Technical Bulletin

# Natural Stone Headwalls

6/2014

Center for Dirt and Gravel Road Studies

**NATURAL STONE HEADWALL OR ENDWALL –** A wall built of natural stone at a pipe opening to support the road and protect it from the erosive forces of flowing water. Walls built at the inlet of a pipe are called **headwalls**. Walls built at the outlet of a pipe are called **endwalls**..


Headwall at pipe inlet.


Endwall at pipe outlet.

## PURPOSES

Headwalls and endwalls are built to support the roadway at pipes and to prevent erosion around pipe installations. Properly constructed headwalls significantly improve the flow capacity of the pipe.

## BENEFITS OF STONE HEADWALLS AND ENDWALLS

- low-cost, long-lasting solution to erosion problems at pipe openings
- prevent flowing water from damaging the road structure
- provide structural support for the road and prevent crushing of the pipe
- increase the flow capacity of pipes by reducing turbulence and directing flow
- visually identify pipe openings and protect them from traffic and maintenance equipment

## HOW STONE HEADWALLS AND ENDWALLS WORK

The strength of a rock wall comes from the weight of the interwoven stacked stones and friction between the rock surfaces. Wall stability comes from tightly fitting the stones together and staggering the joints.

## TYPICAL REQUIREMENTS

- Materials: Rock of uniform thickness, flat on two or three sides that can be handled by one person are ideal. Native sandstone or limestone of any size and shape can be used, but construction will be easier and faster with stones that have some flat sides. In areas where native stone is unavailable, headwalls are constructed of a variety of different materials. Pre-fabricated and cast-in-place concrete, concrete blocks, and molded plastic are environmentally acceptable materials. (Alternate construction techniques will be covered in a separate technical bulletin.)
- Equipment: A pick, shovel, and sledgehammer or pry bar are the only required pieces of equipment. If large rock is available, a skilled operator can save time and labor by placing large stones with a backhoe.

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## CONSTRUCTION

- Excavate on either side of the pipe to make room for the wall. Typically walls need to extend 2-3 times the diameter of the pipe on each side of the pipe. The base of the wall should be at least as low as the bottom of the pipe inlet.
- Push a large flat rock(s) under the pipe opening. This rock armors the erosion-prone earth at the pipe opening.
- Start the base course with the largest available stones (see illustration a). Use rocks with flat sides in the face of the wall taking care to stagger the joints. Irregularly shaped stones can be used to provide support behind the wall and to weave the wall together from front to back for structural integrity (see illustration b).
- Backfill and compact the wall in layers as it is built with material that is damp enough for compaction and free of large roots and clumps of organic material.
- Build the wall to the elevation of the top of the pipe. Place a large stone over the top of the pipe to bridge the two halves of the wall together and protect the pipe. If a large stone is unavailable, continue to build the wall to the desired height, alternating the joints in the rock (see illustration c and elevation view).

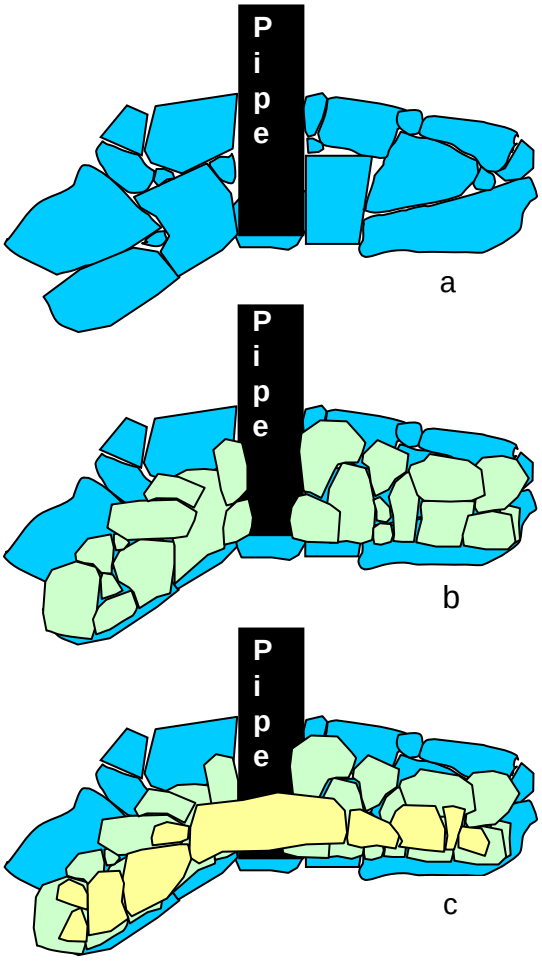
## IMPORTANT CONSIDERATIONS

- The base of the wall carries the greatest load and should be the thickest part of the wall (see cross-sectional view). As a general rule of thumb the wall should be as thick at its base as the projected height (e.g. a pipe with an outside diameter of 18" and 12" of cover requires a wall about 30" thick at its base).
- Geotextile reinforcement of headwalls vastly increases the strength and durability of headwalls and can be especially useful when rock is scarce or rounded and difficult to stack. (See Technical Bulletin D-003b for details of geotextile reinforcement.)
- Walls are typically "canted back" or sloped against the load they are holding. Depending on the size and shape of stone, the height of the projected wall, and the potential load above the wall, wall builders will cant their walls back between ½" and 2" per foot of wall height. Properly backfilled, the more a wall is canted back, the stronger it will be (see cross-sectional view).

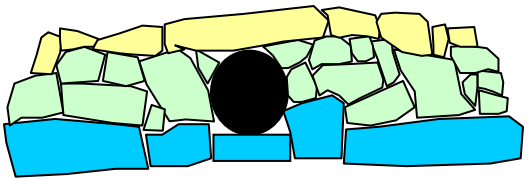
### KEYS 2 SUCCESS

- cant the wall back
- stagger joints for stability and strength
- backfill and compact as the wall is built
- set the base of the wall approximately equal to the projected height

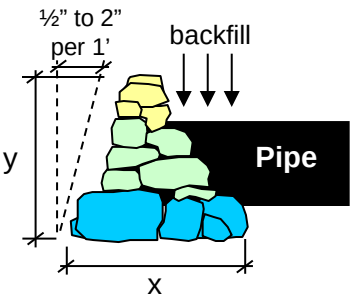
Headwall Construction Sequence:
Plan or Bird's Eye View




Elevation or Turtle's Eye View



Cross-Section or Cutaway View




x = y

**Figure 1**