer complete, measure for the next course. Size the logs longer than the first layer and for each consecutive layer.
    a. It is critical to maintaining a 5° lower angle in the center in relation to the outside edge of the logs.
    b. Each layer is keyed into the bank, the deeper it is keyed into the bank the better.

c. Throw the excavated soil uphill, use it to fill the gaps. Tamp all soils into place. Use a shovel handle or such tool to tamp, and compact the soil. Do not use your foot.

9. NonWoven Geotextile Fabric Underlay (looks like felt) is wrapped around the finished mod-crib wall on the upslope side and nailed flush to the contour of the crib wall with roofing nails (min. length of 2.5”).
   a. Extend the fabric 8 inches up the slope from crib wall and trenched 8 inches down. Secure with fabric staples such that water flowing down the slope will not run under the structure.

   b. Do not skimp on the fabric. This protects silt from getting between the layers and lifting the logs.
   c. Cut and hammer in stakes.

Wing walls should be placed at the side of the structure to prevent water from flowing around edges. This step is critical in areas recently burned or areas of high flow. (See Diagram 2).

MATERIALS NEEDED

1. An expert sawyer and labor crew with hand tools
2. 8 oz. NonWoven Geotextile Fabric Underlay such as www.erosionpollution.com/geotextile-fabric.application
3. Erosion Control Coir Mat such as http://nilex.com/sites/default/files/Spec
4. Coir Rolled Erosion Control Products such as http://nilex.com/sites/default/files/Spec%20Sheet_C700BN.pdf
5. 20° Template
6. Box 2 ½ inch roofing nails
7. Pick mattock

8. Pulaski ax
9. Shovel
10. Single jack
11. Chainsaw
12. Framing nails
13. 10 lbs sledgehammer
14. Fabric staples
15. 2-foot level
16. Seed
17. Log carrier
18. Mcleod
19. Tape measure

OPTIONS FOR INSTALLING MODIFIED CRIB WALLS

There are a variety of options that can be employed with the Mod-Crib Wall.

The Crib Wall pictured to the left is a very large structure, in a large drainage. Because it was down lower in the watershed. The area behind the structure filled in with sediment during the first storm event.

On steep slopes that flatten out into an alluvial fan, no matter how small, a sill should be installed. A sill has logs that are laid straight across the drainage. At least one log must be below grade and one at grade--if you cannot get one below grade and one at grade do not put in a sill. The greater the number of logs below grade the better (this is hard to do when hand digging). The water will fan out across the logs instead of concentrating in the middle like in a crib wall. When installing a sill, think wide. Place the sills in steps, mitigating 1 to 2 feet of fall. Any time the water can be encouraged to spread out, it will slow the speed of the water down.

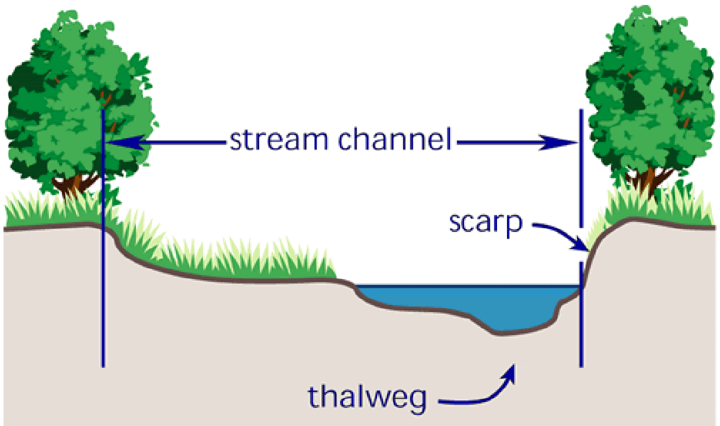
Another option when the ground starts to flatten out is to install Log Erosion Barriers https://www.nrcs.usda.gov/Internet/FSE_DOCUMENTS/nrcs144p2_062017.pdf with wing walls. They must be staggered and installed on a level area.

A kicker log installed where several small drainages come together is another option. This is a log that directs the water into a Mod-Crib wall. The log is staked to prevent rolling and inadvertently changing the flow of water.

Flying V's can also help direct water to the Modified Crib Wall.

Concepts that help to understand

- Think about the big storm when planning where to place structures.
- Maintain the 20 percent angle, and the 5-degree downward angle.



- The thalweg is where the main force of the water flow in the channel exists.
- Thalweg, ˈtälˌveg/*noun*

GEOLOGY

1. a line connecting the lowest points of successive cross-sections along the course of a valley or river.

http://www.fgmorph.com/images/03/03_14_01.gif

- An archway is one of the strongest and oldest architectural structures.

The  "Why is the arch so strong? Instead of pushing straight down, the load of an **arch** bridge is carried outward along the curve of the **arch** to the supports at each end. weight is transferred to the supports at either end. These supports called the abutments, carry the load and keep the ends of the bridge from spreading out."

www.design-technology.org/archbridges.htm

The same concept is used in a Crib Wall, only that the arch is laid down. The abutments are strongest at a 20-degree angle, just like in a cathedral. Logs cannot be arched with hydrological success. The Crib structure exerts the same counterforce as a stone arch.

- Always think about water being on the offense and your structure being on the defense, prevent flanking and undercutting.
- **Remember that the objective** is to hold the sediment on the hill slope by slowing down or directing the water.
- Fabric and coir are the equalizers. Fabric captures fine particles that will eventually lift the structure. While Coir is strong and rough. It will protect the channel and slow the water, holding the seed and young sprouts.

Lessons Learned

This series did not have the wing walls. A large event(50-year storm) hit this drainage and the structures were flanked. Wing walls would have prevented the flanking by helping to roll the water into the center of the structure. The channel widened.

Here is a good example of the benefit of seeding. Many look at flood mitigation as channeling water. Remember the overall objective is to reestablish plants, nurse crop, grasses, shrubs, willows and then finally trees.

Below the photo on the left is a crib that has filled with sediment. The one on the right has more room for storage. Notice how the sediment has built up on the outside first. Grasses establish quickly on the downhill side. These photos were taken a year after installation. These are in a series of 15.