



Field Reference

Course 300. Rock Retaining Walls

STUDENT SKILL OUTCOMES:

- Understanding of ideal rock size & shapes for rock structures.
- Safe quarrying and transport of rock, especially safe use of rock bars.
- Construction of effective rock walls from one to three tiers.
- If time allows, side projects include installing guide rocks, rip rap, and other minor trail armoring.

KEY TERMS:

Batter: the inward slope of the outside face of a rock wall. Expressed as a ratio of rise to run, as in 3:1, meaning 3 inches or feet of rise to 1 inch or feet of run. Such batter helps stabilize a rock wall.

Cap Rock: the top tier of large stones on a constructed rock wall. Must be large and stable enough to withstand horse traffic. An irregular top is ideal to encourage trail users to stay away from the edge.

Foundation Rock: very large base stones of a constructed rock wall, all set on a solid insloped base. Flat on top and insloped for next tier of rocks. Ideally the lowest one is held in place by bedrock or a solid boulder.

Guide Rocks: (aka dummy rocks) large rocks buried solidly on the outside edge of tread on a steep side slope can keep horses to the middle of the tread, preventing them from collapsing the outside edge.

Mechanical Advantage: in essence, the multiplication of one's strength by using simple machines such as levers (rock bars), inclined planes (wedges) and pulleys (blocks & tackle). Most trail tools, such as a pick mattock for example, are combinations of levers (the handle) and wedges (the pick and mattock).

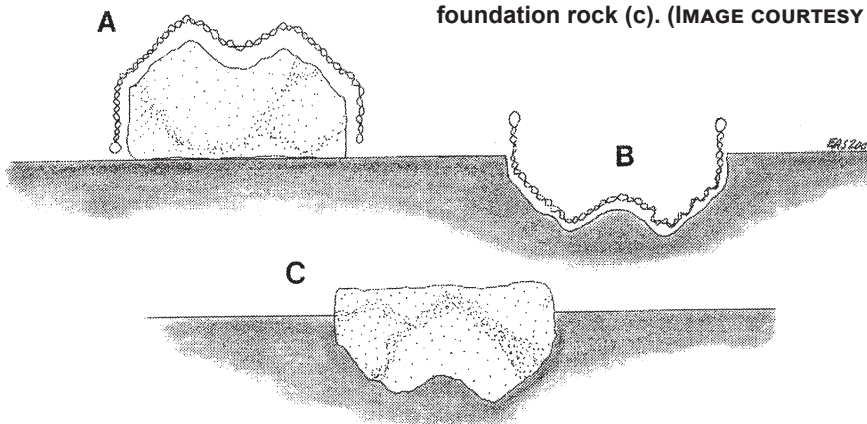
Mineral Soil: dirt that includes little or no organic material, ideal for trail tread and fill.

Riprap: (aka scree or junk wall) medium to large angular rocks loosely (or ideally carefully) stacked on an unstable slope to slow erosion. In trail work, riprap may be placed adjacent to steps or check dams on the sides of **gullied tread**, or to stabilize tread **backslope** or downslope. In some locales, riprap instead refers to **rock armoring** of tread.

Rock Armoring: (some places aka riprap) creating a solid dry tread by installing tightly-fitted rocks (preferably large). Various techniques include: flagstone paving, stone pitching, boulder causeway.

Rock Crush: small pieces of angular rock (essentially gravel) created by smashing larger rocks with a sledge. Used for fill around rock placements to stabilize them. Small angular rocks can also be collected if readily available. Round rocks and gravel act as ball bearings and thus are unacceptable for rock work.

Figure 1. Using a length of malleable wire molded over a rock (a), will allow you to dig the foundation hole (b) to match the irregular bottom of the rock. This results in a well-seated and stable foundation rock (c). (IMAGE COURTESY OF VOC)



Rock Shopping: the thorough search for quality rocks for construction for walls, water bars, checks, etc. Generally the search is uphill or across the side slope, for ease of transport, since quality rocks will be larger than one person can carry.

Rowing Rocks: the lateral swing of a rock bar over a fulcrum to adjust a large rock sideways.

KEY CONCEPTS:

- 1) Safety Documents and Concerns:
 - Personal Protective Equipment (PPE), Job Hazard Analysis (JHA), Tailgate Safety Session (TSS), Emergency Action Plan (EAP)
- 2) Trail Crew Leave No Trace: Have a positive impact on the land through trail work and be sensitive to off trail and camping impacts.
- 3) Where retaining walls are appropriate
- 4) Shape and size of ideal wall rocks
 - Roughly rectangular
 - If you can lift it, it's too small
- 5) Steps in building a rock retaining wall
 - Excavate a solid, insloped foundation
 - Anchor the first rock, or use a large first rock
 - Set one tier at a time, keeping level, tops insloped
 - Maximize contact and eliminate wobble
 - Simple rock shaping
 - Shims: only from inside, never from outside face
 - In-leaning batter
 - Fill with crush; pack tight
 - Tie stones for taller walls
 - Cap stones should be very large
- 6) Other uses of rock (sample only if time allows)
 - Rock Checks
 - Guide Rocks
 - Riprap
 - Rock Armoring
 - Drain Crossings
- 7) Where to look for rocks
 - Uphill
 - Not from sensitive streambeds
- 8) Using fulcrums to pry rocks loose
- 9) Safe rock transport with rock bars, picks, and slings or stretchers
 - Rowing or skidding is better than rolling
 - Rolling is better than lifting
 - Lifting should be done with multiple persons, using slings or stretchers

Figure 2. Step to constructing a rock retaining wall. (IMAGE COURTESY OF IMBA)

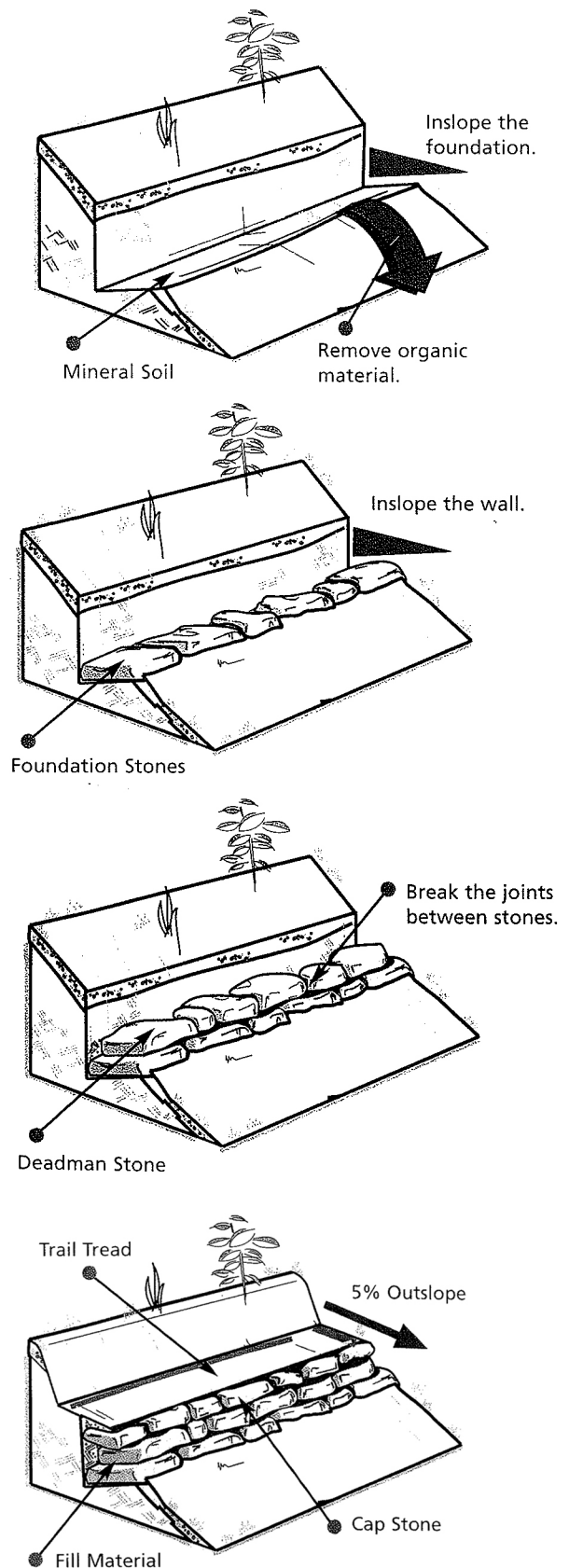


Figure 3. Side view of a wall illustrating the different elements of the structure. This wall and the hillslope have been drawn at an exaggerated angle to help illustrate the concept of batter (run over rise). The batter here is almost 1:1 but it would actually be about 1:4 for most walls. (IMAGE COURTESY OF VOC)

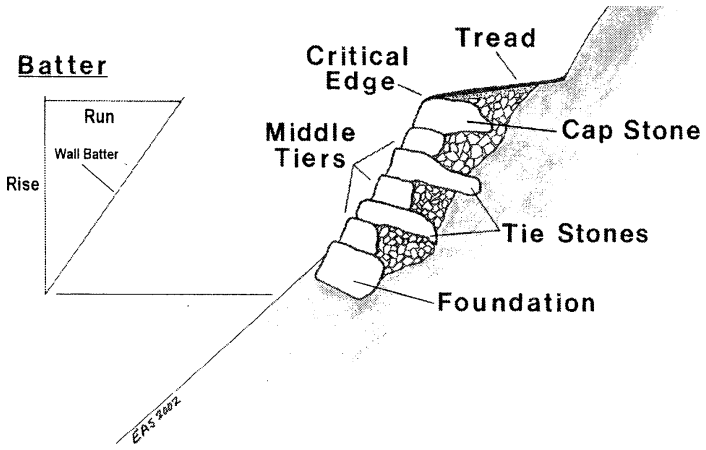


Figure 4. Calculated rock weights. (IMAGE COURTESY OF VOC)

ROCK DIMENSIONS (in inches)	GRANITE, BASALT, LIMESTONE (weight in pounds)	SANDSTONE (weight in pounds)
6 x 8 x 12	57	47
6 x 10 x 12	71	58
6 x 12 x 18	128	105
8 x 10 x 12	95	78
8 x 12 x 18	170	140
8 x 12 x 24	226	187
10 x 10 x 10	98	81
10 x 10 x 12	118	97
10 x 12 x 18	212	175
12 x 12 x 18	255	210
12 x 12 x 12	170	140
12 x 18 x 18	383	314
12 x 18 x 24	510	420
12 x 18 x 36	765	629
12 x 24 x 24	680	560
24 x 24 x 24	1360	1120
24 x 36 x 36	3060	2519
24 x 36 x 48	4080	3359

Figure 5. Using a small rock as a fulcrum with a rock bar to lift a larger rock. (IMAGE COURTESY OF VOC)

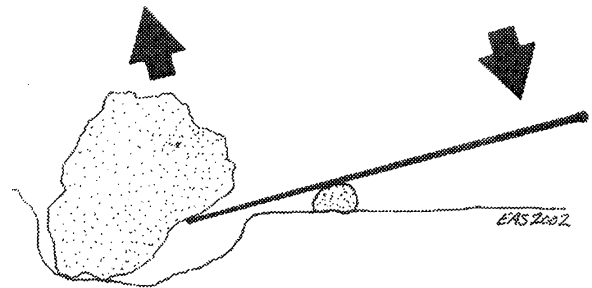


Figure 6. To move a large or awkward buried rock, first dig the soil out around it. Next, use rock bars with stone fulcrums to lift the rock up, while simultaneously filling the hole in with smaller stones. Eventually, the rock will be lifted out of the hole but the addition of the fill and it can then be moved out of the way easily. (IMAGE COURTESY OF VOC)

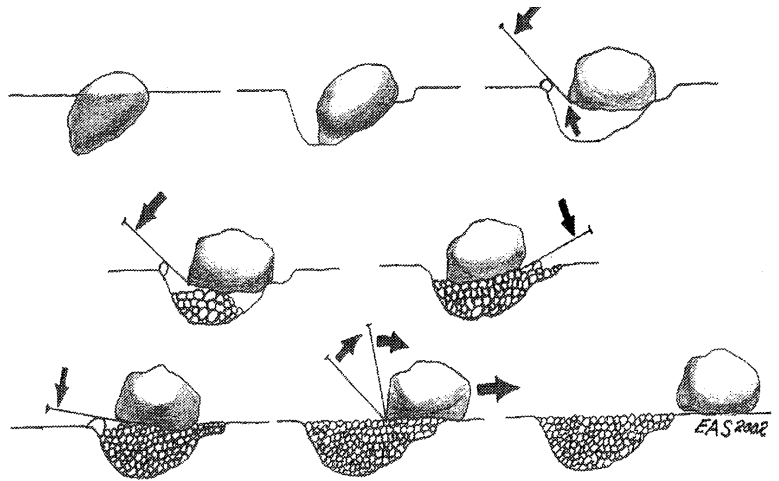


Figure 7. Austin rockslings. (IMAGE COURTESY OF VOC)

