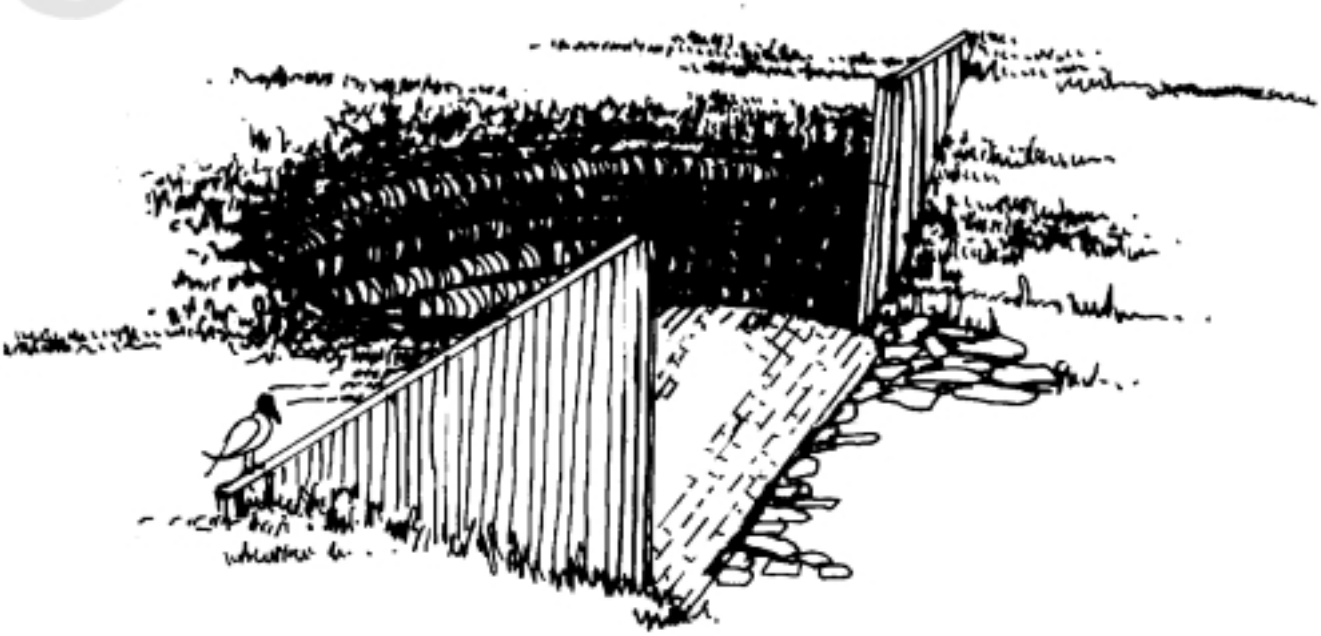
PRIMARY USE: To control the grade and head cutting in natural or artificial channels.
ADDITIONAL USES: Remove sedimentation.

GRADE STABILIZATION STRUCTURE

What is it? A structure used to control the grade and head cutting in natural or artificial channels. These structures come in many designs.

Purpose

Grade stabilization structures are installed to stabilize the channel grade and control erosion to prevent the formation or advance of gullies and headcuts. The practice is used in areas where structures are necessary to stabilize the site.



Grade Stabilization Structure
Perspective View

Limitations

Use in areas where the concentration and flow velocity of water require structures to stabilize the grade in channels or to control gully erosion. Should be designed by qualified professional.

Materials

Many designs. Materials include concrete, metal, and soil.

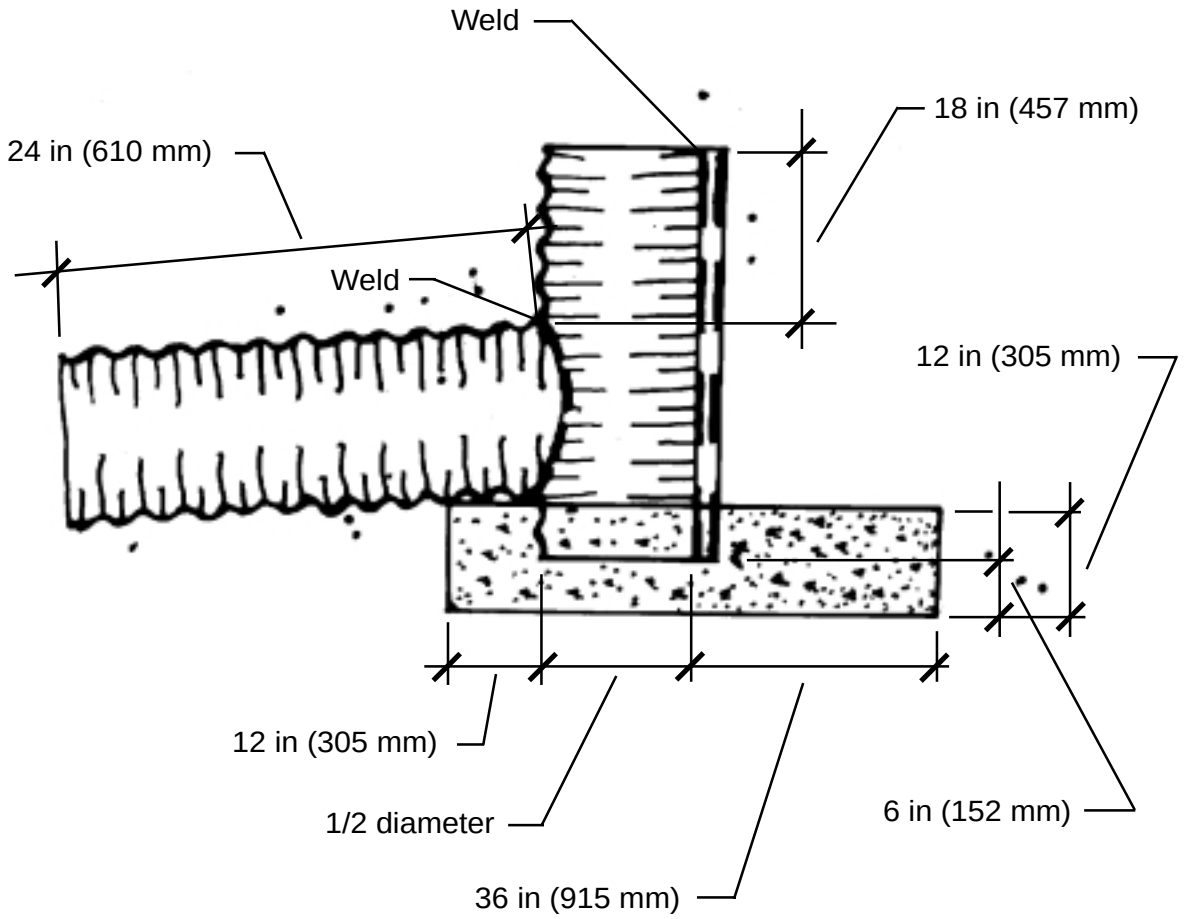
Installation

Use grade stabilization structures:
1. Where head cutting or gully erosion is active in natural or constructed stream channels,
2. Where beds of intersecting channels are at different elevations,
3. Where a flatter grade is needed for stability in a proposed channel or water disposal system.

Source: NRCS National Handbook of Conservation Practices, NRCS Planning and Design Manual, NRCS.

GRADE STABILIZATION STRUCTURE

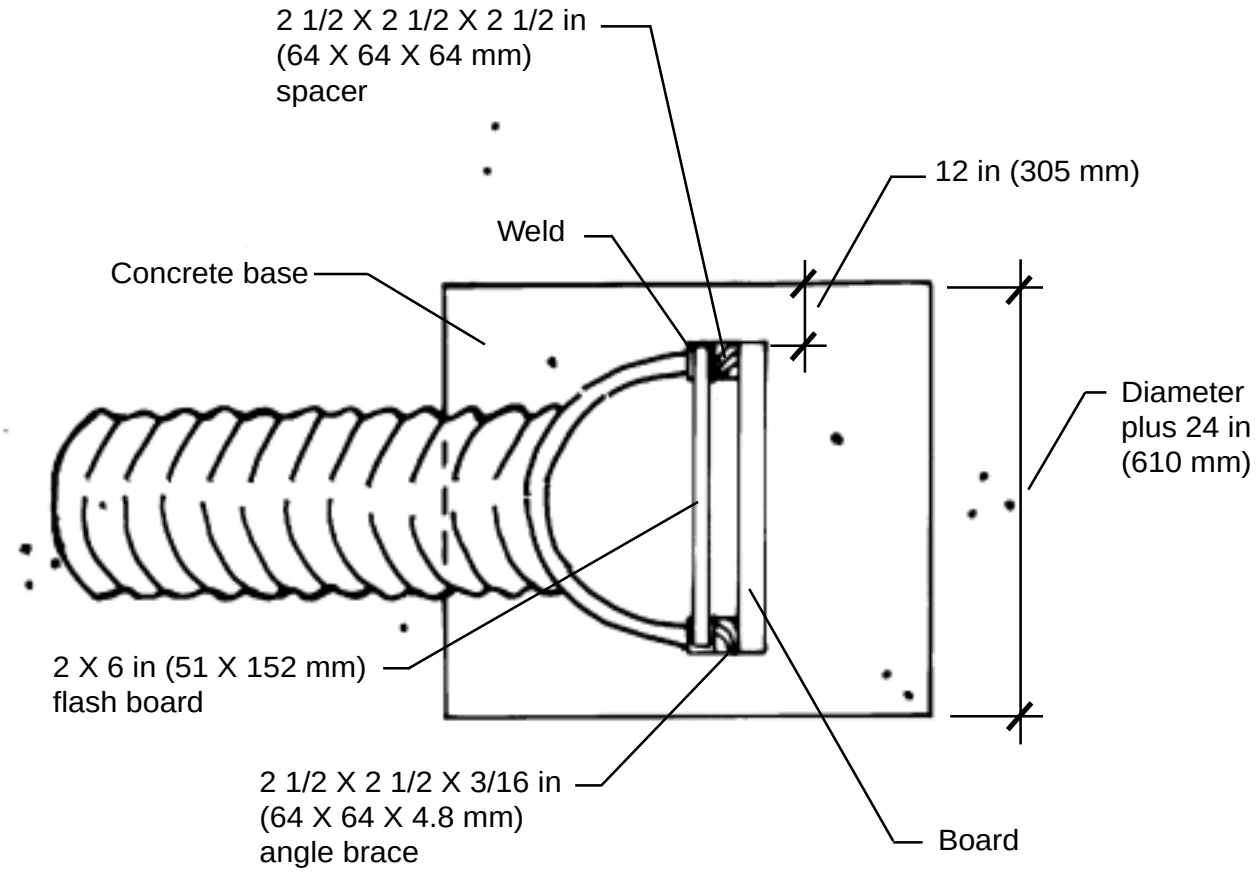
Additional Drawings:



Vertical Drop Structure
Section View

GRADE STABILIZATION STRUCTURE

Additional Drawings:



Vertical Drop Structure
Plan View

Source: NRCS National Handbook of Conservation Practices, NRCS Planning and Design Manual, NRCS.

Supplemental Information

GRADE STABILIZATION STRUCTURE

Additional Considerations:

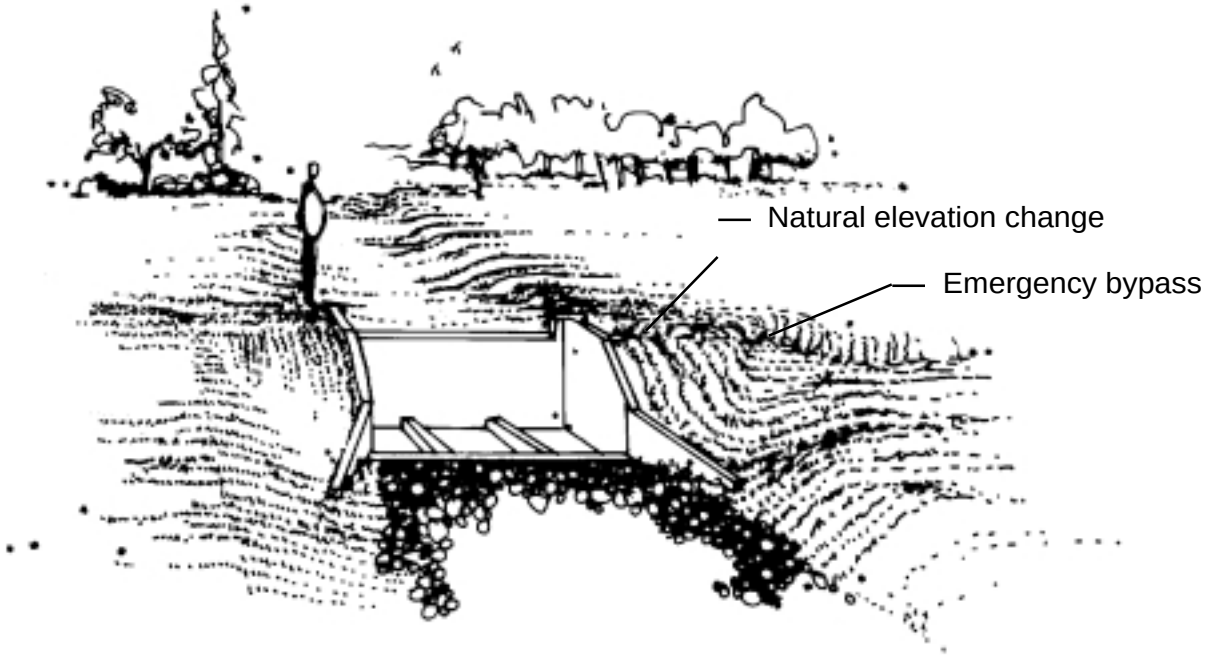
Grade stabilization structures are usually installed as part of a vegetated water disposal system. If the channel grade is erosive with a vegetative liner, the designer should consider using nonerodible channel liners (riprap or paving), or a vegetated channel in combination with grade stabilization structures. In deciding which type of system to use, the designer should consider:

1. The differences in channel depths, widths, and spoil disposal.
2. The effect the deeper channel will have on the water table, especially near the structure.
3. Entrances of surface water into the deeper channel system, and the need for an emergency bypass, at structure locations.
4. Side slope stability.
5. Outlet flow volume and velocity.
6. Environmental and aesthetic impacts.
7. Cost comparisons including maintenance.

In general, shallow channels stabilized with riprap or concrete are preferred to deeper earth channels that require grade stabilization structures.

Grade stabilization structures are often used to stabilize progressive head cutting in an existing channel. An on-site evaluation should be made to determine if the channel upstream and downstream from the proposed structure will be stable for the design flow conditions. Base the stability evaluation on clear water flow, as another head cut may begin below the structure once sediment sources upslope are controlled.

Grade stabilization structures may be vertical drop structures , concrete or riprap chutes, gabions, or pipe drop structures. Permanent ponds or lakes, or detention basins may be part of a grade stabilization system.



Reinforced Drop Spillway for Grade Stabilization with Emergency Bypass and Downstream Protection Perspective View

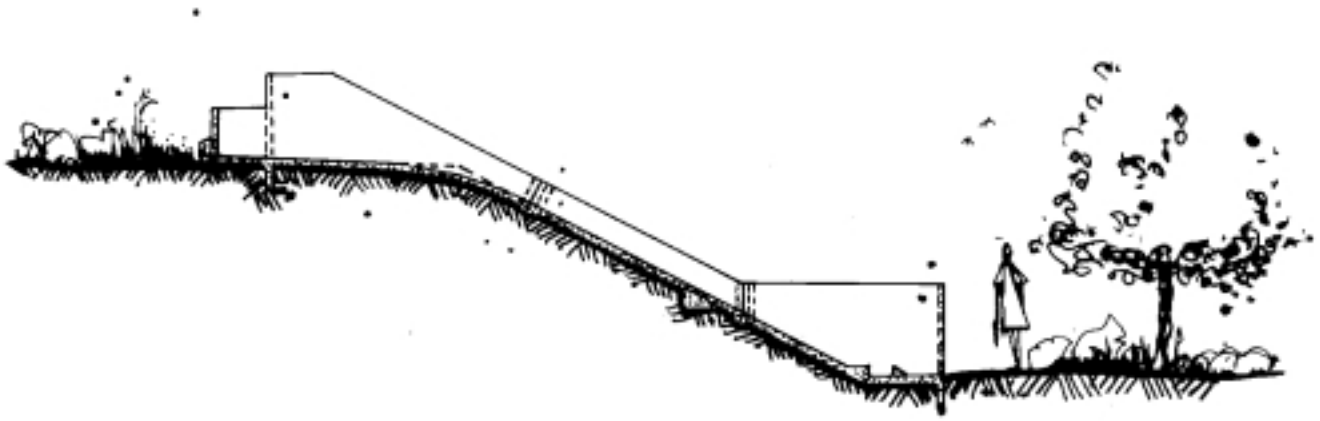
Source: NRCS National Handbook of Conservation Practices, NRCS Planning and Design Manual, NRCS.

Supplemental Information

GRADE STABILIZATION STRUCTURE

Additional Considerations and Drawings:

Where structure discharges exceed 100 cfs (2.8 m^3/s) and grade drops are higher than 10 ft (3 m), consider concrete chutes. This type of grade control structure is often used as an outlet for large water impoundments.



Reinforced Concrete Chute Spillway for Grade Stabilization
Section View

Where flows exceed 100 cfs (2.8 m^3/s) and the drop is less than 10 ft (3 m), a vertical drop weir constructed of reinforced concrete or sheet piling with concrete aprons is generally recommended. Small flows allow the use of prefabricated metal drop spillways or pipe overfall structures. Pipe drop grade stabilization structures are commonly used where channels intersect at different elevations, especially when flows are less than 50 cfs (1.4 m^3/s). Pipe drop structures also make convenient and long-lived channel crossings and often incorporate permanent water impoundments in grade stabilization structures.

Source: NRCS National Handbook of Conservation Practices, NRCS Planning and Design Manual, NRCS.

Supplemental Information

GRADE STABILIZATION STRUCTURE

Design Criteria

Designs for grade stabilization structures can be complex and usually require detailed site investigations. Design of large structures - passing more than 100 cfs (2.8 m^3/s), storing more than 50 acre-ft (60,000 m^3) of water, or more than 15 ft (4.5 m) in total height - require a qualified engineer familiar with hydraulics and experienced in structure design. Advice on the control of stream channel erosion may be obtained from the local USDA NRCS office.

1. Location of structure - Locate the structure on a straight section of channel with no upstream or downstream curves within 100 ft (30 m). Ensure that the foundation material at the site is a stable, relatively homogeneous, mineral soil with sufficient strength to support the structure without uneven settling. Piping potential of the soil should be low. The structure may be located on the main channel with floodwaters in excess of design capacity allowed to flow around the structure and reenter the channel downstream. Or the structure may be on a main stream side channel where excess floodwaters will flow over the bank of the main stream. Protect the area where bypass flood flows reenter the channel or overflow the streambank. Consider diversion of flow for dewatering during construction as part of site evaluation.

2. Capacity - As a minimum, design the structure to control the peak runoff from the 10-year storm or to meet the bankfull capacity of the channel, whichever is greater. Ensure that bypass spillway capacity is adequate to prevent structural failure from larger storms, based on the expected structure life and consequences of failure. Large structures involve greater costs (and may impose a greater safety hazard) and should be designed for a higher level of stability and safety. Foundation drainage is needed to reduce hydrostatic loads on drop spillway structures. New products such as plastic, prefabricated drainage devices are available that provide positive drainage, are easy to install, and may be less costly than conventional drainage methods.

3. Grade elevations - Set the crest of the structure inlet at an elevation that will stabilize the grade of the upstream channel or overfall. Set the outlet section at an elevation that will provide a stable grade downstream to assure stability.

4. Structural dimensions - The National Engineering Handbook (Drop Spillways, Section 11, and Chute Spillways, Section 14), prepared by the USDA Soil Conservation Service (now Natural Resources Conservation Service - NRCS), gives detailed information useful in the design of grade stabilization structures.

5. Outlet conditions - Keep the velocity of flow at the outlet within the allowable limits for the receiving stream. The allowable limits shall be based on the most restrictive soil layer identified in the channel bank soil profile. Place a transition section consisting of properly sized riprap at the toe of the structure to prevent erosion of the channel bed.

Maintenance

Once a grade stabilization structure has been properly installed and the area around it stabilized, maintenance should be minimal. Inspect the structure periodically and after major storms throughout the life of the structure. Check the fill around the structure for piping, erosion, and settlement and ensure that good protective vegetation is maintained. Check the channel at the structure entrance and outlet for scour and debris accumulation that may cause blockage or turbulence. Check the structure itself for cracking or spalling of the concrete, uneven or excessive settlement, piping, and proper drain functioning. Check emergency bypass areas around the structure for erosion, especially where flow reenters the channel. Repair or replace failing structures immediately.

Source: NRCS National Handbook of Conservation Practices, NRCS Planning and Design Manual, NRCS.