NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

GRADE STABILIZATION STRUCTURE
(No.)
CODE 410

DEFINITION

A structure used to control the grade and head cutting in natural or artificial channels.

SCOPE

This standard applies to all types of grade stabilization structures, including a combination of earth embankments and mechanical spillways and full-flow or detention-type structures. This standard also applies to channel side-inlet structures installed to lower the water from a field elevation, a surface drain, or a waterway to a deeper outlet channel. It does not apply to structures designed to control the rate of flow or to regulate the water level in channels (587).

PURPOSE

To stabilize the grade and control erosion in natural or artificial channels, to prevent the formation or advance of gullies, and to enhance environmental quality and reduce pollution hazards.

CONDITIONS WHERE PRACTICE APPLIES

In areas where the concentration and flow velocity of water require structures to stabilize the grade in channels or to control gully erosion. Special attention shall be given to maintaining or improving habitat for fish and wildlife where applicable.

DESIGN CRITERIA

The structure must be designed for stability after installation. The crest of the inlet must be set at an elevation that stabilize upstream head cutting.

Road Structures. The minimum design storm for grade stabilization structures involving public roads must consider current MNDOT criteria for culvert and bridge design. MNDOT requires a risk assessment for any road crossing where the conduit through the road has a cross sectional area larger than that of a 48" diameter culvert. This applies to new or modified structures. Contact MNDOT for the risk assessment procedures. The county engineer or the district office of MNDOT should have the Average Daily Traffic (ADT) for the road.

Embankment dams. Class (a) dams that have a product of storage times the effective height of the dam of 3,000 or more, those more than 35 ft in effective height, and all class (b) and class (c) dams shall meet or exceed the requirements specified in Technical Release No. 60 (TR-60).

Class (a) dams that have a product of storage times the effective height of the dam of less than 3,000 and an effective height of 35 ft or less shall meet or exceed the requirements specified in Pond (378).

The effective height of the dam is the difference in elevation, in feet, between the emergency spillway crest and the lowest point in the cross section along the centerline of the dam. If there is no emergency spillway, the top of the dam is the upper limit.

Grade stabilization structures with a settled fill height of less than 15 ft and 10-year frequency, 24-hour storm runoff less than 10 acre-ft, shall be designed to control the 10-year frequency storm without overtopping. The mechanical spillway, regardless of size, may be considered in design and an emergency spillway is not required if the combination of storage and mechanical spillway discharge will handle the design storm. The embankment can be designed to meet the requirements for Water and Sediment Control Basins (638) rather than the requirements for Pond (378).

Drop, chute, and box inlet drop spillways shall be designed according to the principles set forth in the Engineering Field Handbook for Conservation Practices, the National Engineering Handbook, and other applicable NRCS publications and reports.

NRCS-Minnesota
October 1999

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version of this standard, contact the Natural Resource Conservation Service.

The minimum capacity shall be that required to pass the peak flow expected from a design storm of the frequency and duration shown in table M-1, less any reduction because of detention storage. Structures must not create unstable conditions upstream or downstream. Provisions must be made to insure reentry of bypassed storm flows.

Table M-1. - Design criteria for establishing minimum capacity of drop, chute, and box inlet drop spillways.

Drainage Area (acres)	Vertical Drop (ft)	Frequency of minimum design 24-hour duration storm (yrs)		Freeboard (ft)
		Principal Spillway	Total Capacity	
0 - 450	5 or less	5	10	1.0
0 - 450	5 - 10	10	25	1.0
450 - 900	10 or less	10	25	1.0
All others		25	100	1.0

Toe wall drop structures can be used if the vertical drop is 4 ft or less, flows are intermittent, downstream grades are stable, and tail water depth at design flow is equal to or greater than one-third of the height of the overfall.

Box inlets on road structures. The minimum horizontal cross sectional area of the drop box shall be 1.5 times the cross sectional area of the structure. A permanent floor must be provided throughout the length of the culvert or bridge when a drop box is attached.

Box inlets on existing road structures will be designed using the following criteria. Storm runoff flows will be calculated for the appropriate frequency storm required by MNDOT. When the structure capacity is less than the storm flow, the drop box will be designed to 125% of the structure capacity. When the structure capacity is from 100% to 150% of the storm flow, the drop box will be designed for 125% of the storm flow or to the structure capacity whichever is greater. When the structure capacity is greater than 150% of the storm flow, the drop box will be designed to 150% of the storm flow.

Island-type structures. If the mechanical spillway is designed as an island-type structure, its minimum capacity shall equal the capacity of the downstream channel. Provision must be made for safe reentry of bypassed flow as necessary.

Table M-2. - Design criteria for establishing minimum capacity of side inlet structures or drainage structures.*

Drainage Area (acres)	Vertical Drop (ft)	Total Capacity, Frequency of minimum design 24-hour duration storm (yrs)
0 - 250	0 - 10	10
250 - 900	0 - 10	25
All others		50

* A principal spillway is required for all structures and may be designed based on drainage curves for watersheds with an average slope less than 2%. Use one drainage curve above the ditch design curve.

Side-inlet drainage structures. The design criteria for minimum capacity of open-weir or pipe structures used to lower surface water from field elevations or lateral channels into deeper open channels are shown in table M-2. Generally, side inlet structures do not have to meet the criteria for ponds (378). However, in some cases seepage control measures such anti seep collars or drain diaphragms may be warranted.

Landscape resources. In highly visible public areas and those associated with recreation, careful considerations should be given to landscape resources. Landforms, structural materials, water elements, and plant materials should visually and functionally complement their surroundings. Excavated material and cut slopes should be shaped to blend with the natural topography. Shorelines can be shaped and islands created to add visual interest and valuable wildlife habitat. Exposed concrete surfaces may be formed to add texture or finished to reduce reflection and to alter color contrast. Site selection can be used to reduce adverse impacts or create desirable focal points.

General criteria. Earth embankment and emergency spillways of structures for which criteria are not provided under the standard for ponds (378) or in TR-60 must be stable for all anticipated conditions. If earth spillways are used, they must be designed to handle the total capacity flow indicated in tables M-1 or M-2 without overtopping the dam. The foundation preparation, compaction, top width, and side slopes must ensure a stable dam for anticipated flow conditions. Discharge from the structure shall be sufficient that no crop damage results from flow detention.

Necessary sediment storage capacity must equal the expected life of the structure, unless a provision is made for periodic cleanout.

The earth embankment pond structures are potentially hazardous and precautions must be taken to prevent serious injury or loss of life. Protective guardrails, warning signs, fences, or lifesaving equipment shall be added as needed.

If the area is used for livestock, the structures, earthfill, vegetated spillways, and other areas should be fenced as necessary to protect the structure. Near urban areas, fencing may be necessary to control access and exclude traffic that may damage the structure or to prevent serious injury or death to trespassers.

Protection. The exposed surfaces of the embankment, earth spillway, borrow area, and other areas disturbed during construction shall be seeded or sodded as necessary to prevent erosion. If climatic conditions preclude the use of vegetation, nonvegetative coverings such as gravel or other mulches may be used.

PLANS AND SPECIFICATIONS

Plans and specifications for installing grade stabilization structures shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

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