Check Dam (CD)

Practice Description
A check dam is a small barrier or dam constructed across a swale, drainage ditch or other area of concentrated flow for the purpose of reducing channel erosion. Channel erosion is reduced because check dams flatten the gradient of the flow channel and slow the velocity of channel flow. Most check dams are constructed of rock, but hay bales, logs and other materials may be acceptable. Contrary to popular opinion, most check dams trap an insignificant volume of sediment.

This practice applies in small open channels and drainageways, including temporary and permanent swales. It is not to be used in a live stream. Situations of use include areas in need of protection during establishment of grass and areas that cannot receive a temporary or permanent non-erodible lining for an extended period of time.

Planning Considerations
Check dams are used in concentrated flow areas to provide temporary channel stabilization during the intense runoff periods associated with construction disturbances. Check dams may be constructed of rock, logs, hay bales or other suitable material, including manufactured products. MDOT Drawing ECD-4 at the end of this practice shows the typical application of check dam structures. Most check dams are constructed of rock. Rock may not be acceptable in some installations because of aesthetics; therefore, alternative types of check dams need to be considered.

Rock check dams
Rock check dams (Figures CD-1 and CD-2) are usually installed with backhoes or other suitable equipment, but hand labor is likely needed to complete most installations to the quality needed. The rock is usually purchased, and some locations in the state may not have rock readily available. The use of rock should be considered carefully in areas to be
mowed. Some rock may be washed away during heavy rain events and should be removed before each mowing operation. Additional installation drawings are provided at the end of this practice as MDOT Drawings ECD-8 and ECD-9.

Log check dams
Log check dams (Figure CD-3) are more economical from a materials cost standpoint since logs can usually be salvaged from clearing operations. The time and labor required would be greater for log check dams. Increased labor costs would offset the reduced material costs. Log check dams would not be permanent but may last long enough to get grass linings established.

Hay bale check dams
Check dams constructed of hay bales (Figure CD-4) have the shortest life of the materials discussed and are only used as a temporary means to help establish a channel to vegetation. MDOT Drawing ECD-5 is provided at the end of this practice and shows more specifics for hay bale check dams. MDOT Drawing ECD-6 shows typical details for a straw wattle ditch check as an alternative to hay bale check dams. Hay bale check dams should not be used where permanent watercourse protection is needed and should be used only in concentrated-flow areas where only minimal runoff occurs.

Without proper installation, which is rarely done, hay bale check dams always fail.

Check dams should be planned to be compatible with the other features such as streets, walks, trails, sediment basins and rights-of-way or property lines. Check dams are normally constructed in series, and the dams should be located at a normal interval from other grade controls such as culverts or sediment basins.
Figure CD-2  Cross Section of Typical Rock Check Dam

Figure CD-3  Typical Log Check Dam

L = DISTANCE REQUIRED SO THAT POINTS A & B ARE OF EQUAL ELEVATION.
Design Criteria and Installation

Formal design is not required. The following limiting factors should be adhered to when designing check dams.

Drainage Area
Ten acres or less (rock or logs).

Maximum Height
Two feet when drainage area is less than 5 acres.
Three feet when drainage area is 5 to 10 acres.

Depth of Flow
Six inches when drainage area is less than 5 acres.

Twelve inches when drainage area is 5 to 10 acres.

The top of dam, perpendicular to flow, should be parabolic. The center of the dam should be constructed lower than the ends. The elevation of the center of the dam should be lower than the ends by the depth of flow listed above.

Side Slopes
2:1 or flatter.

Spacing
Elevation of the toe of the upstream dam is at or below elevation of the crest of the downstream dam.
Keyway

The rock or log check dam should be keyed into the channel bottom and abutments to a depth of 12 to 24”. The keyway width should be at least 12”. The keyway is to prevent erosion around the end of and beneath the dam. Hay bale check dams should be embedded into the soil at least 3”.

Rock Check Dams

Rock check dams should be constructed of durable rock riprap. Rock material diameter should be 2” to 15”.

In soils where failure by piping of soils into the rock is likely, a geotextile will be used as a filter to separate the soils from the rock. Geotextile should conform to the requirements of type I geotextile in Table CD-1.

<table>
<thead>
<tr>
<th>Property</th>
<th>Test method</th>
<th>Class I</th>
<th>Class II</th>
<th>Class III</th>
<th>Class IV</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile strength (lb)²</td>
<td>ASTM D 4632</td>
<td>180 minimum</td>
<td>120 minimum</td>
<td>90 minimum</td>
<td>115 minimum</td>
</tr>
<tr>
<td></td>
<td>grab test</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Elongation at failure (%)²</td>
<td>ASTM D 4632</td>
<td>≥ 50</td>
<td>≥ 50</td>
<td>≥ 50</td>
<td>≥ 50</td>
</tr>
<tr>
<td>Puncture (pounds)</td>
<td>ASTM D 4833</td>
<td>80 minimum</td>
<td>60 minimum</td>
<td>40 minimum</td>
<td>40 minimum</td>
</tr>
<tr>
<td>Ultraviolet light (% residual tensile strength)</td>
<td>ASTM D 4355</td>
<td>70 minimum</td>
<td>70 minimum</td>
<td>70 minimum</td>
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<tr>
<td></td>
<td>150-hr exposure</td>
<td></td>
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<tr>
<td>Apparent opening size (AOS)</td>
<td>ASTM D 4751</td>
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<td>As specified</td>
<td>As specified</td>
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<td></td>
<td>max. no.40³</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Permittivity sec⁻¹</td>
<td>ASTM D 4491</td>
<td>0.70 minimum</td>
<td>0.70 minimum</td>
<td>0.70 minimum</td>
<td>0.10 minimum</td>
</tr>
</tbody>
</table>

Table copied from NRCS Material Specification 592.

1 Heat-bonded or resin-bonded geotextile may be used for Classes III and IV. They are particularly well suited to Class IV. Needle-punched geotextile is required for all other classes.
2 Minimum average roll value (weakest principal direction).
3 U.S. standard sieve size.
Site Preparation
Determine location of any underground utilities.

Locate and mark the site for each check dam in strategic locations (to avoid utilities and optimize effectiveness of each structure in flattening channel grade).

Remove debris and other unsuitable material that would interfere with proper placement of the check dam materials.

Excavate a shallow keyway (12”-24” deep and at least 12” wide) across the channel and into each abutment for each check dam.

Materials Installation
As specified, install a non-woven geotextile fabric in the keyway in sandy or silty soils. This may not be required in clayey soils.

Construct the dam with a minimum 2:1 side slope over the keyway and securely embed the dam into the channel banks. Position rock to form a parabolic top, perpendicular to channel flow, with the center portion at the elevation shown in the design so that the flow goes over the structure and not around the structure.

Erosion and Sediment Control
Install vegetation (temporary or permanent seeding) or mulching to stabilize other areas disturbed during the construction activities.

Construction Verification
Check finished size, grade and shape for compliance with standard drawings and materials list (check for compliance with specifications if included in contract specifications).

Common Problems
Consult with a qualified design professional if any of the following occur:

Variations in topography on site indicate check dam will not function as intended. Change in plan will be needed.

Materials specified in the plan are not available.

Maintenance
Inspect the check dam for rock displacement and abutments for erosion around the ends of the dam after each significant rainfall event. If the rock appears too small, add additional stone and use a larger size.

Inspect the channel after each significant rainfall event. If channel erosion exceeds expectations, consult with the design professional and consider adding another check dam to reduce channel flow grade.
Sediment should be removed if it reaches a depth of ½ the original dam height. If the area behind the dam fills with sediment, there is a greater likelihood that water will flow around the end of the check dam and cause the practice to fail.

Check dams may be removed when their useful life has been completed. The area where check dams are removed should be seeded and mulched immediately unless a different treatment is prescribed. In some instances check dams should be left as a permanent measure to support channel stability.

References

BMPs from Volume 1

Chapter 4
Temporary Seeding (TS) 4-103

MDOT Drawing ECD-4
Ditch Check Structures, Typical Applications and Details 4-124

MDOT Drawing ECD-5
Temporary Erosion, Sediment and Water Pollution Control Measures, Silt Fence and Hay Bale Ditch Check 4-125

MDOT Drawing ECD-6
Details of Erosion Control Wattle Ditch Check 4-126

MDOT Drawing ECD-7
Details of Erosion Control Silt Dike Ditch Check 4-127

MDOT Drawing ECD-8
Rock Ditch Check 4-128

MDOT Drawing ECD-9
Rock Ditch Check with Sump Excavation 4-129

MDOT Drawing ECD-20
Details of Erosion Control Sandbag Ditch Check 4-130
Runoff Conveyance

**NOTES:**

1. **Ditch Check Placement:** Illustrates a tool of temporary practices that can be used. Ditch checks are installed to control runoff velocity and thus reduce erosion and provide for trapping of sediment.

2. **Selection of the Appropriate Ditch Check Size:** As a function of the upstream drainage area, ditch gradient, soil type, economy, and safety.

3. **Ditch Checks can be removed for maintenance and/or replacement but must remain in place until upstream areas have been permanently stabilized. Maintenance includes inspection, cleaning, and replacement if necessary.**

4. **Max Bale Ditch Check:** Used where it has been determined that max bale checks are economical. Max bale ditch checks are used to intercept low volume flows or low to moderate gradient ditches.

5. **Silt Fence Ditch Check:** Used where it has been determined that silt fence checks are economical. Silt fence ditch checks are used to intercept low volume flows or low to moderate gradient ditches.

6. **Sand Bag Ditch Check:** Used for silt fence and max bale ditch checks in concrete paved ditches or in ditches that have rocky bottoms.

7. **Wattle Ditch Check:** Appropriate for velocity reduction and control of sediment transport under low to medium flow conditions.

8. **Silt Ditch Check:** Can be used on ditches with concentrated flows within the clear zone where riprap can not be used. As construction progresses.

9. **Rock Ditch Check with Sump Excavation:** Can be placed in ditches to control on-site sediment trapping during construction. The sump excavation is used when ditches receive drainage from cut or fill slopes or other critical areas. When the ditch is excavated, the check should extend no more than 3 feet. They can be used in series to increase on-site sediment trapping efficiency.

10. **In general, Ditch Checks should not be placed in live streams.**

11. **Configuration and Spacing:** May be adjusted if approved by the engineer to accommodate future safety, water flow, or soil erosion installation challenges.

**HINSDALL DEPARTMENT OF TRANSPORTATION**

**Ditch Check Structures:**

Typical Applications and Details

**ECO-4**
**Runoff Conveyance**

**PLAN VIEW**

- **TRAPEZOIDAL DITCH**
- **PROFILE VIEW**

**NOTES:**
1. Minimum recommended check spacing is 100 feet unless shown otherwise on the plans of erosion control plan approved by the engineer. See spacing guidance on EDP-4.
2. Anchoring rod stakes shall be sized, spaced, and be of a material that effectively secures the check. A minimum of two stakes per bale is required. All non-degradable materials shall be removed when no longer needed.
3. Bales shall be embedded in the soil a minimum of 4'.
4. Bales shall be placed in a row with ends tightly abutting the adjacent bales. The bales shall be placed with dimensions parallel to the ground.
5. Soil is compacted along the base of the upstream face to prevent piping.
6. Multiple adjacent rows of bales are required as needed.

**HAY BALE DITCH CHECK SELECTION GUIDELINES**

Hay bales are used to intercept low volume flows in low to moderate gradient ditches.
WATTLE DITCH CHECK SELECTION GUIDELINES

WATTLE DITCH CHECKS ARE APPROPRIATE FOR VELOCITY REDUCTION AND CONTROL OF SEDIMENT TRANSPORT UNDER LOW TO MEDIUM FLOW CONDITIONS.
SILT DIKE DITCH CHECK SELECTION GUIDELINES

SILT DIKES CAN BE USED IN DITCHES WITH CONCENTRATED FLOWS WITHIN THE CLEAR ZONE WHERE RIPRAP CAN NOT BE USED.

NOTE:
1. MINIMUM RECOMMENDED PLACEMENT INTERVAL BETWEEN SILT DIKE DITCH CHECK IS 100' UNLESS SHOWN OTHERWISE. ON THE PLAN OR EROSION CONTROL PLAN APPROVED BY THE ENGINEER. SEE SPACING GUIDANCE ON ECD-4
2. INSTALLATION SHALL BE IN ACCORDANCE WITH MANUFACTURER'S RECOMMENDATIONS.

PLAN VIEW

SECTION B-B

SILT DIKE INSTALLATION FOR ROADWAY DITCHES

SECTION A-A

NOTICE: STAPLES SHALL BE PLACED WHERE THE UNITS OVERLAP AND IN THE CENTER OF THE UNIT.
Runoff Conveyance

PLAN VIEW
DETAIL FOR TRAPEZOIDAL DITCH

SECTION B-B

SECTION A-A
TEMPORARY ROCK DITCH CHECKS IN ROADSIDE DITCHES

DETAIL FOR SPACING BETWEEN DITCH CHECKS
SAND BAG DITCH CHECK SELECTION GUIDELINES

SAND BAG DITCH CHECKS ARE USED FOR VELOCITY REDUCTION AND MINIMAL SEDIMENT TRAPPING IN CONCRETE PAVED DITCHES OR IN DITCHES THAT HAVE ROCKY BOTTOMS.

DETAIL (DITCH CHECK)

NOTES:
1. MINIMUM RECOMMENDED PLACEMENT INTERVAL BETWEEN SAND BAG DITCH CHECK IS 100' UNLESS SORDONZ OR OTHERWISE ON THE PLANS OR APPROVED BY THE ENGINEER. SEE SPACING GUIDANCE ON ECD-N.
2. PREVENTING SEDIMENT FROM ENTERING A PAVED DITCH IS PREFERABLE TO CAPTURING SEDIMENT WITHIN PAVED DITCH.

SECTION A-A

ELEVATION DETAIL

NOTE: END POINTS "A" MUST BE HIGHER THAN FLOWLINE POINT "B"