SECTION 5.7

DITCH RELOCATION/CONSTRUCTION AND TRANSITIONS

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DITCH RELOCATION/CONSTRUCTION AND TRANSITIONS

Relocated or recently constructed ditches are often lined with grass, riprap, or concrete to control erosion resulting from concentrated runoff. Channels with grass lining may be used where the slope does not exceed 5%, and the design velocity will not exceed 5 feet per second. These type of channels are often preferred over riprap and concrete channels because they are less expensive to install, and provide the added benefit of improved water quality and water retention.

Channels with riprap lining are recommended where flow is too high for grass channels; where steep grades, wetness, prolonged base flow, and seeping and/or piping would cause erosion; where highly erosive soils or climatic conditions would preclude the establishment of vegetation; and where runoff must be conveyed in a limited space.

Channels with concrete lining are much more expensive to install than either grass or riprap channels. They are most often used in very flat areas where maintaining sufficient flows would be difficult to achieve with riprap or grass. Care must be taken when constructing concrete-lined channels to achieve the correct grade or in-channel ponding will result.

Ground water in the immediate proximity of concrete and riprap channels will not likely be impacted. However, it should be noted that neither of these channels appreciably filter out runoff-born contaminants; rather, contaminants are transported to a downstream location.

Special handling may be required when a new ditch has to be located adjacent to a wetland or has to cross a wetland. These circumstances may require that the channel be enclosed either as a long culvert or as a non-perforated tile or tubing. Other design innovations may also be possible and have to be addressed on a case-by-case basis.

Channel transitions are used to provide a gradual tie-in between the existing stream or ditch, and on-line channel improvements such as retention basins or channel relocations. They are also used at the junction of two channels. Transitions should be designed to maintain the existing flow regime, and avoid hydraulic jumps.

If the ditch is being relocated, the existing channel should be kept undisturbed until the relocated channel is complete and fully stabilized. Once the new channel is established, the water may be diverted to the new channel by means of a channel tie-in/transition section.

Grade transitions (chutes) are open channels (usually paved) used to convey high-velocity water down a steep slope without erosion. They are widely used where concentrated runoff from an upland area needs to be directed to a receiving stream or ditch that is located at a significantly lower grade. Chutes are also sometimes used to safely convey the high-velocity current exiting culvert outlets to the receiving waterbody. Rock chutes may also be modified for in-channel use for grade stabilization purposes.

In-channel grade stabilization structure help control sedimentation by reducing bank erosion caused by excessive channel grades. Reducing the grade slows water velocities, thereby reducing the erosive action of the water. These structures are also sometimes used outside the main channel for grade transition purposes. Grade stabilization structures can be complex, and should only be designed by a qualified engineer.

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PRACTICE 701
CHANNEL WITH GRASS LINING

DESCRIPTION

- A natural or constructed channel that is shaped or graded to required dimensions and established with vegetation for stable conveyance and runoff. (Note: a variation of this practice may also be found as "Grass-Lined Channel" in the Indiana Erosion Control Handbook.)

Exhibit 701a: Channel with Grass Lining (Source: North Carolina Erosion Control Manual)

PURPOSE

- To carry runoff as a new ditch, a relocated section of an existing watercourse, a by-pass channel, or to carry concentrated runoff from a small watershed area to a stable outlet without damage from erosion or flooding.

WHERE APPLICABLE

- New ditches, ditch relocations, by-pass channels, roadside ditches, channels at property boundaries, outlets for diversions, and other channels draining low areas where slopes are $\leq$ 5%.
- Sometimes used in place of curb and gutter for conveyance of storm water.

ADVANTAGES

- Carries concentrated runoff without damage from erosion or flooding.
- Enhance water quality by filtering out pollutants.
- Provide some water retention benefits.

CONSTRAINTS

- Not suitable for high-velocity flow or where channel slope must be more than 5%.
- Need room for a relatively large cross section.
- Requires establishment of a dense, erosion resistant vegetative cover (Practice 1102 Vegetative Stabilization).
- Requires erosion control blankets or matting while vegetation becomes established (Practice 1104 Erosion Control Blankets).

- May require drainage tile (Practice 201 Tile Drain Installation) if areas have high water table or if there are seepage problems.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Vegetative stabilization.
- Erosion control blankets or matting.

Installation

- Install Sediment Basin (Practice 801) or Temporary Diversion (Practice 104), if necessary.

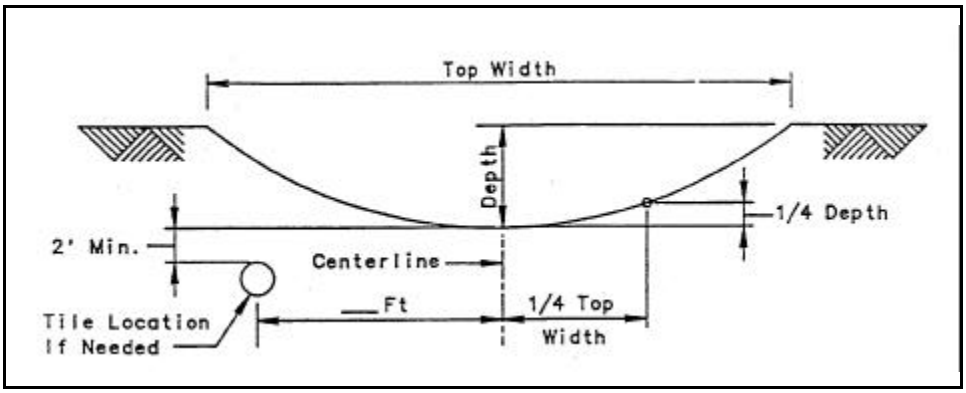

Exhibit 701b: Parabolic Cross Section (Source: NRCS Standard Specifications)

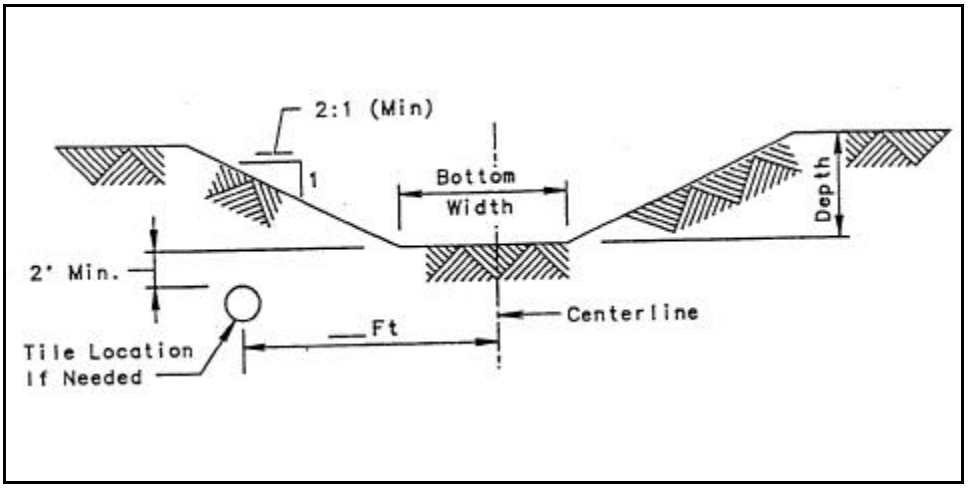

Exhibit 701c: Trapezoidal Cross Section (Source: NRCS Standard Specifications)

- Clear and Grub (Practice 107) construction area.
- If drainage tile is needed, it should be located ± 1/3 of the distance away from the center of the top width of the waterway. The top of the tile should be 2'-4' below the bottom of the waterway, except when impractical due to soil or outlet conditions.
- Channel cross section should be parabolic or trapezoidal. The parabolic shape is preferred.
- Protect all concentrated inflow points along the channel with erosion resistant linings, riprap (Practice 702) or other appropriate measures.

- Seed and mulch the channel immediately after grading (Exhibit 701d or Exhibit 1102b), and protect with erosion control blankets and/or matting.
- Stabilize outlets during channel installation (Practices 1001 and 1002).

Special Considerations

- Optimum seeding dates are March 1 to May 10 and August 1 to September 30. Permanent seeding done between May 10 and August 10 may need irrigation.
- Maximum permissible velocities of flow shall not exceed the values shown in Exhibit 701d.

Channel Slope	Lining	Velocity (ft/sec)[1]
0-5%	Tall Fescue (endophyte-free)[2] Kentucky Bluegrass Smooth Bromegrass	5
	Grass-legume Mixture	4
	Red Fescue Red Top	3
	Small Grains[3]	2.5
5-10%	Tall Fescue (endophyte-free)[2]	5
	Kentucky Bluegrass Smooth Bromegrass	4
	Grass-legume Mixture	3
> 10%	Tall Fescue (endophyte-free)[2] Kentucky Bluegrass Smooth Bromegrass	3

1 Permissible velocities should be decreased 25% for highly erodible soils.

2 Tall fescue provides little cover for, and may be toxic to, some species of wildlife. The use of endophyte-free tall fescue in this Handbook has only been recommended in high velocity areas that are subject to frequent inundation or flow. The IDNR recognizes the need for additional research on alternatives to tall fescue, such as buffalo grass, orchard grass, smooth Bromegrass, and switchgrass. When feasible, alternative vegetative lining such as those presented in Exhibit 1102b should be considered.

3 For temporary seeding and its optimum dates, see Practice 1102 Vegetative Stabilization.

Exhibit 701d: Permissible Velocities for Channels Lined with Vegetation

MAINTENANCE

- Inspect channel following storm events and repair as necessary.
- Check channel outlet and road crossings for blockage, sediment, bank instability, and piping or scour holes. Repair as necessary.
- Remove sediment and debris from channel as necessary to maintain design cross section and grade and to prevent spot erosion.

REFERENCES

Related Practices

- Practice 107 Clearing and Grubbing.
- Practice 201 Tile Drain Installation.
- Practice 702 Channel with Riprap Lining .
- Practice 703 Channel with Concrete Lining.
- Practice 704 Channel Transitions (Tie-ins).
- Practice 705 Channel Transitions (Chutes).
- Practice 706 In-Channel Grade Stabilization Structure.
- Practice 1001 Tile Drain Outlet Extension.
- Practice 1002 Riprap-Lined Apron.
- Practice 1102 Vegetative Stabilization.
- Practice 1104 Erosion Control Blankets and Matting.

Other Sources of Information

- Illinois Urban Manual.
- Indiana Erosion Control Handbook.
- NRCS Standard Specifications.

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PRACTICE 702
CHANNEL WITH RIPRAP LINING

DESCRIPTION

- A constructed channel that is shaped or graded to required dimensions and lined with riprap for stable conveyance and runoff. (Note: a variation of this practice may also be found as "Riprap-Lined Channel" in the Indiana Erosion Control Handbook.)

Exhibit 702a: Channel with Riprap Lining (Source: NRCS Files)

PURPOSE

- To carry runoff as a new ditch, a relocated section of an existing watercourse, a by-pass channel, or to carry concentrated runoff from a small watershed area to a stable outlet without damage from erosion or flooding.

WHERE APPLICABLE

- New ditches, ditch relocations, by-pass channels, roadside ditches, channels at property boundaries, outlets for diversions, and other channels draining low areas.
- Concentrated runoff is such that a lining is needed to control erosion.
- Steep grades, wetness, prolonged base flow, seepage, or piping would cause erosion.
- Use by people or domestic animals precludes use of vegetated waterways.

- Soils are highly erosive or other soil or climatic conditions preclude using vegetation.

ADVANTAGES

- Carries concentrated runoff without damage from erosion or flooding.
- More resilient than channel with vegetative lining.
- Lower maintenance than channel with vegetative lining.
- Controls seepage, piping, and sloughing or slides.

CONSTRAINTS

- More expensive than channel with vegetated lining.
- May increase likelihood of dissolved and suspended substances being transported to surface waters due to high flow velocities.
- Does not provide wildlife habitat.
- Side slopes must be 2:1 (1V:2H) or flatter.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Rock (size and gradation according to specifications).
- Geotextile fabric for filtering or aggregate (INDOT CA No. 5) filter layer under the riprap.

Installation

- Clear and Grub (Practice 107) channel and spoil areas.
- Excavate cross section to the lines and grades shown in design specifications, overcutting for thickness of riprap and filter material.

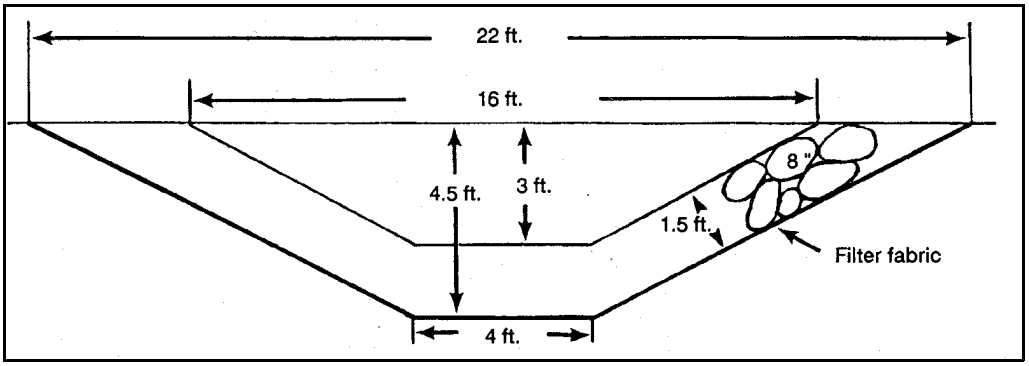

Exhibit 702b: Typical dimensions and installation details of a channel with riprap lining (Source: Indiana Erosion Control Handbook)

- Install geotextile fabric in the excavated channel as a foundation for the riprap.
- Place riprap over the foundation to the depth and thickness and elevation shown in the design plans. It should form a dense, uniform, and well-graded mass with few voids.
- Blend the finished rock surface with the surrounding landing surface so there is no overfall or channel construction.
- Stabilize channel inlet points, and install needed outlet protection during channel installation.
- Stabilize disturbed areas after construction is completed.

Special Considerations

- Piping and bank instability may result if geotextile is omitted or damaged during installation.
- Undercutting may result if riprap is not extended far enough downstream.
- Gullying along the edge of the riprap may occur if riprap is not blended to the ground surface.
- Poorly graded riprap or stones not placed to form a dense, stable channel lining may result in rock material displacement and erosion of the foundation.

MAINTENANCE

- Inspect channel following storm events and repair as necessary.
- Check channel outlet and road crossings for blockage, sediment, bank instability, and piping or scour holes. Repair as necessary.
- Remove sediment and debris from channel as necessary to maintain design cross section and grade and to prevent spot erosion.

REFERENCES

Related Practices

- Practice 107 Clearing and Grubbing.
- Practice 701 Channel with Grass Lining .
- Practice 703 Channel with Concrete Lining.
- Practice 704 Channel Transitions (Tie-Ins).

Other Sources of Information

- Indiana Erosion Control Handbook.
- NRCS Standard Specifications.
- North Carolina Erosion Control Manual.

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PRACTICE 703
CHANNEL WITH CONCRETE LINING

DESCRIPTION

- A constructed channel that is shaped or graded to required dimensions and lined with concrete for stable conveyance and runoff.

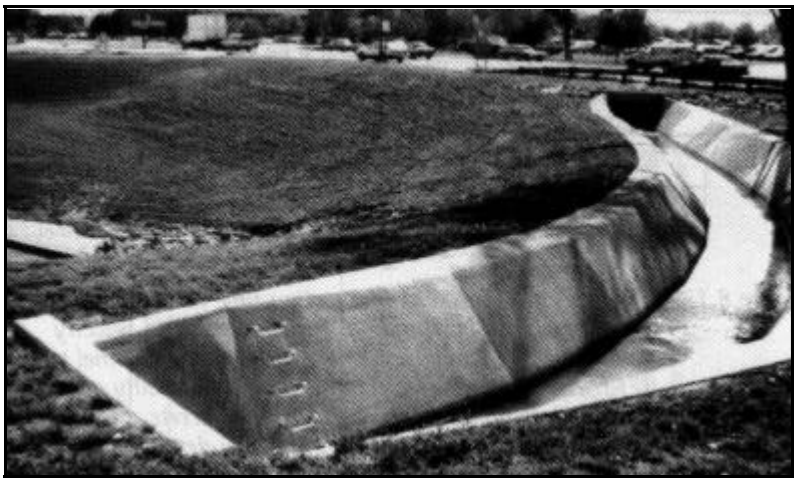

Exhibit 703a: Channel with Concrete Lining (Source: ASCE Urban Stormwater Manual)

PURPOSE

- To carry runoff as a new ditch, a relocated section of an existing watercourse, a by-pass channel, or to carry concentrated runoff from a small watershed area to a stable outlet without damage from erosion or flooding.

WHERE APPLICABLE

- New ditches, ditch relocations, by-pass channels, roadside ditches, channels at property boundaries, outlets for diversions, and other channels draining low areas.
- Concentrated runoff is such that a lining is needed to control erosion.
- Steep grades, wetness, prolonged base flow, seepage, or piping would cause erosion.
- Use by people or domestic animals precludes use of vegetated waterways.
- Soils are highly erosive or other soil or climatic conditions preclude using vegetation.

ADVANTAGES

- Carries concentrated runoff without damage from erosion or flooding.
- More resilient than channel with vegetative lining.
- Lower maintenance than channel with vegetative lining.
- Controls seepage, piping, and sloughing or slides.

CONSTRAINTS

- More expensive than Practices 701 or 702.
- May increase likelihood of dissolved and suspended substances being transported to surface waters due to high flow velocities.
- Does not provide wildlife habitat and should be avoided in situations where wildlife habitat is an intended use.

- Sideslopes must be 2:1 (1V:2H) or flatter.
- Requires tile drain unless installed on low shrink-swell soils that are well-drained.
- Special care should be utilized during design and installation as freeze-thaw tends to break up the lining.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Concrete should be plastic enough for thorough consolidation and stiff enough to stay in place on side slopes. Minimum strength should be 3,000 lb/in^2.
- Types I, II, or (if necessary) Types IV or V Portland cement should be used.
- Aggregate should be $\leq$ 1.5".

Installation

- Clear and Grub (Practice 107) channel and spoil areas.
- Excavate cross section to the lines and grades shown in design specifications. Cross sections may be triangular, parabolic, trapezoidal, or rectangular. No spoil should be deposited adjacent to the lined waterway unless such spoil and the adjacent area have a positive grade toward the lined waterway or inlets.
- Concrete lining should be 4" in most areas, and 6"-8" with welded wire fabric reinforcing in problem areas.
- Stabilize channel inlet points, and install needed outlet protection during channel installation.
- Stabilize disturbed areas after construction is completed.

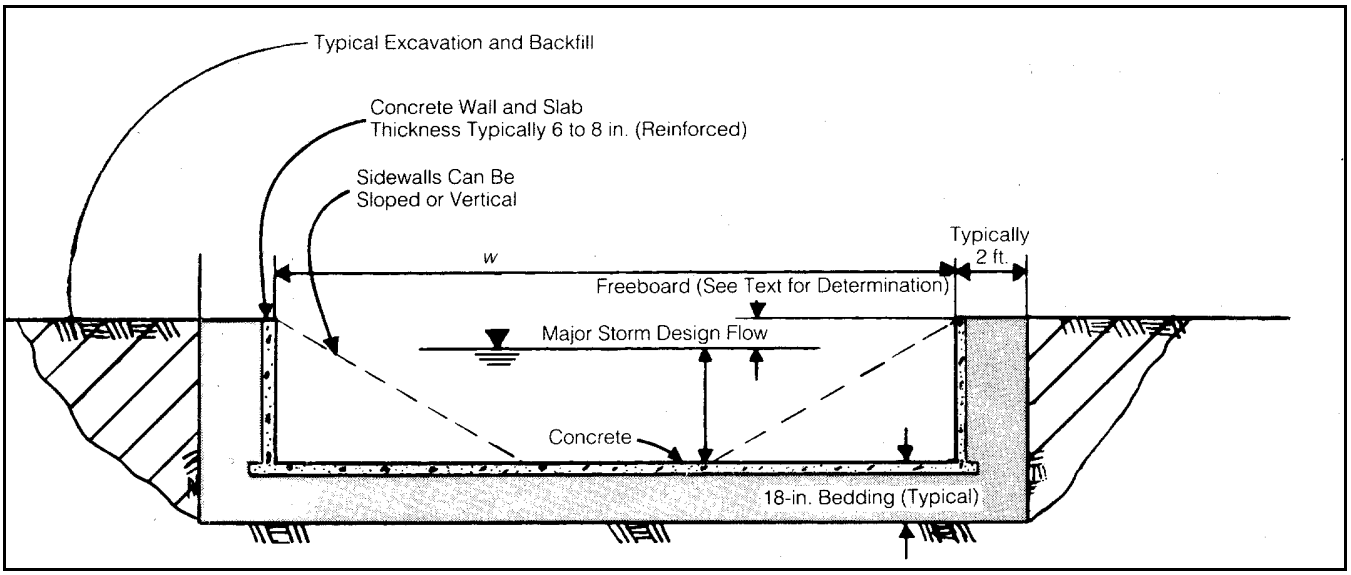

Exhibit 703b: Schematic of channel with concrete lining (Source: ASCE Urban Stormwater Manual)

Special Considerations

- The minimum freeboard for channels with concrete lining should be 0.25' above design in high water areas where erosion-resistant vegetation cannot be grown adjacent to the paved side slopes.
- The maximum capacity of the waterway flowing at designed depth shall not exceed 200 ft^3/sec.

- Contraction joints in concrete linings, if required, should be formed transversely to a depth of about 1/3 of the thickness of the lining at a uniform spacing in the range of 10'-15'.

MAINTENANCE

- Protect lined channel from damage by farm equipment and vehicles. Do not use lined channel as a roadway, and practice care when crossing.

REFERENCES

Related Practices

- Practice 107 Clearing and Grubbing.
- Practice 701 Channel with Grass Lining.
- Practice 702 Channel with Riprap Lining.
- Practice 704 Channel Transitions (Tie-Ins).

Other Sources of Information

- Indiana Erosion Control Handbook.
- NRCS Standard Specifications.
- ASCE Urban Stormwater Manual.

Last Print/Revision Date: October 13, 1996

PRACTICE 704
CHANNEL TRANSITIONS (TIE-INS)

DESCRIPTION

- Gradual transition of channel cross-section to match changing cross-section shape (geometry) or direction.

Exhibit 704a: Channel Transition (Source: Noble County Surveyor's Office Files)

PURPOSE

- To create a stable, transitional segment where a stream or ditch joins with another stream or ditch, on-line detention basin, or other on-line improvements.

WHERE APPLICABLE

- On-line channel improvements.
- Junctions of streams and ditches.

ADVANTAGES

- Avoid abrupt changes in channel velocity and conveyance (hydraulic jumps).
- Maintain existing flow regime.
- Reduce erosive forces.

CONSTRAINTS

- Difficult to achieve within short reaches.
- May require water diversions during construction.
- May require special cover treatment.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Suitable fill for smooth transition.
- Riprap, erosion control matting, or similar material are needed to protect transition zone.

- Seed or sod for well established vegetative cover where necessary.

Installation

- Horizontal angles at point of contraction should be no sharper than 1:1 (1W:1L).
- Horizontal angles at point of expansion should be no sharper than 4:1 (1W:4L).
- Vertical expansion and contraction should be no steeper than 10:1 (1V:10H).
- Establish non-erosive grade prior to junction with water feature.

Special Considerations

- Stream or ditch bank may need to be armored against erosion at throttle points.
- Delta formation (sediment deposition) may be a problem where channel velocity drops out of a transition zone
- If a considerable difference in grades exists between the two channels, chutes or grade stabilization structure may be necessary.
- Avoid additional runoff inflow at a point of transition within a channel reach.

MAINTENANCE

- Periodically check throttle points for signs of erosion. Armor bank as necessary.
- Dredging sediment depositions may be necessary.

REFERENCES

Related Practices

- Practice 601 Channel Bottom Dipping.
- Practice 602 Channel Bank Excavation.
- Practice 701 Channel with Grass Lining.
- Practice 702 Channel with Riprap Lining .
- Practice 703 Channel with Concrete Lining.
- Practice 705 Grade Transitions (Chutes).
- Practice 706 In-Channel Grade Stabilization Structure.
- Practice 801 In-channel Sediment Basin.
- Practice 802 In-channel Floodwater Retention Basin.
- Activity 5.5 Eroded Streambank Repair.

Other Sources of Information

- Davis Handbook.
- ASCE Urban Stormwater Manual.

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PRACTICE 705
GRADE TRANSITIONS (CHUTES)

DESCRIPTION

- Open channels (usually paved with rock, concrete block, or reinforced vegetation) which act as a grade treansition to convey high-velocity water down a steep slope without erosion. (Note: these practices are also included in the Indiana Erosion Control Handbook as outlet protection structures.)

Exhibit 705a: Typical Grade Transition (Rock Chute). (Source: CBBEL Files)

PURPOSE

- To convey high-velocity water down a steep slope without erosion.

WHERE APPLICABLE

- Where runoff has to be conveyed down a steep slope.
- New channels constructed as outlets for culverts and conduits.
- High velocity sections of streams or ditches.

ADVANTAGES

- Minimizes the potential for downstream erosion by reducing the velocity and energy of concentrated Stormwater flows.
- Reduces the effects of turbidity and sedimentation downstream.

CONSTRAINTS

- May require heavy machinary to install.
- Generally not appropriate on slopes steeper than 10% (grade stabilization or drop structures must be considered for extremely steep slopes.)
- Contributing drainage area should not be more than 100 acres for Rock and Concrete Block Chutes, and no more than 20 acres for Reinforced Vegetated Chutes.
- Peak runoff from a 10-year frequency, 24 hour duration storm event must be accommodated in most cases.
- Rock Chutes may be aesthetically objectionable when dry.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

<u>Rock Chute</u>

- Crushed Stone Riprap.

- Geotextile Fabric.

Concrete Block Chute
- Concrete block.
- Geotextile fabric.
- Plastic sheeting.
- Sand.

Reinforced Vegetated Chute
- Erosion control blankets and turf reinforcement mat (Practice 1104)
- Gravel or crushed stone riprap.
- Drain tile.

Installation

Rock Chute
- Excavate the apron area subgrade below design elevation to allow for the thickness of filter and riprap.
- Compact fill used in the subgrade to the density of the surrounding undisturbed material, and smooth enough to protect fabric from tearing.
- Place geotextile fabric on the foundation. If more than one piece of fabric is needed, then upstream piece should overlap the downstream piece by at least one foot.
- Install riprap to the lines and elevations shown in the design.
- Make sure the top of the apron is level with or slightly below the receiving stream.
- Blend the riprap smoothly to the surrounding grade.
- Stabilize all disturbed areas immediately following installation.

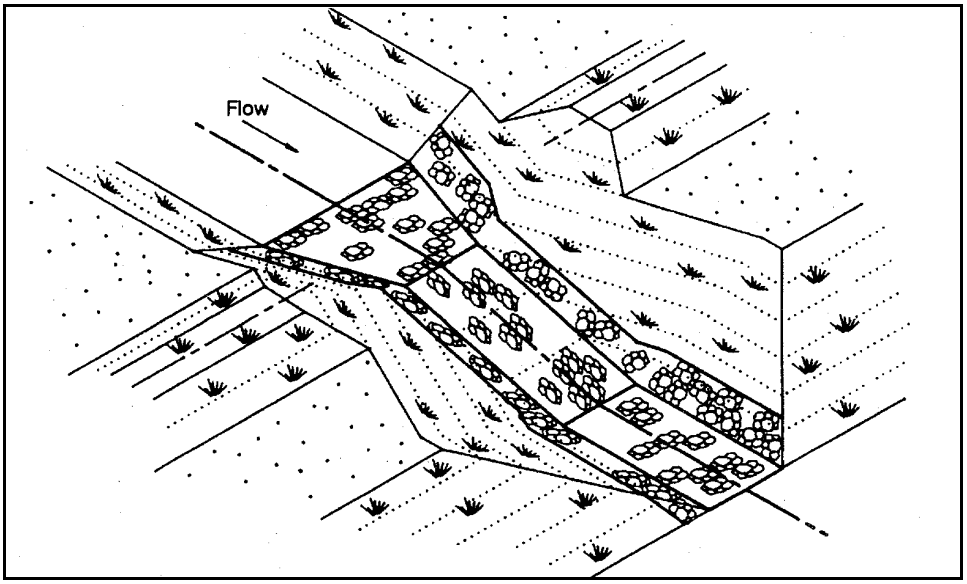

Exhibit 705b: Oblique view of a Rock chute (Source: Indiana Erosion Control Handbook)

Concrete Block Chute

- Construct a ridge on either side of chute.
- Excavate chute, inlet, and outlet apron to about 10" below the design plan finished grade to allow for thickness of foundation materials and concrete blocks. (The aprons, when installed, should be on a zero grade).
- Compact any fill used in the subgrade to the density of the surrounding undisturbed material.
- Smooth subgrade enough to protect plastic sheeting and geotextile fabric from tearing.
- Make a small trench around the perimeter of the structure (i.e. edges of inlet and outlet aprons and top of the chute side slopes) to secure the sheeting and fabric.
- On the smoothed subgrade, install first the plastic sheeting, then 2" of sand, and finally the geotextile fabric.
- Press the plastic sheeting and geotextile fabric into the trench and fill with soil to anchor.
- Lay the concrete block (holes facing up) on the geotextile fabric taking care not to damage the fabric.
- Fill holes in blocks with soil.
- Stabilize all disturbed areas immediately following installation.

Exhibit 705c: Concrete Block Chute (Source: CBBEL Files)

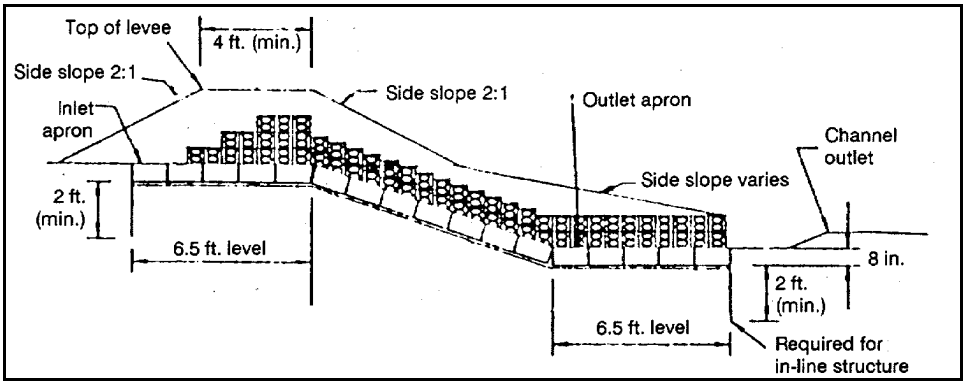

Exhibit 705d: Detailed cross-sectional view of a concrete block chute (Source: Indiana Erosion Control Handbook)

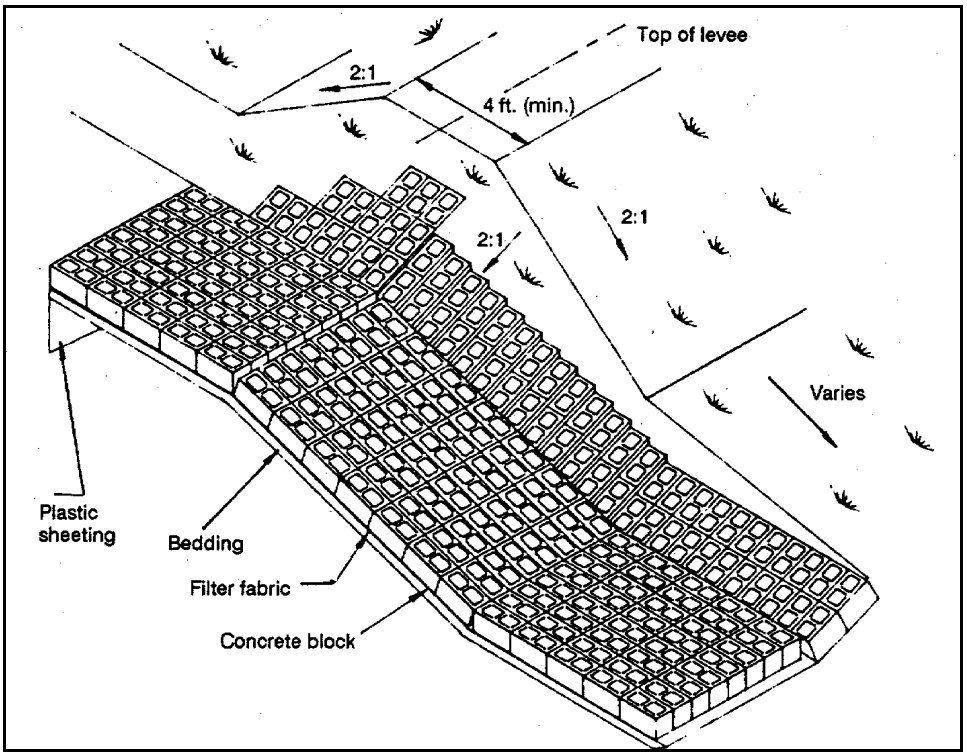

Exhibit 705e: Oblique view of a concrete block chute (Source: Indiana Erosion Control Handbook)

Reinforced Vegetated Chute

- Construct a ridge on each side of the chute to contain runoff, according to designed capacity.
- Excavate and/or fill and compact the required section and slope to finished grade as specified in the erosion and sediment control plan.
- Construct the inlet and outlet aprons so they are straight, aligned with the receiving channel, and at zero grade.
- Lay drain tile outside the chute area, including outlet pipe section and animal guard.
- Install and anchor the turf reinforcement mat according to manufacturers directions, and cover with soil.
- Immediately following mat installation, permanently seed (Practice

1102), fertilize, and install erosion control blankets according to manufacturers directions.

Exhibit 705f: Reinforced Vegetated Chute (Source: Indiana Erosion Control Handbook)

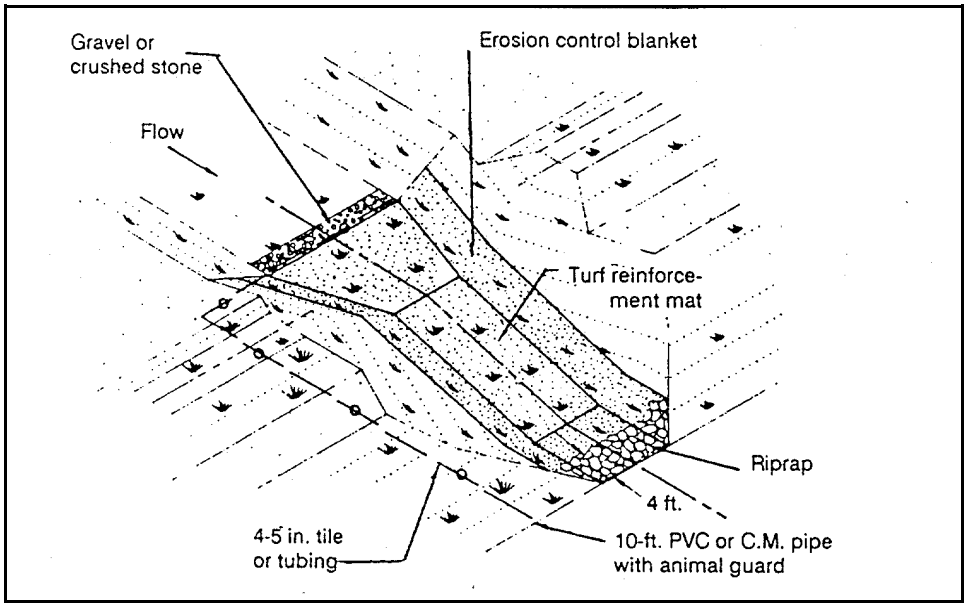

Exhibit 705g: Oblique view of a reinforced vegetated chute (Source: Indiana Erosion Control Handbook)

Special Considerations

- Downstream erosion may occur if the downstream apron area is not flat.
- It may be necessary to install a subsurface drain to intercept seepage from and drain it away from the structure.
- Scouring around inlet apron, or overtopping and bypassing of chute, may occur if the chute is not constructed to designed capacity.

MAINTENANCE

- Inspect inlet and outlet after storm events for scouring, and repair as needed.
- Keep inlets and outlets free of debris and other obstructions.
- Do not drive equipment or vehicles on the structure.
- Vegetated Chute: during establishment of vegetation, inspect after each storm event, checking especially for blockage, sediment and scour holes.
- Remove accumulated sediment and make other repairs as necessary.

REFERENCES

Related Practices

- Practice 1102 Vegetative Stabilization.

Other Sources of Information

- Indiana Erosion Control Handbook.
- Illinois Urban Manual.
- North Carolina Erosion Control Manual.

Last Print/Revision Date: October 13, 1996

PRACTICE 706
IN-CHANNEL GRADE STABILIZATION STRUCTURE

DESCRIPTION

- Structure designed to reduce channel grade in streams and ditches.

Exhibit 706a: In-Channel Grade Stabilization Structure (Source: North Carolina Erosion Control Manual)

PURPOSE

- To prevent erosion of a channel that results from excessive grade in the channel bed. This practice allows the designer to adjust channel grade to fit soil conditions.

WHERE APPLICABLE

- Where head cutting or gully erosion is active.
- Where beds of intersecting channels are at different elevations.
- Where a flatter grade is needed for stability in a proposed channel or water disposal system.

ADVANTAGES

- Stabilizes progressive head cutting in existing streams and ditches.
- Stabilizes erosion gullying.

CONSTRAINTS

- Expensive to install.
- May require emergency bypass where surface water enters the structure.
- Usually requires extensive engineering.
- May impact fish migration at normal and low flows.

DESIGN AND CONSTRUCTION GUIDELINES

Materials

- Grade stabilization structures may be constructed of concrete, riprap, gabions, or pipe drop structures.

Installation

- Grade stabilization structures can be complex and should be designed by a qualified engineer.

- The structure should be located on a straight section of the channel with no upstream or downstream curves within 100'.
- The foundation material should be stable, homogenous, mineral soils with sufficient strength to support the structure.
- Flood bypass should be available. Protect the area where bypass flow enters the channel downstream.
- The structure should be designed to control the peak runoff from a 10 year storm, or to meet the bankfull capacity of the channel, whichever is greater.
- Set the crest of the structure's inlet at an elevation that will stabilize the grade of the upstream channel. Set the outlet section at an elevation that will provide a stable grade downstream to assure stability.
- Foundation drainage should be provided for to reduce hydrostatic loads on drop spillway structures.
- Velocity flow at the outlet should be kept within the allowable limits for the receiving stream. Place a transition section consisting of properly-sized riprap at the toe of the structure to prevent erosion of the channel bed.

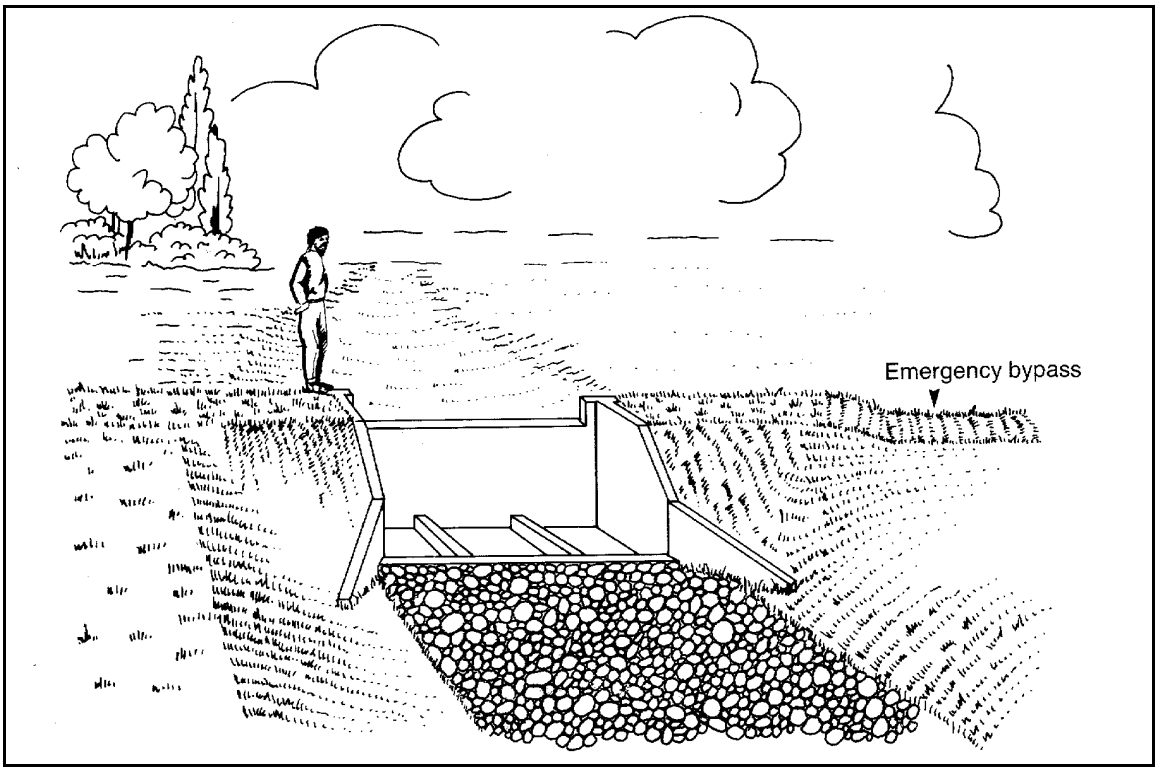

Exhibit 706b: Reinforced concrete drop spillway for grade stabilization with emergency bypass and downstream protection (Source: North Carolina Erosion Control Manual)

Special Considerations

- Surface runoff should be diverted around the structure during construction.
- Make the end of the riprap section as wide as the receiving channel, and make sure the transition section of riprap between the structure

end sill and the channel is smooth.

- Make sure there is no overfall from the end sill along the surface of the riprap to the existing channel bottom.
- Stabilize disturbed areas as soon as possible (Activity 5.11 Revegetation and Site Stabilization).
- If conditions allow, rock chute (Practice 703) modified for in-channel use may be used instead of a grade stabilization structure as a transition section.

MAINTENANCE

- Inspect periodically after storm events throughout the life the structure.
- Check fill around the structure for signs of piping, erosion, and settlement and to ensure that good protective vegetation is maintained.
- Check inlet and outlet for signs of scour or erosion.
- Check emergency bypass for signs of erosion.
- All deficiencies should be repaired immediately.

REFERENCES

Related Practices

- Practice 705 Grade Transitions (Chutes).
- Practice 1102 Vegetative Stabilization.
- Activity 5.11 Revegetation and Site Stabilization.

Other Sources of Information

- Indiana Erosion Control Handbook.
- North Carolina Erosion Control Manual.
- NRCS National Engineering Handbook.

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